

# Microwave, Infrared & Bluetooth Communication



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# Microwaves

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- microwaves - electromagnetic waves with a frequency between 1GHz (wavelength 30cm) and 12GHz (wavelength 1mm)
- microwaves frequency are further categorized into frequency bands: L (1-2 GHz), S (2-4 GHz), C (4-8 GHz), X (8-12 GHz)
- receivers need an unobstructed view of the sender to successfully receive microwaves
- microwaves are ideal when large areas need to be covered and there are no obstacles in the path



# Advantages of microwaves over radio waves

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- because of high frequency, more data can be sent through microwaves -> increased bandwidth, higher speeds
- because of their short wave length, microwaves use smaller antennas



# Disadvantages of microwave communication

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- they require no obstacle is present in the transmission path
- the cost of implementing the communication infrastructure is high
- microwaves are susceptible to rain, snow, electromagnetic interference



# Microwaves usages

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- carrier waves in satellite communications
- cellular communication
- bluetooth
- wimax
- wireless local area network
- GPS (Global Positioning System)

# Microwave communication concepts

- LoS (Line of Sight) – is a visible straight line between the sender and the receiver
- LoS propagation – propagation(broadcast) of microwaves in a straight line free from any obstructions
- Fresnel zone – elliptical(oval) area around the LoS between a sender and receiver; microwaves spread into this area once are generated by an antenna; this area should be free of any obstacles:



# Microwave propagation modes

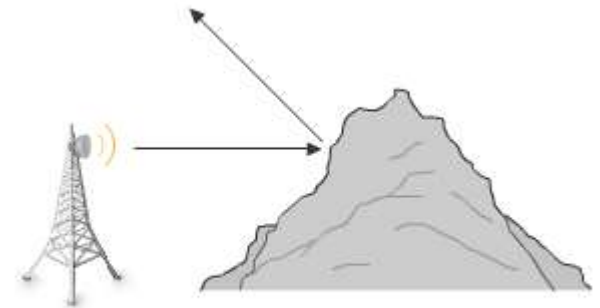
- microwaves, once generated, propagate in a straight line in all directions
- there are 3 modes of propagation possible, and the mode is decided based on distance and terrain(place)



Line of Sight Propagation

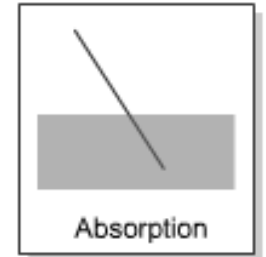
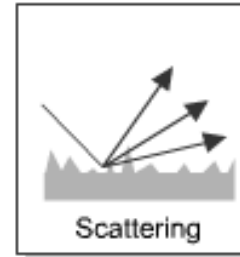
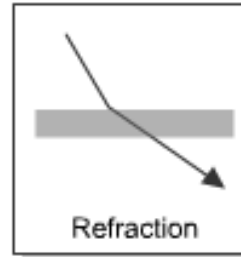
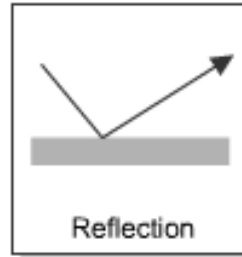
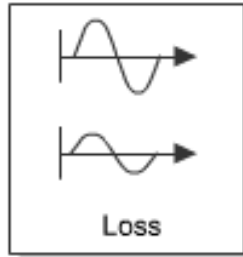
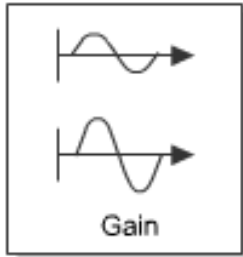


Skywave Propagation



Ground Reflected Path

# Microwave signal attenuation



Spread  
out





# Infrared & Bluetooth communication

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- are used in Wireless Personal Area Networks, a small area wireless network, spanning a range around 30 feet, involving computers/laptops, PDAs, cellular phones

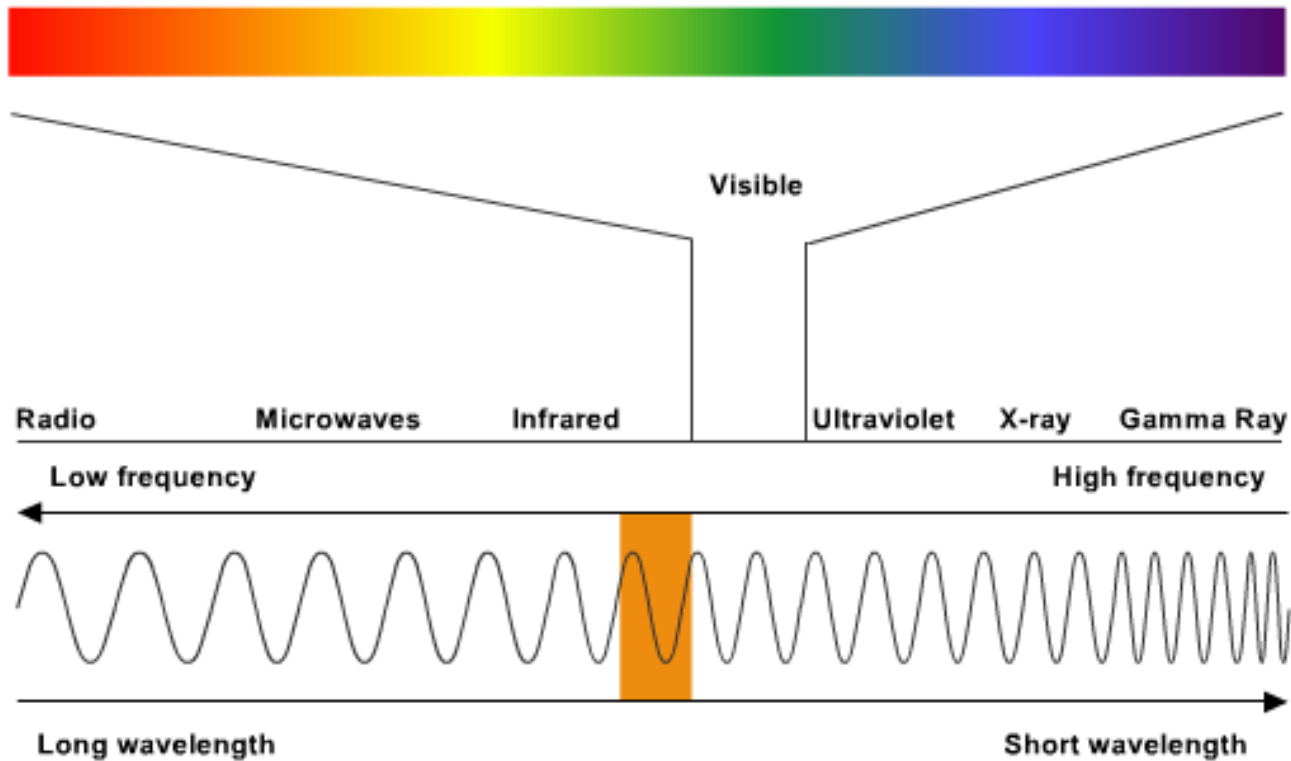


# Infrared waves

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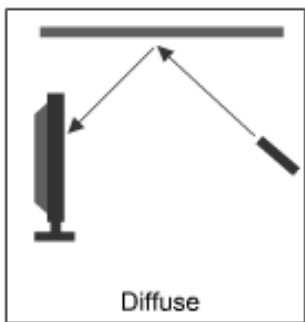
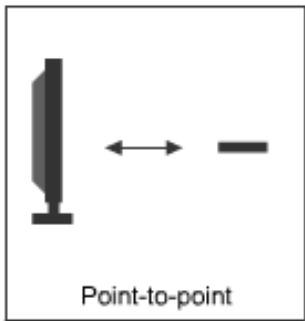
- have frequency between 300 GHz and 400 THz (unit of freq. )and wave lengths between 1 mm and 750 nm
- are classified into sub bands:
  - near-infrared (120THz-400THz): are visible to the human eye as red and violet
  - mid-infrared (30THz-120THz)
  - far-infrared (300GHz-30THz): are not visible to the human eye, but are radiated in the form of heat (heat of light)
- electromagnetic waves which are pulses of infrared light
- are used for short range communication, unobstructed (e.g. remote control for a TV set), though they can reflect on hard surfaces
- factors affecting communication: bright sunlight, hard obstacles (e.g. walls, doors), smoke, dust.

# Wireless infrared communication = Wireless optical communication



# Infrared configuration

- there are 2 infrared system configurations:
  - point-to-point communication : transmitter and receiver are placed in the LoS, directed toward each other, free of obstacles; directed LoS systems
  - Diffuse (broad) communication: transmitter and receiver are placed in the vicinity,(neighborhood) but not necessary in a straight line; non-directed non-LoS systems





# Infrared devices

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- many infrared devices (e.g. remote control, laptop, pda) follows the rules from IrDA (InfRared Data Association)



L E D



L D

# Infrared communicating devices



**Infrared  
technology**



**Infrared  
technology**



# Bluetooth



Piconet



## Bluetooth (2)

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- short range communication (30 feet) between various devices like laptops, PDAs, PCs, gaming consoles etc.
- creates a WPAN
- data and voice is exchanged at 2.4 GHz
- max 8 devices can be connected to each other (**piconet**)
- bluetooth devices operate at low power levels (1miliWatt)
- “Bluetooth” technology was named in the memory of Danish king Harald Bluetooth





# Bluetooth security

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- is wireless, so susceptible to interception
- Bluetooth offers authentication and authorization
- Bluetooth offers non-discoverable mode (enable)



# Bluetooth devices

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- laptops
- personal computers
- printers
- PDA
- GPS receivers
- cellular phones
- gaming consoles
- head phones