CS 168 Introduction to the Internet
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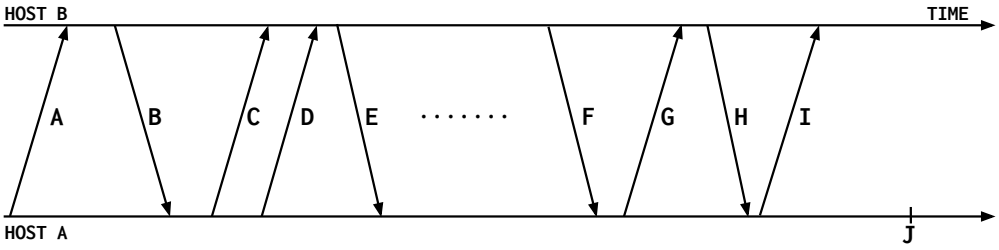
Discussion 9: TCP & DNS

1 Pop Quiz: TCP vs UDP

For each statement below, mark whether describes TCP, UDP, both (mark both) or neither (mark none).

	TCP	**UDP**
Provides reliable transport	X	
Limits messages to a single packet		X
Has source port in the header	X	X
Requires connection establishment	X	
You used this for your project 1.	X	
It is optional to use the L4 checksum with this protocol (under IPv4)		X

2 Flags



The above figure shows the life cycle of a TCP connection with normal termination - that is, connection establishment, data exchange, and teardown.

(1) For each of the arrows, choose whether it is a SYN, ACK, data, FIN or RST packet. A single arrow might have more than one of these flags set.

A:	SYN	D:	data	G:	FIN
B:	SYN + ACK	E:	ACK	H:	FIN + ACK
C:	ACK	F:	ACK	I:	ACK

(2) When host A sends packet I, it sets a timer that ends at point J. What is the purpose of this timeout?

Solution: Host A sets a timer when it sends the last ACK. This ensures that if the ACK is dropped, B can resend its FIN+ACK, and host As connection will still be open to receive this message. Host B wont close its connection until it gets host As ACK (or it times out).

3 TCP in Action

Consider a sender sending 1000 B of data to a receiver over **TCP**. The sender sends packets of 100B, the window size is 300B, and the ISN is 99 (so D100 is the first packet sent, then D200, and so on). Remember, TCP uses a sliding window, and retransmits the packet containing the next expected byte on a timeout or the 3rd duplicate ACK.

The link is **flaky**! The **initial** transmission of packets **D200 and D700** get dropped.

(1) Fill in the below table with all packets sent by the sender until the receiver has received all packets and the sender knows that. For simplicity, assume that packets (data and ACKs) arrive in order. You may or may not need to fill in all lines.

#	Packet # Sent	Sent on timeout?	Dropped?	*Cumulative* ACK
1	D100			A200
2	D200		X	
3	D300			A200
4	D400			A200
5	D200	X		A500
6	D500			A600
7	D600			A700
8	D700		X	
9	D800			A700
10	D900			A700
11	D700	X		A1000
12	D1000			A1100
13				
14				

(2) If the RTT of the link is 10ms and the timeout is initially 3 seconds, what is the total time needed for the receiver to receive all packets and for the sender to know that? Assume small packets (negligible transmission delay) and negligible processing time, and that the estimates that go into the RTO remain constant during the events below.

Solution: 2*RTO + 5 RTT = 6.05 s
1*RTT for 1, 1*RTO before 5, 2*RTT for 5-7, 1*RTO before 11, 2*RTT for 11-12
Fix: Note that we have 2*RTT for 5-7 – not 3*RTT. Because D500 and D600 are sent at practically the same time, it takes 1 RTT from we send D500 until we receive A700.