*i*Journals: International Journal of Software & Hardware Research in Engineering (IJSHRE)
ISSN-2347-4890
Volume 10 Issue 2 February 2022

Performance Analysis for Coexistence between 4G and 5G Networks

Emad A. Mohammed

Computer Techniques Engineering Department, Northern Technical University

e.a.mohammed@ntu.edu.iq

ABSTRACT

The growth of number of users and real time applications caused a shortage in the wireless resources especially in the licensed band. 4G Networks support many applications and offer a good bandwidth for the users, but still there is a need to provide more bandwidth for users with heavy traffic. 5G networks that utilized nonorthogonal multiple access (NOMA,) provide high data rate. In this paper a coexistence technique between 4G and 5G is introduced to enhance network throughput. Performance analyses has been provided. Throughput of 193 Mbps enhancement is acquired by transition from 4G to 5G.

KEYWORDS:4G, 5G, LTE, Physical layer, QoS, NOMA, Throughput.

1.INTRODUCTION

Nowadays, 4G networks support many real time applications that required high data rates such as video call and video games.[1]. 4G networks provides data rates up to 1Gbps with different modulation and coding techniques. Stationary and mobile user are both supported.[2]. Different technologies can support 4G networks such as Wi-Max and LTE. The main architecture of 4G networks enabled high performance characteristics, ensuring good quality of service (QoS). These networks basically depend on point to multipoint transmission aided with orthogonal frequency multiple access (OFDMA)[3]. High speed data transmission can be achieved at physical layer due to variable bandwidths, adaptive modulation and adaptive coding. 4G networks also depends on cellular system to support mobility by roaming and IP mobility, where the radius of these cells can be from 100m to 1 kilometer[4]. Figure (1) illustrates 4G network architecture.

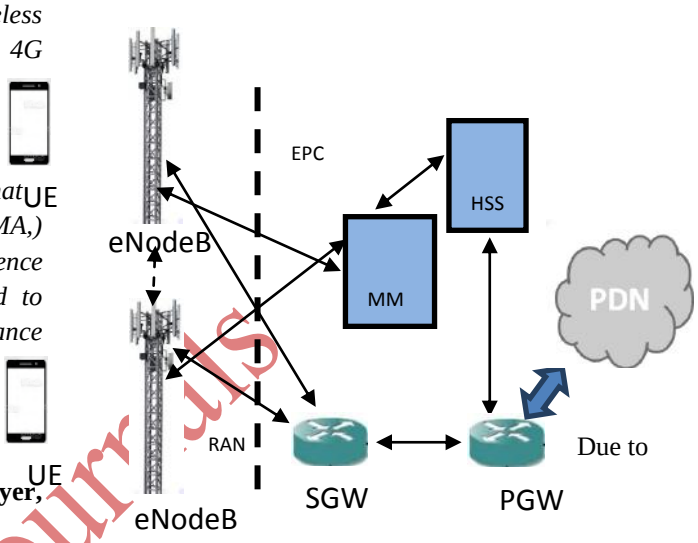

Fig 1: 4G NetworkArchitecture

Due to real time application growth, more bandwidths should be available to the users to meet their requirements. 5G Networks were the great solution to achieve high data rate, larger bandwidth, and QoS insurance[5,6]. The major idea in 5G networks design, is to give more bandwidth for users in case of demand. Limited resources of bandwidth is the key problem, so to overcome this problem more than one user should sharing the same bandwidth.[7]. Nonorthogonal multiple access (NOMA) as radio access technology is applied to give necessary bandwidth. In conventional orthogonal frequency division multiple access (OFDMA), each user can use a certain number of sub-carriers, while in NOMA all users can use the same sub-carriers as shown in figure (2).[8].

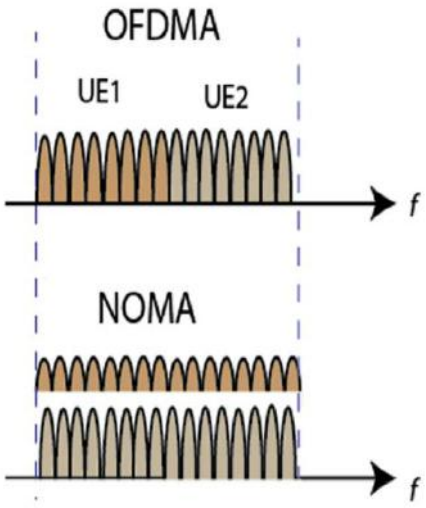

Fig2: OFDMA versus NOMA

To cancel the impact of interference, each user equipment (UE) should perform successive interference cancellation (SIC) as well as, the transmitter.

The main architecture of 5G networks is similar to 4G networks with one difference, that is the de-centralized, which mean each cell in 5G can perform the whole network core, while in 4G, network core combines all cells[9].

2. RELATED WORKS

In 2019, Aymen I. Zreikat and Suat Mercan, studied the performance of OFDM based 5G network as an extension for 4G. performance of both 5G and LTE were analyzed under the same simulation parameters.[10]

In 2019. Lei Wan, et al, Coexistence between LTE and 5G-NR has been proposed. Spectrum balance in the up-link in both LTE and 5G were studied, while the traffic load in the down-link has been improved through utilizing 5G.[11]

In 2020, Prakash Suthar, et al, suggested a network architecture for migration between 4G an 5G. QoS has been improved by using network slicing in 5G network. [12]

In 2021, Karolis Kiela et al, propose a Network-in-a-Box (NIB) method to improve the data rate. Multi band and multi carrier networks have been studied. Packet latency has been enhanced by using 5G instead of 4G.[13]

In 2022, Akhileswar Chowdary, et al, Coordinated multi-point transmission and reception (CoMP) combined with NOMA has been proposed to improved total throughput for cellular 5G networks. Benchmark system based on OMA has been analyzed for appropriate coverage area. [14].

3. PROPOSED SYSTEM MODEL

Each UE in the cell performs a periodic scan for a beacon transmitted by the BS to give extra bandwidth for time critical application and roaming from 4G to 5G to ensure QoS. This beacon contains full information about the cell and divided into many slots for reservation extra bandwidth. UE who demands higher QoS will reserve its slot and stay in listening to the acknowledgment from the base station. Figure (3) illustrates the main fields of the beacon

preamble	Control	UE	Reservation

Fig 3: Beacon main fields

The major field is reservation field which contains full information about UE, such as demanded bandwidth, user position, user status…etc.

4. MODEL ASSUMPTIONS

1. The system has been implemented under the following assumptions

2. Each UE equipped with SIC.

3. Communication channel is additive white Gaussian noise (AWGN)

4. Each UE has the ability to switch from 4G to 5G frequencies.

5. Noise power density is -90dBm/Hz.

5.RESULTS

Throughput of 4G network has been calculated for 20MHz bandwidth. Figure (4) shows throughput of 4G against bit energy for two subcarriers sets. 1024 and 2048 subcarriers with 14ms subcarrier spacing have been used to determine throughput.

For 5G networks, bandwidth is 100MHz and interference noise after applying SIC is -90dbm/Hz which is added to AWGN power density, so SNIR will be twice at average. Two sets of subcarriers have been used which are: 4096 and 5*4096 with standard subcarrier spacing 1ms. As Shown in figure (5)

Figure (6) illustrates throughput for 4G and 5G for the same number of subcarriers. It is obvious that a gain of 193.5Mbps in throughput can be achieved by using 5G

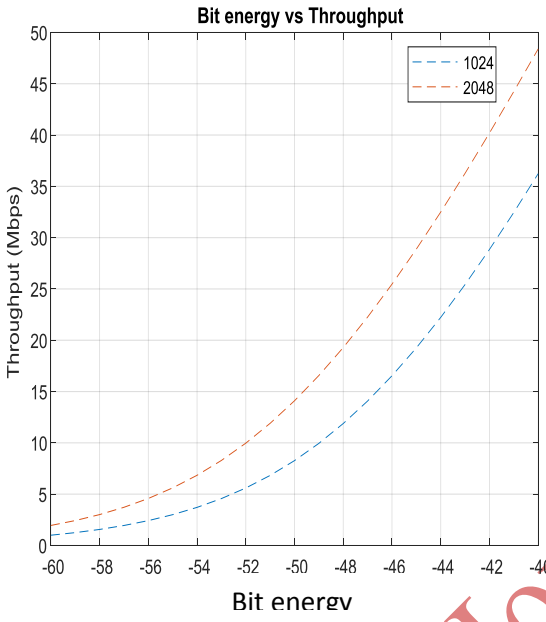

Fig4:. Throughput of

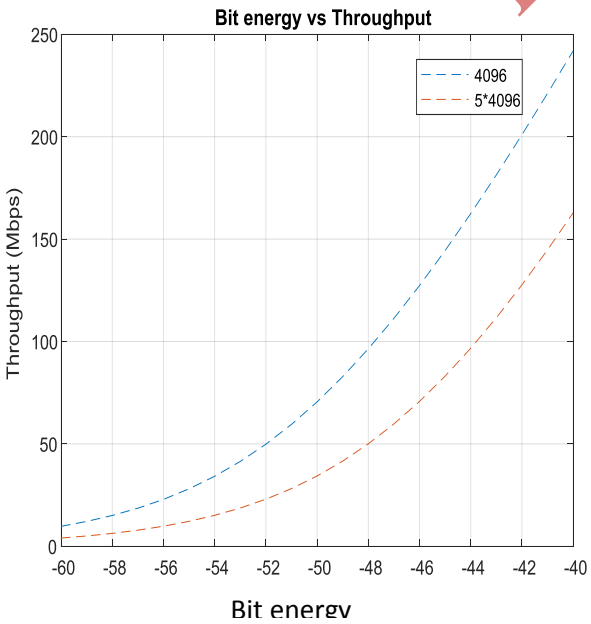

Fig 5: Throughput of 5G

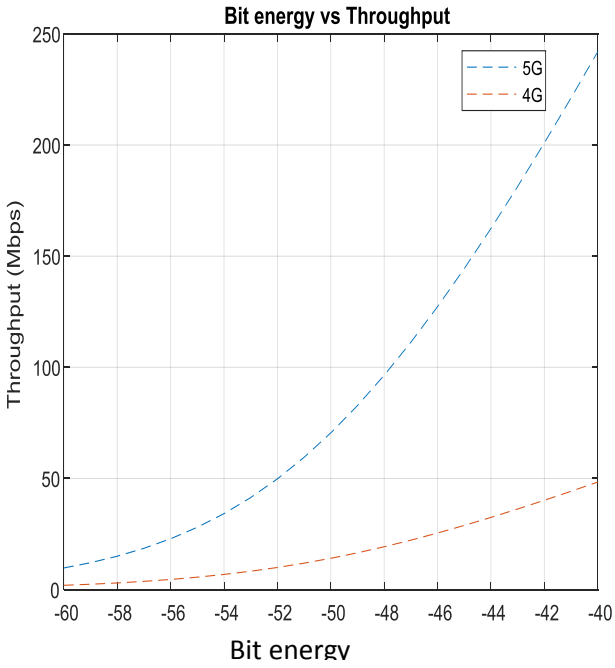

Fig 6: Throughput of 4G and 5G

6. CONCLUSIONS

Network throughput is a major function in quality of network performance. A good method to utilizing available resources is to give each user what does really need for QoS. The transition between 4G and 5G has been investigated to meet this requirement. Performance analysis shows that about 193Mbps improvement can be achieved for the user that uses 5G network.

7. REFERENCES

1. E.T. Tchao, J.D.Gadze, Jonathan Obeng Agyapong" Performance Evaluation of a Deployed 4G LTE Network" International Journal of Advanced Computer Science and Applications. Vol. 9, No. 3, pp. 165-178. 2018

2. Prof. Giriraj Prajapati, Prof. K.C Mahajan" Studies of Dynamic Capacity Enhancement 4G Using a Smart Antenna in Wireless Communication" International Journal of software & Hardware Research in Engineering. Volume 1 Issue 1, pp. 1-6. September 2013

3. Alaa Deshar Farhood, Neelesh Agarwal, A.K. Jaiswal, Navendu Nitin and Maham Kamil Naji " Performance Analysis of OFDMA in LTE" International Journal of Current Engineering and

Technology, Vol.4, No.3, pp.1614-1619, June 2014.

4. Abdulaleem Ali Almazroi "Performance Analysis for 4G Broadband Cellular Networks"

International Journal of Advanced and Applied Sciences. Vol.5 No.9 pp.12-17. 2018

5. Priyanka Datta, Rajesh Rohilla "Optimization and Performance matrices in 5G

Networks" 2nd IEEE International Conference on Power Energy, Environment & Intelligent Control (PEEIC2019). 2019. India.

6. A Reddy, Sheeba Kumari M, V. Hanwani "5G New Radio Key PerformanceIndicators Evaluation for IMT-2020 Radio Interface Technology" IEEE Access Vol.9. pp. 112290-112311. 2021

7. V. Dhanwani, N. Kumar, A. K. Bachkaniwala, D. Rawal, and S. Kumar "Assessment of candidate technology ETSI: DECT-2020 new radio" inProc. IEEE 3rd 5G World Forum (5GWF), Sep. 2020, pp. 625-630.

8. Dr. Dilip Sharma, Deepti Mousik "A Study on Non-Orthogonal Multiple Access (NOMA) for 5G systems and beyond" International Journal of Software & Hardware Research in Engineering Volume 8 Issue 2 pp.39-43. 2020

9. Gambo Junaidu, Suleiman Abdullahi , Lawal Idris Bagiwa " A Survey on 5G Mobile Networks: The Perspective of Technology, Security Threats and Mitigations" International Journal of Software & Hardware Research in Engineering (IJSHRE) Volume 9 Issue 4 pp. 48-52. 2021

10. Aymen I. Zreikat and Suat Mercan" Performance Study of 5G Downlink Cell" NEW2AN 2019/ruSMART. pp. 1–13, 2019.

11. Lei Wan, Zhiheng Guo, and Xiang Chen "Enabling Efficient 5G NR and 4G LTE Coexistence" IEEE Wireless Communications Vol 26. Issue 1 pp.6-8. 2019

12. Prakash Suthar, Vivek Agarwal, Rajaneesh Sudhakar Shetty, Anil Jangam "Migration and Interworking between 4G and 5G" IEEE 3RD 5G World Forum (5GWF) pp. 401-406. 2020. India

13. Karolis Kiela, Marijan Jurgo 2, Vytautas Macaitis and Romualdas Navickas "5G Standalone and 4G Multi-Carrier Network-in-a-Box Using a Software Defined Radio Framework" Sensors. 2021. doi.org/10.3390/s21165653

14 Akhileswar Chowdary; Garima Chopra; Abhinav Kumar; Linga Reddy Cenkeramaddi "Enhanced User Grouping and Pairing Scheme for CoMP-NOMA-based Cellular Networks" 14th International Conference on COMmunication Systems &NETworkS (COMSNETS). 2022. India.