

Data Link Layer: Framing

Kameswari Chebrolu

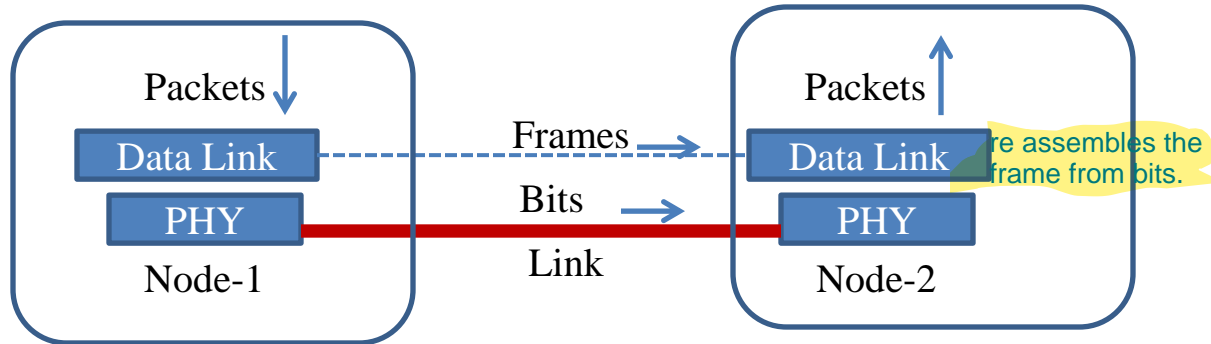
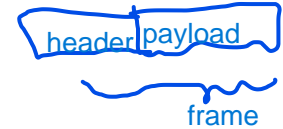
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Data-Link Layer

PHY: bit-by-bit
LINK : hop by hop

- 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) to avoid collision of packets
 - Framing
- Switching (Interconnecting LANs)



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)

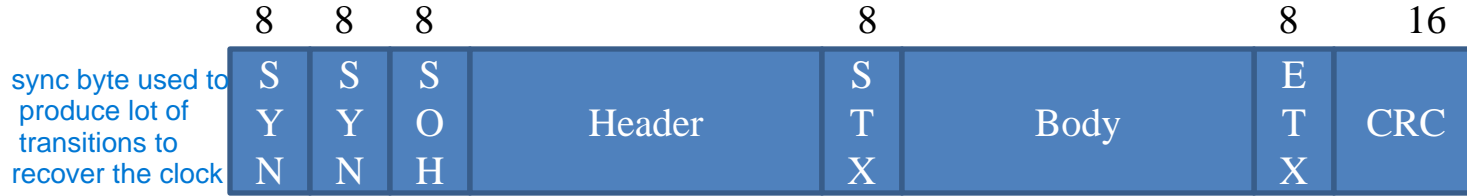
Sentinel Approach

- 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)

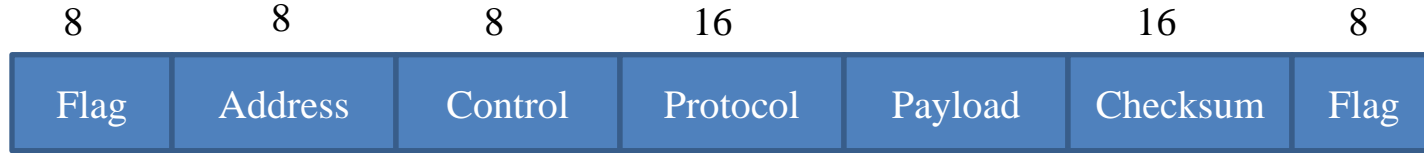
Byte Oriented Protocols

- 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



BISYNC Frame Format



PPP Frame Format



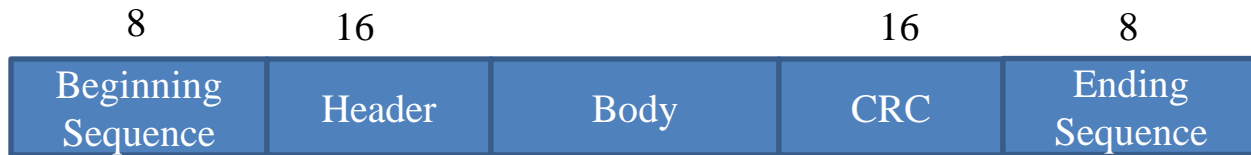
DDCMP Frame Format

byte count of the frame

CRC..for error detection

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



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

DLE.ETX..... sent as DLE.DLE.DLE.ETX

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

011111 1110 .. original
0111110 1110 ..Transmitted

what if reciever recieves 01111111
FRAME ERROR

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