Report

William Jiang

Question1: A brief discussion of how you have implemented the PTP protocol. Provide a list of features that you have successfully implemented. In case you have not been able to get certain features of PTP working, you should also mention that in your report.

At first, I only implemented the sequence number $nextSeqNum$ and acknowledgement number $ackNum$, with a fixed Maximum segment size and Maximum window size. I successfully set up the connection via 3-way handshake and 4-segment connection termination, I use 3 Boolean variables to indicate the state of the connection: set_syn that tells the sender to handshake; set_fin that tells the sender to terminate; $connected$ that tells the sender current state of the connection. I successfully set the handshake and termination and sent the file from the sender to the receiver.

Then I implemented the PL module, I initialize the random generator with the given seed. If the generated value is greater than the $pdrop$, then I send the packet, else I drop the package. I also implemented the cumulative acknowledgement in the receiver. I initialize a buffer pck_buffer to store the data with a sequence number higher than expected. The acknowledgement number sent by the receiver indicates all previous data were received correctly.

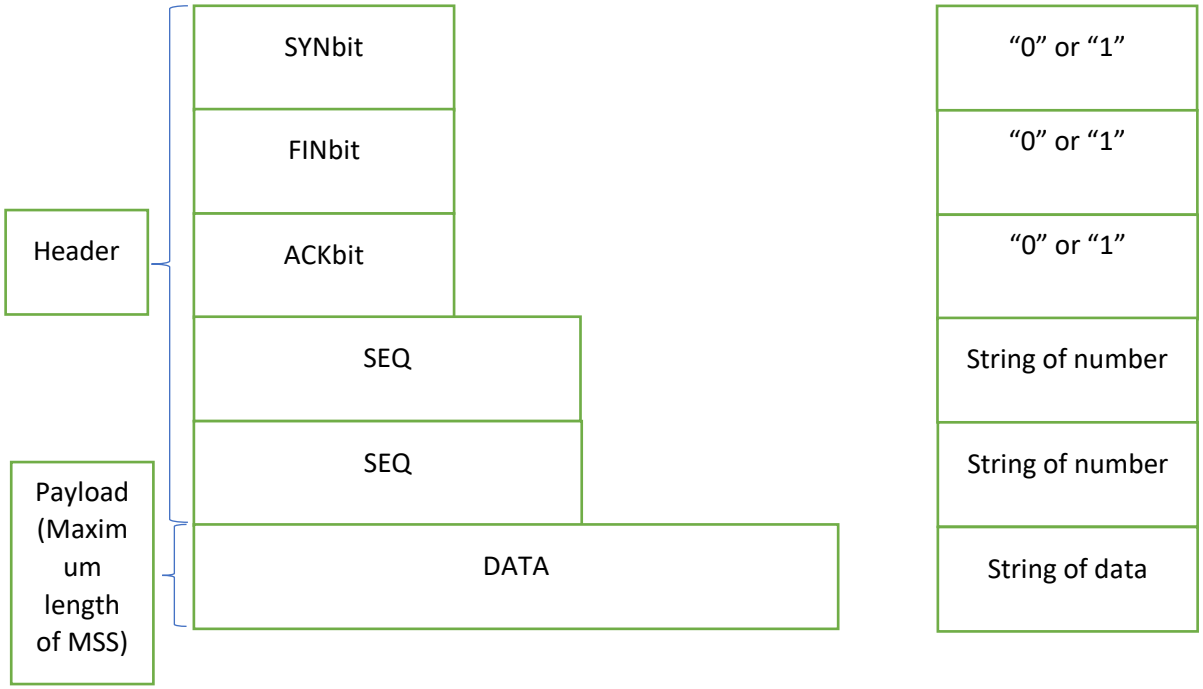
At last, I implemented the fast retransmit. I initialize two variables $sendBase$ and $sendBase\_count$, $sendBase$ is the smallest unacknowledged sequence number and $sendBase\_count$ is the times of received it as an acknowledgement. If $sendBase\_count == 3$ then I retransmit the packet and restart the timer.

Feature	Is implemented?
3-way handshake (SYN, SYN+ACK, ACK)	Yes
4-segment connection termination (FIN, ACK, FIN, ACK), combined FIN and ACK	Yes
Sender: Singer timer for timeout	Yes
Sender: Timeout retransmit	Yes
Sender: Maximum segment size	Yes
Sender: Maximum window size	Yes
Sender: PL module	Yes
Sender and Receiver: Sequence number and acknowledgement number	Yes
Sender and Receiver: Cumulative acknowledgement	Yes
Sender and Receiver: Fast retransmit	Yes
Receiver: Packet buffer	Yes

Question2: A detailed diagram of your PTP header and a quick explanation of all fields (similar to the diagrams that we have used in the lectures to understand TCP/UDP headers).

The header is implemented as a string separated by comma ",":
"SYNbit,FINbit,ACKbit,SEQ,ACK,DATA",

SYNbit is a character of "0" or "1", FINbit is a character of "0" or "1", ACKbit is a character of "0" or "1", SEQ is the string of the sequence number, ACK is the string of the current acknowledgement number, DATA is the data we are sending as a string, it has a maximum length of mss.



Question3a:

$pdrop = 0.1, timeout = 50ms$

Assignment > Sender_log.txt

1	snd	0.112	S	0	0	0
2	rcv	0.144	SA	0	0	1
3	snd	0.182	A	1	0	0
4	snd	0.278	D	1	50	1
5	rcv	0.297	A	1	0	51
6	snd	0.356	D	51	50	1
7	rcv	0.372	A	1	0	101
8	drop	0.378	D	101	50	1
9	snd	1.593	D	151	50	1
10	rcv	1.617	A	1	0	101
11	snd	1.681	D	201	50	1
12	rcv	1.697	A	1	0	101
13	snd	1.765	D	251	50	1
14	rcv	1.78	A	1	0	101
15	snd	1.864	D	101	50	1
16	snd	1.936	D	301	50	1
17	rcv	1.952	A	1	0	301
18	snd	2.004	D	351	50	1
19	rcv	2.019	A	1	0	351
20	snd	2.071	D	401	50	1
21	rcv	2.085	A	1	0	401
22	snd	2.136	D	451	50	1
23	rcv	2.151	A	1	0	451

Assignment > Sender_log.txt

1364	rcv	49.98	A	1	0	32501
1365	snd	50.012	D	32501	50	1
1366	rcv	50.063	A	1	0	32551
1367	snd	50.095	D	32551	50	1
1368	rcv	50.146	A	1	0	32601
1369	snd	50.177	D	32601	50	1
1370	rcv	50.228	A	1	0	32651
1371	snd	50.26	D	32651	50	1
1372	rcv	50.31	A	1	0	32701
1373	snd	50.342	D	32701	50	1
1374	rcv	50.393	A	1	0	32751
1375	snd	50.426	D	32751	18	1
1376	rcv	50.477	A	1	0	32769
1377	snd	51.579	F	32769	0	1
1378	rcv	51.602	FA	1	0	32770
1379	snd	51.639	A	32770	0	1
1380	Total bytes: 32768					
1381	Total segments: 656					
1382	Total dropped: 61					
1383	Total retransmitted: 61					
1384	Total duplicated acks 183					
1385						

$prdop = 0.1, timeout = 5ms$

Assignment > Sender_log.txt

1	snd	0.114	S	0	0	0
2	rcv	0.153	SA	0	0	1
3	snd	0.196	A	1	0	0
4	snd	0.279	D	1	50	1
5	rcv	0.298	A	1	0	51
6	snd	0.359	D	51	50	1
7	rcv	0.375	A	1	0	101
8	drop	0.381	D	101	50	1
9	snd	1.617	D	151	50	1
10	rcv	1.642	A	1	0	101
11	snd	1.747	D	201	50	1
12	rcv	1.766	A	1	0	101
13	snd	1.857	D	251	50	1
14	rcv	1.874	A	1	0	101
15	snd	1.993	D	101	50	1
16	snd	2.055	D	301	50	1
17	rcv	2.071	A	1	0	301
18	snd	2.165	D	351	50	1
19	rcv	2.181	A	1	0	351
20	snd	2.3	D	401	50	1
21	rcv	2.318	A	1	0	401
22	snd	2.398	D	451	50	1
23	rcv	2.414	A	1	0	451

Assignment > Sender_log.txt

1364	rcv	48.205	A	1	0	32501
1365	snd	48.225	D	32501	50	1
1366	rcv	48.268	A	1	0	32551
1367	snd	48.288	D	32551	50	1
1368	rcv	48.331	A	1	0	32601
1369	snd	48.351	D	32601	50	1
1370	rcv	48.393	A	1	0	32651
1371	snd	48.414	D	32651	50	1
1372	rcv	48.456	A	1	0	32701
1373	snd	48.476	D	32701	50	1
1374	rcv	48.518	A	1	0	32751
1375	snd	48.548	D	32751	18	1
1376	rcv	48.593	A	1	0	32769
1377	snd	49.675	F	32769	0	1
1378	rcv	49.701	FA	1	0	32770
1379	snd	49.727	A	32770	0	1
1380	Total bytes: 32768					
1381	Total segments: 656					
1382	Total dropped: 61					
1383	Total retransmitted: 61					
1384	Total duplicated acks 183					
1385						

The round trip time is arount 0.02ms to 0.1 ms.

Timeout interval = estimated rtt + 4 * devrtt = 0.4 + 4 * 0.8 = 0.36

Test1: $pdrop = 0.1, timeout = 0.36ms$

Assignment > Sender_log.txt

1	snd	0.117	S	0	0	0
2	rcv	0.151	SA	0	0	1
3	snd	0.193	A	1	0	0
4	snd	0.276	D	1	50	1
5	rcv	0.294	A	1	0	51
6	snd	0.352	D	51	50	1
7	rcv	0.368	A	1	0	101
8	drop	0.374	D	101	50	1
9	snd	1.574	D	101	50	1
10	rcv	1.784	A	1	0	151
11	snd	1.981	D	151	50	1
12	rcv	2.037	A	1	0	201
13	snd	2.131	D	201	50	1
14	rcv	2.149	A	1	0	251
15	snd	2.405	D	251	50	1
16	rcv	2.436	A	1	0	301
17	snd	2.52	D	251	50	1
18	rcv	2.537	A	1	0	301
19	snd	2.591	D	301	50	1
20	rcv	2.606	A	1	0	351
21	snd	2.658	D	351	50	1
22	rcv	2.673	A	1	0	401
23	snd	2.724	D	401	50	1

Assignment > Sender_log.txt

1504	snd	112.522	D	32551	50	1
1505	rcv	112.563	A	1	0	32601
1506	snd	112.587	D	32601	50	1
1507	rcv	112.628	A	1	0	32651
1508	snd	112.653	D	32651	50	1
1509	rcv	112.704	A	1	0	32701
1510	snd	112.729	D	32651	50	1
1511	rcv	112.771	A	1	0	32701
1512	snd	112.795	D	32701	50	1
1513	rcv	112.836	A	1	0	32751
1514	snd	112.86	D	32751	18	1
1515	rcv	112.901	A	1	0	32769
1516	snd	113.987	F	32769	0	1
1517	snd	114.006	D	32769	0	1
1518	rcv	114.054	FA	1	0	32770
1519	snd	114.088	A	32770	0	1
1520	Total bytes: 32768					
1521	Total segments: 656					
1522	Total dropped: 70					
1523	Total retransmitted: 136					
1524	Total duplicated acks 161					
1525						

Test2: $pdrop = 0.3, timeout = 0.36ms$

Assignment > Sender_log.txt

1	snd	0.106	S	0	0	0
2	rcv	0.346	SA	0	0	1
3	snd	0.394	A	1	0	0
4	snd	0.512	D	1	50	1
5	rcv	0.647	A	1	0	51
6	snd	0.675	D	1	50	1
7	rcv	0.749	A	1	0	51
8	drop	0.758	D	51	50	1
9	snd	1.861	D	51	50	1
10	rcv	2.031	A	1	0	101
11	snd	2.059	D	101	50	1
12	rcv	2.161	A	1	0	151
13	snd	2.184	D	151	50	1
14	rcv	2.259	A	1	0	201
15	snd	2.281	D	201	50	1
16	rcv	2.381	A	1	0	251
17	snd	2.405	D	201	50	1
18	rcv	2.675	A	1	0	251
19	snd	2.773	D	251	50	1
20	rcv	2.901	A	1	0	301
21	snd	3.149	D	301	50	1
22	rcv	3.234	A	1	0	351
23	snd	3.341	D	301	50	1

Assignment > Sender_log.txt

12301	rcv	1251.911	A	1	0	261901
12302	snd	1251.948	D	261951	50	1
12303	rcv	1251.961	A	1	0	261951
12304	snd	1251.997	D	262001	50	1
12305	rcv	1252.011	A	1	0	262001
12306	snd	1252.047	D	262051	50	1
12307	rcv	1252.06	A	1	0	262051
12308	snd	1252.098	D	262101	44	1
12309	rcv	1252.11	A	1	0	262101
12310	rcv	1252.141	A	1	0	262145
12311	snd	1252.158	F	262145	0	1
12312	rcv	1252.179	FA	1	0	262146
12313	snd	1252.205	A	262146	0	1
12314	Total bytes: 262144					
12315	Total segments: 5243					
12316	Total dropped: 649					
12317	Total retransmitted: 1235					
12318	Total duplicated acks 991					
12319						

When a package is dropped, the sender either retransmit it in the timeout, or retransmit it when it received 3 duplicate acknowldegemtns.

Question2b:

$timeout = 0.36ms$

Assignment > Sender_log.txt

1	snd	0.196	S	0	0	0
2	rcv	0.268	SA	0	0	1
3	snd	0.354	A	1	0	0
4	snd	0.507	D	1	50	1
5	rcv	0.577	A	1	0	51
6	snd	0.7	D	1	50	1
7	rcv	0.736	A	1	0	51
8	drop	0.752	D	51	50	1
9	snd	2.266	D	51	50	1
10	rcv	2.559	A	1	0	101
11	snd	3.068	D	101	50	1
12	rcv	3.167	A	1	0	151
13	snd	3.336	D	151	50	1
14	rcv	3.428	A	1	0	201
15	snd	3.578	D	151	50	1
16	rcv	3.613	A	1	0	201
17	snd	3.756	D	201	50	1
18	rcv	3.791	A	1	0	251
19	snd	3.93	D	251	50	1
20	rcv	3.966	A	1	0	301
21	snd	4.106	D	301	50	1
22	rcv	4.194	A	1	0	351
23	snd	4.339	D	301	50	1

Assignment > Sender_log.txt

12145	snd	1198.484	D	261901	50	1
12146	rcv	1198.496	A	1	0	261801
12147	snd	1198.511	D	261951	50	1
12148	rcv	1198.627	A	1	0	261801
12149	snd	1198.71	D	261801	50	1
12150	snd	1198.729	D	262001	50	1
12151	rcv	1198.742	A	1	0	261801
12152	snd	1198.757	D	262051	50	1
12153	rcv	1198.924	A	1	0	262001
12154	snd	1198.949	D	262101	44	1
12155	rcv	1198.961	A	1	0	262051
12156	rcv	1198.987	A	1	0	262101
12157	rcv	1199.058	A	1	0	262145
12158	snd	1199.079	F	262145	0	1
12159	rcv	1199.435	FA	1	0	262146
12160	snd	1199.529	A	262146	0	1
12161	Total bytes: 262144					
12162	Total segments: 5243					
12163	Total dropped: 638					
12164	Total retransmitted: 1153					
12165	Total duplicated acks 1040					
12166						

$timeout = 1.44ms$

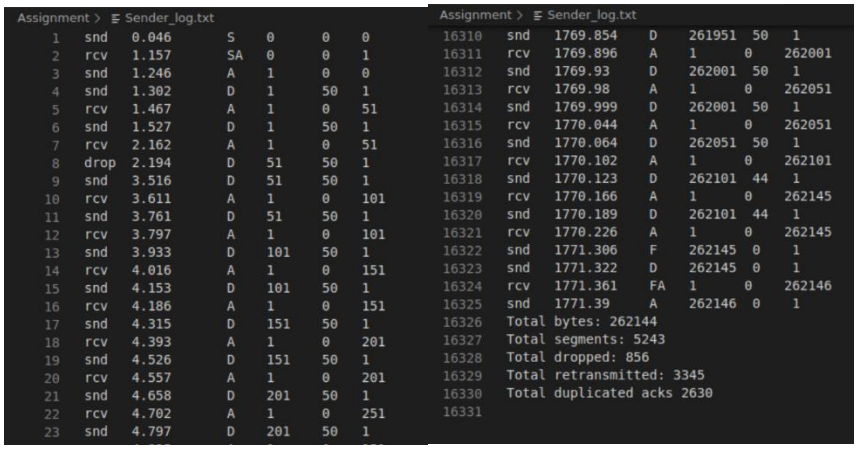
Assignment > Sender_log.txt

1	snd	0.174	S	0	0	0
2	rcv	0.234	SA	0	0	1
3	snd	0.275	A	1	0	0
4	snd	0.373	D	1	50	1
5	rcv	0.392	A	1	0	51
6	snd	0.451	D	51	50	1
7	rcv	0.467	A	1	0	101
8	drop	0.473	D	101	50	1
9	snd	1.688	D	151	50	1
10	rcv	1.745	A	1	0	101
11	snd	1.866	D	101	50	1
12	rcv	1.901	A	1	0	201
13	snd	2.048	D	201	50	1
14	rcv	2.173	A	1	0	251
15	snd	2.235	D	251	50	1
16	rcv	2.251	A	1	0	301
17	snd	2.304	D	301	50	1
18	rcv	2.319	A	1	0	351
19	snd	2.368	D	351	50	1
20	rcv	2.383	A	1	0	401
21	snd	2.433	D	401	50	1
22	rcv	2.448	A	1	0	451
23	snd	2.497	D	451	50	1

Assignment > Sender_log.txt

11110	rcv	617.877	A	1	0	261801
11111	snd	617.891	D	261901	50	1
11112	rcv	617.901	A	1	0	261851
11113	snd	617.914	D	261951	50	1
11114	rcv	617.999	A	1	0	261901
11115	snd	618.021	D	262001	50	1
11116	rcv	618.032	A	1	0	261951
11117	snd	618.046	D	262051	50	1
11118	rcv	618.056	A	1	0	262001
11119	snd	618.069	D	262101	44	1
11120	rcv	618.154	A	1	0	262051
11121	rcv	618.169	A	1	0	262101
11122	rcv	618.179	A	1	0	262145
11123	snd	618.196	F	262145	0	1
11124	rcv	618.876	FA	1	0	262146
11125	snd	618.913	A	262146	0	1
11126	Total bytes: 262144					
11127	Total segments: 5243					
11128	Total dropped: 581					
11129	Total retransmitted: 607					
11130	Total duplicated acks 1571					
11131						

$timeout = 0.09ms$



$Tcurrent$ =0.36ms

rtt	Total transmitted	Time
0.36ms	6478	1200ms
1.44ms	5850	619ms
0.09ms	8588	1771ms

The larger the timeout value, the less package transmitted, and the time taken to transmitted is also shorter. The timeout value with $1.44ms$ has the least package transferred and takes the least time. The timeout value $Tcurrent = 0.36ms$ is not long enough for the rtt as there may be some congestion in the link. The timeout with $0.09ms$ is too short for the response from the receiver, we retransmitted a lot of package wasted a lot of bandwidth, it also take longer to finish the transfer. We should use a longer timout period such as $1ms$ for the package transfer.