CSN – 341 (Computer Networks)

Assignment 1

Group – 16

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Q.1) Describe the different wireless technologies you use during the day and their characteristics. If you have a choice between multiple technologies, why do you prefer one over another?

Ans. The Few of the Most common wireless technologies we use daily, and their characteristics are:

1. **Wi-Fi** - Our IIT Campus has IITR_WIFI_HIGHSPEED almost everywhere.
   - Characteristics: High-speed wireless local area network (WLAN) technology used for connecting devices like smartphones, laptops, and tablets to the internet or local networks.
   - Usage: Accessing the internet, streaming videos, online gaming, smart home device control.
   - Preference: Preferred for high-speed data transfer and wide coverage within a home or office environment.

2. **Bluetooth** - For Connecting our headset to Laptop or Phone for audio transmission wirelessly
   - Characteristics: Short-range wireless communication technology for connecting devices like headphones, keyboards, mice, and smartwatches.
   - Usage: Hands-free calling, audio streaming, file sharing, and controlling smart devices.
   - Preference: Preferred for low-power, short-range connections between devices.

3. **Cellular Networks** (3G, 4G, 5G) - Calling services or use of Mobile-data when Wi-Fi is not working properly.
   - Characteristics: Wireless communication networks providing internet access to mobile devices, with the use of Cell Tower (Specific Sim-Company).
   - Usage: Making calls, sending text messages, browsing the internet, streaming videos, and using mobile applications.
   - Preference: Chosen based on coverage, speed, and data plan requirements. 5G is preferred for its higher speeds and lower latency.

4. **GPS** (Global Positioning System) - During marking our attendance for classes, the attendance system uses GPS to verify if we are near the desired location (LHC)
   - Characteristics: Satellite-based navigation system providing geolocation data.
   - Usage: Navigation, location-based services, fitness tracking, and mapping applications.
   - Preference: Essential for location-aware services and navigation tasks.

Factors Influencing Technology Choice

The choice of wireless technology depends on several factors:

- **Data Transfer Rate**: For high-speed data transfer, Wi-Fi or cellular networks are preferred.
- **Range**: Bluetooth is ideal for short distances, while Wi-Fi and cellular networks offer broader coverage.
- **Power Consumption**: Bluetooth is known for low power consumption, making it suitable for battery-operated devices.
- **Security**: Wi-Fi and cellular networks often employ encryption to protect data, but the level of security can vary.
- **Cost**: Wi-Fi is typically included in internet plans [Free for us], while cellular data involves subscription fees.

In conclusion, we utilize a combination of these wireless technologies throughout the day, with Wi-Fi being the primary choice for internet access and Bluetooth for connecting peripherals. Cellular networks are essential for staying connected with friend and family in campus life, and GPS aids in navigation and location tracking. The specific choice of technology depends on the task at hand and the desired level of performance, range, and security.

Q.2) Suppose users share a 2 Mbps link. Also suppose each user transmits continuously at 1 Mbps when transmitting, but each user transmits only 20 percent of the time.

a) When circuit switching is used, how many users can be supported?

Ans. We have 1 Mbps per user transmission bandwidth, our channel bandwidth = 2Mbps. Hence, the maximum number of users supported on the network are 2.

b) For the remainder of this problem, suppose packet switching is used. Why will there be essentially no queuing delay before the link if two or fewer users transmit at the same time? Why will there be a queuing delay if three users transmit at the same time?

Ans. If we only have user <= 2, the channel's bandwidth directly supports the transmission of packet, we don't need to hold them until the channel is busy.

There will be queuing delay if users >= 3, since now our channel's bandwidth is not enough, we need to hold some packets at both ends until the channel is free, this will add the queuing delay to Latency of transmission.

c) Find the probability that a given user is transmitting.

Ans. Probability that user is transmitting = 20% = 0.2 [The duration for which it is transmitting will be its probability].

d) Suppose now there are three users. Find the probability that at any given time, all three users are transmitting simultaneously. Find the fraction of time during which the queue grows.

Ans. P (all three are transmitting) = 0.2 * 0.2 * 0.2 = 0.008.

The queue will be growing only at times when we have all three transmitting, thus fraction of time it would happen = 0.8 %.

Q.3) Assume that we have created a packet-switched internet. Using the TCP/IP protocol suite, we need to transfer a huge file. What is the advantage and disadvantage of sending large packets?

Ans. Following are the merits and demerits of sending a large packet over a packet-switched network.

Merits

- **Reduced overhead**: Fewer packet headers relative to the data, improving efficiency.
- **Potentially higher throughput**: Larger packets can carry more data per transmission, potentially increasing overall throughput.

Demerits

- **Increased risk of loss**: A single packet loss results in the loss of more data, requiring retransmission of a larger chunk.
- **Network congestion**: Large packets can worsen network congestion, leading to packet drops and retransmissions.
- **Maximum Transmission Unit (MTU) limitations**: If a packet exceeds the MTU of a network link, it must be divided into smaller packets, introducing overhead and potential delays. MTU is the maximum size of data(bytes) that can be sent over a particular network link in a single packet.

In conclusion, while large packets can offer some advantages, the potential drawbacks often outweigh the benefits in most real-world network scenarios. Smaller, more manageable packet sizes generally provide a better trade-off between efficiency and reliability.

Q.4) What happens when you use cables longer than the prescribed length in a network?

Ans. The issues we face if we use a long wire than prescribed over a network are:

- **Signal Attenuation**: Cables are designed to carry signals over a specific maximum distance. When you exceed this distance, the signal strength diminishes due to attenuation, resulting in weaker and potentially distorted signals.
- **Increased Latency**: Longer cables introduce more delay in signal transmission. This increased latency can slow down communication between network devices, affecting overall network performance. (Although valid, but if we consider same distance transmission with one long and multiple shorter wire (it's now a fair comparison) things are not so straight to say longer wire increases latency).
- **Data Corruption and Loss**: As the signal weakens, the likelihood of errors in data transmission increases. This can lead to corrupted data packets, which may need to be retransmitted, further reducing network efficiency.
- **Reduced Network Speed**: Overextended cables might not support the intended speed of the network (e.g., Gigabit Ethernet) and could force the network to operate at a lower speed to maintain a stable connection.
- **Interference and Noise**: Longer cables are more prone to picking up electromagnetic interference from external sources. This interference can further degrade signal quality, leading to more errors and disruptions.
- **Potential for Increased Crosstalk**: In twisted pair cables, longer lengths can lead to increased crosstalk, where signals from one pair of wires interfere with another pair, causing data errors.

Few More Issues:

- Protocol Issues: Some protocols have time-limit after which packet arrival is considered dropped or lost, and asks for retransmission
- Troubleshooting Difficulty
- Cost of installation, maintenance etc.67

Q.5) Explain the difference between circuit switching and packet switching. Describe a scenario where packet switching would be more efficient than circuit switching and vice versa.

Ans. Differences between Circuit-Switched and Packet-Switched Networks:

Circuit Switching: A Dedicated Line

Imagine a phone call: you dial a number, a connection is established, and you have an exclusive line for the duration of the call. This is circuit switching.

Key Characteristics:

- Dedicated circuit for the entire communication
- Guaranteed bandwidth
- Higher setup time

- Less efficient use of network resources

Packet Switching: Breaking it Down

Packet switching is like sending letters through the postal system. Your message is broken into smaller pieces (packets), each with its own address. These packets travel independently through the network, and the recipient reassembles the message.

Key Characteristics:

- Data divided into packets
- Shared network resources
- Lower setup time
- Potential for congestion and packet loss
- More efficient use of network resources

When to Use Which?

- **Circuit Switching**: Ideal for real-time applications with consistent bandwidth requirements, like voice calls or video conferencing.
- **Packet Switching**: Better suited for data transfer applications where efficiency and flexibility are priorities, such as email, file sharing, and web browsing