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A Short Review on 4G Technology

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Abstract-

The versatile world is anticipating another age innovation to supplant the third era because of the expanded interest for speed, interactive media support and different tools. This is where mobile connectivity comes into play in the fourth generation. 4 G versatile systems administration gives better speed, high limit, lower cost and IP-based administrations. The fundamental reason for 4G remote is to uproot the present center improvement with a solitary general progression dependent on IP.The paper will include a summary of the different generations of previous 4 G mobile device technologies. The paper also covers 4 G's technical aspects and how it operates, as well as how it will lead to future telecommunications and networking technology developments. Various techniques involved in 4G like OFDM, mobile WiMax, LTE, SC-FDMA and UMB will also be explained in the paper.

Keywords- IP, MIMO, 4G, OFDM

I. Introduction

4 G system can provide a comprehensive IP solution where users can receive voice, data and streamed multimedia at higher data rates than previous generations on an Anytime, Anywhere basis. The moving toward 4 G (fourth era) versatile correspondence frameworks are intended to tackle staying 3 G (third era) frameworks issues and give a wide scope of new administrations, extending from top notch voice to top quality video to high-information remote channels. The increasing demands and requirements for the ubiquity of wireless communication systems have resulted in the need for a better understanding of fundamental communication theory and electromagnetic issues and their implications for the design of highly capable wireless systems. The word 4 G, meaning 4th Wireless Technology Generation, defines mobile wireless services

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established by the ITU's Radio Communication Sector (ITU-R) and named International Mobile Telecommunications Advanced (IMT-Advanced). It is a descendant of criteria for 3 G and 2 G families [1].

From the international point of view, this innovation is the way to communicate and interact with more omnipresent means all the time. The understanding of 4 G wireless networks is that they provide fast and high frequency or latency and over packaged information communication. It is said that a 4 G network provides a robust and stable all-IP solution where users can be provided with facilities such as i. IP telephony, ii. Ultra-broadband Internet connectivity, iii. Gaming services and iv. Streaming multimedia. The ITU has seen two models that are intended to meet the necessities of 4 G IMT-Advanced set forth by, 3GPP and IEEE.These are the LTE Advanced and Wireless MAN-Advanced (WiMAX-Advanced) standards and will abandon the old spreading framework development for OFDMA and other night out plans used in 3 G frameworks, using MIMO development, channel-subordinate booking and flexible channel transport.

4 G systems, i.e. cellular broadband wireless access systems, have attracted a great deal of interest in the mobile communication arena as a promise for the future. Scientists and providers are increasingly interested in 4 G wireless networks. Customers will approach various administrations with this element, expanded inclusion, the solace of a solitary gadget, one bill with diminished all out access expenses, and increasingly stable remote access in any event, when at least one systems come up short or lose[1].

II. Evolution of 4G

4G Technology and its antecedents 3G, 2G and 1G are all from a similar group of cell correspondence guidelines, which are confirmed by the ITU. The ITU for example between national Telecommunications Union is built up by the United Nation, which regulates every one of the broadcast communications matters everywhere throughout the world.

Toward the finish of the 1940s, the main radio telephone utility was presented, and was intended to clients in vehicles to general society land-line based phone organize. At that point, in the sixties, a framework propelled by Bell Systems, called IMTS, or, Improved Mobile Telephone

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Service, brought many enhancements, for example, direct dialing and more band-width.The very first IMTS-based analog systems were produced in the late sixties and early seventies. The 1 G or First Generation was a simple gadget, created during the 1970s, 1 G had two significant upgrades, this was the chip development, and the electronic change of the control interface between the telephone and the phone site. 2 G started replacing the old 1 G at the end of the year 1980 and was first introduced in Finland. The system arrangement of 2G was far more than the 1G, would be wise to radio correspondence and 2G systems were advanced.

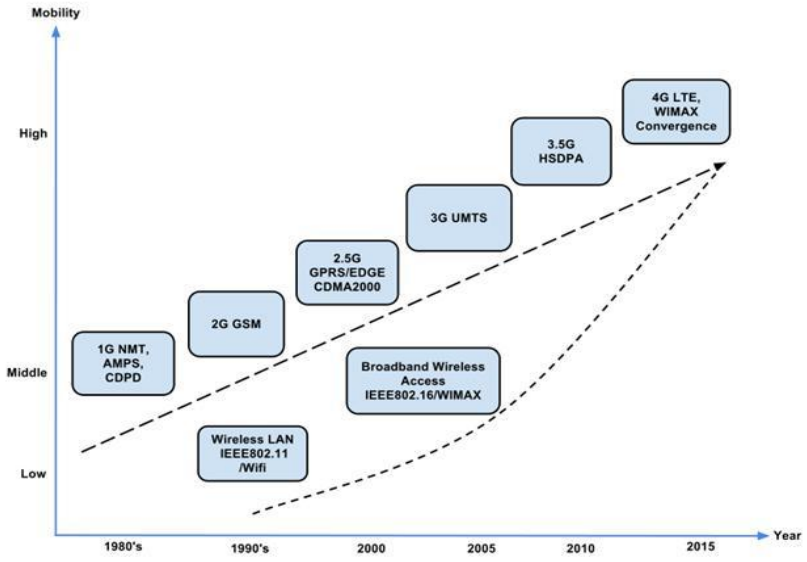

Figure 1: Evolution of technology to 4G

After 2 G, came the more proficient innovation 3 G, it set up its underlying foundations in late 2000, while ITU consented to the 3 G guidelines in 1999. The Third Generation innovation currently can without much of a stretch be discovered everywhere throughout the world on about all standard radio advancements, for example, CDMA and the GSM. Verizon is the first cellular network operator to set up the 3 G network in 2003. 3 G technology provides a data transfer speed of up to 2 mbps at fixed locations (when the user is stationary) and at least 384 kbps when the user travels.

4 G innovation, the Fourth Generation Technology, is the condition of - the-workmanship and ultra-quick innovation, and it gets more consideration consistently despite the fact that this

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innovation is still in its beginning times. 4 G innovation expects to give the quickest speed to all clients, portable or cell phone clients, with an information move pace of up to 100 mbps, while it goes for the most elevated speed of 1 Gbps for stationary clients [2].

III. 4G Reference model

Figure 2 shows the reference model of 4G. The referencemodel of 4G consists of four domains: service and application, service platform, packet based core network and new radio access[4]. Service and software from both the new and existing access systems are widely available. Smooth distribution of products and software by the operator. Server architecture offers the server foundation to help understand the Software and Application Domain products and applications that are provided. It also supports the application of multimedia, high-speed / large-capacity network and QoS network.The core network based on the packet is independent of the access systems. This allows interconnection between wireless 4 G systems and other communication systems (e.g., cellular 2G/3 G, W-LAN, DSRC, electronic broadcasting, and other IP networks, etc.) to provide seamless connectivity to uses.

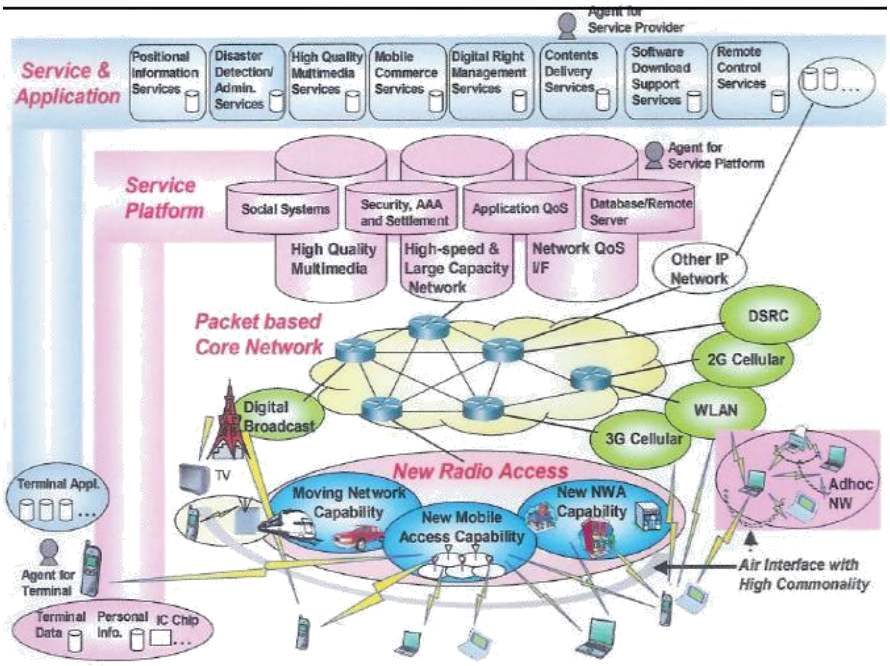

Figure 2: Reference model of 4G systems[4]

IV. Technologies used in 4G

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1 LTE Advanced

LTE Advanced is not a new technology, but an update to the current LTE network. LTE Advanced is a nominee for the IMT-Advanced standard, officially submitted to ITU-T by the 3GPP organization. It is expected that LTE Advanced will be the first true 4 G system available.The general target of LTE is to give an elite radio-get to framework that offers full vehicle speed portability and can serenely exist together with HSPA and past systems[3]. The LTE network's overall structure is identical to the networks of GSM and UMTS (Universal Mobile Telecommunications System). Nonetheless, to simplify the overall structure, the number of logical network nodes has been reduced. Simplifying the architecture would reduce deployment costs as well as overall network delays [13].

1.1 Technology Components of LTE-Advanced

1. OFDM

OFDM is a frequency division multiplexing (FDM) plot used as an advanced multi-transporter tweak strategy. Symmetrical Frequency Division Multiplexing (OFDM) is an innovation that permits transmitting high information rates over channels at an equivalent low multifaceted nature. Symmetrical Frequency Division Multiplexing (OFDM) is not quite the same as that of past ages, giving adaptable and productive utilization of various transporter transfer speeds alongside resistance to clamor and multipath obstruction. Bit rates are on the request for 100 Mb/s when a 20 MHz bearer is utilized.

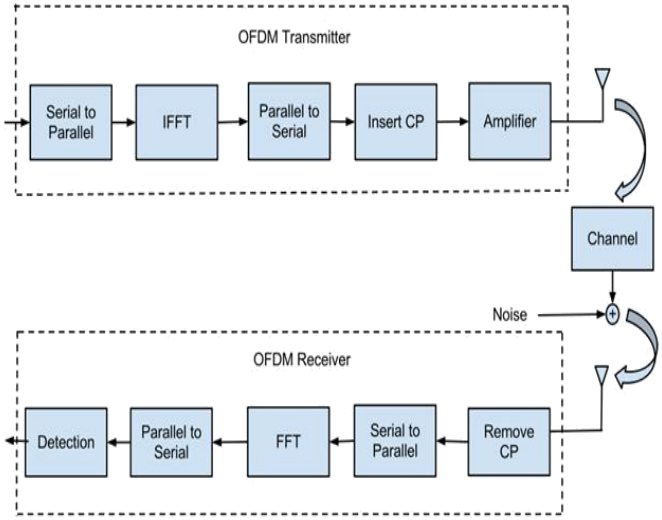

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Figure 3: Working of OFDM

How OFDM works: An OFDM transmitter gets information from an IP arrange, deciphering the information before balance and encoding it. An IFFT converts the OFDM signal into an analog IF signal that is sent to the RF transceiver. By reversing this process, the receiver circuit reconstructs the information. The receiver can separate and process each sub-carrier without interfering with other sub-carriers with orthogonal sub-carriers. ODFM offers better quality of connection and communication than other wireless transmission techniques. [2].

2. SC-FDMA

LTE-Advanced's uplink transmission system has been retained to a large extent, i.e. multi-access (SC-FDMA) single carrier frequency division (SC-FDMA) is used, which is a pre-coded multi-access (OFDMA) orthogonal frequency division (DFT) scheme [11].The transmission of the physical uplink shared channel (PUSCH) utilizes DFT precoding in both MIMO and non-MIMO modes.

3. MIMO-Advanced Antenna Systems

Progressed multi-reception apparatus frameworks make it feasible for new 4 G systems to accomplish higher information rates over the air organize (for example more than 100 Mbps). In spite of the fact that 4G systems utilize a viable multi-get to technique considered the Orthogonal Frequency Multiple Access Division (OFDMA), OFDMA alone can't create the foreseen higher yield in 4G frameworks. Different receiving wire procedures assume a basic job in expanding otherworldly proficiency.

MIMO is a multi-antenna system that uses advanced signal processing techniques to increase capacity in a radio connection; it uses multiple transmitting channels and receives antennas with different data streams transmitted across each antenna. In the quest for broadband remote frameworks with higher limit, execution and unwavering quality, MIMO radio wire frameworks are an enchantment fixing.MIMO innovation utilizes multi-way to

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convey higher information throughput and, simultaneously, increment range and unwavering quality without devouring additional radio recurrence. The key thought, notwithstanding, is that a transmitter sends numerous streams on different transmitting radio wires and each transmitted stream experiences different ways to arrive at every collector recieving wire as appeared in Figure 4.Using superior signal processing techniques, the various paths taken by the same stream to enter multiple receivers require the cancelation of errors. MIMO speaks to multiplexing space-division (SDM) data flag on spatially isolated N numerous radio wires are multiplexed and gotten on M reception apparatuses. Both the transmitter and the beneficiary have various parallel channels that work at the same time on a similar recurrence band and simultaneously[5][6].

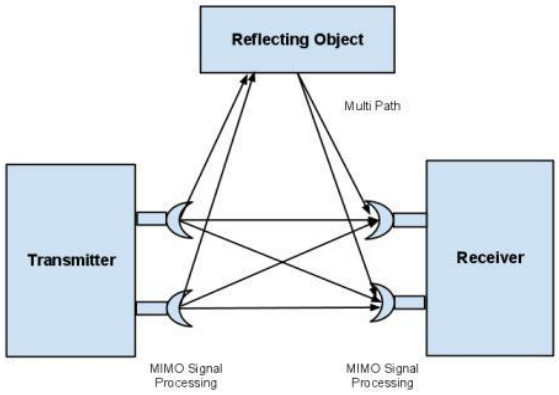

Figure 4: MIMO[6]

2 Software Defined Radio

SDR is one type of open remote engineering (OWA). A software defined radio framework, or SDR, is a radio correspondence structure where parts normally realized in hardware (for instance channels, speakers, modulators/demodulators, etc.) are somewhat executed on a PC or embedded PC contraptions using programming.A given radio software is one that can be configured by using code to any radio or frequency standard. However, if a new standard were to be

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established, a simple software update would allow the phone to support the new standard. This is impossible for current phones.[1]

A software-defined 4 G radio would be able to work on different broadband networks and be able to transfer easily to another network when operating outside the home network of users. One of the best advantages of software-defined radios is its great flexibility to program for new wireless standards.

3 Mobile WiMAX

WiMAX (Worldwide Interoperability for Microwave Access) is a networking system for the wireless transmission of high-speed Internet access to vast geographic areas, and this technology is a standard established by IEEE to conform with IEEE 802.16. Portable WiMAX is a remote broadband arrangement that enables versatile and fixed broadband systems to unite through a mutual broadband access innovation and adaptable system engineering. The Wireless WiMAX Air Interface is actualized by the Orthogonal Frequency Division Multiple Access (OFDMA) to upgrade multi-track quality in non-viewable pathway settings. Portable WiMAX systems offer potential outcomes for future updates in both radio access advances and system engineering, in this manner giving a great deal of adaptability in arrange execution alternatives and accessible administrations[12].

3.1 Main features of Mobile WiMAX

OFDMA

The mobile WiMAX air interface uses Orthogonal Frequency Division Multiple Access (OFDMA) as the radio access method for improved multipath performance in non-line-of-sight (NLOS) environments.

High Data Rates

The use of multiple-input multiple-output (MIMO) antenna techniques along with flexible sub channelization schemes, adaptive modulation and coding enable the mobile WiMAX

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technology to support both peak downlink (63 Mbps per sector) and uplink high data rates (28 Mbps per sector) up to in a 10 MHz channel.

Quality of service (QOS)

The fundamental premise of the IEEE 802.16 MAC architecture is QoS. In addition, sub channelization and MAP-based signaling schemes provide a flexible mechanism for optimal scheduling of space, frequency and time resources over the air interface on a frame-by-frame basis.

Scalability

The mobile WiMAX technology utilizes scalable OFDMA (S-OFDMA) and has the capability to operate in scalable bandwidths from 1.25 to 20 MHz to comply with various spectrum allocations world-wide.

Security

The mobile WiMAX incorporates the most advanced security features that are currently used in wireless access systems. These include Extensible Authentication Protocol (EAP) based authentication, Advanced Encryption Standard (AES) based authenticated encryption, and Cipher-based Message Authentication Code (CMAC) and Hashed Message Authentication Code (HMAC) based control message protection schemes. By encrypting the links between the BS (Base station) and the SS (sub-scriber station), WiMAX provides subscribers with privacy (against eavesdropping) and security across the broadband wireless interface. WiMAX also has built-in VLAN support, which provides protection for data that is being transmitted by different users on the same BS.

Mobility

To guarantee ongoing applications, for example, Voice over Internet Protocol (VoIP), the handheld WiMAX underpins advanced handover plans with latencies underneath 50 ms.[12]

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4 UMB

UMB (Ultra Mobile Broadband) is an OFDM-based standard that includes multi-antenna transmission support and up to 20 MHz channel bandwidth. In terms of technology and functionality used, it is similar to LTE, with one major difference being that UMB uses uplink OFDM while LTE uses single carrier modulation. UMB's utilization of OFDMA would have dispensed with a large number of the impediments of its antecedent's CDMA innovation, including the "breathing" wonder, the trouble of including limit by means of microcells, the fixed data transfer capacity measures that point of confinement the all out transmission capacity accessible to handsets, and the close unlimited oversight of the necessary protected innovation by one organization.

V. Features of 4G

Some features that are expected to be supported by most 4G networks include [9][10]:

Higher Bandwidths

4 G networks are supposed to provide higher bandwidth coverage to multimedia services. Through 4 G networks, bandwidths up to 100Mbps can be reached.

Packet-Switched Network

Although 3 G networks are made up of both circuit-switched and packet-switched systems, it is expected that 4 G networks will be based entirely on packet-switched networks. IP is intended to be used as a 4 G network converted to a packet.

Stringent Network Security

It is expected that network safety will be further evolved in 4 G networks.

Global mobility and network scalability

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Although 3 G networks have not provided true global connectivity, this is one of 4 G network criteria.

VI. Applications of 4G

Using the 4 G administration will basically be the same as the 3 G administration, while offering much higher rates of information movement, empowering either more speed-concentrated applications or more customers to encounter great paces while interfacing just using 1 transporter. Applications include:

1. Virtual Presence: This means that 4 G still delivers network support, even if the user is off-site.
2. Virtual Navigation: 4 G provides users with interactive navigation that allows users to access the street, house, etc. database in large cities. This involves transmission of data at high speed.
3. Tele-Medicine: 4 G facilitates mobile patient health tracking. A client does not need to go to the hospital and at anytime and anywhere can get video conference help for a doctor.
4. Tele-geoprocessing: It is a combination of GIS (Geographic Information System) and GPS (Global Positioning System) where a user can check for the position.
5. Crisis Management: Catastrophic events can make interchanges frameworks separate. It may take days or weeks to restore the process in today's world. In 4 G, however, these disaster problems are likely to be resolved in a few hours.
6. Education: 4 G gives a decent chance to individuals associated with deep rooted learning. Individuals can proceed with their training on the web in a financially savvy route anyplace on the planet.

The other significant feature that 4 G could make available that 3 G was not necessarily the opportunity to be used as a major internet access point in homes or companies when preparing to multiple high-speed connections.

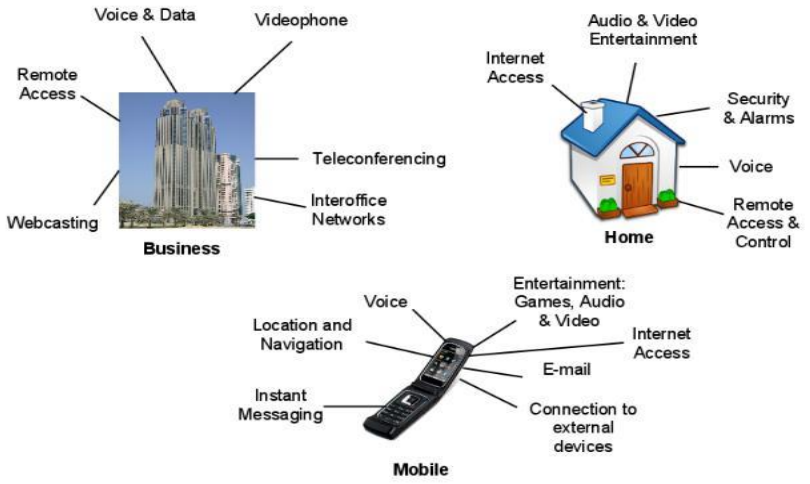

Figure 5: Specific applications to be supported by a 4G integrated communications system[8]

7. Conclusion

Gauges in the media communications industry are continually changing as advances are made in new innovations and the general population interest for a more extravagant substance, conveyed at quicker speeds and are the fundamental driver behind these mechanical improvements consistently.4G can be known as MAGIC- Mobile Multimedia, Global connectivity assistance, seamless mobile system and personalized service anytime. 4 G is committed to being a very exciting wireless communication technology that will change people's lives in the digital world. There are many striking attractive 4 G features including very high data speed, international roaming, and so on.The new 4 G mobile communications networks would solve the remaining 3 G services issues. The forthcoming 4 G would consist of entirely packet-switched networks. It is expected to end-to-end support all-IP. To bring various forms of multimedia services at lower cost, it would accommodate speeds of up to 100 Mbps. It is differentiated from all other peer systems and cellular networks by its use and benefits.

Future generations of wireless networks are expected to provide the global, linked community with virtually unlimited opportunities. Network technology developments will provide an

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ecosystem where practically anything is accessible through any connected device, anywhere, at any time.

References

[1] 4G, urlhttp://en.wikipedia.org/wiki/4G

[2] 4gTechnology,http://www.four-g.net/links. html

[3] Erik Dahlman, Stefan Parkvall, Johan Skold, ”4G: LTE/LTE-Advanced for Mobile Broadband”, Aca-demic Press, 2010

[4] Honglin Xia, “Fourth-generation Mobile Technology 4G", 2007

[5] “Advanced Antenna Systems”,Technology Digest, 2011

[6] Subharthi Paul, “LTE and Ultra-Mobile Broadband (UMB) Technologies for Broadband Wireless Access”, 2008

[7] Arti Rana, Kamaljeet Kaur, Anuj Aggarwal, “Wire-less Network (3G and 4G)”, 2007

[8] Gary Breed, “Visions for 4G: Many Ways to Achieve Integrated Wireless Connectivity”, 2007

[9] SumitKasera, NishitNarang, “3G Networks”, Tata McGraw-Hill Education, 2004

[10] Ajay R. Mishra, “Advanced cellular network planning and optimization”, 2007

[11] Lionel FuependapMetugeReya, “4G Technology Features and Evolution towards IMT-Advanced”, 2010

[12] “Mobile WiMax”, Software solutions in radio communications, 2007

[13] Sh. A. Er, “LTE Network Architecture”, [online] Available:http://ershoeb.blogspot.nl/2016/03/lte-network-architecture.html.