

Exam Instructions:

1. The exam will be available from Monday (May 1st at 5 pm) to (May 4th at 11:59 pm). Please DO NOT start at the last minute, as no late submission will be accepted unless you have permission from the instructor.
2. The instructor will do his best to respond to anyone as soon as possible to answer any questions. Please email me or text me on my phone at +17042875149. (Please don't call)
3. The exam is an open book and notes; however, copying and pasting is not allowed. You have to write the answers in your own words. If you have to copy and paste, you must mention the reference you used. For instance, if you copied something from StackOverflow, you must include the link to your answer or your answer will not be considered.
4. You have to include the question before the answer so we ensure the answer is in the right place to the question.
5. Handwriting is only accepted for IP addressing problems, charts, or drawings.
6. Your plagiarism percentage should be at most 10%. We will check your percentage, and any percentage higher than the allowed percentage will be deducted from your overall exam grade. However, if the percentage exceeds 10% because you added the questions to your answer, we will not consider it.
7. You are not allowed to share your answers with anyone during the test or after. In case of similar solutions, all parties will receive a zero.
8. The following resources are helpful for validating your answer. Showing the solutions from those tools with your work steps will be considered.
 - IP addressing calculator (<https://www.calculator.net/ip-subnet-calculator.html>)
 - Decimal to the binary converter (<https://www.rapidtables.com/convert/number/decimal-to-binary.html>)

Best of Luck

Ali

Q1: Alice wants to send a message to Bob, Assuming they are using the TCP/IP connection stack, and the following information describes the connection:

- The message size is 10MB
- The maximum that could be sent at a time is 64KB (data + header)

Answer the following questions:

- How would the message will be processed (Hint: refer to Protocol Data Unit PDU topic)
- Assuming the message is an HTTP request, what would be the source and destination port number
- Do you think the transmission protocol used will be (TCP or UDP)? Justify your answer.

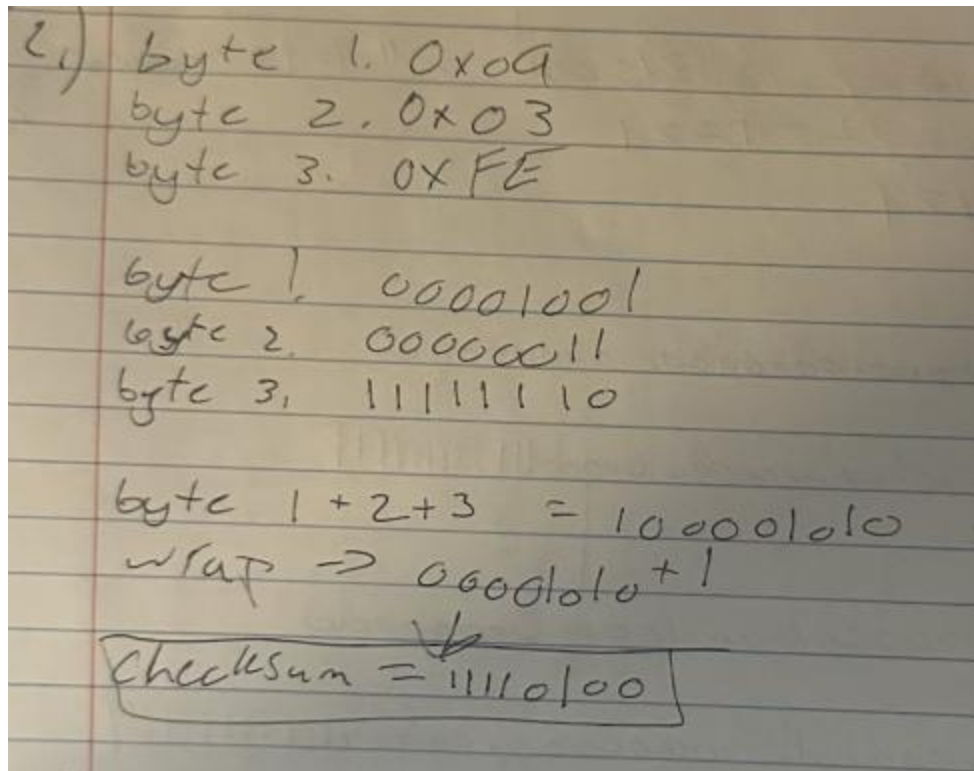
A.) The message will be processed using Protocol Data Unit PDU. A PDU is a data packet with header + data so Alice will send a PDU with a header containing her info and the 10mb of data.

B.) The source port will be a port chosen by Alice's PC and the destination port will be 80 (the default for http)

C.) The protocol will be TCP because TCP is reliable, ordered delivery, and is more suited for larger data than UDP.

Q2: Given the following bitstreams (101101010000111100111000111001011010001110100101), Answer the following questions (Show your detailed work):

- Calculate the checksum.
- What would be the output that will be sent to the receiver?
- Assume the data has been delivered to the receiver; verify the received data.



Q3: Describe the Head of Line Blocking (HOL) problem in HTTP/1. Does HTTP/2 suffer from the same problem? If Yes, explain how the HTTP/2 protocol solves the problem.

Head of line blocking HOL is when a queue of packets cant move forward because of congestion, HTTP/2 still suffers from HOL, but it uses multiplexing to break up data into smaller chunks to mitigate the impact of HOL.

Q4: Given the following bits sequence D (10001010111110110101) and the generator G (11001), answer the following? (Show your detailed work)

- On the sender side, Calculate the Cyclic Redundancy Check.
- What would be the output that will be sent to the receiver?
- On the receiver side, validate the received data.

5-1 at end

Handwritten list of binary strings (4 bits) with arrows indicating a sequence:

- 11001
- 10000
- 01001
- 10100
- 01101
- 00010
- 01011
- 10111
- 11111
- 00100
- 01000
- 10001
- 10000
- 10011
- 10100
- 11011
- 00100
- 01000
- 10000
- 10010

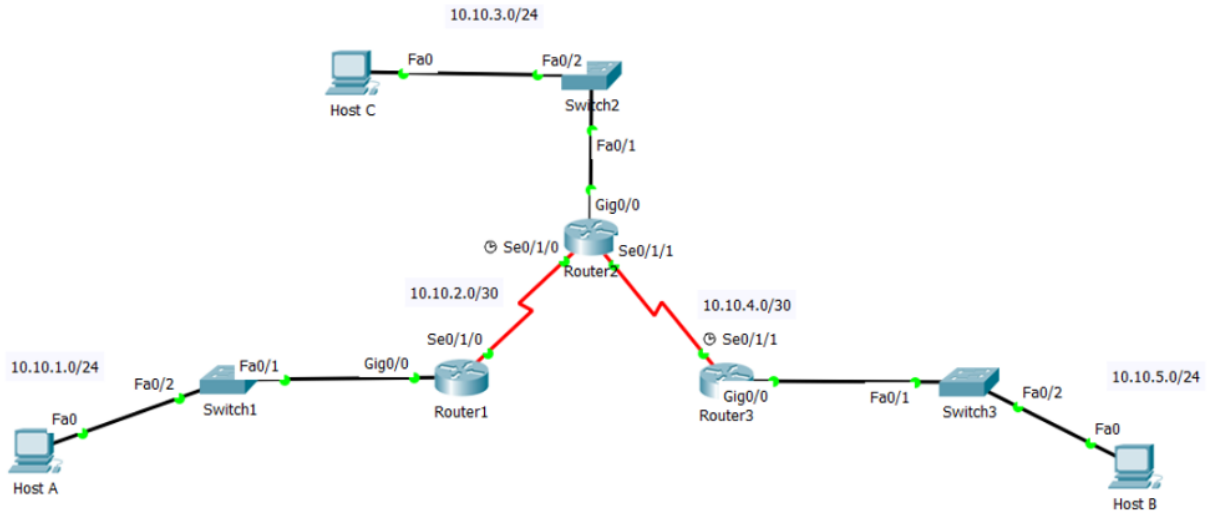
CRC \rightarrow 1000101011110101011

ϕ means no error, Data validated

Q5: in your own words, What are the differences between the switch and hub? Is there a time when a switch will act as a hub?

The biggest difference is a hub is on the physical layer while a switch is on the data link layer. Another difference is that a hub sends all traffic to all connected computers while a switch selectively forwards data to its destination.

Q6: Given the following network topology and the addressing table, if Host A wants to send a message to Host B, show (source & destination network address, source, and destination link-layer addressing) for each step



Machine	Interface name	IP address	MAC Address
Host A	Fa0	10.10.1.1	AB:AC:AF:11:22:33
Host B	Fa0	10.10.5.1	AB:AC:AF:22:44:31
Host C	Fa0	10.10.3.1	AB:AC:AF:33:12:3F
Router 1	Gig0/0	10.10.1.254	BC:AB:CA:76:28:81
Router 1	Se0/1/0	10.10.2.1	BC:AB:CA:83:99:10
Router 2	Se0/1/0	10.10.2.2	BC:AB:CA:98:77:21
Router 2	Se0/1/1	10.10.4.1	BC:AB:CA:71:12:AB
Router 2	Gig0/0	10.10.3.254	BC:AB:CA:62:01:81
Router 3	Gig0/0	10.10.5.254	BC:AB:CA:09:07:1B
Router 3	Se0/1/1	10.10.4.2	BC:AB:CA:81:AC:F1

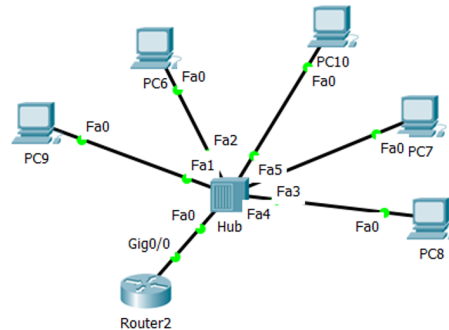
6.) Host A → Host B
 Source address AB:AC:AF:11:22:33
 Destination address BC:AB:CA:76:28:81
 Source IP 10.10.1.1
 Destination IP 10.10.5.1
 → Router 3
 Source Address BC:AB:CA:09:07:1B
 Destination Address AB:AC:AF:22:44:31
 Source IP 10.10.1.1
 Destination IP 10.10.5.1

Host A
 ↓
 Router 1
 ↓
 Router 3
 ↓
 Router 2
 ↓
 Host B

Q7: Given the following topology, answer the following:

- How many collisions and broadcast domains?

- Suppose you replace the hub device with six ports switch configured with three virtual local area networks. How many collision and broadcast domains? Justify your answer.
- Based on the changes done in step 2, PC8 is unable to communicate with PC9. Why do you think the reason might be?
- How can PC8 communicate with PC9?



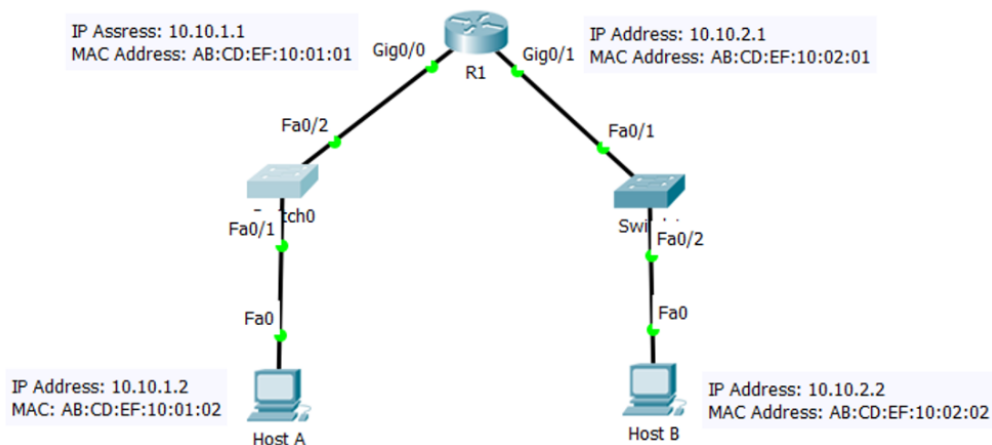
A.) Hubs broadcast all to all so there is 1 broadcast domain. Since 1 broadcast there is 1 collision domain.

B.) 6 port switch with 3 VLAN is 3 broadcast which also means 3 collision domains.

C.) If two pcs cant communicate then they are probably on different VLAN

D.) To allow them to communicate they would have to both be on the same VLAN.

Q8: Refer to the following topology; Host A wants to send a packet of data to Host B for the first time. According to that scenario, what would be the first step Host A should take to start communicating with Host B? Justify your answer.



Host A sends Host B an ARP request to get Host B mac address. Then it adds IP and mac address to data, then sends to the switch to reach Host B.

Q9: Alice lent money to Bob, and they created a document stating the amount of money Alice lent. This document has been encrypted using the symmetric algorithm AES. Alice and Bob are the only ones who know the key used for encryption. After a while, Alice asked Bob for her money back, and Bob gave her \$10. at this point, Alice said the amount of money was \$1000, but Bob denied it. They went to the police station and got copies of the encrypted document. The officer asks Bob and Alice to decrypt the document for further investigation. Surprisingly, Alice's document stated the loan money was \$1000. Also, Bob's document noted the amount of money was \$10. according to this scenario, answer the following questions:

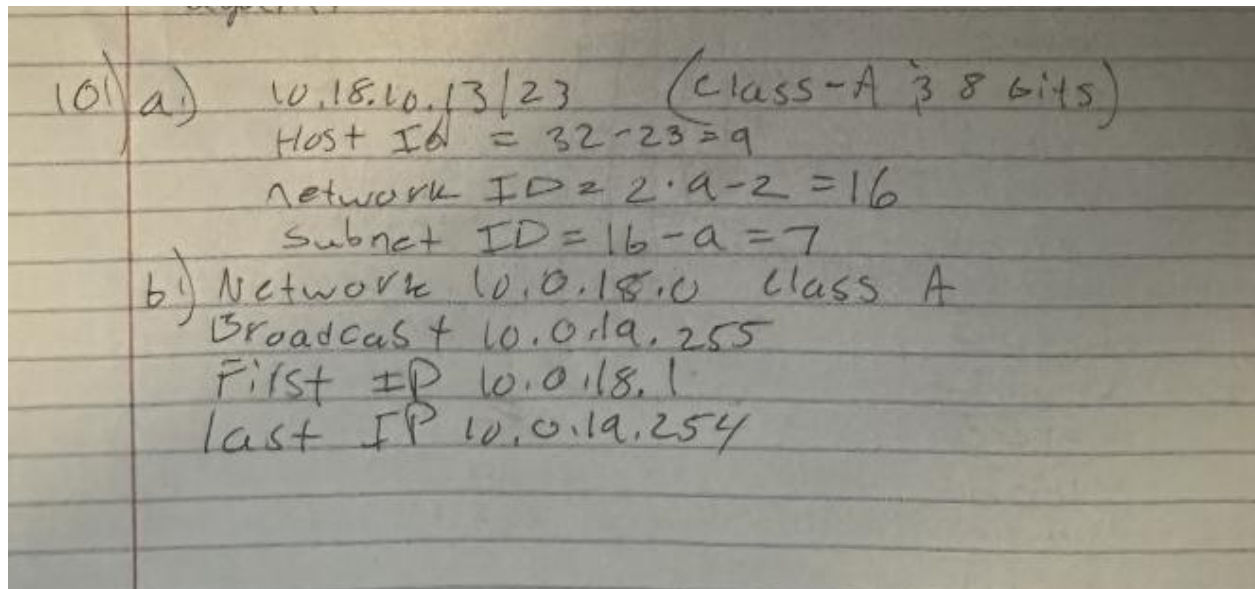
- Why are both documents different? As you know, both copies matched at the agreement time.
- Clearly, there is a problem in the protocol used; propose another protocol that may not be vulnerable to such a problem.

A.) AES is a symmetric algorithm meaning the same key is used for encryption and decryption. One of the two people with the key decrypted the document, changed the value and then encrypted it again.

B.) Another protocol is the RSA algorithm. RSA is asymmetric meaning there is a public key and a private key, blocking someone from decrypting and changing the value then encrypting again.

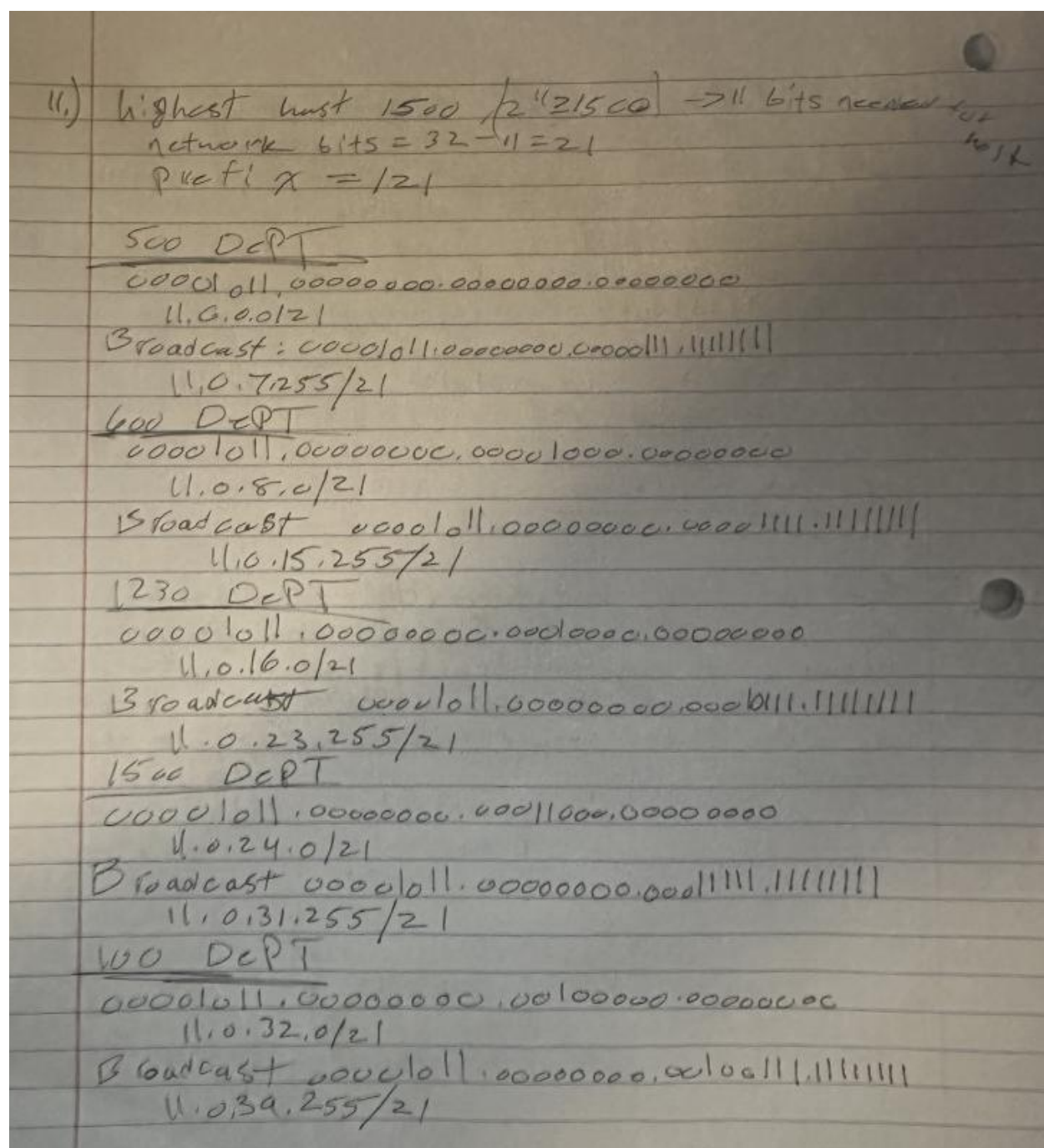
Q10: Given the IP address (10.18.10.13/23), answer the following (Show your work on a hard copy paper):

- How many bits are allocated for (network, subnet (if any), hosts)
- What is the network address, broadcast address, first IP address, last IP address of the 10th network?



Q11: You work for a company, and the ISP provides you with the address (11.13.10.0/8). You must create an addressing schema that creates equal host address space and ensures the least IP address wastage in each network. If you know that you have five departments, each Department has 500, 600, 1230, 1500, and 100 hosts, respectively. Answer the following (Show your work on a hard copy paper):

- What is the proposed prefix you may use? Why?
- What is the network address broadcast address for each department?



Q12: You studied public cryptography briefly. Based on what you learned, answer the following questions:

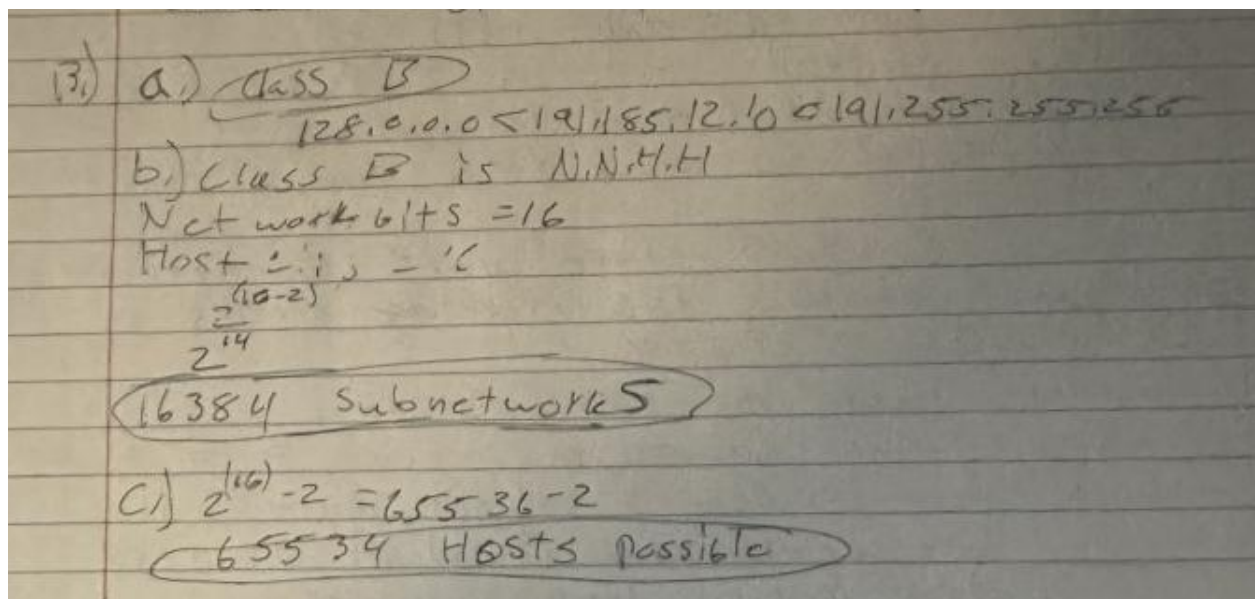
- Provide one practical use case that is hard to achieve without public-key cryptography.
- Is public cryptography suitable for large messages? Justify your answer

A.) One use that is hard without public key cryptography is secure messaging. Without the cryptography the data would be plaintext making it extremely vulnerable.

B.) Yes it is secure for large messages because it can be broken up into smaller data and the chunks separately encrypted, leading to it being more secure.

Q13: Given the IP address (191.185.12.10), answer the following (Show your work):

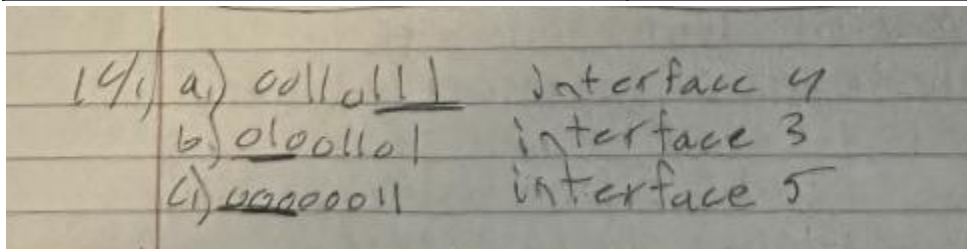
- Using the priority bits, what is the class of this address?
- Assuming we are using the default subnet mask of the class, how many subnetworks can we create?
- Assuming we are using the default subnet mask of the class, how many hosts can we have in each subnetwork?



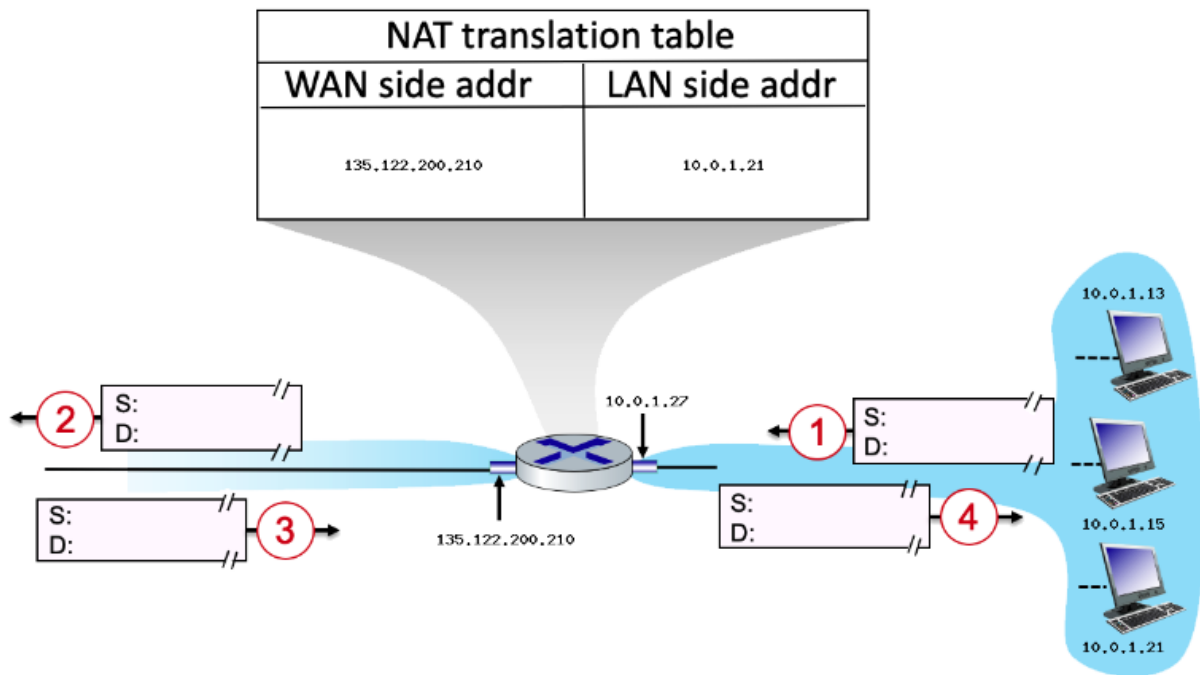
Q14: Given the following forwarding table, suppose a router uses the longest prefix forwarding and receives three datagrams (00110111), (01001101), and (00000011). Which interface will each datagram use?

Prefix Match	interface
01	1
11	2

010	3
111	4
000	5
otherwise	6



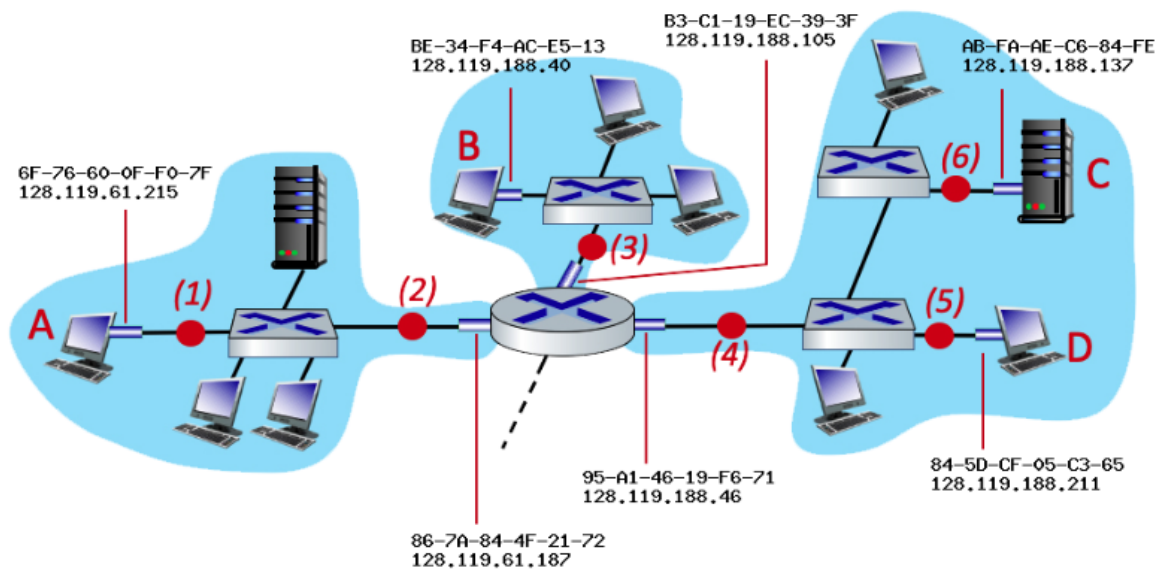
Q15: Consider the scenario below in which three hosts, with private IP addresses 10.0.1.13, 10.0.1.15, 10.0.1.21 are in a local network behind a NAT'd router that sits between these three hosts and the larger Internet. IP datagrams being sent from or destined to; these three hosts must pass through this NAT router. The router's interface on the LAN side has the IP address 10.0.1.27, while the router's address on the Internet side has the IP address 135.122.200.210. Suppose that the host with IP address 10.0.1.21 sends an IP datagram destined to host 128.119.164.182. According to the following topology, show the source and destination IP address for each step

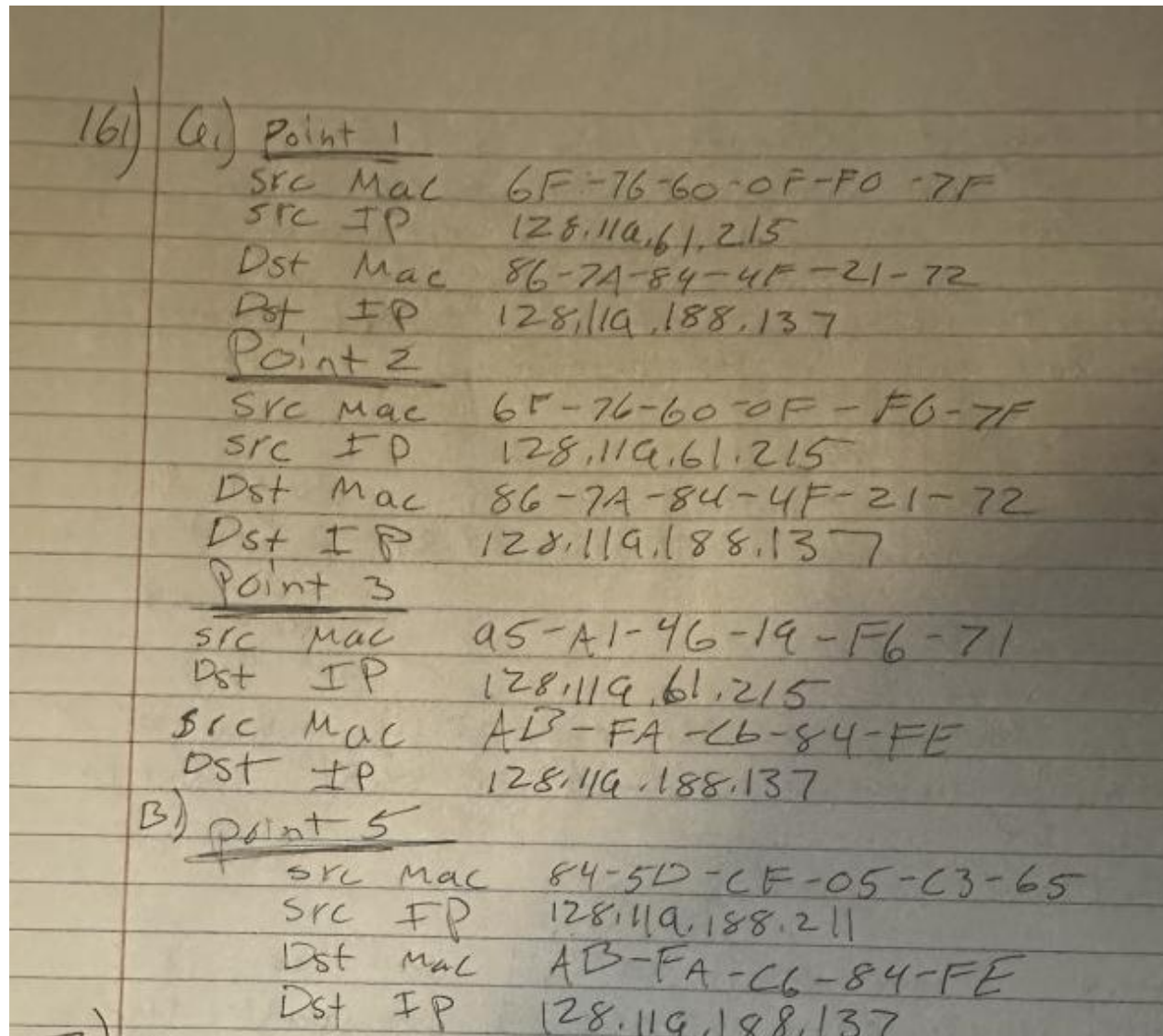


15	1	2	3	4
src IP	10.0.1.13	128.119.1.63/90	10.0.1.27	10.0.1.27
src port	3435	80	3435	80
dst IP	10.0.1.27	10.0.1.27	128.119.1.63/90	10.0.1.13
dst port	80	80	80	3435

Q16: Consider the following topology, answer the following questions:

- If A sent a message to C, answer the following:
 - What are the source and destination IP and MAC address of at point (1)
 - What are the source and destination IP and MAC address of at point (2)
 - What are the source and destination IP and MAC address of at point (4)
- If D sent a message to C, what are the source and destination IP, MAC addresses





Q17: Given a network of a startup company which has four departments. Each department has between 10-15 employees. One of their core requirements is to have complete isolation for each network which each department cannot have a direct connection to the other department (each department must have its own subnetwork). They need your help as a consultant to decide on the network hardware that ensures the minimum purchase amount.

Absolute minimum cost would be one router and four switches. The four switches would ensure each department is completely isolated on their own network.

Q18: You are a network engineer and must design a network for your new site with the following requirements:

- The main IP address given by the ISP is (10.10.0.0/8)
- Each router can only have up to 3 network cards.
- You have six departments that have the following number of hosts (256, 200, 180, 160, 80, 110)

According to the given facts, answer the following: (You must show your work)

- How many subnetworks do you have to create? Justify your answer.
- What is the proposed prefix you may use? Why?
- What would be the subnet mask in the decimal representation?
- How many bits are allocated for (network, subnet (if any), hosts)
- What is the size of (hosts space, subnetworks space)
- For each subnetwork, provide the network address, broadcast address, 1st and last IP address?

(81) a) Since 6 dept there are 6 sub networks
b) biggest dept is 256 therefore prefix is $32-8=24$ $2^8=256$
c) subnet mask is 255.255.255.0
d) 24 bits for network, 0 for subnet, 8 for hosts
e) host space is 256, subnet space is 1
f) Dept 1 Network: 10.10.0.0 Broadcast: 10.10.0.255
first: 10.10.0.1 last: 10.10.0.254
Dept 2 Network: 10.10.1.0 Broadcast: 10.10.1.255
first 10.10.1.1 last 10.10.1.254
Dept 3 Network: 10.10.2.0 Broadcast: 10.10.2.255
first 10.10.2.1 last 10.10.2.254
Dept 4 Network: 10.10.3.0 Broadcast: 10.10.3.255
first 10.10.3.1 last 10.10.3.254
Dept 5 Network: 10.10.4.0 Broadcast: 10.10.4.255
first 10.10.4.1 last 10.10.4.254
Dept 6 Network: 10.10.5.0 Broadcast: 10.10.5.255
first 10.10.5.1 last 10.10.5.254