Framing and Stuffing

Computer Networks

Spring 2012

Framing & Stuffing Outline

- Synchronous vs Asynchronous Transmissions
- Asynchronous Character Transmissions
- Framing – Identifying Synchronous Block Boundaries
- Byte Stuffing
- Bit Stuffing
- PPP Byte Stuffing

Synchronous versus Asynchronous Transmissions

There exists a hierarchy of synchronization tasks:

- *Bit level* : recognizing the start and end of each bit.
- *Character or byte level* : recognizing the start and end of each character (or small unit of data)
- *Block or message level* : recognize the start and end of each large unit of data (in networks this is a frame).

Synchronous versus Asynchronous Transmissions [Halsall]

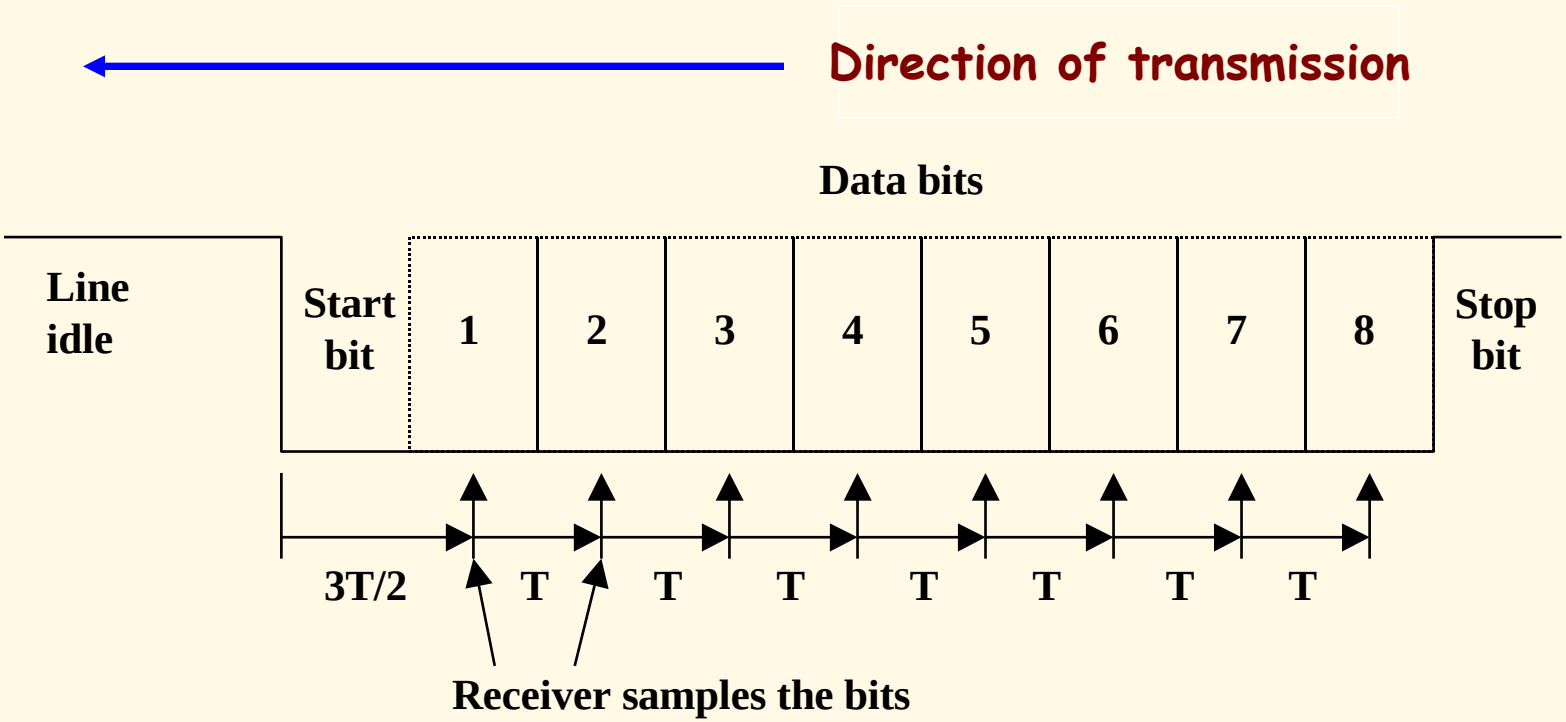
A fundamental requirement of digital data communications is that the receiver knows the starting time and the duration of each bit.

Asynchronous transmission :: each character (or byte) is treated independently for clock (bit) and character (byte) synchronization purposes and the receiver resynchronizes at the start of each character received.

Synchronous transmission :: the complete frame is transmitted as a contiguous string of bits and the receiver endeavors to keep in synchronism with the incoming bit stream for the duration of the frame.

Byte Level Synchronization in Asynchronous Transmissions

Characters transmitted at random intervals (e.g., from keyboard)



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Synchronous Transmissions

- More efficient, i.e., less overhead
- Blocks of characters are transmitted without start and stop codes.
- The transmitted stream is suitably encoded so the receiver can stay 'in synch' by:
  - Using a separate clock line.
  - Embedding clocking information into data (e.g. biphase coding).

Methods to Identify Frames

[Tanenbaum]

1. Byte counts
2. Starting/ending bytes [byte stuffing]
3. Starting/ending flags [bit stuffing]
4. Using physical layer coding violations (i.e., invalid physical codes, used in token rings)

Framing

The contents of each frame are encapsulated between a pair of reserved characters or bytes for frame synchronization.

Byte Count Example

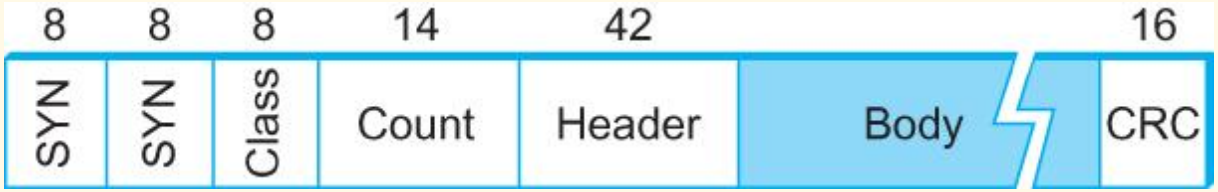


Figure 2.8 DDCMP Frame Format

DDCMP byte-counting approach:

- **Count** :: the number of bytes contained in the frame body.
- If *count* is corrupted, framing error!!

Byte Stuffing
[HDLC Example]

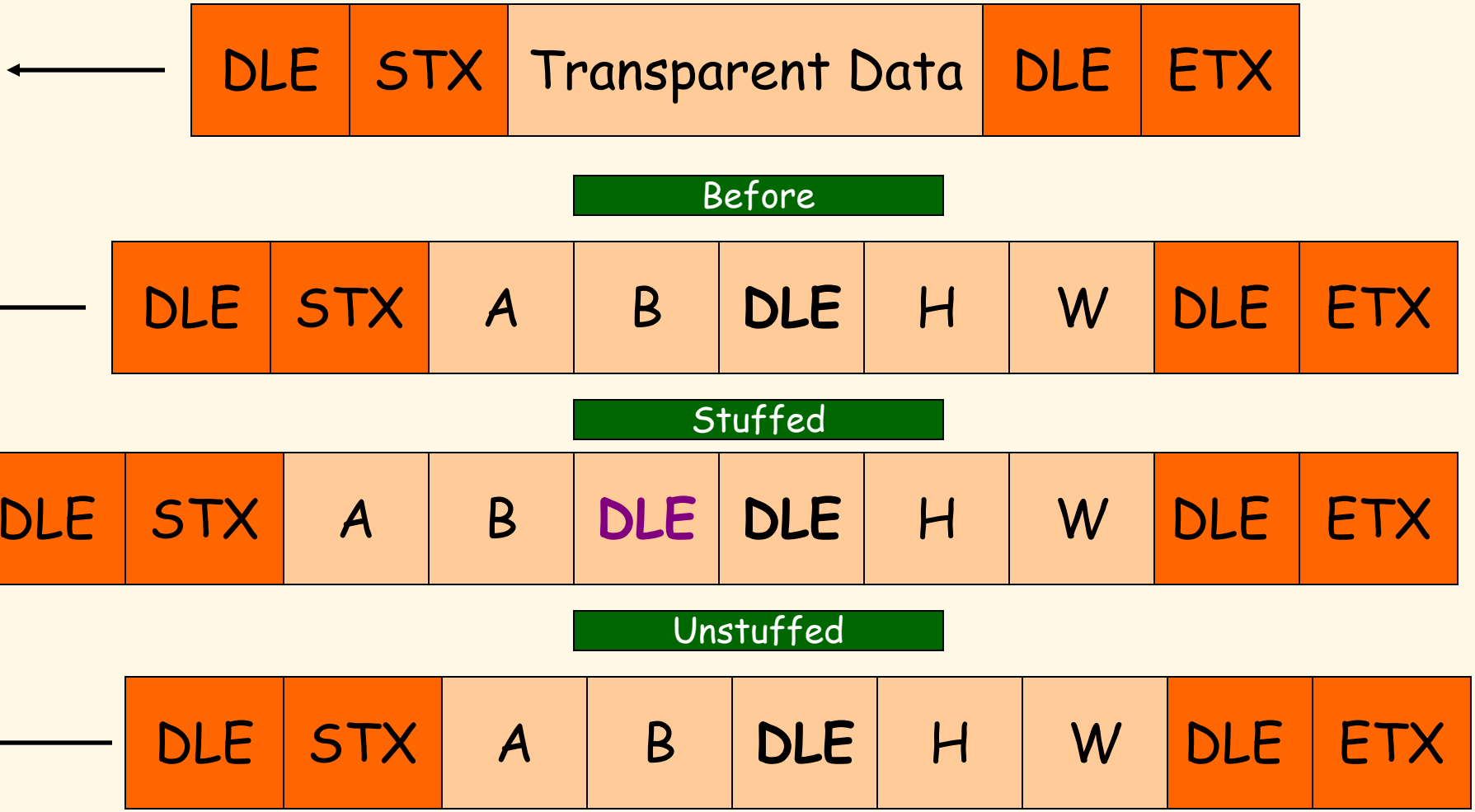
Also referred to as character stuffing.

- ASCII characters are used as framing delimiters (e.g. DLE STX and DLE ETX).
- The problem occurs when these character patterns occur within the "transparent" data.

Solution: sender stuffs an extra DLE into the data stream just before each occurrence of an 'accidental' DLE in the data stream.

The data link layer on the receiving end unstuffs the DLE before giving the data to the network layer.

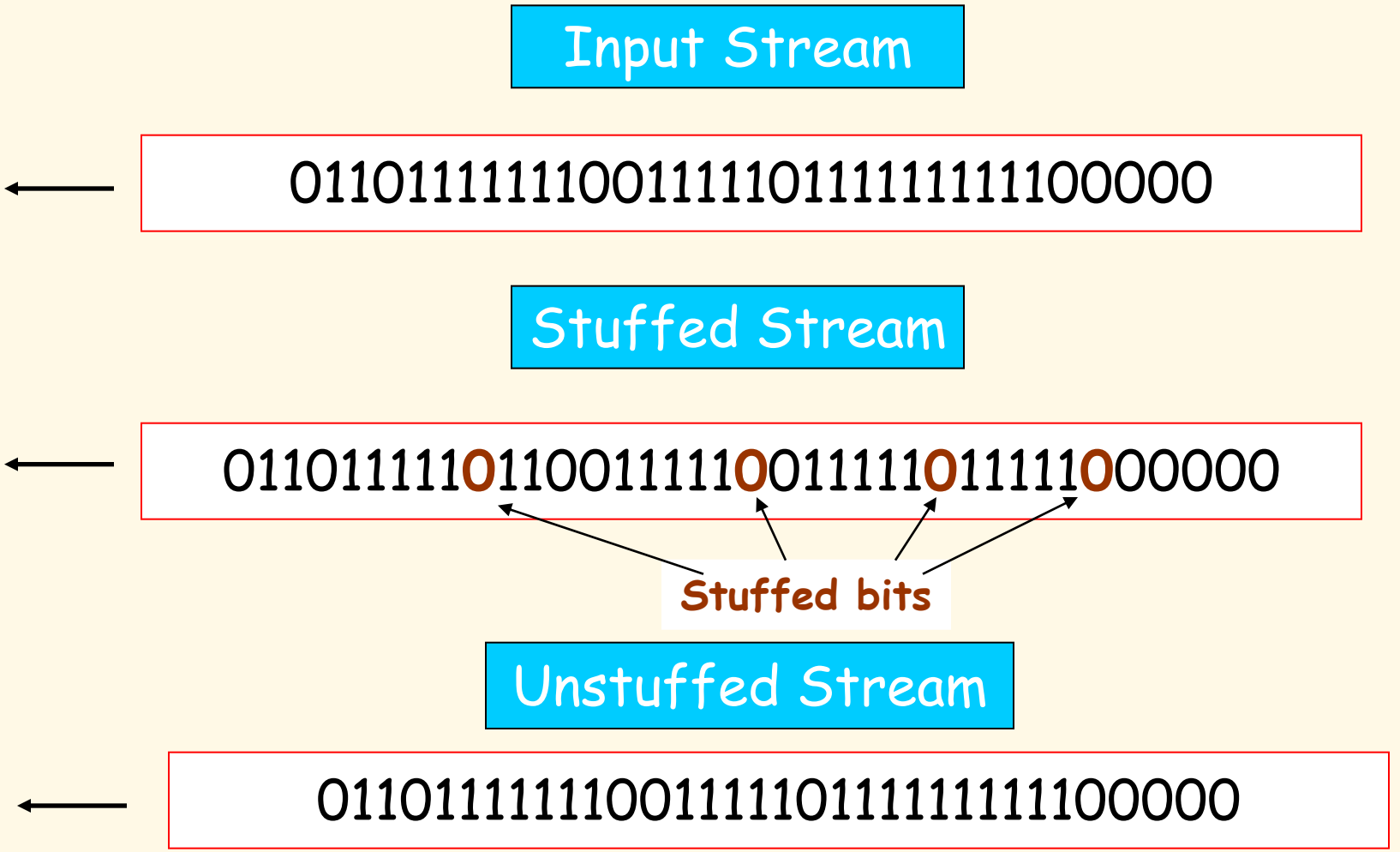
HDLC Byte Stuffing



HDLC Bit Stuffing

- Each frame begins and ends with a special bit pattern called a flag byte [01111110]. {Note this is 7E in hex.}
- Whenever the sender data link layer encounters *five consecutive ones* in the data stream, it automatically stuffs a 0 bit into the outgoing stream.
- When the receiver sees *five consecutive incoming ones followed by a 0 bit*, it automatically destuffs the 0 bit before sending the data to the network layer.

Bit Stuffing



PPP (Point-to-Point Protocol) Frame Format

All stations are to accept the frame

Unnumbered frame

Specifies what kind of packet is contained in the payload, e.g., LCP, NCP, IP, OSI CLNP, IPX

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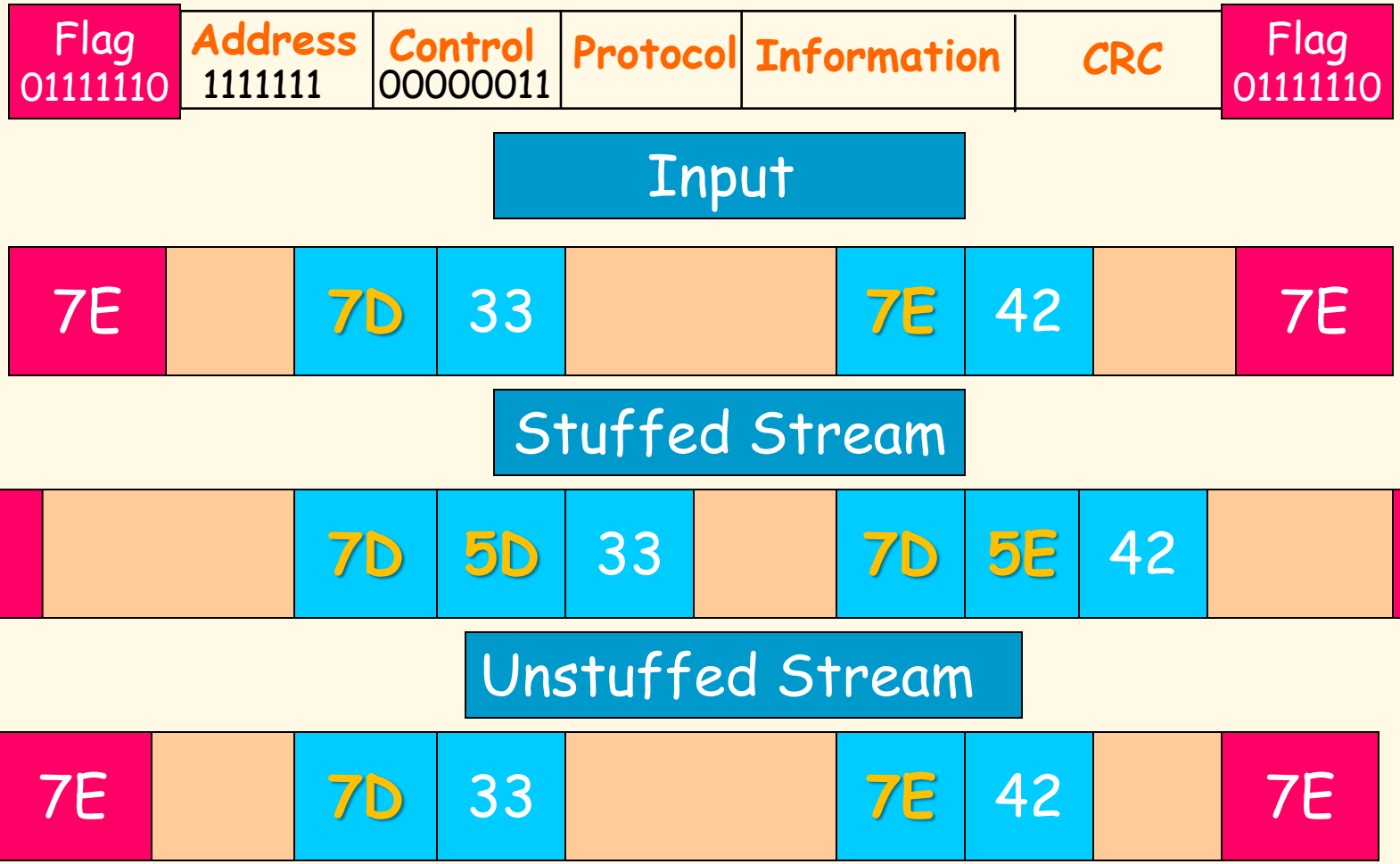
PPP Byte Stuffing



Framing & Stuffing Summary

- Synchronous vs Asynchronous Transmissions at different levels.
- Character Transmissions {Asynchronous}
- Synchronize bits (physical layer issue) to send blocks of characters as frames at data link layer.
- Framing – identifying a frame.
- HDLC and PPP Byte Stuffing
- Bit Stuffing