IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 6, June 2017

Capacity Improvement for Multi-Tier 5G Networks

Haitham Al Fatli

M.E. Electronics, SCOE, Pune, India

Abstract: Recently, there is a significant need of fastest wireless networks for 5G. Radio resource and interference management are the biggest challenges in multi-tier and heterogeneous 5G cellular networks. In this project, the capacity of 5G network is enhanced by resource and interference management algorithm. The simulation is carried on MIMO channel using QPSK modulation technique. The simulation result of joint distributed cell association and power control (CAPC) methods resulted into maximum system throughput, less energy consumption, less delay, less latency and balance traffic loads- It also requires less signal-to-interference ratio (SIR) for high priority users.

Keywords: Cell Association, Resource, Interference, 5G Networks, CAPC, Wireless Networks.

I. INTRODUCTION

As know that multi user MIMO systems deliver the huge benefits to wireless communication networks like 5G as compared to traditional wireless communication systems. For networks life 5G, there is requirement of high speed, hence Multiple-input, multiple-output orthogonal frequency-division multiplexing (MIMO-OFDM) is the dominant air interface for 4G and 5G broadband wireless communications. It combines multiple-input, multiple-output (MIMO) technology, which multiplies capacity by transmitting different signals over multiple antennas, and orthogonal frequency-division multiplexing (OFDM), which divides a radio channel into a large number of closely spaced sub channels to provide more reliable communications at high speed. For 5G networks, there is major research problem is the improvement of capacity through the efficient approach of resource management and interference management. In MIMO, this can be achieved by designed efficient channel estimation technique. In this paper, we are presenting the new transmission scheme for MIMO-OFDM a system is proposed with goal of improving the channel estimation efficiency. The new transmission approach reduces significantly the complexity of the conventional MIMO-OFDM systems for the symmetric channel for 5G networks. Proposed approach working is based on channel coding which make use of the estimated channel parameters extracted from a pilot signal transmitted by the destination receiver. Thus, the transmitted signal is very much adapted to the channel impairments and variations. In this new MIMO-OFDM model, the channel parameters are estimated from a pilot data transmitted by the receiver end. These estimated parameters are used by a special channel coding block to adapt the transmitter signal to the diverse channel impairments and variations. To reduce the system complexity we have removed the pilot insert, the pilot extraction, the MIMO encoder and the MIMO decoder from the conventional MIMO-OFDM scheme. In this paper, we are presenting new model and algorithms for 5G multitier network designs with aim of improving the performance of throughput, delay and jitter as compared to current approaches. Related works on 5G resource management and other components is presented. Proposed system architecture and methodology is discussed. The simulation results and its discussion presented. The conclusion and future work is presented. Calculating the network performance is kind of difficult task, mainly because the system administrators are unsure of which implementation approach is suitable for the use of which LAN or WAN networks. A very common & efficient method for the testing of network performances is by initiating a simple file transfer protocol from the end user to the main server. however, this method of file transfer protocol is debatable because we are not only measuring the speed of data transfer but also we are calculating the hard disk delays on both ends of the stream i.e. at end user & the main server. The destination target can accept more data stream & have higher data transmission rate than the sender is capable of sending, or paradoxically the other way around. These glitches, caused by the hard disk drives, OS queuing mechanism or any other hardware component entities, introduces an unwanted delay in the system, ultimately resulting into providing incorrect data results. The best & most efficient way of measuring the maximum throughput of the network is by minimising the delay that is introduced by the machines participating in the system testing. For the performance of these tasks High/Mid-end machines (servers, workstations or laptops) are to be used, where these machines are not dealing with any other tasks during the test implementation. Many of large companies have the luxury of ample financial resources to overcome all of the above glitches and can purchase expensive equipment used for the testing environments of the networks, on the other hand the rest of us can only rely on other methods, most amongst which are gettable from the freely available open source community. The Fifth generation (5G) of mobile networks will support a wide range of features and use cases', going well beyond current cellular networks. While increased capacity to support enhanced mobile broadband (eMBB) services is a key driver, 5G will also be required to support ultra-reliable low-latency communications (URLLC) and massive machine communications (mMTC). The 5G system is being designed to be implementable over a multitude of network architectures (ranging from C-RAN to distributed C-RAN, also known as edge C-RAN), enabling different backhaul and fronthaul latencies. Furthermore, 5G is envisioned to cover a wide range of frequency bands, ranging from bands below 6 GHz to millimeter wavebands. The current and projected dramatic growth of mobile data traffic necessitates the development of fifth-generation (5G) mobile communications technology. In section II, related works discussed. In section III, proposed system architecture and methodology is discussed. In section IV, the simulation results and its discussion presented. Finally, in section V, the conclusion and future work is presented.

II. RELATED WORKS

There are number of techniques proposed on 5G systems. In this part, talking about various strategies for displayed in 2015 and 2016 on 5G connect with various targets, for example, control (vitality) productivity, limit change, throughput change, examinations and so on.

In [11], creators laid out the difficulties for impedance administration in 5G multi-level systems considering its dreams, necessities, and key components. These systems will be described by the presence of various get to need for clients and levels alongside the likelihood of synchronous network of clients to numerous BSs. Alongside these elements, distinctive BS relationship for uplink and downlink transmission open new difficulties and in the meantime increment degrees of flexibility for power control and cell affiliation. Open difficulties have been highlighted and rules have been given to change the current plans with a specific end goal to make them reasonable for 5G multi-level systems. In this specific situation, a promising heading for future research is to devise effective joint CAPC techniques that fulfill targets, for example, amplifying framework throughput, adjust movement stack subject to a base SIR for high need clients. To address these numerous goals, asset mindful client affiliation can be consolidated with regular cell affiliation strategies to fulfill the required destinations in this paper. In [12], creators investigated the utilization of the mmWave band (20–100 GHz) to plan the 5G upgraded neighborhood gets to which fulfills the necessities for 5G systems with pinnacle rates in overabundance of 10 Gbps, cell-edge rates of no less than 100 Mbps, and latencies of under 1.0 msec. Creators exhibited case for utilizing mmWave groups, specifically the 28, 38, 71–76 and 81–86 GHz groups for a 5G eLA. Broad channel estimations demonstrate extremely practically identical way misfortune conduct for both the get to and backhaul situations for 28 and 73 GHz groups in New York City. In [13], investigation of the current planning calculations for Multiuser-MIMO remote frameworks is given by writers in this article. The conduct of these calculations is investigated for a huge scale radio wire frameworks known as Massive MIMO, where it is proposed to utilize a great deal of recieving wires to multiplex messages to a few client gadgets at each time and recurrence asset. In [14], creators shed light on the potential and usage of IM strategies for MIMO and multi-bearer correspondences frameworks, which were required to be two of the key advances for 5G frameworks. In particular, creator concentrated on two promising uses of IM: spatial tweak and orthogonal recurrence division multiplexing with IM, and talked about the current advances and future research bearings in IM innovations toward range and vitality effective 5G remote systems. In [15], creator presented first the overview of different procedures for power enhancement of the forthcoming 5G systems. The essential concentrate of this article was on the utilization of transfers and little cells to enhance the vitality proficiency of the system. Creator talked about different situations of handing-off for the cutting edge systems. Alongside this, the significance of synchronous remote power and data exchange, huge MIMO and millimetre waves has been broke down for 5G systems. In [16], creators exhibited close mix of both WiFi and LiFi innovations empowers off-stacking open doors for the WiFi system to free assets for more portable clients in light of the fact that stationary clients will ideally be served by LiFi. Along these lines, LiFi and WiFi can productively work together. They actualized a few methods for channel conglomeration for the recommended concurrence, and shown by confirmation of-idea results, utilizing cutting edge LiFi and WiFi frontends, that both advancements together can dramatically multiply the throughput for individual clients and offer noteworthy collaborations, yielding a joined arrangement that can satisfactorily address the requirement for improved indoor scope with the most elevated information rates required in the fifth era of versatile systems (5G). In [17], creator concentrated on the execution and mistake execution investigations of the MIMO-OFDM-IM conspire for cutting edge 5G remote systems. Greatest probability (ML), close ML, straightforward least mean square mistake (MMSE) and requested progressive impedance cancelation (OSIC) based MMSE finders of MIMO-OFDM-IM were proposed and their hypothetical execution is examined. It has been indicated by means of broad PC reenactments that MIMO-OFDM-IM plot gives an intriguing exchange off between mistake execution and ghostly effectiveness and it accomplishes significantly preferable blunder execution over traditional MIMO-OFDM utilizing distinctive sort identifiers and under reasonable conditions.

III. METHODOLOGY

(MIMO-OFDM) is the dominant air interface used for broadcasting 4G and 5G broadband wireless signals. It combines (MIMO) technology, which multiplies the capacity of the system by transmitting different signal frequencies over

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 6, June 2017

multiple antennas, and (OFDM), divides a radio channel into a large number of closely spaced sub channels to provide more reliable communications at high speed. Figure 1 shows the example model of MIMO-OFDM transmission.

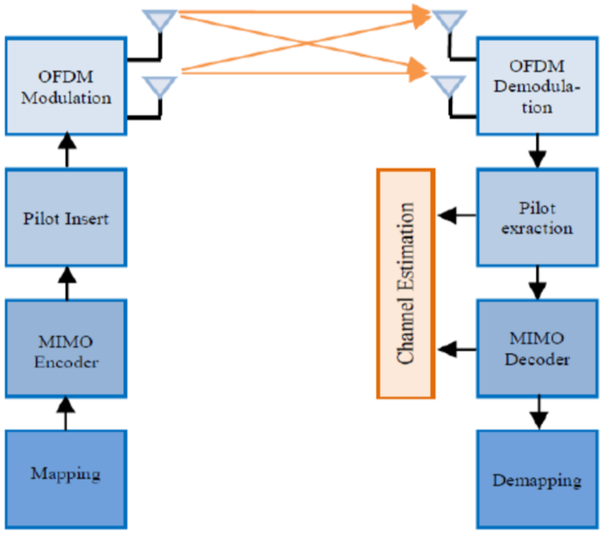

Figure 1: MIMO-OFDM

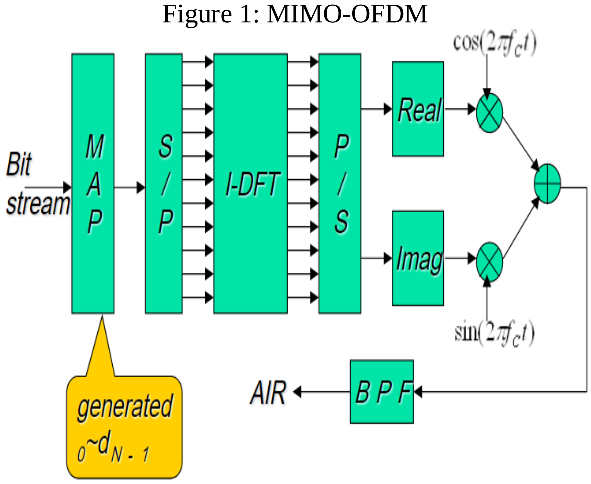

Figure 2: OFDM Modulator

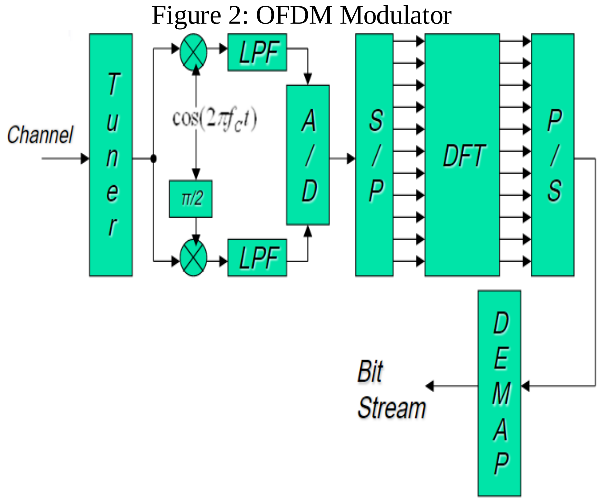

Figure 3: OFDM demodulator

Base-band OFDM signal is:-

$$s_B(t) = \sum_{n=0}^{N-1} \{a_n \cos(2\pi n f_0 t) - b_n \sin(2\pi n f_0 t)\} \quad (1)$$

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 6, June 2017

The (an) and (bn) are calculated from $S_B(t)$

$$\int_0^T s_B(t)\cdot\cos(2\pi k f_0 t)dt$$
$$=\sum_{n=0}^{N-1}\left\{a_n\int_0^T \cos(2\pi n f_0 t)\cos(2\pi k f_0 t)dt - b_n\int_0^T \sin(2\pi n f_0 t)\cos(2\pi k f_0 t)dt\right\}$$
$$=\frac{T}{2}a_k$$
$$\int_0^T s_B(t)\{-\sin(2\pi k f_0 t)\}dt=\frac{T}{2}b_k \qquad (2)$$

S_B (t) = up converted to pass-band signal S (t)
F_c = frequency shift
The general structure of MIMO-OFDM system is shown in figure 1. The proposed system consists of 2 transmit and 2 receive antennae. The OFDM signal for each antenna is obtained by applying the inverse Fast Fourier transform (IFFT) and can be detected using Fast Fourier transform (FFT) [5]. A pilot sequence is inserted and used for the channel estimation. Also, a cyclic prefix is inserted in front of the OFDM symbol at the last step of OFDM modulation block. The time length of the cyclic prefix should be greater than the maximum delay spread of the channel. The main function of the cyclic prefix is to guard the OFDM symbol against Inter Symbol Interference (ISI), hence, this cyclic prefix is called the guard interval of the OFDM symbols [Ref]. The MIMO coding can use several encoders such as STBC, VBLAST and golden coding.

Proposed Model and Details

In this paper, first presenting is the OFDM-MIMO wireless transmitter and receiver designed for 5G network in MATLAB using QPSK modulation and turbo encoding technique. Figure 4 is showing the MATLAB Simulink based wireless transmission system. As showing in figure, the transmitter generating the random data in order to transmit to intended recipient through the different processes like data modulation, data encoding, channel estimations (MIMO), data transmission (AWGN) over wireless medium and then reverse tasks at the receiver end. This process is repeated still their end of simulation time. Based on the sent and received packets, then error rate and data is computed for this module. The FRE block computes the performance of designed MIMO system by considering the two transmitter and two receiver antennas

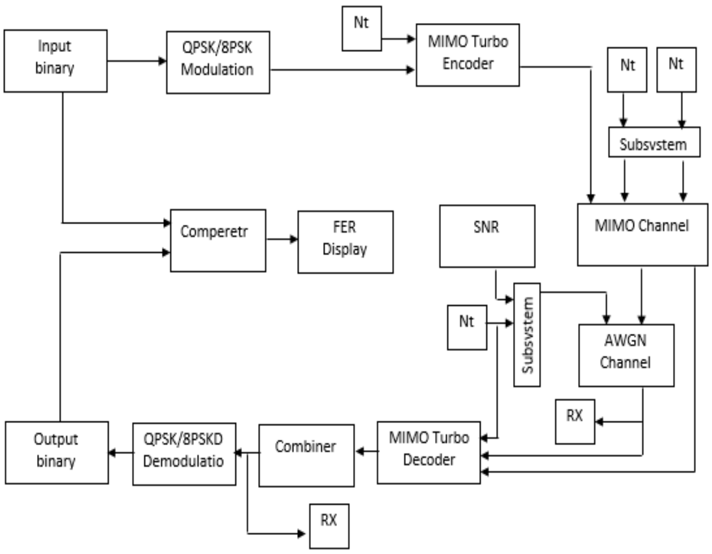

Figure 4: Proposed MIMO System Diagram in MATLAB

In this new MIMO-OFDM model, the channel parameters are estimated from a pilot data transmitted by the receiver end. These estimated parameters are used by a special channel coding block to adapt the transmitter signal to the diverse channel impairments and variations. To reduce the system complexity than have removed the pilot inserts the pilot extraction, the MIMO encoder and the MIMO decoder from the conventional MIMO-OFDM scheme. The channel coding is based on the channel variations, this channel in our case is between two transmit antennae and two receive antennae, and it can be modelled as shown in the figure 6. First, the receiver send a pilot signal to the transmitter, which can expressed as follows

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 6, June 2017

$$\begin{cases} Y_1^p = H_{11}.X_1^p + H_{21}.X_2^p + N_1^p \\ Y_2^p = H_{12}.X_1^p + H_{22}.X_2^p + N_2^p \end{cases} \quad (3)$$

Algorithm 1: OFDM-MIMO Transmitter
Input: Random binary data
Output: Encoded data
Step 1: Transmitter node generates binary data continuously to transmit receiver over wireless channel.
Step 2: Apply QPSK Modulation
Step 3: Apply Turbo Encoding on Modulated data
Step 4: Send encoded data to MIMO wireless channel with two sending antennas
Step 5: Data transmitted to receiver through AWGN channel.
Step 6: STOP

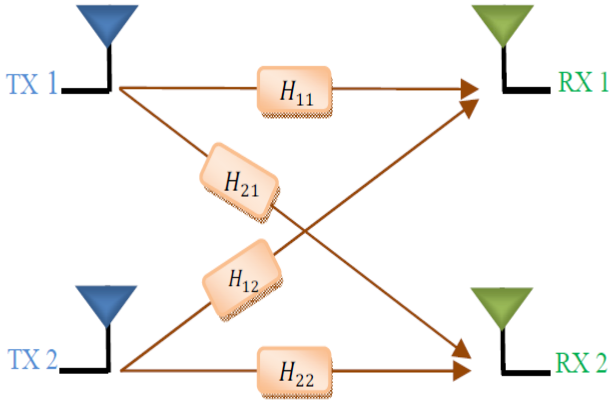

Figure 5: MIMO channel model

Algorithm 2: OFDM-MIMO Receiver
Input: Encoded Data
Output: Recovered Binary Data
Step 1: Receiver node receives the encoded data using two receiving antennas
Step 2: Apply turbo decoder
Step 3: Apply QPSK Demodulation
Step 4: Receiving original data
Step 5: Measure BER and Error Rate Performance
Step 6: STOP

IV. RESULTS AND DISCUSSION

The simulation work as per the plan presented in figure 2 is conducted using NS2. Table 1 is showing the simulation properties and parameters used for MATLAB simulation.

Table1: Simulation configuration parameters for MATLAB

FFT Size	256
Block size	8
Sub band size	20
SNR Range	0:2:40
Number of iterations	120
Channel Type	Iden Channel
Equalizer Type	MMSE
Modulation Technique	BPSK, QAM
Number of subcarriers	256
Filter type	Pulse shaping filter
Oversampling factor	4

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 6, June 2017

Table 2: Simulation Parameters for NS2

Number of Small Cells	10, 20, 30, 40 and 50
Traffic Patterns	CBR (Constant Bit Rate)
Network Size (X x Y)	1200 * 300
Max Speed	10 m/s
Simulation Time	100s
Transmission Packet Rate Time	10 m/s
Pause Time	1.0s
Routing Protocol	AODV
MAC Protocol	802.22
Cell Association Schemes	RACA/DACA/HCA
Number of RA resources per frame	4

Based above configurations, figures 7 to 10 are showing the simulation results with comparison among RACA, DACA and proposed technique.

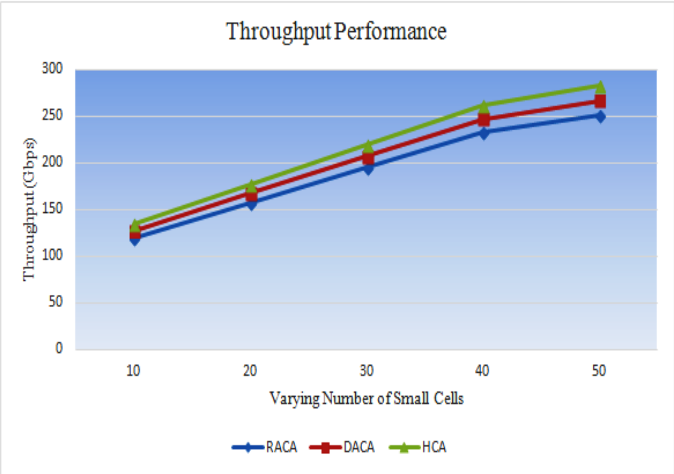

Figure 7: Throughput Performance Analysis

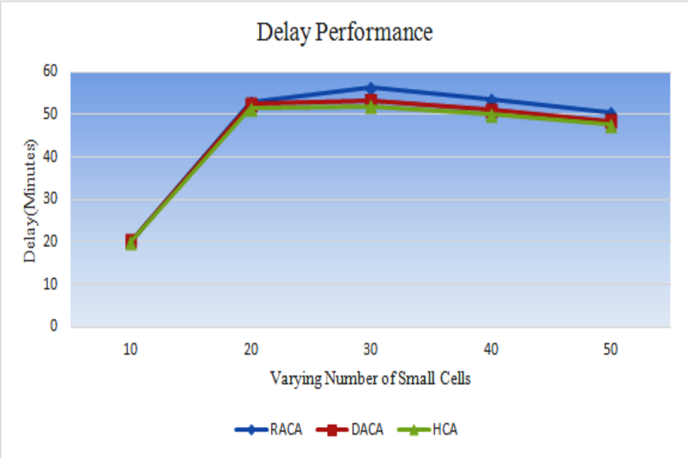

Figure 8: Performance Analysis of Delay

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 6, June 2017

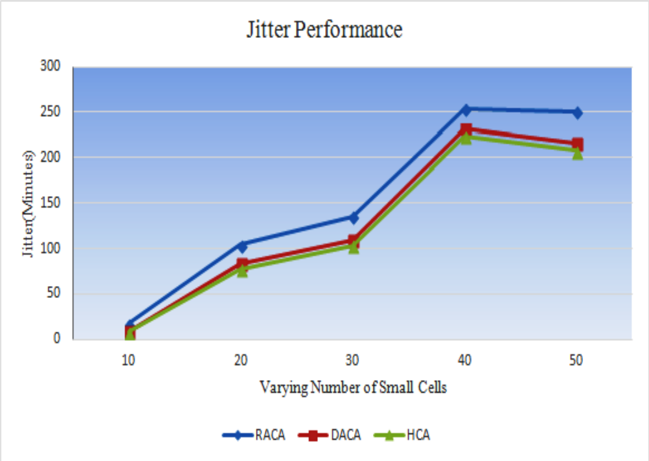

Figure 9: Performance Analysis of Jitter

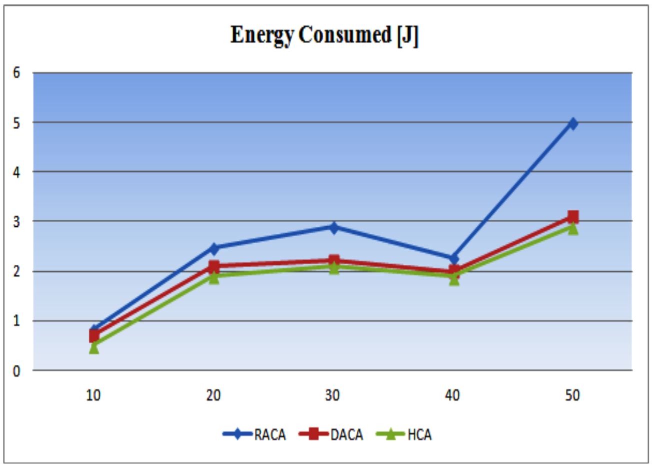

Figure 10: Energy Efficiency Analysis

Figure 7, 8, 9, and 10 are showing the improvement in proposed technique HCA as compared to previous methods.
To take care of the momentum look into issues in 5G systems, in this paper endeavoured to outline novel asset administration method with objective of accomplishing the productive trade-off between transmission rate, postponement, vitality and jitter proficiency in future correspondence systems, The MIMO Channel square recreates the recurrence level Rayleigh blurring MIMO channel from the (Nt) transmit radio wires to the (Nr) get recieving wires. The piece is arranged as a spatially free 4x4 MIMO channel with transmit and get radio wire determination. The Sample rate (Hz) parameter is set to 2e6/3 that is computed in view of the casing length, code rates and model specimen time. The Maximum Doppler move (Hz) parameter is set to 100. The square uses this esteem so the MIMO channel acts like a semi static blurring channel, i.e., it keeps generally steady amid one code piece transmission and shifts along various squares. The principal contribution to this square is a (Ns x Nt) variable-measure network, where the quantity of segments (Nt) compares to the quantity of chose transmit recieving wires and the quantity of columns (Ns) relates to the quantity of orthogonal code tests that the framework transmits over each transmit radio wire in an edge. The second and third contributions to this piece are (1 x 4) settled size twofold line vectors to show that the main Nt transmit and Nr get recieving wires are being chosen for the present edge transmission, separately. The primary yield of this piece is a (Ns x Nr) variable-measure channel yield grid. The second yield of this square is a (Ns x 1 x 4 x 4) variable-estimate channel pick up exhibit with NaN esteems for those unselected transmit-get reception apparatus sets.

BER: bit error rate is used to compute the difference between original transmitter signal and received signal at reliever.
BER (t) = abs (x (t) – r (t));

Where, x (t) is original signal generated at transmitter end, and r (t) is received signal at receiver end at time t.
Below figures 11 and 12 are showing the BER performance using BPSK and QAM modulation technique respectively for basic MIMO-OFDM, Recent method and proposed model with clipping technique

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering

ISO 3297:2007 Certified

Vol. 6, Issue 6, June 2017

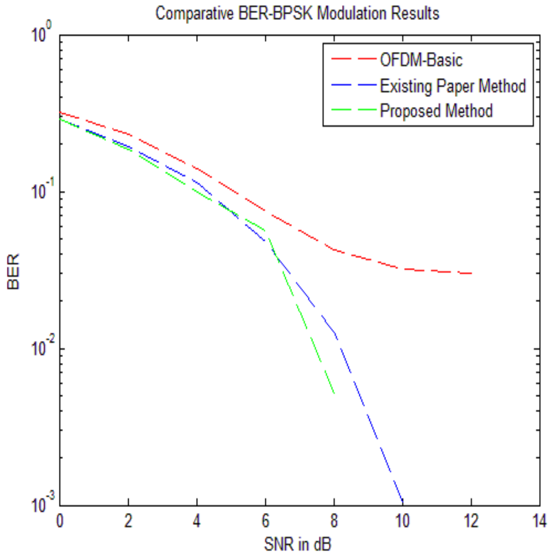

Figure 11: BER performance analysis using BPSK modulation

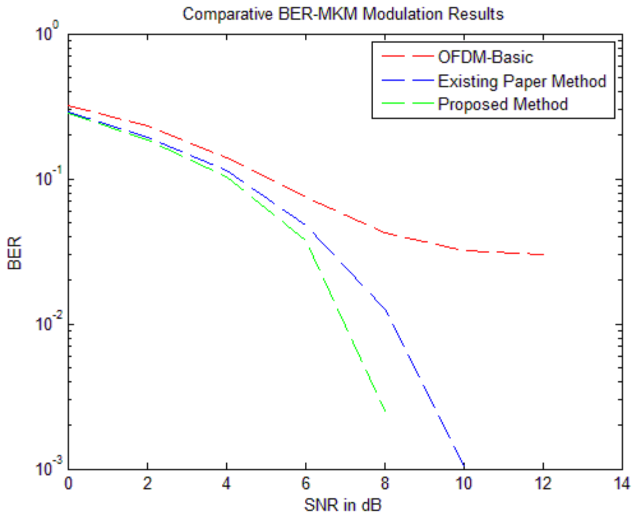

Figure 12: BER performance analysis using QAM modulation

V. CONCLUSION AND FUTURE WORK

Amid this examination proposal work, to concentrated that to expand the correspondence limit and information movement, 5G portable system is presented with huge measure of range in millimeter wave groups. The prerequisites, the current asset administration strategies and finish engineering of multi-level 5G systems are considered in this proposal.therefore concentrated that current frameworks for correspondences and mmWave based interchanges having distinction as far as blockage affectability, directivity, high proliferation misfortune and so forth. Such as mmWave based correspondence qualities presenting the many research challenges for abusing the mmWave interchanges potential consideration of framework configuration, incorporated circuits, spatial reuse, and dynamic control, hostile to blockage and so on.

Hence, in this venture can propose the crossover method for radio asset administration with objective of enhancing the execution of jitter and delay. The proposed HCA strategy depends on two arrangements of planning the system designs by receiving the millimeter wave and little cell advancements keeping in mind the end goal to enhance the execution of jitter and delay, for example, RACA and DACA. From the pragmatic outcomes, it is demonstrating the execution of throughput when contrasted with DACA strategy is enhanced by 35 %. The execution of postponement is limited by 32 % when contrasted with DACA. The jitter execution HCA is limited by 28 % when contrasted with DACA. For future work, ongoing organization and assessment of proposed strategy ought to be finished.

REFERENCES

[1] Ertugrul Basar, "On Multiple-Input Multiple-Output OFDM with Index Modulation for Next Generation Wireless Networks", IEEE TRANSACTIONS ON SIGNAL PROCESSING, 2016.
[2] Ertugrul Basar, "Index Modulation Techniques for 5G Wireless Networks", IEEE Communications Magazine, July 2016.
[3] Moussa Ayyash, Hany Elgala, Abdallah Khreishah, Volker Jungnickel, "Coexistence of WiFi and LiFi Toward 5G: Concepts, Opportunities, and Challenges", IEEE Communications Magazine, February 2016.
[4] Akshita Abrol, "Power Optimization in 5G Networks: A Step towards GrEEn Communication", IEEE Translations and content mining are permitted for academic research only, 2016.
[5] F. M. Maciel, J. Sánchez, L. Soriano, F. R. C. Soria and J. Flores, "User Scheduling Algorithms in Multiuser Massive MIMO Systems Towards 5G", IEEE LATIN AMERICA TRANSACTIONS, VOL. 13, NO. 12, DECEMBER 2015
[6] Amitava Ghosh, Senior Member, Timothy A. Thomas, Mark C. Cudak, "Millimeter-Wave Enhanced Local Area Systems: A High-Data-Rate Approach for Future Wireless Networks", IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS, VOL. 32, NO. 6, JUNE 2014.
[7] Ekram Hossain, Mehdi Rasti, Hina Tabassum, and Amr Abdelnasser, "Evolution Towards 5G Multi-tier Cellular Wireless Networks: An Interference Management Perspective", arXiv:1401.5530v2 [cs.NI] 17 Feb 2014.
[8] Ericsson, "5G Radio Access, Research and Vision," white paper, 2013.
[9] Metis, "Scenarios, requirements and KPIs for 5G mobile and wireless system," ICT-317669 METIS project, May 2013
[10] D. Astely, E. Dahlman, G. Fodor, S. Parkvall, and J. Sachs, "LTE release 12 and beyond [accepted from open call]," IEEE Communications Magazine, vol. 51, no. 7, pp. 154–160, 2013.
[11] X. Zhou, R. Zhang, and C. K. Ho, "Wireless information and power transfer: Architecture design and rate-energy tradeoff," in Proceedings of IEEE Global Communications Conference (GLOBECOM'12), pp. 3982–3987, Dec. 2012
[12] J. Oh and Y. Han, "Cell selection for range expansion with almost blank subframe in heterogeneous networks," in Proceedings of IEEE International Symposium on Personal Indoor and Mobile Radio Communications (PIMRC'12), pp. 653–657, 2012.
[13] J. Sangiamwong, Y. Saito, N. Miki, T. Abe, S. Nagata, and Y. Okumura, "Investigation on cell selection methods associated with inter-cell interference coordination in heterogeneous networks for lte-advanced downlink," in Proceedings of European Wireless Conference Sustainable Wireless Technologies, pp. 1–6, 2011..
[14] I. Guvenc, "Capacity and fairness analysis of heterogeneous networks with range expansion and interference coordination," IEEE Communications Letters, vol. 15, no. 10, pp. 1084–1087, 2011.
[15] M. Rasti and A.-R. Sharafat, "Distributed uplink power control with soft removal for wireless networks," IEEE Transactions on Communications, vol. 59, no. 3, pp. 833–843, 2011
[16] M. Rasti, A.-R. Sharafat, and J. Zander, "Pareto and energy-efficient distributed power control with feasibility check in wireless networks," IEEE Transactions on Information Theory, vol. 57, no. 1, pp. 245–255, 2011.
[17] G. Foschini and Z. Miljanic, "A simple distributed autonomous power control algorithm and its convergence," IEEE Transactions on Vehicular Technology, vol. 42, no. 4, pp. 641–646, 1993.