

# An Overview of 5G Wireless Cellular Technologies

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**Abstract-** 5G technology stands for fifth Generation Mobile technology. From generation 1G to 2G and from 3G to 5G this world has revolutionized by improvements of wireless network. This revolution brought up some drastic changes in our social life. This paper also focuses on all preceding generations of mobile communication along with fifth generation technology. Fifth generation network provide cost-effective broadband wireless connectivity (very high speed), which will be probably 1gigbit per second Speed. The paper throws light on network architecture of fifth generation technology. Currently 5G term is not officially used. Fifth generation negotiate on (Voice over IP) VOIP-enabled devices that user will get a high level of call volume and data transmission. Fifth generation technology will be done all the requirements of customers who always want advanced features in cellular phones. The main features in 5G mobile network is that user connect to the multiple wireless technologies at the same time and can switch between them. This forthcoming mobile technology will support IPv6 and flat IP. Fifth generation technology will offer the services like Documentation, supporting electronic transactions (e-Payments, e-transactions) etc. Index Terms— 5G, 5G Architecture, Evolution from 1G to 5G, Comparison of all Generations.

**Key Words:** Wireless Communication, Cellular Networks, 5G.

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## I. INTRODUCTION

Wireless communication has started in early 1970s. In next four decades, a mobile wireless technology has evolved from 1G to 5G generations [1-3]. Fifth generation encompasses high speed standard and protocols where a user never experienced before. The Fifth generation technologies offer various new advanced features which makes it most powerful and in huge demand in the future. Presently the planet is driven by 4G (UMTS-Universal Mobile Telecommunication System, cdma2000), LTE (Long Term Evolution), Wi-Fi (IEEE 802.11 wireless networks), WiMAX (IEEE 802.16 wireless and mobile networks), as well as sensor networks, or personal area networks (e.g. Bluetooth, ZigBee) [4-8]. Mobile terminals include variety of interfaces like GSM which are based on circuit switching. All wireless and mobile networks implements all- IP principle, that means all data and signaling will be transferred via IP (Internet Protocol) on network layer. Fifth generation technology will have support like camera, MP3 recording, video player, large phone memory, audio player etc. that user never imagine and for children rocking fun with Bluetooth technology and Pico nets. The fifth generation wireless mobile multimedia internet networks can be completely wireless communication without limitation, which makes perfect wireless real world – World Wide Wireless Web

(WWW). Fifth generation is based on 4G technologies. The 5th wireless mobile internet networks are real wireless world which shall be supported by LAS- CDMA(Large Area Synchronized Code Division Multiple Access), OFDM (Orthogonal frequency-division multiplexing), MCDMA (Multi-Carrier Code Division Multiple Access), UWB (Ultra-wideband), Network-LMDS (Local Multipoint Distribution Service), and IPv6 [9]. Fifth generation technologies offers tremendous data capabilities and unrestricted call volumes and infinite data broadcast together within latest mobile operating system. Fifth generation should make an important difference and add more services and benefits to the world over 4G [10]. Fifth generation should be more intelligent technology that interconnects the entire world without limits. This generation is expected to be released around 2020. World of universal, uninterrupted access to information, entertainment and communication will open new dimension to our lives and change our life style significantly.

## II. EVOLUTION OF WIRELESS TECHNOLOGIES

Mobile communication has become more popular in last few years due to fast revolution in mobile technology [11].

This revolution is due to very high increase in telecoms customers. This revolution is from 1G- the first generation, 2G- the second generation, 3G- the third generation, and then the 4G- the fourth generation, 5G- the fifth second generation.

**A.** First Generation (1G) 1G emerged in 1980s. It contains Analog System and popularly known as cell phones. It introduces mobile technologies such as Mobile Telephone System (MTS), Advanced Mobile Telephone System (AMTS), Improved Mobile Telephone Service (IMTS), and Push to Talk (PTT). It uses analog radio signal which have frequency 150 MHz, voice call modulation is done using a technique called Frequency-Division Multiple Access (FDMA) [12]. It has low capacity, unreliable handoff, poor voice links, and no security at all since voice calls were played back in radio towers, making these calls susceptible to unwanted eavesdropping by third parties.

**B.** Second Generation (2G) 2G emerged in late 1980s. It uses digital signals for voice transmission and has speed of 64 kbps. It provides facility of SMS (Short Message Service) and use the bandwidth of 30 to 200 KHz. Next to 2G, 2.5G system uses packet switched and circuit switched domain and provide data rate up to 144 kbps. E.g. GPRS, CDMA and EDGE [13-16].

**C.** Third Generation (3G) it uses Wide Band Wireless Network with which clarity is increased. The data are sent through the technology called Packet Switching. Voice calls are interpreted through Circuit Switching. Along with verbal communication it includes data services, access to television/video, new services like Global Roaming. It operates at a range of 2100MHz and has a bandwidth of 15-20MHz used for High-speed internet service, video chatting. 3G uses Wide Band Voice Channel that is by this the world has been contracted to a little village because a person can contact with other person located in any part of the world and can even send messages too.

**D.** Fourth Generation (4G) 4G offers a downloading speed of 100Mbps. 4G provides same feature as 3G and additional services like Multi-Media Newspapers, to watch T.V programs with more clarity and send Data much faster than previous generations. LTE (Long Term Evolution) is considered as 4G technology. 4G is being developed to accommodate the QoS and rate requirements set by forthcoming applications like wireless broadband access, Multimedia Messaging Service (MMS), video chat, mobile TV, HDTV content, Digital Video Broadcasting (DVB), minimal services like voice and data, and other services that utilize bandwidth.

### III. COMPARISION OF 1G TO 5G

Various generations are compared in Table 1 in terms of data bandwidth, multiplexing, switching and core network.

**Table 1: Comparison of Generations.**

Contents	1G	2G	3G	4G	5G
START	1970	1990	2004	NOW	2020
DATA BW	2kbps	64kps	2Mbps	1Gbps	>1Gbps
MULTIPLEX	FDMA	TDMA	CDMA	CDMA	CDMA
SWITCHING	CIRCUIT	CIRCUIT	PACKET	ALL PACKET	ALL PACKET
CORE NETWORK	PSTN	PSTN	PACKET N/W	INTER NET	INTER NET

### IV. 5G ARCHITECTURE

Fifth generation mobile systems model is all-IP based model for wireless and mobile networks interoperability. The All-IP Network (AIPN) is capable to fulfill increasing demands of the cellular communications market. It is a common platform for all radio access technologies [12]. The AIPN uses packet switching and its continuous evolution provides optimized performance and cost. In fifth generation Network Architecture consist of a user terminal (which has a crucial role in the new architecture) and a number of independent, autonomous radio access technologies (RAT) [13]. In 5G network Architecture, all IP based mobile applications and services such as Mobile portals, Mobile commerce, Mobile health care, Mobile government, Mobile banking and others, are offered via Cloud Computing Resources (CCR). Cloud computing is a model for convenient on-demand network access to configurable computing resources (e.g., networks, servers, storage, applications, and services) [14-19]. Cloud computing allows consumers to use applications without installation and access their personal data at any computer with internet access. CCR links the Reconfigurable Multi Technology Core (RMTC) with remote reconfiguration data from RRD attached to Reconfiguration Data models (RDM). The main challenge for a RMTC is to deal with increasing different radio access technologies. The core is a convergence of the nanotechnology, cloud computing and

radio, and based on All IP Platform as shown in Figure 1. Core changes its communication functions depending on status of the network and/or user demands. RMTC is connected to different radio access technologies ranging from 2G/GERAN to 3G/UTRAN and 4G/EUTRAN in addition to 802.11x WLAN and 802.16x WMAN. Other standards are also enabled such as IS/95, EV- DO, CDMA2000...etc. Interoperability process-criteria and mechanisms enable both terminal and RMTC to select from heterogeneous access systems.

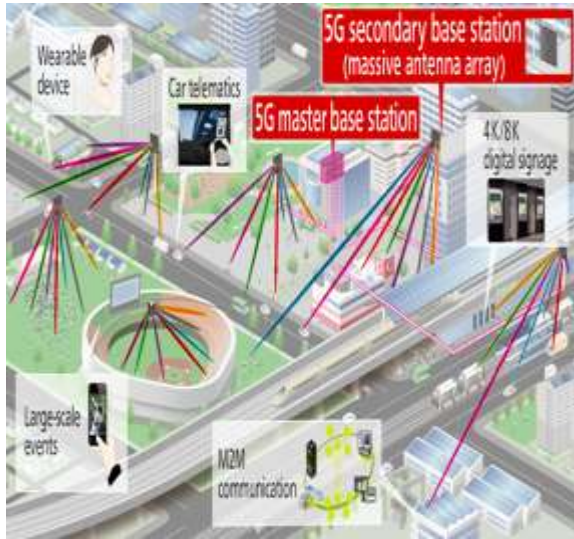


Figure 1: Basic Architecture of 5G

## V. CLOUD COMPUTING

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” a definition from. Hence, cloud computing is a technology that uses the internet and central remote server to maintain data and applications. In 5G networks this central remote server could be a 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 multi -core technology where the user tries to access his private account form a global content provider through cloud computing.

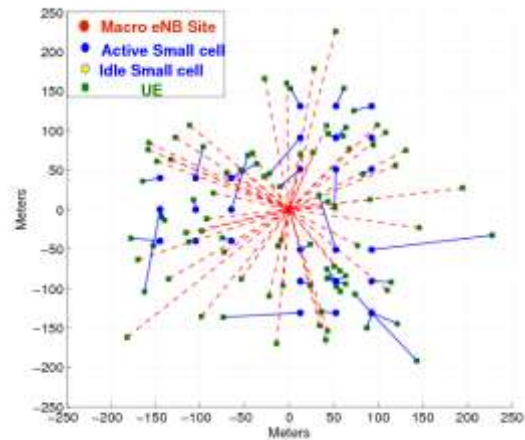


Figure 2: Active-idle Cell Range

## VI. QUALITY OF SERVICE

Next Generation Networks (NGN) consists of support functionalities for data transport, and control transport, as well as functionalities for support of latency, error rate and uptime. Quality of service also involves controlling and managing network resources by setting priorities for specific types of data (video, audio, files) on the network. QoS is exclusively applied to network traffic generated for video on demand, VoIP, streaming media, videoconferencing and online gaming. The primary goal of quality of service is to provide priority to networks, including dedicated bandwidth, controlled jitter, low latency and improved loss characteristics. Its technologies supply the elemental building blocks that will be used for future business applications in campus, wide area networks and service provider networks. There are three fundamental components for basic QoS implementation:

- Identification and marking techniques for coordinating QoS from end to end between network elements.
- QoS within a single network element.
- QoS policy, management, and accounting functions to control and administer end-to-end traffic across a network. The internet of Things covers these aspect as shown in Figure 3 [20-25]

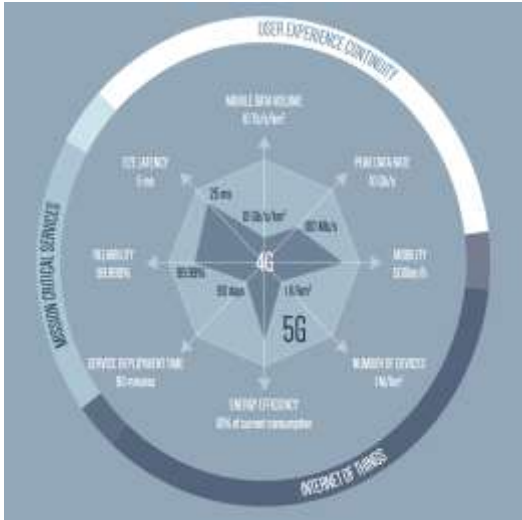


Figure 3: User Experience-Internet of Things

## VII. WHY 5G?

Very High speed, high capacity, and low cost per bit. It supports interactive multimedia, voice, video, Internet, and other broadband services, more effective and more attractive, and have Bi-directional, accurate traffic statistics. 5G technology offers Global access and service portability. It offers the high quality services due to high error tolerance. It is providing large broadcasting capacity up to Gigabit which supporting almost 65,000 connections at a time [26-38]. More applications combined with artificial intelligent (AI) as human life will be surrounded by artificial sensors which could be communicating with mobile phones. 5G technology use remote management that user can get better and fast solution. The uploading and downloading speed of 5G technology is very high. • 5G technology offer high resolution for crazy cell phone user and bi-directional large bandwidth shaping. • 5G technology offer transporter class gateway with unparalleled consistency.

## VIII. CONCLUSION

The development of the mobile and wireless networks is going towards higher data rates and all-IP principle. Mobile terminals are obtaining each year more processing power, more memory on board, and longer battery life for the same applications. 5G include latest technologies such as cognitive radio, SDR, nanotechnology, cloud computing and based on All IP Platform. It is expected that the initial Internet

philosophy of keeping the network simple as possible, and giving more functionalities to the end nodes, will become reality in the future generation of mobile networks, here referred to as 5G.

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