5g wireless communications

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***Abstract* -The 4th generation systems have been deployed or soon to be deployed in many countries. However, with the explosion of wireless mobile devices and services, there are still some challenges that cannot be accommodate even by 4G, such as spectrum crisis and energy consumption. Wireless system designers have been facing the continuously increasing demand for data requirement and mobility required by the new wireless applications and therefore have started research on fifth generation wireless systems that are expected to be deployed in 2020.The 5G generation wireless systems have been expected to be consist of massive MIMO technologies, mobile femtocells, cognitive radio network and future technical challenges have been discussed in this paper.**

***Keywords*: Massive MIMO, Spatial Modulation, Femtocells, etc**

I INTRODUCTION

With the rapid development in mobile internet, the demand for high speed data applications such as such as high speed data streaming, social networking and mobile to mobile wireless communication, have been growing exponentially. To achieve this goal, an advanced networking is required. To address this, 4G network has to be smoothly evolved. A significant and advanced baseband computation is required to meet the complex requirements of new solutions like large scale cooperative processing in a physical layer.

The primary technologies and approaches to address the requirement for 5G system can be classified as follows:

a) Densification of existing cellular networks with massive addition of small cells and a provision for peer-to-peer communication.
b) Simultaneous transmission and reception
c) Massive multiple-input and multiple-output(MIMO)
d) Improve energy efficiency by energy aware communication and energy harvesting
e) Cloud based radio access network
f) Virtualization of wireless resources

What is 5G?

5g radio access technology will be a key component of the Networked Society. It will address high traffic growth and increasing demand for high- bandwidth connectivity. It will also support massive numbers of connected devices and meet the real-time, Higher-reliability communication needs of mission-critical applications.5G will provide wireless connectivity for a wide range of new applications and cases, including wearable, smart phones, traffic safety, critical infrastructure, industry processes and very high-speed media delivery. As a result, it will also accelerate the development of the Internet of Things.

The specification of 5G will include the development of a flexible air interface, NX, which will be directed to extreme mobile broadband deployments, NX also target high-bandwidth and high- traffic usage scenarios, as well as new scenarios that involve mission-critical and real-time communications with extreme requirements in terms of latency and reliability.

II LITERATURE REVIEW

a) In 2008, the South Korean IT program under title "5G mobile communication systems on beam-division multiple access and group cooperation" was formed.
b) In 2012, the UK Government announced the establishment of a5G Innovation Centre at the University of Survey the world's first research centre set up specifically for 5G mobile research.
c) In 2012, the European Commission, under the lead of NeelieKroes, committed 50 million euro for research to deliver 5G mobile technology by 2020.
d) In 2013, a new EU project named CROWD was launched under the technical supervision of IMDEA Networks Institute.

III KEY TECHNOLOGY

1. Massive MIMO

MIMO consist of multiple antennas at both transmitter and receiver. By adding multiple antennas, a greater degree of wireless channel can be offered to accommodate more information data. Hence, a significant performance improvement in terms of reliability, spectral efficiency and energy efficiency. In massive MIMO system, the transmitter and receiver are equipped with large number of antenna elements. The enormous number of received antennas are possessed by one device or distributed to many devices.

In massive MIMO devices the effect of noise and fast fading vanishes, and intracell interference can be avoided. It uses simple precoding and detection methods. By properly using multiuser MIMO in massive MIMO systems, the base station can send separate signals to individual users using the same time-frequency resources.

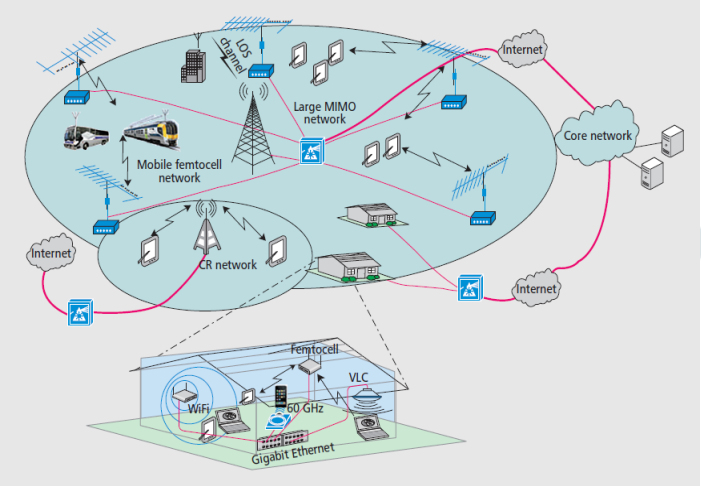

Figure 1: A 5G Heterogeneous Cellular Architecture

2. Spatial Modulation

Spatial Modulation technique is a special modulation technique that has been proposed for low-complexity implementation of MIMO system without degrading system performance. Instead of transmitting multiple data streams from the available antenna, Spatial Modulation technique encode part of the data to be transmitted on the spatial position of each transmit antenna in the antenna array.

Thus the antenna array plays a role of second constellation diagram which can be used to increase data rate with respect to single antenna wireless system. In spatial modulation technique only one antenna is active at a time, while other antennas are idle. A block of information bits splits into to sub-blocks. The first sub-block identifies the active antenna from the set of transmit antennas, while the second one selects the symbol from the signal constellation diagram that will be sent from the active antenna. Therefore the SM modulation is the combination of space shift keying and amplitude or phase modulation. The digital modulation technique normally incorporated is quadrature phase shift keying (QPSK).

Spatial modulation technique can mitigate three major problems in conventional MIMO systems:

a) Inter-channel interference
b) Inter-antenna synchronization
c) Multiple RF chains

The multiplexing gains in the SM increases logarithmically with the increase in number of antennas.

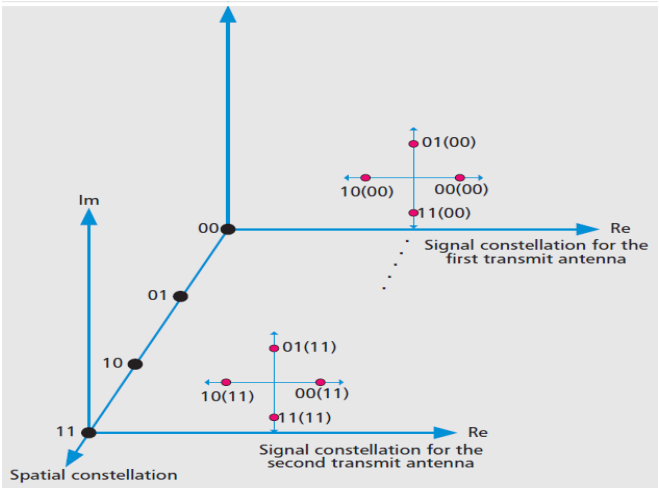

Figure 2: SM Constellation Diagram using Four Transmit Antenna and QPSK Modulation

3. Cognitive Radio Networks

The CR network is an innovative software defined technique considered to be one of the promising techniques for the efficient utilization of RF spectrum. A large portion of the RF spectrum remains underutilized most of the times. In CR networks, a secondary system share spectrum bands with the licensed primary spectrum bands, either on interference-free basis or interference-tolerant basis. The CR networks should be aware of the surrounding radio networks accordingly.

In interference-free CR networks, CR users are allowed to borrow the spectrum resources only when licensed user do not use them.CR receivers should first monitor and allocate the unused spectrum via spectrum sensing and feed the information back to the CR transmitter. A coordinating mechanism is required in multiple CR networks that try to same spectrum to prevent user colliding when accessing the matching spectrum holes.

In interference-tolerant CR network, CR users can share the spectrum resource with licensed system while keeping the interference below threshold. In comparison to interference-free CR network, interference-tolerant CR network gives following enhancements.

1) Enhances spectral utilization
2) Better spectral and energy efficiency

It has seen that the performance of CR network is sensitive to slight change in the user densities. However, the spectral efficiency can be improved by either relaxing the interference threshold of the primary system or considering only the CR users who have short distance with the secondary base station.

4. Mobile Femtocells

The MFemtocell is the new concept that has been recently proposed as a potential technology in the next generation intelligent transport system. An MFemtocell is small cells that can be moved around and dynamically change its connection to an operator's core network. It can be deployed in public trains, buses and in even private cars to enhance service quality to user within vehicle.

IV ADVANTAGES AND DISADVANTAGES

1. Advantages

a) It will give high resolution and bi-directional large bandwidth shaping.
It will help technology to gather all networks on one platform.
b) Most effective and efficient technology.
c) This technology facilitates subscriber supervision tools for the quick action.
d) Most likely, will provide a huge broadcasting data, which will support more than 60,000 connections
e) This technology can be easily manageable with the previous generations.
f) Technological sound to support heterogeneous services.
g) It is possible to provide uniform, uninterrupted, and consistent connectivity across the world.

2. Disadvantages

a) The 5G technology is still under process and research on its viability is going on.
b) The speed, this technology is claiming seems difficult to achieve because the incompetent technological support in most parts of the world.

c) Some of the old devices would not be competent to 5G, hence, all of them need to be replaced with new one-expensive deal.
d) The developing infrastructure needs high costand reliability.
e) Security and privacy issue yet to be solved.

V CONCLUSION

In this paper, the performance requirement of 5G wireless technology have been defined in terms of capacity, spectral efficiency, energy efficiency, data rate and cell average throughput. A new heterogeneous cellular architecture has been proposed using separate indoor and outdoor technologies such as massive MIMO. Some new technologies such as CR networks, Mfemtocells have been proposed with some technical challenges.

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