

**Universidad de León**  
**School of Industrial, Computer and Aerospace Engineering**  
**Course on Distributed Systems and Networks**

### Homework #3. TCP Sliding Window

Submit a single .zip file containing your solutions to HW exercises 1 to 3, only. Exclusively .pdf and files are accepted.  
Submit via agora by 09:00 on Monday 21<sup>st</sup>-October-2024.

#### Introduction

The trace included below between page numbers 3 and 17 represents the lifecycle of a TCP connection between a client host (C) and a server (S). Processes C and S run in two in Lab B6 (See fig. 1). The programs executed in C and S correspond to the client and server programs from the practicals that we did this week (#42), which source code is available in [paloalto.unileon.es](http://paloalto.unileon.es).

The server process opens a TCP socket at port 60000 and turns it into a Welcome Socket (State is always LISTEN). Afterwards, the client process creates a client socket and connects with the server. When the connection is ready, it is the client that sends a 3KB block of data (a, b, c, d, ...) to the server, which responds by sending back the message "Unknown request". We want to analyze the evolution of the `snd.una` and `snd.nxt` TCP state variables on the client, and the `rcv.nxt` on the server side as regards the 3KB transfer. Variables `snd.una` and `snd.nxt` point into c's Transmit Buffer (In the client) and, variable `rcv.nxt` points into s's Receive Buffer.

This homework aims to help you understand the dynamics of the state variables by using a concrete trace from a lab practical. To that end, we ask you to respond to questions 1 to 3, which are about the trace below. The remaining questions will be discussed and solved in next Monday's lecture.

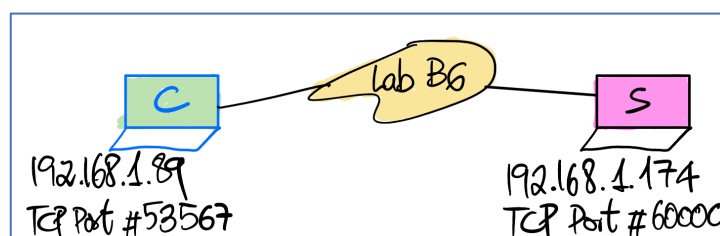


Figure 1. Client and Server hosts in Lab B6 network with their socket IP addresses

1. What is the ISN (Initial Sequence Number) announced by C in the 3-way handshake (See segment the ISN to Seg 0).
2. What should be the response returned by the server to its receiving the preceding ISN? What segment (Seg n) is this response encapsulated into?

3. What is the value of `snd.una` and of `snd.nxt` after Seg 1 is received by c?

*Please, do not submit your solutions to the questions that follow*

4. Question about Seg 3. Right after this segment is fully built and handed over to IP for subsequent transmission:

- a. What is the value of `snd.nxt`?
- b. What is the value of `snd.una`?

5. Question about Seg 3. After this segment is fully received by the server's TCP, what is the value of that TCP's `rcv.nxt`? (Assume that `rcv.nxt` initial value was 0)

6. Question about Seg 4. After this segment is fully built and submitted to IP:

- a. What is the value of `snd.nxt`?
- b. What is the value of `snd.una`?

7. Question about Seg 4. After this segment is fully received by the server's TCP, what should be the value of `rcv.nxt`?

8. Question about Seg 5. After this segment is fully built and submitted to IP:

- a. What is the value of `snd.nxt`?
- b. What is the value of `snd.una`?

9. Question about Seg 5. After this segment is fully received the server's TCP, what is the value of `rcv.nxt`?

10. Question about Seg 6. Observe that ACK 3073, in this segment, means that up to byte with SN 3072 were successfully received by the server (s), which comprises all of the bytes sent by the client the first of which had a SN equal to the ISN announced by the client (These data must acknowledged by the server to the client).

- a. Does this segment carry data, or is it a *pure control* segment sent by s to c?
- b. Could this TCP segment be a quick ack?

- c. What should be the value of the TCP client's `snd.una` after ACK 3073 is received?
11. Questions about Seg 7.
- a. Which of the two hosts is the sender, in this case?
  - b. And the receiver, which is it?
  - c. What is the weight of the payload encapsulated into the segment (In bytes)?
  - d. What range of s-to-c SNs are covered by the data sent encapsulated into this segment?
  - e. What should be the *value* of ACK that, in the future, will effectively acknowledge the successful reception of this block of data by the client? Identify that ACK in a segment having a number (Seg n) larger than Seg 7.

## Trace to a TCP client write op of 3KB long to server

*Notice, each segment starts at a new page heading*

### Seg 0

*(Ethernet: gro off gso)*

**# tcpdump -i eno1 -vvvX tcp port 60000**

```
tcpdump: listening on eno1, link-type EN10MB (Ethernet), snapshot length 262144 bytes
17:02:27.952911 IP (tos 0x0, ttl 64, id 26836, offset 0, flags [DF], proto TCP (6), length 60)
  192.168.1.89.53567 > 192.168.1.174.60000: Flags [S], cksum 0x8486 (incorrect -> 0xeda5),
seq 1702516784, win 64240, options [mss 1460,sackOK,TS val 3579874405 ecr 0,nop,wscale 7],
length 0
  0x0000:  4500 003c 68d4 4000 4006 4d90 c0a8 0159  E..<h.@.M....Y
  0x0010:  c0a8 01ae d13f ea60 657a 5830 0000 0000  .....?.`ezX0....
  0x0020:  a002 faf0 8486 0000 0204 05b4 0402 080a  .....
  0x0030:  d560 8c65 0000 0000 0103 0307  .`.e.....
```

## Seg I

```
17:02:27.953222 IP (tos 0x0, ttl 64, id 0, offset 0, flags [DF], proto TCP (6), length 60)
  192.168.1.174.60000 > 192.168.1.89.53567: Flags [S.], cksum 0xae82 (correct), seq
  1111491506, ack 1702516785, win 65160, options [mss 1460,sackOK,TS val 3406506620 ecr
  3579874405,nop,wscale 7], length 0
    0x0000:  4500 003c 0000 4000 4006 b664 c0a8 01ae  E..<..@..d....
    0x0010:  c0a8 0159 ea60 d13f 4240 03b2 657a 5831  ...Y.`?B@..ezXl
    0x0020:  a012 fe88 ae82 0000 0204 05b4 0402 080a  .....
    0x0030:  cb0b 2a7c d560 8c65 0103 0307  ..*|.`.e....
```

## Seg 2

```
17:02:27.953259 IP (tos 0x0, ttl 64, id 26837, offset 0, flags [DF], proto TCP (6), length 52)
  192.168.1.89.53567 > 192.168.1.174.60000: Flags [.], cksum 0x847e (incorrect -> 0xd9e0),
seq 1, ack 1, win 502, options [nop,nop,TS val 3579874406 ecr 3406506620], length 0
  0x0000:  4500 0034 68d5 4000 4006 4d97 c0a8 0159  E..4h.@.@.M...Y
  0x0010:  c0a8 01ae d13f ea60 657a 5831 4240 03b3  .....?.`ezX1B@..
  0x0020:  8010 01f6 847e 0000 0101 080a d560 8c66  .....~.....`.f
  0x0030:  cb0b 2a7c                                     ..*|
```

### Seg 3

```
17:02:27.953570 IP (tos 0x0, ttl 64, id 26838, offset 0, flags [DF], proto TCP (6), length 1500)
  192.168.1.89.53567 > 192.168.1.174.60000: Flags [.] , cksum 0x8a26 (incorrect -> 0x910a),
seq 1:1449, ack 1, win 502, options [nop,nop,TS val 3579874406 ecr 3406506620], length 1448
  0x0000: 4500 05dc 68d6 4000 4006 47ee c0a8 0159 E...h.@.@.G....Y
  0x0010: c0a8 01ae d13f ea60 657a 5831 4240 03b3 .....?.`ezXlB@..
  0x0020: 8010 01f6 8a26 0000 0101 080a d560 8c66 .....&.....`.f
  0x0030: cb0b 2a7c 6162 6364 6566 6768 696a 6b6c ..*|abcdefghijkl
  0x0040: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x0050: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x0060: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x0070: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x0080: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x0090: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x00a0: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x00b0: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x00c0: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x00d0: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x00e0: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x00f0: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x0100: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x0110: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x0120: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x0130: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x0140: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x0150: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x0160: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x0170: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x0180: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x0190: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x01a0: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x01b0: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x01c0: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x01d0: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x01e0: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x01f0: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x0200: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x0210: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x0220: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x0230: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x0240: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x0250: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x0260: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x0270: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x0280: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x0290: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x02a0: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x02b0: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x02c0: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x02d0: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x02e0: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x02f0: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x0300: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x0310: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x0320: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x0330: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x0340: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x0350: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x0360: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x0370: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x0380: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x0390: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x03a0: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x03b0: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x03c0: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x03d0: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x03e0: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x03f0: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x0400: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
  0x0410: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGLIJKLMNOPQRS
  0x0420: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
  0x0430: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9-+-abcdefghijkl
  0x0440: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
```

0x0450:	4445	4647	4849	4a4b	4c4d	4e4f	5051	5253	DEFGHIJKLMNOPQRS
0x0460:	5455	5657	5859	5a30	3132	3334	3536	3738	TUVWXYZ012345678
0x0470:	392d	2b2d	6162	6364	6566	6768	696a	6b6c	9+--abcdefghijkl
0x0480:	6d6e	6f70	7273	7475	7677	7879	7a41	4243	mnoprstuvwxyzABC
0x0490:	4445	4647	4849	4a4b	4c4d	4e4f	5051	5253	DEFGHIJKLMNOPQRS
0x04a0:	5455	5657	5859	5a30	3132	3334	3536	3738	TUVWXYZ012345678
0x04b0:	392d	2b2d	6162	6364	6566	6768	696a	6b6c	9+--abcdefghijkl
0x04c0:	6d6e	6f70	7273	7475	7677	7879	7a41	4243	mnoprstuvwxyzABC
0x04d0:	4445	4647	4849	4a4b	4c4d	4e4f	5051	5253	DEFGHIJKLMNOPQRS
0x04e0:	5455	5657	5859	5a30	3132	3334	3536	3738	TUVWXYZ012345678
0x04f0:	392d	2b2d	6162	6364	6566	6768	696a	6b6c	9+--abcdefghijkl
0x0500:	6d6e	6f70	7273	7475	7677	7879	7a41	4243	mnoprstuvwxyzABC
0x0510:	4445	4647	4849	4a4b	4c4d	4e4f	5051	5253	DEFGHIJKLMNOPQRS
0x0520:	5455	5657	5859	5a30	3132	3334	3536	3738	TUVWXYZ012345678
0x0530:	392d	2b2d	6162	6364	6566	6768	696a	6b6c	9+--abcdefghijkl
0x0540:	6d6e	6f70	7273	7475	7677	7879	7a41	4243	mnoprstuvwxyzABC
0x0550:	4445	4647	4849	4a4b	4c4d	4e4f	5051	5253	DEFGHIJKLMNOPQRS
0x0560:	5455	5657	5859	5a30	3132	3334	3536	3738	TUVWXYZ012345678
0x0570:	392d	2b2d	6162	6364	6566	6768	696a	6b6c	9+--abcdefghijkl
0x0580:	6d6e	6f70	7273	7475	7677	7879	7a41	4243	mnoprstuvwxyzABC
0x0590:	4445	4647	4849	4a4b	4c4d	4e4f	5051	5253	DEFGHIJKLMNOPQRS
0x05a0:	5455	5657	5859	5a30	3132	3334	3536	3738	TUVWXYZ012345678
0x05b0:	392d	2b2d	6162	6364	6566	6768	696a	6b6c	9+--abcdefghijkl
0x05c0:	6d6e	6f70	7273	7475	7677	7879	7a41	4243	mnoprstuvwxyzABC
0x05d0:	4445	4647	4849	4a4b	4c4d	4e4f			DEFGHIJKLMNO



# Seg 4

17:02:27.953579 IP (tos 0x0, ttl 64, id 26839, offset 0, flags [DF], proto TCP (6), length 1500)

```
192.168.1.89.53567 > 192.168.1.174.60000: Flags [.], cksum 0x8a26 (incorrect -> 0xa074),
seq 1449:2897, ack 1, win 502, options [nop,nop,TS val 3579874406 ecr 3406506620], length 1448
 0x0000: 4500 05dc 68d7 4000 4006 47ed c0a8 0159 E...h.@.@.G....Y
 0x0010: c0a8 01ae d13f ea60 657a 5dd9 4240 03b3 .....?.`ez].B@..
 0x0020: 8010 01f6 8a26 0000 0101 080a d560 8c66 .....&.....`.f
 0x0030: cb0b 2a7c 5051 5253 5455 5657 5859 5a30 ..*|PQRSTUVWXYZ0
 0x0040: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x0050: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x0060: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x0070: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x0080: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x0090: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x00a0: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x00b0: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x00c0: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x00d0: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x00e0: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x00f0: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x0100: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x0110: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x0120: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x0130: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x0140: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x0150: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x0160: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x0170: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x0180: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x0190: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x01a0: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x01b0: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x01c0: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x01d0: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x01e0: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x01f0: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x0200: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x0210: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x0220: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x0230: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x0240: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x0250: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x0260: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x0270: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x0280: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x0290: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x02a0: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x02b0: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x02c0: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x02d0: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x02e0: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x02f0: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x0300: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x0310: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x0320: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x0330: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x0340: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x0350: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x0360: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x0370: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x0380: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x0390: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x03a0: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x03b0: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x03c0: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x03d0: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x03e0: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x03f0: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x0400: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
 0x0410: 6566 6768 696a 6b6c 6d6e 6f70 7273 7475 efghijklmnoprstu
 0x0420: 7677 7879 7a41 4243 4445 4647 4849 4a4b vwxyzABCDEFGHJK
 0x0430: 4c4d 4e4f 5051 5253 5455 5657 5859 5a30 LMNOPQRSTUVWXYZ0
 0x0440: 3132 3334 3536 3738 392d 2b2d 6162 6364 123456789-+-abcd
```

0x0450:	6566	6768	696a	6b6c	6d6e	6f70	7273	7475	efghijklmnoprstu
0x0460:	7677	7879	7a41	4243	4445	4647	4849	4a4b	vwxyzABCDEFGHIJK
0x0470:	4c4d	4e4f	5051	5253	5455	5657	5859	5a30	LMNOPQRSTUVWXYZ0
0x0480:	3132	3334	3536	3738	392d	2b2d	6162	6364	123456789-+-abcd
0x0490:	6566	6768	696a	6b6c	6d6e	6f70	7273	7475	efghijklmnoprstu
0x04a0:	7677	7879	7a41	4243	4445	4647	4849	4a4b	vwxyzABCDEFGHIJK
0x04b0:	4c4d	4e4f	5051	5253	5455	5657	5859	5a30	LMNOPQRSTUVWXYZ0
0x04c0:	3132	3334	3536	3738	392d	2b2d	6162	6364	123456789-+-abcd
0x04d0:	6566	6768	696a	6b6c	6d6e	6f70	7273	7475	efghijklmnoprstu
0x04e0:	7677	7879	7a41	4243	4445	4647	4849	4a4b	vwxyzABCDEFGHIJK
0x04f0:	4c4d	4e4f	5051	5253	5455	5657	5859	5a30	LMNOPQRSTUVWXYZ0
0x0500:	3132	3334	3536	3738	392d	2b2d	6162	6364	123456789-+-abcd
0x0510:	6566	6768	696a	6b6c	6d6e	6f70	7273	7475	efghijklmnoprstu
0x0520:	7677	7879	7a41	4243	4445	4647	4849	4a4b	vwxyzABCDEFGHIJK
0x0530:	4c4d	4e4f	5051	5253	5455	5657	5859	5a30	LMNOPQRSTUVWXYZ0
0x0540:	3132	3334	3536	3738	392d	2b2d	6162	6364	123456789-+-abcd
0x0550:	6566	6768	696a	6b6c	6d6e	6f70	7273	7475	efghijklmnoprstu
0x0560:	7677	7879	7a41	4243	4445	4647	4849	4a4b	vwxyzABCDEFGHIJK
0x0570:	4c4d	4e4f	5051	5253	5455	5657	5859	5a30	LMNOPQRSTUVWXYZ0
0x0580:	3132	3334	3536	3738	392d	2b2d	6162	6364	123456789-+-abcd
0x0590:	6566	6768	696a	6b6c	6d6e	6f70	7273	7475	efghijklmnoprstu
0x05a0:	7677	7879	7a41	4243	4445	4647	4849	4a4b	vwxyzABCDEFGHIJK
0x05b0:	4c4d	4e4f	5051	5253	5455	5657	5859	5a30	LMNOPQRSTUVWXYZ0
0x05c0:	3132	3334	3536	3738	392d	2b2d	6162	6364	123456789-+-abcd
0x05d0:	6566	6768	696a	6b6c	6d6e	6f70			efghijklmnop

## Seg 5

17:02:27.953583 IP (tos 0x0, ttl 64, id 26840, offset 0, flags [DF], proto TCP (6), length 228)

```
192.168.1.89.53567 > 192.168.1.174.60000: Flags [P.], cksum 0x852e (incorrect -> 0xc9ce),
seq 2897:3073, ack 1, win 502, options [nop,nop,TS val 3579874406 ecr 3406506620], length 176
 0x0000: 4500 00e4 68d8 4000 4006 4ce4 c0a8 0159 E...h.@.@.L...Y
 0x0010: c0a8 01ae d13f ea60 657a 6381 4240 03b3 .....?.`ezc.B@..
 0x0020: 8018 01f6 852e 0000 0101 080a d560 8c66 .....`.f
 0x0030: cb0b 2a7c 7273 7475 7677 7879 7a41 4243 ..*|rstuvwxyzABC
 0x0040: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGHIJKLMNOPQRS
 0x0050: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
 0x0060: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9--+-abcdefghijkl
 0x0070: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
 0x0080: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGHIJKLMNOPQRS
 0x0090: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
 0x00a0: 392d 2b2d 6162 6364 6566 6768 696a 6b6c 9--+-abcdefghijkl
 0x00b0: 6d6e 6f70 7273 7475 7677 7879 7a41 4243 mnoprstuvwxyzABC
 0x00c0: 4445 4647 4849 4a4b 4c4d 4e4f 5051 5253 DEFGHIJKLMNOPQRS
 0x00d0: 5455 5657 5859 5a30 3132 3334 3536 3738 TUVWXYZ012345678
 0x00e0: 392d 2b2d 9--+-
```

## Seg 6

```
17:02:27.953899 IP (tos 0x0, ttl 64, id 16883, offset 0, flags [DF], proto TCP (6), length 52)
  192.168.1.174.60000 > 192.168.1.89.53567: Flags [.], cksum 0xcdea (correct), seq 1, ack
3073, win 492, options [nop,nop,TS val 3406506620 ecr 3579874406], length 0
  0x0000: 4500 0034 41f3 4000 4006 7479 c0a8 01ae E..4A.@.@.ty....
  0x0010: c0a8 0159 ea60 d13f 4240 03b3 657a 6431 ...Y.`.?B@..ezdl
  0x0020: 8010 01ec cdea 0000 0101 080a cb0b 2a7c .....*|
  0x0030: d560 8c66 .`.f
```

## Seg 7

```
17:02:27.954064 IP (tos 0x0, ttl 64, id 16884, offset 0, flags [DF], proto TCP (6), length 68)
192.168.1.174.60000 > 192.168.1.89.53567: Flags [P.], cksum 0x71ef (correct), seq 1:17,
ack 3073, win 492, options [nop,nop,TS val 3406506620 ecr 3579874406], length 16
0x0000: 4500 0044 41f4 4000 4006 7468 c0a8 01ae E..DA.@.@.th....
0x0010: c0a8 0159 ea60 d13f 4240 03b3 657a 6431 ...Y.`.?B@..ezdl
0x0020: 8018 01ec 71ef 0000 0101 080a cb0b 2a7c ....q.....*|
0x0030: d560 8c66 556e 6b6e 6f77 6e20 7265 7175 .`.fUnknown.requ
0x0040: 6573 7420 est.
```

## Seg 8

```
17:02:27.954066 IP (tos 0x0, ttl 64, id 16885, offset 0, flags [DF], proto TCP (6), length 52)
  192.168.1.174.60000 > 192.168.1.89.53567: Flags [R.], cksum 0xcdcc (correct), seq 17, ack
3073, win 501, options [nop,nop,TS val 3406506621 ecr 3579874406], length 0
  0x0000:  4500 0034 41f5 4000 4006 7477 c0a8 01ae  E..4A.@.@.tw....
  0x0010:  c0a8 0159 ea60 d13f 4240 03c3 657a 6431  ...Y.`.?B@..ezdl
  0x0020:  8014 01f5 cdcc 0000 0101 080a cb0b 2a7d  .....*)
  0x0030:  d560 8c66  .`.f
```

## Seg 9

```
17:02:27.954084 IP (tos 0x0, ttl 64, id 26841, offset 0, flags [DF], proto TCP (6), length 52)
  192.168.1.89.53567 > 192.168.1.174.60000: Flags [.], cksum 0x847e (incorrect -> 0xcd0),
  seq 3073, ack 17, win 502, options [nop,nop,TS val 3579874406 ecr 3406506620], length 0
    0x0000: 4500 0034 68d9 4000 4006 4d93 c0a8 0159  E..4h.@.@.M...Y
    0x0010: c0a8 01ae d13f ea60 657a 6431 4240 03c3  ....?.`ezd1B@..
    0x0020: 8010 01f6 847e 0000 0101 080a d560 8c66  ....~.....`.f
    0x0030: cb0b 2a7c  ..*|
```

## Seg 10

```
17:02:27.954347 IP (tos 0x0, ttl 64, id 0, offset 0, flags [DF], proto TCP (6), length 40)
  192.168.1.174.60000 > 192.168.1.89.53567: Flags [R], cksum 0x29e5 (correct), seq
1111491523, win 0, length 0
  0x0000:  4500 0028 0000 4000 4006 b678 c0a8 01ae  E..(..@.@..x....
  0x0010:  c0a8 0159 ea60 d13f 4240 03c3 0000 0000  ...Y.`.?B@.....
  0x0020:  5004 0000 29e5 0000 0000 0000 0000  P...).....
^C
11 packets captured
11 packets received by filter
0 packets dropped by kernel
root@debian-ule:/home/administrator/sysadmin/macsh#
```



## Solution

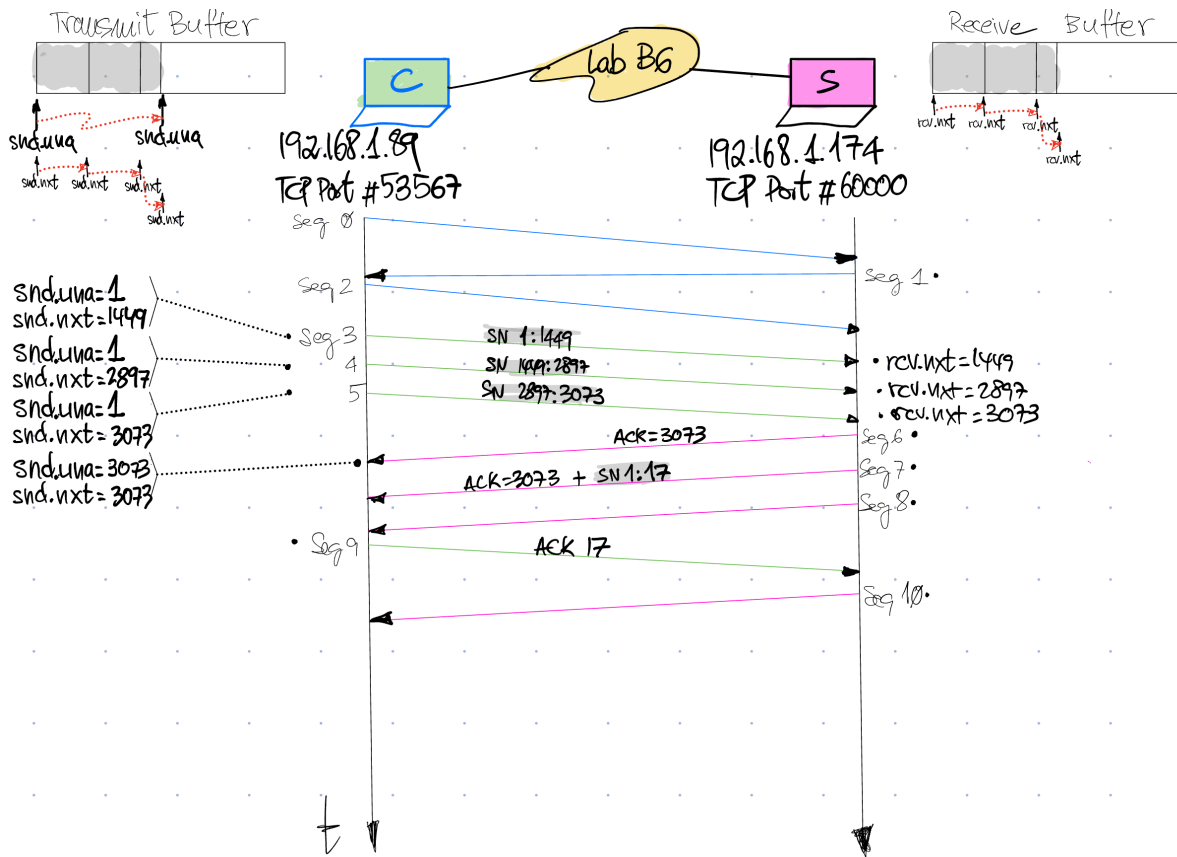


Figure 2. Sketched solution to HW #3