
Challenges of 5G

Dr. Mohamed Abdelghader Morsi Mahmoud

*Head of Research & Study Department, Telecommunications & post Regulatory Authority (TPRA).
Khartoum, Sudan ,
Associate Professor: Alneelain University , Khartoum, Sudan*

1. ABSTRACT

The transition from 4G to 5G presents several transformational challenges which must be tackled to fully realize the 5G vision. There are challenges faced with the new technologies enabling 5G. There are also challenges with the integration of this technology to provide services in different application scenarios. In this paper I mention the important challenges.

2. INTRODUCTION

There are many challenges to address when we move towards 5G standard which demands much higher data rate, ultra low latency, high reliability and security. As we know, fourth generation wireless communication technology LTE and LTE advanced has already been deployed all over the world. 5G – the fifth generation wireless technology requires a new standard to support ultra fast, low latency services to customers.

Let's take a look on major challenges in 5G technology design, development and implementation stages.

5G – Technology Challenges

1. Frequency Bands

Current LTE system operates with more than 50 frequency bands which are below 3.6 GHz range. One of the frequency candidates for early deployment of 5G is sub-6 GHz range. Unlicensed spectrum below 6 GHz (600 MHz and between 3.5 GHz and 6 GHz) will be used for first generation of 5G networks.

5G NR- New Radio standard for 5G networks are set of frequency bands at sub-6 GHz range and millimeter waves of the RF spectrum. Design of hardware at millimeter waves are much complex than low frequency range.

2. Huge Data Volume

As the technology advances, the data volume of each network also 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 and there is huge demand for video contents compared to conventional text form. Multimedia gaming, augmented reality (AR) and virtual reality (VR) applications needs high speed network for better user experience.

3. MIMO Technology

Complex MIMO antenna arrays will be used to deliver high speed data to individual users. The idea of MIMO is to increase number of transmitting antenna at the base station and mobile device (UE) to maximize the data transfer by simultaneously sending and receiving. MIMO technology requires complex algorithms and device capability at both base station and user equipment.

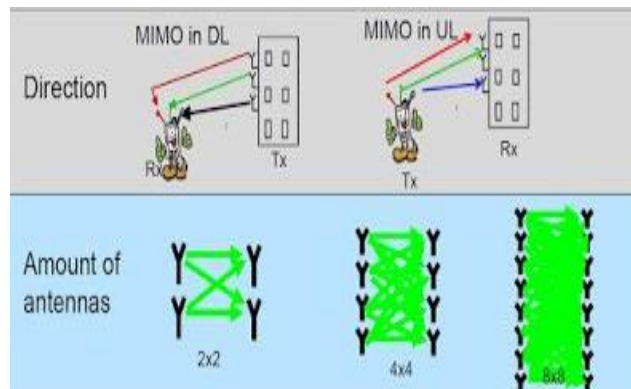


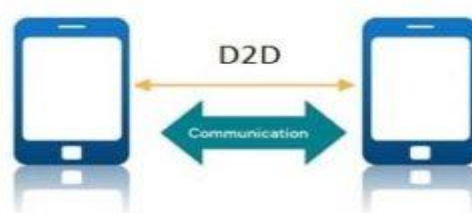
Fig (1): Direction & Amount of Antennas

4. Beamforming

In order to avoid transmission power wastage, new generation wireless transmission technology will use beamforming method to efficiently transmit data to user devices. Compared to conventional base stations, beamforming technology will locate the user's location precisely and transmit signals to that direction using sophisticated antenna array system.

Base station's operating power can be significantly reduced by Beamforming concept. However, Beamforming is a complex task to locate each devices under a particular cell and it needs high level processing at base stations.

4. Device to Device Communication



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. Device to device communication is considered one of the efficient mode of communication during emergency situation (like natural disasters) where connectivity is limited or absent. However, complex data transmission protocols required to implement D2D communication.

5. Increasingly small cells

Today, mobile network rollouts are essentially based on the use of macro base stations: installations that are equipped with high-power antennae deployed to guarantee coverage for a relatively wide area, providing good quality of service. Network configurations are evolving constantly: new radio base stations are installed on a regular basis to increase the networks' capacity, to better meet users' needs in terms of indoor and outdoor coverage, and to improve quality of service. However, this continually growing demand for capacity already requires operators to increase the density of their networks with smaller and smaller cells. 5G – which will probably bring about a sizeable increase in data traffic, and which will use millimetre wave frequencies whose propagation capabilities are weak – will no doubt require the widespread deployment of low-power base stations (small cells).

6. Ultra low Latency Service

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.

7. Ultra Reliability Network

Emergency services and application requires highly reliable network to immediately trigger warning during critical situations. Health monitoring devices, remote patient care devices, fire and rescue services, police, and ambulance services etc... requires wireless network to communicate either self activation from devices or initiated by users.

Real-time monitoring of patients (monitoring of blood sugar, blood pressure and pulse rate) with specials needs are increasing and this trend will grow in future. Interaction between patient and medical practitioner is significant in reporting, diagnosis and treatment.

8. Security and Privacy

Security is one of the most important factors of every wireless transmission system. 5G network has to ensure security and privacy for end users. Since the number of devices connected to network and diversity in technologies, ensuring security is a challenging task. End to end encryption technique are developed to securely communicate between devices and cloud application servers.

9. Smart Automobile

Automobile industry is another driving force behind new technologies like IoT which uses 5G network. New generation cars (vehicles) are equipped with smart infotainment systems (multimedia) with capability to connect with mobile network. In future, smart vehicles will be used as a hub for data transmission to communicate in different modes like vehicle to vehicles, vehicle to infrastructure and other devices. Low latency, ultra reliable network is a core component for autonomous driving.

CONCLUSION

5G is designed to work with diverse application and the complexity is one of the major challenges to address. Since 5G is a platform for many wireless technologies to co-exist,

technology providers has to overcome challenges in terms of signal spectrum, transmission protocols, security and network compatibility etc... Due to huge demand for a smarter network, 5G standard has been evolving faster than expected timeline. However, fully functional 5G network will be available only in 2020 according to analysts.

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