

Pearl 101 of Computer Science (201300070) and Introduction to BIT (201300073)

9 October 2015, 13:45–14:45

- You are allowed to use one A4-sized sheet of paper with your own notes at this exam, and a *simple* calculator.
- The number of points per question is indicated in the margin.

1. Operating systems

- 10 pt (a) Describe briefly, in your own words, what the function *input/output* of an operating system is.
- 10 pt (b) Is the function *protection* also relevant in operating systems for computers that are used by only one person? Explain.
- 10 pt (c) One of the tasks of an operating system is “swapping”. Is it conceivable that parts of the operating system itself are swapped? If so, what part for example? Explain.

2. Networks – protocols

- 9 pt (a) Explain briefly how we owe it (among others) to “layering” that so many different applications work in the internet.
- 9 pt (b) Suppose I establish a TCP connection from my laptop, connected wirelessly to the UT network, to a server somewhere on the internet. Without switching off my laptop, I transport it home, and connect it there (again wirelessly) to my home network, which runs over a commercial internet service provider.
Does that TCP connection “survive” this? In other words, can I still, without setting up a new connection using SYN packets, send data to that server and get acknowledgements back?
- 12 pt (c) Below, you see a few consecutive network packets as displayed by Wireshark running on host 130.89.13.213. There is nothing wrong with these packets, but two packets have been lost (i.e., sent by one host but not received by the other host). Which are those, and how do you see that?

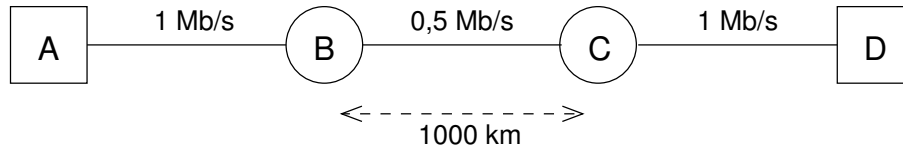
Note: the setting up and tearing down of the connection(s), using SYN and FIN packets, has been omitted here for clarity; so it's not those packets that got lost.

source IP	destination IP		source/dest.port	TCP seq./ack.numbers
130.89.13.213	130.89.144.74	TCP	56922 > 7701	[ACK] Seq=250 Ack=2001 Len=30
130.89.13.213	130.89.144.74	TCP	56922 > 7701	[ACK] Seq=250 Ack=2001 Len=50
130.89.144.74	130.89.13.213	TCP	7701 > 56922	[ACK] Seq=2001 Ack=300 Len=200
130.89.13.213	130.89.144.74	TCP	56922 > 7701	[ACK] Seq=300 Ack=2201 Len=0
130.89.144.74	130.89.13.213	TCP	7701 > 56922	[ACK] Seq=2001 Ack=300 Len=200
130.89.13.213	130.89.144.74	TCP	56922 > 7701	[ACK] Seq=300 Ack=2201 Len=0

Z.o.z. voor vervolg...

3. Networks – delay

Consider a network consisting of an endhost A, two routers B and C, and an endhost D. The only path from A to D is via B and C. The link from A to B is 1 megabit/s, from B to C 0.5 megabit/s, and from C to D 2 megabit/s.



An application on host A generates 3 packets of 1000 bits each (incl. headers), with intervals of 0.001 s, destined for host D. There is no other traffic in this network.

We assume that the computation time needed by routers B and C to decide where to send the packet, is negligible. We also assume that A is geographically close to B, and C close to D; the cable from B to C is 1000 km long, and the signals travel over it at 200 000 km/s.

- 12 pt (a) In the theory we saw that the delay per link per packet consists of four components. One of them is queuing delay, to which we will get back in question (b). Calculate the other components for each of the links, or explain why they are negligible.
- 8 pt (b) At which point(s) in this network will *queuing delay* occur? Explain.
- 20 pt (c) Calculate how long it takes until all packets have arrived at host D, i.e., how much time elapses between the moment host A generates the first packet, and the moment host D receives the last bit of the last packet?
Make your reasoning clear.

End of this test.