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 date
  - 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

S

1 2 3 4 5

Timeout

3 4 5

E D E

R
Go-Back N

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

$LFS - LAR \leq SWS$
Receive Window Size (RWS)

- number of out of order frames receiver is willing to accept
  - LAF – Last acceptable frame (sequence number)
  - LFR – Last frame received
  - LAF – LFR ≤ RWS
  - When SeqNumber frame arrives:
    - If SeqNumber ≤ LFR or Sequence Number > LAF – discard
    - If LFR < Sequence Number ≤ 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?