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Development of Wireless Communication Networks: From 1G to 5G

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***Abstract*:**

Wireless technology is growing very fast these days. Until very recently, wired network was needed to get online. Even wired telephones are becoming a thing of past. Mobile networks have evolved tremendously in last 4 decades [1]. Cellular concept was introduced with 1G ('G' stands for generation) networks. Today, **4G technology** is getting ready to storm the markets and research on 5G has begun. Mobile communication is continuously one of the hottest areas that are developing at a booming speed, with advanced techniques emerging in all the fields of mobile and wireless communications.5G communication systems are being developed to solve the various problems the current communication systems (3G, 2.5G) are facing.4G & 5G will be an intelligent technology that will reduce the number of different technologies to a single global standard. This paper gives evolution of mobile wireless communication networks-1G to 5G how they are different from each other what advantages and disadvantages they have.

1. Introduction

Mobile communications and wireless networks are developing at an astounding speed, with evidences of significant growth in the areas of mobile subscribers and terminals, mobile and wireless access networks, and mobile services and applications. The fourth generation, 4G, of mobile networks that will supersede the 3G and 2G families of standards, is already upon us. A new mobile generation has appeared every 10th year since the first 1G system was first introduced in 1981, followed by the 2G system that started to roll out in 1992, and 3G, which appeared in 2001.[2].The development of 4G systems started in 2002. The real new revolution started with 3GPP in December 1998. 3G systems are designed for multimedia communication: with them person-to-person communication can be enhanced with high quality images and video, and access to information and services on public and private networks will be enhanced by the higher data rates and new flexible communication capabilities of third generation 5G is a packet switched wireless system with wide area coverage and high throughput.5G technology has changed the means to use cell phones within very high bandwidth 5G systems [3].The 4G (fourth generation) communication systems will provide a wide variety of new services, from high quality voice to high definition video to high data rate wireless channels. 4G is intended to provide high speed, high capacity, low cost per bit, IP based services. The goal is to have data rates up to 20 Mbps, even when used in such scenarios as a vehicle traveling 200 kilometers per hour. New design techniques, however, are needed to make this happen, in terms of achieving 4G performance at a desired target of one-tenth the cost of 3G. That's the goal of 4G. In short, Fourth Generation (4G) mobile devices and services will transform wireless communications into on-line, real-time connectivity. 4G wireless technologies will allow an individual to have immediate access to location-specific services that offer information on demand at an amazingly high speed and low cost. Welcome to the world of amazing realities of an amazingly high-speed data communication and mobile technology at a very low cost. That's 4G. wireless uses OFDM and millimeter wireless that enables data rate of 20 mbps and frequency bandof2-8 GHzs. The 5G communication system is envisioned as the real wireless

network capable of supporting wireless world wide web (WWWW) in future.

2. What features 1G has?

1G is the first generation cellular network that existed in 1980s. First generation refers to the analog "brick phones" and "bag phones" as they were first introduced for mobile cellular technology. (NMT, C-Nets, AMPS, TACS) are considered to be the first analog cellular technology cellular systems, which started early 1980s. There were radio telephone systems even before that. 1G network were conceived and designed purely for voice calls with almost no consideration of data services (with the possible exception of built-in modems in some headsets). 1G was replaced by 2G wireless digital standards. It has limitation because there is no encryption, the sound quality is poor and the speed of transfer is only at 9.6kbps [5]. It has FDMA in multiplexing possess circuit switching and uses PSTN as core network. But has only outdoor coverage [6].It has Poor carrier aggregation no MIMO technology, very large cells may range from 2- 20 km and its time consuming too.

3. What features 2G has?

Fully digital 2G networks have replaced analog 1G, which originated in the 1980s. 2G networks first commercially began on the Global System for Mobile Communications, or GSM/CDMA, standard. 2G on GSM standards was first used in commercial practice in 1991 by Radiolinja, a Finish GSM operator that was founded on September 19, 1988[7]. Improved by introducing the concept of digital modulation, which means converting the voice (only) into digital code (in your phone) and then into analog signals. Being digital, they overcame some of the limitations of 1G, such as it omits the radio power from handsets making life healthier, and it has enhanced privacy has better coverage, capacity, offering improved sound quality.GSM supports circuit-switched data (CSD), allowing users to place dial-up data calls digitally, so that the network's switching station receives actual ones and zeroes rather than the screech of an analog modem. It uses TDMA, CDMA in multiplexing possess circuit and packet switching and uses PSTN as core network [6]. All the standards belonging to this generation were commercial centric and they were digital in form. The second generation of wireless mobile communication systems was a huge success story because of its revolutionary technology and the services that it brought to its users. Besides high-quality speech service, global mobility was a strong and convincing reason for users to buy 2G terminals. The second generation standards are GSM, iDEN, D-AMPS, IS-95, PDC, CSD, PHS, GPRS, HSCSD, and WiDEN.[8].Its Peak speed may be up to 14.4 kbps and carrier bit rate is 270.8 kbps & speech coding bit rate is 13kbps also its channel bandwidth is 200 k Hz in GSM. It's safe for consumers to use .Handsets are provided with text messaging. It doesn't support QoS (quality of service) and cannot take multiple parties simultaneously [4]. **2.5G** wireless technology is a stepping stone that bridged 2G to 3G wireless technology and is sometimes used to describe those evolved technologies that were first considered as being 2G. While 2G and 3G have been officially defined as wireless standards by the International Telecommunication Union (ITU), 2.5G has not been defined and was created only for the purposes of marketing. As an interim step up from 2G, 2.5G has seen some of the advances inherent in 3G networks (including packet-switched systems). The evolution from 2G to 3G has ushered in faster and higher-capacity data transmission. Several technologies that have been considered as the evolutionary step to 3G include EDGE (part of the GSM family) and CDMA 2000 1X; at times these technologies are called 3G as they both meet some of the ITU requirements for 3G standards.[7].

3. What features 3G has?

3G is the current generation and third of mobile telecommunication standards. 3G supersedes 2G technology and precedes 4G technology. Current 3G systems have been established through ITU's project on International Mobile Telecommunications 2000 (IMT-2000). 3G technologies have enabled faster data transmission speeds, greater network capacity and more advanced network services. In May 2001, NTT DoCoMo (Japan) launched the first pre-commercial 3G network – branded as FOMA. Following the first pre-commercial launch, NTT DoCoMo again made history on October 1, 2001, with the first commercial launch of 3G in Japan. [7]. It allows simultaneous use of speech and data services and offers data rates of up to 2 Mbps, which provide services like video calls, mobile TV, mobile Internet and downloading.

There are a bunch of technologies that fall under 3G, like WCDMA, EV-DO, and HSPA and others. UMTS-HSPA is the world's leading 3G technology. By 2015 UMTS-HSPA and LTE 3G technologies are expected to account for 3.9 billion global subscriptions, compared to 569 million CDMA EV-DO subscriptions and 59 million WiMAX subscriptions. It's a first mobile broadband based on high capacity broadband data. Its network architecture is cell based but has frequency band dependent on country or continent (1800-2400 MHz) uses bandwidth of 5-20MHz, uses switching scheme of packet and circuit. They are based on two parallel backbone-infrastructures, one consisting of circuit switched nodes, and one of packet oriented nodes. [7] The third generation (3G) has been launched in several parts of the world, although the success story of 2G is hard to repeat. It has various release versions like 3.5G, 3.75G. It

has more features like the data throughput is up to 3.1Mbps, has a peak upload rate of 5 Mbps [4]. It uses turbo codes for error correction. It provides digital navigation but costly in implementation.

4. What features 4G has?

In telecommunications, 4G is the fourth generation of cellular wireless standards. It is a successor to the 3G and 2G families of standards. In 2008, the ITU-R organization specified the IMT-Advanced (International Mobile Telecommunications Advanced) requirements for 4G standards, setting peak speed requirements for 4G service at 100 Mbit/s for high mobility communication (such as from trains and cars) and 1 Gbit/s for low mobility communication (such as pedestrians and stationary users).A 4G system is expected to provide a comprehensive and secure all-IP based mobile broadband solution to laptop computer wireless modems, smartphones, and other mobile devices. Facilities such as ultra-broadband Internet access, IP telephony, gaming services, and streamed multimedia may be provided to users.PRE-4G technologies such as mobile WiMAX and Long term evolution (LTE) have been on the market since 2006 and 2009 respectively, and are often branded as 4G. The current versions of these technologies did not fulfill the original ITU-R requirements of data rates approximately up to 1 Gbit/s for 4G systems. Marketing materials use 4G as a description for LTE and Mobile-WiMAX in their current forms. It uses OFDM in uplink and downlink. [5].

4G LTE (Long Term Evolution) Advanced has following features:

- IMT-A complaint version of LTE, also referred to as E-UTRA (Evolved UMTS Terrestrial Radio Access) or E-UTRAN (Evolved UMTS Terrestrial Radio Access Network).
- UMTS Long Term Evolution (LTE) was introduced in 3GPP Release 8 which supports data rates of up to 300 Mbps (4x4 MIMO) and up to 150 Mbps (2x2 MIMO) in the downlink and up to 75 Mbps in the uplink. Release 10 of LTE is likely to approach IMT-A, download upto 1 Gbps and upload upto 500 Mbps. [1].
- Uses OFDMA for downlink & Uses Single Carrier Frequency Division Multiple Access (SC-FDMA) for uplink.
- Uses 64QAM modulation
- Uses MIMO and beam forming with up to 4 antennas
- All IP Network

5. What features 5G has?

The 5G (Fifth Generation Mobile and Wireless Networks) can be a complete wireless communication without limitation, which bring us perfect real world wireless – World Wide Wireless Web (WWWW). 5G denotes the next major phase of mobile telecommunications standards beyond the 4G/IMT-Advanced standards. At present, 5G is not a term officially used for any particular specification or in any official document yet made public by telecommunication companies or standardization bodies such as 3GPP, WiMax Forum, or ITU-R. Each new release will further enhance system performance and add new capabilities with new application areas. Some of the additional applications, benefiting from mobile connectivity are home automation, smart transportation, security, and e-books [9]. In the 5G system, each cell phone will have permanent "Home" IP address and "care of address" which represents its actual location. When a computer on the Internet wants to communicate with cell phone after that first, it sends a packet to the home address and subsequently server on home address send a packet to the actual location through the tunnel. Server also sends a packet to the computer to inform the correct address so that future packets will send on that address [10]. Cloud computing is a technology that uses the internet and central remote server to maintain data and applications. In 5G network this central remote server will be our content provider. Cloud computing allows consumers and business to use applications without installation and access their personal files at any computer with internet access. The same concept is going to be used in Nano-core where the user tries to access his private account from a global content provider through nano core in form of cloud [11]. The development of cloud computing provides operators with tremendous opportunities. The advanced billing interfaces of 5G technology makes it more attractive and effective with the following future perspectives. [12]

6. Conclusion

Mobile Wireless Communication Technology is going to be a new a dramatic and wide-reaching change in conditions in mobile market. 5G is like a personal data assistant (PDA) now our whole office is in our finger tips or in our phone. 5G technology has a bright future because it can handle best technologies and offer priceless handset to their customers.5G will promote concept of Super Core, where all the network operators will be connected through one single core and have one single infrastructure, regardless of their access technologies.4G and 5Gtechniques provide efficient user services with lower battery consumption, lower outage probability (better coverage), high bit rates in larger portions of the coverage area, cheaper or no traffic fees due to low infrastructure deployment costs, or higher aggregate capacity for many simultaneous users.[6].

6. References

[1] PREETI JAIN, "4G Technology" in "*engineers garage"*

http://www.engineersgarage.com/articles/4G-technology.

[2] GHASSAN A. ABED MAHAMOD ISMAIL KASMIRAN JUMARI:"The Evolution to 4G Cellular Systems: Architecture and Key Features of LTE-Advanced Networks" in IRACST.

[3] H. Holma, and A. Toskala, "WCDMA for UMTS," Volume 4, Wiley Online Library.

[4] SHIPRA GUPTA, SUPRIYA SHAKYA & HIMANSHU TYAGI "The 4G Technology V/S other G Technologies" in International Journal of Advanced Research in Computer Science and Software Engineering-2013

[5] http://www.orissabarta.com/index.php?option=com_content&view=article&id=9479:difference-between-1g-2g-25g-3g-pre-4g-and-4g&catid=43:education&Itemid=86

[6] PANKAJ SHARMA "Evolution of Mobile Wireless CommunicationNetworks-1G to 5G as well as Future Prospective of Next Generation Communication Network" in IJCSMC, Vol. 2, Issue. 8, August 2013.

[7] http://www.4gamericas.org/index.cfm?fuseaction=page&sectionid=361

[8] http://here4share.blogspot.in/2010/09/1g-2g-3g-moble-services.html

[9] Duda, A. and Sreenan, C.J. (2003). Challenges for Quality of Service in Next Generation MobileNetworks. Proc. of Information Technology & Telecommunications Conference (IT&T)

[10] Toh, C. K. 2002. Ad Hoc Mobile Wireless Networks: Protocols and Systems. Prentice Hall, New Jersey,USA. Engineering and Innovative Technology (IJEIT) 1 (1): 26-30

[11] Patil, S., Patil, V. and Bhat, P. (2012). A Review on 5G Technology. International Journal of

[12] http://123seminarsonly.com/seminar-Reports/012/63854282-5G.pdf