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Please enter your preference for the Final Exam Slot.

It would a 24 hour take-home exam and released and collected via Sakai.

- **Slot 1: SAT. 12/18 8PM - SUN 12/19 8PM**
- **Slot 2: SUN 12/19 8PM - MON 12/20 8PM**

In the following table, please enter your preferred slot and info.

If you choose slot 1, please enter 1

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Preferred Slot	Name	RUID	NETID	Email	
1	Yinfeng Cong	186005832	Yc957	Yc957@scarletmail.rutgers.edu	

Questions 1-10: 3 Points Each; Question 11-15: 14 Points Each.

1. List three main classes of MAC protocols

   channel partitioning, random access, and “taking turns”.

2. List two examples of channel partitioning MAC protocols

   TDMA: time division multiple access. Access to channel in “rounds”, each host gets a fixed-length slot in each round
   FDMA: frequency division multiple access. The channel spectrum is divided into frequency bands. Each station is assigned a fixed frequency band.

3. List two examples of “taking turn” MAC protocols

   polling: master node “invites”slave nodes to transmit in turn
   token passing: control token passed from one node to next sequentially. token message

4. List three kinds of routing algorithms

   Link State
   Distance Vector
   Hierarchical Routing

5. List three key drawbacks of the slotted ALOHA protocol

   Collisions, wasting slots
   idle slots
   clock synchronization

6. List the main problem for Class A, B, and C IP addresses, respectively

Not enough nets in class A
Running out of class B addresses
Too many small nets requiring multiple class C addresses

7. List three different IP Support Protocols and their key functions.

ARP: Address Resolution Protocol
Returns a MAC sublayer address or link layer address when given an Internet address. Need IP to MAC address translation.

RARP: Reverse Address Resolution Protocol
RARP performs the inverse action of ARP. RARP returns an IP address for a given MAC sublayer address. Need MAC address to IP address

DHCP: Dynamic Host Configuration Protocol
DHCP offers : Dynamic IP address allocation

8. Please explain the binary (exponential) backoff of CSMA/CD.

after mth collision, NIC chooses K at random from {0,1,2, ..., 2m-1}. NIC waits K·512 bit times, returns to Step 2
longer backoff interval with more collisions

9. Please explain why the Traceroute function increases the TTL by 1 every time?

Because traceroute records the route that packets take, it is a clever use of TLL field.
If we want to determine route we need to progressively increase TTL:
Everytime an ICMP time exceeded message is received, record the sender's address.
Repeat until the destination host is reached or an error message occurs.

10. Please explain the Switch Self Learning Technique

Switch learns which hosts can be reached through which interfaces:

when frame received, switch "learns"location of sender: incoming LAN segment

records sender/location pair in switch table

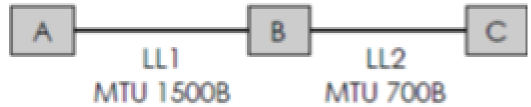
11. Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all of the interfaces in each of these three subnets are required to have the prefix 233.6.3/24. Also suppose that Subnet 1 is required to support up to 31 interfaces, Subnet 2 is to support up to 90 interfaces, and Subnet 3 is to support up to 13 interfaces. Provide three network addresses (of the form a.b.c.d/x) that satisfy these constraints. You do not have to consider Broadcast address separately.

223.6.3.30/27 (we need 5 bits for it)

223.6.3.128/25 (we need 7 bits for it)

223.6.3.158/28 (we need 4 bits for it)

12. Fragmentation. (1) Consider the network in the figure below, where the MTUs (in Bytes) of the link layers for the two hops is listed. These MTUs **include** the header of the packets. The header size is 20 bytes. Please finish the following table by performing the fragmentation on a packet (already in the first row of the table) sent on Link AB with a length of 1420 (including the length of the header) and ID of 45654. After fragmentation, we should have a few smaller packets that can be sent on Link BC with a smaller MTU. All rows starting from the second row should be corresponding to a fragmented packet. You do not have to consider dividing offset by 8.



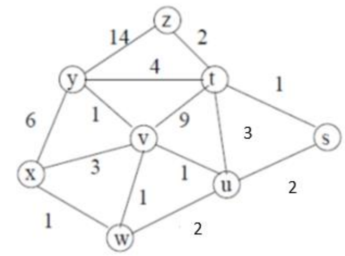
link	length	ID	flgs	offset
AB	1420	45654	0	0
BC	700	45654	1	0
BC	700	45654	1	680
BC	60	45654	0	1360

(2) Where are fragments reassembled? Can they be reassembled anywhere else? Why or why not?

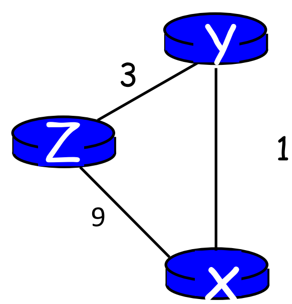
They will be reassembled at final destination as mentioned in lecture pdf. Because all the fragments will have their own independent path, so they won't meet during the process, and they will meet before they get into the final destination. (The final destination would like to get the reassembled fragments, so they must be reassembled)

13. Shortest path routing. For the network on the right, using Dijkstra's shortest path compute the shortest path to all the nodes from node U. Show the intermediate steps in the table below.

N'	D(s) p(s)	D(t) p(t)	D(v) p(v)	D(w) (w)	D(x) p(x)	D(y) p(y)	D(z) p(z)
U	2,u	3,u	1,u	2,u	∞	∞	∞
Uv	2,u	3,u		2,u	4,v	2,v	∞
uvy	2,u	3,u		2,u	4,v		16,y
Uvys		3,u		2,u	4,v		16,y
Uvysw		3,u			3,w		16,y
Uvyswx		3,u					16,y
uvyswxt							5,t
uvyswxtz							



14. Distance vector. Consider a fully connected three-node topology shown on the right slide. Let the link costs be c(x,y) = 1, c(y,z) = 3, c(z,x) = 9. Compute the distance tables after the initialization step and after each iteration of the distance-vector algorithm as done for the example on the lecture slides.



Node x table:

	x	y	z
x	0	1	9
y	∞	∞	∞
z	∞	∞	∞

Node y table:

	x	y	z
x	∞	∞	∞
y	1	0	3
z	∞	∞	∞

Node z table:

	x	y	z
x	∞	∞	∞
y	∞	∞	∞
z	9	3	0

Table from Node x table:

	x	y	z
x	0	1	4
y	1	0	3
z	9	3	0

Table from Node y table:

	x	y	z
x	0	1	9
y	1	0	3
z	9	3	0

Table from Node z table:

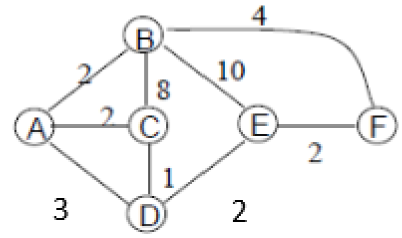
	x	y	z
x	0	1	9
y	1	0	3
z	4	3	0

The final answer:

	x	y	z
x	0	1	4
y	1	0	3
z	4	3	0

15. Distance vector. For the network on the right, indicate the following

a. Initial distance vector tables at E and B



Initial distance vector tables at E:

E		0
B	EB	10
F	EF	2
D	ED	2

Initial distance vector tables at B:

B		0
A	AB	2
C	BC	8
E	BE	10
F	BF	4

b. Final distance vector tables at E and D

Final distance vector tables at E:

E		0
A	AE	5
B	BE	6
C	CE	3
D	DE	2
F	FE	2

AE: A-D-E

BE: B-F-E

CE: C-D-E

DE: DE

FE: FE

Final distance vector tables at D:

D		0
A	AD	3
B	BD	5
C	CD	1
E	ED	2
F	FD	4

AD: AD
BD: B-A-D
CD: CD
ED: ED
FD: F-E-D

c. Suppose distance vectors have been computed at all the nodes and link EB fails. How many distance vector messages are sent by node E as a result of link EB failing.

No distance vector messages are sent by node E then. Because EB is 10 and it is too long. It is not in the shortest path of E to other vectors.