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5G Technology Architecture

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Abstract: *5G Technology stands for fifth Generation Mobile technology. Research on 5G mobile wireless technologies has been very active in between service providers and users. 5G technology has extraordinary data capabilities and has ability to tie together unrestricted call volumes and infinite data broadcast within latest mobile operating system. It highlights salient features, i.e flexibility, accessibility, and cloud-based service. 5G technology going to be a new mobile revolution in mobile market. To fulfill 5G rate and capacity requirements including network densification, employment of large- scale (massive) multiple input multiple output (MIMO), and exploitation of the millimeter wave (mmWave) spectrum to attain Gigabit communications.*

Keywords: Natural fibre, Cement composites, Nano Silica, Mechanical properties, Durability properties.

I. INTRODUCTION

Today and in the recent future, to fulfill the presumptions and challenges of the near future, the wireless based networks of today will have to advance in various ways. Recent technology constituent like high-speed packet access (HSPA) and long-term evolution (LTE) will be launched as a segment of the advancement of current wireless based technologies. Nevertheless, auxiliary components may also constitute future new wireless based technologies, which may adjunct the evolved technologies. Specimen of these new technology components are different ways of accessing spectrum and considerably higher frequency ranges, the instigation of massive antenna configurations, direct device-to-device communication, and ultra-dense deployments.

Since its initiation in the late 1970s, mobile wireless communication has come across from anlogy voice calls to current modern technologies adept of providing high quality mobile broadband services with end-user data rates of several megabits per second over wide areas and tens, or even hundreds, of megabits per second locally. The extensive improvements in terms of potentiality of mobile communication networks, along with the initiation of new types of mobile devices such as smart phones and tablets, have produced an eruption of new applications which will be used in cases for mobile connectivity and a resultant exponential growth in network traffic.

The imagination of our future is a networked society with unbounded access to information and sharing of data which is accessible everywhere and every time for everyone and everything. To realize this imagination, new technology components need to be examined for the evolution of existing wireless based technologies. 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 evolution of ongoing existing technologies. The remainder of the paper is organized as follows: In Section II, we present the evolution of wireless technologies. Section III gives the detailed description of the proposed general 5G cellular network architecture. Section IV comprises of the detailed explanation of the emerging technologies for 5G wireless networks. We conclude our paper in Section V. A list of current research projects based on 5G technologies is shown in the appendix.

II. EVOLUTION OF WIRELESS TECHNOLOGIES

G. Marconi, an Italian inventor, unlocks the path of recent day wireless communications by communicating the letter ‘S’ along a distance of 3Km in the form of three dot Morse code with the help of electromagnetic waves. After this inception, wireless communications have become an important part of present day society. Since satellite communication, television and radio transmission has advanced to pervasive mobile telephone, wireless communications has transformed the style in which society runs. It shows the evolving generations of wireless technologies in terms of data rate, mobility, coverage and spectral efficiency. As the wireless technologies are growing, the data rate, mobility,

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coverage and spectral efficiency increases. It also shows that the 1G and 2G technologies use circuit switching while 2.5G and 3G uses both circuit and packet switching and the next generations from 3.5G to now i.e. 5G are using packet switching. Along with these factors, it also differentiate between licensed spectrum and unlicensed spectrum. All the evolving generations use the licensed spectrum while the WiFi, Bluetooth and WiMAX are using the unlicensed spectrum. An overview about the evolving wireless technologies.

III. 5G CELLULAR NETWORK ARCHITECTURE

To contemplate 5G network in the market now, it is evidentthat the multiple access techniques in the network are almost at a still and requires sudden improvement. Current technologies like OFDMA will work at least for next 50 years. Alternatively, there could be only the addition of an application or amelioration done at the fundamental network to please user requirements. This will provoke the package providers to drift for a 5G network as early as 4G is commercially set up. To meet the demands of the user andto overcome the challenges that has been put forward in the 5G system, a drastic change in the strategy of designingthe 5G wireless cellular architecture is needed. A general observation of the researchers has shown in that most ofthe wireless users stay inside for approximately 80 percent oftime and outside for approximately 20 percent of the time. In present wireless cellular architecture, for a mobile use rto communicate whether inside or outside, an outside base.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 penetration loss, data rate, and energy efficiency of wireless communications.

To overcome this challenge, a new idea or designing technique that has come in to existence for scheming the 5G cellular architecture is to distinct outside and inside through the walls of the building will be slightly reduced. This idea will be supported with the help of massive MIMOtechnology in which geographically dispersed arrayof antenna's are deployed which have tens or hundreds of antenna units. Since present MIMO systems are using eithertwo or four antennas, but the idea of massive MIMO systemshas come up with the idea of utilizing the advantages of largearray antenna elements in terms of huge capacity gains.

The mobile users present outside are usually fitted with a certain number of antenna units but with cooperation a large virtual antenna array can be constructed, which together withantenna arrays of base station form virtual massive MIMO links.

IV. EMERGING TECHNOLOGIES FOR 5G WIRELESS NETWORKS

It is expected that mobile and wireless traffic volume will increase a thousand-fold over the next decade which willbe driven by the expected 50 billion connected devices connected to the cloud by 2020 and all need to access and share data, anywhere and anytime. With a rapid increase in the number of connected devices, some challenges appear which will be responded by increasing capacity and by improving energy efficiency, cost and spectrum utilization as well as providing better scalability for handling the increasing number of connected devices, For the vision of all communicating world relative to today's network, the overall technical aim is to provide a system idea.

V. SYSTEM CONCEPT ON 5G

The 5G services will have very different requirements in terms of minimum data rates, latency, battery life, coverage, data volume, etc. The 5G system concept is highly flexible and configurable in order to adapt to the large variation in requirements (rate, latency, number of devices) that occur in different scenarios. It is a user-centric 5G system concept based on multi-RAT (Radio Access Technologies) that provides improved Quality of user Experience (QoE) and reliability to both consumers and devices/machines.

To address these challenges, new flexible air interfaces, new possible waveforms, and new multiple access schemes, medium access control (MAC), and radio resource management (RRM) solutions, and signaling protocols must be investigated to discard the idea that physical layer improvements are already close to their upper limit. In 5G system there are three generic service and some service enablers.

VI. DENSE AND DYNAMIC RAN

UDN refers to this new paradigm of wireless communication network, which includes network cooperation and ultra-dense availability of access points. Wandering and moving nodes, mounted on a car, bus, or train, can provide

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connectivity to users in their proximity and increase data rates by reducing the radio distance to the nearest access node. D2D communications will guarantee the ubiquity of high-quality services and offload the infrastructure transport network. UDNspresent serious challenges in terms of mobility support, interference management, and operation (cost, maintenance, and backhaul). It is clear that new system designs are needed for 5G networksto tackle the root of the problem, that is, the huge imbalance between the nature of mobile devices and cell infrastructure. This leads to the idea of asymmetric user association and the fact that UL and DL should be treated as independent networks.

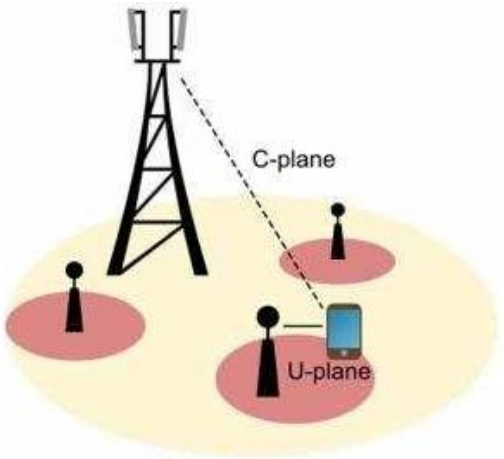

Figure: Decoupling of control and user plane in UDN

6.1 The Spectrum Toolbox

The new spectrum bands must be identified in the International Telecommunication Union-Radio-communication (ITU-R) Radio Regulations to support the increase of traffic demand. In this direction, the worldwide allocation of a number of bands to International Mobile Telecommunications (IMT) technologies is on the agenda for the next World Radio Conference 2015 (WRC-15). Following figure shows Of course, new spectrum bands must be identified in the International Telecommunication Union-Radio-communication (ITU-R) Radio Regulations to support the increase of traffic demand. Despite the fact that the current practice of predominantly using dedicated licensed spectrum will remain the main stream, new regulatory tools and approaches of sharing the spectrum and optimizingits use must be devised. On the other hand, the coverage of higher frequency bands may be limited, for example, tohot spots or dense areas. MMC and low latency on the other hand are required in wide area coverage.

6.2 Air Interface

To meet the requirement, air interface in 5G technology should have flexible Air-interface with flexibility and adaptability. The flexible air interface consists of block and configuration mechanism to support Adaptive waveforms, adaptive protocol, adaptive channel structure, adaptive coding, and adaptive multiple access. Frequency division duplex (FDD) and time division duplex (TDD) systems are expected to further coexist, while TDD- only operation is expected to become more widely used in higher frequency bands. Full duplex is under investigation, but its use will probably be restricted to low-power radio nodes, e.g., for indoor and outdoor small cell applications(including in-band wireless backhaul). Evolved versions of existing communication systems need to be efficiently integrated.

VII. LITERATURE SURVEY

Farris [1] et.al. said that, The Internet of Things (IoT) ecosystem is evolving towards the deployment of integrated environments, wherein heterogeneous devices pool their capacities together to match wide-ranging user and service requirements. As a consequence, solutions for efficient and synergistic cooperation among objects acquire great relevance. Along this line, this paper focuses on the adoption of the promising MIFaaS (Mobile-IoT-Federation-asa-Service) paradigm to support delay-sensitive applications for high-end IoT devices in next-tocome fifth generation (5G) environments. MIFaaS fosters the provisioning of IoT services and applications with low-latency requirements by

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leveraging cooperation among private/public clouds of IoT objects at the edge of the network. A performance assessment of the MIFaaS paradigm in a cellular 5G environment based on both Long Term Evolution (LTE) and the recent Narrowband IoT (NB-IoT) is presented. Obtained results demonstrate that the proposed solution outperforms classic approaches, highlighting significant benefits derived from the joint use of LTE and NB-IoT bandwidths in terms of increased number of successfully delivered.

7.1 Architecture for 5g Network

SDN and NFV are two technologies facilitating each other. SDN enables the separation of control planes from forwarding planes and capability exposure based on centralized control, whereas NFV enables the decoupling of software functions from hardware and virtualization of network functions, which redefines the cloud-based architecture for telecom networks

1. SDN and NFV technologies
2. The latest advancements in CRAN, and
3. MEC technologies.

7.2 NFV Plus SDN

SDN and NFV are significant technology evolutions that are key to realizing 5G networks. The primary focus of SDN is to decouple the control plane from the data plane, allowing operators to simplifyservice and networking provisioning. NFV enables the “cloudification”of Network Functions (NFs), which may be implemented either on dedicated.

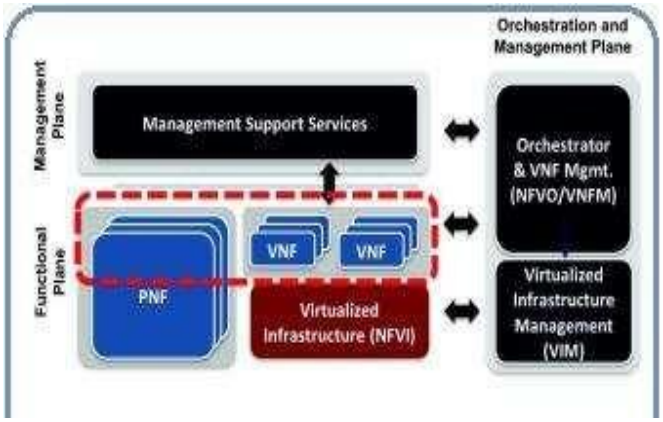

Figure: NFV plus SDN

A. Cloud Radio Access Network(C-RAN)

The main idea behind Cloud-RAN (CRAN) is to pool the Baseband Units (BBUs) from multiple base stations into a centralized BBU pool for statistical multiplexing gain. A minimal set of critical functions remain at the radio head (RRH, Remote Radio Head), whose main function is frequency shifting. With CRAN, it is then possible to have a very tight coordination between cells and to maximize the radio capacity in bps/MHz/cell. Additionally, by leaving only the RRH on-site with a compact power supply, CRAN facilitates antenna site engineering and provides footprint reduction, as well as shorter installation times and lower rental and energy costs. the complications increases in routing and classification of data packets according to their quality of service. On the other hand, software defined network provides quicker reaction to link/node letdowns, higher utilization of the accessible resources, and faster deployment of new updates with ease. These advantages have come up with a centralized control example, which streamlines the arrangement and management.

Network Re-architecture: Network re-architecture, in combination with cloud computing and SDN technologies, reconstructs legacy telecomm network infrastructures to a cloud & network converged one. After network re-architecture is done, the new infrastructure network will focus on enabling the IaaS (telco cloud, IT cloud and Enterprise cloud) capability. In the traditional telecom architecture, the network forms the infrastructure. After the introduction of DCs, DCs and network will constitute together the new infrastructure that is "cloud & network convergent.

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B. Network Service Re-architecture

Network service re-architecture focuses on implementation of VNFs under the NFV framework, further deconstruction and convergence of multiple VNFs, one-button deployment and elastic scalability of multiple VNFs by the management of VNFM, and capability exposure of VNFs. After network re-architecture is done, a NFVI layer based on NFV architecture will be formed, on which, enabled by service orchestration, a variety of VNFs can be rapidly and agilely deployed. These VNFs include those operator‘s self-operated services (vEPC, vIMS, vBNG, vCPE and etc.), which correspond to SaaS capability and the components of PaaS functional component library oriented to third-parties which correspond to PaaS capability.

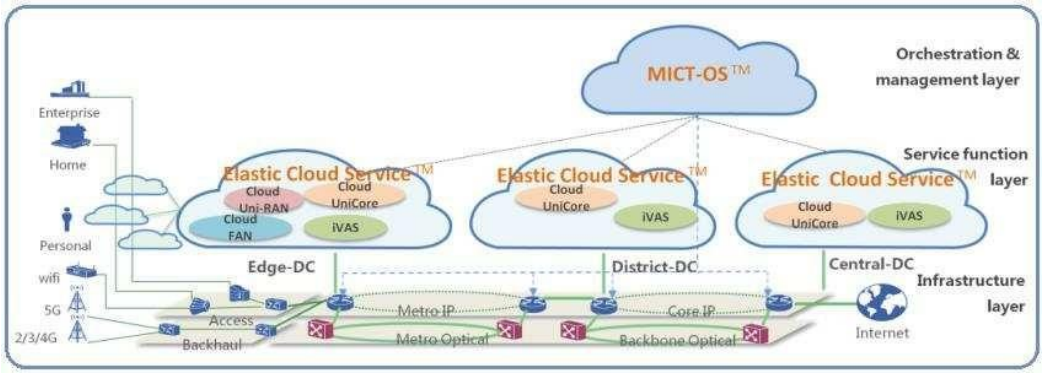

Figure: 5G architecture

Focusing on the triple-layer re-architectures, ZTE develops the ElasticNet solution. ElasticNet means software- defined networks featuring layered structure, centralized control and unified management, which incorporate SDN/NFV frameworks, and to be introduced with ideas of cloud computing, big data and openness. The future network will adopt cloud DCs as the core of architecture. Cloud and network will be integrated. Cloud DCs provide containers and resource pools for network service control, on the other hand fast and flexible network connections make it possible to access massive users and form larger cloud resources pools.At first, IP access is the basic mode for personal, residential and enterprise users to access data centers. Mobile access and fixed network access to cloud DCs are both popular for visiting of massive information of cloud DCs.

The operator need to deploy access networks in a flexible and elastic manner to provide fast connections. SDN-based control becomes a high cost-effectiveness option for cloud access.

Secondly, when network is the basic

structure of the cloud interconnection and various geographically separated clouds are required to be merged into one large cloud, to realize the DCs‘ connections on WAN level will enable the distribution of a tenant across WAN and the migration of VMs across WAN. The cloud interconnection provides cloud IaaS network services.

VIII. CONCLUSION

5G wireless cellular communication systems that have been defined in terms of capacity, data rate, spectral efficiency, latency, energy efficiency, and Quality of service. A 5G wireless network architecture has been explained in this paper with massive MIMO technology, network function virtualization (NFV) cloud and device to device communication. Certain short range communication technologies, like WiFi, Small cell, Visible light communication, and millimeter wave communication technologies, has been explained, which provides a promising future in terms of better quality and increased data rate for inside users and at the equivalent time reduces the pressure from the outside base stations.

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In this paper, I have tried to touch all the generation of the evolution in internets and also I have left no stone unturned in discussing the budding technologies along with their technical challenges which arises due to a variety.

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