IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A REVIEW OF 5G WIRELESS NETWORKS: EMERGING PHYSICAL LAYER SECURITY T ECHNIQUES

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Abstract: Fifth Generation (5G) mobile technologies are emerging as the solution for increasing demands for different aspects like high data rate, reliable connectivity ,low latency, higher capacity and energy and spectrum efficiency. Then, comes into light the concern for security and confidentiality as safeguarding the information in 5G wireless networks is also a vital issue. The Physical Layer Security techniques are grabing interest in wireless communication. This Research paper is providing a comprehensive survey of the 5G networks along with the importance of using Physical layer security techniques. Further, we will explore and study the 5G communication and the techniques like Massive MIMO (Multiple input multiple output), Milimeter wave (mmWave) communication, Non orthogonal multiple access (NOMA), Cognitive radio networks, Visible Light Communication and Heterogeneous Networks. Finally, Future challenges and directions to work beyond 5G are also discussed.

1. INTRODUCTION

Fifth-generation (5G) mobile technologies represent the next iteration of mobile communications technologies that were designed to improve current (e.g., 3G, 4G) mobile networks. 5G networks are anticipated to give faster speeds, greater capacity, and the potential to support new features and services. 5G technologies were introduced to fulfill the increasing demands for mobile data (i.e., more people using more data on more devices). 5G technologies are looking forward to serve current consumer demands and future applications (e.g., industrial Internet of Things, autonomous vehicles). 5G technologies are expected to gain significant consumer benefits and economic benefits.

KEYWORDS: MIMO, NOMA, PLS, VLC

1.1 Features of 5G Technology

- It provides advanced billing interfaces.
- The high quality services of 5G technology based on Policy to avoid error.
- 5G technology is providing large broadcasting of data in Gigabit which supporting almost 65,000 connections.
- 5G technology offer high resolution
- 5G technology offer transporter class gateway with unparalleled consistency.
- The traffic statistics by 5G technology makes it more accurate.
- Through remote management offered by 5G technology a user can get better and fast solution.
- The 5G technology is providing up to 25 Mbps connectivity speed.
- This technology also support virtual private network.
- The new 5G technology will take all delivery service out of business prospect.
- The uploading and downloading speed of 5G technology will be 20 times faster than 4G.
- The 5G technology network offering enhanced and available connectivity just about the world.
- 5G technologies have an extraordinary capability to support Software and consultancy.

Physical Security Techniques can benefit the working of 5G networks in main scenarios. One is the reduction in the latency period of authentication in case of mobile systems. Like there is a scenario in which the vehicle is moving and randomly leaving and joining of the network can be done [1] and in another case roaming around in different networks like base stations , this basically increases the latency in terms of authentication period while doing handover which results in poor performance of the network. So, this can be done by using efficient and automatic authentication so that latency period can be reduced [2].

In mmWave communication, the properties like high directionality and propagation loss are very helpful in encountering the attacks due to evesdropping [3]. In paper [4], the authors discussed the PLS in detail but doesn't talk about its impact and in [5] PLS as a whole is discussed but still missing some future technologies of 5G like Visible Light Communication. So, we have tried to discuss as a whole in comprehensive way

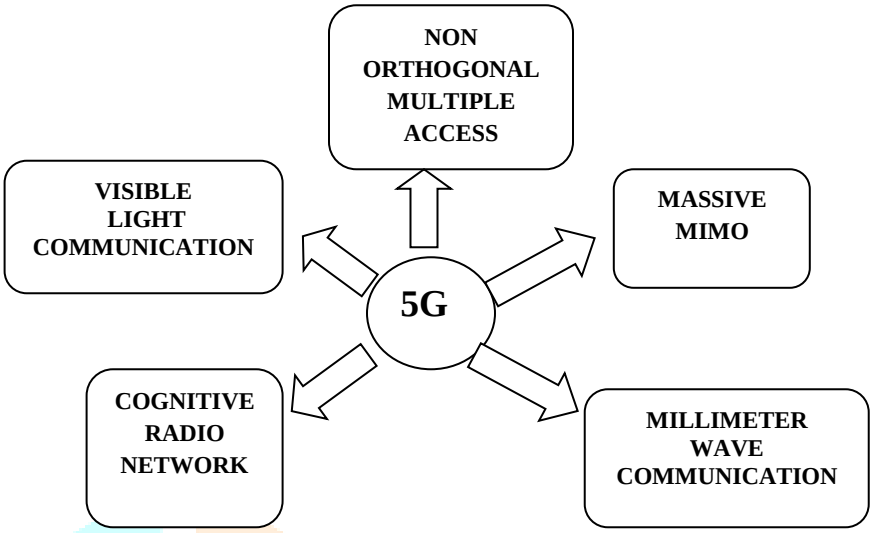

Fig 1: Integration of various emerging Physical layer technologies towards 5G wireless system

2. PHYSICAL LAYER TECHNIQUES

In this section, we will discuss and describe the different Physical layer techniques and the rece/nt advancement made in this respect.

2.1 Massive MIMO :

5G took it to the next level by implementing the concept of massive MIMO as this will greatly increase the transmission gain and spectral efficiency as the number of transmit and receive antennas have increased in a large number [6]. Massive MIMO when combined with smart antenna techniques like beamforming then it becomes one of the major technology that will provide higher throughput and capacity.

But still if we want to implement Massive MIMO with beamforming then there should be utter care as in the selection of the software and hardware elements because their testing and designing will take keen attention as it contain hundreds and thousands of antenna elements[7].

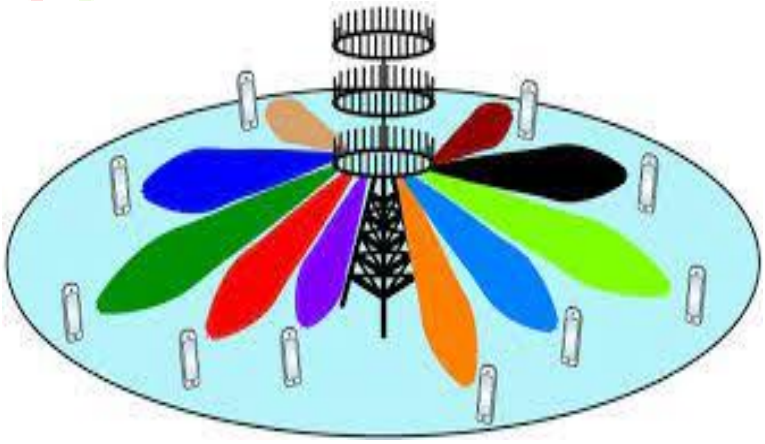

Fig 2: Massive MIMO

This will benefit in future also by implementing more antenna arrays and by using advanced antenna systems (AAS) to gain more capacity and this will enhance the performance of 5G technology.

2.2 MILLIMETER WAVE COMMUNICATION:

This technology is one of the emerging in 5G communication systems and beneficial too. As, mmWave is having features like high directionality which is a plus point as compared to other previous technologies like Microwave [8] and this can improve the performance in terms of efficiency of the PLS techniques[9] as it incorporates hundreds of antennas on a small single platform. Some of the benefits of mmWave is that it easily passes through the obstacles in the path like walls and trees. Large amount of data can be transmitted to long distances as having low frequency and with low latency too and can cover the low density areas too[10].

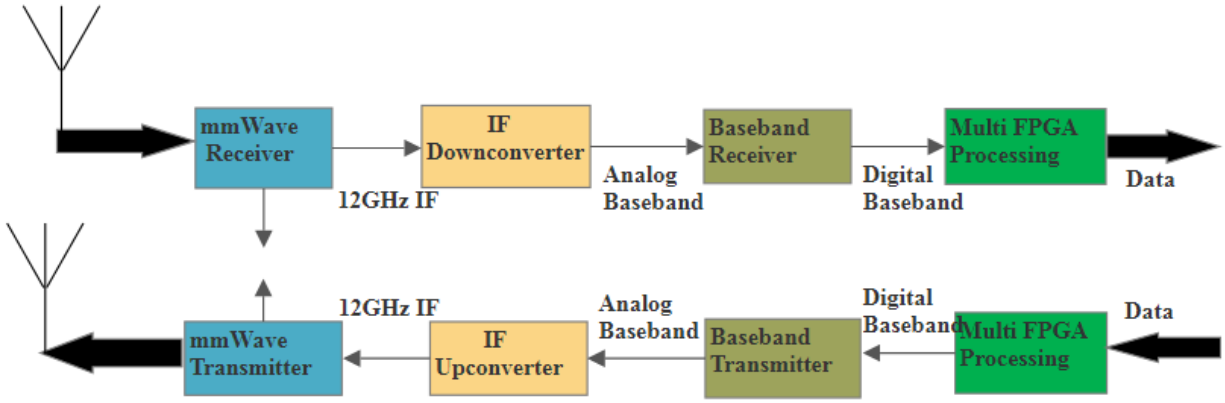

Fig 3: mmWave Communication Prototype for 5G testing

2.3 NON ORTHOGONAL MULTIPLE ACCESS :

NOMA is one of the key principles for radio access in 5G and future networks. NOMA is based on the fundamental idea that more than one user can be served in each orthogonal resource block. In NOMA, several users are multiplexed over the same frequency/ time resource. The multiple users are separated in the power domain. In NOMA, users with good channels can simultaneously use the same bandwidth, in addition to users with poor channel conditions. NOMA can enable massive connectivity and this will support Internet of Things in 5G. NOMA can also lead to low latency. Two users (near and far user) are assigned to a single orthogonal resource block[11].

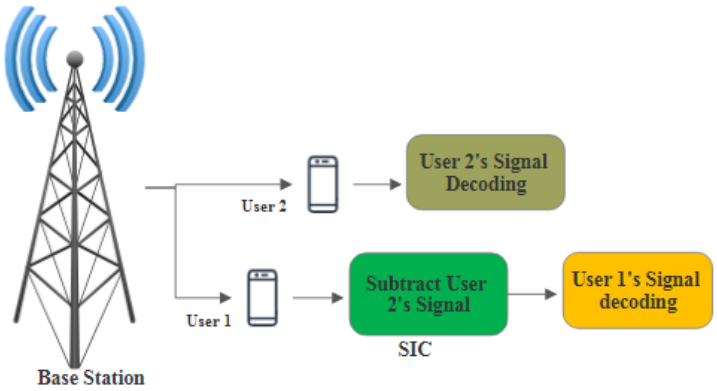

Fig 4: NOMA

2.4 VISIBLE LIGHT COMMUNICATION

Visible light communications (VLC) is a trending technology for future communication links having much higher capacity (it has been accepted to 5GPP) in the visible range of the electromagnetic spectrum (~370–780 nm) utilizing light-emitting diodes (LEDs). A major challenge in VLC is the LED modulation bandwidths, which are limited to a few MHz [12]. VLC offers small cells in large number, they are known as attocells in indoor environment thus improve the capacity, efficiency and mobility.

2.5 COGNITIVE RADIO NETWORK :

In this, dynamic spectrum sharing is done which in return provide higher spectrum efficiencies in 5G communication. Cognitive radio uses a number of technologies including Adaptive Radio (where the communications system monitors and modifies its own performance) and Software Defined Radio (SDR) where traditional hardware components including mixers, modulators and amplifies have been replaced with intelligent software[13]. A cognitive radio network (CRN) is split into two main networks, a primary network and a secondary network. The primary network owns the licensed band and consists of the primary radio base station

and users. The secondary network shares the unused spectrum with the primary network. It consists of the cognitive radio base station and users.

3. CONCLUSION

In this paper, we discussed the 5G wireless network communication along with the physical layer threats and some of the physical layer techniques as solution to the existing threats. For the development of IoT, it is important to understand what are the associated physical-layer security threats as well as possible PLS solutions under the wide-ranging 5G wireless communication techniques. The main aim of this study is to analyze the security challenges and discuss the potential PLS solutions under the 5G IoT networks. We hope this article can help to stimulate further research in this area.

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