Scientific Journal Impact Factor (SJIF): 1.711

e-ISSN: 2349-9745
p-ISSN: 2393-8161

International Journal of Modern Trends in Engineering and Research
www.ijmter.com

A Survey on new generation of wireless networks

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Abstract: If you think that 4G and LTE is the best thing and it's in the process of solving every communication needs we have today, think again! Yes, LTE is good, but it can be a lot better. In fact, get ready for this: the wireless industry is already starting to think 5G (5th generation) wireless technology**.**

Keywords: - 4G, LTE, 5G, LTE-A, WI-MAX, W-CDMA.

I. Introduction

The Fifth generation of wireless network likely to appear after the full deployment of 4G wireless networks. A new mobile generation appear approximately after every 10th year since the 1G (1981). The current 4G system started from 2001 or 2002. So it is expected that 5G will be started from 2020. In every generation we have a new frequency band like for 1G(NMT) we have 30 kHz, for 2G(GSM) we have 200 kHz, for 3G(W-CDMA / FOMA or IMT-2000 / UMTS) we have 20 MHz and for 4G(LTE-Advance / WI-MAX 2.0) we have 100 MHz. We expect a 10 Gbps peak data rates with 8~10 bps/Hz/cell for the 5G, moreover, energy efficiency concepts will be fully integrated into future wireless communication systems to protect the environment..Previous mobile generations have implied substantial increase in peak bit rate (i.e. physical layer net bitrates for short-distance communication), up to 1 Gbit/s to be offered by 4G.The major difference from a user point of view between 4G and 5G techniques must be something else than increased peak bit rate; for example higher number of simultaneously connected devices, higher system spectral efficiency (data volume per area unit), lower battery consumption, lower outage probability (better coverage), high bit rates in larger portions of the coverage area, lower latencies, higher number of supported devices, lower infrastructure deployment costs, higher versatility and scalability or higher reliability of communications.

1.1 Objectives

These are the objectives in several of the research papers below.

(1) In 2008, the South Korean IT R&D program of "5G mobile communication systems based on beam-division multiple access and relays with group cooperation" was formed.

(2) In Europe, Neelie Kroes, the European Commissioner, committed in 2013 50 million Euros for research to deliver 5G mobile technology by 2020. *[2]* In particular, The METIS 2020 Project aims at reaching world-wide consensus on the future global mobile and wireless communications system. The METIS overall technical goal is to provide a system concept that supports 1000 times' higher mobile system spectral efficiency as compared with current LTE deployments.

(3) In addition, in 2013 another project has started, called 5GrEEn, linked to project METIS and focusing on the design of Green 5G Mobile networks. Here the goal is to develop guidelines for the definition of new generation network with particular care of energy efficiency, sustainability and affordability aspects.

Our objective is to provide some definition of 5G technology based on the different research outcomes in field of 5G mobile communication technologies.

1.2 History

(1)In 2008, the South Korean IT R&D program of "5G mobile communication systems based on beam-division multiple access and relays with group cooperation" was formed. *[1]*

(2)On 8 October 2012, the UK's University of Surrey secured £35M for new 5G research centre, joint funded between the British government's UK Research Partnership Investment Fund (UKRPIF) and a consortium of key international mobile operators and infrastructure providers –including Huawei, Samsung, Telefonica Europe, Fujitsu Laboratories Europe, Rohde & Schwarz, and Aircom International– it will offer testing facilities to mobile operators keen to develop a mobile standard that uses less energy and radio spectrum whilst delivering faster than current 4G speeds, with aspirations for the new technology to be ready within a decade.*[16][17][18][19]*

(3)On 1 November 2012, the EU project "Mobile and wireless communications Enablers for the Twenty-twenty Information Society" (METIS) starts its activity towards the definition of 5G. METIS intends to ensure an early global consensus on these systems. In this sense, METIS will play an important role of building consensus among other external major stakeholders prior to global standardisation activities. This will be done by initiating and addressing work in relevant global for a (e.g. ITU-R), as well as in national and regional regulatory bodies.

(4)On 1 January 2013, the ICT Labs project 5GrEEn (Towards Green 5G Mobile Networks) starts its activity under the EIT framework, and linked with the project carrier METIS.

(5)In February 2013, ITU-R Working Party 5D (WP 5D) started two study items: (1) Study on IMT Vision for 2020 and beyond, and; (2) Study on future technology trends for terrestrial IMT systems.

(6)On 12 May 2013, Samsung Electronics stated that they have developed the world's first "5G" system. The core technology has a maximum speed of tens of Gbps (gigabits per second). In testing, the transfer speeds for the "5G" network sent data at 1.056 Gbit/s to a distance of up to 2 kilometres. [20]

(7)In July 2013, India and Israel have agreed to work jointly on development of fifth generation (5G) telecom technologies. *[21]*

(8)On November 6, 2013, Huawei announced plans to invest a minimum of $600 million into R&D for next generation 5G networks capable of speeds 100 times faster than modern LTE networks. *[22]*

1.3 Background

(a) The first whisperings of 5G began during a press event at Mobile World Congress in 2012, when executives from Telefónica, Alcatel-Lucent and Bell Labs discussed the nascent technology. The first question posed by the audience was: since only a sliver of the world's population has 4G (and only if you stretch the definition of it), what exactly is 5G, and who needs it? *[23]*

(b) "5G is more about providing the services people need at the appropriate quality of service," said Marcus Weldon, CTO of Alcatel-Lucent's wire-line-networks product division. In other words, creating a new speed potential isn't as important as matching the right speed to the right application, which is increasingly important as mankind experiences the "rise of the machines." *[23]*

(c) Mobile traffic today is driven by somewhat predictable activities: making calls, receiving email, surfing the web, and watching videos. Over the next 5 to 10 years, billions of new devices with less predictable traffic patterns will join the network, including cars, machine-to-machine (M2M) modules, video surveillance that requires 24-7 bandwidth, or even a biohazard sensor that sends out tiny bits of data each day. Stir in the effects of the meteoric

rise of cloud computing and it's easy to see why new network strategies will be crucial to the fifth evolution of mobile.

(d) 5G represents a convergence of network access technologies. As Ian Miller, director of radio access networks (RANs) at Telefónica, said at last year's Mobile World Congress, "It's all about how we stick these varying access technologies together seamlessly—right now it's a little clumsy." *[23]*

(e) Additionally, baked into the idea of fifth-generation wireless is customer experience. While past Gs have seemed focused on network abilities, 5G's goal is to always offer the right ability for the right service. "Of course there will be substantial speed increases," said Tod Sizer, head of wireless research at Bell Labs, at Mobile World Congress 2012. However, weaving different access technologies together in a fluid fashion and creating smart gateways that choose the "best" connectivity for a given situation, not to mention in a transparent manner, will be the DNA that gives life to 5G.*[23]*

(f) In May, Samsung announced a breakthrough in 5G: a mobile-phone network that can download a high-definition film in one second. *[23]*

(g) As stated in its press release, "Samsung's latest innovation is expected to invigorate research into 5G cellular communications across the world; the company believes it will trigger the creation of international alliances and the timely commercialization of related mobile broadband services."

(h) 5G mobile, according to Samsung, will transmit data several hundred times faster than 4G networks and enable services like 3-D movies, video games and even medical services. Its solution is a millimetre-wave band technology that transmits data "at a frequency of 28 GHz at a speed of up to 1.056 Gbps [gigabits per second] to a distance of up to 2 kilometres." *[23]*

(i) NTT Docomo has also demonstrated lightning-fast wireless broadband. In both cases, however, these achievements took place in laboratory settings, and over spectrum that isn't yet licensed for cellular use. Whether or not Samsung and NTT Docomo's technologies will fuel the future or just future press releases remains to be seen. *[23]*

II. Proposed definition of 5G

We suggest the definition of 5G based on our survey that is

(i) It can be a IMT-2020 Standard defined by International Telecommunication Union (ITU).
(ii) It can be a real broad band with dynamic ad-hoc mobile communication system.
(iii) It can provide a highest speed for real mobile broadband for the higher user mobility and lower user mobility. Ex. A user can download simultaneously 40 HD movies in a one second.
(iv) It will have a more security features will enables a user to secures their private life as the devices will going to become wearable in any form.

2.1 The key concepts for 5G and beyond 4G wireless communications are:

2.1.1. Massive Dense Networks also known as Massive Distributed MIMO providing green flexible small cells 5G Green Dense Small Cells. A transmission point equipped with a very large number of antennas that simultaneously serve multiple users. With massive MIMO multiple messages for several terminals can be transmitted on the same time-frequency resource, maximising beam-forming gain while minimising interference. *[1][5]*

2.1.2 Advanced interference and mobility management, achieved with the cooperation of different transmission points with overlapped coverage, and encompassing the option of a flexible usage of resources for uplink and downlink transmission in each cell, the option of direct device-to-device transmission and advanced interference

cancellation techniques.*[6][7][8]*

2.2.3 Efficient support of machine-type devices to enable the Internet of Things with potentially higher numbers of connected devices, as well as novel applications such as mission critical control or traffic safety, requiring reduced latency and enhanced reliability.

2.2.4 The usage of millimetre wave frequencies (e.g. up to 90 GHz) for wireless backhaul and/or access (IEEE rather than ITU generations)

2.2.5 Pervasive networks providing Internet of things, wireless sensor networks and *ubiquitous computing*: The user can simultaneously be connected to several wireless access technologies and seamlessly move between them (See Media independent handover or vertical handover, IEEE 802.21, also expected to be provided by future 4G releases. These access technologies can be 2.5G, 3G, 4G, or 5G mobile networks, Wi-Fi, WPAN, or any other future access technology. In 5G, the concept may be further developed into multiple concurrent data transfer paths.*[9]*

2.2.6 Multi-hop networks: A major issue in beyond 4G systems is to make the high bit rates available in a larger portion of the cell, especially to users in an exposed position in between several base stations. In current research, this issue is addressed by cellular repeaters and macro-diversity techniques, also known as group cooperative relay, where also users could be potential cooperative nodes thanks to the use of direct device-to-device (D2D) communications.*[1]*

2.2.7 Cognitive radio technology, also known as smart-radio: allowing different radio technologies to share the same spectrum efficiently by adaptively finding unused spectrum and adapting the transmission scheme to the requirements of the technologies currently sharing the spectrum. This dynamic radio resource management is achieved in a distributed fashion, and relies on software-defined radio. *[10][11]*

2.2.8 Dynamic Ad-hoc Wireless Networks (DAWN), *[12]* essentially identical to Mobile ad hoc network (MANET), Wireless mesh network (WMN) or wireless grids, combined with smart antennas, cooperative diversity and flexible modulation.

2.2.9 Vandermonde-subspace frequency division multiplexing (VFDM): a modulation scheme to allow the co-existence of macro-cells and cognitive radio small-cells in a two-tiered LTE/4G network.*[13]*

2.2.10 IPv6, where a visiting care-of mobile IP address is assigned according to location and connected network.*[9]*

2.2.11 Wearable devices with AI capabilities.*[12]* such as smart watches and optical head-mounted displays for augmented reality

2.2.12 One unified global standard.*[12]*

2.2.13 *Real wireless world* with no more limitation with access and zone issues.*[9]*

2.2.14 *User centric* (or *cell phone developer initiated*) network concept instead of operator-initiated (as in 1G) or system developer initiated (as in 2G, 3G and 4G) standards.*[14]*

2.2.15 Li-Fi, or light fidelity, is a massive MIMO visible light communication network to advance 5G. Li-Fi uses light-emitting diodes to transmit data, rather than radio waves like Wi-Fi.*[15]*

2.2.16 *Worldwide wireless web* (WWWW), i.e. comprehensive wireless-based web

applications that include full multimedia capability beyond 4G speeds.[12]

III. Applications

5G technology including camera, MP3 recording, video player, large phone memory, dialling speed, audio player and much more you never imagine. For children rocking fun Bluetooth technology and Pico nets has become in market.

IV. Features

5G (5th generation) technology offers high resolution for crazy cell phone user and bi-directional large bandwidth shaping.

- The advanced billing interfaces of 5G technology makes it more attractive and effective.
- 5G technology also providing subscriber supervision tools for fast action.
- The remote diagnostics also a great feature of 5G technology.
- The 5G technology is providing up to 25 Mbps connectivity speed.
- The high quality services of 5G technology based on Policy to avoid error.
- 5G technology is providing large broadcasting of data in Gigabit which supporting almost 65,000 connections.
- 5G technology offer transporter class gateway with unparalleled consistency.
- The traffic statistics by 5G technology makes it more accurate.
- The new 5G technology will take all delivery service out of business prospect
- Through remote management offered by 5G technology a user can get better and fast solution.
- The 5G technology also support virtual private network.
- The uploading and downloading speed of 5G technology touching the peak.
- The 5G technology network offering enhanced and available connectivity just about the world.
- 5G network is very fast and reliable.

V. Challenges

With the IMT-Advanced (IMT-A) standards ratified by the International Telecommunications Union in November 2010 and IMT-A, i.e. the fourth generation (4G), wireless communication systems being deployed in the world, the fifth generation (5G) mobile and wireless communication technologies are emerging into research fields. Based on the Internet Protocol architecture of 4G communication systems, unprecedented numbers of smart and heterogeneous wireless devices will be accessing future 5G mobile and wireless communication systems with a continuing growth of Internet traffic. Therefore, compared with 4G communication systems, significantly higher wireless transmission rates are expected in 5G communication systems, such as 10 Gbps peak data rates with 8~10 bps/Hz/cell. Moreover, energy efficiency concepts will be fully integrated into future wireless communication systems to protect the environment.

To meet the above challenges, 5G mobile and wireless communication systems will require a mix of new system concepts to boost spectral efficiency, energy efficiency and the network design, such as massive MIMO technologies, green communications, cooperative communications and heterogeneous wireless networks. We expect to explore the prospects and challenges of 5G mobile and wireless communication systems combining all of the above new designs and technologies.

VI. Proposed architecture for 5G mobile networks

The proposed architecture is based on cognitive radio by which device can determine its location and location information like temperature, environment (free space, flat or smooth surface etc), sense spectrum used by neighbouring device, change frequency, adjust output power and even

alter transmission parameters and characteristics. A cognitive radio is transceiver (beam) that is able to understand and respond to its operating environment. Thus cognitive radio concerns mobile devices and networks which are computationally intelligent about resources and related communication to explore user communication needs and provide wireless services, be appropriate to those needs. *[24]*

The main component will be (1) RAN (2) Different Access Technology (3) Big Data platform.

6.1 All spectrum access:

New Design for all-Spectrum radio access nodes will require breakthroughs in fundamental radio technologies like the air interface, RAN, radio frequency, transceiver and devices. New radio backhaul and new fibber access for the fixed network will be an integral part of next generation commercial network solutions. The following figure shows a overview of 5G radio Network architecture. *[25]*

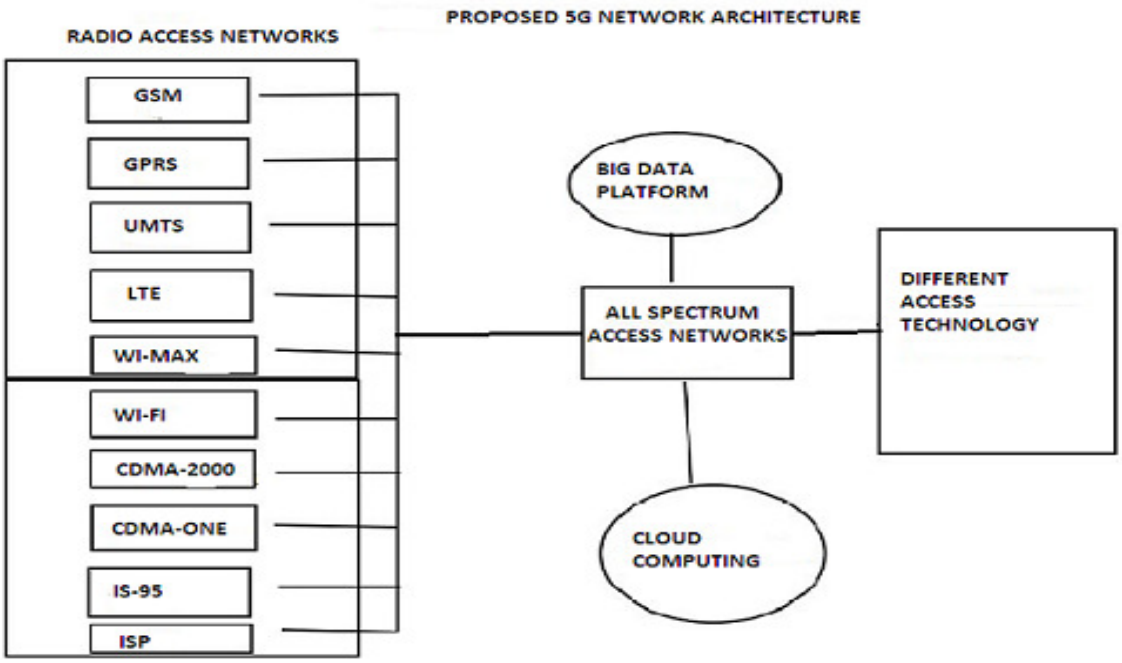

Fig.1.1 The proposed 5G networks architecture

VII. Conclusion

In this paper we have discussed the existing and future wireless mobile communication generation. We proposed network architecture for the 5G mobile network in which we included RAN, Cloud computing, big data platform, and different access technologies.

VIII. Future Enhancement

5G network technology will reveal a new era in mobile communication technology. There are so many networking concepts available which can take part in the 5G network. In future we will include these concepts in the 5G network that will enhance the use of 5G.

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