



Chapter 7

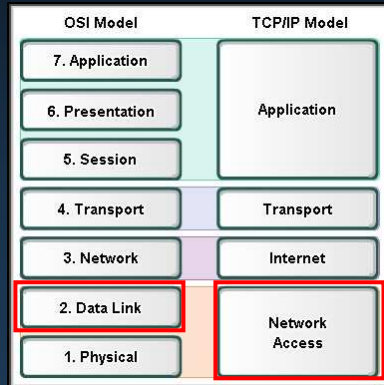
OSI Data Link Layer

Note for Instructors

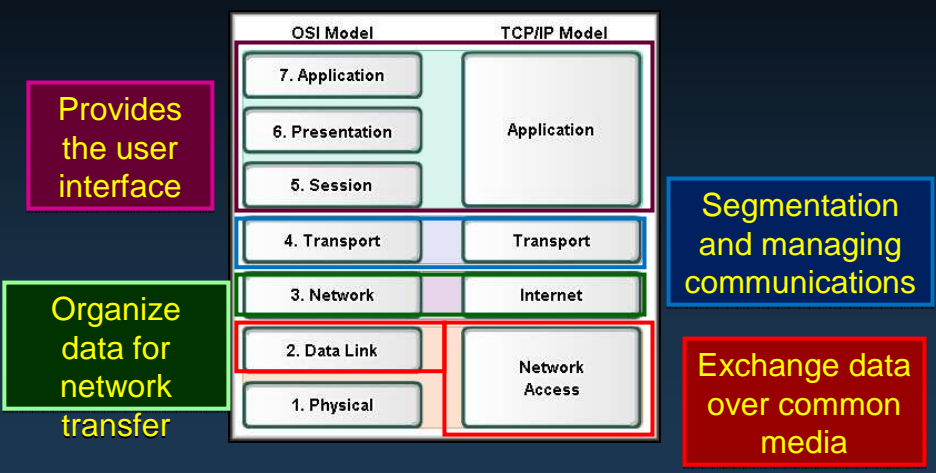
- These presentations are the result of a collaboration among the instructors at St. Clair College in Windsor, Ontario.
- Thanks must go out to Rick Graziani of Cabrillo College. His material and additional information was used as a reference in their creation.
- If anyone finds any errors or omissions, please let me know at:
 - tdame@stclaircollege.ca.

OSI Data Link Layer

Accessing the Media

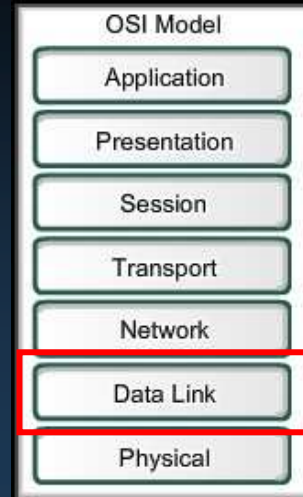


OSI Data Link Layer



Supporting and Connecting to Upper Layer

- Two basic functions:
 - Allows the upper layers to access the media using **framing**.
 - Controls how data is placed on the media and received from the media using **media access control (MAC)** and **error detection**.



Supporting and Connecting to Upper Layer

Terminology



Frame



A PDU at the Data Link layer is called a frame.

Node



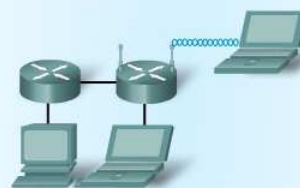
A node is a device on a network.

Media



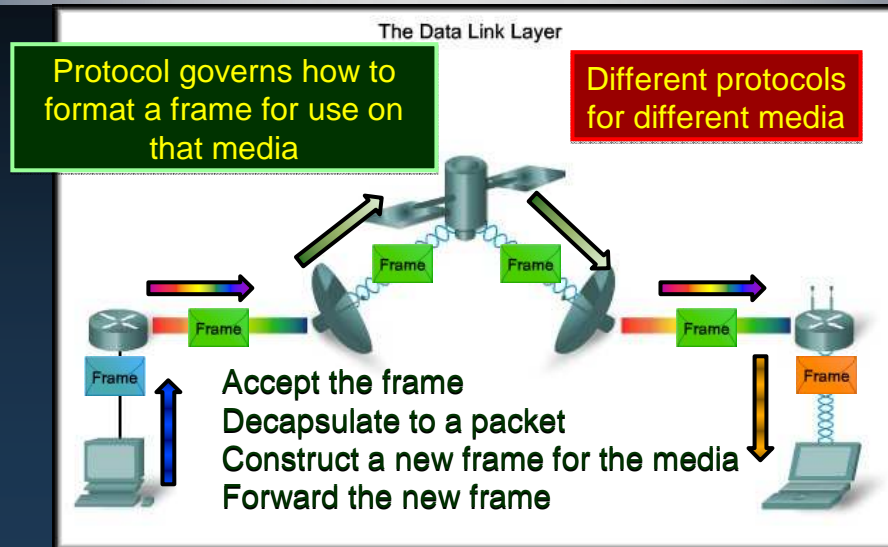
The media are the physical means used to carry data signals.

Network



A network is two or more devices connected to a common medium.

Supporting and Connecting to Upper Layer



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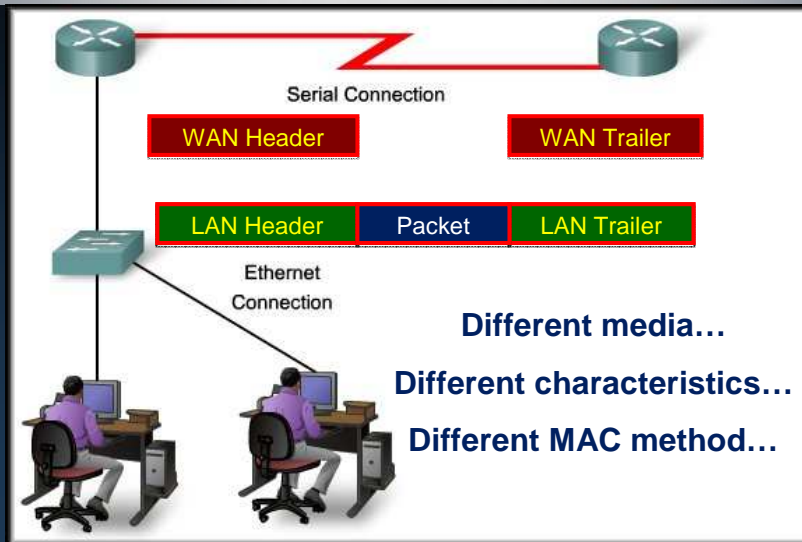
Controlling Transfer Across Local Media

- *Layer 2 protocols specify the encapsulation of a packet into a frame and the techniques for getting the encapsulated packet on and off each media.*
 - The technique is termed the Media Access Control (**MAC**) method.
 - Different media might require a different MAC method.
 - Each media type encountered can have **different characteristics**. (Especially a router where several different media types can co-exist.)

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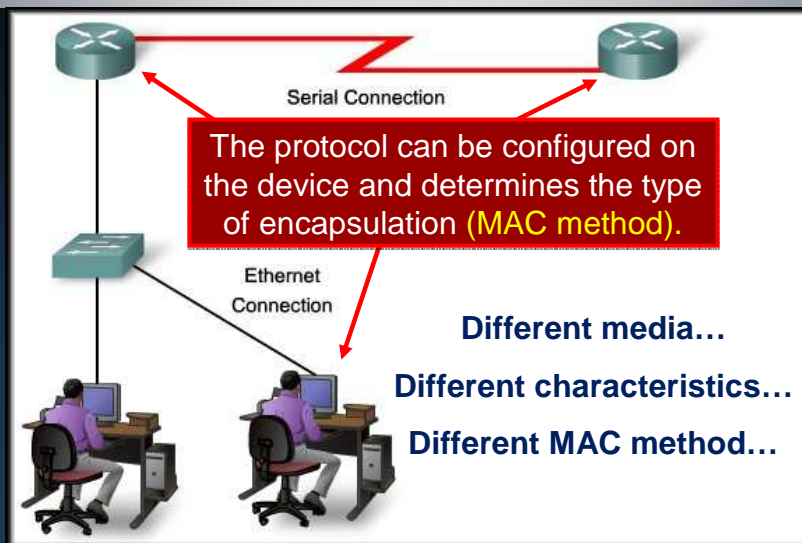
Controlling Transfer Across Local Media



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Controlling Transfer Across Local Media

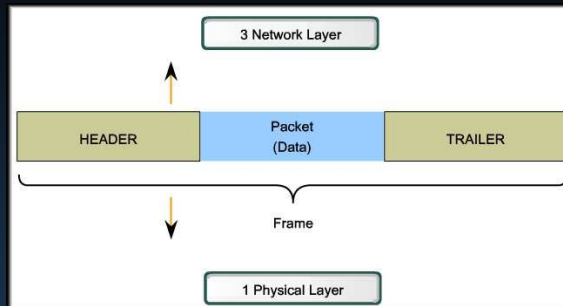


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Creating a Frame

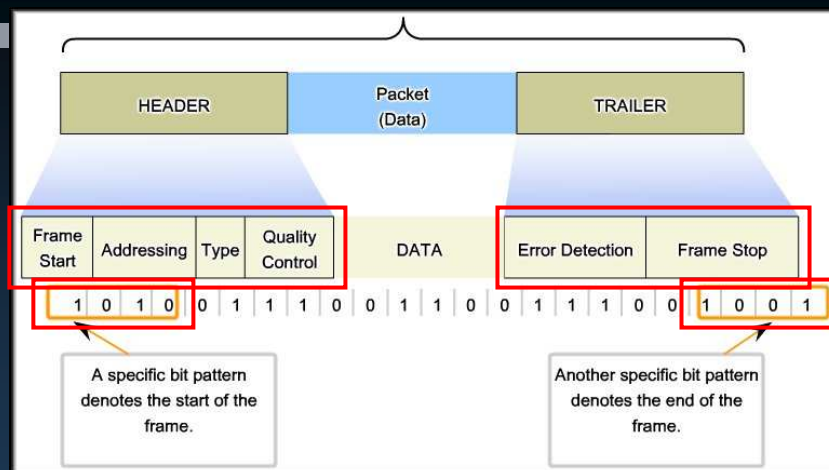
- The description of a frame is the key element of each protocol.
- Different protocols require different information to function properly.
 - Which nodes are in communication with each other.
 - When communication between individual nodes begins and when it ends.
 - Which errors occurred while the nodes communicated.
 - Which nodes will communicate next.



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Creating a Frame



- Frames travel the media as a stream of bits.
- The framing of the packet inserts control information in specific fields.....**MORE DETAILS LATER**.....

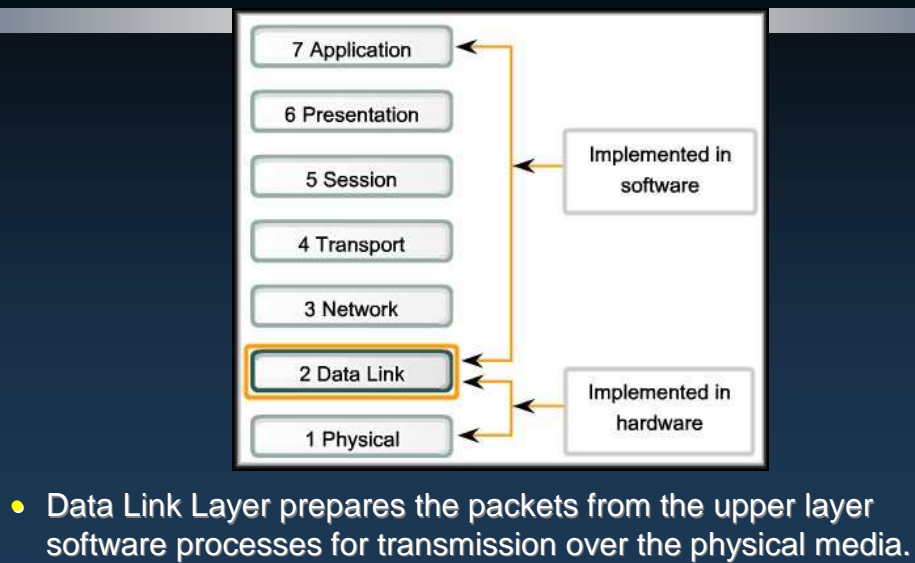
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Connecting Upper-Layer Services to the Media



Connecting Upper-Layer Services to the Media

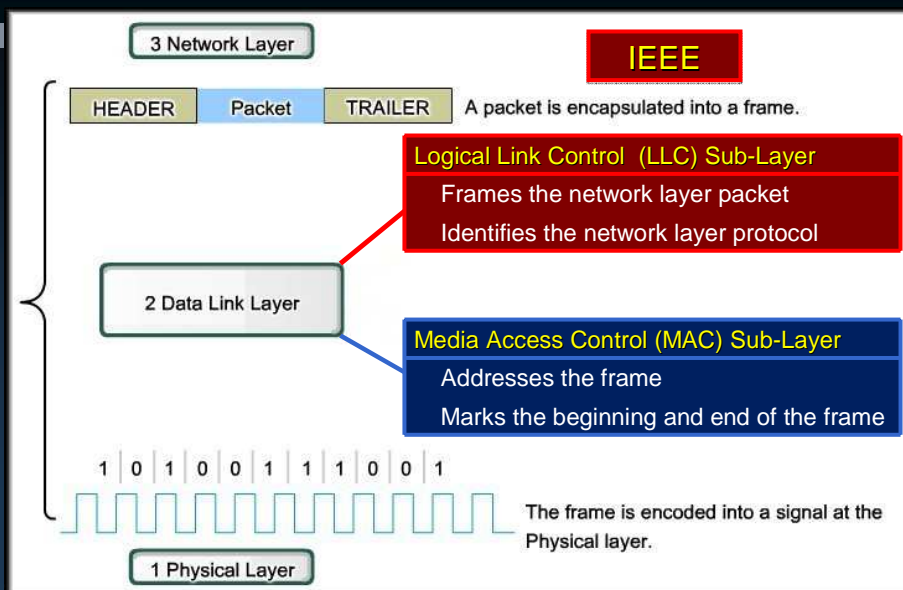


Standards

- Not defined by RFCs as in the other layers.
- Defined by engineering organizations.

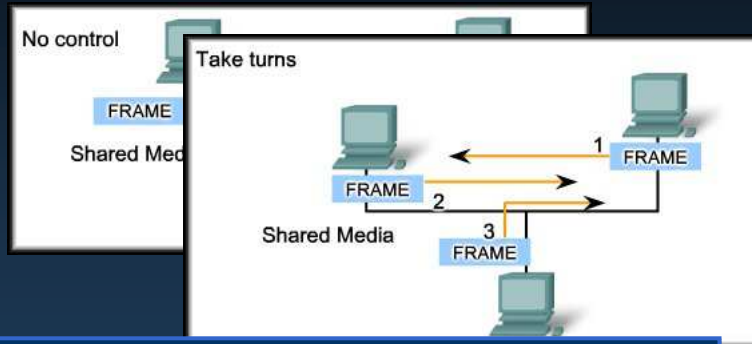
ISO:	HDLC (High Level Data Link Control)
IEEE:	802.2 (LLC), 802.3 (Ethernet) 802.5 (Token Ring) 802.11 (Wireless LAN)
ITU:	Q.922 (Frame Relay Standard) Q.921 (ISDN Data Link Standard) HDLC (High Level Data Link Control)
ANSI:	3T9.5 ADCCP (Advanced Data Communications Control Protocol)

Connecting Upper-Layer Services to the Media



Placing Data on the Media

- Regulating the placement of data on the media is termed **Media Access Control**.

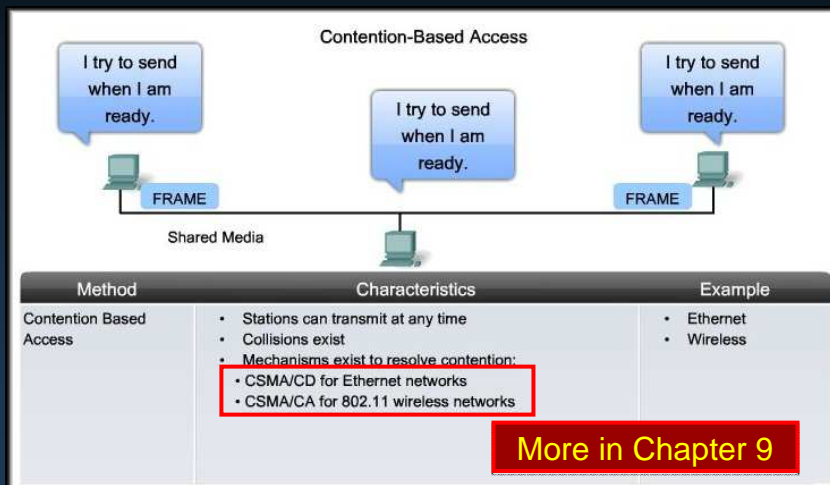


Media sharing: *If and how* the nodes share the media.

Topology: How the connection *appears* to the Data Link layer.

MAC for Shared Media

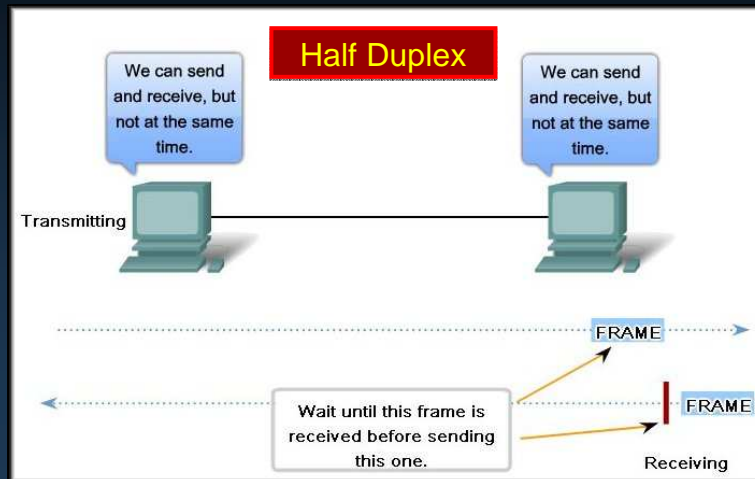
- Two Basic Methods:**



More in Chapter 9

MAC for Non-Shared Media

- **Point-to-Point Connections:** Type of communication.



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Logical Topology vs Physical Topology

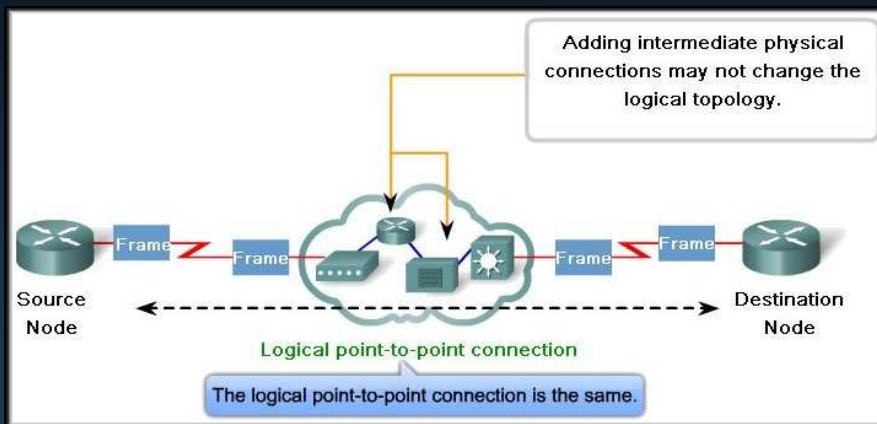
- **Physical Topology:**
 - Arrangement of the nodes and the physical connections between them (**More in Chapter 9**).
- **Logical Topology:**
 - The way a network transfers frames among nodes. The use of virtual connections between the nodes regardless of the actual physical connection.
 - Point-to-Point
 - Multiaccess
 - Ring

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Point-to-Point Logical Topology

- Concerned with full or half duplex.

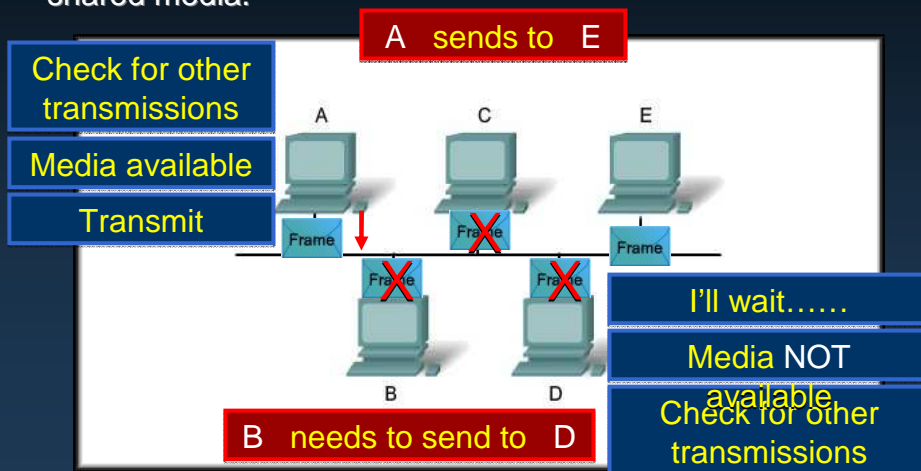


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Multiaccess Logical Topology

- Enables a number of nodes to communicate using the same shared media.

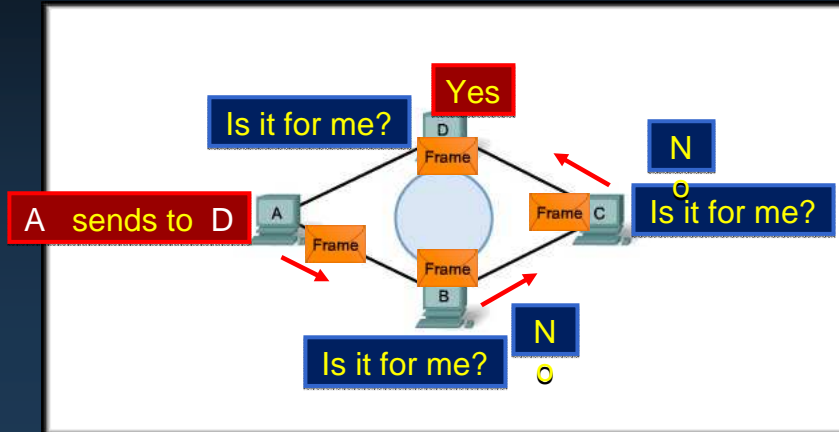


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Ring Logical Topology

- Each node receives a frame in turn. If it is not addressed to the node, it passes it on.

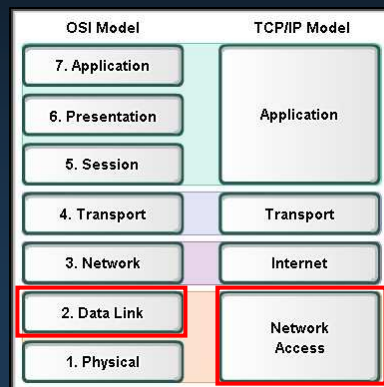


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OSI Data Link Layer

Addressing and Framing Data



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The Frame

- There are many different Data Link Layer protocols...
- The Data Link Layer protocol **describes the features** required for the transport of frames.

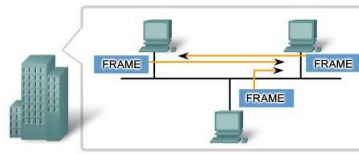
In a fragile environment, more controls are needed to ensure delivery. The header and trailer fields are larger as more control information is needed.

Greater effort needed to ensure delivery = higher overhead = slower transmission rates



In a protected environment, we can count on the frame arriving at its destination. Fewer controls are needed, resulting in smaller fields and smaller frames.

Less effort needed to ensure delivery = lower overhead = faster transmission rates



- Integrated into the encapsulation process.
- *No single frame protocol meets the needs of all data transportation across all types of media.*

The Frame

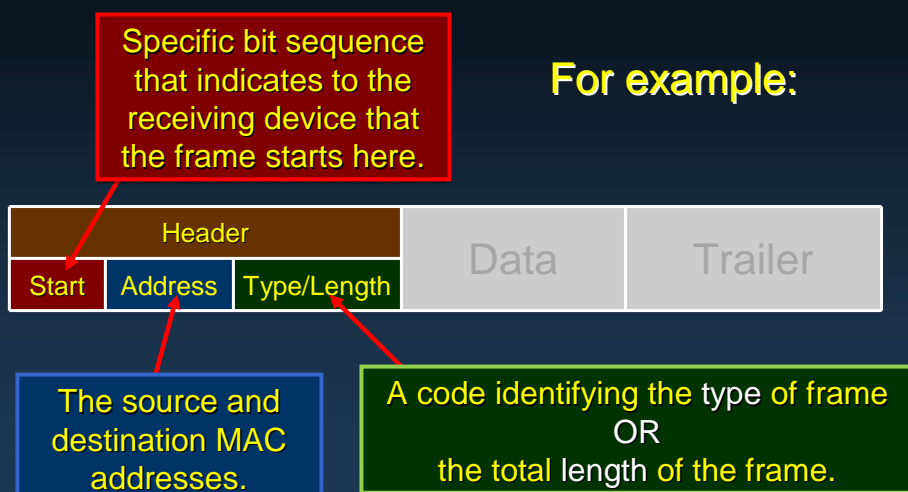
- However, each Data Link Layer protocol is constructed using the same basic format.
 - **It's the contents that differ...**



Framing: Role of the Header

- Contains the **control information** required by the protocol.
 - **Some sample fields.....**
 - Start of Frame
 - Source and Destination MAC Addresses
 - Priority/Quality of Service
 - Type/Length
 - Logical Connection Control
 - Physical Link Control
 - Flow Control
 - Congestion Control

Framing: Role of the Header



Addressing: Where the Frame Goes

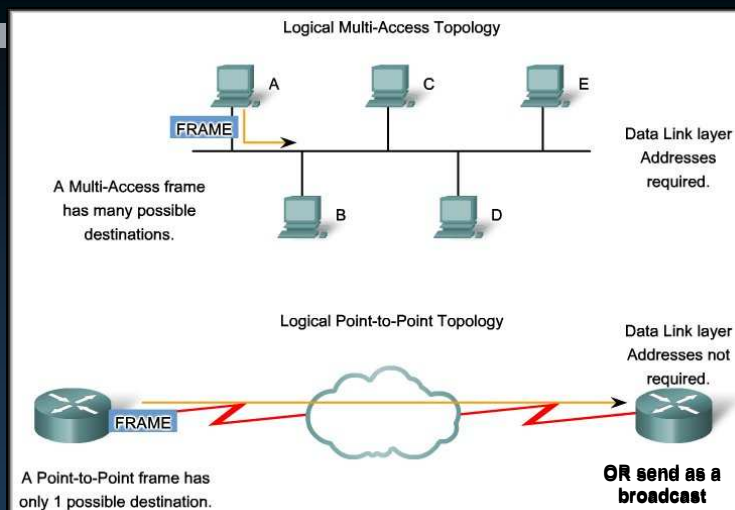
- The addresses used this layer are referred to as **physical addresses**.
- They are the burned-in MAC addresses of the network device (PC: **NIC**, Router: **Physical port**).
- They are only used for **local delivery**.
 - If the frame must be transported to another segment, the frame is re-encapsulated by the receiving device and forwarded.



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Addressing: Where the Frame Goes



- The Data Link Layer protocol will define the addressing required to move the frame through the network.

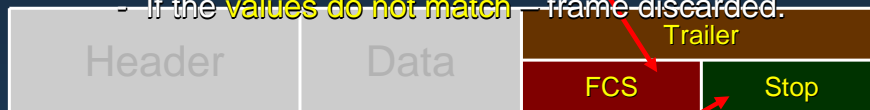
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Framing: Role of the Trailer

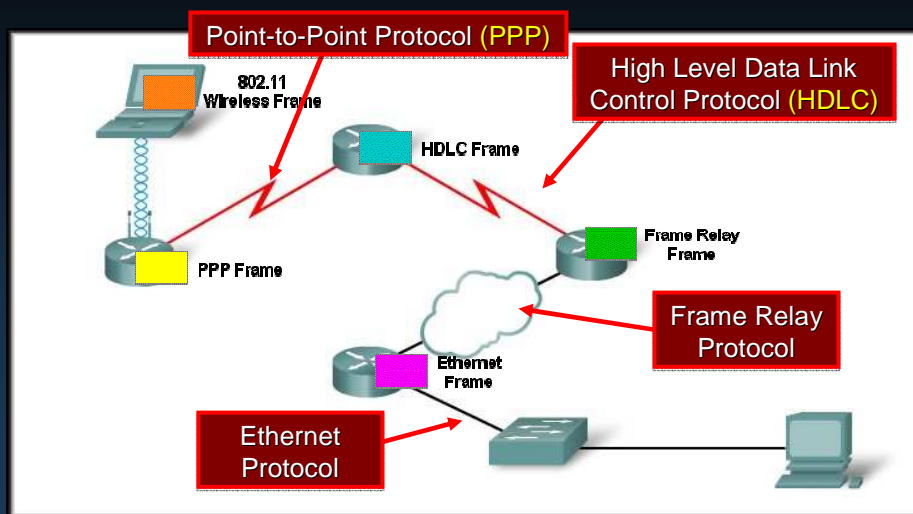
Frame Check Sequence (FCS): Used to provide basic error checking, usually with a Cyclic Redundancy Check (CRC).

- Sending device uses an algorithm on the bits of the header and data portions.
- The resulting value is placed in the FCS field.
- Receiving device does the same thing.
- If the values match – no error.
- If the values do not match – frame discarded.

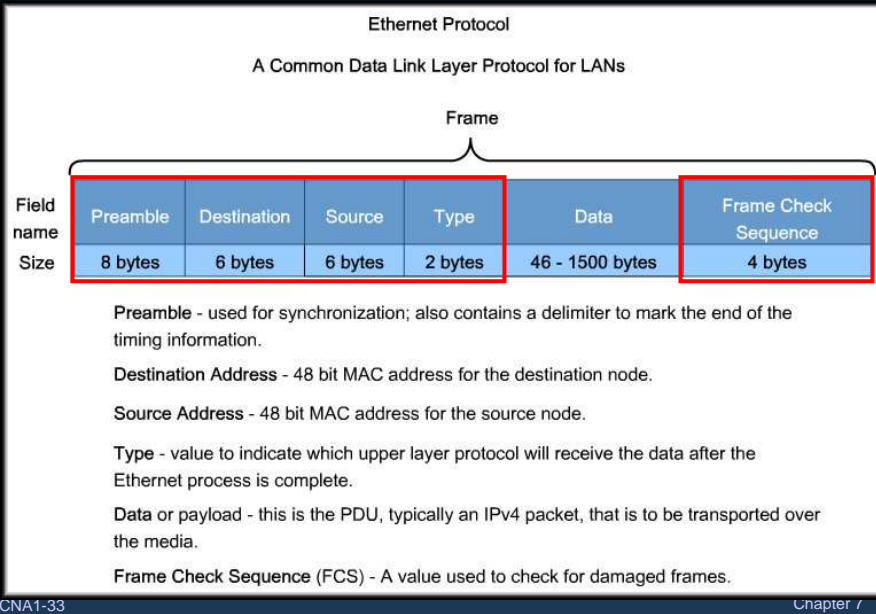


A specific sequence of bits that indicate the end of the frame.

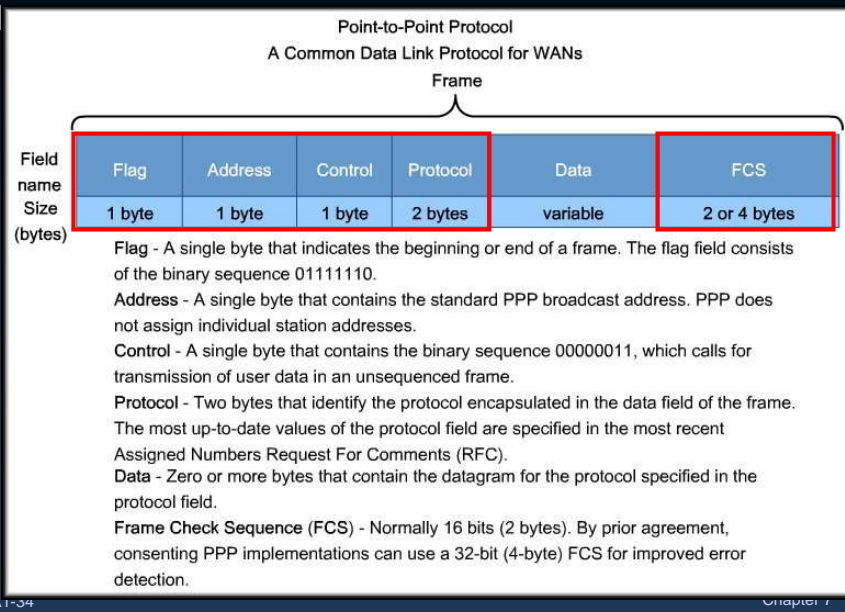
Sample: Data Link Layer Frames



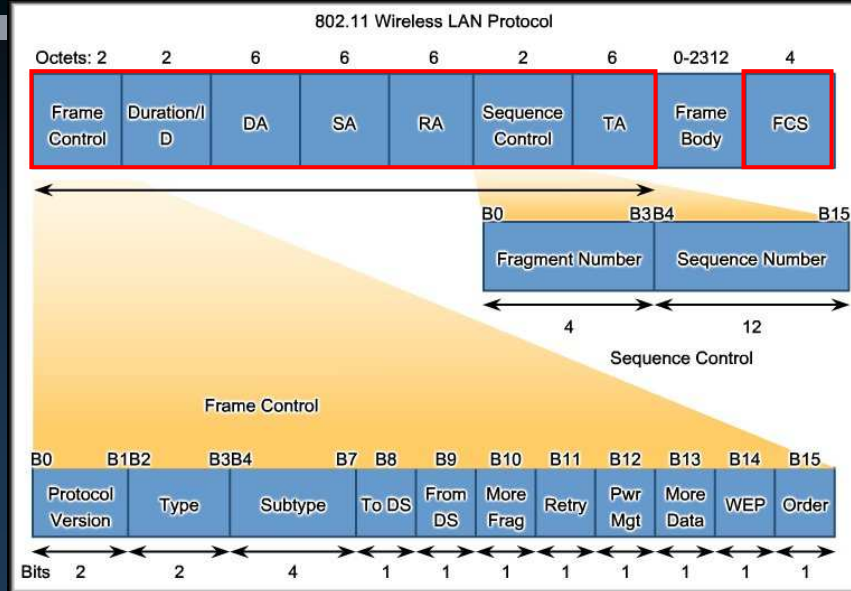
Ethernet Protocol for LANs



Point-to-Point Protocol for WANs



Wireless Protocol for LANs



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Putting It All Together

Both the text and the online curriculum follow a packet from the source to the destination.

Text: Pages 267 – 262

Curriculum: Section 7.4.1

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