5G WIRELESS COMMUNICATIONS SYSTEMS: PROSPECTS AND CHALLENGES

*Muaz Gultekin, Havva Kesoglu, Çiğdem Menderes, Mufit Cetin
Faculty of Engineering, Department of Computer Engineering Yalova University, Turkey

Abstract

5G is a wireless networking architecture built on the 802.11ac IEEE wireless networking standard, which aims to increase data communication speeds and rate by up to three times compared to its predecessor, 4G (IEEE 802.11n). The main problem of 5G is the issue of energy consumption and effective communication of devices. The solutions presented in the context are: Smallcell technology and energy harvesting. In this study, we have proposed a novel approach which insist of two methods that described in details. In addition to this, to provide the communication of the devices, the structure MMC and MNs has been examined and the results are discussed in this text.

Key words: 5G, Small cell, Energy Harvesting, Moving Massive Machine Communication (MMC)

1. Introduction

In recent years, the large the amount of the data increases via mobile technology and web technology. 5G provides large bandwidth and a new communication protocol. Thanks to that data communication handled efficiently. 5G come up with a new technology which have many novel features that bring a new fresh solution into communication technology [1]. However, the rapidly changing development of the mobile network and further expansion of the use of mobile applications has brought some problems. These main problems are energy consumption and effective communication between equipment's.

Increase in the number of Internet-connected devices and wireless communication of these devices; two approaches have been adopted in order to avoid the energy consumption. First, the distance between the terminals is put forward to reduce Small cell Technology. Smallcell to improve coverage in harsh environments and are effective to provide increased data capacity of a small station on the network. Second; used for self-powered devices with as little power, namely the energy is energy harvesting methods. Efficient interactions between Small cell technology and energy harvesting methods are less energy as a result of the user. One of the main problems in 5G technology is an effective communication of the devices. To bring solutions to the problems that occur in communication devices have been proposed two methods. The first is a Massive Machine Communication technology (MMC). MMC allows the connection to be established between network-enabled devices and wireless communication systems that will be used in the future. The second is Moving Networks technology. This technology provides networking communicates with another mobile node or nodes of moving objects.

*Corresponding author: Address: Faculty of Engineering, Department of Computer Engineering Yalova University, Yalova TURKEY. E-mail address: bilgi@yalova.edu.tr, Phone: +902268155722 Fax: +902268155734

2. Energy Efficiency

In traditional wireless network communication maximizing data transfer rate, coverage and capacity is targeted. However the suggested solutions cause energy drops [2]. To overcome these problems in the new generation wireless network new paradigms were offered which handle energy efficiency as main attribute on the structure. The new generation design has many node according to classical design. So more nodes required more energy. That's why the offered solution must be have an acceptable energy consumption level. This paradigms comes with this new smart attribute (energy efficiency) [3]

2.1. Smallcell

Smallcell is new and extensive concept of new generation nodes design. This designed targeted to low power for radio access node. Another aspect of this design is operating in licensed and unlicensed carrier according to their grades. Small cell range extended from 10 meters to several hundreds. Small cell architecture obtain home applications and enterprises. In addition to that small cell architecture work efficiently in metropolitan networks and public spaces. There are many types of small cell solution. These types are femtocell, picocell, metrocell [4]. These type of smallcell technology based on femtocell technology. The strentgth of femtocell sources from it's the collection of standards, software, open interfaces, new flexible chips and know-how. Another ability of the smallcell technology is that can be implemented to existing structure. So we can easily express that smallcell technology bring a new and fresh breed for existing network [5].

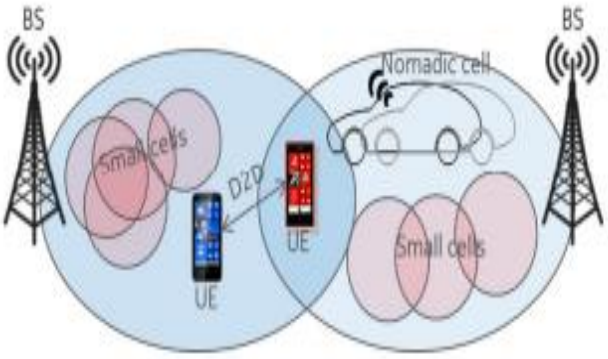

Fig 1. Example of a figure caption.

2.2. Energy Harvesting

Wireless energy harvesting from man-made electromagnetic radiation is a promising 5G technology to maximize the lifetime of wireless energy constrained networks. Recently, practical wireless energy harvesting receivers, based on the time switching (TS) or the power splitting (PS) designs have been proposed. Most existing works examine wireless energy.[6],[7]

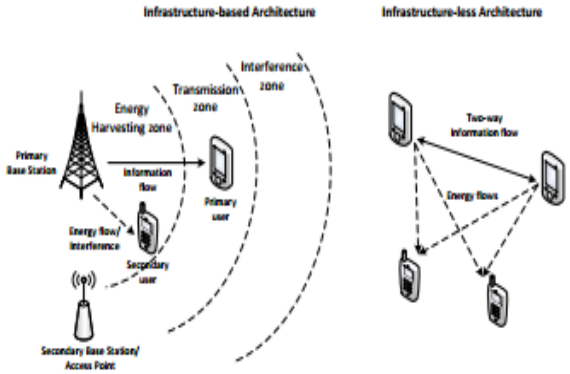

Fig 2. An Energy Harvesting Cognitive Radio Network

2.3. Massive Machine Communication

MMC will form the basis of the Internet of Things with a wide range of application fields including the automotive industry, public safety, emergency services, medical solutions, etc. This HT addresses the characteristics and requirements associated with these applications and provide enablers for efficient support of machine-related communications.[8]

Fig 3. Example of Massive Machine Network

2.4. Moving Networks

MN will enhance and extend linking together potentially large populations of jointly moving communication devices. [9] A moving network node (e.g. vehicles or buses with advanced networking capabilities) or a group of such nodes can form a "moving network" that communicates with its environment, i.e., other fixed or mobile nodes that are inside or even outside the moving entity.[10],[11]

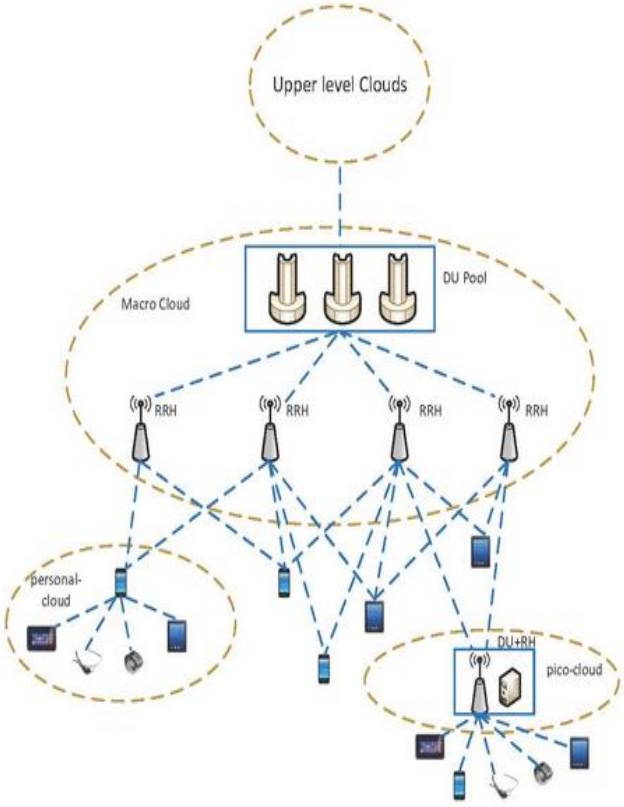

Fig 4. Vehicles or Buses with Advanced Networking

3. Simulation Results

Mobility is occurred when the distance between two small cells is about 200 meters. (>150)

In our simulation, the same of pilot power in two small cells makes handover location is same (There is no impact). [12], [13]

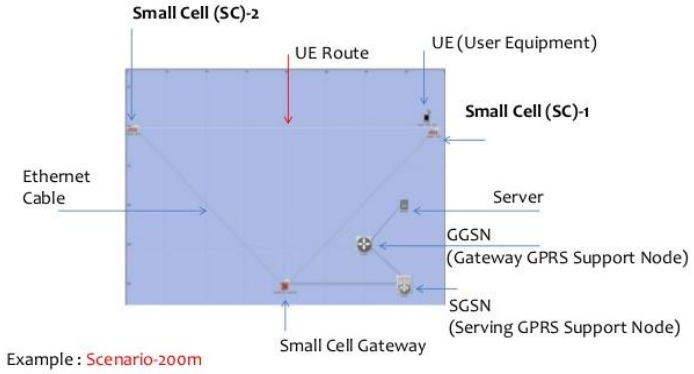

Fig 5. Small Cell Configurations

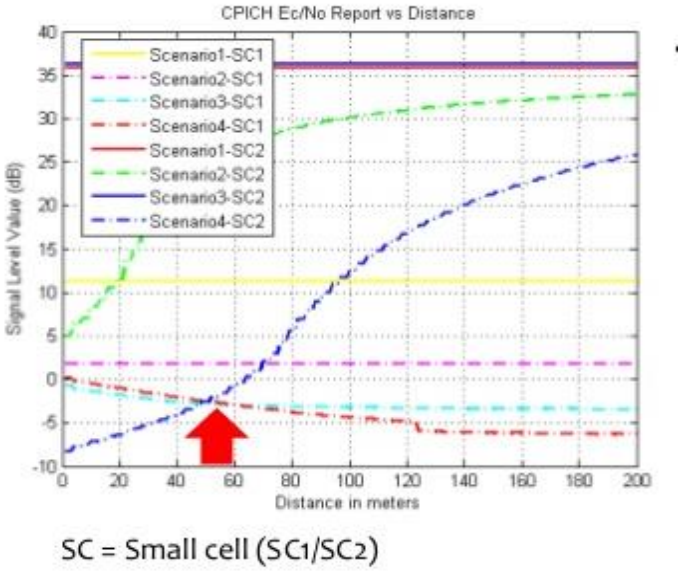

Fig 6. Small cell simulation results

Scenario	Distance
Scenario-1	50 m
Scenario-2	100 m
Scenario-3	150 m
Scenario-4	200 m

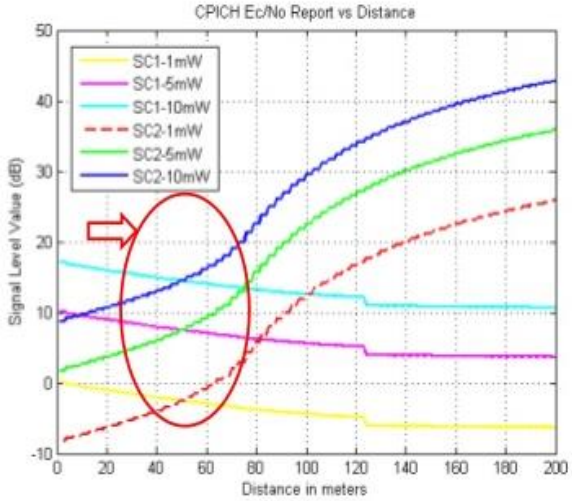

Fig 7. Small cell simulation results

Conclusions

There is no mobility when two small cells is placed no more 150 meters , the same CPICH Tx Power between two small cells is not impact to the handover zones.

Still ongoing Research (compare to, still have gap 50 m). Further Works; the impact of hysteresis margin (HM) and the power adjustment of the small cells have to investigate, our research will move to LTE System.

References

[1] Jeffrey G. Andrews, *Fellow, IEEE,* What Will 5G Be?

[2] Ziaul Hasan, Student Member, IEEE, Hamidreza Boostanimehr, Green Cellular Networks: A Survey, Some Research Issues and Challenges

[3] Renato L.G. Cavalcante, Slawomir Stan´czak, Martin Schubert, Andreas Eisenblätter, and Ulrich Türke, Toward Energy-Efficient 5G Wireless Communications Technologies, 2014

[4] Amit Khetawat**,** the Trouble with Small Cells, 2014

[5] Simon Saunders**,** Why small cells make a big difference

[6] Xiao Lu, Ping Wang, Dusit Niyato, Wireless Networks with RF Energy Harvesting: A Contemporary Survey, 2014

[7] Ioannis Krikidis, *Senior Member, IEEE,* Simultaneous Information and Energy Transfer in Large-Scale Networks with/without Relaying, 2014

[8] METIS: Mobile Communications for 2020 and beyond

[9] Afif Osseiran,Volker Braun, Taoka Hidekazu, The foundation of the Mobile and Wireless Communications System for 2020 and beyond,2014

[10] Afif Osseiran1, Federico Boccardi, Scenarios for the 5G Mobile and Wireless Communications: The Vision of the METIS Project, 2014

[11] Olav Queseth, Hans Schotten, Mobile and wireless communications Enablers for the Twenty-twenty Information Society, 2013

[12] Muhammad Z. Shakir, David Lopez Perez, Small-cells: Capacity, Mobility and Energy Efficiency Perspectives, 2014

[13] Mark C. Reed, He Wang, Performance Benefits of Small Cells and Radio Optimization in Co-Channel Deployments