

# Technological Buzz And Fear Of Missing Out: Smartphone Users Readiness On 5g Network Integration

Lawal, K.H

*Computer Science Department Federal University of Technology Minna, Nigeria*

Submitted: 05-07-2021

Revised: 19-07-2021

Accepted: 22-07-2021

**ABSTRACT:**The promise of 5G Network integration can completely overhaul how the users interact and manipulate with wireless devices. However, there are various intricate and technical issues to be tackled and resolved. The argument is that the future and usage of the 5G network depends largely on the expectations and readiness of the market components such as consumers, investors, and technological and business objectives. To this very end, it is necessary if it could be ascertained that technological and business objectives held by the wireless telecommunications and technologies providers/operators have been actualized in the times past and also ascertain if the held objectives were complementary, consistent, or contradictory with the technological and other needs of the consumers; to say summarily, where the consumers' expectations met. Answers to these would aid us in determining the level of readiness smartphone users have about the advent of the 5G network integration. Eventually, there have been many inventions, innovations, and technological invasions in the global market. Often, it is observed that technological inventions and innovations come into the global market as a surprise. Thus, the conceptualization of the concept is known and referred to as technological invasion. Technological invasion comes with its pros and cons. The study employed the structural equation model approach using the smart partial least square to analyze the subject matter, it was found that there are high expectations of the 5G network, and this appears to be having a negative influence on the smartphone organizations as they might be incurring huge cost to avoid scrambling of subscribers. The study recommends that; since the likely effect of the introduction and integration of the 5G network will be very high. Hence, organizations involved in the distribution of smart devices show urgency, start

producing efficient devices, and meet the expectations that come with the integration of 5G.

**KEYWORDS:** 5G Network, wireless telecommunications, technological invasion, structural equation model, smartphone.

## I. INTRODUCTION

There is trending report that about half of smartphone users in the world have in on time or the other experience distress relating to a data plan, which results in limited usage of their mobile broadband as the mobile phone users all have fears of overt fees. Similar reports show that the most secret mobile host, which drains mobile data, is relatively the rate of mobile advertising, as about an average of 45% of the monthly data is usually sunk up by mobile advertising. Only about 30% of smartphone users are aware of the draining that mobile advertising does to their monthly data bucket, while a number of up to 70% are not aware of draining that mobile advertising does to their data allowances. Suggestions show that only a bit above half of the smartphone users across the globe would, if aware, look up to the network operators to make the users be in charge of whether or not the mobile advertising ought to be seen, to ensure that the network operators are transparent as to the consumption of mobile data usually drained via mobile ads (Matthé et al, 2017).

Arguments being dished out are that the global telecommunication market is overtly demanding for consumers to voyage or manipulate. A number above 50% of smartphone users stated that it is complex comprehending the things inclusive in mobile data plans allowances and attempting to survey the alternatives, to pick the best mobile data plan allowance suitable for one is highly complicated. The primary effect of these circumstances is that there is an excellent disproportionate rate regarding what consumers

purchase and what they make use of. To this effect; just about 33% make use of all their mobile data allowance at any given time; the remaining percentage are overusing or underusing the mobile data allowance; thus, they either exceed the allowed mobile data plan or have subsisting or unused data after the completion or expiration of the allowed period (Mendes et al, 2016).

Because consumers do not want to spend money which they would not derive utility from nor get stranded or frustrated in the middle of online activity, about 15% of the massive data users tend to purchase a lesser data than they need; while about 55% of low data users purchase more data than they may need. These consumers' responses have not solved the problem of satisfying the consumers and giving them the utility they deserved; it instead enriches the consumers' distress level once the data allowance is cut off as it reaches its limits. These are actual experiences faced by an average of 50% of smartphone users on the global market (Szabo et al, 2015).

The network operators, to aid consumer's experience, thought it wise to introduce the unlimited data plan regime. Theoretically, these unlimited mobile data usage plans reduce the complexity usually associated with the decision process; this is relative because the unlimited data plan eliminates the requirement to decide the amount or volume of mobile data to purchase. On the empirical level, the identified benefits of unlimited data plans are not all-encompassing; just a little above 40% of smartphone users who adopted the unlimited data plan across the globe can be said to be comfortable or satisfied with the simplicity and transparency associated with the plans. One would agree that the percent is not as high as expected compared with the percentage (34%) of smartphone users on fixed data plans who are comfortable and satisfied as to the simplicity and transparency of the fixed data allowances (Zhang et al, 2017).

The suggested reason for this slight difference in the level of consumer utility is not farfetched. It may be associated with the fact that unlimited data plans are to be used subject to usually specified or non-specified limitations. Some of these limitations or restrictions could be seen in terms of speeds, buffering and streaming rates, among others. While other forms of restrictions come up once a user had exceeded the fair usage policy; in the form of lower video quality, minimum internet speeds, poor audio, among others. From these, it could be seen that the interest of smartphone users is not majorly for unlimited

mobile data plans but rather a sense of limitless. Thus, recorded observations show that overwhelming consideration favours the idea that a trend or move towards 5G Network integration would offer the smartphone users a sense of limitless mobile data usage and, at the same, enhance the possibility of the network operators in getting the monetary value of the mobile broadband effectively. There is a need for evolvement (Wübben et al, 2014).

## **II. BACKGROUND**

The evolvement is necessitated on the basis that smartphone users have varied needs. Thus, network operators and mobile operators are required to make invention and innovation which goes over and above mere data buckets and allowances, but one that should be considerate of the way and manner in which mobile broadband plans applies to individual users concerning the devices being used and services they are being used for while connecting to the network.

The 5G network integration should not come as a technological invasion. The conclusion that postulates that smartphone users are not interested in 5G network integration has been negated by a recent survey that found that more than 70% of users of smartphones around the globe are interested in the advent of 5G Network integration. Though the 5G network integration creates business and market opportunities for select industries and businesses, more than 50% of the operators whom opinions are obtained stated categorically that 5G planning would work towards attaining consumers utility (Wübben et al, 2014).

Even though new issues need to be looked into and possibly, proffer solutions before the invention and integration of the 5G network. The following analysis would aid our comprehension of the concept as a whole. Surveys show that 40% of smartphone users assert that they possess the knowledge of 5G Network integration possibilities. About 10% assert that they can explain 5G network integration possibilities to others. The republic of China and the USA ranks amongst the top countries with the highest percent of awareness of the 5G network integration. While 75% of smartphone users in China are aware, it is recorded at 44% in the USA. The possibility of 5G network integration has created essential business objectives and expectations amongst the concerned entities. The expectations span across various issues that the previous or existing networks are less efficient to solve. There is a massive expectation about enhanced internet speed and coverage, as well as

qualitative delivery. This could be associated with the fact that only 50% of all smartphone users could state that performance expectations of the current prevailing networks have been attained; this must, to a more considerable extent, be the focal point for the 5G network. Though 5G network is not yet handy; more than 30% of smartphone users surveyed already have expectations which are not merely about enhanced internet speed, cost-effective mobile broadband, and coverage (Björnson et al, 2017)

According to Stuart Long, aside from the innovations, the 5G network would have on Smartphones, a buzz exists regarding 5G network integration concerning other technologies. He opined that various things would benefit from the 5G network integration; to him, these various things including but not limited to any form of things that need a rapid response in its ability to source, sort, and transfer data, examples: autonomous car, drones or similar technologies; and electronics, like cutting-edge security cameras, among others.

Despite how innovative and exciting the prospect of a 5G network may appear to be, there are serious concerns across the globe as to the impediments the network and the relatively new technological inventions that will come with it would pose to the sovereign security of nations. The issues about national security steam around who will build, develop, or maintain the technology, how would it be done, when and where it would be done. The information available is that security experts see the possibility of the 5G network being a threat to national security unless appropriate measures are taken as quickly as possible in tackling the concerns. The paramount concern being that wherein a foreign-based technological company is coming to invent and start an infrastructure relating to a vital area like communication, it may, in the long run, be a suicide mission (Braun, 2017).

The dimension from which 5G network integration comes is the angle of transformational mobility from the current generations of networks, most specifically the current reigning generation, known as the 4G. The 4G network, also known as the 4<sup>th</sup> Generation network, came with its buzz, with America and China topping the charts of its earlier recipients. Records show that it took a long while for it to stand a foot in Latin American. The 5G network integration is meant to provide faster speed for data, and it carries a considerable rate of data able to be used by a massive number of users at a simultaneous time frame. The bottom line is

that irrespective of the level of density in a given area, the areas such as airports, sports stadiums, and major urban centres will still experience the level of fastness embedded in the internet speed of the network as well as the low latency of 5G network integration services. The consolation about the latency embodied in the 5G network is that it has the potential of being less than ten milliseconds; it follows that its fastness could be compared to the blink of an eye or even faster than a blink. The 5G network integration brings quality experiences, such as lower latency, higher technological capacity, and higher output (Fettweis et al, 2014).

Whether or not the 5G network integration is possible or reality is no longer a question to contemplate; what matters is the circumstance to manage and condone the rate of an impact the coming network integration will have on almost every angle at which technology is used. The integration will boost and bring faster speeds with complimentary lower latency. In theory, the 5G Network integration brings along with its massive novel frontiers right from smartphones to automated self-driven cars. The complexity that comes with the 5G network implies that companies, operators, and device producers and manufacturers, carriers, among others, must work harmoniously towards the 5G network integration proper (Simsek et al, 2017).

### **III. OBJECTIVES OF THE STUDY**

The main objective emanating from the study is to analyze the buzzing effect of missing out on the targeted market by the producers and distributors of the smartphone. The specific objectives of the study areas below;

- i. To verify the effect of the integration of the 5<sup>th</sup> Generation network (Into existing infrastructure or Mobile Telephony Systems)
- ii. To investigate the expectations of smartphone users about the capabilities and capacity of 5G technology (5<sup>th</sup> Generation network)

### **IV. LITERATURE REVIEW**

The 5G network, fully known as the 5th generation network, has to with enhanced wireless technology, thus, causing lots of excitement amongst the smartphone users about its launching and integration. The 5G network integration is a form of technology that will help eliminate the issues that current generations of networks cannot solve. It will give room for devices to make downloads, not just faster but more quality than the current generations of networks (Braun et al., 2017).

5G network integration is an abbreviated form of referring to the fifth generation of cellular networking. 5G network is the relative aftermath of the existing present 4G / LTE networks. The way and manner in which 4G/LTE network integration brought a new and novel radical dimensional shift from the then 3G network, the 5G network come with its radical shift and novel dimensions. It is suggested that in order to understand the expected impact and technological overhaul that would come with the 5G network integration, one needs to take a walk along the memory lane to recall the level of impacts the introduction of the 3G network had on the interactions and usages we make of our smartphones and compare those with the ones that prevailed when the 4G network was launched. It need not be argued at length that the technological innovations that came along with the 4G network were enormous. To this end, it would be more comprehensive when it is posited that the expected 5G network will be of more remarkable technological advancement and will create a high time experience in the usages and interactions of smartphones to its users (Szabo et al, 2015).

Based on obtained surveys, smartphone users expect that during the initial phase of 5G network integration, the needs and issues surrounding mobile broadband will be tackled since there will be an increase in the demand and use of smartphones. Smartphone users hope that the possibility to make downloads of gigabytes in seconds will be reigning within less than 24 months of the inception of the 5G network, though the expectation is that it will be more direct on the republic of China, the UK, and the USA. Another ideal expectation is that the 5G network will make earphones deliver a real-time translation of language, the possibility of being able to watch live shows from various viewing centres within a coverage area that utilizes live stream cameras. This particular expectation is predicted to be realistic within two years from launching the 5G network. The seemingly complex technologies like 3D hologram calling, self-driving cars, and connected robots are amongst the things the consumers expect within the first phase of the 5G network integration. However, they are expected to come to reality in the long run of the 5G network integration (Wunder, Jung, Kasparick, Wild, Schaich, Chen, ten Brink, Gaspar, Michailowet al, 2014).

As discussed earlier, smartphone users are having technological distress in terms of the usages of mobile data allowances; as a result, about 50% of the surveyed smartphone users are hopeful that

the integration and launching of the 5G network would reduce or eliminate the distress they face as a result of the monthly mobile broadband bills they pay. What the smartphone users or consumers in general think is that the intervention of the 5G network would eradicate payment for gigabytes being used by the smartphones; and over 50% expect that in place of the payment for gigabytes used, a once for all fee could be paid for every single 5G service or any single device which is connected or attached to a 5G network.

5G network integration comes with specific challenges, especially for operators who ought to prepare to meet and keep up with the enormous expectations that consumers and smartphone users have about the network. Therefore, it is suggested that a trendy adjustment towards a pricing system based on the services proffered or better-still, providing services that would make the smartphone users have a deep sense of unlimited mobile data plan, could be a significant move and added plus by carriers. About 60% of the smartphone users have great concern and issue that it possible that even before the 5G network will reach and gain more comprehensive coverage; the 4G network devices and connectivity will be refurbished with no improvement at all but just a repackaging and will be advertised and perhaps sold as if it were 5G network device and connectivity. Smartphone users are demanding that technological and mobile and network operators should avoid any form of business strategy that will be built on falsehood, which will not offer the customers the needed real-life experience (Wunderet al, 2014).

The incoming 5G network integration has promised to eliminate or, at best, reduce the network congestion and pushes data as fast as never before in that smartphone users could get as download a whole of bulky data in the form of seasonal movies in few minutes and possibly it might help cars to drive themselves. The transition into the 5G network seems more like a revolution in the technological world, considering its promises. In 2019, some tech companies, who happened to be amongst the largest carriers in the USA, set up a sample of 5G networks in some parts of some cities. Furthermore, with the few smartphones readily available to test-run, it was recorded that though there were improvements; but the improvements were not that meaningful or impactful in so far as the cellular networks are concerned.

5G is the 5<sup>th</sup> generation cellular network, which is a novel cellular standard. It is as if it had become a habit and normalcy for operators and

carriers to make a shift into a new wireless cellular standard in intervals estimated to be a ten years gap. It is roughly a decade past that the 4G network integration, known as the fourth-generation cellular network, was launched. Opinions have it that the 4G network came in with significantly faster internet speeds and more robust and better reliability when compared to the 3G, it came to replace or displace. Moreover, if records are not failing us, it was also about ten years or more interval before the 4G network that the 3G network was the 3rd generation of the cellular network came into the global market. The arrival or coming of the 3G network displaced the 2G network since it is fast and has much reliability test than the then-current prevailing network; 2G network. With the illustration so far, it is much easier to understand and comprehend the entire concept and unprecedented changes that will come along with it. However, amongst all the generations, the 5G network seems to be the most confusing and complicated of them all (Simsek et al, 2017).

The truth is that communications via wireless technology tend to become more critical as the years roll by. There are popular demands which imply that there is increased access and need for data and information all around the globe. The more information one has, the better the person's position to stay at the flow and in the mainstream of technological development, enhancement in business, education, or other relative development plans. It follows that any form of improvement or advancement in wireless network and communications would, as a matter of necessity, facilitate likely improvements and advancement in technology, business, and other relevant sectors. The enhancement that the 5G network may bring in mobile wireless communications would enhance the inter-human relationship, co-existence, and connection of humans all around the universe ((Simsek et al, 2017).

Benefits of 5G network Integration (are these headings for further discussion? If not, kindly use bullet points)

Improving accessibility

Extending the reach of mobile broadband

Improving safety, health, and security

There is an excellent possibility that a fifth-generation wireless network, known in short as 5G network, would be, when finally launched more than 100 times faster when compared to the 4G, and it has the propensity to power and enables the "Internet of Things," including but not limited in coverage to telemedicine and self-driving cars. The comparative advantage to any country that

takes the lead in the adoption and integration of the 5G network is that the country would have a phenomenal improvement and advancement in areas of technology, economy, entertainment, and security when compared with other countries (Braunet al, 2017).

The integration of the 5G network implies that it will be adopted in the making of calls, texts, messaging, chatting, and internet surfing. Heroically, it will be massively faster in comparison with all other networks in the previous generations and will open new frontiers to varieties of smartphone users around the universe. The network will adopt a fresh higher radio frequency while transmitting information or data (Gonzalez et al, 2017).

5G will tackle many more roles than the generations before them. It will not only impact how humans interconnect via mobile networks, but it will also have a massive and colossal impact too on the interconnection, operation, control, and manipulation of machines, objects, and devices to which it is wired to. Hopefully, if expectations are not flawed, the 5G network comes with higher levels of effective performance and efficient delivery and service, empowering smartphone users and offering them real-life experiences and new industries. 5G will usher in multi-Gigabytes per second faster rates, ultra-low latency, massive delivery/capacity, and a more satisfying uniform user experience ((Björnson et al, 2017).

**There are several differences between 4G and 5G: (Please make bold since it is a heading. Apply as appropriate)**

5G is a unified platform that is more capable than 4G

5G uses a spectrum better than 4G

5G is faster than 4G

5G has more capacity than 4G

5G has lower latency than 4G

5G is a unified platform that is more capable than 4G

## V. METHODOLOGY

The study employs a Structural Equation Model for the study. The rationale for this is that for the study of this nature where the survey approach is employed and the instrument of questionnaire been used for data collection, Herath & Rao (2009) and Simkin & McLeod (2010) suggested the use of Structural Equation Modeling as it is best for taking care of normality assumption of a multivariate situation (Aliet al, 2005). The Smart PLS software was used for the

analysis as it allows for employing the bootstrapping operation to analyze variances of the inner model and path coefficients (Ringle, Wende, & Becker, 2015). The maximum sample size suitable for the use of Smart PLS, according to Peng & Lai (2012), is 100. However, this study carried out in the Abuja metropolis via the online survey, sampled 50 individuals randomly. The analysis of their responses to the questions in the data collection instruments is as given below.

The demographic distribution of the respondents shows that 36% of the respondents are female, while the remaining 64% of the respondents are male. Their data depicting the age of the respondents revealed that 12% are below the age of 30, 30% of the respondents are within the age of 30-39years, 32% of the respondents are between the age of 40-49years, 18% of the respondents are between the age of 50-59years, while 8% of the respondents are 60years and above.

The 50 respondents that participated in this study are strictly those that own a smart device. In respect to that, 34% of the respondents own an iPhone device, 22% of the respondents own a Samsung smart device, 30% of the respondents own a Tecno smart device, 6% of the respondents are owners of Infinix smart device while 8% have several other smart devices aside from the once mentioned above.

The reflective model was employed in the study. This is because the indicators are highly correlated and interchangeable; as such, the validity and reliability need to be critically examined (Haenlein & Kaplan, 2004; Hair et al., 2013; Petter et al., 2007). For a reflective measurement scale, the direction of causality moves from the latent variable blue colour to the indicator, which is in yellow.

### Explanation of Target Endogenous Variable Variance

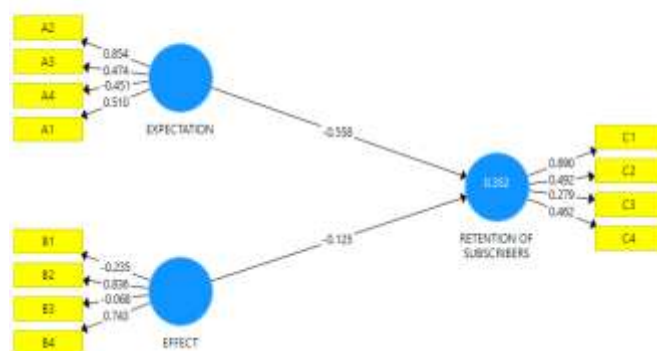


Fig 1: Model of Smartphone users Readiness on 5G network integration

From the figure above, the coefficient of determination,  $R^2$ , is 0.352 to retain subscribers latent variables. This shows that the two latent variables (Expectations and effect) moderately explain 35.2% of the variance in the retention of subscribers. Marcoulides & Saunders (2006) opined that for estimation with a coefficient of determination of above 0.25 shows that with such parameters, the minimum sample size employed appears to be significant in the actualization of the study's objectives.

### Analysis of the Path Coefficient

From figure 1 above, the path coefficient of the relationship between Expectation and the Retention of Subscribers shows that expectations

from the users of the smart devices have a strong negative effect on the organization's retention of customers/Subscribers of their products. The effect had a coefficient of -0.558, which is statistically significant. The relationship between the effects of the integration of the 5G network and retention of smart device customers/subscribers had a coefficient of -0.125, indicating that introducing the 5G network had a strong negative effect on retention of smart device customers/subscribers. As Wong (2013) noted, the outcome was statistically significant in a PLS model; a path coefficient above 0.1 tends to be significant.

The stop criterion Changes: reveals the number of iterations reached, and it is expected that the model converges with the minimum number of iterations.

From the output obtained from the smartPLS, it is evident that a stable estimation was obtained as the

algorithm converged 15<sup>th</sup> iterations before reaching the maximum iteration.

**Table 1: Discriminatory Validity**

Di	EFFECT	EXPECTATION	RETENTION OF SUBSCRIBERS	
EFFECT	0.573			
EXPECTATION	0.177	0.595		
RETENTION OF SUBSCRIBERS	-0.225	-0.577	0.577	

From the table above, the discriminatory validity coefficient in the principal diagonal appears to be valid as the values are higher than 0.5. This shows

that the various indicators in the research instrument employed for the study are valid.

**Table 2: Bootstrapping Output**

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics ( O/STDEV )	P Values
EFFECT -> RETENTION OF SUBSCRIBERS	-0.126	-0.18	0.162	0.781	0.435
EXPECTATION -> RETENTION OF SUBSCRIBERS	-0.554	-0.562	0.169	3.282	0.001

From the output of the bootstrapping in table 2 above, the result shows the descriptive statistics of the relationships between latent variables. The result shows that EXPECTATION ->

RETENTION OF SUBSCRIBERS had a statistically significant P-value. This means that the relationship between expectation and retention of customers/subscribers appears to be significant.

**Table 3: Collinearity Test**

INDICATORS	A 1	A 2	A 3	A 4	B 1	B 2	B 3	B 4	C 1	C 2	C 3	C 4	
	V	1.0	1.	1.	1.	1.	1.	1.	1.	1.	1	1.05	
	I	72	17	08	07	22	18	03	15	07	07	.	1
	F		6	9	9		1	3	2	6	9	0	0
												0	8

From the collinearity result displayed above, considering the Variance Inflation Factor, none of the values of the indicators was more significant than 5, which means that the model has no problem of collinearity.

## VI. CONCLUSION

The conclusion emanating from this study is that the expectations of Smartphone users and devices appear to be very high. It is likely to harm the brand organizations as they scramble to keep pace with the integration of the 5<sup>th</sup> generation network (5G). Part of the effect this may likely have is the fact the some of the newly purchased devices by the smartphone users might be going into extinction and forcing them to get a new device that is up to date and, as such, having a cost effect on their disposable income. Another effect is that it is likely to create employment as an organization may demand more human resources to increase its output. Smartphone users are expecting a network that will be faster than the current generations of a network. It is expected to provide a unified platform better than the current network generations. Also, the 5G network is anticipated to improve the accessibility of the network. The effect of this may be costly to the organizations that distribute and produce smart devices.

## VII. RECOMMENDATIONS

The recommendation that ensues in the course of this research are as follow;

1. The likely effect of the introduction and integration of the 5G network will be very high; hence, organizations involved in the distribution of the smart devices should, as a matter of urgency—start producing devices that are efficient and meet the expectations that come along with the integration of the 5G.
2. There is a need for organizations to survey to sample the opinions of smartphone users in the quest to develop devices that suit their learning. The affordability of the provisioning of the 5G network will assist in limiting the scramble effect among consumers.

## REFERENCES

1. 5G Network available on [www.jdpower.com/press-releases/us-wireless-network-quality-performance-study-volume-2](http://www.jdpower.com/press-releases/us-wireless-network-quality-performance-study-volume-2) accessed on the 14th January 2020
- [2]. Björnson E., Jorswieck E., Debbah M., and Ottersten B. 2017 “Multi-Objective Signal Processing Optimization: The Way to Balance Conflicting Metrics in 5G Systems” *JMC* 5(2)
- [3]. Braun, P. J. Pandi, S. Schmoll, R Fitzek, F. 2017. “On the study and deployment of mobile edge cloud for tactile Internet using a 5G gaming application” in 14th IEEE Annual Consumer Communications & Networking Conference (CCNC), pp. 154-159,
- [4]. Fettweis, Gerhard, and SiavashAlamouti. 2014. “5G: Personal Mobile Internet beyond What Cellular Did to Telephony”, *Communications Magazine*, IEEE 52 (2): 140-145,
- [5]. Gonzalez, A., Kühlmorgen, S. Festag, A. Fettweis, G. 2017, “Resource Allocation for Block-Based Multi-Carrier Systems Considering QoS Requirements” in *Proceedings of the IEEE Global Communications Conference*,
- [6]. Importance of 5G; available on <https://www.rpc.senate.gov/policy-papers/the-importance-of-5g&ved=2ahUKEwi3> accessed on 12 January 2020
- [7]. Matthé, M. Gaspar, I. S. Mendes, L. Zhang, D., Danneberg, M. Michailow, N. and Fettweis, G. 2017. “Generalized Frequency Division Multiplexing: A Flexible Multi-Carrier Waveform for 5G” in *5G Mobile Communications*,
- [8]. Mendes, L. Michailow, N. Matthe, M. Gaspar, I. Zhang, D. Fettweis, G. 2016 “GFDM: Providing Flexibility for the 5G Physical Layer” in *Opportunities in 5G Networks: A Research and Development Perspective*, CRC Press,
- [9]. Simsek, M Zhang. D. Öhmann, D., Matthé, M. Fettweis, G. 2017. “On the Flexibility and Autonomy of 5G Wireless Networks” in *IEEE Access*,
- [10]. Szabo, D., Gulyas, A. Fitzek, F. H. P. and Lucani, D. E., 2015 “Towards the Tactile Internet: Decreasing Communication Latency with Network Coding and Software-Defined Networking,” *European Wireless 2015; 21st European Wireless Conference; Proceedings of, Budapest, Hungary*, pp. 1-6.
- [11]. What is 5G? Available on <https://www.qualcomm.com/invention/5g/w>



- [hat-is-5g&ved=2ahUKEwi3](#) accessed on 14<sup>th</sup> January 2020
- [12]. Why is 5G important? Available on <https://www.verizon.com/about/our-company/5g/why-5g-important-discover>, accessed on 12<sup>th</sup> January 2020
- [13]. Wübben, D. Rost, Bartelt, P. J. Lalam, M. Savin, V. Gorgoglione, M. Dekorsy, A. and Fettweis, G., 2014. "Benefits and Impact of Cloud Computing on 5G Signal Processing: Flexible centralization through cloud-RAN", IEEE Signal Processing Magazine (SPM), 6(31): 35-44,
- [14]. Wunder, G. Jung, P. Kasparick, M. Wild, T. Schaich, F. Chen, Y. ten Brink, S. Gaspar, I. Michailow, N. Festag, A. Mendes, L. Cassiau, N. Ktenas, D. Dryjanski, M. Pietrzyk, S. Eged, B. and Vago. P. 2014 "5G NOW: Non-Orthogonal, Asynchronous Waveforms for Future Mobile Applications", IEEE Communications Magazine (ComMag), 12(52),
- [15]. Zhang, D. Festag, A. Fettweis, G. 2017. "Performance of Generalized Frequency Division Multiplexing Based Physical Layer in Vehicular Communication" in IEEE Transactions on Vehicular Technology.