Solution TD4

Exercise 1

1- Datagrams carrying fragments:
- These are A, C and D
- Datagram C, A: more = 1
- Datagram D: offset field not 0

2- The data size of datagram A:
- The datagrams A, C, D follow an order (C -> A -> D), so to calculate the size of the data in data length of C, and the offset of D to find the required value,
  - The data size of C = Total length - head length
  - $(0000\ 0000\ 0101\ 1010)_2$ - $(101)_2$
  - 84 - 20 bytes
  - 64 bytes
- The offset of D
  - $(0001\ 1000\ 0110)_2 \times 8$ bytes
  - 390×8 bytes
  - 3120 bytes
- A data size = 3120 - 64 bytes = 3056 bytes

3- Offset of the A datagram:
- It comes from the end of the C datagram, i.e. its total length - the header.
- Offset of A = 64 bytes $(0000\ 0000\ 1000)_2$

4- Fragments of the same datagram
- Fragments C - A - D belong to the same datagram
- Equal identifiers
- Offset of C is 0,
- A's flag M is 1
- D's flag M is 0

5- Total size of original message
- Calculate the data size of each datagram
- A data = 3056 bytes
- Data from C = 64 bytes
- Data from D = 70 bytes
- Data from B = 47388 bytes
- Total length = 50578 bytes

6- There is indeed an inconsistency in this message.
- The length of datagram B is very long compared to the other datagrams.
- The offset field is 0, which could indicate that it is the first in a list.
- But Flag M is set to zero, meaning that it is not fragmented.

Exercise 2

1- 150-20=130

2- 130/8=16.25

For a fragment size of 16x8=128 bytes

3- 576 - 20 (Header) = 556 bytes

556/128 = 4.34 i.e. 4 fragments of 128 bytes and one of 44 bytes.

4- 44 bytes

5- OFFSET FRAG1 = 0

OFFSET FRAG2 = 16

OFFSET FRAG3 = 32

OFFSET FRAG4 = 48

OFFSET FRAG5 = 64

Exercise 3

4	5	00	00	3C
6E		56	00	00
FF		06	**A3**	**96**
C2		E1	12	05
C2		E1	12	07

Exercise 4

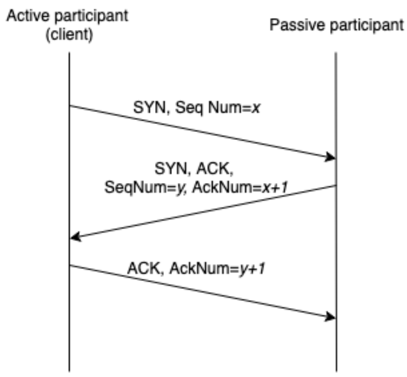
A 1500-byte frame is made up of the Ethernet header, which is 26 bytes long, so each IP packet has a size of 1500-26=1474 bytes.
When passing through B, the IP packet is fragmented so that its contents fit into 492-byte packets.
To achieve this, each packet is split into three 492-byte packets for the first two and 490-byte packets for the last. The flags and fragment offset bits are set accordingly. In addition, the TTL (Time to Live) is modified, the checksum is recalculated, etc. These modified packets are then transmitted on network 20.

Exercise 5

1- With 2 messages the caller of the connection receives a data segment for a connection that is awaiting establishment confirmation.

With 3 messages (right-hand drawing), the called party must wait to receive an acknowledgement of its confirmation (in the form of data or acknowledgement) before being able to transmit its own data. This prevents the caller from finding himself in an ill-defined state.

2- Here is a diagram of the messages exchanged



3- A TCP connection is identified by (port S, host S, port D, host D). It is quite possible to open a connection between machines A and B, ports X and Y, close it, then some time later open a new connection, still between machines A and B and ports X and Y. In this case, we're talking about different incarnations of the same connection.

The initial sequence number (ISN) is chosen to avoid this situation. Originally, it was to be drawn randomly; in practice, it is usually updated by a 32-bit counter incremented every $4\,\mu s$.

4- If the SYN is a retransmission, its ISN value is the same as in the first SYN. Otherwise, and if the ISN values are generated by a clock, then the ISN of the second SYN will be different from that of the first SYN.

5- No: Identification only identifies fragments from the same datagram. On reception, the reassembled datagram can be de-sequenced. The TCP segment it contains is therefore also de-sequenced, and SequenceNumber can be used to manage this de-sequencing.

6- NumSeq does not start at 0 for a transfer: the initial ISN number is generated, either randomly, or usually on the basis of a clock (incremented every 4 s).

7- 1 Gbit/s is exactly 125 MB/s. Furthermore, the sequence numbers loop back when 2^{32} bytes are sent, i.e. around 4 GB. Therefore, it takes 4 GB/125 MB/s, or 32 s.

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Exercise 6