

A review of Wi-Fi, WiMAX and 3GPP LTE Technologies

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Abstract: The Internet has become one of the most widely used tool today. Be it for business, education, entertainment or communication, the widespread applications of the internet are ample to serve any request. With a great utility at hand, it has become important to develop technologies from propagation of signals to allow multiple users to connect to the internet simultaneously. WiFi, WiMAX, 3GPP and LTE are wireless technologies developed in the recent decade that provide effective transmission of signals to remote users on personal and commercial devices. In this paper we shall take a closer look at these technologies and review their development and application.

Keywords: Wi-Fi, WiMAX, 3G, LTE, wireless technology, networking, modem.

Introduction

A wireless network is any type of computer network that uses wireless data connections for connecting network nodes. Wireless networking is a method by which homes, telecommunications networks and enterprise (business) installations avoid introducing cables into a building, or as a connection between various equipment locations. Wireless telecommunications networks are implemented and administered using radio communication. This implementation takes place at the physical level (layer) of the OSI model network structure.

Types of Networks

A. Wi-Fi network

Wi-Fi is a technology that allows an electronic device to exchange data or connect to the internet wirelessly using radio waves. It is defined as any Wireless local area network (WLAN). Wi-Fi can be accessed by a router. The router allows the user to connect to a network resource such as the Internet via a wireless network access point. To connect to a Wi-Fi LAN, a computer LAN, the computer has to be equipped with a wireless network interface controller. The combination of computer and interface controller is called a station. All stations share a single radio frequency communication channel. Transmissions on this channel are received by all stations within range^[1].

A router acts as the base of the station. There are two kinds of routers: wired, and wireless. The modem of a wired router has the following ports :

- Phone Line/DSL port that is connected to the telephone line.
- USB Socket for physically connecting the router to a device.
- Ethernet cord
- Power cord

Router sends a radio frequency signal to nearby devices which can be detected by those devices with a built in Wi-Fi card. By this action, the router acts like an access point. A wireless access point (WAP) connects a group of wireless devices to an adjacent wired LAN. An access point resembles a network hub, relaying data between connected wireless devices in addition to a (usually) single connected wired device, most often an Ethernet hub or switch, allowing wireless devices to communicate with other wired devices.

Wireless routers integrate a Wireless Access Point, Ethernet switch, and internal router firmware application that provides IP routing, NAT, and DNS forwarding through an integrated WAN-interface. A wireless router allows wired and

wireless Ethernet LAN devices to connect to a (usually) single WAN device such as a cable modem or a DSL modem. A wireless router allows all three devices, mainly the access point and router, to be configured through one central utility.



Figure 1. Representation of internet connectivity using Wi-Fi

Applications:

Wi-Fi connectivity finds wide range applications in commercial as well as private sector. The major area of use is connecting personal computers and gadgets to the internet. However, beside this basic use, Wi-Fi also has diverse utility.

- To convert smartphones into multipurpose remotes and to carry out multitasking with other gadgets connected to the same network.
- Sensor networking and measurements^[2].
- Miniaturized Wi-Fi system module using SiP/IPD for handheld device applications^[3].
- Localization and navigation for autonomous indoor mobile robots.
- Wi-Fi-based subway navigation system.

Developments being made in technology:

- Currently, the 802.11ac technology is being developed, which will triple speed by making better use of the 5GHz band, and “beam forming” technology to enhance signal quality. This will push data at a rate of 1.3 gigabits per second and powerwireless networks for whole homes rather than just single rooms.
- The shorter-range, but higher-throughput 60GHz frequency is also being put to good use in the 802.11ad specification, and will allow speeds of up to 7 gigabits per second across short distances.

B. WiMAX:

WiMAX (Worldwide Interoperability for Microwave Access) is a wireless communications standard designed to provide 30 to 40 megabit-per-second data rate. WiMAX refers to interoperable implementations of the IEEE 802.16 family of wireless-networks standards. It is a standard spaced alternative to DSL and cable networks^[4].

WiMAX towers are set up around an area or space. The towers are space to form a mesh network. The signal from one tower can be transmitted to another through cables or through line of sight microwave link to another antenna. The antenna found on such towers can be categorized into namely three types: omnidirectional broadcasts (360 degree propagation), sector broadcasts (60/90/120 degree propagation) and panel- point to point.

The towers are capable of transmitting and receiving radio signals that are WiMAX oriented. Signals from these go to transceivers on any device that can receive an Ethernet network. The receiver can be a modem with a PC/MCE card or a

gadget with a built in card. Through exchange of radio signals, the device is virtually connected to the network. Through this network that covers distances of several kilometers, the user is typically served with a speed of 70 Mbps or more.

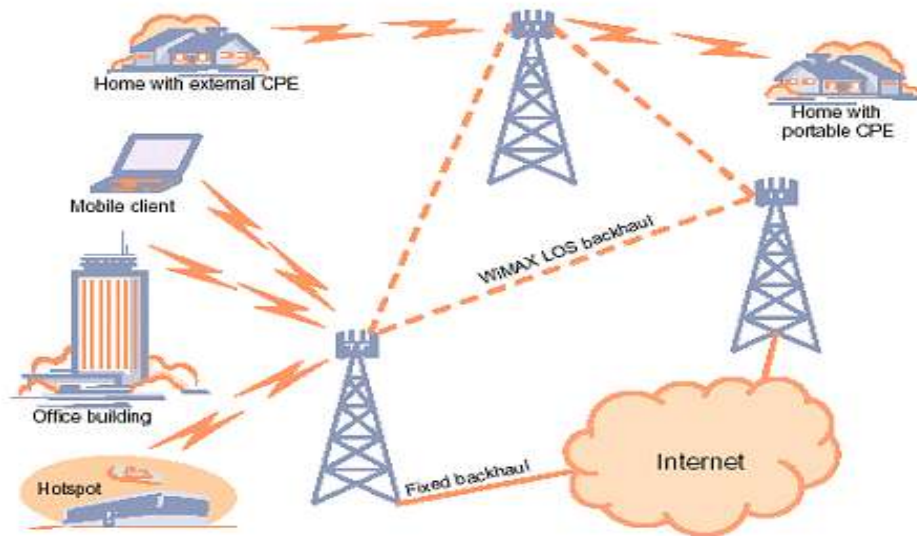


Figure 2. Pictorial representation of WiMAX connectivity.

Applications:

- Providing portable mobile broadband connectivity across large areas.
- Providing data, telecommunications (VoIP) and IPTV services (triple play).
- Smart grids and metering
- Mobile WiMAX: Providing internet access to devices in motion.
- Ubiquitous access: High speed data transfer, video and media streaming.
- USB can provide access to a WiMAX network through a dongle. Dongles have omnidirectional antennas of lower gain compared to other devices. They are generally connected to notebook or net book computers for internet connectivity. These are best used in areas of good coverage.

C. 3GPP, LTE:

3G is an acronym that stands for third generation wireless technology. Wireless communication has undergone rapid advancements in the recent years. The 1st generation wireless technology (1G) established wireless communication in cellular devices through analog signal exchange. The technology only allowed voice calls and plain text messages to be transmitted to and from devices. This was followed by 2G that brought digital signals into the picture with exchange of packet data. It could offer data exchange rate of 10-200 kbps.

3G has brought in the technology of high speed data transfer, offering speeds of up to 324 kbps. 3G signals can be broadly categorized into two types: GSM and CDMA.

- GSM came into use as a tool for identification of SIM cards on networks.
- CDMA was equipped with EMEI number that enabled the network to correspond with the device to determine its location and track its usage.
- 3GPP (3rd Generation Partnership Project) includes the development and maintenance of:
 - The Global System for Mobile Communications (GSM) including GSM evolved radio access technologies (e.g. General Packet Radio Service (GPRS) and Enhanced Data Rates for GSM Evolution (EDGE)).
 - An evolved third Generation and beyond Mobile System based on the evolved 3GPP core networks, and the radio access technologies supported by the Partners (i.e., UTRA both FDD and TDD modes).
 - An evolved IP Multimedia Subsystem (IMS) developed in an access independent manner.

Applications:

3G technology with its high speed data transfer and efficiency has widespread applications. These include:

- Augmenting vehicular 3G users through inter-vehicle communications[5].
- High efficiency digitally linearized GaN based power amplifier.
- Supervisory system in industries[6].

Developments being made in technology:

LTE, an acronym for Long Term Evolution, commonly marketed as 4G LTE, is a standard for wireless communication of high-speed data for mobile phones and data terminals.

It is based on the GSM/EDGE and UMTS/HSPA network technologies, increasing the capacity and speed using a different radio interface together with core network[7].

The higher capacity allows for data exchange rates of up to 5 Mbps, with more recent technologies in HSPA achieving speeds of up to 7 Mbps.

LTE is significantly more advanced from its predecessors and achieves the following advantages:

- Fast, efficient and intelligent networking
- Broader range of bandwidth for transmission.
- Communication is now possible between devices connected to the same or similar network, allowing exchange of data and information wirelessly.
- Low cost of LTE chips that can be installed into devices to make them LTE compatible.
- Easy upgrade and compatibility with 3G technologies.

Conclusion

Wireless networks, namely Wi-Fi, WiMAX, 3GPP LTE are ideal for different usage. The availability of wireless network suffices the present need for connectivity. These networking options are optimum for personal and commercial use, with options available for every need based usage. With the current trend of development in progress, the future of networking is bright with endless possibilities.

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