Energy Efficient Model for 5G HetNet

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Abstract— To address the challenge in rising mobile data demand which are data traffic and communication signal overlapping in the wireless communication (5G). To overcome the challenge in mobile data some potential solutions are used, they are Small Cell Networks (SCN), Multi-tier Radio Access Technologies (Multi RAT), Device to Device Communication (D2D), massive multiple-input-multiple-output (MMIMO), network function virtualization (NFV) and base station (BS) .In this paper, we represent the energy efficiency communication model for 5G HetNet. In this paper, we are considering Access Network Power Consumption and Backhaul Network Power Consumption for HetNet. We formulate and calculate the Analytical Model for Access Network and Analyzing of Access Model, Backhaul Model, Communication Model. Backhaul solution are the most energy efficient model to handle the 5G HetNet systems. To address the challenge of increasing the power demand focused on the "Green Communication and Networking" to develop the energy efficient solutions for the next generation wireless communication model.

Key words: Energy Efficiency, Communication Model, Small Cell Networks (SCN), Backhaul Solutions, Heterogeneous Network (HetNet)

I. INTRODUCTION

5G simply the fifth generation of the network and refers to the wireless based on IEEE 802.11ac. 5G will provide more speed better than 4G and 5G offer speeds up to 1Gb/s at a distance of 2 kilometers for tens of 1Mb/s for thousands of connection with the use of an 8*8 MIMO. The frequency for the 5G ranges from 3 to 300 GHz. Major 5G research challenge is to achieve energy savings up to 90%.With the development of massive MIMO antenna and millimeter-wave communication technologies in 5G mobile communication systems, large number of small cells will be deployed to form 5G ultra-dense cellular networks. Therefore, the first challenge is how to design the architecture of 5G ultra-dense cellular networks. In this section, the distributed architecture of ultra-dense cellular networks with single and multiple gateways is proposed for further evaluation

HetNet is a mixed wireless infrastructure with the combination of high power macro cell and low power small cells (micro, pico, femto). HetNet brings network closer to the user by offering Signal- to-Interference-plus-Noise Ratio (SINR).SINR improves the link robustness and Quality of Service (QoS).HetNet is used for the modern mobile telecommunication networks. And is a network comprised of computers using similar configurations and protocols. HetNet have several aspects

1) Use of multiple radio access technologies
2) Operation of different cell size and approaches
3) Backhaul

HetNet consist of two levels of BS: Macro Cell BS and Small Cell BS. These levels of technologies can make use of same technologies (LTE) or can use different technologies (LTE and Wi-Fi).

The total power consumption of the 5G system are achieved by the both access network power consumption and backhaul network power consumption. Access network power consumption is related to the speed and the volume of the mobile data traffic. The result of the radio access network power consumption is to reduce the energy consumption for the mobile networks based on the LTE technologies which operates at 1800MHz in urban areas and 800MHz in sub-urban and rural regions.

In mobile networks the backhaul contribution to the total power consumption is usually neglected because of its limited impact compared to that of the radio base stations. Benefits of the power savings are realized if both the access network power consumption and the backhaul network power consumption in the 5G HetNet had the outcome with the savings. Data traffic generated in the small cells are to be backhauled to the network and to increase the variety of backhauling solution are to be expected to be deployed including wired, wireless or mixed architectures. Very high frequency of 60-80GHz (mm Wave) technology is considered as an alternative wireless backhaul solutions. Issue of increasing the backhaul power consumption has the attention from the service providers because of its impact on network power budget. While SCN are used to reduce the bandwidth scarcity problem in HetNet by the increasing numbers of uncoordinated and the lightly loaded active SCNs can increase the access network power consumption .In this paper, we are investigating the power consumption of the 5G system by using the access and backhaul network power consumption. For achieving the power consumption of the 5G system two technical solutions are being used: Passive Optical Network(PON) and Millimeter Wave (mm Wave).The gain from this paper would be the Power savings and Operational cost. The aim of the paper isto reduce the power consumption without reducing the signal frequency and range of 5G access network.

II. LITERATURE SURVEY

Renchao Xie .F et.al [2012] proposed and investigated that the energy efficient aspect of the spectrum sharing and power allocation in heterogeneous radio networks with the femtocells. A gradient based iteration is proposed to attain the Stackberg equilibrium solution to the energy efficient. The three stages in the stackberg equilibrium is at primary network offers the spectrum selling to the BS and then cognitive BS buys the spectrum size and allocates the spectrum to the femtocell and finally femtocell BS allocates the power allocation. The complication of this paper is that perfect knowledge of dynamic channel and the imperfect channel state information are considered.

Ali Riza Ekti et.al [2013] proposed and investigated the Heterogeneous Network (HetNet) is the promising

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wireless network in the future with low power, low cost small cells and are also planned to support the macro cells networks to reduce the signaling and uplink power consumption. This model is proposed to evaluate the power consumption of the HetNets. This results indicates the AUPF and traffic load have significant impact on the downlink power consumption. It is proposed to calculate the number of active Base Station and controlling the downlink power consumption. The hindrance in this paper is that extended to the problems of deployment of hybrid backhaul technologies, CO2 emission analysis and the mobility of the mobile users.

Patrick Kwadwo Agyapong et.al [2014] proposed and considered the two layer architecture of the 5G mobile network by consisting radio network and network cloud and integrating various enablers such as Massive MIMO, C/ U plan-split ,NFV and SDN. six challenges in the 5G mobile data is that higher capacity, higher data rate, lower E2E latency, massive device connectivity, reduced operational cost and consistent QoE. Pitfall of the proposed system is that NFV and SDN are more cost effective and the intelligent algorithms that will better utilize the available networks. Even though mobile data traffic is rising to its peak.

Ting Yang et al [2015]proposed and investigated the energy efficient scheduling and green scheduling for both classic and heterogeneous cellular networks. Green scheduling have significantly reduced the transmit power and improve the energy efficiency of the cellular systems. Different techniques have been developed for different constraints and scenarios in the literature. This model is proposed with the maximum power consumption with the high bandwidth range and the high signal frequency.

III. PROBLEM DEFINITION

Backhaul solution is the most energy efficient to handle 5G HetNet data demands while maintaining 4G networks Quality of Service (QoS). Problem in the existing system is that the data traffic is availed with high signal frequency and the power consumption is high. In the proposed system, the signal frequency, range and the power consumption is reduced by using the Energy Efficient Resource Management and Planning Algorithm. And this paper is proposed with the optimum instant time when traffic backhauling should switch from one technology to another to minimize the overall power consumption in the 5G system.

IV. METHODOLOGY

A. *Energy Efficient Resource Management & Planning*

1) *Algorithm*

By this algorithm the required number of active SCNs that will minimize the power consumption of the access network which satisfies the data demand and minimizes the data traffic. For each hour in the day the total number of SCNs are calculated. Also calculating the required number of bandwidth (network densification).

B. *Model for Network Analysis*

1) *Access Network Analysis*

In the access network analysis optimum number of active SCNs are calculated by measuring the required bandwidth which leads to the power consumption without sacrificing the Quality of Service. The reduced number of SCNs deploys the energy efficiency up to 45% during the peak hours. When comparing the power consumption of the existing system and proposed system, power consumption is reduced up to 2%.

2) *Backhaul Network Analysis*

In the backhaul network analysis the backhaul power consumption reaches the maximum of 20 because of using the fewer SCNs. In the PON solution the less power is consumed during the high data traffic. In the proposed PON solution consumes the least power consumption. It deploys and reaches the 50 of the existing systems during the peak hours of the mobile data traffic in the day. 39% of the power is consumed during the traffic data.

3) *Communication Network Analysis*

In the communication network analysis, the total network power consumption and energy efficiency. In the proposed system the 48% less power consumption is achieved when comparing to the existing systems. By using the green communication 35% of the power is consumed and the energy efficient.

V. SYSTEM IMPLEMENTATION

A. *System Architecture*

The Base Station in the middle zone will directly connected to the core network that will be the network densification, the core network will be connected to the network access for which will mainly connected to the main small cell network

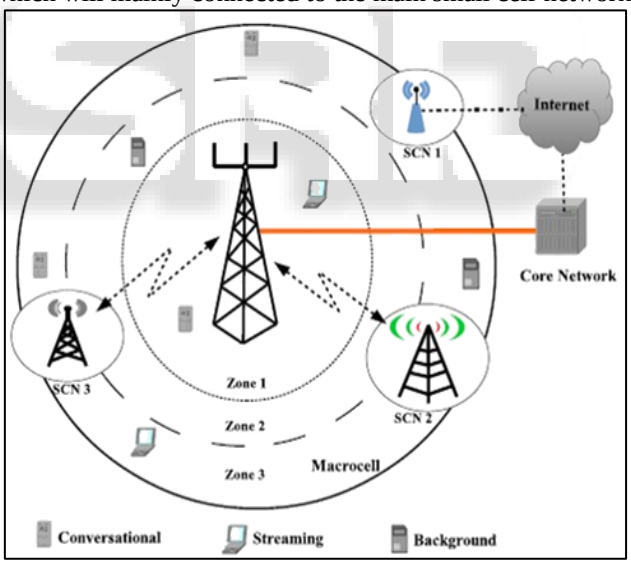

Fig. 1: Architecture

B. *Notations*

Q set of 5G multi-tier HetNet , index q
J set of SCN Base Station, index j
A set of subzone area, index a Z set of subzone area, index z
T set of traffic class, index t
U set of users, index u

C. *Analytical model for Access Network*

In this module, the formulation of the required bandwidth of the macro cells using the traffic loads are being proposed for the system. The signal received and the transmission power and the number of Base stations are available in the signal frequency are calculated for a single user.

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D. Energy Efficiency Management

In this energy effieciency management, the planning and the resorce management technique for the total number of users and the traffic signals are revealed as the input for the signal transmission. The output provided by this module is calculated for the total number of active SCNs with minimum power consumed and the required amount of bandwidth. These are calculated based on the hour in a day and each Base Stations and the required SCNs.

E. Module Result

The overall module results in the minimum power consumption of the access network with the minimum amount of bandwidth range and signal frequency. Green communication model consumes less significant amount of less power that the methods used in the existing system. The single backhaul solution is being used for the optimum time instant for the when the backhauling solutions switching from one technology to another for reducing the power consumption. The possibility of using the BS caching technique to enable the longer sleep periods so the power savings are achieved.

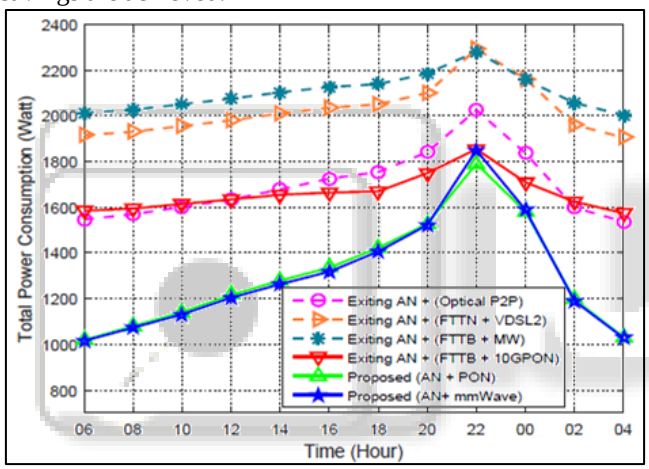

Fig. 2:

VI. RESULT

The result of this paper is that 5G access network is proposed with the 40 to 50% of the power is consumed. In future 70 to 100% of the power can be consumed by the system. By using the backhauling solutions can be reduced in the future. The number of active SCNs in the access network can be reduced. The significant amount of power is consumed in this paper by using the SCNs. The bandwidth can be reduced in the future. In future the access network is available with no data traffic in the system.

VII. CONCLUSION

In the future, 5G system plays a vital role in the communication model without any traffic in the signal and frequency bandwidth. The signal range of the system will be totally reduced in the future proposing system for the 5G communication system. Network Densification (bandwidth) will lead to the higher power consumption in the 5G system. In this paper, we are analyzing the energy efficient optimization for the power consumption of the 5G system which is related to the product of Base Stations (BS) and the number of Base Station. The aim of the investigation is to have the impact of the bandwidth from both the access and backhaul network perspectives. The analytical model for 5G system is developed which considers the variation in the traffic signal and calculates the optimum number of SCNs. Green communication model consumes a significant amount of less power than the existing system. The combined affect high capacity of both access and backhauling network helps to achieve the lower average delay and low jitter. In this paper, the power consumption is literally reduced. And it is concluded that the green communication model consumes a significant amount of less power. Power consumption of the 5G system is calculated based on the time and watt. Energy Efficiency is calculated based on the time and Mbps. The benefit from the 5G HetNet system is the operational cost and the power savings.

REFERENCES

[1] Md Munjure Mowla, Iftekhar Ahmad, Daryoush Habibi, and QuocVietPhung , " A Green Communication Model for 5G System" IEEE Trans.,vol.1,pp.264-280,May.2017
[2] 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.
[3] Q. Li, H. Niu, A. Papathanassiou, and G. Wu, "5G network capacity:key elements and technologies," IEEE Veh. Technol. Mag., vol. 9, no. 1,pp. 71–78, Mar. 2014.
[4] X. Ge, S. Tu, G. Mao, C. X. Wang, and T. Han, "5G ultra-dense
[5] cellularnetworks," IEEE Wireless Commun., vol. 23, no. 1, pp. 72–79, Feb. 2016.
[6] J. Andrews, S. Buzzi, W. Choi, S. Hanly, A. Lozano, A. Soong, andJ. Zhang, "What will 5G be?" IEEE J. Sel. Areas Commun., vol. 32,no. 6, pp. 1065–1082, Jun. 2014.
[7] Z. Hasan, H. Boostanimehr, and V. K. Bhargava, "Green cellular networks:A survey, some research issues and challenges," IEEE Commun.Surveys Tuts., vol. 13, no. 4, pp. 524–540, 2011.
[8] Fehske, F. Richter, and G. Fettweis, "Energy efficiency improvementsthrough micro sites in cellular mobile radio networks," in Proc. IEEE GLOBECOM Workshops, Nov. 2009, pp. 1–5.

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