



APPENDIX P  
GLOSSARY FOR  
DATA AND COMPUTER  
COMMUNICATIONS, EIGHTH EDITION

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*In studying the Imperium, Arrakis, and the whole culture which produced Maud'Dib, many unfamiliar terms occur. To increase understanding is a laudable goal, hence the definitions and explanations given below.*  
—Dune, Frank Herbert

Some of the definitions in this glossary are from the *American National Standard Dictionary of Information Technology*, ANSI Standard X3.172, 1995. These are marked with an asterisk.

**Abstract Syntax Notation One (ASN.1)** A formal language used to define syntax. In the case of SNMP, ASN.1 notation is used to define the format of SNMP protocol data units and of objects.

**Aloha** A medium access control technique for multiple access transmission media. A station transmits whenever it has data to send. Unacknowledged transmissions are repeated.

**amplitude** The size or magnitude of a voltage or current waveform.

**amplitude modulation\*** A form of modulation in which the amplitude of a carrier wave is varied in accordance with some characteristic of the modulating signal.

**amplitude-shift keying** Modulation in which two different amplitudes of the carrier frequency represent the two binary values.

**analog data\*** Data represented by a physical quantity that is considered to be continuously variable and whose magnitude is made directly proportional to the data or to a suitable function of the data.

**analog signal** A continuously varying electromagnetic wave that may be propagated over a variety of media.

**analog transmission** The transmission of analog signals without regard to content. The signal may be amplified, but there is no intermediate attempt to recover the data from the signal.

**angle modulation\*** Modulation in which the angle of a sine wave carrier is varied. Phase and frequency modulation are particular forms of angle modulation.

**application layer** Layer 7 of the OSI model. This layer determines the interface of the system with the user.

**asymmetric encryption** A form of cryptosystem in which encryption and decryption are performed using two different keys, one of which is referred to as the public key and one of which is referred to as the private key. Also known as public-key encryption.

**asynchronous transfer mode (ATM)** A form of packet transmission using fixed-size packets, called cells. ATM is the data transfer interface for B-ISDN. Unlike X.25, ATM does not provide error control and flow control mechanisms.

**asynchronous transmission** Transmission in which each information character is individually synchronized (usually by the use of start elements and stop elements).

**attenuation** A decrease in magnitude of current, voltage, or power of a signal in transmission between points.

**ATM Adaptation Layer (AAL)** The layer that maps information transfer protocols onto ATM.

**authentication\*** A process used to verify the integrity of transmitted data, especially a message.

**automatic repeat request** A feature that automatically initiates a request for retransmission when an error in transmission is detected.

**balanced transmission** A transmission mode in which signals are transmitted as a current that travels down one conductor and returns on the other. For digital signals, this technique is known as differential signaling, with the binary value depending on the voltage difference.

**bandlimited signal** A signal all of whose energy is contained within a finite frequency range.

**bandwidth\*** The difference between the limiting (upper and lower) frequencies of a continuous frequency spectrum.

**baseband** Transmission of signals without modulation. In a baseband local network, digital signals (1s and 0s) are inserted directly onto the cable as voltage pulses. The entire spectrum of the cable is consumed by the signal. This scheme does not allow frequency-division multiplexing.

**baud** A unit of signaling speed equal to the number of discrete conditions or signal events per second, or the reciprocal of the time of the shortest signal element.

**bit error rate** The probability that a transmitted bit is received in error.

**bit stuffing** The insertion of extra bits into a data stream to avoid the appearance of unintended control sequences.

**bridge\*** A functional unit that interconnects two local area networks (LANs) that use the same logical link control protocol but may use different medium access control protocols.

**broadband** In general, wide bandwidth equipment or systems that can carry signals occupying a large portion of the electromagnetic spectrum. Typically, a broadband communication system can simultaneously accommodate voice, data, video, and other services. In digital transmission systems, the term connotes high data rate.

**broadband ISDN (B-ISDN)** A second generation of ISDN. The key characteristic of broadband ISDN is that it provides transmission channels capable of supporting rates greater than the primary ISDN rate.

**broadband LAN** The use of coaxial cable for providing data transfer by means of analog (radio-frequency) signals. Digital signals are passed through a modem and transmitted over one of the frequency bands of the cable.

**broadcast** The simultaneous transmission of data to a number of stations.

**broadcast address** An address that designates all entities within a domain (e.g., network, internet).

**broadcast communication network** A communication network in which a transmission from one station is broadcast to and received by all other stations.

**bus\*** One or more conductors that serve as a common connection for a related group of devices.

**byte** A group of bits, usually eight, used to represent a character of other data.

**carrier** A continuous frequency capable of being modulated or impressed with a second (information-carrying) signal.

**CATV** Community Antenna Television. CATV cable is used for broadband local networks, and broadcast TV distribution.

**cell relay** The packet-switching mechanism used for the fixed-size packets called cells. ATM is based on cell relay technology.

**checksum** An error-detecting code based on a summation operation performed on the bits to be checked.

**ciphertext** The output of an encryption algorithm; the encrypted form of a message or data.

**circuit switching** A method of communicating in which a dedicated communications path is established between two devices through one or more intermediate switching nodes. Unlike packet switching, digital data are sent as a continuous stream of bits. Bandwidth is guaranteed, and delay is essentially limited to propagation time. The telephone system uses circuit switching.

**coaxial cable** A cable consisting of one conductor, usually a small copper tube or wire, within and insulated from another conductor of larger diameter, usually copper tubing or copper braid.

**codec (coder-decoder)** Transforms analog data into a digital bit stream (coder), and digital signals into analog data (decoder).

**collision** A condition in which two packets are being transmitted over a medium at the same time. Their interference makes both unintelligible.

**common carrier** In the United States, companies that furnish communication services to the public. The usual connotation is for long-distance telecommunications services. Common carriers are subject to regulation by federal and state regulatory commissions.

**common channel signaling** Technique in which network control signals (e.g., call request) are separated from the associated voice or data path by placing the signaling from a group of voice or data paths on a separate channel dedicated to signaling only.

**communications architecture** The hardware and software structure that implements the communications function.

**communication network** A collection of interconnected functional units that provides a data communications service among stations attached to the network.

**connectionless data transfer** A protocol for exchanging data in an unplanned fashion and without prior coordination (e.g., datagram).

**connection-oriented data transfer** A protocol for exchanging data in which a logical connection is established between the endpoints (e.g., virtual circuit).

**contention** The condition when two or more stations attempt to use the same channel at the same time.

**conventional encryption** Symmetric encryption.

**crosstalk\*** The phenomenon in which a signal transmitted on one circuit or channel of a transmission system creates an undesired effect in another circuit or channel.

**CSMA (Carrier Sense Multiple Access)** A medium access control technique for multiple-access transmission media. A station wishing to transmit first senses the medium and transmits only if the medium is idle.

**CSMA/CD (Carrier Sense Multiple Access with collision Detection)** A refinement of CSMA in which a station ceases transmission if it detects a collision.

**current-mode transmission** A transmission mode in which the transmitter alternately applies current to each of two conductors in a twisted pair to represent logic 1 or 0. The total current is constant and always in the same direction.

**cyclic redundancy check** An error detecting code in which the code is the remainder resulting from dividing the bits to be checked by a predetermined binary number.

**data circuit-terminating equipment (DCE)** In a data station, the equipment that provides the signal conversion and coding between the data terminal equipment (DTE) and the line. The DCE may be separate equipment or an integral part of the DTE or of intermediate equipment. The DCE may perform other functions that are normally performed at the network end of the line.

**datagram\*** In packet switching, a packet, independent of other packets, that carries information sufficient for routing from the originating data terminal equipment (DTE) to the destination DTE without the necessity of establishing a connection between the DTEs and the network.

**data link layer\*** In OSI, the layer that provides service to transfer data between network layer entities, usually in adjacent nodes. The data link layer detects and possibly corrects errors that may occur in the physical layer.

**data terminal equipment (DTE)\*** Equipment consisting of digital end instruments that convert the user information into data signals for transmission, or reconvert the received data signals into user information.

**decibel** A measure of the relative strength of two signals. The number of decibels is 10 times the log of the ratio of the power of two signals, or 20 times the log of the ratio of the voltage of two signals.

**decryption** The translation of encrypted text or data (called ciphertext) into original text or data (called plaintext). Also called deciphering.

**delay distortion** Distortion of a signal occurring when the propagation delay for the transmission medium is not constant over the frequency range of the signal.

**demand-assignment multiple access** A technique for allocating satellite capacity, based on either FDM or TDM, in which capacity is granted on demand.

**differential encoding** A means of encoding digital data on a digital or analog signal such that a signal change rather than a signal level determines the binary value.

**digital data** Data consisting of a sequence of discrete elements.

**digital signal** A discrete or discontinuous signal, such as voltage pulses.

**digital signature** An authentication mechanism that enables the creator of a message to attach a code that acts as a signature. The signature guarantees the source and integrity of the message.

**digital switch** A star topology local network. Usually refers to a system that handles only data but not voice.

**digital transmission** The transmission of digital data, using either an analog or digital signal, in which the digital data are recovered and repeated at intermediate points to reduce the effects of noise.

**digitize\*** To convert an analog signal to a digital signal.

**encapsulation** The addition of control information by a protocol entity to data obtained from a protocol user.

**encrypt\*** To convert plaintext or data into unintelligible form by the use of a code in such a manner that reconversion to the original form is possible.

**error detecting code\*** A code in which each expression conforms to specific rules of construction, so that if certain errors occur in an expression, the resulting expression will not conform to the rules of construction and thus the presence of the errors is detected.

**error rate\*** The ratio of the number of data units in error to the total number of data units.

**flow control** The function performed by a receiving entity to limit the amount or rate of data that is sent by a transmitting entity.

**frame** A group of bits that includes data plus one or more addresses and other protocol control information. Generally refers to a link layer (OSI layer 2) protocol data unit.

**frame check sequence (FCS)** An error-detecting code inserted as a field in a block of data to be transmitted. The code serves to check for errors upon reception of the data.

**frame relay** A form of packet switching based on the use of variable-length link-layer frames. There is no network layer and many of the basic functions have been streamlined or eliminated to provide for greater throughput.

**frequency** Rate of signal oscillation in hertz.

**frequency division multiplexing** The division of a transmission facility into two or more channels by splitting the frequency band transmitted by the facility into narrower bands, each of which is used to constitute a distinct channel.

**frequency modulation** Modulation in which the frequency of an alternating current is the characteristic varied.

**frequency shift keying** Modulation in which the two binary values are represented by two different frequencies near the carrier frequency.

**full-duplex transmission** Data transmission in both directions at the same time.

**fundamental frequency** The lowest frequency component in the Fourier representation of a periodic quantity.

**half-duplex transmission** Data transmission in either direction, one direction at a time.

**hash function** A function that maps a variable length data block or message into a fixed-length value called a hash code. The function is designed in such a way that, when protected, it provides an authenticator to the data or message. Also referred to as a message digest.

**HDLC (high-level data link control)** A very common bit-oriented data link protocol (OSI layer 2) issued by ISO. Similar protocols are LAPB, LAPD, and LLC.

**header** System-defined control information that precedes user data.

**hop count** The number of hops along a path from a given source to a given destination is the number of network nodes (packet-switching nodes, ATM switches, routers, etc.) that a packet encounters along that path.

**impulse noise** A high-amplitude, short-duration noise pulse.

**integrated services digital network** A worldwide telecommunication service that uses digital transmission and switching technology to support voice and digital data communication.

**intermediate system (IS)** A device attached to two or more networks in an internet and that performs routing and relaying of data between end systems. Examples of intermediate systems are bridges and routers.

**intermodulation noise** Noise due to the nonlinear combination of signals of different frequencies.

**internetwork** A collection of packet-switching and broadcast networks that are connected via routers.

**Internet Protocol** An internetworking protocol that provides connectionless service across multiple packet-switching networks.

**internetworking** Communication among devices across multiple networks.

**layer\*** A group of services, functions, and protocols that is complete from a conceptual point of view, that is one out of a set of hierarchically arranged groups, and that extends across all systems that conform to the network architecture.

**local area network (LAN)** A communications network that encompasses a small area, typically a single building or cluster of buildings, used to connect various data processing devices, including PCs, workstations, and servers.

**local loop** Transmission path, generally twisted pair, between the individual subscriber and the nearest switching center of the public telecommunications network.

**longitudinal redundancy check** The use of a set of parity bits for a block of characters such that there is a parity bit for each bit position in the characters.

**Manchester encoding** A digital signaling technique in which there is a transition in the middle of each bit time. A 1 is encoded with a high level during the first half of the bit time; a 0 is encoded with a low level during the first half of the bit time.

**medium access control (MAC)** For broadcast networks, the method of determining which device has access to the transmission medium at any time. CSMA/CD and token are common access methods.

**microwave** Electromagnetic waves in the frequency range of about 2 to 40 GHz.

**modem (modulator/demodulator)** Transforms a digital bit stream into an analog signal (modulator), and vice versa (demodulator).

**modulation\*** The process, or result of the process, of varying certain characteristics of a signal, called a carrier, in accordance with a message signal.

**multicast address** An address that designates a group of entities within a domain (e.g., network, internet).

**multimedia** Human-computer interaction involving text, graphics, voice and video. *Multimedia* also refers to storage devices that are used to store multimedia content.

**multiplexing** In data transmission, a function that permits two or more data sources to share a common transmission medium such that each data source has its own channel.

**multipoint** A configuration in which more than two stations share a transmission path.

**network layer** Layer 3 of the OSI model. Responsible for routing data through a communication network.

**network terminating equipment** Grouping of ISDN functions at the boundary between the ISDN and the subscriber.

**noise** Unwanted signals that combine with and hence distort the signal intended for transmission and reception.

**nonreturn to zero** A digital signaling technique in which the signal is at a constant level for the duration of a bit time.

**octet** A group of eight bits, usually operated upon as an entity.

**Open Systems Interconnection (OSI) Reference model** A model of communications between cooperating devices. It defines a seven-layer architecture of communication functions.

**optical fiber** A thin filament of glass or other transparent material through which a signal-encoded light beam may be transmitted by means of total internal reflection.

**orthogonal** Denotes signals that are mutually transparent or noninterfering.

**packet** A group of bits that includes data plus control information. Generally refers to a network layer (OSI layer 3) protocol data unit.

**packet switching** A method of transmitting messages through a communication network, in which long messages are subdivided into short packets. The packets are then transmitted as in message switching.

**parity bit\*** A check bit appended to an array of binary digits to make the sum of all the binary digits, including the check bit, always odd (odd parity) or always even (even parity).

**PBX** Private branch exchange. A telephone exchange on the user's premises. Provides a switching facility for telephones on extension lines within the building and access to the public telephone network.

**period** The absolute value of the minimum interval after which the same characteristics of a periodic waveform recur.

**periodic waveform** A waveform  $f(t)$  that satisfies  $f(t) = f(t + nk)$  for all integers  $n$ , with  $k$  being a constant.

**phase** For a periodic signal  $f(t)$ , the fractional part  $t/P$  of the period  $P$  through which  $t$  has advanced relative to an arbitrary origin. The origin is usually taken at the last previous passage through zero from the negative to the positive direction.

**phase modulation** Modulation in which the phase angle of a carrier is the characteristic varied.

**phase-shift keying** Modulation in which the phase of the carrier signal is shifted to represent digital data.

**physical layer** Layer 1 of the OSI model. Concerned with the electrical, mechanical, and timing aspects of signal transmission over a medium.

**piggybacking** The inclusion of an acknowledgment to a previously received packet in an outgoing data packet.

**plaintext** The input to an encryption function or the output of a decryption function.

**point-to-point** A configuration in which two stations share a transmission path.

**poll and select** The process by which a primary station invites secondary stations, one at a time, to transmit (poll), and by which a primary station requests that a secondary receive data (select).

**power spectral density (PSD)** The PSD of a signal is a function of frequency that represents the power per unit bandwidth of the spectral components at each frequency.

**presentation layer\*** Layer 6 of the OSI model. Provides for the selection of a common syntax for representing data and for transformation of application data into and from the common syntax.

**private key** One of the two keys used in an asymmetric encryption system. For secure communication, the private key should only be known to its creator.

**propagation delay** The delay between the time a signal enters a channel and the time it is received.

**protocol** A set of rules that govern the operation of functional units to achieve communication.

**protocol control information\*** Information exchanged between entities of a given layer, via the service provided by the next lower layer, to coordinate their joint operation.

**protocol data unit (PDU)\*** A set of data specified in a protocol of a given layer and consisting of protocol control information of that layer, and possibly user data of that layer.

**public data network** A government-controlled or national-monopoly packet-switching network. This service is publicly available to data processing users.

**public key** One of the two keys used in an asymmetric encryption system. The public key is made public, to be used in conjunction with a corresponding private key.

**public-key encryption** Asymmetric encryption.

**pulse code modulation** A process in which a signal is sampled, and the magnitude of each sample with respect to a fixed reference is quantized and converted by coding to a digital signal.

**residual error rate** The error rate remaining after attempts at correction are made.

**repeater** A device that receives data on one communication link and transmits it, bit by bit, on another link as fast as the data are received, without buffering.

**ring** A local network topology in which stations are attached to repeaters connected in a closed loop. Data are transmitted in one direction around the ring and can be read by all attached stations.

**router** An internetworking device that connects two computer networks. It makes use of an internet protocol and assumes that all of the attached devices on the networks use the same communications architecture and protocols. A router operates at OSI layer 3.

**routing** The determination of a path that a data unit (frame, packet, message) will traverse from source to destination.

**scattering** (1) **(fiber optics)** The change in direction of light rays after striking a small particle or particles, or due to minute variations in the density of glass. (2) **(radio-wave propagation)** The production of waves of changed direction or frequency when radio waves encounter matter.

**service access point** A means of identifying a user of the services of a protocol entity. A protocol entity provides one or more SAPs for use by higher-level entities.

**service level agreement** A contract between a network provider and a customer that defines specific aspects of the service that is to be provided.

**session layer** Layer 5 of the OSI model. Manages a logical connection (session) between two communicating processes or applications.

**signal element** The part of a signal that occupies the shortest time interval of a signaling code. It is the smallest element recognized by a receiver and can correspond to a single bit, a part of a bit, or multiple bits.

**signaling** The exchange of information specifically concerned with the establishment and control of connections, and with management, in a telecommunication network.

**simplex transmission** Data transmission in one preassigned direction only.

**sliding-window technique** A method of flow control in which a transmitting station may send numbered packets within a window of numbers. The window changes dynamically to allow additional packets to be sent.

**space division switching** A circuit-switching technique in which each connection through the switch takes a physically separate and dedicated path.

**spectrum** Refers to an absolute range of frequencies. For example, the spectrum of CATV cable is now about 5 to 400 MHz.

**star** A topology in which all stations are connected to a central switch. Two stations communicate via circuit switching.

**statistical time division multiplexing** A method of TDM in which time slots on a shared transmission line are allocated to I/O channels on demand.

**stop and wait** A flow control protocol in which the sender transmits a block of data and then awaits an acknowledgment before transmitting the next block.

**streaming media** Refers to multimedia files, such as video clips and audio, that begin playing immediately or within seconds after it is received by a computer from the Internet or Web. Thus, the media content is consumed as it is delivered from the server, rather than waiting until an entire file is downloaded.

**switched communication network** A communication network consisting of a network of nodes connected by point-to-point links. Data are transmitted from source to destination through intermediate nodes.

**symmetric encryption** A form of cryptosystem in which encryption and decryption are performed using the same key. Also known as conventional encryption.

**synchronous time division multiplexing** A method of TDM in which time slots on a shared transmission line are assigned to I/O channels on a fixed, predetermined basis.

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

**telematics** User-oriented information transmission services. Includes teletex, videotex, and facsimile.

**thermal noise** Statistically uniform noise due to the temperature of the transmission medium.

**time division multiplexing** The division of a transmission facility into two or more channels by allotting the facility to several different information channels, one at a time.

**time division switching** A circuit-switching technique in which time slots in a time multiplexed stream of data are manipulated to pass data from an input to an output.

**token bus** A medium access control technique for bus/tree. Stations form a logical ring, around which a token is passed. A station receiving the token may transmit data and then must pass the token on to the next station in the ring.

**token ring** A medium access control technique for rings. A token circulates around the ring. A station may transmit by seizing the token, inserting a packet onto the ring, and then retransmitting the token.

**topology** The structure, consisting of paths and switches, that provides the communications interconnection among nodes of a network.

**transmission medium** The physical path between transmitters and receivers in a communications system.

**transport layer** Layer 4 of the OSI model. Provides reliable, transparent transfer of data between endpoints.

**twisted pair** A transmission medium consisting of two insulated wires arranged in a regular spiral pattern.

**unbalanced transmission** A transmission mode in which signals are transmitted on a single conductor. Transmitter and receiver share a common ground.

**value-added network** A privately owned packet-switching network whose services are sold to the public.

**virtual circuit** A packet-switching service in which a connection (virtual circuit) is established between two stations at the start of transmission. All packets follow the same route, need not carry a complete address, and arrive in sequence.

**white noise** Noise that has a flat, or uniform, frequency spectrum in the frequency range of interest.