Module 4 Assessment: The Network Layer

You may use any resource (except for other people) to help you answer these questions. You may ask LLMs questions to help you understand concepts however the answers you submit should represent your understanding of the material, not merely the output of an AI tool. Questions should be answered within the context of this course's material.

1. Below is a router's forwarding table. For simplicity, we will use a reduced IP address format that is 15 bits long, divided into 3 5-bit chunks. The smallest IP address is 0.0.0, and the highest IP address is 31.31.31. This table behaves identically to an IPv4 routing table.

    a. For each row, convert the destination Address Range into a bit pattern showing which bits are fixed for all addresses in the subnet and which bits can vary (use an X for bits that can vary). The first entry has been completed as an example.

Destination Address Range	Bit Pattern	Link Interface
0.0.0/4	0000X XXXXX XXXXX	A
18.0.0/5	00010 XXXXX XXXXX	B
18.4.0/8	00010010 XXXXX XXXXX	C
7.1.0/10	00000111 XXXXX XXXXX	D
4.0.0/3	00XX XXXXX XXXXX	E
4.16.0/8	00000100 0001XXXX XXXX	F
7.0.0/6	000001 00XXXX XXXXX	G
0.0.0/0	XXXXX XXXXX XXXXX	H

    b. Determine which link interface would be used for the following IP addresses.
        i. 18.7.30 = B

        ii. 6.0.0 = H

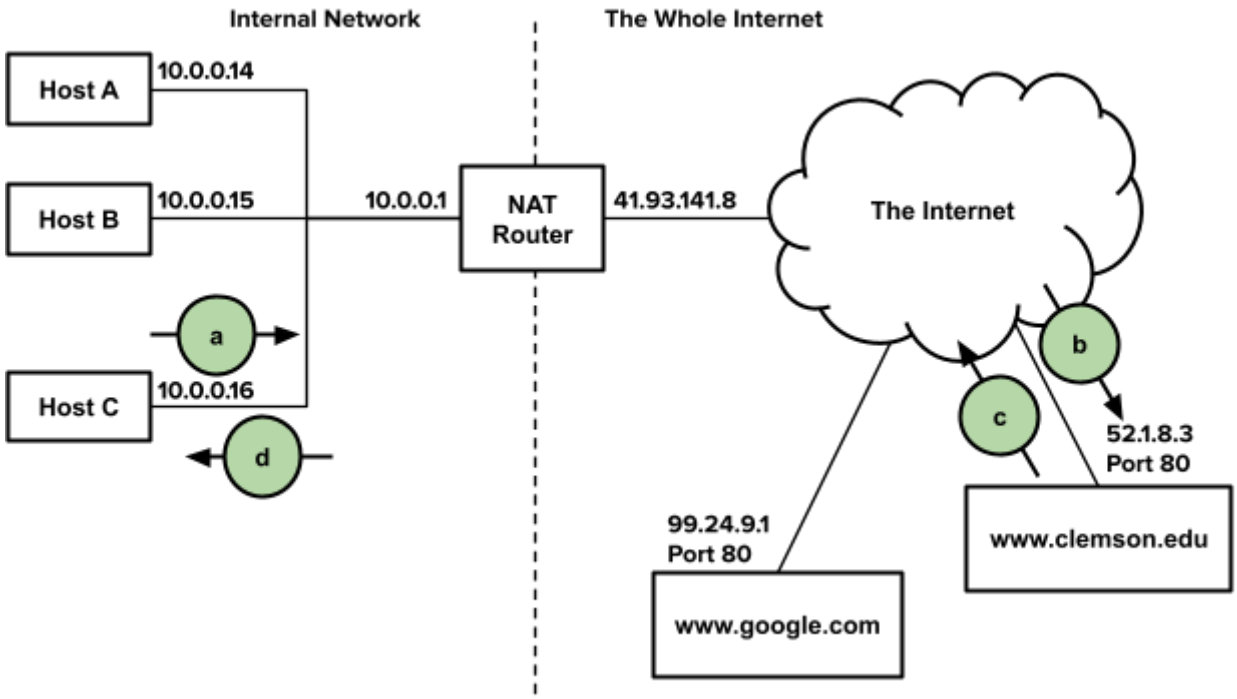
        iii. 1.27.8 = H

        iv. 8.4.16 = G

2. The Network Address Translation (NAT) protocol runs on edge routers and allows separate edge networks to share the same subnet address space. A hypothetical subnet behind an edge router running the NAT protocol is shown below. Assume that Host C wants to make a request to www.clemson.edu on port 80, where it knows Clemson runs a web server.

   The next page has four abridged headers, one for each of the points a,b,c, and d indicated on the image below. Complete each of these abridged headers with the IP addresses and port numbers that would be present at that point in the communication process.

   Some port numbers may be assigned to random values. When that occurs, use a single capital letter to indicate that a random number has been assigned. Use this letter wherever that random port would appear.



a)

Abridged Packet Header	
Source IP: 10.0.0.16	**Destination IP:** 52.1.8.3
Source Port: R	**Destination Port:** 80

b)

Abridged Packet Header	
Source IP: 41.93.141.8	**Destination IP:** 52.1.8.3
Source Port: R	**Destination Port:** 80

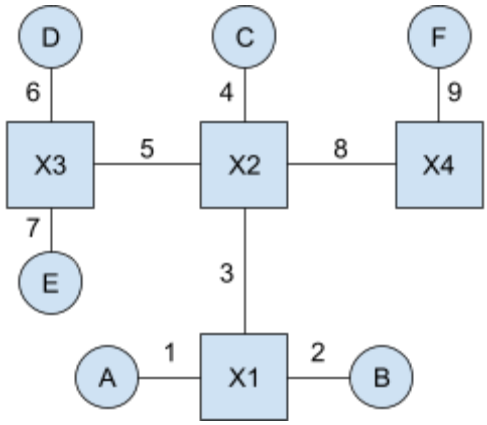
c)

Abridged Packet Header	
Source IP: 52.1.8.3	**Destination IP:** 41.93.141.8
Source Port: 80	**Destination Port:** R / B source

d)

Abridged Packet Header	
Source IP: 52.1.8.3	**Destination IP:** 10.0.0.16
Source Port: 80	**Destination Port:** R / A source

3. Consider the switched network to the right. Squares designate switches, circles designate host systems, and lines designate the links connecting the systems. Each link is labeled with a number, as are the hosts and switches. The switches in this network are self-learning switches. Your job for this problem is to explain how information flows through the network as a specific series of packets is sent out. **Assume that the switching tables start out empty, and that each problem builds on the switching table constructed in the previous part of the problem (i.e. copy the contents of your answer for part N into N+1 before updating it)**



Each entry in the switching table consists of a host name and the link the switch should forward a packet to in order to reach that host. For example, to reach **B**, **X1** would forward a packet to link **2**; in contrast, to reach **B**, **X3** would forward a packet to link **5**.

a. Host F sends a packet to Host C.

Which <u>switches</u> (e.g. X1, X2, X3,...) receive this Packet?: _____X2 and X4_____

What is the contents of the switching tables after the packet has finished moving through the network?

Switch X1		Switch X2		Switch X3		Switch X4	
Host	Link	Host	Link	Host	Link	Host	Link
		F	8			F	9
		C	4			C	8

b. Host C responds to Host D with a packet.

Which <u>switches</u> (e.g. X1, X2, X3, X4) receive this packet?: _____X2 and X3_____

What is the contents of the switching tables after the packet has finished moving through the network?

Switch X1		Switch X2		Switch X3		Switch X4	
Host	Link	Host	Link	Host	Link	Host	Link
		F	8	C	5	F	9
		C	4	D	6	C	8
		D	5				

c. Host B sends a packet to Host C.

Which <u>switches</u> (e.g. X1, X2, X3, X4) receive this packet?: __X1 and X2_____

What is the contents of the switching tables after the packet has finished moving through the network?

Switch X1		Switch X2		Switch X3		Switch X4	
Host	Link	Host	Link	Host	Link	Host	Link
B	2	F	8	C	5	F	9
C	3	C	4	D	6	C	8
		D	5				
		B	3				

d. Host E sends a packet to Host B

Which switches (e.g. X1, X2, X3, X4) receive this packet?: __X1 X2 and X3_____

What is the contents of the switching tables after the packet has finished moving through the network?

Switch X1		Switch X2		Switch X3		Switch X4	
Host	Link	Host	Link	Host	Link	Host	Link
B	2	F	8	C	5	F	9
C	3	C	4	D	6	C	8
E	3	D	5	E	7		
		B	3	B	5		
		E	5				

e. Host A sends a packet to Host F.

Which switches (e.g. X1, X2, X3, X4) receive this packet?: ___X1 X2 and X4_____

What is the contents of the switching tables after the packet has finished moving through the network?

Switch X1		Switch X2		Switch X3		Switch X4	
Host	Link	Host	Link	Host	Link	Host	Link
B	2	F	8	C	5	F	9
C	3	C	4	D	6	C	8
E	3	D	5	E	7	A	8
A	1	B	3	B	5		
		E	5				
		A	3				

4. For each of the following signals, decode it using each of the four methods we discussed in class (NRZ, NRZI, Manchester, and 4B5B encoding). If the signal cannot be decoded into a string of 0's and 1's, say so instead of decoding it.

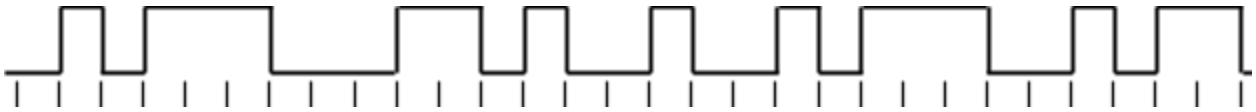
a)

NRZ	NRZI	Manchester	4B5B
0110101010100110100 10110100101	0101111111110101110 11101110111	001111001010101	Cannot be decoded

b)

NRZ	NRZI	Manchester	4B5B
1111001001011101101 11001011101	1000102201110011011 00101110011	101101010100101	Cannot be decoded

c)



NRZ	NRZI	Manchester	4B5B
0101110001101001001 01110010110	0111001001011101101 11001011101	0101001011100 10	Cannot be decoded