

1. The STP protocol is implemented with sender, receiver and a Packet object. Both the sender and receiver have an important variable called state to determine which kind of Packet it's expecting. Packet has a list with header at the front and data appended at the end, and will be converted to a string when sending, and parsed back when received by the receiver. In the handshake phase the sender binds the SYN packet and the receiver host ip and port to the receiver, and receiver gets the host and port. Pipelining is implemented through a queue-like list with all unACKed packets, which pops off the packets that have smaller sequence numbers than the ACK received. Timer is implemented within the UDP socket interface. Fast retransmit is implemented. The receiver keeps the last received in-order sequence number, and dismisses every packet that are not expected. Teardown is implemented in a similar manner as handshake.

Implemented features:

Threeway handshake

Four-segment connection termination

Timer

Simplified TCP sender (sequence number, timeout handle, etc.)

Receiver (ACK generation, buffer, etc.)

Fast retransmit

MSS & MWS

PLD

Log generation

2.

Sender	Receiver
Acknowledgement	
Sequence Number	
Flag (i.e., SYN, SYNACK, ACK, FIN, FINACK)	
Data (variable length)	

3. (a) should use 250ms. Because using 1000ms will trigger fast retransmit and timeout at similar rate and resulting in more duplicates.

With pdrop = 0.3 there are more retransmits

Pdrop = 0.1	Pdrop = 0.3
50	50
150	150
200	200

250	250
300	300
350	400
400	450
450	100
500	100
550	100
100	600
100	150
100	250
100	300
100	350
100	450
600	550
150	600
200	650
250	200
300	200
400	200
450	200
500	700
550	250
600	300
650	350
700	400
800	550
350	600
350	650
350	750
350	800
350	900
350	450
850	450
400	450
450	950
500	500
550	550
600	650
650	750
700	900
750	1000
800	1050
850	600
900	1100
950	650
1000	700
1050	750

1150	800
1200	850
1250	950
1300	1000
1400	1050
1450	1100
1500	1150
1550	900
1100	1400
1100	950
1100	1000
1100	1050
1100	1100
1100	1150
1150	1200
1200	1300
1250	1450
1350	1500
1400	1550
1450	1250
1500	1250
1550	1300
1300	1550
1350	1350
1400	1450
1500	1500
1550	1550
1450	1400
1500	1450
1550	1500
	1550

3.(b) if timeout value is too low, there will be more retransmits; if too high, the transfer time will increase dramatically

Timeout (ms)	250	1000	62.5
Number of packets	94	94	165
Time spent (s)	1.171	4.178	0.443

Appendix:

Timeout (ms)	1000	50	250	500	3000
Seq num	50	50	50	50	50
	150	150	150	150	150
	200	200	200	200	200
	250	250	250	250	250
	300	300	300	300	300
	350	350	350	350	350
	400	400	400	400	400
	450	450	450	450	450
	500	500	500	500	500
	550	550	550	550	550
	550	100	100	100	100
	100	100	100	100	100
	100	100	100	100	100
	100	100	100	100	100
	100	100	100	100	100
	100	100	100	100	100
	100	100	100	100	100
	100	600	600	600	600
	100	150	150	150	150
	600	200	200	200	200
	150	250	250	250	250
	200	300	300	300	300
	250	400	400	400	400
	300	450	450	450	450
	400	500	500	500	500
	450	550	550	550	550
	500	600	600	600	600
	550	650	650	650	650
	550	700	700	700	700
	600	800	800	800	800
	650	350	350	350	350
	700	350	350	350	350
	800	350	350	350	350
	350	350	350	350	350
	350	350	350	350	350
	350	350	350	350	350
	350	850	850	850	850
	350	400	400	400	400
	350	450	450	450	450
	350	500	500	500	500
	850	550	550	550	550
	400	600	600	600	600
	450	650	650	650	650
		700	700	700	700

	500	750	750	750	750
	550	800	800	800	800
	600	850	850	850	850
	650	900	900	900	900
	700	950	950	950	950
	750	1000	1000	1000	1000
	800	1050	1050	1050	1050
	850	1150	1150	1150	1150
	900	1200	1200	1200	1200
	950	1250	1250	1250	1250
	1000	1300	1300	1300	1300
	1050	1400	1400	1400	1400
	1150	1450	1450	1450	1450
	1200	1500	1500	1500	1500
	1250	1550	1550	1550	1550
	1300	1100	1100	1100	1100
	1350	1100	1100	1100	1100
	1400	1100	1100	1100	1100
	1450	1100	1100	1100	1100
	1500	1100	1100	1100	1100
	1550	1150	1150	1150	1150
	1100	1200	1200	1200	1200
	1100	1250	1250	1250	1250
	1100	1350	1350	1350	1350
	1100	1400	1400	1400	1400
	1100	1450	1450	1450	1450
	1100	1500	1500	1500	1500
	1150	1550	1550	1550	1550
	1200	1300	1300	1300	1300
	1250	1350	1350	1350	1350
	1350	1400	1400	1400	1400
	1400	1500	1500	1500	1500
	1450	1550	1550	1550	1550
	1500	1450	1450	1450	1450
	1550	1500	1500	1500	1500
	1300	1550	1550	1550	1550
	1350				
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	1550				
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