Assignment 2

# Part 1

No. |Time | 192.168.0.16 |

| | | 185.164.136.79 |

1 |0.000000 | SYN | |Seq = 0

| |(61450) ------------------> (4001) |

2 |0.037141 | SYN, ACK | |Seq = 0 Ack = 1

| |(61450) <------------------ (4001) |

3 |0.037206 | ACK | |Seq = 1 Ack = 1

| |(61450) ------------------> (4001) |

4 |0.066290 | ACK - Len: 1448 |Seq = 1 Ack = 1

| |(61450) <------------------ (4001) |

5 |0.068121 | ACK - Len: 1448 |Seq = 1449 Ack = 1

| |(61450) <------------------ (4001) |

6 |0.068125 | PSH, ACK - Len: 1200 |Seq = 2897 Ack = 1

| |(61450) <------------------ (4001) |

7 |0.068189 | ACK | |Seq = 1 Ack = 2897

| |(61450) ------------------> (4001) |

8 |0.068190 | ACK | |Seq = 1 Ack = 4097

| |(61450) ------------------> (4001) |

9 |0.068291 | FIN, ACK | |Seq = 4097 Ack = 1

| |(61450) <------------------ (4001) |

10 |0.068328 | ACK | |Seq = 1 Ack = 4098

| |(61450) ------------------> (4001) |

11 |0.068338 | FIN, ACK | |Seq = 1 Ack = 4098

| |(61450) ------------------> (4001) |

12 |0.096127 | ACK | |Seq = 4098 Ack = 2

| |(61450) <------------------ (4001) |

1. SYN sent by client to server to initiate TCP connection. Client SEQ number is initialised at 0.
2. Server ACKs client’s SYN to begin TCP connection. SYN sent by server to client to initiate TCP connection in the opposite direction. Server SEQ number is 0, server ACK number is 1 since it has received 1 byte of data – the SYN from the client.
3. ACK sent by client to server to ACK TCP connection. Client SEQ number is increased to 1 for previous SYN sent. Client ACK number also increments to 1.
4. First part of message sent from the server to the client. Server SEQ number is still 1.
5. Second part sent to the client. Server SEQ number increased to 1449 since 1448 bytes have already been sent.
6. Sending final 1200 bytes, server SEQ incremented to 2897 (1449+1448)
7. Client ACKs first two messages; client ACK number increases to 2897 (1+1448+1448).
8. Client ACKs final message; client ACK number increases to 4097.
9. Server sends FIN to indicate it has completed sending messages.
10. Client ACKs the FIN; client ACK number increases to 4098.
11. Client sends FIN to indicate it has completed sending messages.
12. Server ACKs the FIN; server ACK number increases to 2. This completes the transmission.

# Part 2

No. |Time | 192.168.0.16 |

| | | 185.164.136.79 |

1 |0.845038 | SYN | |Seq = 0

| |(61453) ------------------> (4002) |

2 |0.876866 | SYN, ACK | |Seq = 0 Ack = 1

| |(61453) <------------------ (4002) |

3 |0.876940 | ACK | |Seq = 1 Ack = 1

| |(61453) ------------------> (4002) |

4 |0.908654 | ACK - Len: 1448 |Seq = 1 Ack = 1

| |(61453) <------------------ (4002) |

5 |0.912004 | ACK - Len: 1448 |Seq = 1449 Ack = 1

| |(61453) <------------------ (4002) |

6 |0.912008 | ACK - Len: 1448 |Seq = 2897 Ack = 1

| |(61453) <------------------ (4002) |

7 |0.912076 | ACK | |Seq = 1 Ack = 2897

| |(61453) ------------------> (4002) |

8 |0.912231 | ACK | |Seq = 1 Ack = 4345

| |(61453) ------------------> (4002) |

9 |0.912578 | ACK - Len: 1448 |Seq = 4345 Ack = 1

| |(61453) <------------------ (4002) |

10 |0.913778 | ACK - Len: 1448 |Seq = 5793 Ack = 1

| |(61453) <------------------ (4002) |

11 |0.913781 | ACK - Len: 1448 |Seq = 7241 Ack = 1

| |(61453) <------------------ (4002) |

12 |0.913828 | ACK | |Seq = 1 Ack = 7241

| |(61453) ------------------> (4002) |

13 |0.913900 | ACK | |Seq = 1 Ack = 8689

| |(61453) ------------------> (4002) |

14 |0.913971 | ACK - Len: 1448 |Seq = 8689 Ack = 1

| |(61453) <------------------ (4002) |

15 |0.913973 | ACK - Len: 1448 |Seq = 10137 Ack = 1

| |(61453) <------------------ (4002) |

16 |0.914013 | ACK | |Seq = 1 Ack = 11585

| |(61453) ------------------> (4002) |

17 |0.914226 | ACK | |Seq = 1 Ack = 11585

| |(61453) ------------------> (4002) |

18 |0.914888 | ACK - Len: 1448 |Seq = 11585 Ack = 1

| |(61453) <------------------ (4002) |

19 |0.914890 | ACK - Len: 1448 |Seq = 13033 Ack = 1

| |(61453) <------------------ (4002) |

20 |0.914931 | ACK | |Seq = 1 Ack = 14481

| |(61453) ------------------> (4002) |

21 |0.914988 | ACK | |Seq = 1 Ack = 14481

| |(61453) ------------------> (4002) |

22 |0.937854 | ACK - Len: 1448 |Seq = 14481 Ack = 1

| |(61453) <------------------ (4002) |

23 |0.937858 | ACK - Len: 1448 |Seq = 15929 Ack = 1

| |(61453) <------------------ (4002) |

24 |0.937859 | ACK - Len: 1448 |Seq = 17377 Ack = 1

| |(61453) <------------------ (4002) |

25 |0.937860 | ACK - Len: 1448 |Seq = 18825 Ack = 1

| |(61453) <------------------ (4002) |

26 |0.937861 | ACK - Len: 1448 |Seq = 20273 Ack = 1

| |(61453) <------------------ (4002) |

27 |0.937864 | ACK - Len: 1448 |Seq = 21721 Ack = 1

| |(61453) <------------------ (4002) |

28 |0.937865 | ACK - Len: 1448 |Seq = 23169 Ack = 1

| |(61453) <------------------ (4002) |

29 |0.937866 | ACK - Len: 1448 |Seq = 24617 Ack = 1

| |(61453) <------------------ (4002) |

30 |0.937867 | ACK - Len: 1448 |Seq = 26065 Ack = 1

| |(61453) <------------------ (4002) |

31 |0.937868 | ACK - Len: 1448 |Seq = 27513 Ack = 1

| |(61453) <------------------ (4002) |

32 |0.937869 | ACK - Len: 1448 |Seq = 28961 Ack = 1

| |(61453) <------------------ (4002) |

33 |0.937870 | ACK - Len: 1448 |Seq = 30409 Ack = 1

| |(61453) <------------------ (4002) |

34 |0.937870 | ACK - Len: 1448 |Seq = 31857 Ack = 1

| |(61453) <------------------ (4002) |

35 |0.937937 | ACK | |Seq = 1 Ack = 17377

| |(61453) ------------------> (4002) |

36 |0.937937 | ACK | |Seq = 1 Ack = 20273

| |(61453) ------------------> (4002) |

37 |0.937937 | ACK | |Seq = 1 Ack = 23169

| |(61453) ------------------> (4002) |

38 |0.937937 | ACK | |Seq = 1 Ack = 26065

| |(61453) ------------------> (4002) |

39 |0.937991 | ACK | |Seq = 1 Ack = 28961

| |(61453) ------------------> (4002) |

40 |0.937991 | ACK | |Seq = 1 Ack = 31857

| |(61453) ------------------> (4002) |

41 |0.938111 | ACK | |Seq = 1 Ack = 33305

| |(61453) ------------------> (4002) |

42 |0.938608 | ACK | |Seq = 1 Ack = 33305

| |(61453) ------------------> (4002) |

43 |0.938959 | ACK | |Seq = 1 Ack = 33305

| |(61453) ------------------> (4002) |

44 |0.939157 | ACK | |Seq = 1 Ack = 33305

| |(61453) ------------------> (4002) |

45 |0.939333 | ACK | |Seq = 1 Ack = 33305

| |(61453) ------------------> (4002) |

46 |0.966054 | ACK - Len: 1448 |Seq = 33305 Ack = 1

| |(61453) <------------------ (4002) |

47 |0.966067 | ACK - Len: 1448 |Seq = 34753 Ack = 1

| |(61453) <------------------ (4002) |

48 |0.966217 | ACK - Len: 1448 |Seq = 36201 Ack = 1

| |(61453) <------------------ (4002) |

49 |0.966222 | ACK - Len: 1448 |Seq = 37649 Ack = 1

| |(61453) <------------------ (4002) |

50 |0.966226 | ACK - Len: 1448 |Seq = 39097 Ack = 1

| |(61453) <------------------ (4002) |

51 |0.966229 | ACK - Len: 1448 |Seq = 40545 Ack = 1

| |(61453) <------------------ (4002) |

52 |0.966347 | ACK - Len: 1448 |Seq = 41993 Ack = 1

| |(61453) <------------------ (4002) |

53 |0.966357 | ACK - Len: 1448 |Seq = 43441 Ack = 1

| |(61453) <------------------ (4002) |

54 |0.966362 | ACK - Len: 1448 |Seq = 44889 Ack = 1

| |(61453) <------------------ (4002) |

55 |0.966365 | ACK - Len: 1448 |Seq = 46337 Ack = 1

| |(61453) <------------------ (4002) |

56 |0.966368 | ACK - Len: 1448 |Seq = 47785 Ack = 1

| |(61453) <------------------ (4002) |

57 |0.966380 | ACK - Len: 1448 |Seq = 49233 Ack = 1

| |(61453) <------------------ (4002) |

58 |0.966515 | ACK - Len: 1448 |Seq = 50681 Ack = 1

| |(61453) <------------------ (4002) |

59 |0.966521 | ACK - Len: 1448 |Seq = 52129 Ack = 1

| |(61453) <------------------ (4002) |

60 |0.966597 | ACK | |Seq = 1 Ack = 36201

| |(61453) ------------------> (4002) |

61 |0.966599 | ACK | |Seq = 1 Ack = 39097

| |(61453) ------------------> (4002) |

62 |0.966599 | ACK | |Seq = 1 Ack = 41993

| |(61453) ------------------> (4002) |

63 |0.966600 | ACK | |Seq = 1 Ack = 44889

| |(61453) ------------------> (4002) |

64 |0.966600 | ACK | |Seq = 1 Ack = 47785

| |(61453) ------------------> (4002) |

65 |0.966601 | ACK | |Seq = 1 Ack = 50681

| |(61453) ------------------> (4002) |

66 |0.966763 | ACK | |Seq = 1 Ack = 53577

| |(61453) ------------------> (4002) |

67 |0.967634 | ACK | |Seq = 1 Ack = 53577

| |(61453) ------------------> (4002) |

68 |0.967858 | ACK | |Seq = 1 Ack = 53577

| |(61453) ------------------> (4002) |

69 |0.968079 | ACK | |Seq = 1 Ack = 53577

| |(61453) ------------------> (4002) |

70 |0.968308 | ACK | |Seq = 1 Ack = 53577

| |(61453) ------------------> (4002) |

71 |0.968661 | ACK | |Seq = 1 Ack = 53577

| |(61453) ------------------> (4002) |

72 |0.968756 | ACK | |Seq = 1 Ack = 53577

| |(61453) ------------------> (4002) |

73 |0.983192 | ACK - Len: 1448 |Seq = 53577 Ack = 1

| |(61453) <------------------ (4002) |

74 |0.983205 | ACK - Len: 1448 |Seq = 55025 Ack = 1

| |(61453) <------------------ (4002) |

75 |0.983524 | ACK - Len: 1448 |Seq = 56473 Ack = 1

| |(61453) <------------------ (4002) |

76 |0.983533 | ACK - Len: 1448 |Seq = 57921 Ack = 1

| |(61453) <------------------ (4002) |

77 |0.983537 | ACK - Len: 1448 |Seq = 59369 Ack = 1

| |(61453) <------------------ (4002) |

78 |0.983540 | ACK - Len: 1448 |Seq = 60817 Ack = 1

| |(61453) <------------------ (4002) |

79 |0.983543 | ACK - Len: 1448 |Seq = 62265 Ack = 1

| |(61453) <------------------ (4002) |

80 |0.983547 | ACK - Len: 1448 |Seq = 63713 Ack = 1

| |(61453) <------------------ (4002) |

81 |0.983628 | ACK | |Seq = 1 Ack = 56473

| |(61453) ------------------> (4002) |

82 |0.983629 | ACK | |Seq = 1 Ack = 59369

| |(61453) ------------------> (4002) |

83 |0.983744 | ACK | |Seq = 1 Ack = 62265

| |(61453) ------------------> (4002) |

84 |0.983744 | ACK | |Seq = 1 Ack = 65161

| |(61453) ------------------> (4002) |

85 |0.984876 | ACK | |Seq = 1 Ack = 65161

| |(61453) ------------------> (4002) |

86 |0.985642 | ACK | |Seq = 1 Ack = 65161

| |(61453) ------------------> (4002) |

87 |0.985892 | ACK | |Seq = 1 Ack = 65161

| |(61453) ------------------> (4002) |

88 |0.986095 | FIN, PSH, ACK - Len: |Seq = 65161 Ack = 1

| |(61453) <------------------ (4002) |

89 |0.986137 | ACK | |Seq = 1 Ack = 65538

| |(61453) ------------------> (4002) |

90 |0.986193 | FIN, ACK | |Seq = 1 Ack = 65538

| |(61453) ------------------> (4002) |

91 |1.006935 | ACK | |Seq = 65538 Ack = 2

| |(61453) <------------------ (4002) |

1. SYN sent by client to server to initiate TCP connection. Client SEQ number is initialised at 0.
2. Server ACKs client’s SYN to begin TCP connection. SYN sent by server to client to initiate TCP connection in the opposite direction. Server SEQ number is 0, server ACK number is 1 since it has received 1 byte of data – the SYN from the client.
3. ACK sent by client to server to ACK TCP connection. Client SEQ number is increased to 1 for previous SYN sent. Client ACK number also increments to 1.
4. From this packet until packet 87, the server sends data, each time incrementing its SEQ and the client responding, each time incrementing its ACK. Server ACK and client SEQ remain at 1 throughout this section.

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1. Server sends final packet with FIN flag to indicate it has completed sending data.
2. Client ACKs final packet, incrementing client ACK to 65538.
3. Client sends packet with FIN flag to indicate it has completed sending data.
4. Server ACKs the client FIN packet, incrementing server ACK to 2, with server SEQ reaching 65538; this completes the transmission.