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# Overview of Wireless Communication

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***Abstract*: Wireless communication is a technique by which information is transmitted between two devices without any wired connection(s). It is the most widely used technique for both long range and short range communication alike. Wireless communication exploits the properties of electromagnetic waves for the purpose of communication. The most common example of wireless communication is the Cellular Phone which uses GSM(Global System for Mobile) & CDMA(Code Division for Multiple Access) technique for communication through wireless channel(s).**

**In this paper we have demonstrated the current trends in the field of wireless communication techniques, and hence develop a basic understanding of various forms like – HF, VHF, Backscattering, Satellite Communication & Microwave Communication Technology.**

## 1. INTRODUCTION

Wireless communications is, by any measure, the fastest growing segment of the communications industry. As such, it has captured the attention of the media and the imagination of the public. Cellular systems have experienced exponential growth over the last decade and there are currently around two billion users worldwide. Indeed, cellular phones have become a critical business tool and part of everyday life in most developed countries, and are rapidly supplanting antiquated wired systems in many developing countries. In addition, wireless local area networks currently supplement or replace wired networks in many homes, businesses, and campuses. Many new applications, including wireless sensor networks, automated highways and factories, smart homes and appliances, and remote telemedicine, are emerging from research ideas to concrete systems.

## 2. HISTORY OF WIRELESS COMMUNICATION

The first wireless network was developed in the Pre-industrial age. Since then these networks have only grown to help the human kind. These systems transmitted information over line-of-sight distances (later extended by telescopes) using smoke signals, torch signaling, flashing mirrors, signal flares, or semaphore flags. An elaborate set of signal combinations was developed to convey complex messages with these rudimentary signals. Observation stations were built on hilltops and along roads to relay these messages over large distances.

These early communication networks were difficult to maintain as well as could not be understood easily hence they were replaced first by the telegraph network (invented by Samuel Morse in 1838) and later by the telephone. In 1895, a few decades after the telephone was invented, Marconi demonstrated the first radio transmission from the Isle of Wight to a tugboat 18 miles away, and radio communications was born. The first network based on packet radio, ALOHANET, was developed at the University of Hawaii in 1971. The advantage of this network was it could connect computer of seven campuses over four islands with a central computer with the help of radio communication. The network architecture used in this case is known as star topology in which all the computers are connected to a central computer. The U.S. military was extremely interested in the combination of packet data and broadcast radio inherent to ALOHANET. The Defense Advanced Research Projects Agency (DARPA) invested significant resources around 1970's and 1980's to develop networks using packet radios for tactical communications in the battlefield. Packet radio networks also found commercial application in supporting wide-area wireless data services.

These services, first introduced in the early 1990's, enable wireless data access (including email, file transfer, and web browsing) at fairly low speeds, on the order of 20 Kbps. A strong requirement of these things but still its market never really materialized, due to their low data rates, high cost, and lack of ―killer applications .

These services mostly disappeared in the 1990s, supplanted by the wireless data capabilities of cellular telephones and wireless local area networks (LANs). The introduction of wired Ethernet technology in the 1970's steered many commercial companies away from radio-based networking. The implementation of wireless area networks(WANs) has also eradicated the use of Ethernet on various industries.

## 3. TYPES OF COMMUNICATION

### *A. Microwave Communication*

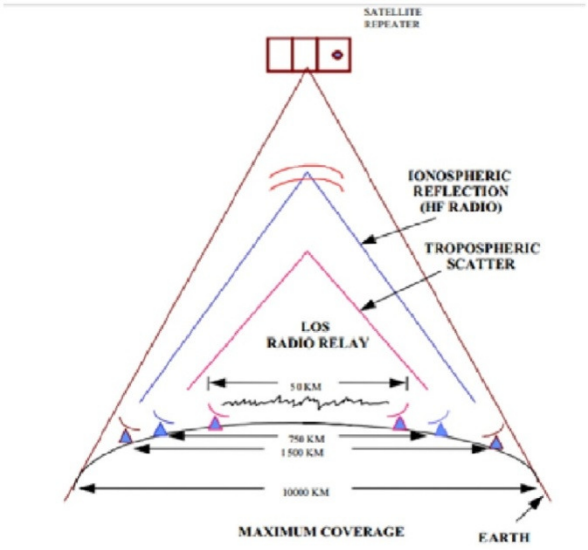
Microwave communication is the transmission of signals via radio using a series of microwave towers. Microwave communication is known as a form of "line of sight" communication, because there must be nothing obstructing the

transmission of data between these towers for signals to be properly sent and received.

- Microwaves - Electromagnetic waves with a frequency between 1GHz (wavelength 30cm) and 3GHz (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.

***Microwave Communication Can Be Analog or Digital***

Microwave communication takes place both analog and digital formats. While digital is the most advanced form of microwave communication, both analog and digital methods pose certain benefits for users.



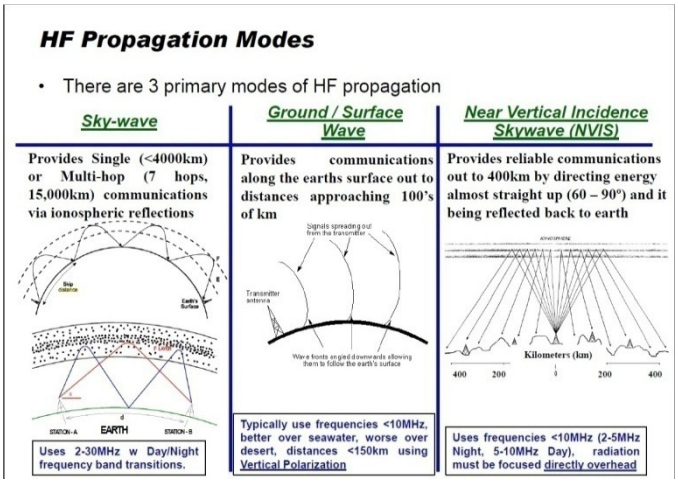

**Modes of Communication**

- High Frequency (HF) Communication

The HF communication system uses the **High Frequency Spectrum** to design and implement communication systems that exploits the **Physical Properties** of HF Radio Channel. HF wave is also known as **Shortwave**

The system operates in the 3 to 30 MHz frequency range in **Amplitude Modulated** or **SSB mode** to transmit and receive information that can be in the form of a transmitted voice or a coded digital signal.

The HF system uses the **skip distance phenomena** to achieve long distance transmission. Skip distance transmission is most effective in the 1.8 to 30 MHz ranges and varies with frequency and time of day.




**Working of HF Waves:-**

A. Ionized (charged) layers > 85km above the earth are created by the suns interaction with neutral air with each layer having varying properties.

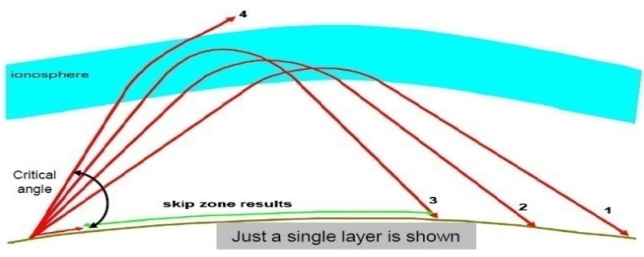
B. Radio waves are bent back to earth when they interact with the layers

***HF Propagation Paths***

**A. PATH 1** - at low elevation angles the path length is greatest (longest "skip") .

**B. PATH 2 and PATH 3** - as the elevation angle is increased, the path length decreases and the ray is reflected from higher in the ionosphere.

**C. PATH 4** - If the elevation angle is increased beyond the critical elevation angle for that frequency then the wave penetrates the ionosphere and there is an area around the transmitter within which no sky wave communications can be received.

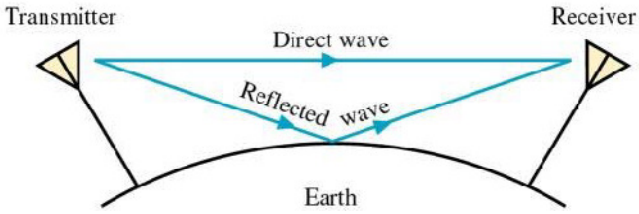



- Very High Frequency (VHF) Communication

Very High Frequency is a term used to describe the 30MHz. to 300MHz. portion of the radio spectrum. This range of frequencies will provide short-range LOS (line of site) communications. The range for VHF communications will typically be 2 to 20 miles depending on equipment used, antenna height, and terrain.

Unlike HF frequencies, the ionosphere does not usually reflect VHF signals. Signals are restricted to the local AO (area of operation). VHF signals are less effected by atmospheric noise and interference from electrical equipment than HF signals. VHF is very limited by terrain (foliage, buildings, mountains). To use VHF it is necessary to be able to visualize a direct line of site between the two stations.

There are two unusual conditions that can cause VHF signals to propagate farther than normal, tropospheric ducting and Sporadic-E. While both of these conditions are possible neither is reliable and are hard to predict.



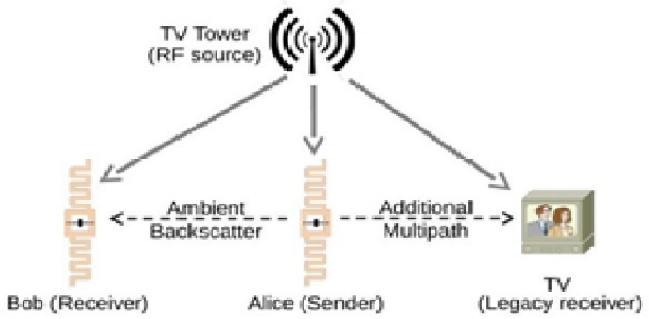

VHF is the best choice to use when communications are needed to tie all personnel together in a localized area.

For handheld type radios the communications range can be from several hundred feet to several miles. With mobile and base VHF radios, which generally have higher output power, this range can be extended out to a much greater distance.The type of antenna and the terrain are the two biggest factors that will influence VHF communications.

### *B. Backscattering*

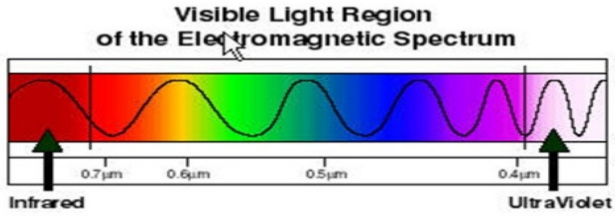
As computing devices become smaller and more numerous, powering them becomes more difficult; wires are often not feasible, and batteries add weight, bulk, cost, and require recharging/replacement that is impractical at large scales. Ambient backscatter communication solves this problem by leveraging existing TV and cellular transmissions, rather than generating their own radio waves. This novel technique enables ubiquitous communication where devices can communicate among themselves at unprecedented scales and in locations that were previously inaccessible.

Ambient Backscatter transforms existing wireless signals into both a source of power and a communication medium. It enables two battery-free devices to communicate by backscattering existing wireless signals. Backscatter communication is orders of magnitude more power-efficient than traditional radio communication. Further, since it leverages the ambient RF signals that are already around us, it does not require a dedicated power infrastructure as in RFID.




### *C. INFRARED Communication-*

IR, or infrared, communication is a common, inexpensive, and easy to use wireless communication technology. IR light is very similar to visible light, except that it has a slightlty longer wavelength. This means IR is undetectable to the human eye - perfect for wireless communication. The IR detector is only looking for infrared that's flashing on and off 38, 500 times per second. It has built-in optical filters that allow very little light except the 980 nm infrared.It also has an electronic filter that only allows signals around 38.5 kHz to pass through. This prevents IR interference from common sources such as sunlight and indoor lighting.




This tutorial will first explain the inner workings of common IR communication protocols. Then we will go over two examples that will allow you to transmit and receive IR data using an Arduino. In the first example, we will read incoming IR data from a common remote control using the TSOP382 IR photo sensor. The next example will show you how to transmit data from an IR LED to control a common appliance, for example your home stereo. This range of wavelengths corresponds to a frequency range of approximately 430 THz down to 300 GHz.

## 4. APPLICATION OF WIRELESS COMMUNICATION

- Mobile : GSM Technology (2G, 3G, 4G).
- Satellite
- WIFI internet
- Defense control
- AIR TRAFFIC CONTROL (ATC)

## 5. SECURITY FOR WIRED VS. WIRELESS

Unlike traditional wire-lined data communication, wireless is based on electromagnetic waves using radio frequencies (RF) propagating through open space. This provides wireless with some unique advantages.

- As communication endpoints don't need to be tied down to a fixed location and dependent on a physical cable.
- The flexibility of wireless data communication, however, comes at a price. Electromagnetic waves are non-discriminatory when it comes to access.
- A wired connection requires physical access to the cable, wireless connections can be made anywhere along the path where the electromagnetic waves propagate.
- Consequently, security-as in secure access-becomes more important for wireless data communication.

## 6. FUTURE ASPECTS & CONCLUSION

Wireless technology is a game changer when it comes to process control. Wirelss lowers implementation cost expand access to information and allows control in areas previously held by economical and technical barriers. These operations and monitoring will change when proven wireless technologies are used. Wireless operations will reinvent traditional approaches in various areas of industrial, defense and even in day to day life.

The technology and information it provides already used to eliminate; the time, the effort, human work in undesirable places, cost and product errors. By using wireless communication, military operations can be controlled from any where and can be regulated as per the need of the situation.

Earlier wireless was strictly point-to-point communication which was a big limitation but due to advancement in technologies this limitation has been overcome. Now technology like mesh network has overcome basic communication needs and provides 99.9% reliability. Every device is coneected to each other because of this which greatly increases the no. of paths of communication as well as eliminating the requirement that the device has to be within a certain distance of the gateway. If one path is blocked then the another path is automatically used without intervention.

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