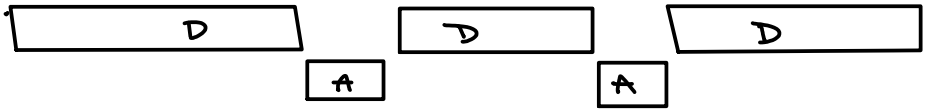
Lecture 16

Exercise 1: 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 N is larger than the number of frames transmitted in 0.5 seconds?

duration

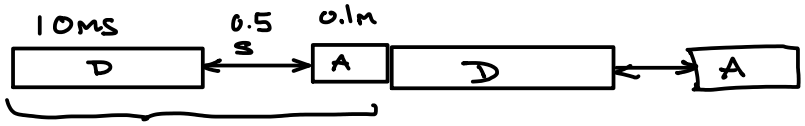
DATA 10^4 bits @ 10^6 b/s $10^4/10^6 = 10$ms

ACK 10^2 bits @ 10^6 b/s $10^2/10^6 = 0.1$ms



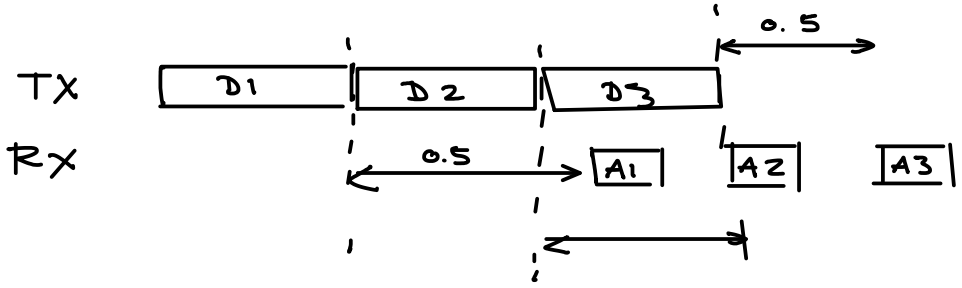
throughput: bits/second of data (average)

$$= \frac{10{,}000 \text{ bits}}{10\text{ms} + 0.1\text{ms}} \simeq 1\text{Mb/s}$$



$$\text{throughput} = \frac{10{,}000 \text{ bits}}{10 + 500 + 0.1 \text{ ms}} = \frac{10{,}000}{510.1 \text{ ms}} \simeq 20 \text{ kb/s}$$

∴ stop and wait not suitable for long delay channels.



$$\text{Throughput} = \frac{10{,}000}{10 \text{ ms}} = 1\text{Mb/s}$$

	use when	cost & complexity
stop & wait	low delay ONLY USEFUL FOR LOW DELAYS	lowest
go-back-N	need to retransmit up to N frames on error BEST FOR LOW ERROR RATES	↕
selective ARQ	need to retransmit only frames with errors → BEST IF HIGH ERROR RATES	highest

Exercise 2: Which of the above flow control methods can be used with frame-oriented protocols? On unidirectional links?

frame oriented → ACK

unidirectional link → only hardware flow control is possible