

CS 4/55201 COMPUTER NETWORKS SPRING 2009 ASSIGNMENTS

In this semester we will solve 40 problems grouped into four sets. All questions are posted below. The assignments are take-home. You can solve all now or in groups as per the due dates. Remember, each assignment report is due on the date specified. If there is no class on the date- it is due on the class immediately following the due date. If a topic related to a particular question(s) has not been covered by the due date in class- you may submit that particular answer(s) with the assignment report of the next set by the next due date. You need to submit a hard copy in the class or email the report to TA. Original and accurate answer is expected.

Due Dates:

Take Home Assignment #1	FEB 19
Take Home Assignment #2	MAR 10
Take Home Assignment #3	APR 02
Take Home Assignment #4	APR 21

NOTE: These are take home assignment but you are expected to solve each on your own and follow honor code. Any copy or unfair means detected will result in severe penalty (such as zero for ALL assignments, expulsion, reporting to university).

SET #1: Introduction and Physical Layer

Q1.1: An alternative to a LAN is simply a big timesharing system with terminals for all users. Give two advantages of a client-server system using a LAN.

Q1.2: Which of the OSI layers handles each of the following:

- (a) Breaking the transmitted bit stream into frames.
- (b) Determining which route through the subnet to use.

Q1.3: A system has n -layer protocol hierarchy. Applications generate messages of length M bytes. At each of the layers, an h -byte header is added. What is the fraction of the network bandwidth is filled with headers.

Q1.4: What is the difference between a confirmed service and an unconfirmed service? For each of the following, tell whether it might be a confirmed service, unconfirmed service, both, or neither.

- (a) Connection establishment. (b) Data transmission. (c) Connection release.

Q1.5: List two ways in which the OSI reference model and TCP/IP reference model are the same. Now list two ways in which they differ.

Q1.6: A noiseless 4-kHz channel is sampled every 1 msec. What is the maximum data rate?

Q1.7: What is the signal-to-noise ratio is needed to put a T1 carrier on a 50-kHz line?

Q1.8: It is desired to send a sequence of computer screen images over an optical fiber. The screen is 480×640 pixels, each pixel being 24-bits. There are 60 screen images per second. How much bandwidth is needed, and how many microns of a wavelength are needed to for this band at 1.30 microns?

Q1.9: Three packet-switching networks each contain n nodes. The first network has a star topology with a central switch, the second is (bidirectional) ring, and the third is fully interconnected, with a wire from every node to every other node. What are best, average, and worst case transmission paths in hops.

Q1.10: A regional telephone company has 10 million subscribers. Each of their telephones is connected to a central office by copper twisted pair. The average length of these twisted pairs is 10 km. How much is the copper in the local loop worth? Assume that the cross section of each section of each stand is a circle 1 mm diameter, the specific gravity of copper is 9.0, and the copper sells for 3 dollars per kilometer.

SET #2: Data Link Layer and MAC Sublayer

Q2.1: If the bit string 0111101111101111110 is bit stuffed. What is the output string?

Q2.2: What is the remainder of obtained by dividing $x^7 + x^5 + 1$ by the generator polynomial $x^3 + 1$?

Q2.3: A 100 km long cable runs at the T1 data rate, the propagation speed in the cable is $\frac{2}{3}$ the speed of light. How many bits fit in the cable?

Q2.4: PPP is based closely on HDLC, which uses bit stuffing to prevent accidental flag bytes within the payload from causing confusion. Give at least one reason why PPP uses character stuffing instead.

Q2.5: The upper layer message is split into 10 frames, each of which has an 80 percent of change to arrive undamaged. If no error control is done by the data link protocol, how many times must the message is sent on the average to get the entire thing through?

Q2.6: Ten thousand airline reservations are competing for the use of a single-slotted ALOHA channel. The average station makes 18 requests/hour. A slot is 125 μ sec. What is the approximate total channel load?

Q2.7: A Seven-story office building has 15 adjacent offices per floor. Each office contains a wall socket for a terminal in the front wall, so the sockets form a rectangular grid in the vertical plane, with a separation of 4 m between sockets, both horizontally and vertically. Assuming that it is feasible to run a straight cable between any pair of sockets, horizontally, vertically, or diagonally, how many meters of cables are needed to connect all sockets using.

- (a) A star configuration with a single router in middle?
- (b) An 802.3 LAN?
- (c) A ring net (without wire center)?

Q2.8: What happens in a token bus if a station accepts a token and then crashes immediately? How the protocol described in text handles this case?

Q2.9: A 4-Mbps token ring has a token holding timer value of 10 msec. What is the longest frame that can be sent on this ring?

Q2.10: Imagine two LAN bridges, both connecting a pair of 802.4 networks. The first bridge is faced with 1000 512-byte frame per second must be forwarded. The second is faced with 200 4096-bytes frame per second. Which bridge do you think will need the faster CPU? Discuss.

SET #3: Network Layer

Q3.1: Give three examples of protocol parameters that might be negotiated when a connection set up.

Q3.2: Consider the subnet of Fig. 5-15(a). Distance vector routing is used, and the following vectors have just come to router C: from B(5, 0,8, 12,6,2); from D:(16,12, 6,0,9,10); and from E:(7,6,3,9,0,4). The measured delays to B, D, and F are 6,3, and 5 respectively. What is C's new routing table? Give both outgoing line to use the expected delay.

Q3.3: In the text it was stated that when a mobile host is not at home, packets sent to its home LAN are intercepted with its home agent. For an IP network on a 802.3 LAN, how does the home agent accomplish this interception?

Q3.4: The byte-counting variant of the leaky bucket algorithm is used in a particular system. The rule that one 1024-byte packet, two 512-byte packets, etc. may be sent on each tick. Give a serious restriction of this system that was not mentioned in the text.

Q3.5: A Computer on a 6-Mbps network is regulated by a token bucket. The token bucket is filled at a rate 1 Mbps. It is initially filled to capacity 8 megabits. How long the computer at the full 6 Mbps?

Q3.6: Covert the IP address, whose hexadecimal representation is C22F11582 to dotted decimal notation.

Q3.7: A class B networks on the internet has a subnet mask of 255.255.240.0. What is the maximum number of hosts per subnet?

Q3.8: IPv6 uses 16 byte addresses. If a block of 1 million addresses is allocated every pico second, how long will the addresses last?

Q3.9: Give a simple heuristic for finding two paths through a network from a given source to a given destination that can survive any loss of communication lines (Assume that two such paths exist). The routers are considered reliable enough, so it is not necessary to worry about possible router crashes.

Q3.10: Consider the user of differentiated services with expected forwarding. Is there a guarantee that expedited packets experience a shorter delay that regular packets? Why or why not?

SET #4: Transport Layer

Q4.1: List similarities and dissimilarities between TCP and UDP.

Q4.2: Why does UDP exist? Would be sufficient to just let user processes send raw IP packets?

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Q4.4: Discuss the advantages of and disadvantages of sliding window protocols.

Q4.5: What is the total size of the minimum TCP MTU, including TCP and IP overhead but not including data link layer overhead.

Q4.6: RTP is used to transmit CD-quality audio, which makes pair of 16-bit samples 44,100 times/sec, one sample per each of the stereo channels. How many packets per second must RTP send?

Q4.7: Consider the effect of using slow start on a line with a 10 msec round trip time and no congestion. The receive window is 24 KB and the maximum segment size is 2 KB. How long does it take before the first full window could be sent.

Q4.8: The maximum payload of a TCP segment is 65,495 bytes. Why was such number chosen?

Q4.9: A TCP machine is sending full windows of 65,535 bytes over a 1-Gbps channel that has 10 msec on-way delay. What is the is maximum throughput? What is the line efficiency?

Q4.10: Draw a diagram elaborating the TCP connection establishment and release.