

15-744 Spring 2002**Midterm Exam****Name: Answer Key****INSTRUCTIONS:**

- There are 8 pages (numbered at the bottom) make sure you have all of them.
- Please write your name on this cover and at the top of each page in this booklet.
- If you find a question ambiguous, be sure to write down any assumptions you make.
- It is advantageous to partially answer a question than not attempt it at all.
- Be clear and concise. Limit your answers to the space provided.

SCORING:

A	B	C	D	E	Total
/30	/30	/18	/18	/4	/100

A. Multiple Choice - Circle ALL answers that apply (6 points each)

1. Which of the following is true about the different versions of TCP?

(A) As long as no ACKs are lost, NewReno and SACK never timeout. (-3)

(B) Reno is typically forced to timeout when there is more than one loss within a window of data. (+3)

(C) Reno always performs better than Tahoe. (-3)

(D) In all versions of TCP, fast retransmission provides speedier loss recovery than time-outs. (+3)

2. Which of the following is true about the ANTS active networking systems?

(A) The capsule ID uses an MD5 hash of the capsule code to allow the proper matching of code to capsule without a centralized authority. (+6)

(B) An active router contacts the original source of a capsule (i.e. the source address on the IP header) to retrieve the code for processing the capsule. (-5)

(C) Capsule code may be arbitrarily long as long as it executes quickly. (-5)

(D) In order to ensure that a router does not run out of memory, all state associated with a capsule is deleted after it is forwarded. (-4)

3. FIFO/Drop-tail routers maintain full queues and lock-out newly arriving flows. Which of the following is true about OTHER router queuing mechanisms

(A) Choosing a random packet to drop when queues are full eliminates the full queues problem. (-3)

(B) Dropping packets from the front of the queue eliminates the lock-out problem. (+3)

(C) Since fair queueing also drops packets from the tail of queues, it also suffers from the lock-out problem. (-3)

(D) By dropping packets before the queue is full, early drop eliminates the full queues problem. (+3)

4. Which of the following is true about high speed routers?

- (A) They typically update but do not check the IP header checksum. (+6)
- (B) They use bus-based backplanes since it enables easy implementation of broadcast messages. (-5)
- (C) Packets with IP Options are processed as efficiently as packets without Options. (-5)
- (D) They always use output buffering since it allows for the use of slower backplanes. (-4)

5. Which of the following is true about the different route lookup techniques

- (A) The Dagermark fast route lookup algorithm can easily support IPv6 address lookup. (-3)
- (B) A crucial problem with Patricia trees is the memory size of the data structure involved. (-3)
- (C) A crucial problem with Patricia trees is the number of memory accesses needed to lookup a route. (+3)
- (D) Routes can be performed using a single lookup into a ternary CAM (+3)

B. Short Answer (6 points each)

6. Harry Bovik discovers that his router has a disturbing bug. It deterministically drops every 30th packet of a TCP connection. Assuming that the RTT is a constant 100ms, that packets are 1KB each and that the connection is in linear-mode, what is the maximum bandwidth that a TCP connection can achieve?

Answer: Let n = minimum size of TCP window. Then num packets sent before loss = $\text{SUM}(n..2n) = 30 = 3n * (n + 1)/2 \rightarrow n^2 + n = 20 \rightarrow (n - 4)(n + 5) = 0 \rightarrow n = 4$

Therefore, the TCP window (in packets) would go 4,5,6,7,8,4,5,6,7,8...

Therefore, the average window is 6 packets or 6KB. Since the RTT is 100ms:

$$\text{BW} = \text{avg_win}/\text{rtt} = 6\text{KB}/100\text{ms} = 60\text{KB/s}$$

Common mistake: window = 30 packets

Alternate answer: loss rate = 1/30 use TCP BW-loss relationship to calculate BW

7. Name two reasons for why/when you might want to use overlay routing.

Answer: Functionality, simplicity of forwarding/moving complexity to edges, speed

8. The corporate network of Company X consists of about 75,000 machines that simultaneously access the Internet using port-based NAT (NAPT). Assume that intensive Web surfing is done on these machines. What problem could arise if the machines are hidden behind a single IP address?

Answer: NAT box would run out of port numbers

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9. Suppose all packets carried the prefix length of the route that they matched at the last router they went through. How could this be used to speed up prefix match?

Answer: Prefix matches get longer as packets traverse the network. Previous hop prefix length could provide upper bound for length in performing route. Based on "routing with a clue".

10. Recall that DSR is an on-demand, source-routing based protocol for ad-hoc networks.

- (A) Name one advantage that DSR has over AODV due to its use of source-routing.

Answer: More people indirectly discover routes by observing source routes in packets.

- (B) Name one advantage that DSR has over DSDV due to its on-demand nature.

Answer: Routing adapts to load

C. BGP (18 pts)

Acme Corp has been using TTA as an ISP for the past several years. However, they have been unsatisfied with the reliability of this ISP. They decide to hire Harry Bovik to be their network administrator. Harry suggests adding a second link to a different ISP called Runner. Harry needs some help dealing with the complex issues of setting up this second ISP link.

11. The first decision that Harry needs to make is what type of IP addresses to use within Acme. Listed below are his three choices. Identify one advantage and one disadvantage for each approach

(A) Get an address range from TTA's CIDR address range (+3)

Advantage: Easy to change, TTA can aggregate

Disadvantage: May get data routed from Runner due to longest prefix

(B) Get an address range from both TTA and Runner (+3)

Advantage: Can adjust traffic load, TTA/Runner's address aggregation works well

Disadvantage: Each 1/2 of the network depends on single ISP; Need nodes to support 2 addresses

(C) Obtain an address range independent of TTA and Runner (i.e. from IANA) (+3)

Advantage: Best control of traffic

Disadvantage: ISPs may ignore small ranges but hard to get large range

12. Harry wants to effectively use the bandwidth of both OUTGOING links. He notices that the BGP advertisements FROM Acme and Runner contain Multi-Exit Discriminator (MED) values. Harry reads that MED is used to choose between multiple exit points from a network and decides to configure his routers to choose between the ISP routes based on the values. Alice tells Harry this is an incorrect use of MED. Is Alice correct? Why or why not? (+5)

Answer: MED values are not comparable across ISPs

13. Harry is concerned that someone else's traffic will come in one of the ISP links and go out on the other (i.e. that Acme's network will be used as a transit ISP). How can Harry prevent this from happening? (+4)

Answer: Policy implemented by controlling advertisements

D. Mobile IP (18 pts)

Harry Bovik's next assignment at Acme is to allow Acme users to wander the U.S. and still be able to access Acme computing resources.

14. Harry initially installs a DHCP client on all the users' laptops. The users complain that when they are roaming the U.S., their TCP connections are reset whenever they change location. Why do they have this problem? (+6)

Answer: IP address used to define connection

15. Harry addresses the above problem by using Mobile IP instead of DHCP. Many routers in the network check the source address on a packet and drop packets that do not arrive on the interface that the router would use to forward packets to that source address. This is also known as a Reverse Path Forwarding (RPF) check. Assume that this technique was widely deployed in the Internet.

- (A) Why would RPF create a problem for users roaming away from the Acme network? (+3)

Answer: Would filter mobiles outgoing packets

- (B) What would be a simple change that may make the route packets travel somewhat longer but avoid problems with RPF? (hint: use tunnels) (+3)

Answer: Tunnel packet FROM mobile THROUGH Home Agent

16. Harry realizes that the users are receiving poor performance due to handoffs. Each time a handoff occurs, a user's laptop is disconnected from the network for almost 3 seconds. During this time, all packets sent to the laptop are lost. Harry considers deploying either Snoop or I-TCP in his network to solve this problem. Which do you think would work better and why? (hint: consider what the sender is doing during the handoff) (+6)

Answer: I-TCP, sender would timeout with Snoop; +1 for saying that Snoop soft-state was easier to handoff

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E. Freebies (4 pts)

17. Name one paper you would eliminate from the first half of the semester.

MOST COMMON ANSWER = 50 Gbps Router

18. Name one topic you wish the class had covered in greater depth

Answers varied widely