Exercise 4: IP, TCP, UDP

1. Below is an Ethernet-II frame, taken from Internet traffic. Embedded in the frame is an IPv4 packet, starting at the fifteenth byte. Identify the following in the frame:
    a. IP destination address
    b. IP sender address
    c. IP header length
    d. Protocol in the packet's data field

    ```
    08 00 20 7c 94 1c 00 00 39 51 90 37 08 00 45 00
    00 3e 36 00 00 00 80 11 da 4f 82 eb 12 7f 82 eb
    12 0a 04 01 00 35 00 2a ee 6a 00 01 01 00 00 01
    00 00 00 00 00 00 06 67 65 6d 69 6e 69 03 6c 64
    63 02 6c 75 02 73 65 00 00 01 00 01
    ```

2. Below are three more Ethernet-II frames. We are now going to study them from a fragmentation point of view. As in previous assignments, the Preamble, SFD and CRC fields in Ethernet-II have been removed in the six frames below.
    a. Which flags have been set in the different IPv4 headers?
    b. What can be said about the identification field in the IPv4 headers?

    ```
    Ram 1:
    0000: 00 00 0c 07 ac 01 00 00 – 39 51 90 37 08 00 45 00
    0010: 05 dc 48 00 20 00 20 01 – 94 67 82 eb 12 7f 82 eb
    0020: 80 64 08 00 e3 fb 03 00 – 0c 00 61 62 63 64 65 66
    0030: 67 68 69 6a 6b 6c 6d 6e – 6f 70 71 72 73 74 75 76
    0040: 77 61 62 63 64 65 66 67 – 68 69 6a 6b 6c 6d 6e 6f
    ...
    ...

    Ram 2:
    0000: 00 00 0c 07 ac 01 00 00 – 39 51 90 37 08 00 45 00
    0010: 05 dc 48 00 20 b9 20 01 – 93 ae 82 eb 12 7f 82 eb
    0020: 80 64 61 62 63 64 65 66 – 67 68 69 6a 6b 6c 6d 6e
    0030: 6f 70 71 72 73 74 75 76 – 77 61 62 63 64 65 66 67
    0040: 68 69 6a 6b 6c 6d 6e 6f – 70 71 72 73 74 75 76 77
    ...
    ...

    Ram 3:
    0000: 00 00 0c 07 ac 01 00 00 – 39 51 90 37 08 00 45 00
    0010: 04 2c 48 00 01 72 20 01 – b4 a5 82 eb 12 7f 82 eb
    0020: 80 64 69 6a 6b 6c 6d 6e – 6f 70 71 72 73 74 75 76
    0030: 77 61 62 63 64 65 66 67 – 68 69 6a 6b 6c 6d 6e 6f
    0040: 70 71 72 73 74 75 76 77 – 61 62 63 64 65 66 67 68
    ...
    ...
    ```

3. A host with a TCP connection is using a window size of 10,000 bytes, and the previous acknowledgment number was 22,001. The host receives a segment with acknowledgment number 24,001. The host now sends two segments of 1500 bytes each. Draw a diagram to show the situation of the window before and after the latest ACK and after the transmission of the two segments.

4. A UDP datagram contains 16 byte data. Calculate the efficiency of the datagram. Further, calculate the efficiency if the UDP datagram is encapsulated in an IPv4 packet (no options) and an IPv6 packet (no extension headers) respectively.

5. A TCP-segment (no options) contains 16 byte data. Calculate the efficiency. Further, calculate the efficiency if the TCP segment is encapsulated in an IPv4-packet (no options) and an IPv6-packet (no extension headers).

6. The following is a dump of a UDP header in hexadecimal form:
    ```
    06 32 00 0D 00 1C E2 17
    ```

    Identify the following:
    a. Source port number
    b. Destination port number
    c. Total length of the UDP
    d. Length of the data field
    e. The transmission direction (to server or from server)

7. The following is a dump of a TCP header in hexadecimal form:
    ```
    05320017 00000001 00000000 500207FF 00000000
    ```

    Identify the following:
    a. Source port number
    b. Destination port number
    c. Sequence number
    d. Acknowledgement number
    e. Length of the header
    f. Type of segment
    g. Window size

8. Below is a listing of Ethernet-II traffic, in which a TCP message sequence has occurred. Preamble, SFD and CRC have been removed. Your task is to draw an event diagram. Messages are drawn as arrows between timelines (one for each host) in the diagram. Each segment is drawn as an arrow between the two hosts. The following properties should be given at each message:

    a. Type of TCP segment (ACK/FIN...)
    b. Sequence number
    c. Acknowledgement number
    d. Window size

```
Frame 1:

0000: 00 00 0c 07 ac 01 00 08 - 74 41 af a7 08 00 45 00
0010: 00 30 88 14 40 00 80 06 - d5 dc 82 eb 12 bd 82 eb
0020: 84 43 09 93 00 17 f2 d2 - 7a 29 00 00 00 00 70 02
0030: 40 00 2f a2 00 00 02 04 - 05 b4 01 01 04 02
...
...

Frame 2:
0000: 00 08 74 41 af a7 00 00 - 0c 07 ac 01 08 00 45 00
0010: 00 2c 53 3a 00 00 7e 06 - 4c bb 82 eb 84 43 82 eb
0020: 12 bd 00 17 09 93 a9 65 - ab 46 f2 d2 7a 2a 60 12
0030: 0b b8 24 38 00 00 02 04 - 05 b0 00 00
...
...


Frame 3:
0000: 00 00 0c 07 ac 01 00 08 - 74 41 af a7 08 00 45 00
0010: 00 28 88 15 40 00 80 06 - d5 e3 82 eb 12 bd 82 eb
0020: 84 43 09 93 00 17 f2 d2 - 7a 2a a9 65 ab 47 50 10
0030: 44 40 03 69 00 00 00 00 - 00 00 00 00
...
...


Frame 4:
0000: 00 08 74 41 af a7 00 00 - 0c 07 ac 01 08 00 45 00
0010: 00 2b 53 3b 00 00 7e 06 - 4c bb 82 eb 84 43 82 eb
0020: 12 bd 00 17 09 93 a9 65 - ab 47 f2 d2 7a 2a 50 18
0030: 0b b8 23 e8 00 00 ff fd - 18 00 00 00
...
...

Frame 5:
0000: 00 00 0c 07 ac 01 00 08 - 74 41 af a7 08 00 45 00
0010: 00 2e 88 16 40 00 80 06 - d5 dc 82 eb 12 bd 82 eb
0020: 84 43 09 93 00 17 f2 d2 - 7a 2a a9 65 ab 4a 50 18
0030: 44 3d ef 3f 00 00 ff fb - 18 ff fb 1f
...
...

Frame 6:
0000: 00 08 74 41 af a7 00 00 - 0c 07 ac 01 08 00 45 00
0010: 00 31 53 3c 00 00 7e 06 - 4c b4 82 eb 84 43 82 eb
0020: 12 bd 00 17 09 93 a9 65 - ab 4a f2 d2 7a 30 50 18
0030: 0b b8 04 eb 00 00 ff fa - 18 01 ff f0 ff fe 1f
```