EE 4711

Data Communications and Computer Networks

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CRMA Electrical Engineering

EE 4711: Data Communications and Computer Networks

Link Layer (part I)

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Layers, Services, Protocols

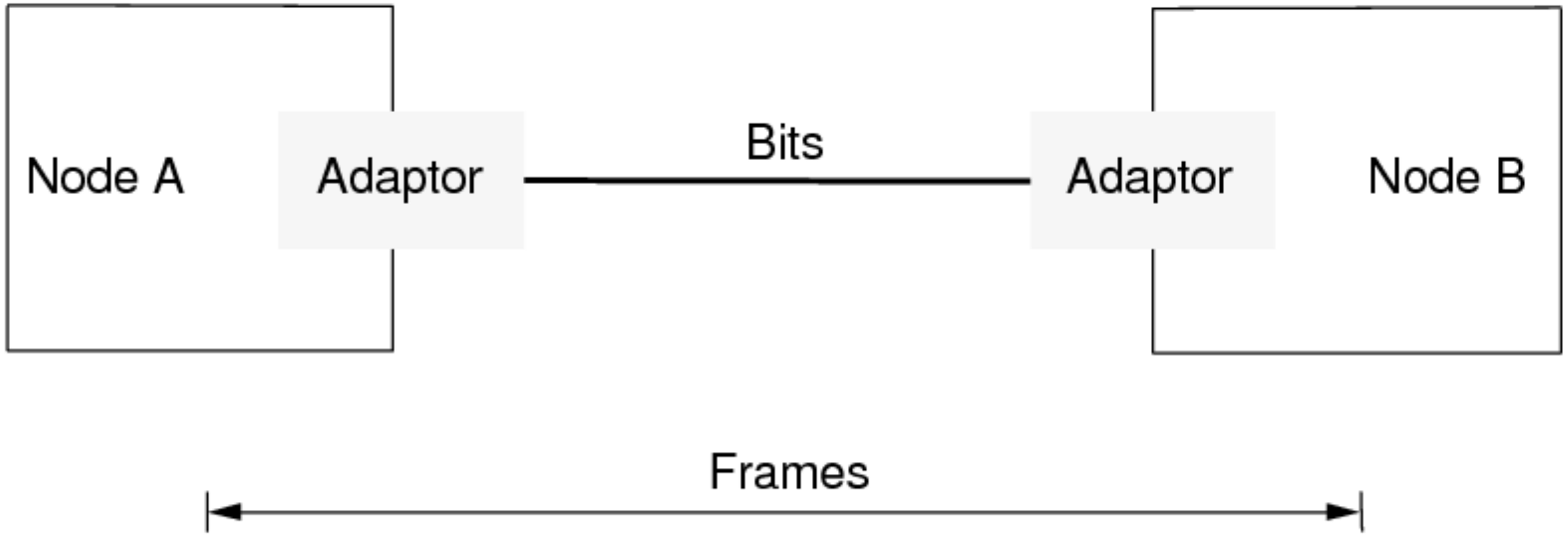
Application	Service: user-facing application. Application-defined messages
Transport	Service: multiplexing applications Reliable byte stream to other node (TCP), Unreliable datagram (UDP)
Network	Service: move packets to any other node in the network IP: Unreliable, best-effort service model
Link	**Service: move frames to other node across link.** **May add reliability, medium access control**
Physical	**Service: move bits to other node across link**

Link Layer

Framing

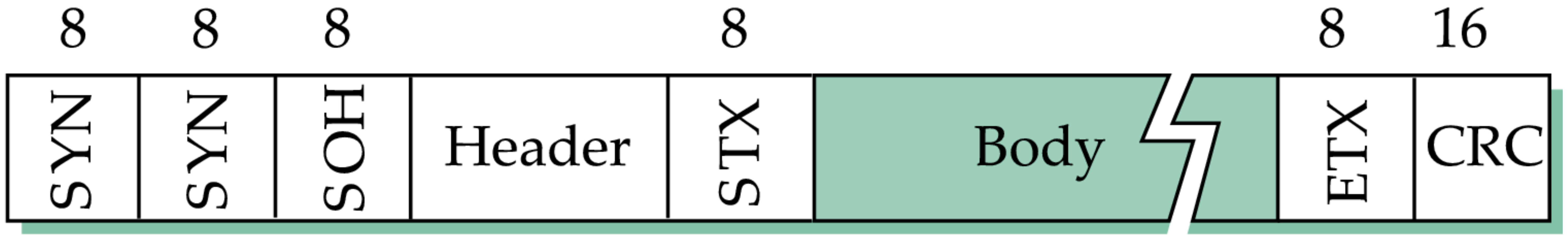
Framing

- The process of grouping bits into frames (packets)
- Typically implemented by the network adaptor
- Why frames?



Byte-Oriented Framing

- BISYNC: Binary synchronous communication
- Frame is a collection of bytes
- Need to indicate the beginning and end of a frame
- Sentinel characters are used



SYN: Synchronization character

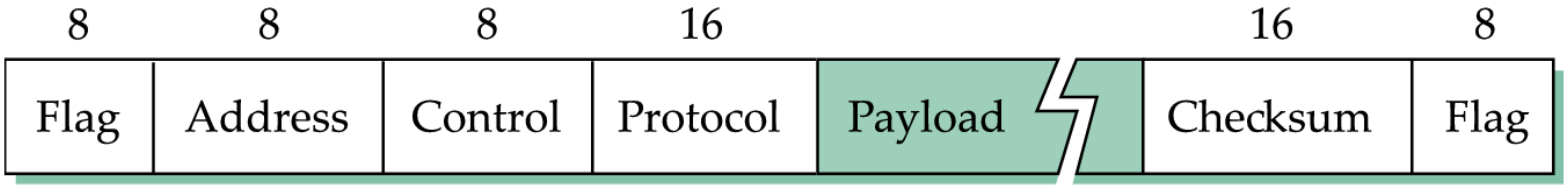
SOH: Start of header

STX, ETX: Start of text, End of text

CRC: Cyclic redundancy check

Byte-Oriented Framing

- Point-to-Point (PPP) protocol used by Internet Protocol (IP) to carry IP packets



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

STX: 0111110

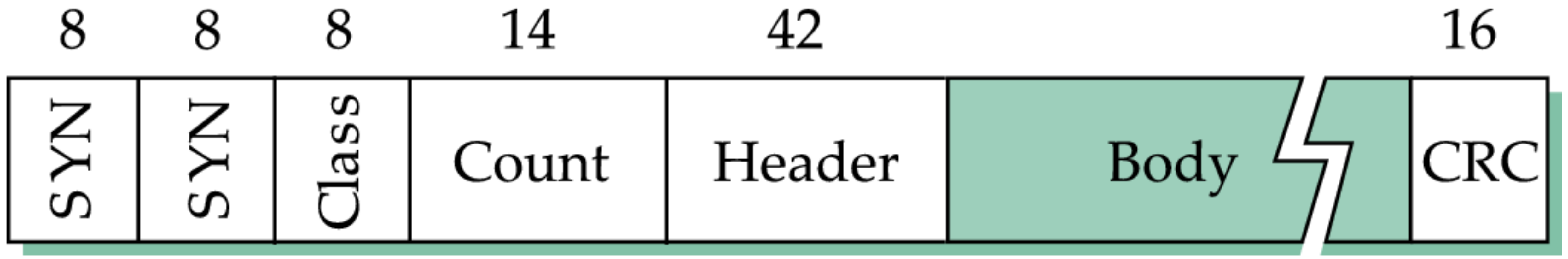
Payload: 1,500 bytes

Checksum: 2 or 4 bytes

Overhead: 8/1508 =0.5%

Byte-counting Framing

- Include the # of bytes in the frame as a field in the header
- Digital Data Communications Protocol (DDCMP)

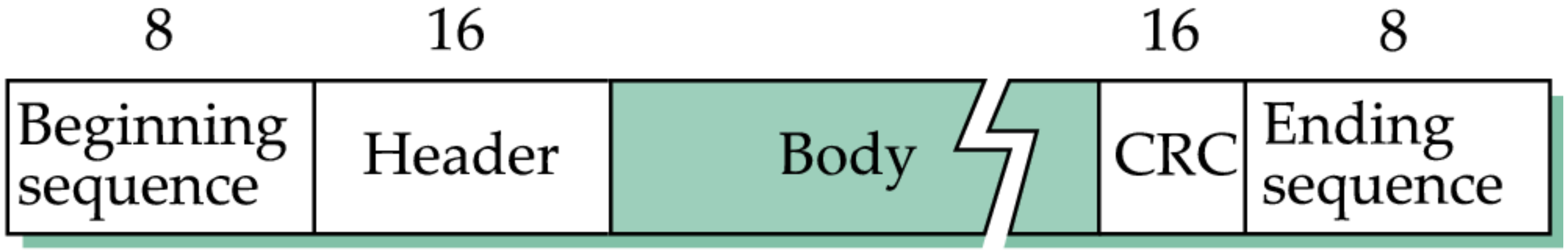


Count: Specifies # of bytes in the body

CRC ensures that count field is not corrupted

Bit-oriented Framing

- High-Level Data Link Control (HDLC)



Beginning/end of frame, flag: 01111110

Instead of inserting bytes do ***bit stuffing***

Sender adds a 0 after five consecutive 1s

Receiver removes zero after five 1s

Example of Bit-stuffing

Sender

1 1 1 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 0 1 1 1 1 1 0

1 1 1 1 1 0 1 0 1 1 1 1 1 0 1 1 1 1 1 0 1 0 1 1 1 1 1 0 0

Receiver

X

1 1 1 1 1 ~~0~~ 1 0 1 1 1 1 1 ~~0~~ 1 1 1 1 1 ~~0~~ 1 0 1 1 1 1 1 0 0

1 1 1 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 0 1 1 1 1 1 0

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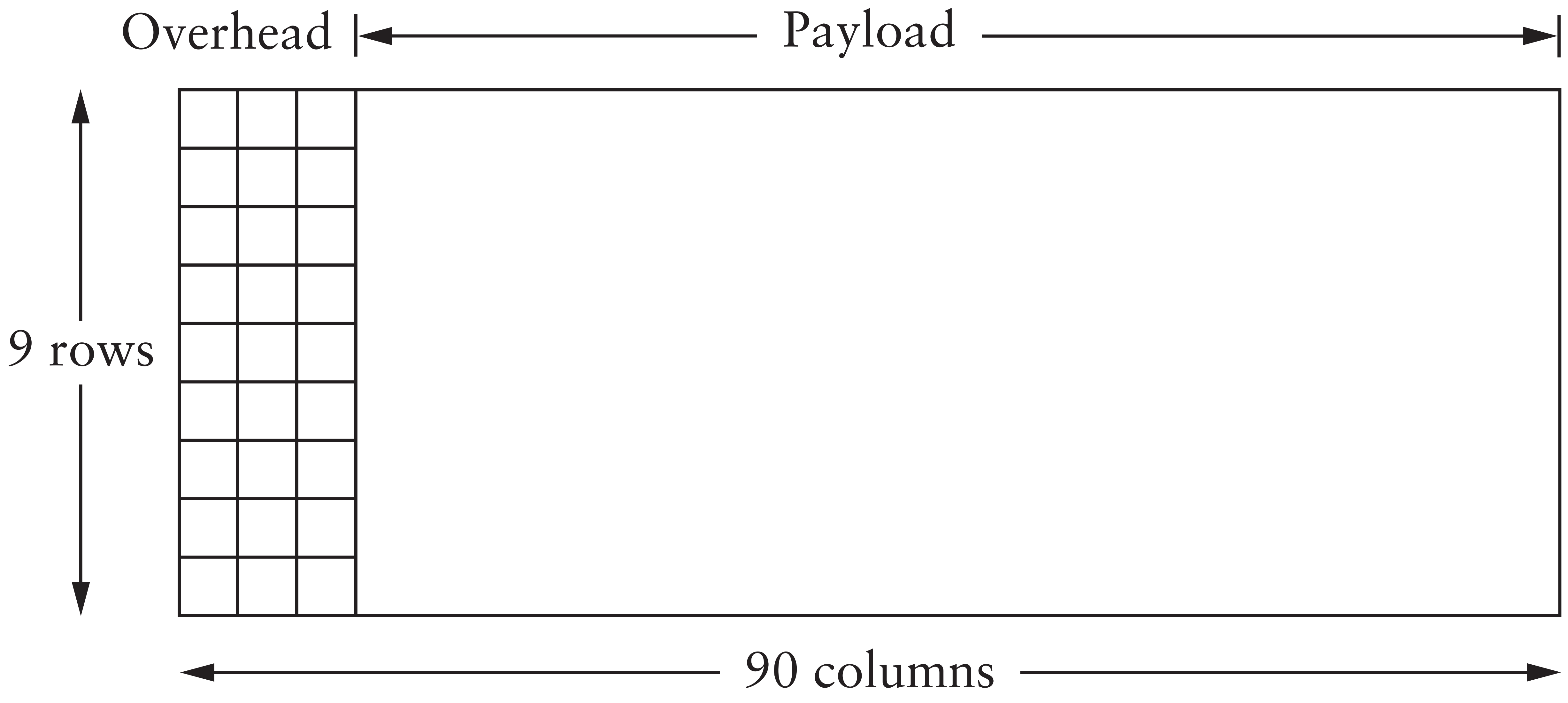
Clock-based Framing

- E.g., SONET (Synchronous Optical Network)



- Each frame is 125μs long
- Look for header every 125μs
- Encode with NRZ