Telecommunications Glossary

ATM--1. Acronym for Asynchronous Transfer Mode. A network technology capable of transmitting data, voice, audio, video, and frame relay traffic in real time. Data, including frame relay data, is broken into packets containing 53 bytes each, which are switched between any two nodes in the system at rates ranging from 1.5 Mbps to 622 Mbps (over fiber optic cable). The basic unit of ATM transmission is known as a cell, a packet consisting of 5 bytes routing information and a 48-byte payload (data). These cells are transmitted to their destination, where they are reassembled into the original traffic. During transmission, cells from different users may be intermixed asynchronously to maximize utilization of network resources. ATM is defined in the broadband ISDN protocol at the levels corresponding to levels 1 and 2 of the ISO/OSI reference model. It is currently used in LANs (local area networks) involving workstations and personal computers, but it is expected to be adopted by the telephone companies, which will be able to charge customers for the data they transmit rather than for their connect time.

BRI--Acronym for Basic Rate Interface. An ISDN subscriber service that uses two B (64 Kbps) channels and one D (16 Kbps) channel to transmit voice, video, and data signals. See also ISDN.

cable modem--A modem that sends and receives data through a coaxial cable television network instead of telephone lines, as with a conventional modem. Cable modems, which have speeds of 500 kilobits per second (Kbps), can generally transmit data faster than current conventional modems. However, cable modems do not operate at the same rate upstream (when sending information) and downstream (when receiving information). Upstream rates vary from about 2 Mbps to 10 Mbps, downstream rates from about 10 Mbps to 36 Mbps. See also coaxial cable, modem.

coaxial cable--A round, flexible, two-conductor cable consisting of—from the center outwards—a copper wire, a layer of protective insulation, a braided metal mesh sleeve, and an outer shield, or jacket of PVC or fire-resistant material. The shield prevents signals transmitted on the center wire from affecting nearby components and prevents external interference from affecting the signal carried on the center wire. Coaxial cable is widely used in networks. It is the same type of wiring as that used for cable television. See the illustration. Compare fiberoptic cable, twisted-pair wiring.

dense wavelength division multiplexing--A data transmission technique in which multiple optical signals, each assigned to a separate color (wavelength frequency), are multiplexed onto a single strand of optical fiber. Because each signal travels separately in its own color band on the fiber, dense wavelength division multiplexing allows for the simultaneous transmission of different types of signals, such as SONET and ATM, each traveling at its own rate of speed. Dense wavelength division multiplexing can greatly increase the carrying capacity of a single optical fiber. Depending on the number, type, and rate of the signals involved, bandwidth can range from more than 40 Gbps to projected highs of 200 Gbps or more. Acronym: DWDM. Also called: wave division multiplexing, WDM. Compare time division multiple access.

dial-up--Of, pertaining to, or being a connection that uses the public switched telephone network rather than a dedicated circuit or some other type of private network.

digital modem--1. A communications device that acts as the intermediary between a digital device such as a computer or terminal and a digital communications channel, such as a high-speed network line, an ISDN circuit, or a cable TV system. Although a digital modem supports standard (analog) modem protocols, it is not a "typical" modem in the sense of being a device whose primary function is to modulate (convert digital to analog) before transmission and demodulate (convert analog to digital) after transmission. It uses advanced digital modulation techniques for changing data frames into a format suitable for transmission over a digital line. See also terminal adapter. Compare modem. 2. A 56 Kbps modem. Such a modem is not purely digital but does eliminate the traditional digital-to-analog conversion for downstream transmissions—that is, transmissions moving from the Internet to the end user. A 56 Kbps modem is also digital in that it requires a digital connection, such as T1, between the telephone company and the user's Internet Service Provider (ISP) in order to achieve its highest speed. See also 56-Kbps modem. 3. A term used to distinguish all-digital communications devices, such as ISDN and cable "modems" from the more traditional analog-to-digital, phone-based modems.

DOCSIS--Acronym for Data Over Cable Service Interface Specification. The International Telecommunications Union standard (ITU Recommendation J.112) that specifies functions and internal and external interfaces for high-speed, bidirectional transfer of digital data between cable television networks and subscribers. DOCSIS-compliant equipment ensures interoperability between cable modems and the cable television infrastructure, regardless of manufacturer or provider. Initially developed by a group of cable television providers, including Time Warner and TCI, DOCSIS was designed to support data, video, and rapid Internet access. Data rates are 27 Mbps to 36 Mbps downstream (from the cable network) and 320 Kbps to 10 Mbps upstream (to the cable network). See also cable modem. Compare IEEE 802.14.

DS--Acronym for Digital Services or Digital Signal, a category used in referencing the speed, number of channels, and transmission characteristics of T1, T2, T3, and T4 communications lines. The basic DS unit, or level, is known as DS-0, which corresponds to the 64 Kbps speed of a single T1 channel. Higher levels are made up of multiple DS-0 levels. DS-1 represents a single T1 line that transmits at 1.544 Mbps. For higher rates, T1 lines are multiplexed to create DS-2 (a T2 line consisting of four T1 channels that transmits at 6.312 Mbps), DS-3 (a T3 line consisting of 28 T1 channels that transmits at 44.736 Mbps), and DS-4 (a T4 line consisting of 168 T1 channels that transmits at 274.176 Mbps).

DSL--Acronym for Digital Subscriber Line, a recently developed (late 1990s) digital communications technology that can provide high-speed transmissions over standard copper telephone wiring. DSL is often referred to as xDSL, where the x stands for one or two characters that define variations of the basic DSL technology. Currently, ADSL (Asymmetric DSL) is the form most likely to be provided, but even it is, as yet, available

only to limited groups of subscribers. The technology exploits unused frequencies on copper telephone lines to transmit traffic typically at multi-megabit speeds. DSL can allow voice and high-speed data to be sent simultaneously over the same line. Because the service is 'always available,' end-users don't need to dial in or wait for call set-up. With DSL you are wired for speed. DSL comes in two flavors, asymmetric and symmetric.

Asymmetric flavors

Asymmetrical variations include: ADSL, G.lite ADSL (or simply G.lite), ADSL2, ADSL2plus, RADSL and VDSL. The standard forms of ADSL (ITU G.992.1, G.992.2, and ANSI T1.413-Issue 2) are all built upon the same technical foundation, Discrete Multi Tone (DMT). The suite of ADSL standards facilitates interoperability between all standard forms of ADSL.

- ADSL: (Full Rate asymmetrical DSL) ADSL offers differing upload and download speeds and can be configured to deliver up to six megabits of data per second from the network to the customer that is up to 120 times faster than dialup service and 100 times faster than ISDN. ADSL enables voice and high-speed data to be sent simultaneously over the existing telephone line. This type of DSL is the most predominant in commercial use for business and residential customers around the world. Good for general Internet access and for applications where downstream speed is most important, such as video-on-demand. ITU-T Recommendation G.992.1 and ANSI Standard T1.413-1998 specify full rate ADSL.
- **G.lite ADSL** (or simply G.lite): The G.lite standard was specifically developed to meet the plug-and-play requirements of the consumer market segment. G.lite is a medium bandwidth version of ADSL that allows Internet access at up to 30 times the speed of the fastest 56K analog modems ~ up to 1.5 megabits downstream and up to 500 kilobits upstream. G.lite is an International Telecommunications Union (ITU) standard, globally standardized interoperable ADSL system per ITU G.992.2.
- **ADSL2**—ITU G.992.3 and G.992.4 adds new features and functionality targeted at improving performance and interoperability, and adds support for new applications, services and deployment scenarios. Among the changes are improvements in data rate and reach performance, rate adaptation, diagnostics and stand-by mode, to name a few. ADSL2 has been specifically designed to improve the rate and reach of ADSL largely by achieving better performance on long lines in the presence of narrowband interference. ADSL2 achieves downstream and upstream data rates of about 12 Mbps and 1 Mbps respectively, depending on loop length and other factors. ADSL2 accomplishes this by improving modulation efficiency, reducing framing overhead, achieving higher coding gain, improving the initialization state machine, and providing enhanced signal processing algorithms.
- **ADSL2plus** (ITU G.992.5) doubles the bandwidth used for downstream data transmission, effectively doubling the maximum downstream data rates, and achieving rates of 20 Mbps on phone lines as long at 5,000 feet. ADSL2plus

solutions will most commonly be multimodal, interoperating with ADSL and ADSL2, as well as with ADSL2plus chipsets.

- **RADSL:** (rate adaptive DSL) A non-standard version of ADSL. Note that standard ADSL also permits the ADSL modem to adapt speeds of data transfer.
- **VDSL** *(very high bit rate DSL)* Up to 26 Mb/s, over distances up to 50 Meters on short loops such as from fiber to the curb. In most cases, VDSL lines will be served from neighborhood cabinets that link to a Central Office via optical fiber. It is particularly useful for 'campus' environments - universities and business parks, for example. VDSL is currently being introduced in market trials to deliver video services over existing phone lines. VDSL can also be configured in symmetric mode.

Symmetric flavors

Symmetrical variations include: SDSL, SHDSL, HDSL, HDSL-2 and IDSL. The equal speeds make Symmetrical DSLs useful for LAN (local area network) access, video-conferencing, and for locations hosting their own Web sites.

- **SDSL:** (symmetric DSL) SDSL is a vendor-proprietary version of symmetric DSL that may include bit-rates to and from the customer ranging of 128 kbps to 2.32 Mbps. SDSL is an umbrella term for a number of supplier-specific implementations over a single copper pair providing variable rates of symmetric service. SDSL uses 2B1Q HDSL run on a single pair with an Ethernet interface to the customer. The industry is expected to quickly move towards the higher performing and standardized G.shdsl technology developed by the ITU with support from T1E1.4 (USA) and ETSI (European Telecommunications Standards Institute).
- **SHDSL** is state-of-the-art, industry standard symmetric DSL SHDSL equipment conforms to the ITU Recommendation G.991.2, also known as G.shdsl, approved by the ITU-T February 2001. SHDSL achieves 20% better loop-reach than older versions of symmetric DSL, it causes much less crosstalk into other transmission systems in the same cable, and multi-vendor interoperability is facilitated by the standardization of this technology. SHDSL systems may operate at many bit-rates, from 192 kbps to 2.3 Mbps, thereby maximizing the bit-rate for each customer. G.shdsl specifies operation via one pair of wires, or for operation on longer loops, two pairs of wire may be used. For example, with two pairs of wire, 1.2 Mbps can be sent over 20,000 feet of 26 AWG wire. SHDSL is best suited to data-only applications that need high upstream bit-rates. Though SHDSL does not carry voice like ADSL, new voice-over-DSL techniques may be used to convey digitized voice and data via SHDSL. SHDSL is being deployed primarily for business customers.
- **HDSL:** *(high data rate DSL)* This variety created in the late 1980s delivers symmetric service at speeds up to 2.3 Mbps in both directions. Available at 1.5 or 2.3 Mbps, this symmetric fixed rate application does not provide standard telephone service over the same line and is already standardized through ETSI and ITU (International Telecommunications Union). Seen as an economical replacement for T1 or E1, it uses one, two or three twisted copper pairs.

- **HDSL2:** *(2nd generation HDSL)* This variant delivers 1.5 Mbps service each way, supporting voice, data, and video using either ATM (asynchronous transfer mode), private-line service or frame relay over a single copper pair. This ANSI (American National Standards Institute) standard for this symmetric service gives a fixed 1.5 Mbps rate both up and downstream. HDSL2 does not provide standard voice telephone service on the same wire pair. HSDL2 differs from HDSL in that HDSL2 uses one pair of wires to convey 1.5 Mbps whereas ANSI HDSL uses two wire pairs.
- **IDSL:** (integrated services digital network DSL) This is a form of DSL that supports symmetric data rates of up to 144 Kbps using existing phone lines. It is unique in that it has the ability to deliver services through a DLC (Digital Loop Carrier: a remote device often placed in newer neighborhoods to simplify the distribution of cable and wiring from the phone company). While DLCs provide a means of simplifying the delivery of traditional voice services to newer neighborhoods, they also provide a unique challenge in delivering DSL into those same neighborhoods. IDSL addresses this market along with ADSL and G.lite as they are implemented directly into those DLCs. IDSL differs from its relative ISDN (integrated services digital network) in that it is an "always-available" service, but capable of using the same terminal adapter, or modem, used for ISDN.

DSLAM--Acronym for Digital Subscriber Line Access Multiplexer. A device in a telephone company central office that splits DSL subscriber lines and connects them to Internet network hosts and to the public telephone network. The use of a DSLAM makes it possible to provide both voice and data service through a single pair of copper wires.

DSL Lite--Short for **D**igital **S**ubscriber **L**ine **Lite**. A variation of ADSL currently under development that simplifies installation but transmits more slowly, at 1.544 Mbps. See also ADSL, DSL.

IDSL--Acronym for Internet digital subscriber line. A high-speed digital communications service that provides Internet access as fast as 1.1 Mbps (megabits per second) over standard telephone lines. IDSL uses a hybrid of ISDN and digital subscriber line technology. See also digital subscriber line, ISDN.

ISDN--Acronym for Integrated Services Digital Network. A high-speed digital communications network evolving from existing telephone services. The goal in developing ISDN was to replace the current telephone network, which requires digital-to-analog conversions, with facilities totally devoted to digital switching and transmission, yet advanced enough to replace traditionally analog forms of data, ranging from voice to computer transmissions, music, and video. ISDN is available in two forms, known as BRI (Basic Rate Interface) and PRI (Primary Rate Interface). BRI consists of two B (bearer) channels that carry data at 64 Kbps and one D (data) channel that carries control and signal information at 16 Kbps. In North America and Japan, PRI consists of 23 B channels and 1 D channel, all operating at 64 Kbps; elsewhere in the world, PRI consists

of 30 B channels and 1 D channel. Computers and other devices connect to ISDN lines through simple, standardized interfaces. See also BRI, channel (definition 2), PRI.

fiberoptic cable or fiber-optic cable--A form of cable used in networks that transmits signals optically, rather than electrically as do coaxial and twisted-pair cable. The light-conducting heart of a fiberoptic cable is a fine glass or plastic fiber called the core. This core is surrounded by a refractive layer called the cladding that effectively traps the light and keeps it bouncing along the central fiber. Outside both the core and the cladding is a final layer of plastic or plastic-like material called the coat, or jacket. Fiberoptic cable can transmit clean signals at speeds as high as 2 Gbps. Because it transmits light, not electricity, it is also immune to eavesdropping.

fiber optics--A technology for the transmission of light beams along optical fibers. A light beam, such as that produced in a laser, can be modulated to carry information. Because light has a higher frequency on the electromagnetic spectrum than other types of radiation, such as radio waves, a single fiber-optic channel can carry significantly more information than most other means of information transmission. Optical fibers are thin strands of glass or other transparent material, with dozens or hundreds of strands housed in a single cable. Optical fibers are essentially immune to electromagnetic interference. See also optical fiber.

frame relay--A packet-switching protocol for use on WANs (wide area networks). Frame relay transmits variable-length packets at up to 2 Mbps over predetermined, set paths known as PVCs (permanent virtual circuits). It is a variant of X.25 but dispenses with some of X.25's error detection for the sake of speed. See also ATM (definition 1), X.25. Speed and cost is usually based upon a specified committed information rate (CIR) and a peak information rate (PIR).

FTTB or FTTH or FTTP--Acronyms for fiber to the business, home, or premise. The installation and use of fiber-optic cable from the central office (CO) directly into a user's premies. It is a replacement for Plain Old Telephone Service (POTS) that enables the distribution of telephony, cable TV, Internet access, multimedia, and other communications over one line.

FTTC--Acronym for fiber to the curb. The installation and use of fiber-optic cable from the central office (CO) to within a thousand feet of a user's home or office. With FTTC, coaxial cable or another medium carries the signals from the curb into the home or office. FTTC is a replacement for Plain Old Telephone Service (POTS) that enables the distribution of telephony, cable TV, Internet access, multimedia, and other communications over one line. Compare FTTH, POTS.

HDSL--Acronym for High-bit-rate Digital Subscriber Line. A form of DSL, HDSL is a protocol for digital transmission of data over standard copper telecommunications lines (as opposed to fiber-optic lines) at rates of 1.544 Mbps in both directions. Also called: High-data-rate Digital Subscriber Line. See also DSL.

last mile--The connection (which may in fact be more or less than one mile) between an end user's system and that of a service provider, such as a telephone company. The "last mile" connection historically has referred to the twisted-pair copper wires used between a home and the telephone company. While this definition remains accurate, "last mile" is now often used more broadly to refer to the link between an end user's system and the high-speed Internet access technology of a service provider, such as an ISP (Internet service provider). Thus, for modem users accessing the Internet through voice-grade lines, the last mile is still equivalent to the phone company's twisted-pair copper wiring. However, because standard modem transmission over voice-grade lines is sometimes frustratingly slow, other last mile solutions have been designed to provide greater speed and bandwidth. These include coaxial cable (used in cable TV), fiber optics, or a radio link (such as a cellular telephone or a point-to-point link). DSL and ISDN are methods for providing high-speed last-mile data service through twisted-pair copper wires. See also DSL, ISDN, twisted-pair wiring. Compare local loop.

Modem--1. Short for **mo**dulator/**dem**odulator. A communications device that converts between digital data from a computer or terminal and analog audio signals that can pass through a standard telephone line. Because the telephone system was designed to handle voice and other audio signals and a computer processes signals as discrete units of digital information, a modem is necessary at both ends of the telephone line to exchange data between computers. At the transmit end, the modem converts from digital to analog audio; at the receiving end, a second modem converts the analog audio back to its original digital form. In order to move a high volume of data, high-speed modems rely on sophisticated methods for "loading" information onto the audio carrier—for example, they may combine frequency shift keying, phase modulation, and amplitude modulation to enable a single change in the carrier's state to represent multiple bits of data. In addition to the basic modulation and demodulation functions, most modems also include firmware that allows them to originate and answer telephone calls. International standards for modems are specified by the International Telecommunications Union, or ITU. Despite their capabilities, modems do require communications software in order to function. See also amplitude modulation, frequency modulation, quadrature amplitude modulation. Compare digital modem. 2. Any communications device that acts as an interface between a computer or terminal and a communications channel. Although such a device may not actually modulate or demodulate analog signals, it may be described as a modem because a modem is perceived by many users to be a black box that connects a computer to a communications line (such as a high-speed network or a cable TV system). See also digital modem.

OC3--Short for **o**ptical **c**arrier **3**. One of several optical signal circuits used in the SONET high-speed fiberoptic data transmission system. OC3 carries a signal of 155.52 Mbps, the minimum transmission speed for which SONET and the European standard, SDH, are fully interoperable. See also SONET.

POTS--Acronym for Plain Old Telephone Service. Basic dialup telephone connections to the public switched network without any added features or functions. A POTS line is nothing but a phone line connected to a simple, single-line telephone instrument.

Satellite--A satellite stationed in geosynchronous orbit that acts as a microwave relay station, receiving signals sent from a ground-based station (earth station), amplifying them, and retransmitting them on a different frequency to another ground-based station. Initially used for telephone and television signals, communications satellites can also be used for high-speed transmission of computer data. Two factors affecting the use of satellites with computers, however, are propagation delay (the time lag caused by the distance traveled by the signal) and security concerns.

PRI--Acronym for Primary Rate Interface. One of two ISDN transmission rate services (the other is the basic rate interface, BRI). PRI has two variations. The first, which operates at 1.536 Mbps, transmits data over 23 B channels and sends signaling information at 64 Kbps over one D channel in the United States, Canada, and Japan. The second, which operates at 1.984 Mbps, transmits data over 30 B channels and sends signaling information at 64 Kbps over one D channel in Europe and Australia. See also BRI, ISDN.

SMDS--Acronym for Switched Multimegabit Data Services. A very high-speed, connectionless, packet-switched data transport service that connects LANs (local area networks) and WANs (wide area networks).

SONET--Acronym for Synchronous Optical Network. A high-speed network that provides a standard interface for communications carriers to connect networks based on fiberoptic cable. SONET is designed to handle multiple data types (voice, video, and so on). It transmits at a base rate of 51.84 Mbps, but multiples of this base rate go higher.

T1 or T-1--A high-speed communications line that can handle digital communications and Internet access at the rate 1.544 Mbps (megabits per second). Although originally designed by AT&T to carry multiple voice calls over standard twisted-pair telephone wiring, this high-bandwidth telephone line can also transmit text and images. T1 speed is attained through multiplexing 24 separate 64 Kbps channels into a single data stream. T1 lines are commonly used by larger organizations for Internet connectivity. Also called: T-1 carrier. Compare fractional T1, T2, T3, T4.

T-carrier--A long-distance, digital communications line provided by a common carrier. Multiplexers at either end merge several voice channels and digital data streams for transmission and separate them when received. T-carrier service, introduced by AT&T in 1993, is defined at several capacity levels: T1, T2, T3, and T4. In addition to voice communication, T-carriers are used for Internet connectivity.

twisted-pair wiring--Wiring consisting of two insulated strands of copper twisted around one another to form a cable. Twisted-pair wiring comes in two forms, unshielded twisted pair (UTP) and shielded twisted pair (STP), the latter named for an extra protective sheath wrapped around each insulated pair of wires. Twisted-pair wiring can consist of a single pair of wires or, in thicker cables, two, four, or more pairs of wires. Twisted-pair wiring is typical of telephone cabling. Compare coaxial cable, fiberoptic cable.

VDSL--Short for **v**ery-high-speed **d**igital **s**ubscriber **l**ine. The high-speed version of the xDSL (digital subscriber line) communication technologies, all of which operate over existing phone lines. VDSL can deliver up to 52 Mbps downstream, but it is effective only within about 4500 to 5000 feet of the central exchange. The data delivery rate is, in fact, related to the distance the signal must travel. To attain a rate of 52 Mbps, for example, the subscriber must be within 1000 feet of the exchange office. At a distance of 3000 feet, the data rate drops to about 26 Mbps; and at 5000 feet, the data rate drops to about 13 Mbps. See also central office, xDSL.

virtual circuit--A connection between communicating computers that provides the computers with what appears to be a direct link but can actually involve routing data over a defined but longer path.

wireless LAN--A LAN (local area network) that sends and receives data via radio, infrared optical signaling, or some other technology that does not require a physical connection between individual nodes and the hub. Wireless LANs are often used in office or factory settings where a user must carry a portable computer from place to place. Also called: WLAN.

X.25--A recommendation published by the ITU-T (formerly CCITT) international communications standards organization that defines the connection between a terminal and a packet-switching network. X.25 incorporates three definitions: the electrical connection between the terminal and the network, the transmission or link-access protocol, and the implementation of virtual circuits between network users. Taken together, these definitions specify a synchronous, full-duplex terminal-to-network connection. Packet format, error control, and other features are equivalent to portions of the HDLC (High-level Data Link Control) protocol defined by the International Organization for Standardization (ISO). See also CCITT X series, HDLC, packet switching, virtual circuit.