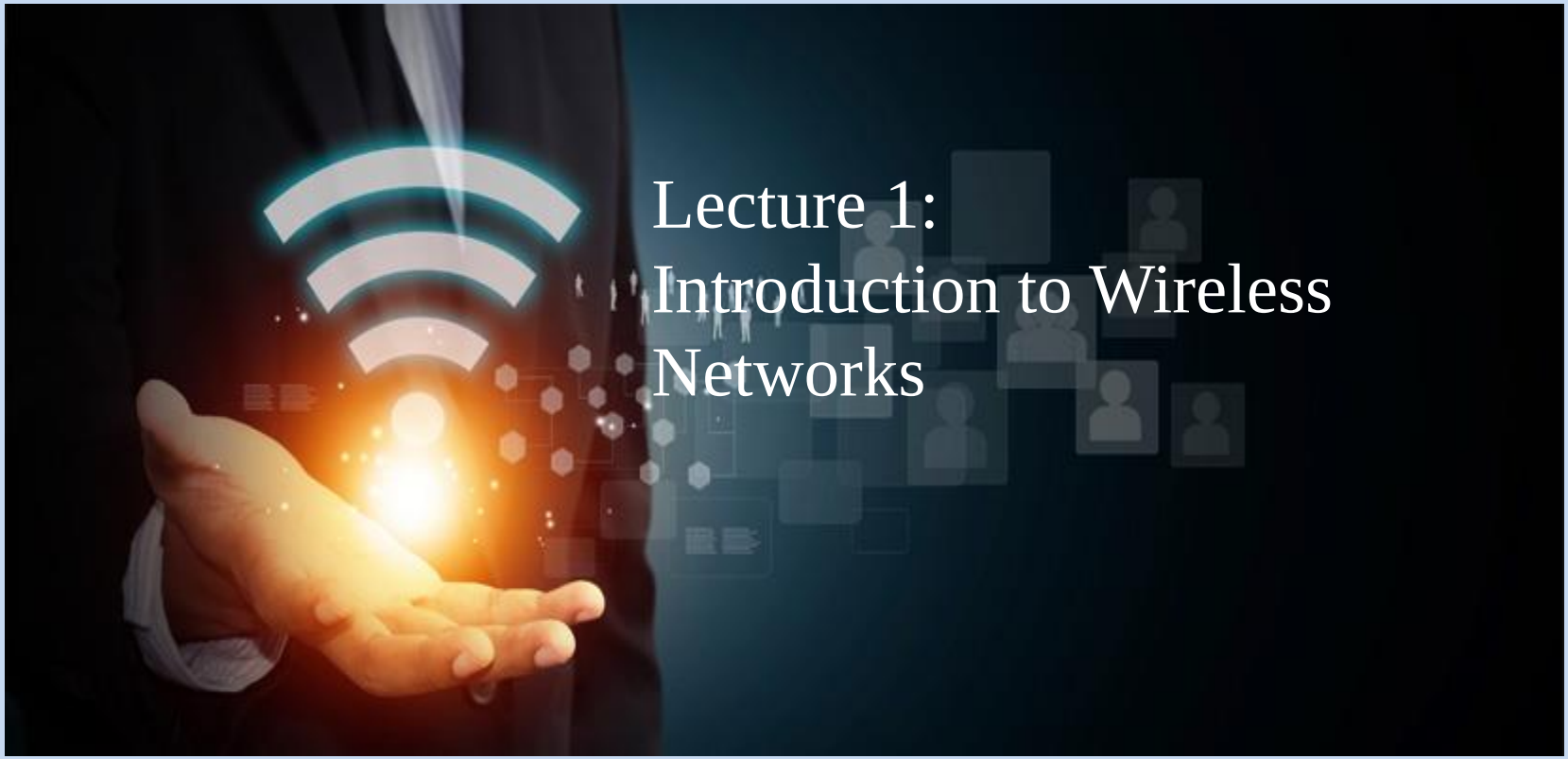
Wireless Networks



Introduction

- **Data Network** is a network that allows computers to exchange data.
  - The simplest data network is two PCs connected through a cable.
  - Most data networks connect many devices.
- **internetwork** is a collection of individual networks connected by networking devices and function as a single large network.
  - The public Internet is the most common example which it is a single network that connects millions of computers.
- **Local Area Network (LAN)** is a network that enabled multiple users in a relatively small geographic area to exchange files and messages and to access shared resources such as printers and disk storage.
- **Wide Area Network (WAN)** is a network that introduced to interconnect these LANs so that geographically dispersed users could also share information.

Introduction

- A wireless network enables people to communicate and access applications and information without wires.

- This provides freedom of movement and the ability to extend applications to different parts of a building, city, or nearly anywhere in the world.

- wireless networks use either radio waves or infrared light for communication between users, servers, and databases. This type of communication is invisible to the human eye. In addition, the actual medium (air) is transparent to the user.
- To provide a good wireless infrastructure, a solid wired infrastructure is a requirement, as this is the backbone for all wired access

Wi-Fi Back to Basics

- **In beginning**

In 1970, the University of Hawaii developed the first wireless network to wirelessly communicate data among the Hawaiian Islands. However, it wasn't until 1991 that the Institute of Electrical and Electronics Engineers (IEEE) began to discuss standardizing WLAN technologies. In 1997, the IEEE ratified the original 802.11 standard—the "802.11" technology term simply refers to Wi-Fi.

Reasons for Wireless Networks

- Mobile communication is needed.
- Communication must take place in a terrain that makes wired communication difficult or impossible.
- A communication system must be deployed quickly.
- Communication facilities must be installed at low initial cost.
- The same information must be broadcast to many locations.

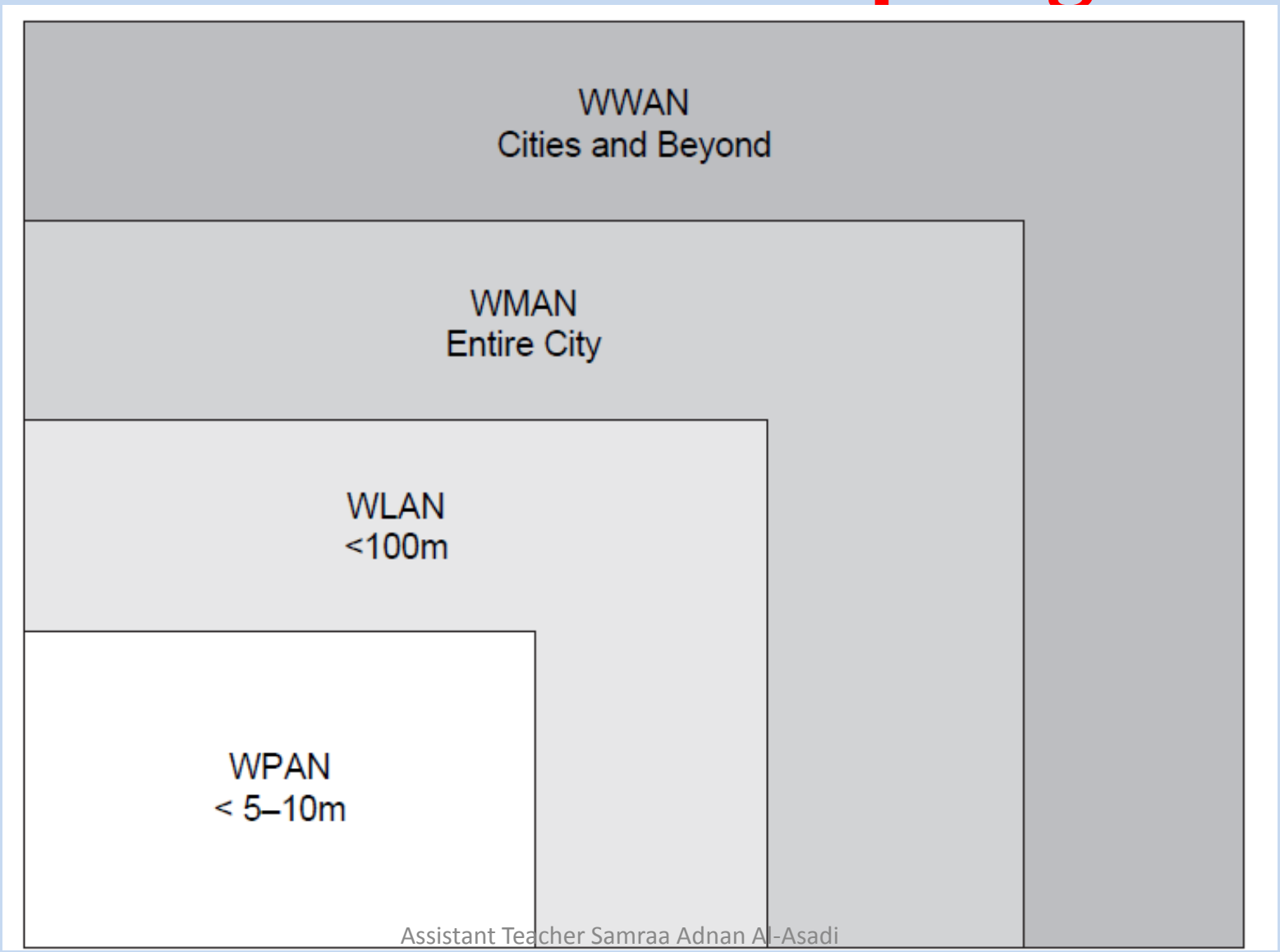
Problems with Wireless Networks

- Operates in a less controlled environment, so is more susceptible to interference, signal loss, noise, and eavesdropping.
- Generally, wireless facilities have lower data rates than guided facilities.
- Frequencies can be more easily reused with guided media than with wireless media.

General Wireless Topologies

- WPAN
- WLAN
- WMAN
- WWAN

General Wireless Topologies



WPAN

Wireless Personal Area Network

WPAN

Wireless PAN Enables the Interconnection of Computer Devices Within Close Reach of the User

WPAN

-- A WPAN is a network that is designed to operate within a 20-foot range.

-- Most wireless PANs use **radio waves** for carrying information through air. For example, the ***Bluetooth***

--Some wireless PANs employ **infrared light** to carry information from one point to another,

- It is free from radio frequency interference
- The line-of-sight requirement between computer devices limits the placement of wireless components.

WLAN

Wireless Local Area Network

WLAN

A Wireless LAN Enables the Interconnection of Computer Devices Within a Building

WLAN

- WLANs are designed for a larger area than that of a WPAN, close to 100 meters from Access Point (AP) to client, or from client to client.

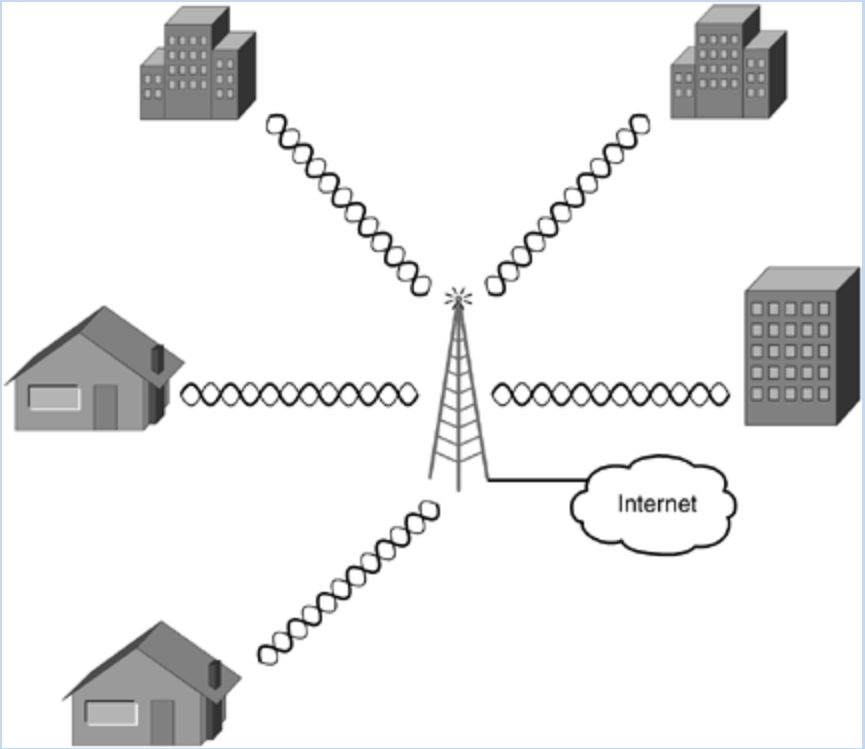
- Wireless LANs are similar to traditional wired Ethernet LANs in their performance, components, costs, and operation.

WMAN

Wireless Metropolitan Area Network

WMAN

Wireless MAN Is an Alterative for Homes and Companies Needing to Connect to an Internet Service



WMAN

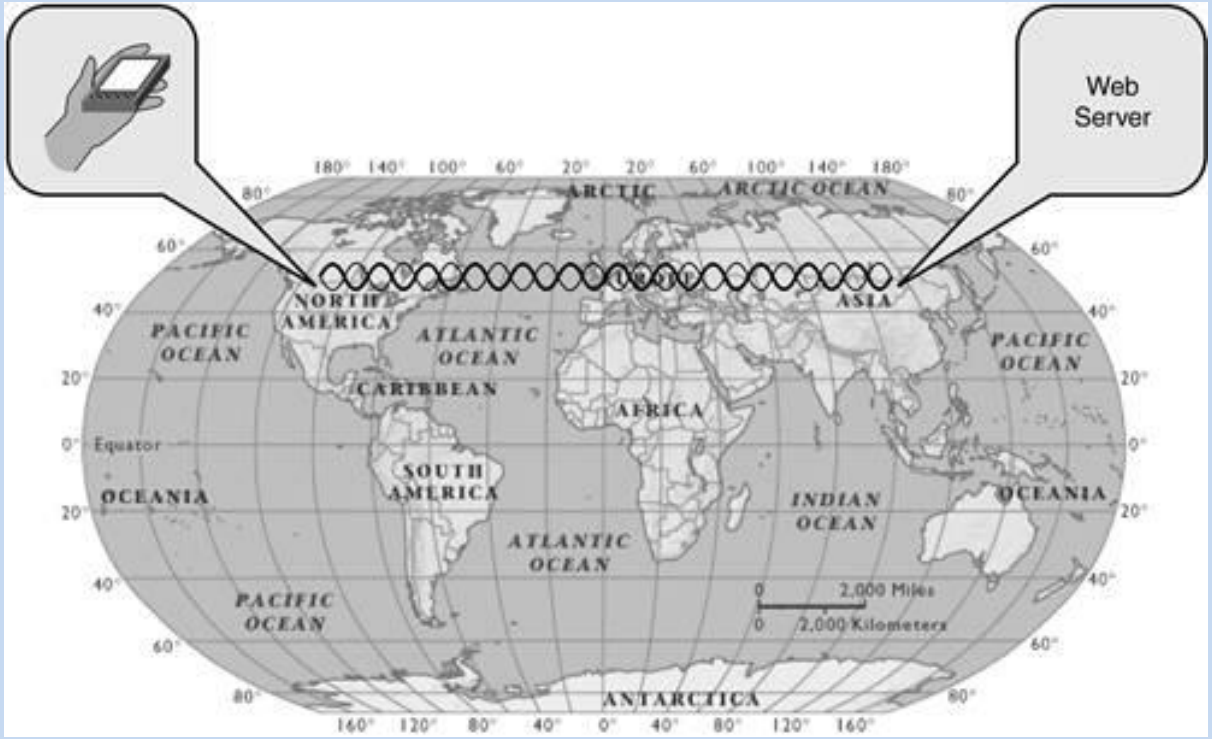
- WMAN
- This technology allows the connection of multiple networks in a metropolitan area such as different buildings in a city, which can be an alternative or backup to laying copper or fiber cabling.
- Most well-known is ***WiMax***.

WWAN

Wireless Wide Area Network

WWAN

A Wireless WAN is Capable of Supporting Mobile Applications over a Wide Area



WWAN

- WWAN
- These types of networks can be maintained over large areas, such as cities or countries, via multiple satellite systems or antenna sites looked after by an ISP. These types of systems are referred to as 2nd Generation systems.
- WWANs require high cost of deployment because they cover a large geographic area.

Wireless Communication Concepts

- **Waves**

- A wave is a type of disturbance that travels through a medium in a given time.

- The medium is a tangible or intangible thing—for example, water, air, wood, wires.

- The disturbance created by the wave conveys useful information—the signal or data.

Wireless Communication Concepts

- **Waves**
- Wireless communications are conducted over ***radio waves***. So, the radio wave is a disturbance that travels through air or space in a given time

- In wireless communications, information is transferred by systematically changing a characteristic or attributes of the radiated waves.

- These attributes include amplitude, frequency, wavelength, and phase.

Wireless Communication Concepts

- **Waves**

Sine wave

- A *sine wave*, is a mathematical relationship (function) that can be used to describe smooth and repetitive movement. This movement is known as ***oscillation***.

Waves Characteristics

- **Frequency..**

- *Frequency* is a central and measurable characteristic of a wave.
- It's a measure of the number of occurrences of a repeating event per fixed unit of time.
- The frequency of a wave is measured in hertz (Hz).
- It is measured according to the number of cycles per second that occur, or the number of completed cycles per second.

Waves Characteristics

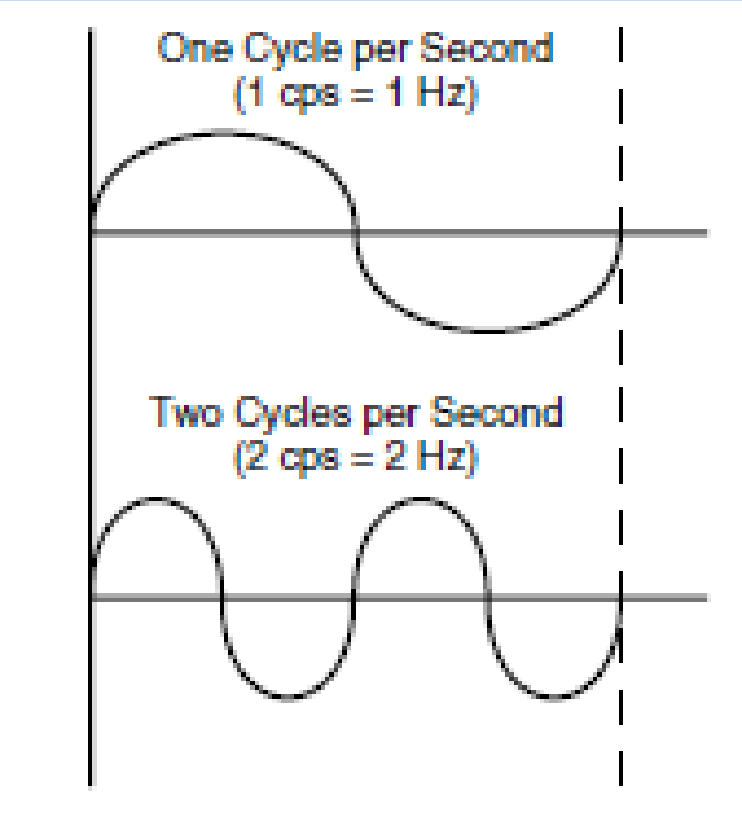
- **Frequency..**

- Radio frequency (RF) is a specific type of frequency that forms the cornerstone of wireless communication technologies and most of the IEEE 802.11 family of standards.

- It is a frequency (or rate of oscillation) within the range of 3 Hz to 300 GHz.

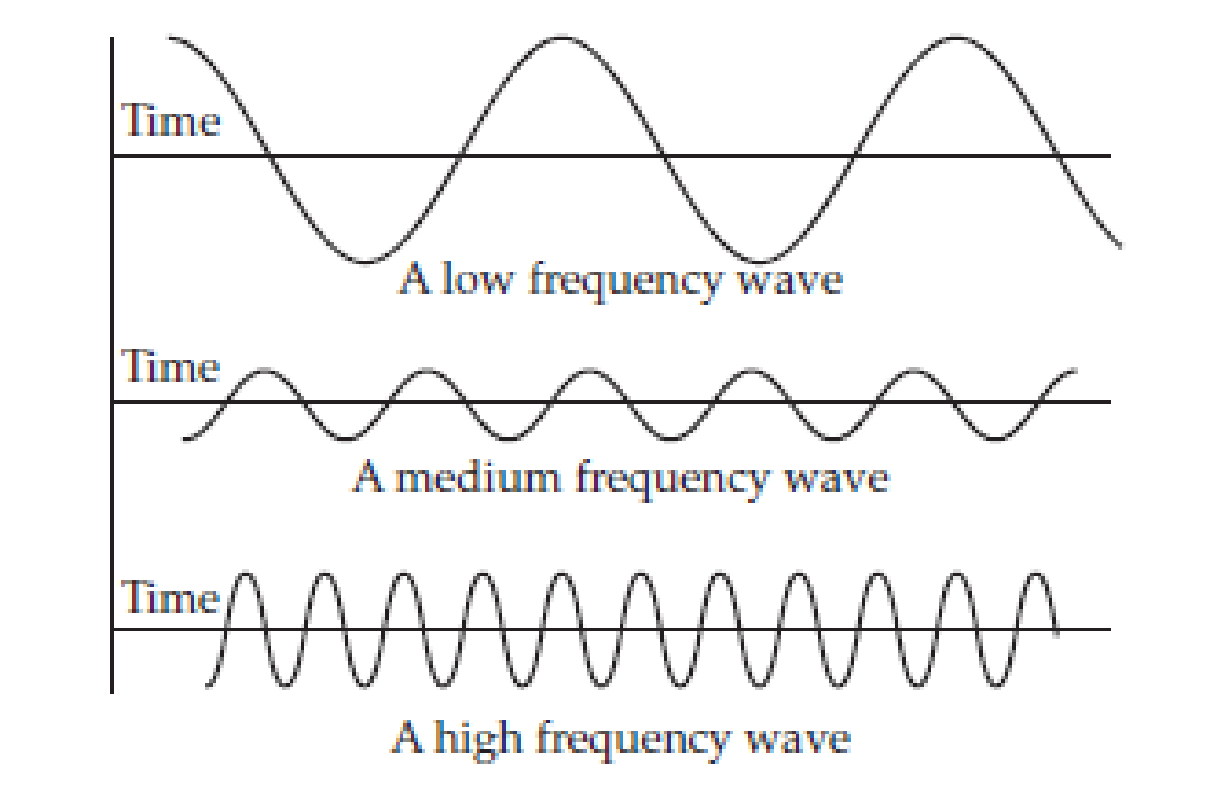
Waves Characteristics

- **Frequency..**



Waves Characteristics

- **Frequency..**

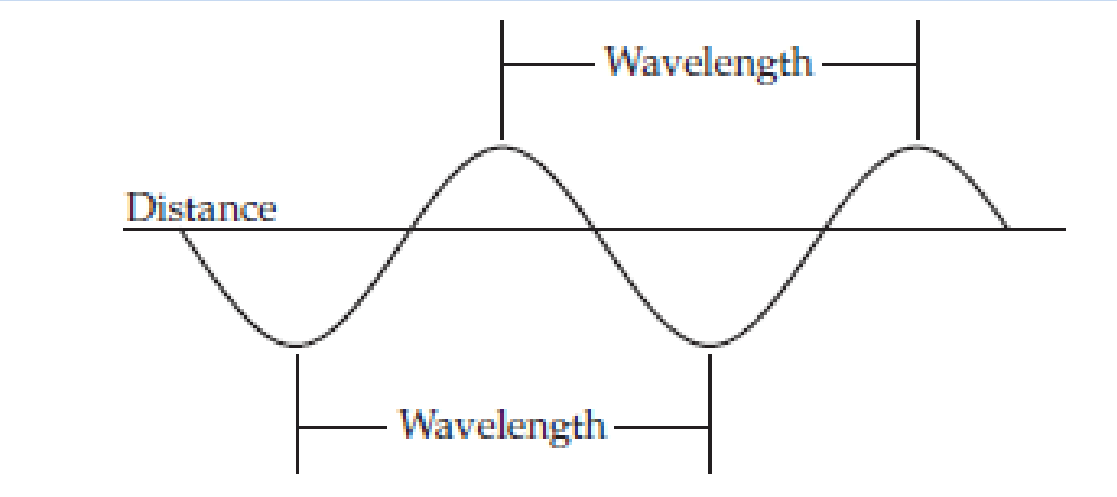


Waves Characteristics

- **Wavelength..**
- A wave consists of successive troughs (lows) and crests (highs).
- The distance between two adjacent crests or troughs is called the *wavelength. So, w*avelength can be measured in several ways—one crest to the next crest, or one trough to the next trough.
- Wavelength is used to reference the period of an oscillating signal.
- In the wonderful world of communications, wireless transmission occurs at very high frequencies, resulting in very small wavelengths.

Waves Characteristics

- **Wavelength..**



Waves Characteristics

- **Wavelength..**

- A wavelength affects how the wave will interact with the medium in which it travels.

- Waves with shorter wavelengths are more easily affected by solid objects (walls, building, trees, furniture, and so on) that lie in their path.

- Waves with longer wavelengths can propagate over longer distances.

Waves Characteristics

- **Question..**

What is the relationship between Wavelength and the Frequency?

- **Answer:**

The higher the frequency, the shorter the wavelength, and the lower the frequency, the longer the wavelength.

Waves Characteristics

- **Amplitude..**
- *Amplitude* is a measure of the magnitude (the relative size or extent) of a wave .
- It is a measure of power, strength, or height of a radio wave (the signal strength).
- Amplitude is formally defined as the maximum displacement of a periodic wave.
- While the amplitude of a periodic wave can change as it propagates through space, its frequency remains the same.

Waves Characteristics

- **Amplitude..**
- The amplitude change can be either :

  A reduction in the signal strength (***attenuation***)

Or:

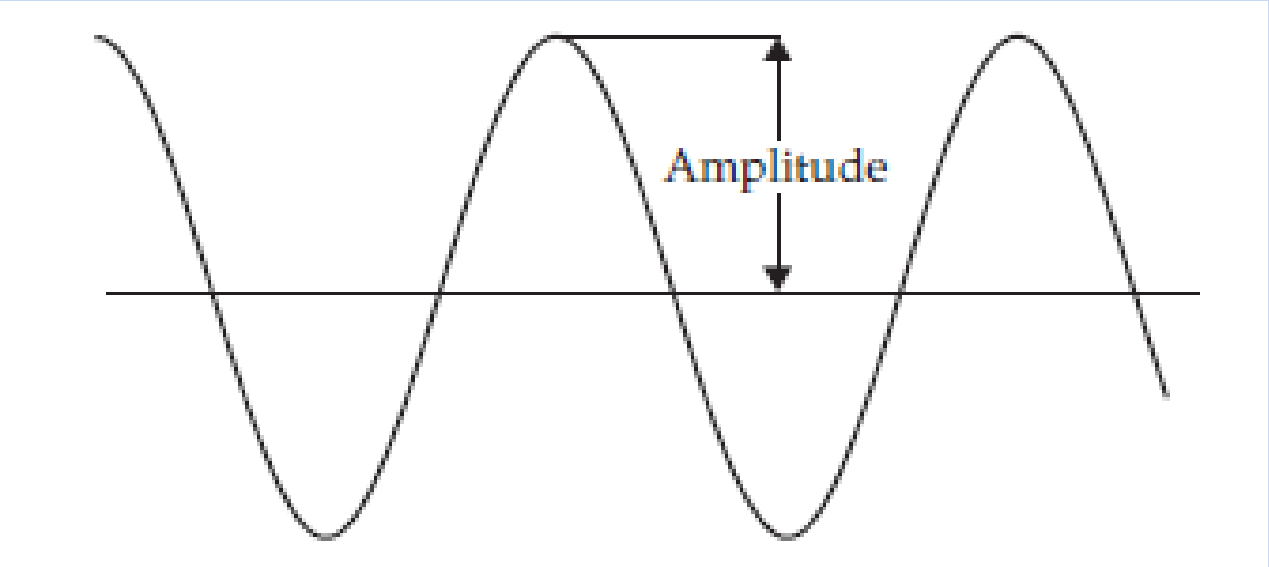
  An increase in the signal strength (***amplification***).

- Various components in wireless devices are responsible for signal attenuation and amplification.

- For example, wiring and connectors can cause attenuation, while an antenna can cause amplification.

Waves Characteristics

- **Amplitude..**



Waves Characteristics

- **Phase..**
- The *phase* of a wave is the offset of the wave from a reference point; it is a relative measure between two quantities.
- The relationship between the two quantities can be expressed in terms of their degrees of separation (0 to 360 degrees).
- For example, two waves that are *completely* in-phase will be said to be 0 degrees out-of-phase (or, they are simply *not* out-of-phase).
- And two waves that are *completely* out-of-phase are said to be 180 degrees out-of-phase.

Waves Characteristics

- **Phase..**

Phase Difference

- Any two wave sources (oscillators) are said to have a *phase difference* if they have the same frequency but different phases.
- The oscillators are then said to be out-of-phase with each other.
- When that happens, the phase difference determines whether the waves **reinforce** or **weaken** each other.

Waves Characteristics

- **Phase..**

Constructive Interference

When the crest (high) of one wave passes through, or is superimposed upon the crest (high) of another wave, the waves are said to constructively interfere with one another. The converse is also true: constructive interference can occur when the trough (low) of one wave passes through or is positioned upon the trough (low) of another wave.

So, given any two waves that are in-phase, the resulting wave or combined waves will be stronger than either of the individual waves. This simply means a stronger signal at the receiving end, this means higher amplitude.

Most forms of constructive interferences are beneficial to a wireless network because they can enhance wireless communications.

Waves Characteristics

- **Phase..**

Destructive Interference

When the crest (high) of one wave passes through, or is positioned upon, the trough (low) of another wave, the waves are said to destructively interfere with one another.

One type of destructive interference is the effect of two waves that are out-of-phase with each other, especially when they cancel each other out. This results in a diminished (lower amplitude) signal.

Wireless network administrator, almost always want to keep all forms of destructive interference to a minimum, because they can hinder or corrupt wireless communications.

Waves Characteristics

Band

- The radio spectrum is divided into different communication frequencies called ***bands***.

Bandwidth

- Bandwidth represents a range of frequencies, and not a single frequency. If fH is the high frequency in a band of frequencies and fL is the low frequency, then the bandwidth becomes:

$$B = fH - fL$$

Examples:

- **NATO K band** This band encompasses frequencies between 20 and 40 GHz.
- **IEEE K band** This band encompasses microwave frequencies ranging from 18 to 27 GHz.

Waves Characteristics

- **Channel..**

- A ***channel*** in communications is the route through which information is sent.

- The RF spectrum bands are divided into channels or groups with fixed widths.

References

- Wireless Network Administration: A Beginner's Guide
- Certified Wireless Network Administrator

Thank You