More Flow Control

CS158a

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Outline

- Finish up Flow control
- Start Medium Access Control Sublayer

Go Back N Protocol

- In the one bit sliding window protocol we are assuming that the transmission time for a frame to arrive together with the time for acknowledgement is negligible.

- In some situations, such as for satellite communication this is false. It might take a 500msec second for a roundtrip.

- Start at time t=0. If the time to send a frame is 20msec, in the best circumstance, it will be t=520 msec before we get an acknowledgement to send the next frame. So the sender is block 500/520 =96% of the time.

- To get around this we can use a larger window. For instance, if we have a window of size 26, then by the time we finish sending our initial 26 frames, it will be t=520msec and so we will get the acknowledgement of the first frame and so we can slide the window and send the 27th frame, etc, continuing along in a **pipelining** fashion.

- What is done when a frame is lost or damaged in the middle of this long sequence of 26 frames?

- There are two strategies to deal with this, **go back** n and **selective repeat**.

- In go back n, we simply do not send acknowledgments for the damages/missing frame and all of those (possibly good) frames that follow it. This will cause the other side to time-out and resend those frames.

Selective Repeat

- The go back n approach can be viewed as the sender have a window size of n and the receiver having a window size of 1. If we increase the window size of the receiver we get the selective repeat approach.
- In the selective repeat approach to handling errors, we first discard the bad frame.
- The receiver then continues to buffer any good frames that are received.
- When the sender times out, it only send the oldest unacknowledged frame.
- When this arrives, the receive can acknowledges the highest number frame that it has gotten in sequence and resumes the protocol.
- This process is sometimes sped up by having the receiver sends a (NAK - negative acknowledgement) for the bad frame.

A picture
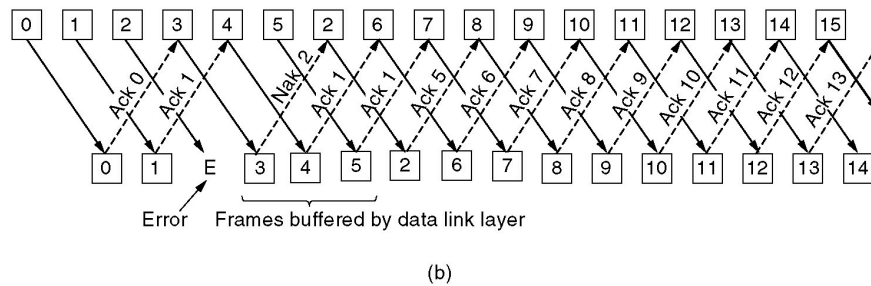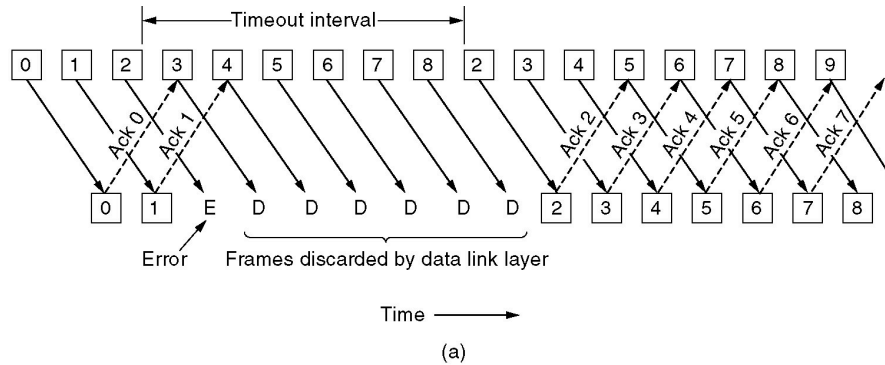
(a) go back n example

(b) selective repeat example

HDLC

- We now look at some actually used data link layer protocols.
- The first we'll consider is **HDLC**, which stands for High Level Data Link Control.
- It is derived from the **SLDC** -- Synchronous Data Link Control protocol used in IBM mainframes.
- HDLC was standardized by both ANSI and ISO and was used in X.25 networks.
- HDLC is a bit-oriented protocol. It uses bit stuffing where a frame looks like:

Bits	8	8	8	≥ 0	16	8
	0 1 1 1 1 1 1 0	Address	Control	Data	Checksum	0 1 1 1 1 1 1 0
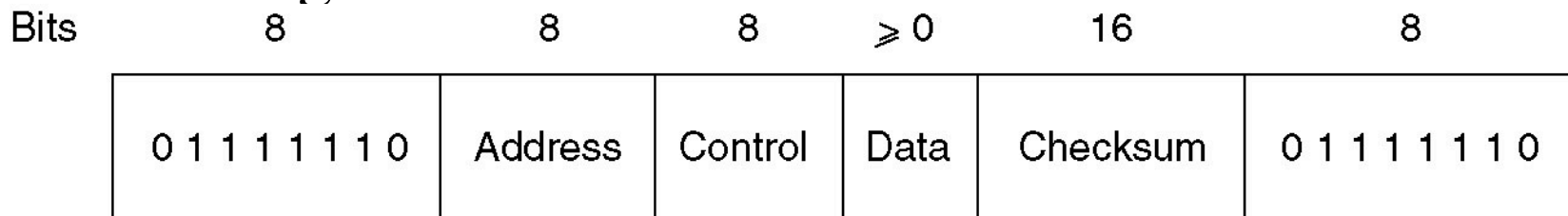
More on HDLC

- In the frame format:
  - The *Control* field is used for sequence numbers, acknowledgements, etc.
  - The *Data* field may contain any information and may be arbitrarily long, although the efficiency of the checksum falls off with length.
  - The *Checksum* field uses a CRC polynomial checksum.

- There are three kinds of HDLC frames: **Information, Supervisory,** and **Unnumbered**.

- The control sequence of these different kinds of frames look respectively like:

Bits	1		3	1	3
(a)	0		Seq	P/F	Next
(b)	1	0	Type	P/F	Next
(c)	1	1	Type	P/F	Modifier
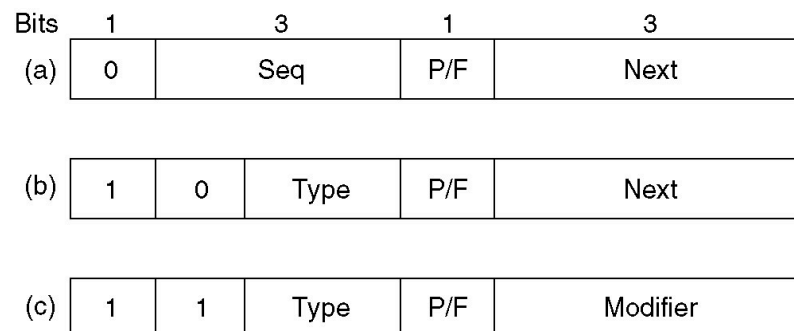
Yet more HDLC

- HDLC uses a 3-bit sliding window protocol.
- In an information frame, the SEQ component has the sequence number of the sliding window.
- The Next frame is used for acknowledgements.
- The P/F frame is less used these days, but was used when a computer was polling a group of terminals, inviting them to send data. All frames sent by the terminal, except the final one have P/F bit set to P, the final one has P/F bit set to F.
- There are two types of supervisory frames: Type 0 is an acknowledgment frame (RECEIVE READY), in the case where there was an ack timeout; Type 1 is an NAK frame (REJECT).
- Unnumbered frames are sometimes used for control purposes or to handle connectionless services.

Datalink Layer in The Internet

- A variant of HDLC, PPP, is used in the protocols to handle point-to-point links on the internet.
- There are two common places where these occur:
  - to connect distant routers on the internet which are connected by say a leased line.
  - to connect a PC via a modem to the ISP's router.

PPP

- PPP stands for **point-to-point protocol**.
- It is defined in RFC 1661.
- It handles error detection, supports multiple protocols, allows IP addresses to negotiated at connection time, permits authentication, makes omelets, etc.
- It provides three features:
    - a frame format similar to HDLC, except character oriented, with byte stuffing:
    - A link control protocol (**LCP**) for bringing lines up, testing them, and negotiating options, as well as tearing them down.
    - A way to negotiate network-layer options in a way that is independent of the network layer protocol. The method is chosen to have a different **NCP (Network Control Protocol)** for each network layer supported.

Introduction to the Medium Access Control Sublayer

- We are now going to start talking about the medium access control sublayer.
- This layer is used to handle communication over broadcast networks. (As opposed to the point-to-point networks of the Data Link Layer).
- Broadcast networks are sometimes called multi-access channels or random access channels.
- This layer is especially important for LANs.
- It is technically below the data link layer in the protocol hierarchies, but it is more complicated, so so we discussing it after the data link layer.