

An Overview of IoT Capabilities Using 5G Technology

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Abstract: IOT and 5G, two of the hottest buzzwords in technology are combining to transform our future by interconnecting everything: humans, cars, appliances and anything else that might benefit from an intelligent connection. Some of the key services for 2020+ timeframe involve smart city applications requiring smart-grid, transportation, medicine, connected homes and sensors creating the environment of Internet of Things. 5G is the foundation access technology for IOT applications. 5G is touted to be faster, reliable, with advanced features and many more that will cater to larger base of applications. As of pre 2020 time frame LTE and advanced LTE (Long Term Evolution) is leading the wireless computing, but the technology that is being offered by LTE is not sufficient to match the capabilities that lay ahead using IoT. IoT is the platform where millions of devices are connected to one another and exchange of data takes place which require an advanced technology, that which can be provided by 5G. In this paper a general view of how 5G will elevate the capabilities of IoT in the near future so as to cater businesses, home appliance consumers, healthcare etc. that will realize the far beyond future very near and early.

Keywords: IoT, LTE, Smart Grid, 5G, Sensors.

I. INTRODUCTION

Today's cell phones have it all. The phones have everything ranging from the smallest size, largest phone memory, speed dialing, video player, audio player, and camera and so on. From the introduction of 1st generation cellular system to latest 4th generation systems, there has been a lot of changeover in usage of voice services and data services. Maintaining the Integrity of the Specifications The creation and entry of 5G technology into the mobile market place will launch a new revolution in the way. Truly innovative technology changing the way mobile phones will be used. 5G Network's router and switch technology delivers Last Yard Connectivity between the Internet access provider and building occupants. 5G's technology intelligently distributes Internet access to individual nodes within the building.

II. WHAT IS 5G?

5G means it is the 5th generation system that has followed the roadmap of analog to digital systems translation, cellular systems to be precise. These systems are termed to have higher speeds, higher bandwidth capacity. They mean to have everything higher than its predecessor's generations.

But researchers envision not only a 5G network with unprecedented data rates and mobile access but also an opportunity to redefine the network to accommodate a wealth of new and diverse connected devices. 5G also presents researchers with a challenge to improve more known, but no less important, issues such as the coverage uniformity across a served region and more energy-efficient networks.



Fig. 1. Features of 5G Technology

As shown in above figure, the features of 5G are applicable over a wide range of applications which will shift the paradigm of mobile computing. The faster speeds (up to several Gbit/s) will really bring in large consumers to IoT. The IoT connectivity will benefit from the services that will be provided by 5G technology. High end gaming options, high quality HD video and sound systems, high internet connections etc can be realized through 5G. The features of 5G that make it distinct from 4G (LTE) technology are

- i. High increased peak bit rate
- ii. Larger data volume per unit square area
- iii. Lower battery consumption
- iv. Lower cost of infrastructural development

5G wireless technologies are touted to bring in connections up to 100 billion devices, and a 10Gbit/s individual user experience capable of extremely low latency and response times. Deployment of these networks will emerge between 2020 and 2030. 5G radio access will be built upon both new radio access technologies (RAT) and evolved existing wireless technologies (LTE, HSPA, GSM and Wi-Fi). 5G will realize networks capable of providing zero-distance connectivity between people and connected devices. The business models and architecture of 5G has been discussed elaborately in [1].

III. ROADMAP TO 5G

The goal is for next generation mobile standards related to “5G technology to be ready by 2020. The ITU (International Telecommunications Union) has set the deadline to set standards for IMT (International Mobile Telecommunication)-2020: a.k.a 5G that will enable a seamlessly connected society, one where every “thing” is part of larger system of internet-enable devices. The ITU and 3GPP (3rd Generation Partnership Project) are getting ready to provide a schedule for the 5G standardization.



Fig. 2. IMT-2020 Standardization

From the above diagram it clearly seen that as of now 5G is at development stage. The spectrum allocation, technical performance requirements future enhancements, deployment is to be done in coming years.

Most estimates point to a 2020 initial rollout of 5G network technology, but standard have to be settled first. The ITU has outlined few specs that network will need to call themselves

5G, including:

- i. 20 Gbps peak download rate
- ii. 10 Gbps peak upload rate
- iii. 30bps/Hz peak spectral efficiency downlink
- iv. 15bps/Hz peak spectral efficiency uplink
- v. 100 Mbps user experienced download rate
- vi. 50Mbps user experienced upload rate.

IV. WHAT IS IOT?

IoT means Internet of Things, the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data. IoT describes a system where items in the physical worlds, and sensors within or attached to those items, are connected to the internet via wireless and wired internet connections. The vision of IoT is expanding to connect everything from industrial equipment to everyday objects. Basically anything you can attach a sensor

and connectivity to can participate in the new connected ecosystems IoT-enabled objects will share information about their condition and the surrounding environment with people, software systems and other machines. This information will be shared in real-time or collected and shared. IoT will incorporate Machine-to Machine (M2M) communications and intelligence drawn from the devices and the network that will eventually allow businesses to automate certain basic task without depending on central or cloud based application and services.

V. IOT ECOSYSTEM

The IoT ecosystem consist of various connected devices that interact with themselves, exchange of data will give out the required and reliable output to the end user. As per few surveys 24 billion devise are expected to get connected by the year 2020 and in terms of investment, various companies are likely to spend a whopping \$5 Trillion in the next five years. Internet of Things refers to rapidly growing network of connected objects that are able to collect and exchange data using embedded sensors.it envisions a near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocols stacks that will make them able to communicate with one another and with the user becoming an intergral part of the Internet[1].the IoT concept, hence, aims at making the internet even more immersive and pervasive. Furthermore, by enabling easy access and interaction with a wide variety of devices such as Thermostats, cars lights, refrigerators, surveillance cameras and more. The major areas where IoT would be predominantly used are:

- i. Smart homes
- ii. Wearables
- iii. Smart cities
- iv. Connected cars

IoT will foster the development of a number of applications that make use of the potentially enormous amount and variety of data generated by such objects to provide new services to citizens, companies and public administration.

A. Smart Homes

The Smart home is likely the most popular IoT application at the moment and in the coming years. Smart homes are founded on a symbiosis of applications that allow home owners to monitor and control a wide range of useful applications such as improved energy efficiency, access control, security, home monitoring and home care.



Fig. 3. A Smart home

Smart homes merges one's lifestyle with the latest technology and energy management tools to make life easier. One can control home from any smart device. From door locks, to lighting, control TVs, security systems and other appliances from any location with access on a smartphone or tablet. For example to access how smart the homes will be, the motion sensors used in the security system is integrated with the home's lights control and HVAC(heating, ventilation and air conditioning) system to switch off the lights and the heating when nobody is in a room. The motion sensor, when the home security system is on, can be used to send an alarm if someone breaks in and moving through the house. Smart homes stresses a lot on energy management as everything will be on automation, hence a lot of energy will be saved or say, a considerably less amount of energy will be consumed by the appliances.

B. Wearables

Watches are no longer just for telling time. For example the Apple watch and other smart watches on the market have turned our wrists in to smartphone holsters by enabling text messaging, phone calls, and more. Devices such as Fitbit have helped revolutionize the fitness world by giving people more data about their workouts.



Fig. 4. Features of Wearable Technology

From the chunky mobile phone wristwatches of the late 2000s to today’s fitness bands, wearable technology has dramatically evolved in recent years. The, wearable as they’re known, are changing the way consumers interact with the environment, and their popularity is growing. However the wearables market is still in the early phases of expansion and currently dominated by health, wellness and activity tracking devices.

C. Smart cities

The IoT has the potential to transform entire cities by solving real problems citizens face everyday. With the proper connections and data, the Internet of Things can solve traffic congestion issues and reduce noise, crime, and pollution.



Fig. 5. A Smart city

New Internet of Things applications that leverage ubiquitous connectivity, big data and analytics are enabling smart city initiatives all over the world. As a result, IoT offering are transforming cities by improving infrastructure, creating more efficient and cost effective municipal services, enhancing public transportation, reducing traffic congestion, and keeping citizens safe and more engaged in the community.

D. Connected cars/ Automotive IoT

The IoT is breaking fresh grounds for car manufactures by introducing entirely new layers to the traditional concept of a car. The upgrade-the connected, smart car comes as a revolutionary way for us to drive and stay in touch with world around

at the same time. By offering a fancy-free variety of infotainment services a connected car applications for drivers, the automotive industry has the potential to become an IoT champion.

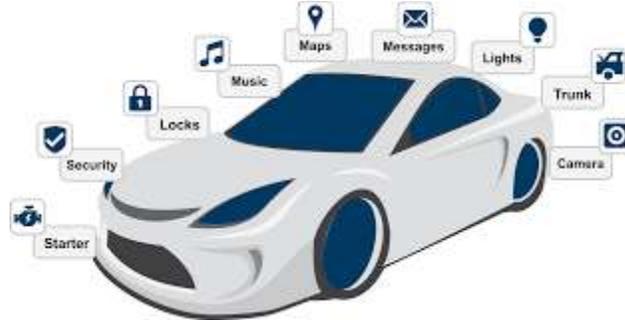


Fig. 6. A Smart car

According to few research firms, by the year 2020 there will be 250 million connected cars on the world’s roads. Car manufacturing companies are ready to deploy driverless or automated cars in the coming years that will be connected cloud-based traffic, gathering large amount of data analysis. There are few other application of IoT-Smart grid, healthcare, agriculture, Industrial. Smart retail, poultry and farming and lots more.

VI. 5G FOR INTERNET OF THINGS

The present wireless networks offered by 4G-LTE is continuing to evolve and become more readily available for many years ahead. But many industry leaders from around the world are hammering out standards for 5G networks, which are projected to switch on around 2020 or sooner. To evolve beyond 4G, intelligence, communication capabilities and processing power will need to be diffused across networks and mobile devices, empowering even the smallest of connected devices to do heavy computational tasks and run rich content and services. 5G is described as the 1st network designed to be scalable, versatile and energy smart for the hyper-connected internet of everything world. The 2G networks were designed for voice, 3G for voice and data, and 4G for broadband internet experience. With 5G, we’ll see computing capabilities getting fused with communications everywhere, so trillions of things like wearable devices don’t have to worry about computing power because network can do any processing needed. These 5G networks will be faster but also a lot smarter. Devices will need to become smarter, too as they will act as networking nodes rather than just terminals. With 5G, computing power and information will feel like they’re following us around. Wearables, smartphones, tablets and other devices with sensors that location and context aware will work together with apps and services we use.

As 5G has been confirmed the official successor to 4G wireless communications as the fifth generation mobile wireless communication technology, 3GPP has laid down standard for it too. 5G-IMT-2020 must support at least 1 million connect devices per square kilometer which points mainly to IoT. 5G will require carriers to have at least 100 MHz of free spectrum and up to 1 GHz where available. The 5G specs also require base stations that can support access from 0Kmph to

500Kmph vehicular speeds. to the end user of smartphones, 20

Gbps download capacity will be offered which is pretty significant when compared to current 4G LTE CAT 16 modems that are around 1 Gbps. 5G networks are expected to offer users a maximum latency of just 4ms(4G-20MS). Below is a tabulated view of differences between 4G and 5G networks in few important aspects.

TABLE I

Specifications	4G(fourth generation)	5G(fifth generation)
Deployment year	2010	2020
Data rate	Up to 20Mbps	>1Gbps
Frequency band	2 to 8 GHz	3 to 300 GHz
Multiplexing	CDMA	CDMA, BDMA

Technologies	Combination of broadband LAN/WAN/PAN	Combination of broadband LAN/WAN/PAN
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From the table above we can it can be seen that the fifth generation mobile networks have an edge over the previous generation in terms of data rates, and frequency bands. The technologies used in 5G will of advances stage such as BDMA (Beam Division Multiple Access). As we have discussed the capabilities of IoT that will shift the paradigm of life style beyond the year 2020. IoT will take a lot of bandwidth for HD video content, high internet speeds, holding huge amount of data, 5G standards have to match them so as to provide seamless service to end user.

VII. CONCLUSION

In this paper a general view of how 5G technology will lift up the capabilities have been discussed. The pre 2020 era is been dominated by LTE technologies that are making a platform for IoT to take upon. The millions of devices that are going to be connected will analyze enormous amount of data, become automated and could do lot smarter things which once were thought impossible. In a nutshell we can describe the 2020+ time frame, the mobile and all of the wireless technology is going to change a lot with the diffusion of IoT. The cities, homes, things, people will be connected to a seamless internet which will sketch new horizons. The ubiquitous presence of IoT will invade every nook and corner around the world making it connected together and make it easier to live. And the world beyond 5G will come with more advanced technologies that will help IoT enabled devices to be connected in a better way which is safe, useful to everybody, smarter than ever.

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