Report

Written in python (python3 used)

1) How I implemented the STP protocol

Sender	Receiver
Three way Handshake (syn synAck ack)	Three way handshake (syn synAck ack)
Four seg termination (fin ack fin ack)(sender initiated)	Four seg termination (fin ack fin ack)
Single timer for timeout operations (and respective RTO calculations)	Cummulative acknowledgments
PLD module	Buffer out of order packets
Timeout retransmissions	Handle corrupted packets (with checksum)
Fast retransmit	Handle duplicate packets
MWS sliding window (multiple segments being sent and received at once (thread implementation))	Immediate acknowledgment (not delayed as per specs)
STP header with needed fields (explained bellow)	

As far as I am aware all the needed features have been successfully implemented.

My STP works by having 2 clients (i.e the sender file and receiver file).

Within the sender file is three classes, PLD, Packet and Sender as well as a 'main' function. These classes hold all the useful and relevant implementation for their specific areas. Initially all the variables needed are initialled as well as a main sender and pld class. The main establishes a connection with the receiver by initiating and completing the 'three way handshake'. At the end of this process it starts three different threads, a sending thread, a receiving thread, and a thread that handles any delayed or re-ordered packets. The main while loop essentially acts as the fourth 'thread' that handles most of the processing. I thought this would be the fastest and easiest way to make sure no packets were lost.

The sender thread/loop is constantly trying to send the next possible packet. A packet is possible to be sent if the number unacknowledged is smaller than the window size. If it is, then a packet is staged for sending and then pushed through the pld module. If it passes through the pld module without anything happening it is successfully sent and it goes back to the beginning of the loop. Otherwise the specific pld error is caused. **Note, whilst the pld module is integrated into main and sender, it uses no information from the sender, i.e it is completely independent of the sender as specified in the specs and could essentially be separated into its own file if needed.**

The receiving thread/loop is constantly trying to receive data using the timeout (RTO) estimation, by setting the socket.settimeout to the RTO value. If at any point a timeout occurs, an exception is chucked and handled by retrasmiting the oldest unacknowledged packet. This packet is re-sent through the pld module within the receiving loop. If a packet is timed-out and re-sent it is flagged as

being unable to be used to calculate RTO. If a packet is successfully received it is appended to a queue, which is handled by the main function.

The last thread is used to handle any delayed or re-ordered packets. Any packet that is delayed or re-ordered is flagged by the system. For Delayed packets, it is sent to a deque, and the thread constantly pops the packets in the deque, and calculates if it is time to send them. If it is, it is sent immediately, and if not it is added to the back of the deck. The re-ordered packet is constantly checked to determine if the maxOrder count has been reached (this count is a global count incremented everytime a packet is sent), and when it is reached the re-ordered packet is sent, and a flag is signalled to tell the system that a new packet is now allowed to be re-ordered (count is set back to zero).

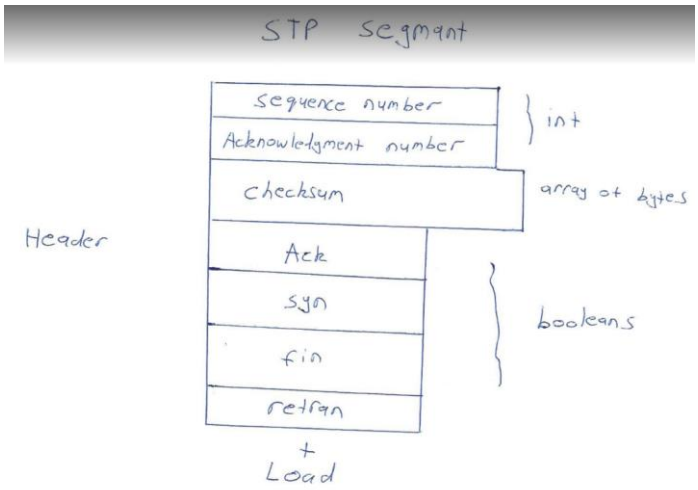
The 'main' function is used to do the calculations for the sequence number and acknowledgment received and compare it to the acknowledgment expected. Every loop it pops a packet of the received queue (if it isn't empty), and does the needed calculations for timeout (if applicable)(min timeout value set to 145ms as per the RFC6298 reccomendation), cumulative ack calculation if the ack is greater than sendbase(to decrement number unacknowledged for the sender thread to have max packets (equal to window size)), and also checks if all the data has been successfully sent and acked, so it can start the finishing sequence. If the ack is equal to the sendbase, then the fast retransmission counter is incremented, and if it equals three then the send base packet is retransmitted (pending pld)(fast retransmission count is set back to zero if a timeout occurs). Once all the data has been received the finishing sequence is initiated (fin, ack, fin, ack).

The receiver on the other hand runs with one thread and a main function. The thread is extremely simple, only waiting for a packet to arrive and then adding it to a Deque for the main function to deal with. The main function initialises all the needed variables and then completes the 3 way handshake with the sender. A packet is popped of the Deque if it is not empty and handled in the following way (the next steps are all run as elif statemnts i.e only 1 will occur). First, if the data is corrupted (checked in comparison with the checksum) it is discarded without sending any ack. Next, if the expected Sequence number is received, the data is immediately appended to the copy file, and the necessary stats, counters and expected numbers are incremented. During this step, if the buffer is not empty (buffer holding packets that were received out of order) the receiver attempts to clear the buffer by checking if the next expected packet is in the buffer. This loop continues until the buffer is cleared, or the next expected packet is not in the buffer. The cumulative ack (or regular ack if nothing was found in the buffer) is now sent for the next expected packet (this is an immediate ack).

Next, the packet is checked to see if it contains a fin flag, and if so the finishing sequence is initiated. Next, the packet is checked to see if it is a duplicate packet. This is needed because otherwise duplicate packets would be added to the buffer, and also so the log file will be accurate. Lastly, if nothing has run then the else statement is activated, i.e this should only happen when a packet has arrived out of order (a packet arrives with seqNum > expectedSeqNum). A dupe ack is sent (with expectedSeqNum as ackNum) and the out of order packet is added to the buffer (this buffer is handled when an expected seqNum is received).

These steps from both the sender and receiver make sure that the packet is reliably received in the shortest possible steps.

2) STP Header



3) Trade offs considered and Made, extensions

For my PLD module, as discussed above it is not held in a separate file, but rather is run just before any packet (bar packets already delayed and re-ordered) are about to be sent. This is ok when run by the sending thread, however it means that the receiving thread (and main thread for fast retransmit) becomes a fair bit slower when an exception occurs (or three dup ack's) and it then has to run the pld module before retransmitting. Whilst it is running this pld module it cannot receive other packets causing the system to slow down. To improve this I would completely separate the pld module from the sender, sending any packet to be sent to the receiver to the pld, who would then have the responsibility of on-sending it to the receiver address if no errors occurred (or creating the error if needed). However this would only improve the speed of the system, and not in any way affect the implementation (i.e it is simple refactoring).

For the timeout calculation I believe that the single timer per window method for RTT calculations and thus RTO calculation are not very accurate or responsive, and a better method would be to track each packet sent and calculate RTT and RTO every time a packet is successfully received without retransmission or errors. To improve this I would have a deque keeping track of all the send times per packet, and calculate the RTO on each successful return.

4) Snippets borrowed

https://pymotw.com/2/socket/udp.html used for implementing my socket code (sending, receiving)

Code snippets for receiving ack from the class textbook (page 248 chapter 3)

Part 5

1)

Startup, 1, 101, 301, 401,501,601, 201, 701, 801, 901, 1001, 1101, 1201, 1301, 1401, 1501, 1601, 1701, 1801, 1901, 2101, 2201, 2302, 2401, 2001, 2501, 2601, 2901, 3001, 2701, 29801, fin received

For a pDrop of 0.1, dropping occurred at packet 201, 2001, 2701 and 2801. As seen in the appendix, for the first dropped packet at the receiver, packet 301, 401, 501 and 601 are all received before 201 is received. This makes sense as three dup ack's are sent (401,501,601 all send ack 201) causing 201 to be retransmitted and the normal sequence to resume. At the end packet 2701 and 2801 are dropped back to back, and because there is not enough data being sent to cause a fast retransmit, a timeout occurs and both packets are re-sent.

For a pDrop of 0.3 way more packets are dropped (24) causing a much more disordered package arrival at the receiver (see appendix). It is critical to note that in the second experiment much more timeouts occurred compared to fast retransmits, and this is because to many packets were being lost (dropped) that the receiver often did not have a chance to even send three ack's before the timeout occurred.

2)

Gamma	Total Packets Transmitted	Time taken to Transmit (mn)
2	12508	106
4	12446	168
6	12450	239

As seen in the table above, it takes longer to run the simulation as gamma increases. This is due to the timeout interval being larger as gamma increases (RTO = estRTT + gamma * devRTT), causing dropped packets (the main cause of error from pld in this situation) to be picked up much slower. However, less packets are needed to be sent as gamma increases, because delayed packets are acknowledged in time to avoid a timeout (bigger gamma = longer timeout (RTO)). This explains the difference between gamma 2 and 4. However gamma 4 and 6 are roughly equal in terms of packets sent, as clearly a gamma of 4 is sufficient to pick up the majority of packets that have been delayed and not dropped.

3)

The file has been successfully transferred. The transfer took 26 minutes.

Duplicated segments do not cause much stress time wise on the receiver. Similarly, in the majority of cases, re-ordering with a maxOrder of 4 will cause a fast retransmit and also not cause much stress timewise on either the sender or the receiver. Since there was 700 more dropped packets than corrupted packets, and the fact that both are handled similarly by the receiver (i.e the receiver doesn't send an Ack for either case, for dropped packets it doesn't know anything came, and for corrupted packets it discards it), I believe that dropped packets was the single biggest contributing factor for transfer time.

Appendix

a) Sender log file (pDrop 0.1)

1	snd	0	S	0	0	0
2	rcv	0.0017731189727783203	SA	0	0	1
3	snd	0.0029916763305664062	A	1	0	1
4	snd	0.0201494693756103 5	D	1	100	1
5	snd	0.0258162021636963 29	D	101	100	1
6	rcv	0.0317535400390625	A	1	0	101
7	drop	0.0377273559570312 5	D	201	100	2
8	rcv	0.0758674144744873	A	2	0	201
9	snd	0.0864291191101074 2	D	301	100	3
10	rcv/DA	0.0973472595214843 8	A	2	0	201
11	snd	0.1131134033203125	D	401	100	3
12	rcv/DA	0.1238999366760253 9	A	2	0	201
13	snd	0.1292865276336670	D	501	100	3
14	snd	0.1403541564941406 2	D	601	100	3
15	rcv/DA	0.1405391693115234 4	A	2	0	201
16	snd/RXTF	0.1668925285339355 5	D	201	100	0
17	rcv/DA	0.2373490333557129	A	2	0	201
18	rcv	0.2898995876312256	A	7	0	701
19	snd	0.3617651462554931 6	D	701	100	8
20	rcv	0.3942553997039795	A	8	0	801
21	snd	0.3997416496276855 5	D	801	100	9
22	snd	0.4209237098693847 7	D	901	100	9
23	rcv	0.4214410718603516	A	9	0	901
24	snd	0.4319999217987060 5	D	1001	100	10
25	rcv	0.4381008148193359 4	A	10	0	1001
26	snd	0.4436147212982178	D	1101	100	11
27	rcv	0.4490787982940674	A	11	0	1101
28	snd	0.4800827503204345 7	D	1201	100	12
29	rcv	0.4801661968231201	A	12	0	1201
30	snd	0.4911758896887207	D	1301	100	13
31	rcv	0.4966189861297607 4	A	13	0	1301
32	snd	0.5281345844268799	D	1401	100	15
33	rcv	0.5280613899230957	A	14	0	1401
34	snd	0.5442378520965576	D	1501	100	15
35	rcv	0.5496985912322998	A	15	0	1501
36	snd	0.5602138042449951	D	1601	100	16
37	rcv	0.5658931732177734	A	16	0	1601
38	snd	0.5714633464813232	D	1701	100	17
39	rcv	0.5772922039031982	A	17	0	1701
40	snd	0.5981624126434326	D	1801	100	18
41	rcv	0.5983145236968994	A	18	0	1801
42	snd	0.614210844039917	D	1901	100	19
43	rcv	0.6196174621582031	A	19	0	1901
44	drop	0.6303627490997314	D	2001	100	20
45	rcv	0.6357152462005615	A	20	0	2001
46	snd	0.6414048671722412	D	2101	100	21
47	snd	0.6524896621704102	D	2201	100	21
48	rcv/DA	0.6579568386077881	A	20	0	2001
49	rcv/DA	0.6738440990447998	A	20	0	2001
50	snd	0.679288387298584	D	2301	100	21
51	rcv/DA	0.7006049156188965	A	20	0	2001
52	snd	0.7007827758789062	D	2401	100	21
53	snd/RXTF	0.7168211936950684	D	2001	100	0
54	rcv/DA	0.7358167171478271	A	20	0	2001
55	rcv	0.7801461219787598	A	25	0	2501
56	snd	0.8258426189422607	D	2501	100	26
57	rcv	0.8383224010467529	A	26	0	2601
58	snd	0.8438758850097656	D	2601	100	27
59	rcv	0.8800511360168457	A	27	0	2701
60	drop	0.8801229000091553	D	2701	100	28
61	drop	0.9063458442687988	D	2801	100	28
62	snd	0.9785535335540771	D	2901	100	28
63	rcv/DA	0.9892916679382324	A	27	0	2701
64	snd	0.9895672798156738	D	3001	28	28
65	rcv/DA	1.0008718967437744	A	27	0	2701
66	snd/RXTT	1.9059126377105713	D	2701	100	0
67	rcv	1.9173889160156625	A	28	0	2801
68	snd/RXTT	2.8219008445739746	D	2801	100	0
69	rcv	2.8537375926971436	A	31	0	3029
70	snd	2.8648550510406494	F	3029	0	32
71	rcv	2.9659812450408936	A	31	0	3029
72	rcv	2.9720206260681152	F	32	0	3030
73	snd	2.9732019901275635	A	3029	0	33
74						
75	Size of the file (in Bytes)		3028			
76	Segments transmitted (including drop & RXT)		39			
77	Number of Segments handled by PLD		35			
78	Number of Segments dropped		4			
79	Number of Segments Corrupted		0			
80	Number of Segments Re-ordered		0			
81	Number of Segments Duplicated		0			
82	Number of Segments Delayed		0			
83	Number of Retransmissions due to TIMEOUT		2			
84	Number of FAST RETRANSMISSION		2			
85	Number of DUP ACKS received		10			

Receiver log File (pDrop 0.1)

1	rcv	0	S	0	0	0
2	snd	0.0015282630920410156	SA	0	0	1
3	rcv	0.002726554870605468	A	1	0	1
4	rcv	0.025228977203369	D	1	100	1
5	snd	0.029414415359497	A	1	0	101
6	rcv	0.030447721481323242	D	101	100	1
7	snd	0.03276705741882324	A	2	0	201
8	rcv	0.08675765991210938	D	301	100	3
9	snd/DA	0.08767414093017578	A	2	0	201
10	rcv	0.11315608024597168	D	401	100	3
11	snd/DA	0.11392641067504883	A	2	0	201
12	rcv	0.13424062728881836	D	501	100	3
13	snd/DA	0.13500499725341797	A	2	0	201
14	rcv	0.1454768180847168	D	601	100	3
15	snd/DA	0.14624071121215820	A	2	0	201
16	rcv	0.17185211181640625	D	201	100	0
17	snd	0.17547321319580078	A	7	0	701
18	rcv	0.36679720878601074	D	701	100	8
19	snd	0.36834216117858887	A	8	0	801
20	rcv	0.40468978881835940	D	801	100	9
21	snd	0.40612316131591797	A	9	0	901
22	rcv	0.42602705955505370	D	901	100	9
23	snd	0.42748785018920900	A	10	0	1001
24	rcv	0.42819142341613770	D	1001	100	10
25	snd	0.42963433265686035	A	11	0	1101
26	rcv	0.44859886169433594	D	1101	100	11
27	snd	0.44998264312744140	A	12	0	1201
28	rcv	0.48017001152038574	D	1201	100	12
29	snd	0.48186254501342773	A	13	0	1301
30	rcv	0.49613714218139650	D	1301	100	13
31	snd	0.49753260612487793	A	14	0	1401
32	rcv	0.53334609140319820	D	1401	100	14
33	snd	0.53476428985595700	A	15	0	1501
34	rcv	0.54925417900085450	D	1501	100	15
35	snd	0.55066323280334470	A	16	0	1601
36	rcv	0.56533694267272950	D	1601	100	16
37	snd	0.56675934791564940	A	17	0	1701
38	rcv	0.57641530036926270	D	1701	100	17
39	snd	0.57793426513671880	A	18	0	1801
40	rcv	0.59806060791015620	D	1801	100	18
41	snd	0.59961891174316410	A	19	0	1901
42	rcv	0.61932158470153810	D	1901	100	19
43	snd	0.62065768241882320	A	20	0	2001
44	rcv	0.64645266532897950	D	2101	100	21
45	snd/DA	0.64715838432312010	A	20	0	2001

46	rcv	0.6574914455413818	D	2201	100	21
47	snd/DA	0.6582129001617432	A	20	0	2001
48	rcv	0.6842374801635742	D	2301	100	21
49	snd/DA	0.6852447986602783	A	20	0	2001
50	rcv	0.7059037685394287	D	2401	100	21
51	snd/DA	0.7067763805389404	A	20	0	2001
52	rcv	0.7217879295349121	D	2001	100	0
53	snd	0.7254538536071777	A	25	0	2501
54	rcv	0.8309977054595947	D	2501	100	26
55	snd	0.832679033279419	A	26	0	2601
56	rcv	0.8488137722015381	D	2601	100	27
57	snd	0.8501412868499756	A	27	0	2701
58	rcv	0.9837250709533691	D	2901	100	28
59	snd/DA	0.984576940536499	A	27	0	2701
60	rcv	0.9945318698883057	D	3001	28	28
61	snd/DA	0.9952571392059326	A	27	0	2701
62	rcv	1.9109258651733398	D	2701	100	0
63	snd	1.9127628803253174	A	28	0	2801
64	rcv	2.8269145488739014	D	2801	100	0
65	snd	2.8298354148864746	A	31	0	3029
66	rcv	2.8700003623962402	F	3029	0	32
67	snd	2.870830774307251	A	32	0	3030
68	snd	2.9720866680145264	F	32	0	3030
69	rcv	2.974546432495117	A	33	0	3029
70						
71	Amount of data received (in Bytes)		3028			
72	Total segments received		35			
73	Data segments received		31			
74	Data segments with Bit Errors		0			
75	Duplicate data segments received		0			
76	Duplicate ACKs sent		10			

Sender Log File (pDrop 0.3)

1	snd	0	S	0	0	0
2	rcv	0.0018813610076904297	SA	0	0	1
3	snd	0.0033321380615234375	A	1	0	1
4	drop	0.010326862335205078	D	1	100	1
5	snd	0.011689424514770508	D	101	100	1
6	snd	0.017291069030761719	D	201	100	1
7	snd	0.035938262939453125	D	301	100	1
8	drop	0.042012453079223633	D	401	100	1
9	rcv/DA	0.036624908447265625	A	0	0	1
10	rcv/DA	0.06206536293029785	A	0	0	1
11	rcv/DA	0.07298755645751953	A	0	0	1
12	FRdrop	0.0839226245880127	D	1	100	1
13	drop	1.5760487453460693	D	1	100	1
14	snd/RXTT	3.1308364868164062	D	1	100	0
15	rcv	3.1583209037780762	A	4	0	401
16	snd	3.2076613903045654	D	501	100	5
17	rcv/DA	3.2342026233673096	A	4	0	401
18	drop	3.2499916553497314	D	601	100	5
19	drop	3.2967889308929443	D	701	100	5
20	snd	3.3636448383333313	D	801	100	5
21	rcv/DA	3.3996846675872803	A	4	0	401
22	snd/RXTT	4.893354177474976	D	401	100	0
23	rcv	4.961411714553833	A	6	0	601
24	drop	4.986024618148804	D	901	100	7
25	snd	5.009059906005859	D	1001	100	7
26	rcv/DA	5.087184429168701	A	6	0	601
27	snd/RXTT	6.590274333953857	D	601	100	0
28	rcv	6.622171878814697	A	7	0	701
29	snd	6.668828010559082	D	1101	100	8
30	rcv/DA	6.694713354110718	A	7	0	701
31	snd/RXTT	8.206872463226318	D	701	100	0
32	rcv	8.294037810900691	A	9	0	901
33	snd	8.330110788345337	D	1201	100	10
34	drop	8.346233367919922	D	1301	100	10
35	rcv/DA	8.351648569107056	A	9	0	901
36	snd/RXTT	9.853125095367432	D	901	100	0
37	rcv	9.91003704071045	A	13	0	1301
38	drop	9.946053981781006	D	1401	100	14
39	drop	9.963636159896851	D	1501	100	14
40	snd	9.97462010383606	D	1601	100	14
41	rcv/DA	9.986377954483032	A	13	0	1301
42	snd	9.99178957939148	D	1701	100	14
43	rcv/DA	10.00822925567627	A	13	0	1301
44	drop	11.514092206954956	D	1301	100	14
45	snd/RXTT	13.032093524932861	D	1301	100	0
46	rcv	13.130041122436523	A	14	0	1401
47	snd	13.182121753692627	D	1801	100	15
48	rcv/DA	13.24361276626587	A	14	0	1401
49	snd/RXTT	14.755342245101929	D	1401	100	0
50	rcv	14.817791223526001	A	15	0	1501
51	drop	14.843486309051514	D	1901	100	16
52	drop	16.32425856590271	D	1501	100	16
53	drop	17.851880073547363	D	1501	100	16

54	drop	19.411656141281128	D	1501	100	16
55	drop	20.937868356704712	D	1501	100	16
56	snd/RXTT	22.472802877426147	D	1501	100	0
57	rcv	22.611042022705078	A	19	0	1901
58	snd	22.666156768798828	D	2001	100	20
59	snd	22.678782463073730	D	2101	100	20
60	rcv/DA	22.678966522216797	A	19	0	1901
61	snd	22.684520244598390	D	2201	100	20
62	rcv/DA	22.700771808624268	A	19	0	1901
63	snd	22.700565814971924	D	2301	100	20
64	rcv/DA	22.716694116592407	A	19	0	1901
65	FRdrop	22.738309621810913	D	1901	100	20
66	rcv/DA	22.749495983123780	A	19	0	1901
67	snd/RXTT	24.234955072402954	D	1901	100	0
68	rcv	24.286031961441040	A	24	0	2401
69	drop	24.321959733963013	D	2401	100	25
70	drop	24.342957258224487	D	2501	100	25
71	drop	24.354134798049927	D	2601	100	25
72	snd	24.365149974822998	D	2701	100	25
73	rcv/DA	24.392184495925903	A	24	0	2401
74	snd	24.407762765884400	D	2801	100	25
75	rcv/DA	24.418615102767944	A	24	0	2401
76	drop	25.930251359939575	D	2401	100	25
77	snd/RXTT	27.465545415878296	D	2401	100	0
78	rcv	27.550094604492188	A	25	0	2501
79	drop	27.586094141006470	D	2901	100	26
80	snd/RXTT	29.034150838851930	D	2501	100	0
81	rcv	29.097023487091064	A	26	0	2601
82	snd	29.143824577331543	D	3001	28	27
83	rcv/DA	29.149702072143555	A	26	0	2601
84	drop	30.656439304351807	D	2601	100	27
85	snd/RXTT	32.174178838729860	D	2601	100	0
86	rcv	32.185629844665530	A	29	0	2901
87	drop	33.686184167861940	D	2901	100	30
88	snd/RXTT	35.222189188800354	D	2901	100	0
89	rcv	35.265167236328125	A	31	0	3029
90	snd	35.287786006927490	F	3029	0	32
91	rcv	35.388907909393310	A	31	0	3029
92	rcv	35.394982099533080	F	32	0	3030
93	snd	35.396017313003540	A	3029	0	33
94						
95	Size of the file (in Bytes)		3028			
96	Segments transmitted (including drop & RXT)		59			
97	Number of Segments handled by PLD		55			
98	Number of Segments dropped		24			
99	Number of Segments Corrupted		0			
100	Number of Segments Re-ordered		0			
101	Number of Segments Duplicated		0			
102	Number of Segments Delayed		0			
103	Number of Retransmissions due to TIMEOUT		22			
104	Number of FAST RETRANSMISSION		2			
105	Number of DUP ACKS received		18			

Receiver Log File (pDrop 0.3)

1	rcv	0	S	0	0	0
2	snd	0.0013802051544189453	SA	0	0	1
3	rcv	0.0029065608978271484	A	1	0	1
4	rcv	0.025099754333496094	D	101	100	1
5	snd/DA	0.026175975799560547	A	0	0	1
6	rcv	0.026990175247192383	D	201	100	1
7	snd/DA	0.02780461311340332	A	0	0	1
8	rcv	0.04087376594543457	D	301	100	1
9	snd/DA	0.042043209075927734	A	0	0	1
10	rcv	3.115478754043579	D	1	100	0
11	snd	3.118901252746582	A	4	0	401
12	rcv	3.2125930786132812	D	501	100	5
13	snd/DA	3.213693857192993	A	4	0	401
14	rcv	3.338324785232544	D	801	100	5
15	snd/DA	3.3392646312713623	A	4	0	401
16	rcv	4.8983213901519775	D	401	100	0
17	snd	4.903478384017944	A	6	0	601
18	rcv	5.014092206954956	D	1001	100	7
19	snd/DA	5.015094995498657	A	6	0	601
20	rcv	6.595268249511719	D	601	100	0
21	snd	6.596875429153442	A	7	0	701
22	rcv	6.668657541275024	D	1101	100	8
23	snd/DA	6.669461965560913	A	7	0	701
24	rcv	8.212249279022217	D	701	100	0
25	snd	8.21843433380127	A	9	0	901
26	rcv	8.33506965637207	D	1201	100	10
27	snd/DA	8.33590579032898	A	9	0	901
28	rcv	9.858095645904541	D	901	100	0
29	snd	9.861684322357178	A	13	0	1301
30	rcv	9.979738712310791	D	1601	100	14
31	snd/DA	9.980822801589966	A	13	0	1301
32	rcv	9.996954202651978	D	1701	100	14
33	snd/DA	9.99771785736084	A	13	0	1301
34	rcv	13.0370216369629	D	1301	100	0
35	snd	13.046465396881104	A	14	0	1401
36	rcv	13.187058687210083	D	1801	100	15
37	snd/DA	13.188015699386597	A	14	0	1401
38	rcv	14.76063871383667	D	1401	100	0
39	snd	14.762360334396362	A	15	0	1501
40	rcv	22.472647428512573	D	1501	100	0
41	snd	22.47653341293335	A	19	0	1901
42	rcv	22.67192029953003	D	2001	100	20
43	snd/DA	22.672977924346924	A	19	0	1901
44	rcv	22.683634042739868	D	2101	100	20
45	snd/DA	22.68454647064209	A	19	0	1901
46	rcv	22.690450429916382	D	2201	100	20
47	snd/DA	22.691208839416504	A	19	0	1901
48	rcv	22.70543670654297	D	2301	100	20
49	snd/DA	22.706169366836548	A	19	0	1901
50	rcv	24.24522137641906 7	D	1901	100	0
51	snd	24.254216432571 41	A	24	0	2401
52	rcv	24.370115288151367	D	2701	100	25
53	snd/DA	24.371113061904907	A	24	0	2401
54	rcv	24.40760040283203	D	2801	100	25
55	snd/DA	24.408446311950684	A	24	0	2401
56	rcv	27.47050976753235	D	2401	100	0
57	snd	27.472315549850464	A	25	0	2501
58	rcv	29.03952145576477	D	2501	100	0
59	snd	29.046117305755615	A	26	0	2601
60	rcv	29.143657445907593	D	3001	28	27
61	snd/DA	29.144461393356323	A	26	0	2601
62	rcv	32.17913317680359	D	2601	100	0
63	snd	32.18211102485657	A	29	0	2901
64	rcv	35.22727012634277	D	2901	100	0
65	snd	35.229633808135986	A	31	0	3029
66	rcv	35.2929317952024	F	3029	0	32
67	snd	35.293729066848755	A	32	0	3030
68	snd	35.39493536949158	F	32	0	3030
69	rcv	35.411051750183105	A	33	0	3029
70						
71	Amount of data received (in Bytes)		3028			
72	Total segments received		35			
73	Data segments received		31			
74	Data segments with Bit Errors		0			
75	Duplicate data segments received		0			
76	Duplicate ACKs sent		18			

3) (Sender Log File Snipets, gamma = 2)

```
 1 snd                 0                       S     0     0     0
 2 rcv                 0.0009608268737792969   SA    0     0     1
 3 snd                 0.0017039775848388672   A     1     0     1
 4 snd                 0.002573728561401367    D     1     50    1
 5 drop                0.003306150436401367    D     51    50    1
 6 drop                0.0039677619934082003   D     151   50    1
 7 snd                 0.0045855045318603516   D     201   50    1
 8 drop                0.005177497863769531    D     251   50    1
 9 snd                 0.005773544311523437    D     301   50    1
10 drop                0.006402969360351562    D     351   50    1
11 snd                 0.006981372833251953    D     401   50    1
12 snd                 0.007571458816528320    D     451   50    1
13 rcv                 0.09176611900329590     A     1     0     51
14 rcv/DA              0.10258007049560547     A     1     0     51
15 rcv/DA              0.11331439018249512     A     1     0     51
16 rcv/DA              0.12402105331420898     A     1     0     51
17 snd/RXTF            0.13480877876281738     D     51    50    0
18 rcv/DA              0.14559388160705566     A     1     0     51
19 rcv                 0.15647292137145996     A     2     0     101
20 drop                0.19981479644775390     D     551   50    3
21 snd/delay           0.25187468528747560     D     101   50    1
22 rcv                 0.27979969978332520     A     3     0     151
23 snd                 0.33186006546020510     D     601   50    4
24 rcv/DA              0.36779141426086426     A     3     0     151
25 snd/delay           1.02397775650024410     D     501   50    2
26 rcv/DA              1.07393383979797360     A     3     0     151
27 drop                2.04911041259765620     D     151   50    4
28 snd/RXTT            3.08583760261535640     D     151   50    0
29 rcv                 3.14681506156921400     A     5     0     251
30 drop                3.17405629158020000     D     651   50    6
31 drop                3.21048879623413100     D     701   50    6
32 drop                4.15174460411071800     D     251   50    6
33 snd/RXTT            5.18302989006042500     D     251   50    0
34 rcv                 5.28093552589416500     A     7     0     351
35 drop                5.32789707183837900     D     751   50    8
36 drop                5.34536838531494100     D     801   50    8
37 snd/RXTT            6.27030014991760250     D     351   50    0
```

```
18688 snd/delay              6375.0962834358215      D     308051   50    6153
18689 rcv/DA                 6375.10778713226300     A     6152     0     307601
18690 snd/RXTF               6375.13338136673000     D     307601   50    0
18691 rcv                    6375.144418001175000    A     6156     0     307801
18692 drop                   6375.187826633453000    D     308101   50    6157
18693 snd                    6375.205462694168000    D     308201   3     6157
18694 rcv/DA                 6375.216596126556000    A     6156     0     307801
18695 snd/delay              6375.783854722977000    D     308151   50    6157
18696 rcv/DA                 6375.826794385910000    A     6156     0     307801
18697 drop                   6376.479746580124000    D     307801   50    6157
18698 snd/RXTT               6377.159979104996000    D     307801   50    0
18699 rcv                    6377.187341451645000    A     6157     0     307851
18700 snd/delay              6377.891353368759000    D     307851   50    0
18701 rcv                    6377.907060384750000    A     6159     0     307951
18702 drop                   6378.569798707962000    D     307951   50    6160
18703 snd/RXTT               6379.259932279587000    D     307951   50    0
18704 rcv                    6379.282785892487000    A     6162     0     308101
18705 drop                   6379.945518970489500    D     308101   50    6163
18706 snd/RXTT               6380.629544258118000    D     308101   50    0
18707 rcv                    6380.667129039764000    A     6165     0     308204
18708 snd                    6380.689427375793500    F     308204   0     6166
18709 rcv                    6380.790380239487000    A     6165     0     308204
18710 rcv                    6380.796459436417000    F     6166     0     308205
18711 snd                    6380.797326087952000    A     308204   0     6167
18712
18713 Size of the file (in Bytes)                    308203
18714 Segments transmitted (including drop & RXT)     12508
18715 Number of Segments handled by PLD               12504
18716 Number of Segments dropped                       6304
18717 Number of Segments Corrupted                     0
18718 Number of Segments Re-ordered                    0
18719 Number of Segments Duplicated                    0
18720 Number of Segments Delayed                       1243
18721 Number of Retransmissions due to TIMEOUT         6108
18722 Number of FAST RETRANSMISSION                    231
18723 Number of DUP ACKS received                      3086
```

Receiver Log File Snipets (Gamma = 2)

```
 1 rcv                0                    S    0      0    0
 2 snd                0.0006909370422363281 SA   0      0    1
 3 rcv                0.0015096664428710938 A    1      0    1
 4 rcv                0.027930259704589844  D    1      50   1
 5 snd                0.030114650726318 36  A    1      0    51
 6 rcv                0.030922651290893555  D    201    50   1
 7 snd/DA             0.036549091339111 33  A    1      0    51
 8 rcv                0.037305116653442 38  D    301    50   1
 9 snd/DA             0.038808215454101 56  A    1      0    51
10 rcv                0.038796663284301 76  D    401    50   1
11 snd/DA             0.039576053619384766  A    1      0    51
12 rcv                0.040287017822265625  D    451    50   1
13 snd/DA             0.041049957275390625  A    1      0    51
14 rcv                0.139889001846313 48  D    51     50   0
15 snd                0.141420125961303 7   A    2      0    101
16 rcv                0.256952047348022 46  D    101    50   1
17 snd                0.258457899093627 93  A    3      0    151
18 rcv                0.336964845657348 63  D    601    50   4
19 snd/DA             0.339437484741210 94  A    3      0    151
20 rcv                1.029043436050415     D    501    50   2
21 snd/DA             1.029999256134033 2   A    3      0    151
22 rcv                3.091153621673584     D    151    50   0
23 snd                3.093863010406494     A    5      0    251
24 rcv                5.188104152679443     D    251    50   0
25 snd                5.190259695053101     A    7      0    351
26 rcv                6.275397539138794     D    351    50   0
27 snd                6.278369665145874     A    11     0    551
28 rcv                6.432904958724976     D    1001   50   12
29 snd/DA             6.433567762374878     A    11     0    551
30 rcv                11.669804334640503    D    551    50   0
31 snd                11.672221422195435    A    13     0    651
32 rcv                12.044985294342041    D    1101   50   14
33 snd/DA             12.045841693878174    A    13     0    651
```

```
12380 rcv                6371.571648359299     D    307901 50   6151
12381 snd/DA             6371.572489976883     A    6150   0    307501
12382 rcv                6374.337012529373     D    307501 50   0
12383 snd                6374.339153051376     A    6152   0    307601
12384 rcv                6374.480946302414     D    308001 50   6153
12385 snd/DA             6374.481785297394     A    6152   0    307601
12386 rcv/dup            6374.497263431549     D    307501 50   0
12387 snd/DA             6374.4981009960175    A    6152   0    307601
12388 rcv                6375.096236944199     D    308051 50   6153
12389 snd/DA             6375.09725022316      A    6152   0    307601
12390 rcv                6375.138383388519     D    307601 50   0
12391 snd                6375.14159488678      A    6156   0    307801
12392 rcv                6375.210459947586     D    308201 3    6157
12393 snd/DA             6375.21133685112      A    6156   0    307801
12394 rcv                6375.789093255997     D    308151 50   6157
12395 snd/DA             6375.78998208046      A    6156   0    307801
12396 rcv                6377.165234804153     D    307801 50   0
12397 snd                6377.17178606987      A    6157   0    307851
12398 rcv                6377.896444797516     D    307851 50   0
12399 snd                6377.89849114418      A    6159   0    307951
12400 rcv                6379.265071392059     D    307951 50   0
12401 snd                6379.267978668213     A    6162   0    308101
12402 rcv                6380.63472533226      D    308101 50   0
12403 snd                6380.637104511261     A    6165   0    308204
12404 rcv                6380.694788455963     F    308204 0    6166
12405 snd                6380.695496559143     A    6166   0    308205
12406 snd                6380.796428442001     F    6166   0    308205
12407 rcv                6380.797447919846     A    6167   0    308204
12408
12409 Amount of data received (in Bytes)       308203
12410 Total segments received                  6204
12411 Data segments received                   6200
12412 Data segments with Bit Errors            0
12413 Duplicate data segments received         35
12414 Duplicate ACKs sent                      3086
```

Sender Log File (gamma = 4)

1	snd	0	S	0	0	0
2	rcv	0.0011026859283447266	SA	0	0	1
3	snd	0.0016183853149414062	A	1	0	1
4	snd	0.002511739730834961	D	1	50	1
5	drop	0.0032553672790527344	D	51	50	1
6	drop	0.0039434432983398844	D	151	50	1
7	snd	0.0046358108520507812	D	201	50	1
8	drop	0.0053064823150634766	D	251	50	1
9	snd	0.006021738052368164	D	301	50	1
10	drop	0.006695747375488281	D	351	50	1
11	snd	0.007438421249389648	D	401	50	1
12	snd	0.008156061172485352	D	451	50	1
13	rcv	0.10066413879394531	A	1	0	51
14	rcv/DA	0.10651922225952148	A	1	0	51
15	rcv/DA	0.17820477485656738	A	1	0	51
16	rcv/DA	0.19917225837707520	A	1	0	51
17	snd/RXTF	0.22525668144226074	D	51	50	0
18	rcv/DA	0.24113845825195312	A	1	0	51
19	rcv	0.25229787826538086	A	2	0	101
20	snd/delay	0.25256824493408203	D	101	50	1
21	drop	0.26809787750244140	D	551	50	3
22	rcv	0.26820206642150879	A	3	0	151
23	snd	0.31586217880249023	D	601	50	4
24	rcv/DA	0.37791013717651367	A	3	0	151
25	snd/delay	1.0299797058105469	D	501	50	2
26	rcv/DA	1.0510187149047852	A	3	0	151
27	drop	2.6097323894500732	D	151	50	4
28	snd/RXTT	4.179250717163086	D	151	50	0
29	rcv	4.31939172744751	A	5	0	251
30	drop	4.371819019317627	D	651	50	6
31	drop	4.392319917678833	D	701	50	6
32	drop	5.8625977039337160	D	251	50	6
33	snd/RXTT	7.467935085296631	D	251	50	0
34	rcv	7.5489327907562256	A	7	0	351
35	drop	7.5838129520416260	D	751	50	8
36	drop	7.59693717956543	D	801	50	8
37	snd/RXTT	9.107626914978027	D	351	50	0
38	rcv	9.14782214164733900	A	11	0	551

18579	drop	10118.558006286621	D	307801	50	6148
18580	rcv/DA	10118.5582153797150	A	6147	0	307351
18581	snd/RXTT	10119.887626886368	D	307351	50	0
18582	rcv	10119.919371604920	A	6148	0	307401
18583	snd	10119.969974279404	D	307851	50	6149
18584	rcv/DA	10120.019822835922	A	6148	0	307401
18585	snd/RXTT	10121.331877231598	D	307401	50	0
18586	rcv	10121.363811492920	A	6149	0	307451
18587	snd	10121.419858455658	D	307901	50	6150
18588	rcv/DA	10121.440797567368	A	6149	0	307451
18589	drop	10122.770222663880	D	307451	50	6150
18590	snd/RXTT	10124.114929199219	D	307451	50	0
18591	rcv	10124.279284477234	A	6151	0	307551
18592	snd	10124.319907426834	D	307951	50	6152
18593	rcv/DA	10124.330240249634	A	6151	0	307551
18594	snd	10124.335624933243	D	308001	50	6152
18595	rcv/DA	10124.356833457947	A	6151	0	307551
18596	snd/RXTT	10125.691884756088	D	307551	50	0
18597	rcv	10125.74316740036	A	6156	0	307801
18598	drop	10125.784926891327	D	308101	50	6157
18599	snd	10125.805424928665	D	308151	50	6157
18600	snd	10125.816667318344	D	308201	3	6157
18601	rcv/DA	10125.816723823547	A	6156	0	307801
18602	rcv/DA	10125.838101387024	A	6156	0	307801
18603	snd/delay	10125.871852397919	D	308051	50	6157
18604	rcv/DA	10125.923724412918	A	6156	0	307801
18605	snd/RXTF	10125.964854001999	D	307801	50	0
18606	rcv	10125.995823860168	A	6162	0	308101
18607	drop	10127.29958319664	D	308101	50	6163
18608	drop	10128.643839120865	D	308101	50	6163
18609	snd/RXTT	10129.993810653687	D	308101	50	0
18610	rcv	10130.065427064896	A	6165	0	308204
18611	snd	10130.066230535507	F	308204	0	6166
18612	rcv	10130.167083501816	A	6165	0	308204
18613	rcv	10130.173089265823	F	6166	0	308205
18614	snd	10130.174001216888	A	308204	0	6167
18615						
18616	Size of the file (in Bytes)		308203			
18617	Segments transmitted (including drop & RXT)		12446			
18618	Number of Segments handled by PLD		12442			
18619	Number of Segments dropped		6277			
18620	Number of Segments Corrupted		0			
18621	Number of Segments Re-ordered		0			
18622	Number of Segments Duplicated		0			
18623	Number of Segments Delayed		1234			
18624	Number of Retransmissions due to TIMEOUT		6046			
18625	Number of FAST RETRANSMISSION		231			
18626	Number of DUP ACKS received		3088			

Receiver Log File (gamma = 4)

1	rcv	0	S	0	0	0
2	snd	0.0008640289306640625	SA	0	0	1
3	rcv	0.00163316726684570 31	A	1	0	1
4	rcv	0.020786285400390625	D	1	50	1
5	snd	0.039521455764770 51	A	1	0	51
6	rcv	0.040151119232177734	D	201	50	1
7	snd/DA	0.040732145309448 24	A	1	0	51
8	rcv	0.041297435760498 05	D	301	50	1
9	snd/DA	0.041881322860717 77	A	1	0	51
10	rcv	0.042423486709594 73	D	401	50	1
11	snd/DA	0.043011903762817 38	A	1	0	51
12	rcv	0.043568372726440 43	D	451	50	1
13	snd/DA	0.044142007827758 79	A	1	0	51
14	rcv	0.226648092269897 46	D	51	50	0
15	snd	0.227884054183959 96	A	2	0	101
16	rcv	0.257419109344482 4	D	101	50	1
17	snd	0.258463621139526 37	A	3	0	151
18	rcv	0.320793628692626 95	D	601	50	4
19	snd/DA	0.321418205369873 05	A	3	0	151
20	rcv	1.0349085330963135	D	501	50	2
21	snd/DA	1.0357041358947754	A	3	0	151
22	rcv	4.18418288230896	D	151	50	0
23	snd	4.188502073287964	A	5	0	251
24	rcv	7.47299051284 79	D	251	50	0
25	snd	7.474895238876343	A	7	0	351
26	rcv	9.112634897232056	D	351	50	0
27	snd	9.115665197372437	A	11	0	551
28	rcv	9.2651839256286 62	D	1001	50	12
29	snd/DA	9.265836477279663	A	11	0	551
30	rcv	17.224842786788 94	D	551	50	0
31	snd	17.22668218612671	A	13	0	651
32	rcv	17.58076047897339	D	1101	50	14
33	snd/DA	17.58144760131836	A	13	0	651
34	rcv	24.0888080596923 83	D	651	50	0
35	snd	24.090112924575806	A	14	0	701
36	rcv	25.678280353546143	D	701	50	0
37	snd	25.679627656936646	A	15	0	751
38	rcv	25.78077745437622	D	1201	50	16
39	snd/DA	25.781442403793335	A	15	0	751
40	rcv	29.533389806747437	D	751	50	0

12304	rcv	10118.456842422485	D	307251	50	0
12305	snd	10118.45874619484	A	6147	0	307351
12306	rcv	10118.544777870178	D	307751	50	6148
12307	snd/DA	10118.547852039337	A	6147	0	307351
12308	rcv	10119.892532110214	D	307351	50	0
12309	snd	10119.89375925064	A	6148	0	307401
12310	rcv	10119.974895954132	D	307851	50	6149
12311	snd/DA	10119.975611925125	A	6148	0	307401
12312	rcv	10121.336786746979	D	307401	50	0
12313	snd	10121.339780807495	A	6149	0	307451
12314	rcv	10121.424785852432	D	307901	50	6150
12315	snd/DA	10121.42554140091	A	6149	0	307451
12316	rcv	10124.11994600296	D	307451	50	0
12317	snd	10124.121775388718	A	6151	0	307551
12318	rcv	10124.324807882309	D	307951	50	6152
12319	snd/DA	10124.325537204742	A	6151	0	307551
12320	rcv	10124.340604543686	D	308001	50	6152
12321	snd/DA	10124.341239213943	A	6151	0	307551
12322	rcv	10125.696795701 98	D	307551	50	0
12323	snd	10125.700346946716	A	6156	0	307801
12324	rcv	10125.810792446136	D	308151	50	6157
12325	snd/DA	10125.811338663101	A	6156	0	307801
12326	rcv	10125.821534872055	D	308201	3	6157
12327	snd/DA	10125.82222032547	A	6156	0	307801
12328	rcv	10125.877173185349	D	308051	50	6157
12329	snd/DA	10125.87784075737	A	6156	0	307801
12330	rcv	10125.964755296707	D	307801	50	0
12331	snd	10125.967906951904	A	6162	0	308101
12332	rcv	10129.998819589615	D	308101	50	0
12333	snd	10130.001148462296	A	6165	0	308204
12334	rcv	10130.071153640747	F	308204	0	6166
12335	snd	10130.07188463211	A	6166	0	308205
12336	snd	10130.172810316086	F	6166	0	308205
12337	rcv	10130.173892259598	A	6167	0	308204
12338						
12339	Amount of data received (in Bytes)		308203			
12340	Total segments received		6169			
12341	Data segments received		6165			
12342	Data segments with Bit Errors		0			
12343	Duplicate data segments received		0			
12344	Duplicate ACKs sent		3088			

Sender Log File (gamma = 6)

1	snd	0	S	0	0	0
2	rcv	0.0011489391326904297	SA	0	0	1
3	snd	0.002003908157348633	A	1	0	1
4	snd	0.0032837390899658203	D	1	50	1
5	drop	0.0150759220123291 02	D	51	50	1
6	drop	0.04530358314514 16	D	151	50	2
7	rcv	0.05596470832824707	A	1	0	51
8	snd	0.07192993164062 5	D	201	50	2
9	drop	0.11288595199584961	D	251	50	2
10	rcv/DA	0.11305642127990723	A	1	0	51
11	snd	0.12394356727600098	D	301	50	2
12	rcv/DA	0.15052199363708496	A	1	0	51
13	drop	0.15587615966796875	D	351	50	2
14	snd	0.21753597259521484	D	401	50	2
15	rcv/DA	0.2697913646697998	A	1	0	51
16	snd	0.2764148712158203	D	451	50	2
17	snd	0.28653264045715 33	D	501	50	2
18	snd/delay	0.2767832279205322	D	101	50	1
19	rcv/DA	0.29677677154541016	A	1	0	51
20	rcv/DA	0.3182046413421631	A	1	0	51
21	rcv/DA	0.34937000274658203	A	1	0	51
22	FRdrop	0.42099738121032715	D	51	50	2
23	snd/delay	1.1989002227783203	D	51	50	0
24	rcv	1.2468578815460205	A	3	0	151
25	snd	1.2988922595977783	D	551	50	4
26	rcv/DA	1.32523846626281 74	A	3	0	151
27	drop	1.33069729804992 68	D	601	50	4
28	snd/RXT	3.5180351734161377	D	151	50	0
29	rcv	3.579702854156494	A	5	0	251
30	drop	3.6188316345214844	D	651	50	6
31	drop	3.6364541053771973	D	701	50	6
32	drop	5.731700897216797	D	251	50	6
33	snd/RXT	7.914928674697876	D	251	50	0
34	rcv	8.040005207061768	A	7	0	351
35	drop	8.100078105926514	D	751	50	8
36	drop	8.120750427246094	D	801	50	8
37	snd/RXT	10.206929922103882	D	351	50	0
38	rcv	10.314737796783447	A	12	0	601
39	drop	10.361004829406738	D	851	50	13
40	drop	10.381664037704468	D	901	50	13
41	drop	10.392861127853394	D	951	50	13
42	drop	10.413865089416504	D	1051	50	13
43	snd/delay	10.442862272262573	D	1001	50	13
44	rcv/DA	10.484569549560547	A	12	0	601

18588	rcv/DA	14375.0927298069	A	6147	0	307351
18589	drop	14377.318533182144	D	307351	50	6148
18590	snd/RXT	14379.577899456024	D	307351	50	0
18591	rcv	14379.640859127045	A	6149	0	307451
18592	snd	14379.726907014847	D	307851	50	6150
18593	rcv/DA	14379.743705511093	A	6149	0	307451
18594	snd	14379.749139785767	D	307901	50	6150
18595	rcv/DA	14379.769941091537	A	6149	0	307451
18596	snd/RXT	14382.063654899597	D	307451	50	0
18597	rcv	14382.142059803009	A	6154	0	307701
18598	drop	14382.170929431915	D	308001	50	6155
18599	snd	14382.196595430374	D	308051	50	6155
18600	snd	14382.213427066803	D	308101	50	6155
18601	rcv/DA	14382.213307380676	A	6154	0	307701
18602	snd	14382.230578184128	D	308151	50	6155
18603	rcv/DA	14382.235945224762	A	6154	0	307701
18604	rcv/DA	14382.255471944809	A	6154	0	307701
18605	snd/delay	14382.255722522736	D	307951	50	6155
18606	FRdrop	14382.266725063324	D	307701	50	6155
18607	rcv/DA	14382.282743215561	A	6154	0	307701
18608	drop	14384.486874818802	D	307701	50	6155
18609	snd/RXT	14386.738505601883	D	307701	50	0
18610	rcv	14386.803482532501	A	6160	0	308001
18611	drop	14386.830868244171	D	308201	3	6161
18612	drop	14389.014179706573	D	308001	50	6161
18613	snd/RXT	14391.254966974258	D	308001	50	0
18614	rcv	14391.266708135605	A	6164	0	308201
18615	snd/RXT	14393.48693060875	D	308201	3	0
18616	rcv	14393.529914617538	A	6165	0	308204
18617	snd	14393.55247592926	F	308204	0	6166
18618	rcv	14393.753701925278	A	6166	0	308205
18619	rcv	14393.759650945663	F	6166	0	308205
18620	snd	14393.760637044907	A	308204	0	6167
18621						

18622	Size of the file (in Bytes)	308203
18623	Segments transmitted (including drop & RXT)	12450
18624	Number of Segments handled by PLD	12446
18625	Number of Segments dropped	6279
18626	Number of Segments Corrupted	0
18627	Number of Segments Re-ordered	0
18628	Number of Segments Duplicated	0
18629	Number of Segments Delayed	1234
18630	Number of Retransmissions due to TIMEOUT	6034
18631	Number of FAST RETRANSMISSION	247
18632	Number of DUP ACKS received	3114

Receiver Log File (gamma = 6)

1	rcv	0	S	0	0	0
2	snd	0.0007085800170898438	SA	0	0	1
3	rcv	0.0018854141235351562	A	1	0	1
4	rcv	0.0082960128784179690	D	1	50	1
5	snd	0.0098547935485839840	A	1	0	51
6	rcv	0.0772788524627685500	D	201	50	2
7	snd/DA	0.0781350135803222700	A	1	0	51
8	rcv	0.1289818286895752	D	301	50	2
9	snd/DA	0.1298282146453857400	A	1	0	51
10	rcv	0.2176520822432373	D	401	50	2
11	snd/DA	0.2183840274810791	A	1	0	51
12	rcv	0.2805309295654297	D	451	50	2
13	snd/DA	0.2812495231628418	A	1	0	51
14	rcv	0.2818398475646972700	D	101	50	1
15	snd/DA	0.2824440002441406	A	1	0	51
16	rcv	0.2916400432586670	D	501	50	2
17	snd/DA	0.2923400402069092	A	1	0	51
18	rcv	1.2039439678192139	D	51	50	0
19	snd	1.2061147689819336	A	3	0	151
20	rcv	1.3039116859436035	D	551	50	4
21	snd/DA	1.3048267364501953	A	3	0	151
22	rcv	3.5182750225067140	D	151	50	0
23	snd	3.5204522609710693	A	5	0	251
24	rcv	7.9202523231506350	D	251	50	0
25	snd	7.9224281311035156	A	7	0	351
26	rcv	10.2121844291687010	D	351	50	0
27	snd	10.215735435485840	A	12	0	601
28	rcv	10.448004007339478	D	1001	50	13
29	snd/DA	10.448764562606812	A	12	0	601
30	rcv	19.268169641494750	D	601	50	0
31	snd	19.269845724105835	A	13	0	651
32	rcv	21.708183050155640	D	651	50	0
33	snd	21.709571838378906	A	14	0	701
34	rcv	28.452013015747070	D	701	50	0
35	snd	28.453531742095947	A	15	0	751
36	rcv	30.679173231124878	D	751	50	0
37	snd	30.685870885849	A	16	0	801
38	rcv	30.798480987548828	D	1251	50	17
39	snd/DA	30.806476831436157	A	16	0	801
40	rcv	35.811920642852780	D	801	50	0
41	snd	35.816216230392456	A	17	0	851
42	rcv	40.196176528930664	D	851	50	0

12310	rcv	14372.670319080353	D	307751	50	6147
12311	snd/DA	14372.676333904266	A	6146	0	307301
12312	rcv	14374.982256412506	D	307301	50	0
12313	snd	14374.98417854309	A	6147	0	307351
12314	rcv	14375.07184100151	D	307801	50	6148
12315	snd/DA	14375.072586536407	A	6147	0	307351
12316	rcv	14379.582909584045	D	307351	50	0
12317	snd	14379.585204601288	A	6149	0	307451
12318	rcv	14379.732138115689	D	307851	50	6150
12319	snd/DA	14379.732978343964	A	6149	0	307451
12320	rcv	14379.75412607193	D	307901	50	6150
12321	snd/DA	14379.754889965057	A	6149	0	307451
12322	rcv	14382.068946838379	D	307451	50	0
12323	snd	14382.074254989624	A	6154	0	307701
12324	rcv	14382.20183968544	D	308051	50	6155
12325	snd/DA	14382.202823162079	A	6154	0	307701
12326	rcv	14382.219447851181	D	308101	50	6155
12327	snd/DA	14382.220334768295	A	6154	0	307701
12328	rcv	14382.235813379288	D	308151	50	6155
12329	snd/DA	14382.236658334732	A	6154	0	307701
12330	rcv	14382.260724544525	D	307951	50	6155
12331	snd/DA	14382.26142168045	A	6154	0	307701
12332	rcv	14386.743531227112	D	307701	50	0
12333	snd	14386.748057365417	A	6160	0	308001
12334	rcv	14391.260001897812	D	308001	50	0
12335	snd	14391.263415336609	A	6164	0	308201
12336	rcv	14393.491945028305	D	308201	3	0
12337	snd	14393.493413686752	A	6165	0	308204
12338	rcv	14393.557720422745	F	308204	0	6166
12339	snd	14393.558454990387	A	6166	0	308205
12340	snd	14393.759445667267	F	6166	0	308205
12341	rcv	14393.767382383347	A	6167	0	308204
12342						
12343	Amount of data received (in Bytes)		308203			
12344	Total segments received		6171			
12345	Data segments received		6167			
12346	Data segments with Bit Errors		0			
12347	Duplicate data segments received		2			
12348	Duplicate ACKs sent		3114			

Part c Sender Log File

```
1 snd                   0                       S       0       0       0
2 rcv                   0.0013868808746337 89   SA      0       0       1
3 snd                   0.0019960403442382812   A       1       0       1
4 snd/Cor               0.0085492134094238 28   D       1       50      1
5 snd                   0.0377783775329589 84   D       51      50      1
6 rcv/DA                0.0600368976593017 6    A       0       0       1
7 snd                   0.0756175518035888 7    D       101     50      1
8 rcv/DA                0.0916125774383544 9    A       0       0       1
9 snd                   0.1026110649108886 7    D       151     50      1
10 rcv/DA               0.1183674335479736 3    A       0       0       1
11 snd                  0.1237523555755615 2    D       201     50      1
12 snd/RXT              0.1293394565582275 4    D       1       50      0
13 snd                  0.1447293758392334      D       251     50      1
14 snd/Cor              0.1717116832731543      D       301     50      1
15 snd/DUP              0.1715545654296875      D       1       50      0
16 snd                  0.1825342178344726 6    D       351     50      1
17 rcv/DA               0.1881182193756103 5    A       0       0       1
18 snd                  0.2035686969757080      D       401     50      1
19 rcv                  0.2144000530242920      A       5       0       251
20 snd                  0.2198181152343750      D       451     50      6
21 rcv                  0.2251069545745849 6    A       6       0       301
22 snd                  0.2309100627899170      D       501     50      7
23 rcv/DA               0.2310166358947754      A       6       0       301
24 snd/Cor              0.2364535331726074 2    D       551     50      7
25 rcv/DA               0.2418456077575683 6    A       6       0       301
26 snd                  0.2471668720245361 3    D       601     50      7
27 rcv/DA               0.2528359889898413 1    A       6       0       301
28 snd                  0.2583029270172119      D       651     50      7
29 snd/RXT              0.2636866569519043      D       301     50      0
30 snd                  0.2693347930908203      D       751     50      7
31 rcv/DA               0.2694442272186279 3    A       6       0       301
32 rcv/DA               0.2958977222442627      A       6       0       301
33 rcv/DA               0.3168489933013916      A       6       0       301
34 snd/RXT              0.3377835750579834      D       301     50      0
35 snd/DUP              0.3748722076416015 6    D       301     50      0
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82107 snd                       1565.6760001182556      D       1605401         50              32101
82108 rcv                       1565.6764554977417      A       32101           0               1605051
82109 rcv/DA                    1565.6771850585938      A       32101           0               1605051
82110 snd/rord                  1565.6762351989746      D       1605201         50              32099
82111 snd                       1565.6774451732635      D       1605451         50              32102
82112 rcv/DA                    1565.6778593063354      A       32101           0               1605051
82113 rcv/DA                    1565.6785893440247      A       32101           0               1605051
82114 snd/RXT                   1565.6893348693848      D       1605051         50              0
82115 snd                       1565.6787047386170      D       1605501         50              32102
82116 rcv/DA                    1565.6955609321594      A       32101           0               1605051
82117 snd/DUP                   1565.701141834259       D       1605501         50              32102
82118 rcv/DA                    1565.7065389156342      A       32101           0               1605051
82119 rcv/DA                    1565.7196831703186      A       32101           0               1605051
82120 snd/RXT                   1565.7304606437683      D       1605051         50              0
82121 rcv/DA                    1565.7412884235382      A       32101           0               1605051
82122 rcv/DA                    1565.752204656601       A       32101           0               1605051
82123 rcv/DA                    1565.7630457878113      A       32101           0               1605051
82124 rcv/DA                    1565.7739112377167      A       32101           0               1605051
82125 rcv                       1565.7846913337708      A       32111           0               1605551
82126 rcv/DA                    1565.7954668998718      A       32111           0               1605551
82127 snd                       1565.7957730293274      D       1605551         35              32112
82128 rcv/DA                    1565.801044702530       A       32111           0               1605551
82129 rcv                       1565.8122763633728      A       32112           0               1605586
82130 snd                       1565.8230636119843      F       1605586         0               32113
82131 rcv                       1566.024086713791       A       32113           0               1605587
82132 rcv                       1566.0301070213318      F       32113           0               1605587
82133 snd                       1566.031002521515       A       1605586         0               32114
82134
82135 Size of the file (in Bytes)                       1605585
82136 Segments transmitted (including drop & RXT)       44838
82137 Number of Segments handled by PLD                 44834
82138 Number of Segments dropped                        4187
82139 Number of Segments Corrupted                      3353
82140 Number of Segments Re-ordered                     2138
82141 Number of Segments Duplicated                     3678
82142 Number of Segments Delayed                        0
82143 Number of Retransmissions due to TIMEOUT          2771
82144 Number of FAST RETRANSMISSION                     6273
82145 Number of DUP ACKS received                       26471
```

Part c Receiver Log File

1	rcv	0	S	0	0	0
2	snd	0.0011267662048339844	SA	0	0	1
3	rcv	0.0020966529846191406	A	1	0	1
4	rcv/Cor	0.026479482650756836	D	1	50	1
5	rcv	0.04290890693664551	D	51	50	1
6	snd/DA	0.04381704330444336	A	0	0	1
7	rcv	0.080535888671875	D	101	50	1
8	snd/DA	0.08123540878295898	A	0	0	1
9	rcv	0.10754132270812988	D	151	50	1
10	snd/DA	0.10818433761596668	A	0	0	1
11	rcv	0.12865805625915527	D	201	50	1
12	snd/DA	0.12950038909912211	A	0	0	1
13	rcv	0.13006114959716797	D	1	50	0
14	snd	0.1331472396850586	A	5	0	251
15	rcv	0.14452195167541504	D	251	50	1
16	snd	0.14595317840576172	A	6	0	301
17	rcv/dup	0.17654395103455459	D	1	50	0
18	snd/DA	0.1776123046875	A	6	0	301
19	rcv/Cor	0.17819070816040044	D	301	50	1
20	rcv	0.18738937377929688	D	351	50	1
21	snd/DA	0.18808102607727051	A	6	0	301
22	rcv	0.20878124237060547	D	401	50	1
23	snd/DA	0.20956993103027344	A	6	0	301
24	rcv	0.22473597526550293	D	451	50	6
25	snd/DA	0.22559428215026855	A	6	0	301
26	rcv	0.23587250709533691	D	501	50	7
27	snd/DA	0.23647546768188477	A	6	0	301
28	rcv/Cor	0.23707222938537598	D	551	50	7
29	rcv	0.25216293334960938	D	601	50	7
30	snd/DA	0.25290989875793457	A	6	0	301
31	rcv	0.26327586174011231	D	651	50	7
32	snd/DA	0.26397252082824707	A	6	0	301
33	rcv	0.26454925537109375	D	301	50	0

77920	snd/DA	1565.6633727550507	A	32101	0	1605051
77921	rcv/dup	1565.6639289855957	D	1605251	50	32099
77922	snd/DA	1565.6646523475647	A	32101	0	1605051
77923	rcv	1565.6652069091797	D	1605301	50	32099
77924	snd/DA	1565.6656987667084	A	32101	0	1605051
77925	rcv	1565.6661999225616	D	1605351	50	32099
77926	snd/DA	1565.6666989326477	A	32101	0	1605051
77927	rcv	1565.6809320044983	D	1605401	50	32101
77928	snd/DA	1565.6815967559814	A	32101	0	1605051
77929	rcv	1565.6821377277374	D	1605201	50	32099
77930	snd/DA	1565.6827628612518	A	32101	0	1605051
77931	rcv	1565.68337392807	D	1605451	50	32102
77932	snd/DA	1565.6840181350708	A	32101	0	1605051
77933	rcv	1565.6845955848694	D	1605501	50	32102
77934	snd/DA	1565.685210943222	A	32101	0	1605051
77935	rcv	1565.694321155548	D	1605051	50	0
77936	snd	1565.7133116722107	A	32111	0	1605551
77937	rcv/dup	1565.714280128479	D	1605501	50	32102
77938	snd/DA	1565.7149102687836	A	32111	0	1605551
77939	rcv/dup	1565.7373847961426	D	1605051	50	0
77940	snd/DA	1565.7474942207336	A	32111	0	1605551
77941	rcv	1565.8007125854492	D	1605551	35	32112
77942	snd	1565.8025329113007	A	32112	0	1605586
77943	rcv	1565.828084230423	F	1605586	0	32113
77944	snd	1565.828740119934	A	32113	0	1605587
77945	snd	1566.0298051834106	F	32113	0	1605587
77946	rcv	1566.0308418273926	A	32114	0	1605586
77947						
77948	Amount of data received (in Bytes)		1605585			
77949	Total segments received		40650			
77950	Data segments received		40646			
77951	Data segments with Bit Errors		3353			
77952	Duplicate data segments received		4879			
77953	Duplicate ACKs sent		26471			