

Session 6

Exercise 1: TCP

a.

1.

The name of the server is `course-3networkarchitecture.ei.fti.uantwerpen.be`.

No.	Time	Source	Destination	Protocol	Length	Info
8	0.439647	143.129.40.79	143.129.43.250	TCP	66	51276 → 443 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
9	0.716839	143.129.40.79	143.129.43.250	TCP	66	51278 → 443 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
39	3.681208	143.129.40.79	143.129.43.250	TCP	66	50828 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
41	3.683409	143.129.43.250	143.129.40.79	TCP	66	80 → 50828 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM WS=128
42	3.683563	143.129.40.79	143.129.43.250	TCP	54	50828 → 80 [ACK] Seq=1 Ack=1 Win=262656 Len=0
43	3.683838	143.129.40.79	143.129.43.250	HTTP	548	GET / HTTP/1.1
44	3.685484	143.129.43.250	143.129.40.79	TCP	60	80 → 50828 [ACK] Seq=1 Ack=495 Win=64128 Len=0
45	3.688474	143.129.43.250	143.129.40.79	HTTP	518	HTTP/1.1 302 FOUND (text/html)
48	3.692962	143.129.40.79	143.129.43.250	HTTP	580	GET /student_number?redirection=index HTTP/1.1
49	3.697669	143.129.43.250	143.129.40.79	HTTP	1050	HTTP/1.1 200 OK (text/html)
62	3.742135	143.129.40.79	143.129.43.250	TCP	54	50828 → 80 [ACK] Seq=1021 Ack=1461 Win=262656 Len=0
73	3.789400	143.129.40.79	143.129.43.250	HTTP	557	GET /favicon.ico HTTP/1.1
84	3.793876	143.129.43.250	143.129.40.79	HTTP	439	HTTP/1.1 404 NOT FOUND (text/html)
107	3.830844	143.129.40.79	143.129.43.250	TCP	54	50828 → 80 [ACK] Seq=1524 Ack=1846 Win=262400 Len=0
282	7.213186	143.129.40.79	143.129.43.250	HTTP	882	POST /student_number HTTP/1.1 (application/x-www-form-urlencoded)
283	7.218296	143.129.43.250	143.129.40.79	HTTP	1121	HTTP/1.1 200 OK (text/html)
289	7.267971	143.129.40.79	143.129.43.250	TCP	54	50828 → 80 [ACK] Seq=2352 Ack=2913 Win=261120 Len=0
318	8.911963	143.129.40.79	143.129.43.250	HTTP	864	POST /student_number HTTP/1.1 (application/x-www-form-urlencoded)
319	8.916305	143.129.43.250	143.129.40.79	HTTP	494	HTTP/1.1 302 FOUND (text/html)
322	8.922865	143.129.40.79	143.129.43.250	HTTP	679	GET /student_number=20242689 HTTP/1.1
323	8.925864	143.129.43.250	143.129.40.79	HTTP	980	HTTP/1.1 200 OK (text/html)
333	8.966294	143.129.40.79	143.129.43.250	TCP	54	50828 → 80 [ACK] Seq=3787 Ack=4279 Win=261632 Len=0
388	10.314819	143.129.40.79	143.129.43.250	HTTP	672	GET /session6/?student_number=20242689 HTTP/1.1
391	10.321660	143.129.43.250	143.129.40.79	HTTP	988	HTTP/1.1 200 OK (text/html)
405	10.362399	143.129.40.79	143.129.43.250	TCP	54	50828 → 80 [ACK] Seq=4405 Ack=5213 Win=262656 Len=0
445	11.764928	143.129.40.79	143.129.43.250	HTTP	690	GET /session6/exercise1?student_number=20242689 HTTP/1.1

[Checksum Status: Unverified]
Urgent Pointer: 0
[Timestamps]
[Time since first frame in this TCP stream: 0.002630000 seconds]
[Time since previous frame in this TCP stream: 0.000275000 seconds]
[SEQ/ACK analysis]
[RTT: 0.002355000 seconds]
[Bytes in Flight: 494]
[Bytes sent since last PSH flag: 494]
TCP payload (494 bytes)
Hypertext Transfer Protocol
GET / HTTP/1.1
Request Method: GET
Request URI: /
Request Version: HTTP/1.1
Host: course-3networkarchitecture.ei.fti.uantwerpen.be
Connection: keep-alive
DNT: 1
Upgrade-Insecure-Requests: 1
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/130.0.0.0 Safari/537.36 Edg/130.0.0.0
Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/avif,image/webp,image/apng,*/*;q=0.8,application/signed-exchange;q=0.7
Accept-Encoding: gzip, deflate
Accept-Language: nl,en-US;q=0.9,en;q=0.8
[Response in frame: 45]
[Full request URI: http://course-3networkarchitecture.ei.fti.uantwerpen.be/]

0040 2f 31 2e 31 0d 0a 48 6f 73 74 3a 20 63 6f 75 72 /1.1: Host: cour
0050 73 65 2d 33 6e 65 74 77 6f 72 6b 61 72 63 68 69 se-3netw orkarchi
0060 74 65 63 74 75 72 65 2e 65 69 2e 66 74 69 2e 75 tecture. ei.fti.u
0070 61 6e 74 77 65 72 70 65 6e 2e 62 65 0d 0a 43 6f antwerpe n.be:Co
0080 6e 6e 65 63 74 69 6f 6e 3a 20 6b 65 65 70 2d 61 nnection : keep-a
0090 6c 69 76 65 0d 0a 44 4e 54 3a 20 31 0d 0a 55 70 live:DN T: 1:Up
00a0 67 72 61 64 65 2d 49 6e 73 65 63 75 72 65 2d 52 grade:In secure:R
00b0 65 71 75 65 73 74 73 3a 20 31 0d 0a 55 73 65 72 equests: 1:User
00c0 2d 41 67 65 6e 74 3a 20 4d 6f 7a 69 6c 6c 61 2f -Agent: Mozilla/
00d0 35 2e 30 20 28 57 69 6e 64 6f 77 73 20 4e 54 20 5.0 (Win dows NT
00e0 31 30 2e 30 3b 20 57 69 6e 36 34 3b 20 78 36 34 10.0; Wi nd4; x64
00f0 29 20 41 70 70 6c 65 67 65 62 4b 69 74 2f 35 33) AppleW ebKit/53
0100 37 2e 33 36 20 28 4b 48 54 4d 4c 2c 20 6c 69 6b 7.36 (KH TML, lik
0110 65 20 47 65 63 6b 6f 29 20 43 68 72 6f 6d 65 2f e Gecko) Chrome/
0120 31 33 30 2e 30 2e 30 2e 30 20 53 61 66 61 72 69 130.0.0.0 Safari
0130 2f 35 33 37 2e 33 36 20 45 64 6f 2f 31 33 30 2e /537.36 Edg/130.
0140 30 2e 30 2e 30 0d 0a 41 63 63 65 70 74 3a 20 74 6.0.0.-A ccept: t
0150 65 78 74 2f 68 74 6d 6c 2c 61 70 70 6c 69 63 61 ext/html, applica
0160 74 69 6f 6e 2f 78 68 74 6d 6c 2b 78 6d 6c 2c 61 tion/xht ml+xml,a
0170 70 70 6c 69 63 61 74 69 6f 6e 2f 78 6d 6c 3b 71 pplicati on+xml;q
0180 3d 30 2e 39 2c 69 6d 61 67 65 2f 61 76 69 66 2c =0.9,ima ge/avif,
0190 69 6d 61 67 65 2f 77 65 62 70 2c 69 6d 61 67 65 image/we bp,image
01a0 2f 61 70 6e 67 2e 2a 2f 2e 3b 71 3d 30 2e 38 2c /png,*/*;q=0.8,
01b0 61 70 70 6c 69 63 61 74 69 6f 6e 2f 73 69 67 6e applicat ion/sign
01c0 65 64 2d 65 78 63 68 61 6e 67 65 3b 76 3d 62 33 ed-excha nge:v=b3
01d0 3b 71 3d 30 2e 37 0d 0a 41 63 63 65 70 74 2d 45 ;q=0.7... Accept-E
01e0 6e 63 6f 64 69 6e 67 3a 20 67 7a 69 70 2c 20 64 ncoding: gzip, d
01f0 65 66 6c 61 74 65 0d 0a 41 63 63 65 70 74 2d 4c eflate... Accept-L
0200 61 6e 67 75 61 67 65 3a 20 6e 6c 2c 65 6e 2d 55 anguage: nl,en-U

2.

The protocol HTTP uses is `TCP`.

```

Frame 43: 548 bytes on wire (4384 bits), 548 bytes captured (4384 bits) on interface \Device\NPF_{F3CADC1F-33BF-413A-966C-1A982E2...
Ethernet II, Src: ASUSTekCOMPU_c2:01:97 (10:7c:61:c2:01:97), Dst: All-HSRP-routers_03 (00:00:0c:07:ac:03)
Internet Protocol version 4, Src: 143.129.40.79, Dst: 143.129.43.250
Transmission Control Protocol, Src Port: 50828, Dst Port: 80, Seq: 1, Ack: 1, Len: 494
  Source Port: 50828
  Destination Port: 80
  [Stream index: 6]
  [Stream Packet Number: 4]
  Conversation completeness: Incomplete, DATA (15)
    ..0. .... = RST: Absent
    ...0 .... = FIN: Absent
    .... 1... = Data: Present
    .... .1.. = ACK: Present
    .... ..1. = SYN-ACK: Present
    .... ...1 = SYN: Present
    [Completeness Flags: ..DASS]
  [TCP Segment Len: 494]
  Sequence Number: 1 (relative sequence number)
  Sequence Number (raw): 3131041406
  [Next Sequence Number: 495 (relative sequence number)]
  Acknowledgment Number: 1 (relative ack number)
  Acknowledgment number (raw): 2083592466
  0101 .... = Header Length: 20 bytes (5)
  Flags: 0x018 (PSH, ACK)
    000. .... = Reserved: Not set
    ...0 .... = Accurate ECN: Not set
    .... 0... = Congestion Window Reduced: Not set

```

b.

The first 3 frames will make a handshake with TCP between client and server.

39	3.681208	143.129.40.79	143.129.43.250	TCP	66	50828 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
41	3.683409	143.129.43.250	143.129.40.79	TCP	66	80 → 50828 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM WS=128
42	3.683563	143.129.40.79	143.129.43.250	TCP	54	50828 → 80 [ACK] Seq=1 Ack=1 Win=262656 Len=0

c.

Frame 39: The client sends a SYN packet to the server on port 443.

Frame 41: The server responds with a SYN-ACK packet to the client.

Frame 42: The client sends an ACK packet back to the server, completing the handshake.

39	3.681208	143.129.40.79	143.129.43.250	TCP	66	50828 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
41	3.683409	143.129.43.250	143.129.40.79	TCP	66	80 → 50828 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM WS=128
42	3.683563	143.129.40.79	143.129.43.250	TCP	54	50828 → 80 [ACK] Seq=1 Ack=1 Win=262656 Len=0

d.

Total bytes: 66B + 66B + 54B = 186B

39	3.681208	143.129.40.79	143.129.43.250	TCP	66	50828 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
41	3.683409	143.129.43.250	143.129.40.79	TCP	66	80 → 50828 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 SACK_PERM WS=128
42	3.683563	143.129.40.79	143.129.43.250	TCP	54	50828 → 80 [ACK] Seq=1 Ack=1 Win=262656 Len=0

Epoch time frame 39: 1730898701,799112s

```

UTC Arrival Time: NOV  8, 2024 15:11:41.799112
Epoch Arrival Time: 1730898701.799112000
[Time shift for this packet: 0.000000000 sec]

```

Epoch time frame 42: 1730898701,801467s

```
UTC Arrival Time: Nov  6, 2024 13:11:41.801467s
Epoch Arrival Time: 1730898701.801467000
[Time shift for this packet: 0.000000000 sec]
```

Epoch time delta: 1730898701,801467s - 1730898701,799112s = 0,002355s

Throughput: 186B / 0,002355s = 78980B/s = 78,98MB/s

Exercise 2: UDP

a.

There are 4 fields in the UDP header:

- **Source Port:** port of the sending application.
- **Destination Port:** port of the receiving application.
- **Length:** length of the UDP header and data.
- **Checksum:** used for error-checking of the header and data.

```
[Stream Index: 5]
User Datagram Protocol, Src Port: 1534, Dst Port: 1534
  Source Port: 1534
  Destination Port: 1534
  Length: 16
  Checksum: 0xe508 [unverified]
  [Checksum Status: Unverified]
  [Stream index: 5]
  [Stream Packet Number: 1]
  ▶ [Timestamps]
  UDP payload (8 bytes)
```