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A COMPREHENSIVE STUDY ON 5th GENERATION MOBILE COMMUNICATION

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ABSTRACT

Currently, the fourth generation cellular communication provides a low latency that is insufficient. It is unable to cope up with the future requirements. The future is the enhanced version of today. Various aspects that are to be considered in the next generation of mobile communication are enormous unprocessed raw facts and figures, better data rates, increment in mobile devices etc. This technology is termed as 5G. This paper draws its attention on the advancements towards the improvement considered as the improved version of 4g i.e.5g. We discuss the comparative study that tells the evolution of previous generations in the case of cellular communication as well as the major limitations of 4g. All of these features will improve the performance scenario and will result in a better tomorrow.

Keywords: 5th Generation, Large Scale Antenna System, 3-D Spectrum, Progression.

I. INTRODUCTION

It appears from the current rate of requirement growth that the enormous requirements of the wireless data transmission can never end. Sometimes, the factor can be latency or sometimes it can be data rates. This certainly shows that the 4th generation of mobile communication is insufficient in coping up with the demands of the present generation. This emerges a requirement of an advanced version of the current version basically termed as 5th generation of mobile communication or in short 5G. There is a 3-D spectrum (Fig.1) that contains Device, Data and Data transfer rates that heads to the enlargement of 5G mobile communication. This is so because, by 2020 the statistics believed that the cellular web/network services would be used by more than 50 billion connected devices and smart objects/devices are in the Internet of Things (IOT) scenario.

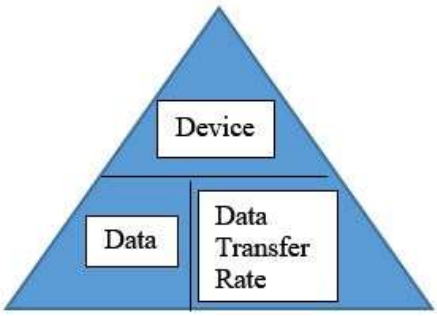

Fig.1 the 3-D Spectrum responsible for 5G

According to the forecasting department, billions of global networked devices will be there in between the year (2014-2019) [2]. The Fig.2 is depicting the CISCO's Visual Network Index (2015) concerning forecasting of billion global networked devices.

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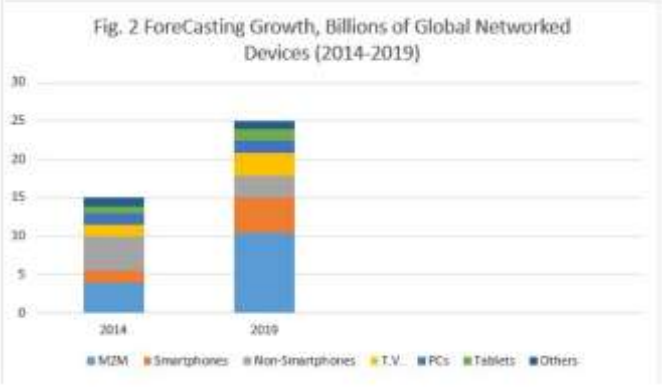

Fig. 2 Forecasting Growth, Billions of Global Networked Devices (2014-2019)

The vision of Fig.2 pertaining succeeding years depicts that the world will follow a networked culture that will allow the accessibility of the unprocessed raw facts and figures any moment and by anyone [5]. The future essentials will be fulfilled with the incorporation of present world technologies such as Long Term Evolution, Wireless fidelity, High Speed Packet Access or 3rd generation Partner Ship Project abbreviated as LTE, Wi-Fi, HSPA, 3GPP, respectively.

II. PROGRESSION OF WIRELESS NETWORKS

It can be depicted with the following illustration (Fig.3) that tells about the mobility (Low Speed, Medium Speed and High Speed) as well as the data rates [6]. The Mobility is covered on the y-axis dimension and the data rates are covered on the x- axis dimension. As the generations are emerging the data rate are also improving that is directly proportional to the mobility [7].

When the 1g data rate was finalized that is 14.4 kbps (depicted in Fig.3), then it was hard to believe that one day it will exceed the 100 mbps case

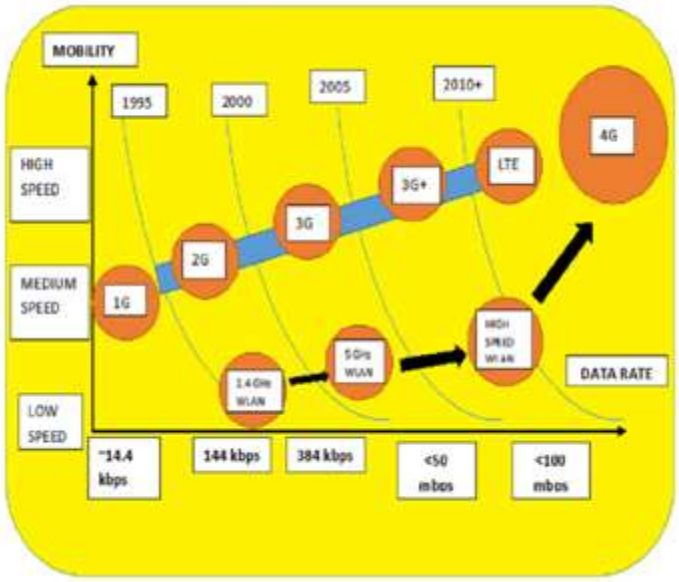

Fig. 3 evolution of wireless communication

Important features of various generations:

1G: First Generation

It was disclosed in the early 1980s. 1G was introduced with 2.4 kbps data rate.
Important members of the first generation mobile networks are-

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- Advanced mobile phone system
- Nordic mobile telephone
- Total access communication system

Commonly abbreviated as AMPS, NMT and TACS respectively.

Drawbacks of the first generation mobile networks are-

- Low in range
- Careless handoff
- Low quality of voice association
- No reliability

Gathering and playing of voice calls use to take place in radio tower. Therefore, the chances of overhear of calls by unauthorized person was possible.

2G: Second Generation

In the late 1990s, the second generation concerning mobile communication was publicize that used digital mechanism in the mobile phones [8]. The first system of 2G was Global system for mobile communication abbreviated as GSM that provides 64 kbps data rate especially in voice communication. Low powered Radio signals are used in 2G mobile phones due to which batteries last for prolonged time. The significant mechanism provided by 2G are as follows -

- SMS (Short Message Service)
- E-mail (Electronic Mail)
- GSM (Global system for mobile communication)
- CDMA (Code Division Multiple Access)
- IS-95 (Interim Standard – 95)

2.5G: Advancement in Second Generation of mobile networks (2G + General Packet Radio Service)

It uses a 2G framework along with a packet service known as General Packet Radio Service (GPRS). A combination of both the switching techniques are used i.e. switching as well as packet. In this, the data rate can perform well up to 144 kbps. Enhanced data Rate for Global System for Mobile Evolution (EDGE) [9]. Code Division Multiple Access (CDMA) acts as a main technology coping with the 2.5G.

Architecture of GPRS:

The fig.4 depicts the architecture of GPRS.

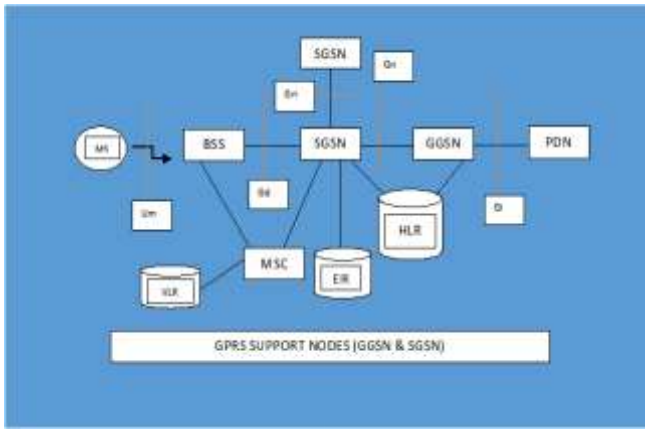

Fig.4 GPRS Architecture

Terms used in Fig.4:

- SGSN : Serving GPRS Support Nodes
- GGSN : Gateway GPRS Support Nodes
- MS : Mobile Station

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- BSS : Base Station Subsystem
- PDN : Packet Data Network
- VLR : Visitor Location Register
- HLR: Home Location Register
- EIR : Equipment Identity Register
- MSC : Mobile Switching Center
- Um, Gn, Gd, Gi : Interfaces

3G: Third Generation

In the year 2000, a technology named 3G was introduced. 3G mobile technology provides data rate of 2MBPS.In 3G mobile technology structure, IP i.e. internet protocol played a major role. For maintenance of quality of services in 3G, an unusual development was made.

Properties such as global roaming and enhanced voice quality made 3G structures incredible. In 3G structure there is requirement of more power as compared to 2G structure [10].

This is important drawback of 3G structure. The plans introduced in 3G are more expensive as compared to 2G. 3G involves implementation of following mechanisms-

1. WCDMA : Wideband Code Division Multiple Access
2. UMTS : Universal Mobile Telecommunications Systems
3. CDMA 2000 : Code Division Multiple Access

Mechanism such as HSUPA/HSDPA and EVDO has evolved to new wireless services known as 3.5G with better data rate of 5-30 MBPS.

- HSDPA stands for High Speed Downlink Packet Access.
- HSUPA stands for High Speed Uplink Packet Access.
- EVDO stands for Evolution Data Optimized network of technology.

3.75G: Advancement in Third Generation Mobile Networks

The future of mobile data facilities depends on the current technologies and their advancements supporting this world i.e. Long Term Evolution (LTE) as well as Worldwide Interoperability for Microwave Access (fixed) (WIMAX) [11]. Technologies like these have the capability to have the add-ons in network capacity and provide high speed services to the users such as on request video and P2P sharing of a data file on the vast dimension. 3.75G provides better performances in comparison to previous generations but with low in cost.

4G: Fourth Generation

4G is the successor of 2G and 3G structure family. The 3rd Generation Partnership Project generally known as 3GPP, is currently maturing the Long Term Evolution technology as forthcoming 4G standard along with WIMAX technology. The Internet Protocol is capable of providing a secure and full solution to some problems arising in 4g communication networks. The desirable properties that users are provided with on daily basis are voice, data and multimedia with high speed of data rate as compared with previously introduced structures (1G, 2G and 3G). The different applications of 4G structure are-

- MMS (Multimedia Message Service)
- DVB (Digital video Broadcasting)
- Video chat
- High definition TV content
- Mobile TV

5G: Fifth Generation

The demand is increasing exponentially in a day to day basis because of which the 4th generation of communication can be substituted with the 5th generation in corporation with BEAM Division Multiple Access (BDMA) as well as Filter Bank Multi Carrier (FBMC) [12]. When the base station communicates with the mobile station, the BDMA technology performs its respective function. For this procedure, a beam that is orthogonal in nature is allocated to every mobile station, The BDMA technique will segment the beams of antenna according to the location considering multiple accesses and will help in enhancing the size of the

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CODEN: IJESS7

system [13]. There are 6 factors that were not appropriately addressed by the 4G mobile network scenario and that leads to an emerging concern of 5g that includes:

- Higher Capacity
- Higher Data Rate
- Lower end to end latency
- Massive Device Connectivity
- Reduced Cost
- Consistent Quality of Experience.

It will be 10x faster in comparison to 4g [14]. It will have a lower cost than the previous versions. Various standards whose approaches are considered as the basic elements and leads for the effective functioning of 5g are:

- IEEE 802.11ac
- IEEE 802.11ad
- IEEE 802.11af

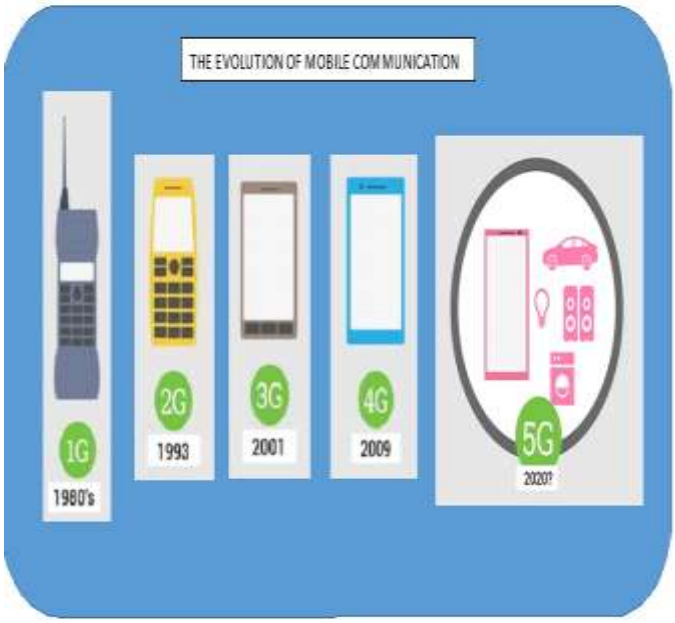

Fig. 5 Evolution of Mobile Communication

III. WHY 5G IS NEEDED?

If we contrast the other wireless communication technologies with the 5th generation then, it's certain that it's better than the previous versions. The points which illustrates the pros of 5G mobile networks are as follows [15]:

- Greater Coverage sector
- Battery saving is more
- Singularly Reliable
- Eminently Secure
- High Resolution for cell phone users
- The speed of uploading as well as downloading will touch the peak
- Enhanced and Available Connectivity
- 25 Mbps connectivity speed
- Bidirectional large BW
- Energy as well as Spectral Effectiveness is appropriate.

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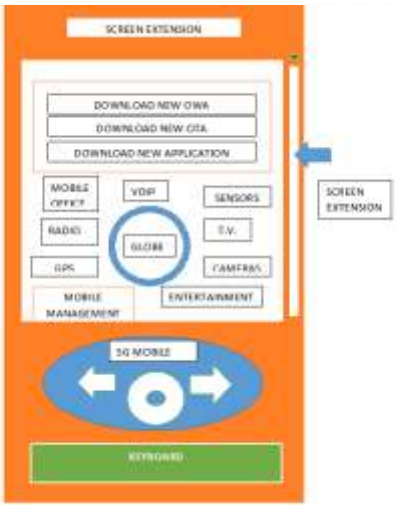

Fig. 6 this illustration depicts a representation of 5g mobile

Index

- OWA- Open Wireless Architecture
- OTA- Over The Air Programming
- VOIP- Voice Over Internet Protocol
- GPS- Global Positioning System

IV. CONCLUSION

The 5g will create a revolution in the dimension of wireless system and the upcoming future will be the changed one. As the review has illustrated, the carrying out necessity of the 5g communication scenario are Service concerning quality, Rate of data, volume, discontinuity, energy expertise. The framework of 5g is also presented in this paper. The Progression of Wireless Transmission is also presented in this paper.

In Conclusion, We would consider that the prototype of 5G infrastructure is ongoing by now and will be launched by 2020.The 5G mobile network is defined by 8 features:

- Data Rate up to 10Gbps
- Latency of 1milli second
- 1000x bandwidth concerning per unit area
- 100x number of connected devices in comparison to 4G LTE.
- Availability- 100%
- Coverage- 100%
- Network Energy Usage will be reduced by 90%.
- Up to 10 years battery life for low powered Internet of Things devices.

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