CCCN 312 Computer Networks

Fall 2022

Homework Assignment # 1

Due: 24/12/2022

PLO K2	PLO K2	PLO S1	PLO V4	Total
CLO1.1	CLO1.2	CLO2.1	CLO3.1	
Part I	NA	Part II	Part III	/100
/29	--	/35	/36	

Section: CY1

Date: 22 / 12 /2022

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Part I **____ /29**

1. What are the five layers in the Internet protocol stack (TCP/Ip Protocol Stack)?[5] **[/19]**
   What are the principal responsibilities of each of these layers? [10]
   Map each of the following protocols to the appropriate layer: IP, Wi-Fi, TCP, HTTP. [4]

Layer 5: Application (HTTP)

- Exchanges messages from a network application end system to another using transport layer services.

-Provides the translations for the internet's end system for example: DNS (Domain Name System) which identifies the website name to an address made of 32 bits.

-It has the HTTP protocol for web transfers.

Layer 4: Transport (TCP, UDP)

-Delivers the application messages between two applications ends. It also transports hosts destination address using network layer services.

-TCP is one of the protocols used in this layer that provides a connection that helps the flow and the transportation of messages within applications. It also breaks down messages into smaller pieces called segments.

Layer 3: Network (IP)

-Moves packets or datagrams from one host to another using link layer services. Using the IP in the datagram, it has routing protocols that determines the source to destination paths that's going to be taken by the packets. Routers act upon IP which determines the route between source and destination.

Layer 2: Link (WIFI)

-It is responsible of moving frames from a network system to another using network layer services. Examples of links like WIFI or cable access. So frames here are being moved from one host to the nearby one and this is where switches comes in place.

Layer 1: Physical

-Are where individual bits are going to be transmitted from one node to the next using link layer services like fiber optics which has different protocols transmission for different links.

2. Explain the concept of *encapsulation* in networking discipline? **[/4]**

It depicts or explains how the packets in different layers are moving along the paths by each layer depending on the next. An application layer message is passed from the host to the transport layer and then this transport layer adds a header information that the receiver will use. The application and transport header together makes what it's called a segment and that's where encapsulation happens. The transport layer later sends the segment to the next layer which is network layer which adds the header for source and destination creating the network datagram. Datagram is then passed to the link layer which adds their own special header too and so on what happens for the rest of the layers.

3. True or False **[/6]**
   - Host breaks applications messages into packets. (T)
   - The upper three layers of the OSI layering model correspond to the top layer in the TCP/IP model. (T)
   - Communication between two applications (e.g., client and a server) starts from the physical layer (F)
   - Network layer is commonly named IP layer. (T)
   - Communication between two hosts starts from the physical layer. (T)
   - Different application protocols needed for different physical links. (T)
   - A router can process up to the application layer. (F)

Part II **____ /35**

4. Consider sending a packet from a source host to a destination host over a fixed route. **[/10]**

List the 4 delay components in the end-to-end delay [4]. Aka nodal delay

-Nodal processing delay: the rate at which when the packet arrives in the router it checks for the header to determine which direction the packet should take.

-Transmission delay: the rate at which all the packet's bits is going to be fully pushed out from the host to the outgoing link.

-Propagation delay: rate at which the bits propagate from the beginning of the link to the end till it reaches the destination; it depends on the speed of the link that it's going to traverse in. Like optic fibers or copper wires.

-Queuing delay: the rate at which queue or a wait happens for the arriving packet if there is other packet is being transmitted; this depends on the number of packets in the queue.

Which of these delays are constant and which are variable?[2]

Nodal processing delay is constant because the process is all about the router checking the header of the packet as its not dependent of time change.

Transmission delay is also constant.

Propagation delay is constant as the link determines a fixed speed that the bits traverse through.

Queuing delay on the other hand is variable since the queuing depends on the number of packets that will arrive in the router and the size of the packet itself.

Where can packets be lost/dropped? And why? [4]

Packets could be dropped or lost. The router has a queuing place for which multiple packets wait to be transmitted to the outgoing link. When the queue tries to store a packet in its buffer it could see it already filled up, that's where packet loss occurs due to overflow. This results from when the average rate at which the bits arrive in the queue is faster than the transmission rate.

5. A packet of length 10000 bits propagates over a link of distance 4000 km, propagation speed 3.0×10^8 m/s, and transmission rate 2 Mbps. (example1 & example2) **[/15]**
   - Calculate the propagation delay in millisecond (ms). [4]

Propagation delay = d/s which is distance of the link over propagation speed m/sec

= 4000 km / 3.0×10^8 = 4000000/300000000 = 0.01333333×10^3 = 13.33333 msec

- Calculate the transmission delay in millisecond (ms).[4]

Transmission delay = L/R which is length of bits in a packet over the transmission rate
$10000/2x10^6 = 10000/2000000 = 0.005x10^3 = 5$ msec

- What is the total delay (ignoring other delay components)? [2]

Total delay is the sum of propagation and transmission delay =
5 + 13.33333 = 18.33333 msec

- If the packet was 10,000 bytes, would this change the propagation delay? [5]

10,000 bytes is equal to 80,000 bits but that won't change the propagation delay as it only depends on the distance length of the link and the propagation speed of light consequently d/s.

6. 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 R_1=700 kbps, R_2=1 Mbps, and R_3=1.5 Mbps. **[/10]**
   - Assuming no other traffic in the network, what is the throughput for the file transfer? [3]

   To know the throughput of different links, it is often found out by the bottleneck link that transfers data at the lowest capacity.
   R_1=700000 bps R_2=1000000 bps R_3=1500000 bps
   So, 700000 bps is the throughput for file transfer.

   - 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?[3] *hint: 1 byte = 8 bit*

4 million bytes should be converted to bits by multiplying it by 8, hence $4x8x10^6/700000$ = 45.71 s to reach Host B.

   - Repeat (a) and (b), but now with R_2 reduced to 100 kbps. [4]

   R_1=700 kbps R_2= 100 kbps R_3=1.5 Mbps
   700000 100000 1500000 bps
   a) Throughput is R_2 = 100000 bps
   b) $4x8x10^6/100000$ = 320 s to reach Host B

Part III	**____ /36**

7. What is the difference between a virus and a worm? **[/4]**

-A virus is a malicious code that damages or modifies data in a computer system and it is not controlled remotely. Human actions spread viruses by opening email attachments or clicking on shared file links which result in harmful consequences to the system.

-A worm is same as the virus, but it doesn't cause changes in the system but only replicate itself to slow down the computer resources by consuming memory and bandwidth. Worms can also be regulated remotely. Worms spread rate is faster than viruses but is considered less harmful.

8. **Access Networks:** **[/8]**

- Describe what is meant by access networks. [4]

  Networks that contain end systems connected to the edge router which connects them to other end systems in other networks. Like DSL (Digital Subscriber Line) which uses dedicated lines that transmits both voice telephone signals and data at the same time to then get separated by the DSLAM (Digital subscriber line access multiplexer) for telephone network ISP and the internet. Cable based access which uses Hybrid fiber coax shared cable across homes to access networks. Home uses access points that connect multiple wireless devices that connects them to the router, enterprise has dedicated cable links for institutions like universities and FTTH that provides internet access through optical fibers in rates of gigabits per second (fiber to the home) also are types of access networks.

- What are the different types of links (physical media) used in access network? Name some technologies. [4]

  Physical media lies into 2 categories: guided and unguided media. Guided are where signals propagate in a solid medium however unguided is where signals propagate freely in the atmosphere. Examples of guided that are used in access networks like Cable based access which is made from HFC hybrid of fiber (uses light beams for transmission) and coaxial cable (two concentric copper conductors that is bidirectional), DSL made of copper wire, and twisted pair which is two insulated copper ethernet wires. Unguided have wireless radio that carries signals in electromagnetic spectrum and radio links types such as terrestrial microwaves, wireless LAN, and satellites.

9. **Performance**: In packet switching transmission over the network, we mention some factors that affect the performance of the packets: loss, delay, throughput. *Briefly*, describe their impact from your perspective as a user? **[/6]**

Use your own understanding, your own words

As a console gamer, throughput rate plays a big role in data transfers in the network in which when data must go from one host to another. As I always try to download an update for the game I want to play, I regularly face issues on the speed of the download in my network due to many people sharing the same internet. So fast rate throughput is important as the users need a fast speed data recovery in a short amount of time.

All types of delays play a crucial part in gaming; when I want to play against online players, I would expect the game to deliver a high send and response time over my network to ensure that no lag can affect my performance in the game. Packet loss disturb the game in general, it could be lost while data is transmitted from one host to another, and this could be due to congestion in the network. To my own personal experience, when I play a first-person shooter game, I want to make sure I don't miss the shot I can get to eliminate the enemy but unfortunately packet loss could negatively affect the shots in the game.

10. **Network Core switching:** **[/8]**

Name the switching technology corresponding to each attribute.

Attribute	**Switching technology**
Resources needed for a connection must be reserved.	__ circuit switching ___
The number of users is fixed.	___circuit switching__
The number of users is flexible.	___ Packet Switching__
Each user transmits at full link speed.	___Packet Switching__
Each user gets a fraction of link speed.	___circuit switching_
Reserved resources are wasted if not used.	___ Packet Switching_
Guaranteed performance for a connection.	___ circuit switching__
Used in the Internet core	___ Packet Switching_

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11. Use your own words to describe the structure of today's Internet? **[/10]**

Hint: ISPs of different tiers – content provider networks – access networks – interconnection points - IXP – peering

I believe today's internet has been developed for our best convenience. For example, by providing content delivery networks expanding it geographically, different servers could be accessed at any time in any place with high performance such as streaming videos from Netflix. Using FTTH fiber to the home is an awesome access network as it provides high speed network connection rating in gigabits that aids in the access of high internet speed in the most crucial times. Mobile networks that have been provided by different kind of ISPs (internet service providers) made a huge impact of providing the opportunity of connecting to internet services that ranges in 10s of kilometers which also contribute in connecting with different ISPs in the world using IXP (Internet exchange point).In tier 1, IXP helps connect multiple ISPs that aid in internet traffic exchange. Peering links can be in a direct way in which there are no involvement in the middle between two ISPs. Moreover, Tier2 is a service provider connection between tier3 and tier 1 ISPs.Tier3 on the other hand, has multiple of smaller ISPs that ranges in millions of accesses that's connected to the top tiers providing network access to various access networks such as, enterprise and residential.