

5G Network : Change and Development

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Abstract – 5th Generation Mobile Network or simply 5G is the forthcoming change of mobile technology. The features and its usability are much beyond the expectation of a normal human being. With its ultra-high speed, it is potential enough to change the meaning of a cell phone usability. To meet the demands, drastic improvements need to be made in cellular network architecture this paper presents the results of detailed survey on the fifth generation cellular network architecture and some of the key developing technologies that are helpful in improving the architecture and meeting the demands of users. The prime focus is on the 5G cellular network architecture, massive multiple input multiple output technology, and Device-to-Device communication. In this paper, a general probable 5G cellular network architecture is proposed, which shows that D2D, small cell access points, network cloud, and the Internet of Things can be a part of 5G cellular network architecture.

Keywords— 5th Generation, Cloud, D2D, Massive MIMO, mm-wave, Relay, Small-cell.

1. INTRODUCTION

From a technical point of view, fifth generation mobile wireless – or 5G, as it's unremarkably renowned – is a lot of regarding “development” than “change.” In different ways 5G merely builds upon the mobile infrastructure established by the present wireless standard, 4G LTE. From the point of view of the imagination, however, 5G is poised to redesign the technological world as we all know it. The new standard that is predicted to be installed by 2020 can support data transmission rates of between 10 and 20 gigabits per second per mobile base station, at speeds ten to a hundred times quicker than typical 4G connections. These abilities can build it potential to enhance device technologies, video game, AI and machine learning for unprecedented applications. The imaginings of our future may be a Wireless networked society with unbounded access to data and sharing of information that is accessible everywhere and each time for everybody and everything. To understand this imagination, new technology components got to be inspected for the development of existing wireless primarily based technologies.

Gift wireless principally based technologies, just like the third Generation Partnership Project (3GPP) LTE technology, HSPA and Wi-Fi, will be combining new technology elements that may be serving to meet the wants of the long run. Present wireless based technologies, like the 3rd Generation Partnership Project (3GPP) LTE technology, HSPA and Wi-Fi, will be incorporating new technology components that will be helping to meet the needs of the future. Nevertheless, there may be certain scenarios that cannot be adequately addressed along with the development of ongoing existing technologies. The instigation of completely new wireless based technologies will complement the current technologies which are needed for the long term realization of the networked society. The remainder of the paper is organized as follows: In this section gives the detailed description of the proposed general 5G cellular network architecture. It also comprises of the detailed explanation of the emerging technologies for 5G wireless networks.

2. GENERATIONS OF MOBILE NETWORK TECHNOLOGY

Development of Mobile Technologies:

Mobile communication has become a lot of in style in previous couple of years thanks to quick change in mobile technology. This change is thanks to terribly high increase in telecoms customers. This change is from 1G- the primary generation, 2G-the second generation, 3G- the third generation, and so the 4G- the fourth generation, 5G- the fifth second generation.

A. First Generation (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 system (IMTS) and push to talk (PTT).

B. Second Generation (2G): arise in late 1980s. It uses digital signals for voice broadcast and has speed of 64 kbps. It provides capability 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 swapped domain and provide data rate up to 144 kbps.

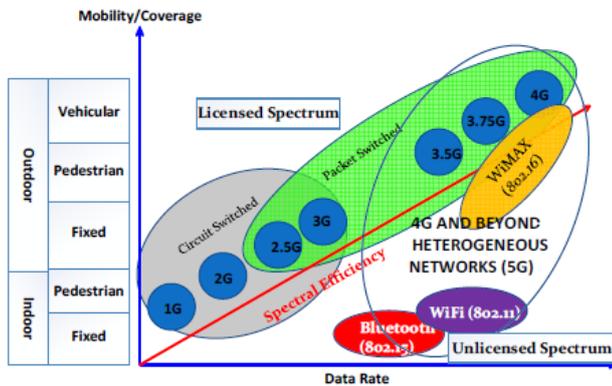


Fig. 1. Evolution of Wireless Technologies.

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. Sideways with verbal announcement it comprises of information services, access to television/cinematic, new services like world Roaming.

D. Fourth Generation (4G): is generally denoted as the descendant of the 3G and 2G standards. 3rd Generation Partnership Project (3GPP) is currently standardizing Long Term Evolution (LTE) Advanced as forthcoming 4G standard along with Mobile Worldwide Interoperability for Microwave Access (WiMAX). It also 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.

E. Fifth Generation (5G): 5G mobile technology has changed the means to use cell phones within very high bandwidth. With an tremendous increase in the demand of the users, 4G will now be easily replaced with 5G with an progressive access technology named Beam Division Multiple Access (BDMA) and Non- and quasi-orthogonal or Filter Bank multi carrier (FBMC) numerous access. The idea behind BDMA technique is enlightened by considering the case of the base station communicating with the mobile stations. In this communication, an orthogonal beam is assigned to each mobile station and BDMA technique will divide that antenna beam according to locations of the mobile stations for giving numerous accesses to the mobile stations, which harmoniously increase the capability of the system.

3. DESIGN OF 5G MOBILE NETWORK PLANNING

A mobile user to connect whether inside or outside, an outside base station present in the central of a cell helps in communication. So for inside users to communicate with the outside base station, the signals will have to travel

through the walls of the indoors, and this will result in very high diffusion loss, which harmoniously costs with concentrated spectral competence, data rate, and energy competence of wireless communications. To overwhelmed this challenge, a new concept or manipulative technique that has come in to animation for scheming the 5G cellular architecture is to separate outside and inside setups. With this designing technique, the diffusion loss through the walls of the building structure will be somewhat reduced. This idea will be reinforced with the help of enormous MIMO (Multiple Input and Multiple Output) technology, in which geologically detached collection of antenna's are situated which have tens or hundreds of antenna units all around. Since present MIMO systems are using either two or four antennas, but the idea of enormous MIMO systems has come up with the idea of employing the benefits of big collection of antenna elements in terms of huge capacity achievements. To construct a large gigantic MIMO network, initially the outside base stations will be tailored with large antenna collections and among them some are detached around the hexagonal cell and associated to the base station through optical fiber cables, supported with gigantic MIMO expertise. The mobile users current outside are typically fitted with a convinced amount of antenna components but with collaboration a large virtual antenna collection can be built, which composed with antenna collections of base station form virtual enormous MIMO associations. Furthermore, every building will be installed with large antenna arrays from outside, to communicate with outdoor base stations with the help of line of sight components. The wireless access points inside the building are associated with the large antenna of collections through cables for collaborating with indoor users. This will significantly improves the energy efficiency, cell average throughput, data rate, and spectral efficiency of the cellular system but at the expense of increased infrastructure budget. For inside communication, certain technologies like WiFi, Minor cell, extreme wideband, millimeter wave communications, and noticeable light communications are useful for minor range communications having huge data rates.

Mobile minor cells are located inside the moving automobiles to communicate with the customers inside the automobile, while the gigantic MIMO unit involving of large antenna collections is placed external the automobile to communicate with the external base station. The network function virtualization (NFV) cloud contains of a User plane entity (UPE) and a Control plane entity (CPE) that achieve complex layer functionalities connected to the User and Control plane, correspondingly. Special network functionality as a service (XaaS) will provide service as per need, supply pooling is one of the examples. XaaS is the association between a radio network and a network cloud.

The 5G cellular network architecture is explained in the figure below. It has equal significance in terms of front end and back end network correspondingly. In this paper, a general 5G cellular network architecture has been proposed as shown in Fig. 2. It describes the interconnectivity among the dissimilar developing technologies like Gigantic MIMO network, Reasoning Radio network, and mobile and stationary small-cell networks. This planned architecture also describes the role of network function virtualization (NFV) cloud in the 5G cellular network architecture. The theory of Device to Device (D2D) communication, small cell access points and Internet of things (IoT) has also been amalgamated in this proposed 5G cellular network architecture. In overall, this proposed 5G cellular network architecture may provide a good platform for future 5G regularization network.

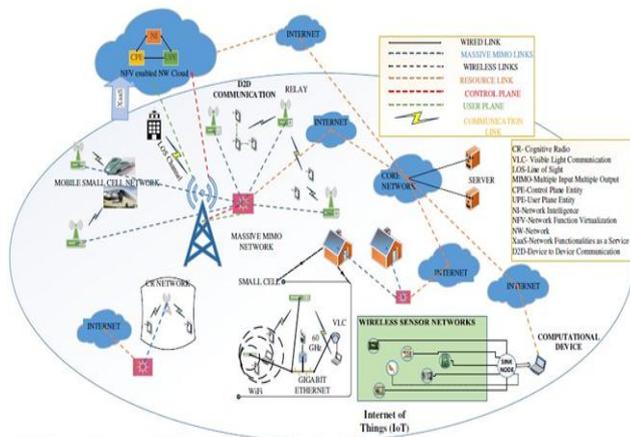


Fig 2: A General 5G cellular network architecture.

4. DEVELOPING TECHNOLOGIES FOR 5G WIRELESS NETWORKS

To deliver a commercial connected platform for an assortment of applications and requirements for 5G, we will study the below technology components:

- A. Radio-links: comprises the development of new broadcast waveforms and new methods of multiple access control and radio resource management.
- B. Multi-node and multi-antenna transmissions: contains designing of multi-antenna transmission/reception technologies constructed on massive antenna conformations.
- C. Network dimension: comprises considering the request, traffic and mobility organization, and novel methods for well-organized intervention management in composite heterogeneous placements.

D. Spectrum usage: comprises since extended spectrum band of procedure, as well as operation in new spectrum rules to provide a complete system idea for new spectrum rules that cautiously addresses the needs of each practice situation.

E. Device-to-Device (D2D): communications references to straight communication amongst devices permitting local conversation of user plane traffic without going through a network infrastructure. Device to Device Communication system can be clarified by envisioning a two level 5G cellular network and named them as macro cell level and device level. The macro cell level comprises of the base station to device communications as in an orthodox cellular system.

F. Massive Machine Communications (MMC): will procedure the basis of the Internet of Things with an extensive variety of application fields including the automotive industry, public safety, emergency services and medical field.

G. Moving Networks (MN): will improve and spread linking together possibly large inhabitants of together moving communication devices.

H. Ultra-dense Networks (UDN): will be the main driver whose goals are to rise capacity, escalation energy effectiveness of radio links, and enable better manipulation of under-utilized spectrum.

I. Ultra-reliable Networks (URN): will enable high degrees of accessibility.

Massive MIMO is an evolving technology that has been upgraded from the current MIMO technology. The Massive MIMO system uses arrays of antenna containing few hundred antennas which are at the same time in one time, Frequency slot serving many tens of user terminals. The main objective of Massive MIMO technology is to extract all the benefits of MIMO but on a larger scale. In general, massive MIMO is an evolving technology of Next generation networks, which is energy efficient, robust, and secure and spectrum efficient. Massive MIMO depends on spatial multiplexing, which further depends on the base station to have channel state information, both on the uplink as well as on the downlink. In case of downlink, it is not easy, but in case of uplink, it is easy, as the terminals send pilots. On the basis of pilots, the channel response of each terminal is estimated. In conventional MIMO systems, the base station sends the pilot waveforms to the terminals and based on these, the terminal estimate the channel, quantize it and feedback them to the base station. This process is not viable for massive MIMO systems, especially in high mobility conditions because of two

reasons. Firstly the downlink pilots from the base station must be orthogonal among the antennas, due to which the requirement of time, frequency slots for the downlink pilots increases with the increase in the number of antennas. So Massive MIMO systems would now require a large number of similar slots as compared to the conventional MIMO system. Secondly, as the number of base station antennas increases the number of the channel estimates also increases for each terminal which in turn needed hundred times more uplink slots to feedback the channel responses to the base station. A general solution to this problem is to work in Time Division Duplexing (TDD) mode and depend on the reciprocity amid the uplink and downlink channels. Massive MIMO technology depends on phase coherent signals from all the antennas at the base station, but the computational processing of these signals is simple. Below are certain positives of a massive MIMO system.

5. CHARACTERISTICS OF 5G TECHNOLOGY

5G will be able to support all communication needs from low power Local Area Network (LAN) - like home networks for example, to Wide Area Networks (WAN), with the right latency/speed settings. The way this need is addressed today is by aggregating a broad variety of communication networks (WiFi, Z-Wave, LoRa, 3G, 4G, etc...) 5G is designed to allow simple virtual networks configurations to better align network costs with applications needs. This new approach will allow 5G Mobile Network operators to catch a larger piece of the IoT market pie by being able to deliver cost-effective solutions for low broadband, low power applications. 4G networks today use the USIM application to perform strong mutual authentication between the user and his/her connected device and the networks. The entity hosting the USIM application can be a removable SIM card or an embedded UICC chip. This strong mutual authentication is crucial to enable trusted services. Security solutions today are already a mix between security at the edge (device) and security at the core (network). Several security frameworks may co-exist in the future and 5G is likely to re-use existing solutions used today for 4G networks and for the cloud (SEs, HSM, certification, Over-The-Air provisioning and KMS). The standard for strong mutual authentication for 5G networks has been finalized

In 2018. The need for security, privacy and trust will be as strong as for 4G if not stronger with the increased impact of IoT services. Local SEs in devices can not only secure network access but also support secure services such as emergency call management and virtual networks for IoT. Wi-Fi wireless is a "Local Area Network" technology, limited in operation range and very limited in both speed

and latency. Many IoT services are demanding more ubiquity, more mobility, and more performance speed-wise and response time-wise.

5G will truly unleash a true IoT eco-system. 5G technology going to be a new mobile revolution in mobile market. Through 5G technology now you can use worldwide cellular phones and this technology also strike the china mobile market and a user being Proficient to get access to Germany phone as a local phone. With the coming out of cell phone alike to PDA now your whole office in your finger tips or in your phone. 5G technology has extraordinary data capabilities and has ability to tie together unrestricted call volumes and infinite data broadcast within latest mobile operating system. 5G technology has a bright future because it can handle best technologies and offer priceless handset to their customers. May be in coming days 5G technology takes over the world market. 5G Technologies have an extraordinary capability to support Software and Consultancy. The Router and switch technology used in 5G network providing high connectivity. The 5G technology distributes internet access to nodes within the building and can be deployed with union of wired or wireless network connections. The current trend of 5G technology has a glowing future.

6. CONCLUSIONS

In this paper, a thorough inspection has been done on the performance necessities of 5G wireless cellular communication organizations that have been definite in terms of volume, data rate, spectral efficiency, dormancy, energy efficiency, and Superiority of service. A 5G wireless network construction has been elucidated in this paper with gigantic MIMO technology, network function virtualization (NFV) cloud and device to device communication (D2D). Convinced short range communication technologies, like Wi-Fi, Small cell, Visible light communication, and millimeter wave communication technologies, has been explained, which affords a promising future in terms of better quality and enlarged data rate for inside users and at the corresponding time reduces the pressure from the outside base stations. 5G technologies offers marvelous data competencies and unobstructed call volumes and infinite data broadcast self-possessed within latest mobile operating system. Fifth generation makes a significant change and add more facilities and welfares to the world over 4G. Fifth generation should be more intelligent technology that communicates the entire world without limits. This generation is expected to be released around 2020. The world of universal, never-ending access to information, entertainment and communication will open new

dimension to our lives and change our life style suggestively.

5G can revolutionize the mobile expertise with supercharged wireless network, which might support up to ten to twenty GBPS of knowledge transfer speed.

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