Brief Overview of Nigeria Telecommunication Network

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ABSTRACT

This paper presents an overview of the Nigerian Telecommunication Network. The purpose of the review is to explore the telecom business in Nigeria looking at its genesis, historical evolution, and the occurrences in the colonial, post-colonial period and following deregulation of the sector. Additionally, it will investigate the privatization of NITEL, the masts networks in Nigeria, base stations and potential effects of proximity. From the review, Liberalization process began around the year 2000 with the adoption of the National Policy on Telecommunications and has resulted in an increase in the number of people with direct access to telecom services in Nigeria, as well as an increase in the number of towers, masts and base stations with potential health hazards and compliance with regulatory bodies. Additionally, the report demonstrates what networks are now available in the Nigerian Telecommunications Industry, highlighting options for the country's telecommunications industry's development.

INTRODUCTION

The worldwide networking industry has expanded exponentially in recent years, resulting in a dramatic increase in the number of wireless devices. For the first time, the global total of cell phone customers is expected to exceed eight billion, reaching 8.3 billion in 2019. Between 2018 and 2019, the overall subscriber base expanded by around 393 million. With a worldwide population of 7.7 billion people as of 2020, mobile customers currently outweigh the global population by a large margin. This comes on the heels of an exceptionally successful period of expansion. In 2014, the penetration rate in the United States exceeded 100%, and it has been greater than 100% for several years in nations like as the United Kingdom (UK) and Australia.

On other continents, like as Africa, the penetration rate has gradually grown. For instance, Cameroon witnessed a 39.3 percent increase in smartphone users from 2010 to 2019, reaching 81.76 per 100 residents in 2019, while Kenya's average reached 100 for the first time in 2019. In 2020, Nigeria's total active lines (mobile GSM, mobile CDMA, fixed wired/wireless, and VoIP) would exceed 199 million users, which is similar to the world's population.

Nigerian telecommunications stretch all the way back to 1886, when the British business Cable & Wireless Ltd built telegraphic undersea cable connections between Lagos and London during the colonial period. As a result, phone lines connecting the famed commercial hub to Jebba, Ilorin, Calabar, and Ibadan were established. It's worth mentioning that telephone lines facilitated the development of alternative modes of communication in Nigeria, including radio, television, and the internet.

LITERATURE REVIEW

The post-colonial era began with Nigeria's independence in 1960, following the colonial period. Nigeria created its first National Development Plan. The first National Development Plan prioritized telecommunications network expansion to meet the requirements of a rising commercial and industrial sector. Regrettably, the expansion plan's objectives were not completely accomplished by the end of its five-year timeline, since only 40% of the projected phone lines were constructed. The failure to fully implement the plan has been linked to the crippling effect of the Nigerian Civil War of 1967-70 on the economy. The fundamental procedure for establishing Nigerian External Telecommunications (NET) Limited as a limited liability company began during this time period as well. Between 1970 and 1975, a second National Development Plan was prepared. This time period was devoted to rebuilding infrastructure devastated by the civil war. Due to funding restrictions, the primary objective of the plan period was to complete the National Telex Network. A third National Development Plan was designed between 1975 and 1980 with the objective of greatly boosting telecom capacity and infrastructure. This was the most effective plan, since the bulk of its objectives were accomplished. In 1984/1985, the Telecommunications Division of the Post and Telecommunications Department merged with Nigerian External Telecommunications (NET) to form The Nigerian Telecommunications Limited (NITEL), commercializing telecom services. NIPOST and NITEL were established following the dissolution of the Department of Posts and Telecommunications. The government formed NITEL as a monopoly operator to provide fixed telephone, telegraph, and payphone services. Installed capacity climbed to 400,000 lines in 1987, but connected capacity varied between 205,000 and 250,000 lines. Between 1987 and 1992, NITEL's performance remained stagnant, and the Institution consistently failed to satisfy consumer expectations [1].

With the advent of democracy in 1999, General Olusegun Obasanjo's then-Government introduced a new National Telecommunications Policy. The Policy was announced by the Ministry of Communication in May 2000 with the general objective of upgrading and rapidly expanding the Telecommunications Network and Services. 20 The National Telecommunications Policy effectively deregulated the industry. Among its short-term aims is the promotion of competition to satisfy rising demand through the total liberalization of the Telecommunications sector and the revision and update of Telecommunications regulations to bring all Telecommunications operators under the NCC's regulatory authority. The Policy resulted in the enactment of two independent pieces of legislation: the Nigerian Communications Act, Chapter N97, LFN Laws of the Federation of Nigeria 2004, and licensing. In recent years, the telecommunications business has grown, in contrast to the pre- and post-liberalization eras. For a sector that contributed 0.62 percent to Nigeria's GDP in 2001, the contribution climbed to 8.68 percent in 2014, and despite the severe impact of the current recession on the Nigerian economy between 2015 and 2017, the sector's contribution increased to 9.1 percent in Q1 2017. Contribution to GDP climbed from 8.39 percent in the third quarter of 2018 to 9.85 percent in the fourth quarter of 2018. According to the Nigerian Communications Commission's website, this rate grew to 10.11 percent in Q1 2019. 22 Additionally, there were 41,975,275 active lines in 2007; however, this figure has increased since then. As of 2017, there were 139,144,705 active telephone lines servicing an estimated 183 million people. Preliberalisation was characterized by the state's ownership and backing of a monopoly telecommunications sector and associated infrastructure. The sector's development has been characterized by a slow pace of network rollout, significant wait times for services, and customers' reliance on a single service provider, resulting in substandard service delivery. However, liberalization of the telecommunications sector has resulted in enhanced services, the elimination of monopoly powers, an increase in domestic and foreign investment, the promotion of innovation and advanced services, the generation of government revenue, increased sector efficiency, and the expansion of services to undeserved and unserved areas.

Nitel's privatization

Nigeria adopted privatization in 1988 with the passing of the Privatization and Commercialization Act. The Act formed the Technical Committee on Privatization and Commercialization, which was charged with privatizing all state firms marketed in 1993. NITEL, of course, was one of these commercialized private companies. The Federal Military Government adopted the Bureau of Public Enterprises Act in 1993, repealing the 1988 Act and established the Bureau for Public Enterprises (BPE) to oversee the execution of the Privatization program. Privatization is addressed further in the Federal Republic of Nigeria's Constitution, as amended by Sections 43 and 44, which grant private individuals the right to hold mobile and immovable property that the government cannot acquire without compensation. The privatization of NITEL has been marred by controversy and a significant degree of political maneuvering. Numerous observers have made the connection between this and the Federal Government's lack of honesty and seriousness. The original attempt to privatize NITELS failed in 2002 because to the inability of the United Kingdom's Investors International London Ltd (ILL) to pay the 1.317 Billion. In 2003, another attempt was made with the cooperation of the Switch Co. named pent to manage NITEL and put it on sound financial footing, but it failed once again. The following year, a third attempt to sell NITEL to Egypt's Orascom failed. In 2006, 51% of NITEL's shares were sold to a government-owned transactional firm (TRANSCOPY), but this deal also failed to turn the company around, since Transcorp was unable to solve NITEL's problems. In 2009, the Federal Government established a technical advisory council to monitor the carrier's operations. NITEL conducted a strategic core investor sale in 2011 and selected New Generation Communications Limited and Omen International as preferred and reserved bidders, respectively. Tunde Ayeni, creator of Sahara Energy, Tonye Cole, and two other corporations used their NATCOM Telecommunications Consortium to emerge as the sole bidders for NITEL/MITEL in August 2015, paying $242.3 million, or around N42.4 billion at the time. 24 Numerous persons have argued that the claimed sale or privatization of NITEL should have occurred through open and competitive bidding rather than secret bidding.

The Nigerian Communications Commission (NCC) was formed in 1992 following the merging of two government entities: the telecommunications division of the Ministry of Communications' Posts and Telecommunications (P&T) department and the Nigerian External Relations Commission. By allowing for innovation and private sector engagement, the NCC directive contributed in the liberalization of terminal end equipment.

Gsm in Nigeria

In 2001, Nigeria's telecommunications industry received a major boost when the Global System for Mobile Communication (GSMC) was launched (GSM). Competition between Econet (now known as Airtel) and MTN in Nigeria began on August 8 of the same year. Five-year renewable GSM licences were granted to them, allowing them to operate in the 800 and 1900 MHz frequency bands, respectively Operations were given a set of core goals by the NCC. Each country's geopolitical states were tasked with signing up at least 100,000 members in the first year of operations; 1.5 million consumers were targeted over the next five years; and a minimum of 5% regional penetration was targeted in each state.

GLO, Nigeria's second-largest network operator, has over 45 million members as of December 2018 and plans to reach 54 million by 2020. The Glo-1 underwater cable, an $800 million high-capacity fiber-optic connection between the United Kingdom and Nigeria, was built by GLO as the first telecommunications company. For the first time, a subsea cable connecting the United Kingdom and Nigeria has been put into service. The 3,400-kilometer Yello Bahn cable, erected by MTN, lets the business to extend its service area in Nigeria. One of Nigeria's four GSM licences cost the telecommunications industry $285 million in January 2001. Since its establishment in August 2001, MTN has steadily grown its networks across Nigeria, investing more than $1.8 billion in the process. 223 cities and towns, over 10,000 villages and municipalities as well as a growing number of roads across Nigeria are currently connected by the network. 3 14 African nations are served by Airtel Africa, which is a major telecommunications and mobile money service provider. From Econet to Vmobile, Zain, Celtel, and finally, Airtel, it has undergone numerous rebrandings. Over 99 million people in Africa were using Airtel at the end of March 2019. On the London Stock Exchange, it is traded on the FTSE 250 Index. One of Nigeria's first big internet service providers, Etisalat Nigeria, launched in 2008. Eco Sim and 0809uchoose, which was the first to sell Nigerians their own mobile phone numbers, are two of the company's best-known goods and services.

Telephony *via* mobile devices is rapidly spreading across the country. On Nov. 20, 2020, there will be more than 208 million active phone customers in the United States (208,774,015), which is nearly the entire population of the country. Previously, in 2017, there were more than 148 million active phone customers. An extensive network of base stations serves as the foundation for the Wi-Fi infrastructure, which links users *via* Radio Frequency (RF) broadcasts. Telecom carriers are forced to increase the number of base stations, whether on the roof or on the ground, because of the rapid expansion in the number of users on various networks. High-rise buildings in urban areas have rooftop antennas, but in rural regions, the antennas are placed on the ground. For rooftop installations, the normal height is between 3 and 15 metres, and for ground-based constructions, the typical height is between 15 and 50 metres.

Communication towers in Nigeria

According to a research, there are around 4 million telecom towers in use worldwide, with a predicted annual growth rate of 4.1 percent through 2020. The global demand for tower construction was estimated to exceed $20.3 billion in 2014. By 2020, the installed base is expected to have risen from 4 million to 5 million towers. As of 2016, Nigeria has 25, 396 towers, with 85 percent of the BTS owned or operated by individual tower businesses. Nigeria now has 53,460 third- and fourth-generation (3G and 4G) Base Transceiver Stations (BTS). Because there is no legislation governing their location, cell towers are being erected randomly near to schools, creches, public playgrounds, industrial facilities, hospitals, universities, campuses, and terraces in densely populated urban residential neighborhoods.

Mobile phone base stations

Cellular (mobile) phone usage in Nigeria has expanded considerably over the years, necessitating the development of cell phone towers to serve the whole country. Base stations, sometimes referred to as cell phone towers, are permanent transmission locations that are connected to a network's mobile phone grid. They have three antennae, two for reception and one for transmission. Two are utilized on the receive side, allowing the base station to compare signals and select the optimal antenna for each client inside the cell. They are composed of a tower and a base structure with electronics, and their purpose is to receive and broadcast radio signals, similar to a mobile phone. Mobile phone towers broadcast electricity at amounts ranging from a few watts to 100 watts or more, depending on the size of the region they are meant to cover. Mobile phone tower antennas with a length of around 100 cm and a diameter of approximately 20-30 cm are frequently erected on raised buildings or towers between (15-50) meters above ground to interact with cell phone users who are frequently close to the ground. These antennas typically generate relatively narrow RF beams in the vertical direction, but the RF field intensity increases dramatically as one walks away from the base station and subsequently diminishes as one gets farther away from the antenna.

Types of base station

Existing base stations come in a variety of configurations. Each kind has a specific application based on the coverage required: The following are the fundamental transceiver communication base stations:

1. **Macro cell:** Used in broad regions such as rural areas and roads due to its ability to traverse great distances; also, its performance may be boosted by improving the transceiver's efficiency.
2. **Micro cell:** Used in situations where a mobile network requires additional coverage to ensure a high level of service to customers.
3. **Pico cell:** Used within residences when a mobile network need additional coverage to guarantee a consistent level of service to clients.

Base station network

About every ten years, a new generation of mobile networks is launched. The first commercial mobile network went live around 1980, and since then, numerous innovations have revolutionized the mobile communication sector. In the previous 40 years, a wide range of terms, acronyms, and abbreviations have been developed to describe the many technologies that have been developed. There are countless 2G, 3G, and 4G base stations scattered across the environment, offering services to users of mobile phones and other devices, the evolution of mobile communication technology the fifth generation (5G) of the technology is currently being developed, which reflects the most recent advancements in mobile communications. To describe the first generation of mobile networks, known as "1G," the term "1G" can be used. A variety of analogue cellular technologies were employed in the development of 1G network in various parts of the world in the 1980s. AMPS (Advanced Mobile Phone System), NMT (Nordisk MobilTelefoni or Nordic Mobile Telephone), TACS (Total Access Communications System), and C-Netz were some of the mobile phone technologies included in this grouping (Funktelefonnetz-C or Radio Telephone Network C). However, the Nordic/Scandinavian region, the UK and Germany generally used TACS, whereas the United States and some Asian countries mostly used NMT. The FDMA-Frequency Division Multiple Access technology was used in the early days of wireless networks. Second generation technology D-AMPS was later renamed AMPS.

This term refers to the second generation of mobile networks, which came after the first. Text messaging (SMS) and a small amount of mobile data were protected on these networks. Throughout the 1990s, 2G networks were installed around the world using a variety of digital technologies. In the second generation of mobile networks, GSM is the most extensively utilised technological standard for GSM (GSM). Additional second-generation mobile networks were also deployed using the Digital Advanced Mobile Phone System (D-AMPS), as well as Interim Standard 95 (IS-95) (2G). Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA) were introduced in the second generation of mobile networks. The radio component of a mobile network uses access technologies to wirelessly link mobile phones to the network *via* radio waves. Data services were not efficiently delivered on GSM and D-early AMPS's circuit-switched networks. General Packet Radio Service (GPRS) was GSM feature that allowed for the addition of new network nodes to the GSM architecture so that mobile data (internet) services could be provided efficiently.

Because of its role in the development of 3G data services, the GPRS network is sometimes referred to as 2.5G. SGSN (Serving GPRS Support Node) and GGSN (Serving GPRS Support Node) are the acronyms for these network nodes (Gateway GPRS Support Node). As part of the 3G network upgrade, the EDGE – Enhanced Data for Global Evolution – update was launched, which increased peak download speeds from 171.2 kbps to 384 kbps from GPRS (with EDGE). EDGE and GPRS are two distinct technologies, and we have a dedicated website that explains the difference between the two. IS-95, often known as cdmaOne, is a key technology of the 2G era and is widely used. First CDMA network in the world, IS-95 was also designed to deliver mobile data services. IS-95 was available in A and B flavours. Data can be downloaded at a maximum rate of 14.4 kbps using the IS-95 A. IS-95 B may enhance these data transmission rates to 115 kbps, according to the manufacturer's specifications. Since CDMA2000 is utilised for 3G cellular services, IS-95 is particularly noteworthy.

Mobile networks in the third generation are referred to as 3G. There have been two main migration routes to 3G, both based on CDMA technology (Code Division Multiple Access). Respectively in the transition from GSM to 3G, UMTS was employed, whereas CDMA2000 was utilised for IS-95 and D-AMPS. Wideband Code Division Multiple Access, also known as WCDMA, is the technology behind the UMTS (Universal Mobile Telecommunications Systems) standard. Up to two megabits per second are available for downloads while the typical data transfer rate is up to 384kbps. A specialised article on 3G UMTS technology, frequencies, and bandwidths is available on our website. UMTS is also the foundation for HSPA (High-Speed Packet Access) networks. Data transmission rates of up to 14.4 Mbps downlink and 5.76 Mbps uplink are possible with HSPA. HSDPA (High-Speed Downlink Packet Access), HSUPA (High-Speed Uplink Packet Access), and Evolved High-Speed Packet Access (HSPA+) have all been added to UMTS since its first release as part of the 3GPP Release 1999. In terms of downlink data rates, HSPA+ can deliver as much as 42 megabits per second (Mbps) and 11.5 megabits per second (Mbps) (Mbps). For IS-95 and D-AMPS, CDMA2000 was principally designed. In both the downlink and uplink directions, CDMA2000 enables peak data speeds of up to 153 kbps. As EVDO technology evolved, data transfer rates on CDMA2000 networks were also increased (EVolution Data Optimized). Up to 14.7 Mbps of theoretical download speed is theoretically supported by Evolved Digital Subscriber Line (EVDO).

The fourth generation of mobile networks is also referred to as "4G." LTE, short for Long Term Evolution, is the technology that makes it possible (of mobile networks). While UMTS and CDMA2000 are still in use, LTE is the path to 4G. A different technology, WiMAX, is also capable of meeting 4G requirements, but LTE has become the dominant technology for international deployments of 4G networks. With LTE, only packet switching occurs, as opposed to the combined usage of circuit and packet switching in prior 2G and 3G networks. 5 LTE's voice and SMS capabilities can be enhanced through the usage of Voice over LTE (VoLTE). There is a circuit-switched back-up for LTE networks that allows them to deliver voice and SMS even if the phone doesn't support VoLTE or the base station doesn't support it. A peak downlink data throughput of up to 300 Mbps can be achieved using LTE over 3G networks. 4G LTE networks are capable of providing reliable mobile internet services to consumers because of their typical speeds. As a mobile hotspot, LTE can be used on a mobile phone as a supplement to your home broadband service. Advancements in the form of LTE-A and LTE-A Pro were introduced after the first launch of LTE. Mobile devices are referred to as LTE+, which may theoretically deliver download speeds of up to 1 Gbps and 3 Gbps, respectively, on LTE-Advanced and LTE-Advanced Pro. Despite these peak rates, 4G LTE's average speed is far lower than this. Download speeds of up to 65 Mbps are possible on 4G LTE Advanced networks. LTE is based on OFDMA, a radio access technology that is significantly more efficient than previous radio access technologies. Higher data rates and better utilisation of available bandwidth are both made possible by OFDMA's QAM modulation technology, which is supported by OFDMA.

Fifth-generation mobile networks (sometimes referred to as "5G") are the most advanced generation of mobile networks to date. The New Radio (NR) technology, which is based on the OFDMA standard, makes this possible. 5G stands apart from past generations of mobile networks because of its inherent flexibility, which allows it to handle a wide range of applications. As a result of 5G's high speed and ability to serve a huge number of devices, a range of sectors can now go digital [2]. The device also has the ability to operate in a wide spectrum of frequencies, including high and low frequencies. For real-time services, 5G's higher frequency bands offer a limited coverage area but a low latency (less than 1 millisecond). eMBB (enhanced mobile broadband), mMTC (massive machine type communication), and ultra-reliable low latency communications are the three primary types of 5G applications (uRLLC). We have a separate post on eMBB, mMTC, and uRLLC that will help you better grasp these three foundational 5G technologies. Lower frequency bands have a larger range, but a longer physical delay. As a result, the lower frequency bands of 5G can be widely deployed in rural areas. For real-time applications, such as self-driving cars, manufacturing, Virtual Reality (VR), and the Internet of Things (IoT), higher frequency bands with lower latency are preferable [3].

5G NR networks usually provide significantly faster internet rates than 4G LTE networks. Even though 5G theoretically has a maximum downlink speed of more than 10 Gbps, the average downlink speeds of less than 150 Mbps are relatively uncommon. Non-standalone (5G) deployments currently make up the majority of 5G rollouts, however this isn't true 5G as of yet. The term "5G non-standalone" refers to the use of both 4G and 5G networks in order to make 5G possible [4].

GSM network

Networking using mobile devices. It is the world's most popular digital mobile network. TDMA, GSM, and CDMA are the three most popular technologies. Switching SIM cards is a breeze if you have 12 GSM phones available. There are several characteristics of GSM that may be found in today's mobile phones, including caller identification, call forwarding, call waiting, text messaging, and conference calling. Mobile phone users in Europe and other areas of the world are familiar with the GSM (Global System for Mobile Communication) digital network. TDMA, GSM, and CDMA are the three digital wireless telephony technologies that are most widely used today: GSM is the most widely used (CDMA) (CDMA). In addition to the two extra user data streams, each with its own time slot, GSM transmits the digitised and compressed data [5]. At 900 megahertz (MHz) or 1,800 megahertz (MHz), it can operate (MHz). UMTS, HSCSD, GPRS, and EDGE are all part of the evolution of wireless mobile telecommunications [6]. GSM is one of the most important components of this process (UMTS). Analog predecessors of GSM were developed, with the most notable examples being the United States' Advanced Mobile Phone Service (AMPS) and the United Kingdom's Total Access Communication System (TACS). For these networks, customer demand has been too high to keep up with the growth of their infrastructure [7]. We need a more efficient cellular technology that can be used around the world, due to the limitations of the current systems. The GSM network is made up of four independent components that work together to maintain overall network functionality: mobile devices, base station subsystems, network switching subsystems, and Operation and Support Subsystems (OSS).

The mobile device establishes a hardware connection to the network. The network may be able to utilise the information on a SIM card to identify a particular mobile user. The BSS is responsible for connecting the phone to the NSS [8]. It is made up of a Base Transceiver Station (BTS) and a control station for the Base Station (BSC). When it comes to mobile phones, there are two types of systems: the BTS, which is responsible for the hardware, and the BSC, which deals with intelligence (Figure 1). Communication between base transceiver stations is maintained by the base transceiver station controller. Providing cellular services requires the NSS component of the GSM network architecture, referred to as the core network, to track calls' locations. Mobile service carriers own the NSS outright. Mobile Switching Centre (MSC) and Home Location Register (HLR) are just two of the many components that make up the NSS (HLR). Figure 2 Call and SMS routing, SIM card authentication and storage of caller account information are all provided by these components [9].

Figure 1. Generation of wireless technology.

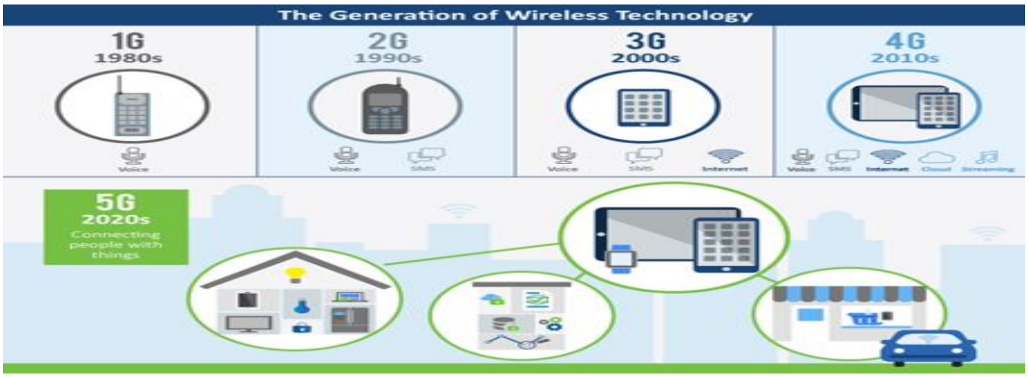

Figure 2. A base station.

Cellular networks and base station in Nigeria

Radiofrequency (RF) radiation emitted by cellular phone terminals and base transceiver stations has been a major worry since the rapid proliferation of mobile communications technology in the last few decades, particularly for people in Nigeria (BTS). Mobile phone technology has changed the worldwide landscape of telecommunications, especially in developing nations like Nigeria, due to its numerous advantages. Despite its limitations, around 1.6 billion mobile phones and cell towers are being installed [10].

International and national standards and guidelines on telecommunication network

Concern over the health risks associated with radio frequency radiation has developed as wireless technology has expanded [11]. The WHO, ICNIRP, FCC, and IEEE are only some of the international organisations that provide rules and protocols for doing research on the radio frequency field, its effects on human health, and radiation monitoring [12]. The thermal effects of radio frequency radiation are the basis for these instructions. These guidelines provide safe exposure limits for the general public and occupational groups, i.e., those who do the actual work. It is not a new issue that radiofrequency fields pose a threat to human health, but ICNIRP's work on non-ionizing radiation and its effect has been recognised by the WHO. Concerns regarding the probable health effects of radiofrequency radiation were initially raised in Europe and North America. For measuring RF environmental exposure, the FCC has adopted these internationally acknowledged safety guidelines since 1985, whereas the majority of Europe follows ICNIRP criteria. Following significant investigation into the health effects of radio frequency radiation, seasoned scientists and engineers created IEEE standards. For the EPA's (Safety Code 6: Canada), the National Institute of Occupational Health and Health (NIOSH), and the OSHA, federal health and safety agencies have also been keeping tabs on RF exposure risks, as well as conducting investigations [13].

At doses below those recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), numerous adverse health effects have been documented, including altered white blood cells in children, childhood leukaemia, impaired motor function, reaction time, and memory, as well as headaches, dizziness, fatigue, weakness, and insomnia [14].

By integrating the power flow along the source's radius, r, we get the average power output. Vertical and horizontal are the two directions that antennas emit [15]. There is a single main lobe and a number of secondary lobes. 65 degrees horizontally and 6 degrees vertically is the primary lobe's half-power beamwidth (HPW–defined as the angular range within which maximum power is reduced to half its value).

Based on the worldwide principles, different countries have implemented their own radiation regulations, or safety rules. According to the 1998 ICNIRP standards, a safe power density of f/200, where f is given in megahertz, is acceptable in Nigeria. The GSM900 transmitting band (935-960 MHz) has a power density of 4.7 W/m^2 =4700 mW/m^2, but the GSM1800 transmitting band (1810-1880 MHz) has a power density of 9.2 W/m^2 =9200 mW/m^2.

The ICNIRP guidelines state categorically that the overall amount of radiation must be taken into account when multiple frequency fields are exposed at the same time. This restriction has been applied to individual carriers in Nigeria, resulting in radiation levels many orders of magnitude greater than those allowed by ICNIRP regulations, depending on the total number of transmitters in that location. The elderly, women, and young children who live in close proximity to the towers are particularly at risk from this radiation, which is available 24 hours a day, seven days a week [16].

The Nigerian Communications Commission (NCC) and the regulation of the telecommunication sector

NCC-sponsored GSM licence auctions in 2001 resulted in the introduction of new telecoms firms, including Multilinks (MTN), Zoom (Visafone), Airtel (GLO), Etisalat (Ethiopia's largest telecoms company), and Visafone. Act

No. 19, 2003, which established the Nigerian Communications Commission, governs the agency. The Nigerian Communications Commission (NCC) was founded to oversee the country's communications sector. 38 Standards and specifications for communication equipment and infrastructure in Nigeria are developed and disseminated by the Commission. Technical codes and requirements are designed to improve network facility safety and to accept international standards, among other goals. All feasible steps are required under the National Communications Commission Act, 2003, to ensure the safety of people, property, and the environment while establishing network infrastructure. An example of NCC rules and regulations is the Guidelines on Technical Specifications for the Installation of Telecommunications Masts and Towers. For the sake of environmental safety and appropriate engineering practices, the Guidelines require telecom service providers and operators, as well as tower installers, to conform to a set of requirements. This means that towers must be situated back a maximum of five meters from any demised property, save for the fence. As a further precaution, the 2009 NCC Guidelines dictate that all generators within a base station are placed five meters away from any demised structures, with the exception of a fence. Guidelines stipulate that all towers in residential areas must meet the setback requirements for heat, smoke, and noise pollution created by generating units [17].

NCC guidelines for the location of telecommunications towers and other infrastructure

According to the Nigerian Communication Commission Act of 2009, the following is said on the siting of telecommunications towers and masts:

1. Masts and towers shall be sited in compliance with the Act's rules and the laws regulating collocation and infrastructure sharing in order to minimize their number, protect and promote public safety, and have a minimal aesthetic impact on the neighborhood.
2. In residential zones, telecommunications towers more than 25 metres in height would be disallowed.
3. Where towers exceeding 25 metres in height are approved, they must be setback a minimum of 5 metres from the adjacent demised property, excluding the fence.
4. A minimum distance of 1 (one) kilometer must exist between two or more towers exceeding 55 metres in height.

The National Environmental Standards and Regulations Enforcement Agency (NESREA) and the Telecommunications Sector.

As a result of the passage of the National Environmental Standards and Enforcement Agency Act in 2007, it was founded in 2007. The Federal Government formed the Agency as a parastatal of the Federal Ministry of Environment in accordance with Section 20 of the 1999 Nigerian Constitution, as amended. Regulations, standards, rules, policies, and recommendations pertaining to environmental protection are under the purview of the Agency.

National Environmental (Standards for Communications and Broadcast Facilities) Regulations, 2011, were created by the Agency to achieve this purpose. As a result of the Rules, Nigerian telecommunications companies will be required to adhere to environmental laws, regulations, and standards uniformly. This is how NESREA got its start in the telecom industry.

Accordingly, the minimum setback distance from any property's perimeter wall to the base of the mast/tower is ten metres, as stipulated by NESREA Regulation. The NCC and NESREA split at this moment. Setting back 10 metres is required for the first option, while 5 meters is required for the second. We already mentioned that MTN's base station was shut down because of NESREA's strict enactment of this provision of its Regulation. Both Regulations provide for a maximum distance of 1.2 meters between antennas, yet MTN's tower was moved back 1.2 metres. Due to NESREA's actions, several other telecommunications companies, like as Airtel, Glo, and others, had to seal and close their base stations.

CONCLUSION

This paper evaluated global best practices in the telecommunications business and compared them to the situation in Nigeria. Liberalization and privatization, both of which are internationally acknowledged best practices, have been examined, with particular focus on the fact that privatization is expressly endorsed by our laws, as demonstrated by the Constitution. Additionally, it identified base station networks in line with several international and local standards and laws controlling the placement and construction of base stations and masts, as well as the accompanying occupational and public exposure constraints. This paper recommends that study be performed on the electromagnetic radiation emitted by mobile communication base stations, as many individuals may be uninformed of the downsides of telecommunication networks.

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