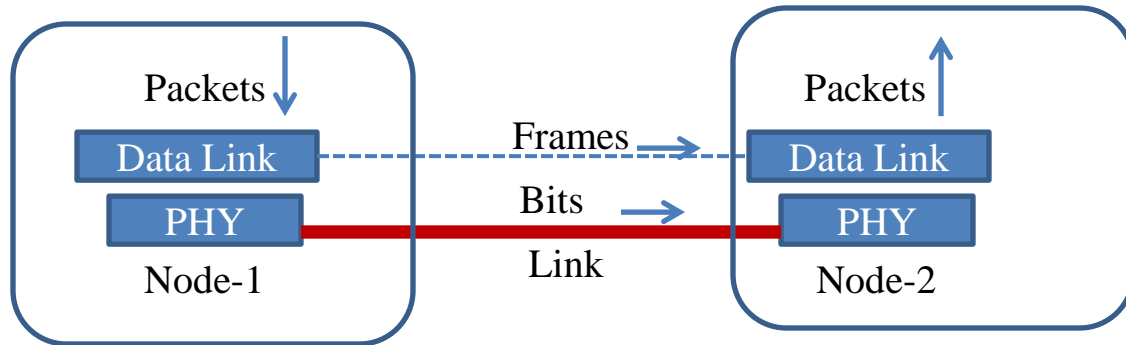# Data Link Layer: Framing

Kameswari Chebrolu

Data-Link Layer

- Frame-by-Frame next-hop delivery

    – Frame: Block of data exchanged at link layer

- Uses services of PHY layer (which delivers bits) to deliver frames

Link Layer Protocols

- Link could be point-to-point or broadcast

  - Broadcast: Many nodes connected to same communication channel (e.g. wireless)

- Protocol:

  - Define format of frames to be exchanged over the link

  - In response to frames, action to be taken by nodes

  - Examples: Ethernet, Token-Ring, WiFi, PPP etc

Services

- Logical Link Control (LLC): Interface between Network layer and MAC sub-layer

    – Multiplexing

    – Error Detection

    – Error Recovery (optional)

    – Flow Control (optional)

- Media Access Control (MAC): Controls access to physical media (Broadcast Channels)

    – Framing

- Switching (Interconnecting LANs)

LLC
MAC

Framing

- Blocks of data (termed frames at link layer) exchanged between nodes

- How do you determine which set of bits constitutes a frame?

A Possible Approach

- Keep link idle between two frames

- Not Used. Why?

- Dependency on PHY layer

  - Some Encodings may use idle time to encode data (unipolar)

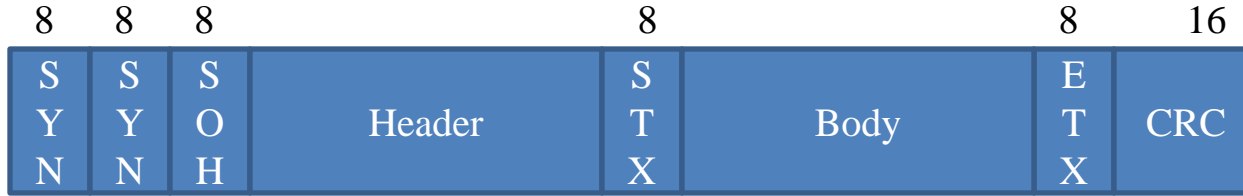 - Some PHY Layers don't keep link idle (to maintain synchronization)

Sentinel Approach

- Use special character or bit sequence to indicate start and end of frames

- Byte Counting:

  – Used to determine end of frame (Sentinel still used at beginning of frame)
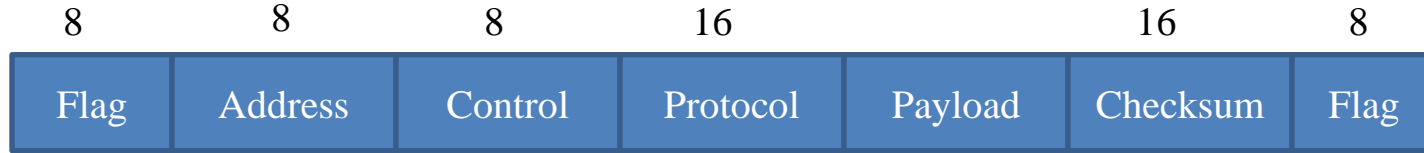
Byte Oriented Protocols

- View frame as collection of bytes (not bits)

- Special byte acts as the sentinel

- Examples:

  - BISYNC (Binary Synchronous Communication) developed by IBM

  - DDCMP (Digital Data Communication Message Protocol)

  - PPP (Point-to-Point Protocol)

Byte Oriented Protocols

SYN (8)	SYN (8)	SOH (8)	Header (8)	STX (8)	Body	ETX (8)	CRC (16)

BISYNC Frame Format

Flag (8)	Address (8)	Control (8)	Protocol (16)	Payload	Checksum (16)	Flag (8)

PPP Frame Format

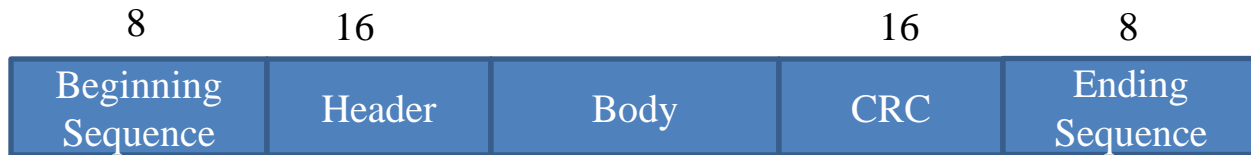| SYN (8)	SYN (8)	Class (8)	Count (14)	Header (42)	Body	CRC (16)

DDCMP Frame Format

Bit Oriented Protocols

- View frame as collection of bits

  - Bits could be from ASCII characters, pixel values in an image, binary file

- HDLC (High-level Data Link Control)

  - Sequence: 01111110

8	16		16	8
Beginning Sequence	Header	Body	CRC	Ending Sequence

HDLC Frame Format

Problem

- What if the sentinel character (e.g. ETX or ending sequence) appears in the body (payload)?

  - Frame terminated prematurely

Byte/Character Stuffing

- Used in Byte oriented protocols

- Sentinel characters escaped by "DLE" (Data Link Escape) character

  - DLE itself is escaped by another DLE

  - E.g. Send "DLE ETX" instead of "ETX" in Body

Bit Stuffing

- Flag: 01111110

- In body of message:

  - Sender inserts a 0 after 5 consecutive 1's

  - Receiver removes the 0 that follows 5 1's

Summary

- Data link layer services

- Framing: How to detect beginning and end of frames

- Byte and bit oriented protocols (Sentinel approach)

  - Byte and bit stuffing