

I. Multiple Choice (15points, 1 points for each question)

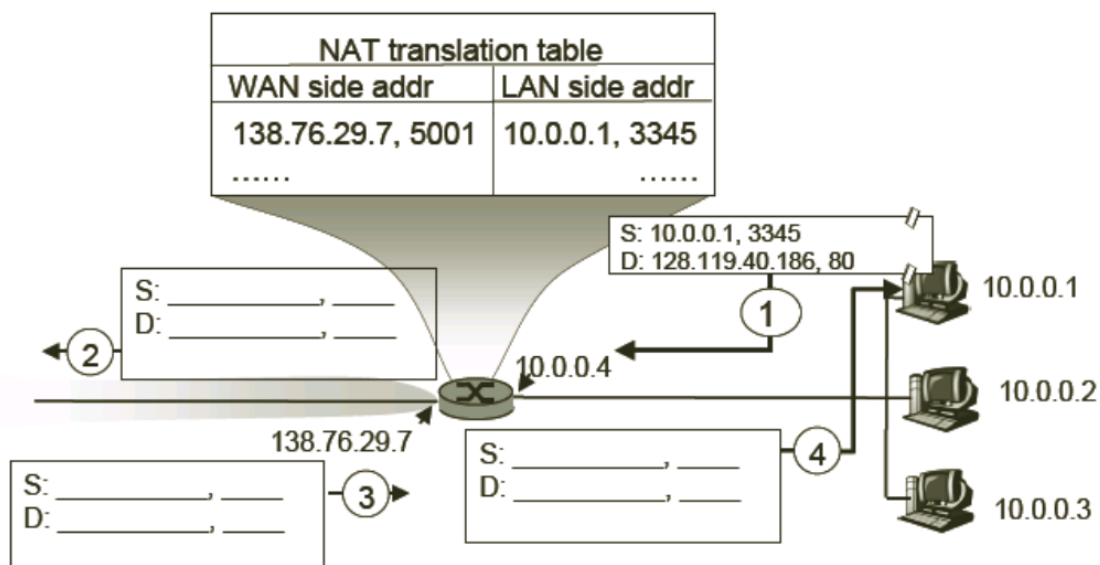
- (1) Class of an IP address can be determined from ()
 A. first 8 bits B. first 3 bytes C. first 5 bits D. first 4 bits
- (2) An ARP reply is normally _____.
 B. A. Broadcast B. multicast C. unicast D. none of the above
- (3) If no free buffers in router, the arriving packets will be:
 A. dropped B. queued C. returned D. marked
- (4) What is the default persistent model in HTTP/1.1:
 A. Nonpersistent HTTP B. Persistent without pipelining
 C. Persistent with pipelining D. Nonpersistent with pipelining
- (5) In GBN, when receiver receive a out-of-order packet, then discard and re-ACK the packet with:
 A. highest in-order sequence # B. lowest in-order sequence #
 C. highest in-order port # D. lowest in-order port #
- (6) Which device can break subnet into LAN segments:
 A. IP mask B. NAT C. Router D. Switch
- (7) What's a network? From IP address perspective they can physically reach each other without intervening router and the device interfaces with:
 A. same IP address B. same TCP port #
 C. same network part of IP address D. same host part of IP address
- (8) In RDT Approaches, which is designed for performance:
 A. checksum B. pipeline C. sequence # D. ACK or NAK
- (9) UDP socket identified by:
 A. two-tuple (source IP address, source port number)
 B. two-tuple (dest IP address, dest port number)
 C. two-tuple (source IP address, dest port number)
 D. two-tuple (dest IP address, source port number)
- (10) The Internet's network layer has three major components, the first component is the IP protocol, the second component is the routing protocol, the final component is ____? ()
 A. forwarding B. address translation C. check D. ICMP
- (11) IP addressing assigns an address to 223.10.198.250/29, the network address for this network is _____.
 ()
 A. 223.10.198.248 B. 223.10.198.250 C. 223.10.198.0 D. 223.10.0.0
- (12) Which of the following services is not provided by TCP?
 A. Delay guarantees and bandwidth guarantees B. Reliable data transfers and flow controls
 C. Congestion controls D. In-order data transfers
- (13) The SYN segment is used for _____.
 A. TCP connection setup B. TCP flow control
 C. TCP congestion control D. Closing a TCP connection
- (14) There are two 16-bit integers: 1110 0110 0110 0110, 1101 0101 0101 0101. Their checksum is _____.
 A. 0100010001000011 B. 1011101110111100
 C. 1111111111111111 D. 1000000000000000
- (15) If an application developer chooses _____ protocol, then the application process is almost directly talking with IP.
 A. HTTP B. RIP C. CSMA/CD D. UDP

2. True or False (15 points, 1.5 points for each statement)

- (1) A source's retransmission timeout value (RTO) is always set equal to the measured RTT.
- (2) A receiver reduces the advertised window size in response to congestion at routers along the path.
- (3) An Internet router connecting N subnetworks requires $N-1$ IP addresses.
- (4) Circuit switching networks require signaling and control for establishing circuits.
- (5) Framing is required in frequency division multiplexing.
- (6) Routing on the Internet is divided in two tiers.
- (7) A receiver reduces the advertised window size in response to congestion at routers along the path.
- (8) The Slow-Start algorithm increases a source's rate of transmission faster than "additive increase".
- (9) Ethernet is a LAN so it is placed in the second layer of the OSI reference model.
- (10) UDP provides connectionless service and delivers packets quickly. In case of packet loss, UDP does not provide retransmission.

3. please answer following questions briefly (40 points)

- (1) The diagram below shows a packet traveling through a NAT router: Packet 1 is sent from the internal host (S) to the NAT router; packet 2 is sent from the NAT router to the external web server (D), packet 3 is received from the web server by the NAT router; and packet 4 is sent by the NAT router to the original host. Fill in the missing source and destination IP addresses and port numbers in packets 2-4. (3 points)



- (2) Name two modifications of IPv6, from the IPv4, that allow a router to process a packet quicker: (4 points)
- (3) What is the key difference between distance-vector and link-state routing protocols in terms of how protocol messages are sent? Give the names of a distance-vector algorithm and protocol. Give the names of a link-state algorithm and protocol. (4 points)
- (4) Given a message $M = 1010001101$, determine the CRC using the polynomial $P = x^5 + x^4 + x^2 + 1$. Show your work. What is the transmitted message T ? (6 points)
- (5) Name and describe two types of frame errors that occur in the transmission of frames. (4 points)
- (6) The client A wants to request a Web page from Server B. Suppose the URL of the page is `http://172.16.0.200/experiment`, and also it wants to receive French version of object. The time-sequence diagram is shown below, please fill in the blanks. (5 points)

Packet ①: SYN flag bit=_____

ACK flag bit=_____

Sequence number= 92

Packet ②: SYN flag bit=1

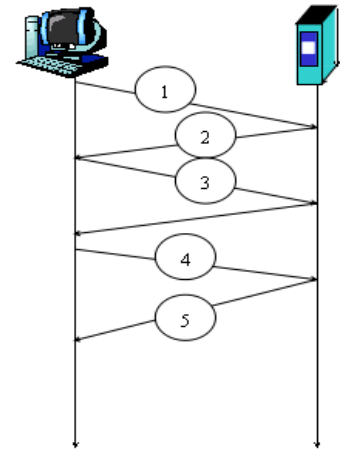
ACK flag bit=_____

Sequence number=100

Packet ③: SYN flag bit=_____

ACK flag bit=1

Sequence number=_____



- (7) We saw that TCP and UDP provide two very different service models. Suppose that an application wants all of the functionality provided by UDP but only some of the functionality provided by TCP (e.g., the application wants reliable message transfer and flow control, but not congestion control). How would an application get this different service in today's Internet? (4 points)
- (8) What is the purpose of the IF-MODIFIED-SINCE field in an HTTP GET message? (4 points)
- (9) Suppose that we want to change the IP address of `gaia.cs.umass.edu` from `128.119.40.186` to `128.119.40.187` and change this mapping in the DNS authoritative name server for `gaia.cs.umass.edu`. Once this mapping is changed in the authoritative name server, will all future references (generated anywhere in the Internet) to `gaia.cs.umass.edu` then be sent to `128.119.40.187`? Explain briefly (in two or three sentences). (6 points)

4. Analysis (30 points).

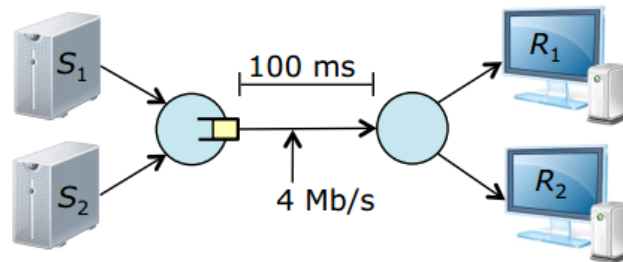
- (1) We use CIDR. Without using longest prefix matching a forwarding table looks like this. If we use longest prefix matching we can combine a few entries together. What is a table with a minimum number of entries that still be able to forward packet correctly?

Prefix	Outgoing Interface
128.0.0.0/11	eth1
128.16.0.0/12	eth1
128.24.0.0/12	eth2
128.32.0.0/12	eth2
128.40.0.0/12	eth1
128.48.0.0/11	eth1
128.64.0.0/9	eth0
128.128.0.0/10	eth0
128.160.0.0/11	eth1
128.176.0.0/11	eth0
128.192.0.0/9	eth0
default	eth3

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Prefix	Outgoing Interface
default	eth3

- (2) The diagram at right shows two TCP senders at left and the corresponding receivers at right. Both senders use TCP Tahoe. Assume that the MSS is 1 KB, that the one-way propagation delay for both connections is 100 ms and that the link joining the two routers has a bandwidth of 4 Mb/s. Let $wnd1$ and $wnd2$ be the values of the senders' congestion windows and assume that $wnd1 = wnd2$.



- ① What is the smallest value of wnd_i for which the link joining the two routers stays busy all the time?
 - ② Assume that the link buffer overflows whenever $wnd1 + wnd2 \geq 200$ KB and that at time 0, $wnd1 = 40$ KB and $wnd2 = 160$ KB. Approximately, what are the values of $wnd1$ and $wnd2$ one RTT later? Also, what are the values of $ssthresh$ for each of the two connections? Assume that all losses are detected by triple duplicate ACKs.
 - ③ After 7 more RTTs, approximately what are the values of $wnd1$ and $wnd2$?
 - ④ Approximately, how many more RTTs before $wnd1 + wnd2 \geq 200$ KB again? What is $wnd2 - wnd1$ at this point?
 - ⑤ Approximately, how many more RTTs pass before $wnd1 + wnd2 \geq 200$ KB and $wnd2 - wnd1 \leq 10$ KB?
- (3) Consider the following graph of the network. Suppose Host A will send a datagram to Host B, Host A run OICQ on port 4000, Host B run OICQ on port 8000. All of ARP tables are up to date. Enumerate all the steps when message "Hello" is sent from host A to host B.

