

FUTURE GENERATION 5G TECHNOLOGY & ENABLING DEVICE TO DEVICE COMMUNICATION IN FUTURE CELLULAR NETWORK

¹SHAIK.ARSHAD RAHMAN, ²PAVAN REDDY GOTTIMUKKULA, ³ERRABELLY ANUDEEP
¹student, ²student, ³student
¹electronics and communication engineering,
¹sreenidhi institute of science and technology, Hyderabad, India

Abstract: Shortage of signal strength at some places in a geographical region, high latency and high data traffic problems has motivated to develop a new technology. D2D in 5G communication is one of the potential technology. In this concept, communication between different devices of similar functionalities is possible. Which we have seen in Wi-Fi and Bluetooth communication, which are unlicensed industrial scientific advancements. This concept can be applied to licensed mobile communication which can solve legacy problems. 5G technology has advanced such an extent that high data at faster rate can be transmitted and it also enables smart mobile to smart mobile communication

In this paper, you can see what is meant by 5G technology and how device to device communication in 5G technology is used to overcome some of the problems like latency and High data rate. You can able to know how 5G is used to increase the signal strength at some regions using D2D communication from this article. As a part of research D2D places significant role in upcoming 5G technologies. Present 4G LTE technology has reached to maturity and has started deploying so, we are in eager for a search of new generation

Index Terms - MIMO, latency, mm wave, small cell, D2D (Device to Device Communication), 5G communication

I. INTRODUCTION

Communication between devices such as mobile phones etc. is said to be device to device communication. D2D enables communication between devices in closer proximity range .this concept is inspired from Wi-Fi and Bluetooth communication, which works over unlicensed scientific bands. Mobile network don't support direct air based device to device communication. Since it has number of advantages, we are interested in implementing this.

Machine to machine communication and D2D (Device to Device communication) plays increasing role in upcoming technologies.

In a recent survey, it has been estimated that global internet users are reached 4.77 billion this lead to heavy traffic, ultra-high latency problems. And as the geographical area has divided into hexagonal cells in cellular communication there is shortage of signal strength between adjacent cells in 4G LTE communication so we are awaiting of newer technology, hence 5G communication has drawn more attention and extensive research is going on to develop 5G technology

5G technology increases the data rate and battery life by 10 times and reduces the latency by 5 times. This concept is based on frequency hopping or reuse. You will come to know this concept in further sections. As a part of development (5G technology) it has left many challenges, this challenges can be tackled by introducing D2D communication. D2D in 5G has a high potential to solve some of the legacy problem, as we have seen in 4G LTE such as latency and bandwidth limitation.

Now the section-2 explains the Literature review report of the paper, section-3 explains about the problem statement in accordance with 5G, and the later section filled up with the overview of 5G, and the last section with the advantages, comparison, conclusion and ends up with the Reference.

II. LITERATURE REVIEW REPORT

Richard W.Ziaolkowski and Thomas C.Baum proposed a 28 GHz omnidirectional circularly polarised antenna to support D2D communication in 5G environment this antenna can be operated at 28 GHz frequency. He said Present mobile are incapable of supporting this high frequencies since the mobiles should be updated to support 5G communication. His paper says that linear wave should be converted in to circular wave to support 5G communication

Macro Mezzavilla in his paper suggested that 5G communication using D2D brings several revolutionary changes in public safety. He describes in his paper that 5G has high potential that it highly supports video streaming and low latency which can be applied in public safety department .He mean that emergency responses can be generated in case of accidents, natural calamities through IOT (INTERNET OF THINGS) devices .quick message can be generated in case of emergencies

Godfrey A.Akpakwu, states in his paper that 5G can applied for communication between low power devices such as mobile, IOT(INTERNET OF THINGS) based washing machinist's, tube lights etc. as a part of IOT(INTERNET OF THINGS).He says that IOT(INTERNET OF THINGS) is an emerging and promising technology which can connect to global objects .He draws the attention of committees for the attention of devices such as sensor etc.

Xuemin (Sherman) Shen describes in his paper that challenge's faced by 5G technology in cellular communication and he also describes how it can be overcome by using D2D communication. He shows solutions by discussing cross layer resource control under

bustly data traffic and D2D enabled ultra-dense deployment with small cells. He illustrate the technology which supports 5G communication such as MIMO etc.

Macro Mezzavilla in his paper suggested that 5G communication using D2D brings several revolutionary changes in public safety. He describes in his paper that 5G has high potential that it highly supports video streaming and low latency which can be applied in public safety department .He mean that emergency responses can be generated in case of accidents, natural calamities through IOT (INTERNET OF THINGS) devices .quick message can be generated in case of emergencies

Godfrey A.Akpakwu, states in his paper that 5G can applied for communication between low power devices such as mobile,IOT(INTERNET OF THINGS) based washing machines ,tv's, tube lights etc. as a part of IOT(INTERNET OF THINGS).He says that IOT(INTERNET OF THINGS) is an emerging and promising technology which can connect to global objects .He draws the attention of committees for the attention of devices such as sensor etc.

Xuemin (Sherman) Shen describes in his paper that challenge's faced by 5G technology in cellular communication and he also describes how it can be overcome by using D2D communication. He shows solutions by discussing cross layer resource control under bustly data traffic and D2D enabled ultra-dense deployment with small cells. He illustrate the technology which supports 5G communication such as MIMO etc.

III. PROBLEM STATEMENT

As concerned with present scenario smart phone users and internet users are increasing at a rapid rate and it is estimated within 2018 internet users reaches up to 4.77 billion which results in high internet traffic .And it also leads to packets dropping, congestion of Bandwidth results. Due to use of optical fibers and time division multiplexing schema in 4G LTE it has results in slower data rate transmission

Legacy Enodes are incapable of communicating with adjacent Enodes it has led to delays in packet switching

Legacy plays an increasing role in present advancing environment where past generations are failed to achieve that.

IV. INTRODUCTION TO 5G TECHNOLOGY

As we aware of the fact that every new generation brings new revolutionary changes in the environment where with the introduction of 1g, has brought voice calls in to the market

Then after 2g provided voice calls as well as texting facilities (SMS) as the advancement goes on increasing it led to introduction of 3g technology which provided online and browsing services

At last we are in 4g which provided high speed data which we are enjoying now, but it has not reached our necessities hence we are awaiting for new generation i.e. 5G

And as the number of internet users are increasing day by day we are receiving low speed data and facing call drop problems

Legacy network uses bandwidth in the ranges of 3 kHz to 6 GHz hence bandwidth is becoming congested due to more number of applications

Hence there is a necessity to switch to higher frequencies as fig shown below



Fig 1 shows bandwidth used by regular applications (e.g. Phones, tablets etc.) and 5G applications

This led to introduction about the 5G technology. It is too early to define the actual definition of 5G technology since research is going on

Now here I am listing some technology which supports 5G communication

1. Millimeter wave
2. Small cell
3. MIMO
4. Beamforming
5. Full duplex

4.1Mm wave technology:-

As we seen bandwidth used by legacy networks are in the range of 3 kHz to 6 GHz since it is getting congested there is necessity to open up above frequencies to cope up with current internet usage. This lead to introduction of millimeter waves.

Waves whose frequency in the range of 30 GHz to 300 GHz are known as millimeter waves. These frequent are used to transmit the data at faster rate

Calculation of wavelength:-

We know $f=C/\lambda$

1. If $f=30\text{GHz}$, $c=3*10^{10}$ cm/sec (velocity of light)

$$\lambda=c/f=3*10^{10}/30*10^9$$

$$\lambda=1\text{mm}$$

2. If $f=300*10^9$

$$\lambda=100\text{mm}$$

Hence from the above calculation we can say that wavelength of these wave are ranging from 1mm to 100mm..It means when it is compared with previous generation here cycles per second is more in the case of mm waves. Hence data rate is high.

4.2 Small cell

As mm suggest length of wave is small, even though it is beneficial it opened up some of the crucial challenges to solve that is these waves get absorbed by obstacles such as walls, trees

That means these waves are incapable of travelling through long distance and it has poor penetration power this lead introduction about small cell technology

The idea here is to place number of highly directional antennas over a geographical cell this makes signal power to not go down. Simple the antennas acts as repeaters. This is employed at cost.

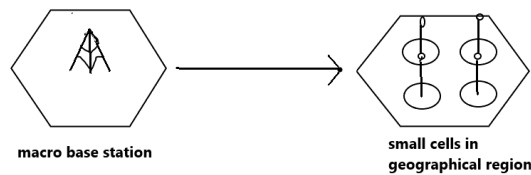


Fig2: illustrate small cell

4.3MIMO:-

MIMO stands for multi input and multi output. Let's us have a glance over 4g base station it has 50 to 100 antennas around the base station (Enode), But when we see the base station of 5G technology it has more number of antennas in the range of 1000 these are used to increase signal strength over a region .through this we can achieve low latency and high data rate. Power consumption is minimized by using mm wave technology.

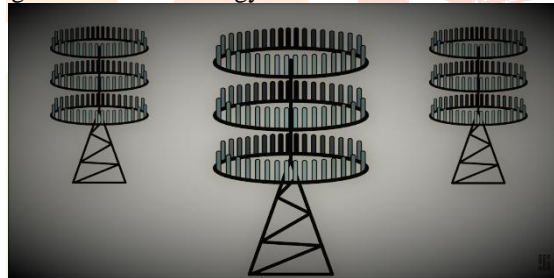


Fig 3: MIMO station

(This figure is taken from IEEE Spectrum Staff)

4.4 Beamforming:-

By introduction of above mentioned MIMO concept it improved data rate to 5 GHz but put up a challenge to researchers. The challenge is that signal from one base station interferes with adjacent base station as shown in fig

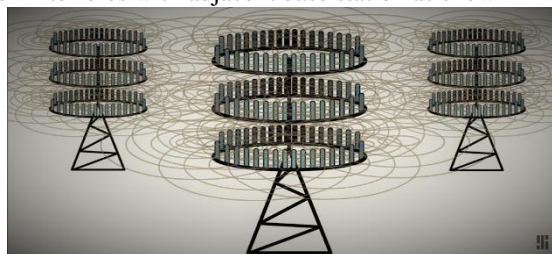


Fig 4: Interference of signal

(This figure is taken from IEEE Spectrum Staff)

Due to this noise is introduced and packet loss occurs

To solve this beamforming concept has introduced it says that instead transmitting signals all around the geographical cell we transmit the signal in the form of beam to a particular users so by implementing this we can reduce the interference

4.5 Full duplex

The legacy antennas only supports half duplex communication it is due to reciprocity property

It leads to handling problems in this technologies antennas are designed to support full duplex communication. Full duplex in which antenna performs transmission as well as reception one at a time. This can be achieved by using silicon transistor switch

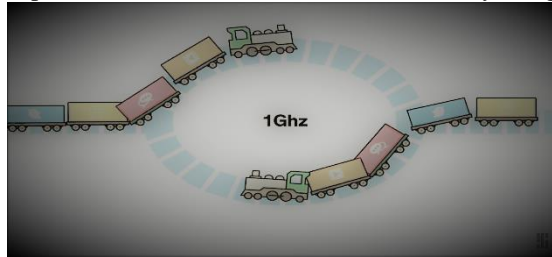


Fig 6: shows the full duplex communication
(This figure is taken from IEEE Spectrum Staff)

V. D2D Communication:

Communication between two or more devices is known as D2D communication .there are many ways to communicate with the devices they are based on relay ,based on operators ,independent of base stations etc out of them we are discussing here two types:

1. Direct communication (LOS)
2. Frequency hopping

5.1 Direct Communication

In this type of communication two or more devices exchanges the information in absence of obstacle such as walls and trees. This is also known as line of sight communication

Figure illustrate LOS communication

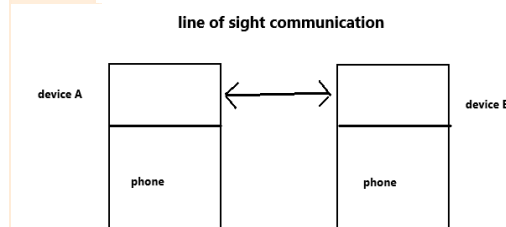


Fig 7: Line of sight communication

5.2 Frequency Hopping

In this we can see that controlled link is established by an operator. Exchange of information can be done in presence of obstacles. Technique here used is sender (the device which it wants to transmit the information) first it sends to base station ie ENODE then the BS transmit it to other device (receiver).in this information pass through three places.

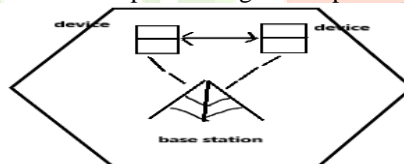


Fig 8: shows hopping communication in cell

D2D provides solutions for above mentioned problems:

However 5G has several unique propagation features compared to those of microwave frequencies to achieve seamless coverage area.

1. From section 1 we have seen that mm waves cannot travels longer distance due to shorter wave length .we have propagation loss is directly proportional to square of frequencies
2. Due to shorter wavelength of mm waves results in diffraction about the obstacles
3. Mm waves are incapable of penetration through obstacles

VI. PROPOSED IDEA

The above mentioned problems can be solved using D2D communication in cellular Network

By providing D2D links between devices we can maintain constant signal strength .this done by LOS communication or via hopping
Due to high frequencies BS to BS station communication can also be achieved .interference challenges can be handled efficiently .due to use of D2D communication spectrum efficiency can be improved

VII. SOLUTION FOR SHORTAGE OF SIGNAL STRENGTH

Through D2D communication we can achieve solution for shortage of signal strength. Usually there are some areas in a geographical region (cell), in which some users get full signal strength where other with poor signal strength it may due to obstacles or propagation loss. Idea here is that mobile users in the same geographical region (cell) will share their signal strength to each other users. This can be maintained through proper protocol. This type of data transfer may be seen in Wi-Fi or hotspot. Similar concept can be applied here and security is key constrain which can be achieved by establishing proper protocol.-60dbmv is usually termed as good signal strength, whereas -112dbmv is said as poor signal strength.

Consider an example if a person X has -60dbmv signal strength it can be transferred to person Y who has poor signal strength .The transfer may be based on priority that means more signal strength to owner, approximately 20dbmv to person Y. So by implementing this we can avoid call drops and we can receive more data rate. This can be perfectly achieved by maintaining proper algorithm. Hence by implementing this we can extend the coverage area.

VIII. COMPARISON TABLE

parameters	1G	2G	3G	4G	5G
system	Analog	Digital	Digital	Digital	Mm waves
multiplexing	FDMA	TDMA,CDMA	CDMA	CDMA	OFDMA, CDMA
Switching type	Circuit switching	Circuit switching for Voice and Packet switching for Data	Packet switchin g except for Air Interface	Packet switching	Packet switching
speed	2.4kbps	50kbps	400kbps	100Mbps	1Gbps
supports	Voice only	Voice and data	Voice and Data	Voice and Data	Voice and Data
bandwidth	Analog	25 MHz	25 MHz	100 MHz	100ghz
Operating frequency	800 MHz	GSM:900 MHz,1800 MHz CDMA: 800MHz	2100MHz	850MHZ, 1800MHZ	5Ghz

Table 4.1: This shows comparison between different generations in cellular network

IX. ADVANTAGES BY IMPLEMENTING D2D COMMUNICATION

Now we can achieve high data rate

High Reliability

Low latency

More bandwidth

Multiuser interface

More coverage area

X. FUTURE SCOPE

In future, we can expect that it will have tremendous market demand .it will make new revolutionary changes. By implementing this technology we can reduce latency and data rate problems. Hence speed of response of each device can be improved

XI. CONCLUSION

5G wireless networks are expected to provide advanced performance to enable many new applications. In this paper, we have presented a comprehensive study on recent development and why D2D in 5G is considered as one of the potential technology.

In rest of the article we focused on comparison between different technologies and we have stated some of the legacy problems which can be overcome by using D2D communication

So, we hereby conclude that D2D in 5G will be a potential technology.

XII. ACKNOWLEDGMENT

We convey our sincere thanks to **Rahul Reddy** Associate Professor and **Dr.Asha Devi** mam ECE department, Sreenidhi Institute of Science and Technology, for their continuous help and support to complete this work.

Finally, we extend our sense of gratitude to almighty, our parents, all our friends, teaching and non-teaching staff, who directly or indirectly helped us in this endeavor

XIII. REFERENCES

1. Macro Mezzavilla,Member,IEEE,Michele Polese Public safety communication above 6 Ghz: Challenges and Opportunities
2. Wei Lin ,Member,IEEE,Richard W.Ziolkowski 28 Ghz Compact Omnidirectional Circularly polarized antenna for D2D communication in Future 5G system
3. Xuemin(Sherman)Shen D2D communication in 5G cellular network
4. Godfrey A.Akpakwu,Graduate Student Member,IEEE A survey on 5G networks for the internet of things: communication technologies and challenges