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the EXTENSION

A Technical Supplement to control NETWORK

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Glossary of Industrial Ethernet Terms

The interest in Industrial Ethernet has brought about a completely new dictionary of terms. Here are some of the most important terms we have introduced in earlier Extension articles.

4B/5B—A block encoding scheme used to send Fast Ethernet data. In this signal encoding scheme, 4 bits of data are turned into 5-bit code symbols for transmission over the media system.

10BASE-T—10 Mbps Ethernet system based on Manchester signal encoding transmitted over Category 3 or better twisted-pair cable.

10BASE2—10 Mbps Ethernet system based on Manchester signal encoding transmitted over thin coaxial cable. Also called Cheapernet or ThinNet.

10BASE5—Original 10 Mbps Ethernet system based on Manchester signal encoding transmitted over thick coaxial cable. Also called ThickNet.

10BASE-F—10 Mbps Ethernet system based on Manchester signal encoding transmitted over fiber optic cable. This is a base standard for three fiber optic implementations.

10BASE-FP—10 Mbps passive MAU fiber optic implementation which is not popular.

10BASE-FB—10 Mbps backbone MAU fiber optic implementation which is not popular.

10BASE-FL—Popular 10 Mbps link fiber optic implementation which replaces the older FOIRL implementation.

100BASE-FX—100 Mbps Fast Ethernet system based on 4B/5B signal encoding transmitted over fiber optic cable.

100BASE-T—Term used for the entire 100 Mbps Fast Ethernet system, including both twisted-pair and fiber optic media types.

100BASE-T2—100 Mbps Fast Ethernet system designed to use two pairs of Category 3 twisted-pair cable. Not a popular technology.

100BASE-T4—100 Mbps Fast Ethernet system designed for four pairs of Category 3 twisted-pair cable. Not a popular technology.

100BASE-TX—100 Mbps Fast Ethernet system based on 4B/5B signal encoding transmitted over two pairs.

100BASE-X—Term used when referring to any Fast Ethernet media system based on 4B/5B block encoding. Includes 100BASE-TX and 100BASE-FX media systems.

802.2—IEEE Working Group for Logical Link Control (LLC).

802.3—IEEE Working Group for CSMA/CD LANs (local area networks).

AUI—Attachment Unit Interface. The 15-pin signal interface defined in the original Ethernet standard that carries signals between a station and an outboard transceiver.

Auto-Negotiation—A protocol defined in the Ethernet standard that allows devices at either end of a link segment to advertise and negotiate modes of operation such as the speed of the link, flow control or half- or full-duplex operation.

Backbone—A network used as a primary path for transporting traffic between network segments. A backbone network is often based on higher capacity technology, to provide enough bandwidth to accommodate the traffic of all segments linked to the backbone.

Bandwidth—The maximum capacity of a network channel. Usually expressed in bits per second (bps). Ethernet channels have a bandwidth of 10-, 100-, and 1000 Mbps.

Baud—A baud is a unit of signaling speed representing the number of discrete signal events per second and depending upon the encoding can differ from the bit rate.

Bit—A binary digit. The smallest unit of data, either a zero or a one.

Bit Rate—The amount of bits that can be sent per second. Usually described in units of kbps or Mbps and frequently referred to as the data rate.

Block Encoding—Block encoding is a system whereby a group of data bits are encoded into a larger set of code bits. Block encoding is used in Fast Ethernet.

BNC—A bayonet locking connector used on 10BASE2 thin coaxial cable segments and is commonly found in communication systems.

Bridge—A device that connects two or more networks at the data link layer (layer 2 of the OSI model).

Broadcast Domain—The set of all stations in a network that will receive each other's broadcast frames. A single segment or set of segments connected with a repeater or switches are included in a broadcast domain.

Broadcast—A transmission initiated by one station to all stations on a network.

Bus—A shared connection for multiple devices over a cable or backplane.

Category 3—Twisted-pair cable with electrical characteristics suitable for carrying 10BASE-T. Not recommended for new installations.

Category 5—Twisted-pair cable with electrical characteristics suitable for all twisted-pair Ethernet media systems, including 10BASE-T and 100BASE-TX. Category 5 and Category 5e cable are the preferred cable types for structured cabling systems.

Category 5e—An enhanced version of Category 5 cable, developed to improve certain cable characteristics important to Gigabit Ethernet operation. It is recommended that all new structured cabling systems be based on Category 5e cable; however, this cable may not be the best for use in industrial installations because of noise susceptibility.

Coaxial Cable—A cable with an outer conductor, surrounding an inner conductor. Coaxial cables are used for 10BASE5 and 10BASE2 Ethernet systems.

Collision—The result of having two or more simultaneous transmissions on a common signal channel such as half-duplex Ethernet or shared Ethernet.

Collision Domain—The set of all stations and repeaters connected to a network where faithful detection of a collision can occur. A collision domain terminates at switch ports.

CRC—Cyclic Redundancy Check. An error checking technique used to ensure the accuracy of transmitted data.

Crossover Cable—A twisted-pair patch cable wired in such a way as to route the transmit signals from one piece of equipment to the receive signals of another piece of equipment, and vice versa. This allows communication between two DTEs or two DCEs. The opposite of a crossover cable is the straight-through cable.

CSMA/CD—Carrier Sense Multiple Access/Collision Detect. The medium access control (MAC) protocol used in Ethernet.

Data Link Layer—Layer 2 of the OSI reference model. This layer takes data from the network layer and passes it on to the physical layer. The data link layer is responsible for transmitting and receiving frames. It usually includes both the media access control (MAC) protocol and logical link control (LLC) layers.

DCE—Data Communications Equipment. Any equipment that connects to Data Terminal Equipment (DTE) to allow data transmissions between DTEs. DCEs are not considered end devices or stations.

DTE—Data Terminal Equipment. Any piece of equipment at which a communication path begins or ends. A station (computer or host) on the network is capable of initiating or receiving data.

Encoding—A means of combining clock and data information into a self-synchronizing stream of signals.

Error Detection—A method that detects errors in received data by examining cyclic redundancy checks (CRC) or checksum.

Ethernet—A popular local area networking (LAN) technology first standardized by DEC, Intel, and Xerox (or DIX) and subsequently standardized by the IEEE through the 802.3 committee.

Fast Ethernet—A version of Ethernet that operates at 100 Mbps. Although 100 Mbps is not considered fast, this reference is still used.

Fast Link Pulse—A link pulse that encodes information used in the Auto-Negotiation protocol. Fast link pulses consist of bursts of the normal link pulses used in 10BASE-T.

FDI—Fiber Distributed Data Interface. An ANSI standard (ANSI X3T12) for a 100 Mbps token passing network (Token Ring) based on fiber-optic and twisted-pair cable. Some of this technology is used in the Fast Ethernet standard.

Fiber Optic Cable—A cable with a glass or plastic filament which transmits digital signals in the form of light pulses.

Flow Control—The process of controlling data transmission at the sender to avoid overfilling buffers and loss of data at the receiver.

FOIRL—Fiber Optic Inter-Repeater Link. An early version of fiber optic link segment replaced by 10BASE-FL

Forwarding—The process of moving frames from one port to another in a switching hub.

Frame—The fundamental unit of transmission at the data link layer of the OSI mode.

Full-Duplex Operation—A communications method that allows for the simultaneously transmission and reception of data.

Gigabit Ethernet—A version of Ethernet that operates at 1000 Mbps.

Half-Duplex Operation—A communications method in which transmissions and receptions can occur in either direction but not at the same time.

Hub—A device with three or more ports at the center of a star topology network. Hubs can usually be cascaded with a hub-to-hub connection. Frequently this name is used to mean repeating hub.

IEEE—Institute of Electrical and Electronics Engineers. A professional organization and standards body.

Interframe Gap—An idle time between frames, also called the *interpacket gap*.

Intranet—The Internet is the worldwide collection of networks based on the use of TCP/IP network protocols.

Jabber—The act of continuously sending data. A jabbering station is one whose circuitry or logic has failed, and which has locked up a network channel with its incessant transmissions.

Jitter—Also called phase jitter, timing distortion, or inter-symbol interference. The slight movement of a transmission signal in time or phase that can introduce data errors and loss of synchronization.

Late Collision—A failure of the network in which the collision indication arrives too late in the frame transmission to be automatically dealt with by the medium access control (MAC) protocol. The defective frame may not be detected by all stations requiring that the application layer detect and retransmit the lost frame, resulting in greatly reduced throughput.

Link Integrity Test—This test verifies that an Ethernet link is connected correctly and that signals are being received correctly. This is a helpful aide but does not guarantee the link is completely functional.

Link Layer—Short for *Data Link Layer*. This is layer 2 on the OSI model.

Link Light—An optional status light on a DTE or DCE that indicates the status of the link integrity test. If this light is lit on both ends of the link, it indicates that the link is passing the link integrity test.

Link Pulse—A test pulse sent between transceivers on a 10BASE-T link segment during periods of no traffic, to test the signal integrity of the link.

Link Segment—A point-to-point segment that connects only two devices and is “capable” of supporting full-duplex operation.

LLC—Logical Link Control. A standardized protocol and service interface provided at the data link layer and independent of any specific LAN technology. Specified in the IEEE 802.2 standard.

MAC—Medium Access Control. A protocol operating at the data link layer used to manage a station’s access to the communication channel.

MAC Address—A unique address assigned to a station interface, identifying that station on the network. With Ethernet, this is the unique 48-bit station address. Same as the physical address.

Manchester Encoding—Signal encoding method used in all 10 Mbps Ethernet media systems. Each bit of information is converted into a “bit symbol” which is divided into two halves. One half is high and the other is low. Manchester encoding results in a 20 Mbaud stream although data is only being sent at 10 Mbps.

MAU—Medium Attachment Unit. The MAU provides the physical and electrical interface between an Ethernet device and the medium system to which it is connected. Also referred to as a transceiver.

MDI—Medium Dependent Interface. The name for the connector used to make a physical and electrical connection between a transceiver and a media segment. For example, the RJ-45-style connector is the MDI for 10BASE-T and 100BASE-TX.

MDI-X—An MDI port on a hub or media converter that implements an internal crossover function. This means that a “straight-through” patch cable can be used to connect a station to this port, since the signal crossover is performed inside the port.

MII—Medium Independent Interface. Similar to the original AUI function, but designed to support both 10 and 100 Mbps. An MII provides a 40-pin connection to outboard transceivers (also called PHY devices). Used to attach 802.3 interfaces (MACs) to a variety of physical media systems.

Media Converter—A device that converts signals from one media type to that of another.

Mixing Segment—A bus segment capable of supporting two or more devices on the same bus. Coaxial cable segments are classified as mixing segments.

Multicast—A transmission initiated by one station to many stations on the network.

Network Layer—Layer 3 of the OSI reference model. At this layer routing of packets between multiple networks occur.

NIC—Network Interface Card. Also called an adapter, network interface module, or interface card. The set of electronics that provides a connection between a computer and a network.

Octet—Eight bits (also called a byte). This term is typically used in communication protocol descriptions.

OSI—Open Systems Interconnection. A 7-layer reference model for networks, developed by the International Organization for Standardization (ISO). The OSI reference model is a formal method for describing the interlocking sets of networking hardware and software used to deliver network services. It is a good model to refer to but strict compliance to the model is seldom accomplished.

OUI—Organizationally Unique Identifier. A 24-bit value assigned to an organization by the IEEE. Ethernet vendors use the 24-bit OUI they receive from the IEEE in the process of creating unique 48-bit Ethernet addresses. Contemporary Controls has been assigned a vendor OUI.

Packet—A unit of data exchanged at the network layer. This is a much abused definition and the terms frame and packet are frequently interchanged.

Patch Cable—A twisted-pair or fiber optic jumper cable used to make a connection between a network interface on a station or network port on a hub and a media segment, or to directly connect stations and hub ports together.

PHY—Physical Layer Device. The name used for a *transceiver* in Fast Ethernet and Gigabit Ethernet systems.

Physical Layer—The first layer in the OSI seven layer reference model. This layer is responsible for physical signaling, including the connectors, timing, voltages, and related issues. Data sent over the physical layer are termed symbols.

Plenum Cable—A cable that is rated as having adequate fire resistance and satisfactorily low smoke-producing characteristics for use in plenums (air handling spaces). Air handling spaces

are often located below machine room floors, or above suspended ceilings requiring the use of plenum rated cable.

Point-to-Point Technology—A network system composed of point-to-point links. Each point-to-point link connects two and only two devices, one at each end. Devices could be DTEs or DCEs but no more than two can be connected on one link.

Port—A connection point for a cable. Repeater hubs and switching hubs typically provide multiple ports for connecting Ethernet devices.

Promiscuous Mode—A mode of operation where a device is configured to receive all frames on a network regardless of its destination address. Typically used by network analyzer tools.

Propagation Delay—The signal transit time through a cable, network segment, or device. Important in making collision domain calculations.

Protocol—A set of agreed-upon rules and message formats for exchanging information among devices on a network.

Repeater—A physical layer device used to interconnect segments within the same network. An Ethernet repeater can only link Ethernet segments that are all operating in half-duplex mode and at the same speed. Some repeaters can offer media conversion as well.

Repeating Hub—A repeater with more than two ports. This name is frequently shortened to simply hub.

RJ-45—An 8-pin modular connector used on twisted-pair links.

Router—A device or process based on Layer 3 network protocols used to interconnect networks at the network layer.

SC—Subscriber Connector. This is a type of fiber optic connector used in 100BASE-FX fiber optic media systems. The connector is designed to be pushed into place, automatically seating itself.

Segment—A cable made up of one or more cable sections and connections joined together to produce the equivalent of a continuous cable.

Slot Time—A unit of time used in the medium access control (MAC) protocol for Ethernet.

ST—Straight Tip. This is a type of fiber optic connector used in 10BASE-FL and FOIRL links, but can be found on 100BASE-FX systems as well. The male end of this connector has an inner sleeve with a slot cut into it, and an outer ring with a bayonet latch. The inner sleeve is aligned with a mating key in the socket and the outer ring is turned to complete the bayonet latch.

Star Topology—A network topology in which each station on the network is connected directly to a hub.

Straight-through—Refers to a cable where cable connections at both ends of the cable are pinned the same way. Used to connect a DTE to a DCE.

Station—A unique, addressable device on a network. Sometimes referred to as a node.

Switching Hub—A switching hub is another name for a bridge, which is a device that interconnects network segments at the data link layer. Switching hubs are typically located in the center of a star topology, and provide multiple ports for connections to network stations. Frequently this name is shortened to switch.

Terminator—A resistor used at the end of copper network cables to minimize reflections.

Topology—The physical layout of a network.

Transceiver—A combination of the words transmitter and receiver. A transceiver is the set of electronics that sends and receives signals on a media system. Transceivers may be internal or external. Sometimes called a MAU.

Twisted-Pair Cable—A multiple-conductor cable whose component wires are paired together, twisted, and enclosed in a single jacket. A typical Category 5 twisted-pair segment is composed of a cable with four twisted pairs contained in a single jacket. Each pair consists of two insulated copper wires that are twisted together.



Industrial Ethernet Slide Chart provides fast comparison of specifications to the technology's physical layers. The back of the chart provides Ethernet hardware definitions as well as the pinouts and cabling to RJ-45 connectors.

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References

Ethernet The Definitive Guide, Charles E. Spurgeon, 2000, O'Reilly & Association, Inc.

International Standard ISO/IEC 8802.3 ANSI/IEEE Std 802.3, 2000, The Institute of Electrical and Electronic Engineers, Inc.