National University of Computing and Emerging Sciences - CFD Campus

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**Computer Networks Spring 2025**

**Assignment # 01**

# Submission Guidelines:

1. Submit your assignment as hardcopy(Handwritten) in class as well as in soft copy on Google Classroom. Please submit your file in this format **22F\_XXXX\_A1**
2. The assignment should be on A4 pages.
3. Deadline for submission is Wednesday (26-2-2025) 12:00 noon
4. Do not submit your assignment after the deadline. Late submission will not be accepted.
5. Plagiarism from the internet (ChatGPT) or any peer is strictly prohibited.
6. In case of plagiarism zero marks will be awarded.

**Question # 01. (15)**

* 1. Discuss the concept of "packet switching" and explain how it differs from "circuit switching." Provide real-world examples of both.
  2. Consider a scenario where a network link has a high bandwidth but experiences significant latency. How might this impact on real-time communication applications like voice or video calls?
  3. Discuss the advantages and disadvantages of a decentralized network architecture.
  4. Define the Layered Internet Protocol and briefly explain its 5 layers.
  5. Describe the concept of "network edge" and "network core." How do these concepts relate to the overall structure of the Internet?

**Question # 02. (15)**

Suppose two hosts, A and B, are separated by 20,000 kilometers, and are connected by a direct link of R = 5 Mbps. Suppose the propagation speed over the link is 2.5 \* 108 meters/sec.

1. Calculate the bandwidth-delay product, R \* dprop.
2. Consider sending a file of 800,000 bits from Host A to Host B. Suppose the file is sent continuously as one large message. What is the maximum number of bits that will be in the link at any given time?
3. Provide an interpretation of the bandwidth-delay product.
4. What is the width (in meters) of a bit in the link? Is it longer than a football field?
5. Derive a general expression for the width of a bit in terms of the propagation speed s, the transmission rate R, and the length of the link m.

**Question # 03. (10)**

Ali, a photographer, is trying to upload a high-resolution photo album from his laptop (Host A) to a cloud storage server (Host B). His internet connection goes through three different network segments with varying speeds:

* + **Home Wi-Fi**: 500 kbps
  + **ISP Backbone**: 2 Mbps
  + **Cloud Server Network**: 1 kbps

## Tasks:

1. Considering no other traffic, determine the maximum possible throughput of Ali's file transfer.
2. If Ali is uploading an album of **4 MB**, estimate how long it will take to complete the transfer.
3. If the ISP Backbone speed suddenly drops to **100 kbps**, how would this impact the throughput and the transfer time?

**Question # 04. (20)**

Sarah, a cloud engineer, is transferring a **10,000,000-bit** file from her data center to a remote server over a network link with a **bandwidth of 10 Mbps**. The **one-way propagation delay** of the link is **50 milliseconds**, and the **signal propagation speed** is **200,000 km/s**.

## Tasks:

1. Calculate the time required to transmit the entire file over the link.
2. Determine the one-way propagation delay if the total distance between the data center and the remote server is **473 km**.
3. If the packet transmission time is **0.003 seconds** and the packet propagation time is **0.001 seconds**, calculate the total end-to-end delay for a single packet.
4. Compute the bandwidth-delay product for this network link and explain its significance in determining the amount of data in transit at any given time.

**Question # 05. (20)**

# Case Study:

Skystream Media, a leading video streaming platform, faced significant challenges in delivering seamless, high-quality video content to its growing global audience. As users demanded uninterrupted streaming experiences across multiple devices and network conditions, Skystream needed to build a **resilient and scalable network infrastructure**. The company made strategic decisions in its **network design, security policies, and data transmission techniques** to ensure low latency, high throughput, and data integrity, even during peak traffic periods like major sporting events or global movie premieres.

To efficiently handle varying traffic loads, Skystream adopted **packet switching** over circuit switching. This allowed dynamic bandwidth allocation, ensuring that millions of simultaneous video streams could be delivered smoothly.

Additionally, Skystream leveraged a **layered network architecture** to maintain scalability and security.

Through strategic network design and security implementation, Skystream Media successfully maintained **high availability, low buffering times, and secure video streaming**—critical factors that contributed to its dominance in the streaming industry.

## Questions:

1. Why did Skystream Media choose **packet switching** over circuit switching for its video streaming services? How did this decision impact network efficiency, especially during high- traffic events?
2. How did Skystream manage to maintain **low latency and high throughput** during global streaming events? What challenges did they face in reducing **packet loss and buffering issues**?
3. Discuss the importance of a **layered network architecture** in Skystream’s infrastructure. How did it contribute to **scalability, security, and quality of service**?
4. What steps did Skystream Media take to make sure videos played smoothly without **delays** or **interruptions**, even when many people were watching at the same time?

**Good Luck 😊**