

Data Communication Part-6

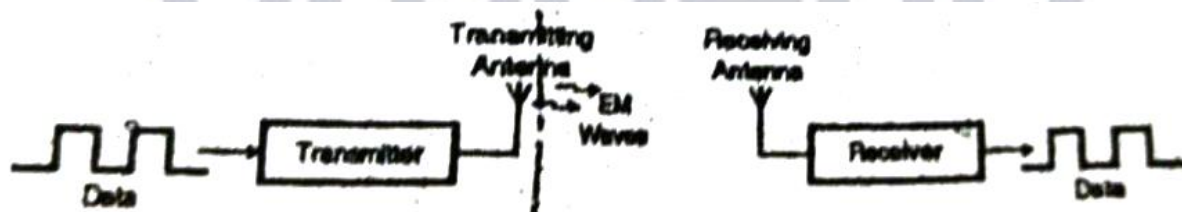
Data communication Part-6

Content :

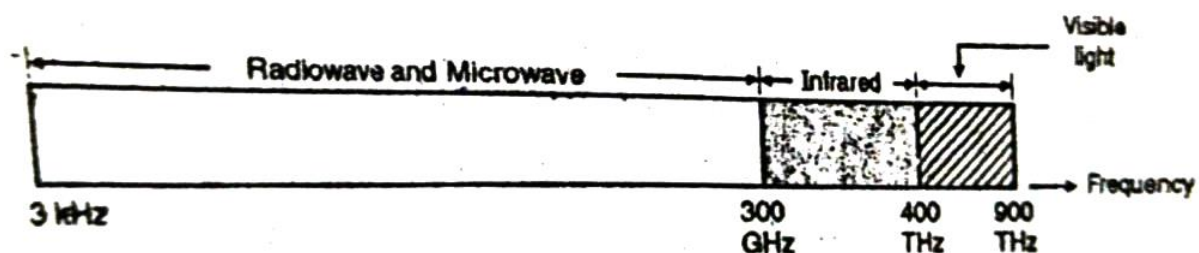
1. Unguided Media
2. Propagation method
3. Infrared Signals
4. Radio waves
5. Micro waves
6. Switching methods

Unguided (Wireless) Media :

- Unguided or Wireless media does not use conductor or wire as a communication channel
- Instead it uses the air or vacuum as medium to carry the information from transmitter to receiver .
- The transmitter first converts the data signal into electromagnetic waves and transmits them using suitable antenna .
- The receiver receives them using a receiving antenna and converts the EM waves into data signal again as shown is diagram given below:



Note: The electromagnetic spectrum used for wireless communication is diagram below :



Propagation Methods:

- The unguided can travel from the transmitter to receiver in many different way. The most important methods are :
 - Ground wave propagation
 - Sky propagation
 - Space propagation or line of sight propagation

Bands : The electromagnetic spectrum is divided into several sub-bands . Table gives various frequency bands , corresponding type of propagation and application .

S.No.	Name	Frequency	Wavelength	Propagation Method
1	Extremely low frequency(ELF)	30-300 Hz	10^7 to 10^6 m	Ground
2	Voice frequency (VF)	300-3000 Hz	10^6 to 10^5 m	Sky
3	Very low frequency (VLF)	3-30 Hz	10^5 to 10^4 m	Sky
4	Low frequency (LF)	30-300 kHz	10^4 to 10^3 m	Sky
5	Medium frequency (MF)	300kHz- 3 Mhz	10^3 to 10^2 m	Sky
6	High frequency(HF)	3-30 Mhz	10^2 to 10 m	Sky and line of signal
7	Very high frequencies(VHF)	30-300Mhz	10 to 1 m	Sky and line of signal
8	Ultra high frequencies(UHF)	300 Mhz- 3 Ghz	1 to 10^{-1} m	Sky and line of signal
9	Super high frequencies (SHF)	3-30 Ghz	10^{-1} to 10^{-2} m	LOC
10	Extremely high frequency (EHF)	30-300Ghz	10^{-2} to 10^{-3} m	LOC
11	Infrared	-	0.7 to 10 pm	LOC
12	Visible high	-	0.4 to 0.8 pm	LOC

EM spectrum and communication Application:

In the radio communication system the frequencies ranging from few kilohertz to many gigahertz all are being used for various purpose .

Detailed table for entire usable frequency spectrum and applications



S.No.	Frequency Band	Wavelength	Applications
1	30Hz – 300 Hz Extremely low frequency ELF	10^4 to 10^3 Km	Power transmission
2	300 Hz – 3 KHz Voice frequencies (VF)	10^3 to 10^2 km	Audio applications
3	3 kHz – 30 kHz Very low frequencies (VLF)	10^2 to 10^1 km	Submarine communications , navy , military communications
4	30kHz – 300 kHz Low frequency (LF)	10 to 1 km Long waves	Aeronautical and marine , navigation these frequencies act as sub carriers
5	300 kHz – 30 MHz Medium frequencies (MF)	1 km to 100 m Medium waves	AM radio broadcast , Marine and aeronautical communication
6	3 MHz – 30 MHz High frequencies (HF)	100 to 10 m Short waves	Shortwave transmission , amateur and CB communication
7	30 MHz – 300 MHz Very high frequencies (VHF)	10 to 1 m	TV and FM broadcasting
8	300 MHz – 3 GHz Ultra high frequencies(UHF)	1 m to 10 cm Microwaves	UHF TV channels. Cellular phones , Military applications
9	3GHz – 30 GHz(SHF)	10^{-1} to 10^{-2} m	Satellites communication and radar
10	30 GHz – 300 GHz(EHF)	10^{-2} to 10^{-3} m	Satellites and specialized radars

INFRARED Signals:

- The EM signals having frequencies above 300 GHz are not referred as radio waves
- The signal occupying the range between 0.1 mm and 700 nanometers (nm) are called infrared signals .
- These used in various special kinds of communication as listed below :
 1. In astronomy to detect stars and other heavenly body
 2. For guidance in weapon systems
 3. Tv remote control



Visible Light :

- Light is a special type of electromagnetic radiation. It was wavelength in the range of 0.4 to 0.8 μm .
- Light is used in various kind of communications.
- Light waves can be modulated and transmitted through the glass fibers in the optical fiber communication systems.
- Light signals can also be transmitted through free space . Laser is a type of light which can be easily modulated with voice and data information

Type of Wireless Media :

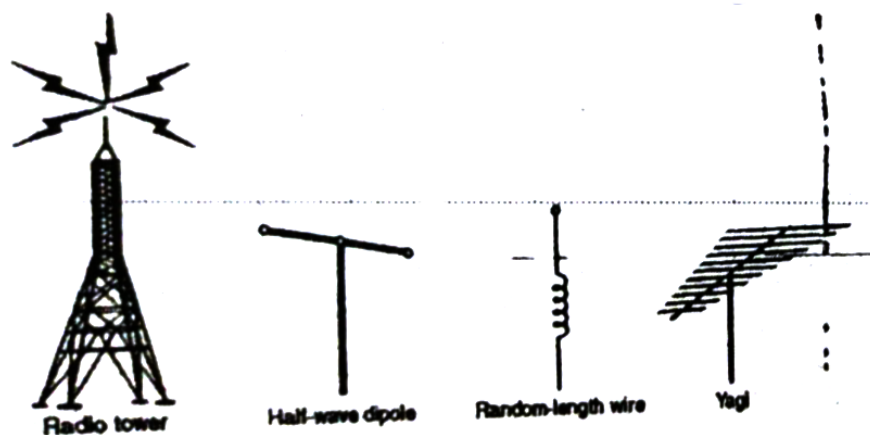
- It does not use an electrical or optical conductor . In most cases the earth's atmosphere is the physical path for the data
- Wireless media is used when distance or obstructions make cable media difficult . There are three main types
 1. Radio -Wave
 2. Microwave
 3. Infrared

Radio Wave Transmission Systems

- Radio waves have frequencies between 10 kHz and 1 gigahertz . The range of electromagnetic spectrum between 10 kHz and 1 GHz is called radio frequency(RF)
- Radio waves include the following types:
 1. Short wave used in AM radio
 2. Very high frequency (VHF) used in FM radio and TV
 3. Ultra High Frequency(UHF) used in TV
- The radio frequency bands are regulated and require a license from the regulator body unregulated frequency bands are also present which operate at less than 1 watt transmitted power .
- Radio waves can be broadcast directionally or omnidirectional. various kinds of antennas are used to broadcast these signals as shown in figure .



- The power of the RF signal is determined by the antenna and transceiver.
- Each range has characteristic that affect its use in computer network . For example network application , radio waves fall into three categories :
 1. Low power , single frequency
 2. High power , single frequency
 3. Spread - spectrum



Microwave Transmission System :

It makes use of the lower gigahertz frequencies of the electromagnetic spectrum . These frequencies , are higher than the RF and they produce better throughput and performance .

Two types of microwave data communication systems are:

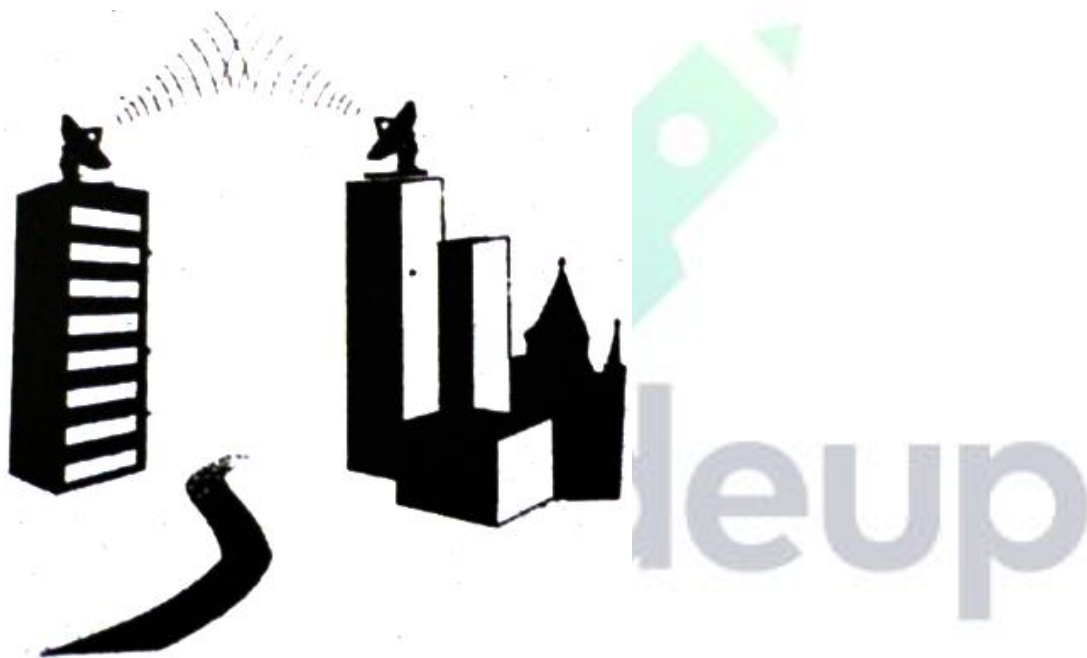
1. Terrestrial
2. Satellite

Microwaves :

- Microwave are basically electromagnetic waves having frequencies between 1 and 300 Ghz
- Microwave are unidirectional
- The microwave band is wide (299 Ghz) so it is possible to allot wider sub bands. Therefore it can support high data rates.

Terrestrial Microwave Systems:

- These systems use directional parabolic antennas to transmit and receive signals in the lower gigahertz range as shown in diagram
- The signals are highly focused and the physical path must be line of sight
- Relay towers are used to extend signals. Smaller terrestrial microwave systems can be used within building
- Microwaves LANs operate at low power using small transmitters that communicate with omnidirectional hubs. Hubs can then be connected to form the entire networks



Characteristics of Terrestrial Microwave Systems:

- The frequency range used is from 4-6 GHz and 21-23 GHz
- It supports a bandwidth from 1 to 10 mbps
- Attenuation is affected by frequency, signal strength, atmospheric conditions and antenna size.
- The signals are affected by EMI effect, eavesdropping and jamming
- Line of sight requirements make installation difficult
- Short distance system can be inexpensive but long distance systems are relatively expensive.

Advantages of Microwave Link :

- Installation of tower and associated equipments is cheaper than laying down a cable of 100km length
- Less maintenance as compared to cables
- Repeaters can be used. So effect of noise is reduced
- No adverse effects such as cable breakage etc.
- Due to the use of highly directional antenna , these links do not make any interference with other communication systems.
- Size of transmitter and receiver reduces due to the use of higher frequency

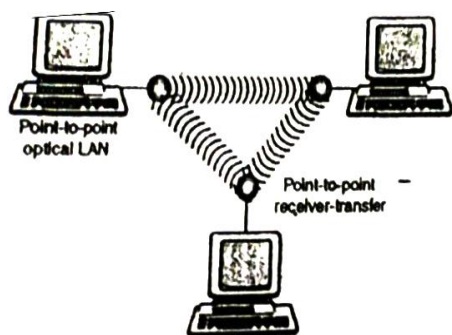
Disadvantages:

- Signal strength at the receiving antenna reduces due to multipath reception
- The transmission will be affected by the thunderstorms and other atmospheric phenomenon's

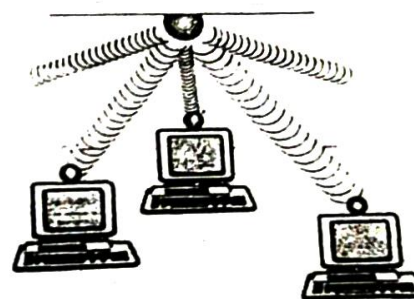
Applications of Microwave Transmission :

- One-to-one communication
- In cellular phones
- In satellite networks
- In wireless LANs

Point-to-point and Broad Cast Infrared Media :



(a) Point-to-point infrared media in a network



(b) Broadcast infrared media

S.No.	Factors	Point to point	Broadcast
1	Frequency range	100 GHz to 1000 terahertz	100 GHz to 1000 terahertz
2	Bandwidth	Data rates between 100 kbps to 16 mbps	Data rates less than 1 mbps
3	Node Capacity	2 (source to destination)	More than one
4	Attenuation	Depends on quality of emitted light , its purity , atmospheric conditions and signal obstructions	Depends on the quality of emitted light, its purity atmospheric conditions
5	EMI	Affected by intense light	Affected by intense light
6	Installation	Requires precise alignment	Fairly simple
7	Cost	Moderately high if laser is used	High if laser is used

Switching methods :

- It is an important technique that can determine how connections are made and how data movement is handled in wide area network(WAN) .
- Data sent across point switched telephone network or other internetworks can travel along different paths from sender to receiver
- Switching sends data along different routes. These are three switching techniques:
 1. Circuit switching
 2. Message switching
 3. Packet switching

S.no.	Parameter	Message Switching	Circuit Switching	Packet switching
1	Application	Telegraph network for transmission of telegrams	Telephone network for bi-directional , real time transfer of voice signals	Internet for datagram and reliable stream service between computers
2	End terminal	Telegraph , teletypes	Telephone , modem	Computer
3	Information type	Morse, boudot , ASCII	Analog voice or PCM digital voice	Binary Information
4	Transmission system	Digital data over different transmission media	Analog and digital data over different transmission media	Digital data over different transmission media
5	Addressing Scheme	Geographical addresses	Hierarchical numbering plan	Hierarchical address space
6	Routing Scheme	Manual	Route selected during call setup	Each packet routed independently
7	Multiplexing Scheme	Character or message multiplexing	Circuit multiplexing	Packet multiplexing shared media access network



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