EVOLUTION OF 5 G TECHNOLOGY-A STUDY

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ABSTRACT

To meet the demands in wireless networks, we pave the path for 5G to emerge. 5G is the fifth generation wireless networks which will serve our future mobile communication technology. Stand-out features of this technology include reduced battery consumption, minimum outage probability, lower cost, higher bit rates, higher capacity for many simultaneous users, best signaling and bandwidth efficiency in addition to overcoming of existing limitations. This paper presents the comprehensive study on 5G.
Keywords: VOIP, Dynamic Adhoc Wireless Network, Wireless mesh network

1. INTRODUCTION

The growth in demand from users for better mobile broadband experiences is encouraging the industry to look ahead at how networks can be modified to meet future extreme capacity and performance demands. Though the path towards 2020 has been set out already in our Technology Vision 2020, the growth in the demand will not stop. The combinations of existing and evolving systems which include existing systems like LTE-Advanced and Wi-Fi, coupled with new technology will be involved in the Communications and control beyond 2020. The cellular plans offered worldwide will change with the arrival of 5G. The evolution of 5G technology into the mobile marketplace will create a new revolution in the way international cellular plans are offered.

5G technology is on its way to change the communication way in which most of the users access their handsets. Enhanced level of call volume and data transmission will be made possible with 5G and VOIP enabled gadget with the innovative market giant. With 5G technology, one can connect the mobile phone to a laptop for broadband internet access. 5G will be a technology which will provide all the possible applications, by interconnecting a universal device with most of the pre-existing communication infrastructure devices. In practical, any new generation has to offer significant gain over the existing generation. 5G system enhances today's emerging services with cost and energy efficiency [1]. 5G systems will provide services beyond 4G systems [2] with,

1. Real wireless world with no limitation
2. Pervasive networks providing multiple concurrent data movement paths.
3. Wearable devices with all capabilities,
4. Unified global standard.
5. Smart Radio which allows different radio technologies to share the same spectrum.

2. EVOLUTION OF WIRELESS TECHNOLOGIES

2.1. First-Generation (1G):

The 1st generation was introduced for the voice services in early 1980's based on the Advance Mobile Phone Service (AMPS) [3] technology. All the systems were analog and used frequency division multiple access (FDMA) service scheme. The channel capacity of the 1G system was approximately 30 KHz and frequency band of 824-894 MHz [4].

2.2. Second Generation Systems (2G):

The 2nd generation was pioneered in 1990's based on GSM technology that uses eight channels per carrier with a frame duration of 4.6 milliseconds (ms) [5] and data rate of 22.8 kbps and it was a digital system. It was mainly used for voice communication with extra features like e-mails and SMSs. Time division multiple access (TDMA) and code division multiple access (CDMA) [6] where the digital modulation schemes in 2G with Frequency band of

approximately 850-1900 MHz Family of this generation consists of 2G, 2.5G, and 2.75G.

2.3. Third Generation Systems (3G):
The services of 3G include high-speed mobile access along with Internet Protocol (IP) services. The main features of 3G are wireless web base access, multimedia, email, and video conferencing. The packet switching-based wireless services are made possible in 3G using WCDMA air interface, so that computers, telephones, and other devices may share the same wireless network and the Internet anytime [7]. 3G system offers data rates up to 2 Mbps over 5 MHz channel carrier width, based on the device mobility and spectrum efficiency. The data rate depends on the environment surrounding the device (like 144 kbps in satellite communication, 384 kbps in urban areas). Frequency band allotted for 3G is 1.8 - 2.5 GHz.

2.4. Fourth-Generation Systems (4G):
 4G is an advanced version of 3G and 2G standards. The 3GPP standardized Advanced LTE [8] as future 4G standard. 4G frameworks provide a secure IP-based network along with facilities such as voice, streamed multimedia and data rate higher than previously existing technologies. The new services facilitated in 4G include mobile TV, video chat, HDTV, Multimedia Messaging Service (MMS), and Digital Video Broadcasting (DVB).

2.5. FIFTH GENERATION (5G)
5G is the future mobile communication technology which is not deployed yet. Main challenges for the deployment of a 5G wireless system will be increasing the capacity of the systems and quality of service within the limited frequency spectrum, whose band of frequency ranges from 3GHz to 300GHz and the Bandwidth of 1Gbps or higher. 5G will be a technology which will provide all the possible applications, by interconnecting a universal device and most of the pre-existing communication infrastructure devices. The upgradable terminals enabled with the cognitive radio that will be appropriate in multimode phase will be used as the 5G radio terminals .All the upgradable software will be made available on the internet so that it can be downloaded on the run so that it will be easily approachable. In the 5G networks, more care is needed on the development of the user side terminals which will have the access to the wide range of wireless technologies at the same time and will combine various flows from various technologies. Also, for a given service the terminals will make the ultimate choice from various wireless access network providers. The expectations on 5g include [9]:
•   Better interoperability and more feasibility.
•   Upgraded data coding and modulation techniques.
•   Reduced battery consumption.
•   Minimum-outage probability.
•   Good coverage and higher data rates.
•   More concurrent data movement paths.
•   Higher data rates in mobility.
•   Enhance cognitive radio/SDR Security.
•   Increase system level spectral efficiency.
•   Applications based on World Wide Wireless Web.
•   Full multimedia accessibility.
•   Applications with Artificial Intelligent (AI).
• Fewer traffic fees due to lower infrastructure implementation costs.
•   Smart beam steering antenna systems.

The comparison between all the generations of mobile technologies is given in the table:

Table 1: Comparison of Generations of Mobile Technologies (1G – 5G)

TECHNO LOGY	1G	2G	3G	4G	5G
Evolution	1970 - 1980	1990- 2004	2004- 2010	2010	2015
Freq Band	824- 894 MHz	850- 1900 MHz	1.8-2.5 GHz	2-8GHz	3-300GHz
Speed	2.4K bps	64Kbps	144kb ps- 2Mbps	100Mbps - 1Gbps	Higher than 1Gbps
Signal	Anal og	Digital	Digital	Digital	Digital
Services	Voice Tele phony	Higher capacity packetized data, Digital voice, SMS.	Integrated high quality data , audio and video	Dynamic data access, wearable devices	Dynamic information access, wearable devices with artificial intelligence capabilities.

3. KEY CONCEPTS IN 5G:

Certain key concepts are needed to go beyond 4G wireless communications and reach 5G with its stand-out features such as reduced battery consumption, minimum outage probability, lower cost, higher bit rates, higher capacity for many simultaneous users, best signaling and bandwidth efficiency in addition to overcoming of existing limitations.
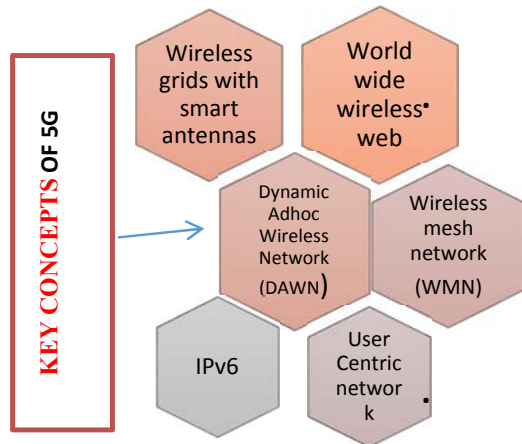

Fig 1: Key Concepts of 5G

Key concepts for 5G wireless communications are:

• Dynamic Adhoc Wireless Network (DAWN) [10], essentially identical to Mobile Adhoc network (MANET), Wireless mesh network (WMN) or Wireless grids [11] along with smart antennas and flexible modulations.

• The Internet Protocol Version6 (IPv6) address will be assigned based on the location and connected network.

• High altitude stratospheric platform station systems (HAPS).

• Actual wireless technology with no limitation for access and zonal issues.

• User-centric network concept in 5G instead of the operator-centric network (as in 3G) or service-centric network (as in 4G).

• World Wide wireless web (WWWW) [12], the wireless-based web applications that include full access to multimedia beyond 4G speed.

4. FEATURES OF 5G:

The extra added features of 5G will act as the point of attraction and make it popular. Such features of 5G are:
• 5G networks will be very fast and highly reliable.

• The concept of handheld devices will be revolutionized with the arrival of 5G. All the services and applications will be accessed by individual IP as gaming, telephony, and many other multimedia applications.

• 5G will provide features like messenger, multimedia applications, photo gallery, telephony, camera, mp3player etc. making no difference between a PC and a mobile phone.

• High speed, high capacity, and low cost per bit. It will support voice, video streaming, interactive multimedia, Internet, and other broadband services.

• It will be bidirectional and provide accurate statistics on traffic.

• The introduction of new radio system will be possible, where the same frequency spectrum is shared by different radio technologies. This can be done by finding a cognitive radio.

• In 5G network, every mobile will have an IP address (IPV6) [13] based on the location and network being used.

• It will support virtual private networks and advanced billing combined together.

• 5G technology may broadcast data in Giga bit that supports nearly 70,000 connections.

• 5G technology will have extraordinary data capabilities and will be able to tie unrestricted call volumes and infinite data broadcast together within the latest mobile operating system.

• 5G Technology will have the extremely high capability to support Software and Consultancy.

• Higher connectivity will be proved by the Router and switch technology in 5G network.

• The 5G technology will distribute internet access to nodes within the building and can be deployed with wired or wireless network connections.

5. OBJECTİVES OF 5G

The main objective of 5G is to have better performance than other wireless technologies. Some other objectives of 5G is shown in the Fig: 2
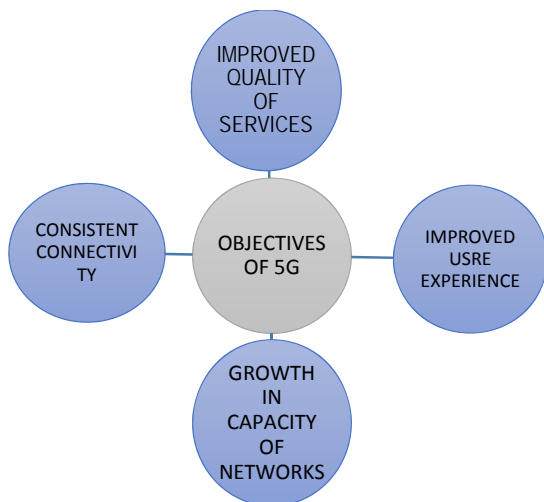
Fig 2: Objectives of 5G

Improve the quality of service and User Experience- Consumer expectations for mobile broadband service quality are increasing in parallel with traffic complexity and increase in usage. Considerable demands on service management are placed by Complex and constantly evolving multivendor networks and services. The focus is shifting towards the management of the delivery of high-quality services i.e., to support service centric and user-centric managements.

Consistent Connectivity - The Capability for instant service availability and adaptability based on-demand will be characterized by an ICT network as the next wave of the Digital Society. The foundation for a whole new set of mobile applications to proliferate and push the capabilities of communications beyond what is currently possible will be laid as an instant immediacy in mobile services. When there would be a provision of higher capacity of network required for handling enormous connections, widespread adoption of M2M services will be encouraged.

Ability to handle innovative Growth in Network Capacity- Server workloads are increasing by 10% a year. Network bandwidth demand is increasing by 35%. Storage capacity is increasing by 50%. The growth of power costs is 20%.The capacity of the networks is to be optimized. Over 1.5 billion Web pages are accessible, 450,000 iPhone applications are being accessed, over 200,000 Android applications are being used, and 10,500 radio stations are existing. All drives demand IT.

6. CONCLUSION

In this paper, a comprehensive study on 5G is presented. The fifth generation which is based on 4G technologies is expected to be released around 2020. The 5G technologies include all kinds of an advanced feature such as an extension to higher frequency bands, flexible spectrum usage, advanced multi-antenna transmission, user/control separation, and lean design, device-to-device communication which makes 5G mobile technology most powerful and demanding in near future. 5G technology with more artificial intelligence will interconnect the entire world without limits. The universal wireless world with uninterrupted information access, communication and entertainment will open a new dimension to our lives and change our lifestyle significantly.

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