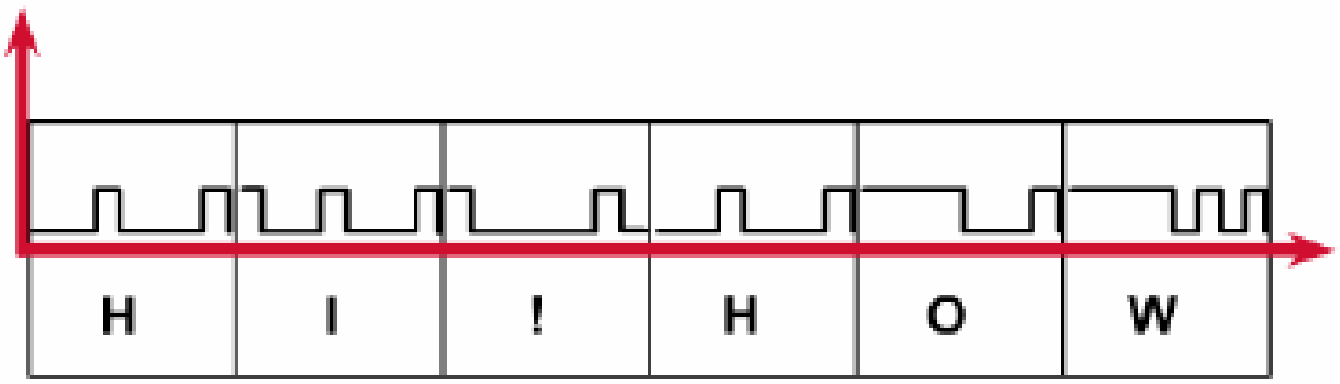
Chapter 6

LAYER 2 CONCEPT

The Saigon CTT

LAN STANDARDS

Limitations of Layer 1

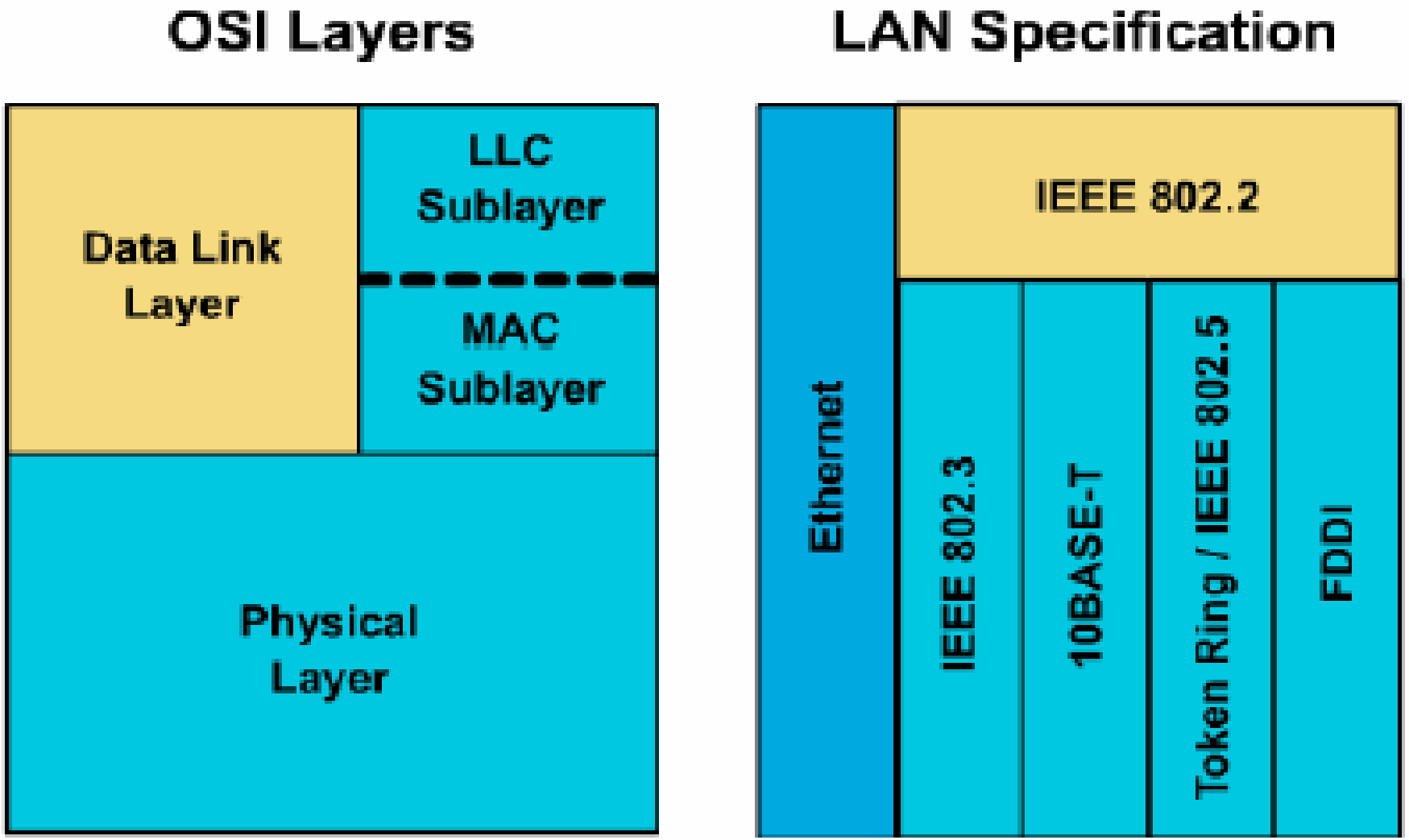


- Cannot organize streams of bits.
- Cannot name or identify computers.
- Cannot communicate with the upper-level layers.
- Cannot decide which computer will transmit binary data.

Layer 2

- Layer 2 uses *framing* to organize or group the bits.
- Layer 2 uses an *addressing* process to identify computers.
- Layer 2 uses *Logical Link Control* (*LLC*) to communicate with the upper-level layers.
- Layer 2 uses *Media Access Control* (*MAC*) to decide which computer will transmit.

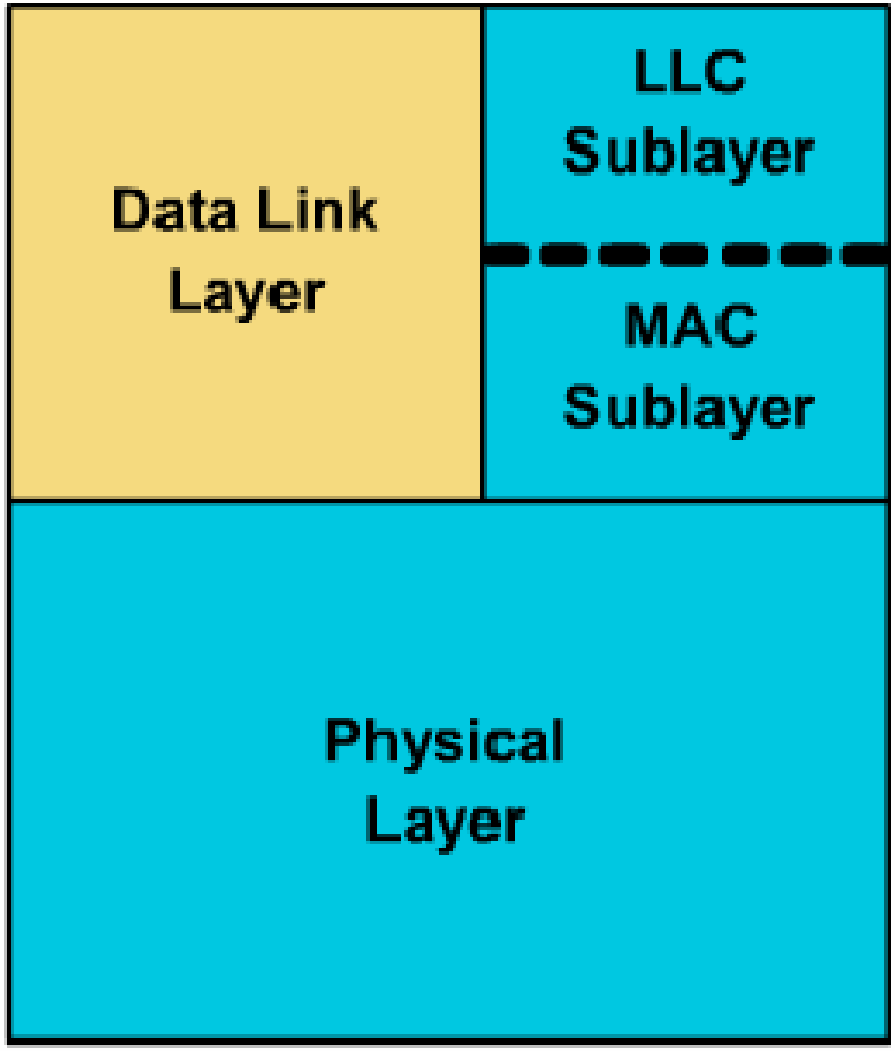
OSI and various LAN standard



IEEE

- The Institute of Electrical and Electronic Engineers.
- LAN standards:
  - 802.1d: Spanning tree.
  - 802.2: LLC.
  - 802.3: MAC ~ Ethernet.
  - 802.5: MAC ~ Token ring.
  - 802.11: Wireless LAN.

IEEE LAN Standard

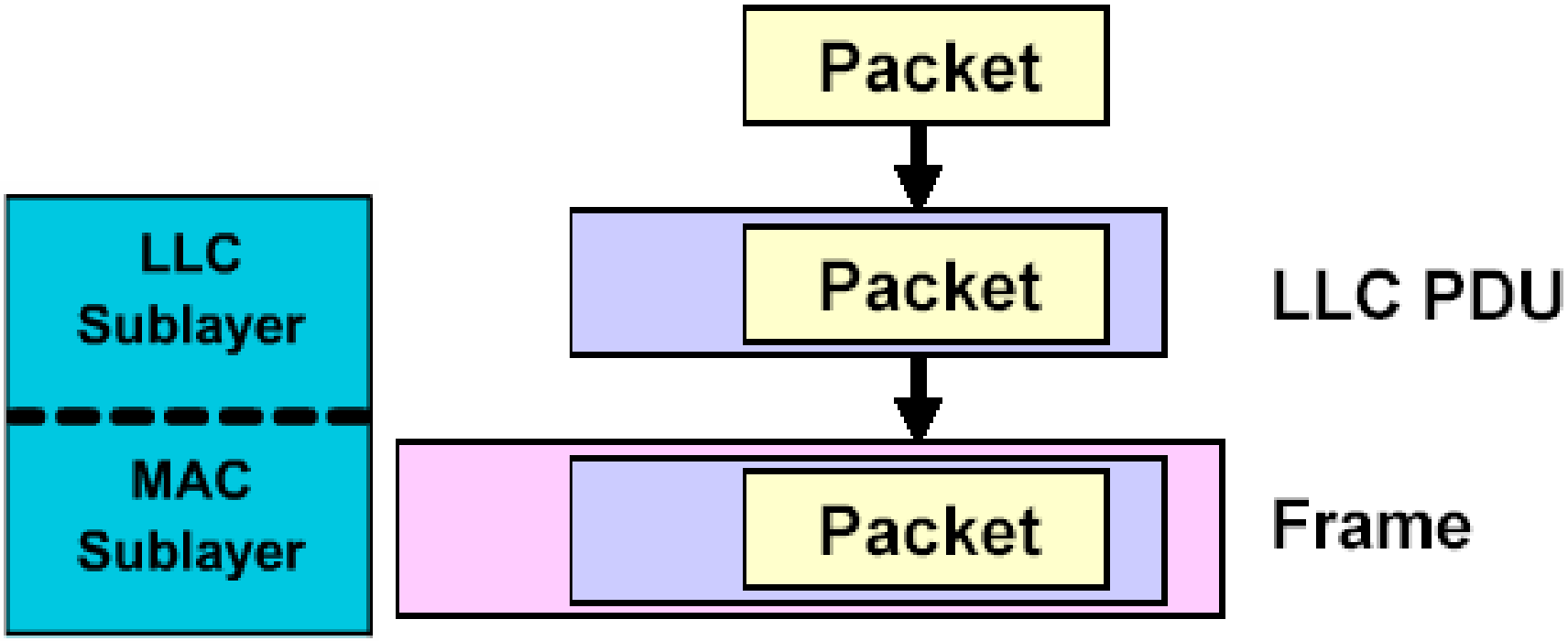


- **Logical Link Control (LLC): Transitions up to the network layer.**
- **Media Access Control (MAC): Transitions down to media.**

Two Sub-layers WHY ?

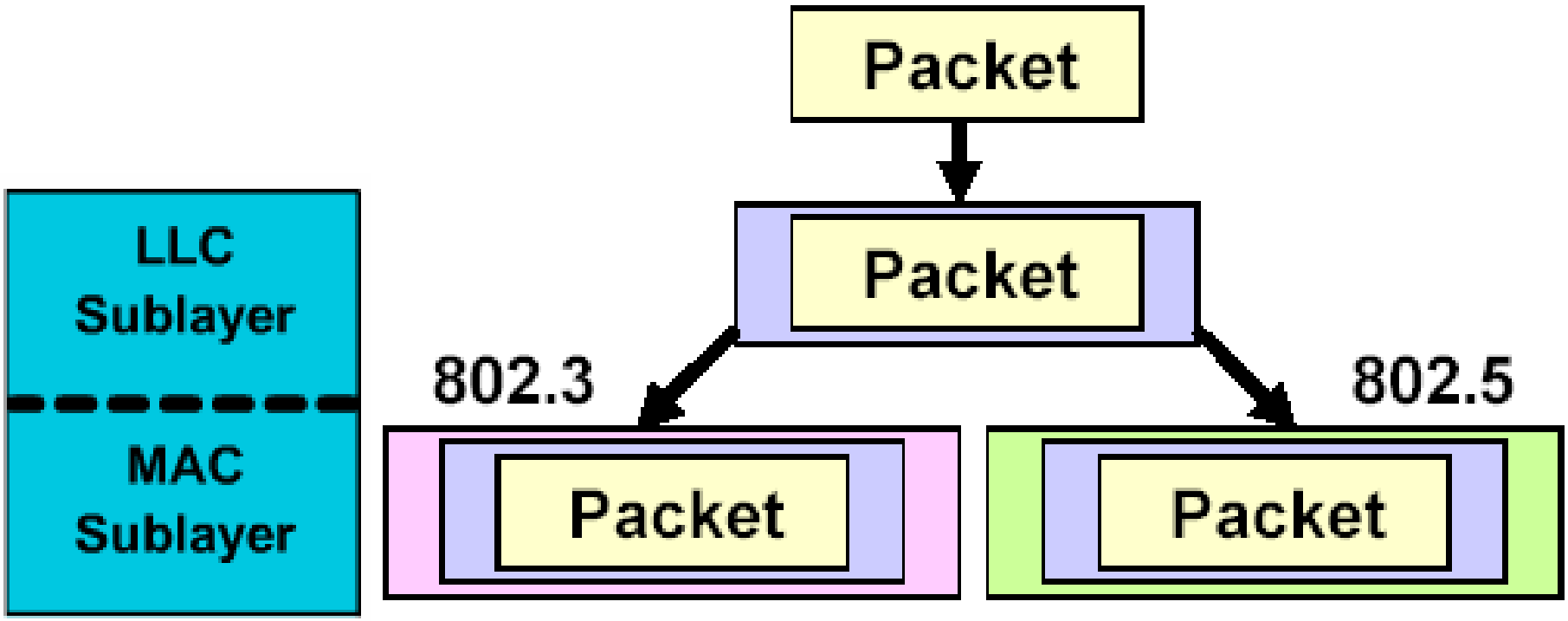
- **LLC serves to communicate upward to Network layer, independent of the specific LAN technology used and Upper layer.**
- **MAC serves to access and communicate downward to the technology-specific Physical layer.**

LLC



- **PDU: Protocol data unit**
- **DSAP: Destination service access point**
- **SSAP: Source service access point**

MAC



- **Naming.**
- **Framing.**
- **Media access control rules.**

4 Concepts of Layer 2

1. Layer 2 uses framing to organize or group the data.
2. Layer 2 uses a flat addressing convention.
3. Layer 2 communicates with the upperlevel layers through LLC.
4. Layer 2 uses MAC to choose which computer will transmit binary data, from a group in which all computers are trying to transmit at the same time.

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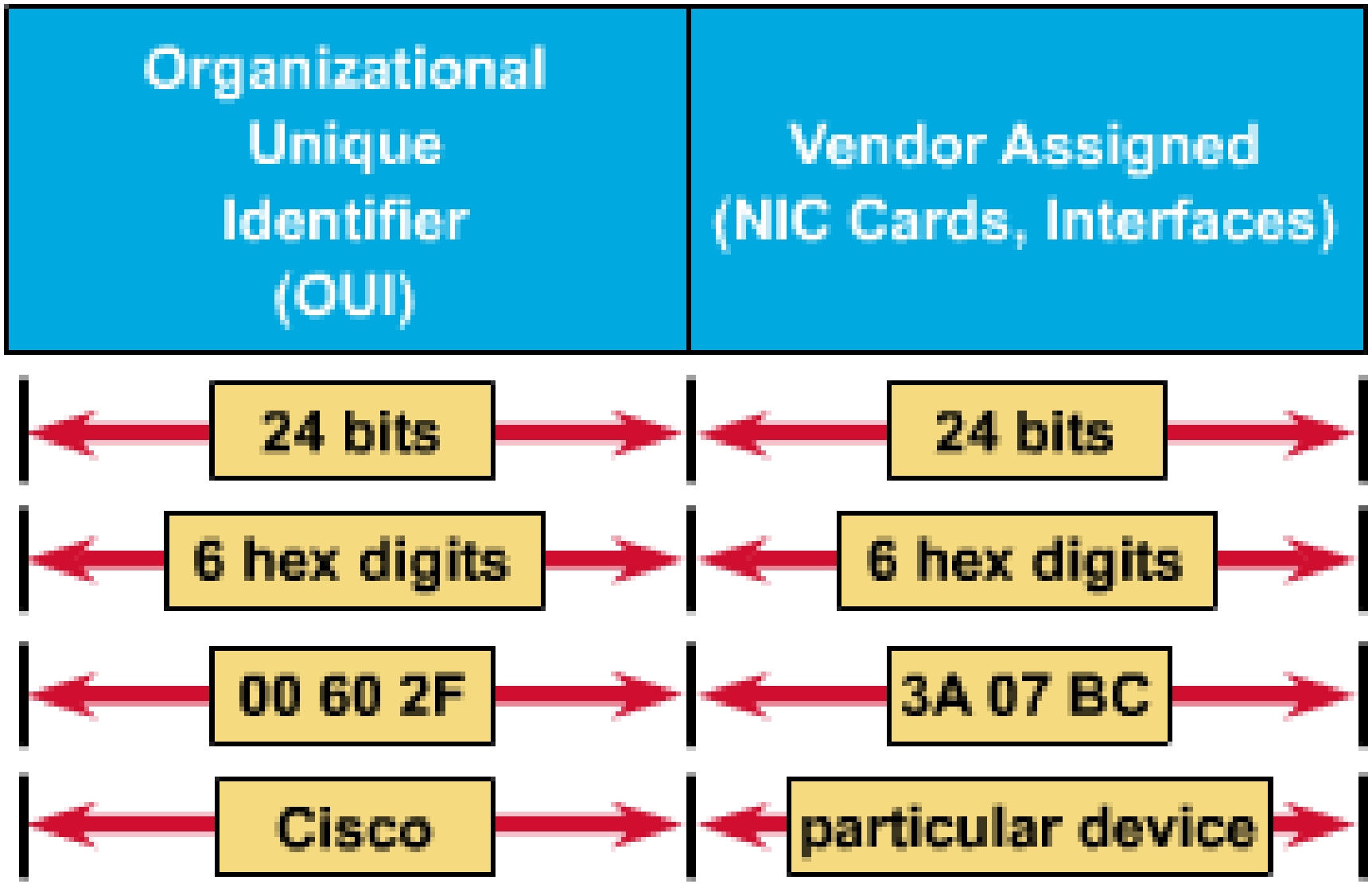
MAC ADDRESSING

MAC Address

- Every computer has a unique way of identifying itself : MAC address or physical address.
- The physical address is located on the Network Interface Card (NIC).
- MAC addresses have no structure, and are considered flat address spaces.

MAC address format



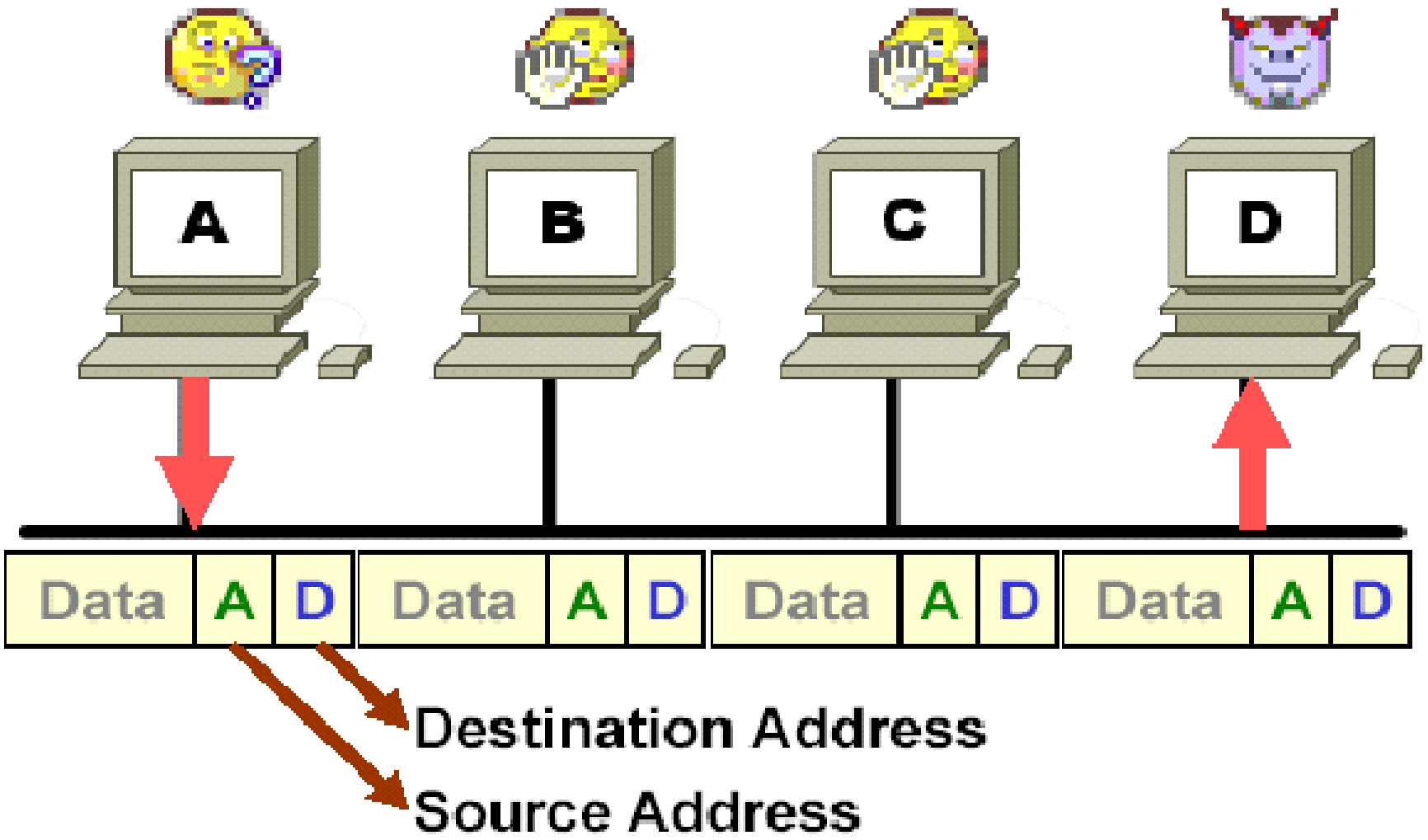
MAC address format

- The first six hexadecimal digits, which are administered by the IEEE, identify the manufacturer or vendor.
- The remaining six hexadecimal digits comprise the interface serial number.

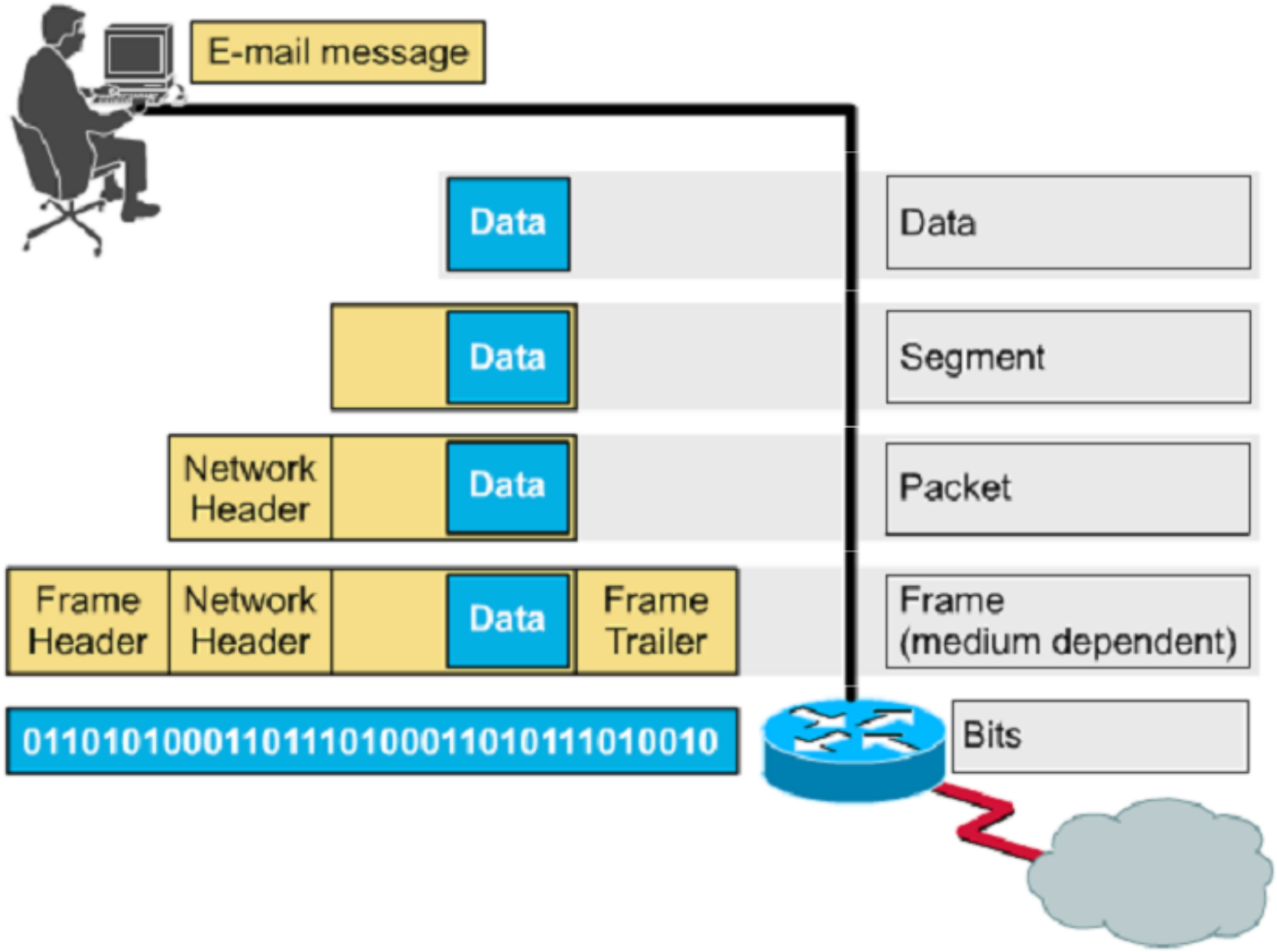
MAC address

- **MAC addresses are sometimes referred to as *burned-in addresses* (*BIAs*) because they are burned into read-only memory (ROM) and are copied into random-access memory (RAM) when the NIC initializes.**
- **0000.0c12.3456 or 00-00-0c-12-34-56.**

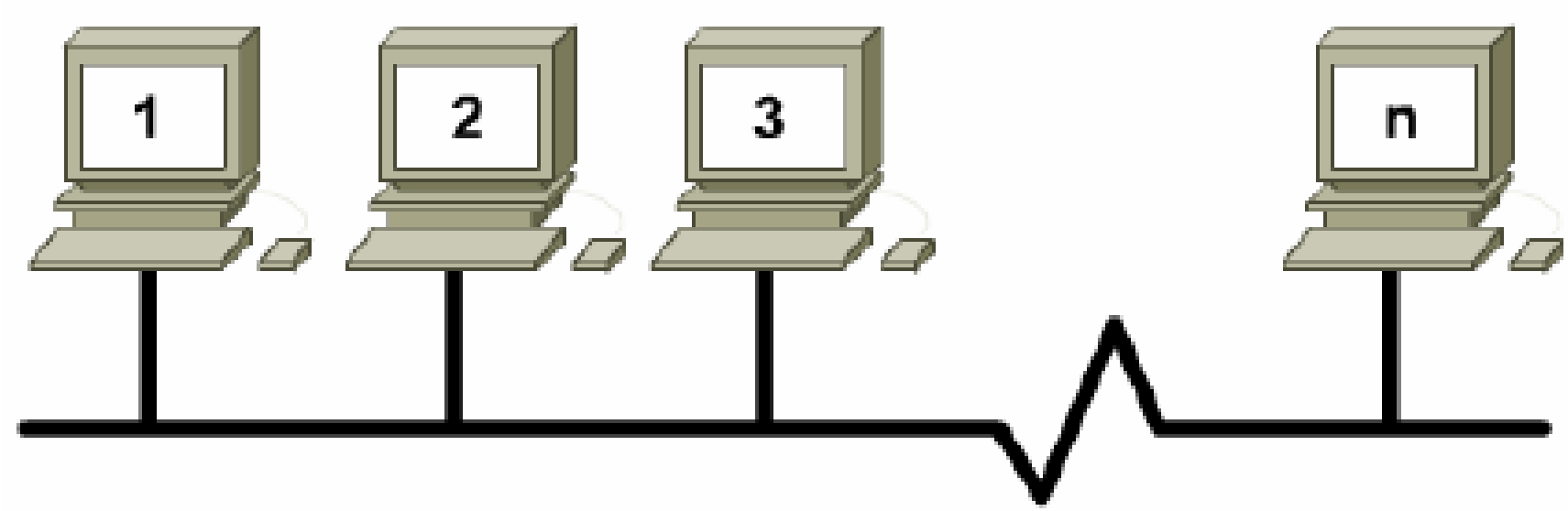
Using MAC addresses



Encapsulation



Limitation of MAC



- Flat, does not work well in internetwork.
- Hardware dependent.

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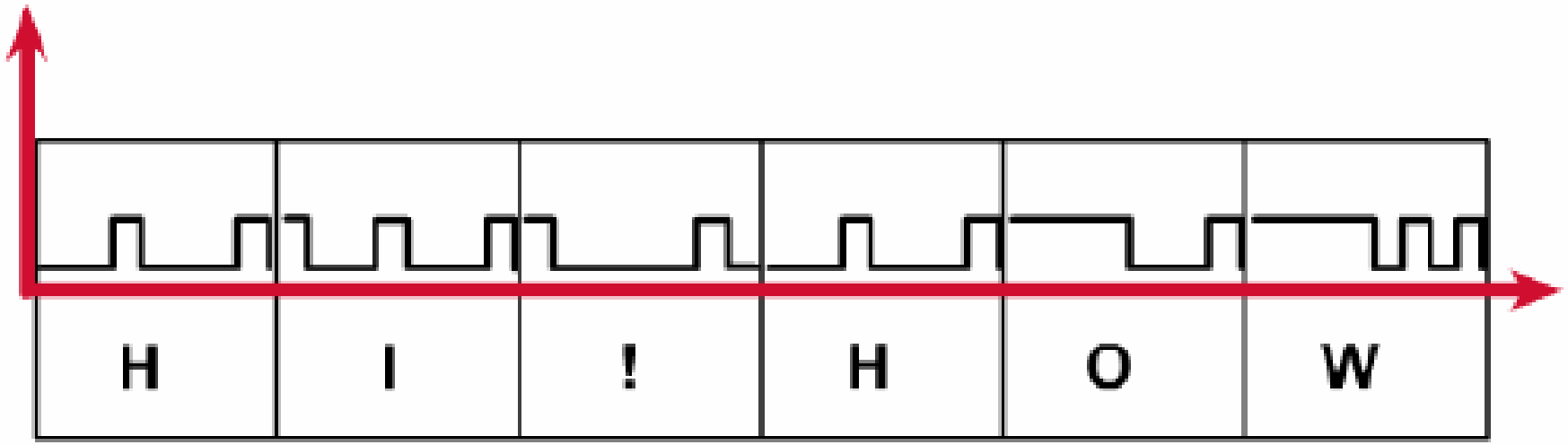
FRAMING

Encoding

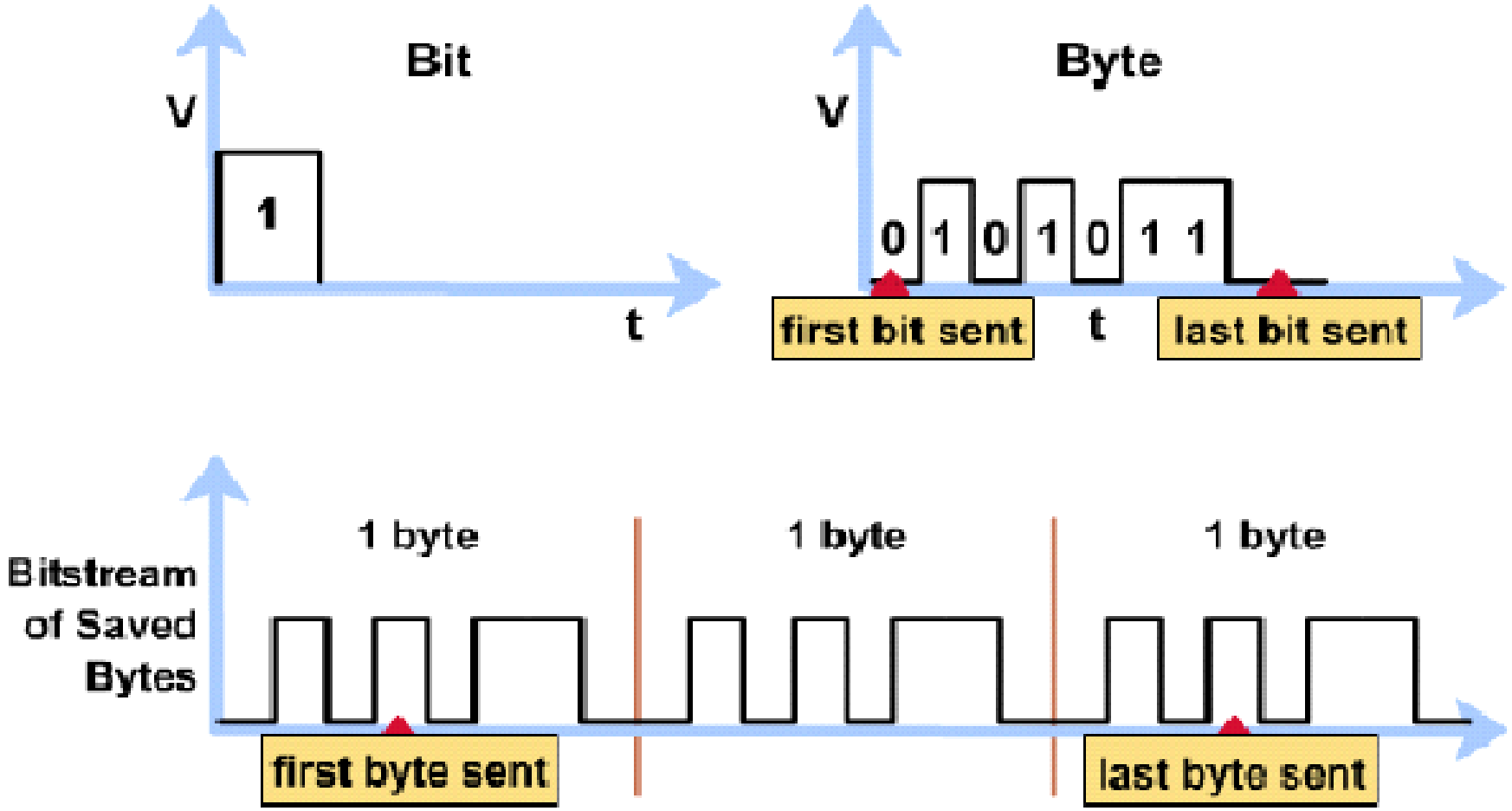


- **Encoding is the process of converting information into a form that can travel on a physical link.**

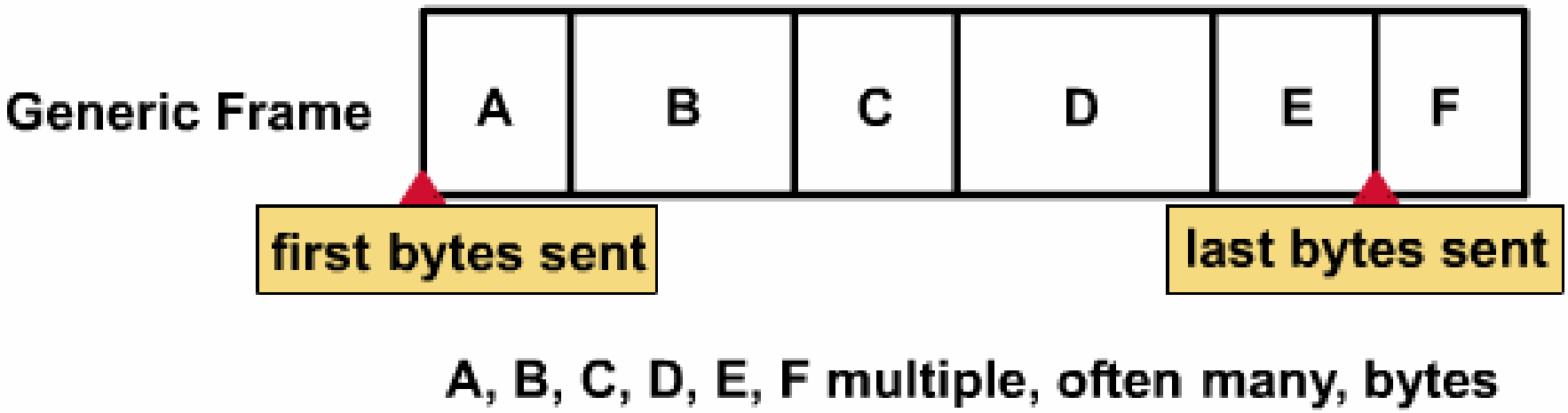
Why framing is necessary?

- Which computers are communicating with one another.
- When communication between individual computers begins and when it terminates.
- A record of errors that occurred during the communication.
- Whose turn it is to “talk” in a computer “conversation”.

Frame format diagram



Frame format diagram



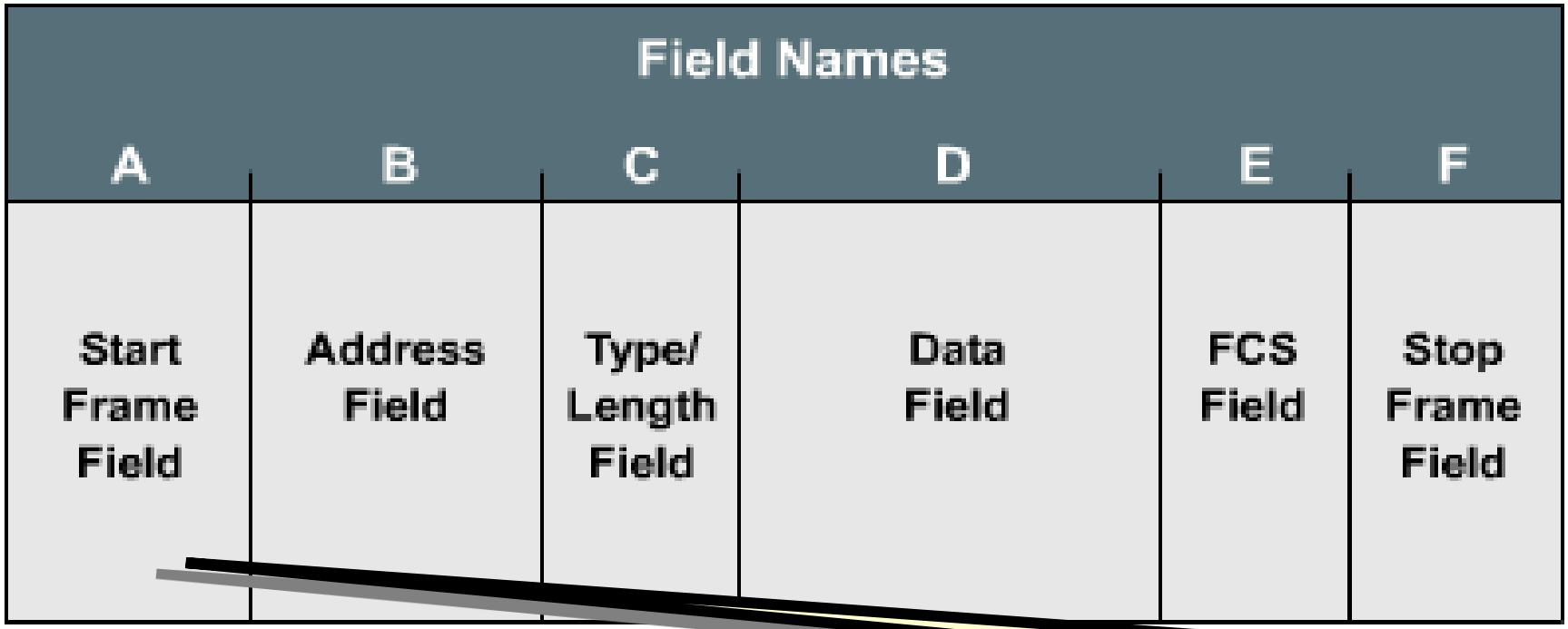
- **The frame format diagram shows different groupings of bits (*fields*) that perform other functions.**
- **Read them from left to right.**

Generic frame format

Field Names					
A	B	C	D	E	F
Start Frame Field	Address Field	Type/ Length Field	Data Field	FCS Field	Stop Frame Field

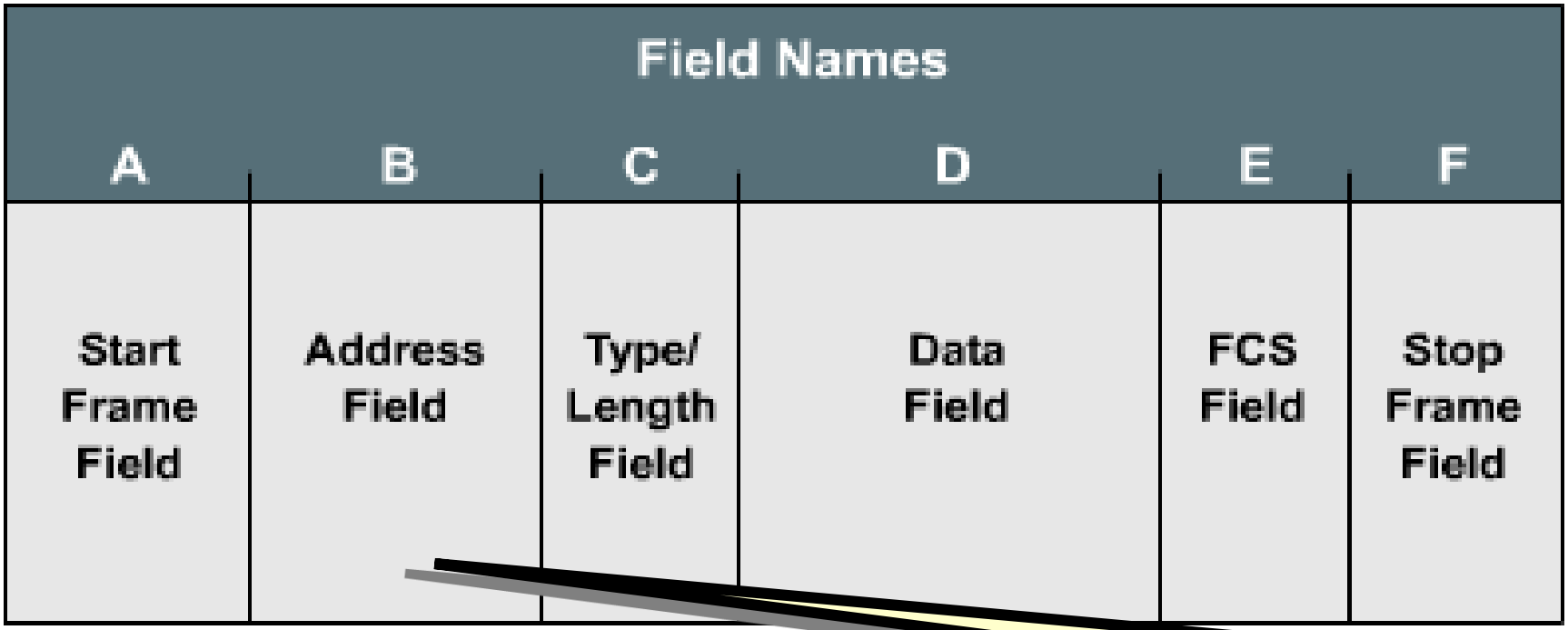
- There are many different types of frames described by various standards.

Start frame field



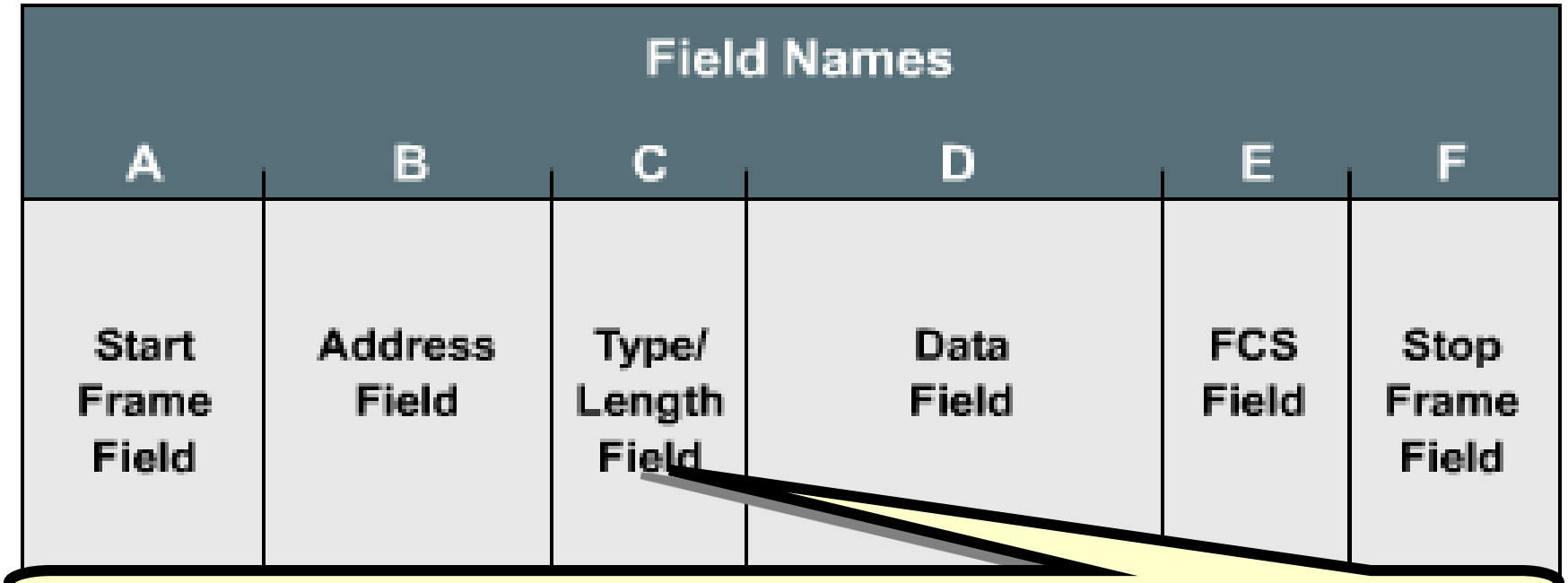
The Start Frame field tells other devices on the network that a frame is coming down the wire.

Address field



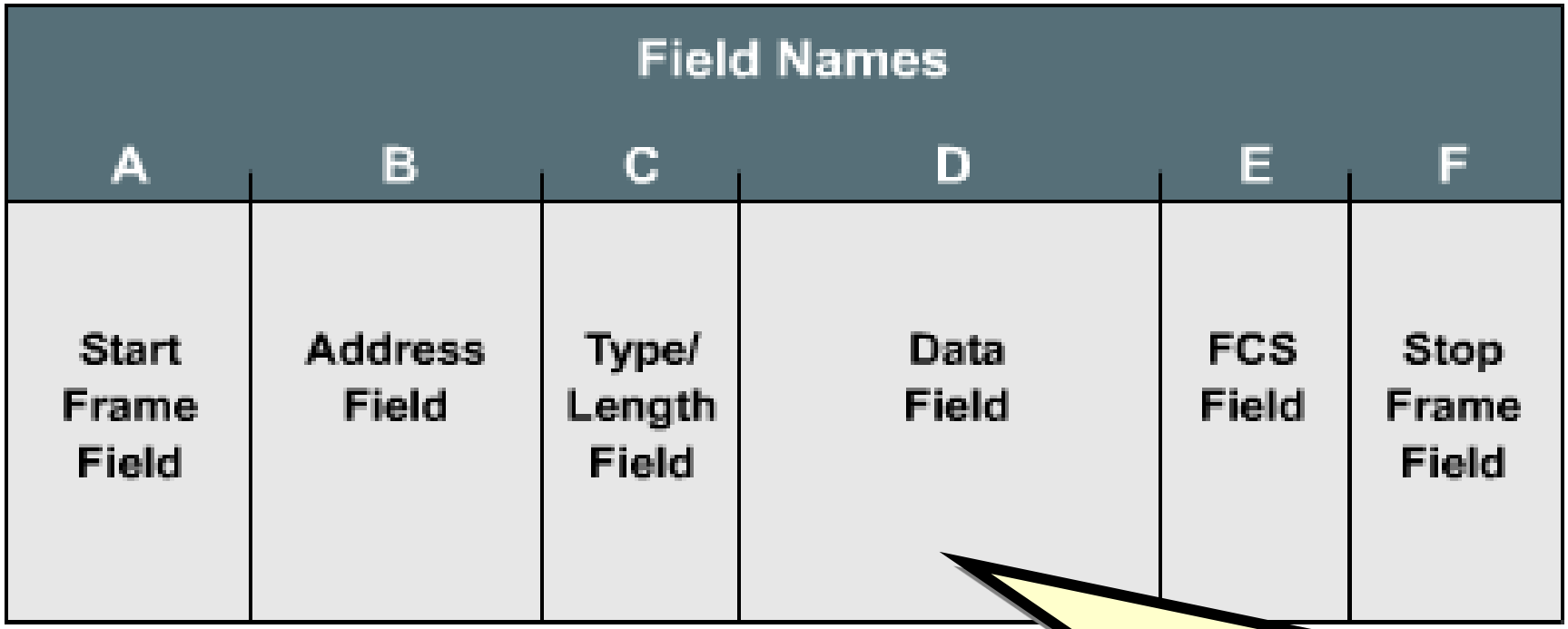
The Address field stores the source and destination MAC addresses.

Type/Length field



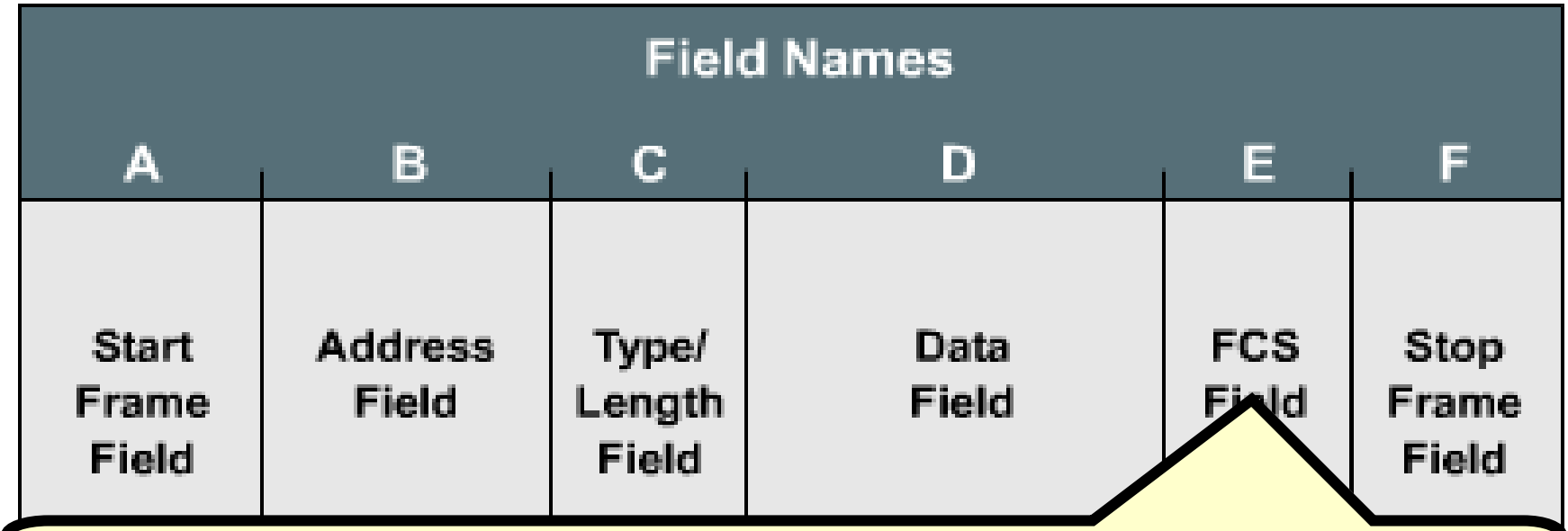
The Type/Length field is an optional field used by some protocols to either state what type of data is coming or possibly the length of the frame.

Data field



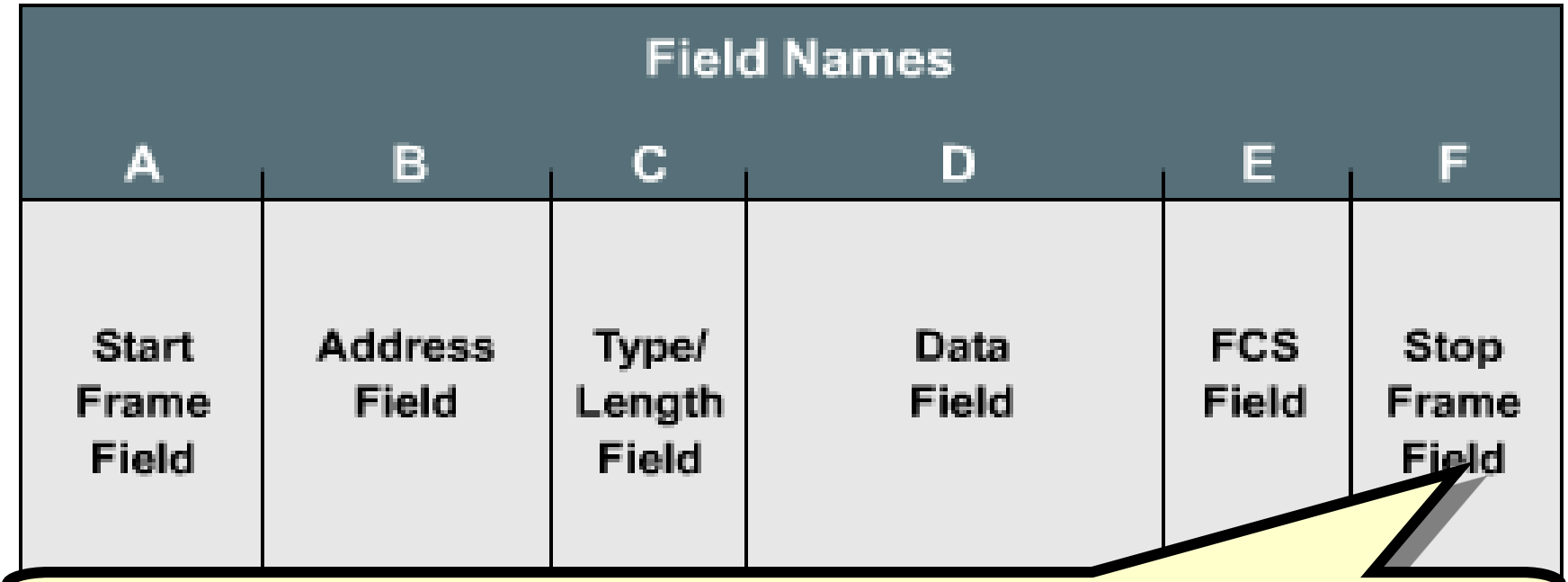
The **Data field** is the actual information being sent by the upper layer protocols. Therefore, it will be all upper layer data.

Frame Check Sequence field



The Frame Check Sequence (FCS) field, contains a number that is calculated by the source computer and is based on the data in the frame, is used for error notification.

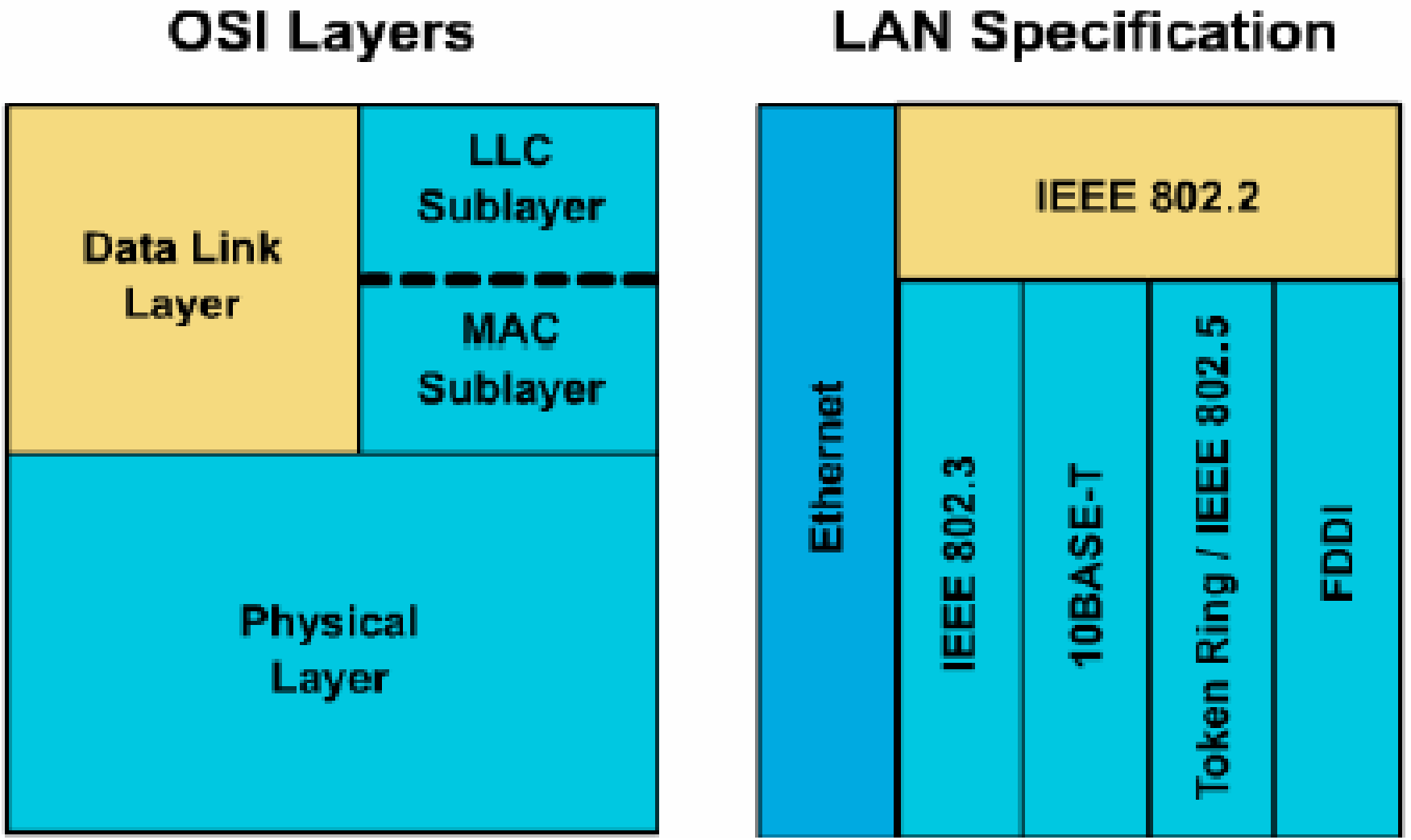
Stop frame field



The **Stop Frame field**, also called the Frame Trailer, is an optional field that is used when the length of the frame was not specified in the Type/Length field.

MEDIA ACCESS CONTROL

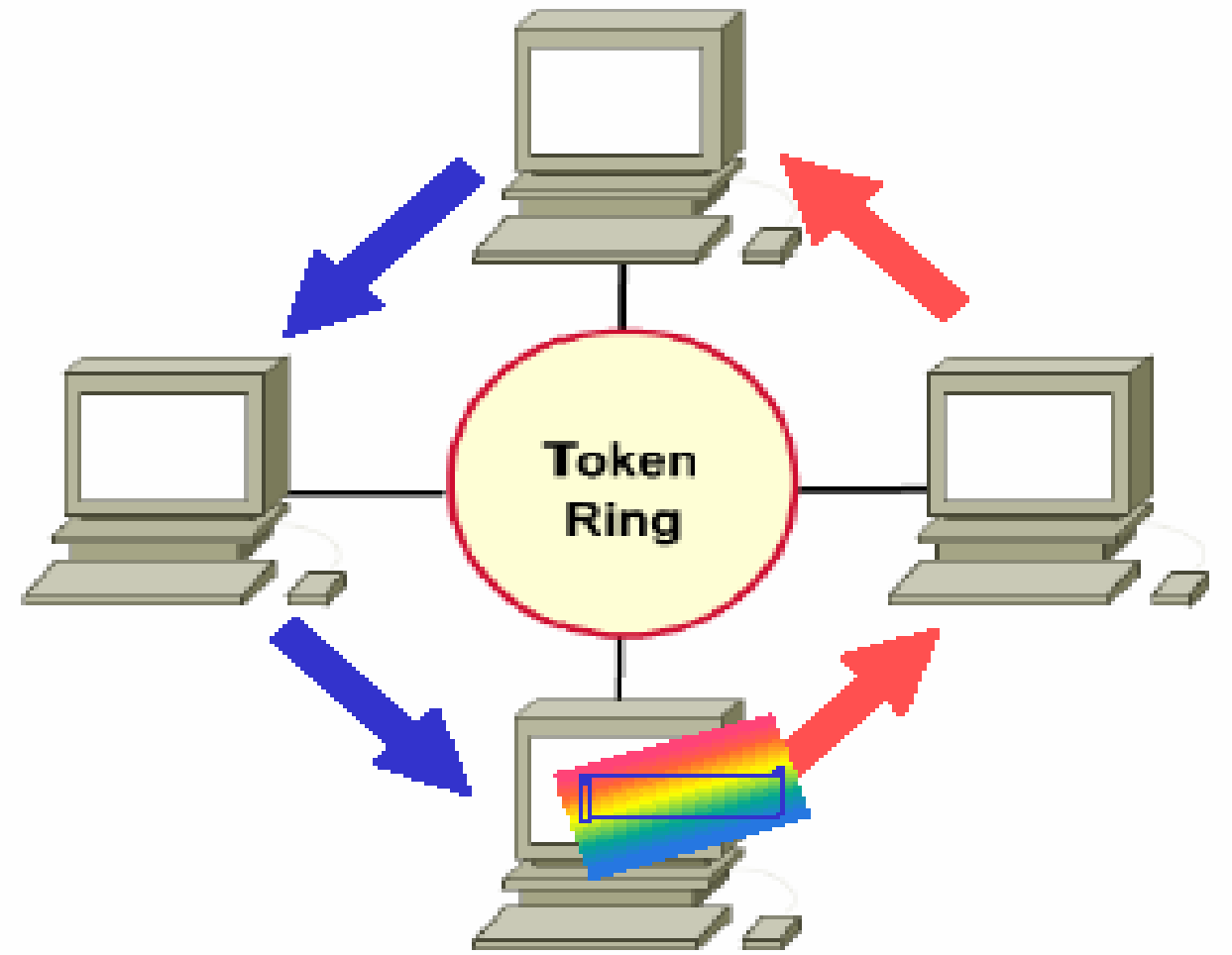
Definition MAC



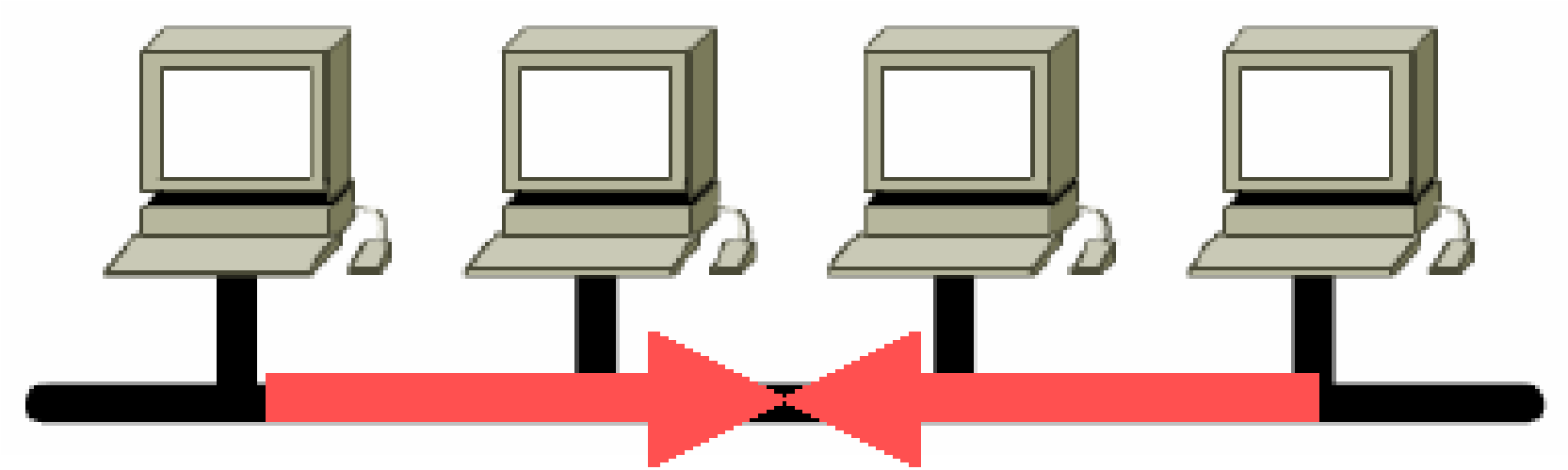
Definition MAC

- Specified by the technology being used.
- Determine who can transmit and when.
- Two types:
  - Deterministic: “Let’s take turns”.
    - *Token-Ring, FDDI.*
  - Non-deterministic: “First come, first serve”.
    - *Ethernet : CSMA/CD.*

Deterministic MAC protocol



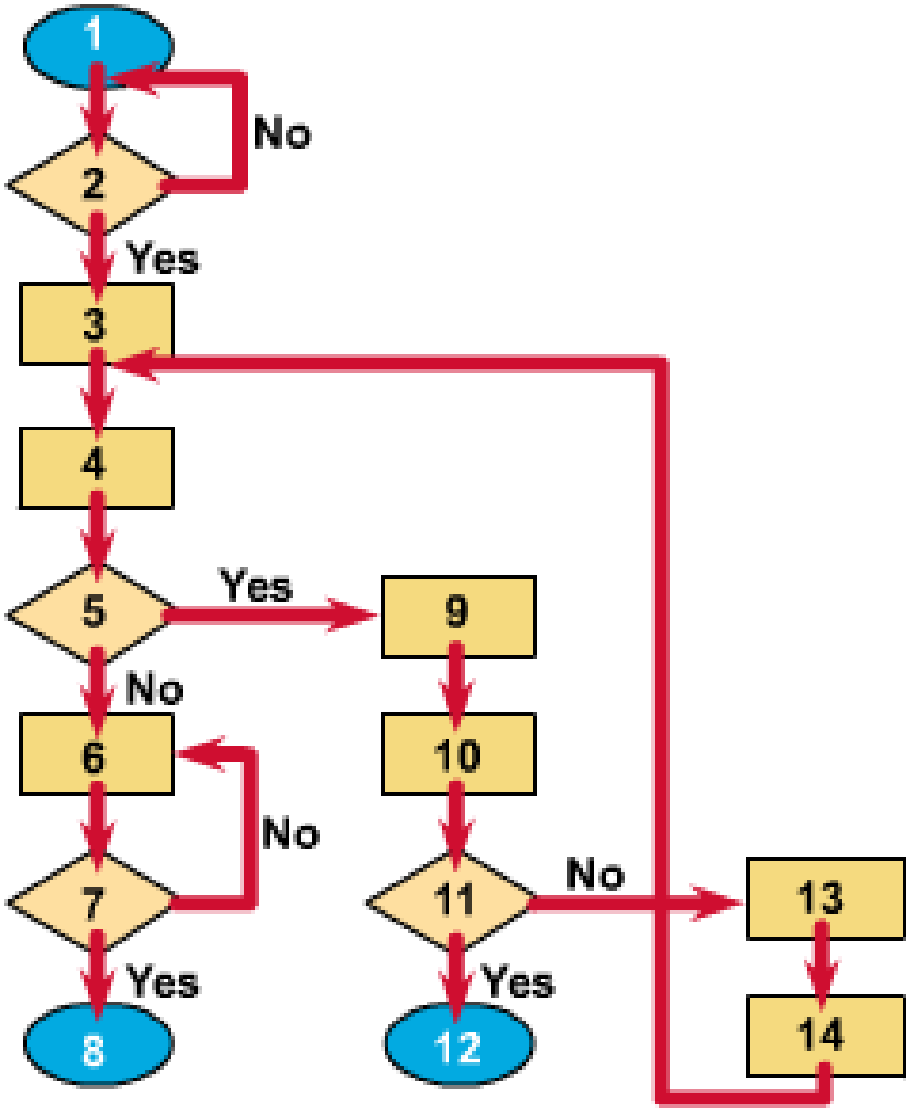
Non-deterministic MAC protocol



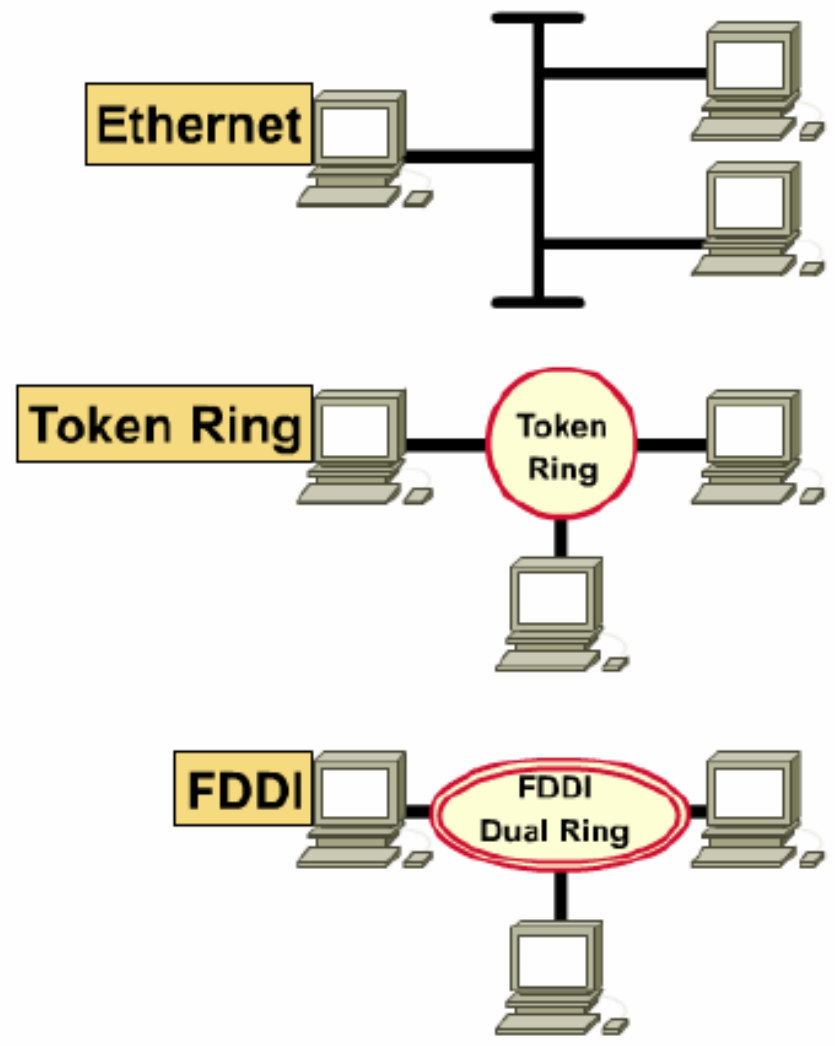
- Carrier Sense Multiple Access with Collision Detection (CSMA/CD).

CSMA/CD

1. Host wants to transmit
2. Is carrier sensed?
3. Assemble frame
4. Start transmitting
5. Is a collision detected?
6. Keep transmitting
7. Is the transmission done?
8. Transmission completed
9. Broadcast jam signal
10. attempts = attempts + 1
11. attempts > too many?
12. Too many collisions; abort transmission
13. Algorithm calculates backoff
14. Wait for t seconds



LAN Technologies



- **Ethernet**: logical broadcast topology
- **Token Ring**: logical token ring topology
- **FDDI**: logical token ring topology