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# Methodology for 5G-Multi-tier Wireless Networks Capacity Optimization

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**Abstract:** ***Now days there is more number of research studies going on emerging wireless communication technology called 5G. 5G networks are nothing but the combination of multiple network tiers with varying sizes, the various types of sizes, transfers the powers, using the backhaul connections, there are various types of radio access technologies (RATs) that are accessed by an unusual numbers of smart and heterogeneous wireless devices. In the multi-tier networks, there is key problem of is usefull and interference management. The resource and interference management is having direct impact of 5G network capacity performance. Therefore the current most of 5G related research studies are having objective of 5G network capacity improvement along with power efficiency through the novel resource and interference management technique. In this paper, we first presenting the OFDM-MIMO wireless transmitter and receiver designed for 5G network in MATLAB using QPSK modulation and turbo encoding technique, and then secondly proposed optimized joint distributed the cell association and power control (CAPC) technique that fullfill the objectives such as maximizing method throughput, less energy consumption, less delay, less latency and to the high priority users the balance traffic load subject to a minimum SIR .To address these a various types of objectives, resource aware user association can be intigrated with the conventional cell association systems to fulfill the needed objectives. The practical simulation and analysis of proposed hybrid resource management method is done using NS2. This paper presents both MATLAB and NS2 outcomes.***

**Keywords:** Cell Association, Resource, Interference, 5G Networks, CAPC, Wireless Networks, OFDM-MIMO

## 1. Introduction

The current demand of high speed networks leads to continues research on fifth generation development (5G) technology is used to the mobile communication. 5G has a major vision and conceives configuration focuses on that incorporate 10-100 x crest date rate, 1000 x organize limit, 10 x vitality proficiency, and 10-30 x bring down inactivity. In accomplishing these desires, administrators and bearers are wanting to use metro-cells and little cells to enhance the client encounter and enhance general system execution [1] [2]. Henceforth, there are extensive market premiums on the advancement of imaginative backhaul and fronthaul answers for ultra-thick heterogeneous systems that are a development of the existing backhaul and fronthaul advancements [3]. Along these lines, one of the primary contemplations the administrators are confronted with today is step by step instructions to move existing backhaul/fronthaul foundation toward Internet Protocol (IP)- based backhaul/fronthaul answers for hyperdense little cell organization. Additionally, the data rates of 5G would imply that the backhaul/fronthaul be fiber optic.

However, to the many developed areas it's unlikely that fiber will be economical for all installation sites and will face deployment restrictions to keep.To the hyper dense small-cells supported cloud netwroks the another one potential adoring resoluations is the use to the internal working and joint architecture of open-access and backhaul/front haul specifcation[3]. To the access network improvment the need of adaptive and sensible backhauling/front hauling solutions which is minimize the operations together. he arrangement, union, what's more, financial matters of sensible backhauling/front pulling frameworks which is the precise essential figures picking the reasonable backhaul/front pull innovations for different radio get to advancements (counting little cells, transfers, and dispersed reception apparatuses) and heterogeneous-sorts of intemperate movement inside the future cell arrange [4]. Thus, it's basic to explore the fluctuation of end-to-end backhaul answers for 5G systems. Changed typical bodies like Next Generation Mobile Networks (NGMN), metro neighborhood arrange Forum (MEF), and Broadband Forum (BBF) additionally are taking in the suggestions on their plot portable backhaul organize.By the system level simulations the LTE-Advanced method are developed. The copy of the results implicit that the relinquishing minmization technique these will be effectively minimize the relinquishing failure rate. With speedily developing in point-to-point microwave technologies, the wireless backhaul resolution is changing into a pretty different for little cell networks.

Supported simulation and measuring results, the microwave backhaul technology at high frequencies was a viable high performance resolution for wireless little cell backhaul links in non-line-of-sight (NLOS) [6]. In addition, compared o the sub five gigahertz frequencies will offer the upper antenna aquired to the same antenna sizes these is superior NLOS backhaul link with the use of higer frequencies.Using the hundread Gigabit per second amount this makes it potential to developed little, compact, point-to-point mounted backhaul links. Sixty gigahertz and to the top capability last mile and pre-aggregation backhaul were explored in 70-80 gigahertz millimeter wave communication technolgoies [7]. Additionally, the orthogonal frequency-division multiple (OFDM) access to the passive optical networks were mentioned because the optical technology complement for sanctioning.The versatile is a cost-effective hybrid coverage fast with the network simulation results for tightened urban little cell backhaul application, versatile high capability hybrid mm wave/optical mobile backhaul networks conferred a extremely promising approach to the future


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mobile backhaul networks. A traditional OFDM having number benefits for end to end wireless communication [18], but despite of such benefits OFDM is suffering from the frequency offset and phase noise problems in case of multicarrier communication systems. Multicarrier communication is used in aerial vehicle communications which are operating at high speed in the recent wireless communications the order is minimize the spectrum effeciency[19]. For multicarrier methods such as OFDM, it is challenging task to achieve the orthogonality among the all subcarriers. And hence this resulted to the degradation of performance as well as ICI (inter carrier interference) will occur [20]. Hence in this paper, we first presented the MIMO-OFDM model designed for 5G networks using MATLAB to analyze the capacity improvement results in terms of bit error rate.

However, along with BER performance, the energy is also important parameter for 5G networks and which is heavily depends on the use of CAPC methods in 5G network. The second contribution is the presented hybrid technique and its evaluation in terms of energy and throughput against existing resource and interference management methods of 5G networks using NS2. In section II, related works on 5G resource management and other components is presented also the ICI techniques of MIMO-OFDM discussed. In section III, proposed system architecture and methodology is discussed. The simulation results and its discussion are displayed in section IV. The conclusion and futture work is discuss in the section V.

## 2. Related Works

There are number recent methods proposed on 5G networks. In this section we are discussing different methods for presented in 2015 and 2016 on 5G network with different objectives such as power (energy) efficiency, capacity improvement, throughput improvement, investigations etc.

**Ekram Hossain et.al (2014)**
In [11], they discussed complications of the interference management into the 5G network with the focusing on their key features, goals & needs has been presented by author, Through the availability of current access priority for the users these network has been evaluated & into the multiple BSs the tiers with the use of possible connectivity of the users. In that new function , various BS allocation for the uplink & downlink transmission creating the new issues & similarly it was enhancing the degrees of cell allocation & power control freedom For replacing the existing scheme outlines has been given & challenges has been highlighted for creating them appropriate to the 5G multi-tier networks. In this case, future research proper implementation is the efficiency of device Joint CAPC technique which is giving the satisfaction like the enhancing system throughput, For the higher priority users balance traffic load subject for reducing SIR. For analysing these several objectives, Along with the conventional cell association technique the resource aware user allocation has been collaborated for getting the necessary objectives into this paper.

**Amitava Ghosh et.al (2014)**
In [12], creators explored to the design the 5G enhanced local area using the of the mm Wave band (20–100 GHz (eLA) this is satisfies the requirements of 5G networksaccesses with peak rates in excess of 10 Gbps, cell-edge rates of at least 100 Mbps, and latencies of less than 1.0 msec. Authors presented case for using mm Wave bands, in particular the 28, 38, 71–76 and 81–86 GHz bands for a 5G e LA. The mesurements of extensive channel present the very comparable path with the loss behaviour for multiple access and backhaul scenarios for 28 and 73 GHz bands in New Y or k City.

**F. M. Maciel et.al (2015)**
In [13],in this article the authors presented the study of the existing scheduling algorithms for the Multiuser-MIMO wireless systems.These algorithms is analyzed for a large-scale antenna systems known as Massive MIMO, this is used to the various types of antennas to multiplex messages to various types of user devices are every time and frequency resources.

**Ertugrul Basar (2016)**
In [14], authors revealed insight into the potential and execution of IM methods for MIMO and multi-bearer interchanges frameworks, which were required to be two of the key innovations for 5G frameworks. In particular, creator concentrated on two promising applications of IM: spatial balance and orthogonal recurrence division multiplexing with IM, and talked about the current advances and future research headings in IM advances toward range and vitality effective 5G remote systems.

**Akshita Abrol (2016)**
In [15], author introduced first the survey of various techniques for power optimization of the upcoming 5G networks. The primary focus of this article was on the use of relays and small cells to increase the energy efficiency of the network.

Author discussed various scenarios of relaying for the next-generation networks. Along with this, the importance of simultaneous wireless power and information transfer, massive MIMO and millimeter waves has been analyzed for 5G networks.

**Moussa Ayyash et.al (2016)**
In [16], The close integration of the Lifi & Wifi technologies gives off loading opportunities has been presented by the author for the wifi network for giving users free resources, because other users are giving the preference to LiFi. For the suggested coexistence they developed many ways of the aggregation of channel,& by the proof-of-concept output they have been demonstrated, along with.Usin the state-of-the-art LiFi & Wi-Fi frontends, these two technologies with each other are most of separate users & significant has triple the throughput synergies has been given, the mixed solution has been focused adequately which is the required to the maximize the indoor coverage along with the higher data rates those have needed into the 5G into the mobile network.


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**Ertugrul Basar (2016)**
In [17], author focused on the implementation and error performance analysis of the MIMO-OFDM-IM scheme for next generation 5G wireless networks. Maximum likelihood (ML), near-ML, simple minimum mean square error (MMSE) and ordered successive interference cancellation (OSIC) based MMSE detectors of MIMO-OFDM-IM were proposed and their theoretical performance is investigated. It has been shown via extensive computer simulations that MIMO- OFDM-IM scheme provides an interesting trade-off between error performance and spectral efficiency as well as it achieves considerably better error performance than classical MIMO- OFDM using different type detectors and under realistic conditions.

In [18] [19], the techniques called window shaping or windowing are presented for ICI reduction in OFDM-MIMO. The method of window shaping for the OFDM system was improved the resistance to CFO residual to the approximate 8 times and also increased the offset of sampling frequency. However such changes was done with the penalty of 2dB power. In [20], author introduced the CP-OQAM-OFDM Based SC-FDMA system with the manageable space time coding as well as user bandwidth.

## 3. Methodology

To solve the current research problems in 5G networks, in this paper they have introduce the design of novel resource management technique with goal of achieving the efficient tradeoff between transmission rate, delay, energy and jitter efficiency in future communication networks such as multi-tier 5G networks. First we are presenting the MIMO-OFDM system designed for 5G networks and then presenting the architecture of NS2 based work.

**MIMO-OFDM**

Figure 1 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.

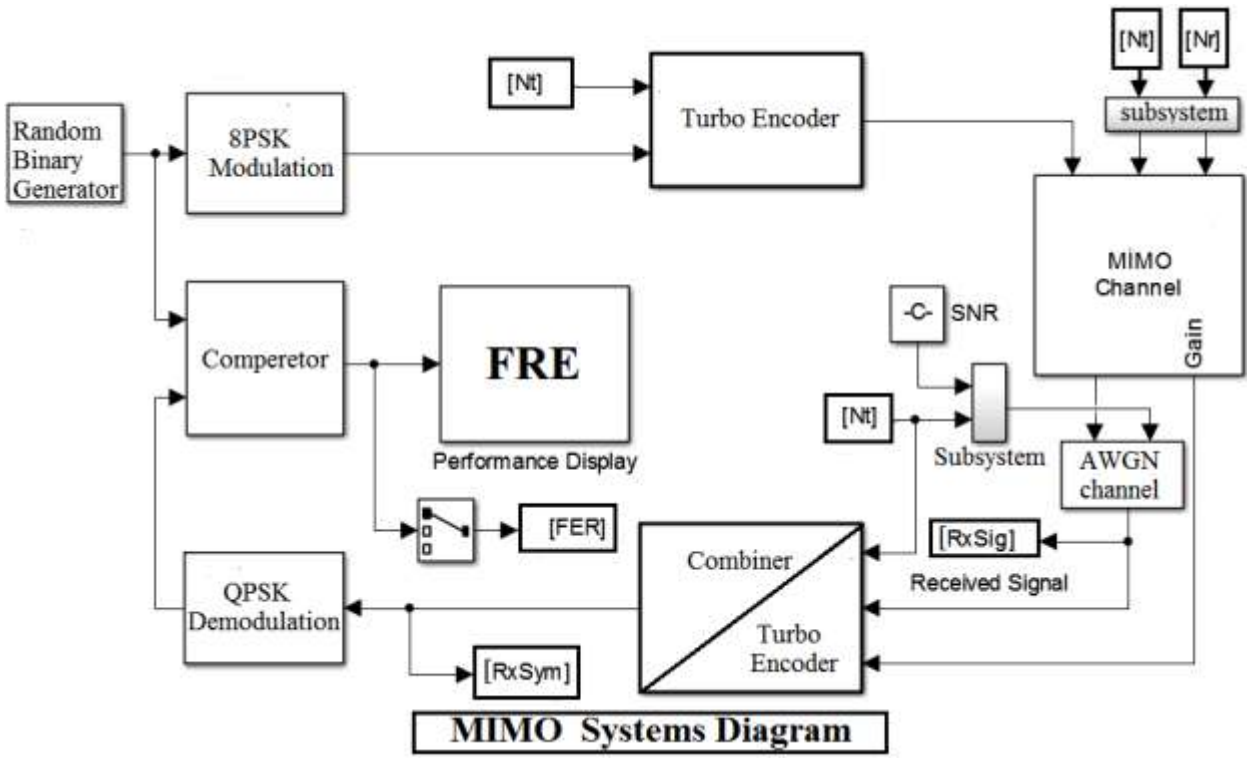


**Figure 1:** MIMO System Diagram in MATLAB


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**CAPC Methods**

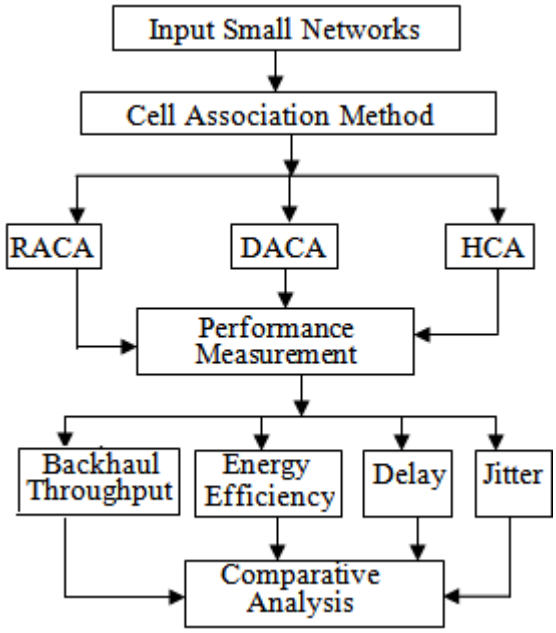


**Figure 2:** System Architecture for NS2 Simulation

As per showing in figure 2, RACA (the resource aware cell association), DACA (distance aware cell association) methods are the existing techniques. HCA (Hybrid Cell Association) is our newly designed technique based on RACA and DACA. Algorithm 1 showing the working of MIMO-OFDM transmitter and Algorithm 2 is showing the working of MIMO-OFDM receiver which is used in design of RACA, DACA or HCA technique.

***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: Select Interference and Resource Management Method (RACA/DACA/HCA).
Step 6: Data transmitted to receiver through AWGN channel.
Step 7: STOP

***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

## 4. Results and Discussion

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

**Table 1:** Simulation Parameters

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

Based above configurations, figures 3 to 6 are showing the simulation results with comparison among RACA, DACA and proposed technique.

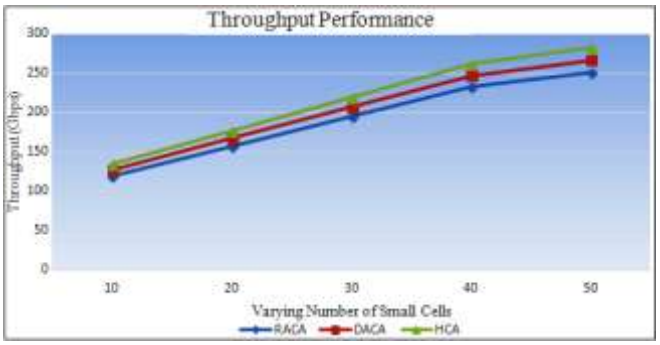


**Figure 3:** Throughput Performance Analysis

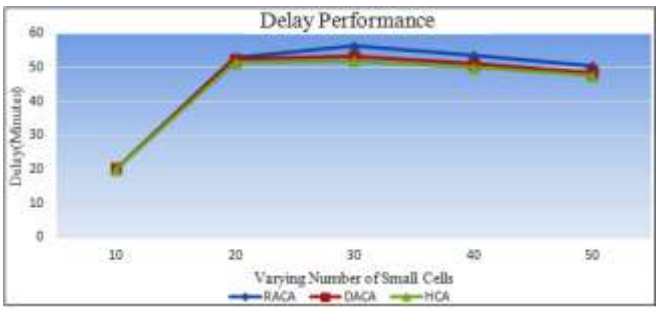


**Figure 4:** Performance Analysis of Delay

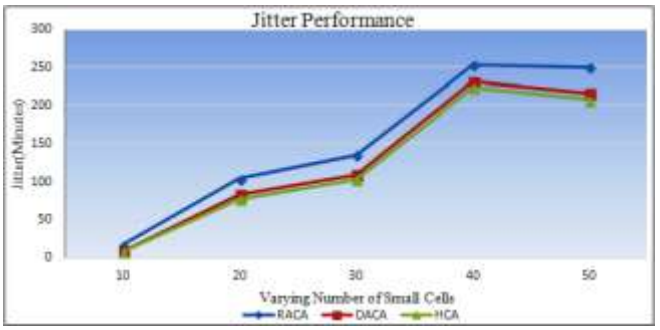


**Figure 5:** Performance Analysis of Jitter


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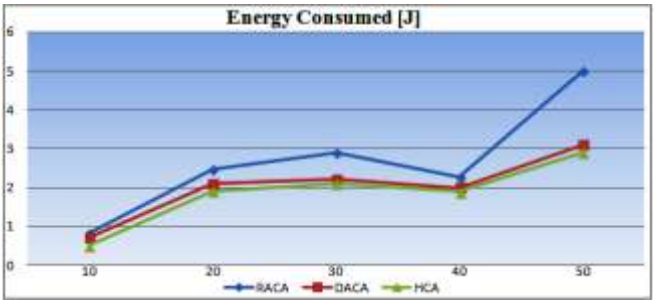


**Figure 6:** Energy Efficiency Analysis

Figure 3, 4, 5, and 6 are showing the improvement in proposed technique HCA as compared to previous methods.

## 5. The Conclusion and Future Work

In this paper we designed and evaluated new technique for radio resource management with goal of improving the performance of jitter and delay. First we designed the MIMO system for 5G-wireless networks and its results displayed in terms of bit error rate. The proposed HCA method is based on two solutions of designing the network architectures by adopting the millimeter wave and latency such as RACA and DACA. From the practical results, it is showing the performance of throughput as compared to DACA method is improved by 15 %. The performance of delay is minimized by 14.3 % as compared to DACA. The energy performance HCA is minimized by 16.7 % as compared to DACA. For future work, real time deployment and evaluation of proposed technique should be done.

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