NETWORKS AND PROTOCOLS

Exercise Sheet 4

Exercise 1

Consider the following ip datagrams:

<table>
<tr><td>100</td><td>101</td><td>111111xx</td><td colspan="2">0000 0000 0101 1010</td></tr>
<tr><td colspan="3">0000 0000 0000 1010</td><td>0x0</td><td>0001 1000 0110</td></tr>
<tr><td colspan="2">0000 0001</td><td>0000 0110</td><td colspan="2">?</td></tr>
<tr><td colspan="5">00001111.11110000.00001111.10001001</td></tr>
<tr><td colspan="5">00001111.11110000.00001111.11111111</td></tr>
<tr><td colspan="5">Data (Datagram D)</td></tr>
</table>

<table>
<tr><td>100</td><td>101</td><td>111111xx</td><td colspan="2">1011 1001 0011 0000</td></tr>
<tr><td colspan="3">0000 0000 0000 1011</td><td>0x0</td><td>0000 0000 0000</td></tr>
<tr><td colspan="2">0000 0001</td><td>0000 0110</td><td colspan="2">?</td></tr>
<tr><td colspan="5">00001111.11110000.00001111.10001001</td></tr>
<tr><td colspan="5">00001111.11110000.00001111.11111111</td></tr>
<tr><td colspan="5">Data (Datagram B)</td></tr>
</table>

<table>
<tr><td>100</td><td>101</td><td>111111xx</td><td colspan="2">0000 0000 0101 0100</td></tr>
<tr><td colspan="3">0000 0000 0000 1010</td><td>0x1</td><td>0000 0000 0000</td></tr>
<tr><td colspan="2">0000 0001</td><td>0000 0110</td><td colspan="2">?</td></tr>
<tr><td colspan="5">00001111.11110000.00001111.10001001</td></tr>
<tr><td colspan="5">00001111.11110000.00001111.11111111</td></tr>
<tr><td colspan="5">Data (Datagram C)</td></tr>
</table>

<table>
<tr><td>100</td><td>101</td><td>111111xx</td><td colspan="2">TL</td></tr>
<tr><td colspan="3">0000 0000 0000 1010</td><td>0x1</td><td>Offset</td></tr>
<tr><td colspan="2">0000 0001</td><td>0000 0110</td><td colspan="2">?</td></tr>
<tr><td colspan="5">00001111.11110000.00001111.10001001</td></tr>
<tr><td colspan="5">00001111.11110000.00001111.11111111</td></tr>
<tr><td colspan="5">Data (Datagram A)</td></tr>
</table>

1. Which datagrams carry fragments?
2. Calculate the data size of datagram A ;
3. If datagram A is a fragment, calculate its displacement;
4. Reassemble the different fragments of the same datagram;
5. Calculate the total size of the original message.
6. Is there any inconsistency in this message? If so, find it.

Exercise 2

Consider a network with an MTU of 150 bytes.

1. Calculate the payload of an IP packet for this network.
2. Deduce the actual size of a fragment in this network.
3. The original datagram is 576 bytes long. Its ID field is 4345. How many datagrams will this packet be fragmented into?
4. What will be the size in bytes of the "Data" field in the last fragment?
5. What is the offset field value for each fragment?

Exercise 3

Faced with a number of malfunctions in your network, you decide to install an analyzer. This captures and decodes all fields. It provides you with the following information:

- IP datagram version 4, no particular option or service invoked, checksum correct
- source address 194.225.18.5
- destination address 194.225.18.7
- data field length 40 bytes
- datagram ID 28 246D (D for decimal)
- TTL 255
- DF and M bits are set to 0 respectively
- the data field encapsulates a TCP segment (identification 0x06)

Based on the above information, you are asked to reconstruct all the fields of the datagram as trapped by the analyzer (in Hexa). The figure below shows the structure of the IP datagram.

Exercise 4

Consider the topology in figure 1 :

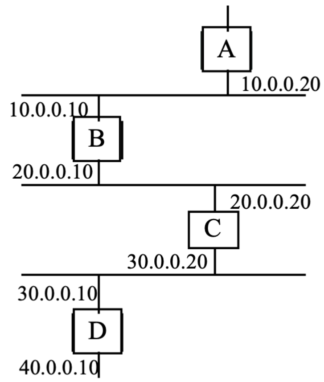

Figure 1: Exercise 4

Subnet 20 only accepts IP packets up to 492 bytes in size. This value is set by the frame format used to transport these packets. The other subnetworks are Ethernet with a maximum frame size of 1518 bytes. Describe what happens at the Ethernet and IP levels, as you pass through Gateway B, when a 1500-byte frame is sent from network 10 to network 30.

Exercise 5

A TCP connection is established by exchanging three-way handshakes.

1. Why three messages? Wouldn't two have been enough?
2. Recall the messages exchanged on a diagram, specifying the fields essential to the establishment.
3. Why doesn't the numbering start at 0?
4. When host A receives two SYN segments from the same port on host B, the second SYN may be a retransmission of the original SYN, or a new connection request (in the case of a failure followed by a reboot of B). How does A differentiate between these two cases?
5. IP has an Identification field for its datagrams. Isn't this redundant with TCP's SequenceNumber field?
6. The 32 bits are sufficient to cover 4 billion bytes of data. Even considering that this amount of data will never be transferred over a single connection, why is it possible to see the sequence number change from $2^{31} - 1$ to 0?
7. Consider TCP operating on a 1 Gbit/s link. How long does it take for the sequence number to loop back completely?

Exercise 6

The TCP exchange shown in the figure 2 corresponds to the transfer of a WEB page between a WEB browser and a WEB server.
WEB page between a WEB browser and a WEB server. It is assumed that the request to the WEB page is 100 bytes and that the WEB page returned is 1000 bytes. There are no transmission errors. For each data segment segment, different information is displayed.
On the one hand, the presence indicators such as SYN, FIN, ACK. By In addition, two digits are shown on the first line. The first digit corresponds to the sequence number of the first byte of the segment, the second second digit corresponds to the number of the first byte of the next segment to be sent. The number in brackets corresponds to the total number bytes transmitted in the segment.
If the segment has a positive positive acknowledgement, the ACK flag is displayed and next to it the the value of the TCP segment acknowledgement field.

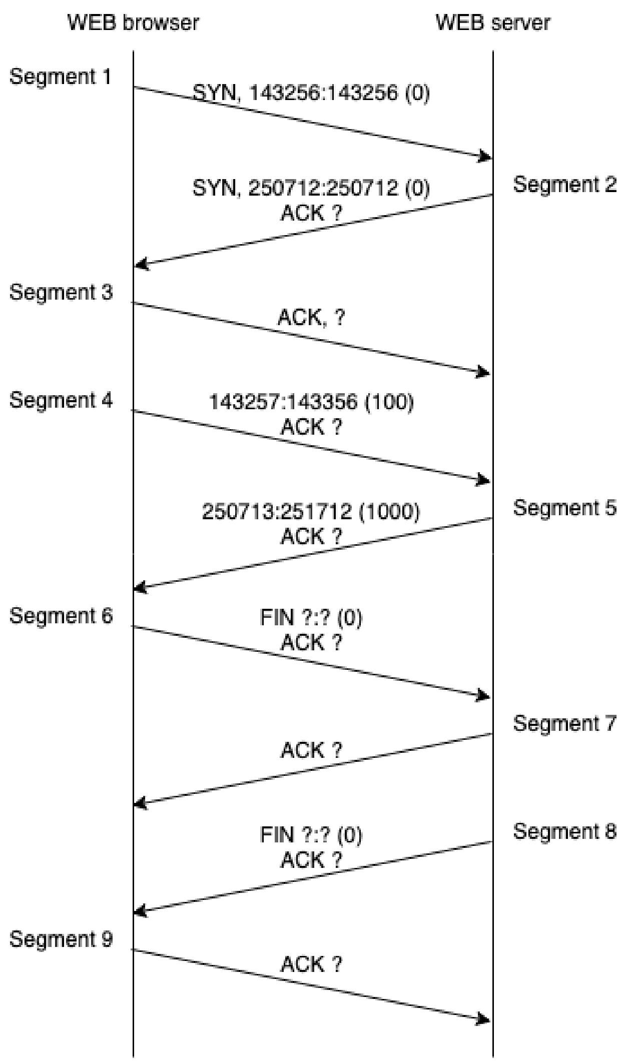

Figure 2: Exercise 6