ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 7, Issue 4, April 2019

A Survey on Energy Efficiency Techniques in 5G Networks

Mrs. Swetha M S, Dr. Anil G N, Mr. Raman Shah, Mr. Shreejwol Disti

Asst. Professor, Department of ISE, BMS Institute of Technology & Management, Yelahanka, Bangalore, Karnataka, India

Professor, Dept. of CSE, BMS Institute of Technology & Management, Yelahanka, Bangalore, Karnataka, India

Student, Department of ISE, BMS Institute of Technology & Management, Yelahanka, Bangalore, Karnataka, India

Student, Department of ISE, BMS Institute of Technology & Management, Yelahanka, Bangalore, Karnataka, India

ABSTRACT: The enhancement in both of the economical, operational and environmental concerns, energy efficiency (EE) has now become the most important factor in the design and implementation of the communication networks. The 5G is considers to be the true World Wide Wireless Web (WWWW). With the 5G technology coming online in few years the importance of energy efficiency has to be considered even more, considering the fact that the 5G of wireless networks will have millions of Base Stations (BS) , billions of devices , massive Multiple Input Multiple Output (MIMO), diverse Quality of Services (QoS). The various techniques of improve the Energy Efficiency includes Seeping mode, Scheduled management, Transmission speed, Cognitive radio in 5G. This survey provides an overview of energy-efficiency in 5G (especially wireless) networks and discusses the challenges to 5G network.

KEYWORDS: Energy Efficiency, 5G, Green communication, HetNet, mm Waves, narrowband Internet of Things (IoT), Coordinated Multipoint (CoMP).

I. INTRODUCTION

With the comprehensive coverage of 3G network and the popularity of the 4G network, corresponding energy consumption is also growing at a staggering rate. Furthermore, it has been reported that energy consumption of mobile networks is growing much faster than information and communication technology overall. However, in 5G network a large number of small cell nodes are densely deployed to support a huge amount of traffic over a relatively wide area, which will consume more energy. Therefore, we should not only focus on improving the data rate, capacity or spectral efficiency, but also begin to focus on reducing the energy efficiency. Base station sleeping is an energy efficient strategy by reducing base station energy consumption. CoMP is also an effective method to improve energy efficiency by reducing the interference between base stations and improving the data rate.

In the past decades, the mobile communications have experienced an explosive growth. The smart phones have increased demands on mobile media and applications. Therefore, in order to provide a proper communication in the presence of dense traffic, 5G mobile communication technology needs to enhance the present mobile capacity for about thousand times.

In this seminar, a strategy for dense cell deployments expand the work in, based on sleep mode that facilitates both energy efficiency and interference mitigation. It also provides capacity incentives to femtocells to sleep even when there are active subscribers, based on user redistribution. We implement this as an extended form of hybrid access mode defining a policy of spectrum management and the terms that dictate which femtocells will sleep. This ensures increased performance for either individual data rates or the entire cluster capacity and power savings.

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 7, Issue 4, April 2019

II. LITERATURE SURVEY

Talking about the related work. I have been able to collect some of the papers, with the methodology the authors have used as follows:
[1]**"A Novel Dynamic Clustering Strategy on Energy Efficiency for Dense Network Deployment".** In this paper, the author talks about the concept of dense network, that makes energy efficiency a hotspot of research in wireless network. Base Station sleeping, CoMP, are the two strategies used for the energy efficiency.
[2]**"An Investigation of Energy Efficiency in 5G Wireless Networks".** This paper talks about the higher demand of high data rates and network capacity. In order to fulfill the demand, the network operators have to install more and more BS that will leads us to high power consumption. So the authors, recommends to use Femtocells and Pico cells under the umbrella of Microcells BS.
[3]**"Energy Efficiency of Small Cell Networks: Metrics, Methods and Market".**In this paper, the EE of small cell networks is analyzed, and the existing objective functions are classified in order to minimize the energy consumption, and maximize EE. In order to improve efficiency on equipment, BS, and network levels, the energy and spectrum market is proposed and guidelines for the future research are presented.
[4]**"Functional Split Architecture for Energy Efficiency in 5G Backhaul".**This paper promises about higher data rate and to enable IoT. The author of this paper aims to present the potential of 5G to meet the demand without causing any significant energy consumption based on functional split architecture particularly for 5G backhaul.
[5] "**Energy efficiency in sleep mode for 5G femtocells"**. In this paper, the author specifically talks about the Sleep Mode in the 5G Femtocells. The authors presents their novel idea of sleep modecombined with hybrid access strategies and they estimate capacity and energy efficiency.

III. ENERGY EFFICIENCY TECHNIQUES

There are many research and development conducted for the better utilization of energy for 5G network, this increases the energy efficiency of 5G. Some of the techniques used for the energy efficiency are:

i. Sleeping Mode

The core idea of Advanced Sleep Modes (ASMs) is to gradual deactivation of the BS's components in order to decrease the Energy Consumption. The idea is to implement the ASMs and to manage users whose service requests occur while the BS is sleeping. As the BS has to wake up periodically to send signaling, the aim is to increase this periodicity in order to extend the sleep durations and thus increasing the energy gains.

ii. Scheduled management

Dominated by delay-sensitive and massive data applications, radio resource management in 5G access networks is expected to satisfy very strict delay and packet loss requirements. Standard scheduling rules are known limited in satisfying higher QoS demands when facing unpredictable network conditions and dynamic traffic circumstances. To deal with real-time scheduling, the Reinforcement Learning (RL) principles are used to map the scheduling rules to each state and to learn when to apply each.

iii. Directional antenna rather than Isotropic antenna

Isotropic antenna is an ideal antenna that radiates its power equally in all the directions. There is no actual physical isotropic antenna. However, an isotropic antenna is often used as a reference antenna for the antenna gain. The antenna gain is often specified in decibels over isotropic (dBi). This is the power in the strongest direction divided by the power that would be transmitted by an isotropic antenna emitting the same total power. 5G networks will use the millimeter-wave spectrum—the radio spectrum above 6 gigahertz

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 7, Issue 4, April 2019

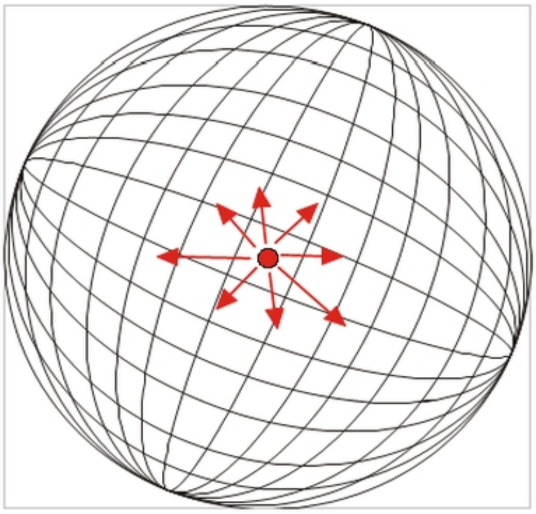

Fig 3.1: isotropic antenna radiating point in space

While that clearly broadens the number of frequencies to which these networks have access to, it comes with the struggle of signals not penetrating / navigating through buildings or other obstacles very effectively. To overcome this problem, Directional Antenna is used.

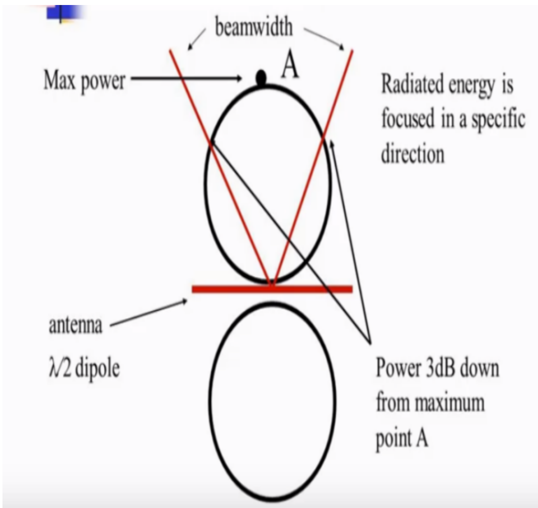

Fig 3.2 Directional antenna

iv. Cognitive radio in 5G

5G and Cognitive Radio (CR) are the two emerging technologies to meet the heavy mobile data traffic of future wireless networks. CR technology and 5G wireless standards are considered as future technologies and they both can be used for realization of smart cities. This work proposes the use of cognitive radio networks for deploying the fifth generation wireless networks in a smart or intelligent city. 5G equipment will also be available at lower cost, lower battery consumption and lower latency than 4G equipment. 5G platform can empower the growth of many industries ranging from entertainment, agriculture, IT and manufacturing industries. The need for more capacity will

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 7, Issue 4, April 2019

demand more spectrums resulting in integration of CR in 5G networks. The focus of CR is to enable much more efficient use of the spectrum though it adapts itself to provide the optimum communications channel.

v. Transmission speed

5G is the industry standard that will supersede the current widespread 4G LTE standard, just as 4G supplanted 3G.This standard is designed to be much faster than current 4G LTE technology.5G tops out at 10 *giga*bits per second (Gbps). That means 5G is a hundred times faster than the current 4G technology—at its theoretical maximum speed, anyway. There will be less time a wireless device needs to spend on transferring the same payloads, doing so will use less energy to transfer the same data.

IV.CHALLENGES IN 5G

The change from 3G to 4G was more of an evolutionary change. It was an incremental, one-step change because the required specifications were very similar. The transition from 4G to 5G, however, will be a fundamental, revolutionary change.

Various challenges for a 5G network are:

i. No. of Connected devices

IoT is growing faster than expected, it will add on billions of devices every year. It is estimated that about 50 billion devices and sensors will be connected via internet by the year 2020. Various types of machines will be connected to the network. Internet of Things will work with various wireless technologies like Wi-Fi, LoRa WAN, and Zig Bee etc… In order to handle such multiple technologies, gateways and network should be compatible and powerful enough to handle huge amount of data from millions of devices.

ii. Data Traffic Volume

Data volume of each network increases every year and the trend is growing. Each network has to support huge volume of data since many applications capable of high resolution video calling, live streaming, downloading etc. The new media trend is towards video standard compared to conventional text form. Multimedia gaming, augmented reality (AR) and virtual reality (VR) applications needs high speed network for better user experience. Comparing to the human to human traffic in cellular networks, a great number of Machine to Machine (M2M) devices in a cell may cause serious system challenges, which will lead to overload and congestion. The number of users using the mobile cellular network to send and receive messages has skyrocketed since the debut of 3G.

iii. Diverse Requirements

3G and 4G provided decent speed, but failed to withstand the expectations of the speed-hungry people. 5G evolution will involve many applications where some require really low latency and high reliability, new system requires new and different QoS requirements. D2D communication is new concept to enhance mobile connectivity by using one mobile device as data hub for other devices, which can't access the base station signal. Mission critical applications and self-driving cars require ultra-low latency services to ensure smooth operation. Any delay could cause unexpected and devastating results in mission critical applications. Latency less than 1 millisecond need to be achieved to satisfy medical applications like remote surgeries. Emergency services and application requires highly reliable network to immediately trigger warning during critical situations.

iv. Energy Consumption

Mobile network infrastructures account for more than 50% of the energy consumption of telecommunication operator network, while the amount of global energy consumption of ICT approaches 4.5% with rising trend. In 2004 data center in US had 2% of nation energy consumption. 100 Tera Watt-hour meter of electricity could be saved. More than 50 percent of the energy is consumed by the computation power at 5G small cell BSs. The computation power of a 5G

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 7, Issue 4, April 2019

small cell BS can approach 800 W when massive MIMO (e.g., 128 antennas) is deployed to transmit high volume traffic.

V. RESULT AND DISCUSSION

Various simulation campaigns have been performed to obtain different evolutionary scenarios of the network's power consumption through the years. In particular, Fig.6 reports the daily average energy consumption related to the considered cluster of mobile network sites for the 3 baseline systems under evaluation. Daily data traffic (in Pb) is also shown.

It can be observed that benefits due to the application of traffic steering from a single legacy RAT (2G or 3G) to 4G are similar, due to similar performance of the legacy RAT (according to the related PM). Furthermore, by jointly steering the traffic of both 2G and 3G RATs towards 4G, additional energy savings can be reached, with similar trends in terms of energy consumption decrease. Note that these traffic steering solutions do not require any investment for the operator and they may be implemented since 2014, allowing for short term benefits' achievement. When considering traffic steering options in combination with network renewal as thought for the baseline system. .

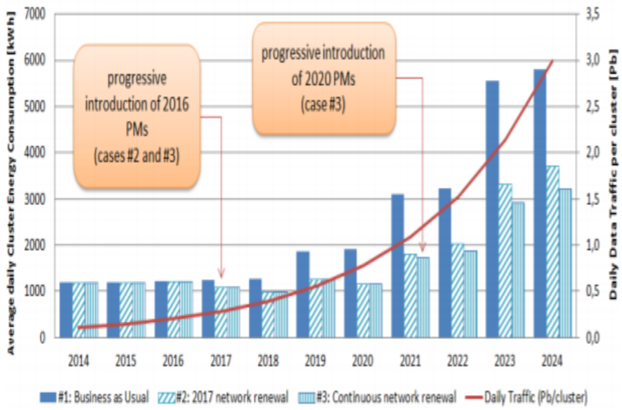

Fig 6: Average energy consumption vs. data traffic

VI. CONCLUSION

5G is just in the development and testing phases, it is expected to hit the market by 2020. 5G enables smart phones are already launched.5G will initiate a big leap for the energy efficiency in telecommunication field. In early stages of 5G developments, the promising enabler for 5G are identified which are MIMO , UDN , Advanced ICIC (Inter-cell interference co-ordination) , and Co-ordinated multi-point processing (CoMP). Transformation from monochrome device to smart model has also triggered the need for more sophisticated network technology. However, now we are using the 3G technology efficiently and in some countries, the people are using the 4G but in future we can use the 5G technology. Many big countries are investing huge amount of money on this project as it was having high demand in the future. It will altogether manufacture flexibility, limit, degree, comparability and meeting. Thusly, it will satisfy the growing solicitations of rising big data, cloud, machine-to-machine, and diverse applications.

VII. SCOPE OF FUTURE WORK

Wireless communications are undergoing a rapid evolution, wherein the quest for new services and applications pushes for the fast introduction of new technologies into the marketplace. Operators are just now starting to make initial profits

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijircce.com

Vol. 7, Issue 4, April 2019

from their deployed LTE networks, and already 5G demos and prototypes are being announced. Moreover, the wireless communications industry has begun to design for energy efficiency.

REFERENCES

1.“A Novel Dynamic Clustering Strategy on Energy Efficiency for Dense Network Deployment”Gang Su, Li Tan, Ya Xu, Lu Feng (Year: 2017, :Page s: 905 – 910 13th International Conference on Natural Computation, Fuzzy Systems and Knowledge Discovery).

2.“An Investigation of Energy Efficiency in 5G Wireless Networks” Safdar Rizvi, Asif Aziz, Muhammad Taha Jilani, Nasrullah Armi, Ghulam Muhammad, Shujaat H. Butt (Year: 2017 , Page s: 142 – 145 International Conference on Circuits, System and Simulation).

3.“Energy Efficiency of Small Cell Networks: Metrics, Methods and Market” YULI ZHANG, YUHUA XU, YOUMING SUN, QIHUI WU, AILING YAO (Received February 12, 2017, accepted March 26, 2017, date of publication April 19, 2017, date of current version May 17, 2017 , Pages: 5965- 5971 IEEE Journals & Magazines

4. Vikas Kumar, MS Swetha, MS Muneshwara, S Prakash, “Cloud computing: towards case study of data security mechanism,” vol-2 issue-4 page no-1-8 2011

5.MS Muneshwara, MS Swetha, M Thungamani, GN Anil, “Digital genomics to build a smart franchise in real time applications,” IEEE International Conference on Circuit, Power and Computing Technologies (ICCPCT),IEEE page no 1-4 2017 .

6. MS Muneshwara, A Lokesh, MS Swetha, M Thungamani, “Ultrasonic and image mapped path finder for the blind people in the real time system,” IEEE International Conference on Power, Control, Signals and Instrumentation Engineering (ICPCSI) IEEE, page no 964-969 2017.

7.“Functional Split Architecture for Energy Efficiency in 5G Backhaul ” Nureily Atikah Nawawy, Norliza Mohamed, Rudzidatul Dziyauddin, Suriani Mohd Sam, Razak (Year: 2018 , 2nd International Conference on Telematics and Future Generation Networks (TAFGEN)).

8. “Energy efficiency in sleep mode for 5G femtocells” Christos Bouras, Georgios Diles. (IEEE Journals 2017).