Transport Layer

Questions

Question 1

In both parts of the Internet File Server example, there is a comment that the value of SERVER PORT must be the same in both client and server.

Why is this so important?

- Server only listens to certain ports.
- If port no. does not correspond, packet cannot be delivered to process.

Question 2

Suppose that the clock-driven scheme for generating initial sequence numbers is used with a **15-bit wide clock counter**. The clock **ticks** once every **100 msec**, and the maximum packet lifetime is **60 sec**. How often need resynchronization take place:

(a) in the worst case?

(b) when the data consumes 240 sequence numbers/min?

32768 ticks = 3276.8 s

Zero generation rate.

would enter forbidden zone at

$3276.8 - 60 = 3216.8$ s

Sequence number = 4t

left edge of forbidden region

$t = 5361.3$ s

$10(t - 3216.8)$

- Additional note re. Q2:

Left edge of forbidden region given by:

$y = 10\,(t - 3216.8)$

Sequence numbers (assuming they start at 0):

$y = 4t$

To find where they intersect:

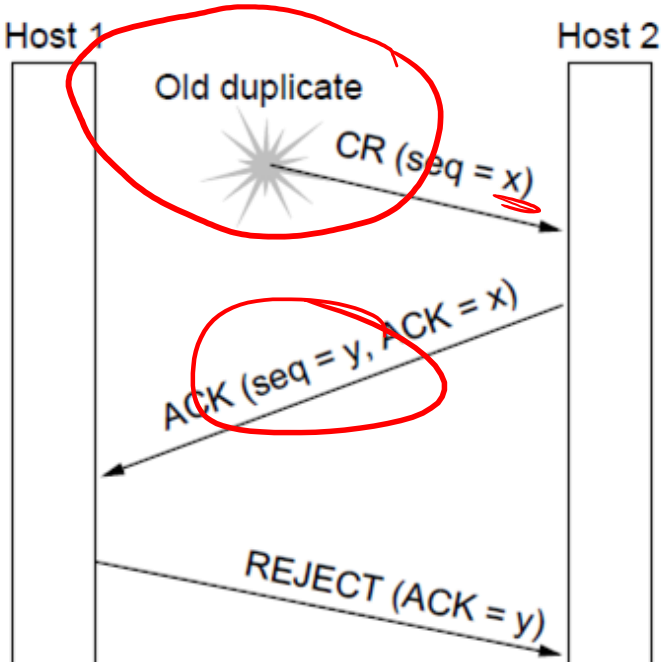
$4t = 10\,(t - 3216.8)$

$\Rightarrow 6t = 32168$

$\Rightarrow t = 5361.3$ s

Question 3

Why does the **maximum packet lifetime, T,** have to be large enough to ensure that not only the packet but also its acknowledgements have vanished?



Question 4

Why does **UDP** exist? Would it not have been enough to just let user processes send **raw IP packets**?

- UDP packets include a dest. port.
- Allows them to be delivered to correct process.

Question 5

Both **UDP** and **TCP** use **port numbers** to identify the destination entity when delivering a message. Give two reasons why these protocols invented a **new abstract ID (port numbers), instead of using process IDs**, which already existed when these protocols were designed.

1. Port number may be well-known, for a certain service.
2. Different OS's can generate different process IDs.
3. A single process may set up multiple lines of communication. Need to discriminate between them.

Question 6

A process on host 1 has been assigned port p, and a process on host 2 has been assigned port q.

Is it possible for there to be **two or more TCP connections** between these two ports at the same time?

- Connection defined by its sockets.

(1-p) — (2,q)

is only possible connection.

Question 7

In a network whose **max segment** is **128 bytes**, max **segment lifetime** is **30 sec**, and has **8-bit sequence numbers**, what is the maximum data rate per connection?

$$255 \times 128 \times 8 = 261,120$$

$$\frac{261,120}{30} = 8,704 \text{ bps}$$

Question 8

To get around the problem of sequence numbers wrapping around while old packets still exist, one **could use 64-bit sequence numbers**.

However, theoretically, an **optical fiber can run at 75 Tbps**. What **maximum packet lifetime** is required to make sure that future 75-Tbps networks do not have wraparound problems even with 64-bit sequence numbers?

Assume that **each byte has its own sequence number**, as TCP does.

Size of sequence space 2^{64} bytes $\approx 2 \times 10^{19}$ bytes

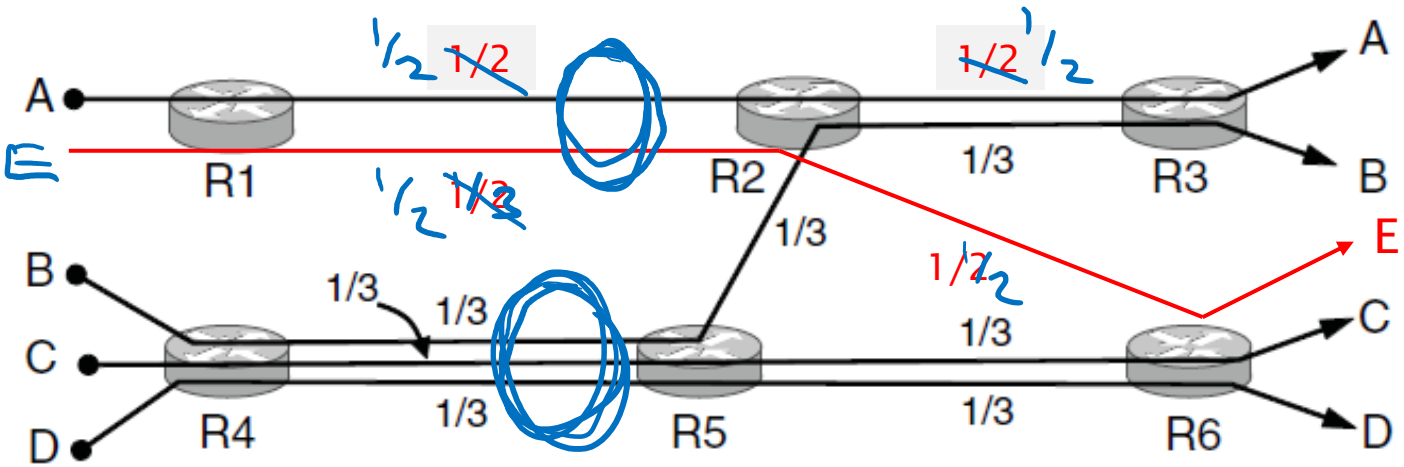
75 Tbps uses up sequence space at approx 9.4×10^{12} seq no's / second.

would take 2Ms to wrap around!

\ 3 weeks

Question 9

Suppose a new flow *E* is added that takes a path from *R1* to *R2* to *R6*. How does the max-min bandwidth allocation change for the five flows?



Question 10

Some policies for fairness in congestion control are:

1. Additive Increase Additive Decrease (AIAD)
2. Multiplicative Increase Additive Decrease (MIAD)
3. Multiplicative Increase Multiplicative Decrease (MIMD)

What are their convergence and stability properties?