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NEWTON'S TELECOM DICTIONARY

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Arithmetic Operation / Array Processor

arithmetic operation The process that results in a mathematically correct solution during the execution of an arithmetic statement or the evaluation of an arithmetic expression.

arithmetic overflow 1. In a digital computer, the condition that occurs when a calculation produces a result that is greater than a given register or storage location can store or represent.

2. In a digital computer, the amount that a calculated value is greater than a given register or storage location can store or represent. The overflow may be placed at another location. See Overflow.

arithmetic register A register (i.e. short-term storage location) that holds the operands or the results of operations such as arithmetic operations, logic operations, and shifts.

arithmetic shift A shift applied to the representation of a number in a fixed radix numeration system and in a fixed-point representation system in which only the characters representing the fixed-point part of the number are moved. An arithmetic shift is usually equivalent to multiplying the number by a positive or a negative integral power of the radix, except for the effect of any rounding; compare the logical shift with the arithmetic shift, especially in the case of floating-point representation.

arithmetic underflow In a digital computer, the condition that occurs when a calculation produces a non-zero result that is less than the smallest non-zero quantity that a given register or storage location can store or represent.

arithmetic unit The part of a computing system which contains the circuits that perform the arithmetic operations. See also ALU.

arj The extension .arj shows that a file or program has been "compressed," and must be "exploded" with the arj program before being either read or used. Groups of files may be compressed together, but this is more commonly done with the zip program. See Zip.

ARM Asynchronous Response Mode. A communication mode involving one primary station and at least one secondary station, where either the primary or one of the secondaries can initiate transmission.

arm and a leg In George Washington's days, there were no cameras. One's image was either sculpted or painted. Some paintings of George Washington showed him standing behind a desk with one arm behind his back while others showed both legs and both arms. Prices charged by painters were not based on how many people were to be painted, but by how many limbs were to be painted. Arms and legs are "limbs," therefore painting them would cost the buyer more. Hence the expression. "Okay, but it'll cost you an arm and a leg."

arm candy Colloquial expression for a dumb, but beautiful female date. On your arm, as you arrive at the party, is a gorgeous woman. "My," say your friends, "You have great arm candy." See also Eye and Wrist Candy.

arm Supplier answered by answering machines. These systems may place the associated

A maker of hardware. A term used especially in the gaming business.

armageddon The fabled battlefield where God's heavenly forces are to defeat the demon-led forces of evil. The final battle.

Armed Forces Radio Service AFRS. A radio broadcasting service that is operated by and for the personnel of the armed services. An example of an AFRS is the radio service operated by the U.S. Army for U.S. and allied military personnel on duty in overseas areas.

ARMIS Automated Management Reporting Information System. Since 1987 the FCC has used the ARMIS system for collecting network infrastructure, financial and operating information from the largest carriers. The FCC produces 10 public reports using this system.

armor Mechanical protection usually accomplished by a metallic layer of tape, braid or served wires or by a combination of jute, steel tapes or wires applied over a cable sheath for additional protection. It is normally found only over the outer sheath. Armor is used mostly on cables lying on lake or river bottoms or on the shore ends of oceans. See Armored Cable.

armored cable 1. A stainless steel handset cord which is meant to resist vandalism. Typically used on a coin phone, most stainless steel handset cords are too short. This is said to be because they were first ordered for use in prisons, where guards wanted to be certain they would not be used by the prisoners as hanging devices. Thus, they requested Western Electric to make them too short for such a use. Whether there is any validity to this story is dubious. However, it is part of telephone industry folk history and therefore, worth preserving.

2. In outside cable an armored cable has its sheath covered with three protective layers: a vinyl jacket, a steel wrap, and another vinyl jacket. Armored cable is intended for use in direct-burial applications; the steel armor protects the sheath from damage during installation. See also Hard Cable.

ARP Address Resolution Protocol. 1. A low-level protocol within the Transmission Control Protocol/Internet Protocol (TCP/IP) suite that "maps" IP addresses to the corresponding Ethernet addresses. In other words, ARP is used to obtain the physical address when only the logical address is known. An ARP request with the IP address is broadcast onto the network. The node on which the IP address resides responds with the hardware address in order that the packets can be transmitted. By way of example, TCP/IP requires ARP for use with Ethernet, in which case the physical address would be defined by the MAC address hard-coded on the NIC (Network Interface Card) of the target workstation. See also RARP.

2. A low-level protocol which serves to map IP addresses, or other non-ATM addresses, to the corresponding address of the target ATM device. Once the ATM address has been identified, the ARP server can stream data to the target device as long as the session is maintained.

ARP table A table of IP addresses stored on a local computer, used to match IP addresses to their corresponding MAC addresses. See also ARP.

ARPA Advanced Research Projects Agency of the U.S. Department of Defense. (The whole DOD annual telecommunications bill exceeds \$1 billion.) Much of the country's early work on packet switching was done at ARPA. At one stage it was called DARPA, which stands for Defense Advanced Research Projects Agency. ARPA was the U.S. government agency that funded research and experimentation with the ARPANET and later the Internet. The group within DARPA responsible for the ARPANET is ISTO (Information Systems Techniques Office), formerly IPTO (Information Processing Techniques Office). See also DARPA Internet. DARPA has changed its name to ARPA and back again. It's hard to keep up.

ARPANET Advanced Research Projects Agency Network. A Department of Defense data network, developed by ARPA, which tied together many users and computers in universities, government and businesses. ARPANET was the forerunner of many developments in commercial data communications, including packet switching, which was first tested on a large scale on this network. The predecessor of the Internet, it was started in 1969 with funds from the Defense Department's Advanced Projects Research Agency (ARPA). ARPANET was split into DARPA (Defense ARPANET) and MILNET (MILitary NETwork) in 1983. ARPANET was officially retired in 1990.

ARPM Average Revenue Per Minute.

ARPU Average Revenue Per Unit. The average revenue generated per wireless customer unit (e.g., pager or cell phone) per month. ARPU is one indicator of the financial performance of a wireless company or other telecom company, which has lots of subscribers.

ARQ Automatic Retransmission reQuest. The standard method of checking transmitted data, used on virtually all high-speed data communications systems. The sender encodes an error-detection field based on the contents of the message. The receiver recalculates the check field and compares it with that received. If they match, an "ACK" (acknowledgment) is transmitted to the sender. If they don't match, a "NAK" (negative acknowledgment) is returned, and the sender retransmits the message. Note: this method of error correction assumes the sender temporarily or permanently stores the data it has sent. Otherwise, it couldn't possibly retransmit the data. No error detection scheme in data transmission is foolproof. This one is no exception.

array 1. The description of a location of points by coordinates. A 2-D array is described with x,y coordinates. A 3-D array is described with x,y,z coordinates.

2. A named, ordered collection of data elements that have identical attributes; or an ordered collection of identical structures.

3. Two or more hard disks that read and write the same data. In a RAID system, the operating system treats the array as if it were a single hard disk.

4. A form of telecommunications wireless antenna. See Array Antenna and Phased Array Antenna.

array antenna Take a bunch of directional antennas. Aim them at the same transmitting source. Join them together. Presto, you now have a very powerful giant antenna. Array antennas are used for picking up weak signals. They are often used in astronomical and defense communications systems. For a bigger explanation, see Phased Array Antenna.

array connector A connector for use with ribbon fiber cable that joins 12 fibers simultaneously. A fan-out array design can be used to connect ribbon fiber cables to non-ribbon cables.

array processor A processor capable of executing instructions in which the

brushes for completing the circuit to a rotating member.

collimate To make light rays parallel. The process of collimation is accomplished by a collimator. See Collimation.

collimation The process by which a divergent or convergent beam of electromagnetic radiation is converted into a beam with the minimum divergence or convergence possible for that system (ideally, a parallel bundle of rays). In the context of telecommunications, collimation generally is used in fiber optics. In fiber optic transmission systems, a diode laser couples to an optical fiber in order to present light signals to the clear center of the core of the fiber through a focusing lens. The focused light signals naturally criss-cross and dance around the edges of the optical fiber, which causes the individual light pulses to lose their shape. This is due to a phenomenon known as "modal dispersion," as different portions of the light signal take different paths, or "modes," as the transverse the fiber. Modal dispersion results in what is known as "pulse dispersion," which describes the overlapping of the individual light pulses at the distant, or receiving, end of the fiber. The bottom line is that the light detector may not be able to distinguish between the individual pulses, and the integrity of the datastream is compromised. Collimation mitigates this effect by lining up the highly-divergent elements of the light beam so that it travels in parallel, rather than criss-crossing. The resulting light beam is relatively uniform, which improves the integrity of the datastream over a distance. Collimation is accomplished by coupling lenses known as "collimators," which fit inside the steel barrels of optical fiber connectors. Collimators can be positioned at the light source, the coupling point between the light source (i.e., transmitter) and the optical fiber, and the coupling point between the optical fiber and the light detector (i.e., receiver). See also Fiber, Modal Dispersion, Pulse Dispersion.

collimator A collimator is an assembly that is used to straighten and make parallel diverging light as it exits a fiber. See Collimation.

collinear antenna A cellular car antenna which looks like a pigtail, because it has a little curlcue in the middle. The curlcue is not a spring, but a clever bit of electro-mechanical magic known as a phasing network, which allows the antenna to boost the effective power of the transmitter's signal. Typically a collinear cellular car antenna is 13 inches high.

collision The result of two workstations (or PCs) trying to use a shared transmission medium (cable) simultaneously—a local area network, for example. The electrical signals, which carry the information they are sending bump into each other. This ruins both signals and both will have to re-transmit 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. Collisions do, however, slow a LAN down. See Aloha, Collision Detection, Collision Domain, Contention and CSMA/CD.

collision detection The process of detecting that simultaneous (and therefore damaging) transmission has taken place. 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 they do not receive an acknowledgement from the receiving station within a certain amount of time (fractions of a second). See Aloha, Collision Domain, Contention and Ethernet.

collision domain Today's most popular local area networking topology is Ethernet. To communicate, Ethernet uses the Carrier Sense Multiple Access/Collision Detect (CSMA/CD) protocol. What this means is that each computer listens to what's going on on the network when it wants to transmit. If no other computer is talking, it will start to send its message. If two computers start to send their messages at the same time, a collision of the messages they're trying to send happens and both stop for a random amount of time and then try to transmit their messages again after that period elapses. This way of controlling traffic on a local area network works well in a lightly-trafficked network. But as traffic builds up (as it always does), it's a problem. Think of a telephone party line. The more people are on, the harder for everyone to get to speak. To control this problem we can break our one-wire Ethernet network into pseudo-separate networks—what are known as collision domains. We insert some intelligent electronics at the entrance to every pseudo-network. That electronics acts as an intelligent traffic cop, keeping traffic that is meant for Joe's PC which resides on subnetwork A away from all the other subnetworks. In this way, we have fewer machines trying to use one wire (i.e. the whole Ethernet LAN), and thus there'll be fewer collisions. Clearly the equipment to do is more costly than an Ethernet hub (which is, in essence, a giant teleconference bridge), since this equipment has to be intelligent, recognizing which messages are to go where. The first equipment that was tried was Bridges. Bridges did not change the packets at all but learned what machines

were on which sides and let traffic flow when it needed to. Later on, Bridges were replaced with routers. Routers are able to look at where packets are coming from and where they are going and determine which way to send them on. (Remember that traffic on any particular segment goes to the entire segment.) These routers would act as gatekeepers to allow only the traffic destined outside the segment to pass through. Multiple network cards in the network server allow the server to function as a router and perform these functions without much cost or overhead. Routers have more intelligence than bridges and can broadcast information to other routers to find the best possible route for a particular data conversation. Routers do modify your packet in terms of the addresses so it can change the path of the packet. That also adds more latency (delay) as now each packet has more processing done to it as it goes through the network.

A few years ago switches came on the market. Switches replaced some or all of the hubs and broke the network into segments. Switches are really a marketing term for bridges. They store and forward the packets without modification and divide your network into multiple segments. The big buzz right now is level 3 switches. Level 3 switching refers to the layer of the OSI model also known as the networking layer. This adds intelligence to the switch to see where the packet is coming from and going to. This happens to be the same way that routers work. In a lightly loaded network switches will slow things down because of latency in getting the packet processed. They make it more difficult to monitor your network using a protocol analyzer. They can cause timeout or expiration issues if you add too many hops into your network. See Ethernet.

collision window The time it takes for a data pulse to travel the length of the network. During this interval, the network is vulnerable to collision.

collocation See Colocation, which is my preferred way of spelling this term.

colocation Colocation occurs when a competing local phone company (often called a CLEC, Competitive Local Exchange Carrier or an Other Common Carrier) locates (i.e. puts) its switches within an incumbent local exchange carrier's (ILEC) central office. An ILEC is the dominant phone carrier within a geographic area as determined by the FCC. Section 252 of the Telecommunications Act 1996 defined Incumbent Local Exchange Carrier as a carrier that, as of the date of enactment of the Act, provided local exchange service to a specific area. The Act provided that the Commission may treat "comparable carriers as incumbents" if they either "occupy a position in the market for telephone exchange service within an area that is comparable to the position occupied by the ILEC or such a "carrier that has substantially replaced an ILEC...." or if "such treatment is consistent with the public interest..."

There are basically two types of colocation—adjacent / physical, and virtual. Adjacent and physical are the same. They mean that your equipment sits in the same building as the ILEC's switching and cable termination equipment. Typically it sits in a locked cage. Only the CLEC and its personnel have the key. Access to that equipment is negotiated between the ILEC and the CLEC through an interconnection agreement. The CLEC will have 24x7 access to it because they have to maintain it for customers who expect service 24 hours a day seven days a week. The concept of colocation—at this stage a peculiarly North American idea—came about through the Telecommunications Act of 1996. U.S. It was a federal bill signed into law on February 8, 1996 "to promote competition and reduce regulation in order to secure lower prices and higher quality services for American telecommunications consumers and encourage rapid deployment of new telecommunications technologies." The Act required local service providers in the 100 largest metropolitan areas of the United States, the Baby Bells, to implement Local Number Portability by the end of 1998. The Act also allowed the local regional Bell operating phone companies into long distance once they had met certain conditions about allowing competition in their local monopoly areas—thus the concept of colocation. That's what the word colocation means. OK, now to the real stuff—how to spell it. Several readers have complained that in previous editions of this dictionary it was spelled "colocation." They point out that their non-technical English language dictionaries spell it collocation—with two "l"s. Random House Dictionary says that back in 1505-15 the word collocation appeared and was based on the Latin collocatus, which derives from collocare. But Random House also includes a spelling from the era of 1965-1970, which it spells colocate and defines as to locate or be located in jointly or together, as two or more groups, military units, or the like; share or designate to share the same place. My preference is colocation, since it seems to me a logical shortening of co-location. But I'm not arguing. Choose which spelling you'd like. See also Carrier Hotel, CLEC, ELEC, ILEC, and Virtual Colocation.

collocation cage A cage in a central office that is erected by the ILEC and rented to a CLEC. CLEC personnel can access and maintain the equipment in the cage.



Federated States of Micronesia This is an interesting story about the commercialization of the Internet. The Federated States of Micronesia is a developing island nation in the Western Pacific Ocean, with a population of about 100,000. The country has little need for its Internet TLD (Top Level Domain) of .fm. So, the government of FMS announced on October 8, 1998 a joint agreement with BRS Media to begin registering and marketing the .fm TLD to the broadcasting industry. A number of FM radio stations have paid a lot of money to use the .fm TLD. How's that for e-commerce? See also TLD and Tuvalu.

feed A television signal source.

feedback 1. The return of part of an output signal back to the input side of the device. Think of the high-pitched squeal you hear when someone brings a microphone too close to the loudspeaker. Not all feedback is as obvious or as irritating. Some feedback is good. See Sidetone, which is what happens when you hear a little in the receiver of you're saying in the transmitter of a phone.

2. The inevitable result when your baby doesn't appreciate the strained carrots.

feeder cable A group of wires, usually 25-pair or multiples of 25-pair, that supports multiple phones in a single cable sheath. These cables may or may not be terminated with a connector on one or both ends. Feeder cable typically connects an intermediate distribution frame (IDF) to a main distribution frame (MDF). But the term "feeder cable" is also used in backbone wiring. And Bellcore defines the term slightly differently: A large pair-size loop cable emanating from a central office and usually placed in an underground conduit system with access available at periodically placed manholes.

feedback control A process by which output or behavior of a machine or system is used to change its operation in order to constantly reduce the difference between the output and a target value. A simple example is a thermostat that cycles a furnace or air conditioner on and off to try and maintain a fixed temperature.

feeder line The cable running between bridges, line extenders and taps.

feeder route A network of loop cable extending from a wire center into a segment of the area served by the wire center.

feeder section A segment of a feeder route that is uniform throughout its length with respect to facility requirements and facilities in place.

feedholes Holes punched in paper or papertape which allow the paper or paper tape to be driven by sprocket wheels.

feedhorn The feedhorn is the focal point of a dish antenna. The feedhorn collects the signals reflected by the dish. The feedhorn is the device used for receiving or radiating microwave signals to or from a parabolic dish reflector.

feedware Software designed to get demand for a product or a new market segment started. Feedware is typically a less-full featured piece of software than the software you're really trying to sell. Feedware typically costs very little. It may even be free. See also Seedware.

FEFO First Ended, First Out. A rule for dealing with things in a queue. For example, higher priority messages will be sent before lower priority messages.

FEI Front end interface.

female amp connector Also called a C Connector or 25-pair female connector. The male version is called a P connector.

femtosecond One-millionth of a billionth of a second. Femtoseconds are used in laser transmission and in other measures of very small happenings. It's 10 to the minus 15. There are as many femtoseconds in one second as there are seconds in thirty million years. There are 1,000,000,000,000 femtoseconds in one second. How small is a femtosecond? In a little more than a second, light can travel from the moon to the earth, but in a femtosecond it only travels one hundredth the width of a human hair.

FEP 1. Front End Processor. The "traffic cop" of the mainframe data communications world. Typically sits in front of a mainframe computer and is designed to handle the telecommunications burden, so the mainframe computer can concentrate on handling the processing burden. Here's a more technical definition: A dedicated communications system that intercepts and handles activity for the host. Can perform line control, message handling, code conversion, error control, and such applications functions as control and operation of special-purpose terminals. Designed to offload from the host computer all or most of its data communications functions. Front end processors are not used in the client/server world.

2. Fluorinated Ethylene Propylene. Also known by the trade name Teflon, a registered trademark of Dupont, and NeoFlon, a registered trademark of Daikin. FEP is the insulation of choice for high performance cable and wire systems installed in return air plenums. As

FEP is really slick, it makes the wire really easy to pull through conduits, around corners, and so on—the same property that makes it so wonderful in the kitchen. FEP also is fire retardant and produces little visible smoke. FEP is used CAT 5 (Category 5) and higher-rated inside wire and cable systems. FEP's high cost has led many manufacturers to use PVC as an insulating compound, and to coat it with flame retardant compounds. Many countries require the use fire-retardant, low-smoke cable jackets, particularly in plenum ceilings. See also CAT 5, Plenum, and PVC.

FER Frame Error Rate. A computation based on the number of frames received with errors compared to frames received without errors. See also Frame Error Rate.

FERF 1. Far-End Receive Failure. A yellow alarm. A message from a remote network element that is having trouble receiving a signal.

2. Far-End Remote Failure. An alarm indicating a failure at the far end of an ATM network, identifying the specific circuit in a failure condition.

fernsprechvermittlungsstelle A central office in German. In Europe, they call a central office a "public exchange," or just plain "exchange." They look at you kinda strange when you say the North American word, namely "central office."

ferreed assembly A glass enclosed reed relay switch in which the reeds are made of some metal which can be opened or closed by an external magnetic field.

ferri chrome A coating used on tape comprising a layer of ferric oxide particles and a layer of chromium dioxide particles and combining the attributes of both.

ferric oxide A coating used on tape comprised of red iron oxide, the original material used for magnetic recording tapes.

ferrite A type of ceramic material having magnetic properties and consisting of a crystalline structure of ferric oxide and one or more metallic oxides, such as those of nickel or zinc. See Barium Ferrite, Hard Ferrite and Soft Ferrite.

ferroresonant transformer A special transformer which puts out regulated AC voltage even when the input voltage is variable. A ferroresonant transformer may be used by itself to correct brownouts or it may be built into a UPS. A ferroresonant transformer has an undesirable characteristic called "high output impedance" which can prevent protective devices such as circuit breakers on equipment plugged into it from functioning, resulting in a possible safety hazard. Another problem is that computer loads applied to ferro based line conditioners or UPS systems cause the voltage waveform applied to the computer to be very distorted, which may result in undervoltage conditions within the computer. Ferro based UPS systems are becoming obsolete because they can become unstable and oscillate when supplying modern power factor corrected power supplies. This definition courtesy APC.

ferrule A component of a fiber optic connection that holds a fiber in place and aids in its alignment.

FET Field Effect Transistor. Very thin and small transistors are used to control pixels in a TFT (Thin Film Transistor) display.

FEXT Far-End Crosstalk. A type of crosstalk which occurs when signals on one twisted pair are coupled to another pair as they arrive at the far end of multi-pair cable system. FEXT is an issue on short loops supporting high-bandwidth services such as VDSL (Very-high-bit-rate Digital Subscriber Line), given the relatively high carrier frequencies involved. Services such as ADSL and HDSL, are not affected to the same extent, as the loops are longer and as such interference tends to be attenuated (weakened) on longer loops. See also Crosstalk. Compare with NEXT.

Fewer A smaller number. The word "fewer" is always confused with the word "less." According to the Oxford American Dictionary, the word "less" is used of things that are measured by amount (for example, eat less butter, use less fuel). Its use with things measured by numbers is regarded as incorrect (for example in "we need less workers"; correct usage is "fewer workers").

FF Form Feed. A printer function used to skip to the top of the next page or form.

FFDI Fast Fiber Data Interface. A proprietary 100 megabit per second local area network that uses fiber optic, coax, shielded twisted pair or unshielded twisted pair. It is manufactured by PlusNet, Phoenix, Arizona.

FFOL Fiber Follow On LAN. Emerging LAN technology.

FFT 1. Fast File Transfer. An ISDN term referring to the fact that file transfers can be accomplished "fast." Reason #1: Two B channels at 64 Kbps each and a D channel at up to 16 Kbps are available to be bonded to provide as much as 144 Kbps. Reason #2: Data transfer is accomplished in an "optimistic" streaming mode, rather than a "pessimistic" packet mode. Therefore, there is no delay associated with acknowledgements. This is possible due to the excellent level of error performance inherent in digital services. The end result is FFT.

Fiber Optic / Fiber Remote

fibers and runs for one mile. That is one route mile (total distance of all fibers), two sheath miles (two sheaths running one mile), and twenty fiber miles (20 fibers running one mile).

fiber optic See Fiber and Fiber Optics.

fiber optic amplifier As light, like electricity or any other form of electromagnetic energy, travels through a physical medium, it attenuates, or loses intensity. At some point in a communications transmission system, you must take your increasingly weak signal and boost it back to its original strength. In analog systems, you simply amplify the weak incoming signal and send it on its way. In addition to amplifying the information signal, any accumulated noise is also amplified. In digital signals, you first regenerate the signal, then amplify it, then send it on its way, with no recognition of or regard for any noise present. Most fiber transmission systems accomplish this process by converting the original light signal on the fiber to electrical impulses, regenerate the signal, then amplify it, then convert it back to light pulses, then send it on its way. This takes significant energy and equipment—not altogether convenient for an underwater cable of several thousand miles. With new fiber optic amplifiers you no longer need to convert the light signal to electrical impulses. A fiber optic amplifier uses special fiber doped with erbium to act as the amplifier. Light comes into this special fiber, is pumped with the correct frequency laser and is amplified with extremely high gain and very low noise through a process of chemical light amplification. It's truly amazing technology. See Erbium-Doped Fiber Amplifier for a more technical explanation.

fiber optic attenuator A small device with two connectors. It reduces the amount of light passing through it, similar to the way sunglasses reduce the amount of light entering your eyes so you can see better.

fiber optic buffer Plastic coating on individual fibers. There are 12 colors to distinguish them from each other.

fiber optic cable See Fiber.

fiber optic connector There are three types: SC, ST and FC. The FC connector can be considered an earlier vintage connector but it was pre-dated by the biconic and SMA. FC connectors were specifically designed for telecommunications applications and initially came into prominence overseas. It came into its own in the 1980s and was the earliest design to incorporate the now standard 2.5mm ceramic ferrule. It also provided non-optical disconnect performance. Another advantage was this connector offered tunable keying which allowed it to be adjusted in order to minimize loss. The FC connector incorporated a threaded coupling nut which provided a secure connection, however as with the biconic and SMA, it did not allow for quick connect and disconnect as the coupling nut had to be rotated many times to thread or unthread the connector. Technicians also found it difficult to work with the threaded connectors particularly if the technician had large hands. The ST connector can be considered as the first of the contemporary connector designs. It utilizes the 2.5mm ferrule which is available in ceramic, zirconia, stainless steel, or plastic materials and is produced as a singlemode or multimode version. A variety of physical contact ceramic and zirconia ferrule styles allow the ST to achieve optimal performance. It is also available as an epoxyless version. The ST connector is easily recognizable because of its quick release bayonet-style locking mechanism. Unlike the threaded connectors, the ST only requires a quarter turn to complete a mating or demating cycle. In the opinion of some people in the industry, one of the early drawbacks to the ST connector was that it was not designed to be pull proof which meant that it could optically disconnect when the patchcord was pulled. The SC connector began to see widespread deployment in the early 1990's particularly among the RBOCs (Regional Bell Operating Companies) and several Independents. It is available in both singlemode and multimode designs. The SC is easily distinguishable by its square body style and utilizes a push - pull feature for mating and demating. The push - pull feature is preferred by many customers because when the ferrules come into contact in the mating sleeve of the adapter there are no rotational forces which could potentially damage a fiber or score the ferrules. This feature also eliminates a potential buildup of particulate in the mating sleeve which could possibly degrade optical performance. The SC is also designed as a pull-proof connector. A pull-proof connector is designed so that the ferrule is decoupled from the connector housing to which the fiber cable is attached. Therefore the connector maintains optical contact when fiber cable is pulled outward or sideways, thus eliminating the possibility of a service outage. In a non-pull-proof connector such as the earlier ST's, the connection can be broken when cable is pulled with a force that is greater than the spring force, which is around 2 - 3 pounds. Since the SC mating and demating is accomplished by push - pull force rather than rotational force, it readily lends itself to duplex connection configurations because it requires less space to engage and disengage.

fiber optic distribution panel A termination device and organizer. It houses splice trays where connector plugs (called pigtails) are attached to the ends of fiber-optic cables.

fiber optic gyroscope A coil of optical fiber that can detect rotation about its axis.

fiber optic inter repeater link An 802.3 Ethernet standard for connecting two repeater devices at 10 million bits per second.

fiber optic link A transmitter, receiver, and cable assembly that can transmit information between two points.

Fiber Optic Test Procedure See FOTP.

fiber optic tracer A device typically based on a flashlight used to test the continuity of optic fibers and to trace multimode fibers from proper connections.

fiber optic transmission system See Fiber Optics, SDH and SONET.

fiber optic waveguide A relatively long thin strand of transparent substance, usually glass, capable of conducting an electromagnetic wave of optical wavelength (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.

fiber optics A technology in which light is used to transport information from one point to another. More specifically, fiber optics are thin filaments of glass through which light beams are transmitted over long distances carrying enormous amounts of data. Modulating light on thin strands of glass produces major benefits in high bandwidth, relatively low cost, low power consumption, small space needs, total insensitivity to electromagnetic interference and great insensitivity to being bugged. All these benefits have great attraction to anyone who needs vast, clean transmission capacity, to the military and to anyone who runs a factory with lots of electronic machinery. The first field trial of an AT&T lightwave system took place in Chicago in 1977. There has been a rapid improvement in cost effectiveness of fiber systems, expressed as cost per bit per kilometer. A one hundredfold increase in cost performance in one five-year period—from 1980 to 1985. Some versions of fiber optics now carry 40 Gbps (forty billion bits per second) in support of more than 600,000 uncompressed voice conversations, and that's over a single wavelength. Some systems run as many as 40 wavelengths through a technique known as Dense Wavelength Division Multiplexing (DWDM). See also DWDM and SONET.

fiber pair Optical fiber transmission systems often, but not always, are deployed in pairs. First, you have to understand that light can only travel in one direction through a strand of fiber. It can go fast. But it can only travel in one direction. Now, let's consider the LAN (Local Area Network), where fiber is installed with a single fiber or a dual fiber. In the LAN, fiber often is deployed on the basis of a single fiber because it's cheaper. In a single fiber LAN, the devices (e.g., a switch or hub, and a server) transmit in half-duplex (i.e. one way at a time). Then they switch quickly to other direction. This is the way a typical local phone line works, i.e. the phone line from your telephone company's central office to the phone on your desk. A fiber communications system, like a LAN, may also be installed with two fibers, or fiber pairs, with the devices using one fiber to transmit and one to receive in full-duplex (i.e., simultaneous two-way) mode. While this approach requires twice the fiber and twice the port interfaces at the device level, the speed of transmission is improved by a factor of at least two. In a FDDI (Fiber Distributed Data Interface) LAN backbone network, each of two fibers continuously is active, with one transmitting in the clockwise direction and one in the counter-clockwise direction. This dual counter-rotating ring configuration is for purposes of redundancy and resiliency, as a break across both fibers at a single physical point will not isolate any two devices. In other words, any device can communicate with any other device on the FDDI network, in one direction or the other.

Now let's consider the WAN (Wide Area Network) domain. In the WAN, fiber typically is deployed in a pair configuration. In some implementations, one fiber is used to transmit and one to receive. In a SONET/SDH implementation, fiber networks are deployed in a dual counter-rotating ring configuration, much like that of FDDI networks, and for the same reasons of redundancy and resiliency. See also FDDI, Fiber Optic, and SONET.

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

fiber remote Fiber Remote extends what Northern Telecom calls Intelligent Peripheral Equipment using dark single or multimode fiber cable. Fiber Remote operates over a range of typical campus distances—from thousands of feet to several miles. Distance is site specific, determined by variables such as the type and quality of the fiber installed and the number of connectors and splices. The signal attenuation between the local PBX system and the remote IPE shelves should not exceed a 13 dB loss. Fiber Remote

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(i.e., spread out) more than the lower frequency components. As they disperse from the center of the fiber core, some of them enter the cladding, where they increase in speed due to the purer nature of the glass that comprises the cladding. See also Chromatic Dispersion.

waveguide flange A mechanical "connector" for joining waveguide sections.

waveguide scattering Scattering (other than material scattering) that is attributable to variations of geometry and refractive index profile of an optical fiber.

waveguide switch A switch which uses a shutter to open or block an aperture in order to block an aperture in order to block or pass radio frequency energy.

wavelength The length of a wave measured from any point on one wave, to the corresponding point on the next wave, such as from crest-to-crest, or trough-to-trough. In other words, a wavelength is the distance an electromagnetic wave travels in the time it takes to oscillate through a complete cycle. There is a direct proportion between the wavelength of a radio signal and its frequency. For example and very close to the bottom of the radio spectrum, a Low Frequency (LF) radio signal is defined as having a frequency range of 30 kHz-300 kHz, with a corresponding wavelength of 10 Km-1Km. LF radio is used in navigation and maritime communications. At the high end of the radio spectrum is Extremely High Frequency (EHF) radio, which is defined as having a frequency range of 30 GHz-300 GHz, and a corresponding wavelength of 1 cm-1 mm. The higher the frequency of the signal, the more Hz (Hertz, or sine waves) are sent per second, and the shorter the corresponding wavelength.

wavelength assignment See Wavelength Scheduling.

Wavelength Division Multiplexing WDM. A way of increasing the capacity of an optical fiber by simultaneously sending more than one ray of light down the fiber. See WDW for a more complete explanation.

Wavelength Interchanging Cross-Connect WIXC. A type of OXC (Optical Cross-Connect). See OXC.

wavelength managed networks As optical fiber gets more and more wavelengths of light pumped down it, so the idea emerges of splitting and switching wavelengths to go in different directions down different fibers. The blue might go to Detroit. The red might go to Chicago. The concept is to do switching without actually having to drop down to electricity. The whole concept is called wavelength managed networks. See also Wavelength Division Multiplexing.

wavelength scheduling Wavelength scheduling is the art, or science, of letting distinct transmitters and receivers use wavelengths (frequency slots) to communicate over an optical network. The optical network can either be broadcast-and-select type (much like Ethernet or Token ring but in the frequency domain) or wavelength routing type. For wavelength routing networks this is often called wavelength assignment and DWDM or CWDM (Coarse WDM) channels are assumed. Wavelength scheduling can also be used for reducing transmission impairments, e.g. fiber non-linearities, as proposed by a patent held by Tella, the Swedish incumbent phone company. Under Tella's patent, wavelength channels are given permission to transmit information in scheduled time slots. The time slots are allocated so that each channel is only given access to the fiber when no more than one of its nearest neighbors is transmitting. As for most wavelength scheduling algorithms, and there are many, little practical use have been found to date for wavelength scheduling.

Wavelength Selective Cross Connect WSXC. A type of Optical Cross-Connect (OXC). See OXC.

wavelet Wavelets are an economical way of compressing images, both still and moving, yielding compression ratios of 100:1 or better. For example, wavelet compression can allow a full-length movie to be stored on a conventional five-inch CD disc. Wavelets are mathematical functions that cut up data into different frequency components, and then study each component with a resolution matched to its scale. They have advantages over traditional Fourier methods in analyzing physical situations where the signal contains discontinuities and sharp spikes. Wavelets were developed independently in the fields of mathematics, quantum physics, electrical engineering, and seismic geology. Interchanges between these fields during the last ten years have led to many new wavelet applications such as image compression, turbulence, human vision, radar, and earthquake prediction. See Wavelet Packet.

wavelet packet According to the IEEE, class of time-frequency waveforms with a location (position), a scale (duration), and an oscillation (frequency). Wavelet packets are used for analyzing data with natural oscillations, such as audio signals and fingerprint images. See Wavelet.

wavelet transform A compression technique which involves the representation

of a discrete signal or image through wavelet functions. Wavelet transform is computed by the fast pyramid algorithm, which involves a series of linear filtering operations in combination with down-sampling by a factor of two. See Down-Sampling, Fast Pyramid Algorithm and Wavelet.

WAW Waiter-Actor-Webmaster. Used to describe fly-by-night graphic designers and Web consultants trying to cash in on the Web boom. "Can you believe they hired that clueless WAW for \$60K a year?!" This definition courtesy Wired Magazine.

way operated circuit A circuit shared by three or more phones on a party line basis. One of the phones usually operates as the control point.

way station One of the phones, other than the central controller, on a way operated circuit. See Way Operated Circuit.

WBA Wireless Broadcast Access.

WBC Wide Band Channel. An FDDI-II term. See FDDI II.

WBEM Web-Based Enterprise Management. A wide-ranging blueprint for unified administration of network, systems and software resources (established by Microsoft, Intel, Compaq, Cisco, BMC Software, and others)....a schema that incorporates three new protocols and four current Internet standards to allow users to manage distributed systems and to access network resources using any Web browser.

WBFH Wide Band Frequency Hopping. WBFH, approved by the FCC in August 2000, is a spread spectrum technique that widens the channel bandwidth to 3 MHz and 5 MHz, as compared to the original 1 MHz. At a rate of roughly 2 Mbps per 1 MHz, WBFH considerably increases bandwidth in HomeRF systems and other wireless systems using Frequency Hopping Spread Spectrum (FHSS). See also FHSS, HomeRF, and Spread Spectrum.

WCAPS Wireless Competitive Access Providers. See Fixed Wireless Local Loop.

WCBC West Coast Billing Center.

WCCP Web Cache Control Protocol. A cache control protocol which runs between a router serving and a transparent proxy cache server. The protocol allows multiple caching proxies to register with a single router to receive intercepted and redirected Web traffic. This process allows the distribution of Web-based information on proxy servers in proximity to the client agent requesting the data, and it does so transparently. When you access a web site, you may be in touch with a proxy server, rather than the origin server. Some Internet purists are really concerned about this, as it violates the basic principles of the Internet, as well as the connection-oriented TCP protocol. See also Cache, Cache Engine, and Proxy.

WCCP V.2 Cisco's communication protocol for cache servers.

WCDMA Wideband CDMA. A high-speed 3G mobile wireless technology officially known as UMTS, (Universal Mobile Telecommunications System), which is also referred to as 3GPP. The technology works by digitizing and transmitting the input signals in a coded, spread spectrum mode over a range of frequencies. WCDMA has the ability to spread its transmissions over a 5MHz carrier. It supports (i.e. it will carry) images, mobile/portable voice, data and video communications at up to 2 Mbps for local area access or 384 Kbps for wide area access. See UMTS.

WCS Wireless Communications Service. Cellular, PCS and the like.

WCV See Weighted Call Value.

WDF Wireless Data Forum. www.wirelessdata.org.

WDM Wavelength Division Multiplexing. A means of increasing the data-carrying capacity of an optical fiber by simultaneously operating at more than one wavelength. WDM is similar to Frequency Division Multiplexing (FDM) in the analog worlds of electrical and radio transmission systems. In optical fiber communications, WDM is any technique by which two or more optical signals having different wavelengths may be simultaneously transmitted in the same direction over one strand of fiber, and then be separated by wavelength at the distant end. Each wavelength is a "virtual channel," which effectively is a separate "light pipe", that can support a given signaling rate, such as OC-48 at 2.4 Gbps or OC-192 at 10 Gbps. Although WDM technology been known since the 1980s, it was restricted to two widely separated "wideband" frequencies. (Note: frequency=speed/wavelength, where the speed of light in glass fiber is essentially constant, so wavelength and frequency are used interchangeably in describing the multiple channels of WDM). The number of distinct wavelengths supported has increased rapidly since WDM became "narrowband" capable in the early 1990s. Initial systems operated at two or four wavelengths, and the term "WDM" is usually used to refer to these low channel-count systems. Beyond WDM is WDWDM (Wide WDM), operating at four channels in applications such as 10GbE (10 Gbps Ethernet). Beyond that is DWDM (Dense WDM), which generally is described as beginning at 10 channels. (Note: The terms do not have absolute differentiating definitions and are used somewhat interchangeably.) DWDM systems in commercial applications use at least eight chan-

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nel or sixteen-channel multiplexers, and standards-based systems as dense as 32-channels have been released and implemented in live carrier networks. The capacity is steadily increasing, both by ever-expanding channel counts and faster supported TDM rates within the individual wavelengths. Generally speaking, existing systems trade-off channel count against maximum supported rate: the current maximum channel count of 32 is limited to OC-48 (almost 80 Gbps net throughput), with systems supporting higher signal rates (e.g., OC-192) supporting fewer than half as many channels. At OC-192, a 32-channel system would yield an incredible 320 Gbps, rounded up. Within the next few years it is reasonable to expect to see systems supporting on the order of 100 wavelengths of OC-192 each, yielding bandwidth of almost 1 Tbps per fiber! The advantage of WDM is that of increasing network capacity without deploying additional fiber. To install enough new actual physical fiber to provide the same bandwidth as the equivalent virtual fiber would be enormously more expensive and often a physical impossibility. WDM also compares very favorably to exclusively upgrading SONET equipment to operate at the higher OC-n layers without WDM, especially since the rate multiplier limit of TDM is hit sooner than the channel multiplier limit of WDM. The ITU-T currently has defined 32 standard wavelengths from which WDM equipment manufacturers can choose (expressed as frequencies, the table is centered at 194.10 THz, with 100 GHz spacing, providing as many as 41 center frequencies from 192.10 to 196.10 THz). ITU-T recommendation G.692 implements an additional table which reduces the spacing to 50 GHz, making 40 additional frequencies available. Further, G.692 makes it plain that the table's endpoints are not absolute, and future systems are fully anticipated to include further wavelengths. It is not unreasonable to expect that as the technology continues to advance, the channel spacings may also be reduced, although not as soon as the endpoints are expanded. Overall, the contemporary wavelength range typically is between 1530nm and 1560nm, with the minimum and maximum wavelengths being restricted by the wavelength-dependent gain profiles of the optical amplifiers. As is common, the standards organizations often are outpaced by technology advances. While most initial fiber optic traffic involved SONET-formatted signals, WDM and SONET are not necessarily linked. Increasingly, carriers are deploying WDM networks in support of packet traffic (e.g., IP and Ethernet) without employing the SONET digital wrapper. SONET is derided for its overhead intensity, complexity, and cost. Note that WDM and DWDM are physical data transport terms, and not specific to SONET, or any other format standard. Long-haul amplification of WDM signals is achieved with optical EDFAs (Erbium-Doped Fiber Amplifiers), rather than optical repeaters. The EDFAs are spaced up to 100 kilometers apart, simultaneously boosting the intensity of all the multiple light channels through a "pump laser." The EDFAs operate more effectively than do conventional optical repeaters, and are much less costly to acquire and operate. See also DWDM, EDFA, SONET, and WWDM.

WDMA Wavelength Division Multiple Access. A technique which is used to provide access to multiple channels carried on different wavelengths on the same fiber-optic cable. Each optical input operates on a different wavelength of light. The multiple inputs are multiplexed over a common long-haul SONET fiber optic link through WDM (Wavelength Division Multiplexing) equipment. See WDM for much more detailed explanation.

WDME Wavelength Division Multiple Emulator. A WDM emulator is used to enhance testing ability and reduce testing time by simultaneously presenting an array of calibrated wavelengths across the spectral range of interest.

WDM Winchester Drive Unit.

WDT See WatchDog Timer.

weaponize A verb meaning to place weapons of destruction in a new environment. I first saw the term in a New York Times article relating to the weaponizing of space.

weather trunk group A trunk group used to provide customers with weather information.

weathermaster method A distribution method where the unused wall space inside heating and cooling units beneath windows is used for satellite location. Cables are fed from a riser or other serving closet to the location through baseboards, conduit, or underfloor system.

web An abbreviation for the Internet's World Wide Web. See Berners-Lee, World Wide Web and Internet.

web address Here's a typical address of an Internet Worldwide Web site

<http://www.harrynewton.com/resume/bio.html> Let's look at what it means:

[http](http://www.harrynewton.com/resume/bio.html) is Hypertext Transfer Protocol. [http](http://www.harrynewton.com/resume/bio.html) lets your browser know to expect a web page (as opposed to an FTP or gopher site).

:// is what several writers have referred to as random punctuation abuse. Basically, it's text to separate the next part of the address, namely the "Sub-domain," which is [www](http://www.harrynewton.com/resume/bio.html).

World Wide Web servers typically use "www," but you may see other names like "web3" or "w3." The next part of the address is the "High-Level domain," which tells you either the type or location of an organization. Common high level domains: .com = commercial .edu = university .gov = government .uk = England .fi = Finland

The last part of the address is "Unique domain." What an organization or person calls its net site, namely harrynewton. Next part is /resume/ which is simply the directory or folder on the computer where the web page is stored. Finally, bio.html is simply the document you're looking for. See also URL.

web advertising Advertising on the Web is expanding rapidly. According to the experts, there are two types of advertising on the Web:

1. Brand advertising, which is intended to generate awareness of and create a specific image for a particular company, product or service; and

2. Direct response advertising, which is intended to generate a specific response or action from the consumer after exposure to an advertisement. Direct response advertising solutions are measured on the short-term benefit from the advertisement and are designed to maximize the number of responses per advertising dollar.

web application server Web application servers are special purpose, powerful PCs which sit between a Web server and a corporate database. They offload processing tasks from the repository and cache frequently requested information. They offer much greater growability, since multiple connections can be run to the database—instead of just one, as in the case when the Web server is linked directly. In short, Web application servers speed up getting answers to requests for information out into Web site users' hands.

web art A definition for the artwork that you are beginning to see proliferating the Internet, especially on home pages.

web browser A Web browser is software which allows a computer user (like you and me) to "surf" the World Wide Web. It lets us select, retrieve and interact with resources on the Web. It lets us move easily from one World Wide Web site to another. Every time we alight on a Web Page, our Web browser moves a copy of the information on the Web to our computer. See the Internet and HTTP.

Web Cache Control Protocol WCCP Web Cache Control Protocol. A cache control protocol which runs between a router serving and a transparent proxy cache server. The protocol allows multiple caching proxies to register with a single router to receive intercepted and redirected Web traffic. This process allows the distribution of Web-based information on proxy serves in proximity to the client agent requesting the data, and it does so transparently. When you access a web site, you may be in touch with a proxy server, rather than the origin server. Some Internet purists are really concerned about this, as it violates the basic principles of the Internet, as well as the connection-oriented TCP protocol. See also Cache, Cache Engine, and Proxy.

web caching This concept is analogous to the caching currently used in computer systems. With Web caching, copies of recently accessed Web objects are stored temporarily in locations that are closer to the user, based on the high probability that some number of these objects will be accessed. As a result, the bandwidth and latency associated with fetching the original object again are eliminated. Web caching is a way to proactively store specific content closer to the users, intercepting and responding to requests for that specific content only. See Cache Engine.

web callback Let's say you're on a web site. You have a question. You want to know more than what you can find out on the site. You see a button on the site "Have us call you." That's called a web call back button. When you hit it, it will produce a small form, asking you for your name and phone number. When you fill the form in, the information is transmitted to the company's telephone automatic call distributor which dials the number when it has an agent free and ready to take the phone call and speak to the customer browsing the company's web site.

web casting More commonly spelled webcasting. Webcasting is defined as the real time delivery of audio, video or animation over the Internet. I first found the word in Business Week in February, 1997. Business Week described it thusly "Swamped by information on the Web? A new technology finds and delivers news for you. It also helps companies reach workers and conduct business online. Call it broadcasting, Internet-style. Call it webcasting." The basic is simple: You go to a webcasting site. You fill in a form detailing what sort of information you want to hear about. Next time you log on, information is "pushed" to you by your webcasting supplier. You might pay for this service. Or it may be advertiser-based. See also Multicasting and Satellite Webcasting.

web collaboration Imagine you're on a Web site that sells tennis racquets. You're searching for a racquet you saw last weekend. But you **lanceo** **lanceo** **lanceo**