REVIEW ON SURVEY FOR 5G CELLULAR AND EMERGING TECHNOLOGY

Yukti Varshney[1], Dr. Vinod Kumar[2]

[1]Assistant professor, Computer Science Department, Apex Institute of Technology, Rampur, Uttar-Pradesh India.
[2]Associate Professor, Deen Dayal Upadhayay Kaushal Kendra Sardar Bhagat Singh Government P.G. College, Rudrapur (U.S. Nagar) Uttarkhand, India.

ABSTRACT

In the near future, i.e., beyond 4G, a portion of the prime destinations or requests that should be tended to are expanded limit, enhanced information rate, diminished inertness, and better nature of administration. To meet these requests, extreme upgrades should be made in cell arrange design. The vision of next generation 5G wireless communications lies in providing very high data rates (typically of Gbps order), extremely low latency, manifold increase in base station capacity, and significant improvement in users' perceived quality of service (QoS), compared to current 4G LTE networks. Ever increasing proliferation of smart devices, introduction of new emerging multimedia applications, together with an exponential rise in wireless data (multimedia) demand and usage is already creating a significant burden on existing cellular networks. As understanding the current status of 5G implementation is important for its eventual commercialization, we also discuss relevant field trials, drive tests, and simulation experiments. Finally, we point out major existing research issues and identify possible future research directions.

Keyword : - *4G (LTE), Enhance LTE, MIMO, 5G, Mobile communication.*

1. INTRODUCTION

THE communication system of data transfer and reception has increasing day by day, through this different functional communication system are established as per generation demanded as 1G, 2G, etc., but now enhancing this communication system with implementation of OFDM for higher rate of data transfer and reception. After implementing OFDM with addition of MIMO system obtained a new evaluation communication i.e. known as LTE (4G).

On the other hand Over the last couple of decades the world has witnessed gradual, yet steady evolution of mobile wireless communications towards second, third and fourth generation wireless networks. Introduction of digital modulations, effective frequency reuse, penetration of packet-based Internet and rapid advancement in physical layer technologies, like WCDMA, OFDMA, MIMO, HARQ etc. have significantly contributed towards this gradual evolution. Besides this, with the ever increasing popularity of smart devices, currently all-IP based fourth generation LTE networks have become a part of everyday life.

2. RELATED WORK

the performance requirements of 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 Wi-Fi,

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. Some key emerging technologies have also been discussed that can be used in 5G wireless systems to future the probable performance desires, like massive MIMO and Device to Device communication in particular and interference management, spectrum sharing with cognitive radio, ultra dense networks, multi radio access technology, full duplex radios, millimeter wave communication and Cloud Technologies in general with radio access networks and software defined networks. This paper may be giving a good platform to motivate the researchers for better outcome of different types of problems in next generation networks [1].

Given the worldwide need for cellular spectrum, and the relatively limited amount of research done on mm-wave mobile communications, we have conducted extensive propagation measurement campaigns at 28 GHz and 38 GHz to gain insight on AOA, AOD, RMS delay spread, path loss, and building penetration and reflection characteristics for the design of future mm-wave cellular systems. This work presents data collected in the urban environments around the University of Texas at Austin (38 GHz) and New York University (28 GHz). Outage studies conducted at 28 GHz and 38 GHz showed that consistent coverage can be achieved by having base stations with a cell-radius of 200 meters [3].
Path loss was larger in New York City than in Austin, due to the nature of the denser urban environment. In New York City, reflection coefficients for outdoor materials were significantly higher, for example, 0.896 for tinted glass, and 0.740 for clear non-tinted glass, compared with those of indoor building materials. Similarly, penetration losses were larger for outdoor materials in New York City. Since signals cannot readily propagate through outdoor building materials, indoor networks will be isolated from outdoor networks and this suggests that data showers, repeaters, and access points may need to be installed for handoffs at entrances of commercial and residential buildings [3].

3. STANDARDS AND ADAPTARION

3.1 Standards

The two competing bodies involved in churning out 4G wireless technologies [ADA07b] are the 3GPP in Europe and the 3GPP2 in North America. The 3GPP is marketed under the brand name of Long Time Evolution or LTE and is working on the 4G technology which is to succeed the 3G technology of UMTS. The 3GPP2 project is marketed under the brand name Ultra Mobile Broadband or UMB and their effort is to make transition to 4G from the existing CDMA2000 family of standards in North America.

The High Level requirements for a 4G technology were identified as:
1. Higher spectral Efficiency
2. Reduced cost per bit
3. Increased Service provisioning by lowering the cost and increasing efficiency and experience
4. Open Interfaces as against closed technologies of the past
5. Power consumption efficiency
6. Scalable and flexible usage of frequency bands

The 3rd Generation Partnership project was established in December 1998, and is a collaborative agreement to bring together a number of Telecommunications standard bodies known as "Organizational Partners" [3GPP]. The stated aim of the collaboration is to "co-operate for the production of a complete set of globally applicable Technical Specifications for a 3rd Generation Mobile System based on the evolved GSM core networks and the radio access technologies supported by 3GPP partners (i.e., UTRA both FDD and TDD modes)". The 3GPP organization is based on a layered hierarchy with a "Technical specifications" Group working under the directions of a "Project Coordination" group to role out technical specifications as shown in Figure 2 (adapted from reference). The "Market Representation Partners" is an organization invited by the Organization Partners to advice them about market requirements and strategies. Individual members make technical contributions to the "Technical specifications Group". The "Organizational Partners" shall have joint ownership and copyright to the technical specifications churned out of the project.

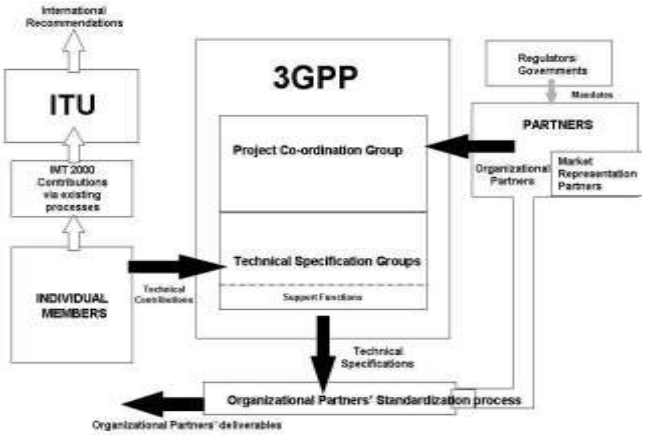

Fig -1: 3GPP Overview [3GPP]

The technical specifications approved by 3GPP for the LTE project include the use of Orthogonal Frequency Division Multiplexing (OFDM) and advanced antenna technologies such as MIMO (Multiple Input Multiple Output). It specifies downlink peak speeds of 326Mbps and uplink peak speeds of 86Mbps, both in a 20 Mhz bandwidth. It also mandates the roundtrip latency between the base station and handsets to 10-milliseconds. The specification documents extend numerous documents and thousands of pages and the information provided above is just a summary of the final results. The 3GPP2 [3GPP2] is the Asian-North American effort for achieving similar capabilities for their CDMA2000 group of specifications and called by the brand-name of UMB. 3GPP2 organization is very similar to the 3GPP organization being a collaborative effort between 5 standards development organization from Asia (China, Japan, North Korea) and North America and multiple Market Representation Partners, providing market advice to the SDO's. The technical specifications approved by 3GPP2 for UMB include and OFDMA based air interface with Frequency 7 of 15 Division Duplexing. The specifications specify downlink peak data rates of 275 Mhz and uplink peak data rates of 75 Mbps on a scalable bandwidth of 1.25-20 Mhz. It also supports the use of advanced antenna systems such as MIMO and Beam forming antennas.
It can be noticed that the technical specification of LTE and UMB are very similar to each other and are based on the same underlying technologies of OFDM and AAS(Advanced Antenna Systems). Both these standards represent a shift towards an All IP network and as such an All IP network has been specified as a part of the System Architecture Evolution (SAE), the core network architecture for LTE.
In the next section we shall discuss about the various technical challenges and discuss in detail the key technologies which make the transition from 3g to 4g possible.

3.2 Technology Adaptation

In this section, we first discuss the two generic technologies of OFDM and MIMO that are adopted by both standards (LTE and UMB) as: **OFDM**
Also OFDM is one of the key technologies which enable non-line of sight wireless services making it possible to extend wireless access system over wide-areas. It is a variant of the Frequency Division Multiplexing scheme in which the frequency channel is divided into multiple smaller sub-channels. In FDM, sub-channelization requires provisioning of guard bands between two sub-channels to avoid interference between them. OFDM (as shown in Figure 2) divides the frequency bandwidth in narrow orthogonal sub-parts called sub-carriers. A sub-channel is an aggregation of a number of these sub-carriers. The sub-carriers include data carriers, pilot carriers and a DC. The data carriers are used to carry data, the pilot carriers are used for channel sensing purposes and the DC mark the Centre of the channel. Each subcarrier is modulated with conventional modulation scheme such as Quadrature Amplitude Modulation or Phase Shift Keying at a low symbol rate. Each user is provided with a integer number of sub-channels which is composed of a number of sub-carriers. User data is carried parallel on each sub-carrier at a low rate. The combination of the parallel sub-carriers at the destination provide for the high data rates.
Since the sub-carriers carry data at a low rate and thus higher symbol time it is more resilient to multi-path effects, thus making it more suitable for wide-area non-line of Sight wireless access technology. Also, the use of overlapping orthogonal sub-carriers without guard bands make it more efficient than FDM scheme. OFDM

resembles CDMA in that it is also a spread-spectrum technology in which energy generated at a particular bandwidth is spread across a wider bandwidth making it more resilient to interference and "jamming". However, unlike CDMA, OFDM allows adaptive assignment of sub-carriers to sub-channels based on channel conditions making it more robust and achieving higher spectral efficiency than CDMA.

The Multi-User version of OFDM is called OFDMA (Orthogonal Frequency Division Multiple Access).

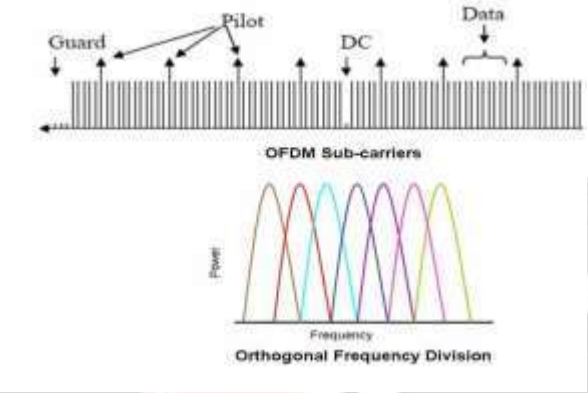

Fig -2: OFDM wave

3.3 MIMO

Multiple-Input Multiple-Output (MIMO) is a key technique in any modern cellular system that refers to the use of multiple antennas at both the transmitter and receiver sides. Base stations and terminals are therefore equipped with multiple antenna elements intended to be used in transmission and reception to make MIMO capabilities available at both the downlink and the uplink. Next-generation cellular systems will have to provide a large number of users with very high data transmission rates, and MIMO is a very useful tool towards increasing the spectral efficiency of the wireless transmission.

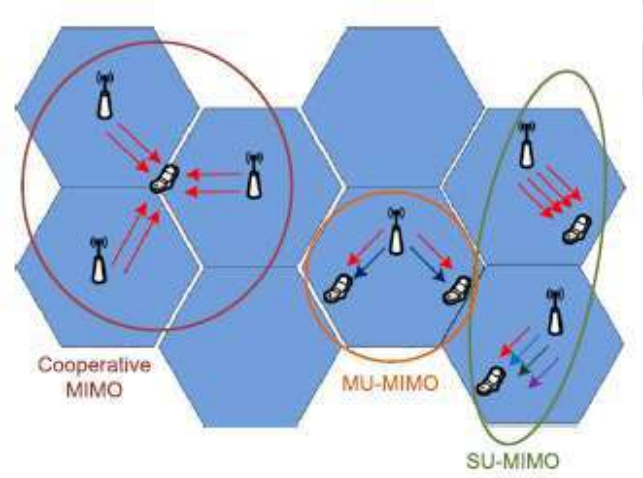

Fig -3: LTE-Advanced main MIMO modes.

4. SURVEY OF WIRELESS TECHNOLOGY

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. The evolution of wireless begins here [2] and is shown in Fig. 1. 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, 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 is below:

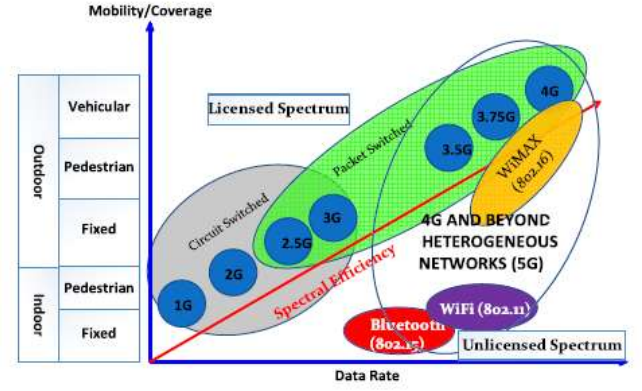

Fig -4: Wireless technology

5. 5G EVALUATION

To think about 5G organize in the market now, it is apparent that the various get to systems in the system are nearly at a still and requires sudden change. Current advances like OFDMA will work in any event for next 50 years. Additionally, there is no need an adjustment in the remote setup which had happened from 1G to 4G.

On the other hand, there could be just the expansion of an application or enhancement done at the key system to please client necessities. This will incite the bundle suppliers to float for a 5G organize as ahead of schedule as 4G is monetarily set up [8]. To meet the requests of the client and to defeat the difficulties that has been advanced in the 5G framework, an exceptional change in the procedure of planning the 5G remote cell engineering is required. A general perception of the specialists has appeared in [14] that the vast majority of the remote clients remain inside for roughly 80 percent of time and outside for around 20 percent of the time.

In present remote cell engineering, for a portable client to convey whether inside or outside, an outside base station introduce amidst a phone helps in correspondence. So for inside clients to speak with the outside base station, the signs should go through the dividers of the inside, and this will bring about high infiltration loss, which correspondingly costs with decreased phantom efficiency, information rate, and vitality efficiency of remote correspondences.

To beat this test, another thought or planning system that has come into reality for conspiring the 5G cell engineering is to unmistakable outside and inside setups [8].With this outlining method, the infiltration misfortune through the dividers of the building will be marginally decreased.

This thought will be bolstered with the assistance of monstrous MIMO innovation [15], in which topographically scattered cluster of reception apparatus' are sent which have tens or many radio wire units. Since present MIMO

frameworks are utilizing either two or four receiving wires, yet the possibility of monstrous MIMO frameworks has thought of using the benefits of substantial exhibit receiving wire components as far as tremendous limit picks up.

To fabricate or develop an extensive monstrous MIMO organize, firstly the outside base stations will be fitted with vast reception apparatus clusters and among them some are scattered around the hexagonal cell and connected to the base station through optical fiber links, supported with huge MIMO innovations. The portable clients show outside are generally fitted with a specific number of receiving wire units however with participation a vast virtual radio wire cluster can be developed, which together with reception apparatus varieties of base station frame virtual monstrous MIMO joins. Besides, every building will be introduced with huge receiving wire clusters from outside, to speak with open air base stations with the assistance of observable pathway parts.

The remote get to focuses inside the building are associated with the extensive receiving wire exhibits through links for speaking with indoor clients. This will altogether enhances the vitality proficiency, cell normal throughput, information rate, and unearthly effectiveness of the cell framework yet to the detriment of expanded foundation cost. With the presentation of such an engineering, within clients will just need to associate or speak with inside remote get to focuses while bigger recieving wire clusters remained introduced outside the structures [8]. For indoor correspondence, certain advancements like WiFi, Small cell, ultra wideband, millimeter wave interchanges [16], and unmistakable light interchanges [17].

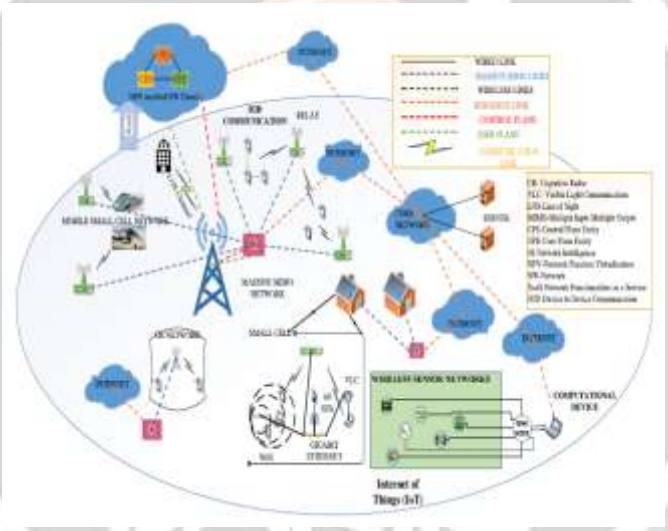

Figure 5: General architecture of 5G network

6. CONCLUSION

Given the worldwide need for cellular spectrum, and the relatively limited amount of survey done on 5G network for mobile communications and emerging technology, after analyzing all aspect given by inventor Mr. G. Marconi.

In this paper, a detailed survey has been done on the performance requirements of 5G wireless cellular communication systems is determined in terms of data rate, efficiency, latency etc., for their invaluable support in deploying the system and in providing experimental data by enhancing the massive MIMO for larger range transmission and reception of data with follows the standards of LTE supports. Hence, it is more intelligent technology, which will interconnect the entire world without limits. Likewise, our world would have universal and uninterrupted access to information, communication, and entertainment that will open a new dimension to our lives and will change our life style meaningfully.

7. FUTURE SCOPE

5th generation technology is designed to provide incredible and remarkable data capabilities, unhindered call volumes, and immeasurable data broadcast within the latest mobile operating system. In future generation of mobile wireless networks which intends to gain space roaming. The world is trying to become completely wireless, appetizing uninterrupted access to information anytime and anywhere with better quality, high speed, increased bandwidth and reduction in cost.

ACKNOWLEDGEMENT

The preferred spelling of the word “acknowledgment” in American English is without an “e” after the “g.” Use the singular heading even if you have many acknowledgments. Avoid expressions such as “One of us (S.B.A.) would like to thank ... .” Instead, write “F. A. Author thanks ... .” **Sponsor and financial support acknowledgments are placed in the unnumbered footnote on the first page, not here.**

REFERANCES

[1] Akhil Gupta, Prakesh kumar Jha, “A Survey of 5G Network: Architecture and Emerging Technologies” IEEE (Student member) vol. 3,2015, pp. 1206-1232.
[2] J. G. Andrews, A. Ghosh, and R. Muhamed, Fundamentals of WiMAX. Englewood Cliffs, NJ, USA: Prentice-Hall, 2007.
[3] T. S. Rappaport, J. N. Murdock, and F. Gutierrez, ``State of the art in 60 Hz integrated circuits & systems for wireless communications," Proc. IEEE, vol. 99, no. 8, pp. 1390-1436, Aug. 2011.
[4] [2] Z. Pi and F. Khan, ``An introduction to millimeter-wave mobile broadband systems," IEEE Commun. Mag., vol. 49, no. 6, pp. 101 107, Jun. 2011.
[5] Spatial Channel Model for Multiple Input Multiple Output (MIMO) Simulations (Release 10), Standard 3GPP TR 25.996, Mar. 2011.
[6] Guidelines for Evaluation of Radio Interference Technologies for IMT-Advanced, Standard ITU-R M.2135, 2008.
[7] T. S. Rappaport, Wireless Communications: Principles and Practice, 2nded. Englewood Cliffs, NJ, USA: Prentice-Hall, 2002.
[8] [6] L. Xichun, A. Gani, R. Salleh, and O. Zakaria, ``The future of mobile wireless communication networks," in Proc. Int. Conf. Commun. Softw. Netw., Feb. 2009, pp. 554-557.
[9] P. Rysavy. (2010). Transition to 4G: 3GPP Broadband Evolution to IMT-Advanced (4G) [Online]. Available: http: //www.3gamericas. org / documents/Transition%20to%204 HSPA%20LTE%20Advanced% 20Rysavy%202010%20PPT.pdf
[10] Nokia Siemens Networks. (2010). Long Term HSPA Evolution: Mobile Broadband Evolution Beyond 3GPP Release 10, Espoo, Finland [Online]. Available: http://lteworld.org/whitepaper/long-term-hspa- evolution-mobile-broadband-evolution-beyond-3gpp-release-10
[11] Ericsson. (2011, Apr.). LTE-A 4G Solution, Stockholm, Sweden [Online]. Available: http://www.ericsson.com/news/110415_wp_ 4g_244188810_c
[12] A. F. Molisch, M. Steinbauer, M. Toeltsch, E. Bonek, and R. Thoma, ``Capacity of MIMO systems based on measured wireless channels," IEEE J. Sel. Areas Commun., vol. 20, no. 3, pp. 561-569,Apr. 2002.
[13] E. H. Ong, J. Kneckt, O. Alanen, Z. Chang, T. Huovinen, and T. Nihtila, ``IEEE 802.11ac: Enhancements for very high throughput WLANs," in Proc. IEEE 22nd Pers. Indoor Mobile Radio Commun., Sep. 2011, pp. 849-853.
[14] E. Perahia and M. X. Gong, ``Gigabit wireless LANs: An overview of IEEE 802.11ac and 802.11ad," ACM SIGMOBILE Mobile Comput. Commun. Rev., vol. 15, no. 3, pp. 23 33, Jul. 2011.
[15] E. Perahia, C. Cordeiro, M. Park, and L. L. Yang, ``IEEE 802.11ad: De ning the next generation multi-Gbps Wi-Fi," in Proc. 7th IEEE Consum. Commun. Netw. Conf., Jan. 2010, pp. 1-5.
[16] [13] A. B. Flores, R. Guerra, E. W. Knightly, P. Ecclesine, and S. Pandey, ``IEEE 802.11af: A standard for TV white space spectrum sharing," IEEE Commun. Mag., vol. 51, no. 10, pp. 92 100, Oct. 2013.

[17] V. Chandrasekhar, J. G. Andrews, and A. Gatherer, ``Femtocell networks: A survey," IEEE Commun. Mag., vol. 46, no. 9, pp. 59-67, Sep. 2008.
[18] F. Rusek et al., ``Scaling up MIMO: Opportunities and challenges with very large arrays," IEEE Signal Process. Mag., vol. 30, no. 1, pp. 40-60,Jan. 2013.
[19] A. Bleicher, ``Millimeter waves may be the future of 5G phones," Samsung's millimeter-wave transceiver technology could enable ultrafast mobile broadband by 2020, Jun. 2013
[20] H. Haas. (Aug. 2011). Wireless Data From Every Light Bulb. [Online]. Available: http://bit.ly/tedvlc
[21] X. Hong, C.-X. Wang, H.-H. Chen, and Y. Zhang, ``Secondary spectrum access networks," IEEE Veh. Technol. Mag., vol. 4, no. 2, pp. 36-43, Jun. 2009.
[22] F. Haider et al., ``Spectral ef ciency analysis of mobile Femtocell based cellular systems," in Proc. IEEE ICCT, Jinan, China, Sep. 2011, pp. 347-351.
[23] P. Agyapong, M. Iwamura, D. Staehle, W. Kiess, and A. Benjebbour, ``Design considerations for a 5G network architecture," IEEE Commun. Mag., vol. 52, no. 11, pp. 65 75, Nov. 2014.
[24] A. Osseiran et al., ``Scenarios for 5G mobile and wireless communications: The vision of the METIS project," IEEE Commun. Mag., vol. 52, no. 5, pp. 26 35, May 2014.

BIOGRAPHIES

Yukti Varshney earned her B.Tech in computer science from SSITM, Aligarh, India in 2008, and the M.Tech in computer science from Shri Venkateshwara University, Gajraula, India in 2015. She is having more than 7 years teaching experience at prestigious institute of U.P. She is currently working as assistant professor in Computer Science Department at Apex Institute of Technology; Rampur, India .She has Her research interests include 5G wireless communications, Memory management techniques, Data Mining & sensor system.

Dr. Vinod Kumar received his Ph.D in Economics from Chaudhari Charan Singh University, Meerut. He having more than 10 years teaching experience U.G. and P.G level at prestigious institute of U.P., Hariyana & Uttrakhand. At present he is working as Associate Professor at Deen Dayal Upadhayay Kaushal Kendra Sardar Bhagat Singh Government P.G. College, Rudrapur (U.S. Nagar) Uttarkhand.