

Opportunities and Trends of Wireless Communications

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Abstract

Wireless communication is a process of transferring information from one place to another place through radio waves. The transfer of information can be either an image or numerical data or voice or video. The design of wireless modules were started to come for a general user in the late 20th century but it has not been accepted in many applications due to its quality degrade over the wired systems. In the beginning of 21st century the improvisation of electronic chips, antenna and microcontroller made the radio wave communication to move forward in a faster way and that made the wireless voice communication as very popular. The paper analyzes the current status of wireless communication in different states and projects the research opportunities by exploring the future expectations of wireless communications.

Keywords: UAV, 5G, antenna, mobile communication, data transmission, information security

1. Introduction

Wireless communications were proposed to reduce the installation and maintenance effort made for wired information transfer system. The regular information transfer system needs cables, wires and conducting materials for data communication. Hence the reliability of such wired communications are mostly depends upon the quality of the components used for. Similarly the quality of such wired systems may also vary with respect to the climatic changes happened over its surroundings. The major drawback on wired communication system is its cable discontinuity. To avoid that most of the wired systems are placed underground to protect the cables from physical damage. However, such wired communication system may also give trouble due to aging of the connected material and short circuit [1].

The wireless communication system requires a wireless supported device and a wireless connecting medium for transmitting the data from one place to another place. The data transfer capability in terms of range or distance is depends upon the type of hardware module used for the application. The wireless communication techniques are widely employed for internet access, cellular topology and home networking kind of applications [2]. Figure 1 explores the type of communication model with their range of communication.

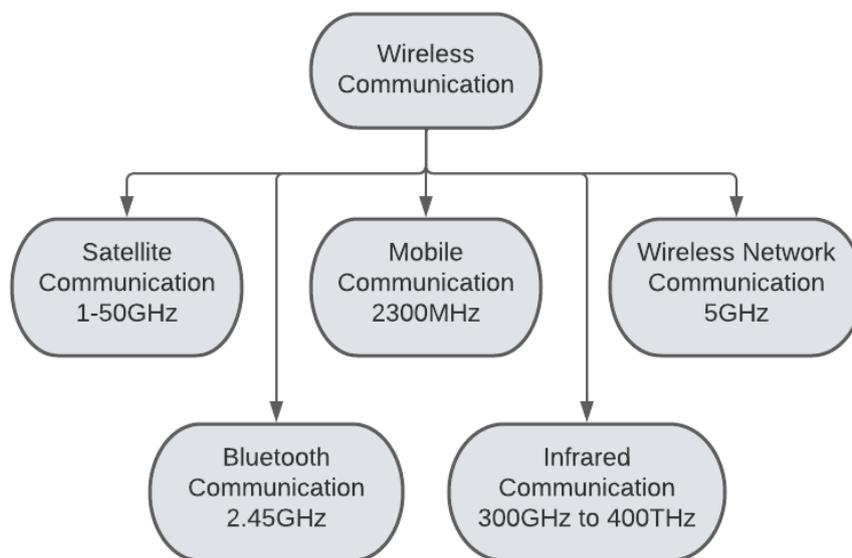


Figure 1. Wireless communication methods and their range

2. Attainments and Limitations of the present Wireless Communication Systems

The wireless communication systems are cost effective as it does not require any additional infrastructure for the data transmission. The wireless systems are also saving the effort made for installing the communication devices over the wall and other places. Apart from that the wireless communication protocol allows the modules and devices to be operated from any location. In some applications the wireless devices can able to work properly on their continuous move. However, the wireless communication devices are affected in deep with the environmental interferences and other strong radio waves going nearby the primary device. For example there might be a performance degrade on Bluetooth communication when it is connected with Wi-Fi too as their connecting frequency is almost same of 2.45GHz [3].

Similarly, security threat is one of the main drawbacks for the wireless communication devices since the data is transmitted through an open air medium. It opens a way for an intruder to access the sensitive information. This can be avoided in many

applications through encryption of the transmission data. Though, there are no preventive methods available so far to save the human and other living things from radiation exposure. Therefore the radiation frequencies are limited with some regulations [4].

3. Analysis on Present Wireless Networks

3.1 Municipal Wireless Networks

The Municipal Wireless Networks (MWN) are widely implemented by the local governance body for providing uninterrupted wireless internet facility as a part for smart city applications. In general the MWNs are implemented with mesh technology and that allows to connect multiple devices without any interruption. However, the MWNs are not implemented with any securing protocol as like of the private networks. But having an in-built security framework on the accessing devices will avoid such limitations on MWN connection [5].

3.2 Wireless Local Area Network

Wireless Local Area Network (WLAN) is designed for providing internet facility to a small circle of area through Wi-Fi technology. It is employed by having a wireless access point for providing wireless internet connection between the device and the remote server. In general, the Wi-Fi technology is implemented with ad hoc network connection and that gives a peer to peer communication. To enable the ad hoc WLAN, the device must have an in-built radio transmission setup. The WLANs are most vulnerable to attacks than the physical network and that is rectified by having a MAC address for avoiding the access of unauthorized devices. However, the Wi-Fi Protected Access (WPA) is considered as a trustable authentication model for WLAN connections [6].

3.3 Wireless Personal Area Network

Wireless Personal Area Network (WPAN) is widely used for making connection between device to device such as mouse and keyboard through a short range wireless frequency. WPAN is also represented as short wireless network. The range of the WPAN devices are widely depends upon the capability of the devices and their specification. In some cases, the WPAN devices are having the ability to act like an access point for sharing the internet connection with other devices. For example the smart phones are having the option to share their general packet radio service connection with the nearby laptops and other devices [7].

3.4 Wireless Wide Area Network

Wireless Wide Area Network (WWAN) is the present mobile broadband connection that includes 2G to 5G enabled wireless connections. It gives a wide range of communication throughout the nation and region. The WWAN is utilized for voice and data communication and media streaming purposes. Though, the communication speed of the WWAN is not equal as of the physical connection system. The communication throughput decreases in WWAN when the distance goes beyond a limit. But the WWAN models are comparatively better than the WLAN in terms of security and cost efficiency. Figure 2 explores the speed range of mobile networks in the current trend [8].

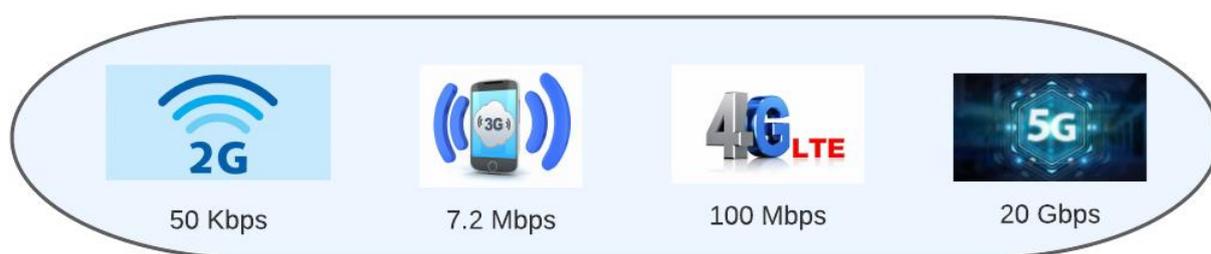


Figure 2. Speed range of different mobile networks

4. Research Opportunities in Wireless Networks

Energy saving is one of the primary requirement for any wireless networks. In MWN the energy consumption levels are not equal all the time as they are implemented with multiple access points in different locations with different user count. Therefore an SDN (Software Define Network) model is employed to MWN for ensuring a better performance with reduced power consumption [9]. A two tiered classification tree approach was utilized to classify the users of MWN for providing a better connectivity. It is defined by analyzing the network usage of a user and the purpose of action of the user in accessing the facility. This enables the MWN to be more secure and efficient in terms of operation [10]. To evaluate the performances of the MWN based networks a city wide testbed was developed for 1.1 square miles. The testbed was incorporated with various MIMO transceivers along with different configuration of CPU and GPU ranges [11].

The sublayer called medium access control plays a major role in the performances of WLAN at various conditions. The numbers of receiving stations connected to the WLAN is directly proportional to the performances of the WLAN. A methodology was designed to analyze the performances of WLAN based on the traffic ratio priority observed on the MAC

layer [12]. Multi rate signal processing is one of the primary requirement for WLAN methods depends for providing the communication at various speed on different access points. A two stage decimation filter was developed to improve the frequency conversion in an efficient manner [13]. There are lot of techniques developed for providing better communication in WLAN. In that, design of dual band antenna plays a major role for providing network connectivity at different frequencies [14].

The dual band antenna designs are also widely used for WPANs. The motive of such design is to provide GPS signal along with a low rate internet connection at a same time [15]. A Lamport's algorithm based technique was developed to enhance the energy consumption of the low power WPANs. This also reduces the delay on MAC layer by overcoming the limitations of collision avoidance approach [16]. The WPANs are implemented on health care applications for observing the heart rate, blood oxygen and blood pressure detection in a human [17]. The work utilizes a Bluetooth network for communicating the sensed readings with android mobile. However, several techniques are developed to improve the battery performance of WPAN with multi objective optimization models [18]. The work regulates the power flow in the circuit by analyzing the event patterns observation on WSNs.

The WWAN models are implemented in the agriculture field by having an underground sensor connection for a long range [19]. The work is implemented with a LoRa MAC layer format for transferring the signal to several kilometers through underground connection. The WWAN systems were also enforced to observe machine vibrations through IoT communication. The work utilizes a multichannel LoRa and NB-IOT for enabling the signal communication [20]. A WSN connection based on IEEE 802.15.4 was structured for wide area IoT application. The work uses a multi-hop transmission with the help of time slotted channel hopping protocol [21]. The experimental work gives a better throughput for high rate applications and a better battery life for lower rate models.

5. Conclusion and Future Trends of WSNs

The rise of WSN in real-time application has started just before a decade on several applications. Especially the interest on IoT among the researchers is increasing because of its ease of integration with android devices. Though such IoT kind of applications are not implemented in many sectors due to its irregularity in security and data transmission. The reliability of WWAN and WPAN has not reached to the satisfaction level. At the same time the MWN and MWLAN models are suffering from providing an efficient data transmission

to the user. The research for improving the performances of WSN is still going on and it is implemented by altering the routing nature of the traditional systems. Similarly the researches are also going for improving the security of the data transmitted through WSNs. However, the research on MWN is not moving faster as like of WLAN and WPAN as it has a research constraint on simulations. Similarly the researches are going very slowly in the area of WWAN. The future WSN system may have an uninterrupted connection with an efficient energy routing and secure network on all the applications.

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