

1) Suppose the output of a Windows IP Configuration command is as shown below:

Ethernet adapter Local Area Connection:

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Connection-specific DNS Suffix . : ceat.okstate.edu
Description: Realtek RTL8139/810x Family Fast Ethernet NIC
Physical Address. . . . . : 00-30-1B-0E-3A-CC
IP Address. . . . . : 139.78.70.228
Subnet Mask . . . . . : 255.255.224.0
Default Gateway . . . . . : 139.78.71.254
DHCP Server . . . . . : 139.78.191.14
DNS Server . . . . . : 139.78.192.1
Lease Obtained. . . . . : Wednesday, April 28, 2010 9:08:53 AM
Lease Expires . . . . . : Friday, April 30, 2010 9:08:53 AM

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1a) [7] Write the binary MAC address of this Network Internet Card (that would actually be placed in an Ethernet header). [Answer: 00000000 00110000 00011011 00001110 00111010 11001100]

1b) [7] Write the binary Internet address, currently assigned to this PC, that would actually be placed in an IPv4 header. [10001011 01001110 01000110 11100100]

1c) [7] Suppose this organization has been assigned all IPv4 addresses from 139.78.0.0 to 139.78.255.255. How many subnets are there, and how many end devices (PC's, printers, etc.) can be assigned per subnet? [The first two bytes are the network address. The first three bits of the third byte are used for the subnets, hence there are $2^3 = 8$ subnets and $2^{11} = 8192$ possible devices in each subnet.]

1d) [7] Are this PC and the Default Gateway part of the same subnet (Ethernet LAN)? Explain. [Yes. Both are on subnet 010 as both have these three bits as the lead bits in the third byte.]

1e) [7] Are the DHCP and DNS servers part of the same subnet (Ethernet LAN)? Explain [Both are on different subnets. The first three bits in the third byte are 101 and 110 for the DHCP and DNS servers, respectively. Neither match subnet 010 of the PC.]

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2) *N* Voice over IP (VoIP) phones are directly attached to a corporate branch office router via 10 Mbps Ethernet point-to-point connections. The router is attached to corporate HQ by a 1.5 Mbps Leased Line. Tests have shown that to get good quality voice, the time lapse between voice hitting a phone microphone and clearing the router needs to be less than or equal to 55 msec.

Assume the following:

*The VoIP phones code voice at a fixed rate of 12 Kbps and generate one packet every 38 msec, leaving 12 msec of allowable delay at the router.

*Each Ethernet packet contains 66 bytes of overhead.

*The Leased Line packets contain 47 bytes of overhead.

*Propagation delay between the phones and the branch office router can be ignored.

*Processing delays at the branch office router can be ignored.

2a) [15] If there is no other traffic on the branch office system, once the leading edge of a VoIP packet hits the branch office router, how long will it take for the trailing edge to exit? [653.1 μ sec]

2b) [20] Suppose there are N active VoIP phones on the branch office network and no other traffic. How large can N be such that all N packets can completely clear the branch office router in 12 msec? Assume a worst case situation, where N active VoIP phones are synchronized such that the leading edges of all N packets hit the router simultaneously. [21]

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3) A TCP connection has been operating normally with an Advertised Window = Congestion Window = 16 segments. Suddenly a Time Out occurs and the Congestion Window is reduced. Assume no other problems occur and that the Advertised Window remains at 16 segments.

3a) [10] Estimate the number of round trip times it will take for the congestion window to again reach the advertised window. [12]

3b) [10] How many segments would be transmitted during this period? [105]

Same situation, but this time the Time Out occurs after Fast Retransmit was used.

3c) [10] Estimate the number of round trip times it will now take for the congestion window to again reach the advertised window. [9]

3d) [10] How many segments would be transmitted during this period? [108]

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4) It is the year 2110. You are about to transmit a large 20 MB application file to a Facebook pal on the planet Jupiter, currently $664(10^9)$ meters away, using a 100 Mbps inter-planetary Internet link. Link packets can support 8,000 application bytes, and can be transmitted back to back.

4a) [20] Suppose UDP is used, with each UDP packet requiring 55 bytes of overhead (7 B Point-to-Point protocol, 40 B IPv6, and 8 B UDP). With UDP, the entire application file can be stuck in packets and immediately transmitted back-to-back. Compute the time it will take to transmit this file. Time starts when the leading edge of the 1st packet is injected into the link and ends when the trailing edge of the last packet arrives at your friend's house on Jupiter. [2214.6 seconds = 36.9 minutes]

4b) [20] Now suppose you're using TCP, with each TCP packet requiring 67 bytes of overhead (7 B Point-to-Point protocol, 40 B IPv6, and 20 B TCP). A mis-configuration has resulted in a window size of only 8 TCP segments (64 KB) being advertised. Assuming error free

transmission, estimate the time it will take to transmit this file. For this problem you can either ignore or include the effects of Slow Start. Calculate time in the same manner as problem 4a. [Ignoring slow start, 1,383,125 seconds = 16.01 days].

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