TDTS06 – Computer networks (TEN1)
Final Examination: 14:00-18:00, Saturday, August 25, 2012
Time: 240 minutes
Total Marks: 40
Grade Requirements: three (20/40); four (28/40); and five (36/40).
Assistance: None (closed book, closed notes, and no electronics)
Instructor: Niklas Carlsson

Instructions:

- Read all instructions carefully (including these)!!!! Some questions have multiple tasks/parts. Please make sure to address *all* of these.
- The total possible marks granted for each question are given in parentheses. The entire test will be graded out of 40. This gives you 10 marks per hour, or six minutes per mark, plan your time accordingly.
- This examination consists of a total of 12 questions. Check to ensure that this exam is complete.
- When applicable, please explain how you derived your answers. Your final answers should be clearly stated.
- Write answers legibly; no marks will be given for answers that cannot be read easily.
- Where a discourse or discussion is called for, be concise and precise.
- If necessary, state any assumptions you made in answering a question. However, remember to read the instructions for each question carefully and answer the questions as precisely as possible. Solving the *wrong* question may result in deductions! It is better to solve the *right* question incorrectly, than the *wrong* question correctly.
- Please write your AID number, exam code, page numbers (even if the questions indicate numbers as well), etc. at the top/header of each page. (This ensures that marks always can be accredited to the correct individual, while ensuring that the exam is anonymous.)
- Answers can be provided in either English or Swedish. (If needed, feel free to bring a dictionary from an official publisher. Hardcopy, not electronic!! Also, your dictionary is not allowed to contain any notes; only the printed text by the publisher.)
- Good luck with the exam.

1) Question: Forwarding (4)

Show, illustrate, and explain the path of a Hyper Text Transfer Protocol (HTTP) POST message (that fits into a single frame) as it is sent from a client to a Web server. You can make the following assumptions:

- The client machine uses Ethernet, has a single interface with a MAC address AA:AA:AA:BB:BB:BB and an IP address 111.222.111.222
- The MAC and IP addresses of the HTTP server are DD:DD:DD:DD:DD:DD and 222.222.111.111. Similar to the client, the server has a single interface.
- The gateway router closest to the client has four interfaces. The first is the interface closest to the client and has MAC and IP addresses BB:BB:BB:BB:BB:BB and 111.222.111.111. The second interface has MAC and IP addresses CC:CC:CC:BB:BB:BB and 111.222.122.122. The third interface has MAC and IP addresses AA:CC:AA:CC:AA:CC and 111.222.133.133. Finally, the fourth interface has MAC and IP addresses AA:AA:AA:DD:DD:DD and 111.222.144.144.
- The routing table at the gateway router has many entries. However, for this question, the three most closely matching entries for each interface states 222.222.0.0/18 (over interface 2), 222.222.192.0/18 (over interface 3), and 222.222.0.0/16 (over interface 4).

In addition to the above answers, you should also draw a picture of the topology and clearly state any assumptions you make about the topology (including parts of the networks not explained above) or anything else needed to solve the question. As with all your answers it is important that you also explain how you derived your answer. For example, why was the packet taking this particular route?

2) Question: Encapsulation (4)

Consider the same scenario as in question 1 (above). Show and illustrate the single link-layer frame for the Hyper Text Transfer Protocol (HTTP) POST message (that fits into a single frame) when it is passed down to the physical layer of the client on its way towards the Web server. You do not have to show all the details of the different headers; however, you should (i) specify what protocols the different headers are associated with, and (ii) provide the address information associated with the source and destination fields for each of the different headers (contained within this frame).

3) Question: TCP fairness (4)

Assume a bottleneck link with four users behind it A, B, C, and D? Assume that they are all downloading large files from different servers, but that their bandwidth bottleneck is the shared link. Assume A uses two connections, B one connection, C three connections and D four connections. The round trip time (RTT) for the connections of clients A and B are 50ms and the RTT for clients C and D are 150ms. Furthermore assume that the total bandwidth of the link is 50Mbps. Estimate the download rate of the different clients?

4) Question: TCP slow start (4)

Consider two machines A and B which are located 100ms apart. Assume that A is requesting a file from B using HTTP. Draw a figure and explain the entire communication sequence, including TCP handshake and connection teardown. You can assume that the payload is 20 packets and each packet can be sent in 1ms, and that the sixth (6) packet is lost. For simplicity, you can assume that the TCP version is implementing fast retransmit, initially have ssthresh = 4, and the timeout period is constant at 400ms.

5) Question: TCP (2)

Please provide an example (using a figure and supporting text) of a triple duplicate ACK. Your answer should explain what it is and what action typically is taken at such an event.

6) Question: BGP routing (4)

Please explain how the Border Gateway Protocol (BGP) picks between two paths. The first path has a one-way delay of 150ms, three AS-hops, and the other path has a one-way delay of 100 ms, and is three AS-hops away. (Here, AS stands for Autonomous System.) Your answer should explain any assumptions you must make regarding the use of different gateways, their distance to the current router, as well as the impact of any potential business agreements between the different AS. Please use a picture and carefully explain your answer.

7) Question: Distance vector routing (4)

Consider a node A with neighbors B, C, and D. Node A currently has the distance table below. (Note that the network currently is not in a very good shape, and a few routing table updates will be needed to get the network back into shape.) Assume that it receives an updated distance vector from neighbor B which looks as follows [∞, 0, 2, 4, 7, 10, 3]. First, update the table below, including A's own distance vector. Second, assume that poison reverse is implemented, and explain what information the node sends to each its neighbors (after the table has been updated).

	Costs			
Destination	A (via)	B	C	D
A	0 (A)	∞	∞	∞
B	1 (B)	0	4	2
C	1 (C)	2	0	3
D	1 (D)	3	5	0
E	? (?)	8	7	10
F	? (?)	3	9	6
G	? (?)	11	6	4

8) Question: Forwarding vs. routing (2)
Please explain the main difference between forwarding and routing.

9) Question: 802.11 (4)
The 802.11 protocol can handle some hidden-terminal problems using the RTS-CTS mechanism. Please explain the following: (a) What is the hidden-terminal problem? When and how does it occur? (b) How does the RTS-CTS mechanism help towards solving the hidden-terminal problem? Please illustrate with the communication sequence when two nodes A and C both want to communicate with an intermediate node B.

10) Question: BitTorrent (2)
Please explain what incentive BitTorrent provides peers to upload pieces to others?

11) Question: Steady-state throughput (4)
Explain why TCP is not well equipped for mobile environments. For this question, you may want to illustrate and discuss what the expected steady state throughput may be under different packet loss rates.

12) Question: MAC vs IP (2)
Why do we need both an IP and a MAC address?

Good luck!!