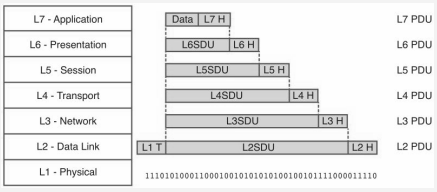
OSI Layers

Application Layer	Includes all the services of a user application, including the interaction with the end user. **Protocols:** FTP, HTTP, SMTP **Devices:** Hosts, Servers
Presentation Layer	Provides services to the application layer to deal with specific syntax, which is how data is presented to the end user
Session Layer	Provides services to the presentation layer to establish a session and exchange presentation layer data
Transport Layer	Includes services for end-to-end connection establishment and information delivery. **Protocols:** TCP, UDP **Devices:** Stateful firewalls
Network Layer	Includes the function necessary to transmit information across a network and provides abstraction on the underlying means of connection. **Protocol:** IP **Devices:** Router
Data Link Layer	Includes protocols and functions to transmit information over a link between two connected devices. **Protocols:** Ethernet, PPP, ATM **Devices:** Switches
Physical Layer	Provides services for the transmission of bits over the data link. **Protocols:** Ethernet, cable, optical **Devices:** Repeater

Encapsulation



Encapsulation: Each layer protocol adds its own protocol header and passes the information to the lower-layer protocol

Protocol Control Information (PCI): Is the information added by the protocol

Protocol Data Unit (PDU): Is composed by the data produced at that layer plus the PCI for that layer

Service Data Unit (SDU): A unit of data that has been passed down from a layer or sublayer to a lower layer

Ethernet Physical Layer

10BASE-T	**IEEE standard:** 802.3 (Ethernet) **Speed:** 10 Mbps **Media:** Twisted pair (copper) **Maximum Distance:** 100 m
100BASE-T	**IEEE standard:** 802.3u (FastEthernet) **Speed:** 100 Mbps **Media:** Twisted pair (copper) **Maximum Distance:** 100 m
1000BASE-T	**IEEE standard:** 802.3ab (GigaEthernet) **Speed:** 1000 Mbps **Media:** Twisted pair (copper) **Maximum Distance:** 100 m
1000BASE-LX	**IEEE standard:** 802.3z (GigaEthernet) **Speed:** 1000 Mbps **Media:** Long wavelength (single-mode fiber) **Maximum Distance:** 5 km
10GBASE-T	**IEEE standard:** 802.3an (10 GigaEthernet) **Speed:** 10 Gbps **Media:** Twisted pair (copper) **Maximum Distance:** 100 m

Each standard name follows the format sTYPE-M

s: The speed. For example, 1000

TYPE: The modulation type. For example, baseband [BASE]

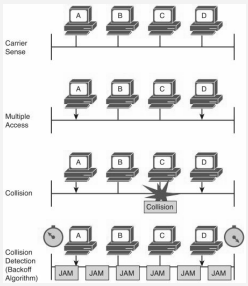
M: The information about the medium. Examples include T for twisted pair, F for fiber, L for long wavelength, and X for external sourced coding

Ethernet Medium Access Control

Half duplex	Two Ethernet devices share a common transmission medium. The access is controlled by implementing Carrier Sense Multiple Access with Collision Detection (CSMA/CD)
Full duplex	Two devices can transmit simultaneously because there is a dedicated channel allocated for the transmission. Because of that, there is no need to detect collisions or to wait before transmitting

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CSMA/CD



Carrier Sense Multiple Access/Collision Detection:
When a collision occurs, it is detected by CSMA/CD-enabled devices, which will then stop transmitting and will delay the transmission for a certain amount of time, called the backoff time. The jam signal is used by the station to signal that a collision occurred. All stations that can sense a collision are said to be in the same collision domain

Ethernet Frame

Preamble	**Length in Bytes:** 7 **Function:** Used for the two stations for synchronization purposes
Start Frame Delimeter	**Length in Bytes:** 1 **Function:** Indicates the start of the Ethernet frame. This is always set to 10101011
Destination Address	**Length in Bytes:** 6 **Function:** Contains the recipient address of the frame
Source Address	**Length in Bytes:** 6 **Function:** Contains the source of the frame
Length/Type	**Length in Bytes:** 2 **Function:** This field can contain either the length of the MAC Client Data (length interpretation) or the type code of the Layer 3 protocol transported in the frame payload (type interpretation)

Ethernet Frame (cont)

MAC Client Data and Pad	**Length in Bytes:** 46-1500 **Function:** This field contains information being encapsulated at the Ethernet layer. The minimum length is 46 bytes and the maximum length depends on the type of Ethernet frame: - 1500 bytes for basic frames - 1504 bytes for Q-tagged frames - 1982 bytes for envelope frames
Frame Check Sequence	**Length in Bytes:** 4 **Function:** This field is used by the receiving device to detect errors in transmission

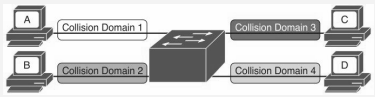
Ethernet Addresses

Broadcast	A broadcast MAC address is obtained by setting all 1s in the MAC address field. This results in an address like FFFF.FFFF.FFFF. A frame with a broadcast destination address is transmitted to all devices within a LAN
Multicast	A frame with a multicast destination MAC address is transmitted to all frames belonging to the specific group
Unicast	A unicast address is associated with a particular device's NIC or port. It is composed of two sections. The first 24 bits contain the Organizational Unique Identifier (OUI) assigned to an organization. The other portion of the MAC address can be assigned by the vendor itself

To transmit a frame, Ethernet uses source and destination addresses. The Ethernet addresses are called MAC addresses, or Extended Unique Identifier (EUI), and they are either 48 bits or 64 bits. The MAC address is usually expressed in hexadecimal. The following two ways are the ones used the most:
01-23-45-67-89-ab (IEEE 802 notation)
0123.4567.89ab (Cisco notation)

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LAN Switches



Collision Domain: Two or more stations needing to share the same medium.
LAN Switch: Device that allows multiple stations to connect in full-duplex mode. This creates a separate collision domain for each of the ports.

Switch Frame Fowarding

MAC address table	This table holds the link between a MAC address and the physical port of the switch where frames for that MAC address should be forwarded
Dynamic MAC address learning	This mechanism helps populating the MAC address table. When a switch receives an Ethernet frame on a port, it notes the source MAC address and inserts an entry in the MAC address table, marking that MAC address as reachable from that port
Ethernet Broadcast domain	A broadcast domain is formed by all devices connected to the same LAN switches. Broadcast domains are separated by network layer devices such as routers. An Ethernet broadcast domain is sometimes also called a subnet

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