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ECE 4380/6380: Computer Communications **Spring 2018** 25

Exam 2 (Each of the 4 problems is worth 25 points) **Wednesday, April 11**

6380 students: For problem 1, you only need to answer any 8 of the short answer questions. 25

4380 students: For problem 1, you only need to answer any 5 of the short answer questions. Extra credit earned on any extra answers will be added to your total homework score. 22

← Nah im good

1 Short Answer. Your answer to each question should be twenty words or less. 25

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1.1 In the distributed spanning tree algorithm, why does the root bridge periodically send configuration messages even after the system has stabilized?

in case a link goes down so that bridges can adapt to that

1.2 Assume router R8 receives a broadcast ARP query that is requesting host H25's MAC address. The other fields in R8's ARP table include H25's IP address and the IP and MAC addresses for the source of the ARP packet, which is host H19. If R8 finds that H25's IP address **is** in its ARP table but H19's IP address **is not** in its ARP table, how does R8 update its ARP table and what ARP reply packet does R8 send?

R8 will add the source of the packet's IP to it's table and R8 will reply with its own MAC address in an ARP packet

1.3 How do IP routers catch packets that have been going around in loops?

decrement TTL counter

1.4 For the global Internet, describe a scaling concern that is addressed by classless interdomain routing (CIDR).

Not enough address space

or both ok CIDR shrinks best answer routing/forwarding tables so more space is available in table

1.5 What is the triangle routing problem that arises in Mobile IP, and how can it be addressed?

It is the problem of packets going to the home agent and tunneling to the current foreign agent for the mobile device, and it can be addressed by sending a reroute message to the router connected to the internet to go directly to the foreign agent for some time

1.6 BGP has replaced EGP because a design assumption made in EGP no longer applies to the modern Internet. What was this assumption, and what was added to BGP because this assumption is no longer true?

EGP assumed that its networks had no loops but BGP advertises with information that can be used to calculate if loops exist.

1.7 The traceroute function allows a network engineer to discover the IP addresses for the routers in the path to some destination. What features of IP and ICMP make this capability easy to implement?

IP's TTL count allows someone to send packets with incrementally larger TTL values so each one will decrement to zero at the next router & will send back an ICMP packet from said router

1.8 A host that receives an IP packet that has been fragmented must wait until it collects all of the fragments associated with this packet. What actions does that host take if, after a suitably long period of time, there are still one or more fragments missing?

It will throw the packets away or send an ICMP error message to the source

1.9 Multiprotocol label switching (MPLS) combines some of the properties of virtual circuits with the flexibility and robustness of datagrams. Name the two main applications of MPLS that have led to its widespread deployment.

VPN support & tunnel support

1.10 Protocol-independent multicast (PIM) was developed in response to the scaling problems of earlier protocols. In PIM sparse mode (PIM-SM), routers explicitly join the multicast distribution tree using PIM protocol messages known as Join messages. Where does a router send the Join message?

To the rendezvous point or RP

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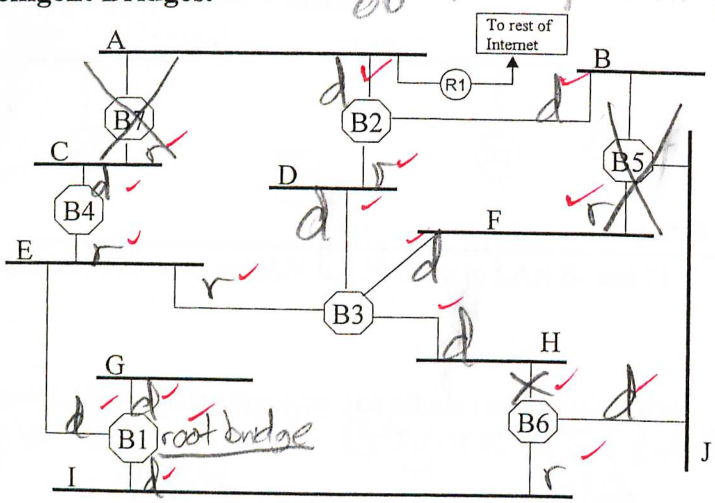
All links with B5 & B7 do not participate and B6→H does not participate

2 Spanning Tree Algorithm for Intelligent Bridges.

Consider the spanning tree algorithm for the network shown to the right. The seven bridges numbered 1 to 7 run the spanning tree algorithm. Router R1 is connected to LAN A and provides a connection to the Internet.



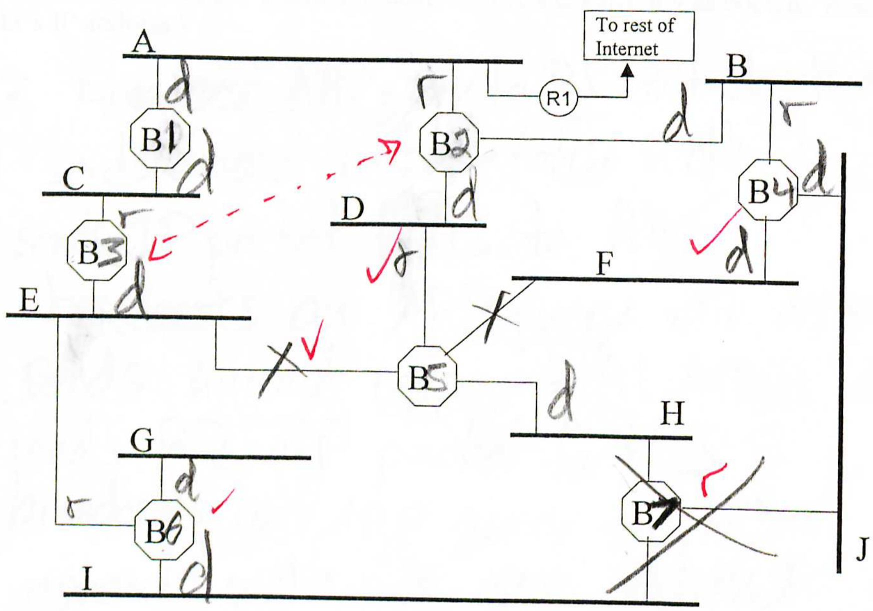
2.1 Indicate on the figure the spanning tree. Be sure to indicate the root port for each bridge (except the root bridge), the designated port for each LAN, and the links and bridges that do not participate in forwarding data frames.

2.2 Assume that hosts attached to LAN J generate traffic with destinations found through the router to the rest of the network, and the bridges have learned which port to use for forwarding traffic between LAN J and R1. Which bridges forward frames generated by hosts on LAN J to R1?

B6, B1, B3, B2

2.3 Assume that hosts attached to LAN's H, I, and J generate traffic with destinations found through the router to the rest of the network. Renumber the bridges so that the traffic from the hosts on LAN H traverses LAN D to LAN A, LAN I traverses LAN E to C to A, and LAN J traverses LAN B to A. Draw the resulting spanning tree in the figure below showing the new bridge numbers and root and designated ports. You can only change the numbers assigned to the bridges (e.g., links cannot be moved and no new links can be added).

H→D→A
I→E→C→A
J→B→A



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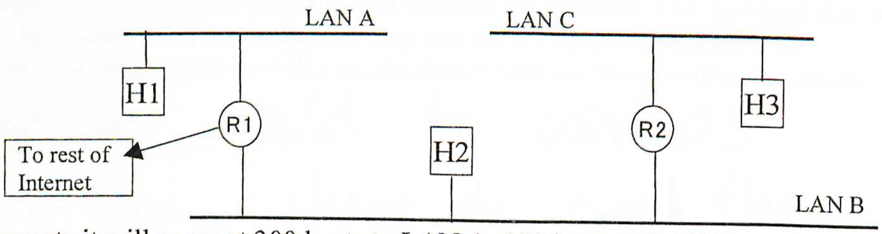
3 IP Forwarding, LAN Forwarding, ARP, and Subnet Masks.



Suppose an organization has been assigned a Class B address with network number 149.123.0.0 The organization uses subnets to configure three local area networks (LANs) shown in the figure. The organization expects it will connect 300 hosts to LAN A, 150 hosts to LAN B, and 75 hosts to LAN C.

3.1 Give a subnet number and mask for each LAN assuming that only one subnet can be assigned to each LAN.

LAN A → give 512 (9 bits) LAN B → give 256 (8 bits) LAN C → give 128 (7 bits)

LAN A → 0.0 → 1.255 LAN B → 2.0 → 2.255 LAN C → 3.0 → 3.127

SubNet Number	Mask	LAN
149.123.0.0 ✓	255.255.254.0 ✓	LAN A
149.123.2.0 ✓	255.255.255.0 ✓	LAN B
149.123.3.0 ✓	255.255.255.128 ✓	LAN C

✓

3.2 Suppose that H2 is configured with only a default route to R1 in its IP forwarding table. Assume that IP address and subnet masks are correctly assigned for all hosts and routers. Give the sequence of *all* Ethernet frames that are transmitted on the LAN's when H2 has a packet to forward for H3. For each Ethernet frame, specify its destination address and the type of packet the frame contains. (Assume that network has been idle long enough so that all ARP caches have timed out and H2 has not forwarded any packets to hosts on LAN C since it was booted. Also, assume H2 knows H3's IP address.)

✓

1) H2 broadcast ARP query to R1 ~~with destination H3~~
2) R1 sends unicast response to H2 with its own (R1's) MAC address
3) H2 sends IP packet for H3 to R1 ✓
4) R1 broadcasts an ARP query with destination ~~H3~~ R2
5) R2 sends unicast response to R1 with its own MAC address
6) R1 sends R2 IP packet for H3 ✓
7) R2 broadcasts an ARP query for H3 ✓
8) H3 responds with its own address ✓
9) R2 sends H3 the IP packet ✓

3.3 Because the nodes build ARP caches, not all the frames listed in part 3.2 are required for H2 to send a sequence of packets to H3. Describe an additional mechanism (besides ARP caching) that is available in IP to reduce the number of frames that are required for H2 to send a sequence of packets to H3. Include in your description how this mechanism works and the benefits that result.

✓ ICMP redirect could be used as R1 might know where to send the packet immediately, which in that case it would send H1 an ICMP redirect message to tell it to add a host-specific destination to its forwarding table.

3.4 Assume that R2 is upgraded to serve as an 802.11 access point. The access point assigns IP addresses for the mobile hosts that associate with it from LAN B's allocation. Also, Mobile IP is enabled and router R2 serves as the home agent. Suppose an IP packet arrives at R1 from the Internet with a destination address corresponding to a mobile host associated with this access point. Describe the frames that are transmitted on LAN B in delivering this packet to the mobile host. In particular, R1 is an old router and does not know about Mobile IP or 802.11.

X

-3

The frames for Mobile IP utilize tunnels so that a mobile device can still "keep" its IP address. The frames on LAN B would be frames "in a tunnel" meaning they are frames with destination address for R2, yet have an encapsulated packet for said mobile device inside the frame for R2.

but R1 is an old router that does not understand mobile IP -- it does not know to set up a tunnel. instead, proxy-ARP allows R2 to respond to R1's ARP query for the mobile's IP address

4 Distance-Vector Routing.

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Consider a network that has nodes designated as A, B, C, … . There is a cost assigned to each link in the network, and do not assume that the cost is the same in each direction on a link. Node C's forwarding table is shown below.

Beginning forwarding table for C		
Destination	Next Node	Cost to destination
A	A	9
B	B	7
C	C	0
D	D	5
E	B	13
F	A	11
G	D	13

Assume that all the nodes are asynchronously executing a distributed version of the Bellman-Ford algorithm. Consider just the basic Bellman-Ford algorithm and not any of the extensions (such as split horizon or poison reverse).

4.1 Based on the entries in the forwarding table, which nodes must be neighbors of node C and what is the cost of the link from C to each of these neighbors?

A, B, and D are neighbors of C and the costs to each are (A,9), (B,7), + (D,5)

4.2 The cost assigned to the link from node C to node B changes to 9. Clearly mark in the table below changes (if any are necessary) that node C should make to its forwarding table.

Forwarding table for C		
Destination	Next node	Cost to destination
A	A	9
B	B	~~7~~ 9
C	C	0
D	D	5
E	B	~~13~~ 15
F	A	11
G	D	13

C→E=15 ⇒ B→E=6
C→F=11 ⇒ A→F=2
C→G=13 ⇒ D→F=8

~~5+14=19~~
9+14=23

4.3 Continuing with this example, next assume that node C receives the following routing update message from node B. In the table below update node C's forwarding table (including any changes from part (4.2)).

C→E changes as B→E goes from 6→14

G→G changes as C→B→G costs 12 & C→D→G costs 13

Routing update message from node B	
Destination	Cost to destination
A	9
B	0
C	5
D	2
E	14
F	3
G	3

Forwarding table for C		
Destination	Next node	Cost to destination
A	A	9
B	B	9
C	C	0
D	D	5
E	B	23
F	A	11
G	B	12

4.4 For the remainder of this problem ignore the changes given in parts (4.2) and (4.3), and instead use the "beginning forwarding table for C" as given in the beginning of this problem. Now assume that there have been some changes in the network (but no changes to the links from C to its neighbors). Node A has updated its forwarding table and should send a routing update message to node C, however this message is lost so that node C does not receive this message. Also, node A does not know that the message was lost and so does not retransmit the message. Next node C sends a routing update message based on its forwarding table, and this message is correctly received at node A. Clearly mark in the table below changes (if any are necessary) that node A should make to its forwarding table.

C sends

Dest	Cost
A	9
B	7
C	0
D	5
E	13
F	11
G	13

Forwarding table for A		
Destination	Next node	Cost to destination
A	A	0
B	B	2
C	C	5
D	C	10
E	B	3
F	~~F~~ C	~~18~~ 16
G	~~F~~ C	~~20~~ 18

B, C, F are neighbors of A

A→B = 2

A→C = 5

A→F = 18

A→C→D = 10

⇒ C→D = 5

which A is in the D.V. ∴ no change

After node A has changed its forwarding table according to part (4.4), and node C still has its "beginning forwarding table for C". What problem is there in this network?

C goes through A to get to F, and A now believes it goes through C to get to F so a loop has formed