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An Eco-System of SDR, SDN and Massive MIMO for 5G Networks

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Abstract: *In this paper we are presenting the integration of state-of-the-art technologies like Software Defined Radio (SDR),Software defined Network, Network Function Virtualization and Massive Multiple Input Multiple Output (MIMO) to enhance performance of future 5G mobile networks. This will create a paradigm shift of Mobile Network infrastructure from traditional to the more sophisticated . Among the Ecosystem, SDR and SDN provide a base for controlling the network operations such as switching between different architecture-based networks such as WiFi and cellular without any loss of connectivity through simple application programs. Network Function Virtualization contributes to network portability and interoperability where as High through put is achieved with the incorporation of Massive MIMO.*

Keywords: *SDR, SDN, Massive MIMO, 5G*

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I. Introduction

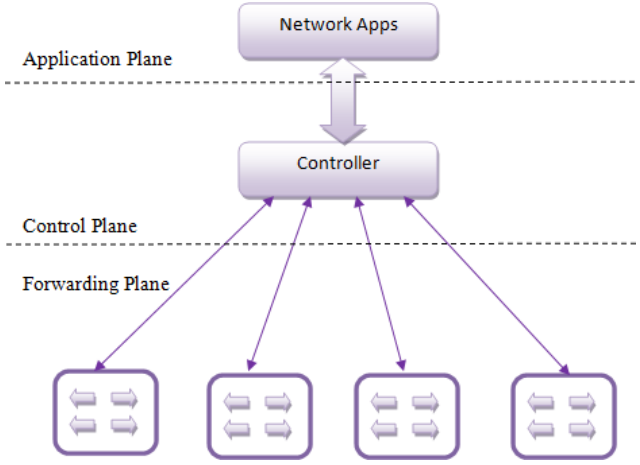
In this era of internet, our basic utility activities are getting online, like payment of various kinds of bills, shopping, exchange of thoughts and sharing of ideas and concepts through social mobile apps like whatsApp, Facebook, and twitter.

These are tempting people to use mobiles for faster and convenient solutions. This has risen the number of mobile subscribers and thus given rise to sharp hikes in data rates. To meet these growing data rates, the latest state-of-the-art infrastructure in network device architectures, blended with Software Defined Radio(SDR), Software Defined Network(SDN), massive MIMO and Network virtualization Function(NFV) can be leveraged to improve the efficiency of wireless links and thus obtain maximum data rates.

The virtualization concept especially Network Function Virtualization (NFV) minimizes the cost of network infrastructure by excluding hardware (network equipments like switches) and thus enhances the performance by avoiding hardware maintenance. The SDR concept helps to reconfigure the radio(frequencies) using simple programs. These programmable networks can have the specific software installed or else at run-time they could be loaded from available libraries of software-defined-radio packages. The SDN is a state-of-the-art technology, using which the network devices like routers, switches and bridges could be managed using simple application programming interfaces.

SDN architecture as shown in figure 1. basically comprises of the control plane and the data plane with open interfaces in-between the centralized controller and switches/routers.

Fig:1. Basic Architecture of SDN based Network



The primary motivation to combine state-of-the-art technologies like soft-ware defined radio , soft-ware defined networks and network function virtualization for future 5G mobile networks is to cut the equipment costs and power consumption and enhance openness and multi- tenancy. As the most of the control in the network is through software, rather than hardware devices, the cost of infrastructure decreases to large extent, thus providing cost effective solutions.

The rest of our paper is organized as follows. We have discussed basic aspects of NFV, SDR, and SDN, and then proposed an integrated design for future 4G/5Gnetworks. We presented the intricacies of NFV and SDR/SDN based networks. We discussed and suggested some open problems in the implementation of our scheme, followed by the conclusion of the article.

II. SDR And SDN

SDR: Software Defined Radio(SDR) is basically a communication system based on radio frequency where normally components are implemented by programs on a computer system or embedded system rather than traditional hardware implementation. The basic SDR platform comprises of an antenna, a broadband Analog-to-Digital (Digital-to-Analog) converter, a multi-band radio frequency (RF) module, , DSP processors, and other expansions.

SDR can perform multiple functions by separating the system hardware architecture and functions, through software based on a relatively common hardware platform. The operating frequency, , modulation, system bandwidth and source encoding etc could be easily programmed.

SDN: Basically SDN comprises of two planes , control plane and data plane. The control plane has all the software needed to control network operations like routing and switching. The data plane is plainly responsible for forwarding of data packets to the routes and devices dictated by control plane. SDN introduces centralized control of all network operations, through simple application programs. Thus it eliminates vendor support for simple configurations of network devices. This concept avoids the overhead of implementing myriad of protocol standards. The straight forward management of the forwarding plane of network devices is possible because of the interface between open APIs, infrastructure layers and SDN control, both physically and virtually[5].

SDN concept develops independency between network and applications. The network is not aware of the applications through which it is been controlled, and the applications are abstracted with various network parameters. This results in in optimal use of computational, network resources and storage.

The Flexibility could be incorporated in the design and deployment through the concept of Network Function Virtualization(NFV). Besides this, NFV supports SDN, by providing proper infrastructure on which software of SDN can run properly

SDN objectives are satisfied by NFV with the help of servers and switches. Besides this, SDR presents many functional virtualization supports to mobile networks[3]. From physical level signals up to extraction of data packets from the Application layer, SDN can applied and be used. In order to build congestion of an end to end transmission channels from various network SDN is employed.

Massive MIMO: In order to serve myriad of mobile users with the same time-frequency resource parallely, Massive MIMO (multiple-input multiple-output)make use of the antenna arrays of some hundred elements [2].Traditional MIMO is imposed and scaled up by the massive MIMO in order to avail all advantages and benefits at higher level.

This benefit includes:

- To increase the radiated energy efficiency up to 100 times and simultaneously increasing the capacity.
- Smaller budgets, low power supplies
- Reducing latency on air interface.
- Making a strong and tough unusual interference made by users as well as deliberate jam.
- To reduce limitation on accuracy of each and every individual amplifier and RF chain[2].

Further board-band networks which are energy efficient and stronger, massive MIMO will be very fruitful.
Antenna arrays of MIMO mobilize large quantity of information regarding spacial domain in real time [4].
This, in turn, raises a problem of MIMO co-ordination by raising computational complexity.
The SDN processes spacial information well then network will achieve better performance. Although massive MIMO has many advantages, but, it does face challenges like implementation of the SDR, SDN.
Arrays of MIMO mobilize big amount of base-band data in computational time which in turn raises the computational complexity.
Growth of Mobile traffics is increasing exponentially which is far away from the capacity of 4G. To meet this demand MIMO and millimeter wave system can be incorporated in the mobile architectures and infrastructures with program based control through SDR and SDN.

III. Expected Standards For 5g

Future 4G/5G will going to use more sophisticated technologies to utilize the bandwidth and also interconnection with many different user equipment and devices. Increase in tremendous use of NFV, SDN and SDR will simplify the new generation networks and also reduce the cost of network construction[1].

In this section we present the necessary extensions to current standards which don't take future 5G networks into consideration. SDR is there for modulation, and signal processing. SDN focuses on transportation and QoS whereas NVF deploys the services and function. Based on this understanding the different layers are incorporated in technologies.

SDR: Application of MIMO leads to high data throughput and mobility of 4G/5G and is embedded in SDN. It also helps in utilizing the channel efficiently. The IMT- Advanced and the ITU-T technical requirement for 4G planned to increase the bandwidth from 20MHz to 40MHz and also increase the antenna number to 3,4 or even more.

The networks with different architectures and topologies of 4G beyond should emphasize the use of underlying network schemes such as WiFi or cellular. To achieve the function more effective architecture and efficient algorithms need to be used[2].

SDN: The real work lies in, control plane security , mobile management and inter-ISP handoff . Due to separation of control plane and data plane, switching between networks with different architectures and topologies such as WiFi networks and cellular networks without any loss of connectivity can be achieved.

IETF proposed the use of a SDN based mobile IP (MIP) which helps in relocating from one network to the other. In SDN standards security has paramount concern. Protection of user privacy and devices should be strong to network attacks.

NFV: The development and deployment of healthy ecosystem is implemented through portability and interoperability of virtual devices. Portability helps to optimize the use of service and network deployment. The interoperability decouples the virtual devices from the physical equipment provided by different vendors.

IV. Potential Sdn For 5g Networks

The most widely deployed SDN technology[1] is Open- Flow which provides a set of protocols that a controller uses to communicate with network devices in an SDN architecture. The primary objective of proposing Open- Flow is to enable researchers in industry and Academia to test and use new ideas in the environment of production and provide a platform to switch the control logic from a device(switch) into the controller(program).

The intention of Open-Flow was not to get the code of the vendors device when controlling a switch but instead provide a platform that would help researchers run experiments in production networks. However, SDN and Open-Flow have been developed by the industry as a strategy to cut production costs and hardware complexity, along with enhanced functionality of the network.

Open-Flow has myriad of outstanding capabilities like, it is possible to control multiple switches from a single controller and to analyze traffic statistics using programming APIs, centralized control, flow abstraction, dynamic updating of forwarding rules and software-based traffic analysis. These features have been exploited by the Research communities to experiment with innovative ideas and propose new paradigms and approaches to improve the performance of future 5G mobile networks.

The research is going in Data traffic management, network management, security, availability, network and data center virtualization, wireless applications and ease of configuration. These research have been implemented in basic infrastructures , such as real hardware networks and virtual simulations [5]. The aim of Open-Flow based applications is to simplify network management and ease the configuration of a network, as well as add security features.

The OpenFlow based networks, provides a novel model to make routing more efficient by applying various routing rules associated with data flows so that the modification of partitions of the networks layout and traffic flows can be as immediate as in an SDN.

The controller component of Open-Flow is the main aspect of the network where routing of packets is decided. As per the best shortest energy efficient routing algorithm , the route is chosen and then the packet is forwarded, The controller allocates rights to use the flow tables as well as the rules which dictates the network forwarders how to direct traffic flows.

The management of wired networks such as 5G core is primarily addressed by the present SDN standards in use. 5G mobile networks, also involve a large number of wireless technologies like radio access network (RAN) that specially includes massive MIMO and HetNets. Likewise, in this paper we make an effort to extend the function of SDN to cooperate with these edging technologies in 5G network, including Hetnets, massive MIMO, density small cells, etc. We also highlighted the function of SDN on coping with the radio resource management in massive MIMO HetNets.

References

[1]. R. Q. Hu and Y. Qian, ``An energy efficient and spectrum ef_cient wireless heterogeneous network framework for 5G systems," IEEE Commun. Mag., vol. 52, no. 5, pp. 94-101, May 2014.

[2]. V. Jungnickel et al., ``The role of small cells, coordinated multipoint, and massive MIMO in 5G," IEEE Commun. Mag., vol. 52, no. 5, pp. 44-51, May 2014.

[3]. L. E. Li, Z. M. Mao, and J. Rexford, "Cell SDN: Software- Defined Cellular Networks," Techinical Report, Princeton University, 2012.

[4]. H. Masutani et al., ``Requirements and design of flexible NFV network infrastructure node leveraging SDN/OpenFlow," in Proc. Int. Conf. Opt. Netw. Design Modeling, May 2014, pp. 258-263.

[5]. N. Cvijetic, ``Optical network evolution for 5G mobile applications and SDN-based control," in Proc. 16th Int. Telecommun. Netw. Strategy Planning Symp. (Networks), Sep. 2014, pp. 1-5.

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