Quadrant II – Notes

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Unguided Media: Wireless

• Unguided medium transport electromagnetic waves without using a physical conductor.

• This type of communication is often referred as wireless communication. • Signals are normally broadcast through free space and thus are available to anyone who has a device capable of receiving them.

• Electromagnetic spectrum ranging from 3 kHz to 900 THz used for wireless communication.

• Unguided signals can travel from the source to the destination in several ways: ground propagation, sky propagation, and line-ofsight propagation.

Propagation Methods

1. Ground propagation ➢ Radio waves travel through the lowest portion of the atmosphere, hugging the earth. ➢ These low-frequency signals emanate in all directions from the transmitting antenna and follow the curvature of the planet. ➢ Distance depends on the amount of power in the signal: The greater the power, the greater the distance.

2. Sky propagation ➢ Higher-frequency radio waves radiate upward into the ionosphere (the layer of atmosphere where particles exist as ions) where they are reflected back to earth. ➢ This type of transmission allows for greater distances with lower output power.

3. Line-of-sight propagation ➢ Very high-frequency signals are transmitted in straight lines directly from antenna to antenna. ➢ Antennas must be directional, facing each other, and either tall enough or close enough together not to be affected by the curvature of the earth. ➢ Line-of-sight propagation is tricky because radio transmissions cannot be completely focused.

Bands

• The section of the electromagnetic spectrum defined as radio waves and microwaves is divided into eight ranges, called bands, each regulated by government authorities.

• These bands are rated from very low frequency (VLF) to extremely high frequency (EHF).

Radio Waves

• Electromagnetic waves ranging in frequencies between 3 kHz and 1 GHz are normally called radio waves.

• 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. The omnidirectional property has a disadvantage. The radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signals using the same frequency or band.

• A good candidate for long-distance broadcasting such as AM radio since waves can propagate in the sky mode.

• Radio waves can penetrate walls. This characteristic can be both an advantage and a disadvantage. It is an advantage because, for example, an AM radio can receive signals inside a building. It is a disadvantage because we cannot isolate a communication to just inside or outside a building.

• The radio wave band is relatively narrow, just under 1 GHz, compared to the microwave band. When this band is divided into sub-bands, the sub-bands are also narrow, leading to a low data rate for digital communications.

• Almost the entire band is regulated by authorities (e.g., the FCC in the United States). Using any part of the band requires permission from the authorities.

Microwaves

• Electromagnetic waves having frequencies between 1 and 300 GHz are called microwaves.

• Unidirectional. When an antenna transmits microwaves, they can be narrowly focused. This means that the sending and receiving antennas need to be aligned. The unidirectional property has an advantage. A pair of antennas can be aligned without interfering with another pair of aligned antennas.

• Microwave propagation is line-of-sight. Since the towers with the mounted antennas need to be in direct sight of each other, towers that are far apart need to be very tall. The curvature of the earth as well as other blocking obstacles do not allow two short towers to

communicate by using microwaves. Repeaters are often needed for long distance communication.

• Very high-frequency microwaves cannot penetrate walls. This characteristic can be a disadvantage if receivers are inside buildings.

• The microwave band is relatively wide, almost 299 GHz. Therefore, wider sub-bands can be assigned, and a high data rate is possible.

• Use of certain portions of the band requires permission from authorities.

Infrared Waves

• Infrared waves, with frequencies from 300 GHz to 400 THz, can be used for short-range communication.

• Infrared waves, having high frequencies, cannot penetrate walls. o This advantageous characteristic prevents interference between one system and another. Ex: When we use our infrared remote control, we do not interfere with the use of the remote by our neighbours. This same characteristic makes infrared signals useless for long-range communication. We cannot use infrared waves outside a building because the sun's rays contain infrared waves that can interfere with the communication.

Line Coding

• Line coding is the process of converting digital data to digital signals.

• Converts a sequence of bits to a digital signal.

• At the sender, digital data are encoded into a digital signal; at the receiver, the digital data are recreated by decoding the digital signal.

Manchester and Differential Manchester

Manchester Encoding

➢ The idea of RZ and the idea of NRZ-L are combined into the Manchester scheme.

➢ Duration of the bit is divided into two halves.

➢ The voltage remains at one level during the first half and moves to the other level in the second half.

➢ The transition at the middle of the bit provides synchronization.

Differential Manchester Encoding

➢ Combines the ideas of RZ and NRZ-I.

➢ There is always a transition at the middle of the bit, but the bit values are determined at the beginning of the bit.

➢ If the next bit is 0, there is a transition; if the next bit is 1, there is none.