

5G WIRELESS NETWORK- ARCHITECTURE AND TECHNOLOGY

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ABSTRACT

Today and the recent future i.e. beyond 4G, we can introduce the new technology i.e. 5G wireless technology because of some of the demands that need to be addressed are high capacity, improve transmission data rate, decreased latency and better quality of service. To meet these demands, some of the new technologies are used in 5G wireless network. The technologies are interference management, spectrum sharing with cognitive radio, ultra-dense network, multi-radio access technology association, full duplex radios, millimeter wave solution for 5G cellular networks, and cloud technologies for radio access networks. 5G technology can serve as a flexible platform and will ensure the coverage of hardware, technologies, application and service. In this paper presents the results of a detailed study on the fifth generation (5G) cellular network architecture and some of the new technologies that are helpful in improving the architecture and meeting the demands of users.

Keyword: - 1G, 2G, 3G, 4G, 5G, Quality of service, GSM.

1. INTRODUCTION

5G cellular technology is a very high level technology. User never experienced ever before such a high level technology. The 5G technology include all type of advanced features which make 5G technology most powerful and in huge demand in near future. 5G technology has a glowing future in the current trend because of the router and switch technology used in 5G wireless network providing high connectivity as well as 5G technology distribute internet access to node within the building and also the 5G terminals will have software defined radios, modulation schemes, error-control schemes that can downloaded from internet.

With the emergence of cell phones, in the near future there is the infrared features i.e. you can share data within a line of sight that means the two devices has to be aligned properly to transfer data, but in case of Bluetooth you can transfer data even when you have the cell phone in your pocket up to a range of 50 meter. The wireless based networks of today will have to advance in various ways. Recent technology components like high-speed packet access (HSPA) and long-term evolution (LTE) will be launched as a segment of the advancement of current wireless based technologies.

Now In this digital world we have different technologies such as wireless and mobile technologies, which are vastly developed, like 3G mobile networks (UMTS, cdma2000), LTE (Long Term Evolution), Wi-Fi (IEEE 802.11 wireless networks), WiMAX (IEEE 802.16 wireless and mobile networks), also a accompanying networks, like a sensor networks, or personal area networks (e.g., Bluetooth, ZigBee).

2. EVOLUTION OF WIRELESS TECHNOLOGIES i.e. 1G TO 5G

An Italian inventor, G. Marconi, open the path of new technologies and recent day wireless communications by communicating the letter 'S' along a distance of 3Km in the form of three dot Morse code with the help of electromagnetic waves. After this inception, wireless communications have become an important part of now a days. Beginning of evolution and the emerging technologies are here and is shown in Fig. 1.

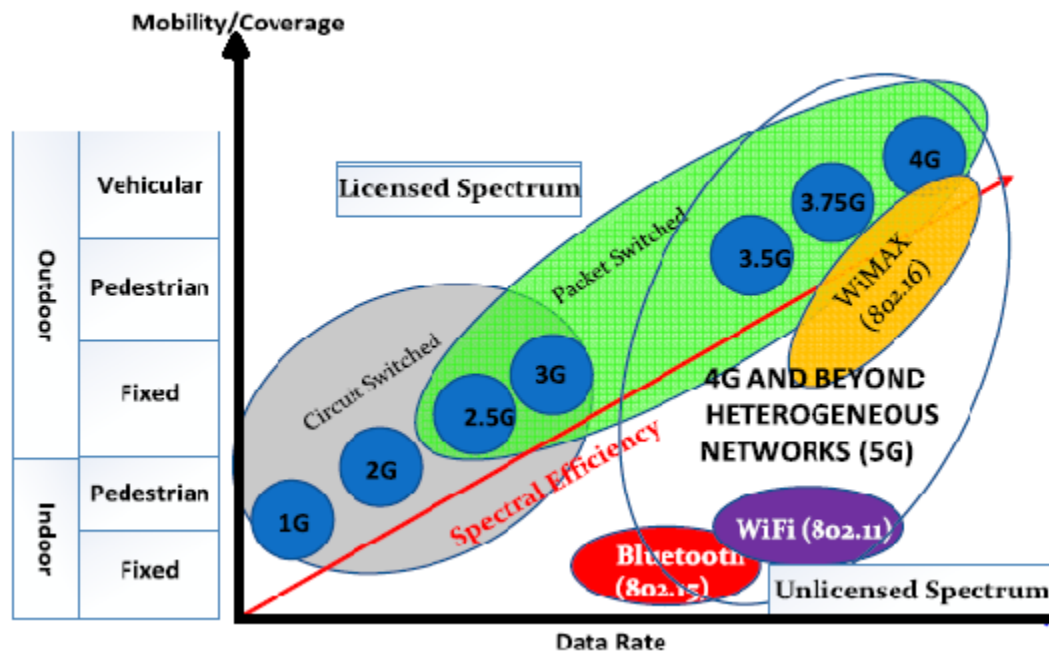


Fig -1: Evolution of Wireless Technology

The above fig -1 shows that the evolving generations of wireless technologies in terms of data transmission rate, mobility, coverage and spectral efficiency. Above figure also shows that the 1G and 2G technologies use circuit switching while 2.5G and 3G uses both circuit and packet switching and the next generations from 3.5G to now i.e. 5G are using packet switching. Along with these factors, it also differentiates between licensed spectrum and unlicensed spectrum. The licensed spectrum used all the evolving generations while the unlicensed spectrums are used Wi-Fi, Bluetooth and WiMAX.

2.1 1st Generation

The 1st generation was introduced in 1980's. It was old analog system and supported the 1st generation of analog mobile phones, which has a data rate up to 2.4kbps. Advanced Mobile Phone System (AMPS), Nordic Mobile Telephone (NMT), and Total Access Communication System (TACS) this is some of major subscribers was launched by US and is a 1G mobile system.

2.2 2nd Generation

In 1990's the 2nd generation was introduced which provides services like Short Message Service (SMS), text messages, picture messages and e-mail. Some important technologies were GSM, Code Division Multiple Access (CDMA), and IS-95 is used in 2nd generation mobile system. Data rate is up to 64 kbps.

2.3 3rd Generation

The mobile phones and mobile telecommunications services is a generation of standards of International Mobile Telecommunications-2000 (IMT-2000), is also known as 3rd generation which established late 2000. 3G includes the introduction and utilization of Wideband Code Division Multiple Access (WCDMA), Universal Mobile Telecommunications Systems (UMTS) and Code Division Multiple Access (CDMA) 2000 technologies, the evolving technologies like High Speed Uplink/Downlink Packet Access (HSUPA/HSDPA) and Evolution-Data Optimized (EVDO). It imparts transmission speeds from 125kbps to 2Mbps.

2.4 4th Generation

4G is introduced or established around 2010 – 2015. The 3G and 2G standards are generally referred to as the descendants of 4G. There are some advantages of 4G technology such as voice, data and multimedia will be imparted to subscribers on every time and everywhere as well as Applications of 4G network are Multimedia Messaging Service (MMS), Digital Video Broadcasting (DVB), and video chat, High Definition TV content and mobile TV.

2.5 5th Generation

By the demand of the users or customers, 4G will now be easily converted with 5G which have Lots of advanced emerging technology such as Beam Division Multiple Access (BDMA) and Filter Bank multi carrier (FBMC) multiple accesses. The main reason behind an idea to shift towards 5G is based on current drifts, is considered that 5G cellular networks must address six challenges that are not effectively addressed by 4G i.e. high level capacity, increased data rate, lower End to End latency, massive number of connection, sustainable cost and Quality of Experience. These challenges are listed below:

- Capacity - x1000
- Data rate - x10-100
- End to End latency - < 5ms
- Massive number of connection - x10-100
- Cost - lower
- Quality of Experience(QoS) – Consistent

Some standards are very helpful such as IEEE 802.11ac, 802.11ad and 802.11af which act as a building block in the road towards 5G. 5G is a packet switched wireless system with wide area coverage and high throughput as well as 5G wireless uses OFDM and millimeter wireless that enables data rate of 20 mbps and frequency band of 2-8 GHz. 5G is going to be a packed based network. 5G technology is very high level technology it will provide high speed and better coverage than the current 4G as well as signaling efficiency should be enhanced.

3. NETWORK ARCHITECTURE FOR 5G MOBILE TECHNOLOGIES

5G cellular network architecture are use some new technologies like OFDMA and massive MIMO.

3.1 OFDMA

OFDMA stands for orthogonal frequency division multiplexing access. It is addition of an application which done at the fundamental network to meet the user requirement. The OFDMA technology will work at least for next 50 years. The wireless setup which had come about from 1G to 4G has not needed to change. The fifth-generation advancement made in the mobile communication field. The orthogonal frequency division multiplexing (OFDM) is used to comprise packet switched wireless system with wide area coverage, high throughput at millimeter waves (10 mm to 1 mm). To overcome the challenges and meet the demands of the user it has been put forward in the 5G system.

3.2 Massive MIMO

Massive MIMO is an emerging technology which is upgraded from the current MIMO technology. Massive MIMO technology extract all the benefits of MIMO on a larger scale this is an important objective of massive MIMO technology. It also uses the arrays of antenna which contain few hundred of antennas which are at same time in one time. Massive MIMO is generally used an emerging technology of next generation networks, which is energy efficient, robust, secure and spectrum efficient. To develop the large number of massive MIMO network, firstly the outside base stations which can be fitted with number of antenna arrays and they linked to the based station through optical fiber cables, using massive MIMO technologies. Secondly, large antenna arrays in stalled with every building from outside, the help of line of sight use with outdoor base stations for communication.

Since the 5G cellular architecture is explained in detailed and it is heterogeneous, so it must include microcells, macro cells, small cells, and relays. A mobile small cell concept partially comprises of mobile relay and small cell

and a mobile device is an integral part of 5G wireless cellular network. The 5G cellular network has equal importance in terms of front end and back end network respectively. In this paper, a general 5G cellular network architecture is as shown in Fig. -2

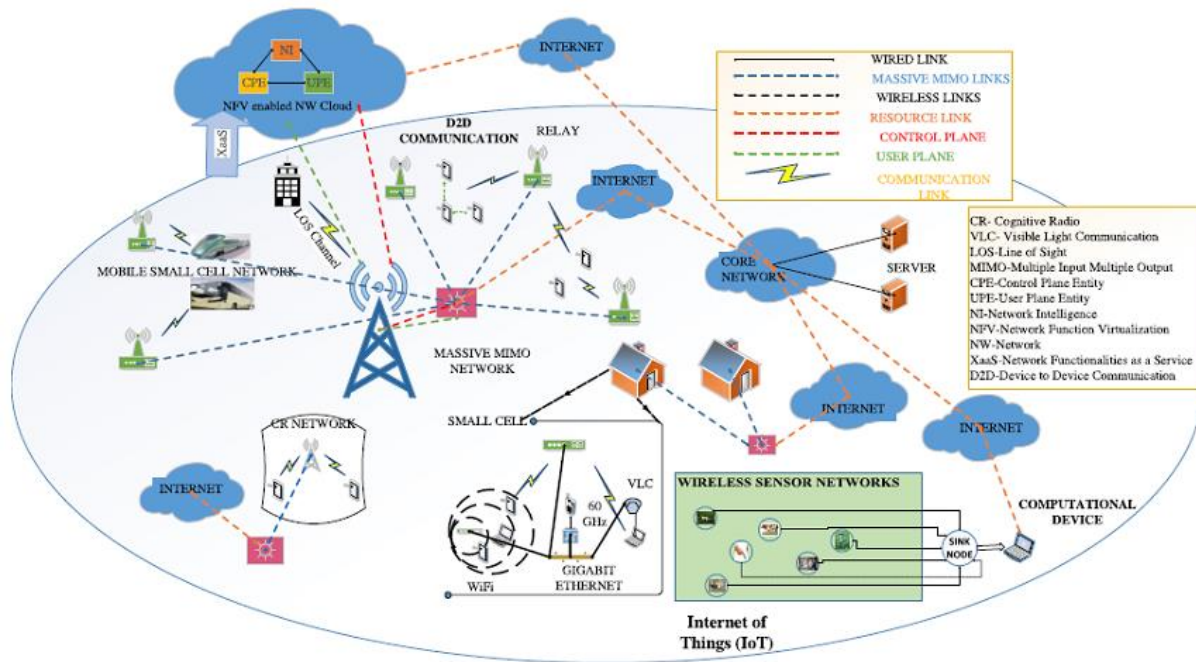


Fig -2: A general architecture of 5G cellular technology

The above 5G cellular network architecture shows the interconnectivity between the different current technologies such as Massive MIMO network, Cognitive Radio network, mobile and static small-cell networks. In this section the proposed architecture introduced the most promising emerging technologies that are listed below:

- network function virtualization (NFV)
- cooperative communications
- Automated network organization
- Flexible backhauling
- Advanced traffic management and offloading

The concept of Device to Device (D2D) communication, small cell access points and Internet of things (IoT) has also been important in this 5G cellular network architecture. In general, this proposed 5G cellular network architecture may provide a flexible platform for future 5G standardization network.

4. SYMBOLS

Table -1: Symbols

| | |
|-------|---|
| HSPA | High-Speed Packet Access |
| LTA | Long-Term Evolution |
| UMTS | Universal Mobile Telecommunications Systems |
| WiMAX | Worldwide Interoperability For Microwave Access |
| CDMA | Code Division Multiple Access |
| WWW | World Wide Wireless Web |
| EVDO | Evolution-Data Optimized |
| BDMA | Beam Division Multiple Access |
| FBMC | Filter Bank Multi Carrier |

| | |
|-------|--|
| OFDM | Frequency Division Multiplexing |
| PSTN | Public Switched Telephone Network |
| TDMA | Time Division Multiple Access |
| WAP | Wireless Application Protocol |
| WCDMA | Wideband Code Division Multiple Access |

5. FEATURES OF 5G TECHNOLOGY

To study some different research papers on 5G technology, the main features the technologies are as follows:

- 1000 times more devices which have High speed, high capacity, and low cost per bit and also increased data volume per area.
- 10 to 100 times increased number of connected devices which Support interactive multimedia, voice, streaming video, Internet, and other broadband services, more effective and more attractive, Bidirectional, accurate traffic statistics.
- 10 to 100 times increased typical user data rate as well as wide range of application.
- It is not only more software option but also 10 times extended battery life for low power Massive Machine Communication (MMC) devices.
- Reduced End-to-End (E2E) latency or virtually '0' latency.
- Very high capacity as well as response time is faster.

6. CONCLUSION

In this paper we study the 5G wireless cellular communication system which describes the requirements such as capacity, data rate, spectral efficiency, latency, energy efficiency, and Quality of service. This paper also introduced some emerging technologies like massive MIMO technology, network function virtualization (NFV) cloud and device to device communication. Migration to 5G networks ensures convergence of networks, technologies, applications and services. 5G wireless technology is one of the high demand technology because of the message what your brain thinks can automatically type in your mobile. 5G is a promising Generation of wireless communication that will change people's lives.

7. REFERENCES

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