Quinn Roemer

Professor Xuyu Wang

CSC 138

September 26, 2020

1. List six access technologies. Classify each one as home access, enterprise access, or wide-area wireless access.
    - Cable Internet Access (home access)
    - Digital Subscriber Line (home access)
    - Fiber (home access, enterprise access)
    - Wi-Fi (home access, enterprise access)
    - Ethernet (home access, enterprise access)
    - 3G, 4G, LTE (wide-area wireless access)

2. What advantage does a circuit-switched network have over a packet-switched network?
    - Circuit-switched networks can guarantee a certain bandwidth for each user on a dedicated line by reserving the line for each user.

3. List the 5 layers in the internet protocol stack. What are the principal responsibilities of each of these layers?
    - **Application Layer:** Where network applications and their protocols reside. Allows an application in one system to communicate with another systems application. Includes protocols such as HTTP, SMTP, and FTP.
    - **Transport Layer:** Transport application-layer messages between application endpoints using the TCP or UDP protocols.
    - **Network Layer:** Moves datagrams from one host to the other. Uses the IP protocol.
    - **Link Layer:** Receives network layer datagrams and delivers datagrams to the next node along the route. Includes Ethernet, Wi-Fi, and cable access networks.
    - **Physical Layer:** Moves individual bits within a frame from one node to the next. Protocols are dependent on the transmission medium for the link (twisted-pair copper, fiber, etc.).

4. Suppose users share a 3 Mbps link. Also suppose each user requires 150 kbps when transmitting, but each user transmits only 10% of the time. (See the discussion of packet switching versus circuit switching in Section 1.3).
    a. When circuit-switching is used, how many users can be supported?
        - The link can support **20 users** (3000 kbps / 150 kbps = 20)

b. For the remainder of this problem suppose packet-switching is used. Find the probability that a given user is transmitting.
   - Probability that a given user is transmitting is **0.1 or 10%**

c. Suppose there are 120 users. Find the probability that at any given time exactly N users are transmitting simultaneously. (Hint: Use the binomial distribution).
   - Probability N users transmitting simultaneously =
   $$\frac{\mathbf{120}!}{\boldsymbol{N}!\,(\mathbf{120}-\boldsymbol{n})!} * \ (\mathbf{0.1})^{\boldsymbol{N}} * (\mathbf{1}-\mathbf{0.1})^{\mathbf{120}-\boldsymbol{N}}$$

d. Find the probability that there are 21 or more users transmitting simultaneously.
   - Probability >=21 Users are transmitting simultaneously =
   $$\sum_{\boldsymbol{i}=\mathbf{21}}^{\boldsymbol{N}} (\mathbf{0.1})^{\boldsymbol{i}}(\mathbf{1}-\mathbf{0.1})^{\boldsymbol{N}-\boldsymbol{i}}$$

5. Consider figure 1.19(b). Now suppose that there are M paths between the server and the client. No two paths share any link. Path k (k=1, … ,M) consists of N links with transmission rates R_1^k, R_2^k, … , R_n^k. If the server can only use one path to send data to the client, what is the maximum throughput that the server can achieve? If the server can use all M paths to send the data, what is the maximum throughput that the server can achieve?
   - If the server can use one path, the maximum throughput is the path with the fastest minimum transmission rate between two links.
     Maximum Throughput = Max(Min(all path links))

   - If the server can use M paths, the maximum throughput is the minimum of each path link added together
     Maximum Throughput = Min(path one links) + Min(path two links) + … + Min(path M links)