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Impact of 5G on IOT Implemented Devices

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Abstract— As the IOT is gaining popularity there is a requirement for a technology which can support large amounts of data transmission efficiently and at very high bandwidth. The near-term future i.e. the next generation of IOT devices one of the primary needs or goals that need to be met are greater capacity, a higher speed of data transfer, and decreased latency. The development of next generation wireless mobile communication technology namely, 5G which promises to fulfil the needs of complex IOT architectures. This paper focuses on the requirements which can be fulfilled by 5G and enlightens architecture, merits and demerits of 5G network. A detailed survey on 5G enabled IOT devices, the research on this type of network have been conducted in various places around the globe.

Keywords— IoT (Internet of Things) IoT, Authentication, Autonomous Things, 5G, 5G -Network

I. INTRODUCTION

5G, the latest mobile technology is the 5th generation. It's a brand new wireless standard that has been developed after 1G, 2G as well as 4G. 5G represents a new type of network developed to link almost everything and everyone that includes devices, objects as well as equipment. The 5G technology is designed to provide higher speeds at multi-Gbps with extremely low latency, and higher security. Enormous network capacity, increased availability, and a better user experience for a larger amount in users. Performance and efficiency improvements allow users with exciting new experiences, and also connects to the

world of new businesses. [1] In general, 5G is employed across three primary types of connected services which include high-speed wireless broadband and mission critical communication and the huge IoT. The most notable feature in 5G is that it was built for forward compatibility, the ability to be flexible enough to support future services which aren't available yet.

A. Mobile broadband that is enhanced with mobile connectivity

In addition to increasing the performance of phones, 5G mobile technology is also able to provide new experiences that are immersive, such as AR and VR which have faster speeds with more reliable data rates, with less latency, and less price per bit.

B. Communications that are mission-critical

5G will create new services that will revolutionize industries through ultra-reliable accessible, low-latency connections like remote control of vital infrastructure, vehicles and medical procedures.

C. Massive Internet of Things

5G was designed in order to connect a range sensor embedded in almost everything, due to its capability to cut power consumption in terms of data rates, mobility and power consumption. This will provide extremely efficient affordable connectivity options.

5G is designed to provide high-speed data speeds of as high as 20 Gbps according to IMT-2020 requirements. Qualcomm Technologies' leading 5G technology includes Qualcomm(r) Snapdragon(tm), Qualcomm(r) Snapdragon(tm) X65 is designed to deliver 10 Gbps at the peak data rate downlink.

However, 5G is far more than just speed. Alongside higher peak data rates, 5G was developed to boost capacity on the network, by expanding into new spectrums, including mmWave.

5G also has the potential to provide reduced latency to provide quicker response, and also give a more consistent user experience, ensuring that speeds remain high even when users move about. Additionally the 5G NR mobile network will be supported with also the Gigabit LTE coverage base that will offer all-encompassing Gigabit class connectivity. [1]

II. ARCHITECTURE OF 5G IOT

IoT in a 5G framework mainly comprises of five layered architecture and involves the operation of collecting data, processing, analyzing and sharing the information between the devices and communication network. (a) IoT Sensor Layer: This layer consists of physical layer system such as smart sensors, devices and communicates to the network layer. (b) Network Layer: Network layer in IoT comprises of low power wide area network (LPWAN) such as Sigfox, LoRa, ZigBee, NB-IoT. (c) Communication Layer: This layer can be considered as the backbone of IoT architecture because it transfers the whole information within the layers. (d) Architecture Layer: It is the framework of IoT, where architecture likes cloud computing, Big Data Analytics are considered. (e) Application Layer: IoT applications like, smart factories, smart homes, smart agriculture, smart transportation etc can be realized. This layer integrates all the devices sensors and information over wireless connectivity using internet.

In this architecture, smart IoT sensors for different application are connected to IoT gateway through low power networks such as SigFox, LoRa or NB-IoT which are used for long distance communications. This efficient gateway collects all the information from IoT

devices and it transmits the collected data to 5G base stations via 5G communication link. 5G communication links can be designed using 5G new radio technologies with efficient numerology selection and mm wave communication technology. Further, IoT signals are processed through 5G cellular base station which has multiple inputs multiple output (MIMO) antenna with additional capability of beam formation and spatial multiplexing. 5G mm wave communication technologies help to transfer radio signals in higher frequencies greater than 6 GHz. This millimeter wave communication is preferred which allows larger frequency operation up to 80 GHz [1]. It can also support maximum number of connected utilities with micro and macro base stations called heterogeneous network for new CRATs. Different applications of IoT are possible with 5G Radio technology. The pictorial representation of this environment is shown in fig 1.

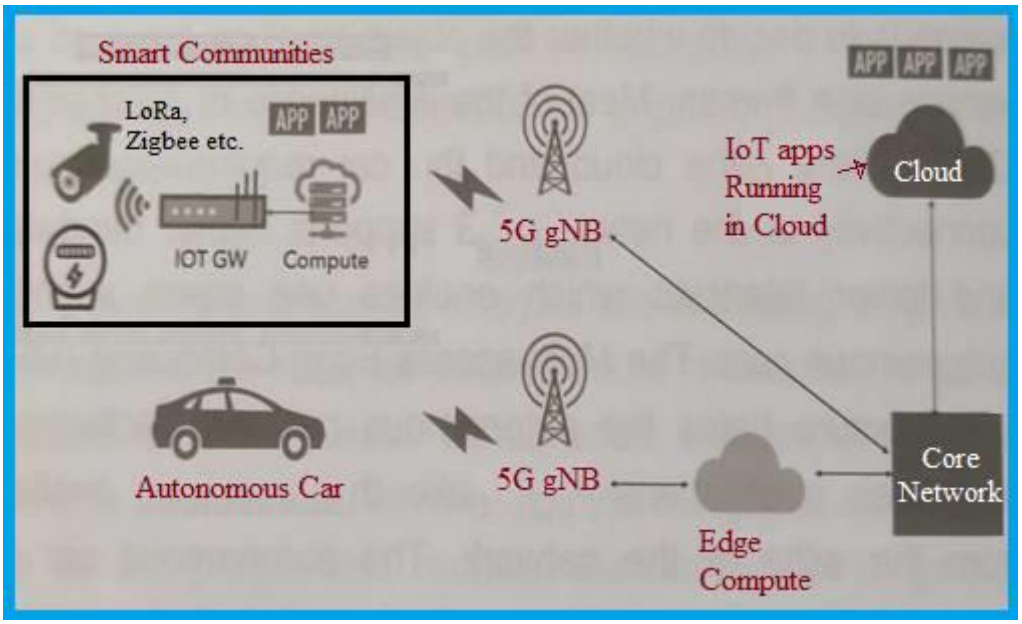

Figure 1. Internet of Things in an intelligent environment.

Due to its extremely low latency, which supports the majority of IoT connected devices as well as MTC, which provides seamless support for M2M/IoT 5G is able to boost the effectiveness in a variety of IoT applications, including those mentioned below[10].

A. The TELEMATICS RELATED Applications

Vehicle tracking with streamlined IoT connectivity empowers logistics companies - 3PLs and 4PLs & delivery vehicles (including FMCGs, White goods, Food delivery aggregators) and cab companies/aggregators.

Connected Cars with seamless low latency connectivity to other vehicles, networks infrastructure, and the rest of the road infrastructure

Telematics allows us to collect, store or send important information needed to regulate objects like vehicles that are in motion using the capabilities that mobile phones offer. For instance, if it is an IoT sensor in your vehicle that is connected to your smartphone it can be capable of monitoring the speed, fuel consumption tire pressure, fuel consumption, and more. and also sending useful alerts. These data points can be used to enhance other alerts such as traffic and weather conditions, making driving more secure. Additional intuitive features are supplied to your car by IoT devices.

B. TELEMETRY Applications

Monitoring of temperature in railway networks could be carried out using 5G-enabled mobile telemetry. This will allow station owners at the railway to develop more secure routes for trains, thereby avoiding a variety of accidents (rail lines are able to expand and contract depending on extreme weather conditions

Smart meters make it easier to in the automation of meter reading and the tracking of faults in different utilities such as gas, water, energy and electricity. The meter reading becomes more discreet and less demanding at home and in other facilities as well. 5G boosts the efficiency of smart meters and helps to speed up power reconnecting after interruptions.

Telemetry also offers information to utility companies. People could be held accountable and be charged additional fees if they use more than usual amounts of electricity (e.g. industrial consumption vs residential consumption). Through analysing a variety of patterns of data power utilities are able to advise consumers to make changes in order to decrease the consumption of power and bill. This will allow them to control the growing demand and strengthen the grid of power. 5G-based IoT sensors are linked to the consumer utility portal which lets customers turn off their devices/power source remotely in the event that they forget to turn off their devices when they leave their homes[2].

C. Smart GRAID AUTOMATION

5G lets us control the smart grid, which is among the most rapidly growing technologies and can be extremely effective compared to the traditional grid. Customers can enjoy high-quality services that are facilitated by AMI and telemetry using IoT devices. Smart grid technology allows for easy integration with a comprehensive system that can control the grid, monitor and analyse challenges that guarantee safe and reliable electric power to everyone.

It allows for live monitoring and hybrid systems, where the possibility of faults being detected and anticipated is high. Solutions are available quickly since it blends intelligent electrical networks and digital communication technology to create an advanced smart grid.

D. REMOTE SURVEILLANCE

Remote video surveillance using 5G networks equipped with IoT sensors are able to observe production lines and high security zones with ultra-HD video. Video Analytics is supported by 5G sensors as well as the high speed low latency transmissions. Thus, IoT sensors send real time alerts whenever any criminal, vandalism, or suspicious activity is identified.

E. SMART TRACKIC STAFFING

5G is able to enable Intelligent Transportation - IoT sensors gather real-time data from vehicles and other infrastructure on the road. They also provide immediate alerts as traffic cabinets incorporate these systems at the respective intersections of the city's streets. Utilizing such systems in a regular basis can result in savings, reliability of the system as well as traffic safety and efficiency.

These smart traffic control systems come with IoT cameras, sensors as well as cellular routers, and automated that can fully deploy 5G networks.

F. Applications for Manufacturing

5G, when combined with IoT can be utilized to automate processes and provide predictive analytics to repair issues via remote monitoring of production lines, helping to transform workflows into instrumented digital processes that collect data by integrating machines, operators and sensors to meet intended business objectives.

Repairs to AR, Collaborative Robotics, Precision mining, and smart manufacturing scenarios such as SCADA automation are just a few examples of examples of how IoT is benefited by 5G's low latency, high speed, and high definition video streaming capabilities.

G. Medical Applications

A low-latency Ultra HD video streaming between ambulances that connect to hospitals with IoT sensors will allow hospitals to keep track of patients who are in transit and help hospitals prepare for immediate treatment.

Smart wearables and sensors integrated in healthcare systems will aid in keeping constant contact with the doctor during surgeries, and patients are medical treatment sooner, which is not possible to access by hand. Robotic surgeries are made easier through the low-latency capabilities of 5G as well as IoT sensors as well.

H. Dairy Farming

Smart agriculture is growing exponentially thanks to a variety of technologies such as IoT drones, robotics and AI, which can help improve the amount and quality of farms. IoT sensors in a farm monitors in real-time

information such as soil water, fertilizer pesticide, as well as other chemical levels, while optimizing the amount of human labour required for production.

The yield of milk, the health of livestock and livestock fields are also tracked by IoT sensors, which also track agricultural vehicles and weather information remotely. Data alerts are sent to the farmer, making farming processes more data-driven and data-driven.

5G and IoT allows farmers to monitor their fields' condition without the need for physical presence, and, in turn, make important choices[2].

I. Smart Cities and Smart HOMES

Smart cities make use of the 5G network as well as IoT sensors to gather real-time data, and also to identify patterns in demand, and create and implement rapid and cost-effective solutions. Similar to IoT sensors found in appliances lighting, thermostats, lights and other gadgets allow homeowners to manage them efficiently using 5G-connected smart-phones and tablets. The ultra-low latency feature 5G provides a user experience that is close to real-time to Smart City as well as Smart homes applications[4].

III.5G-IOT FUTURE TRENDS

5G technology is designed to provide a an easy virtual network in which wireless broadband technology is used to offer greater peak speeds for data and massive network capacity, as well as greater security, etc. and play an important part for vertical markets i.e.5G networks should be designed with new capabilities that meet the requirements of new vertical markets. 5G networks can support billions of devices with higher frequencies and with shorter distances and operate virtually without latency. When comparing 4G and 5G may be difficult, 4G is a cellular broadband network, whereas 5G is more efficient and flexible to ensure a strong connection with the user, and many other that was not possible with 4G [3].

5G is essential to emerging applications, business models, and in new industries as well as in a myriad of intelligent applications. In the discussion of 5G IoT the future cell phones are the basis for the IoT that can help you improve performance and make the best utilization of information. Cellular networks offer a range of IoT services, including scalability and reliability, quality of service security, cost-effective using existing networks.5G networks permit a wide range of services that providers' virtual wide array of networks that are customized to the requirements of each application and offer a high speeds to mobile IoT devices. That’s why battery less sensors are definitely the future of IoT devices. 5G is the wireless technology of cellular mobile networks that bringing new capabilities and deliver high speed that will create more opportunities for people, businesses and society. The 5G network is a new generation of wireless network technology as well as mobile networks which are be expected to transform the way that people are living and working. Upcoming 5G network will be play vital role with IoT and promises to facilitate via 5G-enabled devices, including smartphones, tablets, laptops and IoT As we know very well that strong connection is based upon signal strength so this will be achieved in future while connecting strong connection with help of 5G network. 5G is not just a communications network but high-band 5G spectrum that provides the expected boost to improve quality of life around the world by using unconventional use cases that require low latency, massive connectivity for various application such as smart cities, smart home, eHealth, e-commerce, IoT and more. When we discuss 5G and IoT. IoT is the network of physical item where connection of 5G with IoT will changing way of work, live, travel and do business or in future also 5G wireless network bring great platform for various applications[7].

For remarkable improvement in various applications such as mobile technologies with no latency, provide faster speed as compare to 4G and 3G Fig.4. For this 5G networks will have to offer extremely high connectivity so for this 5G network technology provide boon and

support new opportunities and enhanced mobile broadband also have distinct set of massive IoT use cases.5G technology also promise to provide great platform to transform the way you do business. According to communication 5G networks is a cellular broadband network technology that come out with existing networks .For virtual markets 5G network is emerging to designed simple virtual networks for business enterprise, IT companies and many more [9].

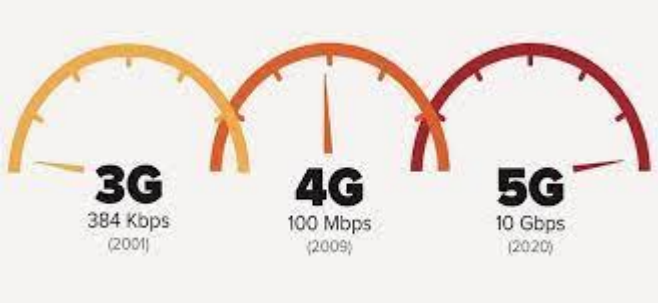

Fig. 2. Comparison between 3G, 4G, and 5G.

IV. CONCLUSIONS

Combining 5G networks and IoT devices will bring an era of connectivity. It marks a major change within the IoT ecosystem that will bring faster speed, lower latency rates and greater reliability, a consistent user experience, and amazing effectiveness, which will aid in making applications that are technology-related better efficient, more user-friendly and economical. Industry 4.0 can be brought to the next stage with 5G. Not only will fifth-generation wireless technology enable high-speed mobile connectivity, but it will also improve IoT data transmission performance. 5GIoT is a completely converged main communications and change-driver for s mart IoT devices and services in the future [8]. 5G will help accelerate the advancement of intelligent machinery and intelligent manufacturing. 5G is projected to be 10 times faster than existing LTE networks, according to research. IoT devices would be able to communicate as a result of the increased speed. The IoT network of the 5th generation has the capability to link 100 billion devices and along with the use of 5G networks, it will be the future technology. While this 5G network and its innovations will play a vital role in leading to technological revolutions for our entire life with the unlimited data plans. 5G can connect a greater number of users at once and offer smarter and quicker services than previous generations. These requirements have begun to hit 5G features to integrate with different IoT technologies, and IoT applications such as fall detection systems in healthcare and MIMO systems would have relevant requirements.

V. FUTURE CHALLENGES OF 5G-IOT

5G is able to generate new revenue streams from the new mobile experiences, apps and services. However, these applications and services put different and demanding requirements on the network in terms of speed, latency, capacity and availability. 5G technology will be more helpful in connecting large number of applications to the IoT devices. Also 5G has the power to handle the data from millions of IoT devices and that will provide a better ability in downloading faster, providing better coverage and also in increasing the data rate. As compared with current network 5G networks will be significantly more complex network. It is still a struggle with delays and slow uploading of files [5]. Internet browsing downloading videos or audio. Online streaming in the speed of. This issue has arisen as the result of advancements in the quality of video like Ultra High Definition (UHD) applications. 5G addresses the issues of 4G. 5G will enable UHD audio and video functions performed in real-

time. 5G will work with existing technologies. 5G should work with speeds of 1 Gbps and even more. The biggest challenge is that 5G will use UHF, which is not equipped with the capability to penetrate obstacles. Its propagation range will be short[6]. The future challenges may occur in low frequency, UHF, deployments automation requirements, low energy consumptions, spectrum harmonization and availability, security, and availability of devices.

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