

A Survey on Wireless Communication Technologies and Standards

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Abstract— Communication is a process through which humans can exchange views, ideas, information etc. They use different languages and signs to communicate with each other. Over last decade humans live in a digital age where information is everything and communication can take place even from long geographical distances. The computer systems need some sort of platform and standards through which data and information can be communicated to each other. In this paper the advantages and drawbacks of communication in wired and wireless transmission media has been discussed. Then different types of wireless communication technologies with their features and drawbacks have been figure out. Finally the comparison between different wireless communication technologies standards has been summarized.

Keywords— Communication; Bluetooth; Wi-Fi; WiMAX; Standards

I. INTRODUCTION

Data Communication refers to the exchange of data between the computer devices through some form of transmission medium such as wired or wireless. For data communication there is a communication system for the communication devices and the communication system is made up of physical equipments and software's (programs). The data communication system has five basic components:

- **Message:** The message or data (information) to be communicated.
- **Sender:** The sender is the device that sends the message.
- **Receiver:** The receiver is the device that receives the message.
- **Transmission medium:** The transmission medium is the path by which the messages travel from sender to receiver.
- **Protocol:** A protocol is a set of rules that governs the communication. It acts as an agreement between the communicating devices. Without it, the communicating devices can be connected by they cannot communicate with each other.

In the telecommunication, the transmission media can be classified into two broad categories – Guided (Wired) and Unguided (Wireless).

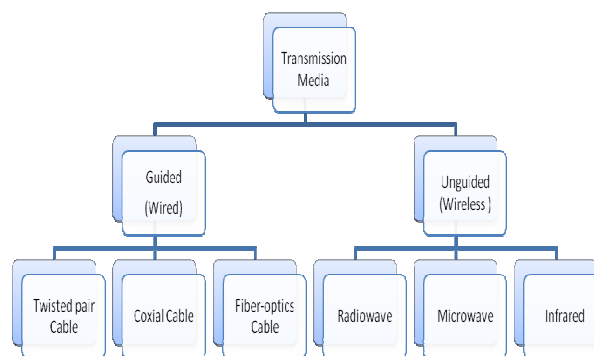


Figure 1: Types of Data Transmission Media

Wired Transmission Media: In this a channel is provided from one device to another; which includes twisted-pair cable, coaxial cable and fiber-optic cable. Signal is travelling along any of these media. Twisted-pair and Coaxial cable use metallic (copper) conductors which accept and transport signals in the form of electric current. Optical fiber is a cable that accepts and transports signals in the form of light [1,5,6,7].

Advantages:

- Wired transmission is more secure than wireless, because in wired transmission the access cannot be done from anywhere since the signal is not being broadcast. Thus, it reduces the hacking problem.
- It has consistent signal strength because of its physical connection with the devices. Wired LAN offers great performance.

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- It is cost effective because of Ethernet cable, hubs, and switches are inexpensive and they are extremely reliable also.
- Wired transmission allows great speed of data sharing up to 1000 Mbps with the Gigabyte Ethernet networking equipment.
- Wired network has low maintenance and it can exist for long time.

Drawbacks:

- ❖ Doing a wire connection is a difficult job, because wire has to run on different environment such as walls, floors, ceilings, etc. it may affects the cable also from which the traffic data is to be flown.
- ❖ Signal may affect by noise that was generated by the machine and magnetic.
- ❖ Length of wire is being a problem because the signal gets weaker, if the wire is too long.
- ❖ Loose cables, cause the single most common and annoying source of failure network in a wired transmission.

Wireless Transmission Media: Wireless Communication Technology has changes the way of data transmission over the world, now this technology has most widely used whether it is in the office or college campus or in house, it uses everywhere. It helps to send the data over a long geographical distance without wires, cables or any other physical interaction with the devices which were in the wired transmission to send data. Wireless communication is a wide term; it involved all the process and formation of connection and communication between one or more devices by using wireless signal through wireless communication devices and technologies. It transfers the data within the range of few meters e.g. Bluetooth or it sends the data thousand kilometres away e.g. radio communication, mobiles phones etc. The most popular way to transfer the data through wireless communication is radio wave, microwaves and infrared [1,5,6,7].

Advantages:

- In Wireless communication data is being transferred over a long distance within no time to the end users; it helps the working professionals to complete their work at anytime and anywhere to improve the productivity of an organization.
- One of the important advantages of this transmission media is that it is mobile and versatile; which makes it easily setup and dissembled.
- It requires less cabling which makes a much better working environment. People do not need to run cables across their house/office, college, which can create trip hazards across rooms, halls and stairs.
- Wireless Network is being used for disaster recovery purposes. It helps to set up a temporarily network which can help in disaster e.g. Ad-hoc wireless network.

Drawbacks:

- ❖ Security is the major concern in wireless transmission media; it is an easy task to an attacker to grab the wireless signals and get the information which was travelling in the wireless medium. That's why it is less secure and vulnerable than the wired transmission.
- ❖ With the increase of devices in the wireless network system, it decreases bandwidth.
- ❖ Wireless systems needs proper installation and maintenance because of security issues.
- ❖ Wireless signals may be affected by the storm, fog, dust, etc. The band of this may cause jamming the wireless signals.

The rest of the paper is organized as follows: Section II discussed different Wireless Communication Technologies. Section III presents various Wireless Technology Standards with their comparison. Finally Section IV concludes the paper.

II. WIRELESS COMMUNICATION TECHNOLOGIES:

The different types of Wireless communication or wireless networking technologies are as follows:

Infrared: It communicated the data or information through infrared [3] radiation. Infrared is an electromagnetic energy at a wavelength that is longer than that of red light. Infrared used in short range of wireless communication, for example Television remote, for a successful infrared communication a photo LED or laser transmitter and a photo diode receptor is required. The LED transmitter transmit the infrared signal in the form that is not visible light to naked eyes, the signal is captured by the photoreceptor, in this way the communication is being done from the source to destination. The source or destination may be the television or mobile phone, laptop, etc. which supports the wireless communication. The infrared communication is also used for security control.



Figure 2: Infrared Communication

Microwave: It involves the transfer of voice and data through the atmosphere by using super high-frequency radio waves called microwaves [2]. It is mainly used to transmit the messages between ground-based stations and satellite communications systems; it is an efficient and effective way

of wireless data transmission that transfers the data by using two separate ways.

First method in which transmission of data through the wireless media of a microwave to the satellite method that transmits information through a satellite that orbits which is approx 22,300 miles above from the earth. Stations on the ground send and receive data signals to and from the satellite with a frequency ranging from 11 GHz to 14 GHz and with a transmission speed of 1 Mbps to 10 Mbps.

Another method is a terrestrial method, in this two microwave towers with a clear line of sight between them which are used ensuring that no obstacles is being there disrupt that signal of sight. For privacy purpose this method is used. The frequency of data transmission for terrestrial systems is generally 4 GHz to 6 GHz or 21 GHz to 23 GHz, and the speed is approx. 1 Mbps to 10 Mbps. Microwave communication is used in Telecom, Defense, Radar communication, Navigation, GPS, etc. The main disadvantage of this communication system is that, it can be affected by the bad weather conditions, especially by rain.

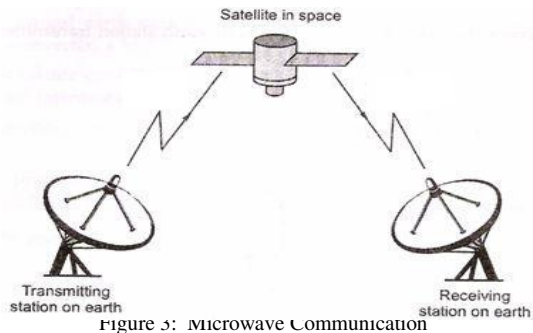


Figure 3: Microwave Communication

Radio Wave: First wireless communication technology is an open radio communication to look out for widespread use and it still serves that purpose. A handy multichannel radio permits the user to speak over short distances, whereas citizen's band and marine radios offer communication services for the sailors. HAM radio used to share data and function emergency communication aids throughout disasters with their great broadcasting gear. Also, use to communicate digital information over the radio frequency spectrum.

Generally in audio broadcasting services, radio broadcasts sound through in the air as radio waves. It uses a transmitter to transmit radio waves at the receiver end with receiving antenna, to broadcast common programming stations that are linked to the radio networks. The broadcast occurs in syndication or simulcast (simultaneous broadcast) or both. One of the main disadvantages of radio communication technology is its range, that still a powerful radio signal is only able to reach at receivers within a limited geographic region. It requires a huge network of radio stations be set up

to communicate effectively over a large geographical area. That's why this radio broadcasting is also being done through cable FM, the internet and satellites. A radio broadcast sends data over long distances (across countries) up to 2 Mbps (AM/FM Radio).

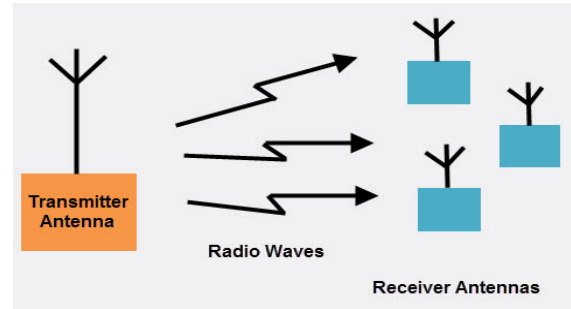


Figure 4: Broadcast of Radio Wave Communication

Bluetooth [3]: The main function of this technology is to allow users to connect a vast variety of electronic devices wirelessly and to a system for the transfer and sharing of data. Nowadays, Cell phones are connected to hands-free earphones, wireless keyboard, mouse and laptops. With the help of this technology it transmits information from one device to other device. Because of its low cost, manufacturers are willing to implement this technology in their devices. It was designed for short range communications with a range of approximately 10m, because of this it consumes less power and is appropriate for very small battery powered and portable devices.

The problems which were in infrared or in cables have been overcome in this technology. The Infrared requires a line of sight, whereas Bluetooth only needs to be in reasonable vicinity. Similarly, cables are not required to transfer the data. Bluetooth devices automatically communicate with each other, it requires very little from the user. It also creates a wireless Personal Area Network (PAN) within its short range.



Figure 5: Bluetooth Communications

Wi-Fi: Wireless-Fidelity (Wi-Fi) [3] is a low-power wireless communication used by many electronic devices such as laptops, smart phones, etc. It works in the same way as a radio can tune into a radio station and the signal over the airwaves. User device can pick up a signal that connects it to the internet. In a Wi-Fi setup, a wireless router serves as a communication hub. The Wi-Fi networks are limited in range due to low power of transmissions allowing users to connect only within close proximity to a router or signal repeater. Wi-Fi is common networking device nowadays whether in home or office or anywhere else the networking applications provides portability without any need of cables. This technology is also known as WLAN (Wireless Local Area Network). However, Wi-Fi has become the more popular name.

Some of the advantages that the Wi-Fi has, firstly due to mobility user can access the internet different from his/her working environment and Wi-Fi is also having a great expandability through which the user can increase the number of clients very easily.

Wi-Fi technology having some disadvantages are security, speed of wireless networks is slower as compared to wired networks and range of Wi-Fi network is also a problem as it cannot be used for long distances. If we have implemented it to a long distance we have to use repeater and additional access point.



Figure 6: Wi-Fi Device

WiMAX: It stands for Worldwide Interoperability for Microwave Access Wireless Broadband Systems which offer fast internet surfing without being connected through cable or DSL is known as WiMAX [8,9,10]. It can potentially deliver the data rates of more than 35 Mbps; so far it can support voice, video and internet data as well. The actual cost of the data available using WiMAX widely varies with the distance from the transmitter. WiMAX is

also one of the versions of 4G wireless available in phones as Sprint's 4G technologies. It operates on two frequency bands, 2 - 11GHz and 10 - 66GHz and has a range which was about 50 km with speed of up to 80 Mbps. This enables smaller wireless LANs to be interconnected by WiMAX creating a large wireless MAN.

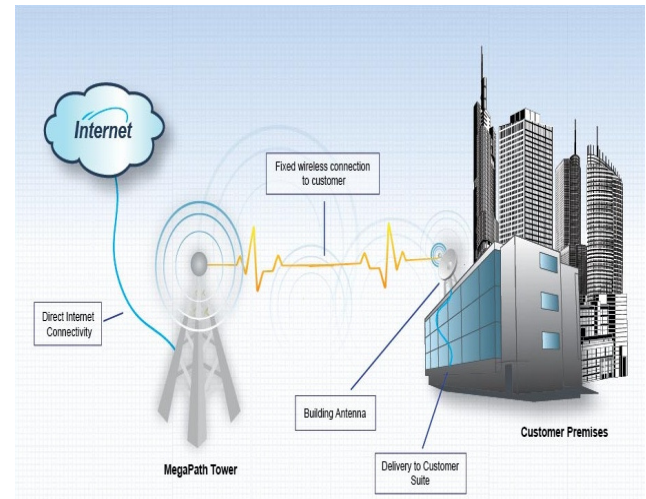


Figure 7: WiMAX

Networking between two cities can be achieved without the need of expensive cabling because of WiMAX. The users could really cut and free from today's Internet access infrastructure arrangements and be able to go online at broadband speeds, almost wherever they like from within a Metro Zone. Some of the disadvantages of WiMAX are, it has required high installation and operational cost, weather can interrupt the signal other wireless equipments can cause interference and it requires line of site for the longer connections, multiple frequencies are used in this. It also has a powerful intensive technology that's why it requires strong electrical supply.

III. WIRELESS TECHNOLOGIES STANDARDS

IEEE (Institute of Electrical and Electronics Engineers) defines the various wireless standards [4] which were accepted worldwide and widely used. Over the decades that followed, the social roles of the technologies under IEEE's aegis continued to spread across the world and reach into more and more areas of people's lives. The professional groups and technical boards of the predecessor institutions evolved into IEEE Societies. By the early 21st century, IEEE served its members and their interests with 38 Societies; 130 journals, transactions and magazines; more than 300 conferences annually; and 900 active standards.

IEEE gives the following standard for Wireless technologies:

- In 1990 – Introduction of IEEE 802.11 to define standards for Wireless Local Area Networks (WLANs)
- In 1997 – Introduction of IEEE 802.11 WLAN protocol
- In 1999 – Introduction of IEEE 802.11a WLAN protocol
- In 1999 – Introduction of IEEE 802.11b WLAN protocol
- In 2003 – Introduction of IEEE 802.11g WLAN protocol
- In 2004 – Introduction of IEEE 802.11i WLAN protocol
- In 2009 – Release of IEEE 802.11n WLAN protocol
- In 2009 – Release of IEEE 802.15 WPAN protocol
- In 2009 – Release of IEEE 802.16 WMAN protocol

Wi-Fi is having three different standards each having different functions 802.11a is more expensive and as a result of this it is not available for public access. 802.11b has transfer the data at the rate of 11 Mbps and its cost is low that's why it is more used by the public. 802.11g has a great speed to send the data as compared to other standards it can transfer the data at the rate of 54 Mbps but this standard is relatively new and yet to be adopted widely. Mostly 802.11b and 802.11g is widely used in airports, railway stations, internet cafes etc because of the advantage of their speed.

Then release of 802.11i is a standard for Wireless local area network (WLAN's) that provides improved encryption for networks that uses 802.11a, 802.11b, and 802.11g standards. In 802.11n it uses multiple inputs and multiple outputs (MIMO) technique to give the Wi-Fi more speed; it can give the speed up to 100 Mbps over a long range. 802.15 is used for WPAN (Wireless Personal Area Network) like Bluetooth and the 802.16 is used for a group of broadband wireless communication standard for Wireless Metropolitan Area Network (WMAN).

Table 1: Comparison of Wireless Technology Standards

	Bluetooth	Wi-Fi (a)	Wi-Fi (b)	Wi-Fi (g)	WiMAX
Standard	802.15	802.11a	802.11b	802.11g	802.16
Frequency (GHz)	2.45	5	2.4	2.4	2 – 66
Speed (Mbps)	0.72	54	11	54	80
Range	10 m	50 m	100 m	100 m	50 km
Advantage	Low cost	Speed	Low cost	Speed	Range, Speed
Disadvantage	Range	Cost	Speed	Cost, Range	Cost

IV. CONCLUSION

This paper gives an overview about different types of Wireless Communication Technologies with their features and drawbacks. We also compared the different standards for Wireless Communication Technologies on the basis of frequency, speed, range etc. We hope that the content present in this paper will be helpful and provide researchers an overview to work on these wireless technologies in the future.

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