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University of Southern California
EE450: Introduction to Computer Networks
Final Exam, Two Hours
May 1, 2001

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Session: ON CAMPUS

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Location:

| | | |
|--------|------|-----------|
| Part 1 | 15% | 11 |
| Part 2 | 15% | 11 |
| Part 3 | 15% | 10 |
| Part 4 | 15% | 12 |
| Part 5 | 20% | 20 |
| Part 6 | 20% | 18 |
| Total | 100% | <u>78</u> |

Notes:

- All your answers should be on the exam paper. If you need additional paper, please write your name, ID, session and location in each extra sheet
- You can work the problems in any order you wish (the goal is to try to accumulate as many points as you can)
- Try your best to be clean, and to show all the steps of your work

Rules:

- This is a closed book, closed notes exam. One post card containing formulas only is allowed along with a calculator
- Adherence to the University's **Code of Ethics** will be strictly monitored and enforced. Academic Integrity violations, such as cheating, will result in a series of actions and penalties including the student failing the class.

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Part 1: Multiple Choice Question (15 points)

1) A URL <http://www.cnn.com/insidepolitics.html>. Here www.cnn.com is

- a) The file
- b) The protocol
- ☒ c) The host
- d) The directory
- e) All of the above

2) The Protocol that is used to when a browser requests a webpage from a webserver is

- a) HTML
- ☒ b) HTTP
- c) TCP
- d) Microsoft Explorer
- e) Netscape Navigator

3) In distance-vector RIP, a router send out information to its neighboring routers

- a) Only when there is a change in its routing table
- ☒ b) At regularly scheduled intervals
- c) Only when a new host is added
- d) Only when a new router is added
- e) Only when a new network is added

4) A host with a domain name "pit.arc.nasa.gov" is on which level of the DNS hierarchical tree (The root is level one)

- a) Third
- ☒ b) Fifth
- ☒ c) Fourth
- d) Second
- e) Not enough information

5) Which of the following Protocols is used to download your e-mail to your PC for reading

- a) SMTP
- ☒ b) POP
- c) TCP
- d) Your friendly neighborhood mail carrier
- e) None of the above

6) Which of the following is not a function of the IP Protocol

- a) Addressing
- ☒ b) Assuring end-to-end Packet delivery
- c) Segmentation of messages into Packets
- d' All of the above are functions of the IP Protocol
- e) None of the above are functions of the IP Protocol

7) An ACK number of 1000 in TCP means:

- a) 999 bytes have been successfully received
- b) 1000 bytes have been successfully received
- ☒ c) Segment # 999 have been successfully received
- d) Segment # 1000 have been successfully received
- e) None of the above

8) Which address uniquely identifies a running application program?

- a) MAC Address
- b) IP Address
- ☒ c) Port Address
- d) Host Address
- ☒ e) Socket Address

9) A host can get its IP address from the DHCP server by using :

- a) 127.127.127.127 as Source IP address and 0.0.0.0 as Destination IP address
- b) 255.255.255.255 as Source IP address and 0.0.0.0 as Destination IP address
- c) 127.0.0.0 as Source IP address and 255.255.255.255 as Destination IP address
- ☒ d) 0.0.0.0 as Source IP address and 255.255.255.255 as Destination IP address
- e) None of the above

10) Which of the following does UDP guarantee?

- a) Non-duplicated data delivery to the application layer
- b) In-order data delivery to the application layer
- ☒ c) Error-free data delivery to the application layer
- d) a and b only
- ☒ e) None of the above

11) Which of the following would make a good subnet mask for the address

190.0.46.201?

- a) 255.255.1.0
- b) 255.255.160.0
- ☒ c) 255.255.248.0
- d) 255.255.4.0
- e) None of the above

$46 = 32 + 8 + 4 + 2$
 $208 = 128 + 64 + 16$

$$\begin{array}{r} 128 \\ 64 \\ 32 \\ \hline 254 \\ 16 \\ \hline 240 \\ 8 \\ \hline 248 \end{array}$$

12) With token passing protocol,

- a) Only the node holding the token can transmit a message
- b) Only the node holding the token can receive a message
- c) Any node can transmit so long as the medium is not used
- d) Collisions may occur if the traffic is heavy
- e) a and b only

13) During an FTP session, the data connection is opened

- a) Exactly once
- b) Exactly Twice
- c) As many times as necessary
- d) There is insufficient information in the question

14) When a host on Network A sends a message to a host in Network B, which address does the router look at?

- a) Socket Address
- b) MAC Address
- c) IP Address
- d) Port Number
- e) All of the above

15) A device has two IP addresses. One IP address is 192.123.46.219. The other address could be

- a) 192.123.46.220
- b) 192.123.46.0
- c) 192.123.47.219
- d) All of the above
- e) None of the above

128
64
192
16
208
8
216
3
219
1
219

11011011

Part 2: True/False Question (15 Points)

1. Subnetting is the process of extracting the network address from an IP address

2. The sequence number in the header of the TCP segment identifies the segment number

3. Connection-oriented, reliable message transfer can be provided over an un-reliable, connection-less packet switch network

4. An Ethernet is a LAN providing connection-less service. It is placed in the data link layer of the OSI model

5. In link state routing, every router has exactly the same link state database but the routing tables are different in each router

Distance Vector

ARP Local

- ✓ F 6. A station uses the address resolution protocol to bind the IP address with a MAC address of any other station across the internet
- ✓ T 7. Caching is a method by which an answer to an inquiry can be stored in the memory for a limited time for easy access to future requests
- ✓ F 8. An ARP request and an ARP response are broadcasted to all stations on the LAN
- ✓ F 9. The TCP layer would not be needed if all the links in the Internet were to provide reliable delivery of packets.
- ✓ F 10. Machine A requests service X from machine B. Machine B requests service Y from machine A. The total number of application programs required is 2
- X T 11. TCP has the property of slow start to avoid congestion in the network ^{congestion avoidance}
- ✓ T 12. An IP address 169.5.0.0 corresponds to a network address where as an IP address 169.5.1.1 corresponds to a host IP address
- ✓ F 13. In switched LANs, switch ports must be dedicated to end stations
- X F 14. DNS is a client-server application that identifies each host on the Internet with a unique host name.
- ✓ T 15. The window size in the header of TCP segment defines the size of the sliding window at the receiver that is used for flow control

Part 3 (15 points)

- a) List at least four major differences between a router and a bridge.
- b) List at least three major differences between UDP and TCP. Identify which type of application do you expect being transported over each of these protocols

| | | |
|-------------|----------------|--------|
| (a) | Bridge | Router |
| layer | 2nd | 3rd |
| support | HDX | FDX |
| closed loop | avoid | ok |
| Transparent | Yes | Not |

~~connection~~

~~same MAC all different MAC add~~

(b) UDP TCP

handshaking ~~No~~
guarantee ~~what~~ ~~No~~

Yes

Yes

header

short
(8 bytes)

long (20 bytes)

slow control

don't have

have (window size)

UDP: voice, video as accuracy is concerned.
e-mail, web browsing as delay is concerned

TCP: e-mail, web browsing as accuracy is concerned
voice, video as delay is concerned

Part 4 (Part a: 6 Points, Part b: 9 points)

a) Suppose a group of 10 stations are serviced by an ETHERNET LAN. How much bandwidth (in bps) is available to each station for the following cases:

- The 10 stations are connected to a 10 Mbps ETHERNET Hub
- The 10 stations are connected to a 100 Mbps ETHERNET Hub
- The 10 stations are connected to a 10 Mbps ETHERNET Switch

b) A group of 32 stations is serviced by a Token Ring LAN. Calculate the time it takes to transmit a frame and the throughput of the ring for each of the following cases. Assume each frame is 1000 bits long, assume 50 meters between stations, assume an 8-bit latency per node and assume a 100 Mbps ring

- Case 1: Token is released after completion of transmission
- Case 2: Token is released after return of the Token (after T_f is completed)
- Case 3: Token is released after return of the frame.

(a)

$$① (10 \times 10^6) / 10 = 1 \times 10^6 \text{ bps} \checkmark$$

$$② (100 \times 10^6) / 10 = 10 \times 10^6 \text{ bps} \checkmark$$

$$③ 10 \times 10^6 \text{ bps} \checkmark$$

$$b) T_f = \frac{1000}{100 \times 10^6} = 10 \text{ } \mu\text{sec}, T_{\text{prop}} = \frac{32 \times 50}{2 \times 10^8} = 5.33 \text{ } \mu\text{sec}$$

$$T_{\text{delay}} = 32 \times \frac{8}{100 \times 10^6} = 2.56 \text{ } \mu\text{sec}$$

$$\text{case 1: } T_{\text{total}} = T_f + \frac{1}{32} \times T_{\text{prop}} + \frac{1}{32} \times T_{\text{delay}} = 10.25 \text{ } \mu\text{sec}$$

$$\text{Throughput} = \frac{1000}{10.25} = 97.59 \text{ Mbps}$$

$$\text{case 2: } T_{\text{total}} = \frac{32}{32} \times T_{\text{prop}} + \frac{32}{32} \times T_{\text{delay}} = 8.139 \text{ } \mu\text{sec}$$

$$\text{Throughput} = \frac{1000}{8.139} = 122.855 \text{ Mbps}$$

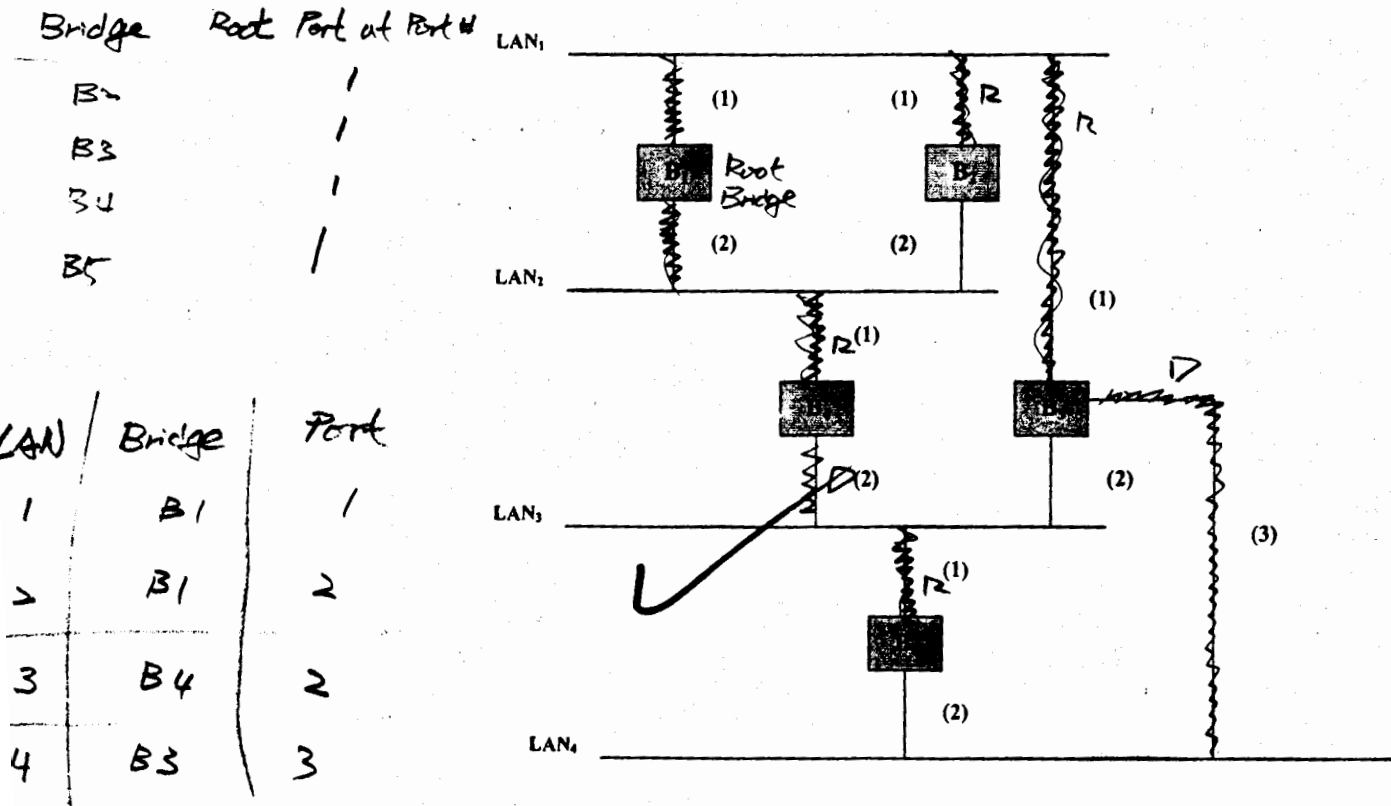
> 100 Mbps
amazing!

$$\text{case 3: } T_{\text{total}} = T_f + \frac{32}{32} \times T_{\text{prop}} + \frac{32}{32} \times T_{\text{delay}} = 18.14 \text{ } \mu\text{sec}$$

$$\text{Throughput} = \frac{1000}{18.14} = 55.137 \text{ Mbps}$$

Part 5 (20 points)

- a) Construct a Spanning-tree topology computed by the spanning tree algorithm for the interconnected LAN shown below. Assume B_1 is the Root Bridge. Go through the process in detail (I am not interested in the final answer). Use the symbol "R" to indicate a "Root Port" and the Symbol "D" to indicate a "Designated Port".



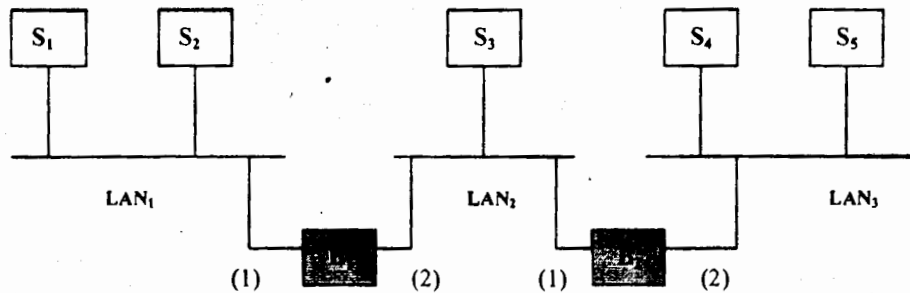
STEP:

1st: activated all port of Root Bridge

2nd: in each Bridge (beside B₁) choose one port that is close to B₁ as Root Port and activated it

3rd: each LAN choose one Designated Port to carry the information.

- b) Consider the following Bridged LAN comprising of three LANs. Assume the forwarding Tables are initially empty. Suppose the following stations transmits frames (in the following order): S_1 to S_5 , S_3 to S_2 , S_4 to S_3 , S_2 to S_1 . Clearly explain, step by step (I am not interested in final answer !!) how the forwarding tables for B_1 and B_2 are filled up with appropriate entries after the frames have been completely transmitted. Indicate the mode of operation of each bridge during each step of transmissions.



① $S_1 \rightarrow S_5$

B_1 will record S_1 , and

and since S_1 is at port 1, B_1 will filter it to LAN1.

B_2 won't do anything

since B_2 won't receive any frame

② $S_1 \rightarrow S_5$

B_1 will record S_1 , and since S_5 is not in the database, B_1 will flood the frame

| Station | Port |
|---------|------|
| S_1 | 1 |
| S_3 | 2 |
| S_4 | 2 |
| S_2 | 1 |

| Station | Port |
|---------|------|
| S_1 | 1 |
| S_3 | 1 |
| S_4 | 2 |
| | |

B_2 will record S_1 , and since S_5 is not in the database, B_2 will flood the frame

③ $S_2 \rightarrow S_2$

B_1 will record S_3 , and since S_2 is not in the database, B_1 will flood the frame

B_2 will record S_3 , and since S_2 is not in the database, B_2 will flood the frame

④ $S_4 \rightarrow S_3$

B_2 will record S_4 , and since S_3 is at port 1, B_2 will forward it to LAN2.

B_1 will record S_4 , and since S_3 is at port 2, B_1 will filter it to LAN1.

Part 6 (20 points)

- a) Given the following 3 IP addresses, identify the subnet mask that would result in the longest subnet ID. What is the subnet ID?

1) 128.150.122.36 = 128.150.122.00100100 : 128.150.122.32
 2) 128.150.122.38 = 128.150.122.00100110 the subnet mask ✓
 3) 128.150.122.55 = 128.150.122.00101111 225.225.225.224 ✓

- b) A small organization has a class C address for seven networks with 24 hosts per network. What is an appropriate subnet mask?

200.200.200.0 ≤ ≤ ≤ ≤ ≤ ≤ ≤ 2³ = 8 > 7 mask: 225.225.225.224 ✓

- c) Consider the following network. The site has been assigned a class B address of 150.100.0.1 as shown below. The site has many subnets (only three are shown for simplicity) and many hosts (only 5 are shown for simplicity). Assume the subnet ID field is 9 bits long and the host ID field is 7 bits long. Explain, in detail, how an arriving packet from the Internet having a destination IP address 150.100.15.11 get delivered. Show me how the routing table in R₁ and R₂ may look like. Show the sequence of IP Packets and Ethernet Frames exchanged to accomplish the transfer.

step:

subnet mask is

225.225.225.128 ✓

since we have 9 bits for subnet ID and 7 bits for host = 7

to do the masking at R₁ means to do logic AND between arriving packet and subnet mask.

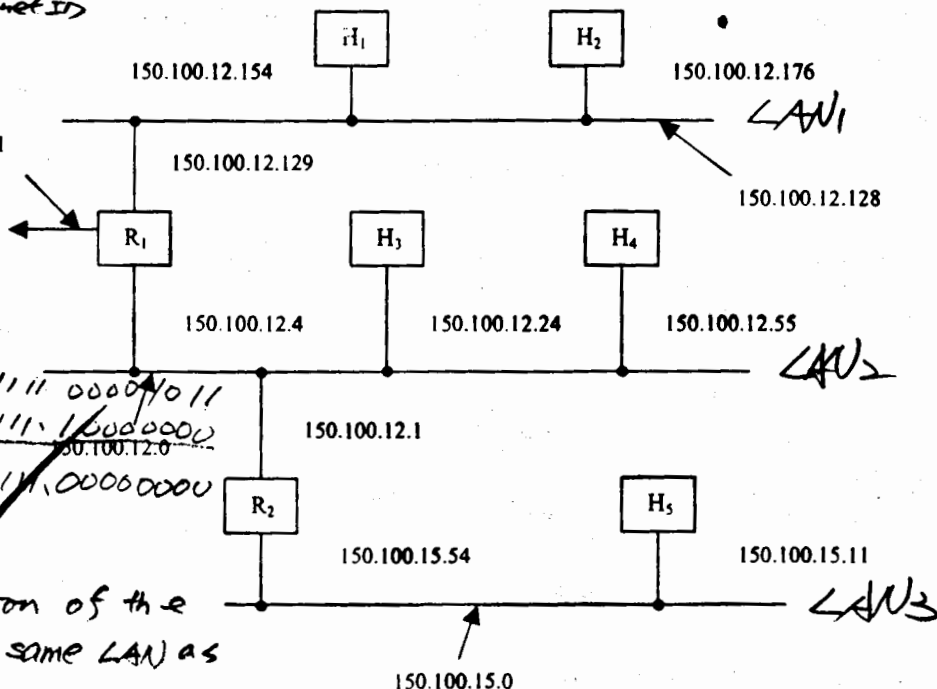
100/0110.01100/00.0000/111 0000/011
 111111.111111.111111.1000000
 0010110.01100100.0000111.00000000
 ⇒ 150.100.15.0 ✓

R₁ knows the destination of the packet is not on the same LAN as H₁, H₂ on, nor on the same LAN as H₃, H₄ on. it needs the help of R₂

R₁ IP | H₅ IP | ...

R₃ MAC | R₁ MAC | ...

H₅ MAC | R₂ MAC | ...



- ④ R₂ receive the frame, since it is explicitly it, R₂ open it and give it to upper layer since it is to H₅, R₂ will put it in frame, and give it to H₅