

BASIC INTRODUCTION OF COMPUTER NETWORKS

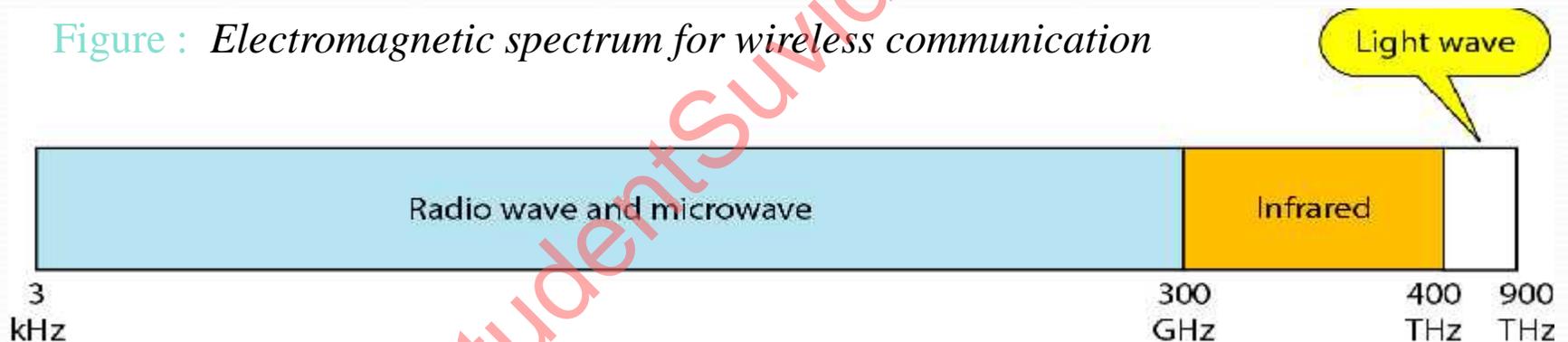
Transmission Characteristics of Guided Media

	Frequency Range	Typical Attenuation	Typical Delay	Repeater Spacing
Twisted pair (with loading)	0 to 3.5 kHz	0.2 dB/km @ 1 kHz	50 μ s/km	2 km
Twisted pairs (multi-pair cables)	0 to 1 MHz	0.7 dB/km @ 1 kHz	5 μ s/km	2 km
Coaxial cable	0 to 500 MHz	7 dB/km @ 10 MHz	4 μ s/km	1 to 9 km
Optical fiber	186 to 370 THz	0.2 to 0.5 dB/km	5 μ s/km	40 km

Unguided Media

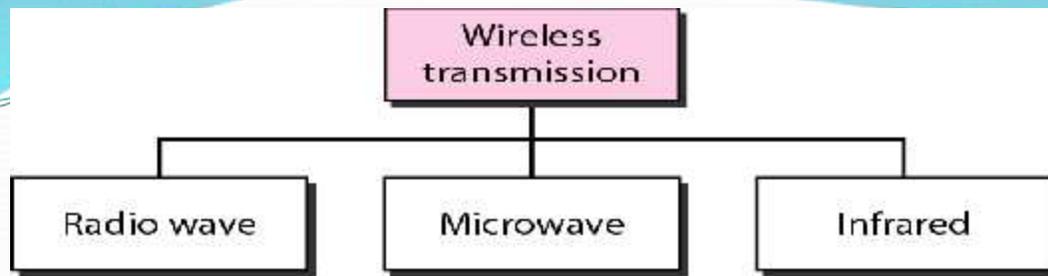
- Unguided media transport electromagnetic waves without using a physical conductor. This type of communication is often referred to as wireless communication.

Figure : *Electromagnetic spectrum for wireless communication*



Radio, satellite microwave, Bluetooth and infrared light are all different forms of electromagnetic waves that are used to transmit data.

Figure 7.19 Wireless transmission waves



Omnidirectional antenna

Radio Waves

Although there is no clear-cut demarcation between radio waves and microwaves, electromagnetic waves ranging in frequencies between 3 kHz and 1 GHz are normally called radio waves; waves ranging in frequencies between 1 and 300 GHz are called microwaves. However, the behavior of the waves, rather than the frequencies, is a better criterion for classification.

Radio waves, for the most part, are omnidirectional. When an antenna transmits radio waves, they are propagated in all directions. This means that the sending and receiving antennas do not have to be aligned. A sending antenna sends waves that can be received by any receiving antenna. The omnidirectional property has a **disadvantage**, too. The radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signals using the same frequency or band.

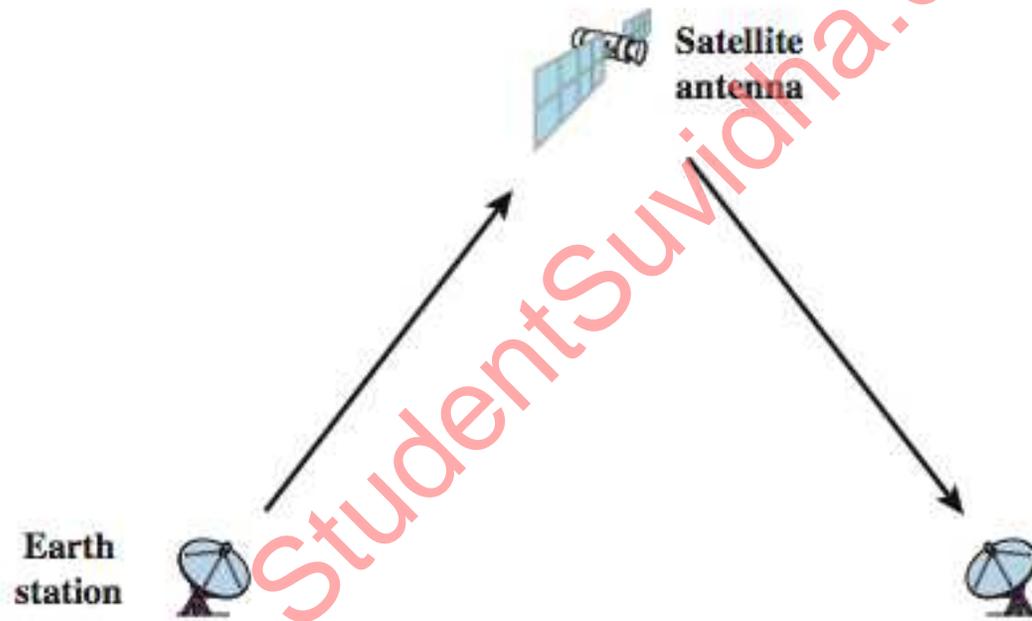
- Between 3 KHz – 1 GHz.
- Radio waves use omnidirectional antenna.
- Radio waves used for multicast communication, such as radio and television.
- Sky Propagation. This makes radio waves a good candidate for long-distance broadcasting such as AM radio.

Satellite Microwave

- Satellite is relay station
- Receives on one frequency, amplifies or repeats signal and transmits on another frequency
 - Eg. Uplink 5.925-6.425 ghz & downlink 3.7-4.2 ghz
- Typically requires geo-stationary orbit
 - Height of 35,784km
 - Spaced at least 3-4° apart
- Typical uses
 - Television
 - Long distance telephone
 - Private business networks
 - Global positioning

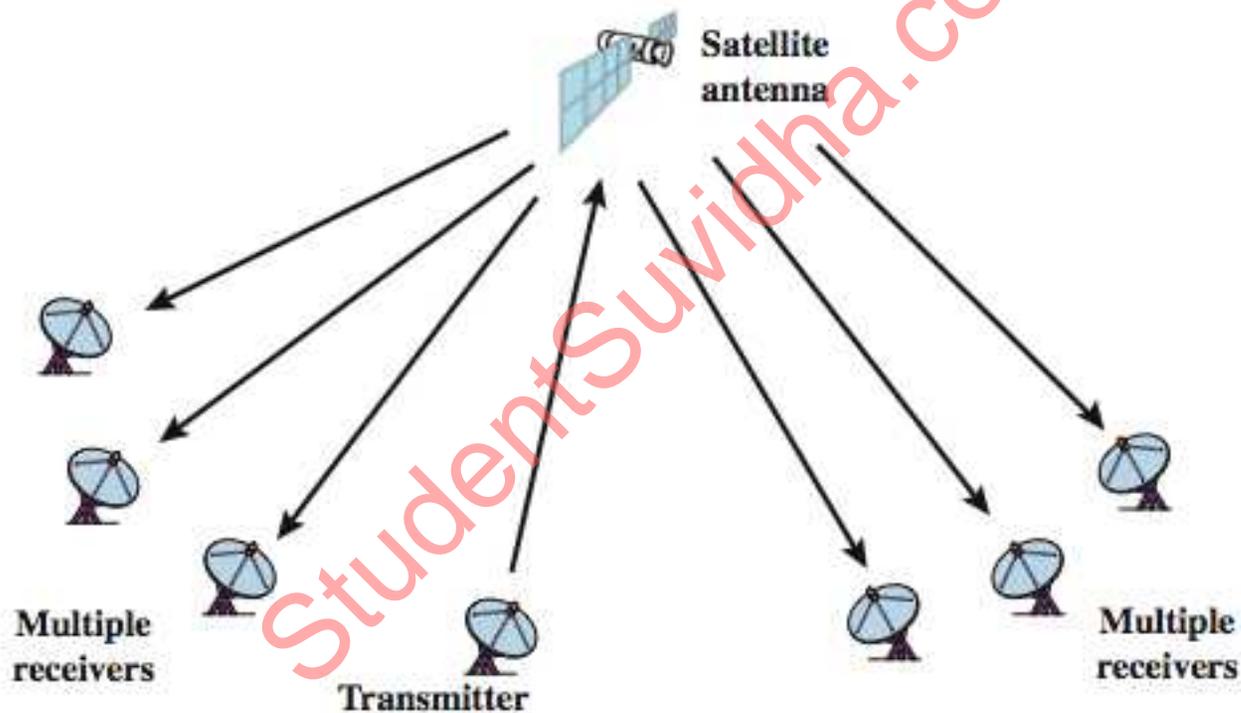
Satellite Point to Point

Link



(a) Point-to-point link

Satellite Broadcast Link



(b) Broadcast link

Infrared Transmission

“Infrared technology allows computing devices to communicate via short-range wireless signals. With infrared, computers can transfer files and other digital data bidirectionally.”

- Modulate noncoherent infrared light
- End line of sight (or reflection)
- Are blocked by walls
- No licenses required
- Typical uses
 - TV remote control
 - IRD port

Infrared

Installation and Usage - Computer infrared network adapters both transmit and receive data through ports on the rear side of a device. Infrared adapters are installed in many laptops and handheld personal devices

Range - Infrared communications span very short distances. Place two infrared devices within a few feet (no more than 5 meters) of each other when networking them. Unlike Wi-Fi and Bluetooth technologies, infrared network signal cannot penetrate walls or other obstructions and work only in the direct "line of sight."

Performance - Infrared technology used in local networks exists in three different forms:

IrDA-SIR (slow speed) infrared supporting data rates up to 115 Kbps

IrDA-MIR (medium speed) infrared supporting data rates up to 1.15 Mbps

IrDA-FIR (fast speed) infrared supporting data rates up to 4 Mbps

IR Advantages:

- Low power requirements: therefore ideal for laptops, telephones, personal digital assistants
- Low circuitry costs: \$2-\$5 for the entire coding/decoding circuitry
- Simple circuitry: no special or proprietary hardware is required, can be incorporated into the integrated circuit of a product
- Higher security: directionality of the beam helps ensure that data isn't leaked or spilled to nearby devices as it's transmitted
- Portable



IR Disadvantages:

- Line of sight: transmitters and receivers must be almost directly aligned (i.e. able to see each other) to communicate
- Blocked by common materials: people, walls, plants, etc. can block transmission
- Short range: performance drops off with longer distances
- Light, weather sensitive: direct sunlight, rain, fog, dust, pollution can affect transmission
- Speed: data rate transmission is lower than typical wired transmission

Comparison of Major Wireless Transmission Media

Medium	Description and Advantages	Limitations and Drawbacks
Microwave	Point-to-point communication in line-of-sight path.	Must have visual contact between antennas.
	Antennas are used (30 miles apart).	Susceptible to environmental interferences
	Provide large capacity.	
	Can be done quickly at lower cost	
Satellites	Can be at high, medium, or low orbit; used in GPSs.	Expensive to build and maintain.
	Complete global coverage is available with three satellites.	
Radio/electromagnetic	Effective for short ranges; used in LANs	Limited range; difficult to secure.
	Inexpensive and easy to install.	Can create interference with communication devices.