CSCI 4171 Networks and Communications
CSCI 6704 Advanced Topics in Networks
Assignment No. 1
Date Given: Monday, September 19th, 2022
Due (on Brightspace): Monday, October 3rd, 2022, 11.59 PM

Write the answers to the questions in a word or similar text-based document, convert the document to PDF and submit ONE PDF file on Brightspace. On top of the document, clearly write your full name and Banner ID.

For research type questions, **cite your sources** at the end of the answer.

For problem-solution type questions, **you must show the intermediate steps and the formulas** that you used in your answer, as appropriate. Just writing the final answer will result in points being deducted.

Question 1 <Exploratory question> We will be heavily focusing on TCP/IP throughout this course. The protocol suite had humble origins, but quickly became the "language" that drives the Internet. Look up online resources on the origins of TCP/IP. One such article is at:
https://catalogimages.wiley.com/images/db/pdf/0782141013.excerpt.pdf

Look up other similar resources as well. Then prepare a report of length approximately 2 pages (12-point font, single line spacing). In your report, address the following key points:
1. Evolution of TCP/IP from its predecessor ARPAnet
2. Features of TCP/IP
3. Differences between TCP/IP and the OSI (Open Source Interconnect) layered model.
4. What is RFC (Request for Comments)?
5. What is the role of IETF (Internet Engineering Task Force)?

Place figures (if any) and references on a separate page. **List references** in proper format, again on a separate page.

Question 2 <Virtual Circuit Packet Switching >
Consider the following network that uses virtual circuit packet switching.

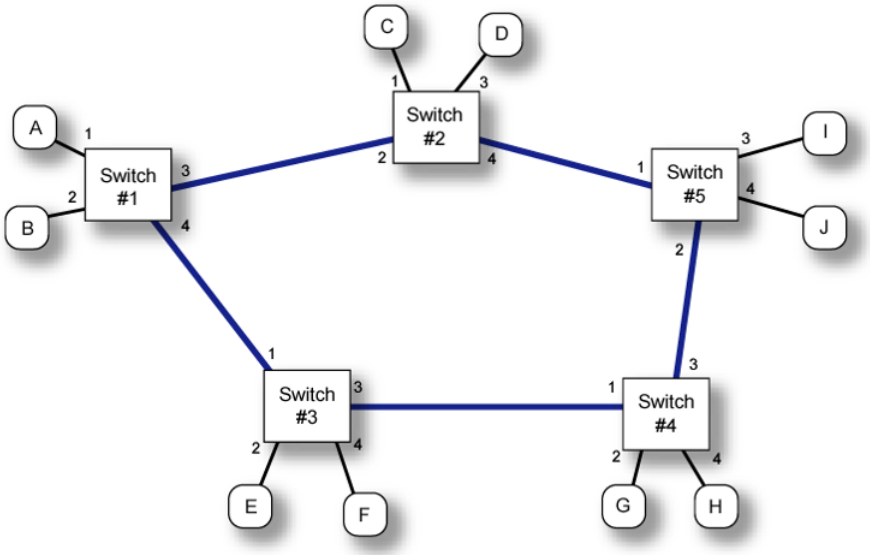


Figure source: https://www.grotto-networking.com/BBMPLS.html

The following virtual circuit paths need to be set up:
Host A to Host J via Switch #2
Host B to Host H via Switch #2 and #5
Host C to Host E via Switch #1
Host D to Host H via Switch #5
Host F to Host I via Switch #4
Host E to Host B via Switch #4, #5 and #2
Host G to Host D via Switch #5
Host H to Host C via Switch #3 and #1
Host I to Host F via Switch #4
Host J to Host A via Switch #2

Using appropriate virtual circuit identifiers, set up the virtual circuit paths and draw the virtual circuit tables in each of the switches #1 to #5 when all the paths are simultaneously active.

You must choose the virtual circuit identifier as follows. On any link in a particular direction, start with the number 10. If 10 cannot be used, use 20. If 10 and 20 cannot be used, use 30, and so on. *This will ensure that you will use a different number only if necessary.*

Question 3 <Bandwidth delay problems>

3 (A) Consider the following scenario:

N = number of hops between two end systems
L = length of the message in bits
B = bandwidth in bits per second, on all links
P = packet size in bits (for datagram and virtual circuit packet switching)
The size is the same for all packets, and it includes the message portion plus any overhead
H = overhead for each packet in bits (for datagram packet switching only; ignore the overhead for virtual circuit packet switching)
S = call set up time in seconds (for circuit switching and virtual circuit packet switching)
R = call release time in seconds (for circuit switching and virtual circuit packet switching)
D = propagation delay per hop in seconds
Ignore queuing and processing delays.

If N = 8, L= 4096, B = 1024, P = 128, H = 32, S = 0.2, R = 0.1, D = 0.001, compute the end-to-end delay for the following three cases:

- Message is sent using circuit switching
- Message is sent using datagram packet switching
- Message is sent using virtual circuit packet switching

Note the following:

- In *circuit switching*, after the call set up, the entire message travels from the source to the destination as a continuous bit stream. There will be one transmission delay at the start, and propagation delay for the message from node to node. You need to add the call set up time and call release time. Other processing and queuing delays can be ignored.
- In *datagram packet switching,* the message is broken into x packets. The number x depends upon how many packets are needed to send the whole message given that each packet is 128 bits and that includes the 32-bit header. So the message content in each packet is only 128-32 = 96 bits. You may have to round up x to the next higher integer. Each packet experiences a transmission delay at every

node. There will be propagation delay for each packet from node to node. There will be no call set up and release time. You can ignore processing and queuing delays.

- In *virtual circuit packet switching*, the message is broken into packets, but each packet has no overhead. However, each packet experiences a transmission delay at every node. There will be propagation delay for each packet from node to node. You need to add the call set up time and call release time. Other processing and queuing delays can be ignored.

3 (B) Consider two hosts, A and B, connected by a single link of bandwidth R bits per sec. Suppose that the two hosts are separated by m meters, and suppose the propagation speed along the link is s meters/sec. Host A is to send a packet of size L bits to Host B. Ignore the processing and queuing delays. Suppose s = 2.5 X 10^8, L = 100 bits, and R = 28 kbps. Find the distance m so that the propagation delay equals transmission delay.

3(C) Suppose two hosts, A and B, are separated by 20,000 kilometers, and are connected by a direct link of R = 2 Mbps. Suppose the propagation speed over the link is 2.5*10^8 meters/sec. Consider sending a file of 800,000 bits from Host A to Host B. Suppose the file is sent continuously as one big message. How long does it take to send the file?

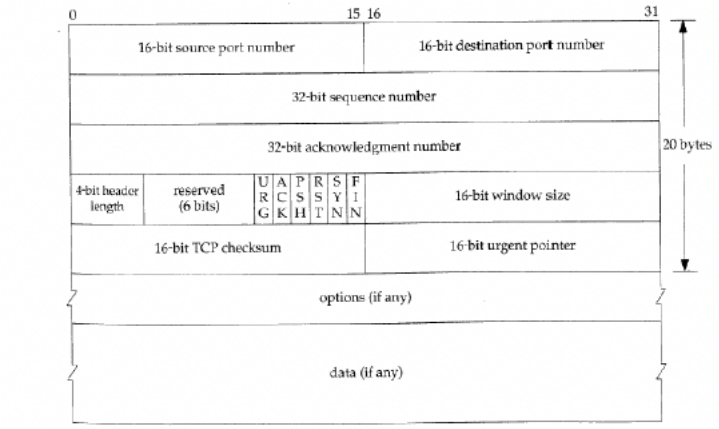
Suppose now the file is broken up into 20 packets each with each packet containing 40,000 bits. Suppose the receiver acknowledges each packet and the transmission time of an acknowledgement packet is 100 ms. Finally, assume that the sender cannot send a packet until the preceding one is acknowledged. How long does it take to send the file?

Question 4: <TCP/IP Encapsulation Discovery using Wireshark>

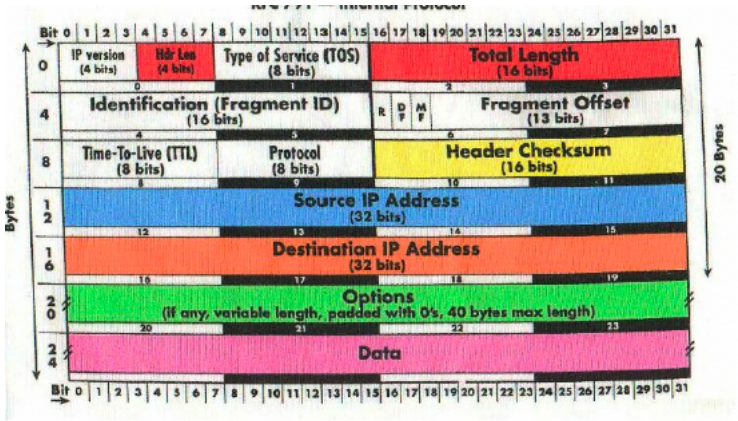
As you would know from your previous course in networking, Wireshark is an excellent tool for packet capture and studying the components of different parts of a message. For this question, you will perform a simple packet capture using Wireshark to identify different headers.

a) If you don't have Wireshark installed on your machine, download Wireshark https://www.wireshark.org/download.html
and understand its features, including how to set the display filters.
b) Clear your browser cache and open a browser window.
c) Start Wireshark capture.
d) Enter http://gaia.cs.umass.edu/wireshark-labs/HTTP-wireshark-file2.html in the browser window.
(This is an HTTP site from the book "Computer Networking: A Top-Down Approach" by Kurose and Ross. It contains a simple HTML file).
e) After a few seconds, close the browser window.
f) Stop Wireshark capture.
g) Set the display filter to HTTP.
h) **Select one HTTP message** and click on various parts of the message, namely, Application Layer, Transport layer, Network Layer and Data Link Layer, thus identifying the TCP segment, the IP datagram and the Ethernet header.
i) Examine the above and identify **all the header components (in decimal or Hex as appropriate)** for the TCP header, the IP header and the Ethernet header.

For the TCP Header, identify as many fields as you can using the figure shown below as a guide. Write their values from your Wireshark capture.

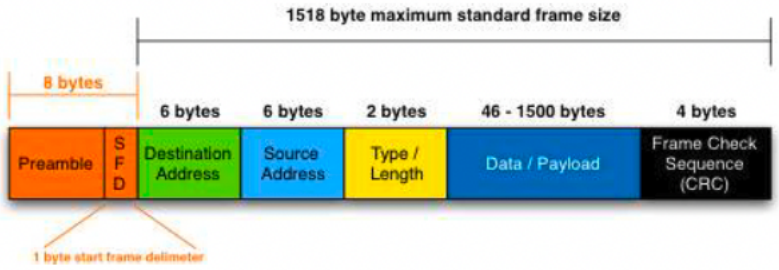


For the IP Header, identify as many fields as you can using the figure shown below as a guide. Write their values from your Wireshark capture.

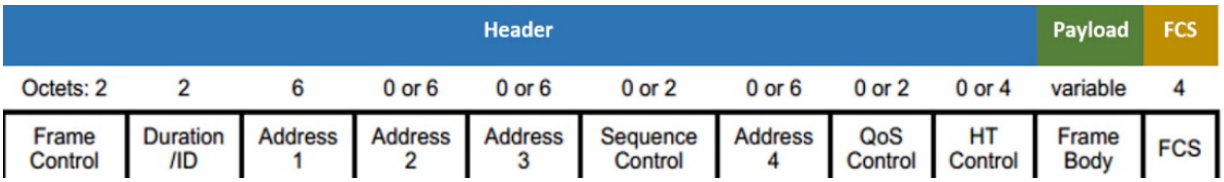


For the Ethernet header, identify as many fields as you can using either the IEEE 802.3 format (if you are connecting via a wired network) or the IEEE 802.11 format (if you are connecting via a wireless network) shown below as a guide. Note that there could be some differences in the formats depending upon which network standard/version that you use.
Write the values from your Wireshark capture.

IEEE 802.3 Standard Ethernet Frame



IEEE 802.11 Standard Frame Format



What you need to put in your answer to this question: A screen snapshot of the Wireshark capture and a listing of the values for each field that you can identify.

Short paragraph answer: Are you able to find the Data Link Trailer in the Ethernet frame capture in Wireshark? Why or why not? (Write a brief answer by looking up web resources).

What to submit: You need to submit one PDF file that contains the answers to all the questions. You can put your answers in a text document and convert it to PDF. If you write your answers in multiple documents, convert all your documents into PDF and then zip it and submit it. Make sure that your full name and banner ID appears on the top of the document.

Late Submission Penalty: The assignment is due on Monday (October 3rd) at 11.59 PM. Late submissions up to 5 hours (4.59 AM on Tuesday) will be accepted without penalty. After that, there will be a 10% late penalty per day on the mark obtained. For example, if you submit the assignment on Tuesday at 12 noon and your score is 8/10, it will be reduced to 7.2/10. Submissions past five days after the grace submission time will not be accepted.