

5G Network Technology: “The key role to boost Economy Growth and Businesses for the Future”

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ABSTRACT

In digital world, the evolution of internet and telecommunications industries of the networks evolved from 2G to 3G and nowadays 4G is expanding in many cities worldwide to increase the businesses facilities. Even though different challenges arose for customers who are still experienced slow internet for daily services in 4G due to lower coverage, which resulted in higher latency in certain areas became the big issue in currently business. Though, the 5G networks is at hand and it is designed to deliver very high data rates and higher coverage with meaningfully better QoS with tremendously low latency. The 5G Networks internet will increase the internet speed in gigabits and facilitating development of new businesses and opportunities. Essentially, this paper describes the advantages of 5G Networks and Technologies behind 5G. It further discussed what consumers are expecting from 5G Networks and what industry sector is expecting from 5G for businesses succeed. With higher capability available in 5G Networks compared to the previous Networks generations like 3G or 4G, undoubtedly 5G Network is the key role to boost digital economy and businesses for the countries vision.

Keywords: - 5G Advantages, 4G Limitations, 5G consumer’s expectation, 5G Industry’s expectation, Technologies behind 5G

I. INTRODUCTION

Rwanda as a the one among other developing countries experienced the role of using high speed internet in many fields including education sector, health sector, communication sector, business sector and so forth. Internet in Rwanda has been introduced at high level after Telecom companies started to integrate in the country from 1998 when MTN Rwanda brought 2G and 3G Networks technologies in Rwanda and it is for a decade when digital transformation started to generate a better digital world where the speed of internet born to facilitate businesses (Huawei,2016). Since introduction of 4G internet after almost two decades when Rwandans experienced the use of 3G and nowadays 4G Network is used together with 3G because there are still numerous numbers of consumers that using 3G networks in their devices due to different circumstances (Bizimana et al.,2020).

Obvious this 4G is good for some reasons but it has experienced different challenges for consumers and in another way, that society still claimed to have slow signal coverage (Bizimana et al.,2020). The Internet Service Providers (ISPs) are among MTN Rwanda, Airtel Rwanda, Mango Telecom and so forth with the aim of extending internet capacity in

speed and flexibility which would resolve current issues on internet (DOUG, 2016).

According to Huawei (2016) Long Terminal Evolution (LTE) network accessibility would be needed to maintain continuity once a customer gain access to 5G which means that LTE still has a big role in 5G implementation because when it start, it will have access to the current infrastructures of previous networks and what will be added based on upgrading software and hardware. What society expecting from 5G network is how 5G could increase bandwidth and makes a constant connectivity.

Due to its high-speed internet connectivity which expects to be 10Gbps, consumers will be able to download high definition quality video in short time ever where the latency will be less than millisecond in 5G technology (Gallagher and Michael, 2019). This will help new creations and innovations in businesses as well as tremendous economic growth of the country (Huawei,2016).

The reason behind this 5G is a backbone of Internet of Things (IoT) and this will bring and increase more network capacity (more spectrums) and also would be needed highly and deeply to resolve current issues available in 4G and creates opportunities of connecting applications with the world (EMF,2020; Qualcomm,2019).

II. LITERATURE REVIEW

2.1. 4G Limitations and challenges for Customers

Every technology has its limitation and challenges and this why technology evolves day to day to find flaws and set solution for previously technologies. The 4G Networks have met some limitation in providing services to the customers and other related to the its implementation and it is why 5G Technology is at hand to provide tremendous solutions with high data rates transmission and increased higher Quality of Services (QoS) than what 4G offered (Bizimana et al.,2020; Gallagher & Michael, 2019).

The most limitation in 4G showed that it is really tough and difficile to listen different multiple bands including 2G, 3G, 4G and other Wi-Fi technologies (Gallagher & Michael, 2019). The technical limitation in 4G were based on its security and how it requires several capable base stations and high energy consumption and well high level of transmitting power (EMF,2020; Ahmad et al., 2019).

Currently, consumers claimed that 4G Networks sometimes showed lower signal or signal goes off just because the 4G Network coverage was limited especially in rural places and it is happened that energy consumption was an issue for smart phones (Bizimana et al.,2020). Because 4G devices have to support multiple bands and this required the consumers to buy new devices which could support new technology of 4G what seen as burden to the consumers (Bizimana et al.,2020).

2.2 Advantages of 5G Networks

According to Qualcomm, there is a hope that 5G would be supporting a wide and vast diversity of devices and sensors where virtual reality, autonomous vehicles and machine to machine technologies would be easier (Huawei,2016). In 5G, smart cities and connected machines will be developed and they will be connected with high speed internet with very lower latency at least 1ms (TechUK, 2017).

The main objectives of 5G technology are ensuring availability, reliability and robustness because the coverage will be increased than in 4G and then, 5G will allow Internet of Things (IoT) to success and it will be targeted to reduce

energy consumption and facilitate fixed and mobile bandwidth in different directions (ITU,2018).

The 5G Networks built with technologies to work with licensed and unlicensed spectrum bands where it will reduce power or energy battery consumption (TechUK, 2017; Ahmad et al., 2019; Huawei,2016). Because 5G will make IoT possible where there will be the connection of everything where city will be connected and health connected with support of wireless backhaul and satellite backhaul which would produce ultra-high frequency just to produce the needed bandwidth (Gallagher and Michael, 2019; TechUK, 2017).

Due to lower energy used by devices with 5G, the quality of data will be increased and transmit power will be reduced to not affect the communication while reducing interferences (EMF,2020). There will be no doubt that 5G networks technology would minimize inequality by increasing access and lowering the cost goes for essential services like these services from healthcare and also education. Because education sectors and healthcare sectors need the advanced internet with higher Quality of Service like 5G which is higher than current technologies from 3G or 4G (ITU,2018).

It is clear to note that the utilization of 5G networks will reduce carbon footprint while conserve the world natural resources once devices are more autonomous and it is the best choice for country's economy growth as this will facilitate new creativities of employment in many sectors (ITU,2018).

Consider the different ways where 5G would act in three important group of its capabilities like Enhanced Broadband, Critical Communications and Massive Internet of Things (DOUG, 2016).

From the Fig 1 where some kinds of examples will boost the economy once 5G networks starting to impact the society, especially in Rwanda, where virtual Reality would be increased and the Smart cities would look like will grow up fast.

The Fig 1 named as the 5G Triangle and this figure illustrates exactly the summary of what customers have to expect from 5G Networks (DOUG, 2016; TechUK, 2017).

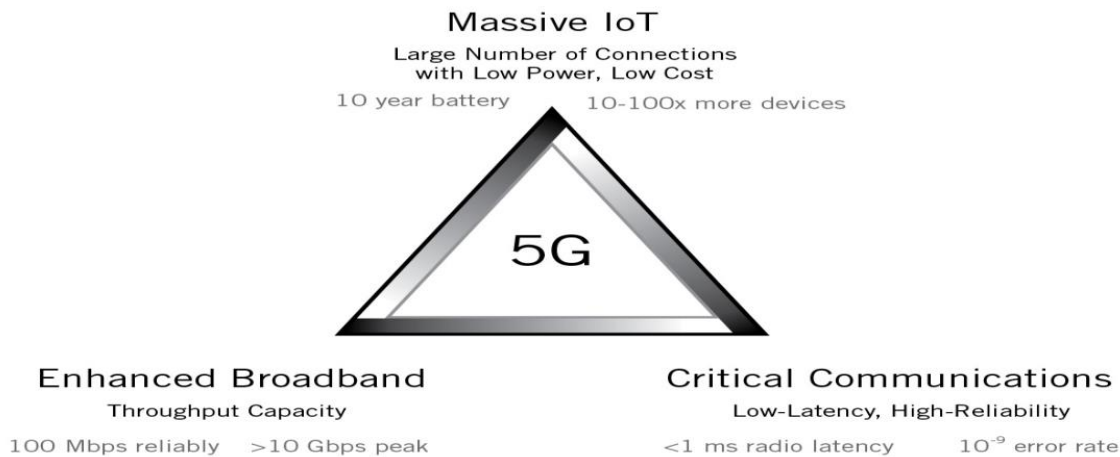


Fig 1: 5G Triangle (DOUG, 2016).

2.3 Industry’s Expectations from 5G Networks

The Fig 1 shows and summarises what the 5G networks would bring to society and business as well for industrial sectors where this would be expected more than what we think that 5G Networks could do including connecting Machine to Machine (M2M) technology, Virtual Reality, high capability of sensors to detect and Internet of Things (IoT) where everything can be connected (DOUG, 2016).

For era of 5G, Medical health industry will be improved the QoS where nurses and doctors will be assisted with remote robots connected like real life operation, and because lowest latency ever of data transmission in 5G every sector will allow services to success without any delay and different services from Education, Businesses, Transport, Health, Telecommunications, and so forth would be benefited from 5G Network once it started in the country (TechUK, 2017).

Some countries launched the 5G Networks or started implementations and Huawei introduced the 5G Networks technology in February 2020 and this would enable accelerating global commercial adoption of 5G and it is that lower band and high band were first used for trial of 5G networks and succeed (CNBC,2020; Huawei,2020).

The future with 5G Networks industries development will make things easier where the creation and transfer of real time data with full wireless network and lower latency and as well as the solution of larger amounts of data will take place than what 4G networks could be done (Ron,2020).

III. TECHNOLOGIES BEHIND 5G NETWORKS

3.1 Band of frequencies used in 5G Networks

Huawei industry revealed a full range of End-to-End 3GPP compliant with 5G product solutions which covered the core network, bearer network, base station and terminals (CNBC,2020). In simple way, Huawei 5G product has a root on 3GPP standards with addition features like full range of 5G that could fit to support millimeter wave (mmWave) which has ability to support 1GHz bandwidth and full scenario or cloud-based characteristics which make possible to provide 5G End-to-End capabilities (Ron,2020; CNBC,2020; Huawei,2020; Qualcomm,2017).

The 5G Network showed that it can operate below 6GHz also called the sub-6 GHz range and also with mmWave which is meant up to 26GHz) which means that the frequency range from 450 MHz to 6 GHz and from 24.25 GHz to 52.6 GHz (Connor,2020; Huawei,2020).

According to Marco (2019) and Qualcomm (2017),the 5G Networks support c-band which provides advantages over lower frequencies based on frequency division duplex technology (FDD) and the sub-bands of 3GHz frequency can be used to cover tower sites, pole sites and small cells with antenna to support the implementation set to be equivalent isotropically radiated power (EIRP) of 65dBm and 5G networks build to support all frequency bands (2G,3G,4G and 5G) and this removes the issues and barriers of bands currently available in 4G Networks (Marco,2019).

3.2. The 5G Networks and C-band

The c-band is the frequency range between 4 to 8GHz and most of them used for satellites TV and they came in different classes and these frequencies band are important in 5G

networks would need also to cover some areas with frequency below 6GHz easily by using smart antennas (Segan,2022).

The C-band provides advantages over lower frequencies and also the Time Division Duplex. Technically, C-band access to a range of spectrum with fewer challenging as it can penetrate indoor and transmits data with non-line of site and then, the previous studies showed that c-band is an economically solution as it can use small cell grids without needing new cell sites as what it would require for mmWave (Marco,2019; Qualcomm,2017; EMF, 2020).

3.3 The Qualcomm” used in 5G Networks

The one of technologies behind 5G Networks system capability including the “Qualcomm” and it is a microscopic receiver embedded on chips designed to be installed in smart phones, tablets and it has built to let mobile phones be capable of sending and receiving signals at frequencies of 26GHz or higher (TechUK,2017). Qualcomm have built with ability to let 5G supporting a vast diversity of devices with unprecedented scale, speed and complexity manner (TechUK, 2017).

By the year of 2018, the Qualcomm industry in the U.S developed and announced that 5G would operate not only for bands below 3GHz and 6 GHz where most communications devices belong but with another ranges of millimeter wave spectrum (between 24 -29.5GHz) in time to permit 5G data (Ron,2020; Qualcomm,2017; Gallagher and Michael, 2019).

3.4 Fibre optic to supports 5G Networks implementations

Fibre optic cable would be used to support enhanced 5G capabilities. Fibre has been demonstrating its scalability, security and ability to handle vast amount of backhaul traffic being generated which means that it suitable to support the success implementation of 5G and it can be used for network backhaul as well as for front haul (Ron,2020).

The 5G networks uses high radio frequencies to provide and handling larger amounts of data in term of multi-gigabit which means that many additional cells or towers will be built and set to allow the redistribute signals on the air to reach to vast area or increase the coverage with enough capability to provide high data rate in gigabits (Ron,2020).

The 5G designed to use radio waves or radio frequency energy where it will use less power to send and receive data and voice over communication channels and it would minimize power consumption on the devices because the transmit power of the device will be controlled by the network (EMF, 2020).

3.5 The beam-forming techniques

However, we cannot forget to say how 5G Network sends data directly to devices and this technique known as beam-forming differ from the previous technologies 3G or 4G where they would send signals in all directions (Kirsten,2021).

This means that it would focus only on your device like smart phone or computer, the location and your mobile network operator. The beam-forming succeed with the technology behind the Multiple Input Multiple Output (MIMO) which uses many spectrum bands (DOUG, 2016; Huawei,2016).

IV. CONSUMER’S EXPECTATIONS FROM 5G NETWORKS

Globally, 5G Networks technology will be the the key major opportunity for consumers who are willingly to make businesses at high level in speed and this 5G would create opportunities for new businesses (ITU,2018). Certainly, this will be the main technology to help governments transforming cities into smart cities and enlarge the country’s economy (ITU,2018).

The current network technology 4G has met with different challenges and this 5G will deliver widely opportunities for consumers and policy makers where it will provide high Quality of Service (QoS) with affordable price and it will allow the rapid creation of new businesses for society.

Undoubtedly, the previous research studies showed that 5G networks will be the latest technology that developed to resolve what failed in 4G and this let 5G to augment data rates and reducing latency more than what 4G could do with high speed connectivity that could cover widely range of kilometres (ITU,2018;EMF, 2020). The 5G would be a considerable increase in network energy efficiency which would let devices use less power (EMF, 2020).

What most people think for 5G about human life?

The researchers are still working on the field to demonstrate if the 5G would be bad for life. However, 5G as the latest wireless technology that uses high frequencies range from 3.5 GHz up to tens of GHz than previous networks like 3G and 4G and it is the technology which uses electromagnetic radiation (Kirsten, 2021;Tom, 2019). These electromagnetic radiations are everywhere as they are a form of energy and come in form of radio wave, x-rays, gamma

rays, microwaves and it is good to keep devices sources of electromagnetic radiations far away from you and to reduce exposure levels and remember to turn off device when not in use which will increase the health safety from electromagnetic radiation (Sarah, 2019).

IV. CONCLUSIONS AND RECOMMENDATIONS

Essentially, this paper described the limitations and challenges in 4G Networks and it described the advantages of 5G Networks and hence discovered some technologies behind 5G Networks. This paper further discussed what consumers are expecting from 5G Networks and what industry sector is expecting from 5G.

Therefore, this paper showed that the challenges which businesses industries have been through with 4G Networks would be resolved in 5G and then we explained more about the best of 5G that would minimize the common issues available in 4G Networks such as issue related to latency, power consumption and speed data rates.

The 5G Networks will make devices to operate with radio waves with a wide ranges of bands of frequencies including the c-band series of frequencies which means that 5G have capability to operate with band of frequencies below 6GHz (below 6GHz also called the sub-6 GHz range and mmWave which is meant up to 26GHz) which means that the frequency range from 450 MHz to 6 GHz and from 24.25 GHz to 52.6 GHz.

Based on the benefits of 5G networks for businesses, and how 5G would resolve the problem arose in 4G and what consumers will gain from this 5G Network technology, we conclude that 5G Network is the key role to boost digital economy and businesses for the country's vision of Rwanda 2050 and then we highly recommend to IT sectors to start the 5G planning for future implementation and then provide or set the policies which will guide the 5G Networks.

FUTURE WORKS

The future works will be based on the security concerns from higher radiations of electromagnetic waves and how humanity could live peaceful with 5G Networks.

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