Industrial Ethernet Overview

What is Industrial Ethernet?

The Ethernet network is a local-area network (LAN) protocol developed by Xerox Corporation in cooperation with DEC and Intel in 1976. Ethernet uses a bus or star topology, and supports data transfer rates of 10 Mbps (standard) or 100 Mbps (using the newer 100Base-T version).

The Ethernet specification served as the basis for the IEEE 802.3 standard, which specifies the physical and lower software layers. Ethernet uses the CSMA/CD access method to handle simultaneous demands. It is one of the most widely implemented LAN standards.

OSI Reference Model

Developed by International Standards Organization (ISO) and stands for **Open Systems Interconnection (OSI)**.
It is designed to deal with connecting open systems to communicate with other systems.
It consists of **seven** layers: a complex structure is partitioned into a number of independent functional layers.
Each layer provides a set of services by performing some well-defined sets of functions. These services are provided by the layered-specific functional entities.
Services at a layer can only be accessed from the layer immediately above it.
Each layer uses only a well-defined set of services provided by the layer below.
Protocols operate between "peer" entities in the different end systems (peer-to-peer protocol rules)

Advantages:
More manageable -Layer N is smaller and built only on Layer (N-1).
Modularity - Different layers can be developed separately and each layer can be modified without affecting other layers as long as the interfaces with immediate layers are kept

Brief Description of model in Each Layer

Physical Layer
The physical layer is responsible for passing bits onto and receiving them from the communication channel. This layer has no understanding of the meaning of the bits, but deals with the electrical and mechanical characteristics of the signals and signalling methods.

Data Link Layer

Data link layer is responsible for both Point-to-Point Network and Broadcast Network data transmission.

It hides characteristics of the physical layer (e.g. transmission hardware from the upper layers.

It is also responsible to convert transmitted bits into frames

It transmits the frames into an error free transmission line by adding error control and flow control.

Network Layer

Network layer is responsible for the controls of routers and subnets operation.

It also handles the formation and routing of packets from source to destination with congestion control.

Transport Layer

Transport layer is a kind of software protocol to control packets delivery, crash recovery and transmission reliability between sender and receiver.

Multiplexing between transport and network connections is possible.

Session Layer

Session layer provides dialogue control and token management.

Presentation Layer

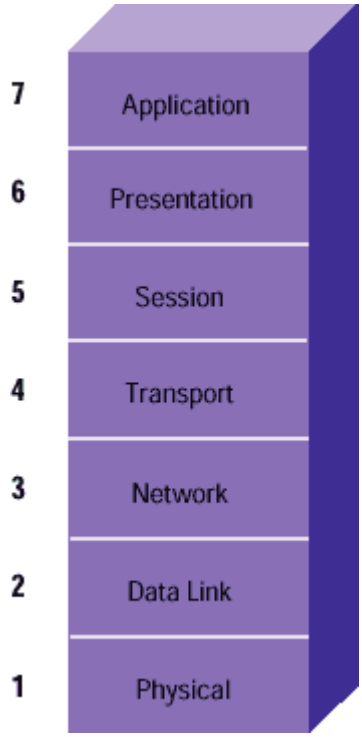
When data is transmitted between different types of computer systems, the presentation layer negotiates and manages the way data is represented and encoded.

Essentially a 'null' layer in case where such transformations are unnecessary.

Application Layer

This top layer defines the language and syntax that programs use to communicate with other programs. For example, a program in a client workstation uses commands to request data from a program in the server.

Common functions at this layer are opening, closing, reading and writing files, transferring files and e-mail messages, executing remote jobs and obtaining directory information about network resources.



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For more details see the files at “Fieldbus Class Room“ Industrial Ethernet Planning and Installation 0.93Mb

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Fundamentals of Networking - Industrial Ethernet

1 - Introduction to PC Networking
2 - Types of Networks
3 - Adding a Network Interface Card (NIC)
4 - Physical Components of a Network
5 - LAN Architectures
6 - Networking Protocols and the OSI Model
7 - TCP/IP Utilities
8 - Connecting to the Internet

Industrial Ethernet Glossary

Interest in Industrial Ethernet has produced an entirely new dictionary with specialist terms. Some of the most important terms are briefly explained here.

4B/5B

A block encoding system for FDDI and ATM. In 4B/5B encoding, all data is divided into 4-bit units (a nibble) and converted to 5-bit units (symbols) by reference to a matrix.

10BaseT

Standard IEEE Ethernet cabling system, where in contrast to 10Base2 and 10Base5 no bus coaxial cable is used, but each station has a star connection around the hubs using a 100 ohm UTP-cable. Despite this 10BaseT is restricted to 10 Mbps and permits cable lengths of up 100 m between station and hub.

10BaseFL

Ethernet cable system using fibre optic cable. 10BaseFL represents all the functions for data transmission from a FOMAU to an active star coupler and connections between star couplers. Data is transmitted asynchronously and is downwardly compatible to the FOIRL standard. The maximum length of a 10Base-FL segment is 2000 m. The normal Ethernet repeater rules apply when reinforcing the signals via repeaters (a maximum of four repeaters in a single cascade). Terminal equipment is connected to 10BaseFL cable directly via optical ethernet adapters or external FOMAU transceivers (via an AUI interface).

100BaseFX

100 Mpbs Fast Ethernet, based on 4B/5B encoding with fibre optics.

100BaseSX

100 Mbps Fast Ethernet system, identical to operations in the 100BaseFx, but 850 nm fibre optic technology is used.

100BaseTX

100 Mbps Fast Ethernet system based on 4B/5B encoding and transmission via two copper cables.

100BaseX

This term is used to describe Fast Ethernet technologies based on the 4B/5B encoding. Includes 100BaseTX and 100BaseFX systems.

802.3.IEEE

The CSMA/CD group is the oldest working group in the 802 project. It defines the norms according to the CSMA/CD access procedures proposed by the DIX-group. This working group focuses on discussing high-speed protocols.

AGING:

Function to update data especially the address buffer. An address is marked "old" after expiration of a time and will be deleted at next cycle, if it is not learned anew.

AUI

Stands for "Attachment Unit Interface". Interface between the transceiver and the network board.

Auto-negotiation

Auto-negotiation means automatic recognition of the opposite end's functions.

By using RJ45 plugs for the different protocols, from 10Base-T to 100Base-T, a compatibility problem occurs which is solved due automatic recognition of the opposite end. Using the auto-negotiation procedure, repeaters or terminal equipment can determine what functions the other end has, so that different devices can be configured automatically.

Bandwidth

Bandwidth states how much information can flow within a set period from one location to the other. Units: Bps, Kbps, Mbps, Gbps.

Baud

Baud is the unit of step speed. A step always lasts for a pre-set time e. g. 1 bit, 1_character. If you multiply the number of bits per state with the baud rate you obtain the transmission speed. Only if the number of states is exactly two (i.e. encoding was carried out at a state of exactly 1 bit), is the baud rate exactly the same as the bit rate.

Bit

Bit is an artificial word made up of binary and digit and constitutes the smallest unit of digital information, either a 0 or a 1.

Bitrate

Bitrate is also referred to as transmission speed, transmission rate or data rate. It is the number of bits that are transmitted per unit of time (typically one second). The bitrate is stated in Bps (bits per second) or in the appropriate powers of 10 as Kbps, Mbps and Gbps. In American English the abbreviation Bps is used.

Bridge

According to their OSI definition, bridges connect sub-network protocols on layer 2 of the OSI reference model.

Broadcast

A broadcast transmission is a simultaneous transmission from one point to all network stations.

Bus

Buses are connection systems for electronic and electrical components. The topology of a bus is always a physical medium which the individual components are connected to and which is terminated at both ends. Transmission on a bus can be done bit or byte parallel, as in the PC-bus, or serially, as for networks in bus topology.

Category 5

Signifies compliance to features specified in EIA/TIA-568-5. With category 5 (cat. 5) components, networks can be set up that are suitable for all twisted-pair cable Ethernet transmission systems up to 100 Mbps, including 10Base-T and 100Base-TX.

Category 5e

The cat. 5e-cable is an extended version of cat. 5 for use in 1000-Base-T networks or for long-distance 100-Base-T network connections (350 m, compared with 100 m for cat. 5). It must fulfil the EIA/TIA 568A-5 specification.

CRC

CRC is an error correction method that creates checksums based on binary numbers by calculating the sums of data groups prior to transmission. CRC is based on the division of polynomials. The principal is that during cyclical block checking, the bits to be monitored are successively fed into a feedback shift register. The length and the number and position of the feedback from the register are stated according to each procedure. The checksum procedure detects individual errors reliably and multiple errors with a high degree of probability.

Crossover-cable

A crossover-cable is a special patch cable where the transmitter and receiver lines at one end have been swapped. Crossover-cables are used to connect two pieces of terminal equipment (computers) or two infrastructure components (switches). Modern switches, because of their auto-crossing function, make connecting normal patch cables with one another possible.

CSMA/CD

An access procedure where several network stations have access to the transmission medium. In the CSMA-system the transmitting station listens to the channel (carrier sensing) before it transmits. A station can then only transmit if the transmission medium has not yet been occupied by another station. If the transmission medium is occupied, the station waits till it is free and can transmit. Because of the signalling times it is still possible for two devices to transmit at the same time. To avoid data loss in this type of collision, both transmitters have to detect the collision (collision detect) and after a randomly-selected waiting time send each of their data packets again. CSMA/CD is a widespread standard process in 10-MBit-networks with hubs. In Industrial Ethernet networks the CSMA/CD system is only used rarely nowadays, because of high demands on network performance.

DCE (Data Communication Equipment)

Data communications facility. Any facility that can relay data between data terminal equipment. DCEs are part of the infrastructure and not terminal equipment.

DTE

(Data Terminal Equipment) data terminal unit: Every device in the network where a communications route starts or finishes. A station (computer or host) in the network that can transmit or receive data.

Error Detection

The error detection code is a detection code (CRC or checksum) used where errors are identified but not corrected as in ECC.

Ethernet

Ethernet is computer networking technology for local networks (LANs). It refers to cable types and signalling for the bit transfer layer (physical layer), packet formats and protocols for checking media access (media access control, MAC)/link layer of the OSI model. Ethernet is standardised to a large extent in the IEEE norm 802.3.

Fast Ethernet

Nowadays a very widespread version of the Ethernet with 100 Mbps over twisted pair cable according to category 5 or higher. The maximum range is 100 m.

Flow Control

This is a function to modify transmission to the capacity of the receiver. Flow control regulates transmission between the transmitter and receiver by causing the transmitter only to send as much data as the receiver can deal with. The different types of Ethernet have different flow control systems. In credit systems (FO cable) the receiver relays to the transmitter the number of data packets that can be transmitted without confirmation. Duplex connections use the PAUSE signal for flow control and back pressure is used in semi-duplex systems to control the data rate.

Forwarding

The process whereby frames are relayed from one port to another in the switch.

Frame

A frame is a data transmission frame on the link layer (layer 2 in the OSI model), which includes the header and trailer information that the bits transmission layer requires for transmission. All frame formats together form the start delimiter of a frame, the destination and source address (destination and source address), the data itself of course and an errorchecking device (a frame check sequence). A maximum of 1500 bytes, with VPN-information of 1524 bytes of payload data per packet are possible in the Ethernet.

Gigabit Ethernet

A version of the Ethernet operating at a data transmission rate of 1000 Mbps.

Fibre optic cables

A type of cable with fibre optics or plastic core that transmits digital signals in the form of light pulses. (Wave lengths 850 nm in 10BaseFL and 100BaseSX or 1300 nm in 100BaseFX).

GPRS

Abbreviation for General Packet Radio Service (standard mobile phone system). GPRS allows a data transmission rate of up to 171.2 kbps and is suitable for internet access. GPRS is based on GSM technology using an Internet protocol (IP).

Semi-duplex operation

The semi-duplex procedure allows bidirectional use of a single transmission line.

The interfaces however can only either transmit or receive at any given time.

Hub

A hub is data communications facility (DCE) that makes it possible to connect three or more devices in a star topology. Modern Ethernet installations hardly use hubs any more but use switches for this purpose because of the higher network output that occurs as a result and the probable transmission times.

IEEE

Association of American Engineers dealing with norm issues.

Internet

The internet is the world's largest network. The internet was developed back in the 1960's for military purposes and approved for commercial use in the 1990's. Internet data transmission is based on the TCP/IP protocol.

Jabber

This error is caused by a constant transmission from a network interface card (NIC). It violates the CSMA/CD rules, hence it cause high utilisation. Cause by faulty NIC or transceiver with transmitting frames greater than 1518 with bad CRF/FCS.

Collision

Collision is when two or more stations transmit at the same time in a joint data channel - e.g. a semi-duplex Ethernet or a shared Ethernet. This means that the data transmitted are worthless because they overlay. By overlaying both signals, the signal level increases to what is known as the collision level. This aborts the transmission to both stations.

Collision Domain

A collision domain is a segment of a CSMA/CD network. In 802.3 Ethernet networks all terminal equipment is on a physical Ethernet segment, also including equipment that is interconnected via a repeater, on the same collision domain. In contrast to repeaters that do not affect the collision domain, bridges and routers separate the collision domains.

LAN

(Local Area Network) local network e.g. within a building (see also WAN).

Link Integrity Test

This test ensures that the Ethernet link is connected properly and that the signals are transmitted correctly. This is a helpful extra but does not guarantee that the link functions perfectly.

Link Layer

The link layer in the OSI reference model.

Link Pulse

The NLP pulse is a recognition pulse that is transmitted from 10Base-T-stations to 100Base-T stations for auto-negotiation. The NLP is a periodic pulse with an interval of 16 +/- 8 ms.

MAC Address

The MAC address is the six byte long hardware address that uniquely identifies a node in the network. The MAC address is hard-coded onto a chip and cannot be manipulated. MAC addresses are assigned according to a particular key that includes unique adapter recognition, identification of the manufacturer and an ID for operating and managing.

Manchester Encoding

Signal encoding where the binary information is shown by the sign of a change in voltage within the bit time. This means that transmitters and receivers are very easy to synchronise, as the transfer in the middle of the bit time produces a reliable frequency. The first half of the bit time includes representing the complementary bit value to be transmitted, the second half represents the bit value (specified for IEEE 802.3 Ethernet and used in 10 Mbit networks).

MDI

The Physical Medium Attachment (PMA) and the Medium Dependent Interface (MDI) both form the actual transceiver (MAU) for the 802.3 standard. The MDI is the physical (electrical, optical) and mechanical interface up to the medium. In the different 802.3-types the interface has a different structure.

MDI-X

MDI stands for Medium Dependent Interface and refers to an Ethernet connection. Auto MDI/MDIX (autocrossing) makes the automatic modification of the transmitting and receiving line of a port possible, i.e. the connected Ethernet cable (crossed/uncrossed) and the configuration of the opposite station (MDI/MDIX) are recognised automatically and its own port is configured appropriately. So all auto MDI/MDIX ports can be used as uplink port.

Media converters

Media converters connect different types of cable to one another and the structure and maintain the functions of the network. In its simplest form a media converter is a quadrupole in the form of a box or network adapter card with a power supply. It modifies different cables - coaxial cables, TP-cables and FO cables - and different plugs to fit one another. In this way media converters can for example be used to modify 100Base-TX to 100Base-FX or to convert monomode fibres to multimode fibres. By using media converters the boundaries of network extension can be increased for example by using fibre optic routes, on the other hand existing networks can be inexpensively integrated into new network concepts.

Multicast

Multicast is a type of transmission from a single point to several subscribers at the same time (group).

NIC

A network adapter board is a circuit board or another hardware component that connects the network directly with the terminal equipment. It can be a plug-in board for the bus system in the terminal equipment. The network adapter board is the physical interface to the communications network. It includes the appropriate jacks for connection to the physical medium.

OPC

Object Linking and Embedding (OLE) is an interface developed by Microsoft to link and embed data between different applications. In this way external, but OLE-compatible texts, graphics or tables can be embedded in other OLE applications. Linking OLE compatible data is carried out by link to the appropriate file. The original file remains untouched. During embedding a copy of the file is embedded in the document.

OSI

OSI are internationally-agreed standards which open systems should work with and define the rules for implementing these norms. Communications systems are a combination of network hardware and network and systems software in a group of networked devices that permit free exchange of information between these devices on the basis of joint protocol agreements and interfaces, independently of the type of these devices or how they are equipped. Systems that implement OSI protocols are an example of this. The OSI standards are freely available and not protected by licences.

Packet

A data packet is a defined arrangement of characters as part of the data network, that are treated as a unit in transmission services with data packet transmission. As well as the payload data, data packets also include control information for addressing, sequence of transmission, flow control and error adjustment at all protocol levels. A data packet can be of a predetermined or variable length, but a maximum length is specified. If the whole destination address is included in each data packet, it is called a datagramme. On the other hand in a virtual connection only the first data packet has the whole address, whereas in the following data packets an assignment is made to the appropriate connection.

Patch cable

In the floor distribution point the patch cable creates a flexible connection between floor distribution point and the horizontal wiring. Patch cables are FO cables or copper cables and are also called jumper cords. Patch cables should be very flexible, have a tight bending radius and if possible should max the fixed cable. Patch cables are taken into account in the ISO/IEC 11801 and EN 50173 standards, but are not included in the transmission features specified for the link classes. This should be changed when the cable standards are revised. The patch cable should then, at a length of up to 5 m, be part of a new definition, the channel specification and included in all the transmission features. The jumper cord and a connection cable, also 5 m long, will then be taken into account in this specification.

PAUSE

A single frame is sent via the full-duplex mode to the available stations, to signify that transmissions are to be reduced.

PHY

Physical Layer device. This term is mostly used for a transceiver in Fast and Gigabit Ethernet.

Physical Layer

The Physical Layer (PHY) is the top sublayer or physical layer consisting of the PMD-sublayer and the PHY-sublayer. The PHY-sublayer is underneath the MAC layer and encodes, decodes and synchronises the station with the transmission frequency and the regeneration of the transmission frequency.

Point-to-Point Technology

A type of connection where a connection is generated between two pieces of terminal equipment. Point-to-Point connections occur in the networked environment, in radio broadcasting in beam radio and in the service area. In networks, where point-to-point connections are concerned, instead of a user network interface, an interface to a central facility in the network can also be operated. The connection permanent or on demand.

Port

Connector on a hardware unit. Usually an input/output channel on the computer or other hardware unit such as modem, router, hub or multiplexer.

Port Mirroring

Port mirroring means that the data traffic of a switch port can be mirrored, in order to detect errors or to measure throughput, onto another port to which a management station can be connected.

Promiscuous Mode

The Promiscuous Mode is a particular receiver mode for network equipment. In this mode the device reads all the incoming data traffic sent to the network interface that has been switched to this mode and transmits the data to be processed to the operating system. Normally this device would only process packets directed to itself, which is done for example in Ethernet networks by evaluating the MAC address.

Propagation Delay

The delay is the time that the signal requires to go from one point in a transmission channel to another. Depending on the transmission medium, the delay is the speed of light, as in satellite transmission, or less when transmitting in data cables and FO cables. It does not depend on the speed of light and depends mostly on the dielectric constant of the medium or in FO cables on the refraction.

Protocol

A data transmission protocol establishes the rules for the exchange of information in the form of a directory.

This includes all formats, parameters and specifications for a complete, perfect and effective transmission of data. Protocols include conventions on data formats, times and how errors are treated when exchanging data between computers. A protocol is a convention on setting up connections, monitoring connections and terminating connections. Different protocols are necessary in a data connection. Protocols can be assigned to each layer of the reference model. There are communication protocols for the bottom four layers of the reference model and higher protocols for control and data provisioning and its application.

Quality of Service (QoS)

QoS are all procedures that influence the flow of data in LANs and WANs so that the service arrives at the receiver in a particular quality. The ITU has developed a hierarchical QoS model, which takes both the technical aspects of the service into account and the availability and handling of the terminal equipment. The ITU defined three QoS classes on this basis.

RapidRing

Ring topology is the simplest and quickest way of achieving network redundancy. RapidRing™ technology was developed because there was no standard. This provides technical staff in industrial automation with a simple and effective way of achieving redundancy. RapidRing™ provides redundancy in the event of a single error. The devices connected to form a ring, are actually wired in a logical ring. As the ring structure would lead to a loop in the network, a link would logically be deactivated (backup link).

Rapid Spanning Tree

The IEEE Standard Rapid Spanning Tree protocol (RSTP, IEEE 802.3w) is - apart from RapidRing™ - another option to provide redundancy in a network. The RSTP makes a structure similar to the network possible. In this way multi-redundancy can be achieved. Using RSTP in a network is not as simple as using RapidRing™, but RSTP does have a lot of interesting options.

Redundant Networks

Redundant networks are usually set up with Rapid Spanning Tree or RapidRing™ technologies. Both systems have their advantages in the areas they are to be used. In industrial automation it is often quite simple to wire ring structures. Using RSTP in a ring of 15 or more switches will not provide satisfactory speed. When using RapidRing™ in this type of installation, switching times of less than 300 ms and also larger rings are possible.

Remote Management

Remote Management of a switch from every network station equipped with Telnet or web browsers. Remote Management assumes that each switch has its own IP address.

Repeaters

A repeater is an active component that takes on the regeneration functions in Ethernet LANs and operates on the bit transmission layer.

Repeating Hub

A repeater with more than two ports. This term is simplified by referring to it as a hub.

RJ45

The advantages of the RJ45 slot system are its compactness and simplicity. It is using for horizontal wiring and wiring work places. The RJ45 slot system is an eight pole miniature slot system for use in connections with SDP and UTP cables. The plug's eight contacts have serial numbers and are protected from corrosion and mechanical stress with a thin gold layer. The contact points are situated between guide rails the cable is connected with insulation piercing. On the side opposite to the contact side, the RJ45 plug has a fluke that locks the slot when sticking it into a RJ45 jack.

SC-plug-in connection

The SC-plug is a small polarised push/pull plug with high packing density. This LWL-plug is square and can be used for multimode fibres and monomode fibres. Typical insertion loss is at 0.2 dB to 0.4 dB, operating loss in monomode fibres at 50 dB and multimode fibres at least 40 dB. If monomode fibres with skew angle coupling are used instead of oval coupling, the operating loss increases to at least 70 dB. In the duplex type, as a SC-Duplex plug, the plug must be used where there is fibre-optic wiring to the terminal equipment. It is also increasingly used in new installations and in FCS and ATM applications.

Segment

The term segment has many meanings. In networks a segment is a network section delimited by bridges, routers or switches. Where LANs are concerned, a LAN segment or a collision domain is referred to. In token ring networks the transmission section between two neighbouring data stations is meant. In the TCP specifications, a segment describes a single information unit on the communication network.

Slot time

This is an important Ethernet value. The slot time is twice the speed of the signal propagation time between the two networks that are farthest away from one another and the minimum packet length of 64 bytes or 512 bits. At a frequency clock speed of 10 Mbps, or a frequency clock cycle of a 100 ns, this produces a slot time of 51.2 µs. At 100 Mbps the frequency is 10 ns, so therefore the slot time for the same packet length is 51.2 µs. The greater the slot time, the poorer the Ethernet performance.

SNMP

The SNMP protocol means that central network management for many network components is possible. SNMP's main objectives are to decrease the complexity of the management functions, to extend the protocol and to be independent of any network components. The SNMP protocol supports monitoring, controlling and administration of networks. According to the SNMP architecture model a network is divided into network management stations (NMS) and network components. The network management stations carry out applications to monitor and control the network components. The network components have management agents, which carry out management functions.

Spanning Tree Protocol

-> see Rapid Spanning Tree.

ST-plug

This LWL-plug (IEC-SC 86B) specified by AT&T is suitable for both monomode fibres and multimode fibres. The ST-plug is a commonly-available plug, used in LANs. It uses a bayonet lock as its locking system. In this LWL-plug the FO cables is guided through a ceramic or metal ferrule with a pin diameter of 2.5 mm and is prevented from twisting by a metal pin. The ceramic ferrule has been grounded to make its contact area convex. A spring means that there is constant contact to the front of the fibres to be connected.

Star topology

In star topology the transmission stations are connected in a star shape to a central node. Star topologies can only exchange data indirectly via the central node. There is a difference between active and passive star systems. In the former, the middle node is a computer that takes over relaying the messages. Its capacity determines the performance of the network. For example: private exchanges. Passive systems only have one node in the middle that combines the routes. This node does not have any exchange role, its purpose is signal regeneration. Passive star systems can for example be operated with TDMA, CSMA/CD or token access procedures.

Straight-through

A type of cable where the cable connections at both ends are the same. This type of cable is mostly used to connect devices such as switches with the station. Straight-through is the normal way of wiring cables - in contrast to crossover cables.

Station

Each hardware component in a network and the terminal equipment connected to the network. Server, router, telephone, fax machine etc and all communication devices connected with a network adapter (NIC).

Switching Hub

Switches are network components that have switching functions. These switching functions can also take place as exchange functions in long-distance networks and in local networks. In long-distance networks the local exchanges have local switches and the remote exchanges have central switches.

Topology

The configuration of the network nodes and connections is called the physical topology. The logical connections of network nodes possible are referred to as the logical topology. This states which node pairs can communicate with one another and whether they have a direct physical connection. The physical and logical topology does not have to be identical in networks. As a rule network topologies can be divided into two classes, where in the first class connections from one node to the next one are set up and in the second class all network nodes are directly connected to the transmission medium.

The most well-known network topologies are ring topology, bus topology, tree topology and star topology. There is also meshed topology in long-distance networks

Transceiver

Transceiver is a compound word made up of transmitter and receiver and signifying a transmitting/receiving device. The transceiver implements network access of a station to the Ethernet and is sometimes called a MAU.

Trunking

The term trunking occurs in Ethernet networks but also in private exchanges and in mobile communication. In large Ethernet networks trunking is the parallel switching of several Ethernet links. The transmission via the parallel links is used to scale the bandwidth and is activated by the spanning tree algorithm. As the spanning tree protocol is unsuitable for granular bandwidth scaling, this technology has been standardised in the IEE 802.3ad working group and called "Aggregation of multiple link segments".

Twisted-Pair Cable

A twisted-pair cable is a symmetrical copper cable consisting of two wires that are twisted together. The conductors consist of insulated copper conductors. In contrast to asymmetrical cables, such as coaxial cables, symmetrical cables do not have reference potential. The advantage is that wires can be arranged to prevent interference between the lines.

VLAN

Virtual networks or virtual LANs (VLAN) are a technological concept for implementing logical work groups within a network. This type of network is implemented using LAN-switching or virtual routing on the link layer or on the network layer.

Full Duplex Operation

In full duplex operation or duplex operation both communications partners can communicate bi-directionally at the same time.

Webserver

A web server is a server programme that provides files via HTTP protocol. These files are usually websites, pictures and style sheets. It makes no difference to the webserver what type of files it supplies. Each time a web site is requested (for example by clicking a link), the browser sends an HTTP query to a web server. This web server can then send the site requested back. The standard ports for the web server are 84 HTTP protocol and 443 for HTTPS, the encrypted HTTP (for example with SSL). Usually all page requests are saved in a log file, from where - by using log file analysis - different statistics on access can be generated. However these do not give the full picture, as HTTP is a connectionless protocol.

Wireless Standards - What is Zigbee?

We're beginning to hear more and more about this wireless technology called ZigBee. A catchy name for sure, but what is it and who needs it? We already have Bluetooth- and Wi-Fi-enabled devices, and WiMAX and Wireless USB proliferation are at the doorstep. Who needs another wireless standard?

Each wireless technology that makes it to market serves a special purpose or function. Bluetooth and wireless USB provide short-range connectivity in what is called a personal-area network (PAN). Bluetooth serves a short-range, moderate-speed, wire replacer, and wireless USB provides short-range, high-speed device connectivity. Wi-Fi is for local-area networks (LANs) and WiMAX is designed to provide wide-area networking (WAN) or metropolitan-area networking (MAN).

ZigBee fills yet another industry niche. It is a PAN technology based on the IEEE 802.15.4 standard. Unlike Bluetooth or wireless USB devices, ZigBee devices have the ability to form a mesh network between nodes. Meshing is a type of daisy chaining from one device to another. This technique allows the short range of an individual node to be expanded and multiplied, covering a much larger area.

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For more details see the files at “Fieldbus Class Room“

Wireless Standards Comparison 139kb

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One ZigBee network can contain more than 65,000 nodes (active devices). The network they form in cooperation with each other may take the shape of a star, a branching tree or a net (mesh). What's more, each device can operate for years off of a AA cell. That means that each node uses little power.

What might be perceived as a disadvantage is the low data rate of ZigBee devices, typically less than 100 kbps, depending on the selected frequency band. Is slow bad? That depends on the function or service the technology is intended to provide.

Who needs ZigBee?

If you are looking for wireless monitoring and remote control solutions, ZigBee may be the answer. Those are the functions for which ZigBee was designed. ZigBee nodes can be used to tie an entire home, office or factory together for safety, security and control.

Nodes are embedded in hundreds of sensors and controls that are built into large infrastructures for home automation, industrial automation, remote metering, automotives, medical equipment, patient monitoring, asset tracking systems, security systems, lighting and temperature control systems, and even toys.

There are three categories of ZigBee devices:

- ZigBee Network Coordinator. Smart node that automatically initiates the formation of the network.
- ZigBee Router. Another smart node that links groups together and provides multi-hoping for messages. It associates with other routers and end-devices.
- ZigBee End Devices. Where the rubber hits the road-sensors, actuators, monitors, switches, dimmers and other controllers.

Bottom line - ZigBee networks provide smart, low-cost, low-power, low-maintenance monitoring and control systems.

To learn more about ZigBee technology, visit the ZigBee Alliance Website http://www.zigbee.org. The Alliance is an association of hundreds of members from around the world, working together to enable reliable, cost-effective, low-power, wirelessly networked, monitoring and control products based on an open global standard.

Ethernet Cable

CAT5 Ethernet Cable

This is inexpensive unshielded twisted pair (UTP) data grade cable, but for industrial control you have to get the shielded twisted pair (STP) cable. It is very similar to ubiquitous telephone cable but the pairs are more tightly twisted. Fast Ethernet carried over CAT5 cable is known as 100BASE-TX. A CAT5 cable usually contains four twisted data pairs of which two are actually used by Ethernet; one pair for transmit and one for receive.

Newer "class 6 or 7" cables such as Belden MediaTwist 1872A have even better performance than CAT5 cable. These newer cable types have less loss and crosstalk within the cable and are more immune to interference from outside sources.

Fiber Optic Cable

Installation of fiber optic cabling is not the rocket science it once was. Great strides have been made in the durability cost and ease of termination of this media.

Fiber optic cable offers two main advantages over twisted pair cable. First, data may be carried much further over fiber. Second, fiber is immune to electromagnetic interference.

There are two basic types of fiber in use today: Multimode and Single Mode. Multimode fiber is used extensively in the data communications industry. Fast Ethernet carried over multimode fiber is known as 100BASE-FX. Ethernet may be carried up to 2 kilometers on this fiber. Single mode fiber is used extensively in the telecom industry. Single mode fiber allows much greater run lengths than multimode fiber. Although there is no official standard for carrying Ethernet over single mode fiber, numerous datacom products offer this capability

Crossover Cable

A crossover cable can be used to directly connect two network devices, hubs or switches. A crossover cable is a CAT5 cable wired such that the transmit data pair at one end is connected to the receive data pair at the other.