International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Development in Wireless 5G Technology

Atharva Mulay[1], Summaiya Pathan[2]

[1, 2]Electronics and Telecommunications Department, Smt. Kashibai Navale College of Engineering Pune 411041

Abstract: ***In the emerging need for rapid internet speed the 4G technology seems to be lacking behind in certain aspects due to which 5G technology is need of the situation. Future generations of cellular networks will need to support the growing number of users and their increasing appetite for high data rate content. 5G technology can significantly improve the quality of experience for users by bringing popular contents closer to the network edge. We make this possible by incorporating Massive MIMO, Con-vex Optimisation etc. 5G technology will offer the services in different fields like documentation supporting electronic transactions etc. 5G design is based on user centric mobile environment with many wireless and mobile technologies on the ground. 5G should be featured with intelligent technologies that interconnects the entire world without limits.***

Keywords: Massive MIMO Optimisation, Green Communication, Network Slicing, Millimetre Waves

1. Introduction

Though the 4G wireless technology provides with high speed internet it is not consistent. The 5G technology offers unparalleled consistency. The limitation of 4G being ser-vice centric will be replaced by user centric feature of 5G. 5G wireless technology can change the way we use wire-less gadgets by providing very high bandwidth. By incorporating features like Software Dependant Networks, NFV, MEC it is possible to bring about a revolution in the network infrastructure. It is expected to support almost 65000 connections at a time. Unlike the 4G technology it will also support virtual private networks (VPN).Also it may also bring a large range of supportive security features like identity management, cloud security.

Motivation

The beaming growth in demand for reliable cellular broad-band experiences is pushing the industry to step ahead at how networks can be leveraged to meet future extreme capacity and performance demands .5G is supposed to be the set of technical components needed to handle these technical requirements. One of the key motivators for 5G is to provide ubiquitous, high speed, high quality wireless broadband coverage to societal and industrial needs be-yond 2020. The real challenge is to enable a host of different platforms able to work together as seamless whole, largely software controlled and flexible enough to support any usage pattern.5G will enable organisations to move into new markets and build new revenue streams with radically new business models and use cases, including Inter-net of Things (IoT) applications. The ability to download a full-length HD movie in seconds, the quick reaction time (low latency) to enable remote surgery, the ability to spin up virtual networks on-demand with network slicing. And the most important of them all battery life. It can be the initialisation of LiFi technology.

2. Vision and Requirements

A. Green Communication

Green communications is the process of segregating energy-efficient communications and networking technologies and products, and diminishing the resource use whenever and wherever possible in all branches of communications.

Adopting green communication technology helps businesses and individuals in reducing power consumption and lowering the operation costs of organisations. In addition, green communication technologies are also vital for the researchers in context of speed and energy monitoring. This technology allows projection of the power consumption and possible options to choose the extent of energy savings and determining the estimated savings.

Green communication technologies are in superior demand because of the concerns over the increase in power consumption in the ICT sector. This sector currently utilises about 8% of the total power production and unless power efficient devices are deployed at a large scale, the ICT sec-tor itself will account for more than 15% of estimated power consumption by 2021. The next generation of wire-less communication technologies "", takes into account energy efficiency as a major goal and aims to achieve nearly 90% saving per service provided. This project aims to develop new green communication technologies for 5G wireless networks. Implementing virtualisation, studying server bolstering, upgrading old for new, creating more efficient systems, Employing system management to im-prove efficiency are few of the concise features that constitute the Green Technology.

Alcatel-Lucent, Ericsson, Huawei Technologies Co. Ltd., Nokia Siemens Networks, Tel Labs, Inc., ZTE Corporation, Cisco Systems, Inc., Sk Telecom, Datong Mobile Communications Equipment Co., Ltd., and Sprint Corporation are the prominent MNC's that contribute a lo t in the development of Green Communication.

B. Massive MIMO

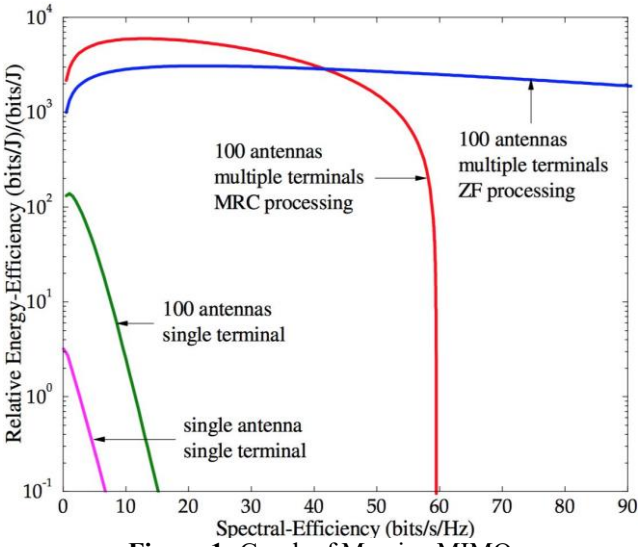

Figure 1: Graph of Massive MIMO

Massive MIMO is the potential enabler for the 5G technology. The traditional MIMO technology incorporates multi-ple antennas that are located at both the ends i.e. the transmitter and the receiver. These antennas are aligned in such a way that the error is being minimized and the on the other hand efficiency is increased for the network. As the name Massive MIMO suggests that the technology scales itself upto hundreds or thousands of antennas and terminals. The antennas included in these systems provide with a new level of efficiency and throughput. The recent from the Bell Labs suggests that at least 16 antennas are required on both the transmitter and receiver.

The potential benefits of using Massive MIMO would be that, it would be less expensive, the round trip latency would be reduced drastically, over simplification of the MAC layer, considerate increase in the data rate etc.

To make it relevant with our proposed 5G technology and understand its correlation with it, a recent survey conduct-ed by CISCO forecasts that 5.5 billion people will own cellular handsets by 2020.The potential applications being streaming 4K videos, driverless vehicles, smart factories and broadband access expanding to the most rural places in the world.

To broadly describe the following MIMO technology in accordance with 5G there are three types namely: cooper-ative MIMO, Massive MIMO and lastly the mm Wave MIMO. But the Massive MIMO is the one which is the most talked about technologies when it comes to creating the next generation of network standards.

A fundamental MIMO is known as a dually-polarised system. This technique utilises both vertical and horizontal polarities to transmit and receive data doubling the net-work capacity compared to singly polarised system.

The main advantage of utilising massive MIMO over traditional MIMO is that the network capacity will be significantly multiplied without requiring more wireless spectrum.

The expected MIMO technology is expected to work in TDD mode which basically relies on the fact of reciprocity between the uplink and downlink channels, also FDD operation may be used in certain cases. The Massive MIMO technique relies on phase coherent but computationally very simple processing of signals from all the antennas at the base station. As discussed earlier the capacity increases manifold this is because of aggressive spatial multiplexing. The phenomenon of coherent superposition of wave-fronts makes it possible to appropriately shape the signals into the desired locations constructively but destructively in the regions where not required. Further lies the problem of interference, which can be minimised by using the principle of zero-forcing (ZF).But this comes at the cost of in-creased transmitted power. So in turn it can be replaced by maximum ratio combining(MRC).The advantage of using MRC over ZF is computational simplicity but also it can act independently over each antenna. The only reason for why MRC works so well for massive MIMO is that the channel responses associated with different terminals tend to be nearly orthogonal when the number of base station antennas is large.The reason we are expecting to use this technique is that the overall spectral efficiency can be 10 times higher than in conventional MIMO because tens of terminals are served simultaneously, in the same time-frequency resource. Considering the cost factor, Massive MIMO can be formed by using low cost equipments. The expensive, ultra linear 50Watts amplifiers can be replaced by hundreds of low cost amplifiers in the milli-watt range. Fig 1 shows the graph of spect relative energy -efficiency.

C. Network Slicing

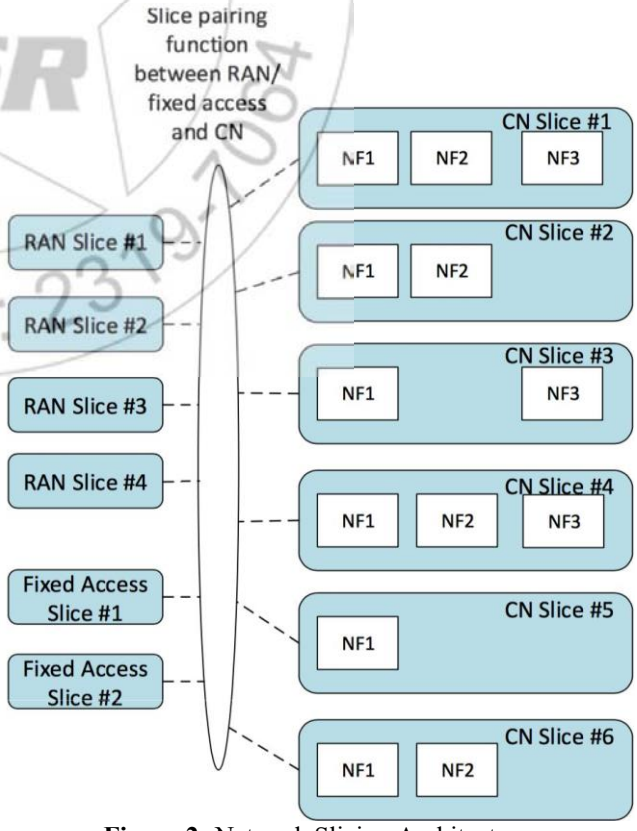

Figure 2: Network Slicing Architecture

Network slicing, in its simplest form, is the ability to modify a set of functions to optimise use of the network for each mobile device. This concept is considered to be the key to meet diverse requirements for the proposed 5G technology which includes future proof scalability and flexibility. The network elements and functions are easily configured and utilised in every network slice to meet a requirement. The implementation of network slicing is grasped to be an end-to-end attribute that involves the core network and the RAN (Radio Access Network).The exist-ing network architectures are relatively monolithic with a transport network that facilitates mobile traffic to end de-vices. They are not flexible enough to support wide range of performance and scalability requirements. Each slice can be optimised to serve a specific vertical application to efficiently support network services, thus providing high degree of flexibility .This is already a well understood methodology in the wireless industry, such as software-defined core networks(SDN).Combining the capabilities of Software defined networking and network function virtualization (NFV)enables the network slicing. Network slicing implementation is end-to-end from the core through the RAN. In the core, NFV and SDN convert the network elements and operations in every slice to meet its own requirement. For RAN, slicing is to be built on physical radio resources or on logical resources absent from physical radio resources. A complex device such as a mobile phone can be authenticated and attached to a diverse set of net-works slices that are each tailored to a specific purpose like streaming video calls, voice calls, website browsing, chat-room and so on. Such devices may need to carry on high-quality voice and video calls, while at the same time continuing background browsing and upload/download functions.

D. Software Defined Networks (SDN)

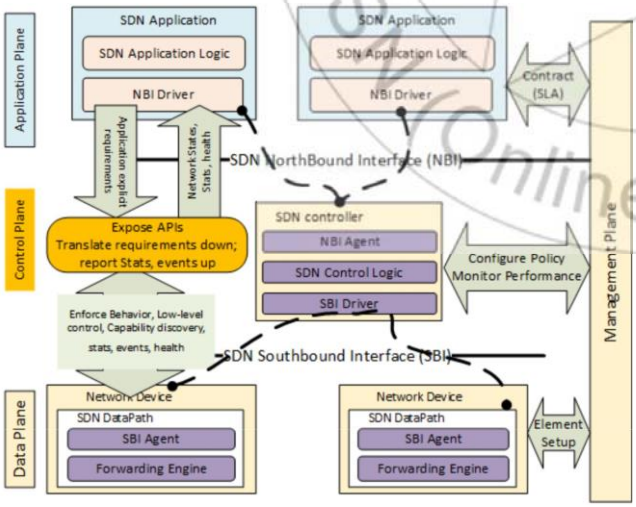

Figure 3: Architecture of SDN

plane. SDN controls the entire network through intelligent orchestration and smart provisioning systems. It also permits on-demand resource allocation, self-service provisioning, real time virtualised networking, and provides security to cloud services. Thus, the network can evolve into an expandable vendor-independent service delivery platform capable of answering rapidly to changing business, end-user, and market needs, which clearly eases the network design and operation. Altogether, the devices themselves doesn't need to understand and process hundreds of proto-col standards but merely accept instructions from the SDN controllers. The value of SDN in 5G wireless networks lies specifically in its ability to provide with new enhancements like network virtualisation, automating and develop-ing new services on apex of the virtualised resources, in secure and trusted networks. Also, SDN provides the aberration of the control logic from vendor-specific hardware to open and vendor-neutral software controllers.

Thus, it simplifies implementing routing and data processing functions of wireless infrastructure into software modules for general purpose computing or even cloud computing.

E. Network Function Virtualisation

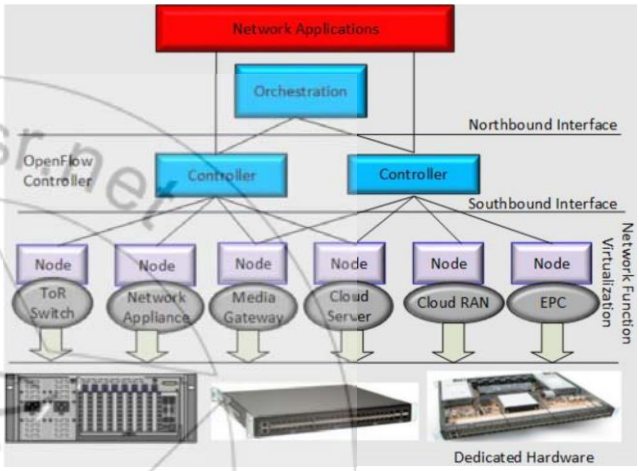

Figure 4: Functioning of NFV

Software-defined networking (SDN) is a technique to build data networking equipment and software that separates and abstracts elements of these systems.SDN techniques have been seen as promising prerequisites for this goal of carrier networks, which will likely play a important role in the design of 5G wireless networks. Software-De-fined Networking (SDN) has emerged as a new proactive architecture for network programmability. The main objective behind SDN is to move the control plane outside the switches and enable control of data through a logical soft-ware called controller.SDN provides simple information to describe the components, the functions they provide, and the method to manage the forwarding plane from a remote controller via a secure channel. This information gists the common requirements of forwarding tables for a majority of switches and their flow tables. This up-to-date view makes the controller able to perform network management functions simultaneously allowing easy modification of the network behaviour through the centralised control

One of the most promising and compelling technology of SDN, having the potential to drastically affect the future 5G networking thus refactoring the architecture of legacy networks, is virtualising as many network functions as possible, known as Network Function Virtualisation (NFV).The concept of NFV is inherited from the classical server virtualisation that could by installing multiple virtual machines running different operating systems, software and processes. The NFV technology aims to build an end-to-end

infrastructure and enables the enhancing of many eclectic network devices by moving network functions from dedicated hardware onto general purpose storage platforms such as servers. The network functions are implemented in software packages that can be deployed in virtualised infrastructure, which will allow for new flexibilities in operating and managing mobile networks. Another important topic in 5G carrier-grade mobile networks which may be improved by implementing NFV in cloud infrastructures is resilience. Implementing network functions in data centres allows transparent migration between either virtual machines or real machines. Furthermore, implementing mobile network functions in data centres will enable more flexibility in terms of resource manage-ment, assignment, and scaling. This impact the development of eco- systems and energy efficiency of networks, as over-provisioning can be avoid by only using the necessary amount of resources.

Enhancing NFV with SDN may offload the centralised location within networks nodes which require high-performance connections between Radio Access Point (RAP) and data centres. Another concept that received a lot of attention with the evolution of SDN and NFV is the Net-work Service Chaining (NSC).The NSC aimed to help carrier-grade to provide continuous delivery of services based on dynamic network function orchestration and automated deployment mechanisms to improve operational efficiency.

F. Information Centric Networking

The Information-Centric Networking (ICN) is a novel net-work architecture that is receiving a lot of attention in the 5G networks. ICN consists of new communication model that revolve around the production, consumption and matching users with content, in-network caching and con-tent-based service differentiation, instead of communication channels between hosts. ICN pushes many design principals from the Web to the network architecture by centering on what is relevant to the user and not where the content is located in the network. So, ICN manages con-tents and names to ensure their uniqueness in the network. The ICN communication model allows built-in native features aiming at optimising and simplifying future content delivery architecture. The service providers should prepare their infrastructure capabilities to support efficient multi-cast data delivery as well as provide seamless mobile connectivity so users can move and the network can continue delivering data packets without interruption. The integration of ICN in the 5G network includes storage and execution capabilities to evolve the network from a dumb pipe transport towards added value intelligent network. Introduction of intelligence in ICN architecture improves the flexibility and scalability of content-naming as well as enhances the performance of the QoS in the network. Intelligent ICN can also made it feasible to integrate mobile radio aware ICN on the 5G networks.

3. Architecture of 5G

The 5G technology is based entirely on IP model designed for wireless mobile networks. A main user terminal and then a number of independent and self governing radio access technologies constitutes the architecture of 5G.Each of the radio technology component is considered as the IP link for the external internet world. The IP technology is exclusively designed to ensure sufficient control of data for appropriate routing of IP packets concerned to a certain application connection ie between the server and the client. Moreover packets should be fixed in accordance with the given policies of the user to make routing accessible. The address space in the network layer is limited also there is

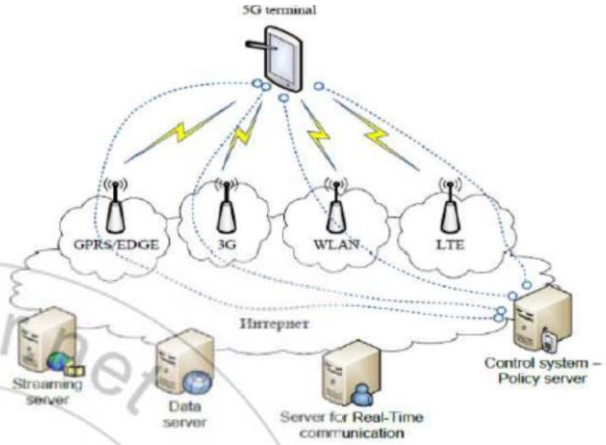

Figure 5: Architecture of 5G

no probability for quality of service support. These concerns are to be solved using the latest version IPv6 which trades significantly bigger header packets. The new architecture allows the user to connect several mobiles or wire-less networks at the same time.

4. Literature Review

There have been phenomenal change and development in the telecom industry. We have different wireless communication system such as 3G, 4G which has innumerable benefits that makes many tasks easy to finish within less time. Nowadays researchers of many domains are exploring the most advance wireless communication technology, which could be 5g.Researchers of some well established mobile research institutes say that in order to meet the requirement of the future in the field of internet, they have started to look for the next generation wireless solutions after the launch of LTE system. So studies on fifth generation for wireless communication technology which is a new and advanced technology in the field of communication, has slowly started to build from last 2 years. The past 3G and 4G have been evolved mainly due the demand of data services over the internet but in case of 5G, it could be more than just data. It would be more energy efficient than the existing technology, whose frequency band could be 3-300 GHz and bandwidth of 1Gbps or higher.

5. Future Scope

As cited earlier, the technology is loaded with multiple advanced features initiating from the super high internet to smooth omnipresent service. The 5th generation technology is designed to provide high end and remarkable data capabilities, unrestricted call volumes, and immeasurable

data broadcast within the latest mobile operating system. Hence it is more smart technology which will interconnect the entire world without any boundaries. Our world will have uninterrupted and universal access to information, communication and entertainment that will lay a foundation to a new dimension to our lives and will enhance our lifestyle meaningfully.

Moreover governments can use this technology as an opportunity for the good governance and can produce efficient environments which will surely encourage continuing investment in 5G, the next generation technology.

6. Conclusion

The conclusion of development in wireless 5G technology is the development of new technology which is to be de-signed on the existing network infrastructure but to up-grade in certain aspects beyond manifold. Now the current work is in the module which offers the best operating sys-tem and low cost for service. There quite a few improvements from first generation to latest generation in the do-main of wireless communication technology. This upcoming technology is available in the market at affordable cost, at larger expectation than previous one. 5G technology offers high reliability and speed for avid mobile phone consumers.

7. Acknowledgments

I wish to express my sincere thanks and deep sense of gratitude to respected guide Prof. N R Bamne in Department of Electronics and Telecommunication Engineering of Smt. Kashibai Navale College Of Engineering, Vadgaon (BK), Pune 41, for the technical guidance and encouragement which motivated us to the completion of the research.

References

[1] Ganesh Patil, Prof Prashant Wankhede; 5G Wireless technology vol 3, Issue.10,Oct 2014,Pg 203-207
[2] M. Sathıya, R.Gowthami, G.Karpagam, B. Saranya, U. Suganya, Cellular and network architecture for 5G wireless communicating networks in mobile technology .Vol.3, Is-sue 2, (Mar-Apr 2015),pp(206-211)
[3] D.Raychaudhari,5G network architecture and the future mobile internet, IEEE 5G workshop,priceton,May26,2015
[4] Wenfeng X,Yonggang W,Chuan Heng F, Dusit N, Haiyong X.A survey on software defined networking,vol. 17,No-1,first quarter2015
[5]Dr.j.Thirumaran,S.Dhinakaran.Green communication and networking system-A challenge to current communica-tions and protocols,ISSN:2347-3878,Impact factor(2014): 3.05