Communications and Computer Networks

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Exercise 5

Information: If necessary, remove the suffix *.sec* of files downloaded from ILIAS.

1 Transport layer

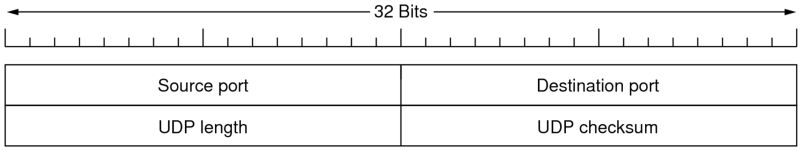
1. What are the main tasks of the transport layer?

> **Solution:** Transport layer implements communciation between two transport entities
>
> It only knows the address of the source and destination station, formally defined as Transport Service Address Point (TSAP) , typically called ports
>
> Connection establishment as well as connection management is part of L4
>
> In addition to the connection build-up and connection dismantling, the transport layer also carries out flow control and monitoring for transmission errors.

2. What are relevant protocols of the transport layer?

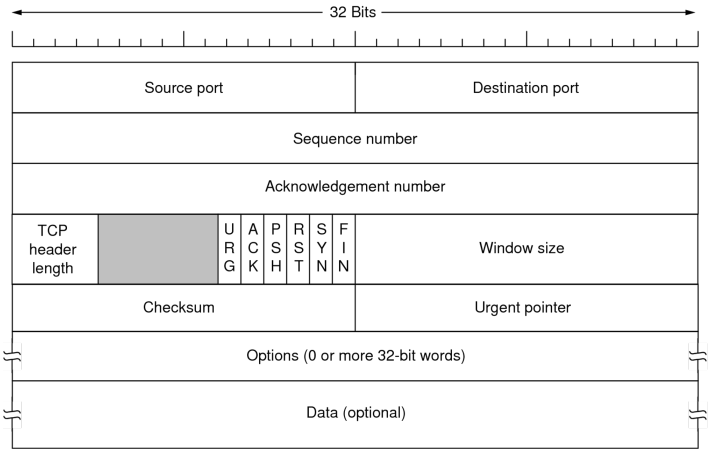
> **Solution:** TCP, UDP, QUIC

3. Sketch the individual fields of an UDP segment and explain their meaning.

> **Solution:**
>
> 
>
>
> - Source Port: Port number of the sender
> - Destination Port: Port number of the recipient
> - UDP Length: Length of the datagram including header
> - UDP Checksum: Checksum including pseudo-header

4. Sketch the individual fields of an TCP datagram and explain their meaning.

Solution:



- 16 Bit Source Port: Port of the sender
- 16 Bit Destination Port: Port of the receiver
- 32 Bit Sequence Number: Sequence number, numbering of each byte
- 32 Bit Acknowledgement Number: Acknowledgement (the next expected byte)
- TCP Header Length: Length of the header in 32 bit words
- URG Flag: Urgent (urgent message)
- ACK Flag: Acknowledgement Number valid
- PSH Flag: Push data (forward data without buffering)
- RST Flag: Resetting the Connection
- SYN Flag: Establishing a connection
- FIN Flag: Disconnection
- Window Size: Slide window for flow control (number of bytes that can be sent before an acknowledgement)
- Checksum: Checksum including pseudo-headers (IP addresses, etc.)
- Urgent Pointer: points to urgent data (byte offset)
- Options: additional options, e.B. maximum size payload

5. Read the RFC 2883 - An Extension to the Selective Acknowledgement (SACK) Option for TCP and explain the relevant problem which led to the standard and explain the implementation idea.

Solution: SACK is Selective ACK: The receiver explicitly lists which packets, messages, or segments in a stream are acknowledged (either negatively or positively). The Selective Acknowledgement (SACK) option in the TCP header contains a number of SACK blocks, where each block specifies the left and right edge of a block of data received at the TCP receiver. RFC 2883 suggests that when duplicate packets are received, the first block of the SACK option field can be used to report the sequence numbers of the packet that triggered the acknowledgement. This extension to the SACK option allows the TCP sender to infer the order of packets received at the receiver, allowing the sender to infer when it has unnecessarily retransmitted a packet.

6. What is the needed Windows size in Byte to get the wanted transmission rates in KBit/s?

Transmission rate	RTT	Windows Size
100	10ms	
100	100ms	
1500	7ms	
1500	506ms	
4000	3ms	
4000	640 ms	
11.500	300 ms	
20.000	2 ms	
40.000	388 ms	
650.000	50 ms	

Solution: $Win = Bandwidth \cdot RTT \cdot 8$

Transmission rate	RTT	Windows Size
100	10ms	8
100	100ms	80
1500	7ms	84
1500	506ms	6072
4000	3ms	96
4000	640 ms	20480
11.500	300 ms	27600
20.000	2 ms	320
40.000	388 ms	124160
650.000	50 ms	260000

7. What do the Sequence and Acknowledgement numbers in the TCP header mean?

Solution: The sequence number indicates the offset from which the data contained in the TCP packet starts in the data stream. The receiver can thus identify the position in the data stream and confirm receipt of the data.

The ACK segment indicates by the value of the confirmation number that all previous octets of the data segments have been received correctly.

When using the ßliding windowmmechanism, the receiving transport instance does not need to acknowledge each segment. The confirmation mechanism works cumulatively.

8. A TCP packet has the values shown in the header:

   IPv4, Src Addr: 193.25.22.84, Dst Addr: 172.22.144.91

   TCP, Src Port: 21, Dst Port: 1188, Seq: 124, Ack: 31, Len: 27

   What must be the values for the Seq-No. and the Ack-No. of the response packet?

Solution: The ACK field in the TCP header indicates which offset (which byte) is expected next by the communication partner. The Seq-No. specifies the offset of the respective packet. Thus the Seq-No. and Ack-No. of the reply packet are Seq-No. = 31 Ack-No.= 124+27 = 151

9. A TCP segment with 3000 bytes of user data is sent over a standard Ethernet (MTU = 1500 bytes). How large are the associated Ethernet frames?

Solution: IPv4-Header = 20 Bytes , TCP-Header = 20 Bytes, Payload = 3000 Bytes
MTU (=1500), IP-Header in every Frame, TCP-Header only in first Frame
Ethernet-Frames: 7+1+6+6+2 = 22 Byte Header, 4 Byte FCS-Tailer
1. Frame: 22 + 1500 + 4 = 1526 Byte Payload to send: 3000 - (1500 - 20 - 20) = 1540 Byte
2. Frame: 22 + 1500 + 4 = 1526 Byte Payload to send: 1540 - (1500 - 20) = 60 Byte
3. Frame: 22 + 60 + 20 + 4 = 106 Byte

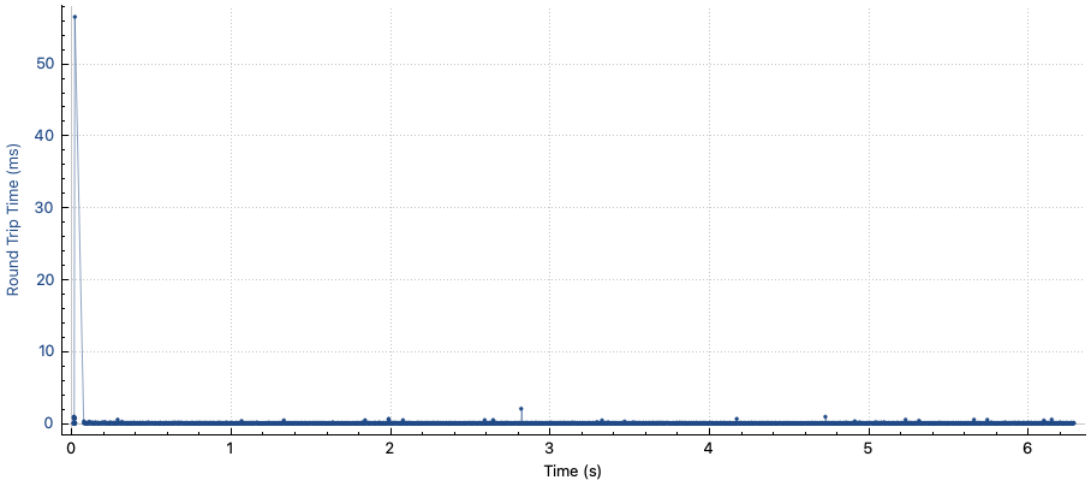
10. Analyse the pcap-file ports.pcap and try to detect the used protocols.

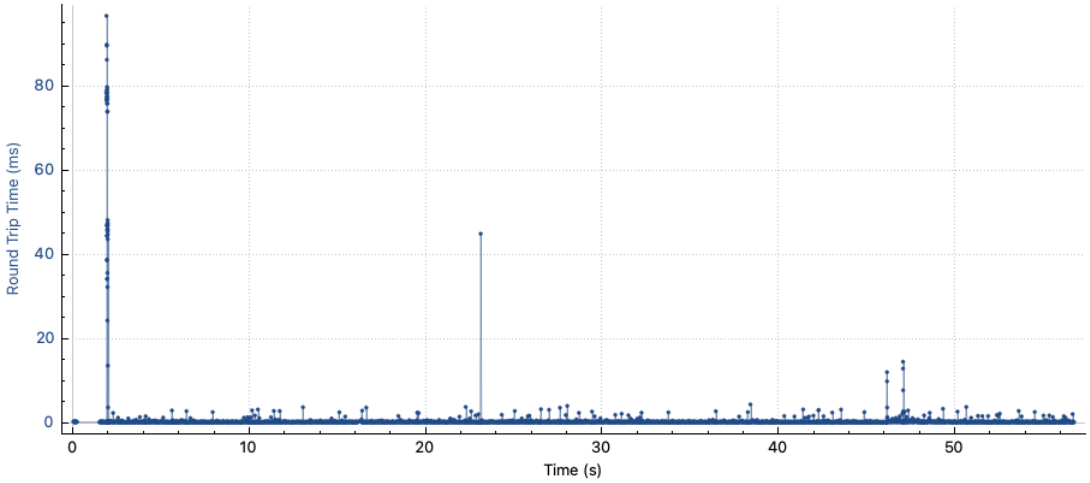
Solution:

1. Submission
2. SMB
3. SMB
4. HTTP
5. SSH
6. LPD
7. Telnet
8. FTP
9. X11
10. RPC
11. SMTP
12. NFS
13. NTP
14. PDL Data Stream (Printing)
15. RDP
16. POP3
17. OpenVPN
18. AFP
19. UPnP
20. MySQL
21. DNS
22. SNMP
23. Tor
24. Dropbox
25. HTTPS

26. ident
27. IMAPS
28. Proxy
29. Linux-HA
30. AFP
31. HTTPS
32. SSH

11. You have the two graphs of a data transmission. Both show the transfer of the same file, but from different systems. What can you say regarding the hosting system?





Solution: The upper one shows a transmission inside a local network (RTT is steady), the lower one shows a transmission from an external system in the internet.