

# Aeroflex Microelectronics

## Fiber Optic Glossary

### A

#### Absorption

1. In an optical fiber, loss of optical power resulting from conversion of that power into heat. Intrinsic causes of absorption in a fiber involve tails of the ultraviolet and infrared absorption bands. Extrinsic components causing loss include (a) impurities, (e.g., the OH<sup>-</sup> ion and transition metal ions) and (b) defects (e.g., results of thermal history and exposure to nuclear radiation). 2. Loss of power in a fiber optic cable resulting from conversion of optical power into heat. This is principally caused by impurities, such as transition metals and hydroxyl ions. It is also caused by exposure to nuclear radiation. See also: Attenuation.

#### Acceptance Angle

1. The half-angle of the cone within which all incident light is totally internally reflected by the fiber core. For graded index fibers, acceptance angle is a function of position on the entrance face of the core. 2. The half angle of the cone which incident light is totally, internally, reflected by the fiber core. It is the angle over which the core of an optical fiber accepts incoming light, usually measured from the fiber axis. It is equal to the arcsine (NA) where NA is the numerical aperture.

#### Active Area

The area of a detector with greatest response.

#### Active Branching Device

A device which converts an optical input into two or more optical outputs with gain or generation.

#### Active Port Diameter

On a light source or detector, the diameter of the area in which light can be coupled to or from an optical fiber.

#### Active Star

An active device that connects two or more fiber optic link segments. Optical signals received on the input fiber of any input/output port pairs are converted to electrical signals. These are relayed to the outputs of all other input/output port pairs, and converted to optical signals which are transmitted on the output fibers. Collisions are detected and enforced by the Active Star. An Active Star may have two types of ports: (1) Asynchronous Ports capable of receiving FOIRL compatible signals, and (2) Synchronous Ports that transmit and receive only those optical signals synchronized to the 10BASE-F synchronous Active Idle signal. Synchronous ports must be used to connect Active Stars.

#### Adapter

In fiber optics, a device for coupling two connectors.

### Address

A number specifying a particular user device attachment point... The location of a terminal, a peripheral device, a node, or any other unit or component in a network ...A set of numbers that uniquely identifies something - a workstation in a LAN, a location in computer memory, a packet of data traveling through a network. Similar to the address of a house.

### Adjustable Attenuator

An attenuator in which the level of attenuation is varied with an internal adjustment. Also known as Variable Attenuator.

### Algorithm

A procedure for solving a mathematical problem, as of finding the greatest common divisor, in a finite number of steps that frequently involves repetition of an operation.

### Alpha

A positive number that indicates the core refractive index shape and ranges from one to infinity.

### Alternate Buffer

In a data communications device, the section of memory set aside for the transmission or receipt of data after the primary buffer is full. This helps the device control the flow of data so transmission is not interrupted because there's no place to put the incoming or outgoing data.

### Amplifier

A device used to boost the strength (dB level) of an electronic signal. Amplifiers are spaced at intervals throughout a cable system to rebuild the strength of TV or data signals that weaken as they pass through the cable network. Midsplit configurations use a forward and a reverse amplifier in the same enclosure to boost signals in both directions. A device which boosts the strength of a signal. Used in broadband networks to prevent the attenuation [deterioration] of transmitted signals.

### Amplitude

The distance between high or low points of a waveform or signal. Also referred to as the wave "height".

### AM

Amplitude Modulation.

### Amplitude Modulation (AM)

1. A transmission technique in which the amplitude of the carrier is varied in accordance with the signal. 2. A transmission technique in which the amplitude of a carrier is varied in sympathy with the information being communicated.

### Analog

1. Any physical property indexed, controlled, or represented by another physical property capable of representing it accurately. Usually refers to a system that codes data by measuring voltages, rather than discrete signals (digitally). 2. A format that uses continuous physical parameters to transmit information. Examples of parameters are voltage amplitude and carrier frequency.

### Analog Signal

An electrical signal that varies continuously over an infinite range of voltage or current values, as opposed to a digital signal, which varies discretely between two values, usually one and zero. It is easiest to think of analog signals as sine waves or various sizes. Compare with Digital Signal.

### Analog to Digital Converter

A device that converts an analog signal, that is, a signal in the form of a continuously variable voltage or current, to a digital signal, in the form of bits.

### Angle of Deviation

In ray optic theory it is the net resultant angular deflection experienced by a light ray after one or more reflections or refraction's. The term is used in reference to prisms with air interfaces. The angle of deviation is the angle between the original incident ray and the emergent ray.

### Angle of Incidence

The angle between an incident ray and the normal to a reflecting or refracting surface. See also: Critical Angle; Total Internal Reflection.

### Angle of Refraction

The angle formed between a refracted ray and the normal to the surface. This angle lies in a common plane with the angle of incidence.

### Angstrom

Unit of length equal to  $10^{-10}$  meter.

### Angular Alignment

The alignment of two optical fibers with respect to the angle formed by their axes.

### Angular Misalignment Loss

The optical power loss caused by angular deviation from the optimum alignment of source to optical fiber, fiber-to-fiber, or fiber-to-detector. See also: Extrinsic Joint Loss; Intrinsic Joint Loss; Lateral Offset Loss.

### Angular Tilt

The angle formed by the axes of two fibers to be joined. Angular tilt causes an extrinsic loss that depends upon the joining hardware and method.

### ANSI

Abbreviation for American National Standards Institute. A voluntary organization that helps set standards and also the U.S. in the International Standards Organization (ISO).

### APD

Avalanche photodiode.

### APF

All Plastic Fiber.

### **Aramid Yarn**

Strength element used in Siecor cable to provide support and additional protection of the fiber optic cable bundles. Kevlar is a particular brand of Aramid yarn.

### **Architecture**

The manner in which hardware or software is structured. Architecture typically describes how the system or program is constructed, how its components fit together; also refers to the protocols and interfaces modules or components of the system. Network architecture defines the functions and description of data formats and procedures used for communication between nodes or workstations.

### **Artificial Intelligence**

The ability of a machine to perform certain functions normally associated with human intelligence, such as judgment, pattern recognition, understanding, learning, planning and problem solving.

### **ASCII (American Standard Code for Information Interchange)**

A system used to represent letters, numbers, symbols and punctuation as bytes of binary signals (ones and zeros).

### **Async**

A mode of data transmission wherein the occurrence of each character is not related to a fixed time frame of reference. Compare with synchronous transmission.

### **Asynchronous**

A method of transmitting data. A low-cost alternative to synchronous communications. One or more bits are added to the beginning and the end of each data character in asynchronous communications. This allows the receiver of the signal to recognize the characters being sent. Asynchronous is the simplest form of communication since it does not require the sender and receiver to each have a clock to time each other to "stay in synch." However, the addition of these extra bits (called "framing" bits) means that more bits have to be transmitted in asynchronous communications to get the same message across than in other methods, like synchronous communications. Asynchronous techniques are popular with mini- and micro-computers.

### **Asynchronous Transfer Mode (ATM)**

The technology selected by the Consultative Committee on international Telegraphy and Telephony (CCITT) to deliver broadband-ISDN services for the worldwide telecommunications network. It is fast, packet-switched technology based on a fixed packet (or cell) size of 53 bytes long (5 bytes header and 48 payload).

### **Asynchronous Transmission**

A mode of data transmission whereby each bit of information is generated separately with some stop/start code to indicate the interval between bits.

### **Atomic Absorption Spectrophotometer**

An instrument used to analyze the sharp resonance line of a sample that, in a flame, emits an atomic vapor. It consists essentially of a light source, a combustion system, a monochromator, a photomultiplier and an electronic readout system.

## ATM

Asynchronous Transfer Mode. This is a new emerging data standard (protocol) that uses many of the same data rates as Fiber Channel and SONET.

## Attenuation

1. In an optical fiber, the diminution of average optical power. In optical fibers, attenuation results from absorption, scattering, and other radiation losses. Attenuation is generally expressed in dB without a negative sign. Calculations and equations involving loss show and use the negative sign. Attenuation is often used as a synonym for attenuation coefficient, expressed in dB/Km. 2. In fiber optic cable, attenuation results from absorption, scattering and other radiation losses. It is usually expressed as decibels per kilometer (dB/Km) without the negative sign. Calculations and equations involving loss show and use the negative sign.

## Attenuation Coefficient

A factor expressing optical power loss per unit of length, expressed in dB/Km.

## Attenuation Limited Operation

The condition prevailing when the received signal amplitude (rather than distortion) limits performance. See also: Bandwidth Limited Operation; Distortion Limited Operation.

## Attenuator

An electronic transducer, either fixed or adjustable, that reduces the amplitude of a wave without causing significant distortion.

## Automatic Optical Inspection

A system for automatic industrial process control or measurement, consisting of an optical module for image acquisition, a segmentation processor to isolate the image from its background, and an image analysis processor.

## Avalanche Photodiode (APD)

1. A photodiode that shows gain in its output power that it receives through avalanche multiplication of photo current. Note: As the reverse-bias voltage approaches the breakdown voltage, hole-electron pairs created by absorbed photons acquire sufficient energy to create additional hole-electron pairs when they collide with ions; thus, a multiplication (signal gain) is achieved. 2. A photodiode that exhibits internal amplification of photocurrent. It accomplishes this by avalanche multiplication of carriers in the junction region. As the reverse-bias voltage approaches the breakdown voltage, electron-hole pairs created by absorbed photons acquire sufficient energy to create additional electron-hole pairs when they collide with ions. A multiplication or signal gain is thereby achieved. See also: Photon; PIN Photodiode.

## Average Power

The average level of power in a signal that varies with time.

## Average Wavelength

The average of the two wavelengths for which the peak optical power has dropped to half.

### Axial (Lateral) Misalignment Loss

The optical power loss caused by two fiber axes that are parallel but not on the same central axis.

### Axial Ray

Alight ray that travels along the optical fiber's axis. See also: Skew Ray.

## B

### Back Scattering

1. That portion of scattered light which returns in a direction generally reverse to the direction of propagation. 2. The return of a portion of scattered light to the input end of a fiber optic cable. It is the scattering of light in the direction opposite to its original direction of propagation.

### Balanced

Signaling code with an equal number of high and low states.

### Bandwidth

1. The range of frequencies handled by a device or system. 2. The information capacity of a fiber optic cable. Precisely it is usually measured in GHz (1 Billion Hz). Occasionally it is idiomatically discussed in terms of the data transmission rate- the BPS- the actual GHz bandwidth can support. In some contexts it is expressed as MHz-Km and denotes the analog bandwidth capability of digital transitions per second that a fiber optic cable can sustain over a 1 Km distance. Occasionally the bandwidth of a light source is referred to. This is the width of the spectrum emitted.

### Bandwidth Limited Operation

1. Usually refers to the maximum effective transfer rate of data; the condition prevailing when the system bandwidth, rather than the amplitude or power of the signal, limits performance. The condition is reached when material and modal dispersion distort the shape of the waveform beyond specified limits. 2. The condition in a fiber optic cable based communications link when bandwidth, rather than received signal power, limits performance. This condition is reached when the signal becomes distorted, principally by dispersion, beyond specified limits.

### Baseband

A method of communication in which a signal is transmitted at its original frequency without being impressed on a carrier.

### Baud

1. A unit of signaling speed equal to the number of signal symbols per second, which may or may not be equal to the data rate in bits per second. 2. A unit of data transmission signaling speed - data transmission rate - equal to the number of signal symbols per second. With binary modulation systems this is the same as the data transmission rate in Bits Per Second. However, it is different with non-binary modulation systems.

### Baud Rate

Measurement of data transmission speed, expressed in bits per second or bps.

### Bayonet Coupling

A quick coupling device for plug and receptacle connection, designed to lock a connector into an adapter or receptacle. An example is an ST® connector.

### Beacon Token Process (FDDI)

A process defined by SMT used to locate ring failures. When a station notes such a failure, it enters the beacon process and begins to continuously transmit "beacon frames". The location will continue to transmit unless it receives a beacon from a station "upstream", in which case it will stop sending its own beacon and repeat the beacon from the upstream station. Soon, only one station, the station immediately "downstream" from the failure, will be beaconing. When a beaconing station receives its own beacon, it indicates that the ring has been restored and that station will stop beaconing and issue a claim.

### Beam Diameter

The distance between two diametrically opposed points at which the irradiance is a specified fraction of the beam's peak irradiance; most commonly applied to beams that are circular or nearly circular in cross section. Synonym: Beamwidth.

### Beam Divergence

The increase in beam diameter with increase of distance from the source.

### Beamsplitter

A device for dividing an optical beam into two or more separate beams; often a partially reflecting mirror. It can be used in a fiber optic cable data link as a directional coupler.

### Bend Loss

1. A form of increased attenuation in a fiber that results from bending a fiber around a restrictive curvature (a macrobend) or from minute distortions in the fiber (microbends). 2. A form of increased attenuation caused by allowing high order modes to radiate from the walls of a fiber optic cable. There are 2 common types of bend losses. The first type results when the fiber optic cable is curved through a restrictive radius or curvature. The second type is generally referred to as microbends. It is caused by small distortions of the fiber optic cable imposed by externally induced perturbations as, for example, slip shod cabling techniques.

### Bend Radius

1. Radius of curvature that a fiber can bend without breaking. 2. Radius a fiber optic cable can bend before the risk of breakage or increase in attenuation. Also referred to as cable bend radius.

### BER (Bit Error Rate)

This is the probability that a transmitted bit is demodulated in error at the destination receiver.

### BER Floor

A limiting of the bit-error ratio (BER) in a digital fiber optic system as a function of received power due to the presence of signal degradation mechanisms or noise.

### Biconic

A connector type which has a taper sleeve which would be fixed to the fiber optic cable. When this plug was inserted into its receptacle the tapered end was a means for locating the fiber optic cable in the proper position. With this connector cap, fit over the ferrules, rest against guided rings and screw onto the threaded sleeve to secure the connection. This was one of the earliest connectors used in fiber optic systems but is in little use at present.

### Binary

A numbering system that allows only two values, zero and one, '0' and '1'. Binary is the way most computers store information, in combination of ones and zeros. Voltage on. Voltage off. See also: Bit.

### Birefringence

A measure of the nonuniform stress distribution in a fiber which gives rise to different phase velocities for the two principal polarization modes.

### BISDN

Broadband Integrated Services Digital Network.

### Bit

A binary digit which is generally either '0' or '1'. It is the smallest representation of information in a communications and/or computing system.

### Bit Error Rate (BER)

In digital applications it is the ratio of bits received in error to bits sent. BERs of  $10^{-9}$  (one error bit to a billion sent) are common.

### Bit Rate

1. The number of bits of data transmitted over a phone line per second. You can usually figure how many characters per second you will be transmitting, in synchronous communications, if you divide the bit rate by ten. The total bits transmitted will depend on re-transmissions, which depends on the noise of the line, etc. 2. The number of bits of data transmitted per second over a communications link. This usually represented as BPS (bps) with KBPS (Kbps) standing for kilo bits per second (1000 BPS) and MBPS standing for mega bits per second (million BPS) and GBPS standing for giga bits per second (billion BPS) etc.

### Block

A collection of transmitted information which is seen as a discrete entity. Usually has its own address, control, routing and error checking information. See also packet and packet switching.

### Blocking

A connection can't be made. A call can't be completed. These are many reasons for blocking. Sometimes not enough equipment. Sometimes not sufficient lines, or sufficient room on the lines.

### Bps

Bits per second, a measure of speed in serial transmission. (See also baud.) There are many ways to measure bits per second. So don't assume that just because one LAN has a faster bits per seconds, it will transmit your information faster. You have to factor in speed of writing and reading from the disk, and the accuracy of transmission. Some datacom schemes have better error-checking systems. Typically such systems force a retransmission of data if a mistake is detected. You might have a fast, but "dirty" (i.e. lots of errors) transmission media, which may need lots of retransmissions. Thus the effective bps of that LAN may actually be quite low. Also used to describe hardware capabilities, as in a 9600-bps modem.

## BR

The rate of data throughput (bit-rate) on the trunk coaxial medium expressed in hertz.

## Break Out

A separation of discrete fibers from a bundle which terminates in a fiber optic termination.

## Break Out cable

Same as a Fan Out cable. This is a multiple fiber optic cables constructed in the tight buffered design. It is designed for ease of connectorization and rugged applications for intra-building and inter-building requirements.

## Bridge

A MAC-level store-and-forward network node. Bridges are used to interconnect LAN segments, thus creating extended LANs. They filter (drop) or forward frames to other LAN segments based on the frame destination and source address.

## Broadband

A method of communication in which the signal is transmitted by being impressed on a higher-frequency carrier. Also the ability of a communications system to carry a multitude of signals simultaneously. In data transmission is denotes transmission facilities capable of handling frequencies greater than those for high-grade voice communications. The higher frequency allows the carrying of several simultaneous channels. Broadband infers the use of a carrier signal rather than direct modulation, baseband.

## Broadband LAN

LAN which uses FDM (frequency division multiplexing) to divide a single physical channel into a number of smaller independent frequency channels. The different channels created by FDM can be used to transfer different forms of information - voice, data, and video.

## Buffer

1. A software program, storage space in RAM or a separate device used to compensate for differences in the speed of data transmission. A printer buffer is the simplest example. The computer can send data to be printed many times faster than the printer can print it. There are two alternatives. Slow the computer down (the typical alternative). Or, put a buffer between the computer and the printer. Have the computer dump to the buffer, and the printer take from the buffer as it's ready. Exactly like a water dam. 2. A protective layer over the fiber optic cable, such as a coating, an inner jacket, or a hard tube. The primary buffer, next to the cladding, is 250  $\mu\text{m}$  in diameter. A secondary buffer of 900  $\mu\text{m}$  is used on indoor cables. See also: Fiber Buffer.

## Buffer Coating

A protective layer, such as an acrylic polymer, applied over the fiber cladding for protective purposes.

## Buffered Fiber

Fiber optic cable protected with an additional material, usually hytrel or nylon, to provide ease in handling, connectorization and increased tensile strength.

### Buffering

It is used in two contexts: First, it refers to a protective material extruded directly on the fiber optic cable coating to protect it from the environment. Secondly, it refers to extruding a tube around the coated fiber optic cable to allow isolation of the fiber from stresses.

### Buffer Tube

A hard plastic tube, having an inside diameter several times that of a fiber, that holds one or more fibers.

### Building Entrance

Terminal cable entrance point where typically a trunk cable between buildings is terminated and fiber is then distributed through the building.

### Bundle

1. A group of individual glass fibers contained within a single jacket acting as one transmission channel. 2. Many individual fiber optic cables within a single jacket or buffer tube. Also, a group of buffered fiber optic cables distinguished in some fashion from another group in the same cable core.

### Bus

Wiring or cables that carry signals around inside a computer, or between computers and other devices.

### Bus Network

A network topology in which all terminals are attached to a transmission medium serving as a bus. All other terminals receive all signals transmitted from a terminal connected to the bus.

### Bypass

The ability of a station to isolate itself optically from a network while maintaining the continuity of the cable plant.

### Bypass Switch

An FDDI station option that ensures ring integrity. The bypass switch has a default state when power is lost. When a power failure occurs, optical connections are made within the DAS that reconnect the incoming primary ring fiber with the primary ring fiber. Similar connections are made on the secondary ring. This allows network operation to continue without the need for reconfiguration, which can still be employed for emergency situations.

### Byte

A unit of 8 bits.

## C

### Cable

Alternate name for fiber optic cable. An assembly of optical fibers (the glass or plastic basic waveguide) and other material providing mechanical and environmental protection and optical insulation of the inner optical waveguide.

### Cable Assembly

Fiber optic cable that has connectors installed on one or both ends. General use of these cable assemblies includes the interconnection of multimode and single mode fiber optical cable systems and optoelectronic equipment. If connectors are attached to only one end of the cable, it is known as a pigtail. If connectors are attached to both ends, it is known as a jumper.

### Cable Bend Radius

Cable bend radius during installation infers that the cable is experiencing a tensile load. Free bend infers a lower allowable bend radius since it is at a condition of no load.

### Cable Jacket

The outermost protective covering applied over the internal cable elements (i.e., core, cladding, buffer, and strength member).

### Cable Plant

The cable plant consists of all the optical elements. For example, fiber, connectors, splices, etc. between a transmitter and a receiver.

### Caching

An access-driven form of replication. Data is replicated and stored locally as it is referenced; only an initial reference to a piece of data requires access to the master copy. Updates merely invalidate the cached items.

### Campus Bridge

Brings a new dimension to internetworking, the ability to link LAN segments to 30 kilometers or more via single mode fiber optic cable.

### Carrier Frequency

The electromagnetic wave frequency selected to transmit information. Optical carrier frequency is from the infrared, visible or ultraviolet spectrum areas (10<sup>12</sup> Hz and above).

### Carrier Sense Multiple Access With Collision Detection CSMA/CD

1. A technique used to control the transmission channel of a local area network to ensure that there is no conflict between terminals that wish to transmit. 2. A technique employed in Ethernet based LANs to control the transmission channel. It assures that there is no conflict between terminals that wish to transmit.

### Carrier Signal

A continuous waveform (usually electrical) whose properties are capable of being modulated or impressed with a second information carrying signal. The carrier itself conveys no information until altered in some fashion, such as having its amplitude changed (amplitude modulation), its frequency changed (frequency modulation), or its phase changed (phased modulation). These changes convey the information.

### CCITT

Abbreviation for Comite Consultatif International de Telegraphic et Telephonic. An international communications standards. Based in Geneva, Switzerland. Concerned with devising and proposing recommendations for international telecommunications.

### Center Wavelength (Laser)

1. The nominal value central operating wavelength defined by a peak mode measurement where the effective optical power resides. 2. The wavelength of an optical source that might be considered its middle. One measure of this is the average of the two wavelengths corresponding to the Full Width Half Maximum-FWHM.

### Center Wavelength (LED)

1. The average of the two wavelengths measured at the half amplitude points of the power spectrum. 2. The wavelength of an optical source that might be considered its middle. One measure of this is the average of the two wavelengths corresponding to the Full Width Half Maximum-FWHM.

### Central Member

The center component of a cable. It serves as an antibuckling element to resist temperature-induced stresses. Sometimes serves as a strength element. The central member is composed of steel, fiberglass, or glass-reinforced plastic.

### Central Office (CO)

1. The place where communications common carriers terminate customer lines and locate switching equipment that interconnects those lines. 2. The places where communications common carriers terminate customer lines and locate switching equipment that interconnects those lines. It is the lowest hierarchical level of a TELCO backbone network. It is from the Central office level that local loops go out to end-user customer premises equipment.

### Centro Symmetrical Reflective Optics

An optical technique in which a concave mirror is used to control coupling of light from one fiber optic cable to another.

## Channel

1. A communications path or the signal sent over a channel. Through multiplexing several channels, voice channels can be transmitted over an optical channel. 2. A communications path derived from a specific transmission medium, as for example fiber optic cables. The channel supports the end-to-end communications of an information source and destination. Besides the transmission medium a channel needs to have a transmitter/receiver (transceiver) and a modulator/demodulator (modem). By multiplexing, several channels can share the same specific transmission medium. Channel is synonymous with link. The term channel is usually employed within the context of multiplexing but not always.

## Chromatic Bandwidth

The inverse of the Chromatic Dispersion.

## Chromatic Dispersion

1. The speed of an optical pulse travelling in a fiber changes as its wavelength changes. Since any practical light source has a certain spectral width, this effect results in pulse broadening called chromatic dispersion. Chromatic dispersion can be measured by the measurement of travel time at different wavelengths. 2. The speed of an optical pulse travelling down a fiber optic cable changes if the wavelength changes. However, any practical light source has a spectral width that is, has components at a number of different wavelengths. This results in a pulse broadening - the time width of pulse broadens as it propagates down a fiber optic cable. This effect is called chromatic dispersion. It can be calculated experimentally by measuring the travel time down a fiber optic cable of light at different wavelengths.

## Cladding

A low-refractive-index, glass or plastic that surrounds the core of a fiber. Optical cladding promotes total internal reflection for the propagation of light in a fiber. The cladding steers light to the core.

## Cladding Mode

1. A mode confined to the cladding; a light ray that propagates in the cladding. 2. A mode that is confined to the cladding. Basically, a light ray that propagates down the cladding. Attenuation is very high in the cladding. Consequently, a cladding mode is eliminated after a few meters.

## Cladding Mode Stripper

A device that encourages the conversion of cladding modes to radiation modes; as a result of its use, cladding rays are stripped from the fiber. A cladding mode stripper often uses a material having a refractive index equal to or greater than that of the waveguide cladding to induce this conversion.

## Cleaving

The process of separating an optical fiber by a controlled fracture of the glass, for the purpose of obtaining a fiber end, which is flat, smooth, and perpendicular to the fiber axis.

### Clock

1. An electronic component that emits consistent signals, like a metronome, that paces a computer's operations. 2. An oscillator-generated signal that provides a timing reference for a transmission link. A clock provides signals used in a transmission system to control the timing of certain functions, such as the duration of signal elements or the sampling rate. It also generates periodic, accurately spaced signals used for such purposes as timing, regulation of the operations of a processor, or generation of interrupts. A clock has two functions: to generate periodic signals for synchronization on a transmission facility, and to provide a time base for the sampling of signal elements. In computers, a clock synchronizes certain procedures, such as communication with other devices.

### Club Des Fibres Optiques Plastiques

Club formed in France to promote Plastic Optical Fiber (POF) for a variety of applications.

### Coating

A material put on a fiber during the drawing process to protect it from the environment.

### Code

A specific way of using symbols and rules to represent information.

### Coder

Digital information transformed into pulses of electricity, digitized as ones and zeros with no errors.

### Coherent Bundle

A bundle of optical fibers that occupy the same relative position at both ends of the bundle.

### Coherent Light

This is light of which all parameters are predictable and correlated at any point into time or space, particularly over an area perpendicular to the direction of propagation or over time at a particular point in space. Simply, coherent light usually refers to the phenomenon relating to the existence of a correlation between the phases of the corresponding components of two light waves or to the values of the phase of a given component at two instants in time or two points in space. Coherent light does not occur naturally in the Universe. It can only be generated in a laser. See Lightwaves.

### Collimation

The process by which a divergent or convergent beam of radiation is converted into a beam with the minimum divergence possible for the system (ideally a parallel bundle or rays). See also: Beam Divergence.

### Collimator

An optical instrument consisting of a well-corrected objective lens with an illuminated slit or reticle at its focal plane. Collimators are used in lens testing to determine focal lengths, and in other metrological applications where a distant object at a known location is required.

### Collision

The result of two work stations trying to use a shared transmission medium (cable) simultaneously (overlapping). The electrical signals, which carry the information they are sending, bump into each other (a collision). This ruins both signals (interference) meaning they both have to retransmit their information. In most systems, a built in delay will make sure the collision does not occur again. The whole process takes fractions of a second. Collisions in LANs make no sound.

### Collision Detection

The process of detecting that simultaneous (and therefore damaging) transmission has taken place on a shared medium. Typically, each transmitting workstation that detects the collision will wait some period of time and try again. Collision detection is an essential part of the CSMA/CD access method. Workstations can tell that a collision has taken place if, having sent data, they do not receive an acknowledgment from the receiving station.

### Collision Detector

An optoelectronic circuit that monitors the signals received via the fiber optic cable from the passive Codestar and sends a "collision presence" signal to the host when more than one data signal is detected coming for the Codestar.

### Combiner

A passive device in which optical power from several input fibers is collected at a common point. See also: Coupler.

### Common Carrier

An organization licensed by some public regulatory authority, e.g. the FCC, to provide a specific set of services for a specific set of rates. Common means the carrier is obligated to carry for everyone. Carrier means they convey something - freight, data, etc. - for their customers. Examples are GTE Sprint, Yellow Freight, AT&T Communications, MCI, American Airlines.

### Communications Application Compiler

A piece of software that translates instructions written in a high-level language into a lower-level language so that the processor can understand them.

### Compatibility

The ability of a computer system to accept and process data prepared by another similar system without having to adapt it.

### Compatibility Interfaces

The MDI coaxial cable interface and the AUI branch cable interface, the two points at which hardware compatibility is defined to allow connection of independently designed and manufactured components to the baseband transmission system.

### Compilation

The translation of programs written in a language understandable to programmers into instructions understandable to the computer. Think of programmers writing in every language but Greek and computer understanding only Greek. In this case, Greek is called machine language. The other languages (the programmer languages) are called things like COBOL, FORTRAN, Pascal, dBASE. A compiler is a special program that translates from all these other languages into machine language.

### Compression

The use of any of several techniques to reduce the number of bits needed to represent information in data transmission or storage. This saves storage space on magnetic storage devices such as hard disk, tape drives and floppy disks. It also saves transmission time.

### Compression Utilities

Applications that squeeze data into smaller files by coding them into special formats or algorithms that take less space.

### Concentrator

A multi-port repeater.

### Concentricity

In a wire or cable, the measurement of the location of the center of the conductor with respect to the geometric center of the circular insulation.

### Conduit

Pipe or tubing through which cables can be pulled or housed.

### Connect Time

The time a circuit is in use. Connect time typically refers to circuit-switched systems, such as telephone lines.

### Connection Management (CMT)[FDDI]

Manages a station's PHY layer components and their interconnections in order to achieve logical connection to the ring. CMT also manages the configurations of MAC and PHY entities within a station. Additionally, CMT includes the detection and isolation of faults at the PHY layer plus monitoring and link quality.

### Connector

1. A junction which allows an optical fiber or cable to be repeatedly connected or disconnected to a device such as a source or detector. 2. A mechanical device mounted on the end of a fiber optic cable, light source, receiver or housing that mates to a similar device. It allows light to be coupled, optically, into and out of a fiber optic cable. A connector allows a fiber optic cable to be connected or disconnected repeatedly from a device. Commonly used connectors include FC/PC, Biconic, SC, ST, D4, and SMA 905 or 906.

### Connector Body

Main portion of a connector to which other components are attached.

### Connector Induced Fiber Loss

That part of the Conductor Insertion Loss, expressed in dB, due to impurities or structural changes to the fiber optic cable by termination or handling with the connector.

### Connector Insertion Loss

See Insertion Loss.

### Connector Panel

The rear surface of a computer or peripheral device, which includes the connectors for peripheral devices or for the computer. Also called Back Panel.

### Connector Plug

A device used to terminate an optical conductor cable.

### Connector Receptacle

The fixed or stationary half of a connection that is mounted on a panel/bulkhead. Receptacles mate with plugs.

### Connector Return Loss

The amount of power reflected from the connector to connector interface. Return loss values are expressed as dB. A typical specification could range from -15 to -60 dB, where, in most cases, -60 is more desirable.

### Connector Time

The time a circuit is in use. Connect time typically refers to circuit-switched systems, such as telephone lines.

### Connector Variation

The maximum value in dB of the difference in insertion loss between mating optical connectors. Also known as Optical Connector Variation.

### Contention

A way to determine how separate workstations can access a cable (shared transmission medium). In this case, each workstation tries to access the network at will. If the network is busy, they must wait and try again. Think of it as "first come, first served"...A "dispute" between two or more devices over the use of a common channel at the same time.

### Controller

A device which acts as the electrical and logical interface between a host system and a local area network. Often it is a plug-in addition to the equipment and involves software as well as hardware. In standard Ethernet, the controller is attached to the network bus by way of a transceiver. For Thin-net, the controller and transceiver are usually combined. A device between the host and terminals that relays information between them. It administers their communication. Controllers may be housed in the host or on a file server. Typically one controller will be connected to several terminals. The most common controller is the IBM Cluster Controller for their family of mainframes.

## Core

1. The light conducting portion of a fiber, defined by its high refractive index. The core is normally in the center of a fiber, bounded by concentric cladding of lower refractive index. 2. The central, light carrying, part of a fiber optic cable. It has an index of refraction higher than that of the surrounding cladding.

## Core Eccentricity

A measure of the displacement of the center of the core relative to the cladding center.

## Core Ellipticity (Non-Circularity)

A measure of the departure of the core from roundness.

## Counter Rotating

An arrangement whereby two signal paths, one in each direction, exist in a ring topology.

## Coupler

1. A device whose purpose is to distribute optical power among two or more ports, or to concentrate optical power from two or more fibers into a single port. Couplers may be active or passive. 2. It is used in two contexts: First, it is a passive device that distributes optical power among two or more ports and this can be in different ratios. Secondly, it is a multi-pod device used to distribute optical power.

## Coupling Efficiency

The efficiency of optical power transfer between two components.

## Coupling Loss

The power loss suffered when coupling light from one optical device to another. There are intrinsic losses (non-ideal fiber parameters) and extrinsic losses (mechanical effects).

## Coupling Ratio

The percentage of light transferred to a receiving output port with respect to the total power of all output ports.

## CPE

Customer Premises Equipment.

## Crimp Sleeve

A hollow, metal cylinder that when crimped, holds the connector to the cable via the strength member of the cable.

## Critical Angle

1. The smallest angle at which a meridional ray may be totally reflected within a fiber at the core-cladding interface. When light propagates in a homogeneous medium of relatively high refractive index ( $n_1$ ) onto an interface with a homogeneous material of lower index ( $n_2$ ). 2. The greatest angle of incidence for which a wave propagating in a homogeneous medium of relatively high refractive index strikes an interface with a medium having a lower refractive index and for which refraction is just possible. With respect to fiber optic cabling the critical angle is therefore the smallest angle at which a light ray will be totally reflected within the fiber and thereby guided down the fiber - total internal reflection.

### Crosstalk

1. The phenomenon of light leakage or information transfer from a waveguide to one adjacent. 2. The pickup in one particular fiber optic cable of unwanted light from another fiber optic cable.

### CSMA/CD

Carrier Sense Multiple Access with Collision Detection.

### CSR

Centro symmetrical reflective optics.

### Cutback

A method for measuring the attenuation or bandwidth of a fiber optic cable by first measuring the full length and then cutting back and measuring, again, the fiber optic cable at a shorter length.

### Cutoff Wavelength

For a single mode fiber, the wavelength above which the fiber exhibits single mode operation.

### CW

Abbreviation for continuous wave. Usually used to refer to the constant optical output from an optical source when it is biased but not modulated with a signal.

### CYTOP®

Perfluorinated polymer trademark of Asahi Glass Co. Ltd.

## D

### Dark Current

1. The external current that under specified biasing conditions, flows in a photodetector when there is no incident radiation. 2. The thermally induced current that exists in a photodiode in the absence of incident optical power.

### Data

The basic elements of information that can be processed or produced by a computer ...A representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing; any representations, such as characters, to which meaning may be assigned.

### Database

Data stored in computer-readable form, and usually indexed or sorted in a logical order. Users can use the index or logical arrangement to find the item of data they need. Used to store names, addresses, order entry data and so on. A typical data base is inventory. Data bases in a central file server are one of the most common LAN applications.

### Data Bus

A system incorporated into fiber optic data communications characterized by several spatially distributed terminals that are served with the same multiplexed signal.

### Data Communications

The movement of encoded information by an electrical transmission system. The transmission of data from one point to another.

### Data Compression

Storing of digital data with techniques that consume less memory space than basic methods.

### Data Frame

Consists of the Destination Address, Source Address, Length Field, LLC Data, Pad and Check Frame Sequence.

### Datagram

A particular type of information encapsulation at the network layer of the adapter protocol. No explicit acknowledgment of the information is sent by the receiver. Instead, transmission relies on the "best effort" of the link layer...A packet that includes a complete destination address specification (provided by the user, not the network) along with whatever data it carries. It is a oneway construct much like a telegram ...A transmission method in which sections of a message are transmitted in scattered order and the correct order is reestablished by the receiving workstation. Used on packet-switching networks.

### Data Link

1. The communication network between nodes of a data transmission system. 2. Transmitter with Modulator, Transmission medium and Demodulator with Receiver that transmits data between two points. When the Transmission medium is a fiber optic cable the data link is a fiber optic data link.

### Data Rate

1. The maximum number of bits of information which can be transmitted per second, as in a data transmission link; typically expressed as megabits per second (Mb/s). 2. Also Data Transmission Rate. The number of bits of information sent per second in a data communications transmission system. It is generally expressed in Bits Per Second, BPS. This may or may not be equal to the Baud rate.

### dB

Decibel, a measure of loss or equivalently attenuation. It is computed as a standard logarithmic unit for the ratio of two powers, voltages or currents. In fiber optics the ratio is power and defined by:

$$\text{dB} = 10\text{Log}_{10} (P1/P2).$$

### dbm

Decibel referenced to a milliwatt.

### dBmV

An abbreviation for decibel millivolt. The level at any point in a system expressed in dB's above or below a 1 millivolts (dBmV). Zero dBmV is equal to 1 millivolt across 75 ohms. The level at any point in a system expressed in dBs above or below a 1 millivolt/75 ohm standard is said to be the level in decibel millivolts or dBmV.

### dB $\mu$

Decibel referenced to a microwatt.

### Decibel (dB)

The standard unit used to express gain or loss of optical power. A standard logarithmic unit for the ratio of two powers, voltages or currents. In fiber optics, the ratio is power.

### Decoding

Validity checking of received transmission characters and generation of valid data bytes and special codes from those characters.

### Delta

Greatest relative difference in refractive index of core and cladding.

### Demultiplex

Separation of channels which has been multiplexed in order to share a common transmission medium. With respect to a fiber optic cable medium it is the process of separating optical channels.

### Destination

Receiver of data; data sink.

### Destination Address

That part of a message which indicates for whom the message is intended. Usually a collection of characters or bits. Just like putting a destination address on an envelope.

## Detector

1. A transducer that provides an electrical output signal in response to an incident optical signal. The current is dependent on the amount of light received and the type of device. 2. A device that generates an electrical signal when illuminated by light. The electrical current is dependent upon the amount of light received. Common detectors encountered in fiber optic data communications are photodiodes, photodarlingtontons and phototransistors.

## D4

A connector type. It is very similar to the FC connector with its threaded coupling, tunable keying and PC end finish. The main difference is its 2.0-mm diameter ferrule. Designed originally by the Nippon Electric Corp.

## Diameter Mismatch Loss

The loss of power at a joint that occurs when the transmitting half has a diameter greater than the diameter of the receiving half. The loss occurs when coupling light from a source to a fiber optic cable, from a fiber optic cable to another fiber optic cable or from a fiber optic cable to a detector.

## Diamond Connector

A type of connector.

## Dichroic Filter

An optical filter that transmits light selectively according to wavelength.

## Dielectric

Non-metallic and therefore non-conductive. Glass fiber optic cable is therefore considered dielectric. A dielectric cable contains no metallic components.

## Diffraction

As a wavefront of light passes by an opaque edge or through an opening, secondary weaker wavefronts are generated, apparently originating at that edge. These secondary wavefronts will interfere with the primary wavefronts as well as with each other to form various diffraction patterns.

## 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

1. A data format that uses discrete or separate physical levels to contain information. 2. A data format that uses a discrete, countable and finite number of levels to transmit information. Binary is a special case of this corresponding to two levels.

## DIN 47256

A connector type.

## Directivity

This is also referred to as near end crosstalk. It is the amount of power observed at a given input port with respect to an initial input power.

### Direct Ray

A ray that travels from one point to another without being reflected or refracted.

### Directories and Naming

Facilities for storing location information for different files, databases, tables or objects. Distributed-data technology requires using names for data structures that are unique across the enterprise. Global-naming schemes are essential to the migration of distributed data architectures.

### Dispersion

1. The cause of bandwidth limitations in a fiber. Dispersion causes a broadening of input pulses along the length of the fiber. Two major types are: mode dispersion caused by differential optical path lengths in a multi-mode fiber and material dispersion caused by a differential delay of various wavelengths of light in a waveguide material. 2. A general term for those phenomena that cause a broadening or spreading of light as it propagates down a fiber optic cable. This is the major cause of bandwidth limitations with fiber optic cable. There are three types of dispersion - modal, material and waveguide. Differential optical path lengths in multi-mode fiber optic cables cause modal dispersion. Material dispersion is caused by a differential delay of various wavelengths of light in a waveguide material. Waveguide dispersion is caused by light travelling in both the core and cladding materials in single-mode fiber optic cables.

### Distortion

The unwanted change in waveform that occurs between two points in a transmission system. AMPLITUDE vs FREQUENCY DISTORTION is caused by the non-uniform gain or attenuation of the system with respect to frequency. DELAY vs FREQUENCY DISTORTION is caused by differences in the transit time of frequencies within a given bandwidth under specified conditions. NON-LINEAR DISTORTION is a deviation from the normal linear relationship between the input and output of a system or component.

### Distortion Limited Operation

Generally synonymous with bandwidth-limited operation.

### Distributed Data Processing

The processing of information in separate locations equipped with independent computers. The computers are connected by a network, even though the processing is geographically dispersed. Often a more efficient use of computer processing power since each CPU can be devoted to a certain task. A LAN is the perfect example of distributed processing.

### Distributed Feedback Laser (DFB)

An injection laser diode which has a Bragg reflection grating in the active region, in order to suppress multiple longitudinal modes and enhance a single-longitudinal mode.

### DLC Data Link Control

The set of rules used by two nodes, or stations, on a network to perform an orderly exchange of information over the network. A data link includes the physical transmission medium, the protocol, and associated devices and programs, so it is both physical and logical.

### Domain

In networks, the technical term for a subdivision of the hosts on a network, the division can be physical, as in separate building LANs, or logical, as in giving the hosts

in a particular administrative area their own name group even though they are on the same physical network.

### Dominant Mode

The mode in an optical device's spectrum with the most power.

### Dopant

1. A material, usually germania or boron oxide, added to silica to change its index of refraction. 2. Materials added to a core of a fiber optic cable in order to change its characteristics.

### DRAM (Dynamic Random Access Memory)

A form of RAM that requires continuous electricity to keep its contents stored and intact.

### Drawing

The manufacturing process by which fiber optic cable is pulled from preforms.

### Dual Attachment Concentrator

A concentrator that offers two attachments to the FDDI network which are capable of accommodating a dual (counter-rotating) ring.

### Dual Attachment Station

A station that offers two attachments to the FDDI network which are capable of accommodating a dual (counter-rotating) ring.

### Dual Ring (FDDI Dual Ring)

A pair of counter-rotating logical rings.

### Duplex

Characteristic of data transmission. Either full or half duplex. Full permits simultaneous, two-way communication. Half means only one side can talk at once.

### Duplex Cable

A two-fiber cable suitable for duplex (2 way) transmission.

### Duplex (Two Position) Connectors (FDDI)

Used as the physical connections between stations on the FDDI ring to connect fiber optic cables. The connectors are polarized to prevent the transmitting and receiving fibers from becoming inadvertently interchanged.

### Duplex Operation

Transmission on a data link in both directions. Half duplex refers to such transmission, but in a time-shared mode-only one direction can transmit at a time. With full duplex there can be transmission in both direction simultaneously.

### Duplex Transmission

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

### Duty Cycle

In a digital transmission, the ratio of high levels to low levels or the ratio of on time - signal present - to total time - as averaged over many bit or Baud intervals.

### Dynamic Range

In a transmission system, the ratio of the overload level to the noise level of the system, usually expressed in decibels. The ratio of the specified maximum level of a parameter (e.g., power, voltage, frequency, or floating point number representation) to its minimum detectable or positive value, usually expressed in decibels.

### Dynamic Routing Strategy

A way to route messages through a network. If one route is disabled or too busy, another route is chosen automatically. A packet switching network has dynamic routing strategy.

# E

## **Eccentricity (Connector)**

Displacement of the fiber hole from the true centerline of the ferrule's outside diameter.

## **EDFA**

Erbium-doped fiber amplifier.

## **EIA**

Electronic Industry Association.

## **8B/10B Encoding**

A signal modulation scheme in which either 4 bits are encoded into a 5-bit word or eight bits are encoded into a 10bit word. This scheme ensures that too many consecutive zeros do not occur. It is used in ESCON and Fiber Channel.

## **802.3 Network**

A 10 MBPS CSMA/CD bus based LAN; commonly called Ethernet.

## **802.5 network**

A token passing ring network operating at 4 or 16 MBPS.

## **EMI**

Electromagnetic interference. It is any electrical or electromagnetic interference that causes an undesirable response, degradation or failure in electronic equipment. Fiber optic cables neither emits nor receives EMI.

## **Electromagnetic Interference (EMI)**

Any electrical or electromagnetic interference that causes undesirable response, degradation or failure in electronic equipment. Optical fibers neither emit nor receive EMI.

## **Electron**

A particle of matter that affects electricity and electrical current.

## **Electron Microscope**

A device utilizing an electron beam for the observation and recording of submicroscopic samples with the aid of photographic emulsions or other short-wave-length sensors. With the electron microscope, the maximum useful magnification is over 300,000.

## **Electrostatic Lens**

The electrical distribution that serves to influence an electron beam in the same way that an optical lens affects a light beam.

## **Electrostatic Printer**

An instrument used to print an optical image on a specially treated paper. Light and dark portions of the original image are illustrated by electrostatically charged and uncharged portions of the paper.

## **ELED**

Abbreviation for edge-emitting LED.

### Emitter

Term used for a light source.

### Encapsulation

The provision of end-to-end support of communication using a network protocol X across a network which only supports protocol Y by packaging protocol X packets in headers in the data portion of protocol Y packets.

### Encoding

1. Generation of the transmission characters from valid data bytes and special codes. 2. A scheme to represent digital ones and zeros through combining high and low voltage states.

### End Finish

Quality of the surface at an optic-fiber's end, commonly described as mirror, mist, hackle, chipped, cracked, or specified by final grit size used in polishing.

### Endoscope

A medical instrument used to view inside the human body by inserting the instrument into a natural or created aperture. The endoscope may use a coherent fiber optic bundle or conventional optics to relay the image to the eye or a television camera. Illumination is provided by a concentric bundle of noncoherent fiber optics.

### End Separation

The distance between the ends of two joined fiber optic cables. End separation causes an extrinsic loss that depends on the joining hardware and method.

### End Separation Loss

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

### End to End Loss

The optical loss on an installed fiber optic cable data link path. This loss consists of the loss due to the fiber optic cable, splices and connectors.

### E/O

Abbreviation for electrical-to-optical converter.

### Epoxy Connector

A type of fiber optic connector that is terminated onto a cable with use of epoxy to perform a chemical bond.

### Equilibrium Mode Distribution (EMD)

1. The condition in a multi-mode optical fiber in which the relative power distribution among the propagating modes is independent of length. Synonym: Steady State Condition. 2. The steady modal state of a multi-mode fiber optic cable in which the relative power distribution among the modes is independent of the fiber optic cable length. See also: Equilibrium Length; Mode; Mode Coupling.

### **Erbium Doped Fiber Amplifier**

A type of fiber optic cable that amplifies 1550 nm optical signals when pumped with a 980-1480 nm light source.

### **Error Detection**

Checking for errors in data transmission. A calculation is made on the data being sent and the results are sent along with it. The receiving workstation then performs the same calculation and compares its results with those sent. The calculation may be as simple as the number of 1s in one part of the message or it may be as complicated as a cyclical redundancy check ...Code in which each data signal conforms to specific rules of construction so that departures from this construction in the received signals can be automatically detected. Any data detected as being in error is either deleted from the data delivered to the destination, with or without an indication that such deletion has taken place, or delivered to the destination together with an indication that it has been detected as being in error.

### **ESCON**

1. Enterprise Systems Connection Architecture. (ESCON is a registered trademark of IBM). 2. An IBM channel control system based on fiber optic.

### **ESKA**

Trade mark of plastic fiber optic cable manufactured by Mitsubishi Rayon Corp.

### **ESKA GIGA**

Graded index plastic fiber optic cable manufactured by Mitsubishi Rayon Corp.

### **ESKA MEGA**

Trade mark of plastic fiber optic cable manufactured by Mitsubishi Rayon Corp.

### **Ethernet**

1. A network of high-speed transmission cables and software. 2. A 10 Mbit/sec Carrier Sense Multiple Access with Collision Detection (CSMA/CD) standard, utilizing coaxial cable.

### **Ethernet Bridge Connectivity**

Used to connect two or more networks.

### **Ethernet Converted to Fiber**

A 10 Mbit/sec CSMA/CD standard, converted to fiber optics.

### **Ethernet Standards**

Not all Ethernet and IEEE 802.3 standards are identical. In fact, in some instances, there are enough differences in Ethernet standards to cause major problems. In a network environment (such as Ethernet Version 1.0 and IEEE 802.3) nodes can coexist and communicate properly on a network but the important link is overall transceiver-to-node integrity.

### Excess Loss

1. In a fiber optic coupler, the optical loss from that position of light that does not emerge from the nominally operational ports of the device. 2. There are two contexts in which it is used. First, in a fiber optic coupler it is the optical loss from that portion of light that does not emerge from the nominally operational ports of the device. Secondly, it is the ratio of the total output power of a passive component to the input power.

### Extrinsic Fiber Loss

1. Optical fiber loss caused by imperfect alignment of fibers in a connector or splice. Contributors include angular misalignment, axial misalignment, end separation, and end finish - any imperfect joining caused by connector or splice.

### Extrinsic Loss

In a fiber interconnection, that portion of loss that is not intrinsic to the fiber but is related to imperfect joining, which may be caused by the connector or splice. Contributors include angular misalignment, axial misalignment, end separation, and end finish. Generally synonymous with insertion loss.

### End Separation Loss

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

### E/O

Abbreviation for electrical-to-optical converter.

### Epoxy Connector

A type of fiber optic connector that is terminated onto a cable with use of epoxy to perform a chemical bond.

### Equilibrium Mode Distribution (EMD)

The condition in a multi-mode optical fiber in which the relative power distribution among the propagating modes is independent of length. Synonym: Steady State Condition. See also: Equilibrium Length; Mode; Mode Coupling.

### Error Detection

Checking for errors in data transmission. A calculation is made on the data being sent and the results are sent along with it. The receiving workstation then performs the same calculation and compares its results with those sent. The calculation may be as simple as the number of 1 s in one part of the message or it may be as complicated as a cyclical redundancy check ...Code in which each data signal conforms to specific rules of construction so that departures from this construction in the received signals can be automatically detected. Any data detected as being in error is either deleted from the data delivered to the destination, with or without an indication that such deletion has taken place, or delivered to the destination together with an indication that it has been detected as being in error.

### ESCON

Enterprise Systems Connection Architecture. (ESCON is a registered trademark of IBM).

### Ethernet

1. A network of high-speed transmission cables and software. 2. A 10 Mbit/sec Carrier Sense Multiple Access with Collision Detection (CSMA/CD) standard, utilizing coaxial cable.

### Ethernet Bridge Connectivity

Used to connect two or more networks.

### Ethernet Converted to Fiber

A 10 Mbit/sec CSMA/CD standard, converted to fiber optics.

## F

### Fall Time

The time required for the trailing edge of a pulse to fall from 90% to 10% of its amplitude; the time required for a component to produce such a result. "Turnoff time". Sometimes measured between the 80% and 20% points.

### Fan Out Cable

1. Multi-fiber cable constructed in the tight buffered design. Designed for ease on connectorization and rugged applications for intra- or interbuilding requirements. 2. Same as a Break Out cable. This is a multiple fiber optic cables constructed in the tight buffered design. It is designed for ease of connectorization and rugged applications for intra-building and interbuilding requirements.

### Fast Ethernet

A 100 Mbit/sec Carrier Sense Multiple Access with Collision Detection (CSMA/CD) standard, converted for use with fiber optic cable.

## FC

A connector type. It is utilized for single-mode fiber optic cable. It offers extremely precise positioning of the single-mode fiber optic cable with respect to the emitter and detector. It features a position locatable notch and a threaded receptacle. Once installed, the position is maintained with absolute accuracy.

### FC/PC

A connector type. It is utilized for single mode cable. It offers extremely precise positioning of the single mode cable with respect to the emitter and detector. It features a position locatable notch and a threaded receptacle. Once installed the position is maintained with absolute accuracy.

## FDDI

1. The Fiber Distributed Data Interface LAN developed by the ANSI X3T9.5 committee. Development was started in 1982. FDDI was the first LAN based exclusively on optical fiber components. The FDDI PMD standard specifies 2-Km link lengths between token ring nodes based on using 1.3-micron LED sources and 62.5/1.25-micron multi-mode fiber. An alternative PMD utilizes a 1.3-micron LD sources and single mode fiber to achieve greater than 25-Km links between nodes. 2. A standard for fiber optic data transmission systems developed by the American National Standards Institute (ANSI) and associated working groups, that will make fiber optic components from different manufacturers compatible with each other by specifying parameters such as data transmission rate (100 Mb/sec and above), power supply requirements, packaging and components. The FDDI local area networks will support up to 500 stations in a ring topology with circumference of up to 100 Km, with dual rings to provide redundancy in case of cable or system failure. 3. A very high-speed local area networking architecture based upon fiber optic cable as the transmission medium. Many FDDI features were incorporated into Fast Ethernet-100Base-T. FDDI has its own special type of connector.

### **FDM (Frequency Division Multiplex)**

See Frequency Division Multiplexing. Method by which the available transmission frequency range is divided into narrower bands, each used for a separate channel. As utilized by broadband technology, the frequency spectrum is divided up among discrete channels, to allow one user or a set of users access to single channels.

### **Ferrule**

A component of a connector that holds fiber in place and aids in its alignment, usually cylindrical in shape with a hole through the center.

### **Fiber**

1. A single, separate optical transmission element, characterized by a core and a cladding. 2. Any filament or fiber, made of dielectric materials, that guides light, whether or not it is used to transmit signals.

### **Fiber Bandwidth**

1. The frequency at which the magnitude of the fiber transfer function decreases to a specified fraction of the zero frequency value. Often, the specified value is one-half the optical power at zero frequency. 2. The lowest frequency at which the magnitude of the fiber transfer function decreases to a specified fraction of the zero frequency value. Often the specified value is 1/2 of the value of the transfer function at zero frequency.

### **Fiber Buffer**

Material used to protect an optical fiber or cable from physical damage, providing mechanical isolation or protection. Fabrication techniques include both tight jacket or loose tube buffering as well as multiple buffer layers.

### **Fiber Bundle**

An assembly of unbuffered optical fibers. Usually used as a single transmission channel as opposed to multifiber cables, which contain optically and mechanically isolated fibers, each of which provides a separate channel. Fiber bundles, which are used only to transmit light as in fiber optic data communications, are flexible and unaligned. On the other hand, fiber bundles which are used to transmit images may be flexible or rigid, but must contain aligned fibers.

### **Fiber Channel**

1. An ANSI Optical Communications Standard that can transfer data up to 1,062.5 Mbits per second. 2. A high speed point-to-point serial data channel standard. The architecture has been designed so that it can be implemented with high performance hardware that requires little real-time software management. 3. An industry standard specification for computer channel communications over a fiber optic cable. It offers data transmission speeds from 132 MBPS to 1,062 MBPS and transmission distances for 1 to 10 Km

### **Fiber Cleaving**

The controlled fracture of an optical fiber along a crystalline plane resulting in a smooth surface.

### **Fiber Core**

The inner portion of the fiber that transmits light. The index of refraction is higher than that of the cladding that surrounds it.

### **Fiber Loss**

The attenuation (deterioration) of the light signal in transmission through a fiber optic cable.

### **Fiber Distributed Data Interface Network**

A token passing ring network designed specifically for fiber optic cable and featuring dual counter-rotating rings and 100 MBPS operation.

### **Fiber Optics**

Light transmission through optical fibers for communication or signaling.

### **Fiber Optic Attenuator**

A component that is installed in a fiber optic transmission system to reduce the power in the optical signal. It is often used to limit the optical power received by the photodetector to within the limits of the optical receiver.

### **Fiber Optic AUI Extender**

Connects remotely located workstations via fiber optical cables.

### **Fiber Optic Cable**

An optical fiber, multiple fibers, or fiber bundles which may include a cable jacket and strength members (typically Kevlar or steel) fabricated to meet optical, mechanical and environmental specifications.

### **Fiber Optic Communication System**

The transfer of modulated or unmodulated optical energy through optical fiber media which terminates in the same or different media.

### **Fiber Optic Inter Repeater Link**

Standard defining a fiber optic cable link between two repeaters in an IEEE 802.3 network.

### **Fiber Optic Link**

Any optical transmission channel designed to connect two end terminals or to be connected in series with other channels.

### **Fiber Optic Span**

An optical fiber/cable which is terminated at both ends and which may include devices which possibly add, subtract or attenuate optical signals.

### **Fiber Optic Sub System**

A functional entity with defined bounds and interfaces which is part of a system. It contains solid state and/or other components and is specified as a sub-system for the purpose of trade and commerce.

### **Fiber Optic Test Procedure (FOTP)**

Standard test procedures developed and published by the Electronic Industries Association (EIA) under the EIA-RS-455 series of standards.

### **Fiber Optic Waveguide**

A relatively long strand of transparent substance, usually glass, capable of conducting an electromagnetic wave of optical wavelength (visible or near visible region of the frequency spectrum) with some ability to confine longitudinally directed, or near longitudinally directed, lightwaves to its interior by means of internal reflection. The fiber optic waveguide may be homogeneous or radically inhomogeneous with step or graded changes in its refractive index. The indices are lower at the outer regions and the core is thus of an increased refractive index.

### **Fiberscope**

A bundle of systematically arranged fibers that transmits a full color image which remains undisturbed when the bundle is bent. With an objective lens on one end of the bundle, and a magnifying lens at the other, the system becomes a flexible fiberscope used to view objects that could not be seen by direct viewing.

### **File Server**

A storage subsystem shared by multiple workstations on a LAN.

### **Firmware**

Programming functions implemented through a small special-purpose memory unit.

### **FIT Rate**

Number of device failures in 1 billion device hours.

### **FITL**

Fiber in the loop.

### **FM**

Frequency modulation.

### **FO7**

Plastic fiber optic cable connector standardized in Japan.

### **FOIRL**

Fiber optic inter-repeater link.

### **Flat Ferrule**

The ferrule of the connector is flat, thus allowing the whole ferrule face to make contact in a connection.

### **Flux Budgets**

Optical power attenuation permitted between any two transceivers. This attenuation allowance is for optical connector losses, optical cable attenuation and the optical cable attenuation and the optical power division in a Codestar passive fiber optic coupler. The sum of these attenuations, losses and divisions must not exceed the flux budget.

### **Footprint**

1. In an electronic package, the amount of space occupied by a component on the surface upon which it is mounted. 2. The space on an optical component occupied by a light beam.

## FOTS

Fiber optic transmission system.

## F4B/5B Encoding

A signal modulation scheme in which groups of 4 bits are encoded and transmitted in 5 bits in order to guarantee that no more than three consecutive zeros ever occur. It is used in FDDI.

## FOXI

Fiber optic transparent synchronous transmitter-receiver interface.

## FPLD

Fabry-Perot laser diode.

## Frame

A group of bits sent over a communications channel, usually containing its own control information, including address and error detection. The exact size and make-up of a frame depends on the protocol used.

## Frame Relay

Frame relay switching is a form of packet switching, but uses smaller packets and requires less error checking than traditional forms of packet switching. Like traditional X.25 packet networks, frame relay networks use bandwidth only when there is traffic to send.

## Free Space Optical Interconnect

A type of internal photonic connection in an integrated circuit in which a holographic grating is used to focus light at points on a silicon chip, maximizing the speed of signal propagation.

## Frequency

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

## Frequency Division Multiplexing (FDM)

A system that allows the transmission of more than one signal over a common path, by assigning each signal different frequency band.

## Frequency Modulation (FM)

A method of transmission in which the carrier frequency varies in accordance with the signal.

## Frequency Response

The change of gain with frequency.

## Fresnel Reflection

1. Reflection of a portion of the light incident on a planar interface between two homogeneous media having different refractive indices. Fresnel reflection occurs at the air-glass interfaces at entrance and exit ends of an optical fiber. Resultant transmission losses (on the order of 4% per interface) can be virtually eliminated by use of anti-reflection coatings or index matching material. 2. The reflection that occurs at the planar junction of two materials having different refractive indices. Fresnel reflection is not a function of the angle of incidence.

### **Fresnel Reflection Loss**

Loss of optical power due to Fresnel reflections.

### **FTAM**

File Transfer, Access and Management, OSI Version of FTP Based on dissimilar systems.

### **FTP**

The File Transfer Protocol of the DARPA Internet protocol suite, specified by RFC-1011...An upper-level TCP/ IP service that allows copying files across a network.

### **FTTH**

Abbreviation for Fiber-to-the-Home.

### **Fundamental Mode**

The lowest order mode of a waveguide.

### **Fused Coupler**

A method of making a multi-mode or single-mode coupler by wrapping fiber optic cables together, heating them and pulling them to form a central unified mass. By doing this light on any input fiber optic cable is coupled to all output fiber optic cables.

### **Fusion Splice**

A splice accomplished by the application of localized heat sufficient to fuse or melt the ends of two lengths of optical fiber, forming a continuous single fiber.

### **Fusion Splicing**

A permanent joint accomplished by the application of localized heat sufficient to fuse or melt the ends of the fiber optic cable. This process forms a single continuous fiber optic cable.

### **FUT**

Abbreviation for Fiber Under Test.

### **FWHM**

Full width at half maximum. This is used to describe the width of a spectral emission.

## G

### Gap Loss

1. Loss resulting from the end separation of two axially aligned fibers. 2. The optical power loss caused by a space between axially aligned fiber optic cables. For waveguide-to-waveguide coupling, it is commonly called longitudinal offset loss.

### Gateway

Relay at any layer above the network layer.

### GBPS

Giga Bits Per Second = 1 Billion Bits Per Second.

### GHz

Giga Hertz, 1 Billion Hz.

### GI

Graded indexes.

### Gigabit

One billion bits.

### Gigahertz

One billion Hertz.

### GIPOF

Graded index plastic fiber optic cable.

### GOF

Glass Optical Fiber.

### Graded Index Fiber

An optical fiber whose core has a nonuniform index of refraction. The core is composed on concentric rings of glass whose refractive indices decrease from the center axis. The refractive index is changed in a systematic way from the center to the edges to decrease modal dispersion and thereby decrease fiber bandwidth.

### Graded Index Profile

Any refractive index profile that varies with radius in the core.

### GRIN

Graded indexes.

### Ground Loop Noise

Noise that results when equipment is grounded at ground points having different potentials and thereby created an unintended current path. The dielectric of optical fibers provide electrical isolation that eliminates ground loop noise.

# H

## Handshaking

An exchange of predetermined signals for purposes of control when a connection is established between two data sets ...A preliminary procedure, usually part of a communications protocol, to establish a connection.

## Halogen

A term used to identify any of the four elements: chlorine, fluorine, bromine and iodine, grouped together because their chemical properties are similar.

## Hard Clad Silica

A fiber optic cable with a hard plastic cladding surrounding a silica glass core.

## Hard Sheath Cable

Cable or wire contained within a continuous inner or outer metallic sheath.

## Harmonic Distortion

Interference resulting from some type of harmonic signal, measured in decibels (dB).

## Harmonic Frequency

A frequency that appears as the result of a strong signal at a lower frequency.

## HDTV

High definition television.

## Head End

The main or top transmitting device in a broadband network where all transmissions are distributed.

## Header

That part of a message, at the beginning, which contains destination, address, source address, message numbering, and possible other information. It help direct the message along its journey.

## Hertz

1. In communication systems, the number of waves per second or hertz represents a rough measure of two things about a transmitted signal: its center frequency and its bandwidth about the center frequency. The bandwidth, not the center or carrier frequency, is what expresses the ultimate carrying capacity. 2. A unit of frequency equal to 1 cycle per second.

## HIFPI

High performance parallel Interface as defined by ANSIX3T9.3 document.

## Hologram

An interference pattern that is recorded on a high resolution plate. The two interfering beams formed by a coherent beam from a laser and light scattered by an object. If the plate, after processing, is viewed correctly by monochromatic light, a three-dimensional image of the object is seen.

## Hot Plate

Heat source used to produce a mirror finish on the end of a plastic fiber optic cable.

### **HSPN**

High Speed Plastic Network- a program funded by the US Government to promote plastic fiber optic cabling components and applications.

### **Hub**

The center of a star topology network or cabling system. File servers often act as the hub of a LAN. They house the network software and direct communications within the network. They may also act as the gateway to another LAN.

### **Hybrid Adapter**

Device that connects various connector types.

### **Hybrid Cable**

A cable composed of both a fiber optic cable and electrical conductors. Synonym for composite cable.

### **Hybrid Network**

A LAN with a mixture of topologies and access methods. For example, a network that includes both a token ring and a CSMA/CD bus.

### **Hybrid Optical Integrated Circuit**

Device in which the various circuit elements are fabricated in different substrate materials and then appropriately joined together so that the various substrate materials can be chosen to optimize the performance of each type of device in the optical integrated circuit.

## Icon

An image that graphically represents an object, a concept, or a message.

## IDP

Integrated detector/preamplifier.

## IEC

International Electrical Commission.

## IEEE

Abbreviation for the Institute of Electrical and Electronic Engineers, a publishing and standards-making body responsible for many standards used in LANs, including the 802 series.

## Incident Angle

The angle between an incident ray and a line perpendicular to an optical surface.

## Incoherent Fiber Bundle

A bundle of filaments of optical glass or other transparent materials that transmit light only, not optical images. The arrangement of the individual fibers in the bundle is not sufficiently regular to transmit optical images.

## Index Matching Material

1. A material, often a liquid or a cement, whose refractive index is nearly equal to the core index, used to reduce Fresnel reflections from an optical fiber's end face. 2. A material used at an optical interconnection. It has a refractive index close to that of the fiber optic cable core and is used to reduce Fresnel reflections.

## Index of Refraction

The ratio of the velocity of light in a vacuum to the velocity of light in a given medium. The symbol for it is 'n'.

## Index Profile

1. In a graded-index optical fiber, the refractive index as a function of radius. 2. A graded-index fiber optic cable. In it the refractive index at a point varies with the distance of the point from the cylindrical axis i.e. n varies with the radius.

## Information Bit

A bit used as part of a data character within a code group (as opposed to a framing bit).

## Infrared (IR)

The bank of electromagnetic wavelengths between the visible part of the spectrum (about 750nm) and microwaves (about 30mm).

## Injection Laser Diode (ILD)

A solid state semiconductor device consisting of at one p-n junction capable of emitting coherent, stimulated radiation under specified conditions.

## ILD

Injection Laser Diode.

## Insertion Loss

1. Total optical power loss caused by insertion of an optical component such as a connector, splice, or couple into a previously continuous path. 2. The loss in the power of a signal that results from inserting a passive component into a previously continuous path. Examples of such passive devices are connectors, inline star couplers and splices.

## Integrated Detector/Preamplifier

1. A single chip which contains a detector and amplifier which converts optical signals to usable electrical output. 2. A detector package containing a pin photodiode and a transimpedance amplifier.

## Interactive

A way of operating a computer where the computer lets you change things as you go along, asks you questions, lets you enter data directly, etc. Almost all applications software for personal computers, word processors, spreadsheets, etc. are interactive. Compare with batch processing and real-time processing.

## Interchannel Isolation

The ability to prevent undesired optical energy from appearing in one signal path as a result of coupling from another signal path; cross talk.

## Interface

The debarkation point or location on a data device where data comes out of or goes into the device. Examples are the RS-232 interface and the Mouse-PC interface.

## Intermateable

Connectors from a manufacturer may be intermixed and mated with another manufacturer's connectors.

## Internet

The network of networks that were originally connected together by the ARPANET, now expanded to include those networks connected to the NSFnet.

## Intrinsic Joint Loss

Loss caused by fiber-parameter (e.g., core dimensions, profile parameter) mismatches when two nonidentical fibers are joined.

## I/O Application

The device used to insert information, data or instructions into a computing system, or the device used to transfer information or data, usually processed data from a computing system to the external world. Input/output also refers to the act of entering or retrieving information.

## Ion

An atom that has gained or lost one or more electrons and, as a result, carries a negative or positive charge.

### **IPI**

Intelligent peripheral interface as defined by ANSIX3T9.3 document.

### **ISDN**

Integrated Services Digital Network) A standard protocol (format) for digital telecommunications transmissions. ISDN is an international standard for transmitting digital information (text, sound, voice, data, video, etc.)

### **Isochronous**

Data transmission where timing is derived from the signal carrying the data. No timing or clock lead is provided at the customer interface.

### **ISO**

International Standards Organization. An independent international body formed to define standards for multivendor network communications. Its seven-layer OSI reference model specifies how different vendor's products communicate with each other across a network.

### **ISO OSI**

International Standards Organization - Open System Interconnection.

### **Isolation**

Also referred to as far end crosstalk or far end isolation. Predominantly used in reference to WDM products. It is a measure of light at an undesired wavelength at any given port.

## J

### Jitney

Low cost optical link.

### Jitter

1. Statistical variance in switching delay. Cell size determines worst-case switching delay. Small ATM cell size (53 bytes) means low jitter and gives benefits of cut-through switching without the implementation complexity. 2. Deviations from the ideal timing of an event which occur at high frequencies. Low frequency deviations are tracked by the clock recovery and do not directly affect the timing allocations within a bit cell. Jitter is not tracked by the clock recovery and directly affects the timing allocations in a bit cell.

### Jitter, Data Dependent (DDJ)

Jitter that is related to the transmitted symbol sequence. DDJ is caused by the limited bandwidth characteristics, non-ideal individual pulse responses, and imperfections in the optical channel components.

### Jitter, Deterministic (DJ)

Timing distortions caused by normal circuit effects in the transmission system. Deterministic jitter is often subdivided into duty cycle distortion (DCD) caused by propagation differences between the two transitions of a signal and data dependent jitter (DDJ) caused by the interaction of the limited bandwidth of the transmission system components and the symbol sequence.

### Jitter, Duty Cycle Distortion (DCD)

Distortion usually caused by propagation delay differences between low-to-high and high-to-low transitions. DCD is manifested as a pulse width distortion of the nominal baud time.

### Jitter, Random (RJ)

Jitter due to thermal noise which may be modeled as a Gaussian process. The peak-to-peak value of random jitter is of a probabilistic nature, and thus any specific value yields an associated bit error rate.

### Jumper Cable

Fiber optic cable that has connectors terminated on both ends.

### Junction

The intersection of three or more bundles from different directions in a harness assembly.

# K

## K

A standard quantity measurement of computer storage. A K is loosely defined as one thousand bytes. In fact, it is 1,024 bytes, which is the equivalent of two raised to the tenth.

## Kbps

Abbreviation for kilobits per second. 1,000 bits per second.

## Kevlar

See Aramid yarn.

## Key

A short pin or other projection that slides into a mating or groove to guide two parts being assembled. It can prevent a connector interface from rotating and provides greater repeatability.

## Keying

Feature to mechanically and positively code similar connectors to allow mating to a specific connector.

## Kilobyte (KB)

A standard measure of data used with memory. Equal to 1,024 bytes (2 to the tenth power).

## Kilo Hertz (KHz)

1,000 Hz.

## Kilometer

1000 meters or 3,281 feet (0.621 miles); the standard length measurement for optical fibers

## KPSI

A unit of tensile strength expressed in 1,000's of pounds per square inch.

## L

### Lambertian

A uniform radiance distribution.

### Lambertian Radiator

An optical source which has radiance uniform in all directions, proportional to the cosine of the angle from the normal.

### LAN

Local Area Network. This is a geographically limited data communications network. It is often referred to as premises data communications network. Its extent is usually limited to the office building, campus or manufacturing plant - several 1,000 feet.

### Large Core Fiber

Usually this refers to fiber optic cable with a core of 200 mm or more. However, sometimes it is applied to 100/140-fiber optic cable.

### Laser

1. An acronym for Light (by) Amplification (by) Stimulated Emission (of) Radiation. This is a device, which artificially generates coherent light within a narrow range of wavelengths. Lasers can be made to operate in a number of different ways. In one mechanism the molecules of some material are put at higher energy levels. When light is then incident upon the material the molecules make transitions to lower energy levels. The correspondingly released energy is realized as coherent light. Lasers are used as the transmitting source for fiber optic cables when transmission distances are long. Laser light denotes light generated by a laser. 2. A device that produces monochromatic, coherent light through stimulated emission. Most lasers used in fiber optic communications are solid-state semiconductor devices...An acronym for Light Amplification by Stimulated Emission of Radiation ...A device which transmits an extremely narrow and coherent beam of electromagnetic energy in the visible light spectrum. See also; Injection Laser Diodes, Stimulated Emission.

### Laser Chirp

A phenomenon in lasers where the wavelength of the emitted light changes during modulation.

### Laser Modulation

Turning the laser on and off.

### Lasing Threshold

The lowest excitation level at which a laser's output is dominated by stimulated emission rather than spontaneous emission. See also: Laser, Spontaneous Emission, Stimulated Emission.

### Latency

The time interval between when a network station seeks access to a transmission channel and when access is granted or received. Same as waiting time. In a bridge or router, it is the amount of time elapsed between receiving and retransmitting the LAN packet. The length of time the packet is stuck in a bridge or router.

### Lateral Displacement Loss

The loss of power that results from lateral displacement from optimum alignment between two fibers or between a fiber and an active device.

### Lateral Offset Loss

An optical power loss caused by transverse or lateral deviation from optimum alignment of source to optical fiber, fiber-to-fiber, or fiber-to-detector.

### Launch Angle

This term is used in four different contexts. First, it often refers to the beam divergence of a light source. Secondly, it refers to as the beam divergence from any emitting surface such as an LED, laser, prism or fiber optic cable end. Thirdly, it refers to the angle at which a light beam emerges from a surface. Fourthly, in a fiber bundle it refers to the angle between the input radiation vector (the chief ray of input light) and the axis of the fiber bundle. In this case if the ends of the fiber optic cables are perpendicular to the axis of the fiber optic cable then the launch angle is equal to the incidence angle when the ray is external and the refraction angle when initially inside the fiber.

### Launch Fiber

1. An optical fiber used to couple and condition light from an optical source into an optical fiber. Often the launch fiber is used to create an equilibrium modal distribution in multi-mode fiber. Also referred to as Launching Fiber. 2. A fiber optic cable used in conjunction with a source to excite the modes of another fiber optic cable in a particular way. Launching fiber optic cables are most often used in test systems to improve the precision of measurements.

### Launch Numerical Aperture (LAN)

The numerical aperture of an optical system, which is used to couple (launch) power into a fiber optic cable. LNA may differ from the stated NA of final focusing element if, for example, that element is underfilled or the focus is other than that for which the element is specified. LNA is one of the parameters that determine the initial distribution of power among the modes of a fiber optic cable.

### Law of Reflection

Angle of incidence = Angle of reflection.

### Layer

In the OSI model, processing-functions that together compose one layer of a hierarchy of computing functions. Each layer performs a number of functions, essential for successful data communication. See OSI model.

### LD

Laser diode.

### LED

Light Emitting Diode.

### LI Curve

The plot of optical output (L) as a function of current (I) which characterizes an electrical to optical converter.

## Light

1. In a strict sense, the visible spectrum nominally covering the wavelength range of 400 nm to 750 nm. 2. In the laser and optical communications fields, the much broader portion of the electromagnetic spectrum that can be handled by the basic optical techniques used for the visible spectrum extending from the near-ultraviolet region of approximately 0.3 micrometers through the visible region and into the mid-infrared region to 30 micrometers.

## Light Diffusion

The scattering of light by reflection or transmission. Diffuse reflection results when light strikes an irregular surface such as frosted window or the surface of a frosted or coated light bulb.

## Light Emitting Diode (LED)

1. A semiconductor diode that spontaneously emits light from the p-n junction when forward current is applied. 2. A semiconductor device which emits incoherent light from a p-n junction (when biased with an electrical current). Light may exit from the junction strip edge or from its surface (depending on the device's structure).

## Lightguide Cable

An optical fiber, multiple fiber, or fiber bundle which includes a cable jacket and strength members, fabricated to meet optical, mechanical and environmental specifications.

## Light Piping

Use of fiber optic cables to illuminate.

## Light Source

Source of light, which is usually modulated and terminated over a fiber optic cable. It is typically an LED or LD.

## Lightguide

A fiber optic cable or fiber bundle.

## Lightguide cable

A fiber optic cable or fiber bundle which includes a cable jacket and strength members.

## Lightwaves

Electromagnetic waves in the region of optical frequencies. The term "light" was originally restricted to radiation visible to the human eye, with wavelengths between 400 and 700 nm. However, it has become customary to refer to radiation in the spectral regions adjacent to visible light (in the near infrared from 700 to 2,000 nm) as light in order to emphasize the physical and technical characteristics they have in common with light. See Coherent Light.

## Lightwave Data Communication

Made possible by fiber optic technology. Based on the fact that pulses of light transmitted over fiber will enable computer networks to communicate over greater distances at higher rates of speed, with complete immunity to electrical interference of any type, offer greater reliability at lower cost than can electrical, copper-based networks, with either coaxial cable or twisted pair wiring. The conversion of electrical signals to lightwave signals is accomplished via transceivers containing special compound

semiconductors made of gallium arsenide and indium phosphide. These two compounds have enabled the implementation of lightwave communication at extremely high data rates. This technology, when implemented in an Optical Bus Passive Star cabling system, gives the ultimate in reliability for any network. Furthermore, the absence of electrical connectivity between computers avoids grounding problems, ground loops, electromagnetic interference and a host of related problems that are associated with transmission over copper wire or cable. Fiber optic networks, configured in Passive Star topologies, are rapidly becoming known as the most cost-effective, thoroughly reliable, easily-maintained networks in the world.

### Link

A fiber optic cable with connectors attached to a transmitter (source) and receiver (detector).

### Local Area Network (LAN)

A geographically limited network interconnecting electronic equipment. See LAN.

### Logic Gate

An electronic component that is capable of directing the flow of electricity in a circuit based on signals from the computer that corresponds to logical relationships, such as AND, NOT, and OR.

### Longitudinal Mode

An optical waveguide mode with boundary conditions determined along the length of the optical cavity.

### Loopback

Type of diagnostic test in which the transmitted signal is returned to the sending device after passing through a data communications link or network. A test typically runs on a four-wire circuit. The two transmit leads are joined to the two receive leads. A signal is then applied around the loop. This allows a technician or built-in diagnostic circuit to compare the returned signal with the transmitted signal and get some sense of what's wrong. Loopbacks are often done by excluding one piece of equipment after another.

### Loose Tube

A protective tube loosely surrounding a fiber optic cable often filled with a water blocking gel.

### Loose Tube Buffering

A cable construction in which the optical fiber is placed in a plastic tube having an inner diameter much larger than the fiber itself. The loose tube isolates the fiber from the exterior mechanical forces acting on the cushion. The space between the tube and the fiber is often filled with a gel to cushion the fiber.

### Loss

See Absorption, Angular Misalignment Loss, Attenuation, Backscattering, End Separation Loss, Extrinsic Joint Loss, Insertion Loss, Intrinsic Joint Loss, Lateral Offset Loss, Material Dispersion, Microbending, Rayleigh Scattering, Reflection, Transmission Loss.

### Loss budget

An accounting of overall attenuation in a system.

### Low NA

Numerical Aperture around 0.30.

**LUCINATM**

Graded indexes CYTOP® fiber optic cable (GI-COF) manufactured by Asahi Glass Co.

**LUMINOUS®**

Trademark of plastic fiber optic cable manufactured by Asahi Chemical.

# M

## Machine Vision

The use of devices for optical non-contacting sensing to automatically receive and interpret an image of a real scene, in order to obtain information and/or control machines or processes.

## Macro Bend

A large fiber bend that can be seen with the unaided eye.

## Macrobending

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

## Mainframe

A large computer normally supplied complete with peripherals and software by a single large vendor, often with a closed architecture. Mainframes almost always use dumb terminals connected in star configurations.

## MAN

Metropolitan Area Network. A network linking LANs and other networks at many sites within a city area.

## Manchester

Balanced signaling code, used at lower data rates.

## Material Dispersion

Light impulse broadening caused by various wavelengths of light traveling at differing velocities through a fiber. Material dispersion increases with the increasing spectral width of the source. It is attributable to the wavelength dependence of the refractive index of the material used to form the fiber optic cable. It is characterized by the material dispersion parameter,  $M(\lambda)$ .

## Material Scattering

In an optical waveguide it is that part of the total scattering attributable to the properties of the materials used for waveguide fabrication.

## MAU

Medium Attachment Unit. This is an active component of an Ethernet LAN connecting peripheral devices with the electrical bus cable.

## Mbit/Sec

Megabits per second, a measure of network bandwidth.

## MBPS

Abbreviation for megabits per second. One million bits per second.

## MDPE

Medium density polyethylene jacketing.

### Mean Launched Power

The average power for a continuous valid symbol sequence coupled into a fiber.

### Mean Time Between Failure

See MTBF.

### Measurements

Micron = 1  $\mu\text{m}$  =  $10^{-6}$  meter or 0.00003937 inches. Nanometer = 1 nm =  $10^{-9}$  meter or 0.00000003937 inches. Angstrom =  $10^{-10}$  meter or 0.000000003937 inches

### Mechanical Splicing

1. Joining two fibers together by mechanical means to enable a continuous signal. Elastomeric splicing is one example of mechanical splicing. 2. A splice in which fiber optic cables are joined mechanically for example by being glued or crimped in place. However, they are not fused together.

### Media Access Control (MAC) [FDDI]

Defines token-passing protocol for FDDI networks, as are packet formation, addressing and recovery mechanisms. The maximum packet size is 4,500 bytes. MAC controls the flow of data on the ring. Acting like a switch, MAC normally sources IDLE(IDL) control symbols for transmission on the ring. When a start delimiter arrives on the ring, MAC will monitor each packet. If the packet is destined for another station, MAC will simply repeat the packet on the ring, only noting if a transmission error has occurred. If the packet is addressed to MAC's station, the packet will be copied into its buffers while simultaneously repeated on the ring. If the packet was sourced by MAC, the packet will be absorbed and not retransmitted. A fragment of the packet (about 6 bytes) is repeated by MAC. When MAC receives a token and has data to transmit, the token is absorbed. Switching into a sourcing mode, MAC encapsulates its data into proper control symbols for an FDDI packet, and inserts the packet into the ring. MAC continues to insert packets into the ring until it has completed its data transmission or token holding time has expired. At the completion of the transmission, MAC will issue a token that allows multiple packets from different stations to be on the ring concurrently, which increases the effective bandwidth utilization.

### Media Interface Connector (MIC)

A mated connector pair that provides an attachment between an FDDI node and a fiber optic cable plant. The MIC consists of two parts: a MIC plug and a MIC receptacle.

### Medium Attachment Unit (MAU)

The portion of the physical layer between the MDI and AUI that contains the electronics which send, receive, and manage the encoded signals impressed on, and recovered from the fiber optic medium.

### Medium Dependent Interface (MDI)

The mechanical and optical interface between the fiber optic medium and the MAU.

### Megabyte (MB)

A measure of computer memory equal to 1,048,576 bytes.

### Megahertz

A unit of frequency that is equal to one million hertz.

### Message

A logical partition of the user device's data stream to and from the adapter.

### Message Switching

The technique of receiving a message, storing it (if necessary) until the proper outgoing line is available, and retransmitting it toward its destination automatically.

### Metallography

The analysis of metal structure using an optical or electron microscope, generally with a camera, for the recording of observations.

### MFD

Mode field diameter.

### MHz

Mega Hertz, 1 million Hz.

### MIC Plug

The male part of the media interface connector terminates a fiber optic cable.

### MIC Receptacle

The female part of the media interface connector which is contained in a FDDI node.

### Microbend Loss

1. A form of increase attenuation caused by: a) having the fiber curved around a restrictive radius of curvature, or b) microbends caused by minute distortions in the fiber imposed by externally induced perturbations. Excessive bend loss may result from poor drawing or cable manufacturing techniques. In an optical fiber, loss caused by sharp curvatures involving local axial displacements of a few micrometers and spatial wavelengths of a few millimeters. Such bends may result from fiber coating. 2. The loss attributed to microscopic bends in fiber optic cable.

### Microbending

1. In an optical fiber, loss caused by shape curvature involving axial displacements of a few micrometers and spacial wavelengths of a few millimeters. Such bends may result from fiber coating, cabling, packaging, installation, etc. Note: Microbending can cause significant radiative losses and mode coupling. 2. Curvatures of the fiber optic cable which involves axial displacements of a few micrometers and spatial wavelengths of a few millimeters. Micro bends cause loss of light and consequently increase attenuation of the fiber optic cable.

### Micrometer

1 millionth of a meter, abbreviated  $\mu\text{m}$ . Also referred to a micron.

### Micron

One thousandth of a millimeter or one millionth of a meter. A unit of measurement corresponding to 0.00003937 inches. A micron can be used to specify the core diameter of fiber optic network cabling. 1 micron =  $1 \times 10^{-6}$  meters or  $39.37 \times 10^{-6}$  inches. See micrometer.

### Microsecond

One-millionth of a second.

### Misalignment Loss

The loss of power resulting from angular misalignment, lateral displacement and end separation.

### MM

Millimeter, 1 thousandth of a meter.

### MMF

Multi-mode fiber optic cable.

### Modal Bandwidth

A bandwidth limiting mechanism in multi-mode fiber optic cables. It is also used in single-mode fiber optic cables when operated at wavelengths below cutoff. Modal bandwidth arises because of the different arrival times of the various modes. It is a synonym for intermodal dispersion.

### Modal Dispersion

1. Term for multi-mode dispersion, which is pulse broadening due to optical power running via different waveguide modes. 2. The dispersion resulting from difference in the time it takes for different rays to traverse a fiber optic cable.

### Modal Noise

The fluctuation in optical power due to the interaction of the power traveling in more than 1 mode

### Mode

In any cavity or transmission line, one of those electromagnetic field distributions that satisfies Maxwell's equations and boundary conditions. The field pattern of a mode depends on the wavelength, refractive index and cavity or waveguide geometry.

### Mode Coupling

1. In an optical fiber, the exchange of power among modes. The exchange of power may reach statistical equilibrium after propagation over a finite distance that is designated the equilibrium length. 2. The transfer of energy between modes. In a fiber optic cable, mode coupling occurs until the EMD is reached.

### Mode Evolution

The dynamic process a multilongitudinal laser undergoes whereby the changing distribution of power among the modes creates a continuously changing envelope of the laser's spectrum.

### Mode Field Diameter (MFD)

The diameter of optical energy in a single-mode fiber. Because the MFD is greater than the core diameter, MFD replaces core diameter as a practical parameter.

### Mode Filter

1. A device to remove high order modes to stimulate equilibrium mode distribution in a short length of optical fiber. 2. A device used to remove high-order modes from a fiber optic cable and thereby simulate EMD.

### Mode Hopping

Dynamic changing of discrete modes in a source spectrum.

### Mode Mixing

The numerous modes of a multi-mode fiber optic cable differ in their propagating velocities. As long as they propagate independently of each other, the fiber optic cable bandwidth varies inversely with the fiber optic cable length due to multi-mode distortion. As a result of inhomogeneities of the fiber optic cable geometry and the index profile, a gradual energy exchange occurs between modes with different velocities. Due to this mode mixing, the bandwidth of long multi-mode fiber optic cables is greater than the value obtained by linear extrapolation from measurements on short fiber optic cables.

### Mode Scrambler

1. A device for inducing mode coupling in an optical fiber. 2. A device composed of one or more fiber optic cables in which strong mode coupling occurs. Frequently used to provide a mode distribution that is independent of source characteristics.

### Modem

1. Short for modulator-demodulator; a device that converts audio tones of an analog telephone system to digital pulses and vice versa, suitable for data communications through an analog telephone data network. 2. An acronym for Modulator-Demodulator. This is a device that carries out both modulation and demodulation. With the modulation function the modem takes information, which is in digital form - usually, 0's and 1's, and represents it by signals, which can be sent (transmitted) over a transmission medium. With the demodulation function the modem takes signals out of the transmission medium (received) and determines which digits then represent, what sequence of 0's and 1's.

### Mode Partitioning

Change in the dominant mode as a function of time.

### Modes

In guided wave propagation, such as that through fiber optic cable, it is the distribution of electromagnetic energy that satisfy Maxwell's equations and boundary conditions. Specifically, applied to optics and transmission down a fiber optic cable a mode is loosely equivalent to a light ray of classic ray optic theory. Sometimes used to denote a light path through a fiber optic cable.

### Modulation

1. The process by which the characteristic of one wave (the carrier) is modified by another wave (the signal). Examples include amplitude modulation (AM), frequency modulation (FM), and pulse-coded modulation (PCM). 2. Electrical switch to control the light source.

### Monochromatic Light

Light consisting of a single wavelength or a very narrow band of wavelengths. In practice, radiation is never perfectly monochromatic but, at best, displays a narrow band of wavelengths.

### **MTBF**

Mean Time Between Failure. Used by manufacturers to measure reliability of equipment. Almost always measured in hours. Keep in mind that an MTBF figure for a LAN card or a computer is always longer than what you will find in your own experience, because testing methods by manufacturers in laboratories do not reproduce office environments very well. Obviously, "reliability" does not measure "availability". The two must not be confused. If you want extremely high "availability", but duplicate, redundant systems and keep them both running simultaneously. See also: Reliability.

### **Multi Channel Cable**

An optical cable having more than one fiber.

### **Multi Fiber Cable**

An optical cable that contains two or more fibers, each of which provides a separate information channel.

### **Multileg Light Guide**

A fiber optic bundle split along its length with the ends of the fibers extending separately to illuminate different points with a single-light source.

### **Multilongitudinal Mode Laser (MLM)**

An injection laser diode which has a number of longitudinal modes.

### **Multi mode Distortion**

In a multi-mode optical fiber, the pulse distortion resulting from differential mode propagation rates.

### **Multi Mode Fiber Optic Cable**

A fiber that supports propagation of more than one mode.

### **Multiple Reflection Noise (MRN)**

The fiber optic receiver noise resulting from the interference of delayed signals from two or more reflection points in a fiber optic span.

### **Multiplex**

Putting two or more signals into a single channel... To interleave, or simultaneously transmit, two or more messages on a single channel... The use of a common physical channel in order to make two or more logical channels, either by splitting of the frequency band transmitted by the common channel into narrower bands, each of which is used to constitute a distinct channel (frequency-division multiplex), or by allotting this common channel in turn, to constitute different intermittent channels (TDM).

### **Multiplexing**

The process by which two or more signals are transmitted over a single communications channel. Examples include Time Division Multiplexing (TDM) and Wavelength Division Multiplexing (WDM).

### **Multiplexor**

Equipment that permits simultaneous transmission of multiple signals over one physical circuit.

# N

## N,n

A symbol used to represent the refractive index. It is commonly used with a subscript to represent the wavelength of light.

## NA (Numerical Aperture)

The light gathering ability of a fiber optic cable. This defines the maximum angle to the fiber optic cable axis at which light will be accepted and propagated down the fiber optic cable.  $NA = \sin \theta$ , where  $\theta$  is the acceptance angle. NA is also used to describe the angular spread of light from the central axis - as in exiting from the fiber optic cable, emitting from a source or entering a detector.

## NA Mismatch Loss

The loss of power at a joint that occurs when the transmitting half has a numerical aperture greater than the NA of the receiving half. The loss occurs when coupling light from a source to fiber to detector.

## Nanometer

One billionth of a meter. Written nm.

## Nanosecond

One billionth of a second. Written nsec or ns.

## Narrowband

Refers to analog or voice-band data rates or transmission.

## Near End Crosstalk

The optical power reflected from one or more input ports, back to another input port.

## NEC

National Electric Code defines building flammability requirements for indoor cables.

## Network

A series of points interconnected by communication channels. The switched telephone network consists of public telephone lines normally used for dialed telephone calls; a private network is a configuration of communication channels reserved for the use of a sole customer. A series of nodes connected by communications channels ...See also LAN.

## Network Access Control

Electronic circuitry that determines which workstation may transmit next or when a particular workstation may transmit.

## Network Architecture

The structures and protocols of a computer network. See Architecture.

### Network Interface Controllers

Electronic circuitry that connects a workstation to a network. Usually a card that fits into one of the expansion slots inside a personal computer. It works with the network software and computer operating system to transmit and receive messages on the network ...A communications device that allows interconnection of information processing devices to a network.

### Network Layer

The third layer of the OSI model of data communications. It involves routing data messages through the network using alternative routes. See OSI Standards.

### Network Management

The collection of processes, tools and methods necessary to design, install, operate and maintain a network.

### NEXT

Near End cross-talk.

### NIR

Near Infrared.

### NIU

Network Interface Unit.

### NLO

Non-Linear Optics.

### Nodal Points

Of all the rays passing through a lens from off-axis objects point to its corresponding image point, there is always one ray whose direction in the image space is equal to that in the object space. The nodal points are the two points at which these two external rays appear to intersect the axis.

### Nodes (a/k/a Stations)

In computer-based LANs, at least two intelligent systems needing to share data are required. These intelligent systems, when connected to the network, are referred to as Nodes, and are able to communicate with each other via a network topology such as Star, Bus, Ring or Tree. A node usually consists of a personal computer, an adapter with a cable and other adapters to the personal computer (such as: disk drives, printers and plotters). In addition to the personal computer hardware, all necessary software must be available...Points in a network where service is provided, service is used or communications channels are interconnected. Nodes are sometimes used interchangeably with workstations ...A station.

## Noise

The work "noise" is a carry-over from audio practice. Refers to random spurts of electrical energy or interference ...Random electrical signals, generated by circuit components or by natural disturbances, that make up transmitted data inaccurate by introducing errors. Noise can come from lightning, crossed cables, electrical motors ..., Generally, any disturbance that tends to interfere with the normal operation of a communication device or system. Random electrical signals, introduced by circuit components or natural disturbances, which degrade the performance of a communications channel.

## Noise Equivalent Power (NEP)

The radiant power that produces a signal-to-noise ratio of unity at the output of a given optical detector.

## Noise Measurement Units

A series of terms used to express both weighted and unweighted circuit noise, as stated in dBm (decibel rated noise). Noise measurement units vary with the procedures used for noise weighting.

## NRZ

On-Off signaling code.

## Numerical Aperture (NA)

1. The "lightgathering ability" of a fiber, defining the maximum angle to the fiber axis at which light will be accepted and propagated through the fiber.  $NA = \sin\theta$ , where  $\theta$  is the acceptance angle. NA also is used to describe the angular spread of light from a central axis, as in exiting a fiber, emitting from a source, or entering a detector. For multi-mode fiber, the numerical aperture usually ranges from .2 to approximately .5. Single-mode fiber generally has a numerical aperture on the order of .1. 2. This is the imaginary cone which defines the acceptance area for the fiber optic cable core to accept light rays. See NA (Numerical Aperture).

## O

### O/E

Abbreviation for optical-to-electrical converter.

### Ohm

The electrical resistance between two points of a conductor at a constant difference of potential of one volt, applied between these points, produces in this conductor a current of one ampere, the conductor not being the source of any electromotive force.

### Open Standard Interconnect

A 7-layer model defined by ISO for defining a data communication network. It provides means for executing the blue print of the network architecture.

### Operating System

The software of a computer that controls the execution of programs, typically handling the functions of input/output, resource scheduling and data management. See also: DOS.

### Optical Cable

An assembly of fiber optic cables and other material providing mechanical and environmental protection.

### Optical Fiber

Synonym for fiber optic cable.

### Optical Axis

The line passing through both centers of curvatures of the optical surfaces of a lens; the optical centerline for all the centers of a lens system.

### Optical Bandpass

The range of optical wavelengths which can be transmitted through a component.

### Optical Cable Assembly

Generally, an optical cable that has been terminated with connectors on both ends and is ready for installation.

### Optical Channel

An optical wavelength band for wavelength division multiplexing optical communications.

### Optical Channel Spacing

The wavelength separation between adjacent words per minute channels.

### Optical Channel Width

The optical wavelength range of a channel.

### Optical Connectors

Are used to attach the transmit and receive optical fibers in the fiber optic cable to the fiber optic transceiver. The optical connectors are designed to make connection by simply hand tightening the nut on the external optical connector to the connectors on the fiber optic transceiver.

### Optical Continuous Wave Reflectometer (OCWR)

An instrument used to characterize a fiber optic link wherein an unmodulated signal is transmitted through the link and the resulting light scattered and reflected back to the input is measured. Useful in estimating component reflectance and link optical return loss.

### Optical Directional Coupler (ODC)

A component used to combine and separate optical power.

### Optical Disk

A rigid medium, generally polycarbonate substrate coated with a reflective aluminum layer, that stores information (such as audio, video or data) as digital bits in the form of variations in the stored data. Optical disk formats include read-only (ROM) and write-once/read-many (WORM); erasable disks currently under development include phase-change, magneto-optical and dye-polymer media.

### Optical Fiber Cable Link Segment

A length of optical fiber cable containing two optical fibers and comprising one or more optical fiber cable sections and their means of interconnection, with each optical fiber terminated at each end in an optical connector plug.

### Optical Isolator

A component used to block out reflected and other unwanted light.

### Optical Launch Point

Focal point coming out of the laser. From this point you launch into fiber.

### Optical Line

Optical cable.

### Optical Link

Any optical transmission channel designed to connect two end terminals or to be connected in series with other channels. Sometimes terminal hardware i.e. transmitter and receiver, is included in the definition.

### Optical Memory

The direct storage of data as bits in memory using optical systems and properties. The memory makes use of a laser beam that is divided by a beamsplitter and controlled area of storage in memory. On the other side of the memory plane, a laser and a deflector read the memory, bit by bit, with a scanning photodetector. Erasure is accomplished by writing with the beam at a different wavelength.

### Optical Path Power Penalty

The additional lost budget required to account for degradation due to reflections and the combined effects of dispersion resulting from intersymbol interference, mode-partition noise and laser chirp.

### Optical Power (LED)

Radiant power, expressed in watts.

### Optical Power Budget

See Flux Budget.

### Optical Receiver

A device that receives optical signals from an optical transmitter via the receiver fiber of that fiber optic cable. It converts optical signals to electrical signals which are then conditioned and transmitted through the fiber optical transceiver interface cable to the controller and the host.

### Optical Reference Plane

The plane that defines the optical boundary between the plug and the receptacle.

### Optical Return Loss (ORL)

The ratio (expressed in units of dB) of optical power reflected by a component or an assembly to the optical power incident on a component or assembly that is introduced into a link or system.

### Optical Time Domain Reflectometer (OTDR)

A method of characterizing a fiber wherein an optical pulse is transmitted through the fiber and the resulting backscatter and reflections are measured as a function of time. Useful in estimating attenuation coefficient as a function of distance and used to measure attenuation, evaluate splice and connector joints and locate faults.

### Optical Transmitter

Receives electrical signals from the Ethernet controller via the fiber optic transceiver's interface cable and converts electrical signals to optical signals. These optical signals are then transmitted onto the network via the transmit fiber of the optical fiber cable through the SMA connector.

### Optical Waveguide

1. Dielectric waveguide with a core consisting of optically transparent material of low attenuation (usually silica glass) and with cladding consisting of optically transparent material of lower refractive index than that of the core. It is used for the transmission of signals with lightwaves and is frequently referred to as a fiber. In addition, there are some optical components, such as laser diodes, which are referred to as optical waveguides. 2. Synonym for fiber optic cable.

### Optical Window

Wavelength range of a fiber optic cable with a very low attenuation. Fiber optic data links using LED sources work in the 1st window at 850 nm or in the 2nd window at 1300 nm. Fiber optic data links using laser sources work in the 2nd window at 1310 nm or in the 3rd window at 1550 nm.

### OPTI GIGATM

Graded index plastic fiber optic cable developed by Boston Optical Fiber.

### OPTI LUXTM

Step index plastic fiber optic cable developed by Boston Optical Fiber.

### OPTI MEGATM

Step index plastic fiber optic cable developed by Boston Optical Fiber.

### Opto Electrical Converter

Converts an optical signal into an electrical signal.

## Optoelectronics

1. Pertaining to a device that responds to optical power, emits or modifies optical radiation, or utilizes radiation for its internal operation. Any device that functions as an electrical-to-optical or optical-to-electrical transducer. 2. The range of materials and devices that generate light (lasers and light-emitting devices), amplify light (optical amplifiers), detect light (photodiodes) and control light (electro-optic circuits). Each of these functions requires electrical energy to operate and depends upon electronic devices to sense and control this energy. In a broader sense it means pertaining to a device that responds to optical power, emits or modifies optical radiation or utilizes optical radiation for its internal operation. It is any device which functions as an electrical to optical transducer or optical to electrical transducer.

## Oscilloscope

A cathode-ray tube with attendant amplifiers and control circuits for measuring and studying the waveforms of small currents and voltages. A cathode ray tube (CRT) oscilloscope is particularly convenient for studying repetitive phenomena, but a tube with a long-delay phosphor can be used to analyze a single electrical pulse. An oscilloscope equipped with a camera becomes an oscillograph.

## OSI

Open Standards Interconnect.

## OTDR (Optical Time Domain Reflectometer)

A method of characterizing a fiber optic cable wherein an optical pulse is transmitted down the fiber optic cable and the resulting backscatter and reflections are measured as a function of time. The OTDR is useful in estimating the attenuation coefficient as a function of distance and identifying defects and other localized losses.

## Output Power

Radiant power expressed in watts.

## P

### Packet

A group of binary digits, including data and call control signals, switched as a composite whole. The data, all control signals and possible error control information, are arranged in a specific format.

### Packet Buffer

Memory space set aside for storing a packet awaiting transmission or for storing a received packet. The memory may be located in the network interface controller or in the computer to which the controller is connected. See also: Buffer.

### Packet Format

The exact order and size of the various control and information fields of a packet, including header, address, and data fields.

### Packet Switching

A data communications technique in which data is transmitted by means of addressed packets and a transmission channel is occupied for the duration of transmission of the packet only. The channel is then available for use by packets being transferred between different data terminal equipment ...A data transmission method, using packets, whereby a channel is occupied only for the duration of transmission of the packet. The packet switch sends the different packets from different data conversations along the best route available in any particular order. At the other end, the packets are reassembled to form the original message which is then sent to the receiving computer. Because packets need not be sent in a particular order, and because they can go any route as long as they reach their destination, packet switching networks can choose the most efficient route and send the most efficient number of packets down that route before switching to another route to send more packets. The other advantage of packet switching is the unified format that every message is molded into.

### Paraxial Rays

Rays which are nearly parallel with the optical axis.

### Parity Bit

An additional bit added to a group of bits, typically to a 7-bit character. That additional parity bit means that adding up all the bits in every byte will produce an odd or even number, depending on whether you choose odd or even parity. Parity bits are added for error detection.

### Partitioning

Splitting up the data in some way. Ideally, the partitioning is dictated by the nature of the data and typical usage patterns. For example, human resources data about an employee would be stored in the database at the site where the employee works, since most references are from local personnel.

### Passive Branching Device

A device which divides an optical input into two or more optical inputs.

### Passive Star Coupler

Couples one or more input optical signals coming from fiber optic cables to one or more output fiber optic cables acting as receivers. It accomplishes this by using only passive optical components.

### Patch Panel

Distribution area to rearrange fiber optic cable connections and circuits. A simple patch panel is a metal frame. One side of the panel is usually fixed. This means that the fiber optic cables are not intended to be disconnected. On the other side are plugs to connect other fiber optic cables.

### PC

Physical contact.

### PCM

Pulse Code Modulation.

### PCS

Plastic clad silica.

### PD

Photodiode

### PE Polyethylene

This is a type of plastic material used to make cable jacketing.

### Peak Wavelength

The wavelength at which the optical power of a source is at maximum.

### Peripheral Device

A piece of computer hardware--such as a disk drive, printer, or modem used in conjunction with a computer and under the computer's control. Peripheral devices are usually physically separate from the computer and connected to it by wires or cables.

### Period

The time of a single complete cycle.

### PF

Perfluorinated

### Phase Modulation

Modulation is the process of using a medium to carry information. A flashlight beam could be "modulated" by turning it on and off, thus sending digital information. An electrical sine wave traveling down a twisted wire pair can also be modulated to carry information, a sine wave that is defined by its frequency, amplitude and phase. These are the only three parameters of a sine wave that can thus be changed to carry information. Phase modulation is typically used in higher speed modems.

### Photoconductivity

The conductivity increase exhibited by some nonmetallic materials resulting from the free carriers generated when photon energy is absorbed in electronic transitions.

### Photocurrent

The current that flows through a photosensitive device as the result of exposure to radiant power.

### Photodetector

An optoelectronic transducer, such as a pin photodiode or avalanche photodiode.

### Photodiode

A two-electrode, radiation-sensitive junction formed in a semiconductor material in which the reverse current varies with illumination. Photodiodes are used for the detection of optical power and for the conversion of optical power to electrical power.

### Photon

1. The quantum of electromagnetic energy, generally regarded as a discrete particle having zero mass, no electric charge, and an indefinitely long lifetime. 2. A quantum of electromagnetic energy. A discrete unit which lends a particle nature to light in contrast to its wave nature. Photons come into play when one talks about energy exchanges using light.

### Photonics

The technology of transmission of information using light.

### Photovoltaic Effect

Production of a voltage difference across a p-n junction resulting from the absorption of photon energy. The voltage difference is caused by internal drift of holes and electrons.

### Physical Contact Connector

A connector designed with a radiuses tip to assure physical contact of the fiber optic cables and thereby increase return reflection loss.

### Physical Layer

Layer one of the OSI reference model; encodes, modulates and transmits data across physical links (i.e., the transmission medium, such as coaxial cable) on the network; also defines the network's physical signaling characteristics.

### Physical Protocol (PHY)[FDDI]

Describes the encoding scheme used by the network and the related method of timing and re-timing transmissions. In FDDI, each node uses its own internal clock for the transmission or re-transmission of data, as opposed to systems that utilize centralized timing. PHY specifies 4B/5B NRZI (non-return to zero invert), data transmission, which refers to the encoding of 4 bits of information into a 5 bit pattern, a particularly efficient encoding scheme. In NRZI, a binary 1 is represented by a transition at the beginning of a bit interval. The PHY standard also specifies both distributed clocking and elastic buffering. Each station of the FDDI ring has its own clocking source and its own elasticity buffer of at least 10 bits. Each station receives data with clocking information from the previous station, but retransmits the data with clocking information from its own autonomous clock. This effectively limits timing jitter, a common problem with systems with centralized clocking. This is not a problem in an FDDI network however, as station with adequate priority can transmit numerous frames sequentially.

### Pigtail

A short length of optical fiber, permanently fixed to a component, used to couple power between the component and the fiber optic cable used for transmission.

### PIN

Positive intrinsic negative photodiode.

### PIN Diode

A device used to convert optical signals to electrical signals in a receiver. For relatively fast speeds and moderate sensitivity in the 0.75 $\mu$ m to 1.1 $\mu$ m area wavelength, the silicon photodiode is most commonly used. Avalanche photodiodes (APD) combine the detection of optical signals with internal amplification of photocurrent. The internal gain is realized through avalanche multiplication of carriers in the junction region. The advantage in using an APD is its higher signal-to-noise ratio, especially at high bit rates.

### PIN Photodiode

A diode with a large intrinsic region sandwiched between p and n doped semiconducting regions. Photons absorbed in this region create electron-hole pairs that are separated by an electric field, thus generating electric current in a load circuit.

### PIN PD

PIN-photodiode.

### Pistoning

The movement of a fiber optic cable axially in and out of a ferrule end, often caused by changes in temperature.

### Pixel

Contraction of "picture element." A small element of a scene, often the smallest resolvable area, in which an average brightness value is determined and used to represent that portion of the scene. Pixels are arranged in rectangular array to form a complete image.

### Pixel Group Processing

In digital image processing, a subcategory of frame processing that treats each pixel in terms of its relationship to adjacent pixels. Perceived brightness trends facilitate spacial filtering.

### Plastic Clad Silica (PCS) Fiber

A fiber with a glass core and a plastic cladding.

### Plastic Fiber Optic Cable

Fiber optic cables having a plastic core and plastic cladding.

### Plenum

The air handling space between walls, under structural floors and above drop ceilings. This can be used to route intra-building cabling.

### Plenum Cable

A cable whose flammability and smoke characteristics allow it to be routed in a plenum area without being enclosed in a conduit.

### PMD

Physical Media Dependent as defined by ANSI X3T9.5 document.

### PMMA

Polymethylmethacrylate

### POF Consortium

Over 60 Japanese companies, government agencies and universities organized to promote plastic optical fiber-plastic fiber optic cable.

### POF

Plastic Optical Fiber-plastic fiber optic cable.

### POFA

Plastic optical fiber amplifier.

### POFIG

US based POF interest group.

### Point to Point

1. Point-to-point transmission - Transmission of data between only two stations or nodes, i.e., one sender and one receiver. 2. Point-to-Point link - A circuit which connects two (and only two) nodes without passing through an intermediate node.

### Polarization

The direction of the electric field in the lightwave.

### Polarization Mode Dispersion

Pulse spreading in a single mode fiber which happens because of the different group velocities for each of the two perpendicular polarizations of light traveling in the fiber.

### Polarization Stability

The variation in insertion loss as the polarization state of the input light is varied.

### Polishing

Preparing the end of a fiber optic cable by moving the end over an abrasive material.

### POLO

Parallel Optical Link Organization.

### POLYGUIDE©

Polymer optical waveguide developed by DuPont.

### Port

Hardware entity at each end of the link.

## POTS

"Plain old telephone" system

## Power

The rate at which energy is absorbed, received, transmitted, transferred, etc. per unit of time.

## Power Efficiency

The ratio of emitted optical power of a source to the electrical input power.

## Power Meter

Device used to measure attenuation of a plastic fiber optic cable.

## Preform

A glass structure from which an optical fiber waveguide may be drawn.

## Prefusing

Fusing with a low current to clean the fiber end. Precedes fusion splicing.

## Primary Buffer

A part of a computer's memory where fast incoming or outgoing data is kept until the computer has the chance to process it. See also: Buffer, Secondary Buffer.

## Primary Coating

The plastic coating applied directly to the cladding surface of the fiber during manufacturing to preserve the integrity of the surface.

## Protocol

A specific set of rules, procedures or conventions relating to format and timing of data transmission between two devices. A standard procedure that two data devices must accept and use to be able to understand each other. There are three basic types of protocol: character-oriented, byte-oriented and bit-oriented. Protocols break a file into equal parts called blocks or packets. These packets are sent and the receiving computer checks the arriving packet and sends an acknowledgement (ACK) back to the sending computer. The purpose of a protocol is to set up a mathematical way of measuring if the block came through accurately. And if it didn't, asks the distant end to re-transmit the block until it gets it right.

## PTFE

Poly-tetrafluoroethylene, a representative of perfluoropolymer by DuPont and manufactured under the name Teflon®.

## Pulse Coded Modulation (PCM)

A technique in which an analog signal, such as a voice, is converted into a digital signal by sampling the signal's amplitude and expressing the different amplitudes as a binary number. Sampling must be at the Nyquist rate - at least twice the highest frequency in the information signal bandwidth.

### **Pulse Dispersion**

The widening of an optical pulse as it travels the length of a fiber. This property limits the useful bandwidth of the fiber and is usually expressed in terms of nanoseconds of widening per kilometer. The principal mechanisms are material dispersion and multi-mode distortion effect.

### **Pulse Spreading**

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

### **PUR (Polyurethane)**

Material used in manufacture of a type of jacketing material.

### **PVC (Polyvinyl Chloride)**

Material used in manufacture of a type of jacketing material.

## Q

### Quantum Efficiency

In a photodiode, the ratio of primary carriers (electron-hole pairs) created to incident photons. A quantum efficiency of 70% means 7 out of 10 incident photons create a carrier.

# R

## Radiant Power

The time rate of flow of radiant energy, expressed in watts.

## Radiation

The emission and/or propagation of energy through space or through a medium in the form of either waves or corpuscular emission.

## Radius Ferrule (PC Finish)

The ferrule of the connector has a dome tip which allows the fiber face to make physical contact with the fiber face of another PC connector. PC finish reduces back reflection.

## RAM

Random Access Memory. A chip or collection of chips where data can be entered, read and erased. The basic idea of RAM is to speed your computer up. Your CPU could use your floppy as RAM, accessing your floppy every time it needed information. But this would be excruciatingly slow. RAM is the fastest memory device. The fast speed of RAM is good. However, RAM loses its contents when you lose or turn off power. Compare with read-only memory and EPROM.

## Ray

A geometric representation of a light path through an optical medium; a line normal to the wavefront indicating the direction or radiant energy flow.

## Rayleigh Scattering

1. Scattering by refractive index fluctuations that are small with respect to wavelength. The scattered field is inversely proportional to the fourth power of the wavelength. 2. The scattering of light that results from small inhomogeneities in material density or composition. This causes losses in optical power. The losses vary with the 4th power of wavelength. This scattering sets a theoretical lower limit to the attenuation of a propagating lightwave as a function of wavelength. This varies from 10 dB/Km at 0.5 microns to 1 dB/Km at 0.95 microns.

## RAYTELA®

Plastic, fiber optic cable manufactured by Toray Industries.

## RB

Rhodamine B dopant.

## Read Only Memory (ROM)

A chip or collection of chips that cannot be written to by normal computer circuitry. ROM must be programmed by special circuitry, generally using high voltages and high electrical currents. It is impossible to change the instructions on ROM. Its contents do not change when the computer is turned off. Compare with random access memory, RAM, and EPROM.

### Real Time

When the computer works on data as it is created. For instance, a computer figuring out the price of all the phone calls in an office as these phone calls are made. "Realtime" is also used in manufacturing to control robots. Computers which do real-time processing are usually very, very fast and expensive. Compare with batch processing and interactive ...Generally, an operating mode under which receiving the data, processing it, and returning the results takes place so quickly as to actually affect the functioning of the environment, guide the physical processes in question, or interact instantaneously with the human user(s). Examples include a process control system in manufacturing, or a computer assisted instruction system in an educational institution.

### Receiver

In the context of a fiber optic cable based communications link it is an electronic package, which converts optical signals to electrical signals.

### Receiver Overload

The maximum acceptable value of the received average power at point R for a  $10^{-12}$  bit error ratio.

### Receiver Sensitivity

The minimum acceptable value of average received power at point R to achieve a  $10^{-12}$  bit error ratio. It takes into account power penalties caused by use of a transmitter with worst-case values of extinction ratio, jitter, pulse rise and fall times, optical return loss at point S, receiver connector degradations and measurement tolerances. The receiver sensitivity does not include power penalties associated with dispersion, jitter, or reflections from the optical path; these effects are specified separately in the allocation of maximum optical path penalty. Sensitivity takes into account worst-case operating and end-of-life (EOF) conditions. In the case of digital signals the optical power is usually quoted in Watts or dBm.

### Recovery

The way a computer or telephone system resumes operation after overcoming a problem with the hardware (such as a power failure) or a program error.

### Redundancy

1. The part of a message or system that can be thrown away without losing the essential information or service. 2. The part of a system that duplicates the essential tasks to take over should the original fail. Redundancy is built into many systems - or you can build redundancy in, at your option - to insure your system will always work ...That portion of the total information contained in a message which can be eliminated without the loss of essential information, such as characters used only for checking. Also used to describe a computer or communications facility in which there is a spare "backup" device for each important component of the system.

### Reference Surface

The surface of an optical fiber which is used to contact transverse alignment elements of a connector or other component.

### Reflectance

1. The ratio of reflected power to incident power. Note: In optics, frequently expressed as optical density or as a percent; in communication applications, generally expressed in dB. 2. Light that is reflected back along the path of transmission, from either the coupling region, the connector or the terminated fiber optic cable.

### Reflection

The abrupt change in direction of a light beam at an interface between two dissimilar media so that the light beam returns into the medium from which it originated.

### Reflectometer

An instrument for measuring the reflectance of a surface.

### Refraction

The bending of a beam of light at an interface between two dissimilar media or in a medium whose refractive index is a continuous function of position (graded-index medium).

### Refractive Index (of a medium)

The ratio of the velocity of light in a vacuum to its velocity in the medium. Synonym: Index of Refraction. Its symbol is 'n'.

### Refractive Index Profile

The description of refractive index as a function of radius in a fiber.

### Regenerate

See Repeater

### Regenerative Repeater

A repeater designed for digital transmission that both amplifies and reshapes the signal. Sometimes called regenerator.

### Remote Station

Any piece of equipment attached to a LAN by a telephone company supplied link. Technically, that includes all devices that aren't servers. Usually it refers to a work station at a distant location, linked to the main LAN by a modem. See modems ...Data terminal equipment located at a distance from the data processing site and requiring electronic communication for access ...Data terminal equipment for communication with a data processing system in a distant location.

### Repeater

In an optical-fiber communication system, an optoelectronic device or module that receives an optical signal, converts it to electrical form, amplifies it (or in the case of a digital signal, reshapes, retimes or otherwise reconstructs it) and retransmits it in optical form.

### Replaceable Element Attenuator

An attenuator in which levels of attenuation are changed by exchanging elements, each of which had fixed value of attenuation.

### Replication

Duplication of data. Replication is currently the most popular approach to distributed data; the problem is keeping replicated information up to date. Most distributed-data systems provide some form of automatic updating.

### Residual Loss

The loss of the attenuator at the minimum setting of the attenuator.

### Resonator

A volume, bounded at least in part by highly reflecting surfaces, in which light of particularly discrete frequencies can set up standing wave models of low loss. Often, in laser work, the resonator contains two facing mirrors that may either be flat (Fabry-Perot resonator) or have some spherical curvature.

### Responsivity

The ratio of an optical detector's electrical output to its optical input. The precise definition depends on the detector type; generally expressed in amperes per watt or volts per watt of incident optical power.

### Ring

A set of stations wherein information is passed sequentially between stations, each station in turn examining or copying the information, finally returning it to the originating station; a network topology in which stations are connected to one another in a closed logical circle.

### Ring Network

A network topology in which terminals are connected in a point-to-point serial fashion in an unbroken circular configuration.

### Ring Wrap [FDDI]

Reconfiguration of a faulty ring or rings, accomplished by rerouting data from the primary ring onto the secondary ring at two or more locations in the network, thus effectively bypassing cable faults. This redundancy results in a highly reliable network that may be used for demanding applications.

### Riser

Application for indoor cables that pass between floors. It is normally a vertical shaft or space.

### Rise Time

The time for the leading edge of a pulse to increase from 10% to 90% of its peak value.

### ROM

Abbreviation for read-only memory. This type of microchip cannot be altered by the user, it can only be read out.

### Router

An interface between two networks; a network layer relay. While routers are like bridges, they work differently. Routers provide more functionality than bridges. For example, they can find the best route between any two networks, even if there are several different networks in between. Routers provide network management capabilities such as load balancing, partitioning of the network, use statistics, communication priority, and troubleshooting tools that allow network managers to detect and correct problems even in a complex network of networks. Given these capabilities, routers are often used in

building-wide or enterprise-wide networks. There are two types of routers: protocol dependent and protocol independent. Protocol dependent routers rely on the end stations (computers on a LAN) for routing information. Computers tell the routers where (on which network) the destination computer is located and the routers find the best way to get there. This means that routers must understand the language (LAN protocol) the computers are talking, and this makes them protocol dependent. Protocol independent routers discover the location of the destination device on their own and without any assistance from the communicating computers. They therefore do not need to understand the language the computers are using, which makes them protocol independent.

### Routing

The dynamic exchange of network interconnection and topology information among the systems on interconnected networks.

### RX

Receiver.

### RZ

Signaling code.

# S

## SC

A connector type. It is primarily used with single-mode fiber optic cables. It offers low cost, simplicity and durability. Furthermore, it provides for accurate alignment by a ceramic ferrule. It is a push on -pull off connector with a locking tab. It is similar to the connector used for FDDI but is not compatible.

## Scanner

1. A scanner used to trace out an object and build up an image. One of the most common of these types is video scanning. The scanning takes place inside the television tube as electrons, guided by electron optics, sweep linearly across a tube face coated on the inside with a phosphorescent material. Scanners are also used to relay information in optical data processing. 2. A device that automatically measures or checks a process or condition and may initiate a desired corrective action by means of switching. 3. A device for sending recorded data, such as a supermarket bar code.

## Scattering

The change in direction of light rays or photons after striking a small particle or discontinuity. It may also be regarded as the diffusion of a light beam caused by the inhomogeneity of the transmitting medium.

## SCSI

Acronym for Small Computer System Interface. Pronounced "SKUH-zee".

## SCSI Cable Terminator

A device that reduces interference on the SCSI network.

## SDM

Space Domain Multiplexing

## Secondary Mode Group

A second complete set of spectral lines separate from the main group of spectral lines in an optical spectrum.

## Semiconductor Laser

Same as a laser diode.

## Sensitivity

For a fiber optic receiver, the minimum optical power required to achieve a specified level of performance, such as bit error ratio (BER). Alternatively, it is the minimum amount of energy required by a receiver for successful operation.

## Serial

Transmitting or processing data one bit at a time rather than many bits concurrently (parallel).

## Serial Port

The connection on the back of the main unit for devices that use a Serial Interface.

### Serial Transmission

Transmission where one bit of information is sent at a time on a channel. Compare with parallel transmission, in which eight bits - one character - are sent simultaneously. See asynchronous, channel, bit, synchronous ...A mode of transmission in which each bit of a character is sent sequentially on a single circuit or channel, rather than simultaneously as in parallel transmission.

### Serialize

To change from parallel-by-byte to serial-by-bit.

### Server

A computer providing service, such as shared access to a file system, a printer or an electronic mail system to LAN users. Usually a combination of hardware and software. There are variations on the same theme; they are called file servers and print servers.

### Shot Noise

Noise caused by random current fluctuations arising from the discrete nature of electrons.

### Shutter

1. A mechanical or electronic device used to control the amount of time that a light-sensitive material is exposed to radiation. 2. A switch to turn lights on and off rapidly.

### Side Mode

Any observable mode of an optical device's spectrum which is not the dominant mode.

### Signal to Noise Ratio (SNR, S/N)

1. The ratio of the received optical power, with fill signal averaging, divided by the noise floor for the detector; the ratio of signal level to noise level, related to bit error rate performance. 2. The ratio of signal power to noise power.

### Silica

Glass material, nearly pure SiO<sub>2</sub>.

### SI POF

Step index plastic fiber optic cable.

### Simplex

Transmission in only one direction. Generally a communications system or device capable of transmission in one direction only. See Duplex.

### Simplex Cable

A term sometimes used for a single-fiber cable.

### Simplex Transmission

Transmission in one direction only.

### Single Attach Station (SAS) [FDDI]

Only connects to the primary ring. Connections to the SAS are made in a star-like arrangement, rather than a circular arrangement as used for Dual Attach Stations. And Concentrators may be cascaded to form a tree-like architecture.

### Single Attachment Concentrator

A concentrator that offers one attachment to the FDDI network.

### Single Line Laser

Synonym for single-longitudinal mode laser.

### Single Longitudinal Mode Laser (SLM)

An injection laser diode which has a single dominant longitudinal mode. A singlemode laser with a Single Mode Suppression Ratio (SMSR) <25 dB.

### Singlemode Fiber

An optical fiber that supports only one mode of light propagation above the cutoff wavelength. Typically, the diameter of the core is 9-10  $\mu\text{m}$ . Dispersion and power loss through the cable walls are low with this type of cable. It is proper for long distance transmission.

### Singlemode Laser Diode (SMLD)

Synonym for Single-longitudinal mode laser.

### Singlemode Optical Loss Test Set (SMOLTS)

A singlemode version of an Optical Loss Test Set.

### Skew Ray

A ray that does not intersect the optical axis of a fiber (in contrast with a meridional ray).

### SLED

Abbreviation for Surface-emitting LED.

### SMA

A connector type. This was the predecessor of the ST connector. It features a threaded cap and housing. The use of the SMA connector has decreased markedly in recent years being replaced by the ST and SC connectors.

### SMDS

Switched Megabit (or Multi-megabit) Data Services. A way for a corporate network to dial up switched services as fast as 45 megabits per second.

### Snell's Law

The law of refraction: when light is incident on two homogeneous isotropic media with a common boundary.

### SNR, S/N

Signal to noise ratio. Usually expressed in dB.

### Soliton

An optical pulse that does not suffer dispersion as it propagates over a distance.

### SONET

Synchronous Optical Network.

### Source

There is 2 possibilities. First, it is a generator of information or data. Secondly, within the context of fiber optics it is a light emitter, either an LED or laser diode, for a fiber optic cable based link.

### Spectral Attenuation

Measure for the attenuation in dependence on wavelength.

### Spectral Bandwidth (Between half power points)

It is the wavelength interval in which a radiated spectral quantity is not less than half its maximum value. It is a measure of the extent of the spectrum For a light source typical spectral widths are 20 to 60 nm for a LED and 2 to 5 nm for a laser diode.

### Spectral Width

The measure of the wavelength extent of a spectrum. It is usually based upon the 50% intensity points. When referring to the spectral width of sources, typical spectral widths are 20 to 60 nanometer for an LED and 2 to 5 nanometer for a laser diode.

### Spectral Width, Full Width, Half Maximum (FWHM)

The absolute difference between the wavelengths at which the spectral radiant intensity is 50% of the maximum power.

### Spectral Window

A wavelength region of relatively high transmittance, surrounded by regions of low transmittance.

### Speed of Light

186,000 miles per second.

### Splice

1. A permanent junction between optical fibers. May be thermally fused or mechanically applied. 2. An interconnection method for joining the ends of two fiber optic cables in a permanent or semi-permanent fashion. Thermal fusing may carry out splicing or it may be mechanical.

### Splicing

The permanent joining of fiber optic cable ends to identical or similar fiber optic cables without using a connector. See also Fusion splicing and Mechanical splicing.

### Splice Box

Housing for one or more splice organizers. The changeable front panel can be equipped with different connector plugs.

### Splice Closure

A container used to organize and protect splice trays.

### Splice Tray

A container used to organize and protect splice fibers.

### Splicing

The permanent joining of fiber ends to identical or similar fibers, without the use of a connector.

### Splitter

A passive device which divides optical power among several output fibers from a common input.

### Spontaneous Emission

Radiation emitted when the internal energy of a quantum mechanical system drops from an excited level to a lower level without regard to the simultaneous presence of similar radiation. Examples of spontaneous emission include radiation from an LED and radiation from an injection laser below the lasing threshold.

### ST® Connector

1. A type of connector used on fiber optic cable utilizing a spring loaded twist and lock coupling similar to the BNC connectors used with coaxial cabling. 2. A keyed bayonet connector type similar to a BNC connector. It is used for both multi-mode and single-mode fiber optic cables. Its use is wide spread. It has the ability both to be inserted into and removed from a fiber optic cable both quickly and easily. Method of location is also easy. There are two versions ST and ST-II. These are keyed and spring loaded. They are a push in and twist type.

### Stabilized Light Source

An LED or laser diode that emits light with a controlled and constant spectral width, central wavelength, and peak power with respect to time and temperature.

### Star Coupler

A fiber optic coupler in which power at any input port is distributed to all output ports.

### Star Network

A network in which all terminals are connected through a single point, such as a star coupler or concentrator.

### Station

Equipment, such as a computer, terminal, or file server attached to a LAN. Examples are PCs and workstations. Usually stations have keyboards, screens and some processing power. Sometimes, printers are considered stations. "Station" is an imprecise word. It comes from the time before the turn of the 20th century when the telephone industry was regulated by the interstate Commerce Commission and all telephones were called "stations", because the ICC also regulated the railroads. That's why many of today's telecommunications terms sound like railroad terms ...A network node.

### Steady State

Equilibrium mode distribution.

### Step Index Fiber

An optical fiber, either multi-mode or single-mode, in which the core refractive index is uniform throughout so that a sharp step in refractive index occurs at the core-to-cladding interface. It usually refers to a multi-mode fiber.

### Step Index Profile

A refractive index profile in which the refractive index changes abruptly from the value  $n_1$  to  $n_2$  at the core cladding interface.

### Stimulated Emission

Radiation emitted when the internal energy of a quantum mechanical system drops from an excited level to a lower level when induced by the presence of radiant energy at the same frequency. An example is the radiation from an injection laser diode above the lasing threshold.

### Stop Bit

In asynchronous transmission, the last transmitted element in each character. This bit completes the character and alerts the receiver to get ready to accept another character. See also: Asynchronous.

### Strain Relief

A technique involving methods of termination or installation which reduces the transmission of mechanical stresses to the fiber in connector/cable terminations.

### Strength Member

That part of a fiber optic cable composed of aramid yarn, steel strands, or fiberglass filaments that increase the tensile strength of the cable.

### Stripping

Removing the coating from a fiber optic cable.

### Sync

Data transmission in which the occurrence of each signal representing a bit is related to a fixed time frame.

### Synchronous

1. The condition that occurs when two events happen in a specific time relationship with each other and are both under control of a master clock. 2. Synchronous transmission means there is a constant line between successive bits, characters or events. The timing is achieved by the sharing of a single clock. Each end of the transmission synchronized itself with the use of clocks and information sent along with the transmitted data. Synchronous is the most popular communications method to and from mainframes. In synchronous transmission, characters are spaced by time, not by start and stop bits. Because you don't have to add these bits, synchronous transmission of a message will take fewer bits (and therefore, less time) than an asynchronous transmission. But because precise clocks and careful timing are needed in synchronous transmission, it's usually more expensive to set up synchronous transmission.

### Synchronous Optical Network (SONET)

A standard for fiber optic telecommunications interfaces, with a 1300 nm data link operating over single-mode fiber at data rates of 52, 155 and 622 Mb/sec.

### Synchronous Transmission

Transmission in which there is a constant time between successive bits, characters, or events. The timing is achieved by sharing of clocking ...A transmission method in which the synchronizing of characters is controlled by timing signals generated at the 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. Any of several data codes may be used for the transmission, so long as the code utilized the required line control characters. (Also called “bi-sync,” or “binary synchronous.”)

# T

## Tap

A passive 5-300 MHz box-like device, normally installed in-line with a broadband branch cable. Passive circuits tap off only the information signals to its small Type F outlet ports ...An electrical connection permitting signals to be transmitted onto or off a bus. The link between the bus and the drop cable that connects the workstation to the bus ...1) Baseband - The component or connector that attaches a transceiver to a cable. 2) Broadband - (Also called a directional tap or multitap) a passive device used to remove a portion of the signal power from the distribution line and deliver it onto the drop line.

## Tap Loss

In a fiber optic coupler, the ratio of power at the tap port to the power at the input port.

## Tap Port

In a fiber optic cable coupler in which the splitting ratio between output ports is not equal it is the output port containing the lesser power.

## TAXI

Transparent synchronous transmitter-receiver interface.

## TCP/IP (Transmission Control Protocol/Internet Protocol)

A protocol specification that conforms to the latest DOD ARPANET standard. The TCP/IP protocol module corresponds to layers three and four of the ISO protocol model ...A layered set of protocols that allows sharing of applications among PCs and a high speed communications environment. Because TCP/IP's protocols are standardized across all its layers, including those that provide terminal emulation and file transfer, different vendor's computing devices that run TCP/IP can exist on the same cable and communicate with each other across that cable. Corresponds to layers four (transport) and three (network) of the OSI reference model.

## TDM

Time Division Multiplexing.

## Tee Coupler

A three-port optical coupler.

## 10Base F

A fiber optic cable based version of an IEEE 802.3 network.

## 10Base FB

That portion of a 10Base-F network that defines the requirements for the fiber optic cable backbone network.

## 10Base FL

That portion of a 10Base-F network that defines the fiber optic cable link between a concentrator and a station.

### 10Base FP

That portion of a 10Base-F network that defines a passive star coupler.

### 10Base T

A twisted pair cable version of an IEEE 802.3 network.

### 10Base 2

A thin coaxial cable version of an IEEE 802.3 network.

### 10Base 5

A thick coaxial cable version of an IEEE 802.3 network; very similar to the original Ethernet specification.

### Thermal Noise

Noise resulting from thermally induced random fluctuation in current in the receiver's load resistance.

### Thermal Stability

A measure of the insertion loss variation as the device undergoes various environmental changes.

### Throughput Loss

In a fiber optic cable coupler it is the ratio of power at the throughput port to power at the input port.

### Tight Buffer

Type of cable construction whereby each glass fiber optic cable is tightly buffered by a protective thermoplastic coating to a diameter of 900 microns. High tensile strength rating achieved, providing durability, ease of handling and ease of connectorization.

### Time Division Multiplexer

A device which permits the simultaneous transmission of many independent channels into a single high-speed data stream by dividing the signal into successive alternate bits.

### Time Division Multiplex (TDM)

The process or device by which more than one signal can be sent over a single channel by using different time intervals for the different signals. This may be done by varying the pulse duration, pulse amplitude and pulse position.

### Token Ring

The IEEE 802.5 Token Ring protocol provides a deterministic method of shared media access. Two standards exist, one with 4-Mbit/sec operation and the other with 16-Mbit/sec operation. One station, designed the active monitor, initiates a short frame (token) around the ring. Stations sequentially capture the token and are allowed to access the ring until transmission is completed or the token time-out has expired. The token is then passed to the next station.

### Tolerance

Amount of variance from a standard that is allowed.

### Topology

The manner in which the nodes or stations of a network are connected; point to point or switched fabric.

### Total Bandwidth

The combined modal and chromatic bandwidth.

### Total Internal Reflection

The total reflection that occurs when light strikes an interface at angles of incidence (with respect to the normal) greater than the critical angle.

### Transaction Monitors

Systems that control access to databases to ensure consistency, integrity and recovery. A new generation of products that perform this function for distributed databases and file systems is now emerging.

### Transceiver

A combination of transmitter and receiver providing both output and input interfaces with a device.

### Transducer

A device for converting energy from one form to another, such as optical energy to electrical energy.

### Transistor

An electronic switch that controls the routing of signals in a circuit.

### Transmission Loss

Total loss encountered in transmission through a system.

### Transmission Media

Anything such as wire, coaxial cable, fiber optics, air, or vacuum, that is being used to carry an electrical signal which has information.

### Transmitter

In the context of a fiber optic cable based communication link an electrical package, which converts an electrical signal to an optical signal.

### Transparent

Describes the operation of a network such that a user is unaware that a service is being provided by the network; rather, the service appears to be provided by resources local to the workstation.

### Transport Layer

The fourth layer of the OSI model of data communications. High level quality control (error checking) and some alternate routing is done at this level.

### Tree

A LAN topology in which there is only one route between any two of the nodes on the network. The pattern of connections resembles a tree, or the letter T.

### Tree coupler

A passive fiber optical component in which power from 1-input is distributed to more than 2-output fiber optic cables.

### Trunk

The main bundle of a harness assembly.

### Twisted Pair to Fiber Converter

Connects or replaces 10baseT twisted pair Virtual Terminal Protocol (VTP) segments with fiber optic cable.

### Two Phase Commit

A technique for updating multiple data stores in a reliable, recoverable, real-time manner. If a transaction requires updating multiple data stores at different locations, it is always possible for something to fail during the course of the transaction. Two-phase commit protects against this by requiring each data store to make a copy of the current state of the data before updating.

### TX

Transmitter.

## U

### UL

Underwriters Laboratories, Inc.

### ULSI

Ultra Large-Scale Integration, the technique of putting millions of transistors on a single integrated circuit. Compare with LSI, VLSI.

### Ultraviolet

Optical radiation for which the wavelengths are shorter than those for visible radiation, that is approximately between 1 nm and 400 nm.

### Uniformity

The maximum insertion loss difference between ports of a coupler.

### UNIX

Computer operating system from AT&T. Also works on some personal computers. Considered to be very flexible and very powerful. Has enjoyed popularity among engineers and technical professionals. Personal computer versions of Unix are Xenix (for IBM PCs and compatibles) and AU/X for Macintosh. Sadly, there aren't many business programs running on UNIX. UNIX-based programs can also be moved around between small, medium, and large computers.

### UTP to OF Converter

Unshielded twisted pair to fiber optic converter.

### UV

Ultraviolet.

## V

### Vaporware

A term for software (and sometimes hardware) that is discussed or advertised but is not yet available.

### VCSL

Vertical cavity semiconductor laser.

### Velocity of light

The velocity of light is 300,000 Km/sec in a vacuum. In a medium it depends in the refractive index and the wavelength.

### Virtual Connections (Header Connection Identifier)

Each Asynchronous Transfer Mode (ATM) cell contains a virtual connection identifier. Many virtual connections can be established over the same physical links, using a signaling protocol.

### VLSI (Very Large-Scale Integration)

A manufacturing and design process that allows great quantities of electronic components to be put on a single chip. Approximately 1,200,000 transistors can be put on a 1/4" square chip.

## W

### WAN (Wide Area Network)

A network of connected computers that covers a great geographical area. See Wide Area Network.

### Waveguide

A conducting or dielectric structure able to support and propagate one or more electromagnetic field patterns (modes).

### Wavelength

Distance an electromagnetic wave travels in the time it takes to oscillate through a complete cycle. Wavelengths of light are measured in nanometers ( $10^{-9}$  m) or micrometers ( $10^{-6}$ m).

### Wavelength dependence

The variation in an optical parameter caused by a change in the operating wavelength.

### Wavelength Division Multiplexer

A passive fiber optical device used to separate optical signals of different wavelengths carried on one fiber optic cable.

### Wavelength Division Multiplexing - WDM

Simultaneous transmission of several optical signals of different wavelengths on the same fiber optic cable. It is a technique used so that several different communications channels can share the same fiber optic cable.

### WDM

Wavelength Division Multiplexing.

### WIC

Wavelength Independent Coupler.

### Wide Area Network

A data communications network designed to serve an area of hundreds or thousands of miles. Public and private packet switching networks and the nationwide telephone network are good examples of wide area networks.

### Workstation

A computer designed to meet all of one person's needs (typically more powerful than a personal computer). Commonly used for financial, scientific, or industrial applications.

# Z

## Zirconium Arc

A small bulb containing a conducting gas, an arc being formed between a metal ring and a tiny zirconium electrode near the center of the ring. The heated zirconium emits light and constitutes a convenient laboratory point source.

# MISCELLANEOUS

$\mu$ W  
MicroWatt

# COMMENTS

Please send comments to:

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