


Introduction to Telecommunication Systems

Lecture 6



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Unguided Media: Wireless

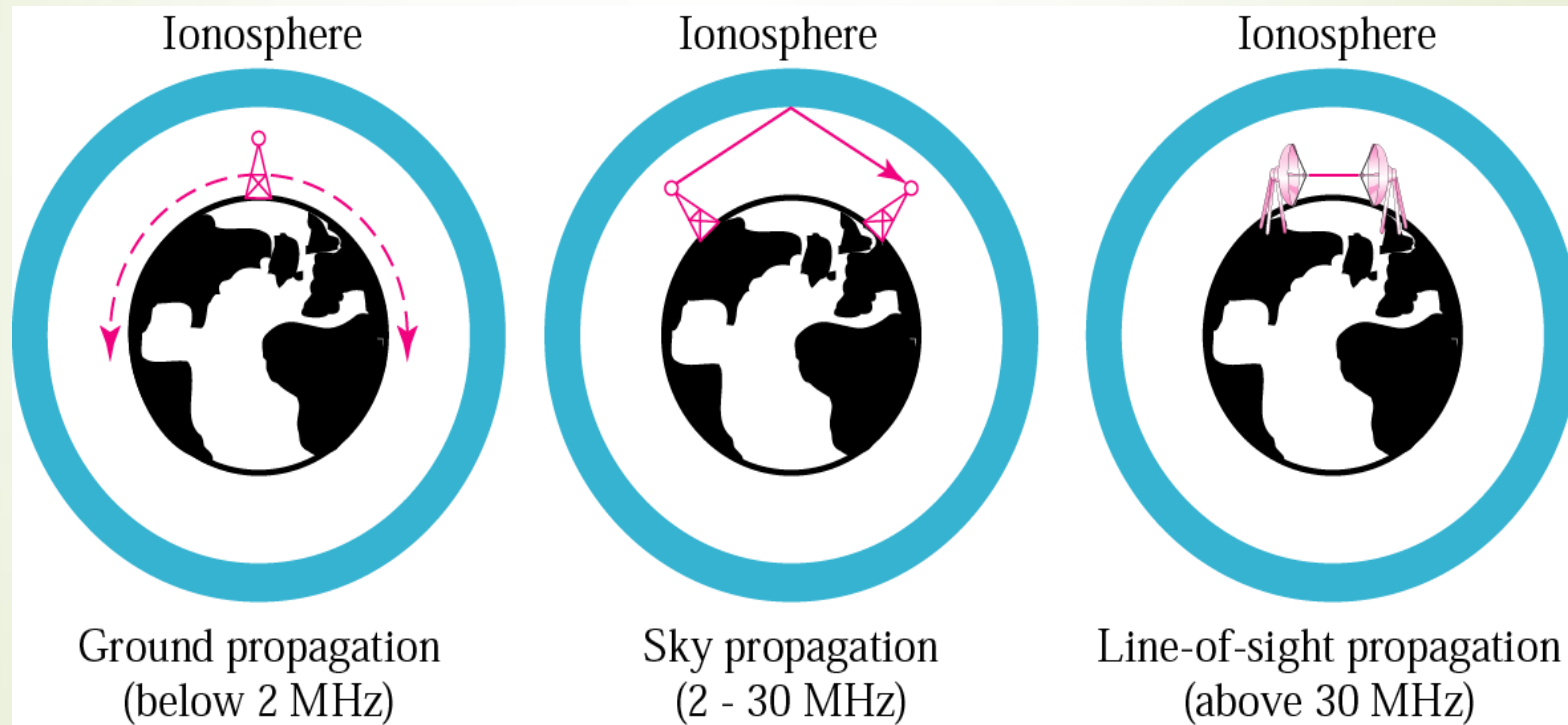
- Unguided media transport electromagnetic waves without using a physical conductor.
- This type of communication is often referred to as wireless communication.
- Signals are normally broadcast through free space and thus are available to anyone who has a device capable of receiving them.

Unguided Media: Wireless

- Unguided signals can travel from the source to destination in several ways:
 - Ground propagation,
 - Sky propagation,
 - Line-of-sight propagation,

Unguided Media: Wireless

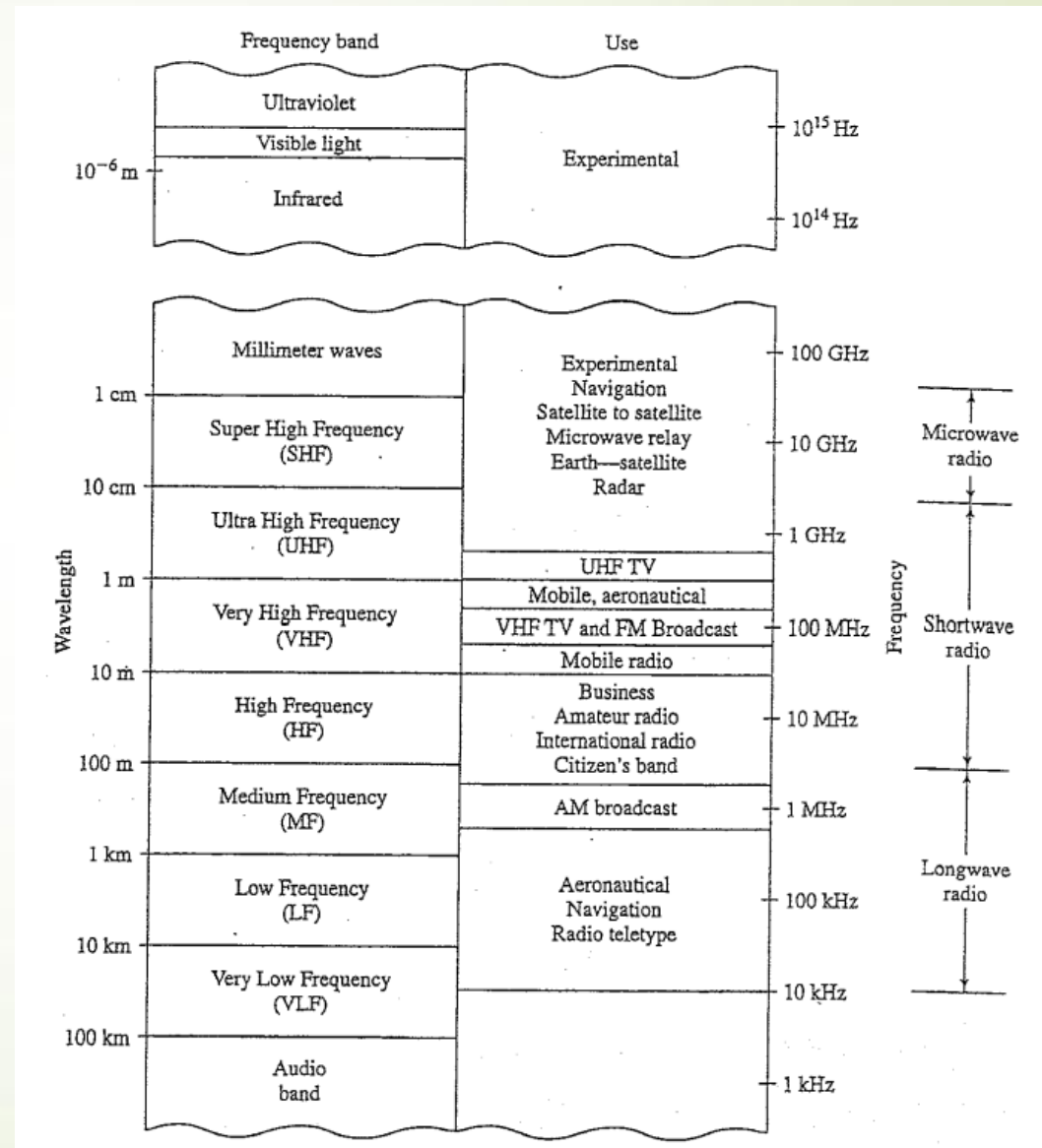
➤ Propagation methods



Unguided Media: Wireless

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Electromagnetic spectrum for wireless communication

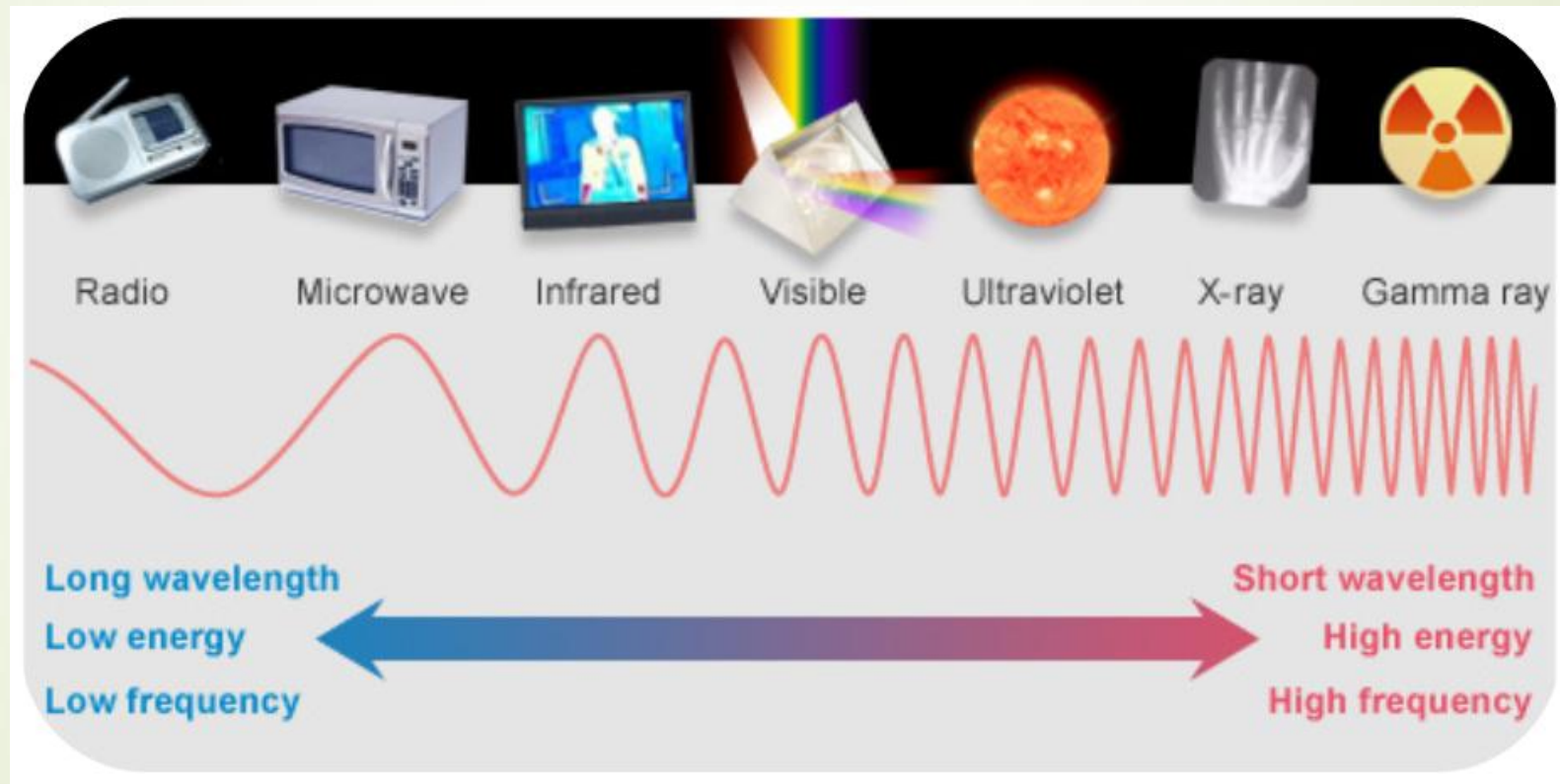


Electromagnetic Spectrum: Bands

Band	Range	Propagation	Application
VLF	3–30 KHz	Ground	Long-range radio navigation
LF	30–300 KHz	Ground	Radio beacons and navigational locators
MF	300 KHz–3 MHz	Sky	AM radio
HF	3–30 MHz	Sky	Citizens band (CB), ship/aircraft communication
VHF	30–300 MHz	Sky and line-of-sight	VHF TV, FM radio
UHF	300 MHz–3 GHz	Line-of-sight	UHF TV, cellular phones, paging, satellite
SHF	3–30 GHz	Line-of-sight	Satellite communication
EHF	30–300 GHz	Line-of-sight	Long-range radio navigation

Electromagnetic Spectrum: Bands

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Gamma Rays

- Gamma rays are given off by stars, and by some radioactive substances.
- They are extremely high frequency waves, and carry a large amount of energy.
- They pass through most materials, and are quite difficult to stop - you need lead or concrete in order to block them out.
- Because Gamma rays can kill living cells, they are used to kill cancer cells without having to resort to difficult surgery.

X-rays

- ▶ X-rays are also very high frequency waves.
- ▶ They will pass through most substances, and this makes them useful in medicine and industry to see inside things.
- ▶ Lower energy X-Rays don't pass through tissues as easily, and can be used to scan soft areas such as the brain.

Ultra-violet

- Ultra-Violet light is made by special lamps, for example, on sun beds.
- It is also given off by the Sun in large quantities.
- Ultraviolet rays can be used to kill microbes.
- Hospitals use UV lamps to sterilize surgical equipment and the air in operating theatres.
- Food and drug companies also use UV lamps to sterilize their products.
- Large doses of UV cause sunburn and even skin cancer.

Visible Light

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- ▶ Our eyes can detect only a tiny part of the electromagnetic spectrum, called visible light.
- ▶ This means that there's a great deal happening around us that we're simply not aware of, unless we have instruments to detect it.

Infrared

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- Infrared waves, with frequencies from 300 GHz to 400 THz (wavelengths from 1 mm to 770 nm), can be used for short-range communication.
- Infrared waves, having high frequencies, cannot penetrate walls.
- They are used for many tasks, for example, remote controls for TVs and video recorders, and physiotherapists use heat lamps to help heal sports injuries.

Microwaves

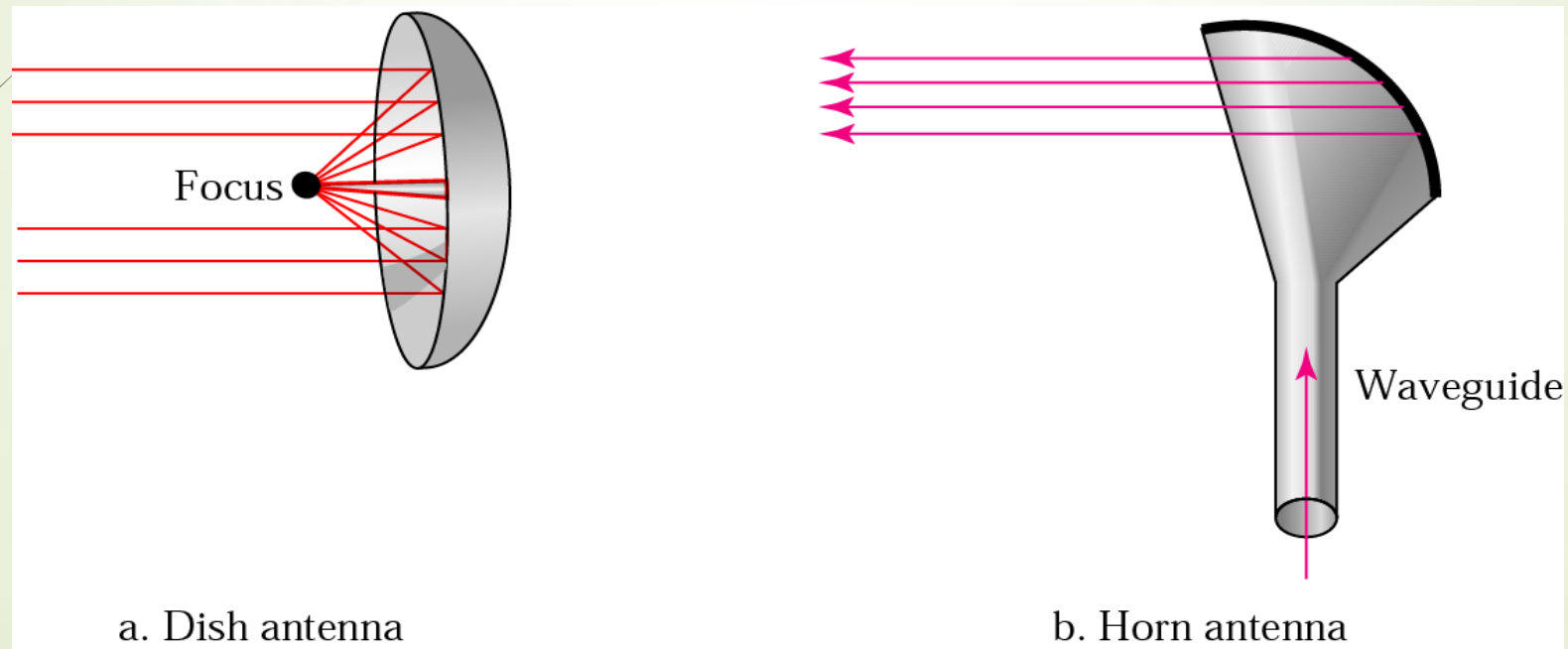
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- ▶ Waves ranging in frequencies between 1 and 300 GHz are called microwaves.
- ▶ Microwaves are unidirectional. The unidirectional property has an obvious advantage. A pair of antennas can be aligned without interfering with another pair of aligned antennas.
- ▶ Microwaves are used for unicast communication such as cellular telephones, satellite networks, and wireless LANs.

Terrestrial Microwave

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- Line of sight
- Long haul telecommunications
- Higher frequencies give higher data rates



Unidirectional Antennas

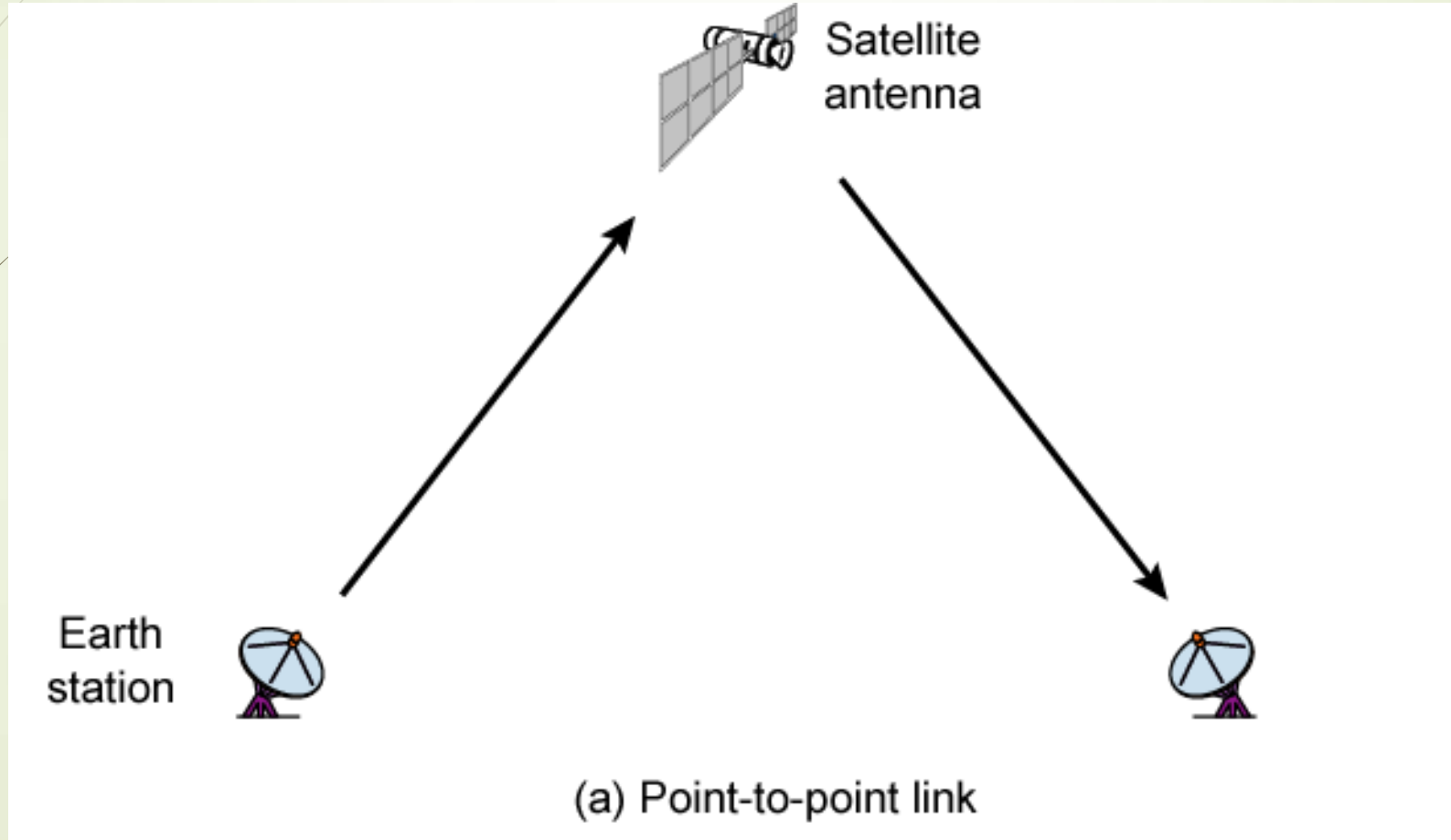
Satellite Microwave

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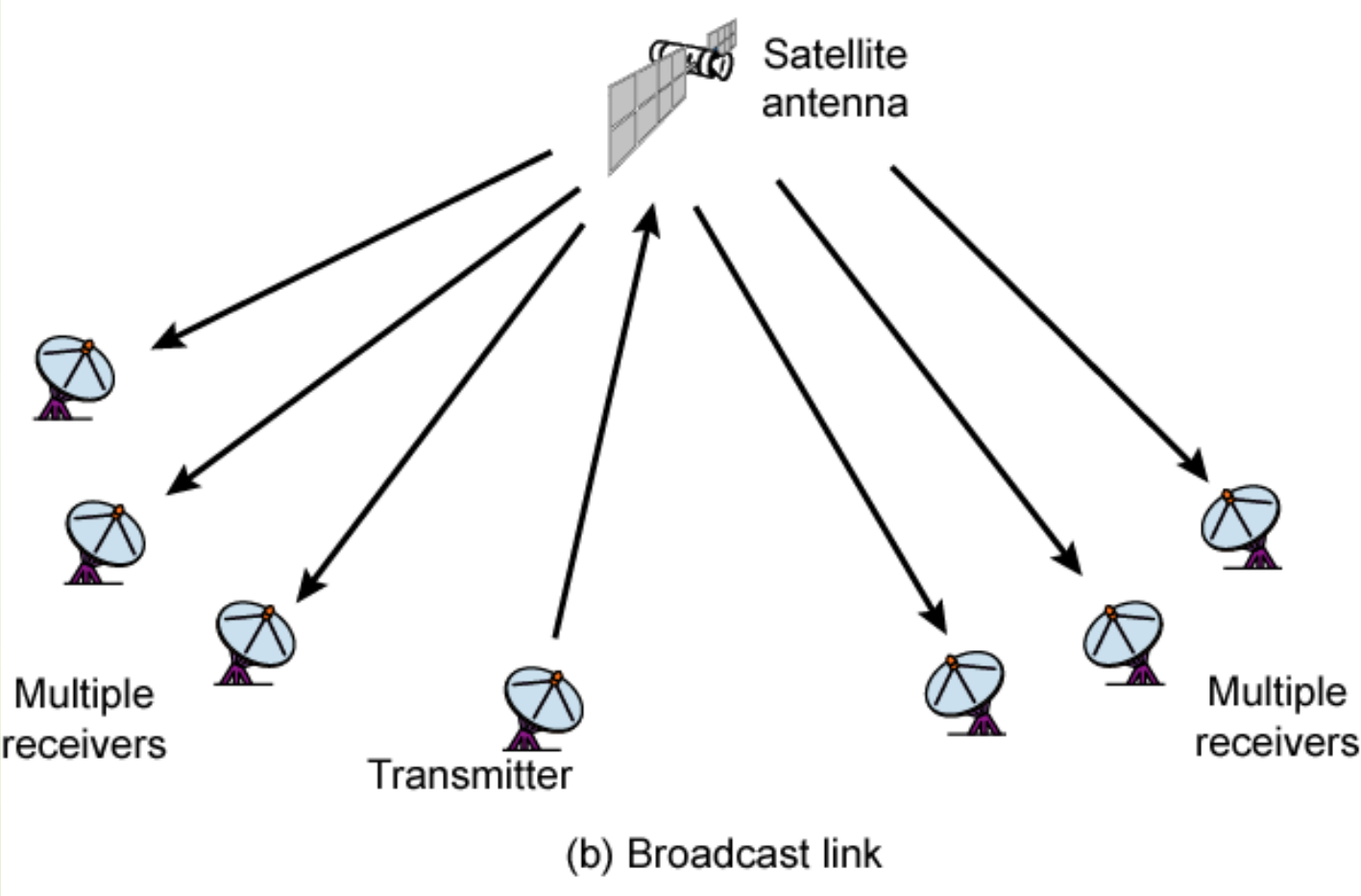
- Satellite is relay station
- Satellite receives on one frequency, amplifies or repeats signal and transmits on another frequency
- Requires geo-stationary orbit
 - Height of 35,784km
- Television
- Long distance telephone
- Private business networks

Satellite Point to Point Link

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Satellite Broadcast Link



Radio Waves

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- Waves ranging in frequencies between 3 kHz and 1 GHz are normally called radio waves.
- 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.

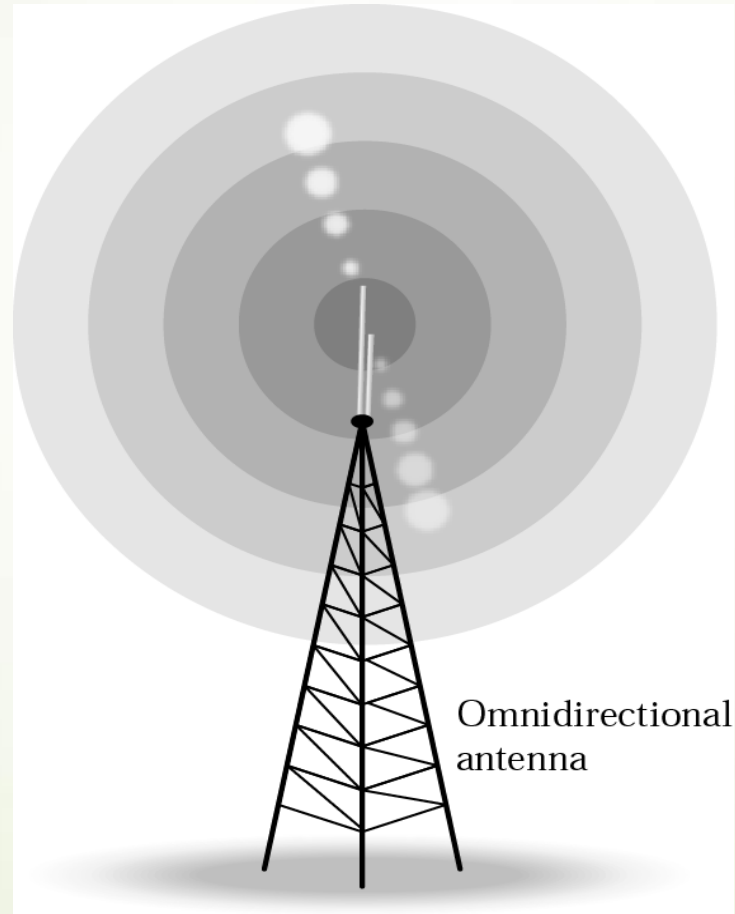
Radio Waves

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- ▶ The radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signals using the same frequency or band.
- ▶ The omnidirectional characteristics of radio waves make them useful for multicasting, in which there is one sender but many receivers.
- ▶ AM and FM radio, television, cordless phones and paging are examples of multicasting.

Radio Waves

➔ Omnidirectional antenna



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