

ADVANCES IN WIRELESS TECHNOLOGIES: A SURVEY

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ABSTRACT

Recent advancements in technology have almost migrated us from wired to wireless era. Wireless technology has shown advancement in a short span of time. Though advancements in wireless technology have not taken modern civilization to the level where it wants to reach but still it has given a lot in such a short time and is still proceeding towards more developments.

Invention of the 21st century smart phones has captured almost the whole market. The world-wide revolution in wireless is changing the lives in term of the working, learning and interacting. Wireless Networking has completely changed the way people communicate and share information by eliminating the boundaries of distance and location and hence, these technologies have become increasingly popular in business as well as in personal lives. This paper throws light on the development of various technological advancement in wireless technology along with their significance and advantages of one over the other. There are various technologies like Bluetooth, GSM, Wi-Fi, WI-Gig, iBeacon, ZigBee which are discussed in this paper.

Keywords: Wireless, GSM, Bluetooth, ZigBee, Wi-Fi

1. INTRODUCTION

The term wireless refers to the communication or transmission of information over a distance without requiring wires, cables or any other electrical conductors [1]. Wireless communication is one of the important mediums of transmission of data or information to other devices. The Communication is set and the information is transmitted through the air, without requiring any cables, by using electromagnetic waves like radio frequencies, infrared, satellite, etc., in a wireless communication technology network. At the end of the 19th century, the first wireless communication systems were introduced and the technology has significantly been developed over the intervening and subsequent years. Today, the term wireless refers to a variety of devices and technologies ranging from smart phones to laptops, tabs, computers, printers, Bluetooth, etc.

WAN and LAN technologies enable device connectivity to infrastructure-based services, either through a wireless carrier provider or through a campus or corporate backbone intranet. The other end of the coverage area is occupied by the short-range personal wireless connectivity technologies that allow personal devices to communicate with each other directly without the need for any established infrastructure. At this end of the coverage area the **Bluetooth** wireless technology offers to the personal connectivity space the benefits of Omni-directionality and the elimination of the line of sight requirement of RF-based connectivity. The personal connectivity space resembles a communication bubble that follows people around and empowers them to connect their personal devices with other devices that enter the bubble. Another focus of the technology is to enable a uniform

interface for accessing data services. Likewise, the user will be able to connect to their cellular phone and access data services.

1.1 The IEEE 802.11 market has seen spectacular growth over the past few years, and this growth is continuing at unprecedented rates [2]. **Wi-Fi** which is also known as Wireless Fidelity is a technology for radio wireless local area networking of devices based on the IEEE 802.11 standards. The first version of the 802.11 protocol was released in 1997, and provided up to 2 Mbit/s link speeds. In 1999, the Wi-Fi Alliance formed as a trade association to hold the Wi-Fi trademark under which most products are sold. Wi-Fi most commonly uses the 2.4 gigahertz (12 cm) UHF and 5.8 gigahertz (5 cm) SHF ISM radio bands. In a Wi-Fi setup, a wireless router serves as the communication hub. These networks are extremely 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 provides service in private homes, businesses, as well as in public spaces at Wi-Fi hotspots set up either free-of-charge or commercially, often using a captive portal webpage for access. Organizations and businesses, such as airports, hotels, and restaurants, often provide free-use hotspots to attract customers. In the early 2000s, many cities announced plans to construct citywide Wi-Fi networks. There are many successful examples; in 2004, Mysore (Mysuru) became India's first Wi-Fi-enabled city[5]. A company called WiFiNet has set up hotspots in Mysore, covering the complete city and a few nearby villages. Wi-Fi also allows communications directly from one computer to another without an access point intermediary. This is called adhoc Wi-Fi transmission. This wireless adhoc networkmode has proven popular with multiplayer handheld game consoles, such as the, PlayStation Portable, digital cameras, and other consumer electronics devices.

1.2 **WiGig** is a wireless connection standard that also operates under the 802.11ad standard. WiGig's name stems from its origins with the Wireless Gigabit Alliance. WiGig acts as a complement to existing Wi-Fi rather than a replacement for it, and provides extremely fast, low-latency wireless internet connectivity. WiGig uses the relatively unused 60GHz spectrum. This enables it to use wider channels; resulting in significantly faster data rates of up to 8 Gbps. WiGig uses beam forming technology to send a finely directed signal between devices at a distance of up to 10 metres. This focused broadcast serves to eliminate any interference from nearby devices, as well as to maintain high performance even in areas where the 60 GHz spectrum might be in heavy use. Multi-band Wi-Fi Certified products are able to smartly and seamlessly switch between 2.4, 5, and 60 GHz frequencies on the fly, according to the connectivity environment. WiGig's data speed of up to 8 Gbps is fast enough to download an HD movie in just a few seconds.

1.3 **iBeacon** is the name for Apple's technology standard, which allows Mobile Apps (running on both iOS and Android devices) to listen for signals from beacons in the physical world and react accordingly. In essence, iBeacon technology allows Mobile Apps to understand their position on a micro-local scale, and deliver content to users based on location. The underlying communication technology is **Bluetooth 4.0 Low Energy (BLE)**. With an iBeacon network, any brand, retailer, app, or platform will be able to understand exactly where a customer is in the brick and mortar environment. This provides an opportunity to send customers highly contextual, hyper-local, meaningful messages and advertisements on their smartphones. iBeacon can also be used with an application as a system, which helps smartphones determine their approximate location or context. This technology should bring about a paradigm shift in the way brands communicate with consumers. iBeacon provides a digital extension into the physical world.

1.4 **Zigbee** is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. The technology defined by the Zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such

as Bluetooth or more general wireless networking such as Wi-Fi. Applications include wireless light switches, home energy monitors, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer.

Its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics. Zigbee has a defined rate of 250 kbit/s, best suited for intermittent data transmissions from a sensor or input device.

1.5 GSM is a standard developed by the European Telecommunications Standards Institute to describe the protocols for second-generation digital cellular networks used by mobile devices such as tablets. 2G networks developed as a replacement 1G analog cellular networks, and the GSM standard originally described a digital, circuit-switched network optimized for full duplex voice telephony. This expanded over time to include data communications, first by circuit-switched transport, then by packet data transport via GPRS (General Packet Radio Services) and EDGE (Enhanced Data rates for GSM Evolution, or EGPRS). In 2G systems, GPRS provides data rates of 56–114 kbit/sec. 2G cellular technology combined with GPRS is sometimes described as 2.5G. It provides moderate-speed data transfer, by using unused TDMA channels in, the GSM system. Enhanced Data rates for GSM Evolution (EDGE) is a digital mobile phone technology that allows improved data transmission rates as a backward-compatible extension of GSM. EDGE can be used for any packet switched application, such as an Internet connection. GSM networks operate in a number of different carrier frequency ranges, with GSM networks operating in the 900 MHz or 1800 MHz bands.

2. LITERATURE SURVEY

Gunnar Heine in his book titled GSM Networks: Protocols, Terminology and Implementation[3], says that ‘The goal of GSM was to replace the purely national, already overloaded, thus expensive technologies of the member countries with an international standard.’ He believes that the knowledge- base and professional approach within GSM together with active cooperation of the industry and reasons like lack of competition, which lead to lower prices and ‘market’ were responsible for success of it.

Concept behind Bluetooth is explained well in Wireless Communications and Networks [4] and provides a universal short-range wireless capability using the 2.4-GHz band by which two Bluetooth devices within 10 m of each other can share up to 720 kbps of capacity. Bluetooth is an always-on, short-range radio hook up that resides on a microchip is intended to support an open-ended list of applications, including data (e.g., schedules and telephone numbers), audio, graphics, and even video, thus it is an important advancement in wireless technology.

He also mentions about the Wi-Fi Alliance, the ‘first’ 802.11 standard to gain broad industry acceptance was 802.11b. The Wireless Ethernet Compatibility Alliance (WECA), renamed the Wi-Fi (Wireless Fidelity- a wireless technology) Alliance, created a test suite to certify interoperability for 802.11b products. The term used for certified 802.11b products is Wi-Fi. The Wi-Fi Alliance is concerned with a range of market areas for WLANs, including enterprise, home, and hot spots.

‘ZigBee is targeted mainly for battery-powered applications where low data rate, low cost, and long battery life are main requirements. In many ZigBee applications, the total time the wireless device is engaged in any type of activity is very limited; the device spends most of its time in a power-saving mode’,[5] . As said by William Stallings ‘The goal of ZigBee is to provide radio operation for months or years without recharging, thereby targeting applications such as sensor networks and inventory tags.’ Hence, it is an important technology in the wireless networks.

2.1 COMPARISON ON DIFFERENT TECHNOLOGY

Technology / Technical Specification	ZigBee 802.15.4	Bluetooth 802.15.1	Wi-Fi 802.11b	GSM/GPRS/CDMA	
Application Focus	Monitoring and Control	and Cable Replacement	Web, Video, Email	WAN, Voice/Data	
System Resource	28 Kbytes	250 Kbytes	1 Mbytes	16 Mbytes+	
Battery Life(Days)	100 to 1000+	1 to 7	1 to 5	1 to 7	
Nodes per Network	255	8	30	1000	
Bandwidth	250 Kbps	800Kbps	11Mbps	64-128Kbps	
Range(Meters)	10-100	100	10-100	1000+	
Success Metrics	Reliable, Power, Effective	Low Cost	Cost Convenience	Speed, Flexibility	Reach ,Quality

The **advantages** of Bluetooth are that it avoids interference from other wireless devices, has lower power consumption, easily upgradeable, cheap cost. The **disadvantages** include that it loses connection in certain conditions, only short range communication and it can be hacked easily. BLE is better than Bluetooth as it has high data rate and low power consumption, also the battery is used till 4-5 years. It lacks in the fact that it has less transfer speed compared to direct Wi-Fi. Wi-Fi is advantageous for its accessibility, convenience and expandability. However, its range comes as a backdrop with high cost for high range. For ZigBee setting up the network is very simple, easy to monitor and control home appliances from remote. Also, replacement cost is high for ZigBee based device. On the other hand GSM provide greater coverage and no roaming. But still it has some disadvantages like bandwidth lag and electronic interference.

In terms of **security** the Bluetooth and BLE are least secure while Wi-Fi has WEP, WPA, WPA2 protocols to secure it but publicly its unsafe, so GSM is better but not the best because there are still man in the middle attacks(MINM) made by hackers which were found to be successful.

2.2 Features of the technologies:

Some of the key features of the wireless technology is given below:

2.2.1 Bluetooth uses a low-power signal with a maximum range of 50 feet with sufficient speed to enable transmission of data. The pairing process identifies and connects any two devices to each other.

2.2.2 ZigBee support for multiple network topologies such as point to point, point to multi point and mesh networks. It is highly reliable and secure. It has long battery life due to low duty cycle.

2.2.3 Bluetooth low energy (BLE), means remove some hardware and software capability and redesign the system for low energy device. BLE is 60-80% cheaper than traditional Bluetooth.

2.2.4 Wi-Fi provides high speed internet access. Also it features as a Scalable System and with Robust Performance. It gives the freedom to use your budget on other mission-critical projects.

2.2.5 GSM technology facilitates with high speed integrated data; voice data, fax, mail, voice mail and mostly used SMS feature. GSM supports data at rates up to 9.6 kbps on POTS, ISDN, PSDN, and HSCSN.

2.2.6 WiGig is operated at 60GHz which allows a wider channel and supports super-fast transfer speeds. It can transfer data 60 times more than Wi-Fi. WiGig can be able to support the Tri band devices. WiGig is a multi-gigabit communication technology.

3. CONCLUSION

In conclusion the advancements of wireless technology look promising in the present as well as for the future. It is playing an increasing role in the lives of people throughout the world. In this paper I have not only discussed but also compared the technologies and have listed their features, advantages and disadvantages and how they have advanced in their own way. In addition, ever-larger numbers of people are relying on the technology directly or indirectly since it has made communication affordable, fast and convenient even at the remote regions of the world. As these wireless technologies have improved, the ability to communicate became even easier. Now, all we have to do is connect via wireless internet to talk with whoever we wish for free. By improving the way we communicate, we've been able to utilize it all sorts of ways. Workplaces often use it to conduct video conferences instead of being forced to travel. Educational services use it to provide students with information direct from their laptops in the classroom. Wireless technologies are available in some cars to prevent accidents on the road. We can even use it in personal trainer devices to ensure we're doing the right amount of exercise, keeping us healthy. These improvements have changed our lives and the future belongs to it. Technologies are being further advanced which would bring about a paradigm shift in the way brands communicate with consumers. Lastly, I would conclude by saying that wireless provides a digital extension into the physical world.

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