

# A Study on Massive MIMO 5G Challenges

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**Abstract:** Massive MIMO is an advance of MIMO technology. M-MIMO uses hundreds of Base stations (BS) to simultaneously serve multiple users. It combines millimeter wave (mmWave) to provide huge spectral efficiency, high reliability and high energy efficiency. Massive MIMO gives huge antennas, high signal strength, less noise reduction and also using better channel model. This paper discusses the detailed description of fifth generation (5G) network architecture and to improve massive MIMO in existing technology.

**Keywords:** 5G, Massive MIMO, mmWave, HetNet, QoS, MWT, SDN, SON, mRATs.

## 1. Introduction

In a mobile communication system, some drawbacks occur in MIMO technology. To overcome this, we go for massive MIMO. It is classified into two types; single user MIMO and multi user MIMO. It is made with an installed dispersed antenna array of approximate hundreds of antenna units. It can be designed by the large antenna arrays at outside base stations. Hexagonal cells scattered by a less number of antennas and connected base stations via optical fiber.

In addition, MIMO technology is used to combine with M-MIMO technology. It is used in the indoor wireless network to increase data rate as they have high bandwidth. The advantage of massive MIMO is high spectrum efficiency caused by large multiplexing gain, high reliability caused by large diversity gain. It utilizes beamforming technology, enabling that targeted use of spectrum [1].

Massive MIMO and mmWave technologies combined together to work with currently used networks and also support various technologies. mmWave is a very less wavelength. It is possible to pack huge antennas into a small coverage area with the help of massive MIMO using BSs and UEs. Benefits of millimeter waves such as broad bandwidth, high spatial resolution, size and weight of mmWave equipment. Another technology of 5G HetNet based on mmWave and massive MIMO are used. Heterogeneous networks provide a more optimized Radio Resource Management and better algorithms to enhance Quality of Service (QoS) requirements [2]. It comprises

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Remote Radio Heads and Relays in Wireless Network. The HetNet provides services with massive connectivity, ultra high data rates, ultra low latency, much improved security, very low energy consumption and quality of experience (QoE) [3].

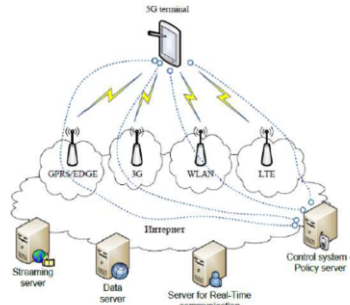


Figure 1. 5G Architecture[4]

Figure 1 describes 5g architecture: It is also used to support GPRS, 3G, Wireless LAN, Long time evolution and LTE advance. It worked with adaptive network of architecture. 5G is evolved from previous generation. These generations are connected to control system policy server, streaming server, data server and server for real time communication[4].

## 2. Related Works

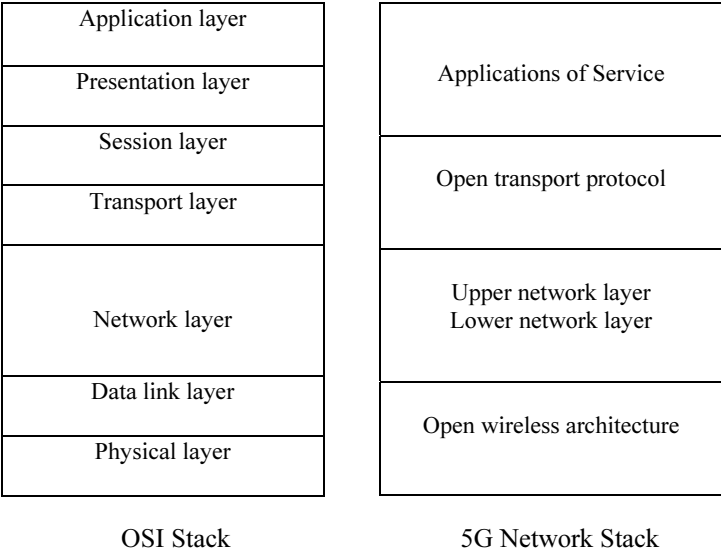
### 2.1 Different Layers of 5G Network

Paul Nikalich et.al[5] discussed various layer architecture of 5G. We will go through the OSI layers such as physical layer, datalink layer and network layer. In 5G network, physical and datalink layer defined by Open Wireless Architecture.

5G mobile communication, Network layer divided into two categories. There are lower and upper network layer. It supports both IPv4 and IPv6. It provided continues data to user without losses.

5G terminal, the transport layer used to deliver data from BS to user. It performs both transport and session in OSI layer. TCP is used in this protocol. This TCP versions, segments are lost due to congestion. So, It can be retransmitted to complete the transmission session.

In application layer specified to share data to customer in real time application. Qos includes delay, losses, jitter, bandwidth etc.



**Figure 2.** Different layer in 5G [5]

2.2 5G Enabling Technology

P. Rost et.al[6] discuss about the important technologies for 5G :

2.2.1 Small Cell Deployment (SCD)

It consists of micro-cells, pico-cells or femto-cells those are called as heterogeneous network (HetNet).

2.2.2 Machine Type Communication (MTC)

It is defined machine to machine communication. It enables direct connection of electronic devices. It also needs quite low latency and remote controlling of mobile devices.

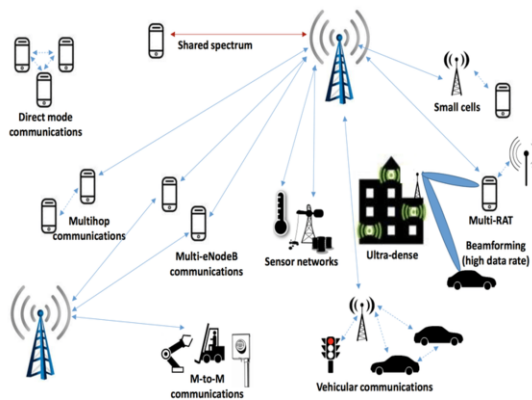
2.2.3 Millimeter Wave Technology (MWT)

This application consists the band from 30 to 300GHz. In this spectrum, Omni-directional path loss is increased that can be adjusted through proper beam-forming.

2.3 Network sharing multi technology

Figure3 illustrates an example of 5g supporting various technologies: It contains small cells, ultra dense provides Multi RAT and beamforming for high data rate, vehicular communication, sensor networks, machine to machine communication. It also gives to

perform shared spectrum, direct mode communications, Multihop and Multi eNodeB communications.



**Figure 3.** 5G supporting various technologies [7]

## 2.4 5G Design Objectives For M-MIMO

R. Baldemair et.al[8] tried to solve spectrum lacking, cognitive radio networks is used to increase radio spectrum. This architecture provides a solution for fast processing and flexible arrangement by different layers. The concept of search network, base station working becomes easier and decreased functionalities make it to less energy consumption.

Multi-connectivity is a technology to get the features like data rate, latency, reliability and availability. The network is controlled by device to device [9]. It includes peer to peer, multicast and broadcast communication. Higher rank modulation and coding schemes used to make better spectral efficiency and added with massive MIMO system to get system capacity more.

## 2.5 Various Applications Of M-MIMO

M-MIMO is a current research area of wireless communication. Some areas are explained in this section[10].

### 2.5.1 Internet of Things

5G Networks need to work with Internet of Things and Machine to Machine Communication. Here, Sensors required low data rates but the main challenge is network connectivity. So, traffic occurs in the network. To overcome this we use in M-MIMO[11].

### 2.5.2 Vehicular communication Network

It is used in vehicle. In this communication reduced road accident and to improve traffic rule efficiency. It acts as an intelligent transportation system. It allows high speed data between two vehicles and reduce noise[12].

### 2.5.3 Application of Security

It is more efficient to secure data by using encryption and decryption. It researched in the pilot design, time division duplex systems. Security of physical layer works with DSP processing, Coding and modulation techniques and Multi access scheme[13].

## 3. Conclusion

In this paper discussed the important challenges for 5G networks which counts higher data rate, higher capacity, low cost and best QoS. The 5G architecture combines various enablers like small cells, massive MIMO and peer-to-peer communication. It maintain data to keep stable and secured in wireless communication. This paper also described different technologies about their drawbacks and how to overcome, which techniques will be enhanced to improve their efficiency.

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