PROBLEMS IN IMPLEMENTING 5G IN INDIA AND SOLUTIONS FOR IT

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Abstract - With the growing demand of high data speed in India and increase in the number of users from the last decade the present technology of 3G and 4G will not be able to meet the requiring internet demands of the users. Hence the development of next generation of the network called the 5th generation of thenetwork is necessary. This paper will represent a comprehensive study on the challenges for the implementation of 5G in INDIA, discuss its future scope, its applications and will propose solutions for the factors that are causing problems in the implementation of 5G.

Keywords - Smart antennas, Deep fibre, Mobile edge computing, Software-defined networking, Cognitive Radio.

I. INTRODUCTION

With the evolution of radio technology and cellular system in the1980s, the evolvement of digital wireless communication took place. From the development of 1G (FIRST GENERATION) in the1980s, 2G (SECOND GENERATION) in 1990s, 3G (THIRD GENERATION) in 2000s, 4G (FOURTH GENERATION) in 2010s and now 5G the advancement towards smarter technology is taking place. 5G or 5th generation is the upcoming advancement made in the field of mobile communication. It aims at ahigher capacity than the existing 4G network. The operating range of 5G network lies in the millimetre wave bands of 28,38 and at afrequency of 60GHz. With reduced latency compared to LTE, data rates of 100 megabits and downloading speed of 1 GB per second 5G focuses on revolutionizing the field of communication with improved signalling efficiency and improved coverage speed.

Apart from providing faster speeds, high downloading speed 5G will also be used in other fields like theInternet of Things, broadcast services and in communication for anatural disaster.
With the implementation of 5G, the new area research has been introduced to the researchers all around the world.

1.1 Architecture and key technology of 5G
The architecture of 5G is advanced and is upgraded to tackle the new situation. Upgradation of the5G network is based upon Cognitive Radio technology which consists of characteristics such as Capability of thedevice to identify its location as well as temperature. The function of Cognitive Radio is to act as a transceiver that matches and respond to the radio frequencies.

The architecture of 5G:
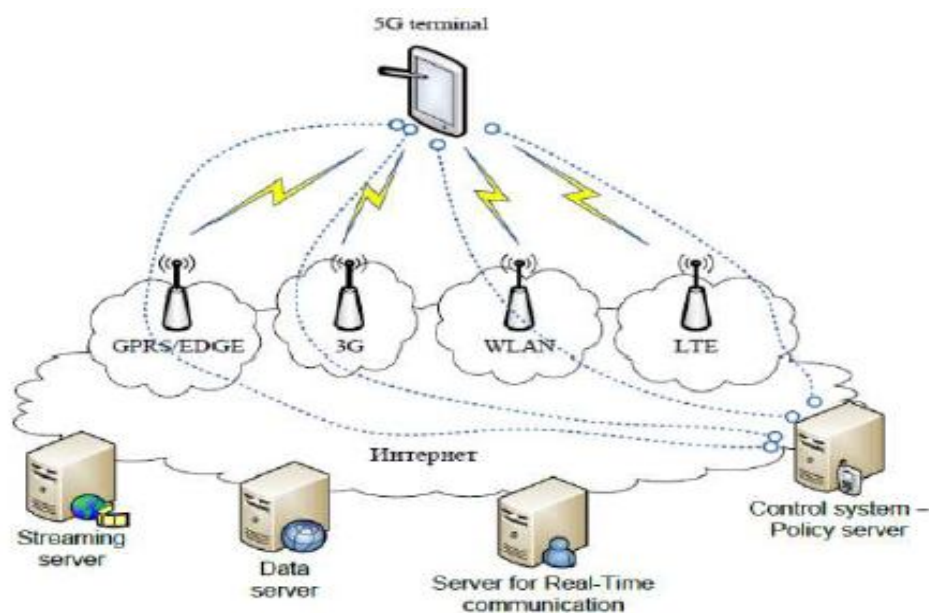As shown in the figure represents the working model of 5G network architecture

Fig1. Architecture of 5G network

The model of 5G is an IP based model for all the wireless networks. The model consists of theuser terminal which is the main part of the5G architecture. The user terminal consists of autonomous radio technologies. The function of the radio technology is to act as an IP link for the internet. The purpose of IP design is to ensure control data for routing of IP packets related to application connections i.e. interfacing between user and applications and servers on the internet. The key technology behind theworking of 5G architecture is the Mater core Technology.

Master Core Technology is the converging point for other technologies in the wireless network. The architecture of Master Core technology allows it to operate in the parallel multimode including all IP network and 5G mode. The main features of 5G and network mode are it controls all the network of.RAN (Radio access networks) and Different access networks. The compatibility feature of this technology makes it more efficient and more powerful.

II. PROBLEMS IN IMPLEMENTATION OF 5G IN INDIA

A. Lack of Regulatory bodies in India's Telecom sector

From the advancement of Broadband over last decade. The telecom sector in India missed good chances in formulating a uniform broadband strategy for India. 5G needs a proper strategy for its implementation and with lack of regulatory bodies, it seems impossible for India to achieve in near future. According to the report of World Bank, the implementation of 5G in India will accelerate the economic growth of India by 13.8%. Apart from lack of policymakers, India's telecom sector is greatly affected by the procedural delays and their multiple issues. Companies who faced loss in 2G spectrum scam have clearly left a lesson for other telecom companies to not invest in India for any future projects. 5G implementation in India will not be in reality until there is a proper regulatory body which will develop the roadmap for 5G in India.

B. India lacks in Fibre Infrastructure

Optical Fibre plays a key role in theimplementation of any new generation of network. For the implementation of 5G in India role of Fibre is very important. It plays a key role in delivering increased data capacity and improve voice calling quality. Due to lack of Fibre infrastructure, India faces poor quality of service and call drop issues which indicate towards country's low investment in Fibre and backhaul infrastructure. Only 20% of towers in India are backhauled compared with 80% in countries like US, China, and Korea focus more on making policy that gives importance to Fibre deployments.

According to a recent report, India only deploys average 15 million kilometres of Fibre every year compared to the current demand of at least 50 Kilometers every year.

C. Last mile Connectivity

Since India lacks Fibre infrastructure it has affected the Last-mile Connectivity as well. A project name NOFN was launched to improve the last mile connectivity in India's rural area connecting all the 2, 50,000 Gram panchayats. The work was assigned to three telecom companies in theratio of 70:15:15 but after two years only limited Gram panchayats were connected. 5G demands upgradation in thenetwork as well as speed but unfortunately due to lack of last mile connectivity in rural India and non-uniformity in networking speed implementation of 5G is still a big dream for India.

D. Low speed of Data and High Rates

Low speed of Data and high rates in India is also a major issue for deployment of 5G in India. Currently, India ranks at 89th position out of 147 countries in terms of average internet speed with 6.5mbp/s. The present data speed offered by companies in India is not constant,especially in rural areas. For downloading large sized files like HD videos, games high data speed is required which is not uniform available in India. The data rate requirement for 5G is 1TBPS but India has only 6.5mbp/s average internet speed this is due to lack of Fibre infrastructure and last mile connectivity.

III. PROPOSED SOLUTIONS FOR THE PROBLEMS IN IMPLEMENTATION OF 5G

3.1 MOBILE EDGE COMPUTING

According to the Cisco's VNI Report, the evolution of cellular networking and broadband technology will see a rapid increase in global mobile data traffic with agrowth rate of 47% from 2016 to 2021.
In the past few years, smartphones have become an integral tool for millions of people all around the world. As far as 5G is concerned it will rely more on high network coverage for mobiles, high data rates. To deal with these features of 5G role Of MEC (Mobile edge computing) comes into light.

Mobile edge computing is the framework of thenetwork with features of cloud computing which provides IT environment at theedge of thecellular network.
The main principle behind theuse of MEC is it runs theapplication and performs processing tasks close to thecellular customer. With this method congestion network is reduced and performance of application gets better.

Architecture of MEC for 5G
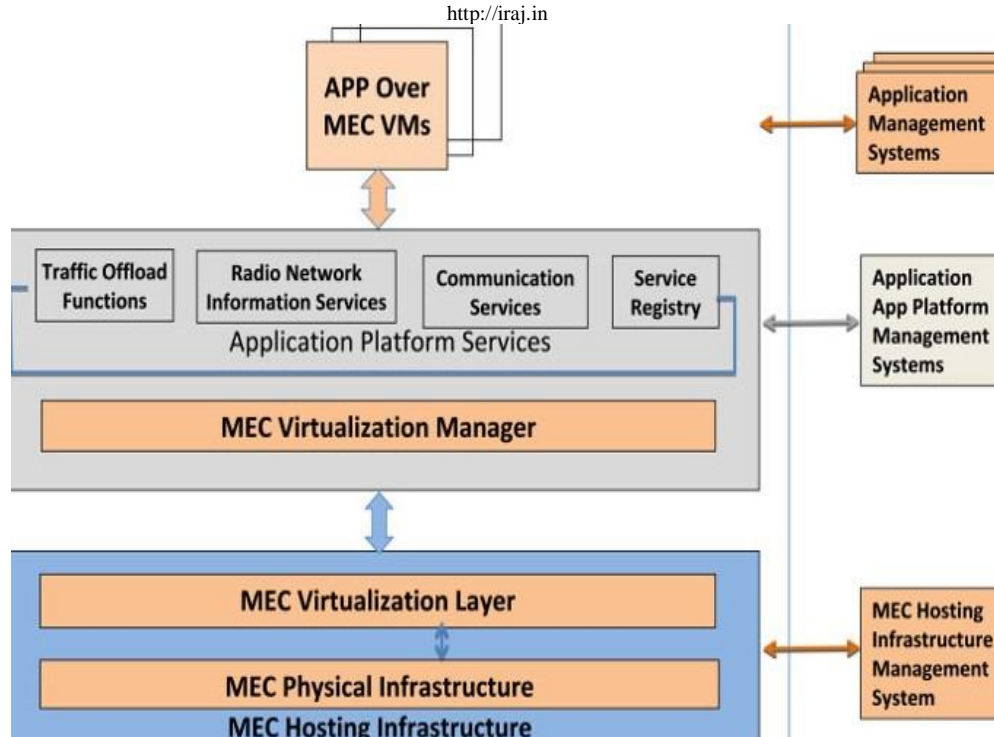
As shown below is the architecture of MEC for 5G

Fig2. The working model of Mobile edge computing

The main parts of MEC architecture are:

1. Mobile edge platform: The function of mobile edge platform is to set the rules of configuration for user plane traffic. Apart from providing configuration it also provides services to compose radio network data.

2. Mobile edge orchestrator: Its function is to maintain anoverall view of MEC servers which helps in determining optimum locations.

3. Mobile edge platform manager: It is responsible for managing MEC application platform.

4. Virtualized Infrastructure Manager: It acts as a manager for the resources of virtualized infrastructure including preparation of infrastructure for running software image.

5. Mobile edge applications: The applications which are part of mobile edge computing it acts as a platform for them.

How MEC works for 5G:

In 5G networking for MEC to work the key element is 5G RAN (Radio access network). MEC will use this RAN for edge cloud computing and the mobile network operators will allow third-party tenants to base station. The application provider will then host its applications on the edge of thenetwork with high bandwidth and low latency, then the mobile edge orchestrator will grant them the network information regarding cell load, bandwidth and the subscriber location. With this networking module, the telecom companies will remove load and congestion from the main network.

3.2 Software define network:

SDN (Software define network) is based on the concept of cloud computing which focuses on programmatically efficient network process to improve theperformance of existing network architecture. The main aim of using SDN is to decentralize traditional network system into one central network.

The main component which does all the centralization of existing network architecture is control plane. It consists of two or more than two controllers system where the complete procedure of centralization takes place.

SDN architecture working module for 5G:
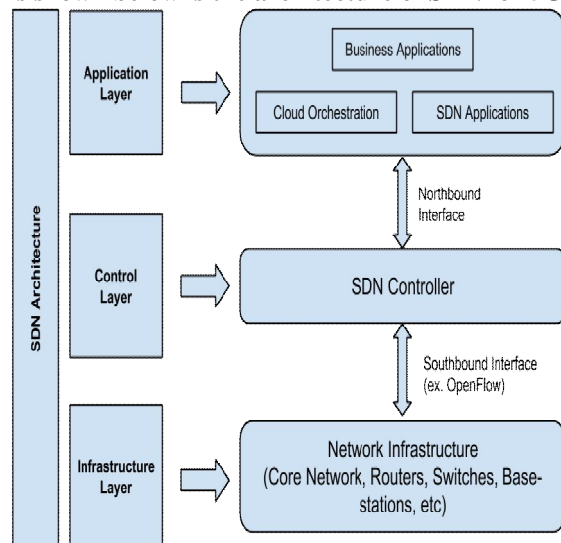**As shown below is the architecture of SDN for 5G**

Fig3. The layers of SDN architecture

To achieve the centralization of network inside control plane the network gets separated into 3 layers

1. Application layer:
The function of this layer is to communicate to SDN controller through API (Application programming interface).

2. Control layer:
This layer separates the control plane from thedata plane. The brain of SDN i.e. control plane is located inside control layer. SDN control plane prepares the logical map for efficient decisions of networks with the help of SDN application which is present in theapplication layer.

3. Infrastructure layer:
The last layer of SDN. It is the base of SDN, its function is to execute SDN data paths and to forward the actual traffic to application layer and control layer.

How SDN helps in implementation of 5G:
As mentioned earlier 5G focuses more on reduced latency, high data speed and low data traffic. SDN plays a vital role in fulfilling all these requirements. SDN will provide a centralized network architecture for 5G where there will be a better flow of data as well as minimization of bandwidth which will be helpful in removing latency. Besides all these facilities it will also provide a way to control the network redundancy with the help of centralized control plane.

3.3. Smart Antennas:
Smart antennas are thecomposition of arrays of antennas which is used to convert radio signals into narrow beams. The main purpose of use of smart antennas is to use complex signal processing for improving the focus for transmission of signals.

1. How smart antennas work:
The working of smart antennas divided into 2 steps namely :
Direction of Arrival Estimation (DOA) method and Beamforming method.

2. The direction of arrival estimation:
In this method of estimation smart antennas use two algorithms MUSIC (Multiple Signal Classification) and Matrix pencil method for the estimation of thesignal using rotational invariance algorithms. The function of MUSIC and Matrix pencil method is to find spatial spectrum and to calculate the DOA (Direction of arrival) from the top point of thespectrum.

3. Beamforming:
Use of this method is to create radiation pattern in the arrays of antennas. The pattern of radiation is achieved by the addition of phases of signal towards the location of the desired mobile targets using afinite impulse response delay line filter. FIR reduces the minimum mean square error between actual and desired beam pattern formation. The algorithms used for beamforming are thesteepest descent and LMS algorithms.

Fig shows Beam Formation in Smart Antennas

4. Use of Smart antennas to boost implementation of 5G:
Since 5G is going to use ahigh data rate of 10 GB/s and network capacity of more than 10,000 times than the existing network. To achieve this target telecom company will need anextra spectrum of broadband. To help companies achieving this target Smart antennas system will play a crucial role by increasing network performance capacity beyond what today exists. Deployment of smart antennas will provide direct communications, will limit interference and will improve the capacity of existing cellular networking.

3.3: Deep Fibre:
To lay down any network technology role of fibre is very important. As mentioned in the section of problems in thedeployment of 5G India lacks in fibre infrastructure and last mile connectivity and only 20% of towers are upgraded for 5G technology. Deep fibre plays an important role in dealing with problems of last mile connectivity and fibre infrastructure.

Deep fibre is the process in which MSO (Multi-server operator) deploys fibre closer to customers for better service. The main work of deep fibre is to remove amplifiers and to push optical-electrical conversion closer to users which results in increase bandwidth potential.
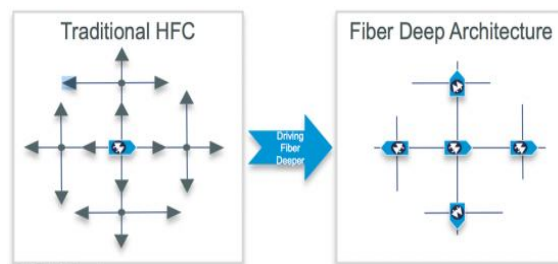

Fig shows the deployment of DEEP Fibre reduces the congestion of network for the users

1. Why Deep Fibre is important for 5G:
The previous generation of broadband technology (3G and 4G) were dependent on broader blocks of spectrum and improved spectral efficiency for maximum results in higher speed and capacity. In the

case of 5G, it is totally different the technology of 5G will depend on the use of higher frequencies and densification. Deployment of fibre closer to thecustomer will generate an existing gateway for increased data traffic from that densification. In the past few years, use of home spots and hotspots require high-speed broadband connections. Users nowadays depend much more on home spots and hotspots for solving high data speed. Without the deployment of Deep Fibre, it is impossible to support the mobile data traffic increase between 2016 and 2021.

2. Apart from increased data traffic the second main reason that is necessary for deployment of Deep Fibre in India is to increase broadband service choice for customers. Deep Fibre will play a major role in nation's infrastructure for providing customers with high-speed broadband connections in all parts of the country at anaffordable price.

APPLICATIONS OF 5G

The arrival of 5G will also bring significant applications in various fields.
1. 5G will set a uniform global standard for all users.
2. It will boost the availability of network and allow people to use their computer and smartphones 24*7.
3. It will transform the world in Wi-FI zone
4. With its strong signals and network, people will be able to use their devices at higher altitude also.

FUTURE SCOPE OF 5G

5G is a technology which promises high speed of data, reduces latency and fast internet speed. It will also give access to unlimited information, entertainment and communication at ahigh-speed level which will change the lifestyle of Indian mobile users. At present, the previous technologies (4G and 3G) are still under trials in many parts of the country. The telecom sector has to think seriously towards the future of 5G and must take necessary steps regarding

thetransition of thenetwork from 3G to 4G and also towards laying down the network framework for 5G. 5G can be used by the government as an opportunity for good governance and for creating agood environment which will boost up the investment in 5G technology.

CONCLUSION

Through this paper, I have tried to study the problems for the deployment of 5G in India, its solutions, applications and its future scope. 5G will transform the current network architecture of India into a new level it will help in raising the economic level of India as well as it will help India to improve its ranking in Internet speed. India will get benefits of 5G only if the current problems in the deployment of 5G will beremoved by the government.

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REFERENCES

[1] Key Technologies and Problems in Deployment of 5G Mobile Communication System by Arun Kumar and Manisha Gupta Foundation of Computer Science FCS, New York, USA Volume 1– No.3, February 2015
[2] https:// wikipedia.org/wiki/Mobile_edge_computing
[3] www.juniper.net/assets/us/en/local/pdf/whitepapers/2000642-en.pdf
[4] 5G Quick Guide Tutorials point.com
[5] https:\\ en.wikipedia.org/wiki/Smart antenna
[6] www.signalintegrityjournal.com/articles/56-smart-antennas-for-5g
[7] www2.deloitte.com/us/en/pages/consulting/articles/communications-infrastructure-upgrade-deep-fiber-imperative.html
[8] SDN for 5G Meade ZolanvariRotation October 2015
[9] Soft Air: A software-defined networking architecture for 5G wireless systems Ian F. Akyildiz a, Pu Wang b, Shih-Chun Lin
[10] www.dqindia.com/five-barriers-to-broadband-adoption-in-india/
[11] https://blogs.cisco.com/sp/the-benefits-of-deep-fiber-hfc.

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