

GLOSSARY OF TERMS

ABYC – (American Boat & Yacht Council) – Standards and Technical Information for Small Craft.

Active Filter - An electronic filter that combines active circuit devices, usually amplifiers, with passive circuit elements, such as resistors and capacitors. Active filters typically have characteristics that more closely match ideal filters than do strictly passive filters.

Address - A unique designation for location of data or the identity of a peripheral device; allows each device on a single communications line to respond to its own message.

Algorithm - A set of rules or detailed plan, with a finite number of steps, for solving a problem. An algorithm can be used as a model for computer program.

Alias Frequency - A false lower frequency component that appears in analog data reconstructed from original data acquired at an insufficient sampling rate.

Ambient Temperature – The natural air temperature or room temperature of the environment, normally specified in degrees Centigrade (°C).

Analog - Continuous real time phenomena.

Analog-to-digital (A/D) conversion - The process of changing an analog signal into a digital value that represents the magnitude of the signal at the moment of conversion.

Analog-to-digital converter (ADC) - An electronic device, often an integrated circuit, that produces a digital output directly proportional to an analog signal input.

ANSI - American National Standards Institute.

Apparent Power - The product of a circuit's RMS voltage and its RMS current. Apparent power is not indicative of the actual power consumed by an apparatus.

API (Application Program Interface) - A set of formalized software calls and routines that can be referenced by an application program to access underlying network services.

APPC (Advanced Peer-to-Peer Communications) - The software that implements Logical Unit (LU) 6.2; a network node definition by IBM featuring high-level program interaction capabilities on a peer-to-peer basis.

Application Layer - The highest layer of the seven-layer OSI model structure; contains all user or application programs; in the IBM Systems Network Architecture, the end-user layer.

Array - Data arranged in a single or multidimensional rows and columns.

ASCII - American Standard Code for Information Interchange. A very popular standard method of encoding alphanumeric characters into 7 or 8 binary bits.

Assembler - A program that converts a list of computer instructions written in a specific assembly-language format into binary instructions that can be executed by a specific processor.

Assembly-language program - A program written directly with processor commands using mnemonic representations of the commands. The program is then processed by an assembler to produce executable machine code.

Asynchronous - A communications protocol where information can be transmitted at an arbitrary, unsynchronized point in time, without synchronization to a reference timer or "clock".

Attenuation - The decrease in magnitude of a signal.

Bandpass filter - A type of filter that allows a band of signal frequencies between two set frequencies to pass while attenuating all signal frequencies outside the bandpass range.

Bandwidth - The range of frequencies available for signaling; the difference between the highest and lowest frequencies of a band expressed in Hertz.

Base Address - A memory address that serves as a point of reference. All other points are located by offsetting (adding to or subtracting from) in relation to the base address.

BASIC - The most common computer language, BASIC is an abbreviation for Beginners All-purpose Symbolic Instruction Code. Relies on English-like instructions which accounts for its popularity and ease of learning.

Baud - Unit of signaling speed. The speed in baud is the number of discrete conditions or events per second. If each event represents only one bit condition, baud rate equals bps. When each event represents more than one bit (e.g., dibit), baud rate does not equal bps.

Baud Rate - Serial communications data transmission rate; normally the number of bits-per-second.

Binary-Coded Decimal (BCD) - A code for representing decimal digits in a binary format.

Bipolar - A signal that includes both positive and negative values.

Bisynchronous Transmission (BSC or BISYNC) - A byte- or character-oriented communications protocol that has become the industry standard. It uses a defined set of control characters for synchronized transmission of binary-coded data between stations in a data-communications system.

Bit (Binary Digit) - Contraction of "binary digit", the smallest unit of information in a binary system; a true or false condition.

BIOS (Basic Input/Output System) - A program, usually stored in ROM, which provides the fundamental services required for the operation of the computer. These services range from peripheral control to updating the time of day.

BPS (bits per Second) - Unit of data-transmission rate.

Broadband - A communications channel that has greater bandwidth than a voice-grade line and is potentially capable of greater transmission rates.

Brownout - A reduction of the voltage in the distribution system caused by overload, a failure in the distribution system, or a deliberate action by the utility company in an effort to reduce power consumption.

Buffer - 1) A temporary-storage device used to compensate for a difference in data rate and data flow between two devices (typically a computer and a printer); also called a spooler. 2) An amplifier to increase the drive capability, current or distance, of an analog or digital signal.

Bus - A data path shared by many devices (e.g., multipoint line) with one or more conductors for transmitting signals, data, or power. In LAN technology, a bus is a type of linear network topology.

Byte - A term referring to eight related bits of information. Eight bits equals one byte.

C - A programming language, developed around the concept of structured programming, that bears a strong resemblance to PASCAL.

Cache Memory - Fast memory used to improve the performance of a CPU. Instructions that will soon be executed are placed in cache memory shortly before they are needed. This process speeds up the operation of the CPU.

CAE - Computer-aided engineering. A computer system designed to aid engineering development.

CAM - Computer-aided manufacturing. A computer system used for automating manufacturing operation.

Call - A software instruction used to pass control to a subroutine of a program. At the completion of this subroutine, control is returned the original program at the point of the "call" statement. Often used for specialized routines such as "analog read" from a data acquisition system or communications transmission/reception.

CCITT (International Consultative Committee for Telephone and Telegraph) - An international association that sets worldwide communication standards (e.g., V.21, V.22, V.22 bis).

CCITT V.35 - is the international standard termed "Data Transmission at 48 Kbps Using 60-180 KHz Group-Band Circuits. "It is typically used for DTE or DCE equipment that interfaces to a high-speed digital carrier, such as AT&T Dataphone Digital Service (DDS).

Central Processing Unit (CPU) - The central part of a computer system that performs operations on data. In a personal computer the CPU is typically a single microprocessor integrated circuit.

Character - Letter, numeral, punctuation, control figure, or any other symbol contained in a message.

Clock - The source(s) of timing signals for sequencing electronic events. (e.g. synchronous data transfer).

Code - As a noun, the text of a computer program. As a verb, to "code" means to write a program.

Cold-Junction Compensation - A method of providing an artificial reference level and compensation for ambient temperature variations in thermocouple circuits.

Common-Mode Rejection Ratio (CMRR) - A measure of an instrument's ability to ignore or reject interference from a voltage common to its input terminals relative to ground. CMRR is usually expressed in decibels (DB).

Communication Protocol - The rules governing the exchange of information between devices on a data link.

Communications Server - A device on a LAN, usually a dedicated computer, that provides network users with communication programs, links to telephone lines, and multiplexing facilities with which to transmit data into and out of the network. Destinations for the transmitted data would include on-site networks or remote networks.

Comparator - An electronic circuit used to compare two values and set an indicator that identifies which value is greater.

Compiler - A computer program used to translate or interpret a higher order language into its relocatable or absolute machine code equivalent.

Concentrator - 1) Any communications device that allows a shared transmission medium to accommodate more data sources than there are channels currently available within the transmission medium. 2) In twisted-pair Ethernet networks, a multiport repeater with diagnostic and administrative capabilities (often referred to as a "hub").

Concurrent - Software that can perform more than one task simultaneously.

Contact Closure - The closing of a switch, often controlled by an electromagnetic relay.

Conversion Time - The time required, in an analog input or output system, from the moment a channel is interrogated (such as with a read instruction) to the moment that accurate data is available. This could include: switching time, settling time, acquisition time, A/D conversion time, etc.

Converter - An apparatus which can convert one power form to that of another. In the case of shore power converters this form can include voltage, frequency, or the number of phases.

Coprocessor - Another computer processor unit that operates in conjunction with the standard CPU. Can be used to enhance execution speed. For example, the 8087 is designed to perform floating point arithmetic.

Counter - In software, a memory location used by a program for the purpose of counting certain occurrences. In hardware, a circuit that can count events.

CPU - (See Central Processing Unit)

Cross Assembler - A computer program that translates machine language code so that it can be read by a different type of CPU.

Crossover - In communications, a conductor which runs through the cable and connects to a different pin number at each end.

Crosstalk - In communications, a phenomenon in which a signal in one or more channels interferes with a signal or signals in other channels. In an analog multiplexer, the ratio of the output voltage to the input voltage with all channels connected in parallel and turned off.

Current Loop - Communications method that allows data to be transmitted over relatively high noise environments. Levels of current, rather than voltage are detected and translated into binary data.

Data Acquisition - Gathering information from sources such as sensors and transducers in an accurate, timely and organized manner. Modern systems convert this information to digital data which can be stored and processed by a computer.

Data Reduction - The process of analyzing a large volume of data to extract and refine a subset of the data for some particular purpose, as in the statistical summarization of data.

DCE (Data Communications Equipment) - Devices that provide the functions required to establish, maintain, and terminate a data-transmission connection; e.g., a modem.

DDS (Digital Data Service) - DDS is wide-bandwidth, private leased line that transmits data in digital, rather than analog, format. DDS lines are 4-wire circuits (transmit pair, receive pair) linked by special repeaters and separate from conventional analog lines. They can provide a higher data-transmission rate and maintain a higher level of data integrity than analog transmission service.

The cost of DDS lines have steadily decreased and is now in the same neighborhood as leased analog lines. DDS has two advantages over analog service:

- o Data moves at higher speeds, allowing transmission of larger volumes.
- o Data error rates are greatly reduced.

Data-transmission rates available for DDS include all of the standard rates used in analog transmission, plus 56 Kbps. At the higher speeds, a multiplexor is often brought in to make full use of the DDS line's capacity.

An Integrated Service Unit (ISU) replaces the modem in the network. An ISU is a combination of the Channel Service Unit (CSU) and the Data Service Unit (DSU), and is most often known as a CSU/DSU (*see Typical DDS Configuration*). Most CSU/DSU's support either sync or async data formats and can handle speeds up to 56 Kbps in point-to-point or multipoint configurations.

Debouncing - Either a hardware circuit or a delay in software to prevent false inputs from a bouncing key or switch contact.

Decibel - A logarithmic measure of the ratio of two signal levels: $dB = 20\text{Log}_{10} (V_1/V_2) = 10\text{Log}_{10} (P_1/P_2)$.

Default - A value assigned or an action taken automatically unless another is specified.

Derating - The reduction in a system's performance resulting from operating conditions other than nominally specified, including temperature, output load, or input voltage.

Design Life - The period of time a converter will perform to its published specifications. Random failure is not a factor.

Digital - A signal which has distinct states. Digital computers process data as binary information having either true or false states.

Digital Data - Information transmitted in a coded form (from a computer), represented by discrete signal elements.

Digital-to-Analog (D/A Conversion) - A device that converts digital computer as a graphic display or as a test stimulus.

Digital-to-Analog Converter (DAC) - A device that converts digital information into a corresponding analog voltage or current.

DIP - Acronym for "dual in-line package". A physical form factor for integrated circuits and switches.

DIP Switches - A bank of switches typically used in setting the hardware configuration and base address of an option card.

Direct Memory Access (DMA) - A method by which information can be transferred from the computer memory to a device on the bus without using the processor.

DOS - Disk operating system.

Down-load - The copying of information from one computer to another.

Driver - (hardware) An electronic circuit that provides input to another electronic circuit.

Driver - (software) A program that exercises a system or system component by simulating the activity of a higher level component.

DSR (Data Set Ready) - A modem interface control signal which indicates that the terminal is ready for transmission.

DTE (Data Terminal Equipment) - Devices acting as data source, data sink, or both.

Duplex - The ability to both send and receive data simultaneously over the same communications line.

Dynamic Range - The ratio of the full scale range (FSR) of a data converter to the smallest difference it can resolve. Dynamic Range (DR)= $2n$. Generally expressed in dB, $DR=20\log 2n$. "n" is the resolution in bits.

EBCDIC (Extended Binary Coded Decimal Interchange Code) - An eight-bit character code used primarily in IBM equipment. The code allows for 256 different bit patterns.

Efficiency - The ratio, specified in percent (%), of output power to input power. Although normally specified at full rated load current, multiple data points can be useful when determining thermal burdens under typical conditions.

EIA (Electronic Industries Association) - A standards organization in the U.S.A. specializing in the electrical and functional characteristics or interface equipment.

EIA-485 - The recommended standard of the Electronic Industries Association that specifies the electrical characteristics of generators and receivers for use in balanced digital multipoint systems.

EMI/RFI (Electromagnetic Interference/Radio Frequency Interference) - "Background noise" that could alter or destroy data transmission.

Emulation - The imitation of a computer system, performed by a combination of hardware and software, that allows programs to run between incompatible systems.

EPROM - Read-only, nonvolatile, semiconductor memory that is erasable (via ultraviolet light) and reprogrammable.

Ethernet - A popular local area network design, the product of Xerox Corporation, characterized by 10-Mbps baseband transmission over a shielded coaxial cable and employing CSMA/CD as the access control mechanism; standardized by the IEEE as specification IEEE 802.3; referring to the Ethernet design or as compatible with Ethernet.

Even Parity - A data-verification method in which each character must have an even number of "true" bits.

Event Counter - A circuit used to count pulses that are related to the occurrences of a certain condition. An event counter can typically be preset, reset and can totalize.

Expansion Board - A plug-in circuit board that adds features or capabilities beyond those basic to a computer, such as a data acquisition system expansion board.

Expansion Chassis - An enclosure used to increase the capabilities of a computer system by providing space for additional expansion boards.

Expansion slots - The spaces provided in a computer for expansion boards that enhance the basic operation of the computer.

FCC - Federal Communications Commission.

FDDI (Fiber Distributed Data Interface) - An American National Standards Institute - specified standard for fiberoptic links with data rates up to 100 Mbps. The standard specifies: multimode fiber; 50/125-, 62.5/125-; or 85/125-u core cladding; an LED or laser light source; and 2 kilometers for unrepeated data transmission at 40 Mbps.

Firmware - A computer program or software stored permanently in PROM or ROM or semipermanently in EPROM.

Floating-Point Numbers - Numbers that contain decimal parts or are represented in scientific notation. Also known as "real" numbers.

Floating Output - The output of a device that is galvanically isolated from the input and from chassis. Floating outputs are useful in eliminating ground loops from distribution systems.

Flow Control - The procedure for regulating the flow of data between two devices; prevents the loss of data once a device's buffer has reached its capacity.

Foreground - In a PC system, the activity subject to direct operator intervention. Other (background) activities continue as previously defined.

FORTRAN - FORMula TRANslation. A high level programming typically used for mathematically intense applications.

Frequency-Division Multiplexor (FDM) - A device that divides the available transmission frequency range into narrower banks, each of which is used for a separate channel.

Front End - The preprocessing of data before a program uses it. Could refer to signal conditioning in a data acquisition system.

FTP (File Transfer Protocol) - An upper level TCP/IP service that allows copying of files across a network.

Full Duplex (FDX) - Simultaneous, two way, independent transmission in both directions.

Gain Amplifier - An electronic circuit that allows the input of low level signals (e.g. thermocouple microphone).

Gateway - A conceptual or logical network station that serves to interconnect two otherwise incompatible networks, network nodes, subnetworks, or devices; performs a protocol-conversion operation across numerous communications layers.

GPIB - General Purpose Interface Bus. A standard bus used for controlling electronic instruments with a computer. Also designated IEEE-488.

Ground - A electrically neutral circuit having the same potential as the surrounding earth. Normally, a non-current carrying circuit intended for the safety purposes. A reference point for an electrical system.

Ground Loop - An alternate feedback path, usually unintentional, between devices sharing a common ground.

GUI (Graphical User Interface) - Pronounced "gooey", an operating system or environment that displays options on the screen as icons, or picture symbols. Users enter commands by pointing at icons with a cursor controlled by hardware device called "mouse", and then clicking a button on the mouse. Invented at the Xerox Palo Alto Research Center in the 1970s, the GUI first became popular on the Apple Macintosh. Other GUI's are Microsoft Windows, Digital Research GEM, and XWindows.

Half Duplex (HDX) - Transmission in either direction, but not simultaneous.

Handshaking - Exchange of predetermined signals between two devices establishing a connection. Usually part of a communications protocol.

Hardware - The visible parts of a computer system, such as the circuit boards, chassis, enclosures, peripherals, cables, etc. It does not include data or computer programs.

HDLC (High-Level Data Link Control) - The international standard communication protocol defined by ISO.

Hertz (Hz) - Cycles per second. A measure of frequency or bandwidth.

Hexadecimal - A numbering system to the base 16.

Hierarchical - A method of organizing data with a series of levels, each with further subdivisions, as in a pyramid or tree structure.

High-level Language - A program used to simplify the creation of computer code. Allows the specification of a computer action using fewer steps than assembly language.

IEEE - (Institute of Electrical and Electronic Engineers) - An international professional society that issues its own standards and is a member of ANSI and ISO.

Input/Output (I/O) - The process of transferring data from or to a computer system including communication channels, operator interface devices, or data acquisition and control channels.

Inrush Current - The peak current drawn by a device upon first application of the supply voltage, usually the result of transformer magnetizing current or the charging of input filter capacitors. Some converters feature circuits which will reduce inrush current, thus eliminating nuisance tripping of input circuit breakers.

Instrumentation Amplifier (IA) - A precision amplifier circuit with both high-impedance differential inputs and high common-mode rejection.

Integer - A whole number, not requiring a fraction, a decimal point or scientific notation for representation.

Integrating A/D Converter - An A/D conversion technique in which the analog input is integrated over time. Different types of integrating A/D converters include dual slope, triple slope, and charge balancing types.

Interface - A shared boundary defined by common physical interconnection characteristics, signal characteristics, and meanings of interchanged signals.

Intelligent Workstation - Sometimes referred to as an intelligent terminal; a terminal (DTE) that can be programmed; any terminal that can provide the user with independent processing power and applications support; examples include personal computers.

Interpreter - A high-level language in which the command statements are converted, one at a time and in the order they are used, into code that can be executed by the processor.

Interrupt - An external event indicating that the CPU should suspend its current task to service a designated activity.

Interrupt Handler - The section of a program that performs the necessary operations to service an interrupt when it occurs.

Interrupt Service Routine - See interrupt handler.

Inverter - A solid state power source which is used to convert one voltage form, usually DC, to another.

I/O - Input/Output, see above.

I/O Address - A method that allows the CPU to distinguish between the different boards in a system. All boards must have different addresses.

I/O Mapping - Method of connecting I/O devices to the CPU in an addressable fashion without using memory space. Disk drivers, printers and monitors are usually I/O mapped.

IPDS (Intelligent Printer Data Stream) - A page-description printer protocol that allows a complete page of text and graphics to be formatted and stored in the printer's memory.

ISDN (Integrated Services Digital Network) - An international project for the standardization of operating parameters and interfaces for a network that will accommodate a variety of mixed digital-transmission services. Access channels under definition include basic rate (144 Kbps) and primary rates (nominally, 1.544 and 2.048 Mbps).

ISO - International Standards Organization.

Isolation Amplifier - An amplifier with electrically isolated inputs and outputs which allow it to amplify a differential signal superimposed on a high common-mode voltage.

Isolation Voltage - The voltage which an isolated circuit can normally withstand. Isolation voltage is usually specified from input to output and/or from any input to the amplifier output, or to the computer bus.

Isothermal - A process or area that is maintained at a constant temperature.

Joule - A unit of energy expended when a force of one newton (a unit of measurement) moves the point of application one meter in the direction of the force (1 watt = 1 joule/second).

Jumper - A wire which connects a number of pins on one end of a cable only, such as looping back Request to Send from Clear to Send.

K - Kilo. In referring to computers, a "kilo" is 1024 or 2 to the 10 th power. (Note that it is actually slightly more than an even 1000).

LAN (Local Area Network) - A type of high-speed data-communications arrangement where all segments of the transmission medium (coaxial cable, twisted-pair wire, or optical fiber) are in an office or campus environment under the control of the network operator.

Latch - A term used to indicate that the state of a digital signal will remain stored until changed by the CPU or specified external command signal.

LDM (Limited Distance Modem) - A signal converter which conditions and boosts a digital signal so that it may be transmitted further than a standard RS-232 signal.

Leased Line - A telephone line reserved for the exclusive use of leasing customers, without interexchange switching arrangements. Also called a private line.

LED (Light-Emitting Diode) - A semiconductor light source that emits visible light or invisible infrared radiation.

Line Turnaround - The reversing of transmission direction from sender to receiver or vice versa when a half-duplex circuit is used.

Linearity - The adherence of a device's response to a straight line relationship. Output is directly proportional to input.

Line Driver - A signal converter that conditions a signal to ensure reliable transmission over an extended distance.

Link Layer - Layer Two of the OSI reference model; also known as the data-link layer.

Linker - A program which combines different sections of a compiled program.

Listener - A device on the GPIB bus that receives information from the bus.

LLC (Logical Link Control) - A protocol developed by the IEEE 802 committee for data-link-level transmission control; the upper sublayer of the IEEE Layer 2 (OSI) protocol that complements the MAC protocol; IEEE standard 802.2; includes end-system addressing and error checking.

Loaded Line - A telephone line equipped with loading coils to add inductance in order to minimize amplitude distortion.

Line Regulation - The change in a converter's output voltage due to a change in the input line voltage, usually expressed in percent over a specified input voltage range.

Load Regulation - The change in a converter's output voltage due to a change in the load current, usually expressed in percent at two or more specified load levels.

Local Area Network (LAN) - A data-communications system confined to a limited geographic area (typically up to 6 miles or about 10 kilometers) with moderate to high data rates (100 Kbps to 50 Mbps). The area served may consist of a single building, a cluster of buildings, or a campus-type arrangement. The network uses some type of switching technology, and does not use common carrier circuits (i.e. telephone lines) although it may provide access to other public or private networks.

Local Line, Local Loop - A channel connecting the subscriber's equipment to the line-terminating equipment in the central office. Usually a numeric circuit (either 2-wire or 4-wire).

Loopback - Type of diagnostic test in which the transmitted signal is returned to the sending device after passing through all, or a portion of, a data-communications link or network. A loopback test permits the comparison of a returned signal with the transmitted signal.

LU 6.2 (Logical Unit 6.2) - In Systems Network Architecture, a set of protocols that provides peer-to-peer communications between applications.

MAC (Media Access Control) - A media-specific access-control protocol within IEEE 802 specifications; currently includes variations for the token ring, token bus, and CSMA/CD; the lower sublayer of the IEEE's link layer (OSI), which complements the Logical Link Control (LLC).

Machine Language - Binary code that is executed directly by a computer CPU and translated into electronic actions. Machine language is different for each CPU type.

Macro - A small set of program steps combined to act as a single, more powerful, program step.

Mainframe - A large-scale computer system that can house comprehensive software and several peripherals.

Mains - A term referring to the utility distribution system.

Manchester Encoding - Digital encoding technique (specified for the IEEE 802.3 Ethernet baseband network standard) in which each bit period is divided into two complementary halves; a negative-to-positive (voltage) transition in the middle of the bit period designates a binary "1", while a positive-to-negative transition represents a "0". The encoding technique also allows the receiving device to recover the transmitted clock from the incoming data stream (self-clocking).

MAP (Manufacturing Automation Protocol) - A suite of networking protocols set by General Motors; it tracks the seven layers of the OSI model.

Mark - Presence of signal. In telegraph communication, a mark represents the closed condition or current flowing. A mark impulse is equivalent to a binary "L".

MAU (Multistation Access Unit) - A wiring concentrator used in local area networks.

Mean Time Between Failures (MTBF) - The average length of time that a system or component works without failure. The "MTBF" rate is calculated using MIL-STD-217.

Mean Time to Repair (MTTR) - The average time it takes between system failure and repair.

Media Management - The ability to manage and the process of managing different media (coaxial cable, twisted-pair cable, optical-fiber cable) used within the same network. Media management involves cable performance monitoring, cable break detection, planning for cable routes, etc.

Memory - Electronic devices that enable a computer to store and recall information. In its broadest sense, memory refers to any hardware capable of serving that end, e.g., disk, tape, or semiconductor storage.

Menu - The list of available functions for selection by the operator, usually displayed on the computer screen once a program has been entered.

Mnemonics - A method of helping a software programmer remember the various commands of a specific computer system. A relatively easy-to-remember alphabetic code is assigned to each machine language command and usually consists of letters extracted from, and thus suggestive of, the command it symbolizes.

Modem (Modulator-Demodulator) - A device used to convert serial digital data from a transmitting terminal to a signal suitable for transmission over a common carrier, or to reconvert the transmitted signal to digital data for acceptance by a receiving terminal.

Modem Eliminator - A device used to connect a local terminal and a computer port in lieu of the pair of modems to which they would ordinarily connect, allows DTE-to-DTE data and control signal connections otherwise not easily achieved by standard cables or connectors.

Modular - (hardware) The use of smaller, application specific components to derive a customized complete system.

Modular - (software) The practice of writing routines to accomplish a specific task and collecting these routines into a larger program.

Monotonicity - The desirable characteristic of a digital-to-analog converter to produce a continuously increasing analog output for a correspondingly increased digital input code.

Multidrop - A single communication line or bus used to connect three or more points.

Multiplexer (mux) - An array of semi-conductor or electromechanical switches with a common output used for selecting one of a number of input signals.

Multipoint Line - See multidrop.

Multitasking - The characteristic of an operating system and/or CPU that allows a processor to perform several operations at once.

NDIS (Network Driver Interface Specification) - A standard established by Microsoft for writing hardware-independent drivers.

Network - An interconnected group of nodes; a series of points, nodes or stations connected by communications channels; the assembly of equipment through which connections are made between data stations.

Network Architecture - A set of design principles, including the organization of functions and the description of data formats and procedures, used as the basis for the design and implementation of a network (ISO).

Network Topology - The physical and logical relationship of nodes in a network; the schematic arrangement of the links and nodes of a network. Networks are typically of either a star, ring, tree, or bus topology, or some combination.

Node - A point of interconnection to a network. Normally, a point at which a number of terminals or tail circuits attach to the network.

Noise - Unwanted disturbances superimposed upon a useful signal that tend to obscure its information content.

Nonvolatile - A memory or data storage device that retains its information content when electrical power is removed. Ordinary RAM is volatile whereas ROM, bubble memory, battery-backed-up CMOS RAM, floppy and hard disks are nonvolatile.

NRZ (Non-Return-to-Zero) - Pulses in alternating directions for successive 1 bits; no change from existing bias for 0 bits.

Null Modem - A device that connects two DTE devices directly by emulating the physical connections of a DTE device. See modem eliminator.

Nyquist Sampling Theorem - If a continuous bandwidth limited signal contains no frequency components higher than a specified frequency then the original signal can be recovered without distortion if it is sampled at a rate of at least twice the specified frequency.

ODI - Open Data-Link Interface. ODI supports TCP/IP and SPX/IPX transport protocols concurrently with existing Ethernet, Token-Ring and ARCNET adapters. This support allows network users greater flexibility in moving files from one network type to another.

Operating System (O/S) - The master control program that governs the operation of a computer system. Software of firmware that manages the internal memory allocation and the control of peripheral devices for applications programs.

Optical Isolation - Two networks connected only through an optoelectric transmitter and receiver with no electrical continuity between the two networks.

OSI (Open System Interconnection) - A logical structure (model) for network operations established within the International Standards Organization; a seven-layer network architecture used for the definition of network protocol standards to enable any two OSI-compliant devices to on carry a meaningful exchange of information; the layers are Physical, Data Link, Network, Transport, Session, Presentation, Application.

Output Noise - The undesirable component of the converter output voltage, usually as a byproduct of the conversion process itself. The most common form of noise is the high frequency component remaining after filtering the PWM (*see definition below*) signal.

Overhead - The amount of computer processing resources, such as time or memory, required to accomplish some task.

Packet - A group of bits (including data and cell control signals) transmitted as a whole on a packet-switching network. Usually smaller than a transmission block.

PAD (Packet Access Device) - An interface between a terminal or computer and a packet-switching network.

Parallel Transmission - Transmission mode that send a number of bits simultaneously over separate lines (e.g. eight bits over eight lines) to a printer. Usually unidirectional.

Parity Bit - A bit that is set at "0" or "1" in a character to ensure that the total number of 1 bits in the data field is even or odd.

Parity Check - The addition of noninformation bits that make up a transmission block to ensure that the total number of 1s is always either even (even parity) or odd (odd parity); used to detect transmission errors.

Passive Filter - A filter circuit using only resistors, capacitors, and inductors. (No active devices such as integrated-circuit amplifiers).

Pascal - A high-level programming language originally developed as a tool for teaching the concepts of structured programming. It has evolved into a powerful general-purpose language popular for writing scientific and business programs.

Peripheral - The input/output and data storage devices attached to a computer such as disk drives, printer, keyboards, displays, data acquisition systems, etc.

Phase Modulation - One of three ways of modifying a sine wave signal to make it "carry" information. The sine wave or "carrier" has its phase changed in accordance with the information to be transmitted.

Physical Layer - Within the OSI model, the lowest layer (Layer One) of network processing below the link layer; concerned with the electrical, mechanical, and handshaking procedures over the interface that connects a device to a transmission medium; referring to an electrical interface, such as RS-232C.

PID - Proportional, integral, derivative. A three-mode control algorithm.

Point-to-Point (link) - A connection between two, and only two, pieces of equipment.

Polling - A means of controlling devices on a multipoint line. A controller will query devices for a response.

Port - A place of access to a device or network, used for input/output of digital and analog signals.

Presentation Layer - Layer six of the ISO reference model; provides standards for restructuring data into the required format, character set or language.

Primary - The input side of an isolating device. In a shore power converter it is connected to the supply mains (*dock power*).

PROM (Programmable Read Only Memory) - Nonvolatile memory chip that allows a program to reside permanently in a piece of hardware.

Protocol Analyzer - A device (or software application) that enables the user to analyze the performance of network data to ensure that the network and its associated hardware/software are operating within the parameters of the network upgrades and expansions, and to perform network maintenance and troubleshooting tests.

Protocol - A formal set of conventions governing the formatting and relative timing of message exchange between two communicating systems.

Power Factor - The ratio of the real power to the apparent power in an electrical circuit. The most efficient use of mains energy occurs when the circuits power factor is high, with 1.00PF being the ideal. Low power factors can be the result of reactive and nonlinear load elements.

Public Switched Network - Any switching communications system - such as Telex, TWX, or public telephone networks - that provides circuit switching to many customers.

PWM - (Pulse Width Modulation) a technique used in modern converters to efficiently change DC (*Direct Current*) to AC (*Alternating Current*).

Quantizing Error - The inherent uncertainty in digitizing an analog value due to the finite resolution of the conversion process. This error can be reduced only by increasing the resolution of the converter.

Queue - A temporary storage location or list of things to be done such as messages that are waiting transmission, or instruction for the CPU.

RAM (Random Access Memory) - Semiconductor read/write volatile memory. Data stored is lost if power is removed.

Range - Refers to the maximum allowable full-scale signal (input or output) that yields a specific performance level.

Rate Generator - A device that provides an output pulse at a software programmable frequency.

Read-Only Memory (ROM) - Computer memory in which data can be routinely read but written to only once using special means when the ROM is manufactured. ROM is used for storing data or programs (e.g. operating systems) on a permanent basis.

Real Numbers - Numbers that can express a fractional value. Also called floating-point numbers.

Real Power - In an AC circuit, true power indicates the actual power consumed by a device. Used with apparent power to calculate power factor.

Real Time - Data acted upon immediately instead of being accumulated and processed at a later time.

Real-World - Referring to events, signals and conditions that occur naturally or in everyday life.

Repeatability - The ability of an instrument to give the same result under repeated identical conditions.

Resolution - The smallest significant number to which a measurement can be determined. For example, a converter with 12-bit resolution can resolve 1 part in 4096.

Response Time - The elapsed time between the generation of the last character of a message at a terminal and the receipt of the first character of the reply. It includes terminal delay and network delay.

Ribbon Cable - A flat cable in which the conductors are side by side rather than in a bundle.

Ring Network - A network topology in which each node is connected to two adjacent nodes.

RISC (Reduced Instruction Set Computing) - Internal computing architecture where processor instructions are pared down so that most can be performed in a signal processor cycle, theoretically improving computing efficiency.

ROM - (See read only memory).

Routine - A self-contained program designated to accomplish a specific task.

RS - Recommended standard. Standards defined for serial data interchange (e.g. RS-232C) newer designations use "EIA" instead of "RS" (e.g. EIA-232C).

RS-xxx Standards - See EIA Recommended Standards.

RS-232 - Interface between DTE and DCE, employing serial binary data interchange.

RS-232C - defines three types of connection: electrical, functional, mechanical. The most commonly used interface, it is ideal for the data-transmission range of 0-20 Kbps/50 ft. (15.2 m). It employs unbalanced signaling and is usually used with 25-pin D-shaped connectors (DB25) to interconnect DTE's (computers, controllers, etc.) and DCE's (modems, converters, etc.). Serial data exits through an RS-232C port via the Transmit Data (TD) lead and arrives at the destination device's RS-232C port through the Receive Data (RD) lead. (RS-232C is compatible with these standards: CCITT V.24; CCITT V.28; ISO IS2110.)

RS-422 - defines a balanced interface with no accompanying physical connector. Manufacturers who adhere to this standard use many different connectors, including screw terminals, DB9, DB25 with nonstandard pinning, DB25 following RS-530, and DB37 following RS-449. RS-422 is commonly used in point-to-point communications conducted with a dual-state driver. Transmissions can run long distances at high speeds.

RS-423 - Electrical characteristics of unbalanced-voltage digital interface circuits.

RS-449 - defines functional/mechanical interfaces for DTE's/DCE's that employ serial binary data interchange, and is usually used with synchronous transmissions. It identifies signals (TD, RD, etc.) that correspond with the pin numbers tended to replace RS-232C, but RS-232 and RS-449 are completely incompatible in mechanical and electrical specifications.)

RS-530 - supersedes RS-449 and complements RS-232. Based on a 25-pin connection, it works in conjunction with either electrical interface RS-422 (balanced electrical circuits) or RS-423 (unbalanced electrical circuits). RS-530 defines the mechanical/electrical interfaces between DTE's and DCE's that transmit serial binary data, whether synchronous or asynchronous. RS-530 provides a means for taking advantage of higher data rates with the same mechanical connector used for RS-232. **However, RS-530 and RS-232 are not compatible!**

RS-530 accommodates data-transmission rates from 20 Kbps to 2 Mbps; maximum distance depends on which electrical interface is used. (RS-530 is compatible with these standards: CCITT V.10, V.11, X.26; MIL-188/114; RS-449).

RS-485 - resembles RS-422 except that associated drivers are tri-state, not dual-state. It may be used in multipoint applications where one central computer controls many different devices. Up to 64 devices may be interconnected with RS-485.

R/W - Read/Write.

SAA (System Application Architecture) - A set of standards developed by IBM, providing identical user interfaces for applications running on PC's, minicomputers and mainframes.

Sample and Hold - A circuit which acquires and stores an analog voltage for a short period of time. Typically used to stabilize the input of an analog to digital converter during conversion.

Sampling Theorem - See Nyquist Sampling Theorem.

SDLC (Synchronous Data Link Control) - IBM standard bit oriented protocol, superseding BSC.

Seebeck Effect - The basic principle behind thermocouples. When a circuit is created by the junctions of two dissimilar metals and the junctions are held at different temperatures, a current caused by the difference in temperature between the two junctions will flow in the circuit.

Sensitivity - A measure of the minimum change in an input signal that an instrument can detect.

Sensor - A device that responds to a physical stimuli (heat, light, sound, pressure, motion, etc.) and produces a corresponding electrical output.

Serial Data Transmission - is the most common method of sending data from one DTE to another. Data is sent out in a stream, one bit at a time, over one channel.

When a computer is instructed to send data to another DTE, the data within the computer must pass through a serial interface to exit as serial data. Then it passes through ports, cables, and connections that link the various devices. The boundaries (physical, functional, and electrical) shared by these devices are called interfaces.

Serial I/O - A common form of data transmission, in which the bits of each character are sent one at a time over the line.

Serial Port - A communications interface that uses one data line to transfer data bits sequentially. On the IBM PC the serial port refers to a standard asynchronous serial interface which uses the 8250/16450 family of UART's.

Serial Transmission - The most common transmission mode; in Serial, information bits are sent sequentially on a single data channel.

Session Layer - Layer Five of the OSI reference model; provides protocols for assembling physical messages into logical messages.

Set Point - A "level" or control point in a feedback system.

Settling Time - The time required, after application of a step input signal, for the output voltage to settle and remain within a specified error band around the final value. The settling time of a system includes that of all of the components of the system.

Shielding - Protective covering that eliminates electromagnetic and radio frequency interference.

Shielded Cable - A cable with foil or other sheathing around it to stop radio frequency interference and magnetic fields from generating extraneous signals on the cable conductors.

Short-Haul Modem - A signal converter which conditions a digital signal to ensure reliable transmission over DC continuous private-line metallic circuits, without interfering with adjacent pairs of wire in the same telephone cable.

Signal-to-Noise Ratio - The ratio of signal strength to the level of noise.

Simplex Transmission - Data transmission in one direction only.

Simultaneous Sample and Hold (SSH) - A data acquisition system in which several sample and hold circuits are used to sample a number of analog channels at the same instant. One sample and hold per analog channel is required.

Smart Hub - A type of twisted-pair connector used in either Ethernet or ARCNET networks. A smart hub has built-in network management facilities, usually in the form of programmed firmware (chips), that allow a network manager to control and plan network configuration, as well as to monitor network performance.

SNMP (Simple Network Management Protocol) - A network management protocol for use with TCP/IP. This protocol runs at the Transport layer of the OSI network model and provides the components for vendor-developed network management utilities.

Software - The non-physical parts of a computer system that includes computer programs such as the operating system, high-level languages, applications programs, etc.

Soft Start - A circuit or device placed in the primary side of a converter to limit the inrush current drawn during turn-on.

Space - Absence of signal. In telegraph communications, a space represents the open condition or no current flowing. A space impulse is equivalent to a binary "0".

Span - The difference between the lower and upper limits of a range. Span is expressed in the same units as the range.

SPARC (Scaleable Processor Architecture Reduced instruction Set Computer) - A very powerful workstation similar to a reduced-instruction-set-computing (RISC) workstation.

Spike - A transient disturbance of an electrical circuit. (e.g. lightning or other electrostatic sources).

Spike Protector - A device placed in an electrical circuit to prevent spikes and some surges that might otherwise damage electronic equipment connected to the circuit.

Stability - The ability of an instrument or sensor to maintain a consistent output when a constant input is applied.

Statistical Multiplexor - A device that allows a single channel to carry information from multiple devices simultaneously.

Straight-Through Pinning - RS-232 and RS-422 configuration that matches DTE to DCE, pin for pin (pin 1 with pin 1, pin 2 with pin 2, and so on).

Strain relief - A bracket or clamp used to secure a cable so that it does not become disconnected accidentally or apply stress at the point of connection to the system.

Subroutine - A sequence of computer instructions that perform a specific task and can be called repeatedly in a program whenever that specific task is required.

Successive-Approximation A/D Converter - An analog-to-digital conversion method that sequentially compares a series of binary-weighted values with an analog input to produce an output digital word in "n" steps, where "n" is the bit resolution of the A/D converter. This process is analogous to weighing an unknown quantity on a balance scale using a set of binary standard weights.

Surge - A sudden change (usually an increase) in the voltage on a power line. A surge is similar to a spike, but is of longer duration.

Switching Frequency - The rate the solid state switches are turned off and on in the electronic circuitry.

Switched Line - A communications link for which the physical path may vary with each usage, such as the public telephone network.

Synchronization - The coordination of the activities of several circuit elements.

Synchronous Transmission - Transmission in which data bits are sent at a fixed rate, with the transmitter and receiver synchronized. Synchronized transmission eliminates the need for start and stop bits with every character.

Syntax - Comparable to the grammar of a human language, syntax is the set of rules used for formatting statements in a particular programming language.

T1 - AT & T term for digital carrier facility used to transmit a DS-1 formatted digital signal at 1.544 Mbps.

T3 - A wide-bandwidth digital transmission facility; part of the hierarchy of T-carrier signals (DS-1, DS-2, etc.). T3 (properly referred to as DS-3) carries 28 DS-1 (T1) signals and operates at 44.736 Mbps. T3 is used almost exclusively by AT & T and regional Bell operating companies. Some private users are employing DS-3 signals with digital microwave systems and/or optical-fiber networks.

Talker - A device on the GPIB bus that simply sends information on to the bus without actually controlling the bus.

TCP/IP (Transmission Control Protocol/Internet Protocol) - A layered set of protocols that allows sharing of applications among PC's in a high speed communications environment. Because TCP/IP's protocols are standardized across all its layers, including those that provide terminal emulation and file transfer, different vendors computing devices (all running TCP/IP) can exist on the same cable and communicate with one another across that cable. Corresponds to Layers Four (transport) and Three (network) of the OSI reference model.

Termination - Placement of a connector on a cable.

Termination Panel - A circuit board with screw terminals or other connector system that allows convenient connection of field signals to a data acquisition or communication system.

Throughput Rate - The maximum repetitive rate at which a data conversion system can operate with a specified accuracy. It is determined by summing the various times required for each part of the system and then by taking inverse of this time.

Time-Division Multiplexor (TDM) - A device that accepts multiple channels on a single transmission line by connecting terminals, one at a time, at regular intervals, interleaving bits (Bit TDM) or characters (Character TDM) from each terminal.

Time Sharing - A method of computer operation that allows several interactive terminals to use on computer. Although the terminal are actually serviced in sequence, the high speed of the computer makes it appear as if all terminals were being served simultaneously.

Time Stamp - Information added to a message, record, or other unit of data indicating the time at which it was processed by the system.

Token Bus - A LAN standard that uses a token-passing media access method on a bus configuration.

Token Ring - A data-signaling scheme in which a special data packet (called a token) is passed from one station to another along an electrical ring. When a station wants to transmit, it takes possession of the token, transmits its data, then frees the token after the data has made a complete circuit of the electrical ring.

Transceiver - A device that can both transmit and receive.

Transducer - A device that converts length, position, temperature, pressure, level, etc., to a different energy form (i.e. voltage or current).

Transient - An abrupt change in voltage, of short duration, (e.g. a brief pulse caused by the operation of a switch).

Transient Recovery Time - The time required by a converter to return the output voltage to the specified level following a load level or line voltage variation. Modern solid state converters offer recovery periods rated in microseconds, motor controller based systems in tens of milliseconds, and generators in seconds.

Transport Layer - Layer Four in the OSI reference model; provides a logical connection between processes on two machines.

Triac - A solid-state switching device used to switch alternating current waveforms.

Trunk - A single circuit between two points, both of which are switching centers or individual distribution points. A trunk usually handles many channels simultaneously.

Turnkey - A system that combines all the hardware and software required for a specific application.

UART - Universal Asynchronous Receiver-Transmitter, see below.

Unloaded Line - A line with no loaded coils that reduce line loss at audio frequencies.

Universal Asynchronous Receiver-Transmitter (UART) - An electronic circuit that translates the data format between a parallel representation within the computer and the serial method of transmitting data over a communications line.

UNIX - Operating system originally designed by AT & T for communicating multiuser, 32-bit minicomputers; has come into wide commercial acceptance because of its predominance in academia and its programming versatility. AT & T System V Version 3 and Berkeley System Development Version 4.3 are currently popular.

Uninterruptible Power Supply (UPS) - A power conditioning unit placed between the commercial power service and the protected device. The UPS uses line power to charge batteries, which, in the case of a power failure, can drive electronic circuitry to produce the appropriate AC requirements for some time period.

UPS - Uninterruptible power supply, see above.

V.xx Standards - A series of standards covering data communications over telephone circuits (for example, V.22, V.29, V.32, etc.) established by the Consultative Committee for International Telegraph and Telephone (CCITT), an international association.

V.22, V.22 bis - Synchronous/asynchronous data transmission, full-duplex operation over 2-wire leased or dialup lines; 1200-bps data rate (V.22 bis, 2400 and 1200 bps). Small businesses can beat the expense of leased lines by using V.22 modems. If you add a leased line, you can still use this modem. V.22 accommodates the equipment found in today's typical "hybrid" network; synchronous mainframes and terminals, and asynchronous PCs. V.22 bis doubles the output (2400 bps) for quick service of large file transfers.

V.25, V.25 bis - Provides for automatic calling and answering circuitry for use on dialup lines. V.25 defines a dialup parallel interface; V.25 bis defines a dial serial autodialing functions with a V.25-complaint modem.

V.32 - Synchronous/asynchronous data transmission, full-duplex operation over 2-wire dialup or 2-wire/4-wire leased lines; 9600-bps data rate (fallback to 4800 bps). The V.32 recommendation is the first universal standard for 9600-bps modems on both types of phone lines. V.32-complaint modems are the industry standard for high-speed networks. Trellis encoding modulation allows high data speeds and reduced errors. Data can be sent over standard dialup lines - a lot less expensive to use than leased lines. And V.32-complaint modems will work anywhere in the world. Any business, large or small, that handles large quantities of data transfer or huge data files can benefit from the fast, accurate data transfers of V.32 technology.

V.32 bis - Synchronous/asynchronous data transmission, full-duplex operation over 2-wire dialup or leased lines; 14,400-, 12,000-, 9,600-, 7,200-, 4,800-bps data rates. It offers two advantages over V.32. First, a V.32 bis modem transmits data faster - up to 14,400 bps. Second, V.32 bis redefines modem-connection negotiations (called training and

retraining). Training is the procedure two modems use to make a connection; they "discuss" and agree upon a data rate. Retraining is a subsequent negotiation after data exchange is under way; retraining is triggered by line noise (the modems want a "cleaner" data exchange, so they stop data transfer, retrain, and then continue data transfer). V.32 bis provides a new procedure called "fastrain", which allows the modem to fall either backward to a slower speed or forward to a faster speed. When two V.32 modems do a fastrain, they stop, determine that they can run faster, and then switch speed in a few milliseconds. Another advantage of V.32 bis over V.33 (see below); V.33 lets you send sync data at 14,400 bps over a 4-wire leased line, but V.32 bis lets you do the same over a 2-wire dialup line, which is less expensive to use than a leased line.

V.33 - Synchronous data transmission, full-duplex operation over 4-wire leased lines, 14,000- or 12,000-bps data rate. A V.33-complaint modem uses the same signal modulation techniques that are used by V.32 modems, but you're restricted to using 4-wire leased lines. If your network requires very high-speed sync data transmission (as do many IBM and all supercomputer environments), choose a V.33 modem.

V.35 -CCITT standard governing data transmission at 48 Kbps over 60- to 108-KHz ground band circuits.

Virtual Memory - A method of making disk storage appear like RAM memory to the CPU, thus allowing programs that need more RAM memory than is installed to run in the system. This technique is slow compared to "real" memory.

Voice-Grade Line - A channel that is capable of carrying voice-frequency signals.

Volatile Memory - A storage medium that loses all data when power is removed.

Voltage-to-Frequency Converter (VFC) - A device which converts an analog input voltage into a sequence of digital pulses with frequency proportional to the input voltage.

Windows - A Graphical User Interface (GUI) environment developed by Microsoft. It permits users to run more than one application on a desktop computer simultaneously. Window, as a generic term, refers to any separate, structured viewing area that can appear on a monitor and provide functional application workspace.

Word - The standard number of bits that a processor or memory manipulates at one time. Microprocessors typically use 8 or 16-bit words.

X.21 - CCITT standard governing interface between data terminal equipment (DTE) and data circuit terminating equipment (DCE) for synchronous operation on public data networks.

X.25 - CCITT standard governing interface between data terminal equipment (DTE) and data circuit terminating equipment (DCE) for terminals operating in the packet mode on public data networks.

X.25 Pad - A device that permits communications between non-X.25 devices and the devices in an X.25 network.

X Terminal - A dedicated platform (terminal) that is designed to run X-server software; used with powerful machines that run 680 x 0 processors such as RISC computers. X is a standard baselevel windowing architecture for UNIX machines and their terminals.

X-ON/X-OFF (Transmitter On/Transmitter Off) - Control characters used for flow control, instructing a terminal to start transmission (X-ON) and end transmission (X-OFF).

Linking Networks and Bridges, Routers and Gateways.

Even if you manage only a few LAN's, linking them makes sense. The LAN's are easier to look after, and resource-sharing is more efficient. The two most popular ways of linking LAN's are via bridges and gateways.

Bridges - connect two or more individual LAN's, often called subnetworks, to create an extended network. Any workstation on any of the subnetworks can share files and data with any other.

A bridge can distinguish between local data and remote data, so data traveling from one workstation to another in the same subnetwork doesn't have to cross the bridge. And because most bridges work at the MAC layer, they can connect different topologies (such as Ethernet and Token Ring) and even different protocols (such as IPX/SPX and TCP/IP).

That is because bridges are protocol-independent - they can transfer data between subnetworks without having to understand it. They also automatically "learn" node addresses from the data they are transferring; you don't have to do any programming. (The address is code unique to each LAN controller card on the network).

Gateways - combinations of hardware and software, connect two dissimilar LAN's or operating environments.

A gateway serves as the interpreter for computers that communicate in different protocols. Since its task is more complicated than a bridge's, it is usually slower and handles fewer devices. Because it works at the top three layers of the OSI model, it is the best choice for connecting systems with completely different architectures. For example, a gateway is the best way to link a NOVELL network and an IBM SNA (System Network Architecture) mainframe computer.

You can also use a gateway to connect your LAN to public-access networks like Telenet or TYMNET. After that, you can share files, send messages and, with software that lets your PC emulate a terminal, log onto a remote computer.

Routers and Brouters - a few things you should know:

Routers are a little "smarter" than bridges. They find the best route for all the data sent to them by the previous router or the end station of the LAN. But routers are protocol-dependent. They have to do more data processing than bridges. And they do not have a bridge's ability to learn addresses.

Brouters do many of the tasks of bridges and routers - without the routers' protocol restrictions. The brouter determines whether the data uses a protocol it can route, and it bridges the data it can not route.

The OSI Model. In 1977 the International Standards Organization created the Open Systems Interconnection (OSI) Model, a conceptual view of networking. It organizes network activity into seven "layers", with the least complex on the bottom and the most complex on the top:

The application layer performs network services like file transfer and email.

The presentation layer handles format and code conversion for the application program.

The session layer establishes and maintains sessions between application programs.

The transport layer handles communication across the network.

The network layers where data-routing across the network takes place.

The data-link layer controls access to the network medium, and is divided into the Media Access Control (MAC) layer and the Logical Link Control (LLC) layer.

The physical layer is the networking medium - cable, connectors, and so on."