

Internetworking, Examination 2G1305
Date: August 20th 2003 at 9:00 – 13:00

KTH/IMIT/LCN

?? **No help material is allowed.**

?? *You may answer questions in English or Swedish.*

?? *Please answer each question on a separate page.*

?? *Fill in the table on page 2 for each question you have addressed.*

?? *The grading of the exam will be completed no later than September 10 2003.*

?? *After grading, the exams will be available for inspection at STEX, Osquldas väg 10.*

?? *Deadline for written complaints is September 24 2003.*

?? *Course responsible is Olof Hagsand, phone 08-790 42 61.*

Your name:.....

Your social security number (personnummer):

Your major (utbildningslinje):.....

Total Points:

Grade:

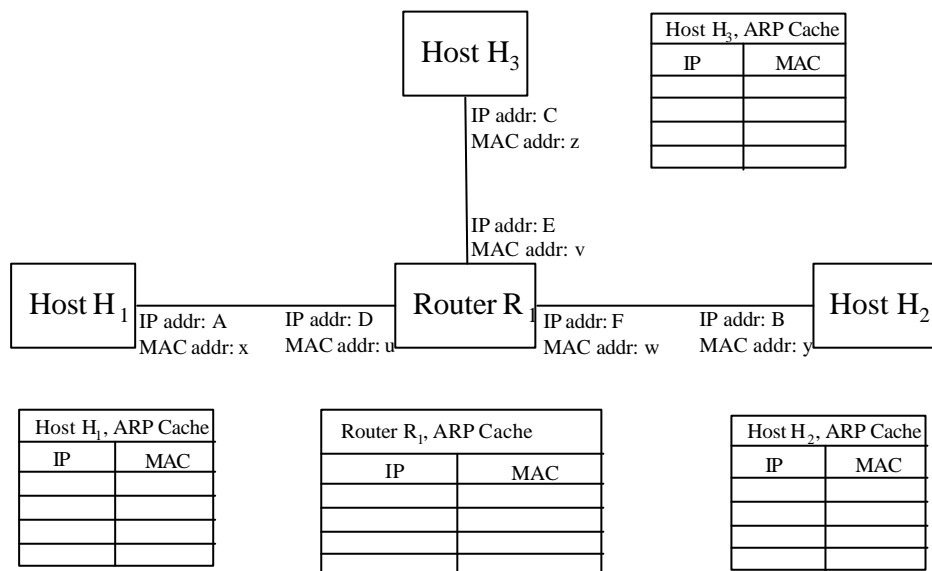
Question	Answered	Potential points	Received points
1		5	
2		5	
3		5	
4		5	
5		5	
6		5	
7		5	
8		5	
9		5	
10		5	
11		5	
12		5	

Total	60	
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1. General (5p)

- Place each of the following protocols in the correct TCP/IP layer (Application, Transport, Network or Link): BGP, IGMP, IPsec, PPP, HTTP, RTP (2p)
- Typically, every layer in the TCP/IP protocol stack adds a header or trailer containing protocol-specific data. What is this called? (1p)
- By what mechanism is transport layer de-multiplexing accomplished in IP? (1p)
- How is application layer de-multiplexing accomplished in UDP and TCP? (1p)

2. Link Layer (5p)



The figure above illustrates three hosts H₁, H₂ and H₃ running IPv4 over a routed network, connected by router R₁. The IP and MAC addresses of the hosts and the router's interfaces are given in the figure. The ARP caches of each host and the router are shown. Assume the ARP caches are initially empty, and that no packets have been sent yet. Now, host H₁ wants to send an IPv4 unicast datagram to host H₂.

Fill in the state of the four ARP caches as they will appear after the IPv4 unicast datagram has been delivered to host H₂, that is, after dynamic ARP resolution has been made. (5p)

3. IPv4 addressing (5p)

Subnet address	Subnet mask	Next Hop / Interface
67.16.120.0	255.255.252.0	Router R1
67.16.124.0	255.255.252.0	Interface A
67.16.123.64	255.255.255.192	Interface B
default		Router R2

Suppose an IPv4 router has built up the routing table shown above. The router can deliver directly over interfaces A or B or it can forward packets to next-hop routers R1 or R2.

Describe what the router does with a packet addressed to each of the following destinations:

- a) 67.16.123.54 (1p)
- b) 67.16.123.105 (1p)
- c) 67.16.121.65 (1p)
- d) 67.16.127.34 (1p)
- e) 67.16.128.89 (1p)

4. IPv4 header (5p)

- a) The IPv4 header has two length fields. Which are they and what are the purposes and limitations of each? (2p)
- b) What is the purpose of the TTL (time-to-live) field? How do routers handle the TTL field when forwarding a datagram? (2p)
- c) Is the IPv4 header checksum end-to-end or hop-by-hop? Why? (1p)

5. TCP and UDP (5p)

- a) Compare the performance of TCP's sliding window versus TFTP stop-and-wait protocol as follows. With a sliding window technique we transferred 32768 bytes in about 35 seconds across a link with RTT that averaged around 1.5 seconds. Calculate how long TFTP would take for the same transfer. TFTP sends 512 bytes per packet. (3p)
- b) An application using UDP sends a datagram that gets fragmented into four pieces. Assume that fragments 1, 3, and 4 make it to the destination and fragment 2 is lost. The application times out and retransmits the datagram 10 seconds later with the same fragmentation. Assume that this time 1 and 3 are lost, and 2 and 4 reach the destination. Assume that the reassembly timer on the destination host is 60 seconds (meaning that fragments 1,3, and 4 are not yet discarded). Can the receiver reassemble the IP fragments? Explain your answer. (2p)

6. TCP (5p)

- a) What is the difference between *flow control* and *congestion control* in TCP? (2p)
- b) Name the two phases of TCP congestion control and describe how the window size increases during these phases. (2p)
- c) TCP's retransmission time-out (RTO) has to be adaptive. On what parameter does the RTO normally depend? (1p)

7. Routing (5p)

- a) BGP uses path-vector routing. Describe how path-vector enhances distance-vector. What is the advantage with the enhancement? (1p)
- b) Which protocol does BGP use as its transport protocol? Name at least one advantage with using this transport protocol. (2p)
- c) BGP uses four message types. Name these message types and explain briefly what each is used for. (2p)

8. Applications (5p)

- a) Why may delay jitter in an IP network be a problem for real-time applications, such as IP telephony? (2p)
- b) Real-time applications communicating over IP can use RTP – Real-time Transport Protocol on top of UDP. There are two important features (header fields) of RTP that applications can use to deal with delay jitter. Name the features and explain how they are used? (3p)

9. Advanced IP networking (5p)

- a) Describe the difference between traditional IP packet forwarding and packet forwarding in MPLS. (1p)
- b) Describe the difference between independent control and ordered control when it comes to assigning labels to forwarding equivalence classes (FECs) in MPLS. (4p)

10. Multicast (5p)

- a) IGMP is used for communicating group membership locally between a multicast router and locally connected hosts. In IGMP version 2, name two situations when a host can send an IGMP report to a router? (2p)
- b) With what main functionality does IGMP version 3 extend IGMP version 2? (1p)
- c) A system uses multicast routing. There are five groups and 100 sources. If a routing algorithm using source-based trees is used, what is the maximum number of different multicast delivery trees that can exist? (1p)
- d) Using the same system as in the previous exercise: How many multicast delivery trees may exist if a multicast routing protocol using shared trees is used? (1p)

11. IPv6 (5p)

- a) Show the shortest form of the following IPv6 address:
2340:0000:0000:000F:7000:119A:A001:0000 (1p)
- b) The IPv6 header includes a Class field and a Flow ID field. Briefly describe the purposes with these fields. (2p)
- c) Name the 3 strategies devised by IETF, for the transition from IPv4 to IPv6. (2p)

12. IPsec and Mobile IP (5p)

- a) Mobile IP: Suppose a remote host sends a datagram to a mobile host. Describe the roles of the home agent and foreign agent in the delivery of the datagram? (2p)
- b) Mobile IP suffers from inefficiency in the data delivery phase. Why? (1p)
- c) IPsec uses two modes: tunnel mode and transport mode. Outline in which situations the two different forms are preferably used. Also, describe the encapsulation in the two modes. (2p)