OSI DATA LINK LAYER

Network Fundamentals – Chapter 7
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Version 4.0

Objectives

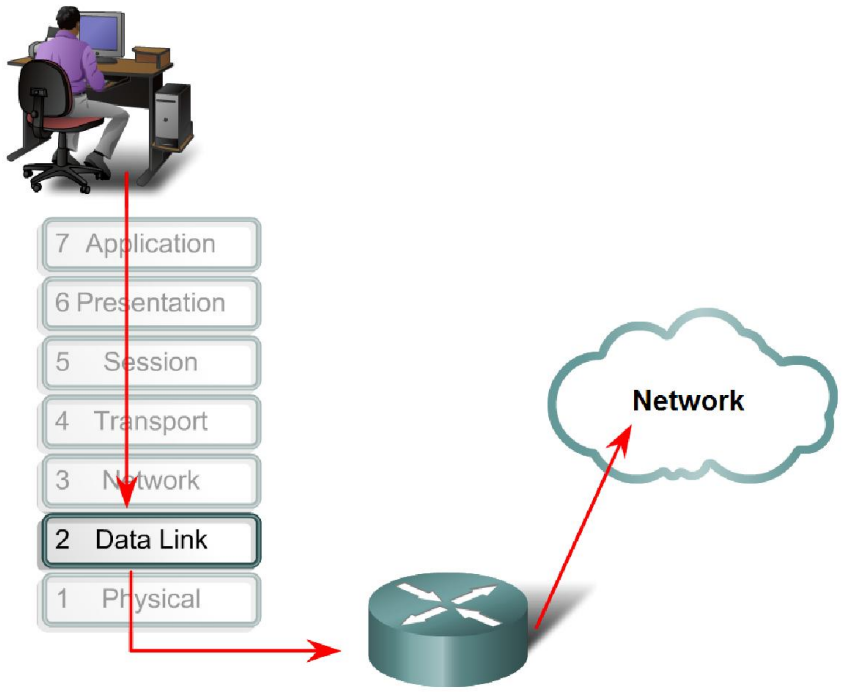
- Explain the role of Data Link layer protocols in data transmission.
- Describe how the Data Link layer prepares data for transmission on network media.
- Describe the different types of media access control methods.
- Identify several common logical network topologies and describe how the logical topology determines the media access control method for that network.
- Explain the purpose of encapsulating packets into frames to facilitate media access.
- Describe the Layer 2 frame structure and identify generic fields.
- Explain the role of key frame header and trailer fields including addressing, QoS, type of protocol and Frame Check Sequence.

Data Link Layer – Accessing the Media

- 2 basic services –
  - Allows upper layers to access the media
  - Controls how data is placed onto the media using media access control and error detection

Data link layer terms

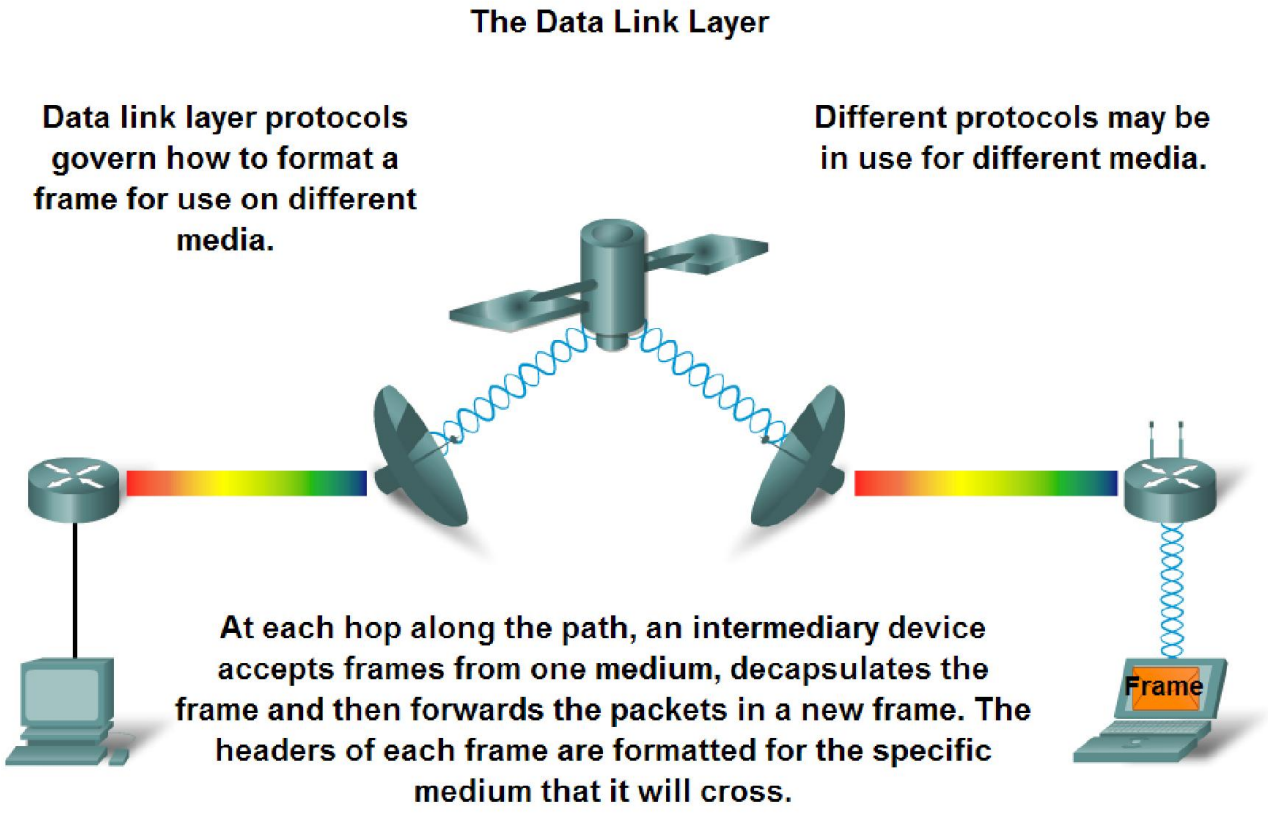
Frame – PDU for layer 2
Node – device on a network
Media – physical means to carry the signals
Network – 2 or more nodes connected to a common medium



The Data Link layer prepares network data for the physical network.

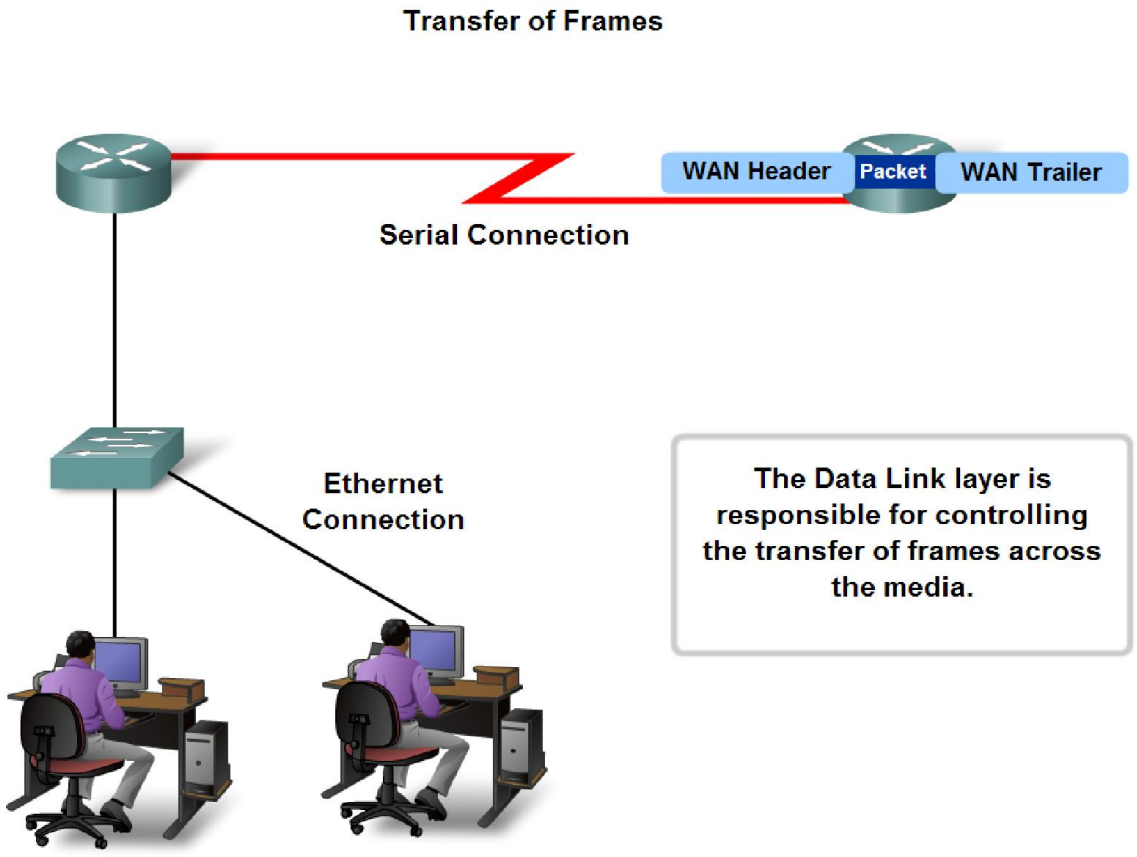
Data Link Layer – Accessing the Media

- Function – responsible for controlling the transfer of frames across the media.



Data Link Layer – Accessing the Media

- The media access control methods may differ from one media type to another and how devices interact with that media is all controlled by layer 2.

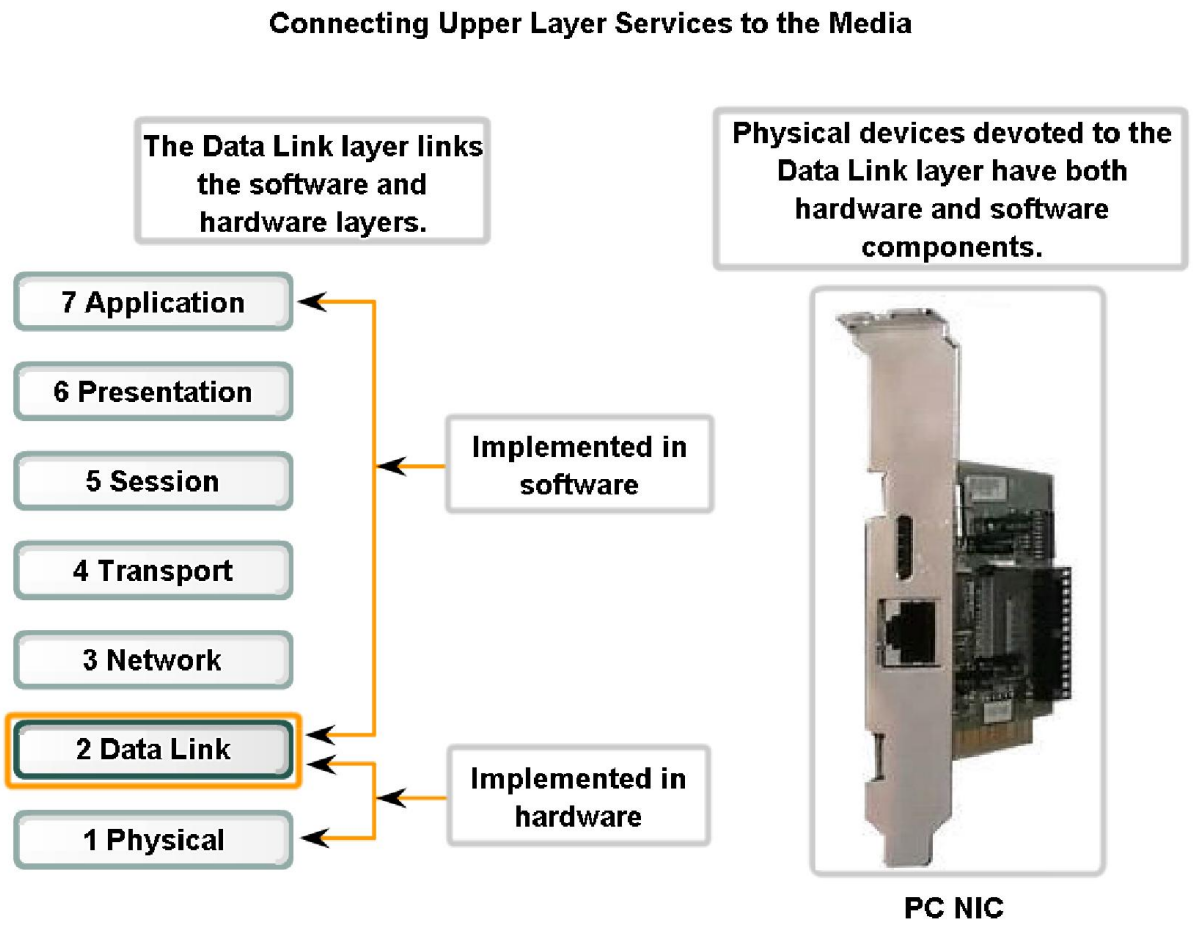


Formatting data for transmission

- Data gets converted into streams of 1s and 0s.
- Framing (layer 2 PDU) breaks this stream into groupings that have control information in the header/trailer.
- These will be discussed in greater detail later.
- Typical fields include:
  - Start/Stop indicator fields – mark beginning/end of the frame
  - Naming/Address fields – who sent/receives this frame
  - Type – type of PDU in this fram
  - Data – the actual payload (Layer 3 packet)

Data Link Layer – Accessing the Media

- It takes hardware & software for all this to work
- Layer 2 devices include NICs, Bridges, and Switches



Data-link layer DIVIDED!

- Logical Link Control (LLC) – defines the software process that provide services to the network layer protocols. Places information in the frame that identifies which protocol is being used (IP, IPX, Appletalk, etc.).
  - closest to the Network Layer
- Media Access Control (MAC) – defines the media access processes performed by the hardware. Will be specific to the type of media being used.
  - closest to the physical layer

Data Link Layer – Accessing the Media

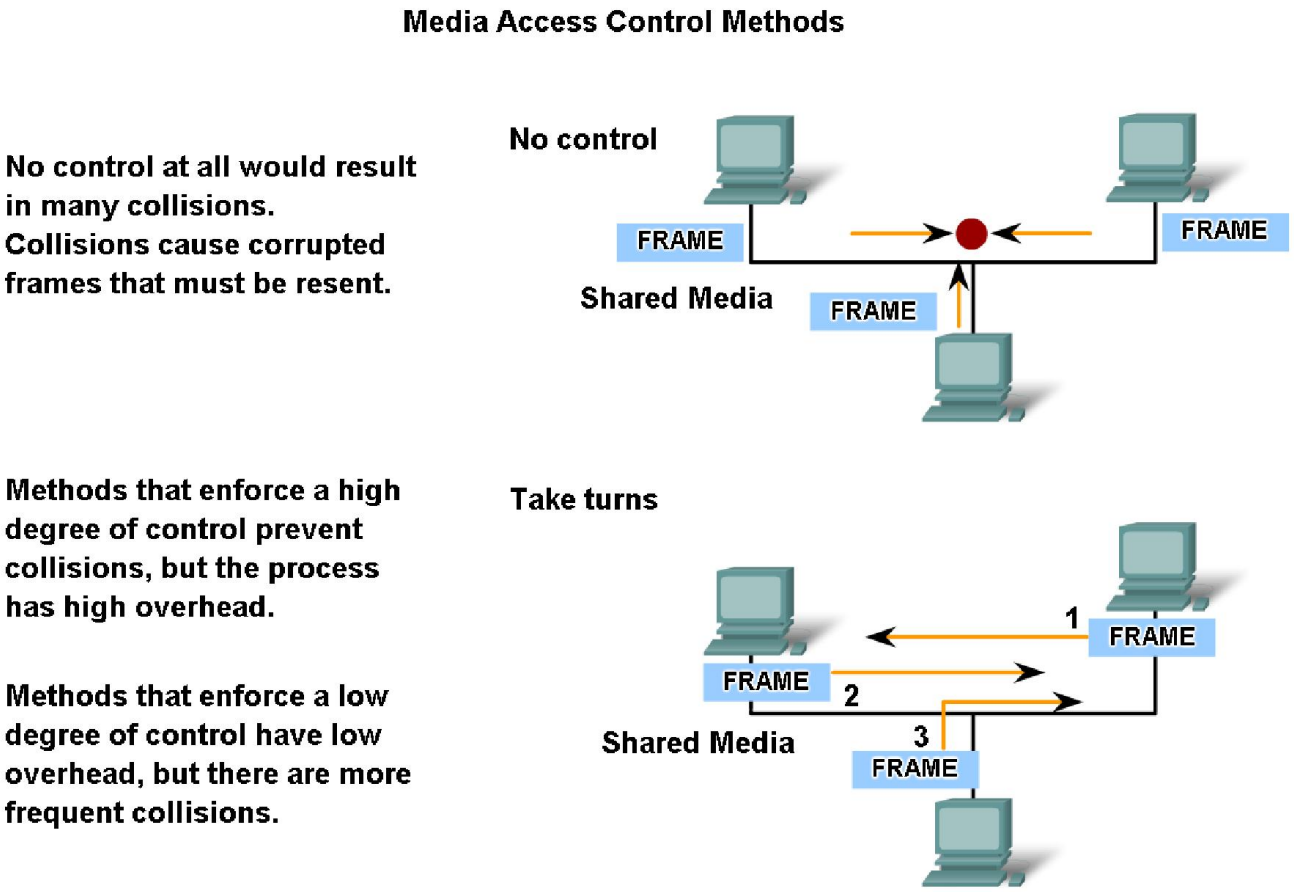
- Data link layer processes are implemented in the NIC (wired) or PCMCIA (wireless). They comply with the standards set forth by these parties!

Standards for the Data Link Layer

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)

Media Access Control Techniques

- Media access control depends on media sharing and the logical topology.

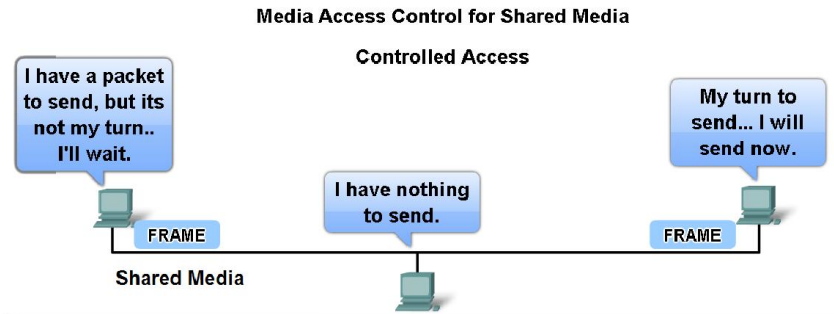


Compare Media Access Control

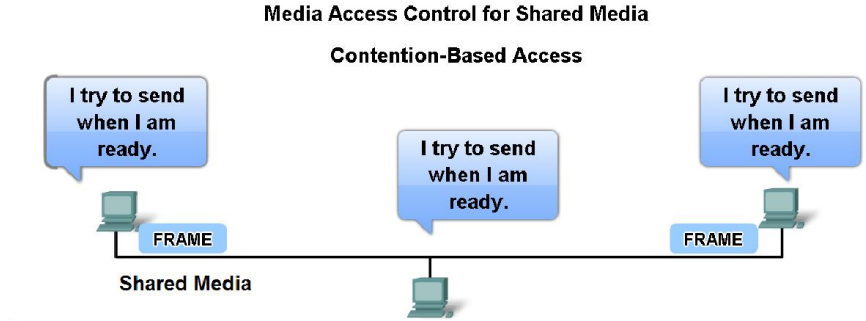
- Think about vehicles ignoring ALL traffic and entering roads without regards to other vehicles. MESSY!
- Traffic can enter roads using different methods, i.e. traffic lights, stop signs, yield signs, merging.
- You have a different set of rules depending on where you enter the road.
- Likewise, there are different ways to regulate placing frames on the media. Protocols at layer 2 determine the rules for access to that media (copper, fiber, wireless, etc.)

Media Access Control Techniques

- Identify two media access control methods for shared media and the **basic characteristics** of each



Method	Characteristics	Example
Controlled Access	• Only one station transmits at a time • Devices wishing to transmit must wait their turn • No collisions • Some deterministic networks use token passing	• Token Ring • FDDI



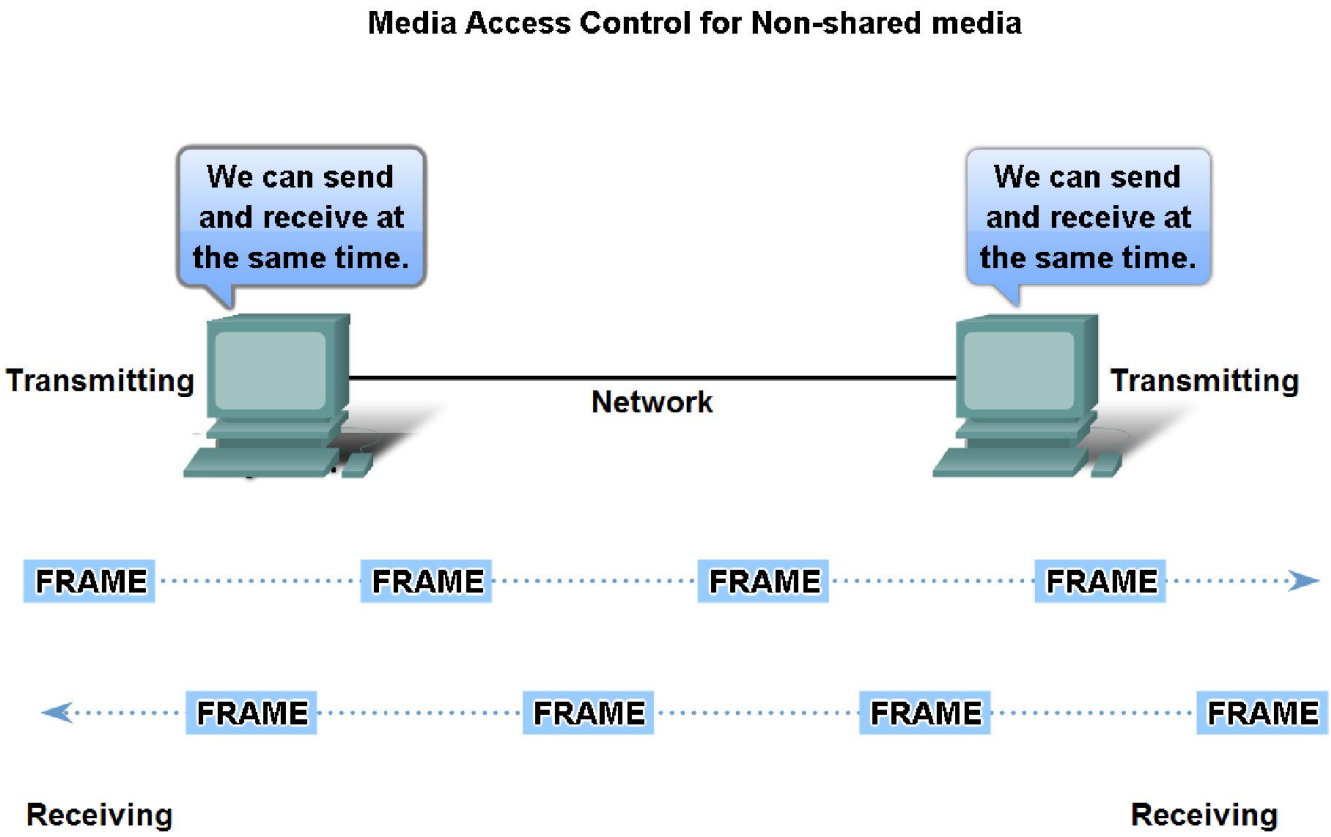
Method	Characteristics	Example
Contention Based Access	• Stations can transmit at any time • Collisions exist • Mechanisms exist to resolve contention: • CSMA/CD for Ethernet networks • CSMA/CA for 802.11 wireless networks	• Ethernet • Wireless

Deterministic…can be inefficient because a device has to WAIT for its turn before it can use the medium.

Non-deterministic…less overhead…Take turns…wait until it hears 'all clear'. Can cause collisions.

Media Access Control Techniques

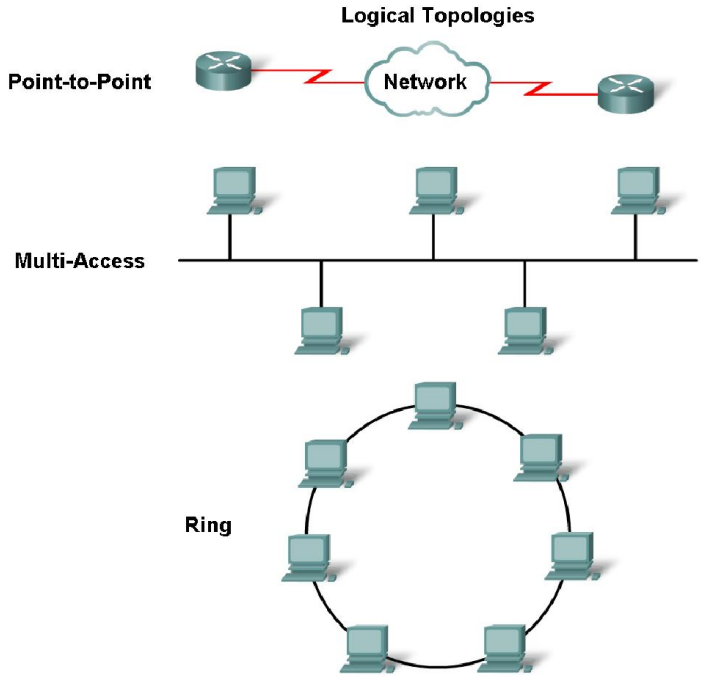
- Full Duplex – Tx/Rx simultaneously (2-way street)
- Half Duplex – Tx/Rx but only one at a time (1 way street)



Media Access Control Techniques

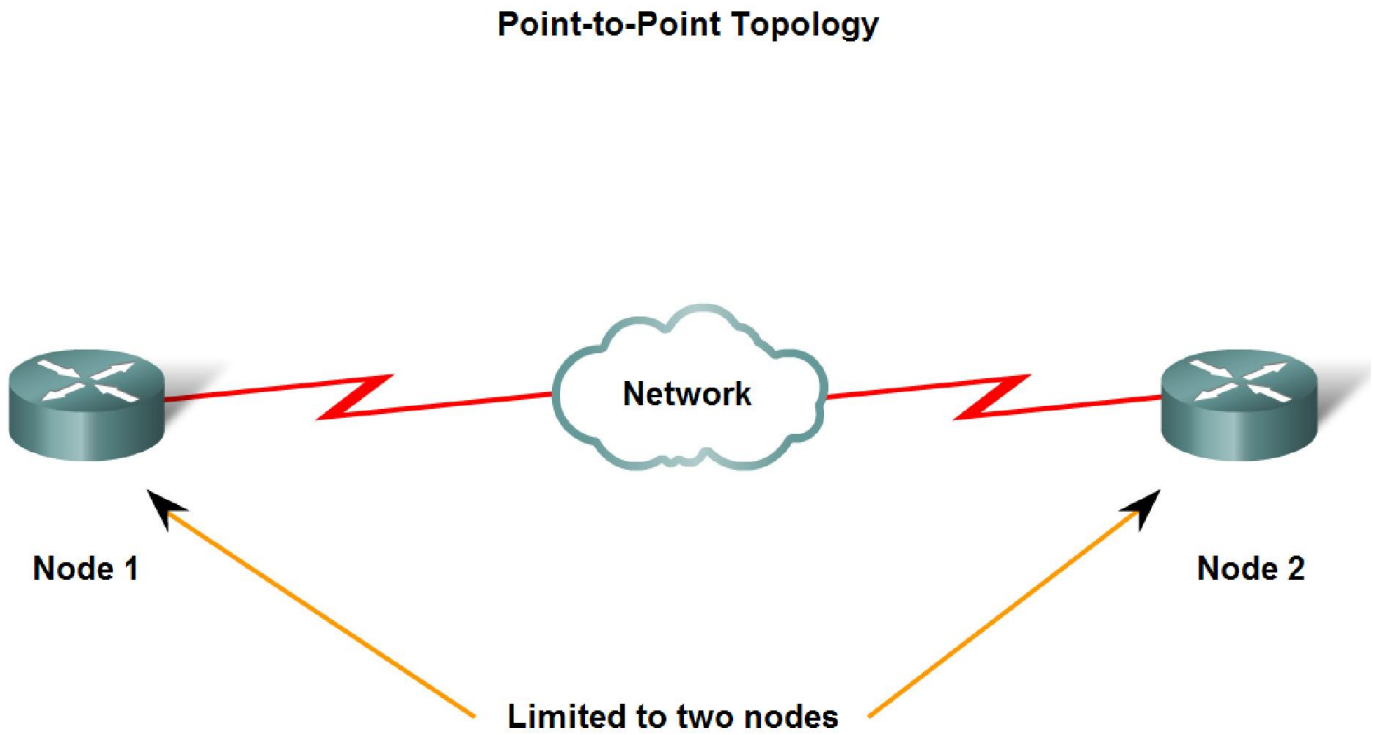
- Logical topology – way a network transfers frames from one node to the next. This is what the data link layer 'sees' when controlling media access. These are virtual connections
- Physical topology – physical arrangement of the nodes and connections.

These 2 are not usually the same!



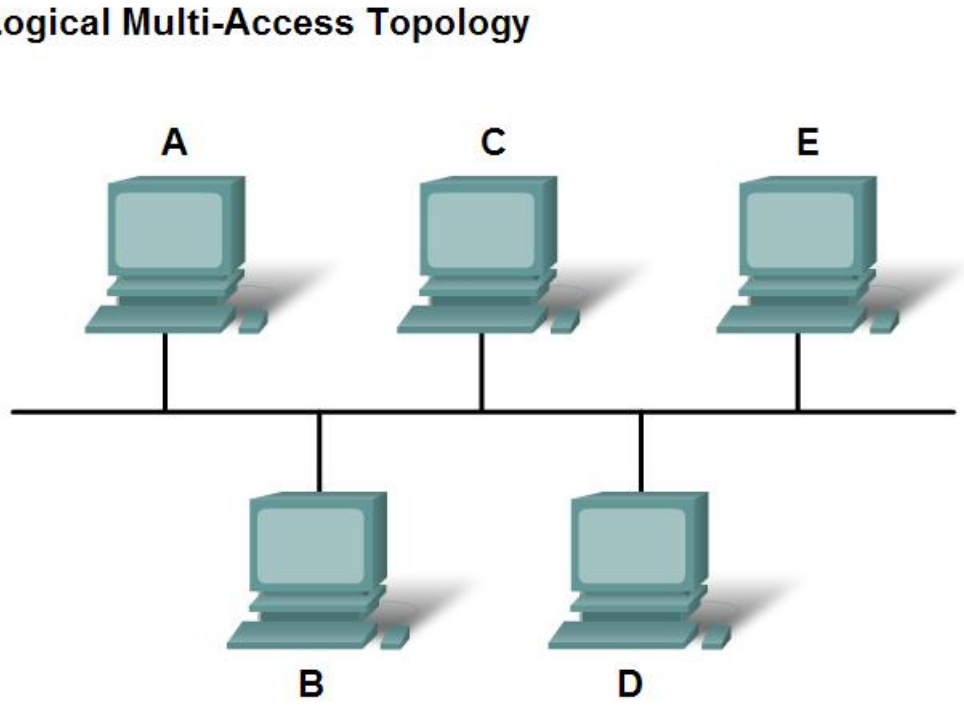
Media Access Control Techniques

- Very simple media access control
- Data can only travel to/from 1 other place. No need to be complicated!



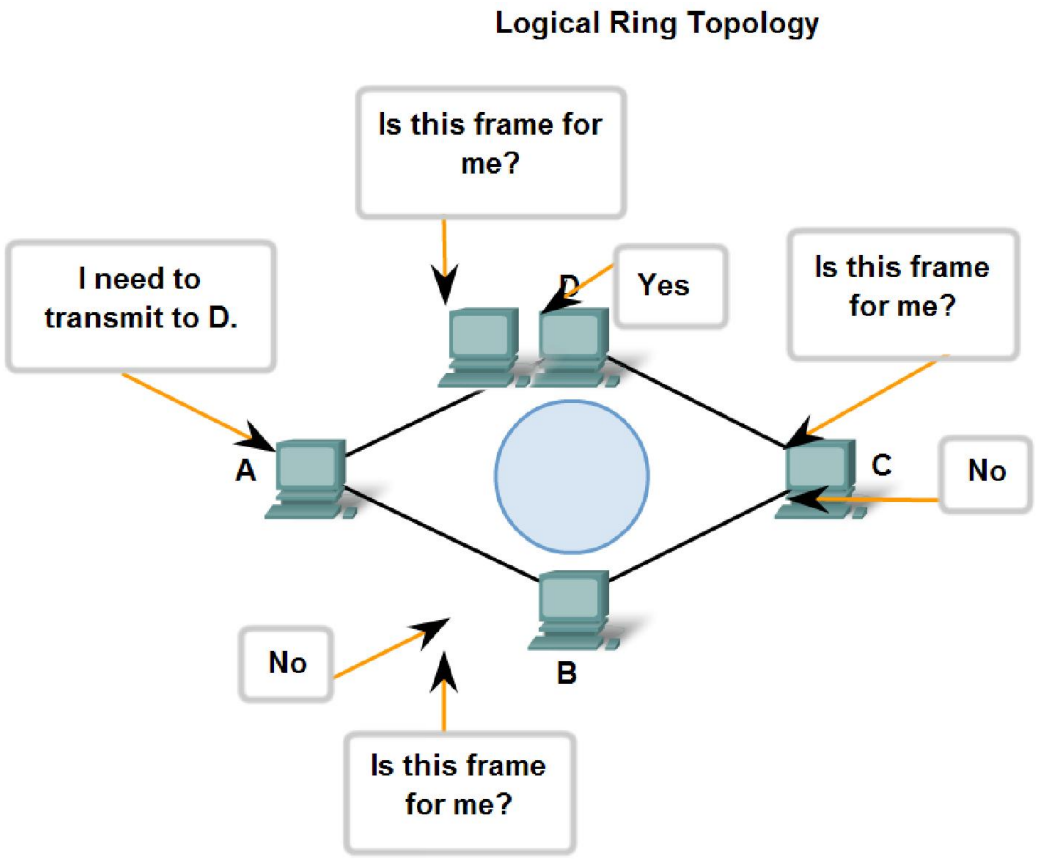
Media Access Control Techniques

- Uses CSMA/CD (Ethernet), CSMA/CA (wireless) or token-passing to transmit data.
- Token-passing - passed sequentially. Can only tx when you have the token.



Media Access Control Techniques

- Frames are passed from node to node – Token passing! Ignored if it doesn't belong to them, and passed on.



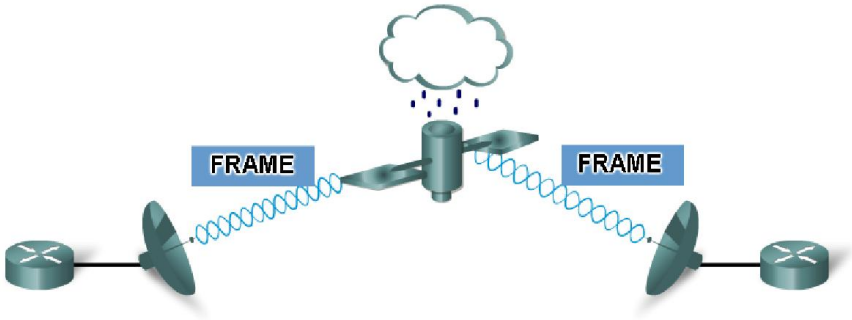
Media Access Control Addressing and Framing Data

- Purpose of encapsulation of data into frames: to facilitate the entry and exit of data on the media!

Data Link Layer Protocols - The Frame

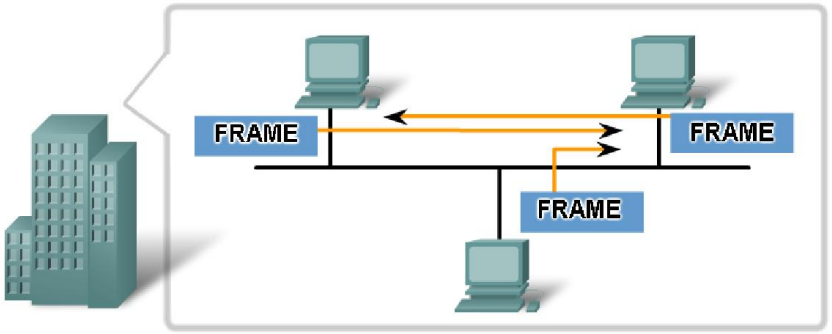
In a fragile environment, more controls are needed to ensure delivery. The header and trailer fields are larger as more control information is needed.

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.

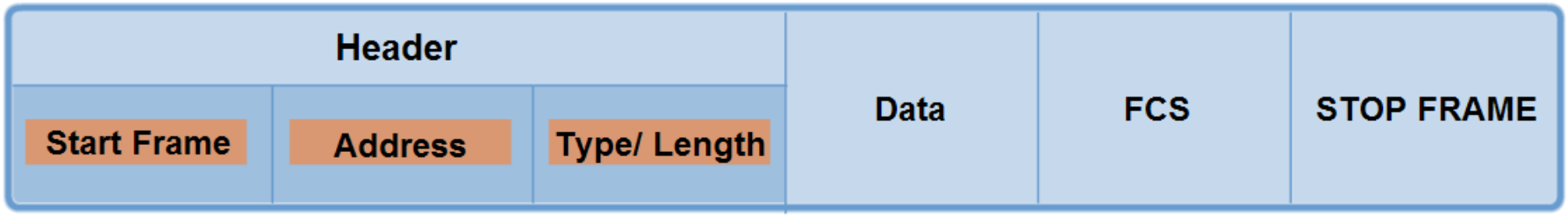
Less effort needed to ensure delivery = lower overhead = faster transmission rates



Media Access Control Addressing and Framing Data

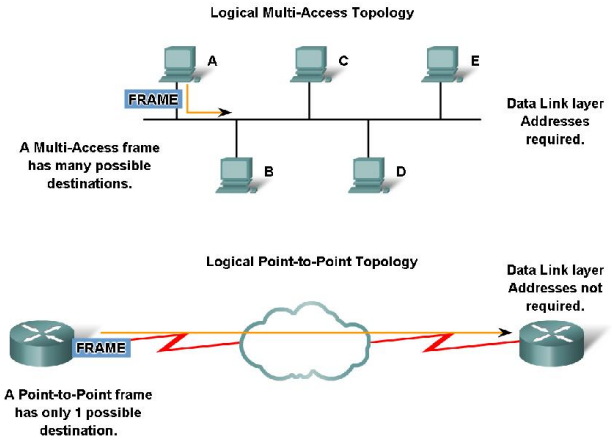
- Start – beginning of frame
- Source/destination address fields – nodes on the network
- Type field – upper layer service in the frame

The Role of the Header



Media Access Control Addressing and Framing Data

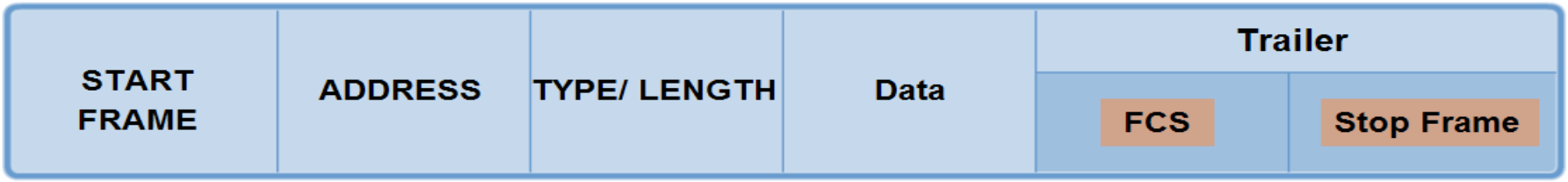
- Layer 2 uses MAC addresses (NIC card). BIA, hardware, physical, adapter…same thing.
- Layer 3 uses IP addresses (logical, network, hierarchical) that reflect the network on which they reside.
- If a device is MOVED from one subnet to another…layer 2 address is the same. Will need to change the layer 3 address for the device to communicate.



Media Access Control Addressing and Framing Data

- Purpose – support any error detection issues
- FCS –CRC (cyclic redundancy check) value is placed in the trailer's FCS field. Upon arriving at it's destination, it is recalculated and checked to make sure the frame has no errors.
- This calculation occurs at every sending/receiving point in the route of that frame. (entering & exiting a device)

The Role of the Trailer



Traveling frames

- As frames traverse the network, the source and destination addresses may change.
- Source MAC – gets reset to the next device (routers) as it travels
- Destination MAC – gets set to the next device in line (router or pc)
- Source IP – NEVER CHANGES
- Destination IP – NEVER CHANGES

That's all for Ch. 7

- Study Guide: NONE
- **Online Ch. 7 Test**
  - MW class - By Sunday Sept. 16, 2012 - midnight
  - T/Th class – By Sunday Sept. 9, 2012 - midnight
- Ch. 7 Test –
  - MW class – Mon 9/17/2012
  - T/TH class - Tues 9/11/2012
- **Lecture for Ch. 6** will begin after