417

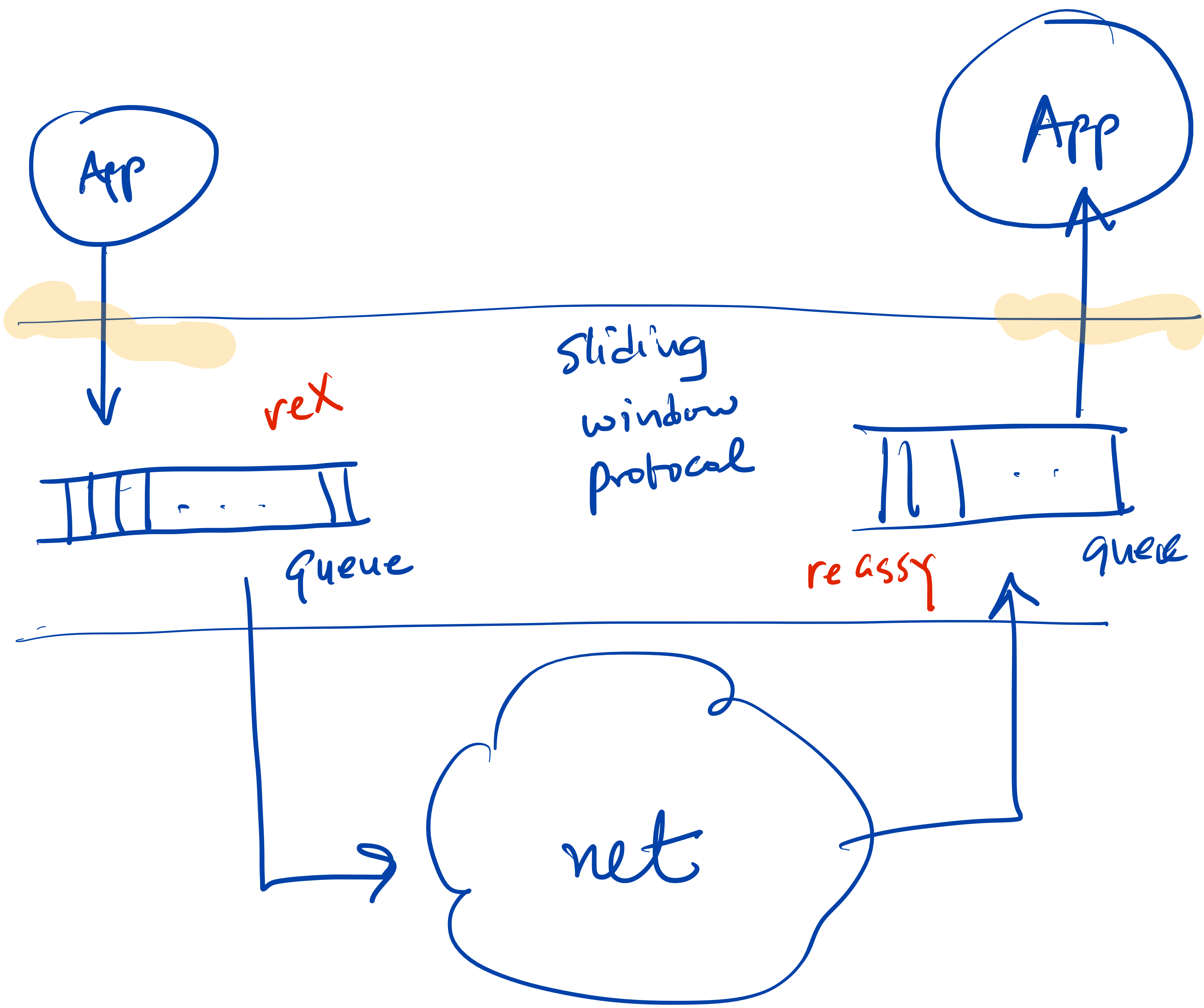
- Sliding Windows

Problems w/ ABP / Stop-and-Go ?

- Latency

- BW / Capacity

Model

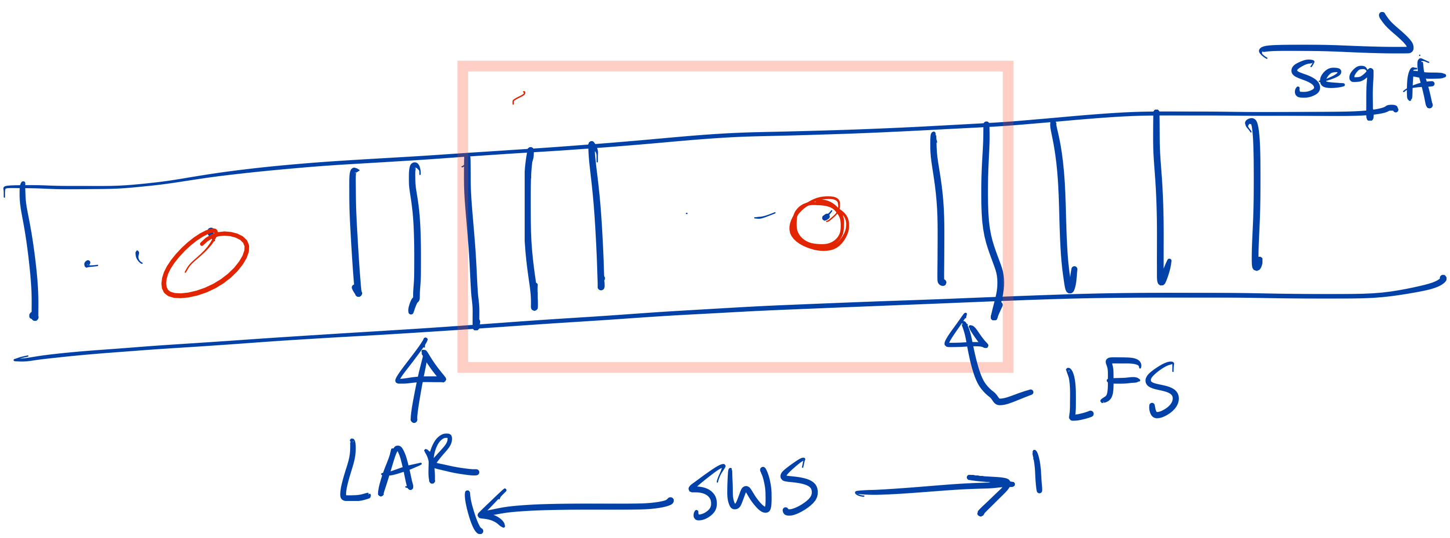


Larger Seq # Space

- Each frame has a seq #

Sender-side variables

SWS : send window size
LAR : Last Ack Recd.
LFS : Last Frame Sent



Invariant

$$LFS - LAR \leq SWS$$

Sender protocol

when <u>proper</u> ACK arrives

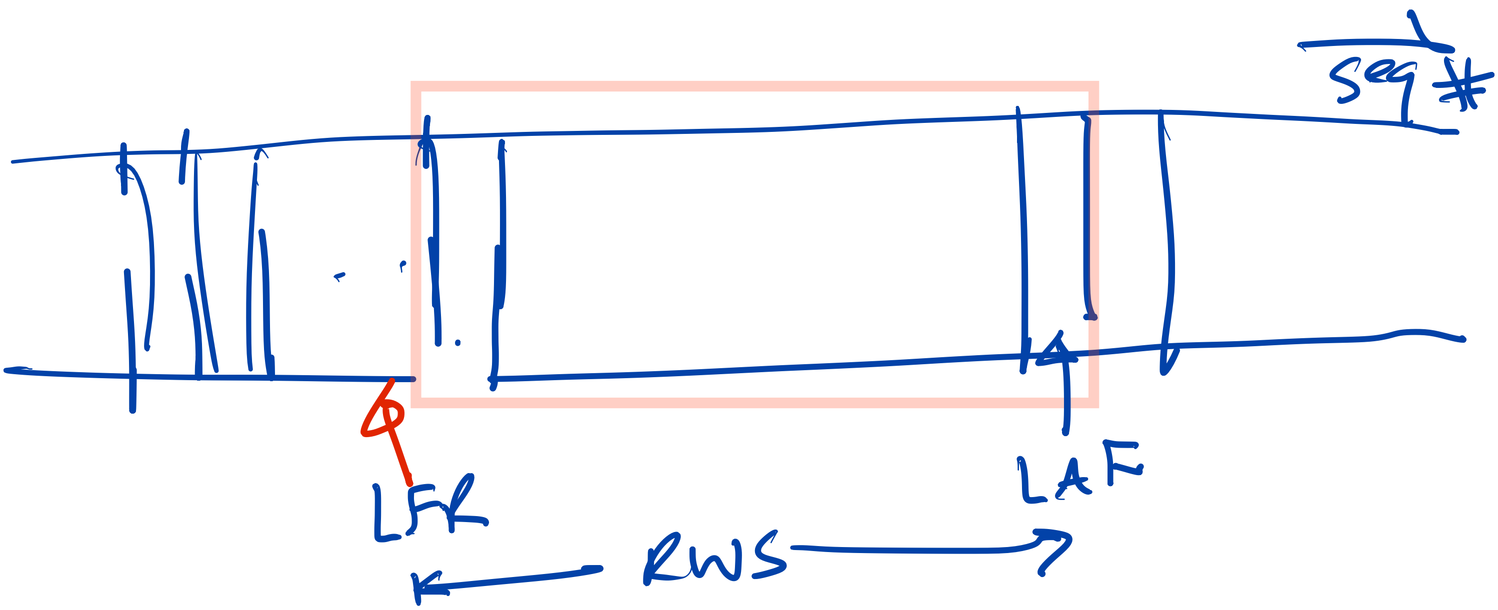
- sender moves LAR to the right
- allows new frame to be sent
- sets timeout for new frames sent
- sender buffers ≤ SWS frames

Receiver

RWS : Recv. window size

LAF : Last Acceptable frame

LFR : Last Frame 'Received'



Invariant :

$$LAF - LFR \le RWS$$

Receiver Protocol

when frame w/ seq # S arrives:

if $S \leq LFR$ or $S > LAF$

Discard?

if $LFR < S \leq LAF$

- Accept
- May buffer (when?)
- must ACK.

what to ACK?

Let α be the largest seq # s.t. all frames w/ seq # $\leq \alpha$ have been received

ACK α

LFR $\leftarrow \alpha$

LAF $\leftarrow \alpha$ + RWS

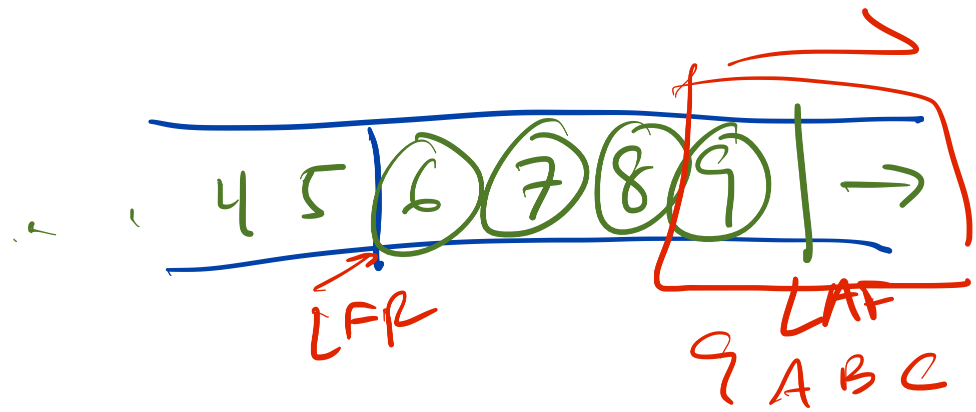
$\Rightarrow$ Cumulative ACK

Example

RWS = 4

LFR = 5

LAF = 9



suppose 7, 8 arrive

buffer 7, 8 , ACK 5

when 6 arrives

LFR = 8

LAF = 12

ACK 8 ?

Variations

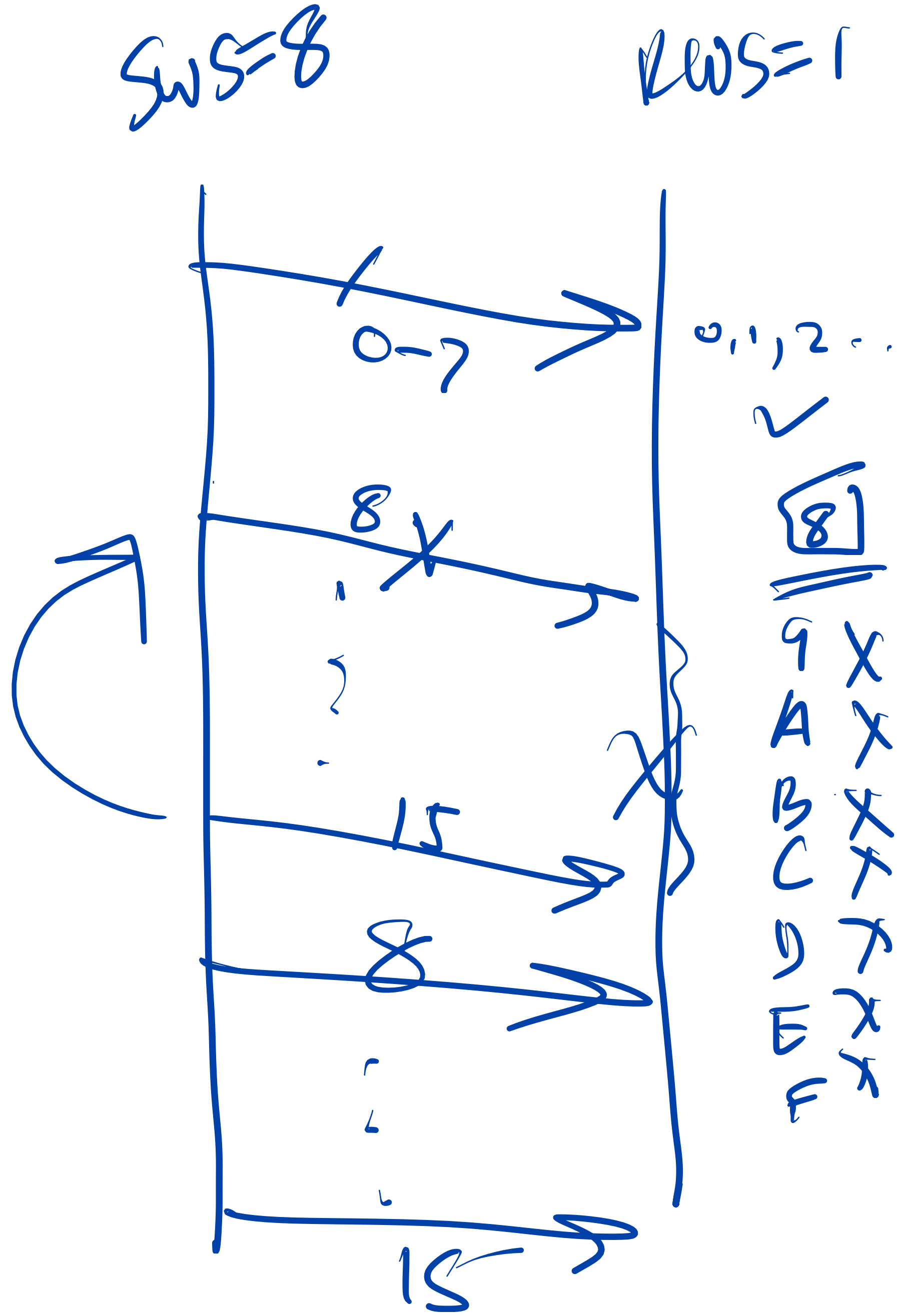
Go-back-N, RWS = 1

NAK

SACK

↓

Selective Ack



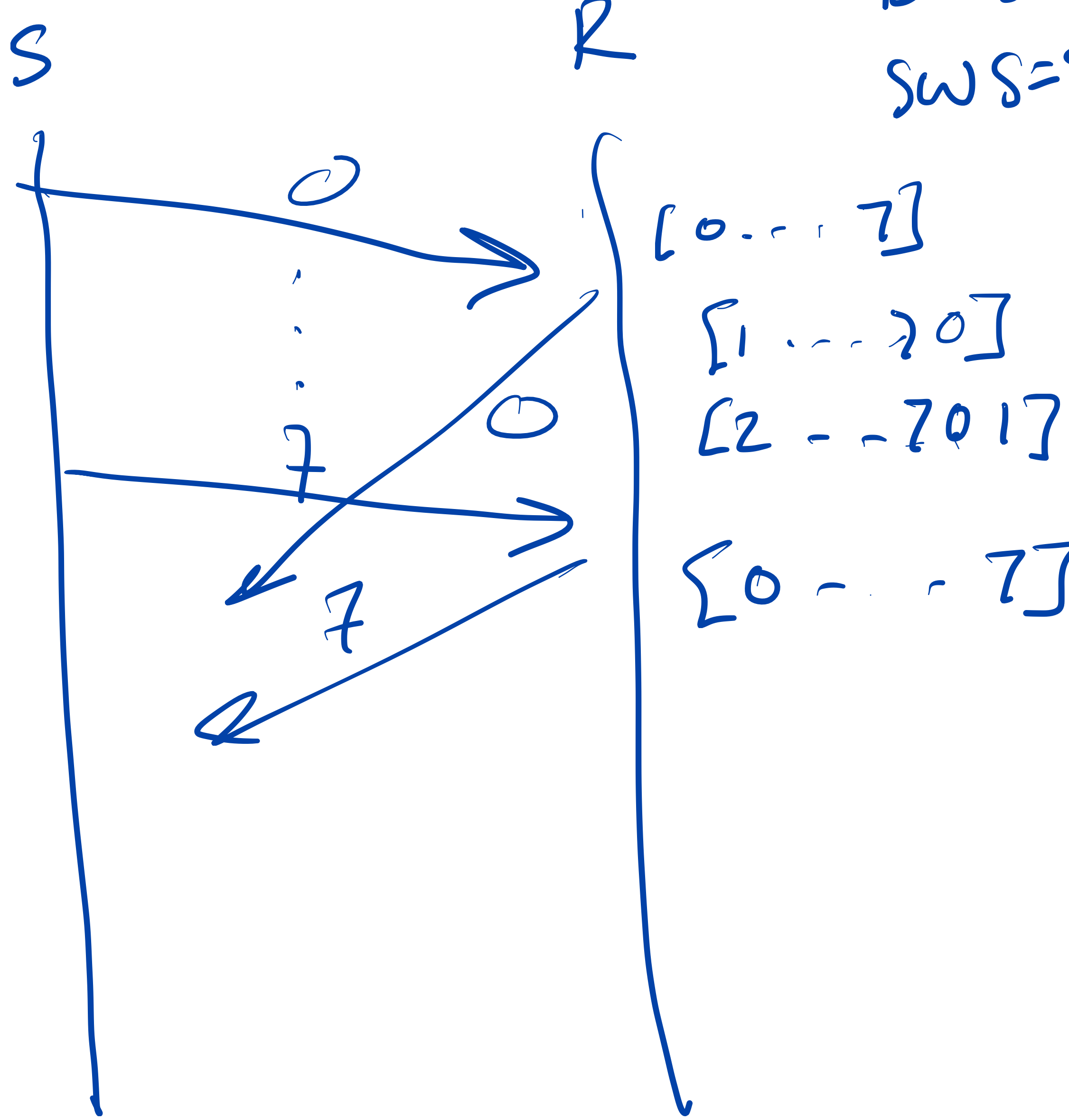
Finite Seq #s

Suppose #seq ≡ |seq| = RWS
= SWS

e.g.

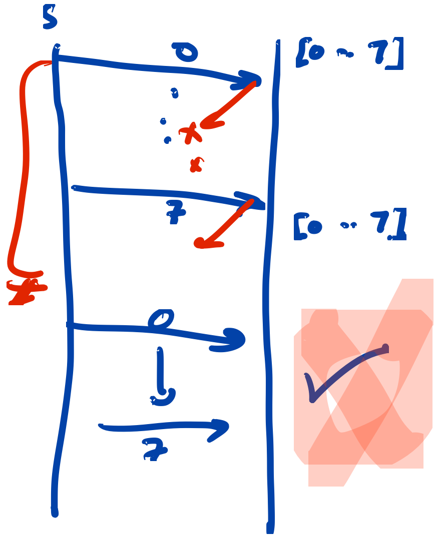
|seq| = 8 (0 .. 7)

RWS=8
SWS=8

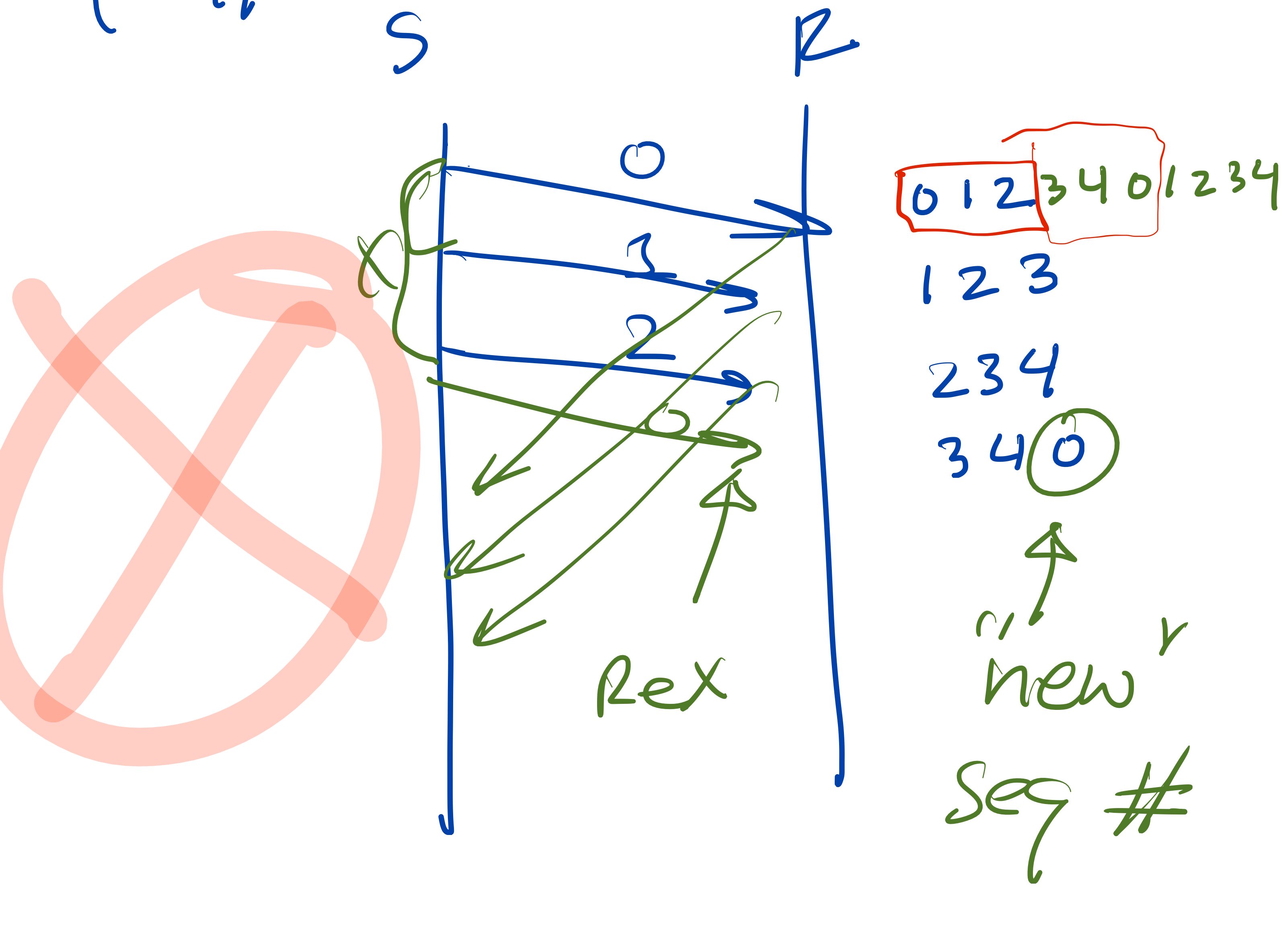


ex #1

R



$|seq| = 5$ $RWS = SWS = 3$



Acceptable Condition

$$RWS, SWS \le \frac{\text{max. seq \# } + 1}{2}$$

$$\rightarrow \frac{|seq|}{2}$$

- max sending seq # 'alternates' between two halves of window

$\longrightarrow$

example

$|seq| = 8$ → 0, 1, ..., 7

RWS = SWS = 4