

2.1.1

PACKET_ID	PACKET_TYPE	CONTROL_PACKET_TYPE	DESTINATION_ID	TRANSMITTER_ID	RECEIVER_ID	SEQ_NO	isSyn	isAck	isFin	SEGMENT_LENGTH
0	Control_Packet	TCP_SYN	NODE-1	NODE-2	ROUTER-3	250000	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_SYN	NODE-1	ROUTER-3	NODE-1	250000	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_SYN	NODE-1	NODE-2	ROUTER-3	500047	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_SYN	NODE-1	ROUTER-3	NODE-1	500047	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_SYN	NODE-1	NODE-2	ROUTER-3	750094	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_SYN	NODE-1	ROUTER-3	NODE-1	750094	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_SYN	NODE-1	NODE-2	ROUTER-3	1000141	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_SYN	NODE-1	ROUTER-3	NODE-1	1000141	TRUE	FALSE	FALSE	0

By analysing the syn flag signals we can see that the value of isSyn which is always true because it basically contains only syn messages and the value of isAck is always false because the syn signal contains only the syn message not the Ack message. In the SynAck signal we can see that the value of Syn and Ack both will be true.

2.2.1

PACKET_ID	PACKET_TYPE	CONTROL_PACKET_TYPE	DESTINATION_ID	TRANSMITTER_ID	RECEIVER_ID	SEQ_NO	isSyn	isAck	isFin	SEGMENT_LENGTH
0	Control_Packet	TCP_ACK	NODE-1	NODE-2	ROUTER-3	250001	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	ROUTER-3	NODE-1	250001	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-2	NODE-1	ROUTER-3	250006	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-2	ROUTER-3	NODE-2	250006	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	NODE-2	ROUTER-3	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	ROUTER-3	NODE-1	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	NODE-2	ROUTER-3	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	ROUTER-3	NODE-1	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	NODE-2	ROUTER-3	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	ROUTER-3	NODE-1	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	NODE-2	ROUTER-3	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	ROUTER-3	NODE-1	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	NODE-2	ROUTER-3	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	ROUTER-3	NODE-1	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	NODE-2	ROUTER-3	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	ROUTER-3	NODE-1	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	NODE-2	ROUTER-3	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	ROUTER-3	NODE-1	250751	FALSE	TRUE	FALSE	0

PACKET_ID	PACKET_TYPE	CONTROL_PACKET_TYPE	DESTINATION_ID	TRANSMITTER_ID	RECEIVER_ID	SEQ_NO	isSyn	isAck	isFin	SEGMENT_LENGTH
0	Control_Packet	TCP_FIN	NODE-2	NODE-1	ROUTER-3	270006	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-2	ROUTER-3	NODE-2	270006	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-1	NODE-2	ROUTER-3	250751	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-1	ROUTER-3	NODE-1	250751	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-2	NODE-1	ROUTER-3	520053	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-2	ROUTER-3	NODE-2	520053	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-1	NODE-2	ROUTER-3	500798	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-1	ROUTER-3	NODE-1	500798	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-2	NODE-1	ROUTER-3	770100	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-2	ROUTER-3	NODE-2	770100	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-2	NODE-2	ROUTER-3	750845	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-1	ROUTER-3	NODE-1	750845	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-2	NODE-1	ROUTER-3	1020148	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-2	ROUTER-3	NODE-2	1020148	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-1	NODE-2	ROUTER-3	1000892	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-1	ROUTER-3	NODE-1	1000892	FALSE	FALSE	TRUE	0

For the signal TCP_Ack the value of isSyn is false, value of isAck is true and the value of isFin is False as the TCP_Ack only contains the acknowledgement message. While in the TCP_Fin, the value of isFin is true, Value of isAck is false and the value of isSyn is also false as the TCP_Fin signal contains only the fin message.

2.3

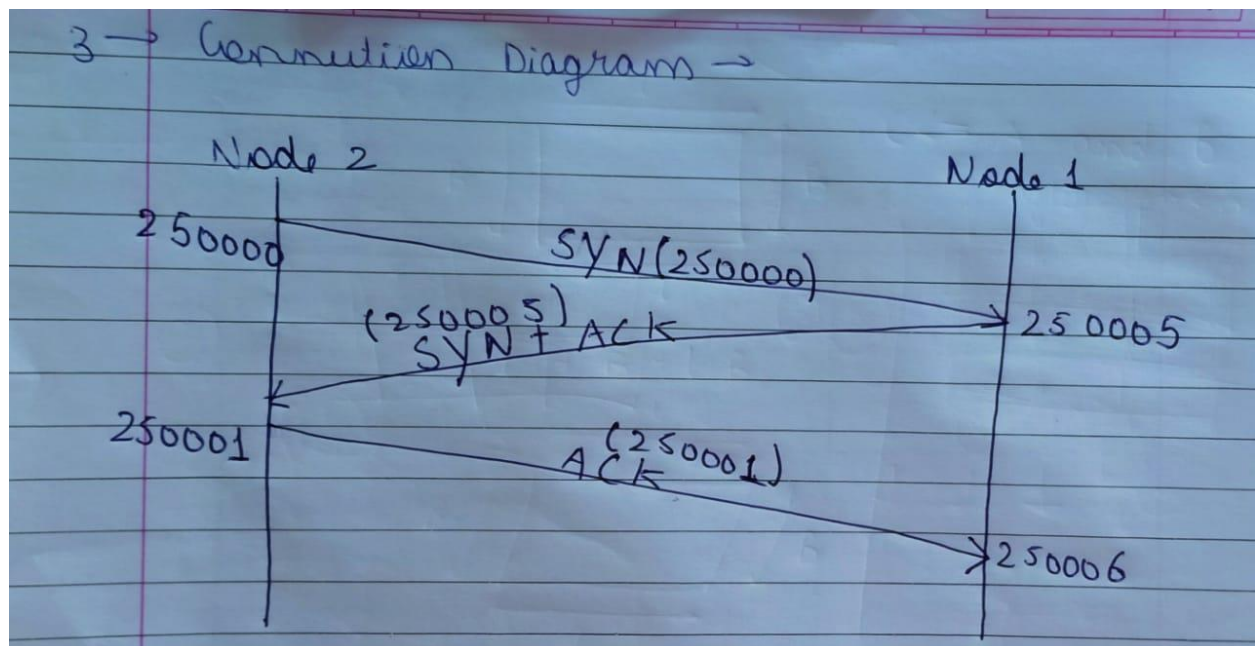
1- The sequence number for the first SYN packet is 250000. It is the seq number of node 2. The sequence number of the acknowledgement is 250005 and it is the sequence number of node 1. Both node 1 and node 2 will have different sequence numbers as in TCP the transmission occurs on either way.

PACKET_ID	PACKET_TYPE	CONTROL_PACKET_TYPE	DESTINATION_ID	TRANSMITTER_ID	RECEIVER_ID	SEQ_NO	isSyn	isAck	isFin	SEGMENT
0	Control_Packet	TCP_SYN	NODE-1	NODE-2	ROUTER-3	250000	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_SYN	NODE-1	ROUTER-3	NODE-1	250000	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_SYNACK	NODE-2	NODE-1	ROUTER-3	250005	TRUE	TRUE	FALSE	0
0	Control_Packet	TCP_SYNACK	NODE-2	ROUTER-3	NODE-2	250005	TRUE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	NODE-2	ROUTER-3	250001	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	ROUTER-3	NODE-1	250001	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-2	NODE-1	ROUTER-3	250006	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-2	ROUTER-3	NODE-2	250006	FALSE	TRUE	FALSE	0

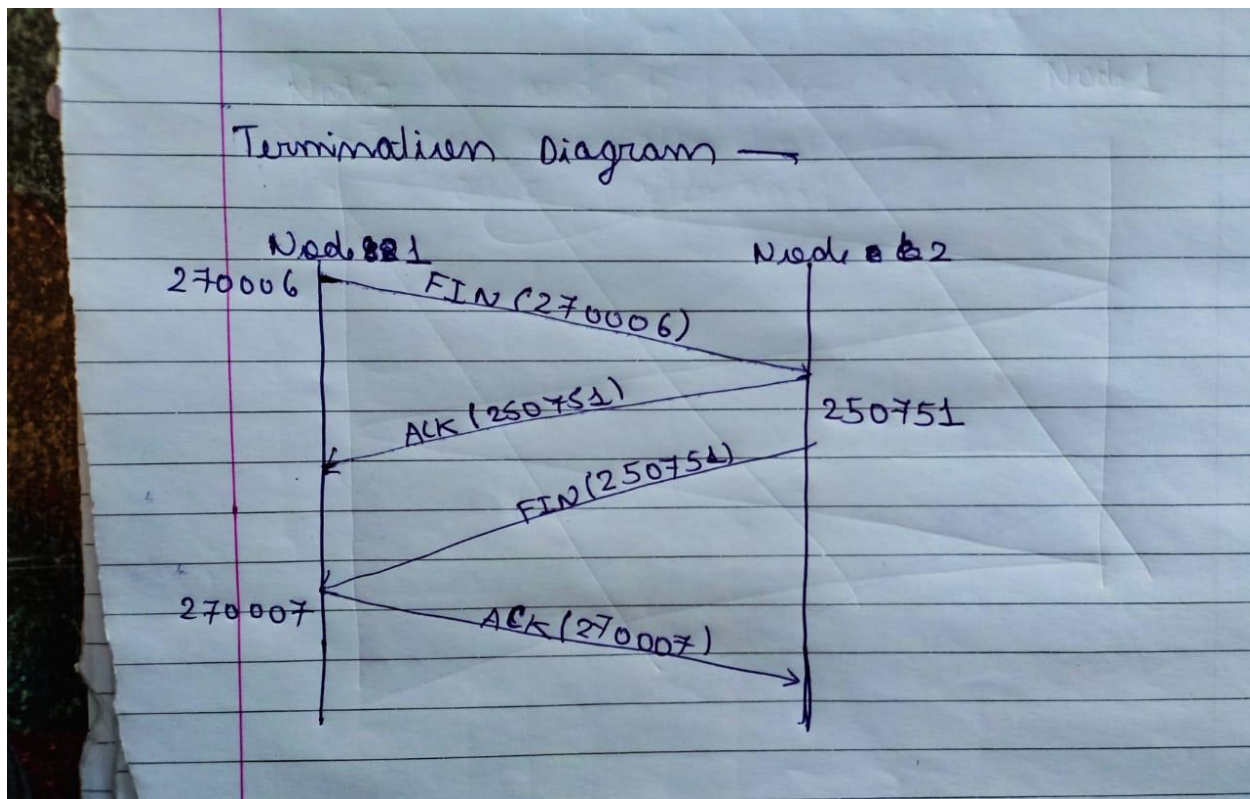
2- The sequence number of the first Fin is 270006 and it is the sequence number of node 1 and the sequence number of the acknowledgment is 250751 and it is the sequence number of node 3. Both node 1 and node 2 will have different sequence numbers as in TCP the transmission occurs on either way.

0	Control_Packet	TCP_FIN	NODE-2	NODE-1	ROUTER-3	270006	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_ACK	NODE-1	NODE-2	ROUTER-3	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	ROUTER-3	NODE-1	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_FIN	NODE-2	ROUTER-3	NODE-2	270006	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_ACK	NODE-1	NODE-2	ROUTER-3	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-1	NODE-2	ROUTER-3	250751	FALSE	TRUE	TRUE	0
0	Control_Packet	TCP_ACK	NODE-1	ROUTER-3	NODE-1	250751	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_FIN	NODE-1	NODE-2	ROUTER-3	250751	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_ACK	NODE-1	ROUTER-3	NODE-1	250751	FALSE	TRUE	TRUE	0
0	Control_Packet	TCP_FIN	NODE-1	ROUTER-3	NODE-1	250751	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_ACK	NODE-2	NODE-1	ROUTER-3	270007	FALSE	TRUE	FALSE	0
0	Control_Packet	TCP_ACK	NODE-2	ROUTER-3	NODE-2	270007	FALSE	TRUE	FALSE	0

3-Connection Diagram:-



Termination Diagram:-



4- TCP uses 4 way finishing as when one node sends the TCP_Fin then there might be some data which is left for transmission and there might be some file which the other node may want to send to this node. So, finishing takes 1 more step than syn.

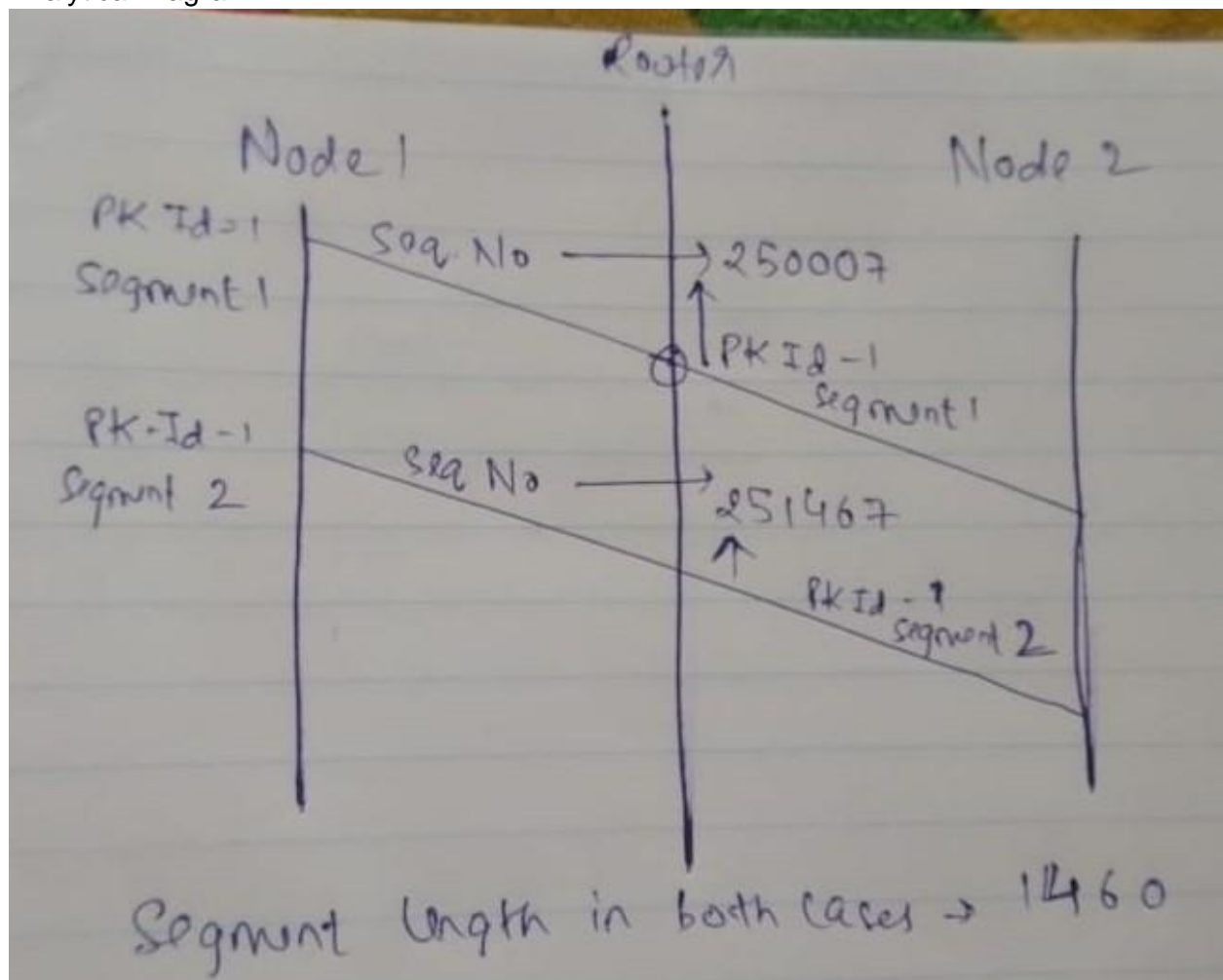
5-It takes 4 sessions to transfer the file from node 2 to node1 which can be seen below where we had set the filter of the signal to TCP_Syn and TCP_Fin and the Destination node to 1 and transmitter to node 2. By this we can see that there are 4 syn and 4 Fin signals and each pair of syn and fin is a session which has been initiated and terminated.

PACKET_ID	PACKET_TYPE	CONTROL_PACKET_TYPE	DESTINATION_ID	TRANSMITTER_ID	RECEIVER_ID	SEQ_NO	isSyn	isAck	isFin	SEGMENT_LEN
0	Control_Packet	TCP_SYN	NODE-1	NODE-2	ROUTER-3	250000	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_FIN	NODE-1	NODE-2	ROUTER-3	250751	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_SYN	NODE-1	NODE-2	ROUTER-3	500047	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_FIN	NODE-1	NODE-2	ROUTER-3	500798	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_SYN	NODE-1	NODE-2	ROUTER-3	750094	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_FIN	NODE-1	NODE-2	ROUTER-3	750845	FALSE	FALSE	TRUE	0
0	Control_Packet	TCP_SYN	NODE-1	NODE-2	ROUTER-3	1000141	TRUE	FALSE	FALSE	0
0	Control_Packet	TCP_FIN	NODE-1	NODE-2	ROUTER-3	1000892	FALSE	FALSE	TRUE	0

PACKET	SEGMENT	PACKET_TYPE	CONTROL_PACK	SOURCE_ID	DESTINATION_ID	TRANSMITTER_ID	RECEIVER_ID
1	1	HTTP	APP1_HTTP	NODE-1	NODE-2	NODE-1	ROUTER-3
1	2	HTTP	APP1_HTTP	NODE-1	NODE-2	NODE-1	ROUTER-3
1	1	HTTP	APP1_HTTP	NODE-1	NODE-2	ROUTER-3	NODE-2
1	2	HTTP	APP1_HTTP	NODE-1	NODE-2	ROUTER-3	NODE-2

SEQ_NO	ACK_NO	isSyn	isAck	isFin	SEGMENT_LEN
250007	0	FALSE	FALSE	FALSE	1460
251467	0	FALSE	FALSE	FALSE	1460
250007	0	FALSE	FALSE	FALSE	1460
251467	0	FALSE	FALSE	FALSE	1460

Analytical Diagram :



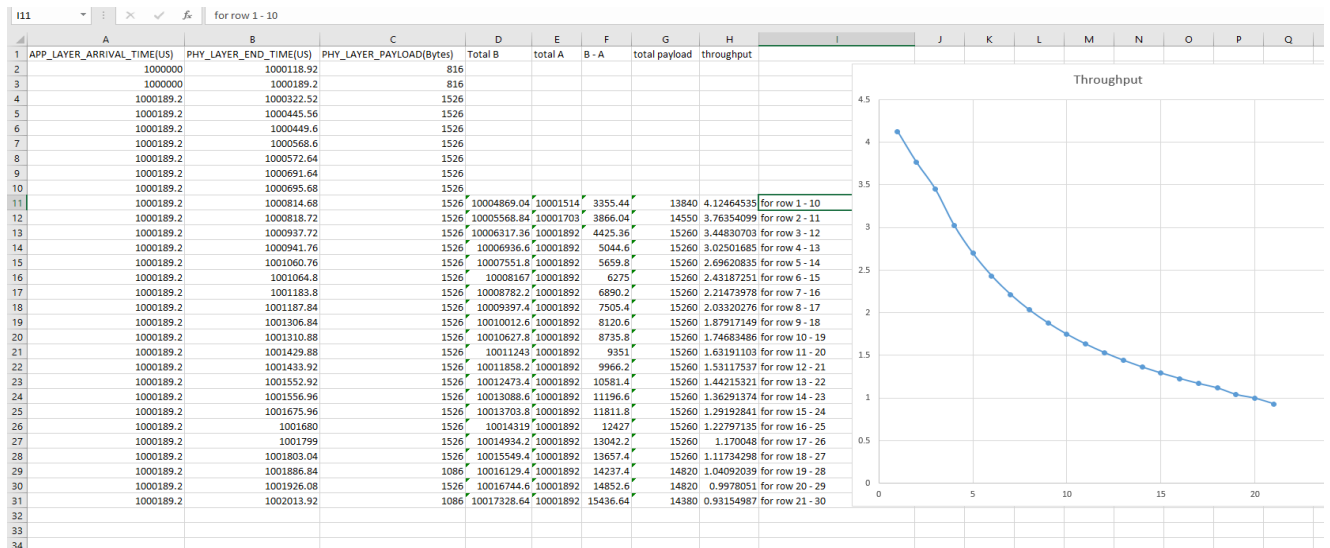
8)

- For the last segment - Sequence Number : $5460 + 4500 = 9960$
- For the FIN Packet - Sequence Number : Sequence Number of Last Segment/packet + size of last segment = $9960 + 500 = 10460$

3.1

1			
2			
3	Row Labels	Sum of PHY_LAYER_END_TIME(US)	Sum of PHY_LAYER_PAYLOAD(Bytes)
4	APP1_HTTP	28033132.56	41848
5	1000189.2	28033132.56	41848
6	HTTP_REQUEST	2000308.12	1632
7	1000000	2000308.12	1632
8	Grand Total	30033440.68	43480
9			
10			
11			
12			

- Payload = 43,480
Time difference = $30033440.68 - 2000189.2 = 28033251.48$
Fixed Throughput = 0.001551
- This screenshot shows us the moving average through:



3.2

1. 4.1246 is the maximum throughput.
2. The screenshot shows the throughput

	A	B	C	D	E	F
2						
3	Row Labels	Sum of PHY_LAYER_END_TIME(US)	Sum of PHY_LAYER_PAYLOAD(Bytes)	Delta	Throughput	
4	1000000	2000308.12	1632	1000308.12	0.0016315	
5	1000189.2	28033132.56	41848	27032943.4	0.001548	
6	2000189.2	4000686.52	1632	2000497.32	0.0008158	
7	2000378.4	56038430.16	41848	54038051.8	0.0007744	
8	3000378.4	6001064.92	1632	3000686.52	0.0005439	
9	3000567.6	90048643.88	44900	87048076.3	0.0005158	
10	4000567.6	8001443.32	1632	4000875.72	0.0004079	
11	4000756.8	112049025.4	41848	108048269	0.0003873	
12	5000756.8	10001821.72	1632	5001064.92	0.0003263	
13	5000946	140054323	41848	135053377	0.0003099	
14	6000946	12002200.12	1632	6001254.12	0.0002719	
15	6001135.2	168059620.6	41848	162058485	0.0002582	
16	7001135.2	14002578.52	1632	7001443.32	0.0002331	
17	7001324.4	196064918.2	41848	189063594	0.0002213	
18	8001324.4	16002956.92	1632	8001632.52	0.000204	
19	8001513.6	224070215.8	41848	216068702	0.0001937	
20	9001513.6	18003335.32	1632	9001821.72	0.0001813	
21	9001702.8	252075513.4	41848	243073811	0.0001722	
22	Grand Total	1356510218	394372		0.0004998	
23	90015325.2	1356510218	394372	1266494893	0.0003114	
24						
25						

The value obtained is approximately twice the throughput obtained in the first part.

3. Max segment size = 150 bytes
 Total data to be sent = 1000 bytes
 Minimum packets to be sent = $1000/150$
 7 packets Out of these 7 packets, packet #1, 4 and 5 are lost. Hence these 3 packets of 150 bytes will be transmitted again.
 Total bytes sent = $1000 + 3 \times 150 = 1450$ bytes
 Packet send rate 10 bytes/second
 Hence, time to send 1450 bytes = $1450/10 = 145$ seconds
 Throughput = Original bytes to be sent/Time required
 = $1000/145 = 6.89$ bytes 55 bits/sec