Assignment – 1
Computer Network
(Last date of Submission: 17-04-2023)

1. Design your own layered architecture for computer network.
2. What is the difference between network layer delivery and transport layer delivery?
3. Why is there a need to support multi-level addressing?
4. What are two reasons for using layered protocols?
5. What are the responsibilities of the data link layer in the Internet model?
6. What are the responsibilities of the network layer in the Internet model?
7. What is the difference between a port address, a logical address, and a physical address?
8. Match the following to one or more layers of the OSI model:
    a) Route determination
    b) Flow control
    c) Interface to transmission media
    d) Provides access for the end user
9. Match the following to one or more layers of the OSI model:
    a) Reliable process-to-process message delivery
    b) Route selection
    c) Defines frames
    d) Provides user services such as e-mail and file transfer
    e) Transmission of bit stream across physical medium
    f) Communicates directly with user's application program
    g) Error correction and retransmission
    h) Mechanical, electrical, and functional interface
    i) Responsibility for carrying frames between adjacent nodes.
10. Suppose a computer sends a frame to another computer on a bus topology LAN. The physical destination address of the frame is corrupted during the transmission. What happens to the frame? How can the sender be informed about the situation?
11. Suppose a computer sends a packet at the network layer to another computer somewhere in the Internet. The logical destination address of the packet is corrupted. What happens to the packet? How can the source computer be informed of the situation?
12. If the data link layer can detect errors between hops, why do you think we need another checking mechanism at the transport layer?
13. Give some advantages and disadvantages of combining the session, presentation and application layer in the OSI model into one single application layer in the Internet model.
14. Consider sending a packet from a source host to a destination host over a fixed route. List the delay components in the end-to-end delay. Which of these delays are constant and which are variable?
15. Visit the Transmission Versus Propagation Delay applet at the companion Web site. Among the rates, propagation delay, and packet sizes available, find a combination for which the sender finishes transmitting before the first bit of the packet reaches the receiver. Find another combination for which the first bit of the packet reaches the receiver before the sender finishes transmitting.
16. How long does it take a packet of length 1,000 bytes to propagate over a link of distance 2,500 km, propagation speed 2.5×10^8 m/s, and transmission rate 2 Mbps? More generally, how long does it take a packet of length L to propagate over a link of distance d, propagation speed s, and transmission rate R bps? Does this delay depend on packet length? Does this delay depend on transmission rate?
17. Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates $R1 = 500$ kbps, $R2 = 2$ Mbps, and $R3 = 1$ Mbps.
    a. Assuming no other traffic in the network, what is the throughput for the file transfer?
    b. Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?

c. Repeat (a) and (b), but now with $R2$ reduced to 100 kbps.

18. Suppose end system A wants to send a large file to end system B. At a very high level, describe how end system A creates packets from the file. When one of these packets arrives to a packet switch, what information in the packet does the switch use to determine the link onto which the packet is forwarded? Why is packet switching in the Internet analogous to driving from one city to another and asking directions along the way?
19. We need to use synchronous TDM and combine 20 digital sources, each of 100 Kbps. Each output slot carries 1 bit from each digital source, but one extra bit is added to each frame for synchronization. Answer the following questions:
    a. What is the size of an output frame in bits?
    b. What is the output frame rate?
    c. What is the duration of an output frame?
    d. What is the output data rate?
    e. What is the efficiency of the system (ratio of useful bits to the total bits).
20. Assume that a voice channel occupies a bandwidth of 4 kHz. We need to multiplex 10 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth.
21. Two channels, one with a bit rate of 190 kbps and another with a bit rate of 180 kbps, are to be multiplexed using pulse stuffing TDM with no synchronization bits. Answer the following questions:
    a. What is the size of a frame in bits?
    b. What is the frame rate?
    c. What is the duration of a frame?
    d. What is the data rate?

Q22. An HTTP GET message (i.e., this is the actual content of an HTTP GET message). The characters *<cr><lf>* are carriage return and line-feed characters (that is, the italized character string *<cr>* in the text below represents the single carriage-return character that was contained at that point in the HTTP header). Answer the following questions, indicating where in the HTTP GET message below you find the answer.

GET /cs453/index.html HTTP/1.1<cr><lf>Host: gaia.cs.umass.edu<cr><lf>User-Agent: Mozilla/5.0 (Windows;U; Windows NT 5.1; en-US; rv:1.7.2) Gecko/20040804 Netscape/7.2 (ax) <cr><lf>Accept:ext/xml, application/xml, application/xhtml+xml, text/html;q=0.9, text/plain;q=0.8,image/png,*/*;q=0.5<cr><lf>Accept-Language: en-us,en;q=0.5<cr><lf>Accept-Encoding: zip,deflate<cr><lf>Accept-Charset: ISO-8859-1,utf-8;q=0.7,*;q=0.7<cr><lf>Keep-Alive: 300<cr><lf>Connection:keep-alive<cr><lf><cr><lf>

a. What is the URL of the document requested by the browser?
b. What version of HTTP is the browser running?
c. Does the browser request a non-persistent or a persistent connection?
d. What is the IP address of the host on which the browser is running?
e. What type of browser initiates this message? Why is the browser type needed in an HTTP request message?

Q23**.** The text below shows the reply sent from the server in response to the HTTP GET message in the question above. Answer the following questions, indicating where in the message below you find the answer.

HTTP/1.1 200 OK<cr><lf>Date: Tue, 07 Mar 200812:39:45GMT<cr><lf>Server: Apache/2.0.52 (Fedora)<cr><lf>Last-Modified: Sat, 10 Dec2005 18:27:46GMT<cr><lf>ETag: "526c3-f22-a88a4c80"<cr><lf>Accept-Ranges: bytes<cr><lf>Content-Length: 3874<cr><lf>Keep-Alive: timeout=max=100<cr><lf>Connection:Keep-Alive<cr><lf>Content-Type: text/html; charset=ISO-8859-1<cr><lf><cr><lf><!doctype html public "-//w3c//dtd html 4.0 transitional//en"><lf><html><lf><head><lf> <meta http-equiv="Content-Type"content="text/html; charset=iso-8859-1"><lf> <metaname="GENERATOR" content="Mozilla/4.79 [en] (Windows NT5.0; U) Netscape]"><lf> <title>CMPSCI 453 / 591 /NTU-ST550A Spring 2005 homepage</title><lf></head><lf><much more document text following here (not shown)>

a. Was the server able to successfully find the document or not? What time was the document reply provided?
b. When was the document last modified?
c. How many bytes are there in the document being returned?
d. What are the first 5 bytes of the document being returned? Did the server agree to a persistent connection?

Q24**.** Obtain the HTTP/1.1 specification (RFC 2616). Answer the following questions:

a. Explain the mechanism used for signaling between the client and server to indicate that a persistent connection is being closed. Can the client, the server, or both signal the close of a connection?
b. What encryption services are provided by HTTP?
c. Can a client open three or more simultaneous connections with a given server?
d. Either a server or a client may close a transport connection between them if either one detects the connection has been idle for some time. Is it possible that one side starts closing a connection while the other side is transmitting data via this connection? Explain.

Q25. Consider transferring an enormous file of *L* bytes from Host A to Host B. Assume an MSS of 836 bytes.

a. What is the maximum value of *L* such that TCP sequence numbers are not exhausted? Recall that the TCP sequence number field has 4 bytes.
b. For the *L* you obtain in (a), find how long it takes to transmit the file. Assume that a total of 66 bytes of transport, network, and data-link header are added to each segment before the resulting packet is sent out over a 155 Mbps link. Ignore flow control and congestion control so A can pump out the segments back to back and continuously.