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Welcome to CPSC 441!



Outline

- MAC address
- Introduction to Ethernet
- Ethernet frame structure
- Ethernet technologies

MAC address

- Different from IP address, MAC address can be regarded as **link-layer address**
- **6-byte** address expressed in hexadecimal numbers
- Usually permanent, no duplication
- Broadcast address **FF-FF-FF-FF-FF-FF**
- Mac address is analogous to a person's SIN number, while IP address is analogous to postal address.

Introduction of Ethernet

- **Ethernet**, defined under **IEEE 802.3**, is one of today's most widely used data communications standards
 - It finds its major use in Local Area Network (LAN)
 - it has largely replaced competing wired LAN technologies
- **Found** by Xerox Palo Alto Research Center (PARC) in 1975
- Original designed as a 2.94 Mbps system to connect 100 computers on a 1 km cable
- Later, Xerox, Intel and DEC drew up a standard support 10 Mbps
- Basis for the IEEE's 802.3 specification

Ethernet network elements

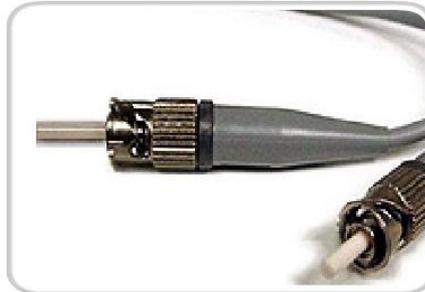
Physical Devices Implementing Ethernet



UTP patch panels in a rack



Ethernet switches



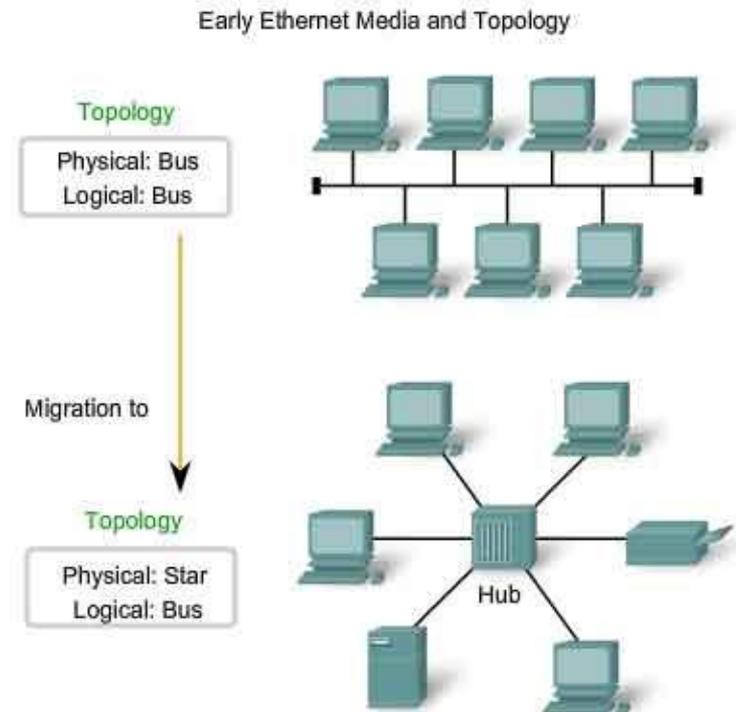
Ethernet fiber connectors



Ethernet switch

Ethernet network topologies

- **Point to point:** This is the simplest configuration as only two network units are used.
- **Coaxial bus:** Broadcast LAN- all transmitted frames travel to and are processed by **all adapters** connected to bus.
- **Hub-based star network:** Also broadcast LAN – hosts are directly connected to a hub with twisted-pair copper wire.

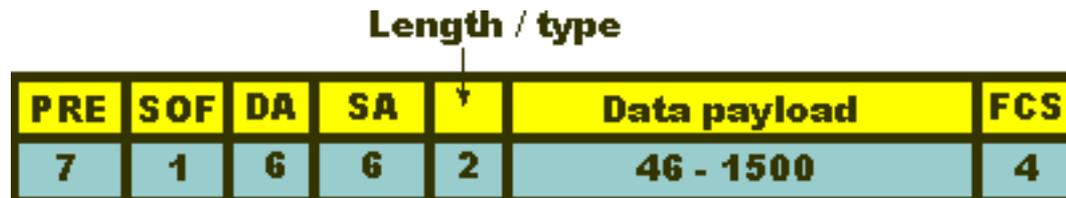


Ethernet network topologies – cont.

- **Hub:** a physical-layer device that acts on individual bits rather than frames. When a bit arrives from one interface, the hub simply re-creates the bit, boost its energy strength, and transmit the bit onto all other interface
- **Hub-based star network:** Hub sends a copy out on all of its other interfaces for whatever it receives.
- **Switch-based star network:** Hub is replaced by switch, so that the packet switch process is taken place on the unit of frame.

Ethernet IEEE 802.3 Frame Format / Structure

- Frame structures are developed within the MAC layer of the protocol stack.
- **10 / 100 Mbps Ethernet MAC data frame format**



– **Header**

- **Preamble (PRE)** - informs the receiving stations that a frame is starting as well as enabling synchronization.
 - **Start Of Frame delimiter (SOF)**- signal the start of the actual frame
 - **Destination Address (DA)** – first bit: 0-an individual address, 1-a group address. The next bit into the DA indicates whether the address is globally administered (0), or local(1). 46 remaining bits-destination address.
 - **Source Address (SA)** - always an individual address the left most bit is always a zero
 - **Length / Type** - It provides MAC information and indicates the number of client data types that are contained in the data field of the frame.
- **Payload: Data** - minimum of 46 bytes, up to 1500 bytes long
- **Trailer: Frame Check Sequence (FCS)** - This field is four bytes long. It contains a 32 bit Cyclic Redundancy Check (CRC).

Ethernet IEEE 802.3 Frame Format / Structure

- **1000 Mbps Ethernet MAC data frame format**

- Extension: When using the 1000Base-X standard, there is a minimum frame size of 416bytes, and for 1000Base-T there is a minimum frame size of 520bytes. to any frames that are shorter than the MFL.

Length / type

↓

PRE	SOF	DA	SA		Data payload	FCS	EXT
7	1	6	6	2	46 - 1500	4	Variable

- **Ethernet addresses**

- Every Ethernet network interface card (NIC) is given a unique identifier called a **MAC address**.
- This is assigned by the manufacturer of the card.
- The MAC address comprises of a **48-bit** number.
 - The first 24 bits identify the manufacturer
 - The second half of the address is assigned by the manufacturer and it is known as the extension of board ID.
- The MAC address is usually programmed into the hardware so that it **cannot be changed**. Even if the interface card moves to another location across the world, the user can be reach.

Ethernet IEEE 802.3 Standards

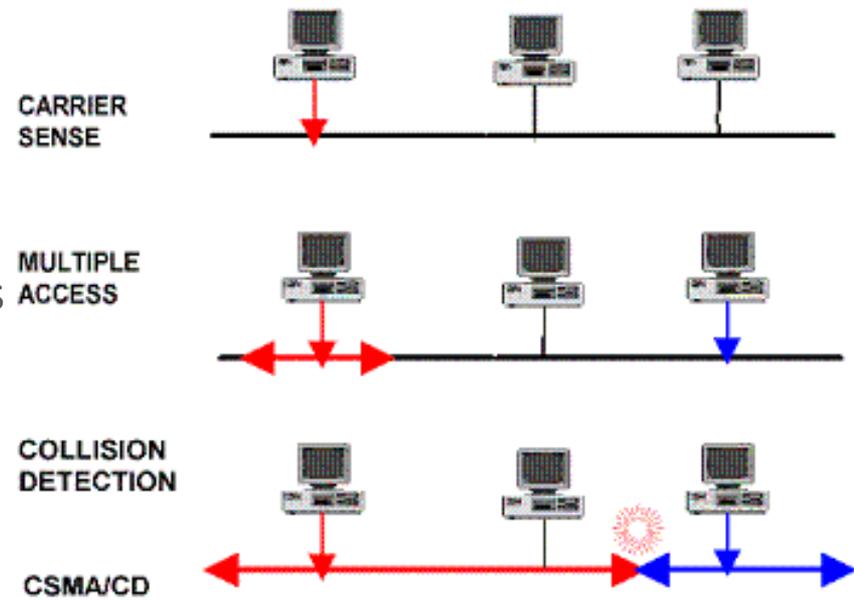
- **Ethernet terminology:** three parts. Eg: **10Base-T** and 100Base-T.
 - **The first number** (typically one of 10, 100, or 1000) indicates the transmission speed in megabits per second.
 - **The second term** indicates transmission type: BASE = baseband (the physical media only carries Ethernet traffic); BROAD = broadband.
 - **The final part refers to the physical media itself**
 - T: means unshielded twisted-pair cables. Further numbers indicate the number of twisted pairs available. For example in 100BASE-T4, the T4 indicates four twisted pairs.

100 Mbps Ethernet / IEEE 802.3u including 100 Base-T

- **100BaseT** Ethernet (Fast Ethernet) is defined under the 802.3 family of standards under **802.3u**.
- One of the most widely used forms of Ethernet.
- All the nodes within the network share the 100 Mbps bandwidth.
- it uses the CSMA/CD access method, but there are some minor differences in the way the overall system operates.
- It runs on UTP or optical fiber cable and uses a star topology.

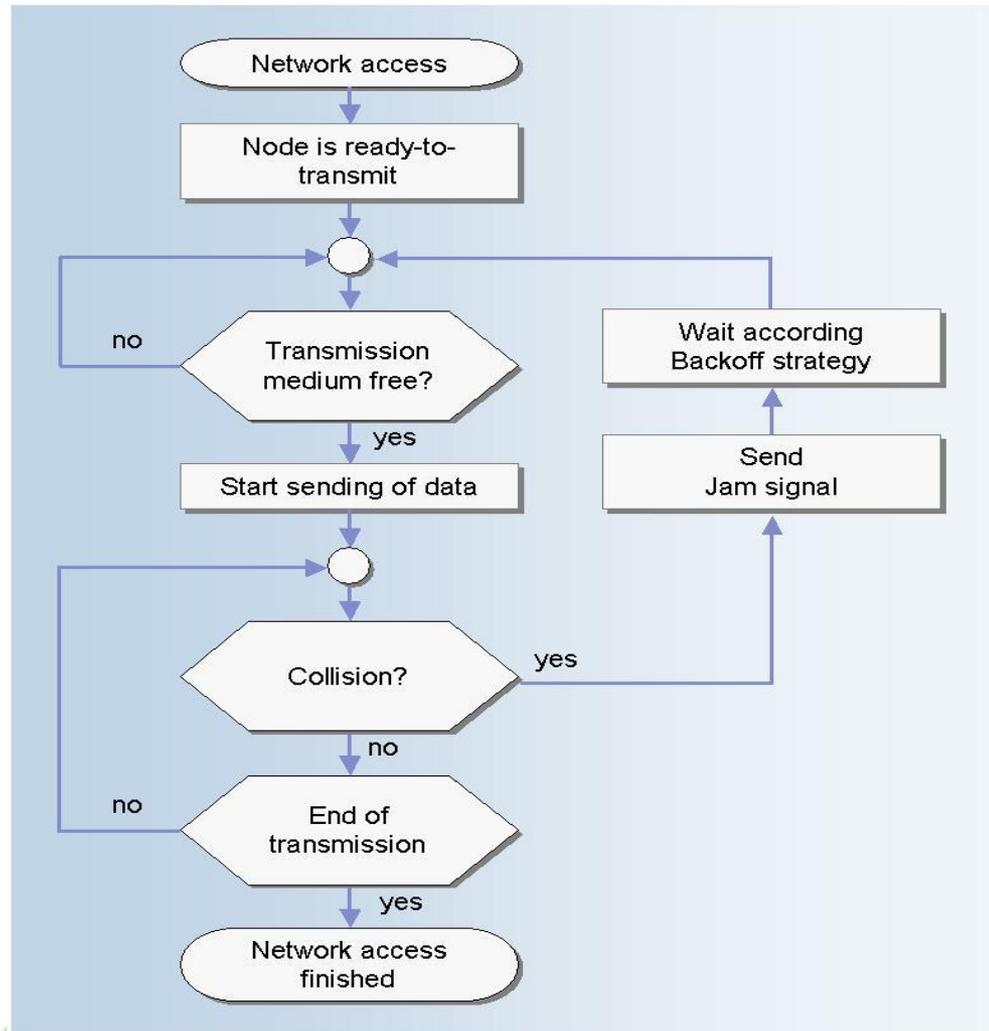
Ethernet Media Access Control method

- Ethernet uses CSMA/CD: **C**arrier **S**ense **M**ultiple **A**ccess / **C**ollision **D**etection
 - **Carrier Sense**: each station listens on the network for traffic and it can detect when the network is quiet.
 - **Multiple Access**: describe the fact that multiple stations can send and receive on the medium
 - **Collision Detect**:
it is still possible that two stations will start to transmit at virtually the same time. If this occurs then the stations can detect this and they will stop transmitting. They then back off a random amount of time before attempting a retransmission.



Ethernet Media Access Control method

- CSMA/CD Algorithm

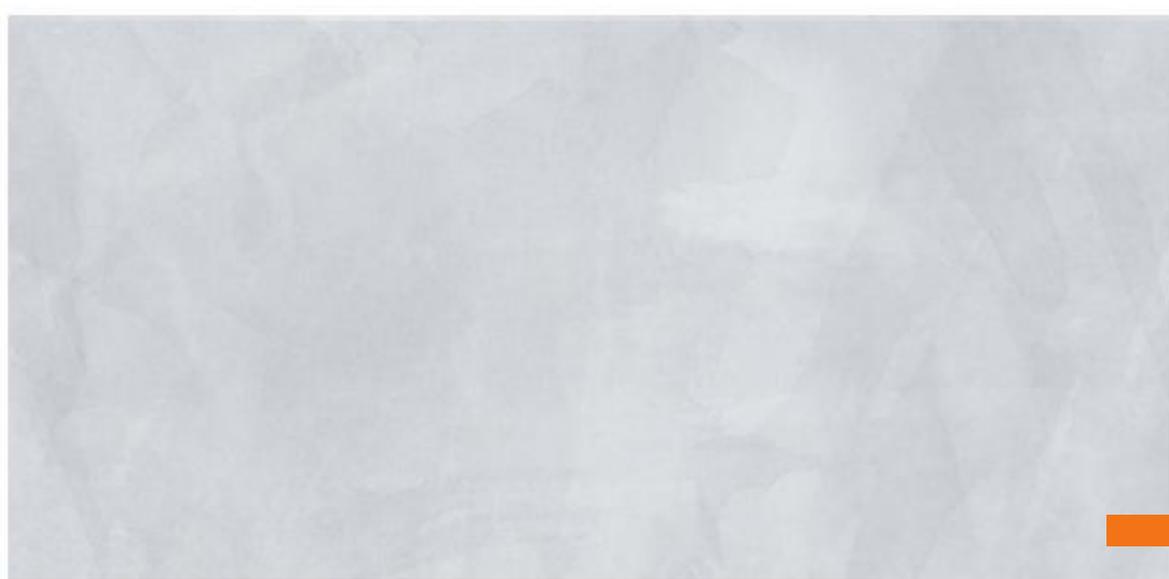


Gigabit Ethernet

- The next development of the Ethernet standard beyond the popular 100Base-T version.
- Allows the transfer of data at speeds of 1000 Mbps or 1Gbps.
- It is particularly easy to install because the 1000Base-T variant is designed to run over Cat 5 UTP (unshielded twisted pair) that is widely and cheaply available.

Gigabit Ethernet

- Provide for half and full duplex operation at speeds of 1000 Mbps.
- Use the 802.3 Ethernet frame formats.
- Use the CSMA/CD access method with support for one repeater per collision domain.
- Provide backward compatibility with 10BASE-T and 100BASE-T technologies.



Thanks for attending!

