UNIFICATION OF 5G WIRELESS TECHNOLOGY AND MEGAMIMO 2.0 NETWORKING SYSTEM

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Abstract – The upcoming trend of 5G network system in the field of communication and technology is the need of the hour for high data transmission for users. The invention of 5th generation is standardized by IEEE 802.11ac standard of broadband technology. The 5G networking ensures wide area mobility in strict sense and provides continuous and contiguous coverage with an excellent speed up to 10 Gbps. It will fulfill the requirements of the bandwidth radio channels, with minimum interference. The MegaMIMO 2.0 is the latest technology which enables the coordination of multiple routers simultaneously and resolves the issue of network congestion with multiple access points. This system works on the existing operating frequency and secures wireless data transmission at about three times faster than the existing systems.

Keywords – millimeter wave technology, worldwide wireless web, broadband services, wireless communication, MIMO.

INTRODUCTION

The 5G networking system has various attributes relating to its operation and working, which includes capacity enhancement, spectral efficiency, quality service, energy efficiency. This technology is also flexible, heterogeneous and evolving.

The innovation enabling 5G communication includes high speed data acquisition, advanced RF domain processing with massive MIMO, clock and timing, millimeter wave technology, power management, replacement of connecting devices with cables for data transmission, portable devices with display interface supporting communication through wireless technology, disable the need of USB cables and its usage for connecting portable devices with other devices, machine type communication for various industrial and commercial applications and upcoming devices talking or interacting with each other in wireless medium. The technology of cloud computing enables efficient cloud storage system to the cloud resources. Mobile and other portable devices supporting e-commerce applications like ridesharing, drone-remote sensing, voice controlling and Bluetooth technology. 74% of population across the globe are mobile broadband service subscribers. It is expected a 10 times growth in wireless data traffic by the year 2019. The technology being developed with the aim of connecting every device enabling tracking.

The need of efficient bandwidth and spectrum requirements gives the need of 5G technology, which is different from previous mobile generations wherein the 5G will not be driven by the broadband speeds corresponding to mobile phones as was done by 4G. The concept of long term evolution (LTE) can be fulfilled for higher data rates and efficient transmission. The protocol of developing a smart city with unbounded network and connectivity with the evolution of high speed information and sharing of data with other citizens is the near future. To implement the thought process, the present technology of 4G communication, 3rd generation partnership project (3GPP) and many others important in these allied fields are joining hands to filter out the short-comings and develop this into reality that will alter the needs and would be user friendly.

1. NEED FOR 5G WIRELESS TECHNOLOGY

The next generation technology of 5G is underway to fulfill the increased capacity, higher data rates and decrease in congestion per user for the respective frequency spectrum. As it is a known fact that increase in traffic, for efficient communication and other applications in cellular and networking, the extensive development and research gives rise to the 5G. The wide improvements in terms of potential use and with the invention of new gadgets supporting the network like smart phones and tablets contribute to a lot of network traffic; acquiring new applications for mobile connectivity. Investments are done to a few requirements such as connection speeds up to 10 Gbps, to ensure security and uninterrupted connectivity. The following expectations which would be fulfilled by the 5G communication and increase the market enormously are:

- Increased network capacity: It is expected for connection speeds up to 10Gbps, 500 times faster than the Long-Term Evolution (LTE) existing technology, which is based on Global System for mobile communications / Enhanced Data Rate for GSM Evolution (GSM/EDGE) – 2G and Universal Mobile Telecommunication Service/ High Speed Packet Access (UMTS/HSPA) – 3G.

- Efficient spectrum: Traditional spectrum has been allocated to the user specification purpose and in reality today's consumer electronics requires spectrum of up to 6GHz, which 5G wireless technology promises to add gigabit speeds at millimeter wave frequencies.

- User Latency: Previously developed LTE-4G communication provided a latency of 20 millisecond. On the other hand, 5G is expected to provide a latency of less than 1 millisecond. With this latency, it is possible to practically implement the concept of self-driving cars, thereby ensuring safety issues and traffic control. The car ought to receive brake command within 1ms when the control command is given. This gives rise to intelligent traffic management in near future.

- Data rate: 5G technology fulfills the need of high data rate by providing a peak data rate of 10Gbps and suggested performance of 100 Mbps for cell edge data rate.

- Massive Machine – Type Communication (MMTC): This actually refers to the usage and storage application functions for more number of users on per km basis

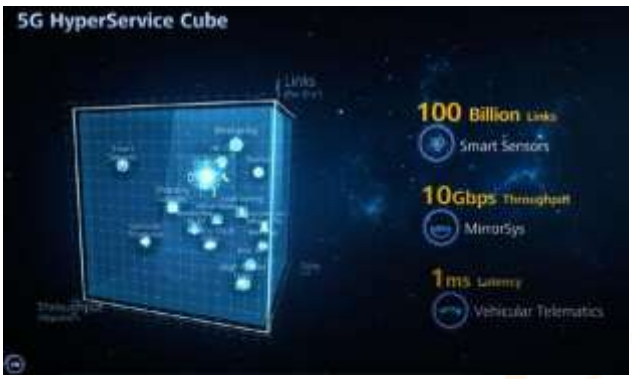

Fig.1 5G hyper service cube depicting various mobile communication technology.

The never ending research in the field of Internet of Things and the expected features in the 5G wireless communication, numerous features are taking a new turn in the communication.

- **SMART WEARABLES**

There is a trending concept of wearables, gaining popularity where these are networked at the back end, plays a major role in healthcare management, thereby increasing the life expectancy by making the user aware of any mishap by measuring the blood pressure, heart rate, temperature of the body, breathing counts etc.

The sensors incorporated inside the wearables collect the data and consequently sends the data to the database through an efficient network. The 5G technology is expected to fulfill the shortcomings of the previously existing technologies through sending real time messages to wearers for avoiding to put their life at risk.

- **AGRICULTURAL INTELLIGENCE**

The revolutionary change in the way of cultivating and harvesting crops, soil quality parameters, usage of river water for irrigation purpose can be seen in the form of work specific sensors which can be applied for keeping a constant supervision for quality and saving the cost in agriculture sector.

In this manner, the farmers will come to know about the fertility of soil, temperature, pressure, humidity in the atmosphere, wherein they can take preventive measures to reduce the wastage and crop failure.

- **INTELLIGENT LOGISTICS**

This revolves around the prime idea of Radio Frequency Identification (RFID). This would assure timely delivery of the consignment and letting the carrier and client to know about the current status of the delivery, by easily grasping the real time data through a network. RFID would read and report the data captured or sensed. This in turn, would lead to meticulous management of logistics and transportation in near future. RFID tags has the unique ability to integrate multi tags simultaneously and has a mainstream in the development in security applications with Internet of Things. RFID enables data capturing and automatic identification. 5G network will not only empower Internet of Things but also Internet of Everywhere, which primarily focuses on high speed data transmission for the effective satellite mobile communication and cellular terrestrial hybrid solutions. For terrestrial or land communication, there is a requirement of convergence of fixed broadcasting. Apart from this 5G will be driven through various software like Network Functions Virtualization (NFV), Software Defined Networking (SDN) and Content Delivery Networks (CDN).

2. TECHNOLOGICAL DEVELOPMENTS IN NETWORKING AND BROADCASTING ENABLING 5G

There are many trends which are upcoming in the communication field like LoRa, Narrowband IOT, HetNets, multi RAT networks and MIMO.

2.1 LONG-RANGE (LO-RA) TECHNOLOGY

It is a technology that offers a long range operation with low power consumption and secure transmission of data. In this both the public and private network system provides better coverage which is far better than the existing cellular networks.

Fig.2 Long range technology for data transmission.

2.2 NARROWBAND INTERNET OF THINGS (IOT)

This technology enables connecting billions of devices in the IOT that will be under the operation in Machine-to-Machine (M-2-M) rather than man-made communication. It is optimized such that it gives low throughput which has ability to provide uplink and downlink of about 200Kbps.

Fig.3 Narrowband Internet of Things

2.3 HETNETS

HETNETS is basically heterogeneous networks that tends to offer a pack or a combination of macro-cells, small-cells along with wireless fidelity (Wi-Fi) networks. The main purpose of proposing this technology is to allow increased capacity to accommodate the ever growing wireless needs without loss in transmission of data fed to it.

Fig.4 Heterogeneous networks

2.4 MILLIMETER WAVE TECHNOLOGY

As known millimeter wave region corresponds to radio band frequencies of 30GHz to 300GHz in the electromagnetic spectrum. The millimeter waves are longer in range as compared to infrared or X-rays. High frequency millimeter waves will increase the wireless capacity and speed for the future dependent technologies enabling 5G. It is expected to deliver data with less than millisecond of delay. The need of the hour is to provide the users with efficient data consumption scales and this is possible by introducing a brand new spectrum, the one which is never been used before for mobile services. This is experimented on millimeter waves by the service providers as they vary from 1mm to 10 cm in length. The whole new idea of transmission of data among the mobile users with the nearest base station is in near progress. Thus, 5G will augment the need of the existing towers with a new innovation, more popularly known as small cells.

2.5 COGNITIVE RADIO

It is a form of wireless communication medium which has the capability of detect the involvement of the communication channels which are in actual use or not. This helps in shifting instantly to the channels which are vacant instead of the ones which are occupied. It optimizes the usage of the RF spectrum, leading to the minimization of interference of communication. Cognitive radio is a hybrid technology which involves the software defined radio (SDR). There exists two kinds of cognitive radio; full cognitive radio and spectrum sensing cognitive radio. The former takes care of all the information extraction regarding the parameters pertaining to electrical node or network and the latter is used for the detection of channels in the radio frequency spectrum. This technology helps in improving the interference coordination of HetNets, increasing the capacity and coverage.

3. EVOLUTION OF CELLULAR SYSTEMS

With generations passing by, development in the field of cellular telecommunications has been taking place continuously to match the pace of networking and every generation evolved with its own innovation. The 5G is envisioned to fulfill the data traffic with least consumption of energy along with Quality of Service (QoS) provision.

- 1st generation (1G) – The access technology for the first generation is Advanced Mobile Phone Service (AMPS). AMPS is frequency modulated and used Frequency Divison Multiple Access technique with a channel capacity of 30 KHz.

  The corresponding data rate – 2.4kbps, frequency band – 800MHz, bandwidth – 30 KHz.

- 2nd generation (2G) – The access technology is Global Systems for Mobile Communication (GSM). It employs the usage of Time Division Multiple Access.

  The corresponding data rate – 10kbps, frequency band – 850/900/1800/1900MHz, bandwidth – 200 KHz. The Code Division Multiple Access (CDMA) has the same data rate and frequency band with a bandwidth of 1.25MHz. The application is extended to both voice and data services, short message

  services (SMS), picture messages, multimedia message services (MMS).

- 2.5th generation (2.5G) – The access technology is General Packet Radio Service (GPRS) and Enhanced Data Rate for GSM Evolution (EDGE).

  The corresponding data rate for GPRS is 50kbps and for EDGE is 200kbps while frequency band is same as that of 2G, bandwidth is 200 KHz.

- 3rd generation (3G) – This generation was defined by 3rd generation partnership project (3GPP) in the year 2000 which enabled data services, web browsing, online TV/videos, video conferencing, email, fax. The access technology is Wideband Code Division Multiple Access (WCDMA)/ Universal Mobile Telecommunication System (UMTS) along with Code Division Multiple Access (CDMA) with data rates of 384kbps, frequency band of 1900/2100 MHz and bandwidth of 5MHz.

- 3.75th generation (3.75G) – The access technology is Long Term Evolution (LTE) - Orthogonal Single Carrier Frequency Division Multiple Access with the advent of online gaming and high definition television. The corresponding data rate is 100-200Mbps with frequency band of 1.8GHz and 2.6GHz respectively. The bandwidth ranges from 1.4MHz to 20 MHz

- 4th generation (4G) – The fourth generation was IP based networking system which fulfilled the need of high speed data, capacity and with information security for the communication. Mobility plays an important role in the efficient operation of cellular operation. Another feature is the terminal mobility which basically meant roaming services among the existing wireless networks anytime and anywhere. The access technology is Long Term Evolution Advanced (LTE-A), Orthogonal/Single Carrier Frequency Divison Multiple Access for which the data rate varies from 1.5Gbps to 3Gbps for downlink and uplink respectively.

- 5th generation (5G) – The access technology is Beam Division Multiple Access (BDMA), perfectly known to be as World Wide Wireless Web Network (WWWW). The

  BDMA depicts the working of communication between the base stations and mobile stations by splitting the antenna beam in accordance with the mobile stations, thereby causing an increase in the network
  capacity. The 5th generation is expected to fulfill the high demands of the user and overcome the shortcomings of the previously existing generations. The expected data rate is up to 10-50Gbps, frequency band of 30-300GHz and bandwidth of 60GHz. Its applications can be extended up to the Ultra High definition video including the virtual reality application.

4. FEATURES AND SUPPORT SYSTEM FOR 5G TECHNOLOGY

In the vision, to create a hassle free communication network throughout the world, a network and a support system is expected to fulfill all the technical requirements which includes 10 to 100 times increase in number of connected devices, 1000 times increase in data volume per area, reduced latency between end-to-end devices and virtual private networks. The issue of accessing a wireless network in a congested public place is still prevalent. To tackle with this problem, a system is developed by researchers from MIT's and Computer Science and Artificial Intelligence Lab (CSAIL). When a number of people are trying to connect to a central wireless network, there occurs a lack of wireless spectrum available for the public to acquire the required data quickly and efficiently.

MegaMIMO 2.0, a Wi-Fi system, and double the range that is three times faster than the conventional Wi-Fi. It is designed to juggle multiple access points all at once without the creation of interference.

In a congested network, two access points (AP) may transmit at the same time and frequency, causing interference. The AP's can avoid this taking turns, but this transmits packets less often and leads to slower data rate.

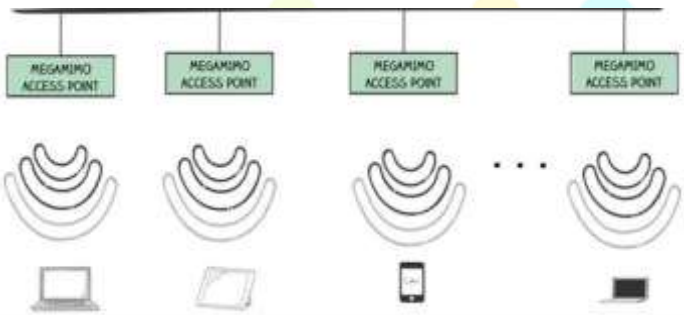

Fig.5 Multiple access points for transmission to various devices.

MegaMIMO 2.0 allows AP's to send data quickly even in congested networks. It continuously adapts to the varying channel conditions as it utilizes the spectrum very efficiently. This can be unified with the 5G network for accurate and safe data transfer for the different users across different platforms. The medium of communication of wireless communication is Ethernet which allows data to be converted into an electrical form of signal. The data is then propagated through radio waves using Wi-Fi.

Vodacom and Nokia are joining hands for the trial of 5G wireless network communication in South Africa. The company has a licensed wide spectrum of 280MHz around the 28GHz band, which it plans to utilize to construct the 5G network system.

CONCLUSION

The unification of 5G wireless communication and MegaMIMO 2.0 can prove to be one of the best methods for propagation of data for different applications. This fulfills the conditions for spectrum sharing without causing interference.

FUTURE SCOPE

The integration of satellite communication networks along with the 5G wireless communication network can be accomplished with the 6G network. It can be used to provide network position identifier, greater involvement of multimedia technology which can prove to be an extraterrestrial civilization in the communication field. Its use can be extended to defence applications, home automation, sea to space communication. Through this the natural calamities and havoc caused by nature can be controlled and accordingly preventive measures can be taken.

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