Next on the agenda is understanding the details of the layers & some widely-used protocols within some of them.

The Physical Layer

Electrical, timing & other interfaces for transfer of data bits between two adjacent nodes

The (Data) Link Layer

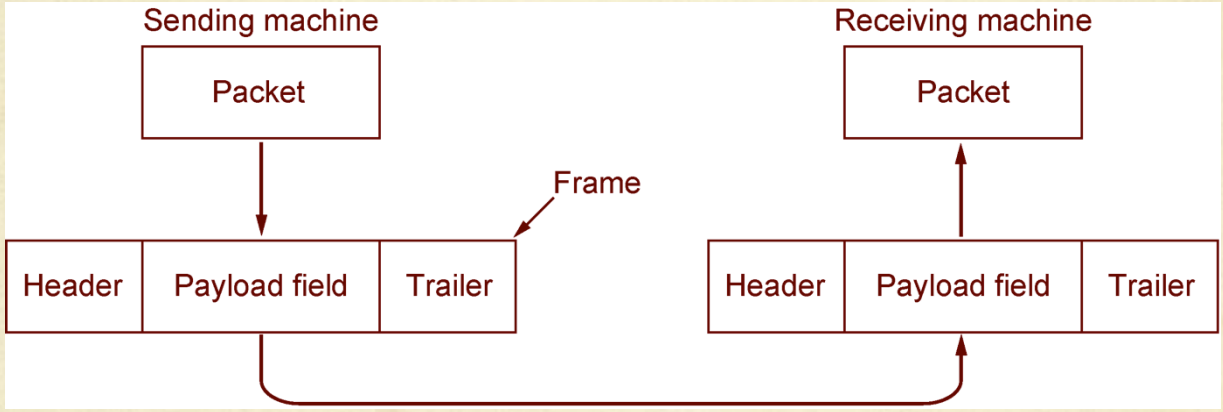
What does the link layer do?

- Provides well-defined services to the network layer…
  - Transfer of data unit b/w *adjacent* nodes (i.e., over *single* link)
    - Unit of data given by network layer is called a *packet*
    - Use *physical* address of nodes (MAC address)
    - Receiver must be able to *distinguish* packets from each other
  - Detect and/or correct transmission errors
    - Ensure packet that reaches receiver network layer is *error-free*
    - *Error control*
  - Regulate flow of packets
    - Ensure receiver does not get *inundated*!
    - *Flow control*

These design goals form recurring theme in multiple layers!

Packet transmission

- Receiver must be able to *distinguish* packets from each other
  - Encapsulates packets given by network layer into *frames*
    - Adds *header* & *trailer* to packets for this



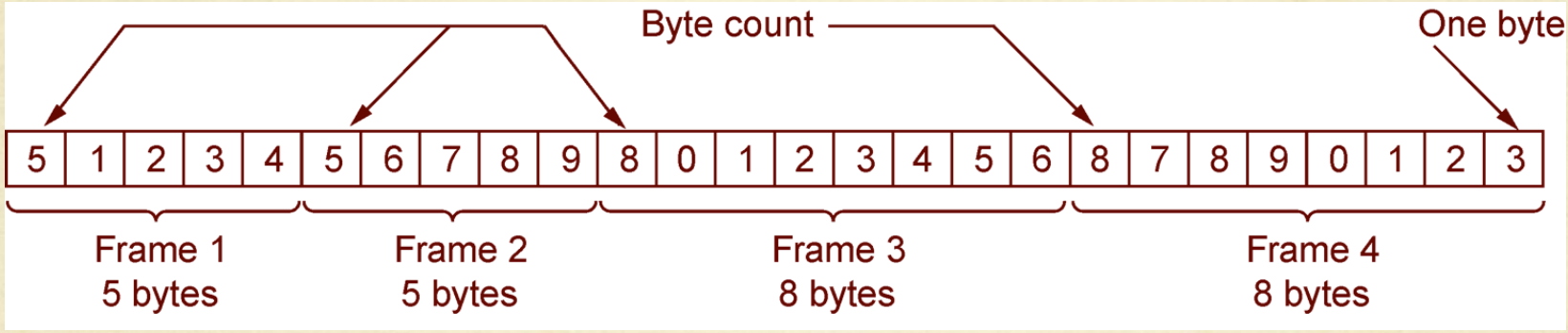
  - Need *understanding* b/w sender & receiver link layers on format of header/trailer
    - I.e., need link layer *protocol* understood by both computers

Framing

- *Byte count*
- *Flag bytes with byte stuffing*
- *Flag bits with bit stuffing*
- *Physical layer coding violations*

Byte count

- Field in header contains number of bytes in frame



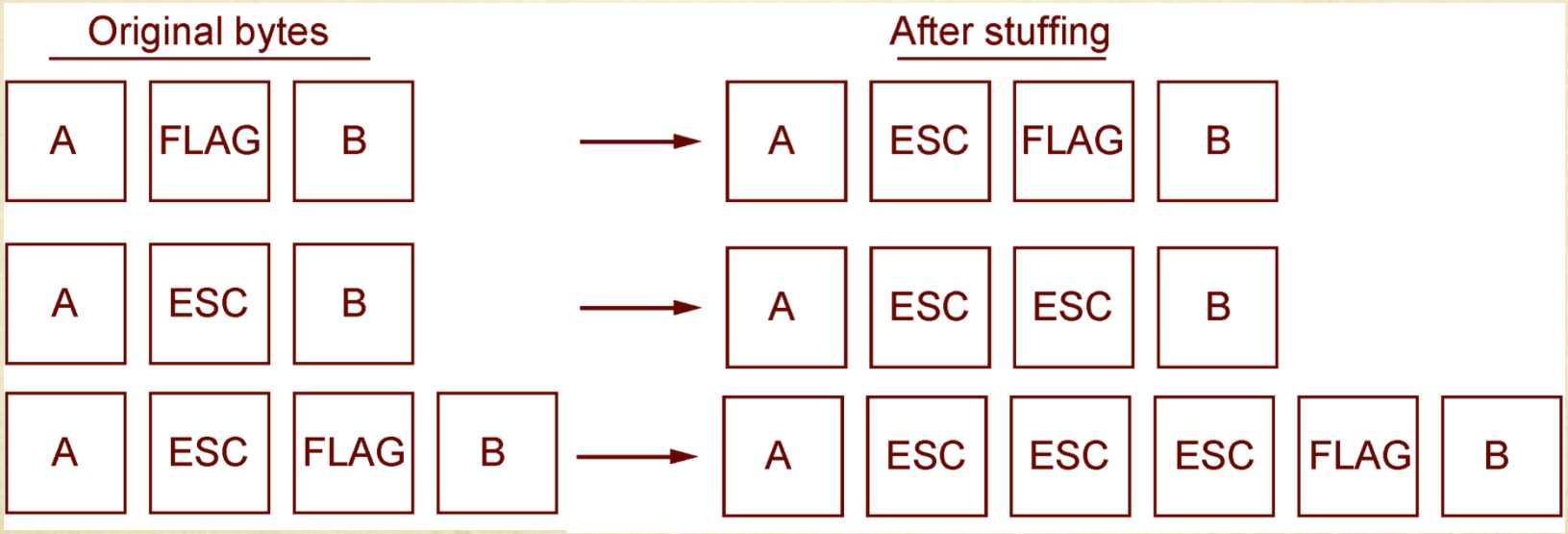
Flag bytes with byte stuffing

- Each frame starts & ends with special bytes
  - Could use same byte – *flag byte* – for start & end

- If receiver sees two *consecutive* flag bytes
  - End of one frame & beginning of next frame

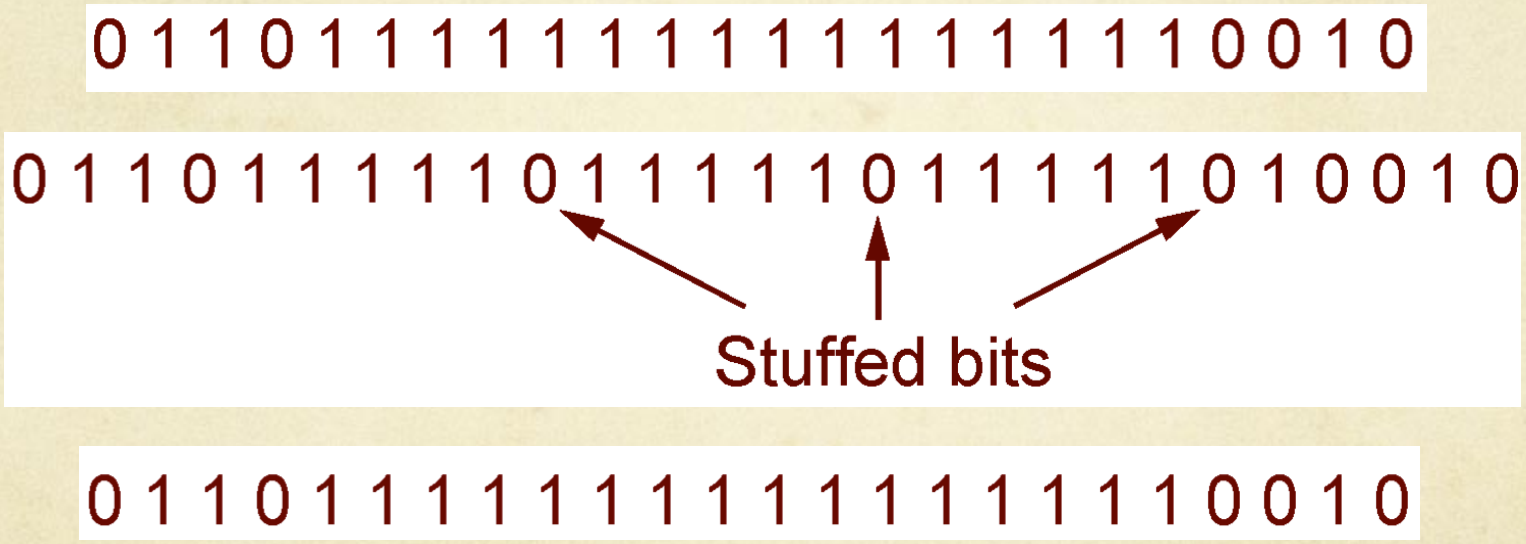
Flag bytes with byte stuffing

- What if flag byte happens to occur within payload?
  - *Byte stuffing* – insert special *escape byte* before flag byte
  - Escape byte itself can be escaped if needed



Flag bits with bit stuffing

- Each frame starts & ends with special *sequence of bits*
  - *Bit stuffing* used if payload contains same sequence of bits



- In byte/bit stuffing, *frame lengths vary* based on payload

Physical layer coding violations

- *Encoding* bits as signals includes redundancy
  - Some signals can never occur in payload
  - Use these "*reserved*" signals as frame delimiters
  - In practice, combination of different methods may be used!