Försättsblad till skriftlig tentamen vid Linköpings Universitet

(fylls i av ansvarig)

Datum för tentamen	*May 24, 2012*
Sal	TER2
Tid	*8-12*
Kurskod	*TDTS04*
Provkod	*TEN1*
Kursnamn/benämning	Computer networks and distributed systems
Institution	*IDA*
Antal uppgifter som ingår i tentamen	*10*
Antal sidor på tentamen (inkl. försättsbladet)	*1+1+3=5*
Jour/Kursansvarig	*Niklas Carlsson*
Telefon under skrivtid	
Besöker salen ca kl.	*9:00 and 11:00*
Kursadministratör (namn + tfnnr + mailadress)	*Madeleine Häger Dahlqvist 013-282360, madha@ida.liu.se*
Tillåtna hjälpmedel	*Dictionary from an official publisher. Hardcopy; not electronic.*
Övrigt (exempel när resultat kan ses på webben, betygsgränser, visning, övriga salar tentan går i m.m.)	*Grades: 5(36/40); 4(28/40); 3(20/40)*
Vilken typ av papper ska användas, rutigt eller linjerat	*Your choice.*
Antal exemplar i påsen	

TDTS04 – Computer networks and distributed systems (TEN1)
Final Examination: 8:00-12:00, Thursday, May 24, 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 10 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 BB:BB:BB: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 222.222.222.222. 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 AA:AA:AA:AA:AA:AA and 111.222.111.111. The second interface has MAC and IP addresses AA:AA:AA:AA:AA:BB and 111.222.122.122. The third interface has MAC and IP addresses AA:AA:AA:AA:AA:CC and 111.222.133.133. Finally, the fourth interface has MAC and IP addresses AA:AA:AA:AA:AA: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 222.222.0.0/16 (over interface 2), 222.222.0.0/18 (over interface 3), and 222.222.192.0/18 (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, clearly explain why the packet takes a particular route?

2) Question: Encapsulation (5)

Consider the same scenario as in Figure 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 mail 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: HTTP (4)

Performance is an important aspect of building good Web services. Please draw a picture and explain how a Web page with three embedded images is obtained if the browser and server are communicating with pipelined HTTP (rather than non-persistent HTTP/1.0). Your figure should clearly show connection establishment and teardown messages, as well as any other messages needed for the file transfer.

4) Question: TCP slow start (5)

Consider two machines A and B which are located 200ms 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 22 packets and each packet can be sent in 0.1ms. You can assume that packet twelve (12) 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 500ms.

5) Question: TCP fairness (4)

Consider the throughput of three users (A, B, and C) with a shared bottleneck link. Assume that they are all downloading large files from different servers, but that their bandwidth bottleneck is the shared link. Assume A uses one Transmission Control Protocol (TCP) connection, B uses three TCP connections, and C has two TCP connections *and* one TCP-friendly UDP flow (attempting to be TCP fair). The round trip time (RTT) for the connections of clients A and C are 200ms and the RTT for client B is 100ms. Furthermore assume that the total bandwidth of the link is 100Mbps. Estimate the download rate of the different clients?

6) Question: Global routing (2)

Give an example of when BGP (and hot potato routing) results in a non-optimal end-to-end routing path, which is *both* physically longer and routes through more routers (than the global shortest path). 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 may not be in a very good shape, and a few routing table updates may be needed to get the network back into shape.) Assume that A receives an updated distance vector from neighbor B which looks as follows [∞, 0, 6, 4, 3, 7, 2]. First, update the table below, including A's own distance vector. Second, assume that poison reverse is implemented, and show (and explain) exactly what information the node sends to each of its neighbors (after the table has been updated).

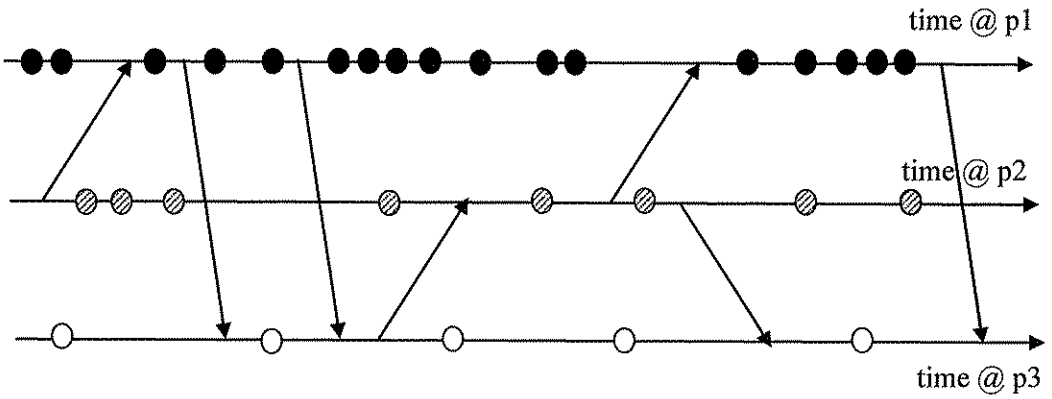
	Costs			
Destination	A (via)	B	C	D
A	0 (A)	∞	∞	∞
B	1 (B)	0	7	6
C	1 (C)	8	0	2
D	1 (D)	8	5	0
E	? (?)	8	9	2
F	? (?)	8	4	6
G	? (?)	8	6	6

8) Question: Transparency (4)

Please name and explain five different types of transparency? Also, explain why transparency is important in distributed systems.

9) Question: Lamport's clock (4)

Assume that you have three processes p1, p2, and p3 which are implementing Lamport's clocks. There are many events that take place at these processes, including some messages being sent between the processes. In the figure below we use circles and arrows to specify in-processor events and messages being sent between processes, respectively. Please provide the logical timestamps associated with each event. You can assume that all three clocks start at zero, at the left-most point in time. (Also, explain how the processes would adjust their clocks if using Lamport's logical clocks.)



10) Question: Corba (4)

In the last lab you used Corba's callback functionality for asynchronous method invocations. (a) Please explain how a callback is implemented in Corba. A figure may be helpful here. (b) Please explain the advantage of asynchronous calls compared to synchronous calls.

Good luck!!