2nd National Level Students' Research Conference on
"Innovative Ideas and Invention with Sustainability in Computer Science and IT-2021"
In association with International Journal of Scientific Research in Computer Science,
Engineering and Information Technology | ISSN : 2456-3307 (www.ijsrcseit.com)

5G : The New Era of Internet

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ABSTRACT

A 40-year-old male Asian elephant was presented to the Veterinary Polyclinic, North Paravur with right pelvic In today's world everyone is likely to have speed and moreover speedy internet. So, there is an intense competition, for every major telecom that is working and trying to make it even faster. Commercial sectors, professional institutions, real-time simulators, devices with AI, robots, smartphones, cars, watches, mobiles and even houses are increasingly requiring speedy and stable internet connections. In future, some of the major requirements or demands that needs to be fulfilled are improved data rate, lower latency, increased capacity and better service quality and better bandwidth. In order to survive in this competitive world where people urge for more and more advancement in technologies here comes the latest iteration of cellular technologies: Fifth Generation Wireless Technology known as 5G. It has three main features: Improved speed, lower latency and ability to connect many devices simultaneously. This paper is contented with the details related to the 5th generation, its architecture and some of the important concepts like CNN and DNN, MIMO (Multiple Input Multiple Output). This paper also highlights cloud technology and artificial intelligence combined with 5G which would make this world a better place to live in.

Keywords - 5G, AI, Cloud Computing, CNN, DNN, MIMO

I. INTRODUCTION

The increase in network traffic has driven the capacity demands of the users of 3G and 4G. In today's world the research for 5G is getting done the most intensively way. It was supposed that the working of 5G would be seen in this world by the end of 2020, and it did work out but not quite efficiently. In some countries the testing of 5G has begun, in fact the nodes that transmits the 5G Signals have also been setup in some cities. There is still no correct definition for 5G yet but that's why we are here to discuss. This paper focuses on the question what is 5G and how it is useful for today's generation? The rest of the paper focuses on the architecture/working of this technology, the evolution from 1G till 5G, Drawbacks of 5G, How we will comeback these drawbacks, 5G with AI Technology, 5G With Cloud Computing and its Boons and banes. The Goal Of 5G is to establish greater speeds at higher capacity per sector and at lower latency than 4G.

II. ARCHITECTURE/WORKING OF 5G

A. Architecture of 5G

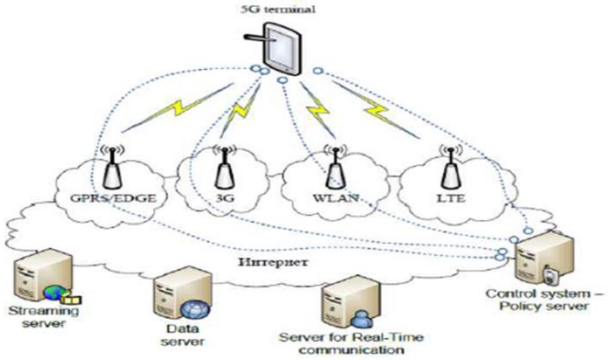
As we all know that 5G is the next generation in the wireless technology, something about how 5G works based on its architecture.5G networks work by transmitting millimeter waves. The 5G is now being dedicated to multiple frequency ranges. The Specific frequency portion of 5G lies between 30-300 GHz. Multi access edge computing or known as (MEC) is the most important part in the working architecture of5G.The Architecture of 5G provides less network trafficking and a higher bandwidth than the previous wireless generations. Frequencies between 24-100 GHz are being tested for 5G.The (Multi Access Edge Computing) MEC is an evolution on cloud computing that brings the applications from centralized data centers to the network and therefore closer to the end users and their devices.The (Network Function Virtualization) NFV decouples the software from hardware by replacing various network functions such as firewalls, load balancers and routers with virtualized instances running as software. Due to which we don't need to invest in expensive hardware element. It includes (NST) network slicing technology that enables multiple virtual networks to run simultaneously.

B. Beamforming

Another technology can be helped to develop 5G which is Beam forming. Beam forming means that we can put up conventional base stations that will receive the signal from the 5G node and will again transmit it to the mobile network. We can also say that it can be worked as a repeater. Now let us talk about the core architecture of 5G.The core network of 5G enables the increased throughput demand and utilizes the cloud and the service-based architecture also known as SBA which spans across all 5G functions which includes authentication, security and aggregation.

How is 5G Better and Different Than 4G?

When 4G was announced, cloud services were usable on mobile phones. What 5G does is that it will take it to a next level. A 5G network has a lot of network processing power built in, that it becomes more than a network and can distribute data that performs processing tasks, either using the full power of centralized resources or the responsiveness of edge computing done close to the user.4G was a great leap forward in networking technology which allowed people to stream music gaming and much more things, 5G is designed to make connection of many more devices (other than smartphones) to these features and provide more features to do the same. Like if we see a smart watch runs on a very small battery, but 5G can provide a connection that will consume little energy for its operations. An Industrial robot can be provided with 5G with extremely fast and secure connectivity.



III. EVOLUTION OF WIRELESS TECHNOLOGY

The Technology in today's world keeps evolving as the technology of the wireless networking has been evolved to its latest generation the 5th generation known as 5G.

A. 1G-The Beginning

Nippon Telegraph and Telephone (NTT) launched1G mobile networks in Tokyo in 1979. By 1984, NTT tried to cover the spread of 1G all over Japan.

The 1st generation came in early1980's. It has a data rate up to 2.4kbps. Advanced Mobile Phone System

(AMPS), Nordic Mobile Telephone (NMT), and Total Access Communication System (TACS) were some of the major subscribers. Few disadvantages of 1G were like reckless handoff, with no security since voice calls were stored and played in radio towers due to which vulnerability of these calls from unwanted eavesdropping by third party increases, below par capacity, and inferior voice associations.

B. 2G-Rise in Revolution

GSM standard in Finland in 1991 launched the 2G or second generation of mobile networks.GSM which stands for Global Systems for Mobile Communications, was actually the first 2G system, which was utilizedwithvoice communication. Having a data rate up to 64kbps, the second-generation mobile handset battery lasts for a longer time. With the help of 2Gpeople could start sending multimedia messages (MMS), send text messages (SMS) on their phones. Initially, transfer speed of 2G was around 9.6 kbit/s so operatorsinvestedin new infrastructure like mobile cell towers. By the end of the era, 40 kbit/s was achievable and EDGE connections offered speeds of up to 500 kbit/s.

C. 3G-Growth In Network/Network Strengthening

In late 2000 the third generation or 3G came into existence. 2Mbps is its transmission rate. 3G's increased data transfer capability emerged to new innovations like video streaming, video conferencing, download game, movies, and voice over IP (like SKYPE). 3G connectivity played a role in making features of Blackberry in 2002. 3G plans are more expensive than 2G since it has more rate of connectivity. Since 3rdGeneration of networking technology involves the introduction and utilization of UMTS and CDMA,WCDMA has over 2000 technologies, the emerging technologies like Evolution-Data Optimized (EVDO) and High Speed Uplink/Downlink Packet Access (HSUPA/HSDPA) has made a massive wireless generation between 3G and 4G called 3.5G with upgraded data rate of 5-30 Mbps.

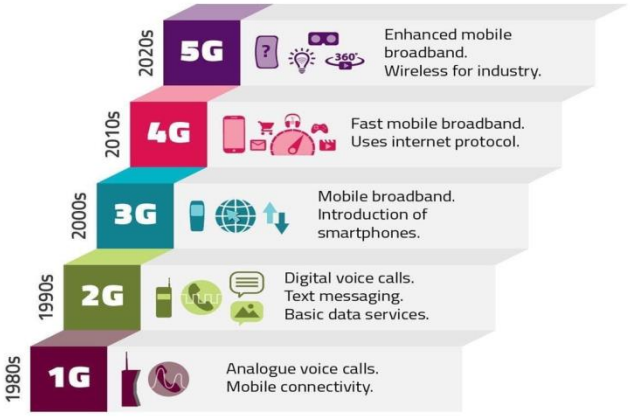
D. 4G-The Era of Streaming

In Stockholm, Sweden, and Oslo, in 2009 4G was first deployed as the Long-Term Evolution (LTE).4G LTE is much faster than 3G, with speed of 150Mbps i.e., potential speed of 80Mbps in real world. With 4G LTE you can easily download a 2GB HD film in 3 minutes 20 seconds, while it would take over 25 minutes on a standard 3G network. Compared to 3G, 4G is much faster with strong connectivity which provides HD video games downloading, crystal clear voice conferencing calls, browse web pages on a one click.Applications made to use a 4G network are Digital Video Broadcasting (DVB), video chat, High-Definition TV content, Multimedia Messaging Service (MMS) and mobile TV.

E. 5G-The Future Of Internet

5th generation mobile network is known as 5G. It is a new global wireless technology after 1G, 2G, 3G, and 4G networks. 5G is a new advanced network which can easily connect virtually everyone and everything at instance. Earlier, one could download a game in minutes but now with the help of 5G to download that same game is possible in seconds.

By 2035, 5G will be able to support 22 million jobs worldwide and also will bring growth to the economic income.



IV. HOW WELL CAN 5G COLLAB WITH ARTIFICIAL INTELLIGENCE?

As a general smart critical thinking procedure, AI can be extensively applied in the plan, design furthermore, streamlining for the 5G organisations. Artificial intelligence is applicable to three primary specialized issues in 5G:

A. Combitional Optimization

One normal illustration of the combinatorial optimisation issue in 5G (new radio) NR is the network source reallocation. Given an asset restricted organisation, an enhanced plan ought to be sorted out to allot assets to various clients who share the organisation to such an extent that the usage of the asset accomplishes greatest effectiveness. As the utilization of the Heterogeneous network (HETNET) engineering in 5G (new radio) NR with highlights like organisation virtualization, network cutting and self-putting together organisations (Child), the related network asset allotment issues are getting more muddled, which requires more compelling arrangements.

B. Detection

The plan of the correspondence recipient is an illustration of the identification issue. An advanced beneficiary can recuperate the sent messages dependent on the got signals, accomplishing limited identification blunder rate. Location will be trying in 5G inside the massive Multiple-In Multiple-Out (MIMO) structure.

C. Estimation

The normal model is the channel assessment issue. 5G requires precise assessment of the channel state information to accomplish interchanges in spatially associated channels of massive Multiple-In Multiple-Out (MIMO). The famous methodology is the supposed preparing arrangement (or pilot succession), where a realized sign is communicated, and the channel state information is assessed utilizing the joined information on the sent furthermore, got signal.

D. Problems difficult to solve

Network resource allocation is a major question in 5G (new radio) NR , which remembers explicit issues for orthogonal pilot resource allocation ,inter-cell resource block allocation, massive Multiple-In Multiple-Out (MIMO),beamforming resource allocation, client bunching and asset pool arrangement in virtualized networks. The organisation asset assignment targets amplifying the throughput of the organisation while adjusting the assistance rate. It's generally a NP-hard combinatorial advancement issue, and the computational intricacy to tackle this sort of issue increments dramatically as the size of the frameworks. Conventional arrangements utilize static segment of the organisation to reduce the computational expense for a problematic arrangement. These days, with the assistance of modern computing technologies, AI will be a new compelling answer for these issues.

E. Uniform Implementation

Traditional techniques are planned in a separation and-vanquish way for some capacity blocks in 5G (new radio) NR. For instance, the actual layer in 5G (new radio) NR comprises of a progression of sign preparing squares, for example, multiuser MIMO space-time handling, non-orthogonal multiple access (NOMO) signal location and encoding furthermore, translating for low density parity check code (LDPC) as well as polar codes. Analysts have endeavored to advance the calculations and usage of each preparing module and made progress by and by. Be that as it may, the proficient and Nonetheless, the productive and adaptable execution of the whole correspondence framework is missing, with ensured execution. It is noted that, artificial intelligence strategies should be

skilled for dealing with every one of the modules. This moves us to additionally build up a uniform AI based execution which turns out together for all the key modules in the 5G (new radio) NR actual layer. By bringing together the modules with AI techniques in both calculation what is more, equipment, the plan, setup and execution of the actual layer correspondences will be less complex, quicker, more practical and more effective.

F. AI for Baseband signal handling: Uniform 5G accelarator

The baseband signal handling in 5G comprises of a progression of sign preparing blocks including massive Multiple-In Multiple-Out (MIMO) identification, non-orthogonal multiple access (NOMO) discovery and translating for polar codes. The expanded number of baseband blocks prompted more equipment region and changed execution structures. Notwithstanding, we notice that the conviction proliferation calculation dependent on factor charts can be applied to all the squares. For every square, the systems are kept unaltered, and we just need to adjust the image set and limitations of the factors to the specific capacity. Henceforth, a uniform accelerator for the baseband can be planned dependent on the conviction engendering calculations with configurable factors.

In any case, the exhibition of conviction spread is restricted in some baseband blocks in specific situations. Here, AI can be a potential answer for these issues. By improving the conviction proliferation strategies with the AI strategies, an artificial intelligence based uniform accelerator can be built. The AI helped conviction engendering calculations can be planned with the accompanying two strategies:

DNN-aided belief propagation:

(1) Unfurl the factor chart of conviction spread by copying the cycles to frame a deep neural network (DNN).

(2) Train the deep neural network (DNN)by directed preparing. Utilizations of this technique in the baseband incorporate the deep neural network (DNN) -based polar codes decoder and the deep neural network (DNN) -supported MMO locator.

Belief propagation-based convolutional neural network (CNN):

(1) Map every hub in the factor diagram of conviction spread to one pixel in an image, in which associated hubs ought to be planned into adjoining pixels; (2) Train the convolutional neural network (CNN) utilizing the acquired pictures. This strategy is used in the BP-CNN channel decoder.

The neural organisations are profoundly self-versatile and solid. By applying deep neural network (DNN)and convolutional neural network (CNN) in the baseband, we can accomplish execution upgrades up to a uniform equipment usage structure. All things considered, the centre activity for convolutional neural network (CNN) is the convolution, while the centre of deep neural network (DNN)is theaugmentation of the two-dimensional lattices. We notice that the systolic design can understand both tasks.

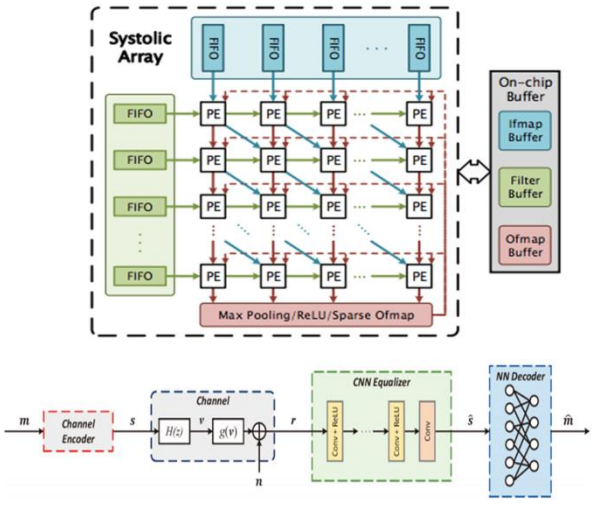


Figure represents a reconfigurable systolic engineering intended for accelerated convolutional neural network.

It very well may be seen that the systolic design is standard and adaptable, which upholds extraordinary

convolutional neural network (CNN)s and deep neural network (DNN) s. This persuades us to investigate the prospects of reusing a similar equipment engineering to acknowledge both 5G and DL calculations.

The related AI accelerator can be together acknowledged by two systems:

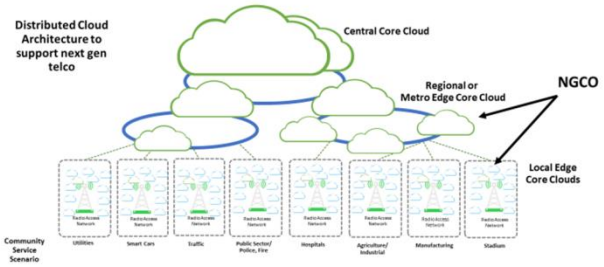
(1) The uniform engineering: The common collector can be collapsed into one uniform processor to spare the gear zone. This processor at first fills in as a CNN-based equalizer with the data signals from the channel. The surrender of the convolutional neural network (CNN) will be spared presently. The processor will at that point work as a DNN-based decoder, for which the spared surrender from the convolutional neural network (CNN) will fill in as the information. The disentangling comes about will be the final abdicate.

(2) The cascade engineering: Two processors will be fell clearly to develop the recipient, one being the CNN-based equalizer whereas the other being the DNN-based decoder. This engineering has more gear utilization, be that as it may, fulfills higher throughput rate.

Generally, the AI based uniform accelerator is more adaptable for the equipment usage, consequently, can accomplish different framework prerequisites.

V. HOW WELL CAN 5G COLLAB WITH CLOUD COMPUTING?

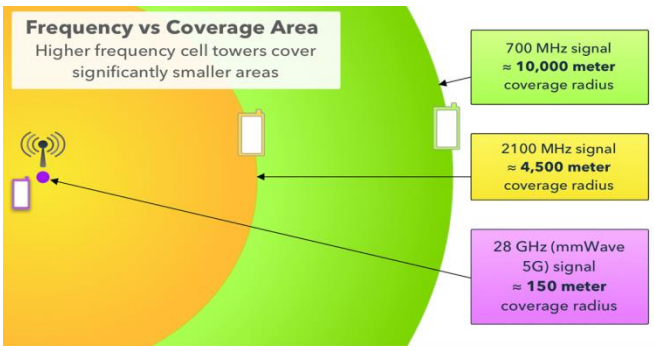
In Today's Organization Cloud processing/Cloud computing is one of the most essential for the processing of data. The future of mobile cloud applications will become more efficient after the widespread of 5G technology. 5thGeneration networking technology will be able to enable the cloud service providers to reach the mobile customers with ease and reliability. Cloud computing technologies will be able to offer more features and options to mobile users, allowing remote workers to access the cloud even where internet connectivity is not reachable. The Cloud Computing features can be enhanced with 5G technology. For example, if a news reporter needs to upload a video within a minute to their cloud then and only then his news will be seen on TV. In this 5G plays big role by providing the efficient upload speed for the user.



VI. DRAWBACKS

First let's talk about drawbacks and how can we comeback on those:

1. As 5G technology transmits millimeter wave which is in 30-300 GHz, it cannot transmit through any obstacles. Even it gets interruptions in the rain. If we see the coverage of 5G, it does not cover a massive area. It only works in a small coverage area. The comeback for both above drawbacks is either beamforming or setting up base signal receivers. These base signal receivers will act as a repeater and transmit the signal further to many receiver mobile phones which will cover up a large area.



2. The 5G millimeter waves have some of the worst adverse effect of human health. TheseEffects includes increase in the risk of cancer, cellular stress, genetic damages, structural and functional changes of the reproductive system, learning and memory defects, neurological disorders, and negative impacts on general well-being. Countries like UK, Ireland, Australia have banned 5G network due to the adverse health effects on the human health saying that people of the nation are not guinea pigs whose health could be sold at a profit. The only comeback to this problem is if we change the frequency from 300 GHz to 600-700 GHz to reduce the millimeter wave radiation.

VII. BOONS

5G provides fast and furious speed:

The speed provided by 5th generation wireless network is 20 gigabits per second. Increased bandwidth = faster speed. With this improved speed all files would be accessed without any lag. Movies can be downloaded within a couple of seconds. The benefits of a fast 5G network go beyond downloading videos and games. Because of the activation of the cloud system devices neednot to depend on the internal memory. As all this can be done on cloud itself, there is no need to save data.

Low Latency:

Latency in simple words is called as lag. It is the time taken by the system to access an event and respond to it. A large file that takes couple of hours to download with 3rd generation technology would take even less than 4 seconds to download with 5th generation technology. Considering the lag, 5G tries to make it negligible. Low latency will work as a boon to help people and save lives across the world in the medical field. Other fields like industry and transport will also be benefited with the use of this new 5G technology.

Greater Capacity of Networks:

The capacity of the 5th generation of Network technology is so high that it will allow more and more people to get connected to the internet, even then the internet connection would stay stable and fast, unaffected by the usage of thousands of users. This shows that one will not be affected and be responsible for anyone else's connectivity and every individual will be able to experience a good and stable internet connection in crowded places as well.

Better Gaming Experience:

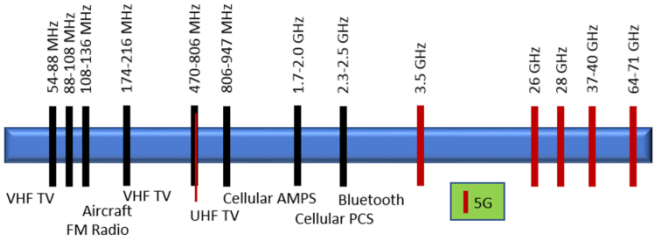
With the 5th generation of Network Technology, the world of gaming will be able to witness innumerable advancements. The 5th generation technology will work to rise the gaming industry on the horizon. Low latency aka "lag" works as a huge benefit to overcome the dreaded lag whichgamers have been awaiting since long time. With the help of 5G added with the cloud gaming server, gamers can enjoy their game on with mobile technology. Response time is reduced to a few of milliseconds because of the advancements done in the 5th generation. As a result, users can experience real time virtual reality.

5G and the Internet of Things:

The 5th generation will help the advancements in IoT to get faster and even better. The 5th generation does way more than just improving the quality of the product. With the help of improved speed and low latency, 5G influenced doorbell cameras are able to record clear videos and load them in milliseconds. Alarm systems got revolutionized with 5G which will help to start the processes quickly without any delay. This will change the face of the security industry.

VIII. SIGNAL FREQUENCY

The diagram below illustrates the signal frequency that 5G currently is being developed right now.



IX. CONCLUSION

5G wireless technology is one of the most efficient technologies which will connect the entire world without limits. It is a multipurpose network for many electric and electronic appliances. It is designed to provide much higher data capabilities, unhindered networks, and vast data broadcasts. In this paper, a detailed review has been done on the 5th generation wireless cellular technology and advancements in capacity, latency, speed, and quality of service provided by the same. In this paper, the evolution of networks from 1G to 5G have been detailed along with the 5G wireless network working and architecture highlighting the improvements in the technological world. Advancements due to 5G in some of the key promising technologies like belief base propagation-CNN and DNN, cloud technology and artificial intelligence have also been discussed in this paper. Moreover, the advantages and drawbacks of 5G networking system have been debated fairly. The 5G wireless technology is still in the developing stage and seems to have a very bright future once completely developed.

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