Network Systems (201600146/201600197), Test 2

March 8, 2019, 13:45–15:15

- This is an open-book exam: you are allowed to use the book by Peterson & Davie and the reader that belongs to this module, and the handout about peer-to-peer communication (i.e., the part of the Kurose&Ross book distributed via Canvas). Furthermore, use of a dictionary is allowed. Use of a simple (non-graphical) calculator is allowed.
- For accessing the on-line books, use of the UT-provided Chromebook is allowed.
- Other written materials, and laptops, tablets, graphical calculators, mobile phones, etc., are not allowed. ***Please remove any such material and equipment from your desk, now!***
- Visiting the toilet without explicit permission of the supervisor is not allowed. During the last 30 minutes of the exam, no toilet visits are allowed.
- Write your answers to open questions on this paper, in the provided boxes, and hand this in.
- Questions marked with (MC) must be answered on the separate multiple-choice form, at the number indicated in the circle.
- Total number of pages: 6.
- Total number of points: 29.

Your name:

(please underline your family name (i.e., the name on your student card), so that we know how to sort)

Your student number:

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1. Physical media

1 pt (a) An 800 km long cable has to be installed between the cities Donlon and Drussels. What would you advise?

MC**01**

A. Use coaxial copper cable, because it is waterproof.
B. Use twisted pair copper cable, because the twists make eavesdropping impossible.
C. Use multimode glass fiber, because it avoids total internal reflection.
D. Use graded index fiber, because it has lowest latency.
E. Use single-mode glass fiber, because it allows highest speeds.

1 pt (b) Which of the following statements about radio communication is true?

MC**02**

A. Multipath makes receiving radio signals easier.
B. Radio waves with a long wavelength can easily be focussed using a parabolic dish.
C. Radio waves with a short wavelength can easily propagate around obstacles.
D. Radio waves can reflect off metal buildings.
E. Radio waves are absorbed by air and therefore cannot travel further than a few km.
F. In space, the strength of a radio wave does not depend on the distance to the transmitter.

1 pt (c) During debates about Drexit (the hypothetical separation of Great Drittain from the Deuropean Union), the signal-to-noise ratio (SNR) in the Dritish parliament can get rather low. What happens to the channel capacity of an analog channel, when the SNR (signal power divided by noise power) becomes very low?

MC**03**

A. When SNR < 1, the capacity is 0.
B. When SNR < 0, the capacity is 0.
C. When SNR goes to zero, the capacity goes to infinity.
D. When SNR goes to zero, the capacity approaches some non-zero limit value.
E. For small SNR, the capacity is approximately linearly proportional to the SNR.
F. For small SNR, the capacity is approximately linearly proportional to $\log_2$ of the SNR.

1 pt (d) Consider framing using `01111110` flags and bit stuffing. If the receiver receives the bits `0111110`x`0`, what should it do?

MC**04**

A. Treat it as the end of the frame, regardless of x.
B. Treat it as the end of the frame only if $x =$ `0`.
C. Treat it as the end of the frame only if $x =$ `1`.
D. Remove the zero before the x, regardless of x.
E. Remove the zero before the x only if $x = 0$.
F. Remove the zero before the x only if $x = 1$.
G. Ignore the frame, since it must contain a bit error.

1 pt (e) Consider a (hypothetical) 3B4B encoding, using the bit patterns 0010, 0011, 0101, 1001, 1010, 1101, 1110 and one more. If we never want more than three consecutive 0s and never more than five consecutive 1s, what would be a good choice for the "one more" bit pattern? (If multiple options are correct, choose the first one that is applicable.)

MC**05** **A.** 1111 **B.** 1100 **C.** 1011 **D.** 1000 **E.** 0110 **F.** 0100 **G.** none

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2. Sharing a medium

The chairman of the Dritish parliament gets tired of shouting "Order, order!" during the Drexit debates and wants to modernize this process. He views the 650 talking MPs (Members of Parliament) as 650 computers transmitting on a shared medium, so he can choose a Medium Access mechanism inspired by computer networking.

One concern is efficiency, which we define as fraction of the time that is actually used for successful speech of MPs (not polls, collisions, etc.).

1 pt (a) Suppose we use a slotted ALOHA system, and 65 MPs want to talk. What is the maximum possible efficiency?

MC**06** **A.** 10 % **B.** 18 % **C.** 37 % **D.** 63 % **E.** 82 % **F.** 90 % **G.** 100 %

1 pt (b) Continuation of the previous question: for what value of the transmission probability p is the maximum efficiency achieved?

MC**07** **A.** 0.15 % **B.** 1.5 % **C.** 6.5 % **D.** 10 % **E.** 18 % **F.** 65 % **G.** 100 %

2 pt (c) Suppose we use a polling scheme, where the poll takes 5 seconds and each MP is allowed to speak for at most 45 seconds when he/she is polled. Assume that 65 of the MPs speak for the full 45 seconds whenever they are polled, while the others say nothing. Calculate the efficiency.

1 pt (d) Continuation of the previous question: under what circumstances would the efficiency be maximized?

MC08

A. if none of the MPs speak when polled.
B. if only one MP speaks when polled.
C. if 10% of the MPs speak when polled.
D. if 36% of the MPs speak when polled.
E. if 90% of the MPs speak when polled.
F. if all of the MPs speak when polled.
G. if all MPs vote in favour of Drexit.

1 pt (e) Another concern is fairness. Is it possible to guarantee an upper bound on how long it takes before an MP can succesfully speak?

MC09

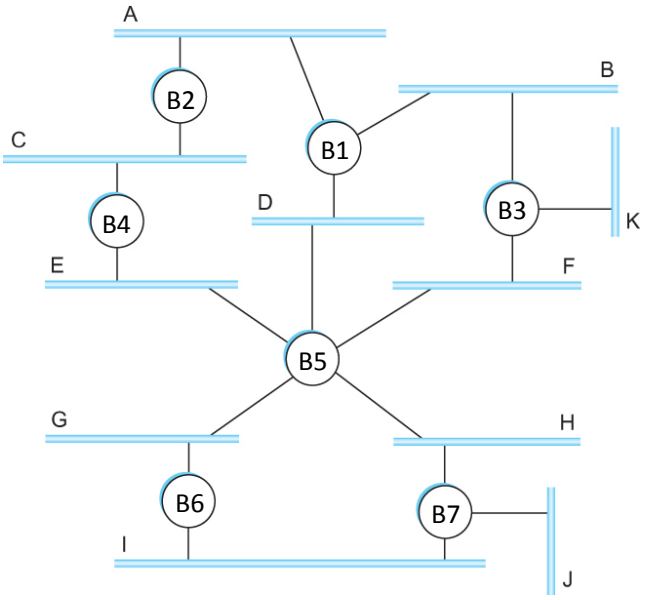
A. ALOHA can guarantee an upper bound, polling cannot.
B. Polling can guarantee an upper bound, ALOHA cannot.
C. Neither ALOHA nor polling can guarantee an upper bound.
D. Both can guarantee an upper bound, but in ALOHA this upper bound is higher.
E. Both can guarantee an upper bound, but in polling this upper bound is higher.
F. Speaking succesfully about Drexit is not possible.

Finally, regardless of Drexit, consider a cable with 3 nodes, A, B, and C. Nodes A and C are at the two ends of the cable, and node B is in the middle, between them. The nodes use Carrier Sense Multiple Access (CSMA), but in node C, the 'carrier sense' circuitry is broken so it always senses the medium as free.

2 pt (f) Describe a scenario in a space-time diagram (analogue to Figure 5.12 in part 5 of the reader) where B and C both transmit a packet, but there is only a collision at node C.
Note: So, the answer to be given should be the space-time diagram.

3. (Inter)Networking

Consider the extended LAN shown in the figure below. We consider the situation where the spanning tree algorithm has converged.



1 pt (a) Which of the bridges has been selected by the algorithm as the root bridge?

MC10

A. B1 **B.** B2 **C.** B3 **D.** B4 **E.** B5 **F.** an arbitrary one
G. none, because there are loops in this network

2 pt (b) Which of the interfaces of which bridges will have been switched off after convergence of the spanning tree algorithm? (Give a list of interfaces in the form Bridgename-LAN, e.g., B1-A)

1 pt (c) Suppose has bridge B2 been misconfigured by an engineer of company XS4none, and as a result, B2 will forward all messages of the spanning tree algorithm it receives without change to its other interface(s). What will be the result?

MC11

A. Nothing. The spanning tree algorithm will function properly.
B. Its neighbour bridges B1 and B4 will believe they are directly connected with a LAN, and act accordingly.
C. Its neighbour bridges B1 and B4 will believe they are not connected via A and C, and act accordingly.
D. Its neighbour bridges B1 and B4 will detect the misconfiguration and act by setting up a tree without B2.
E. B5 will detect the problem, because it receives incompatible messages from B1 and B4, and exclude B2 from the network.
F. The problem will be corrected by the ARQ mechanism.
G. The spanning tree algorithm will fail completely, leaving loops in the network.

2 pt (d) Consider a three-link configuration A—X—Y—B, where host A is connected with a link to a router X, router X to router Y, and router Y is connected to host B. All nodes support IPv4. The link A—X has MTU 1500 bytes, the link X—Y has MTU 500 bytes, and the link Y—B has MTU 492 bytes. Suppose host A is sending a 1000 byte packet to B. Assume that there is no packet loss due to bit errors or buffer overflow.

How many packets will flow over X—Y? [ ] And how many will arrive at host B? [ ]

Suppose a router is applying longest prefix matching and has the following table:

Prefix/Length	Next Hop
130.89.103.114/29	Interface 0
130.89.103.114/32	Interface 1
130.89.103.0/24	R2
130.89.103.64/28	R3
128.96.128.0/20	R4
0.0.0.0/0	R5

For each of the following addresses indicate to which Next Hop a packet with this address will be forwarded, or select 'drop' if the packet should be dropped instead of forwarded.

1 pt (e) 130.89.103.114

MC12 **A.** Interface 0 **B.** Interface 1 **C.** R2 **D.** R3 **E.** R4 **F.** R5 **G.** drop

1 pt (f) 130.89.103.70

MC13 **A.** Interface 0 **B.** Interface 1 **C.** R2 **D.** R3 **E.** R4 **F.** R5 **G.** drop

1 pt (g) 128.96.196.34

MC14 **A.** Interface 0 **B.** Interface 1 **C.** R2 **D.** R3 **E.** R4 **F.** R5 **G.** drop

1 pt (h) Suppose we know the hostname of a host. Using which protocols can we find its MAC address?

MC15
A. Only ARP.
B. Only DNS.
C. First ARP, then DNS.
D. First DNS, then ARP.
E. First ARP, then DNS twice.
F. First DNS, then ARP, then DNS again.
G. It is not possible.

1 pt (i) As a packet travels from one host via some *routers* to another host over several ethernet LANs, which of the following is true?

MC16
A. Only its IP source address changes.
B. Only its IP destination address changes.
C. Both its IP source and IP destination address change.
D. Only its MAC source address changes.
E. Only its MAC destination address changes.
F. Both its MAC source and MAC destination address change.
G. No addresses change.

4. Routing

1 pt (a) What is the difference between routing and forwarding?

MC17

A. Routing is filling the forwarding tables in the routers, whereas forwarding is moving packets from an incoming links of a router to the right outgoing link.

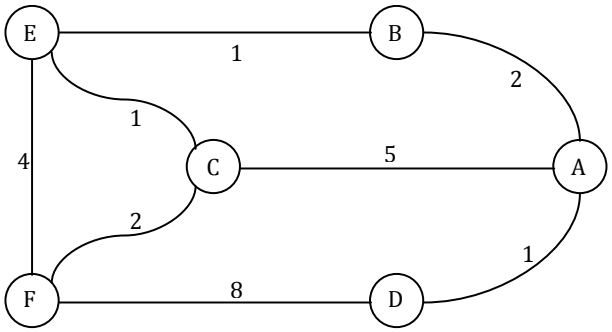
B. Forwarding distributes all link-state information to all routers, whereas routing is the network function that fills the forwarding tables in routers,

C. Routing is the network function that determines the routes through the network, whereas forwarding distributes all calculated forwarding tables to the routers.

D. Routing is used in routers, forwarding in switches.

E. There is no difference, both can be used interchangeably.

4 pt (b) Consider the Dijkstra algorithm running on node A of the sketched network. This algorithm maintains known paths to destinations (of the form `(Destination, Cost, NextHop)` in two lists: `Tentative` and `Confirmed`. Show for each iteration of the algorithm the entries in both lists, by making a table with 3 columns (`Step`, `Confirmed`, `Tentative`), and at least one row per iteration.



Step	Confirmed	Tentative

End of this exam.