TCP

go back N | selective repeat

delay

stop & wait

error rate

e.g. packet 2 is lost.

✓ ✗ ✓

1, ✗, 3

	packets transmitted	packets retransmitted.
stop & wait	123	2
go back N	123	2, 3
selective RPT	123	2

TX BUF: 1, N, N

s/wait

RX BUF: ø, ∅, N

FIFO

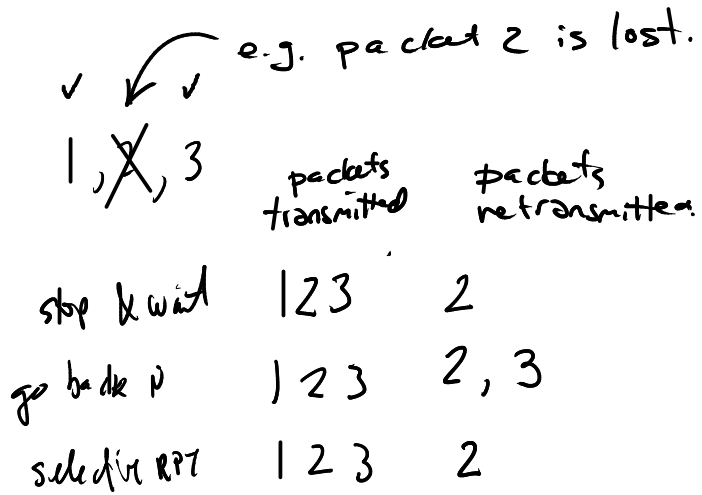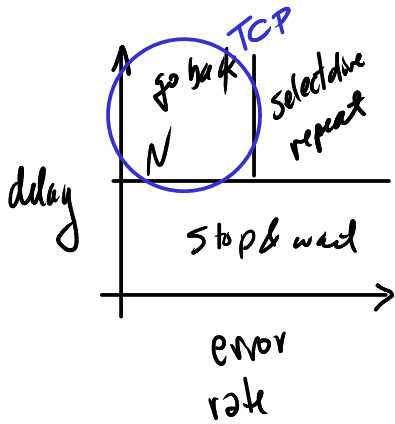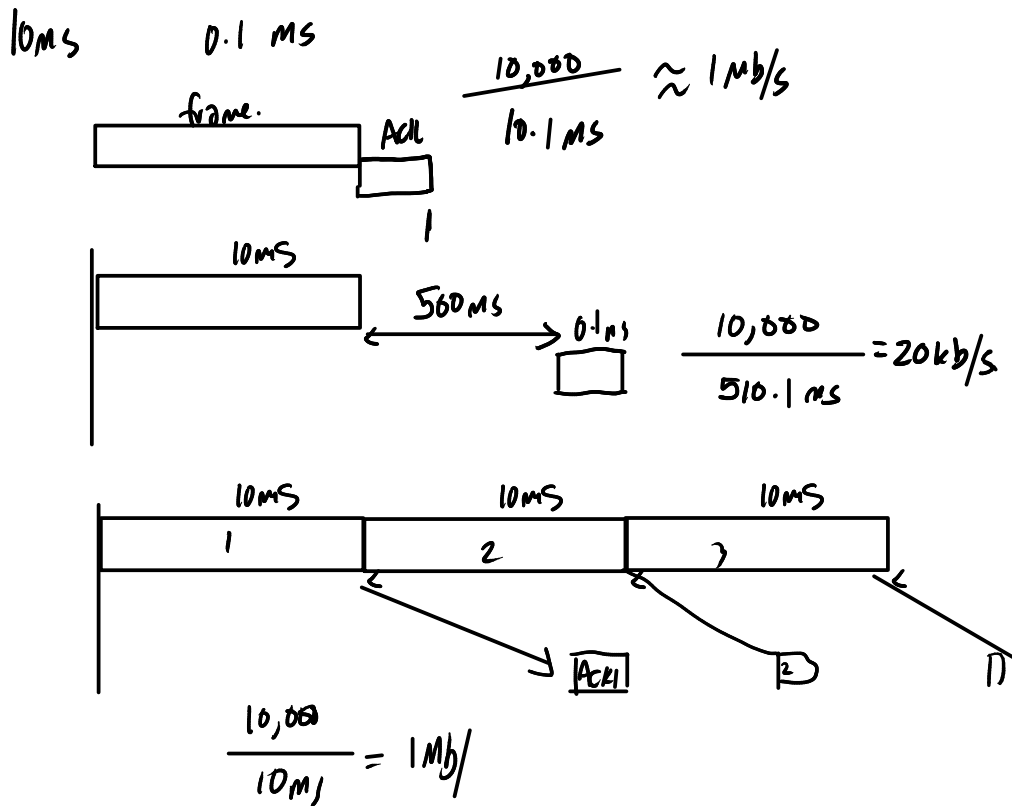malloc()

Exercise 1: Create a table summarizing the different types of ARQ. Include: throughput, transmitter memory, receiver memory and relative complexity.

	throughput if delay		TX mem	Rx mem	Complexity
	no error	error			
s & wait	Lowest		1	0	L
go back N	H	L	N (FIFO)	0	M
sel repeat	H	H	N (FIFO)	N (Link List)	H

Exercise 2: A data communication system operates at 1 Mb/s and uses 10000-bit data frames and 100-bit ACK frames. What are the frame durations? What is the throughput if there is no channel delay and no errors? If the round-trip channel delay is a 0.5s (typical for satellite links)? If go-back-N ARQ is used, assuming the transmitter can store all unacknowledged frames?

10ms   0.1 ms

frame.   ACK

$$\frac{10,000}{10.1 \, ms} \approx 1Mb/s$$

10ms

500ms → 0.1ms

$$\frac{10,000}{510.1 \, ms} = 20kb/s$$

10ms | 10ms | 10ms
1 | 2 | ?

ACK1   [2]   [?]

$$\frac{10,000}{10m/} = 1Mb/$$

Exercise 3: A communication system loses every 10th frame (e.g. due to periodic noise bursts). Ignoring ACK overhead, what is the throughput using go-back-N ARQ? Using Selective ARQ?

— assume 3 frames are unacknowledged.

1 2 3 4 , 1 2 3 4
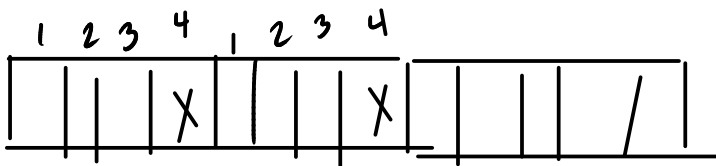
$$\frac{16 \, data}{17 \, transmission}$$

Exercise 4: Which of the above flow control methods can be used with frame-oriented protocols? On unidirectional links?

$$\frac{10}{13} \quad go \, back \, N$$

$$\frac{10}{11} \quad sel. \, repeat$$

	frame-oriented	unidirectional data
h/w	✓	✓
s/w	✓	X
ACK	✓	