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Transformative Power of 5G:

Executive Summary

The communication industry has witnessed a consistent, enveloping transformation. From the first generation of networks centred on voice to the cusp of the 5G era, enabling intelligent connectivity, Internet of Things and Artificial Intelligence and with this evolution, is productivity, interconnectedness, economic benefits and the advancement of the human race.

There exist as always challenges to reaping these digital transformational profits- from infrastructural deficiency, and financing, to over-regulation and the lack of full-scale governmental support in the safety, and security of this infrastructure, to the heart of the matter- the consumer- whose low-income, mostly has become a clog in the wheel in the total democratisation and adoption of mobile broadband.

Data has now become an essential commodity, synonymous with even life itself.

Only nine years after the launch of 4G, we're getting ready for the next generation. While each technology cycle brings greater opportunities to mobile operators, it also requires greater infrastructure investment. To maximize their returns on 5G, they will need to understand how network infrastructure and the associated cost base will evolve over the next few years. With this knowledge, they'll be in a strong position to design an infrastructure investment strategy that best suits their unique needs.

Data has now become an essential commodity, synonymous to even life itself, and as such, the 5G era will witness the use of small cells, which strategically place radios closer to users.

Small cells can be backhauled over copper (xDSL, HFC-based cable modems...), air (microwave millimetre-wave...), or fibre (Ethernet, PON in varying degrees, with the technology choice based on geographic location, economic, environmental, regulatory, and time-to-market criteria.

Mobile Network Operators will be a key driver in up-swinging the move to 5G, which will be catered initially to enterprise hubs and commercial areas, such as Lagos and Abuja. MTN as the leading MNO has recently commenced trial of 5G in Nigeria, with the NCC release of a new spectrum. The question then becomes "when" and not "If". Ironically, the adoption of 4G

Nigeria dramatically falls below the 44 per cent coverage

The future is here.

The Broadband Ecosystem in Nigeria

The deregulation of the Telecommunications sector in 1992, the democratization and commercialization of NITEL (Nigeria Telecommunication Limited) in the 2000s, the emergence of licensed telecoms providers and fixed wireless operators, as well as further increased allocation of powers to the Nigerian Communications Commission (NCC) saw an unprecedented transformation in the Nigerian communications space, and across all sectors of the economy.

Data, once a luxury, became a commodity. (*International capacity per Meg per month cost \$6,000 in 2005, \$300 in 2010 and is less than \$20 in 2018*). Dial-up and VSAT typical speeds went from a very cost expensive 2.4Kbps and 9.6Kbps in the 1990s to 1Mbps to 5Mbps in

2000s, and over 100,000% increase in twenty-five years¹. The entry of wireless operators such as MainOne and Glo 1, Smile submarine cables - stimulated a cost reduction in international bandwidth, as wireless broadband became highly competitive in terms of price and speed with a mutual centring of voice and Data from the GSM Telcos.

Nigeria's broadband sector has seen considerable consolidation among players, from over 400 ISPs in 2012 to about 100 by the end of 2018². While most internet connections are via mobile networks, principally GSM and 3G and LTE, there has been an increasing number of WiMAX operators founding niche markets. Several international submarine fibre-optic cables have landed since 2009, which has contributed to lower pricing for consumers and greater capacity for fixed-line and mobile backhaul³. Currently, 44 percent of mobile subscribers in Nigeria are using 3G technology and 4 percent are using 4G technology⁴. Nigeria's mobile broadband penetration is forecast to rise to 55 per cent of the population by 2025, with 70 per cent having 3G connectivity and 17 per cent having access to 4G networks. 5G network with the 26 GHz, 38 GHz and 42 GHz spectrum bands will be rolled out by 2020.⁵ 5G networks will enable an enhanced broadband experience with speeds of up to 1 Gbps and latency of less than 4 milliseconds.

¹ The Evolution of Broadband, The Impact on ICT &The Way Forward, IPNX

² Nigeria - Fixed Broadband Market - Statistics and Analyses, Buddecomm, (2019)

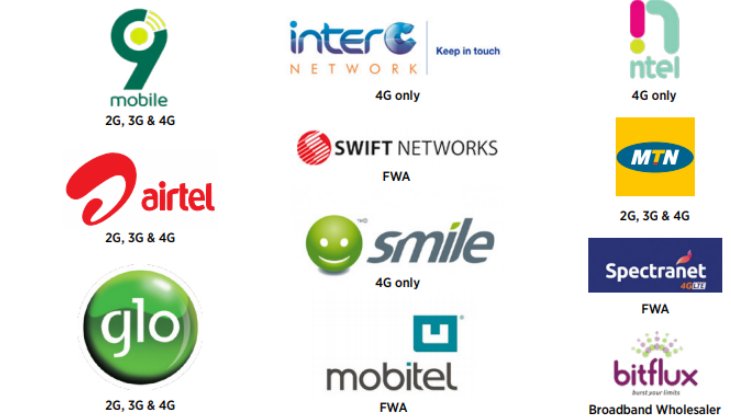
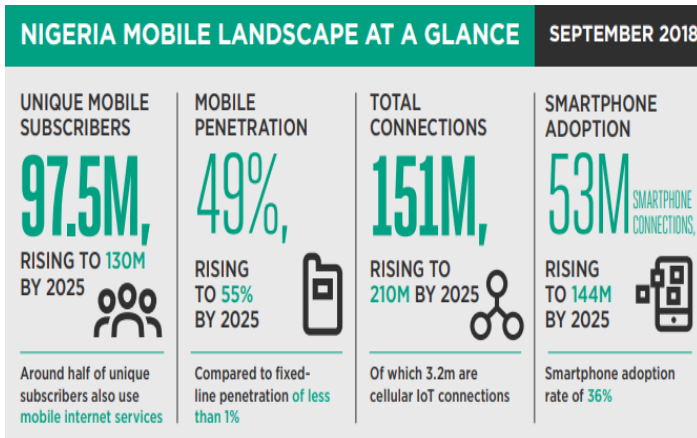
<https://www.budde.com.au/Research/Nigeria-Fixed-Broadband-Market-Statistics-and-Analyses>

³ Nigeria - Fixed Broadband Market - Statistics and Analyses, Buddecomm, (2019)

<https://www.budde.com.au/Research/Nigeria-Fixed-Broadband-Market-Statistics-and-Analyses>

⁴ Jumia

⁵ jumia



Source: GSMA Intelligence

Players in the Broadband Space

Fibre-optic cables touted as the future of wireless communications heralded speeds of over 50Mbps which are now available and affordable, particularly with MTN and Airtel, where sales of 4G data can be as low as one thousand naira for 1.5 Gig. A consistent trend seen is the proliferation of players from an inefficient, corruption-ridden and incapacitated MTEL to a highly competitive, market-driven and consumer-focused global player fighting for an increased share in the explosive population of Nigeria.

With broadband internet, data is generated and processed. transferred, consumed, analysed, and utilized faster, comparable with the speed of light, making social economics, interaction, and businesses more intense, more dynamic, and more efficient. An unintended consequence of this is an increased demand for new IT skills and services which cannot be met with the current spate of graduates churned out by the epileptic educational sector in Nigeria. To offset this problem, businesses and technology industries import expatriates, in cases where this seems unlikely, the exportation of IT jobs by companies becomes the next desirable option.

The growth of broadband internet is driven by a mutually beneficial, symbiotic relationship with the growth of IT products. The Internet of Things (IoT) relies largely on intense internet connectivity powered by data. Cloud computing and the implosion of software-as-a-service (SaaS) and platform-as-a-service (Paas), Infrastructure-as-a-service (IaaS) and other disruptive technologies have enabled innovation and catalysed an enormous demand for a more effective

and faster-speed broadband driving internet providers to keep improving the quality of their service to stay competitive.

The positives of these innovations in the digital era are counterpoint to the privacy and security risks, unfriendly government policies, and infrastructure challenge associated with this model. In 2018 alone, telecom operators recorded over thirty thousand cases of infrastructure vandalism, fibre cables and battery thefts, with Globacom, being the worse hit⁶, including hostility in some communities, with some demanding financial compensation before installation of fibre-optic cables. These and more are responsible for poor network services in some parts of the country, huge losses to telecom operators and low revenue for the government - stalling the growth of cloud computing in Nigeria. As a result of these developments, the broadband offerings of all the service providers in Nigeria are very frustrating/unreliable.

The Main One Cable Company which has laid a 7,000km fibre optic cable linking West Africa to Europe, said that the absence of robust national backbone has led to increased cost of moving capacity around the country. Investigation reveals that to get connected from Lagos to London costs \$600 per megabyte as against \$1,100 between Lagos and Abuja due to governments' inability to encourage investment geared towards strengthening backbone transmission networks.⁷ Despite the lots of effort there has been a slowly dwindling reluctance to embrace this new technological trend in most of Nigeria's business circle as they fear having their technology assets hosted and managed by third parties.

Business rely on cloud computing to provide needed reliability and increased performance to their customers, particularly banks in Nigeria, where provision of virtual servers, data centres and Enterprise solutions limits their own burden of having to maintain infrastructure. Due to the cost of maintenance there is need to outsource these functions to a third party to reduce capital and operational expenses. Major cloud providers such as Microsoft, IBM, Google and Cisco have put in place structures that drive the spread of cloud computing in Nigeria by either

⁶ Nkechi Onyedika-Ugoeze and Sodiq Omolaoye, (2018, November), The Guardian, "Telecom operators record 33,000 cases of theft, destruction of facilities"

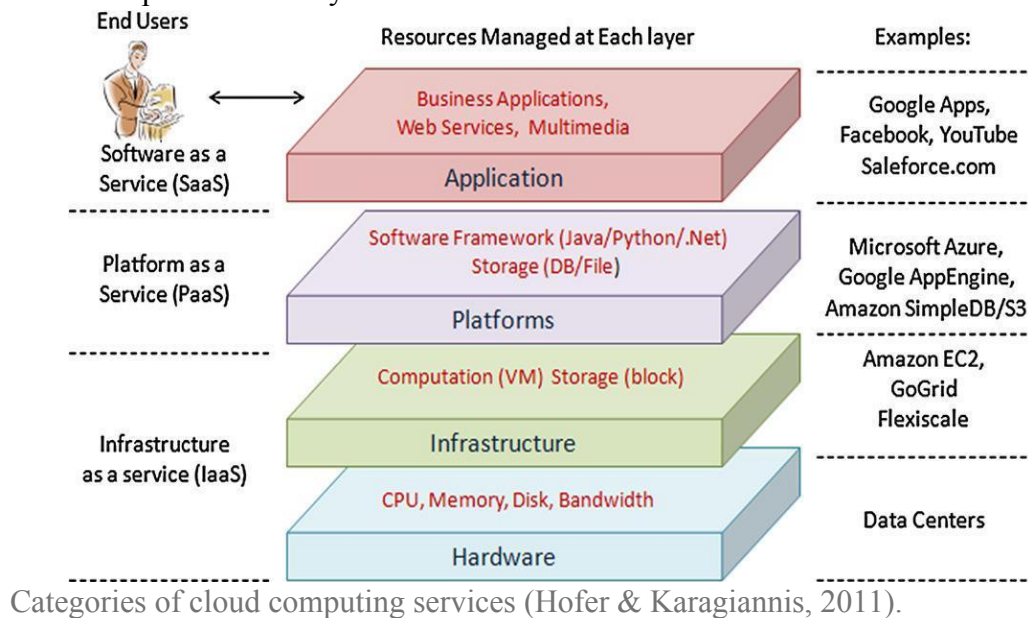
<https://guardian.ng/technology/telecom-operators-record-33-000-cases-of-theft-destruction-of-facilities/>

⁷Nnadozie C. (2013), "Cloud Computing in Nigeria." Department of Computer Science, Faculty of Physical Sciences, University of Nigeria Nsukka. <http://www.unn.edu.ng/publications/files/Nnadozie.%20Chapman%20Eze.pdf>

providing the cloud services directly to organisations or in partnership with local IT firms⁸. Such firms include Dataflex, NetApp, Sunnet for better integration and penetration.

In Nigeria, various global cloud computing companies offer their services in different sectors. For example, Wema Bank Nigeria Plc, partnered with Microsoft and makes use of MS Exchange 2010, MS SharePoint Server 2010 and MS Lync Server 2010 for email messaging, collaboration and video conferencing respectively. Similarly, Nigerian Airspace Management Agency (NAMA) deployed Windows Server 2012 which enables several functions and saves cost. Most notable is the Nigerian Uniform Bank Account Number (NUBAN) gave rise to the change of bank account numbers to a uniform 10-digit number and the Bank Verification Number (BVN).

The average non-IT Nigerian benefit wholesomely from SaaS/PaaS/IaaS technologies due to the lower cost rate, faster deployment time, and increased flexibility that these solutions offer. Access to your Gmail account on any device or stream movies on Netflix; WhatsApp and Facebook, for its instant communication capability allowing messages be stored on the service provider's hardware rather than on your personal device. This allows you access your information from anywhere via the internet, with Gmail allowing up to 10G storage space and on-demand backups and recovery.



⁸ Iwuchukwu, U.C., Atimati, E.E., Ndukwe C.I., Iwuamadi O. C. The State Of Cloud Computing In Nigeria <http://www.iosrjournals.org/iosrjeee/Papers/Vol12%20Issue%203/Version-2/K1203028493.pdf>

The rapid expansion of national fibre backbone networks, has enabled e-commerce, online banking and e-payments, e-health, e-learning and e-government increase in efficiency and performance.

By the end of 2019, mobile broadband (MBB) connections (3G and above) will for the first-time account for the majority (54%) of total mobile connections in Sub-Saharan Africa⁹. In Nigeria, this sector is still dominated by GSM -2G and 3G technology , with an increasing reliance on LTE infrastructure supported by improved terrestrial Fibre networks to provide backhaul for data services as the government has updated its broadband ambitions, aiming to increase penetration from 70% by 2021 though most connections will be via mobile networks, exceeding the 30% target as it currently stands at 33.31% since June 2019¹⁰. This represent an important milestone not just for the region, but for Nigeria, most notable in the way consumers use digital platforms.

Transcending from Voice to Data

The shift in global communications, as a direct correlation to the changing needs of consumer behaviour has catalyzed many Over the Top (OTT) companies rivaling top telecommunications giants which has in turn forced these big guns to restructure their business model. Clearly, maintaining the status quo is a recipe for irrelevance and slow death.

This explosion of OTT alternatives with innovative business model and features like WhatsApp (both audio and video calls), Facebook, skype, etc., offering the same services of voice, messaging and video calls at a much lower rate and with better service efficiency are no longer the exclusive domain of Mobile Network Operators (MNOs). For example, you would rather call your Uncle or friends overseas with your internet data than voice calls due to the exorbitant cost of making international calls.

Prior to 2015, the product and service focus of the global telecommunications industry was voice, known as Telco 1.5¹¹. This has given way to Telco 2.0 characterized by a data-centric

⁹ 5G in Sub-Saharan Africa: laying the foundations, GSMA Intelligence, 2018

¹⁰ Nigerian Investment Promotion Commission, Broadband Penetration: Nigeria Exceeds 30% Target (2019, November) <https://nipc.gov.ng/2019/08/31/broadband-penetration-nigeria-exceeds-30-target/>

¹¹ This Day, The Shift from Voice to Data Communications, (2015) <https://www.pressreader.com/nigeria/thisday/20150115/281921656432494>

model, birthing the digital economic, by leveraging on the power of the internet. The increasing adoption and usage of broadband in Nigeria has mounted increase demand on online consumer behavior and products. In Fintech, Agro-tech and educational technology, as well as entertainment, increasing data consumption has spurred innovation, deepening and spurring the growth of human existence, and pushing human limits while increasing economic returns for Nigeria.

It is no surprise that Telcos Operators have scurried to have their hands on the “sectorial pie”, mainly through retailing, via the sale of content, financial services of borrowing airtime, as well as divested ownership in Network infrastructure.

Competition among ISPs and Telcos have mostly favoured Telcos. This situation, according to ISPs, is forcing traditional ISPs to go out of business, coupled with the harsh business environment in the country. The effect has been a cut down on the 103 licensed ISPs, as only few of them were able to renew their licenses in 2018 and 2019, an indication that more ISPs may have gone under this year. NCC said only 10 per cent of the 103 licensed Internet Service Providers (ISPs) in the country approached it for license renewal last year, leaving 90 per cent out of business.¹²

Possibility of 5G In Nigeria

The mobile industry has demonstrated its ability to connect and transform society through its 2G, 3G and 4G networks over the last 30 years. Traditional mobile technologies (1G, 2G, 3G) were heavily voice oriented, but 3G introduced the first foundation for data services. As an evolutionary technology, 5G will perform all the functions of 4G, enhance existing services, enable new business models with the potential for more, and at a significantly larger scale.

Video traffic which has become a key factor in the demand for a faster internet connection- faster upload, download, video conferencing, and virtual reality will remarkably improve from super-fast download speeds, high levels of reliability and extremely low latency of 5G. Video

¹² This Day “The Huge Data Rip-Off In Nigeria” (2019, May)
<https://www.thisdaylive.com/index.php/2019/05/19/the-huge-data-rip-off-in-nigeria/>

traffic is expected to grow from 56 exabytes used in 2017 to 240 exabytes globally in 2022¹³. To achieve this type of performance, 5g technology will need a lot of small cell coverage and will take advantage of higher bandwidth spectrum.

However, opponents of 5G technology in Nigeria have suggested that Nigeria's macroeconomic environment and relatively low uptake of digital services are sufficient reasons to take a dim view of 5G deployment and adoption in the country. According to them, the notion of 5G in Africa comes across as a contradiction and a situation that is far from becoming reality. A population that could hardly consume the coverage of 4G despite its relative coverage, mainly due to unaffordability of 4G phones and its increased data requirements, where 3G reaches only 70% of the population and 4G nearly 50% of the population. In defense of these, supporters are quite optimistic, citing ongoing investments in 3G and 4G networks that have taken mobile broadband coverage to around a quarter of the total population, while smartphone adoption has doubled over the last three years and now accounts for two in five mobile connections¹⁴ in Sub-Saharan Africa. The increase in cheaper smart phones from China companies has intensified this adoption. According to Jumia mobile report, it is predicted that Nigeria will contribute 4% of the estimated 700 million new global mobile subscribers, making it the only country in Africa recognized with a significant contribution to increasing mobile penetration in the world¹⁵. It is also expected that 28 million new mobile subscribers will emerge from Nigeria between 2019 and 2025. This is a huge market for the 5G technology in Nigeria

The future is not so bleak for 5G technology in Nigeria. For instance, MTN has tested 5G rollout in South Africa, and have conducted a test in Nigeria also, but it is also important that 5G compliant smartphones are in the market and that the smartphones are in the right preference.

There is no one-size-fits-all approach for rolling out 5G in African markets, given the number of factors that come into play, including fiber and infrastructure availability, spectrum availability, and local regulation. In practical terms, most operators are likely to opt for low-band 5G in the near term while trialing—and in some cases deploying—high-band 5G in key business and enterprises hub.

¹³ SDxCentral "What is 5G? Everything You Need to Know" (2016, September) <https://www.sdxcentral.com/5g/definitions/what-is-5g/>

¹⁴ GSMA (2019) '5G in Sub-Saharan Africa: laying the foundations'

¹⁵ Jumia Nigeria Mobile Report (2019) <https://www.jumia.com.ng/mobile-report/>

Is 5G Possible in Nigeria?

Market Readiness Of 5G in Nigeria

A report on 5G in Africa by GSMA, a global trade organization for mobile operators, estimates that only seven African countries, including South Africa, Nigeria and Kenya, will have 5G by 2025¹⁶.

The pre-2G era mirrors almost completely with the pre-5G era with a feeling of uncertainty and social anxiety with new innovative communication technology. In the pre -2G era, it was the revolution of voice, taking the less than 1% of the population who had access to any form of telecommunication service to an ubiquitous degree, despite relatively low GDP per capital income when compared with global GDP, low literacy level, poor access to electricity, lack of pervasive telecoms infrastructure and an overly corrupt system. In spite of this, there was a mass acceptance, adoption, transformation and development of product and services. In this current space, it is a towering demand for data and connectivity. In 1999, GDP per capita in Sub-Saharan Africa, at \$567 on average, was a tenth of global GDP. In 2019, it increased to more than \$1,500, it represents just 14% of the global figure, and infrastructural challenges still persist.¹⁷

5G in Sub-Saharan Africa is sure to happen; it is a natural progression from previous technology generations, cascading within the globalized landscape and use of technology. The advent of the 5G era in the Nigeria then becomes a question of ‘when’ rather than ‘if. * - Are the existing technologies and infrastructure capable of supporting current use cases and demand for 5G internet connectivity? Is the consumer market and other sectors ready to embrace this technology, Are the regulators concerted in the effort to create positive outcome for the use of this technology?

¹⁶ GSMA (2019) ‘5G in Sub-Saharan Africa: laying the foundations’

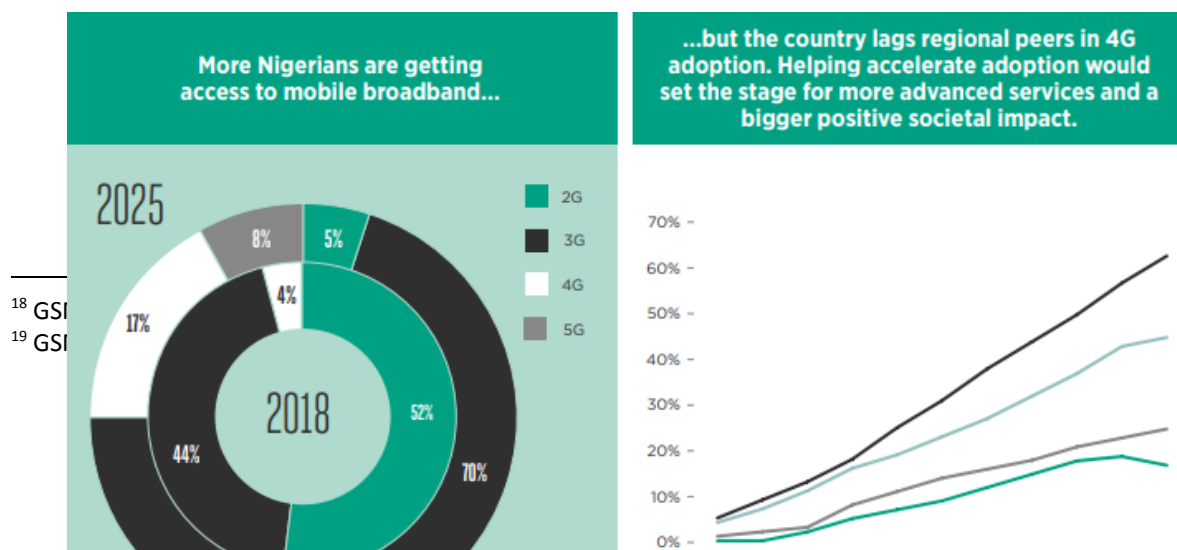
¹⁷ Ibid,

Are there any positives in perhaps being the last entrant in then adoption of 5G Technology? Will the time lag before the full-scale deployment of 5G technology to countries in Africa allow for it to be tested and perfected through market trials in other more technologically advanced countries, such as South Korea and the US, giving room for mistakes to be made by markets that can afford such, lowering costs for both operators and consumers alike? Already, some 164 global operators across 81 markets had undertaken trials as of the end of June 2019¹⁸

The 5G market in Nigeria is all in the timing as with other markets for consumers, producers and operators. According to GSMA, by 2025, there will be commercial 5G services in at least seven markets, including Kenya, Nigeria and South Africa, with 28 million 5G connections (equivalent to 3% of total mobile connections) between them¹⁹. According to Professor Umar Danbatta, the Executive Vice President of the Nigerian Communications Commission (NCC), 5G network with the 26 GHz, 38 GHz and 42 GHz spectrum bands will be rolled out by 2020.

In its early stages, 5G fixed wireless access will be the primary use of network deployment and adoption as targeted local density and need are explored and balanced with the cost affordability, particularly for businesses and enterprises in commercial areas, such as Lagos, Port-Harcourt and Abuja. Major stakeholders include:

For most people, and very rightly so, 5G is impracticable and unlikely in Nigeria. 3G and 4G, particularly are still in the nascent stage, connectivity is still poor, and not ubiquitous in most rural populations. Most markets in the region are still in the early stages of mass-market 4G rollout and this has yet to translate into widespread 4G adoption and resources should be devoted to mass-scaling 2G, 3G, and 4G*



Source: GSMA Intelligence

Furthermore, there is limited availability of key 5G spectrum across most markets, particularly in the mid- and high-frequency bands* However, the 5G era is not imminent for most markets as existing technologies are capable of supporting current use cases and demand for mobile internet connectivity.*

For Consumers – Household and Businesses *in other parts of the world VS, in west Africa and in Nigeria**

Consumers in South Korea, the US and a few other countries are already getting to try out the fifth generation of mobile technology, using the handful of 5G mobile handsets that have entered the market already. In Germany, Deutsche Telekom has operational networks in five cities – Berlin, Bonn, Cologne, Darmstadt and Munich – and it plans to expand the service to Hamburg and Leipzig by the end of 2019, plus another 13 by the end of 2020. South Africa is leading the way to 5G in Africa.

South Africa's Data-only network provider – Rain has rolled out 5G network and is now live in parts of Johannesburg and Tshwane at roughly 68 dollars for around 200 Mbps – compared to the roughly 40 Mbps you can expect on similarly-priced fibre lines.

Russian operator - MTS says it has conducted the first tests in the country of 5G mobile on millimeter wave spectrum, using network infrastructure supplied by Nokia – and achieved a speed of 2.1Gbps on a pre-launch handset, Samsung's Galaxy S10 5G, using a Qualcomm Snapdragon chip²⁰.

An already established dynamic is the ever-increasing demand for a lightning-fast speed, low latency, greater capacity broadband internet, but the challenge in Africa is the consumer.

The continent already has an oversupply of 4G mobile internet that average consumers aren't buying because it is too expensive. In South Africa, 4G coverage is 90% of the population, yet only 20% of the market uses 4G. As at 2017, an estimated 92 million Mobile subscribers in Nigeria, on average, spent N197 billion monthly, on internet data, which results in an average of

²⁰ MTS drives 5G speeds to 2.1Gbps in 28GHz trial in Moscow (2019, September)
<https://www.capacitymedia.com/articles/3824197/mts-drives-5g-speeds-to-21gbps-in-28ghz-trials-in-moscow>

N2,141 being spent per individual, per month on data services²¹. This price might seem inexpensive, however, when compared to the minimum income it's downright exorbitant, which is worsened by a lack of affordable devices to the average rural Nigerian. In Nigeria, for example, only about 4% of mobile internet users pay for 4G services while more than 40% use the cheaper, but slower, 3G internet even though Nigeria has an extensive 4G network. It's the same story over most of Africa where only 10% of the sub-Saharan African population actually uses 4G. In 2019, about 70% of internet users or 64m use up to N1000 data monthly each, while about 15% or 13.8m users, mostly small business owners and middle-class people, each purchase an average of N3000 data monthly. Similarly, 10% of the internet subscribers or 9.15m use N5000 each month, while about 5% of the internet customers or 4.6m buy N10,000 monthly²². As at 2016, prices in Nigeria need to drop by 97% to become affordable for the majority of the country's 180 million people.²³

If Nigerian consumers can hardly afford 4G phones, they certainly won't be able to afford 5G or the new devices necessary to use 5G on a smartphone. At the end of 2018, there were over 36 million smartphone users, representing a penetration of 18.37%.²⁴ Ironically, phone companies have not yet sold out 4G smartphones. 5G phones are so expensive because the devices and the wireless networks they use cost billions to build. For example, one reason why 5G phones cost so much is that the chips cost more and are not integrated yet. A separate modem means one more element that the phone-makers have to buy, with manufacturers having to embeds 5G, 4G, 3G and 2G onto a single chip. Without a 5G-ready chip that can talk to the carrier network, your phone can never reach those lightning speeds. 5G phones are on the horizon, but good, affordable 5G budget phones are still years away, thanks to Asian, lower point price phones have become more democratically inclined, and affordable to population in than rural areas which we can also see being replicated in 5G phones. This happened with 4G, and it will happen with 5G again.

²¹ A Probe into the Expensive Cost of Mobile Data in Nigeria (2019,May)
<https://aanoip.org/a-probe-into-the-expensive-cost-mobile-data-nigeria/>

²² Daily Trust 'Nigerians spend N197bn monthly on internet data'
<https://www.dailytrust.com.ng/nigerians-spend-n197bn-monthly-on-internet-data.html>

²³ PwC 2016 Report

²⁴ Julia Nigeria Mobile Report (2019) <https://www.jumia.com.ng/mobile-report/>

High prices will deter billions of people from switching over from 4G phones to faster 5G. The cheapest 5G handset you can get in the US costs \$840, which is over three hundred thousand in Nigerian Naira, with prices skyrocketing to N720,000 for phones like the Samsung's Galaxy Fold 5G. These phones are currently not available in Nigeria. Already, three models of Apple's 2020 iPhones are already in the works and will support 5G, while Android phones have been produced to match the 5G match. A basic set of features will be needed to make the 5G experience worthwhile, like enough battery capacity to support faster speeds, and processors fast enough to take advantage of the increased data.

5G earliest operation will use Fixed Wireless Access (FWA) as its entry point, and not wide-spread throughout the whole country. It will be mostly localized where there is an extensive concentration of businesses such as financial services, mining, oil and gas and data centres, perhaps having a brew of Fibre and FWA with minor spill-overs into residential areas.

For Regulators and Policy Makers

The lofty ambition of the NCC weighs horrendously and impracticably higher than the capabilities necessary to drive 5G deployment and adoption in Africa, owing much to infrastructure deficit and spectrum availability.

Based on current state of infrastructure, Nigeria is not technically ready to 5G rollout. Moreover, the Nigerian government have not yet developed the regulations that would allow for a 5G rollout, although, it had announced its readiness to roll out 5G network with the 26GHz, 38GHz and 42GHz spectrum bands by 2020²⁵. According to Pro. Umar Garba Danbatta, Executive Vice Chairman of NCC, 'trial testing of the rollout plan had commenced in the country beginning with the Eko Atlantic project, where broadband data would drive connectivity and allow humans to interact with connected devices to check health their status, and remotely control home appliances without physical contact.'²⁶

²⁵ Emma Okonji 'This Day Nigeria's State of Readiness for 5G Rollout' (2019, August)
<https://www.pressreader.com/nigeria/thisday/20190804/281689731430402>

²⁶ Tekedia 'A Letter To The EVC Of NCC On 5G Trial in Nigeria'
<https://www.tekedia.com/a-letter-to-the-evc-of-ncc-on-5g-trial-in-nigeria/>

In Nigeria, it is evident that governments and operators are not fully prepared, otherwise, allocation of the spectrum would have been auctioned faster. This myopic perception can also be attributed to the unexpectedly rapid growth of digital communications and the broadband landscape.

This is compounded by the unfriendly investment climate, worsened by the stiff regulations and bureaucratic process. Preparing an investment climate that enables all parties to profit from the next-generation technology must be at the heart of government policies and NCC regulations. It is important that the NCC changes its approach to licensing, be informed of the progress made by the global telecoms sectors and understand the role 5G will play in holistic development and economic ground if this is to make any meaningful development. The speed, reach and quality of 5G services rely on governments and regulators supporting timely and affordable access to the right amount and type of spectrum, and under the right conditions.

Despite the fact countries from various parts of the world are already discussing the 5G rollout, the issue of regulation is not solely peculiar to Nigeria. Ericsson for instance has joined calls for a rational approach to spectrum license fees since 5G technologies come down to benefitting and transforming society.

It is important that the NCC set modest reserve prices and annual fees, rely on the market to determine spectrum prices, and avoid limiting the supply of spectrum, leading to exorbitant prices.

In view of the role 5G will play in driving future innovation and economic growth, now is the time to begin putting in place the necessary building blocks to facilitate the transition to 5G. The lessons learned in the 3G and 4G eras underscore the need for governments and other stakeholders to address key policy imperatives for the 5G era, both in the wider context of next-generation connectivity and the advancement of the digital economy. Policy-makers and regulators should work in partnership with stakeholders to enable timely, fair and effective awards. Improving access to new spectrum is an opportunity to facilitate universal access to high-speed mobile broadband for everyone and everything.

GSMA Intelligence research shows that mobile operators in developing countries already pay three times more for spectrum compared to operators in developed markets when income levels

are taken into account and might not be affordable. Research has shown that high spectrum prices are linked to more expensive, slower mobile broadband services with worse coverage. Policies that inflate prices to maximize revenues are a key cause. For example, auction reserve prices in developing countries are five times higher than in developed markets once income differences are considered.

To this end, regulatory bodies, the key to 5G evolution and technology-led economic growth, should create the conditions for efficient and timely next-generation network deployment while reducing the regulatory costs for operators.

Reduction in complex planning procedures involving multiple layers of approval and bureaucracy which the NCC and other regulatory bodies are quite notorious for can significantly fasten infrastructure deployment. For example, Fibre as backhaul (both fixed and wireless) require local level access, right of way, including site acquisition to achieve national digital ambitions. Site acquisition, right of way, and co-location are key spaces that require prompt government intervention.

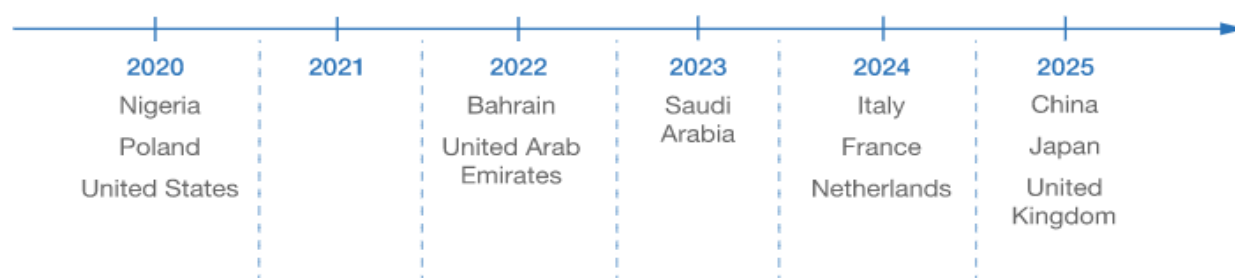
The speed, reach and quality of 5G services rely on governments and regulators supporting timely and affordable access to the right amount and type of spectrum, and under the right conditions, even for trials. That was one of the reservations Vodacom had when it showed off 5G in Lesotho and South Africa

For Operators and Carriers

The deployment, adoption and growth of 5G technology is inherently hinged on the supply of necessary infrastructure. From past experiences with the previous 4G generation network where adoption was just 6% of 51% coverage, clearly showing a clear significant mismatch between supply and demand. Mobile operators are preparing with a brew of resignation and anticipation. They know that it will open opportunities to capture value from new 5G use cases and the gradual widespread adoption of the Internet of Things (IoT) which will equally involve an increase in infrastructure investments in this technology. Meanwhile, operators will still have to upgrade their 4G networks to cope with increasing demand.

This instance of double-speak raises important questions about the investment strategy and future profits for mobile players.

It comes at no small price for an evolution of technology to take place. Hence, many elements of current 5G technology build on 4G networks, rather than representing a total exit which requires a great deal of capital investment. For instance, operators could begin by upgrading the capacity of their existing 4G macro network by modifying a portion of their 2G, or by acquiring additional spectrum when available. When network upgrades are no longer sufficient to support the increased traffic, operators will need to build new macro sites or small cells which will also be dependent on location, driving network cost increases²⁷.



The point when at least one network operators begin running out of capacity and network upgrades are no longer sufficient to support the increased traffic

Source: McKinsey&Company

Mobile operators also need to build the vast network of masts or antennas and undertake large-scale fiberization efforts -install fibres to transmit the signals and densifying existing networks with macro sites, upgrade to the traditional network, the addition of new macro sites, creation of the new 5G layer, and the addition of small cells needed in many highly populated urban areas. Mobile carriers on the continent cannot launch full 5G services until each country's communications regulator holds a spectrum auction to sell the rights to transmit over specific frequencies. For example, Rain in South Africa can only provide 5G because it is using its existing spectrum to transmit the signal.

Rolling out 5G services necessitate expensive investment – which holds no promise of recouping profits in Nigeria. When 4G launched in 2009, mobile operators didn't see the great returns they

²⁷ McKinsey&Company 'The road to 5G: The inevitable growth of infrastructure costs (2019)
<https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-road-to-5g-the-inevitable-growth-of-infrastructure-cost>

had captured with earlier generations. Despite their investments in 4G infrastructure, revenues showed sluggish growth. (confirm research in revenue).

Ironically, this evolution is coming at a time when the outlook for revenue growth in the industry remains subdued and margins in many markets are under pressure. For 5G to be successfully deployed, Operators will invest in new network capabilities and upgrade their networks to multi-standard 5G-ready basebands and radio antennae, deploy fibre deeper into their networks, build more cell sites to support network densification and data centres for edge services, and invest in the latest LTE-Advanced technologies such as carrier aggregation and massive multiple-input multiple-output (MIMO). Given the challenging financial situation, operators, vendors and other ecosystem players will need to explore ways to ease the financial burden.

In rural and suburban areas, as well as along roadways, operators can handle increased traffic simply by densifying existing networks with macro sites. In many highly populated urban areas, by contrast, they'll need to rely on small-cell solutions for two reasons: a higher concentration of traffic, as measured by traffic load per square kilometer, and the use of higher spectrum bands (greater than 3 gigahertz). Mobile operators will need to develop effective strategies to cope with this expected growth in network cost. Standard measures will involve cost-saving efforts, but they will also need to explore more alternative approaches, such as network ownership and sharing (the joint building of new 5G networks), as against the infrastructure-based competition and new revenue models.

Passive infrastructure sharing and the use of tower companies is already a feature in Sub-Saharan Africa, particularly in Nigeria, but will become more widespread, mostly to address some of the specific coverage challenges in the region. However, with the epileptic electricity grid in Nigeria, and the reliance on diesel generators, and the associated challenges of erratic supply reliability, security and fuel theft, many operators in Nigeria should seek ways to run their networks from renewable sources, especially solar.

Vendors can consider new ways of financing network investment such as the lease-to-own-model, whereby the vendor funds the network, build and then enters into a revenue share arrangement with the operator until the equipment vendor recovers the investment cost,

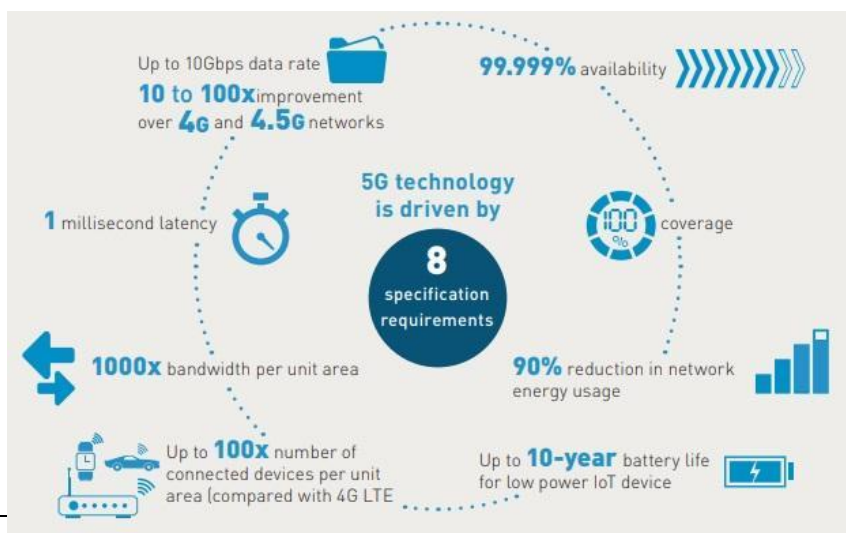
then transferring ownership to the operator²⁸. Some of the challenges other previous generation network includes:

Transformative Power of 5G

5G is the driver and future of the next generation of wireless networking frictionless technology. But it's more than just an evolutionary step forward, it's a revolutionary leap. It is a disruption in every sector which brings new innovations to consumers.

The first wireless networks let us communicate on the go, being introduced in 1982 to support analog voice. The leap to 2G, introduced in 1991 enabled digital voice and text messaging – remember Nokia 3310? 3G was introduced in 1998 to support data and multimedia service, and paved the way for mobile internet and music streaming. And 4G consolidated the true mobile broadband, unleashing the app ecosystem and economy, unified networks architectures and protocols while inspiring other industries to harness the power of wireless. 5G – the latest generation – is expected to unleash a massive IoT (Internet of Things) ecosystem where networks can serve communication needs for billions of connected devices like connected/autonomous cars, factory robotics, smart cities, remote surgery (telesurgery) etc.

5G will be much faster than 4G. How fast are we talking? 10 to x100 faster than what you can get with 4G, topping 10 gigabits per second (Gbps), reducing latency to nearly zero about the normal time it takes for a flash on a normal camera. 1 millisecond, which is 1/1000 of a second.



²⁸ GSMA

Source: www.gemalto.com/

Think upgrading from a two-lane highway to two hundred lanes—much more data will be able to pass through the same busy areas without getting bottlenecked or delayed. These speeds will also allow us to stream high-definition video in seconds and power innovations in fields like virtual reality. In its simplest form, 5G speed enables you to download a whole season of Games of Thrones in two seconds.

5G will use a mix of low-, mid- and high-band spectrum. Low-band spectrum will provide crucial foundational coverage. Mid-band spectrum will enhance that coverage and bolster networks' capacities. And high-band spectrum will enhance those high capacities, by using what the industry calls mmWave technology—tiny radio antennas, measured in millimeters²⁹. The use of shorter frequencies (millimeter waves between 30GHz and 300GHz) for 5G networks is the reason why 5G can be faster.

5G could also play a role in addressing network congestion in city centres, such as Lagos, as an important part of the infrastructure options to support high traffic density. The problem of high traffic density will become more pronounced in the state as the rate of urbanization picks up and cities become more densely populated.

Just over half of Africa's population live within 25 km of a fiber network. In Nigeria, independent estimates put it much lower at around 14%. Tech optimists say 5G could allow Africa to access faster and more stable mobile internet without having to lay fiber optic cables that deliver high-speed broadband.

Mobile technology is having a direct and positive impact on the daily lives of Nigerians, by fostering inclusive growth and enhancing the productivity and efficiency of the economy. In 2017 alone, the total value added by the mobile ecosystem to GDP was \$21 billion, representing 5.5% of GDP, with nearly 500,000 direct and indirect jobs, while \$1.8 billion was the total tax

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contribution of the mobile ecosystem, equivalent to 16% of government tax revenue³⁰. The 5G economy era will see a dramatic increase in revenue as productivity and efficiency in most sectors are enhanced.



For example, the Sub-Saharan Africa region is expected to deliver \$5.2 billion in GDP as a result of mmWave 5G by 2034.²⁶ Once 5G has taken off in Sub-Saharan Africa, the annual gain from mmWave 5G will grow much faster from 2026, closing the gap between early and late adopters.³¹





The 5G era has started to witness some developments. Devices like the Amazon Echo and Google Home, Apple's Siri, Amazon's Alexa and Google's Assistant are at the frontlines of the current transformation in tech and can live inside all sorts of products beyond smart speakers from wristwatches to microwave ovens and eyeglasses, and are gradually making their way through to Nigeria. Thanks to advances in speech recognition, artificial intelligence and processing power, it's now possible to step away from the screens of PCs and phones, and tap into the internet simply by speaking³².

For instance, with the use of 5G technology made possible by the partnership between Vodacom and Nokia, live streaming 4K videos in the VR exhibition event at the Durban July horse race in 2018, was successful, which would have otherwise caused a lot of buffering. 5G promises much more. High-speed wireless connectivity will deliver 4K and 8K videos, holograms, augmented reality, and virtual reality applications for gaming and immersive TV, while bringing people together to enjoy live events³³.

5G technologies promises to open up exciting possibilities and use technology to tackle the biggest challenges faced by individuals and businesses that once seemed achievable only in science-fiction movies. But it also brings with it privacy, security, accessibility and diversity challenges, particularly with intrusive advertisements, hacking and safety of passwords.

Table 3. Some industry applications that 5G could help enable

Industry	Potential 5G use cases, benefits and target users
Information, media & telecommunications 	<ul style="list-style-type: none"> • 5G can help support IoT, which may be a platform for future innovations and inventions. • 5G networks could increase network capacity by 40 times compared with 4G. • Access to a fully wireless and mobile internet: high-speed, high-capacity networking, low latency. <p><i>Target users: ICT providers, Consumers.</i></p>
Arts & entertainment 	<ul style="list-style-type: none"> • Mobile broadband in crowded areas, alleviating issues with capacity, interference & reliability.

Industry	Potential 5G use cases, benefits and target users
Professional, scientific & research services 	<ul style="list-style-type: none"> • Growth of ICT in the form of cloud computing, creation of new software and rise of online information. • More outsourcing of business service functions. <p><i>Target users: Scientific R&D, Legal, Computer Systems design, Consulting.</i></p>
Public administration 	<ul style="list-style-type: none"> • Superfast internet, analytics and advanced software programs could support smarter, fast-response emergency services. • Predictive analytics to forecast and mitigate the impact of natural disasters. • Changes to systemic behaviours, easier processes. <p><i>Target users: Governments, Infrastructure vendors.</i></p>
Health care and social 	<ul style="list-style-type: none"> • 5G could help to better enable an ‘internet of medical things’. • Tactile internet and smart interactions between humans and machines. • Health data mining and analytics could grow as the digital infrastructure becomes more powerful, and through predictive modelling, doctors can better anticipate risks to patients. • Connected medicine could help patients get better quality of care (improved imaging, diagnostics and treatment) and better access to care. <p><i>Target users: Medical device manufacturers, Healthcare providers.</i></p>
Finance & insurance 	<ul style="list-style-type: none"> • Ability to handle a larger volume of data, better analytics and faster speed that could help with fraud detection, and customer segmentation. • Autonomous vehicles may reduce the costs of insurance premiums, and overall costs of risk. • Improved experience, faster transactions. <p><i>Target users: Financial institutions, Insurers, Governments, Consumers.</i></p>

Beyond intelligent connectivity, 5G will be a key enabler of the Fourth Industrial Revolution or Industry 4.0 – a time when technology is seamlessly embedded within society and especially in commercial and industrial processes. However, a clear, supportive strategy and forward-looking policies, and modernized regulations to prepare for the 5G era and attract the necessary investment and skills are essential to realizing the aspirations of the Fourth Industrial Revolution, fully capturing the social and economic benefits in Nigeria and accelerate internet access for millions through increased mobile broadband penetration.

The massive gains expected will also transcend the research and education sector. Mostly supplement their skills with Massive Open Online Courses (MOOCs) and online degrees. 5G could enable live streaming in a virtual reality classroom. Imagine taking classes seamlessly from wherever you are in the world without having to be there.

The wonders of 5G can only be imagined. It is more than just 4G on steroids. When you see a driverless car parking itself, your refrigerator texts you to remind you to pick up tomatoes, or the robot cooks your food before you return, you can thank 5G.

