

## Unguided Transmission Media

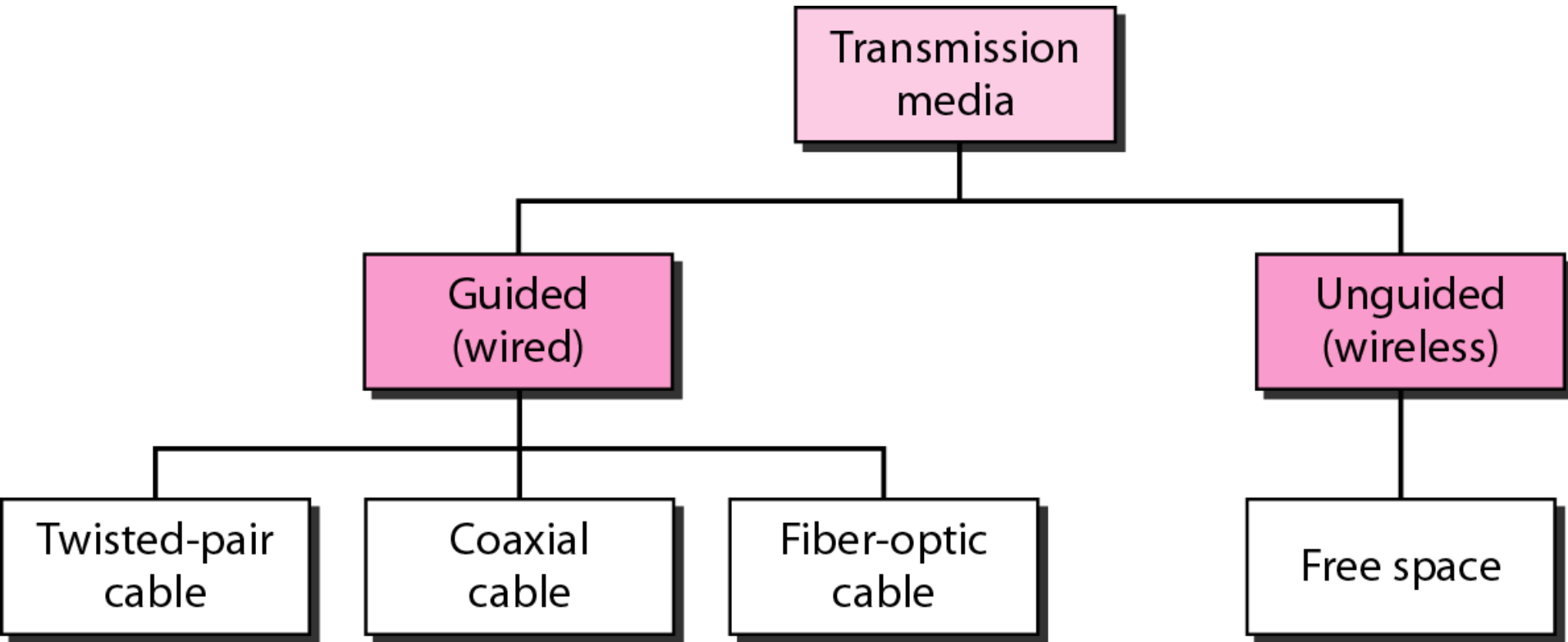
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# INTRODUCTION

- Physical Path between transmitter and receiver in a data communication system
- May be classified into two types:
  - Guided:- Waves are guided along a solid medium, such as copper twisted pair, copper coaxial cable or optical fibre.
  - Unguided:- Provides a means for transmitting electro-magnetic signals through air but do not guide them ,wireless communication.

# Transmission Media Classes



# Wireless Communication

- Transmission and reception are achieved by means of antennas
  - For transmission , an antenna radiates electromagnetic radiation in the air
  - For reception , the antenna picks up electromagnetic waves from the surrounding medium.
  - The antenna plays key role

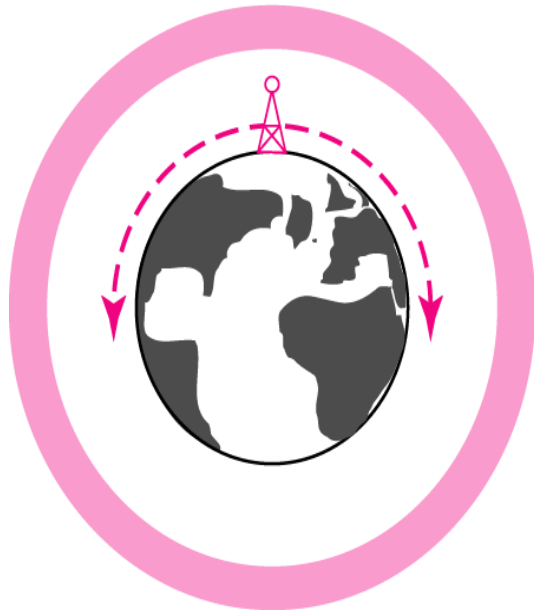
# Wireless Communication

- Basically two types of configuration :
  - Transmitting antenna puts out a focussed electromagnetic beam.
    - Transmitter & receiver must be carefully aligned.
      - Allows point to point communication.
- Transmitted signal spreads in all directions.
  - can be received by many antennas
  - Broadcast communication

# Propagation Methods

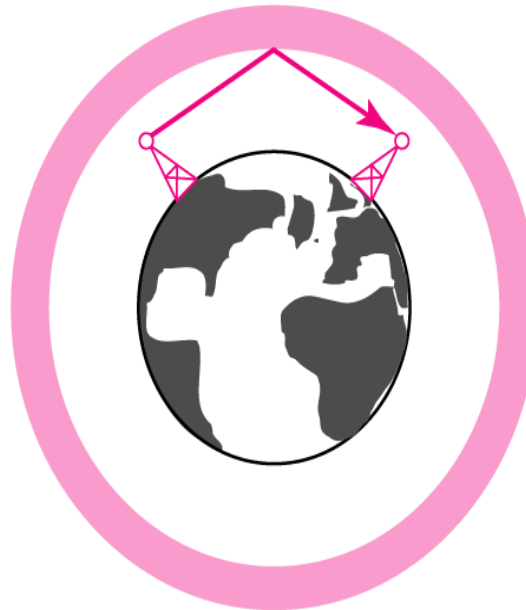
## → Ground Propagation

Ionosphere



Ground propagation  
(below 2 MHz)

Ionosphere



Sky propagation  
(2–30 MHz)

Ionosphere



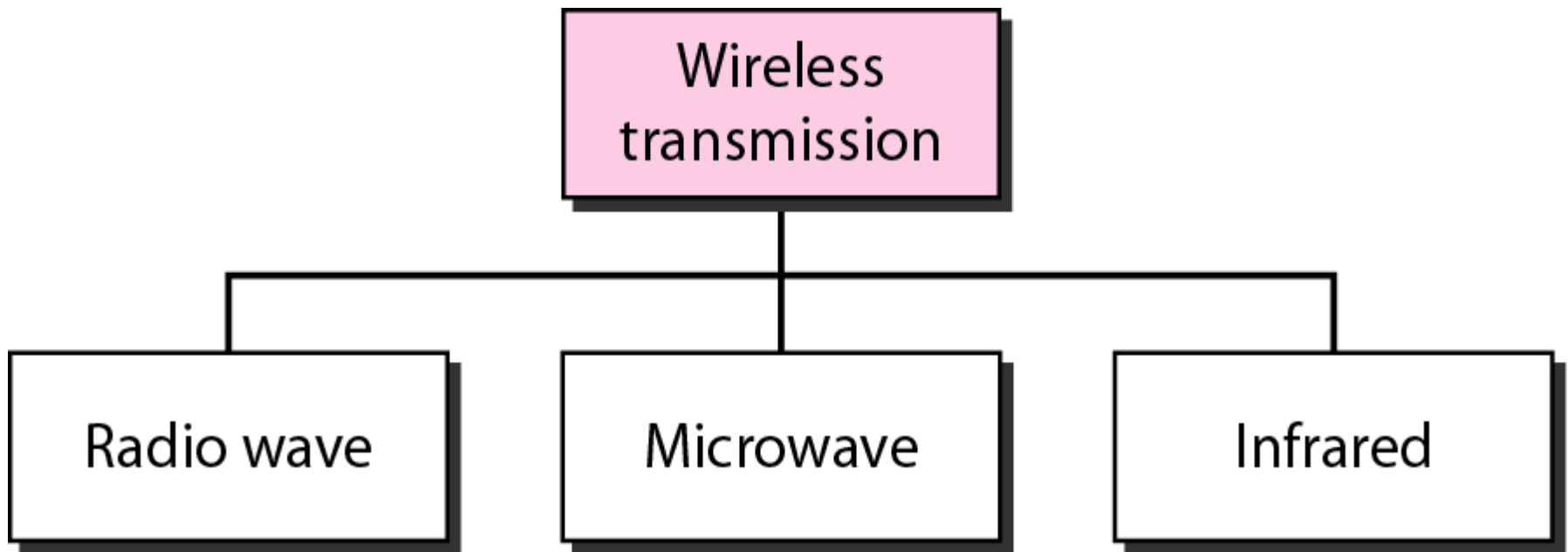
Line-of-sight propagation  
(above 30 MHz)

# Bands

<i>Band</i>	<i>Range</i>	<i>Propagation</i>	<i>Application</i>
VLF (very low frequency)	3–30 kHz	Ground	Long-range radio navigation
LF (low frequency)	30–300 kHz	Ground	Radio beacons and navigational locators
MF (middle frequency)	300 kHz–3 MHz	Sky	AM radio
HF (high frequency)	3–30 MHz	Sky	Citizens band (CB), ship/aircraft communication
VHF (very high frequency)	30–300 MHz	Sky and line-of-sight	VHF TV, FM radio
UHF (ultrahigh frequency)	300 MHz–3 GHz	Line-of-sight	UHF TV, cellular phones, paging, satellite
SHF (superhigh frequency)	3–30 GHz	Line-of-sight	Satellite communication
EHF (extremely high frequency)	30–300 GHz	Line-of-sight	Radar, satellite

# Unguided Media

## Wireless transmission media





# Broadcast Ratio

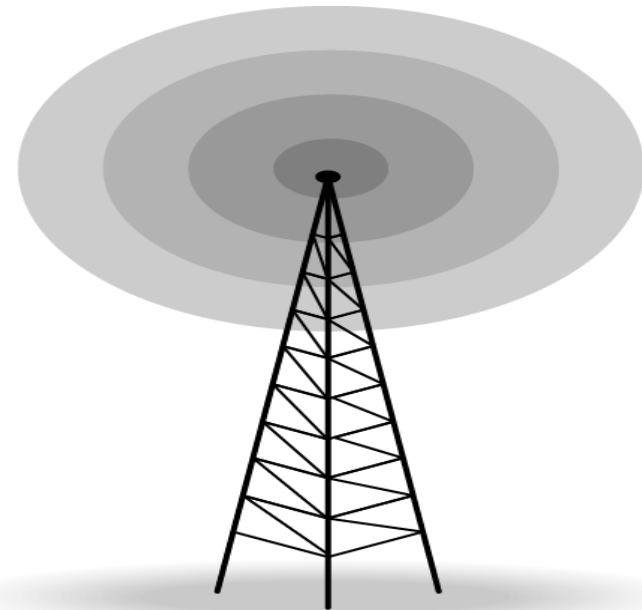
- radio is 3kHz to 300GHz
- use broadcast radio, 30MHz - 1GHz, for:
  - FM radio
  - UHF and VHF television
- is omnidirectional
- still need line of sight
- suffers from multipath interference
  - reflections from land, water, other objects

# Unguided Media - Radio Waves

## Omnidirectional Antenna

→ Frequencies between 3 KHz and 1 KHz

→ Radio waves are used for multicasts communications, such as radio and television, and paging system.

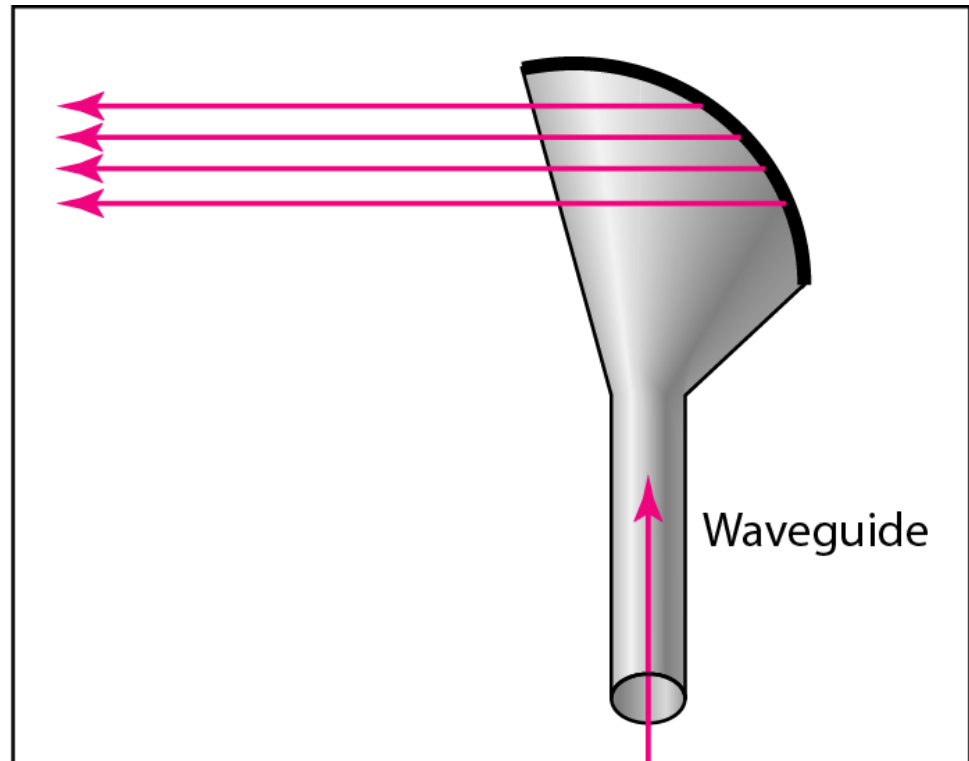
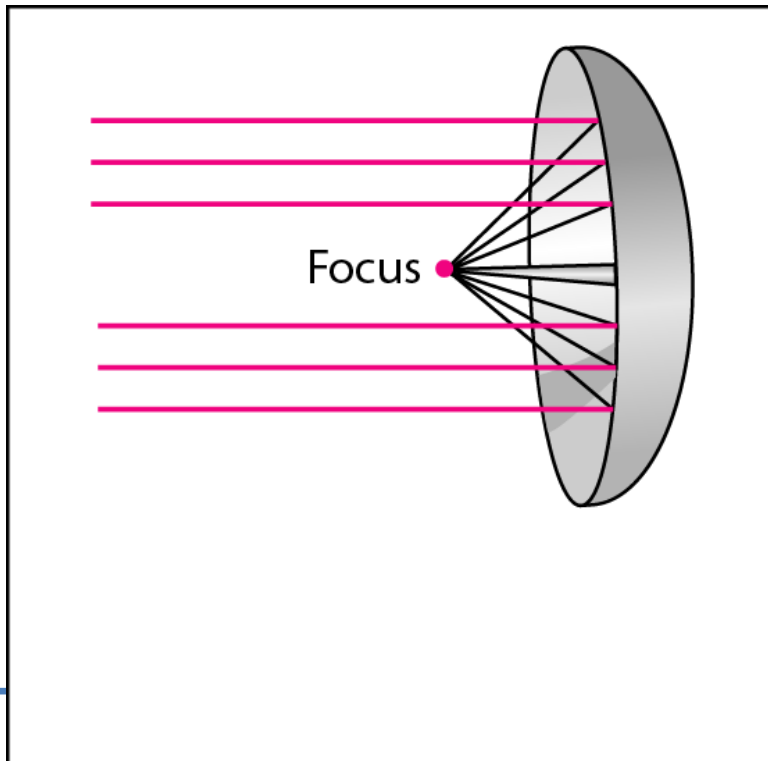


# Terrestrial Microwave

- used for long haul telecommunications and short point-to-point links
- requires fewer repeaters but line of sight
- use a parabolic dish to focus a narrow beam onto a receiver antenna
- 1-40GHz frequencies
- higher frequencies give higher data rates
- main source of loss is attenuation
  - > distance, rainfall
- also interference

# Unguided Media - Microwaves

- Frequencies between 1 and 300 GHz
- Used for unicast communication such as cellular phones, satellite, networks and wireless lans.
- unguided antenna



# Satellite Microwave

- Satellite is relay attention
- Typically requires geo-stationary orbit
  - height of 35,784
  - spaced at least 3-4 apart
- Typical uses
  - television
  - long distance telephone
  - private business network
  - global positioning

# Unguided Media - Infrared

→ Frequencies between 300 GHz to 400 THz.

→ Can not penetrate walls.

→ Used for short-range communication in a closed area using line-of-sight propagation.

# Infrared

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

# Antennas

- Electrical conductor used to radiate or collect
- Electromagnetic energy
- Transmission antenna
  - Radio frequency energy from transmitter
  - Converted to electromagnetic energy by antenna
  - Radiated into surrounding environment
- Reception antenna
  - Electromagnetic energy impinging on antenna
  - Converted to radio frequency electrical energy
  - Fed to receiver
- Same antenna is often used for both purposes



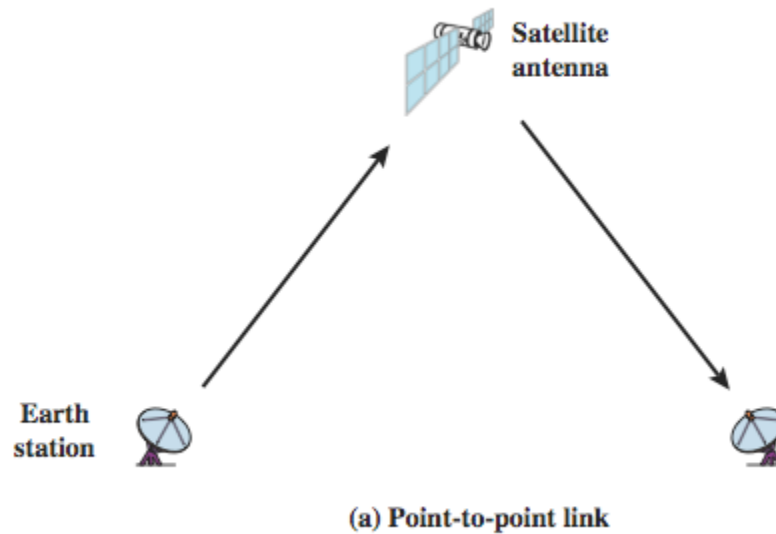
# Radiation Pattern

- Power radiated in all directions
- Not same performance in all directions
  - As seen in a radiation pattern diagram
- An isotropic antenna is a (theoretical) point in space
  - Radiates in all directions equally
  - With a spherical radiation pattern

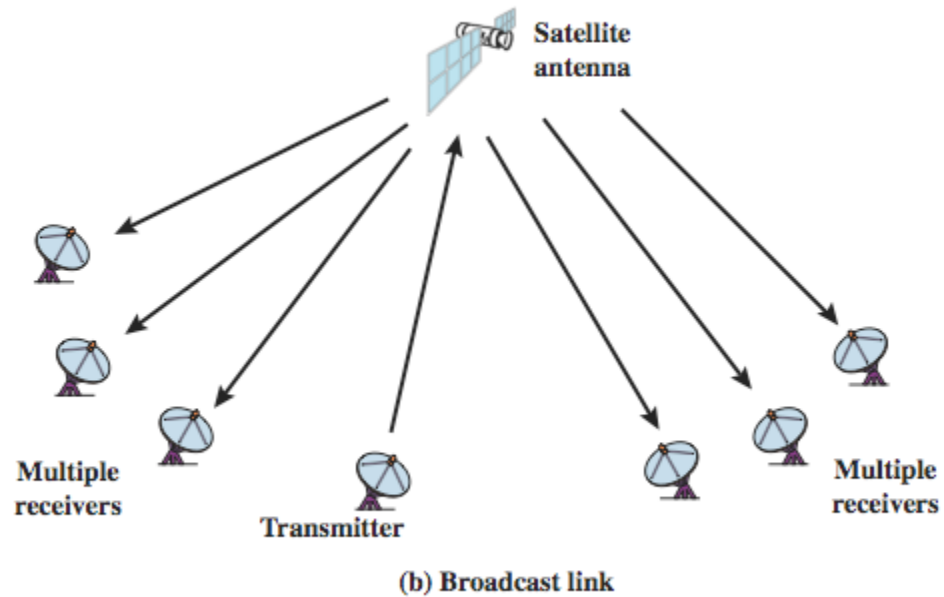
# Antenna Gain

- Measure of directionality of antenna
- Power output in particular direction verses that
- Produced by an isotropic antenna
- Measured in decibels (dB)
- Results in loss in power in another direction
- Effective area relates to size and shape
  - Related to gain

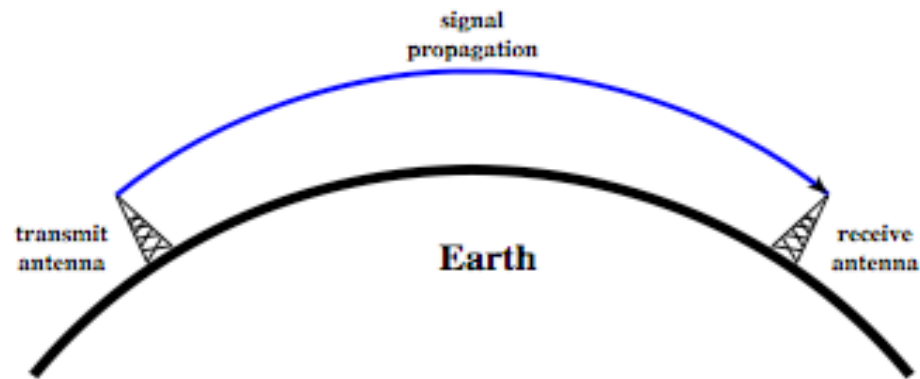
# Satellite Point to Point Link



# Satellite Broadcast Link

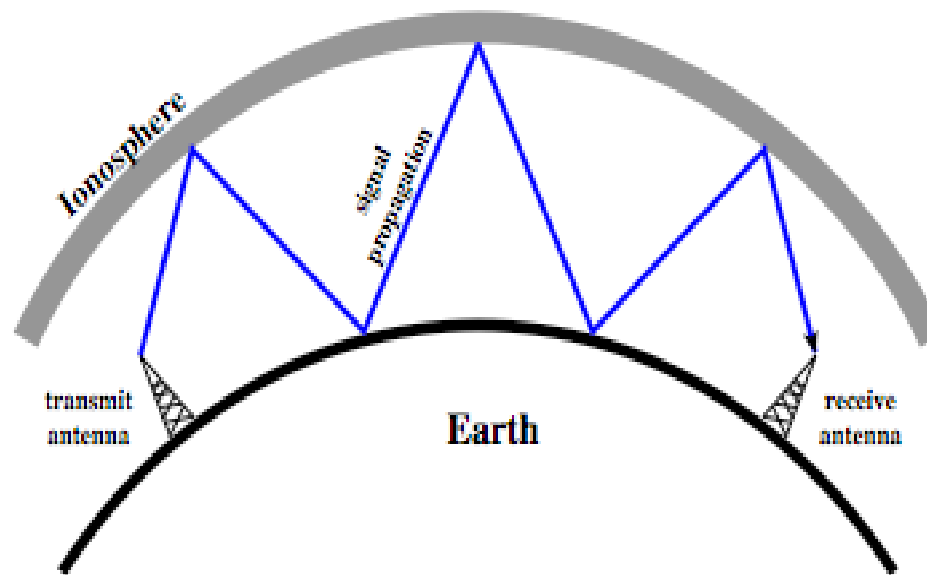


# Wireless Propagation Ground Wave



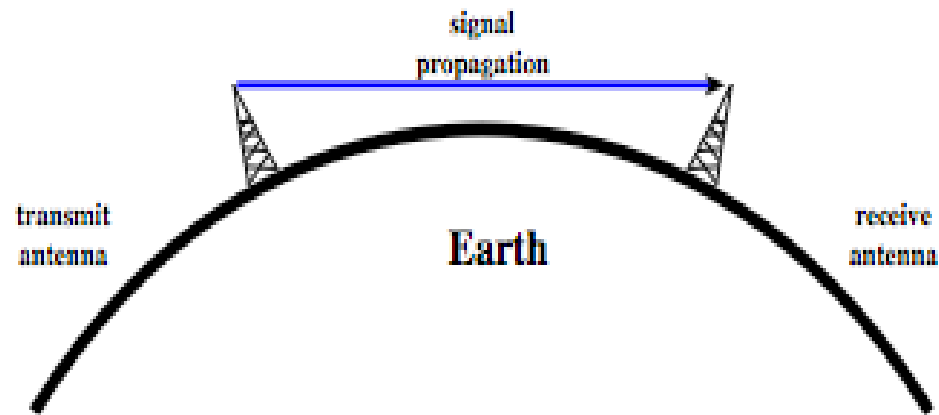
(a) Ground-wave propagation (below 2 MHz)

# Wireless Propagation Sky Wave



(b) Sky-wave propagation (2 to 30 MHz)

# Wireless Propagation Line of Sight



(c) Line-of-sight (LOS) propagation (above 30 MHz)

# Comparision of Media

- Atmospheric Absorption
  - from water vapour and oxygen absorption
- Multipath
  - multiple interfering signals from reflections
- Refraction
- Free space loss
  - loss of signal with distance
  - bending signal away from receiver



# Comparision of Media

→	Medium	Cost	Speed	Atten	Interfere	Security
→	UTP	Low	1-100M	High	High	Low
→	STP	Medium	1-150M	High	Medium	Low
→	Coax	Medium	1M–1G	Medium	Medium	Low
→	Fibre	High	10M–2G	Low	Low	High
→	Radio	Medium	1-10M	Varies	High	Low

# Comparision of Media

- Microw High      1M–10G   Varies   High  
Medium
- Satellite High      1 M–10G   Varies   High  
Medium
- Cellular High      9.6–19.2K   Low      Medium  
Low

# Thanks !