

## Introduction

### Network Hosts and Communication Links

- A **network host** is a computational device that is connected to a network.
- **Hosts** may work as a **server** offering **information resources, services, and applications** to users and other hosts.
- **Hosts** are assigned a unique **network address**.
- The **network edge** refers to the area where a **device or local network interfaces with a large network**.
- A **link** is a **communication channel** that connects two or more devices for the purpose of **data transmission**.
- **Bandwidth** refers to the **maximum rate data can be transmitted over a link**.

### Packets and Packet Switching

- **Packet Switching** is a method of **grouping data into packets** that are transmitted over a network.
- A **network packet** is a formatted unit of data carried by a **packet-switched network**.
- **Packets** consist of **control information, and the payload**.

### Network Devices

- A **modem** or a **modulator-demodulator** is a computer networking device that **converts data** between a **digital format, and an analog format** for the purpose of transmission.
- A **router** is a computer networking device that **creates and manages a local network, and manages the data entering and exiting the network**.
- A **switch** is a computer networking device that **connects devices via packet switching to receive and forward data**.
- **Routers use IP addresses** to route data, and **switches use MAC addresses** to route data.

### Network Terminologies

- A **bit (binary digit)** is a single unit of information.
- A **physical link** is the physical **communication link** that **connects transmitters and receivers**.

- **Guided media** refers to signals that **propagate in a solid medium**.
- **Unguided media** refers to **signals that propagate freely**.
- **Routing** refers to the process of determining the **path a packet will take** to reach it's destination.
- **Forwarding** refers to the **process of receiving a packet, and sending it to the next node in the path**.

## The Internet

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- **The Internet** is a **global computer network** that provides a variety of **information and communication facilities**.
- **The Internet** consists of **interconnected networks** using **standardized communication protocols**.
- A **communication protocol** is a **system of rules that allows two or more entities to communicate of the internet**.
- **Protocols** define the **rules, syntax, semantics, and synchronization** of the communication.
- The **internet network core** refers to the infrastructure (routers) that connect networks together.

### Internet Service Providers and Access Networks

- An **Internet service provider** is an organization that **provides services for accessing, and using the internet**.
- One way an **ISP** can provide their customers with **internet access** is through **existing telephone lines (Digital Subscriber Lines or DLS)**.
- **DSL** was mainly used when the **internet was first created**, and is often referred to as **dial up**.
- The **problem** with **DLS** is that it only supports a single connection.
- A more-modern way **ISPs** provide their customers with **internet access** is with **cable-based access**.
- **Cable-based access** uses **frequency division multiplexing (FDM)** to **transmit data in different channels** allowing for several connections simultaneously.

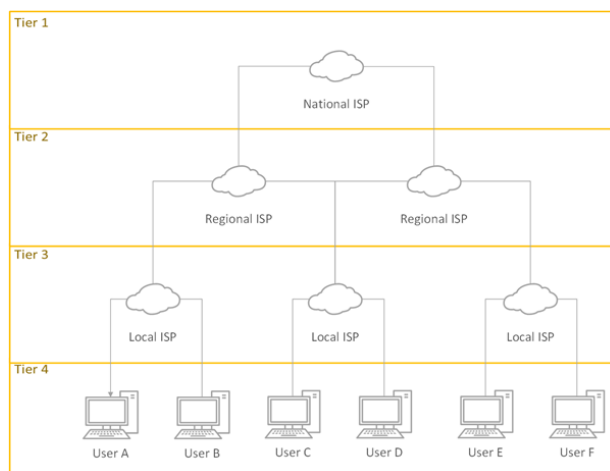
- There are different types of **cables** such as **Hybrid Fiber Coax (HFC)**, and **Fiber Optic Cables**.
- Another way **ISPs** provide their customers with **internet access** is through **wireless access points (WAPs)**.
- **WAPs** use **electromagnetic radiation** to **transmit information** over different frequencies.

## The Network Core

- **The Network Core** is a mesh of **interconnected routers** that use **packet-switching** to transmit data.
- **Transmission delay** refers to the amount of time it takes for a packet to transmit.
- **Transmission delay** can be **calculated** with the following formula  $\text{Delay} = \frac{L}{R}$  where  $L$  is the **length of the packet**, and  $R$  is the **transmission rate of the link in bits per second**.
- **Routers** use the **store and forward principal**; before they can **forward packets**, they have to **wait until the entire packet has arrived**.
- If the **arrival rate** of a packet **exceeds the transmission rate of a link** the packet will be **placed into a queue** for a short period of time; If the queue **runs out of memory** unsent packets will be **overwritten, causing packet loss**.

## The Internet Structure

- **Hosts** connect to the internet via **Access Internet Service Providers**.
- **ISPs are then interconnected**.
- There are different **tiers** of ISPs:



- The **ISP tiers** can have **peer-to-peer links** where they are **directly connected**, or they can have an **internet exchange point** which is an external network where **several networks can exchange data**.
- **Context network providers** (Google, Microsoft, etc) may also run **their own networks** that are connected to the **internet**.