ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 5, Issue 1, January 2018

A Review on 5G Wireless Technologies

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Abstract: Everybody loves speed and speedy internet, so there is no surprise that every major telecom in the world is working to make it even faster. Following the rise of 4G cellular mobile technology; academics, representative mobile operators, academic institutions have begun to explore the technological progress to 5 G communication networks due to some of the key demands of higher data rates, increased capacity, reduced latency and improved Quality of Service. Recently, various research works or projects involving major mobile equipment manufacturers, scholars and foreign mobile network providers have been launched to create the 5G mobile communication technology base. Nevertheless, it was not clear that 5G mobile services were made available for use, their architecture and their performance. We represent in this paper a thorough overview of the next-generation mobile technology which is 5G. We focus on 5G network architecture, 5G radio spectrum, ultra-dense radio access networks (UDRAN), mobile traffic offloading, cognitive radio(CR), software-defined radio (SDR), software-defined networking (SDN), mixed infrastructure and societal impact of 5G networks.

Keywords:5G, Cognitive Radio (CR), FBMC, Radio spectrum, Traffic offloading of mobile, UDRAN.

INTRODUCTION

We have noticed prodigious modification in the world of telecommunications from the last few years. Nowadays and in the future, mobile communication networks of today will have to develop in different ways to accomplish the premises and difficulties of the coming era. Continuous implementation of 4 G mobile networks has encouraged some telecommunications industries to consider further progress towards future technologies and facilities of the fifth generation. Fifth generation (5G) wireless technology with state of art connectivity technologies called BDMA (Beam Division Multiple Connectivity)[1] and FBMC (Filter Bank Multi-Carrier Multiple Access) will replace 4G wireless technology directly. The principle of beam division multiple access (BDMA) technique is explained by considering the instance of the BS (base station) interacting with the MS (mobile station). In this transmission, each MS (mobile stations) will be distributed an orthogonal ray & beam division multiple access technique will split that antenna ray according to the MS (mobile stations), which analogously improves the capacity of the network. A notion of switching to fifth generation is based on current drifts; it is often assumed that fifth generation mobile networks have to solve six problems that are not solved successfully by fourth generation mobile communications networks i.e. higher data rates, massive device connectivity, higher capacity, lower cost & consistent, quality of experience (QoE) and lower end-to-end latency.

NETWORK ARCHITECTURE OF 5G

Fifth generation mobile communication network is a new revolution in the world of telecommunication and by the year 2020, it would be available for use. Fifth generation (5G) mobile networks model is all internet protocolbased model. In the 5G mobile network conception, it is an exceptional approach that the main priorities of fifth generation (5G) mobile system are user terminals. Unlike wireless technologies, the terminal has the right or the opportunity to approach concurrently and it can also amalgamate certain attributes from other technologies. Fifth generation (5G)[2] mobile communications network focuses entirely on user portability as a handset or terminal reacts smartly to select vigorous wireless to wireless networking plans.

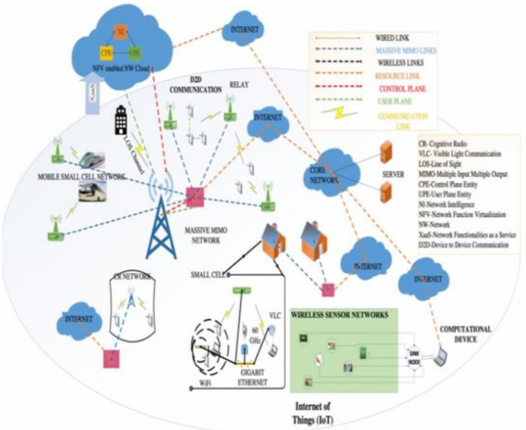

Figure. 1: General network architecture of 5G Mobile Technology

Physical/Medium Access Control Layer:

The top two layers of open system interconnection (OSI) i.e. physical & medium access control layers are defined as network locus, in this case of fifth generation these two layers are elucidated as wireless technology and 5G mobile network is based on open wireless architecture.

Network Layer:

The network stratum is based on internet protocol (IP), as now-a-days there is no race on this stratum. The internet protocol version 4[3] (IPv4) is spread throughout the world & it has various issues such as confined address space & has not any actual prospect for quality of support (QoS) per flow. These problems are resolved in internet protocol version 6 that is IPv6.

Open Transport Protocol Layer:

In the wireless connection transmission control protocol (TCP) retransmit the missing or impaired segments of transmission control protocol[4] (TCP). In fifth generation (5G) mobile technology, it is indispensable due to higher download speed & installed speed.

Application Layer:

With regard to the application, the eventual entreaty of the fifth generation mobile terminal is to provide intelligent service management quality over system heterogeneity. Service quality parameters such as losses, delay, reliability, jitter and bandwidth will be kept in reserve in a 5G handset database with the goal of using smart algorithms running as system processes in the mobile terminal, ultimately providing the primary wireless connection with mandatory quality of service (QoS) and individual cost limitations.

Table 1: OSI Protocol Layer Stack of Fifth Generation

Application Layer	Application (services)
Presentation Layer	
Session Layer	Open Transport Protocol (OTP)
Transport Layer	
Network Layer	Upper Network Layer
	Lower Network Layer
Data Link Layer	Open Wireless Architecture (OWA)
Physical Layer	

RADIO SPECTRUM FOR FIFTH GENERATION (5G)

Usually, each generation of mobile communication networks was allocated new frequency bands & broader spectral bandwidth per radio channel. Mobile communication networks of the fifth generation (5G)[5] will need a great deal of aggregate spectrum to enable flexible bandwidth scaling & enlargement. Supplemental harmonic frequency bands must be assigned to accomplish it.In order to enhance frequency reprocessing, the spectrum will be used on the impartial foundation of radio access technology (RAT), preferably by implementing cognitive radio (CR) concept to mini & large cells. The supplemental fifth generation spectrum may include 100MHz of bandwidth due to high efficiency rate.The vision for long-term is the confluence of broadband & broadcast facilities in joint multi-media networks covering the Ultra-high frequency band below 700 megahertz.In high capacity hotspot, deployments of small cell will play an indispensable role and the spectrum for that could get from the 3500 megahertz band where as much as 400 megahertz of bandwidth is utilized for fastened satellite and broadband wireless access services.

ULTRA-DENSE RAN

A new conception anticipated in the state of affairs of fifth generation (5G) is UDRANETs (Ultra-Dense Radio Access Networks). Ultra-Dense Radio Access Networks[6]

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within door regions are conceived as fewer power access nodes a few meters apart. UDRANETs ' primary aim will be to offer enormously high traffic capability over highly reliable low-range knots. Ultra-Dense Radio Access Networks are likely to operate within the 10-100 GHz frequency range, which has remained virtually unused for commercial cell phone networks despite its prospect of hundreds of megahertz bandwidths. New communication and access systems need to be developed and systematized for this type of system, including spectrum propagation studies in millimeter waves.

TRAFFIC OFFLOADING OF MOBILE

Tablets, smart phones, and mobile broadband devices generate incredibly huge amounts of traffic. Mobile operators[7] are facing tremendous problems with the current wireless network to operate for such a massive growth in mobile traffic devices, smart phones and mobile broadband gadgets delivering incredibly huge traffic volumes. With the new telecommunications network, mobile operators find it difficult to work for such a massive increase in mobile. Traffic offloading involves the use of complemented RAN (radio access networks) to convey information originally intended for mobile cellular networks, thereby reducing blockage on each single radio link and backbone connection. Traffic offloading[8] encompasses a variety of panaceas, which can be classified as overlay and non-overlay panaceas.

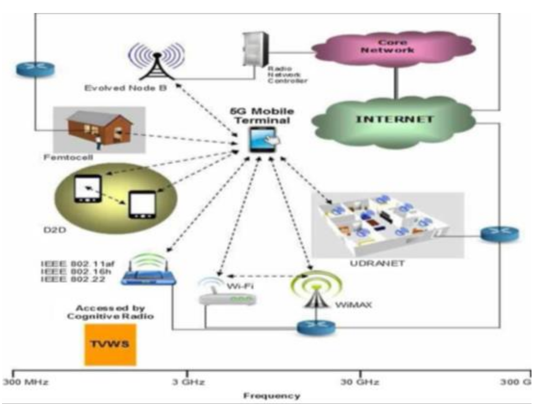

Fig.2: Traffic offloading approaches for fifth generation networks

COGNITIVE RADIO

Cognitive Radio[9] trend supports the opportunistic use by unauthorized (secondary) operators of the underused sections of the permitted frequency bands, i.e. spectrum gaps, or the efficient allocation of the licensed-free gamut. To this end, in order to recognize the vacant radio bands or channels within the time-frequency resource table, cognitive cellular terminals must provide reliable, real-time information on transmission opportunities via radiofrequency gamut analysis.IEEE standards such as IEEE 802.22, IEEE 802.11 and IEEE 802.16h rely on the use of cognitive radio solutions to allow the White Space TV gamut to be distributed on a non-intervening basis with enhanced synchronization mechanisms. The long-term innovation efficiency of the 3rd generation collaboration project has taken proviso to ease interference palliation in overlay systems. In the 3rd generation partnership project EICIC (Enhanced Inter-cell Interference Coordination) was developed to cope with or deal with interference problems in heterogeneous networks.

SOFTWARE DEFINED RADIO (SDR)

Future generation network infrastructure must have sufficient immense pliability to extend in a vigorous and flexible approach to enable systematic spectrum management over dissimilar parameters of radio frequency settings. Reconfigurable platforms based on SDR[10] can promote the vigorous air interface reconfiguration of network nodes through software customizations, representing contemporary traffic requirements. The pliability of the radio frequency concatenations must be more widely reflected in the processing skills of the baseband, where the transmitted radio frequency signals are to be processed. As fifth generation networks will need to take advantage of underused bands.As fifth generation networks will require to exploit underused bands of frequency to circumvent the anticipated crunch of spectrum, execution of cognitive radio on software-defined radio platforms should contemplate coactions & interoperation of multitudinous radio technologies that is, through CRRM (Common Radio Resource Management).

CONCLUSION

Networks of the fifth generation have the capacity to improve broadband cell phone connections in rustic regions. Wealth expenditure for the installation of a huge number of BS and the less ARPU (average revenue per user) has deferred the broad coverage of rustic environments.By using TV White Space & traffic elucidation offloading, the installation of 5G networks in rustic regions will be feasible at a lower budget due to further advantageous propagation situations in the very high-frequency or ultra-high frequency gamut that transforms unswervingly into littler base stations. A detailed study was conducted of potential wireless technology of the fifth generation. We presented network challenges of fifth generation, facilitators & fundamental design, network architecture along with OSI protocol stratum stack, 5G radio spectrum, ultra-dense radio access networks, mobile traffic offloading, cognitive femtocell, Wi-Fi & White-Fi, alternative offloading solution, cognitive radio, software-defined radio, software-defined networking, 5G impacts on society. This paper may offer a better platform to encourage industry representatives, academia and researchers to achieve better results in the future fifth of different kinds of issues and challenges.

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