Opportunities in 5G Edge Computing & Security Challenges

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ABSTRACT

With the current advancement in technology 5G and 6G wireless connections provide easy faster access to the internet and interconnection. The Internet of Things has also made it easier for devices to be interconnected even though they were not built with security in mind. The 5G wireless connection provides high network coverage and data rate speed that can be used in different platforms such as mobile phones, smart cars, and smart cameras which can be combined with machine learning software to provide human like intelligence that can infringe on people's privacy. Places like China are able to monitor and recognize people faces with cameras mounted on street corners, they are able to use machine learning which requires high network speed provided by 5g technology to run the algorithm. The same technology has helped with cars being updated in real-time with current road situations and using machine learning to detect and recognize an object. The device installed on the cars is so small that they use edge computing combined with high-speed access to cloud infrastructure to provide near the real-time output.

KEYWORDS 5G; Security Challenges & Opportunities in Edge computing; Internet of Things; Unmanned Arial Vehicle

I. INTRODUCTION

5G and industry 4.0, to understand 5G the first thing we need to understand is 4G. In cellular technology, there have been 5 generations of cellular technology. The first two generations were communication only basically think of it as a fancy walkie talkie that's what cell phones were really where you were just basically relaying walkie-talkie information through radio towers. The third generation with CDMA gave us the ability to transmit data so then we could start doing multimedia messaging we could send video we could send audio files we could download audio files we could get on the Internet we couldn't do that very well. 4G introduced 4G LTE that went from basically dial-up speeds with 3G DSL speeds to where we can now download a high-speed high-definition video that worked in 20 mega seconds or less. 5G is essentially an extension of the existing cellular technology but what's important to note is that in practice 5G is a lot more than 4G in terms of how it's going to change our lives. 5G supports mesh technology which optimizes the radio spectrum better than 4G and supports device to device communication so you may have heard. 5G makes it possible to support device to device so not only will my phone or my tablet be a 5G client but it also could be a 5G host it could it can share the network with a device that can talk to me but can't talk back to the tower so those are two other benefits of 5G.

Due to the high speed of 5G, data is now being processed at the edge rather than in the cloud to reduce latency. We are now moving to real time data processing and IoT applications this processing needs to be very quick and that's where edge computing is beneficial and a game changer. To understand the architecture of edge computing we need first to understand what edge computing is. Edge computing is playing a pivotal role in ensuring that all the devices such as mobile phones, smart cars, smart watches, and smart homes which are now processing IoT data or real time data big data are connected to this main cloud data center. Why are these edge cloud computing platforms even before we understand this why we wanted on why we need edge computing there are two main factors latency and 2nd is processing? How we can reduce this kind of latency to a device right when you want to listen to your favorite song? What about if you are driving a connected car or a self-automated car and there's an obstacle which is coming in the way of this car suppose this car is now talking to the cloud provider's cloud data center to give the instructions back what they should do because there's a wall in front and you're sitting back on the backseat terrified what should happen. It is these kinds of systems cannot afford these kinds of delays because they can have a very severe impact so that's why edge computing came into the picture.

The driving force for these edge computing technologies is the 5G network because now with the 5G network you have all the speed is becoming so fast that data processing can be done very quickly secondly IoT has three different players in

edge computing one first is your cloud data center second is your edge gateway server and third edge clients. Smart devices or edge client devices have some sort of intelligence built-in within, storage capacity as well, and then it processes the data with higher workloads being sent to the nearby gateway server. The difference between sending it to an edge client versus sending it directly to the cloud is that your edge gateway server would be physically located very near to your device so which reduces the latency and increases the processing power that's why all these gateway servers will be deployed physically closer to all. The systems now where we are seeing the trend of edge computing coming into the picture everywhere where we see today IoT being used for example capturing plant data, transporting intelligent railways, agriculture pesticides which cause harm to the crops, if there are some indications which have come in and smart device need to stop some sort of a spray of this pesticide immediately. Wherein you have all these devices being installed locally within these devices are getting locally installed and then this is sending data to your nearby physically located gateway server. Connected cars are very important now more and more different car manufacturers are installing smart devices within your car and even for self-driving cars in the future where you will be sitting in the backseat. These kinds of technologies would play a prominent role in smart appliances. All those kinds of decisions will be enabled through this technology so these are some areas where we have edge computing playing an important role or will play an important role in the coming times but there are other areas as well. What drives this whole edge computing is the huge data getting generated advent of 5G wireless technology and IoT technologies have enabled edge computing faster processing because now you need faster processing to make good decisions on time intelligence in hand.

When you have a small office or home office having edge devices, which are intelligent devices sitting within you combine with a gateway server where you would have a few racks of servers creates a small data center in its sense. They would be very close sitting very close to your appliance or your device's low latency again a very important factor. Concerns over data security and privacy are one of the things, while the data is being sent to and from many times over your cloud, there could be some intrusion and data breaches if someone directly hacks into these systems where it is installed or maybe just get into your edge gateway server.

Since edge computing is becoming so popular now you would see in the next 10 years or so we will have edge computing in pretty much every area which now. We are using cloud computing but is it fair to say that edge computing will replace cloud computing? We don't think so it would never happen because cloud computing would always be that parent and as edge computing would be a subsidiary of it both would coexist both and enable faster cloud adoption as a whole.

The following is how the rest of the paper is structured: The introduction is covered in section I, and the related work is covered in section II. Then, section III system architecture Section IV analytical model. Does section V present a discussion on can 5G will replace fiberoptic? Finally, section XI concludes the research paper.

II. RELATED WORKS

Cloud computing has been adopted by the most company moving away from traditional infrastructure. As technology evolves comes the new generation of computational offloading edge computing which brings computation closer to a user. With edge, computation has given rise to the Internet of Things (IoT), or what is now known as the Internet of Everything (IoE). Edge computational architecture has brought computation closer to the user with low latency closer to real time processing. Fog or edge computation both perform a similar task that has led to device-to-device connections that help in shared computation as they are context aware and support common data management and communication system. The only major difference is that fog is proprietary and low resource while the edge is cellular network providers and has higher resource capacity. Data security and privacy are major concerns of both technologies which are considered a drawback to the fast adaption of this technology. [1]

With the increase in 5G, wireless technology communication through wireless is becoming more reliable, providing more capacity and more services with fewer resources. This has enabled endpoints to communicate much faster which has accelerated demand for unprecedented mobile network growth. With an increase in smartphones, rural areas have increased network usage this has also been seen in developing countries. With most 5G connectivity relying on satellite power management has also become a problem, especially in developing countries. Since most devices will be able to communicate directly the issue of security raises a major concern. Even though using technology such as mm Wave is inherently secure from attacks such as man in the middle attack, and denial of service attacks this can be enhanced by using bidirectional initial authentication using algorithm encryption, using machine learning such as Convolutional neural network or recurrent neural network.[2]

We agree with the author of the document as having worked in the contact center industry wireless technology has revolutionized the way call center agents can locate the caller. Before it used to be with the landline where the phone is registered as it was a physical facility but with today's mobile technology a caller might be anywhere. Mobile devices can send more data like GPS location and video that can be used by medical personnel in cases of emergency. With 5G technology that enables the device to device communicate at high-speed emergency personnel can get real-time data from a smart watch that can be used in the way an emergency resource responds and this also can be transmitted to the hospital even before the emergency personnel arrives at the hospital thus saving critical time.

We have witnessed that in the most hospital the doctor uses a manual heart telescope that he has to note record manually and enter into the computer manually. With IoT,

all this can be digitized to eliminate manual work and use the time doctors use for manual work to check other patients. With the adoption of 5G wireless speed being a major factor virtualization is becoming common for most machines since they can be deployed at the edge network thus delivering life critical information. [3]

Implementation of 5G through edge computing will provide a major benefit to health care, video analysis, smart home, and cities by adopting new high-speed technology which offers low latency, which helps in reducing cost thus increasing customer satisfaction. Network slicing will help with eliminating reliability since appliances or network devices create a small, meshed network with their virtual resource. Having virtual resource enable devices not to depend on specialized hardware which enables open connection to any endpoint. Machine learning can be used in helping improve communication reliability, and security by learning the pattern used and providing the best option for improving the quality of communication. If machine learning detects security issues it's able to isolate and alert. Machine learning can also be used in slicing the network by detecting commonalities. [4]

IoT adaption has led to great innovation that has helped to reduce energy use only when required. Smart cities, smart homes, smart cars, and smart RFID technology adaption have accelerated in the last few years reducing the use of fossil fuels. In agriculture use of the smart device has helped with watering using only when required which also helps in increasing crop yield. Most homes also are currently using IoT sensors for sprinklers thus reducing water use when it rains or is about to rain. 5G technology has helped with interconnection and also edge computing has been used to process data that otherwise would have taken a long to process and give results in near real-time. Edge computing has also enabled the use of machine learning in fast processing data to provide near real-time interagency. Green-vehicular Adhoc networks (G-VANETs) have reduced greenhouse CO2 emission pollution to our environment. [5]

5G has been the prime catalyst in improving communication performance across devices. With improved communication and low latency to edge devices machine learning can be used to provide near real-time performance across the platform. One main concern has been the privacy and security of the infrastructure which can be abused. Distributed machine learning can be achieved as some data can be processed in the cloud while others can be processed on the edge almost near real-time. There is a growing use of mobile phones in AI and ML where they do part of the processing and other is done on the cloud. This has enabled near real time processing of data such as the recognition of images. Using cloud and edge devices have brought the distribution of ML bringing AI computation to the edge thus helping in privacy and security. [6]

Edge computing has helped decentralized cloud applications with low latency which has accelerated the growth of artificial intelligence and machine learning. ML and AI require powerful computation which can be done when the load is distributed within multiple edge locations some part of processing is done in the cloud which relies on strong cloud infrastructure. For real growth in AI, edge nodes need to collaborate on a standardized architecture that will help with interoperability thus reducing cost. By having standard architecture, it will also enhance growth in security and privacy thus building trust. [7]

Customization of 5G and beyond private networks has been accelerated with the Covid pandemic, this has resulted in automation and digitalization of almost every area of life. Process automation has been centered in every activity from factory to hospital and human interaction using human-machine interfaces. Selling homes moved from face-to-face interaction to virtual reality. Private network connection with 5G wireless help to protect the network from outside threats both physical, and logical. This helps segment both private and public networks which enhances security though it can increase deployment costs and self-management. An isolated network can be integrated with existing industrial networks.[8]

Distributed mobility network technique has helped in the seamless distribution of traffic avoiding network breakdown. This can be achieved by creating a flat network architecture that enables a user to connect to the internet through the nearest local gateway. This has reduced the cost of tunneling traffic and enhanced the quality of experience. Software defined network has brought a lot of flexibility in network assignment via software. 5G will accelerate the flattening of the network with mobile node IPV6 addressing that doesn't require change and thus can connect to any gateway to the internet eliminating the need for a legacy home network and enhancing distributed network mobility management. Mobile node IPV6 addressing is also critical to the connection of smart devices, especially vehicular communication.[9]

Beyond 5G has enabled edge learning as machine learning becomes prevalent in every area of daily life. Privacy is an important part of data can't be transferred to a central location for processing thus the need to process the data at an edge location. The edge learning in the B5G network has helped in utilizing distributed processing of training AI models. Training AI models enable highly distributed data to be used in a fast, cost efficient, and in real time. Using a satellite aerial network as the base station, edge caching and wireless sensing can be used to reduce data load on the network as IoE devices grow. To archive effective data aggregation, we need to adopt a standardized architecture for the huge number of edge devices.[10]

Mobile Edge Computing (MEC) has revolutionized how we mobile phones connect to the internet and its use case, by using 5G to achieve low network latency and higher bandwidth at the edge. It has also enabled computation and storage of data to move from the cloud to the edge device. This has contributed to the reduction of the cost involved with building the cloud and acquiring and maintaining servers in the cloud offloading all these tasks to the edge devices.

Offloading computational tasks to the edge server will help with utilizing idle edge servers as the workload can be shared with an idle system or less utilized servers. This reduces power consumption which is of concern with most cloud environments as the servers are not always utilized. Power consumption can be reduced further by using cluster-based energy aware offloading framework using intelligence to distribute the workload.[11]

Mobile Edge Computing has a lot of advantages like cost-effective as it uses on-demand deployment, and unmanned aerial vehicle (UAVs) increases coverage and computation capacity as they have a reliable line of sight to offload links which reduces energy consumption and latency. This UAV create a meshed network architecture that can cover a large area and depending on their side each can be deployed in diverse application scenarios. A major concern with UAVs is the way they don't have any standard architecture and also power charge when operational. This might affect the critical application and also reduce the line of site communication if there is a weather event, security and privacy is also something that needs to be preserved. We have seen UAVs being used to serve the mobile user for tactical missions in emergency rescue.[12]

Every day we are seeing advancements in technology that are being used to connect almost everything to the internet which is called the internet of everything (IoE). This has created a high volume of data and the expectation of near real-time data processing for such applications as autonomous driving, virtual and augmented reality, and facial recognition. With this expected workload their increased use of energy and storage requirements. Mobile edge computing has been proposed as a solution, but this can be taken further to unmanned aerial vehicles (UAVs) since it has more reach and can combine various platforms such as access points and radio towers to expand their reach reducing backhaul congestion. UAVs can be used in cases of emergency or used in the hostile area to provide support for devices on the ground. Combining machine learning with UAVs can provide real-time information such as image recognition. Using technology like federated learning can advance as you just need to run the model and data will be located at numerous sources without sharing data thus adding privacy.[13]

With today's technology building infrastructure for temporary use in case of disaster or live coverage is not a cost-effective investment. 5G combined with unmanned aerial vehicles (UAVs) can be used at the least cost and time. Deployment of drones or balloons has been used to archive the same purpose. We have seen where airship has been used to project events from the earlier view. We can't just assume that since we have the technology it can work on everything, we have to determine the capacity that mobile edge devices can handle, the amount of information that UAV can compute, and what needs to be computed on the cloud data center. Using this knowledge to calculate the bandwidth need to offload the data we can determine the number of MEC, and UAVs that can be deployed in a particular area.[14]

Optimization of microservices on the edge cloud could be achieved by architecting the infrastructure where the application can be processed both on the edge device and on the cloud. This can help reduce the latency of application response and provide near real-time data. Microservices for edge cloud have been used to run the application in the edge device faster since they are run on any device and they are lightweight so they don't require a lot of resources. Decentralization of network architecture helps to run the application with effective utilization of computing resources. [15]

To effectively share, monitor, and control resource utilization there is a need to incorporate blockchain technologies beyond the 5G network. 5G technology has resulted in the adaption of the internet of things in each sector of life. Users expect near real time data thus computational activities must be near the user at the edge. There is new creativity to meet customer demand since they want near real time delivery while maintaining a high level of security and privacy. Some of the solutions used include network slicing by utilizing technologies such as software define network and network function virtualization though still utilizing the same physical network. A physical network can be split into many logical networks to deliver tailored services which can incorporate different operators and infrastructure suppliers. Blockchain can be used by users to grant partial or full access to data when the user what that access to be removed data can be removed. [16]

Blockchain being a decentralized ledger using a smart ledge algorithm can be used in the Internet of things and edge computing to manage resources in decentralization, transparency, traceability, security, and immutability. Each block of data is encrypted in chronological order and recorded in a smart ledger which can either be private or public. Data security needs maintaining a consensus mechanism in blockchain to enable joint ledge to use thus the need for an appropriate resource management architecture. With a standardized architecture, consistency will be maintained and traceability. [17]

Security and privacy are key in the adaption of 5G technology with its low latency and high reliability which has enabled the advancement of autonomous driving and intelligent mobility. Next generation networks i.e. 5G and beyond will expedite the adaption of artificial intelligence and fully autonomous driving since there is a huge amount of data involved with near real-time output. Devices being able to exchange information with each other is critical for real time output this widen the attack surface for cybercriminals and bring privacy issue as information is being shared. Cybercriminals might use that feature to supply bogus information to a device or jam the devices which can lead to major issues.[18]

Health care has grown with the advancement in technology, 5G takes it to a higher level as the doctor can collect real-time data from patients even at home. Wearable devices such as smart watches connected to the 5G network can provide a

real-time update to a doctor who can alert a patient in cases of emergency. Smart sensors can be placed in an individual without having to stay in the hospital and they can be monitored remotely and in near real time. Security is a major concern as its critical for data to be always encrypted which might increase the cost involved with encryption, decryption, and energy to perform this task. Machine learning plays a great role in the classification and prediction of patient data collected by sensors, some models can be run within the edge device while some can be run on the cloud to provide timely services to the patient. [19]

Multi-access edge computing (MEC), information-centric networking (ICN), and Beyond 5G have been used to reduce the latency of processing data wirelessly. Before the technology, all data was processed in the data center which required data to go through various networks to reach their destination. With Edge computing, most data are processed nearer to the source which has reduced network energy and increased efficiency. High-speed data processing has also created or encouraged great innovation in the field of IoT, which will require standardization to enable interoperability to realize its full potential. Standardization will also help in growth beyond 5G as we move to 6G and beyond. Standardization of the architecture of Multi-access edge computing (MEC) and information-centric networking (ICN) will create a baseline for the future growth of the technology. Both technologies are key to growth as they provide a key architectural baseline for IoT growth and wireless technology that will accelerate content delivery. Standardization will also help in enhancing security and privacy thus helping in quick market adaption creating smart cities and smart home appliances.[20]

III. SYSTEM ARCHITECT

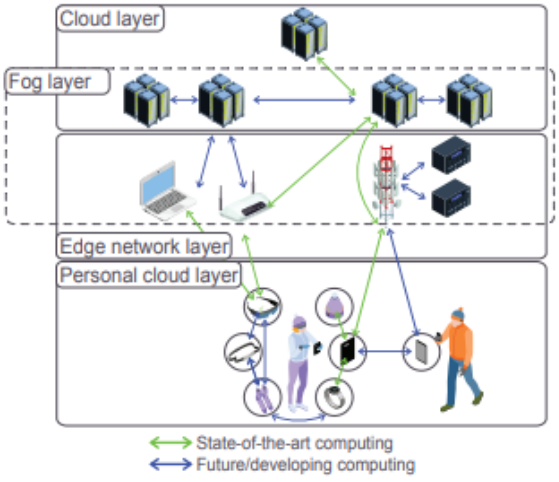

Figure 1. Most common task offloading models.

Cloud computing has been adopted by many organizations as it has reduced the cost involved with leasing or buying hardware and maintaining servers in the data center. This has moved costs from CAPEX to OPEX which is less for most companies.

Big medium and small companies have been able to adapt the architecture with ease of use and convenience as they need just a secure internet connection to access their system. This also brings a lot of security concerns as all these systems are hosted on public sites that can be accessed from anywhere and by anyone. Communication costs between the systems and clients are reduced since they are using a normal internet connection and don't need a dedicated connection.

When accessing the cloud system from an edge device at the personal layer they have to make sure that their device is safe and secure from malicious malware as it can be used to access their network infrastructure to steal or use the data maliciously.

The third party also have been used to compromise the system using third party devices like point-of-sale devices that are already compromised.

We have seen a lot of companies grow organically from a small system as they don't need upfront costs to host devices, they can add devices as they grow without the need for dedicated resource to manage their system. This has been a great advantage of cloud computing. 5G technology will bring a lot of enhancement as access with being fast and closer to the end-user reducing the cost involved with access.

Since Fog computing lack standardization, this might hinder its growth as interconnection and security standard need to be established and adhered to this also might affect the quality-of-service QoS as the is no standardization on service performance.

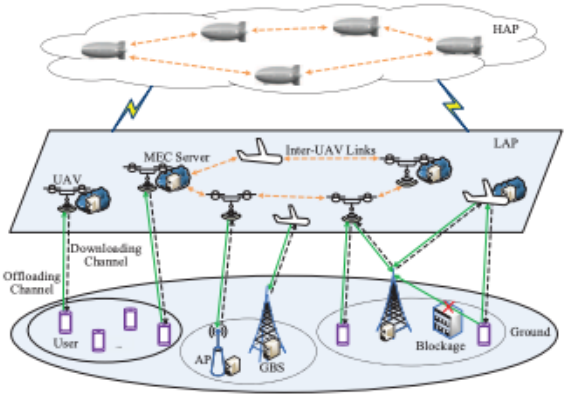

Figure 2: Network architecture for aerial MEC.

With the advance of cloud computing and almost every small medium and big company adapting its use, advances in technology have accelerated in the last ten years. 5G technology has made it even easier to enable faster reliable access to the internet. This has led to growth in mobile edge cloud that includes smart car automation, drones, smart devices IoT, and accelerated adaption of smartphones that can perform just like a computer laptop.

Having such great technology in everyone's hands with ease has also brought about technology being used in malicious ways which make securing this device an important

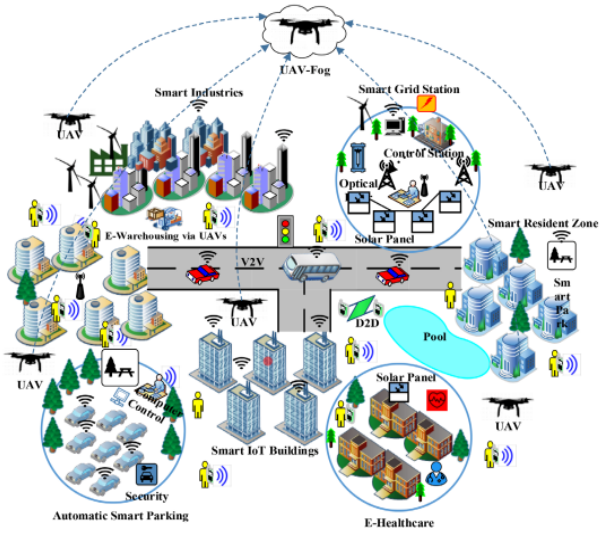

FIGURE 3: Greening UAV-based fog computing infrastructure [5]

part. Privacy has also been reduced since everyone can snap a picture or capture a video and post it online or even stream content online without concern for their privacy or others.

Mobile edge devices have been also used in the surveillance of individuals with or without their concept. Smart homes have also been on the rise thus helping in reducing energy use and helping the environment as you can monitor and control devices remotely.

Mobile Edge Computing has also been used by the military to do surveillance in an area that is dangerous to reach and for transmitting a signal to each other thus creating a mesh network of devices.

Since they are cheaper to operate effectively, deploy on demand, are energy efficient, and provide near real-time data. One of the major challenges is that they need to have a line of sight to communicate effectively there for control towers need to be established. This also brings the issue of security as if the towers are compromised then communication to the MEC devices might be compromised or disrupted.

MEC devices have also accelerated the growth of machine learning and artificial intelligence as most organizations use them to capture images.

Unmanned Arial Vehicle "UAV" has seen major growth in recent times. Combining UAV, cloud computing, and edge computing devices IoT has changed the way we access and utilize the internet. UAVs can cover large areas, unlike base station towers that require a line of sites to communicate with each other to cover a large site. Companies like SpaceX can launch a satellite and move them to the area where needed as they did to Ukraine when they had an issue with their base stations or in case of a medical emergency. They also use less energy compared to the data center or base station since they can be put on sleep mode, and they don't emit harmful gas which contributes to green energy efficiency.

UAVs can be used as a backbone for the network infrastructure, therefore, eliminating the need for running cables from customer sites or base stations to cloud data centers. Smart homes, smart industries, and smart devices can utilize high speed access that is reliable. It's also easy to access the internet even in a remote area where a physical connection is not doable.

Machine learning and artificial intelligence are also accelerated with the growth of fast reliable internet, especially in the field of research in the remote area where cable internet is not available. Smart vehicles can detect and translate images much faster and establish the reliable connection that is needed in case of emergency.

One major disadvantage is that now we have a lot of satellite in terrestrial that can create debris, this will need standardization on how satellite is decommissioned or managed. With a lot of satellites launched this can clog the atmosphere and interfere with critical satellites.

Fast internet connection and UAVs can be used for surveillance of countries or people which is a major privacy concern. UAVs can also be used in directing unmanned vehicles that can be used to commit the crime.

UAV plays an important role when used correctly to grow the penetration of the internet and help its growth.

IV. SYSTEM MODEL

To maximize 5G we can be enhanced the speed of the network by slicing the network into small packets that can be increasing the availability rate and minimize network latencies.

A. Availability with Rates

With the current availability of quantum computing and advanced processing power, machine learning can be used to manage network slicing to prioritize services offered on the same physical infrastructure. It can be tailored to the specific environment and archive service level agreement. These could prioritize paying users over free users or when you have a major event you can limit one network and allow another more bandwidth or detect pick hrs. and adjust accordingly[21].

$$R_m(t) = \sum_{n=1}^{N} \sum_{i=1}^{k_m} c_{i,m}^{n}(t) R_{i,m}^{n}(t) \tag{1}$$

Where:

- The total rate of user equipment (UE) I in slice m.
- The number of network slices is M ( ).
- The is an active UEs of slice m.
- The number of sub-channels is N ( ).
- The adjustment action of sub-channel allocation is (t).

B. Availability with Latencies.

The network slice algorithm should make sure to maintain an expected latency of less than 1ms. Near zero latencies is critical, especially when using a self-driving vehicle or in the medical field like surgery where human life is involved. A few second delay can determine life or death in a situation.

The algorithm should be less complex in design to help in service adoption.

To improve the latency, the average delay (22) can be determined from the queue length, the amount of data arrived, and the number of transmitted packets of UE i in slice m [22].

$$D_m = \sum_{i=1}^{k_m} D_{i,m} \tag{2}$$

The $D_{I,m,}$ and D_m of the UE "i" in slice "m"

The average delay of the slice "m".

The maximum delay of slice m depends on the design of the slices and algorithms.

V. CAN 5G TECHNOLOGY REPLACE FIBER OPTIC

We have seen how G5 growth has accelerated, widely adopted by different wireless carriers, and used in almost every wireless technology. This has led to a question and debate about the 5G network replacing fiber optic cable, especially in homes. While almost every wireless device is built with 5G technology it's still at the inception stage and still growing.

In my neighborhood, we only have an AT&T network, and no other internet provider is allowed, when I try to get T-Mobile 5G Modem they show that it's not available in our area though I can get internet at 5G with my mobile phone. The fight for customer base might be one thing that is hampering the growth and adaption of 5G technology at homes. Most houses are now connected with fiber optic cable which requires a huge investment to install and maintain. The companies want to make sure that they have recouped their investment and made a profit before they can allow access to other providers to protect their market share.

Looking at the access point that provides 5G wireless they are supported by a backhaul of fiber optic cable to maintain 5G speeds. This is done from the core internet to the tower that broadcast a 5G wireless network. Fiber optic cables are also very reliable, especially in bad weather, and can provide almost unlimited bandwidth. Fiber optic cable is also more secure than 5G as it's a wired connection to the endpoint that doesn't rely on radio wave whereas 5G rely on radio wave, one advantage though is when it configured to have end to end encryption that can be used to reduce man in the middle attack.

Another advantage of Fiber Optic cable is being fast and low latency as it has a one millisecond whereas 5G has around four millisecond latency. On the other hand, 5g technology is much cheaper compared to fiber optic due to the cost of cabling to an endpoint. A single 5G tower can support multiple users whereas for fiber cable you will need to run cables to each endpoint thus increasing the cost of material and labor. The setup cost of 5G is minimal as you only need a modem but for fiber optic cable you will need to run fiber cable to each home.

There are sometimes when you will consider 5G technology rather than try to get fiber cable these are cases where the access point to fiber cable is far and access cost is high to run them to your location. 5G technology will provide high speed access to the internet with minimal cost as you only need to buy a modem. Most wireless telecommunication companies like T-Mobile or Verizon are now providing Midband 5g networks to home users.

Sharing access point tower has its advantages of cost reduction there is also disadvantages of congestion which has been seen in most cases where there is a bust of network activities. When there are cases of public emergency, we have seen that most telecommunication companies' access towers are not built to handle a large number of connections. We have seen where people are not able to make calls or access the internet even sending messages is clogged. Fiber optic cable doesn't experience such an issue as each endpoint has its worn dedicated cable to an access point that is capable to handle huge traffic.

VI. CONCLUSION:

We have seen an increase adaption of IoT devices example smart homes that are built integrated with 5G technology this will need an increase in the installation of the access point to handle traffic generated by this device. If this device will be connecting to the access point directly this will add huge traffic and thus might affect speed. Companies have started selling home routers where all the home devices can comment directly and the home router connects to an access point thus eliminating the need to connect to IoT to access the access point directly.

Currently, we don't think that 5G technology will be able to replace fiber optic since 5G technology is not adapted in all areas thus hampering growth and some market have restrictions on the technology that can be implemented. As adaption and products move to 5G there will be enough coverage that areas that are not covered will be automatically covered as 5G technology used dedicated microwave links and thus can't be limited to location. As row material needed to build fiber cable becomes expensive a lot of focus will be on building a 5G network across the country that will cover even remote areas.

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