

MOBILE COMPUTING

CHAPTER – ONE Applications

What is Mobile Computing?

►What is computing?

- ✓Operation of computers (according to oxfords advance learner's dictionary)

►What is the mobile?

- ✓That someone /something can move or be moved easily and quickly from place to place

►What is mobile computing?

- ✓Mobile Computing is using a computer (of one kind or another) while on the move

What is Mobile Computing? (Cont...)

- ▶ Mobile Computing is an umbrella term used to describe technologies that enable people to access network services anyplace, anytime, and with any one.

History of Wireless Communication

- ▶ In ancient time people use the **signal of smoke, light, flags** for communication.
- ▶ In 1843 - Alexander Graham Bells invented the wired communication called **telegraph**
- ▶ In 1864 - James Clerk Maxwell's Theory of **EM Waves**
 - ✓ It laid the theoretical foundation for wireless communication.
- ▶ In 1895 - Marconi's **Wireless Telegraphy**
 - ✓ Marconi sent the first wireless telegraphy signal, using radio waves over a distance.

History of Wireless Communication(Cont...)

- ▶ In 1940s - Frequency Modulation (FM) Radio
 - ✓ It offers higher audio quality and reduced static interference.
- ▶ In 1947 - Invention of the Transistor
 - ✓ It revolutionized electronics and paves the way for the miniaturization of wireless devices.
- ▶ In 1960s - First Communication Satellites
 - ✓ It enables global wireless communication via signals relayed from space.
- ▶ In 1970s - Cellular Mobile Phone Concept
 - ✓ It lead to the eventual establishment of cellular networks.

History of Wireless Communication(Cont...)

►1980s - Advanced Mobile Phone Systems (AMPS)

- ✓the first generation of analog cellular networks
- ✓AMPS, allows for wider mobile phone adoption and basic voice communication.

►1990s - Digital Cellular Networks (2G)

- ✓2G offers better voice quality, SMS texting, and limited data capabilities.

►2000s - Third Generation (3G) and Mobile Data

- ✓3G networks bring faster data transfer, enabling mobile internet access, video calling, and more advanced applications.

History of Wireless Communication(Cont...)

► 2010s - Fourth Generation (4G) and LTE

- ✓ It provides significantly faster data speeds, supporting the rise of smartphones, streaming, and mobile apps.

► 2020s - Fifth Generation (5G)

- ✓ 5G technology aims to deliver ultra-fast speeds, low latency, and massive device connectivity, driving IoT and AR/VR trends.

Benefits of Wireless Network

- ▶ Wireless networks offer numerous benefits that have transformed the way we **communicate**, **work**, and **access information**
 - ✓ **Mobility** and **Flexibility** - can maintain network connectivity on move
 - ✓ **Ease of Installation**: eliminate complex and time-consuming wiring installations.
 - ✓ **Scalability**: New devices can be added to the network without the need for additional physical infrastructure.
 - ✓ **Convenience**: eliminate the need to find and connect physical cables.

Wireless Transmission

- ▶ Wireless transmission refers to the communication of data or information between devices or systems **without the use of physical cables or wires**.
- ▶ Instead, it relies on **electromagnetic waves** to carry signals through the **air** or other mediums and are received and interpreted by appropriate **antennas**.
- ▶ When an antenna is attached to electrical circuit of a computer or wireless device, it converts the digital data into wireless signals and spread all over within its frequency range.

Wireless Transmission (Cont...)

- ▶ The receptor on the other end receives these signals and converts them back to digital data.
- ▶ Examples of electromagnetic waves used in wireless transmission include:

- ✓ Radio waves
- ✓ Microwaves
- ✓ Infrared waves
- ✓ Visible light
- ✓ Ultraviolet waves
- ✓ X-rays

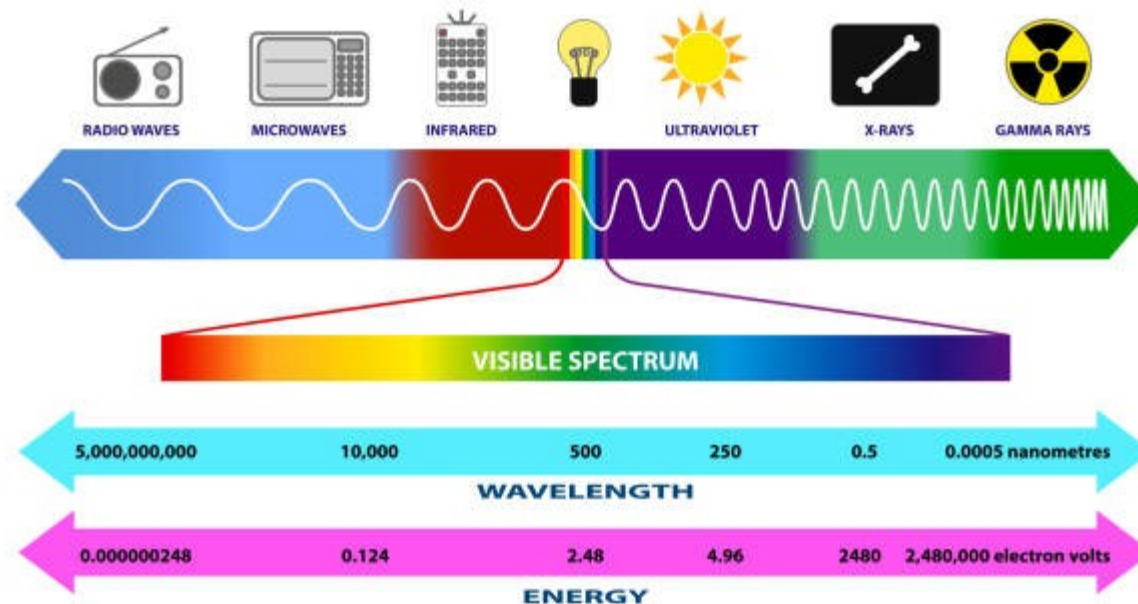


Fig: Electromagnetic Spectrum

Wireless Transmission (Cont...)

- ▶ Electromagnetic spectrum is like a "rainbow" of different kinds of invisible waves that carry energy.
- ▶ These waves have varying sizes and strengths, and each type has its own special job
- ▶ **Radio Waves:** they're big and slow, so they're great for sending music and talk from radio stations to your car/radio.
- ▶ **Microwaves:** they're a bit smaller than radio waves and are used in things like microwave ovens and for beaming signals to satellites in space.

Wireless Transmission (Cont...)

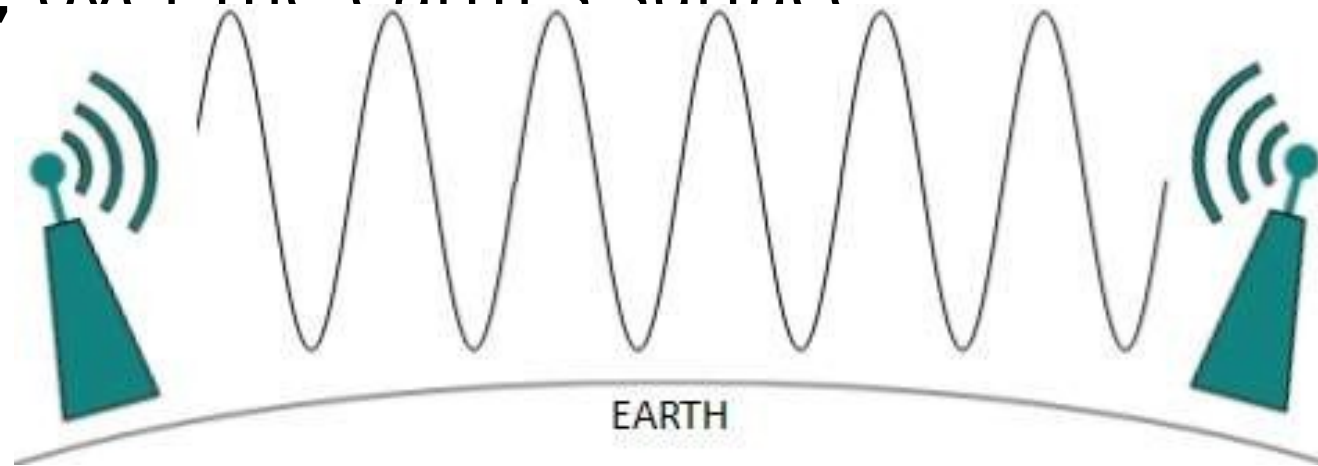
- ▶ **Infrared Waves**: They carry heat and are used in things like TV remote controls
- ▶ **Visible Light**: This is the "colorful" part of the spectrum that our eyes can see.
- ▶ **Ultraviolet Waves**: They're a bit shorter than visible light and can give us a tan but can also cause sunburn if we're not careful.
- ▶ **X-rays**: They can go through things like our skin, but they're also used in hospitals to look inside our bodies and check for problems.
- ▶ **Gamma Rays**: They're the smallest and strongest waves and are used in things like killing cancer cells and exploring the farthest reaches of space.

Frequencies for Radio Transmission

- ▶ Radio transmission refers to the process of sending information, such as **voice**, **data**, or **signals**, through the **air using radio waves**.
- ▶ Radio frequency is easier to generate and because of its large wavelength it **can penetrate through walls** and structures.
- ▶ Radio waves can have wavelength from **1 mm – 100,000 km** and have frequency ranging from **3 Hz to 300 GHz**

Frequencies for Radio Transmission (Cont...)

- ▶ Lower frequencies waves can travel on the ground up to 1000 kilometers, *over the earth's surface*



- ▶ Radio waves of high frequencies are prone to be **absorbed by rain** and other obstacles.

Frequencies for Radio Transmission (Cont...)

- ▶ Radio transmission is a versatile technology used in various applications, including:
 - ✓ **Broadcasting**: AM and FM radio stations use radio transmission to broadcast music, news, and talk shows to a wide audience.
 - ✓ **Two-Way Communication**: Radios, walkie-talkies
 - ✓ **Television Broadcasting**: TV stations transmit audio and video signals over the airwaves for viewing on televisions.

Signal Propagation in Wireless Transmission

- ▶ Signal propagation refers to how electromagnetic signals, such as radio waves, travel from a transmitter to a receiver through various mediums.
- ▶ The way signals propagate can influence the quality of wireless communication (signal strength, coverage area)
- ▶ Wireless transmissions propagate in three modes.
 - ✓ Ground-wave propagation
 - ✓ Sky-wave propagation
 - ✓ Line-of-sight propagation

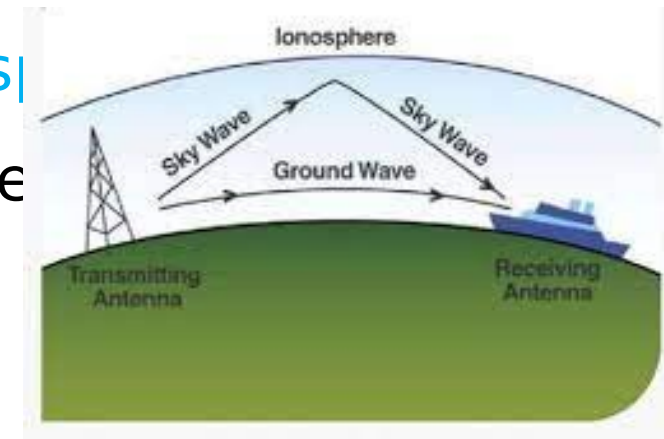
Signal Propagation in Wireless Transmission (Cont...)

► Ground Wave Propagation:

- ✓ involves radio waves following the curvature of the **Earth's surface**.
- ✓ It's effective for **lower frequencies** and provides coverage over **longer distances**.

► Sky Wave Propagation:

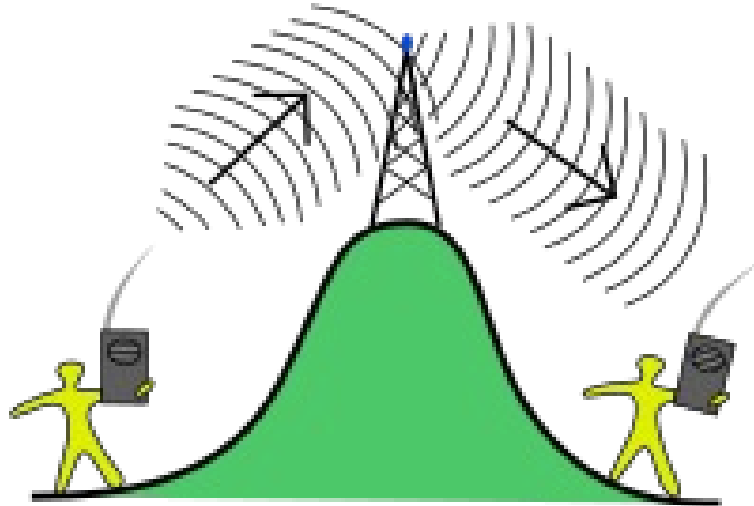
- ✓ involves signals being refracted by the **ionosphere** to bounce off the ionized layers and travel beyond the horizon.
- ✓ This is common in AM radio broadcasting.



Signal Propagation in Wireless Transmission (Cont...)

► Line-of-Sight Propagation:

- ✓ radio waves travel directly from the **transmitter to the receiver** without significant obstacles.
- ✓ This mode is crucial for **reliable** communication in many applications.

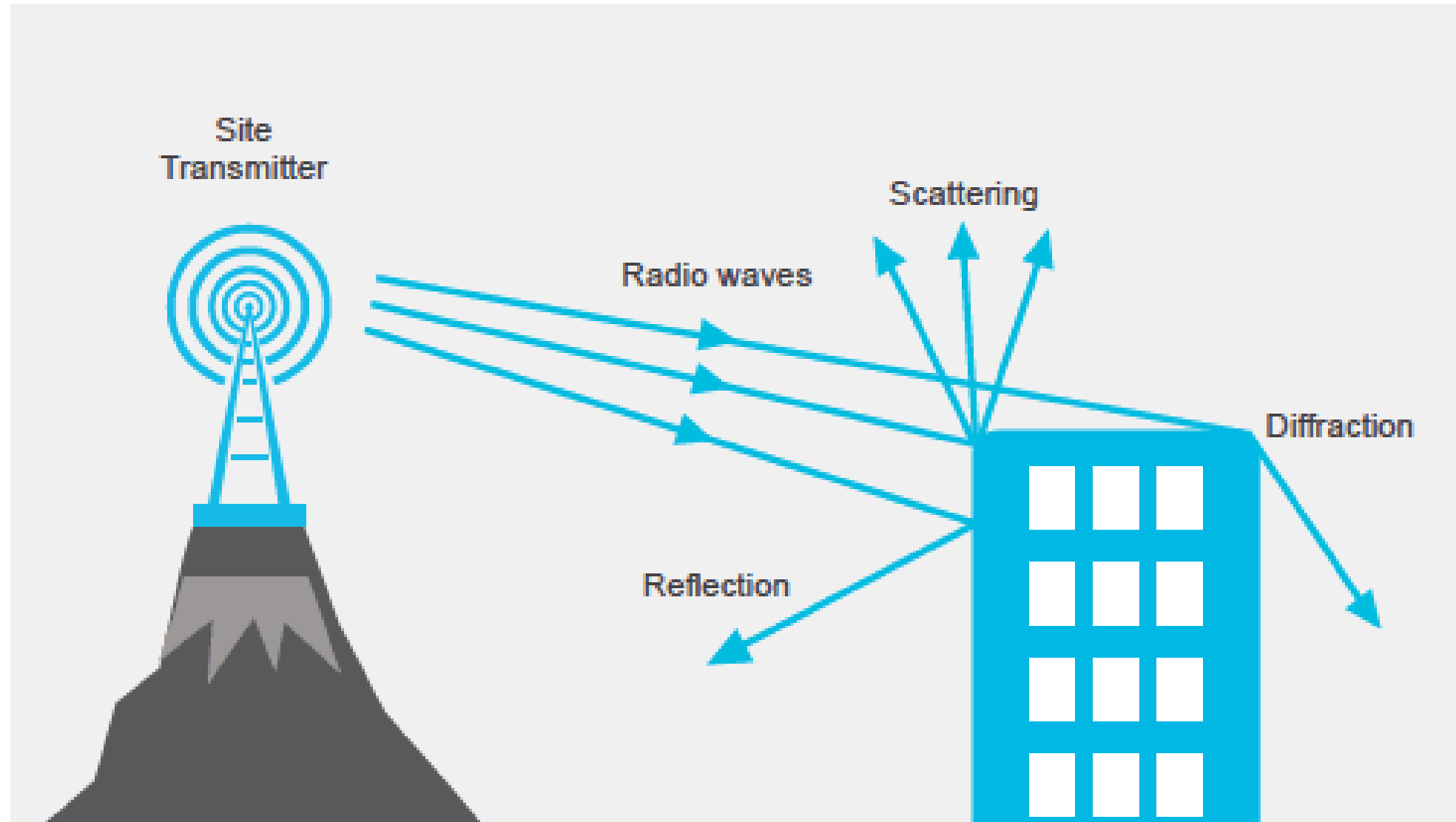


Signal Propagation in Wireless Transmission (Cont...)

► In wireless media, signals propagate using three principles:

- 1. Reflection:** occurs when the signal encounters a large solid surface, whose size is much larger than the wavelength of the signal, e.g., a solid wall.
- 2. Diffraction:** occurs when the signal encounters an edge or a corner, whose size is larger than the wavelength of the signal, e.g., an edge of a wall.
- 3. Scattering:** occurs when the signal encounters small objects of size smaller than the wavelength of the signal.

Signal Propagation in Wireless Transmission (Cont...)



Multiplexing and Modulation

- ▶ Multiplexing is a technique in which, multiple simultaneous analog or digital signals are transmitted across a single data link.
- ▶ The concept behind it is very simple: Proper Resource Sharing and its Utilization.
- ▶ It is done by using a device called Multiplexer(MUX) that combine n input lines to generate one output(i.e. many to one)
- ▶ At the receiving end a device called Demultiplexer(DEMUX) is used to separate signal into its component signals(i.e. one to many)

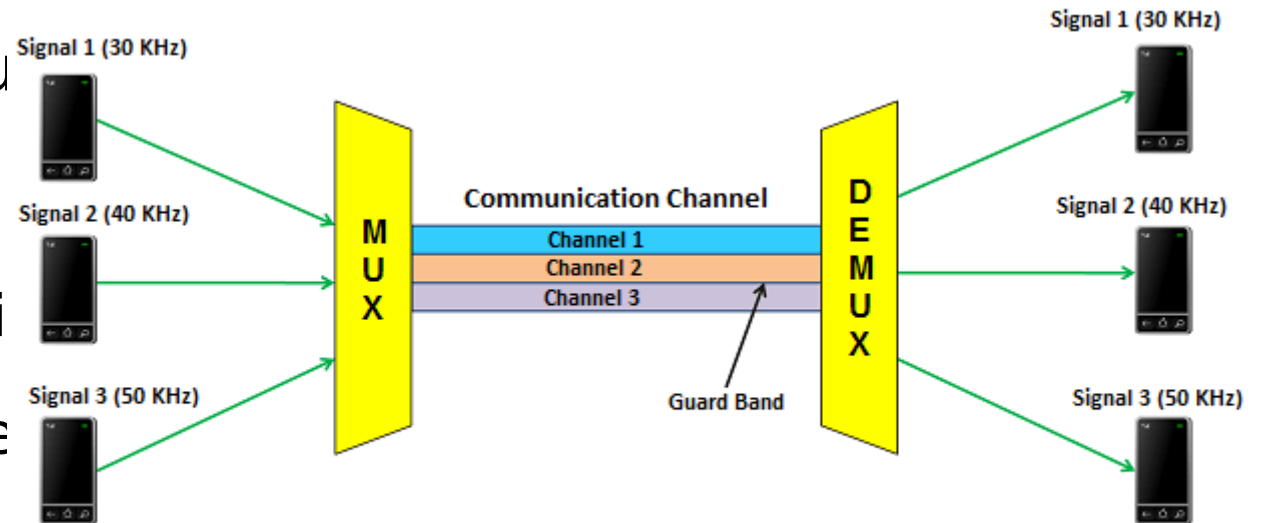
Multiplexing and Modulation

- ▶ Multiplexing can be classified into four types.
 - ✓ Frequency Division Multiplexing(FDM)
 - ✓ Time Division Multiplexing(TDM)
 - ✓ Code Division Multiplexing(CDM)
 - ✓ Space Division Multiplexing(SDM)

Types of Multiplexing

► Frequency Division Multiplexing(FDM)

- ✓ the frequency dimension spectrum is split into bands of smaller frequency.
- ✓ FDM is used because of the fact that, a number of frequency band can work simultaneously
- ✓ applications are:
 - a traditional radio or television broadcasting, mobile or satellite stations, or cable television.



Frequency Division Multiplexing

Types of Multiplexing (Cont...)

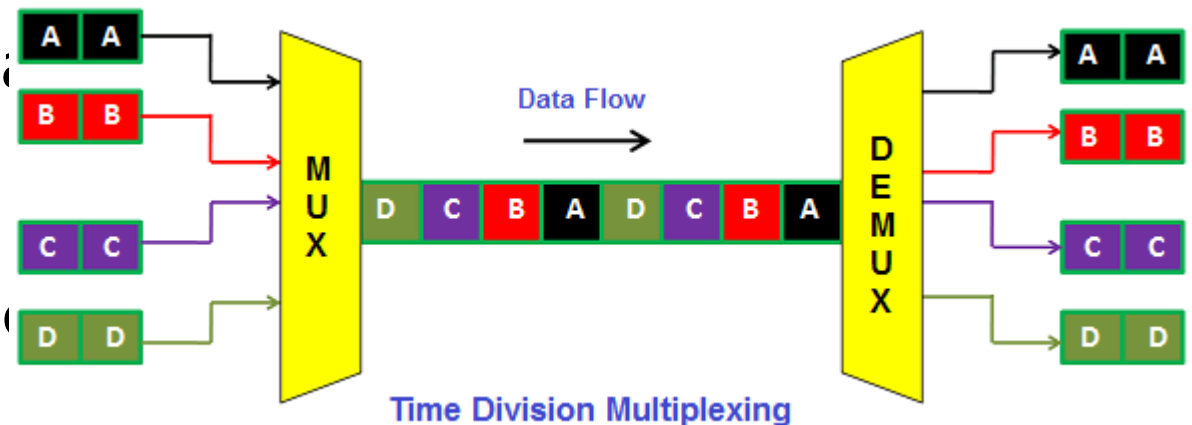
► Time Division Multiplexing(TDM)

- ✓ Is a technique used to transmit multiple signals simultaneously over a single communication channel.
- ✓ In TDM, the channel is divided into several time slots, and each signal is transmitted during its allocated time slot.

✓ It facilitates a single user at a time.

✓ Application:

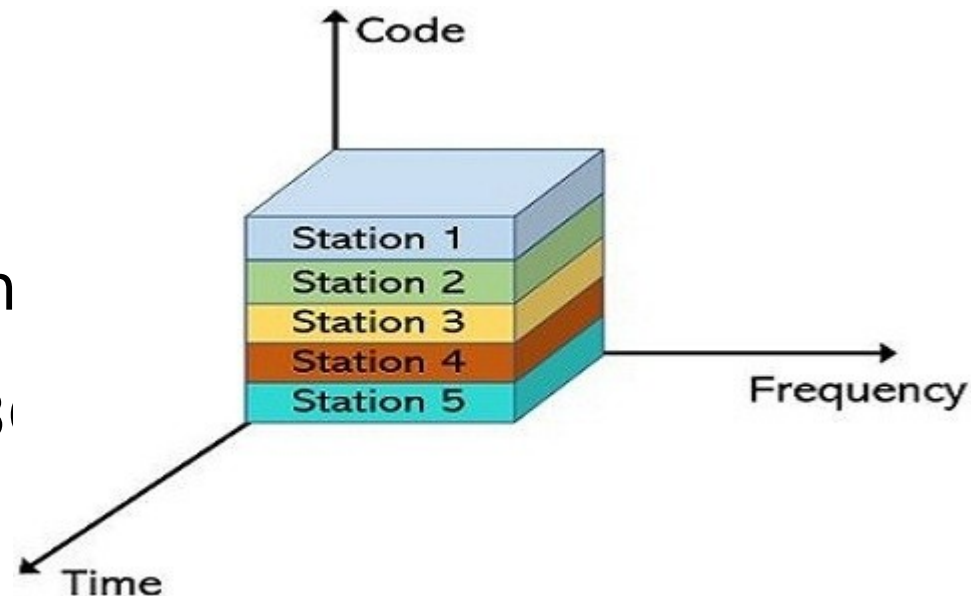
- It is used in telephonic services.



Types of Multiplexing (Cont...)

► Code Division Multiplexing(CDM)

- ✓ every channel is allotted with a unique code so that each of these channels can use the same spectrum simultaneously at same time.
- ✓ It is highly efficient.
- ✓ It is mainly used in Cell Phone Spectrum Technology (2G, 3G)



Types of Multiplexing (Cont...)

► Space Division Multiplexing(SDM)

- ✓ can be called as the combination of concepts of FDM and TDM.
- ✓ the goal is to pass messages or data parallelly with the use of specific frequency at certain interval of time.
- ✓ It means, a particular channel for some amount of time will be used against a certain frequency band.
- ✓ It is used in GSM (Global Service for Mobile) Technology.