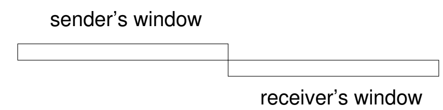
CSE and EE 461
Lecture 12

Autumn Quarter 1997

Selective Repeat

- Normally, the sender and receiver each have window size N.
- If the sequence numbers are {0,1,2,...,s-1} then we must have $s \geq 2N$, that is there are at least 2N sequence numbers.



If sender's window covers frame i and the receiver's covers frame j and i mod s = j mod s then we must have i = j. Otherwise the sender and receiver could be out of synchronization and an error could occur.

Selective Repeat

- Frames are resent selectively when a timeout occurs or negative acknowledgement (nak) arrives.
- A nak i sent by the receiver means that a frame with seq_no = i that was expected did not arrive.
- An ack i acknowledges receipt of all frames in the sender's window at or to the left of i in its window.

Normal Operation Example

Frame no.	0	1	2	3	4	5	6	7	8	9	10
Seq no.	0	1	2	3	4	5	0	1	2	3	4
Send Window											
Rec. Window											

Frame no.	0	1	2	3	4	5	6	7	8	9	10
Seq no.	0	1	2	3	4	5	0	1	2	3	4
Send Window											
Rec. Window											

Frame no.	0	1	2	3	4	5	6	7	8	9	10
Seq no.	0	1	2	3	4	5	0	1	2	3	4
Send Window											
Rec. Window											

Frame no.	0	1	2	3	4	5	6	7	8	9	10
Seq no.	0	1	2	3	4	5	0	1	2	3	4
Send Window											
Rec. Window											

Another Example

Frame no.	0	1	2	3	4	5	6	7	8	9	10
Seq no.	0	1	2	3	4	5	0	1	2	3	4
Send Window											
Rec. Window											

send nak 2

Frame no.	0	1	2	3	4	5	6	7	8	9	10
Seq no.	0	1	2	3	4	5	0	1	2	3	4
Send Window											
Rec. Window											

Frame no.	0	1	2	3	4	5	6	7	8	9	10
Seq no.	0	1	2	3	4	5	0	1	2	3	4
Send Window											
Rec. Window											

send ack 4

Frame no.	0	1	2	3	4	5	6	7	8	9	10
Seq no.	0	1	2	3	4	5	0	1	2	3	4
Send Window											
Rec. Window											

Failure Scenario

- Suppose the receiver in a protocol only sends acks when a frame arrives in its window as in protocol 5. What can happen?

  - Sender repeatedly tries to send frame with sequence number 5 while receiver is waiting for sequence number 0. If the receiver ignors these frames then the protocol hangs.

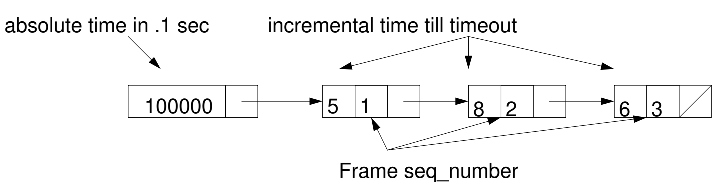
Frame no.	0	1	2	3	4	5	6	7	8	9	10
Seq no.	0	1	2	3	4	5	0	1	2	3	4
Send Window											
Rec. Window											

- Remedy - Receiver must periodically request frame it is waiting for.

  1. request frame on arrival of any frame not expected.
  2. have receiver timeout.
  3. piggyback (ack) request on frame to be sent to other party (protocol 5).

Implementing Timeouts

- We assume that there is a local clock that can interrupt the protocol periodically.
- Each interrupt should be handled very quickly, so as not to slow down the protocol.
- Each frame sent has it own timeout record.
- Example data structure. Suppose frame 1 has .5 sec before timing out and frame 2 has 1.3 sec, and frame 3 has 1.9 sec.



Timeout Example