

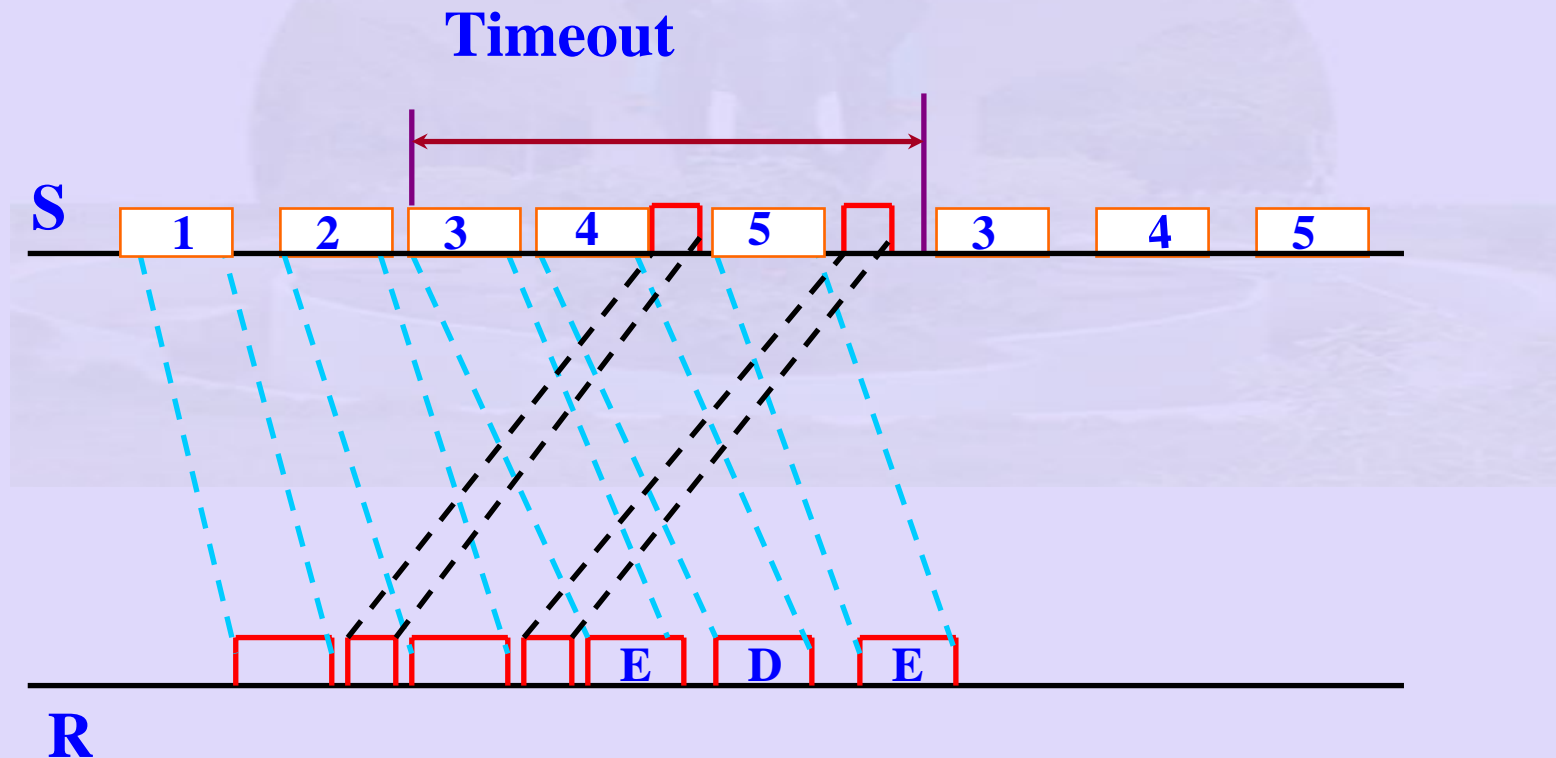
Sliding Window Protocol

- **Sliding window protocol:**
- **Stop & Wait:** inefficient if a is large.
- **Data:** - stream of bulk data
 - - data can be pipelined
 - - transmit window of data
 - - do not worry about getting ack immediately

Sliding Window Protocol

- What should be the size of pipeline?
- How do we handle errors:
 - Sender and receiver maintain – buffer space
 - **Receiver window = 1,**
 - **Sender window = n**

Timing Diagram: Go back-N



Go-Back N

- Discard if correct frame not received
- Use same circuit for both directions
 - Intermix data frames from both $S \rightarrow R$ with ack frames from $R \rightarrow S$
- Use kind field in header:
 - decide whether data or ack
 - piggy back ack on outgoing frame for $R \rightarrow S$
 - Ack field in frame
 - If frame not available for piggybacking \rightarrow Timeout

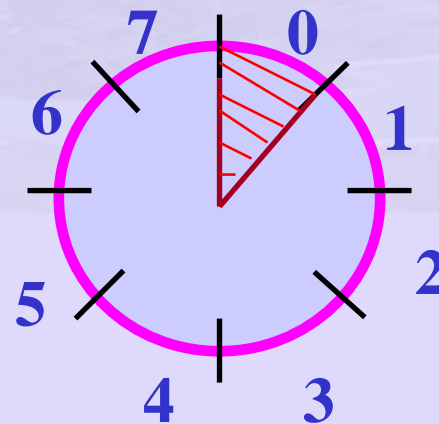
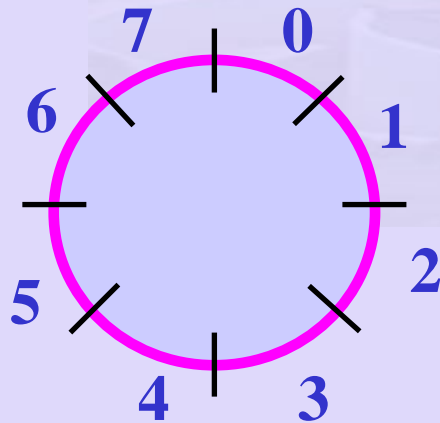
Sliding Window Protocol

- Outbound frame sequence number
- Range - $0 - 2^n - 1$
- n bit field
- Stop & Wait is Sliding window with $n = 1$
- **Sender** – maintain sequence number of frames it is permitted to send
 - sending window
- **Receiver** – maintain sequence number of frames it is expected to accept
 - Receiver window

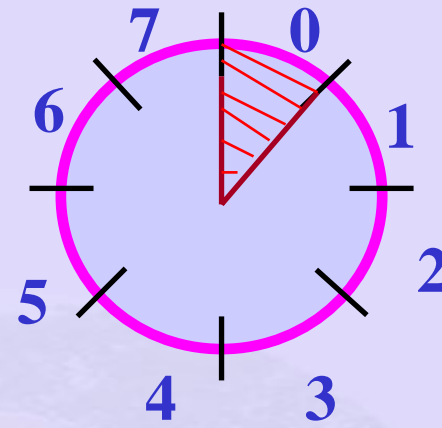
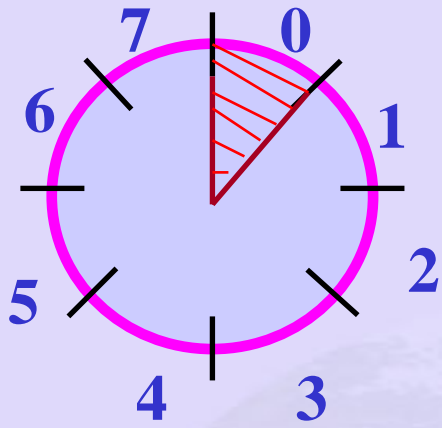
Sliding Window Protocol – An example (Tanenbaum)

Example: SWP: sequence number: Sender 0 - 7
seqno – 3 bit

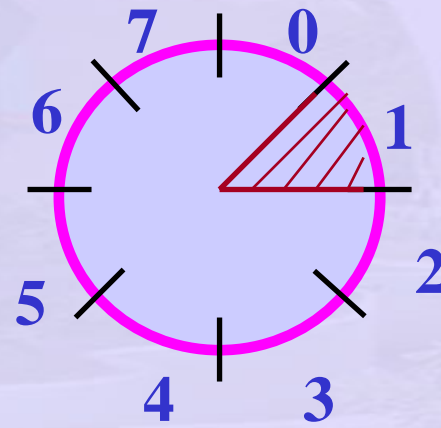
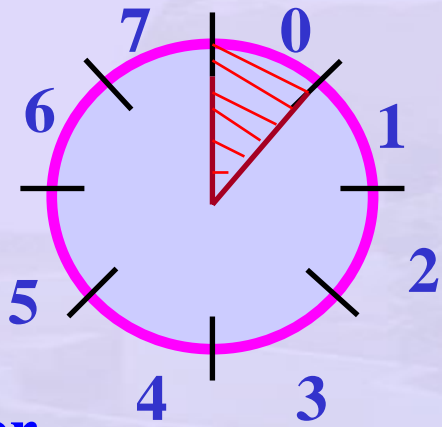
Sender



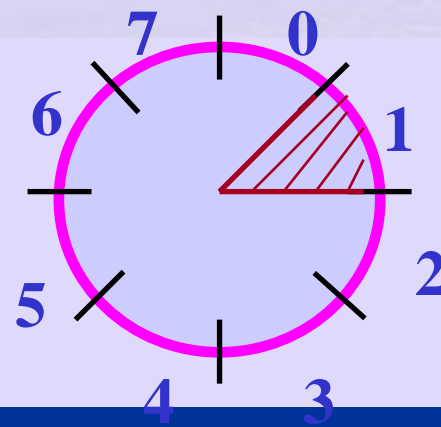
Receiver



Sender

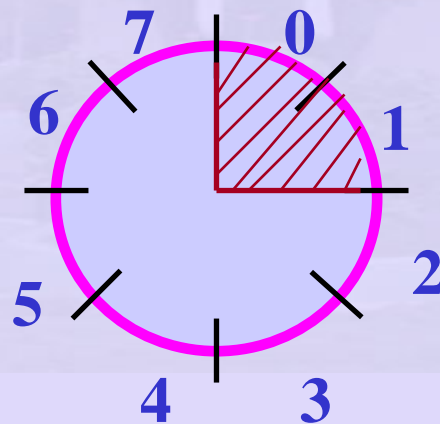


Receiver



SWP -- Example

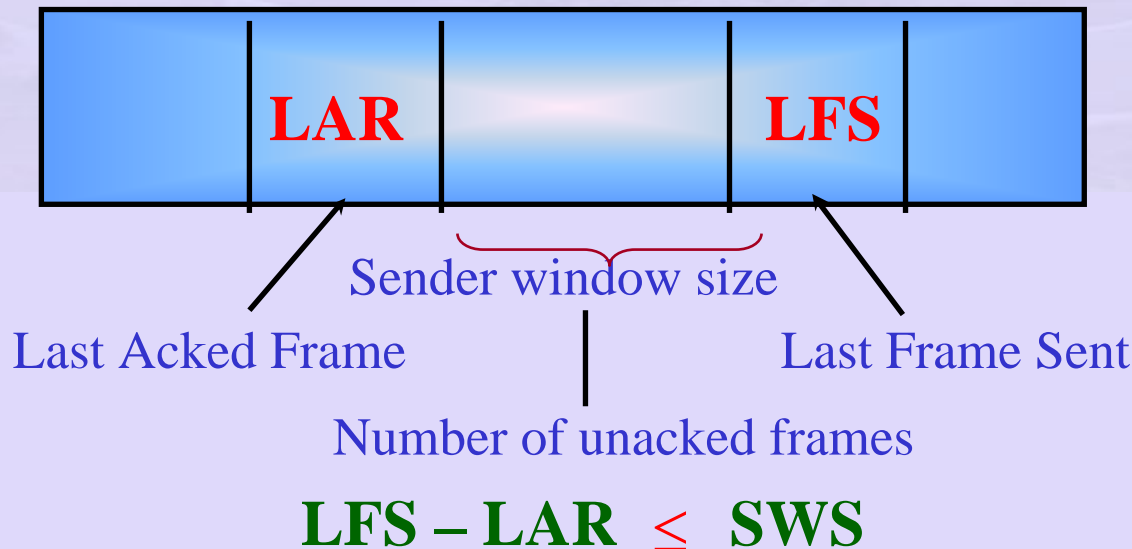
- Larger Sender Window Size



Different Window Sizes: Receiver, Sender (Peterson et al.)

If Sender Window is **n**

How large can the Receiver Window be?



Receive Window Size (RWS)

- number of out order frames receiver is willing accept
 - LAF – Last acceptable frame (sequence number)
 - LFR – Last frame received
 - $LAF - LFR \leq RWS$
 - When SeqNumber frame arrives:
 - If SeqNumber \leq LFR or Sequence Number $> LAF$ – discard
 - If $LFR < \text{SeqNumber} \leq LAF$ – accept frame.



Example: Larger RWS

- Example: $LFS = 5$, $RWS = 4$, $LAF = 9$
- If frame 7 & 8 arrive
 - buffered
 - but ack not sent since 6 not arrived.
 - 7 & 8 out of order.
- If frame 6 delayed –
 - Retransmitted, received later
- - Notice no NAK for 6.
- primarily timeout on 6 – retransmit 6.

SWP – Go back-N – a variation

- largest Sequence Number not yet acked.
- receiver only acks **SequenceNumberAck** even if higher numbered frames are received.
- set **LFR = SequenceNumberToAck**
- **LAF = LFR + RWS**

Selective Repeat Protocol

- Variation SWP:
 - selective ack for frame
 - sender knows what to send
 - problem – complicated
 - can $RWS > SWS$?