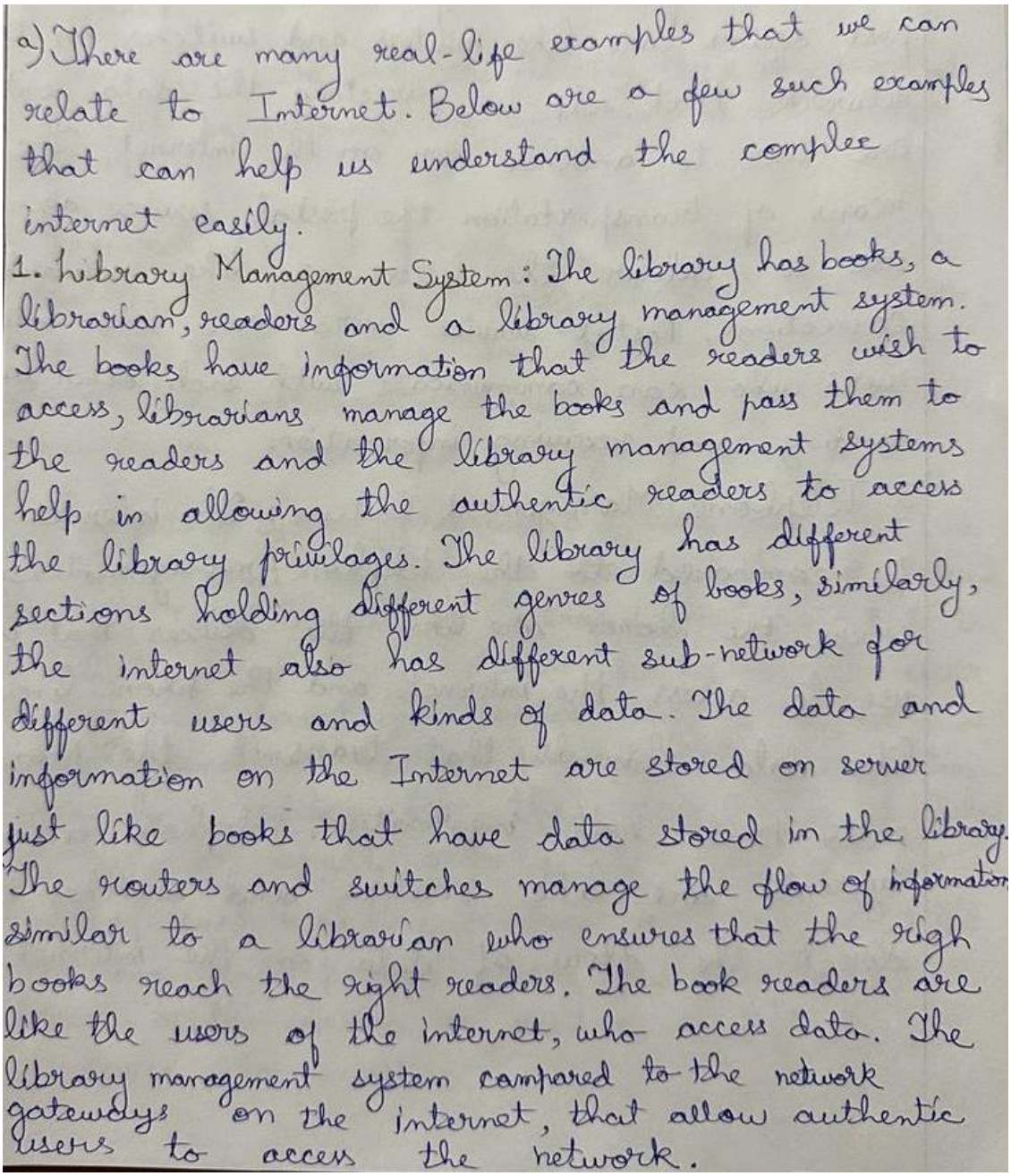
CSCE 5580 – COMPUTER NETWORK

SPRING 2023

SET-2

1. a) As we know that internet is a nut and bolt's view. Can you think of any real-life example that can relate to the Internet? For instance, the Logistic services end system could be sender and receiver, the connection means could be any of the modes of transportation and Storage can be considered as switches and routers.



a) There are many real-life examples that we can relate to Internet. Below are a few such examples that can help us understand the complex internet easily.

1. Library Management System: The library has books, a librarian, readers and a library management system. The books have information that the readers wish to access, librarians manage the books and pass them to the readers and the library management systems help in allowing the authentic readers to access the library privileges. The library has different sections holding different genres of books, similarly, the internet also has different sub-network for different users and kinds of data. The data and information on the Internet are stored on server just like books that have data stored in the library. The routers and switches manage the flow of information similar to a librarian who ensures that the righ books reach the right readers. The book readers are like the users of the internet, who access data. The library management system compared to the network gateways on the internet, that allow authentic users to access the network.

2. Postal Service Systems: The postal system is like the internet in a certain way, the letters represent the data that flows through the internet, and the post offices are like routers and switches on the network that help in directing the data sent by one user to another user on the internet. The means of transportation the postal service agencies use to deliver the letters are like network connections. Postal service users are like internet users who can communicate with each other by sending and receiving information.

3. Telephone Management Systems: The internet can be compared to the telephone management system, where the phones are like the devices that users use to access the internet, and the phone lines are like data channels that transmit the phone calls that hold information. Telephone exchange systems are like routers and switches that direct the flow of data on the internet.

b) What is protocol and explain it with a real-time example?

b) Protocal: A protocol can be defined as the set of rules and procedures that must be followed to enable communication between different systems.

For example, in the healthcare industry, there are protocols that must be followed. One such protocol is CDC for Covid-19.

A protocol can be defined as the procedure and guidelines that define message format, the order in which the messages are sent and received between the network entities and communication activities on transmitted messages.

In computing systems, protocols are used real-time to make sure that the data is transmitted and received correctly. TCP (Transmission Control Protocol) is used to establish connection between sender and receiver devices on internet. The sender sends a request and receiver sends a response for establishing connection using handshaking. Once the connection is established data is exchanged orderly.

Another such real-time protocol is IP, which helps in routing data packets among the devices. IP address of the devices is used to send data from one device to another.

c) Explain about access network briefly?

c) Access Network: In a telecommunication network, an access network connects the users to the network, to access services and applications. It connects the router of the end system to other end systems. Access networks are both wireless and wired. Below are few types of Access Networks:

1. Residential Access Network: These provide connectivity to homes and residential units. These use technologies such as DSL, cable, fiber optic, etc.
   → Cable-based access is network of cable attaches homes to ISP router.
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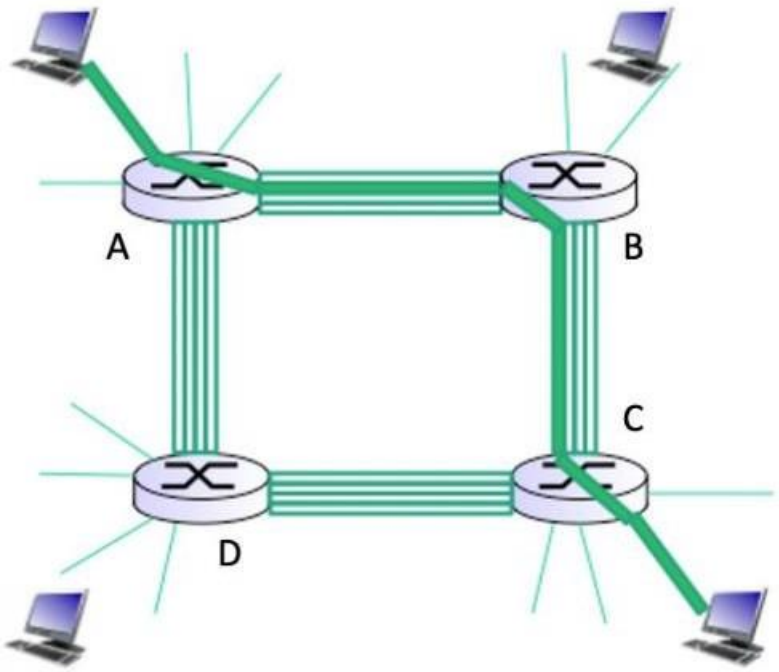
2. Institutional Access Network: These networks provide access to enterprises and institutions like schools, offices, etc. They are either privately owned or provided by the Internet service providers.
3. Mobile Access Networks: These are networks that provide internet connectivity to mobile devices such as smartphones and tablets
4. Wireless Access Networks: These networks connect wireless access networks of end systems to routers.

→ WLANs

→ Wide-area cellular access networks.

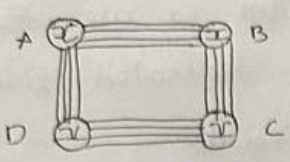
2. Consider the following circuit-switched network where there are 4 links available between each router:



a) Determine the maximum number of simultaneous connections supported at any one time in this network.

b) Suppose that users at the A router want to connect to end users at the C router. Determine the maximum number of simultaneous connections supported at any one time in this network for this scenario.

c) Now, suppose that we have 4 users at the A router wanting to connect to end users at the C router and 4 users at the B router wanting to connect to end users at the D router. Is it possible to simultaneously make these 8 connections in this network? Justify your answer.

2. 

a) There are 4 links available between each router, 4 connections can be made simultaneously between any two routers.

The maximum number of simultaneous connections supported at any one time in the network

= links per router * simultaneous connections per link

= 4 * 4 = 16 connections

b) The user at A wants to connect to C, there are 2 ways, A→B→C or A→D→C. In both the cases, 2 links must be used, each link can support 4 simultaneous connections.

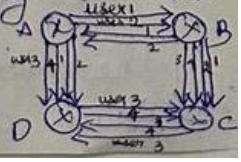
The maximum number of simultaneous connections at one time = links used * simultaneous connections per link

= 2 * 4 = 8 connections

c) Yes, it is possible to simultaneously make 8 connections. We can establish 2 connections from A to B, 2 connections from B to A, 4 connections from A to D, 4 connections from B to C, 2 connections from D to C & 2 connections from C→D. All 8 users are served using 8 separate connections simultaneously without any interference. Below are the 8 paths

A to D (4 users)
2 users : A→B→C
2 users : A→D→C

B to D (4 users)
2 user : B→A→D
2 users : B→C→D



3. Suppose that you have 150 terabytes (note that bytes, not bits, are used here) of data on a drive that you need to be delivered within 24 hours, but preferably faster. If your company has a dedicated 9 Gbps link available to transfer this data, would it be better to use FedEx overnight delivery (will be delivered in exactly 24 hours, but no earlier) or transmit the data on your dedicated link if these are your only options? Show calculations to justify your answer.

We must determine if it is better to use FedEx overnight delivery or company's dedicated link to deliver the data within 24 hours.

→ We know that FedEx can deliver 150 TB in 24 hours

→ We must calculate, if comany's dedicated link can do it faster than FedEx or will it take more than 24 hours, to decide if it is a good idea to use FedEx or Company dedicated link.

$1\,TB = 10^3\,GB$
$1\,GB = 8\,Gbits$

Given,

Data to be transmitted $= 150\,TB = 150 \times 10^3\,GB = 150000 * 8$
$= 1,200,000$ gigabits

Bandwith of company link $= 9$ Gbps
$= 9$ giabits per second

Time taken to transfer 150TB on a 9Gbps link $= \frac{1200,000}{9} = 133,333.33$ seconds
$= \frac{133,333.33}{60 * 60}$ hours

i.e it takes around 37.04 hours in total.

→ We can see from the calculation above that it is better to use FedEx overnight over the company's link.

Company link takes 37.04 hours and the FedEx overnight takes only 24 hours. In comparision FedEx is the better option to transmit the data on the drive within 24 hours.

4. Consider a packet-switching architecture:

   a) List and briefly describe the four main components of delay.

a) The four main components of delay in a packet switching architecture are:

1. Processing Delay: It is the time taken for the packet to be processed by the nodes in the network, including every checks that happen at the node.
2. Queuing Delay: It is the time packet spends waiting on at the output link to be transmitted It can vary depending on the level of congestion in the network.
3. Transmission Delay: It is the time taken to transmit the packet on the output link, it is the packet length by link transmission rate.

$$d_{trans} = \frac{L\ (\text{Packet length})}{R\ (\text{transmission rate})}$$

4. Propagation Delay: It is the time taken to transmit the packet on output link from source to destination. It is length of physical link by propagation speed.

$$d_{prop} = \frac{d\ (\text{length of physical link})}{S\ (\text{propagation speed})}$$

$$\rightarrow d_{nodal} = d_{processing} + d_{queue} + d_{transmission} + d_{propagation}$$

b) Concisely describe what the difference is between transmission and propagation delay.

b) Transmission delay is the time taken to transmit a packet on output link, which mainly depends on the size of the packet and transmission rate of the link. Propagation delay is the time taken by the packet to travel from source to destination, which depends on distance between two nodes and the speed of propagation medium. This is how transmission delay and propagation delay.

$$d_{transmission} = \frac{L\ (\text{packet length})}{R\ (\text{transmission rate})}$$

$$d_{propagation} = \frac{d\ (\text{length of link})}{S\ (\text{propagation speed})}$$

c) How would the propagation delay be affected if the length of the packet is increased?

c) The effect on propagation delay due to increase in length of packet is none. because propagation delay depends on the length of link and the propagation speed of the medium, increase in length of packet does not effect the propagation delay.

Though the propagation delay doesn't directly depend on the packet length, it can indirectly impact the total delay. Because it takes more time to send a lengthy packet and it might take more time for processing the packet at switches and routers.

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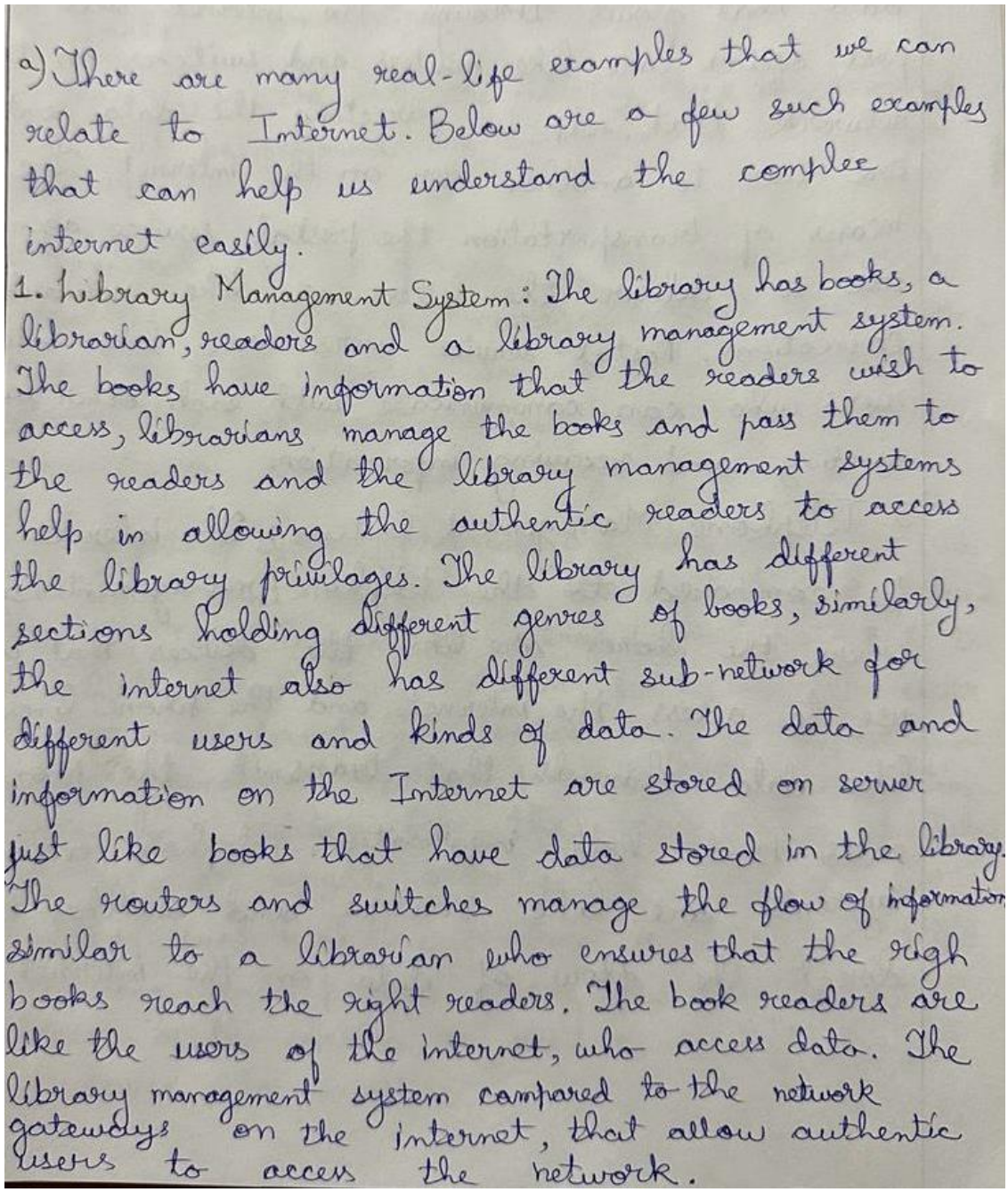

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