ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 7, Issue 3 , March 2020

Analysis of Enhanced Energy Harvesting for Efficient Wireless Sensor Networks on 5G using Td-LTE

L. William Mary , K. L. Sagayaraj , Dr. R. Latha

Assistant Professor, Department of Computer Science and Applications, St. Peter's Institute of Higher Education and Research, Chennai, India
PhD Research Scholar, Department of Management Studies, SRM Institute of Science and Technology, Kattankulathur, Chennai, India
Professor and Head of the Department, Department of Computer Science and Applications, St. Peter's Institute of Higher Education and Research, Chennai, India

ABSTRACT: The 4th generation wireless communication (4G) structures had been deployed or are soon to be deployed in many countries. However, with an explosion of mobile communication and services, there are nevertheless a few demanding situations that can't be accommodated even though 4G, which include the spectrum crises and high energy consumption. Wireless communication system designers were dealing with the continuously increasing demand for high facts costs and mobility required by way of new wireless applications and consequently has begun research on 5th generation (5G) wireless communication systems which might be predicted to be deployed beyond 2020. Plans are set for WiMAX to migrate/combine with TD-TD-LTE (Time Division-Long Term Evaluation) in a multiple heterogeneous get right of entry to 5th generation mode. The demand for information capacity, excessive downloading and fast internet will increase each day. Plausible applications within the endurance of high-speed communication, cell web get entry to, gaming offerings, IP telephony, excessive definition cellular TV, video conference, 3D TV and Cloud Computing so, 3G structures, WiMAX, Wi-Fi are the technology, which is used and looking ahead for the important technology which might be predicted to offer better throughput, transmission as well as low traffic charge. Connectivity to the user everywhere, with excessive statistics due to expanded demand. However, the number of objects like smart devices, industrial machines, smart homes, connected by wireless interface is dramatically increasing due to the evolution of cloud computing and the internet of things technology.

KEY WORDS: LTE, Wi-Fi, 2G/3G Versus LTE, 4G, 5G LTE system, Transmitter

I. INTRODUCTION

Wireless communication has started out its era introduction, revolution and evolution on the grounds that early 1970s. Within the beyond a long time, cellular wireless technology has experienced five generations of technology revolution and evolution, particularly from 0G to 4G. Mobile era varies in 4 essential elements, radio gets entry to, facts prices, bandwidth, and switching schemes. The first phase of the 2G systems offered a record rate as much as 9.6kbps and elevated inside the second segment to reach more than 300 kbps with bandwidth of 200 kHz.
Switching started to be packet similar to circuit starting from the second phase and radio get entry to change into Time Division Multiple/Frequency Division Multiple Access (TDMA/FDMA). Data communication, similarly to the voice exchange, has been the primary attention within the 1/3 technology (3G) technology and a converged community for both voice and information conversation is rising. To cope with the new demanding situations that 5G networks are predicted to solve, diverse varieties of modulation had been proposed, which include filtering, pulse shaping, and pre-coding to reduce the out-of-band (OOB) leakage of Orthogonal Frequency Division Multiple (OFDM) signals.

Filtering is the most truthful approach to lessen the OOB leakage and with a well designed filter, the leakage over the forestall-band may be significantly suppressed. Pulse shaping can be regarded as a kind of sub-carrier based filtering that reduces overlaps among sub-carrier even within the band of a single user, but, it normally has a long tail in time area in step with the Gabor uncertainty precept. Introducing pre-coding to transmit statistics earlier than OFDM

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 3 , March 2020

modulation is likewise a powerful approach to lessen leakage. In addition to the aforementioned tactics to reduce the leakage of OFDM signals, a few new types of modulations have additionally been proposed specially for 5G network.LTE stands for Long Term Evolution and it was started as a project in 2004 by telecommunication body known as the Third Generation Partnership Project (3GPP). SAE (System Architecture Evolution) is the corresponding evolution of the GPRS/3G packet core network evolution. The term LTE is typically used to represent both LTE and SAE.

LTE evolved from an earlier 3GPP system known as the Universal Mobile Telecommunication System (UMTS), which in turn evolved from the Global System for Mobile Communications (GSM). Even related specifications were formally known as the evolved UMTS terrestrial radio access (E-UTRA) and evolved UMTS terrestrial radio access network (E-UTRAN). The first version of LTE was documented in Release 8 of the 3GPP specifications. A rapid increase of mobile data usage and emergence of new applications such as MMOG (Multimedia Online Gaming), mobile TV, Web 2.0, streaming contents have motivated the 3rd Generation Partnership Project (3GPP) to work on the Long-Term Evolution (LTE) on the way towards fourth-generation mobile. The main goal of LTE is to provide a high data rate, low latency and packet optimized radio access technology supporting flexible bandwidth deployments. Same time its network architecture has been designed with the goal to support packet-switched traffic with seamless mobility and great quality of service.

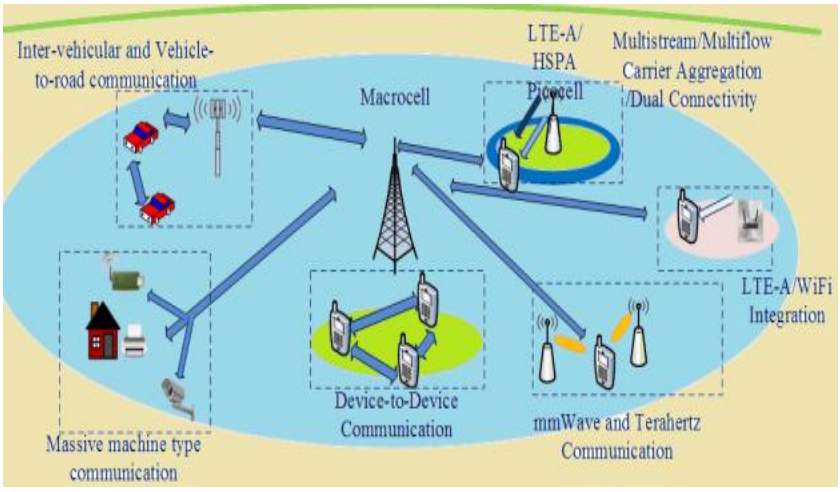

Fig 1. 5G LTE System

II. LITERATURE SURVEY

Bo Wu1, Yong Ding1., et al., 2012 stated that, the user selection and resource allocation problem for the downlink of Orthogonal Frequency Division Multiple Access (OFDMA) wireless systems is investigated. It is assumed that the Base Station (BS) consists of multiple antennas in a distributed Antenna System (DAS), while a single antenna is available to each user. The considered problem is modeled as an optimization problem which takes into account a multiple antenna eavesdropper and artificial noise generation of secure communications.

Heejin Kim, Sang-Rim Lee, Kyoung-Jae Lee, Inkyu Lee., et al., 2013 stated that, Single cell multi-user downlink distributed antenna systems (DAS) where the antenna ports are geographically separated in a cell. First, derive an expression of the ergodic sum rate for DAS in the presence of path loss. Then, we propose a transmission selection scheme based on the derived expressions to maximize the overall ergodic sum rate.

GownMiao, Nageen Himayat, Geoffrey Ye Li, and Shilpa Talwar., et al., 2011 stated that, Power optimization techniques are becoming increasingly important in wireless system design since battery technology has not kept up with the demand of mobile devices. They are also critical to the interference management in wireless systems because

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 3 , March 2020

interference usually results from both aggressive spectral reuse and high power transmission and severely limits system performance. Develop an energy-efficient power optimization scheme for interference-limited wireless communications.

Heshani Gamage; Nandana Rajatheva., et al., 2017 stated that, The performance of a single carrier system employing a large number of antennas is explored in this paper, considering the reliability in the millimeter-Wave (mmWave) range in 5G standardization. A significant disadvantage of Orthogonal Frequency division Multiplexing (OFDM) systems, which are currently being used in 4G LTE downlink, is its large peak-to-average power patio (PAPR).

Anass Benjebbour ; Keisuke Saito ; Yuya Saito ; Yoshihisa Kishiyama., et al., 2015 stated that, The paper introduces an overview of the concept, performance evaluation gains, our ongoing experimental trials and current standardization status. The goal is to clarify the benefits of NOMA over orthogonal multiple access (OMA) such as OFDMA adopted by Long-Term Evolution (LTE), also its combination with MIMO is discussed.

III. METHODOLOGY

Inside the architecture of OFDM transmitter and receiver the elliptic curve cryptography to encode the information as shown in figure 2. The randomly generated data are then subjected to parallel to serial conversion. The modulation technique used right here is Quadrature Phase Shift Keying (QPSK) and Quadrature Amplitude Modulation (QAM). The QAM is 16 or 64 array QAM is used. The sub-carriers are generated cyclic prefix and guard bits are introduced and transmitted. The sub-carrier generated is 512. The channel right here affords high noise environments along with Additive White Gaussian Noise (AWGN), Raleigh, Rician, Pedestrian B, and Vehicular A channels. Whereas the pedestrian B channel offer a high noise variance and Vehicular a channel gives unpredictably high noise variance. At the receiver side Low Density Parity Check (LDPC) is employed. This may be useful in eliminating errors in first little bits.

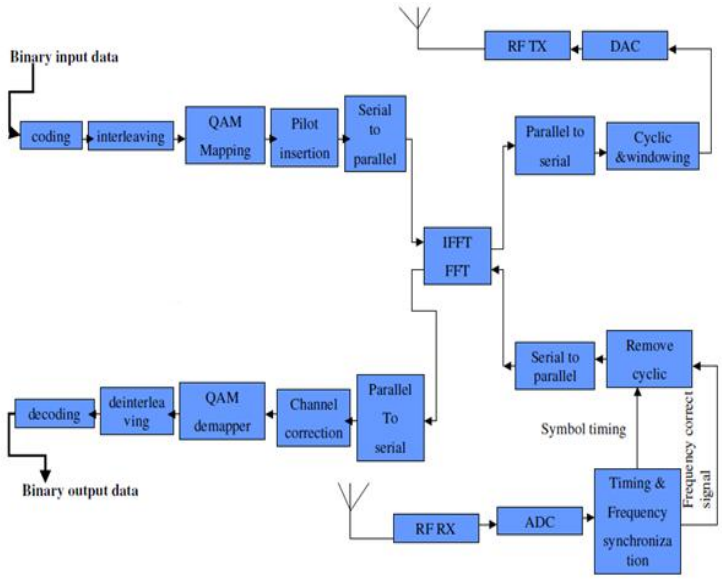

Fig 2. 5G LTE OFDM system

The system begins with to generate simple random records after which apply orthogonal modulation function. In this function the information can be transformed into ones and minus one format (1s and -1s). The sparse sign ought to have M×N dimensional. At the same time as using sparse sign transmission it arises time delay. So keep away from this time

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 3 , March 2020

put off to apply the time latency in micro seconds. The sparse signal is converted into non-stop time complex exponential sinusoidal signal. This sign is used to journey for long distance. Apply twiddle factor for that sign. A twiddle issue is a fast Fourier transform algorithm and estimate twiddle component of that signal. Practice the MIMO channel in this MIMO channel it includes two channels, AWGN and Rayleigh channel.

A. ARCHITECTURE OF 5G

As shown in the following image, the system model of 5G is entirely IP based model designed for the wireless and mobile networks. The system comprising of a main user terminal and then a number of independent and autonomous radio access technologies. Each of the radio technologies is considered as the IP link for the outside internet world. The IP technology is designed exclusively to ensure sufficient control data for appropriate routing of IP packets related to a certain application connection, i.e. sessions between client applications and servers somewhere on the Internet. Moreover, to make the accessible routing of packets should be fixed in accordance with the given policies of the user.

B. LTE EVOLUTION

LTE evolved from an earlier 3GPP system known as the Universal Mobile Telecommunication System (UMTS), which in turn evolved from the Global System for Mobile Communications (GSM). Even related specifications were formally known as the evolved UMTS terrestrial radio access (E-UTRA) and evolved UMTS terrestrial radio access network (E-UTRAN). The first version of LTE was documented in Release 8 of the 3GPP specifications.

Table 1. LTE Evolution

Year	*Event*
Mar 2000	*Release 99 - UMTS/WCDMA*
Mar 2002	*Release 5 – HSDPA*
Mar 2005	*Release 6 – HSUPA*
Year 2007	*Release 7 - DL MIMO, IMS (IP Multimedia Subsystem)*
November 2004	*Work started on LTE specification*
January 2008	*Spec finalized and approved with Release 8*
2010	*Targeted first deployment*

C. LTE EVOLUTION

LTE supports hard QoS, with end-to-end quality of service and guaranteed bit rate (GBR) for radio bearers. Just as Ethernet and the internet have different types of QoS, for example, various levels of QoS can be applied to LTE traffic for different applications. Because the LTE MAC is fully scheduled, QoS is a natural fit. Evolved Packet System (EPS) bearers provide one-to-one correspondence with RLC radio bearers and provide support for Traffic Flow Templates (TFT). There are four types of EPS bearers:

- GBR Bearer resources permanently allocated by admission control
- Non-GBR Bearer no admission control
- Dedicated Bearer associated with specific TFT (GBR or non-GBR)

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 3 , March 2020

- Default Bearer Non GBR, catchall for unassigned traffic

D. 5G TD LTE NETWORK

Low latency is an essential feature for destiny wireless communication structures and 5G TD LTE may be designed to lessen the effect of the PHY layer in the normal machine latency. The predominant technique is to reduce the 5G TD LTE symbol duration and add simplest a unmarried CP for M sub-symbols. The latter property is especially critical; due to the fact, prefixing each sub symbol would genuinely boom the latency and decrease the spectral performance. The short sub symbol length will lead to wider sub-carriers that might go through from frequency selective outcomes of the cell multipath channel.

E. MULTICARRIER 5G WIRELESS COMMUNICATION

A Multicarrier system for 5G technology with transmission, channelization and reception sections are implemented. Pulse shaping, which is likewise regarded as sub-carrier based filtering, can successfully reduce spectrum leakage. According to the Heisenberg-Gabor uncertainty principle, the time and frequency widths of the pulses cannot be reduced at the identical time. Therefore, the waveforms based on pulse shaping is normally non-orthogonal in both time and frequency domain names to preserve high spectral efficiency (SE). In comparison with conventional OFDM, the transceiver shape helping pulse fashioned modulation is more complex.

F. CHARACTERISTICS OF WIRELESS NETWORK

- **Mobility** − A wireless communications system allows users to access information beyond their desk and conduct business from anywhere without having a wire connectivity.
- **Reachability** − Wireless communication systems enable people to stay connected and be reachable, regardless of the location they are operating from.
- **Simplicity** − Wireless communication system are easy and fast to deploy in comparison of cabled network. The Initial set up cost could be a bit high, but other advantages overcome that high cost.
- **Maintainability** − In a wireless system, you do not have to spend too much cost and time to maintain the network setup.
- **Roaming Services** − Using a wireless network system, you can provide service anywhere, anytime, including train, buses, airplanes etc.
- **New Services** − Wireless communication systems provide various smart services like SMS and MMS.

G. ALGORITHM

The novel resource allocation algorithm for achieving maximum EE.

Step 1: Initialize {Pn, m=0, n = 1,2,...,N,m=1,2,...,M}, and n=1.

Step 2: If n>N, stop; otherwise calculate the numerical search upper bound, upper and Elower bound, Elower for each MS m according to equation 1 and equation 2 SNR for Multispectral of a distributed antenna system based on OFDM can be written as, Where Pn, m and hn, m denote the transmit power and the composite fading channel impulse response from Resource allocation n to MS m, respectively. Sigma denotes the complex additive white Gaussian Noise Power.

In this algorithm, hn, m in (1) is modelled as follows.

Step 3: Let,
En={Elower+Eupper)/2,
And calculate pn, m according to the equation.
Step 4: If Summation (M,m)=1 Pn, m > Pn max, let Eupper = En; otherwise
Elower=En.
Step 5: if Pn,m is convergent for each MSm,n=n+1 And go to step 2; otherwise go to step3

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 7, Issue 3 , March 2020

IV. EXPERIMENTAL RESULTS

Bit Error Rate comparison between different wireless communication techniques. The 5G LTE Wi-Max system shows that better performance than all other techniques as shown in the figure 3.

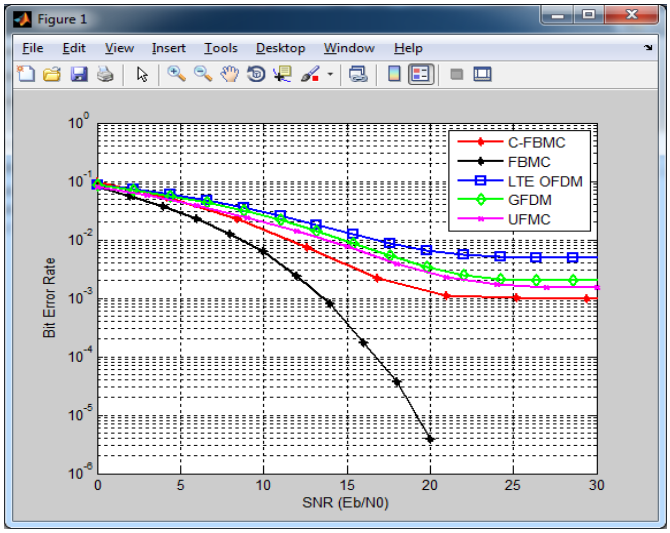

Fig 3. BER performance

Rayleigh fading is a model that can be used to describe the form of fading that takes place while multipath propagation exists. In any terrestrial surroundings a radio sign will travel through a number of various paths from the transmitter to the receiver. The most obvious course is the direct, or line of sight direction. However, there might be very many items across the direct direction. Those items can also serve to reflect, refract, and so forth the sign. As an end result of this, there are many other paths by which the signal may additionally reach the receiver. Whilst the alerts attain the receiver, the general signal is a combination of all the indicators that have reached the receiver thru the multitude of different paths which might be to be had.

A. DATA ANALYSIS TABLE

Table 2. Data Analysis

Data Rate (MB/s)	Modulation	Coding Rate (R)	Conjugate Symmetric Input to IFFT	Time Spreading	Overall Spreading Gain	Coded bits per OFDM symbol (N_{CBPS})
55	QPSK	11/32	Yes	Yes	4	100
80	QPSK	½	Yes	Yes	4	100
110	QPSK	11/32	No	Yes	2	200
160	QPSK	½	No	Yes	2	200
200	QPSK	5/8	No	Yes	2	200
320	QPSK	½	No	No	1	200
480	QPSK	¾	No	No	1	200

In this the table contains all collected data like data rate, modulation, coding rate, conjugate symmetric input to IFFT, time spreading, overall spreading gain, coded bits per OFDM symbol. OFDM belongs to a family of transmission

ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 7, Issue 3 , March 2020

schemes called multicarrier modulation, which is based on the idea of dividing a given high-bit-rate data stream into several parallel lower bit-rate streams and modulating each stream on separate carriers, often called sub-carriers or tones.

V. CONCLUSION AND FUTURE WORK

The channel estimation and maximization schemes of 5G LTE W-Max is exploited through which the overall performance as well as the correlations of wireless communication channel is analyzed in special time varying channel model. The exceedingly time varying channels are predicted efficaciously and the overall performance upgrades are also proven through the higher channel estimation with high accuracy. Flexibility is a key trait of future 5G LTE network requirements, where the communications protocols can be custom designed on a communication basis to optimize performance.

REFERENCES

[1] Anass Benjebbour ; Anxin Li ; Keisuke Saito ; Yuya Saito ; Yoshihisa Kishiyama ; Takehiro Nakamura" NOMA: From concept to standardization" Oct 2015.
[2] Bo Wu1,2 , Yong Ding1, July 2012" Chunk-based User Selection and Resource Allocation in Distributed Secure MISOOFDMA Systems" 1.Zhongzhou University, Zhengzhou, China , 450044, 2.Wuhan University, Wu Han, China , 430072.
[3] Bernado. L, Zemen. T, Tufvesson.F, Molisch. A.F, and Mecklenbrauker. C.F, "Delay and Doppler Spreads of Nonstationary Vehicular Channels for Safety-Relevant Scenarios," IEEE Transactions on Vehicular Technology, vol. 63, no. 1, pp. 82–93, Jan 2014.
[4] Debby Lin; Gilles Charbit I-Kang Fu, Sept 2015" Uplink Contention Based Multiple Access for 5G Cellular IoT"
[5] Ghaith Al-Juboori; Angela Doufexi; Andrew R. Nix, August 2017" System level 5G evaluation of MIMO-GFDM in an LTE-A platform"
[6] Guowang Miao, Nageen Himayat, Geoffrey Ye Li, and Shilpa Talwar, Feb 2011" Distributed Interference-Aware Energy-Efficient Power Optimization"
[7] Heejin Kim, Student Member, IEEE, Sang-Rim Lee, Student Member, IEEE, Kyoung-Jae Lee, Student Member, IEEE, and Inkyu Lee, Senior Member" Transmission Selection Schemes using Sum Rate Analysis in Distributed Antenna Systems" IEEE School of Electrical Eng., Korea University, Seoul, Korea. Email: {heejink, sangrim78, kyoungjae, June 2013, inkyu}@korea.ac.kr.
[8] Heshani Gamage; Nandana Rajatheva; Sept 2017" Performance and PAPR Analysis of Single-Carrier Massive MIMO Systems with Channel Imperfections"
[9] Hyvarinen, J., Karhunen, Oja. E, 2001. "Independent Component Analysis", John Wiley and sons.
[10] Kim. Y, Miao. G, and Hwang. T, "Energy Efficient Pilot and Link Adaptation for Mobile Users in TDD Multi-User MIMO Systems," IEEE Transactions on Wireless Communications, vol. 13, no. 1, pp. 382–393, January 2014.
[11] Peled. A and Ruiz.A, Jan 2003 "Frequency domain data transmission using reduced computationally complexity algorithms,".
[12] Swami. A and Sadler. B.M, 2000. "Hierarchial Digital Modulation Classification Using Cummulants" IEEE Transaction on Communications, 48: 416-492.
[13] Sami H. O. Salih, Mamoun M. A. Suliman, "Implementation of Adaptive Modulation and Coding Techniques using Matlab," 53rd International Symposium ELMAR-2011, 14-16 September 2011, Zadar, Croatia.
[14] Xu. X, He. G, Zhang. S, Chen, and Xu. S, "On Functionality Separation for Green Mobile Networks: Concept Study over LTE," IEEE Communications Magazine, vol. 51, no. 5, pp. 82–90, May 2013.
[15] L. William Mary, K. L. Sagayaraj, "Industry 4.0 A Systematic Literature Review of Analyzing the On-Trend and Future Perception in the Industry", JETIR, Vol 6 Issue 12, December 2019.
[16] Yu Liu, Haimovich. A.M, Fellow,IEEE, Wei Su, Jason Dabin, Emmanuel Kanterakis, "Modulation Classification Of MIMO – OFDM Signals by Independent Component Analysis and Support Vector Machines", T-SP-15550-2013.