Part 1: Multiple Choice Question (15 points)

1. Which of the following statement is NOT true?

a. TCP has an explicit connection establishment phase
b. TCP provides for in-sequence delivery of messages
c. TCP connections are likely to have similar round trip times
d. TCP includes a mechanism to "learn" about buffer space available at receiver

2. What does a URL need to access a document?

(-4

a) IP address
b) Host address
c) Pathname
d) HTTP version
e) Port number

3. The purpose of MTA (Mail Transfer Agents) is

a) Prepare e-mail messages
b) Create e-mail envelopes
c) Transferal of e-mail messages across the Internet
d) All of the above
e) None of the above

4. 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

5. If a TCP flow and a UDP flow share the same "bottleneck" in the network. Which of the following is "more likely" to be true

a) TCP connection will get a greater percentage of the bandwidth than UDP
b) UDP connection will get a greater percentage of the bandwidth than TCP
c) Both TCP and UDP connections will be affected equally by the network congestion
d) TCP will continue because it is reliable but UDP will stop
e) Both connections will terminate

6. **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

7. **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

8. **A sender sends an unencrypted message and its encrypted digest over a network. Which of the following types of information assurance is provided in this scenario?**

a. Confidentiality
b. Integrity
c. Authentication
d. None of the above

9. **A sender sends a message encrypted by a public key of the recipient. Which of the following is NOT provided in this scenario?**

a. Confidentiality
b. Integrity
c. Authentication
d. None of the above

10. **A sender sends a message encrypted by his own private key. Which of the following is NOT provided in this scenario?**

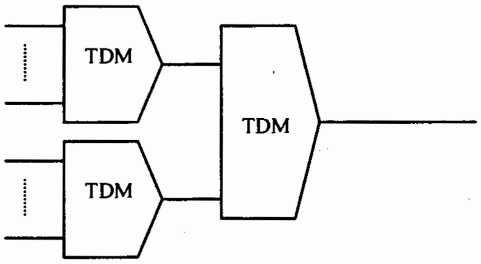
a. Confidentiality
b. Integrity
c. Authentication
d. All of the above

11. If there are 5 routers and 6 networks in an internetwork, how many link-state databases there are

a) 1
b) 5
c) 6
d) 11
e) None of the above

12. Each synchronous TDM serves 10 devices @ 64Kbps each. Each device is active 20% of the time.The minimum bit rate at the output should be

a) 640Kbps
b) 1.92Mbps
c) 1.28Mbps
d) 256Kbps



13. When comparing circuit switching with connection-less packet switching, the probability of "blocking" is

a) Equal to 0 in packet switching and is greater than 0 in circuit switching
b) Equal to 0 in circuit switching and is greater than 0 in packet switching
c) Greater in packet switching than in circuit switching if the network is congested
d) This is a trick question! Both packet switching and circuit switching have the same probability of blocking. They differ only in the fact that packet switching uses "store and forward"

14. Which of the following is true of firewalls?

a. They can be configured to filter packets based on source and destination IP addresses
b. They can be configured to filter packets based on source and destination ports
c. They can be configured to block all access except to specific ports
d. All of the above

15. 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

Part 2: True/False Question (25 Points)

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

F 2. The acknowledgement number in the header of the TCP segment identifies the sequence number of the next segment expected to be received

F 3. A stop and wait ARQ scheme is used over a link between a host and a router. The utilization will improve if the message length is increased while the frame length and the physical distance remains unchanged.

-2

T 4. TCP only acknowledges bytes up to the first missing byte in the stream

T 5. A network has a faulty router (one that produces errors during route calculation). The LS routing protocol is more likely to propagate this route calculation error than a DV routing protocol

F 6. A station uses the address resolution protocol (ARP) to bind the IP address with a MAC address of any other station across the internet

F 7. In switched hubs, all ports are dedicated to the stations attached to them

F 8. Switched hubs have multiple collision domains where as shared hubs have single collision domain

F 9. TCP has the property of slow start to avoid congestion in the network

T 10. HTTP is a state-less application protocol where as FTP is not

should be in IP header

F 11. The TTL is a field in the TCP header that keeps track of the number of hops before a router must discards the packet

F 12. The maximum window size in TCP is limited by the round trip time RTT of the connection

T 13. In CSMA/CD-based LANs, the stations must always listen to the media even if they have no frames to transmit

F 14. If all links in the Internet were to provide reliable delivery service, the TCP reliable service would be redundant.

F 15. Flow control seeks to prevent sender from overburdening the network and thus from causing the router's buffers to overflow

T 16. In iterative DNS services, the local DNS service will return, to the DNS client, the IP address of a DNS server that will probably have the IP address of a host whose name address was specified in the DNS query.

T 17. The Nyquist theorm specify that the minimum sampling rate must be at least equal to twice the bandwidth of the signal being sampled

F 18. The MTU is the maximum number of octets that the IP protocol can encapsulate

T 19. 10B5 and 10B2 have different segment length but same MAC procedures

F 20. A bridged LAN has a single collision and broadcast domains.

F 21. The port field in the TCP/UDP headers is used to identify the protocol the packet should be delivered to

F 22. In TCP Congestion control, when a timer expires at the sender, the threshold is set to one half the previous threshold value

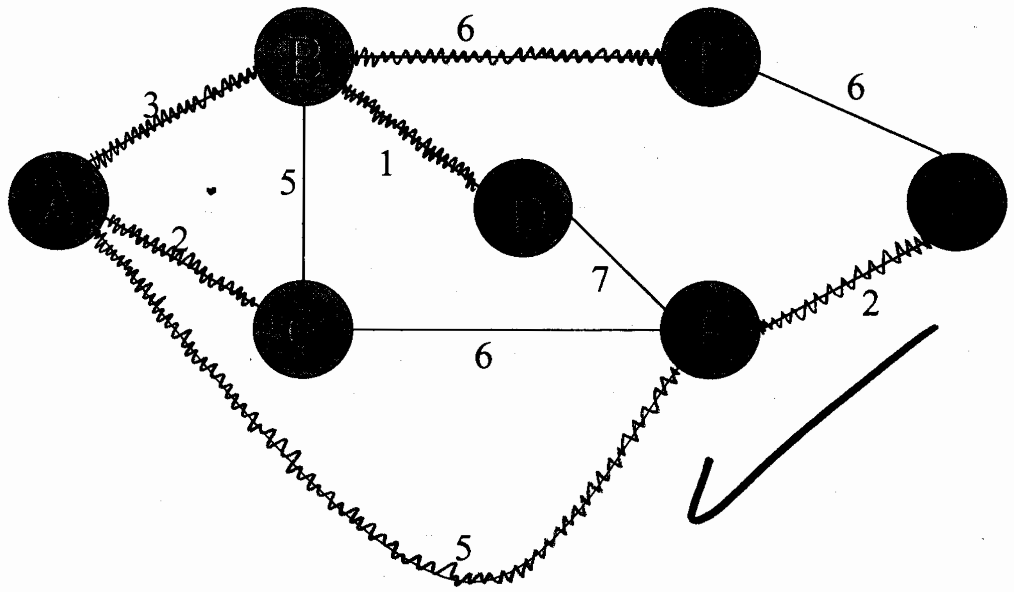
T 23. Suppose host A send a large file to host B over a TCP connection. The number of "un-acknowledged bytes" that A sends can't exceed the size of the receiver buffer

T 24. IP fragmentation is not necessary if every transit network on a route has at least as large as the MTU as the source network

T 25. Suppose host A sends over a TCP connection to host B one segment with a sequence number 38. That segment contains 4 bytes. The acknowledgement number in that same segment ~~number~~ should be 42

Part 3 (15 points, 10 for part "a" and 5 for part "b")

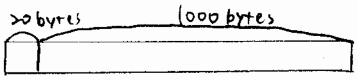
a) Consider the following computer network where each node represents a router and the edge label is the corresponding link cost. All links are bi-directional. Use Dijkstra algorithm to find the shortest path from router A to every other router in the network. Show your work step-by-step (i.e. I am not interested in the final answer. I am interested in algorithm steps). After you finish, identify the SPT carefully on the diagram.



		B	C	D	E	F	G
Step	SPT	D(B), P(B)	D(C), P(C)	D(D), P(D)	D(E), P(E)	D(F), P(F)	D(G), P(G)
0	A	3, A	2, A			5, A	
1	A, C	3, A				5, A	
2	A, C, B			4, B	9, B	5, A	
3	A, C, B, D				9, B	5, A	
4	A, C, B, D, F				9, B		7, F
5	A, C, B, D, F, G				9, B		
6	A, C, B, D, F, G, E						

b) It is desired to transmit a TCP segment of 1000 Bytes (includes the TCP header) over a network using IP. The IP header consists of 20 bytes. The MTU of this network is 256 bytes. Find the required number of fragments indicating their <u>total length</u> and the <u>offset field</u> values in each of these fragments.

※ original packet:

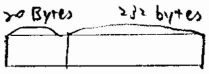


If the MTU is 256 bytes, that means we have 20 bytes IP header and 236 bytes payload,

but payload should be divided by 8, ∴ the max payload is 232 bytes

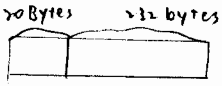
∴ we have 5 fragments as follows:

fragment #1:



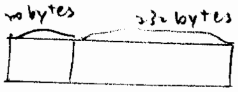
Total length: 252 bytes, Offset: 0

fragment #2:



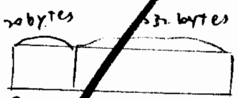
Total length: 252 bytes, Offset: 29

fragment #3:



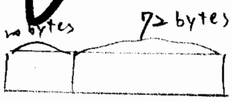
Total lenth: 252 bytes, Offset: 58

fragment #4:



Total length: 252 bytes, Offset: 87

fragment #5:

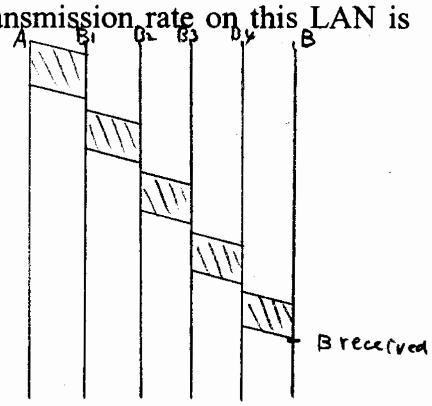


Total length: 92 bytes, Offset: 116

Part 4 (15 points, 5 points each)

$V_{prop} = 2.5\times10^8$ m/s

a) Two nodes "A" and "B" that are attached at the opposite ends of a 2500 meters cable. suppose that ONLY "A" has a frame (1000 bits long) to transmit (i.e. there is no collision) and that the 2500 cable is divided into 5 segments each 500m long, interconnected by bridges (i.e. we have 4 bridges). Suppose each bridge introduces 20-bit delay of processing, store & forward, etc… At what time will the frame from "A" be completely delivered to "B"? What is the throughput ? Assume that the transmission rate on this LAN is 10Mbps. $T_f = \frac{1000}{10\times10^6} = 100\mu sec$



$T_{prop} = \frac{500}{2.5\times10^8} = 2\mu sec$

$T_{process} = \frac{20}{10\times10^6} = 2\mu sec$

- $T_{B\,received} = 5T_{prop} + 5T_f + 4T_{process} = 518\mu sec$
- Throughput $= \frac{1000\,(bit)}{518\times10^{-6}\,(sec)} = 1.93$ Mbps

b) Eight stations are connected to a 1km token ring. The data rate is 1 Mbps. Every station introduces a 1-bit delay. The maximum token holding time for each station is 1 ms. After a station releases the token, it sees the token again after *x* seconds. Assume the speed of propagation is 2x10^8 m/sec. Find the minimum and the maximum values of *x*. What is the largest size frame that can be transmitted?

100 us

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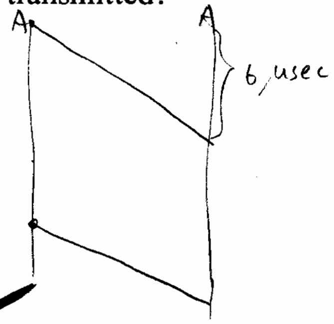
$T_{RingLatency} = \frac{1000}{2\times10^8} + \frac{8\cdot1}{10^6} = 13\mu sec$



- Min of x is $T_{RingLatency} = 13\mu sec$, occurring when other seven stations have nothing to transmit.

- suppose Largest size frame is y, then $\frac{y}{1\cdot10^6} = 1$ ms

∴ y = 1000 (bits), occurring when "early release" used.

c) Consider building a CSMA-CD network running at 1 Gbps over a 1km cable with no repeaters. What is the minimum frame size? Assume the speed of propagation is 2x10^8 m/sec.

set Minimum frame size = X.

$\longrightarrow \frac{X}{1\times10^9} \geq 2\cdot\frac{1000}{2\times10^8} = 10^{-5}$

∴ X ≥ 10000

∴ minimum frame size = 1000 bits

0

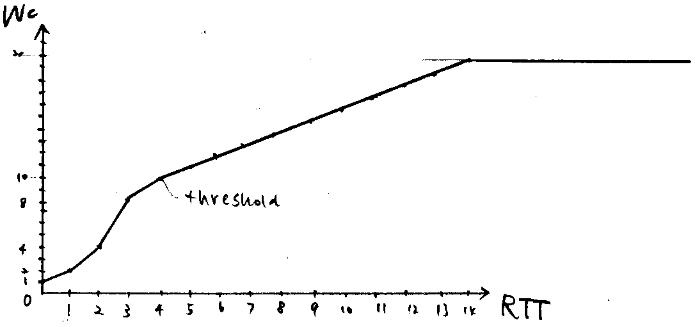
Part 5: TCP Congestion Control (15 points)

In this problem we are trying to investigate the effect of the slow start procedure on the throughput in TCP. Assume a round trip time RTT = 50 msec. Assume that we have an "infinitely" fast network (which means no congestion, but the TCP source doesn't know that) which means zero transmission time. Assume that the maximum receiver advertized window size is 20 segments. Assume that the initial congestion window threshold is set to one half the advertized window. Set up a table with three entries namely RTT, Segments send and congestion window value (like you did in the last homework)

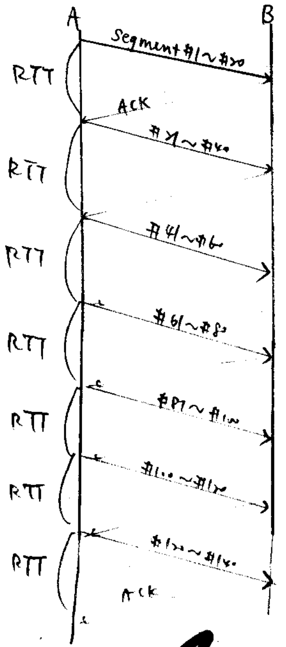
a) Calculate the throughput (in segments/sec) of the first 128 segments sent.
b) Repeat part "a" if no congestion control mechanism is used.

(a)

$$\text{Throughput} = \frac{128 \text{ (segments)}}{13 \times (50\times10^{-3}) \text{ sec}} = 196.92 \text{ (segments/sec)}$$



(b)



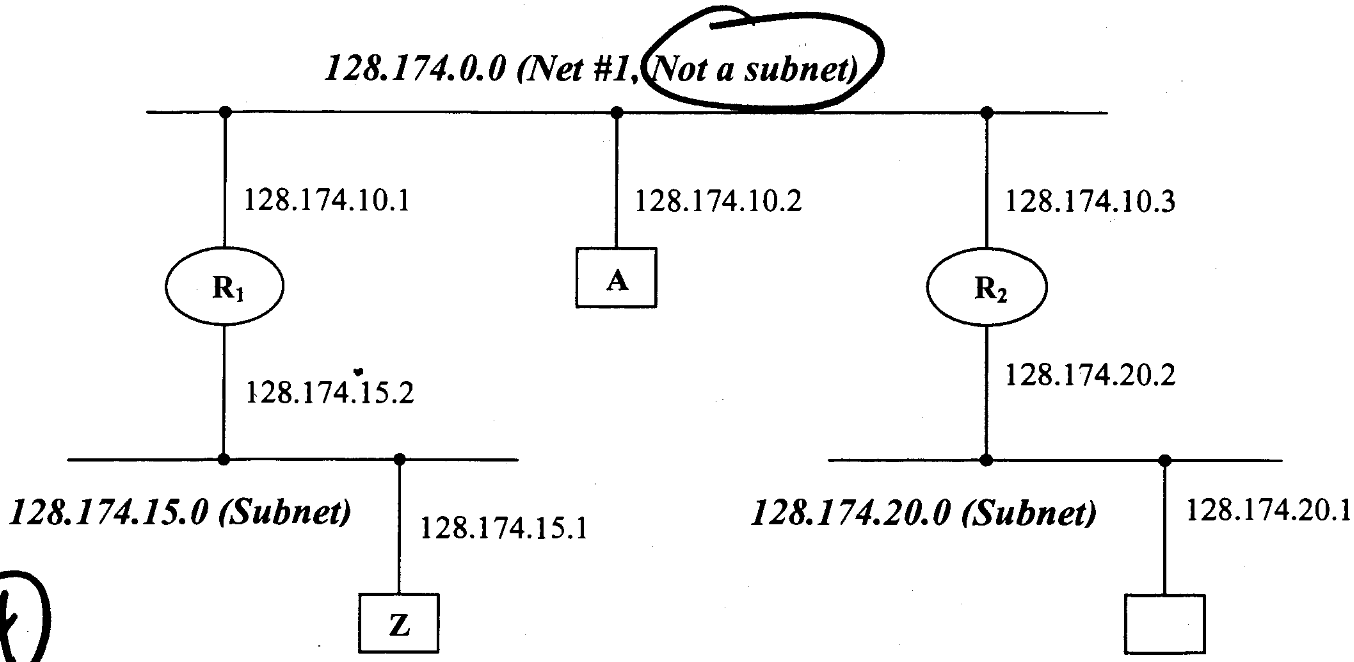
Segments sent ←

RTT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	...
Wc	1	2	4	8	10	11	12	13	14	15	16	17	18	19	20	20	20	...
	#1	#2 #3	#4 #5 #6 #7	#8 ~ #15	#16 ~ #25	#26 ~ #36	#37 ~ #48	#49 ~ #61	#62 ~ #75	#76 ~ #90	#91 ~ #106	#107 ~ #123	#124 ~ #141	...	...	...		

$$\text{Throuput} = \frac{128 \text{ (segment)}}{7\times(50\times10^{-3}) \text{ sec}} = 365.71 \text{ (segments/sec)}$$

Part 6 (20 points, 8 points for "a" and 12 points for "b")

a) Consider the following configuration. Host ~~Z~~ A wants to transmit a packet to host Z. The routing table at host A is as shown below. Fill in the SM part. Will the packet be delivered or is this configuration illegal? Explain clearly either way.



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Routing/Forwarding Table At host A		
Destination Net/Subnet	Subnet Mask	Next Hop IP Address
128.174.0.0	255.255.255.0	-
128.174.15.0	255.255.255.0	128.174.10.1
128.174.20.0	255.255.255.0	128.174.10.3

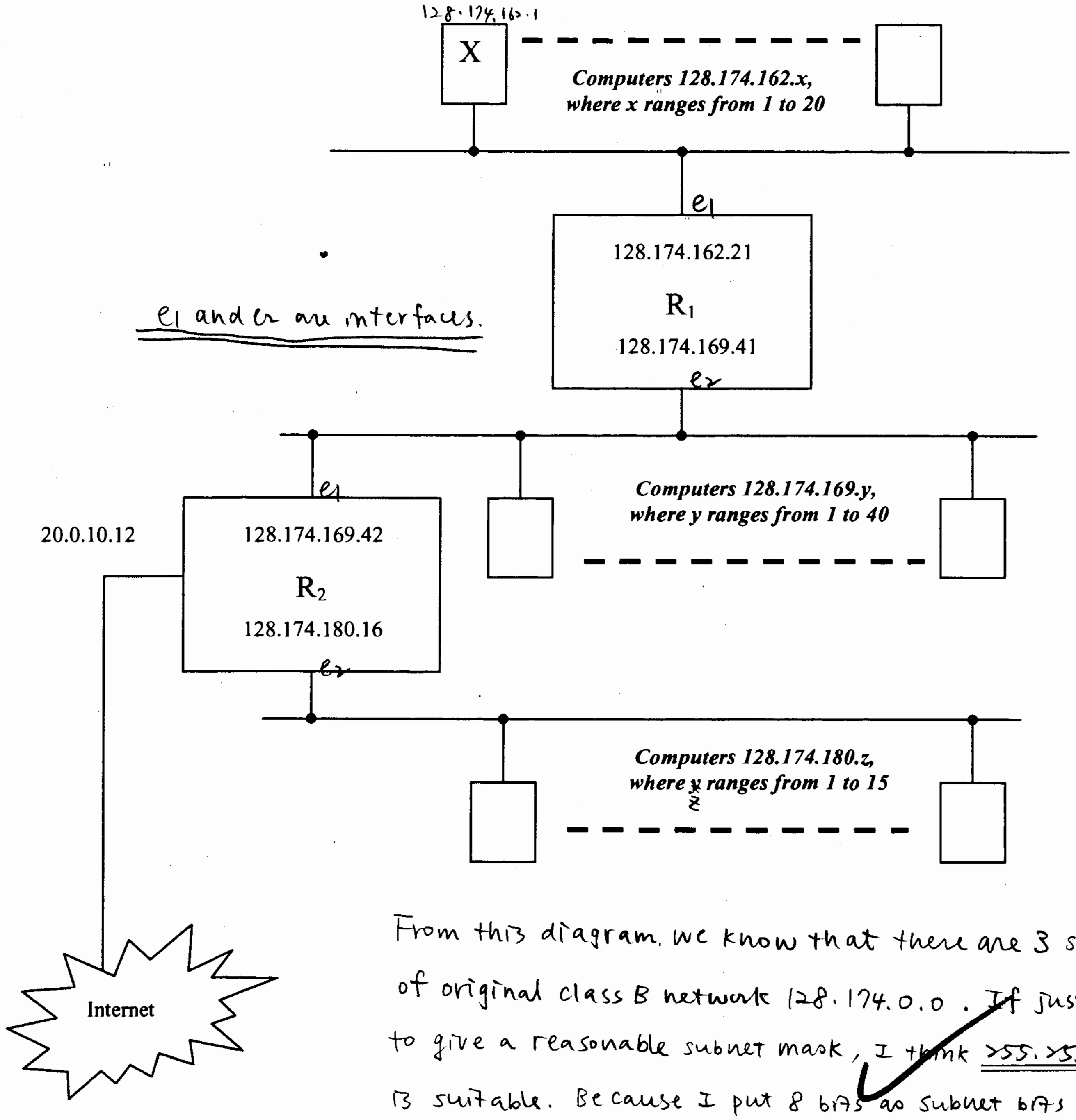
Suppose A wants to transmit a packet to Z

then A will see the destination IP address, which is 128.174.15.1, and mask with subnet mask 255.255.255.0, get result 128.174.15.0.

So A will match its routing table to get the destination subnet address is 128.174.15.0 and next hop is 128.174.10.1 (which is R1). So A will form the frame and destination MAC is MAC of R1. Then R1 receives the frame and see the packet, will see the destination IP is 128.174.15.1 and consult its routing table and perform the same job. Then A's packet can be sent to Z successfully.

∴ No question in this transmission.

b) Consider the following network of computers. Fill-in the entries of the routing table (note that the number of entries in the tables next page is not related to the number of entries you need to fill) at R_1, R_2 and at host X whose IP address is 128.174.162.1. It is essential that each computer can reach each other computer in the network. A common subnet mask should be used for all computers (except at the interface connecting the network to the rest of the Internet). What is that subnet mask?



From this diagram, we know that there are 3 subnets of original class B network 128.174.0.0 . If just want to give a reasonable subnet mask, I think 255.255.255.0 is suitable. Because I put 8 bits as subnet bits and 8 bits for host bits. So we have 2^8-2 subnets and each subnet has 2^8-2 hosts supposed all 0s and 1s not used.

Routing Table for R_1			
Destination Network	Subnet Mask	Next Hop IP address	
128.174.162.0	255.255.255.0	128.174.162.0	(e1)
128.174.169.0	255.255.255.0	128.174.169.0	(e2)
Default		128.174.169.42	(R2)
128.174.180.0	255.255.255.0	128.174.169.42	(R2)

-2

Routing Table for R_2			
Destination Network	Subnet Mask	Next Hop IP address	
128.174.169.0	255.255.255.0	128.174.169.0	(e1)
128.174.180.0	255.255.255.0	128.174.180.0	(e2)
Default		20.0.10.12	
128.174.162.0	255.255.255.0	128.174.169.41	(R1)

Routing Table for ~~H~~X			
Destination Network	Subnet Mask	Next Hop IP address	X
128.174.162.0	255.255.255.0	128.174.162.0	
Default		128.174.162.21	(R1)

X ?