TDTS06 – Computer networks (TEN1)
Final Examination: 8:00-12:00, Thursday, January 12, 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 11 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: Encapsulation (5)

Show and illustrate the two link-layer frames for a HTTP response (that fits into two frames) when they are passed down to the physical layer of the gateway router closest to the client (being served by a remote 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. You can assume that the client machine uses 802.11, have a MAC address AA:AA:AA:AA:AA:AA and an IP address 111.111.111.111; the MAC and IP addresses of the closest gateway router is BB:BB:BB:BB:BB:BB and 111.111.111.222; the MAC and IP addresses of the access point that the client is associated is CC:CC:CC:CC:CC:CC and 111.111.222.222; and finally, the MAC and IP addresses of the HTTP server is DD:DD:DD:DD:DD:DD and 222.222.222.222. You should also draw a picture of the topology and clearly state any assumptions you make about the topology or anything else needed to solve the question.

2) Question: Web-based services and replication (6)

Reliability and performance are important aspect of building scalable and robust services. Please answer the following three questions.

- Napster was one of the first systems to use peer-to-peer technology for file sharing. It used a centralized directory approach. Please explain how this approach works in the peer-to-peer context, and what some of its advantages and disadvantages may be.
- One of the more important mechanisms in BitTorrent is the rarest-first policy. Please explain what this policy does, what it achieves, and why it is important for the success of BitTorrent.
- Give a concrete example how a Content Distribution Network (CDN) can be used to help provide better service to the clients.

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 1 connection, B two connections, C three connections and C four connections. The round trip time (RTT) for the connections of clients A and B are 50ms and the RTT for client C is 100ms. Furthermore assume that the total bandwidth of the link is 100Mbps. 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 10 packets and each packet can be sent in 1ms. You can assume that there are no packet losses. For simplicity, you can also assume that the TCP version is implementing fast retransmit, initially have ssthresh = 4, and the timeout period is constant at 300ms.

5) Question: Hot potato routing (2)

BGP is used for much of the routing on the Internet. Please explain how hot potato routing is used in this context.

6) Question: Switching fabric (2)

Give an example of head-of-line blocking at a router. Please support your answer with a figure.

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, 3, 4, 7, 9, 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).

Destination	Costs			
	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	9
F	? (?)	9	9	6
G	? (?)	10	6	4

8) Question: Multicast delivery (2)

Please explain the main differences between source-based multicast trees and shared multicast trees. Please discuss this from the basis of a video conference with 10 users; each located in different subnets.

9) Question: ALOHA (5)

For this question you are asked to (i) define both slotted and pure ALOHA, (ii) compare their advantages/disadvantages, and (iii) calculate the channel efficiency of slotted ALOHA. Please clearly state any assumptions.

10) Question: Streaming (2)

In practice, why is TCP the primary transport protocol used for video streaming? Are you aware of any video streaming services that use TCP? If so, please provide one or more examples and discuss your answer in the context of these services.

11) Question: DNS (4)

Please explain the service provided by DNS? Also, show the typical route of a query which is routed through four kinds of DNS servers: local, authoritative, root, and TLD. What parts of the query is typically recursive and which part is typically iterative? (This should be clear from your picture.)

Good luck!!