

# Lecture (05)

## Data link layer fundamentals (III)

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## Agenda

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- Recent Ethernet Standards
- Fast Ethernet
- Gigabit Ethernet
- Ethernet Addressing
- Ethernet Framing

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## Recent Ethernet Standards

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- More recently created alternatives, are Fast Ethernet and Gigabit Ethernet
- Fast Ethernet most likely being used on the desktop and Gigabit Ethernet being used between networking devices or on servers.
- Additionally, 10 Gb provides yet another improvement in speed and performance

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## Fast Ethernet

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- Fast Ethernet, as defined in IEEE 802.3u, retains many familiar features of 10-Mbps IEEE 802.3 Ethernet variants.
- The age-old CSMA/CD logic still exists, but it can be disabled for full-duplex point-to-point topologies in which no collisions can occur.
- The 802.3u specification calls for the use of the same old IEEE 802.3 MAC and 802.2 LLC framing for the LAN headers and trailers.
- A variety of cabling options is allowed—unshielded and shielded copper cabling as well as multimode and single-mode fiber.

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## Fast Ethernet (2)

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### Key features

1. higher bandwidth
  2. auto negotiation, allows an Ethernet card or switch to negotiate dynamically to discover whether it should use either 10 or 100 Mbps
- many Ethernet cards and switch ports are called 10/100 cards or ports today because they can autonegotiate the speed.
  - The endpoints autonegotiate whether to use half duplex or full duplex as well.
  - If autonegotiation fails, it settles for half-duplex operation at 10 Mbps.

## Fast Ethernet (3)

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### Recommendations

- for devices that seldom move, such as servers and switches, you should configure the LAN switch and the device to use the identical desired setting instead of depending of autonegotiation
- using autonegotiation for switch ports connected to end-user devices because these devices are moved frequently relative to servers or other network devices, such as routers.

## Gigabit Ethernet

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- The IEEE defines Gigabit Ethernet in standards 802.3z for optical cabling and 802.3ab for electrical cabling.
- Gigabit Ethernet retains many familiar features of slower Ethernet variants.
- CSMA/CD still is used and can be disabled for full-duplex support.
- uses of the same old IEEE 802.3 MAC and 802.2 LLC framing for the LAN headers and trailers
- The most likely place to use Gigabit is between switches, between switches and a router, and between a switch and a server.

## Gigabit Ethernet (2)

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- Gigabit Ethernet differs from the slower Ethernet specifications in how it encodes the signals onto the cable.
- Gigabit Ethernet is obviously faster, at 1000 Mbps, or 1 Gbps.

## Ethernet Addressing

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### Terms:

- Ethernet LAN addressing identifies either individual devices or groups of devices on a LAN
- *Term unicast addresses, or individual addresses, is used because it identifies an individual LAN interface card.*
- While terms *broadcast, multicast, refers to a group addresses.*

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## Ethernet Addressing (2)

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### How dose it work?

- For instance, imagine that Fred and Barney are on the same Ethernet, and Fred sends Barney a frame.
- Fred puts his own Ethernet MAC address in the Ethernet header as the source address and uses Barney's Ethernet MAC address as the destination.
- When Barney receives the frame, he notices that the destination address is his own address, so Barney processes the frame.
- If Barney receives a frame with some other device's unicast address in the destination address field, Barney simply does not process the frame.

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## Ethernet Addressing (3)

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### IEEE standard MAC addresses:

- The IEEE requires globally unique unicast MAC addresses on all LAN interface cards.
- manufacturers encodes the MAC address onto the card, usually in a ROM chip.
- The first half of the address identifies the manufacturer of the card *-organizationally unique identifier (OUI)-*.
- the second half of the address being assigned a number that this manufacturer has never used on another card.

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## Ethernet Addressing (4)

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### Group addresses

- The IEEE defines two general categories of group addresses for Ethernet:
  1. **Broadcast addresses** have a value of FFFF.FFFF.FFFF (hexadecimal notation). The broadcast address implies that all devices on the LAN should process the frame. Ethernet Data-Link Protocols
  2. **Multicast addresses**—are used to allow a subset of devices on a LAN to communicate. Some applications need to communicate with multiple other devices.

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## Ethernet Addressing (5)

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- By sending one frame, all the devices that care about receiving the data sent by that application can process the data, and the rest can ignore it.
- The IP protocol supports multicasting.
- When IP multicasts over an Ethernet, the multicast MAC addresses used by IP follow this format: 0100.5exx.xxxx, *where any value can be used in the last half of the addresses.*

## Ethernet Addressing (6)

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### Summary:

#### LAN MAC Address Terminology and Features

LAN Addressing Terms and Features	Description
MAC	Media Access Control. 802.3 (Ethernet) and 802.5 (Token Ring) are the MAC sublayers of these two LAN data-link protocols.
Ethernet address, NIC address, LAN address, Token Ring address, card address	Other names often used instead of MAC address. These terms describe the 6-byte address of the LAN interface card.
Burned-in address	The 6-byte address assigned by the vendor making the card. It usually is burned into a ROM or EEPROM on the LAN card and begins with a 3-byte organizationally unique identifier (OUI) assigned by the IEEE.
Unicast address	Fancy term for a MAC that represents a single LAN interface.
Broadcast address	An address that means "all devices that reside on this LAN right now."
Multicast address	Not valid on Token Ring. On Ethernet, a multicast address implies some subset of all devices currently on the LAN.

## Ethernet Framing

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### Definition:

- Framing defines the meaning behind the bits that are transmitted across a network.
- Which refers to the definition of the fields assumed to be in the data that is received.

## Ethernet Framing (2)

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### Real life example:

- For instance, if Fred is sending data to Barney over an Ethernet.
- Fred put Barney's Ethernet address in the Ethernet header so that Barney would know that the Ethernet frame was meant for Barney.
- The IEEE 802.3 standard defines the location of the destination address field inside the string of bits sent across the Ethernet .

## Ethernet Framing (3)

### Maximum transmission unit (MTU)

- The IEEE 802.3 specification limits the data portion of the 802.3 frame to a maximum of 1500 bytes.
- The Data field was designed to hold Layer 3 packets; the term *maximum transmission unit (MTU) defines the maximum Layer 3 packet that can be sent over a medium.*
- Because the Layer 3 packet rests inside the data portion of an Ethernet frame, 1500 bytes is the largest IP packet allowed over an Ethernet.

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## Ethernet Framing (4)

### Identifying the Data Inside an Ethernet Frame

There are three type of Ethernet frame

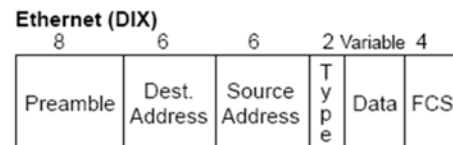
1. Ethernet DIX (early version of Ethernet by DEC, IBM, and Xerox)
2. IEEE Ethernet 802.3
3. IEEE Ethernet with SNAP header (*Subnetwork Access Protocol*)

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## Ethernet Framing (5)

### 1. Ethernet DIX

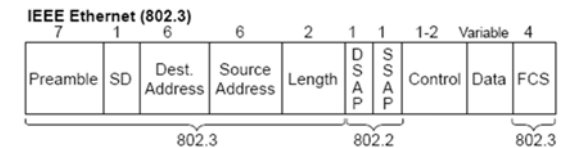


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## Ethernet Framing (6)

### 2. IEEE Ethernet (802.3)



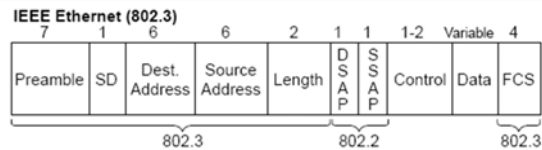
Why?

- when the IEEE created 802.2, it saw the need for a protocol type field that identified what was inside the field called "data" in an IEEE Ethernet frame.
- The IEEE called its Type field the destination service access point (DSAP).

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## Ethernet Framing (7)



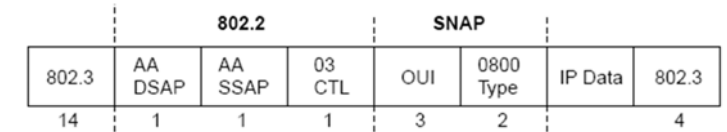
- When the IEEE first created the 802.2 standard, anyone with a little cash could register favorite protocols with the IEEE and receive a reserved value with which to identify those favorite protocols in the DSAP, and SSAP field.
- For instance, Novell registered IPX and was assigned hex E0 by the IEEE.
- However, the IEEE did not plan for a large number of protocols—and it was wrong. As it turns out, the 1-byte-long DSAP field is not big enough to number all the protocols.

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## Ethernet Framing (8)

### 3. IEEE Ethernet with SNAP header



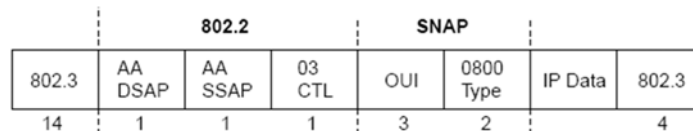
- To accommodate more protocols, the IEEE allowed the use of an extra header, called a *Subnetwork Access Protocol (SNAP) header*
- To identify that type of header, the DSAP, & SSAP field is AA, which implies that a *SNAP header follows the 802.2 header, and the SNAP header* includes a 2-byte protocol type field. Which is used for the same purpose as the DSAP field, but because it is 2 bytes long, all the possible protocols can be identified.

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## Ethernet Framing (9)

- For instance, in Figure, the SNAP type field has a value of 0800, signifying that the next header is an IP header



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## Ethernet Framing (10)

### Other Examples

- Some examples of values in the Ethernet Type and SNAP Protocol fields are 0800 for IP and 8137 for NetWare.
- Examples of IEEE SAP values are E0 for NetWare, 04 for SNA, and AA for SNAP.
- Interestingly, the IEEE does not have a reserved DSAP value for TCP/IP; SNAP headers must be used to support TCP/IP over IEEE Ethernet.

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# Ethernet Framing (11)

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## Headers summary:

### *Protocol Type Fields in LAN Headers*

Field Name	Length	LAN Type
Ethernet Type	2 bytes	DIX Ethernet
802.2 DSAP and SSAP	1 byte each	IEEE Ethernet, IEEE Token Ring, ANSI FDDI
SNAP Protocol	2 bytes	IEEE Ethernet, IEEE Token Ring, ANSI FDDI

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Thanks,..  
See you next week (ISA),...