# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

www.ijraset.com

Call: 🟢08813907089 | E-mail ID: ijraset@gmail.com

# WI-FI Offloading in 5G

Ashwini Sukhdev Dhande[1], Prof. Dr. Anala Pandit[2]

[1, 2]*Department of Computer Science VJTI College, Mumbai*

*Abstract: The growth in internet traffic from mobile phone is exponential. The limited capacity of core data network has become a problem also 5G will demand cellular networks with ultra-low delay, high throughput and low congestion at the core network. To cope with increasing mobile data traffic, researchers are currently working on traffic offloading techniques for delivering data over unlicensed frequency bands i.e., over Wi-Fi.*

*Current offloading schemes offload the data over Wi-Fi without knowing whether Wi-Fi will be able to handle traffic or not. Some offloading schemes directly offload mobile User Equipment (UE) to Wi-Fi.*

*In the proposed solution a check is made whether Wi-Fi would be able to provide offloading service or not. If Wi-Fi is able to provide offloading, then a check is made to decide which User Equipment (UE) should get offloaded over Wi-Fi. In the proposed solution, data is offloaded from the licensed band that is from cellular network to over unlicensed band that is over Wi-Fi access point.*

*Keywords: 5G, millimeter wave, mimo, Wi-Fi, offloading, cellular network*

## I. INTRODUCTION

According to Cisco's annual Global Mobile Data Traffic forecast Update (2017 -2022) the growth in number of mobile and internet based devices will rise exponentially as the technologies with higher capacity and bandwidth are being developed. The forecast also predicted that 5G will have an average traffic of 22GB/month as opposed to 8GB/ month. [1]

This ever increasing demand of data traffic has put immense pressure on increasing the data rate and capacity with the limited spectrum available. To fulfil the ever increasing demand the Mobile Network Operators are using techniques such as

A. Add new BTS
B. Release new spectrum,
C. Increase the spectral efficiency of the technology used.

However, these technologies are operationally and financially not feasible for the operator to use them at a large scale.

Also there has been a lot of competition in Mobile Telecommunication business which adds another constraint in deciding which technology is economically feasible. A mixed approach is always preferred on the other hand. Mobile Data Offloading has always been a lucrative option to the mobile operators.

By 2022, 59 percent of global mobile data traffic (cellular) will be offloaded to Wi-Fi or small cell networks, up from 54 percent in 2017. [1]
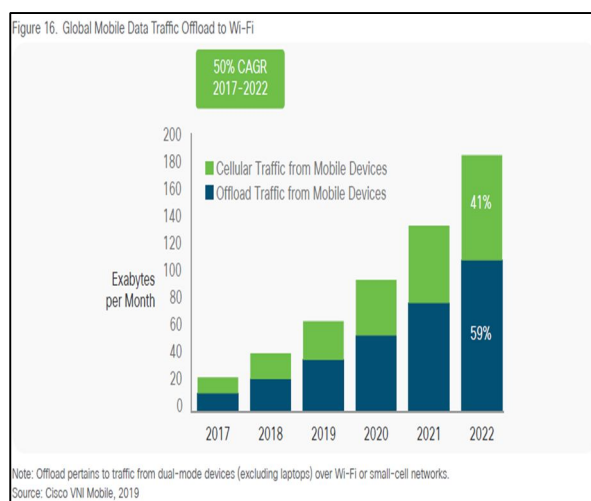


Fig 1. Global Mobile Data traffic offload to Wi-Fi

WIFI offloading provides both better consumer experience in terms of higher data rate and reduced cost of data. Many approaches to tackle the problem of high data rate with increasing no of users have been suggested such as massive multiple-input multiple-output (MIMO), highly dense heterogeneous networks (DenseNets) with small cells, device to- device communications (D2D), Femtocell IP Access (FIPA) and Selective Local Controller Traffic Offloading (SLCTO). However, LTE suffers from limited spectrum available which is licensed as well.

Cellular data offloading or transfer of User Equipment (UE) from U-LTE to Wi-Fi depends on Random-based Transfer (RT).

However, the important question to answer here is whether the remaining throughput of the WIFI network is sufficient to support UE transfer. If the remaining throughput of the targeted Wi-Fi is not sufficient to provide the QoS (Quality of Service) requirements of the transferred UE from LTE, then in this scenario WIFI does not have the capability to serve the device or the UE. To tackle the problem, presented above we propose new technique to manage offloading.

These paper is structured as follow: Section II is about the 5G network. Section III describes Wi-Fi offloading technologies that are proposed for 5G. Section IV is about proposed solution.

## II. 5G TECHNOLOGY

The telecom industry is growing very rapidly. After every decade there comes a new generation of cellular network. Each generation brings many fold increase in data speed and better efficient use of the spectrum. The with the data speed of 10kbps with 2g to 100Mbps with the 4g we have come a long way in improving the data speeds in the cellular network. This exponential increase in the cellular data speed has paved the way for IOT (Internet of Thing).

The generation of cellular network that is coming up which has again promised to revolutionize the telecom industry is 5g. 5th generation or 5g is planned to be up and working by around 2020 or 2021.

The internet speeds promised by 5g is around 1Gbps. To achieve such enormous data speeds there are number of key technologies involved such as the Millimeter Wave Technology, Massive MIMO, Beam forming, Small cell technology etc., we will take a brief look at each of these technologies.

### A. Millimeter Wave Technology

The data rate of a channel is directly proportional to the bandwidth of the channel so higher the bandwidth, higher the data rate .More bandwidth can be allocated at higher frequency. So to support increase in the bandwidth we are moving to even higher frequency range (30 - 300 GHz). These signals at these frequency are called millimeter wave because the wavelength of these signals are in the range of 1-10mm. The problem with the millimeter wavelength in using it in 5g is that waves at these wavelength gets easily attenuated by the surrounding and they cannot penetrate from a thick wall as well. So extensive research is being done to overcome the limitations of millimeter wave as it has the potential to increase our current data speeds by the factor of 100.

### B. Small cell Technology

As the millimeter wave gets easily attenuated by the surrounding and cannot penetrate through walls well, the cell size needs to be reduced if millimeter wavelength is used. Small cell technology has multiple advantages some of them includes

1) It supports Millimeter wave

2) It allows us to reuse the frequency thus supporting even greater no of users.

### C. Beam Forming

This is another key technology in 5G. In 5G the antenna will not radiate signal in all directions instead it will focus its signal in the direction where the device is. This technique is called beam forming when the signal if antenna is focused where the device is thus allowing us to reuse the frequency and giving higher data rates.

### D. Massive MIMO

MIMO an abbreviation for multiple input and multiple output means that there will multiple antennas that are located at the both end of receiver and sender. These antennas must be synchronized in order to minimize the errors and increase efficiency of transmission.

In this technology multiple antenna (Tens or even Hundred) can send a signal to one or more devices and a single device can also communicate with multiple antenna at a same time thus increasing the data rate

\

## III.  CURRENTLY PROPOSED SOLUTIONS

There are multiple solutions to tackle this problem of increasing the data speed and supporting more internet devices with the limited spectrum available. In this research paper we would be focusing on a technology called as the WIFI offloading. In WIFI offloading we offload or redirect the data traffic of a device from the cellular network to the WIFI access point of an operator. Offloading has many advantages as WIFI uses an unlicensed band to operate this reduces the cost of data traffic considerably. So, the user's data traffic is charged at a very low rate. The operator gets benefited as well as the traffic is offloaded from the cellular licensed band to unlicensed band. Thus, allowing the operator to have a greater number of users as well as support higher data rates.

Many researches have been done on the subject of WIFI offloading. Whether to offload, whom to offload is a question that researchers tries to find answer to. Researchers are trying to find different metrics to answer this question. One of the metric is remaining throughput. Remaining throughput of WIFI access point of the operator is one of the main criteria for offloading. If the remaining throughput is high the data traffic can be offloaded from the operator's cellular network to the WIFI access point. [4]

To answer the question of whom to offload, the metrics that are considered are distance of the user from base station, speed of the internet-based user equipment, signal to noise ratio and the Quality of service that user needs. [4]

User equipment is selected on basis of shortest distance between user and AP. And then they also calculate throughput remaining for each Wi-Fi AP. UE with high distance will be transfer to a Wi-Fi network. If the distance between PBS and UE increases, throughput will decrease. Then the decision should be to transfer UE to the closed WI-FI. With increasing the distance between PBS and UE, the total number of offloaded UE from PBS to Wi-Fi network increases. [4] User equipment is selected on basis of speed of user equipment. If UE speed is >3 km/h then generally that UE is transferred on L-LTE. If speed is <3km/h the UE is transferred over Wi-Fi Performance Evaluation. In this scheme UE with higher speed get transferred on L-LTE and UE with lower speed gets offloaded. [4]  SINR is also another metric to decide whom to offload. If the SINR is lower than a particular threshold set, then we offload the cellular traffic to the WIFI access point. This is done to improve the SINR on the cellular network. Whom to offload is also decided on the basis of Quality of Service (QoS) the user demands. If the user's data traffic is delay intolerant (i.e., Streaming Data traffic) then that user may not be offloaded. If the user's Quality of Service is low then that data can be offloaded. Energy is consumed while switching from one network to another so that should also be considered before switching from one network to another. The User Equipment can also assign respective weights according to its need which can help in deciding the operator whom to offload or not. [3]

## IV.  PROPOSED SOLUTION

To implement Wi-Fi offloading elegantly, we are proposing a very simple but effective solution. The solution requires us to maintain geographical Maps of the location where network provider serves.

One map depicts the data usage, Quality of service and the capacity of existing cellular network while the other depicts the Wi-Fi usage, Quality of service and the available capacity, in the geographical area which the network operator serves.

Now for every user where the network operator's Wi-Fi is available, and the cellular network is heavily loaded the operator compares both cellular and Wi-Fi network based on some metrics. These metrics include available bandwidth, Signal to Noise ratio, The Quality of service required and many more. After assessing all the factors, the network operator decides whether to send an alert or not to the user.  If the operator decides to send a notification, an alert is sent to the users to switch on their Wi-Fi for the better user experience. The user after receiving the notification can switch on their Wi-Fi to automatically connect to the service provider's Wi-Fi. In this way the network operator can balance out the traffic and offload the traffic to the Wi-Fi thus saving the precious bandwidth of the cellular network. The authentication of the user is done is through SIM. For the authentication either we can use the One Time Password for generating a session for user to login in Wi-Fi or to make it more user intuitive by using the EAP-SIM authentication. EAP is an authentication framework. It authenticates the user with the existing infrastructure via HLR. The authentication is automatic and thus user friendly. EAP can be better explained with a diagram. [5]
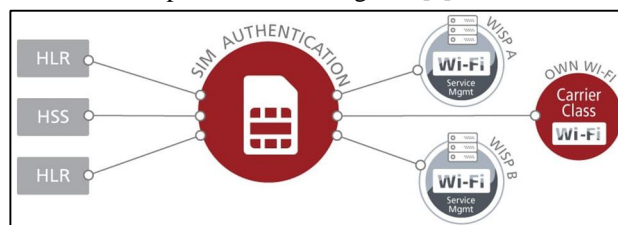


Fig 2. Block diagram of SIM authentication process

The research has shown that, on-the-spot offloading can offload 65% of the cellular traffic. If applications that users are using can tolerate certain delays, the offloading becomes even more effective, the research shows that around 82.1% of the data traffic can be offloaded to Wi-Fi. The research has also shown that the proposed solution can increase the revenue of the operator by 21% to 152%. With the better user experience the no of users will also increase.

For the Wi-Fi offloading to be effective the operators need to deploy Wi-Fi Access Points in a similar way as they install cellular antenna and maintain them. Deploying and maintaining them would still cost lower than using only cellular frequency. According to research it is shown that only few of the access points contribute to most of the traffic. Hence the network operator while deploying a parallel Wi-Fi network needs to consider the places where there is heavy traffic on the cellular. These are the places where network operators needs to deploy more no of access points as they would benefit the most with Wi – Fi offloading.

## V. CONCLUSION

Mobile data offloading has as of late risen as a promising way to deal with diminish the energy utilization in 5G systems. In this paper we are presenting you with a very simple but effective solution to implement Wi-Fi offloading. The solution utilizes Wi-Fi offloading to offload the traffic from limited bandwidth of the licensed band and offload the traffic to Wi-Fi providing better service to customer in terms of QoS as well as reducing the data cost to both consumers as well as the network operator. The solution requires minimum resources to implement and can be easily implemented in the current architecture and would not require any major change in the network provider's infrastructure.

## REFERENCES

[1]    Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2017–2022 (https://www.cisco.com/c/dam/m/en_in/innovation/enterprise/assets/mobile-white-paper-c11-520862.pdf )

[2]    Mobile Data Offloading for Green Wireless Networks (https://ieeexplore.ieee.org/document/8014290/ )

[3]    Intelligent Network Selection for Data Offloading in 5G Multi-Radio Heterogeneous Networks (https://ieeexplore.ieee.org/document/7386161)

[4]    Traffic Offloading for 5G: L-LTE or Wi-Fi (https://ieeexplore.ieee.org/document/8116470)

[5]    https://www.aptilo.com/

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089  ⊙ (24*7 Support on Whatsapp)