Internetworking Examination 2G1305
Date April 23rd, at 10:00 – 13:00

LCN IMIT KTH

?? ***No help material is allowed.***
?? *You may answer questions in English or Swedish.*
?? *Please answer each question on a separate page.*
?? *The grading of the exam will completed no later than May 14 2003.*
?? *After grading, the exams will be available for inspection at KTH STEX at Campus.*
?? *Deadline for written complaints is May 28 2003.*
?? *Course responsible is Olof Hagsand, phone 08-790 42 61.*

Your name:……

Your social security number (personnummer): ……

Your major (utbildningslinje):……..

Total Points: ..……	Grade: ……..

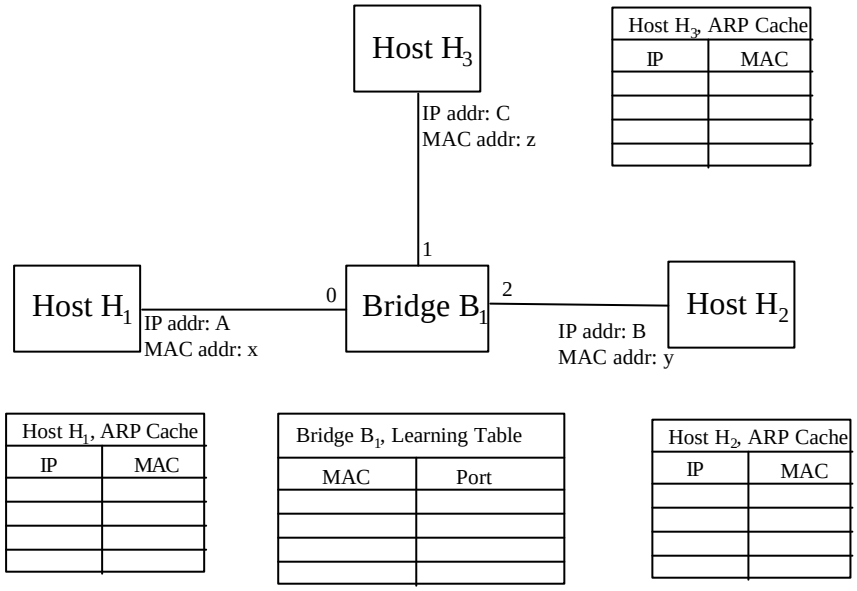
Question	Answered	Potential points	Received points
1		5	
2		5	
3		5	
4		5	
5		5	
6		5	
7		5	
8		5	
9		5	
10		5	
11		5	
12		5	

Total	60	

1. General (5p)

a) Layering – Which are the four layers defined in the TCP/IP protocol stack? (1p)
b) Place each of these protocols in the correct layer: IP, ICMP, OSPF, UDP, Ethernet, HTTP (2p)
c) Define the term *encapsulation* (1p)
d) Define the term *multiplexing* (1p)

2. Link Layer / ARP (5p)



The figure above illustrates three hosts H_1, H_2 and H_3 running IPv4 over an Ethernet bridged by bridge B_1. The IP and MAC addresses of the hosts, and the bridge port numbers are given in the figure. The ARP cache of each host is shown, as well as the learning table (station cache) of bridge B_1. Assume the ARP caches and the learning table is initially empty, and that no packets have been sent by either host. Now, host H_1 wants to send an IPv4 unicast datagram to host H_2.
Fill in the state of the three ARP caches and the learning table (station cache) of bridge B_1 as they will appear after the IPv4 unicast datagram has been delivered to host H_2, that is, after dynamic ARP resolution has been made. (5p)

3. IP Addressing (5p)

Subnet address	Subnet mask	Next Hop / Interface
189.139.29.0	255.255.255.128	Interface 0
189.139.29.128	255.255.255.128	Interface 1
189.139.30.0	255.255.255.128	R2
167.0.213.0	255.255.255.192	R3
default		R4

Suppose an IPv4 router has built up the routing table shown above. The router can deliver directly over interfaces 0 and 1, or it can forward packets to next-hop routers R2, R3 and R4. Describe what the router does with a packet addressed to each of the following destinations:

a) 189.139.29.32 (1p)
b) 167.0.213.91 (1p)
c) 189.139.30.16 (1p)
d) 167.0.213.16 (1p)
e) 189.139.30.163 (1p)

4. IP Fragmentation (5p)

A message from the application consists of 3500 bytes. The message is encapsulated as a UDP datagram over IPv4 (no options). The message is then transferred from a sender to a receiver over (exactly) two local area networks that both use 14 bytes of headers (trailers omitted in this exercise). The first local area network has an MTU of 1500 and the second has a MTU of 1000 bytes. A router is situated between the two local area networks. How many bytes (headers included) will arrive to the link level interface at the receiver? Assume that no PATH MTU discovery is performed: the sender fragments according to the MTU of the first link. An IP header is 20 bytes (without options) and a UDP header is 8 bytes. (5p)

5. TCP Flow Control (5p)

Suppose that a 100Mbps link is being set up between earth and a communication satellite at an altitude of 36,000 km. An image file of 20 MB should be transferred from station A to station B on earth. Assume the speed of light is 300,000,000 m/s.

a) Calculate the minimum RTT for the link. (2p)
b) Calculate the delay * bandwidth product for the link. (1p)
c) Explain the meaning of the bandwidth-delay product. (2p)

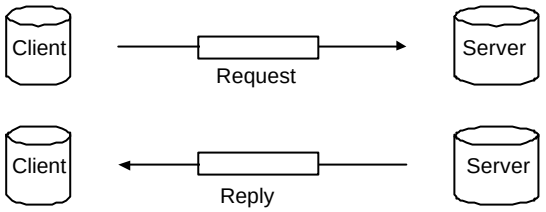
6. TCP (5p)

Important algorithms included in TCP.

a) Retransmission timeout (RTO) in TCP is based on the round trip time (RTT). Karn's algorithm is used to solve a certain problem regarding the calculation of RTO. What problem is solved by Karn's algorithm and how does the algorithm work? (3p)

b) An application that generates data too slowly can cause a silly window syndrome. Briefly describe how Nagle's algorithm deals with this problem. (2p)

7. DHCP (5p)



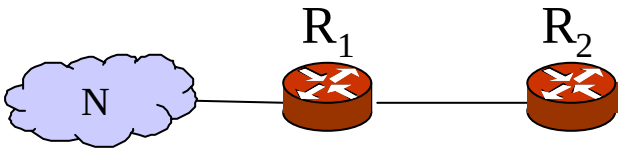
The figure above illustrates a DHCP client sending an initial request (to find out its IP address) to a DHCP server and getting a reply back.

a) Which transport protocol is used for the DHCP request and reply communication? (1p)

b) Which IP addresses are used as source and destination for the request? (2p)

c) Which IP addresses are used as source and destination for the reply? (2p)

8. IP routing: Count to Infinity (5p)



In the figure above, network N is reachable via routers R_1 and R_2. Suppose R_1 and R_2 runs RIP. If the link between R_1 and N is broken, the count-to-infinity problem may occur.

a) What is the count-to-infinity problem and why does it occur? (2p)

Suppose we implemented the following functionalities in RIP:

b) How can the problem be avoided by *triggered updates*? (1p)

c) How can the problem be avoided by *hold-downs*? (1p)

d) How can the problem be avoided by *split horizon*? (1p)

9. IP routing (5p)

a) What is an autonomous system? (1p)
b) Explain the difference between interior and exterior routing protocols. (1p)
c) What is a static route and a dynamic route? (1p)
d) Explain at least three differences between RIP and OSPF (2p)

10. IP Multicasting (5p)

a) What protocol handles the signalling of group memberships between a multicast router and hosts? (1p)
b) Multicast delivery trees: Explain the difference between a shared tree and a source-based tree. (2p)
c) In multicast routing protocols based on distance-vector the multicast routers perform a *reverse lookup*. Explain how this works. (2p)

11. IP QoS (5p)

a) Briefly describe the procedure used by RSVP to set up a reservation in the network. What types of messages are sent between sender/receiver and what information is communicated in these messages? (3p)
b) RSVP maintains soft state in the routers along the path between sender and receiver(s). Explain what this means. (2p)

12. Mobile IP (5p)

a) Describe the triangular delivery and two crossing problem that appears in Mobile IP. (2p)
b) Discovery, Registration and Tunneling are three basic capabilities of Mobile IP. Describe them briefly. (3p)