CprE 489
Lecture 9

Fall Semester 1997

Services Provided by the Data Link Layer

- Services provided to the network layer - there are many options

  - unacknowledged connectionless service - data may be lost

  - acknowledged connectionless service - data may be potentially duplicated if an acknowledgement is lost

  - connection oriented service - data is never duplicated or lost
- Connection oriented service

  - There are acknowledgements and resends of frames.

  - The protocol guarantees that if the network layer provides data stream to the data link layer, that exact same data stream comes out at the the other end to the network layer.
- The network layer and data link layer are usually synchronized. For example, the data link layer will tell the network layer when it is ready for more data.

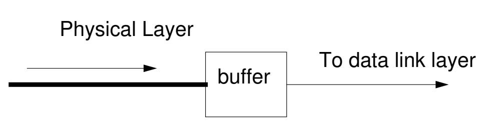
Services Provided to the Data Link Layer

- The physical layer provides services to the data link layer

  - The physical layer simply accepts a bit stream and transmits it to the other end.

  - Bits can be munged by noise or spikes

  - Bits can be lost in the "bit bucket" because the physical layer at the other end has a bounded buffer. If the data link layer does not respond quickly enough then data is overwritten.



What does the Data Link Layer Do?

- **Framing.** Data from the network layer are put into frames. Frames are then sent to the physical layer.
- **Error Control.** Frames contain extra bits to detect errors. These bits are commonly called "checksums". Frames may have to be buffered at the data link layer until an acknowledgement comes back.
- **Flow Control.** Frames contain control information to prevent the sender from swamping the receiver whereby frames are lost in the bit bucket.
- **Link Management.** In a connection oriented service, connections must be opened and closed.

Framing

- Frames are needed to localize where errors occur and because the physical layer has a bounded buffer at the interface to the data link layer.
- Example: X.25 Frame format. Starting and ending flags "01111110"

01111110	address	control	data	checksum	01111110
8	8	8		16	8

Bit Stuffing

- Since it may occur that 01111110 is found in data, or in other parts of the frame, then something must be done to distinguish data from flags. The answer is bit stuffing!
- Stuffing algorithm:

  Except for flags, reading left to right, on seeing 5 consecutive 1's in a row insert a 0.

  00111111111101111110111

  0011111**0**11111**0**011111**0**10111

- Unstuffing algorithm:

  Reading left to right, on seeing 111110, remove the final 0.

Properties of Bit Stuffing

- Normally, all bits between the flags, 01111110, are bit stuffed.
- If some 0 becomes 1 then potentally a flag can be created, causing the frame to be in error.

  110111110011

  110111111011

- If a 1 becomes a 0 no flag is created, but one could become destroyed.