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# **5G Technology** **(IMT – 2020):**

*Global Trends, Deployment Modes,  
Potential Application Areas  
in Nigeria, Facts & Myths.*

**A WHITE PAPER**

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# THE 5G TECHNOLOGY CONCEPT

|   |           |
|---|-----------|
| List of Abbreviations and Acronyms  | 4         |
| <b>1</b>  |           |
| <b>1. Introduction</b>  | <b>6</b>  |
| 1.1 The Global 5G Buzz  | 6         |
| 1.2 Generations of Mobile Networks  | 6         |
| 1.3 Typical Mobile Telecommunication Network                                      | 8         |
| <b>2</b>  |           |
| <b>2. 5th Generation Mobile Network (IMT-2020)</b>                                | <b>9</b>  |
| 2.1 4G Versus 5G Network Capabilities   | 10        |
| 2.2 5G Use-cases and Scenarios  | 11        |
| 2.3 Synopsis on Innovations around 5G Technology                                  | 12        |
| 2.4 Migration Routes to 5G Mobile Network   | 12        |
| 2.4.1 Non-Standalone (NSA) Mode (Leveraging Existing 4G LTE Network Backbone)     | 13        |
| 2.4.2 Standalone (SA) Mode (Implementing 5G Network from Scratch)                 | 13        |
| 2.5 Global Commercial Deployment Trend of the 5G Network                          | 14        |
| 2.5.1 Analysis and Inference from Top 10 Countries with Most Cities on 5G Network | 17        |
| 2.5.2 5G Network Deployments in Africa  | 17        |
| 2.6 Nigeria's Journey to 5G Technology  | 18        |
| 2.7 5G Technology: Facts and Myths  | 19        |
| <b>3</b>  |           |
| <b>3. Potential Socio-economic Applications of 5G in Nigeria</b>                  | <b>20</b> |
| <b>References</b>   | <b>22</b> |

## FIGURES

### List of Figures

|   |    |
|---|----|
| Figure 1: Basic Telecommunication Network Diagram showing Interconnections    | 8  |
| Figure 2: The 17 Sustai   | 9  |
| Figure 3: 4G Versus 5G  | 10 |
| Figure 4: Usage Scenarios of 5G Technology                                    | 11 |
| Figure 5: Two Modes of 5G Network Architecture                                | 13 |
| Figure 6: Sample Heterogenous Wireless Network with 4G and 5G Technologies.   | 14 |
| Figure 7: Where 5G Technology and Network have been deployed as at June 2022. | 15 |
| Figure 8: Top 10 Countries with 5G Deployments by Cities – 2022               | 16 |
| Figure 9: Timeline of notable events in Nigeria's journey to 5G               | 18 |
| Figure 10: Viable Applications of 5G Technology and Network in Nigeria        | 21 |

## TABLES

### List of Tables

|   |    |
|---|----|
| Table 1: Comparison of different Generations of Mobile Telecommunications           | 7  |
| Table 2: Top 10 Countries with 5G Deployments by Cities – 2022                      | 16 |
| Table 3: 5G Network Deployment Trend in Africa                                      | 17 |
| Table 4: Facts and Myths on 5G Technology   | 19 |
| Table 5: Potential Socio-economic Applications of 5G Network in the Nigeria Economy | 20 |

# CONTENT

## LIST OF ABBREVIATIONS AND ACRONYMS

|           |  |
|-----------|--|
| 1G        | First Generation Mobile Network                                  |
| 2G        | Second Generation Mobile Network                                 |
| 3G        | Third Generation Mobile Network                                  |
| 3GPP      | Third Generation Partnership Project                             |
| 4G        | Fourth Generation Mobile Network                                 |
| 5G        | Fifth Generation Mobile Network                                  |
| 5GC       | 5G Network Core (Backbone)                                       |
| 5G NR     | Fifth Generation New Radio                                       |
| AI        | Artificial Intelligence  |
| AMPS      | Advanced Mobile Phone System                                     |
| AR        | Augmented Reality  |
| CapEx     | Capital Expenditure  |
| CDMA      | Code-Division Multiple Access                                    |
| COVID-19  | Corona Virus Disease - 2019                                      |
| DAS       | Distributed Antenna System                                       |
| eMBB      | Enhanced Mobile Broadband  |
| EMF       | Electromagnetic Field  |
| EPC       | Evolved Packet Core  |
| FDMA      | Frequency Division Multiple Access                               |
| FGIMT2020 | Focus Group on International Mobile Telecommunication 2020       |
| FG-ML5G   | Focus Group on Machine Learning for Future Network Including 5G  |
| Gbps      | Gigabit per Second   |
| GPS       | Global Positioning System  |
| GSA       | Global Mobile Suppliers Association                              |
| GSM       | Global System for Mobile   |
| GSMA      | Global System for Mobile Communications Association              |
| HD        | High Definition  |
| HetNet    | Heterogenous Networks  |
| ICT       | Information and Communication Technology                         |
| IEEE      | Institute of Electrical and Electronic Engineers                 |
| IMT       | International Mobile Telecommunication                           |
| IMT-2020  | International Mobile Telecommunication -2020                     |
| IoT       | Internet of Things   |
| ISPs      | Internet Service Providers                                       |
| ITU       | International Telecommunication Union                            |
| ITU-T     | International Telecommunication Union - Telecommunication Sector |
| LAN       | Local Area Network   |
| LTE       | Long Term Evolution  |
| M2M       | Machine to Machine   |
| Mbps      | Megabit per Second   |
| MIMO      | Multiple Input and Multiple Output                               |

|         |  |
|---------|--|
| mMTC    | Massive Machine-Type Communication                                     |
| MSC     | Mobile Switching Centre  |
| MTN     | Mobile Telephone Network PLC   |
| NCC     | Nigerian Communications Commission                                     |
| NGN     | Next Generation Network  |
| NgREN   | Nigeria Research and Education Network                                 |
| NMT     | Nordic Mobile Telephone  |
| NR      | New Radio  |
| NRA     | National Regulatory Agency   |
| NSA     | Non-Standalone   |
| OFDM    | Orthogonal Frequency-Division Multiplexing                             |
| RAN     | Radio Access Network   |
| RAT     | Radio Access Technology  |
| SA      | Standalone   |
| SDG     | Sustainable Development Goal   |
| SG13    | Study Group 13   |
| SIM     | Subscriber Identity Module   |
| SSC     | Smart and Sustainable Cities   |
| TACS    | Total Access Communication System                                      |
| TDMA    | Time Division Multiple Access  |
| TV      | Television   |
| UHD     | Ultra-High Definition  |
| UNESCAP | United Nations Economic and Social Commission for Asia and the Pacific |
| URLLC   | Ultra-Reliable and Low-Latency Communication                           |
| USA     | United States of America   |
| VR      | Virtual Reality  |
| WRC     | World Radiocommunication Conference                                    |
| Wi-Fi   | Wireless Fidelity  |
| ZTE     | Zhongxing Telecommunication Equipment Corporation                      |

# Introduction

## 1.1 The Global 5G Buzz

In and around the COVID-19 pandemic in year 2020, “5G” became a buzz word all over the world. Different myths and assertions relating 5G to the COVID-19 pandemic surfaced on various mass media platforms; social media was buzzing with different theories on how the pandemic was caused by 5G technology deployments mostly across Europe, Asia and America. In fact, a lot of people (non-telecoms professionals) became aware of “5G” as a result of COVID-19. There is no doubt that telecommunication signals generate electromagnetic fields (EMFs) at radio and microwave frequencies – this fact surprisingly fueled theories linking 5G with COVID-19.

As at 2020, countries such as South Korea, United States, China, United Kingdom, etc. had deployed 5G and were rapidly expanding its coverage; there was also a global battle especially by the US against Huawei’s ambitious and audacious global expansions.

This whitepaper is not on correlating or disputing the links between 5G with COVID; it is focused on providing an exposition of 5G technology, its deployment modes, use cases for Nigeria and addressing myths associated with this new and emerging technology.

What really is 5G? It is the 5th generation mobile network, also called IMT-2020; a new global wireless standard after previous generations of mobile networks (1G, 2G, 3G and 4G networks). Conceptually, 5G enables a new kind of network that is designed to connect virtually everyone and everything together including machines, devices and objects at different layers. 5G is up to 100 times faster than 4G.

## 1.2 Generations of Mobile Networks

Over the past decades, mankind has experienced different amazing technological leaps - from the moon landing in 1969 to the birth of the microcomputer in 1973; today, several new and emerging technologies (such as AI, 5G, AR/VR, IoT, NGN connectivity, Smart & Sustainable Cities, etc.) have become available and promises great benefits for mankind. According to UNESCAP (2019), ***“Emerging technologies are considered to possess immense potential to address developmental challenges in almost every field and can serve as game changers towards achieving the Sustainable Development Goals (SDGs)... These technologies have innovative applications that are known to improve the quality of life, drive economic growth, and increase the productivity and efficiency in manufacturing and service sectors”***<sup>1</sup>.

Advancements in semiconductor technology, computer networks and consumer demands contributed to evolution of mobile telecommunication network. From the first-generation mo-

<sup>1</sup> UNESCAP (2019), *Synopsis on International Conference on Emerging Technologies for Achieving Sustainable Development Goals*, published on 9th November, 2019 by the United Nations Economic and Social Commission for Asia and the Pacific, UNESCAP, Online available at <https://www.unescap.org/events/international-conference-emerging-technologies-achieving-sustainable-development-goals>

mobile network (1G) in 1979 to the fifth-generation (5G) mobile network introduced in 2018, mobile telecommunication networks have indeed had their share of astronomical technological advancements. The table below shows a comparison of mobile telecommunications technologies.

**Table 1: Comparison of different Generations of Mobile Telecommunications**

|                           | Generations of Mobile Networks |  |                                      |  |  |
|---------------------------|--------------------------------|--|--------------------------------------|--|--|
|                           | 1G                             | 2G   | 3G                                   | 4G   | 5G   |
| Start of Development      | 1970                           | 1980   | 1990                                 | 2000   | 2010   |
| Year of Introduction      | 1979/1980                      | 1993   | 2001                                 | 2009   | 2018   |
| First Commercial Use      | USA                            | Finland  | Japan                                | South Korea  | South Korea  |
| Technology                | AMPS, NMT, TACS                | GSM  | WCDMA                                | LTE, WiMAX   | MIMO, mmWaves  |
| Access System             | FDMA                           | TDMA, CDMA   | CDMA                                 | CDMA   | OFDM, BDMA   |
| Type of Switching         | Circuit Switching              | Circuit switching for voice, Packet Switching for Data                                 | Packet Switching                     | Packet Switching                                     | Packet Switching   |
| Internet Service          | N/A                            | Narrowband   | Broadband                            | Ultra-Broadband                                      | Wireless World Wide Web  |
| Frequency                 | 30KHz                          | 1.8GHz   | 1.6 to 2GHz                          | 2 - 8 GHz  | 3 – 30 GHz   |
| Bandwidth                 | Analog                         | 25MHz  | 25MHz                                | 100MHz   | 30GHz to 300GHz  |
| Average Download Speed    | 2.4Kbps                        | 64Kbps   | 8Mbps                                | 50Mbps – 1Gbps                                       | 10 - 50Gbps*   |
| Latency                   | N/A                            | 629ms  | 212ms                                | 60 – 90ms  | < 1ms  |
| Innovation and Advantages | Voice Call                     | Digital version of 1G, Multimedia features (SMS, MMS), internet access, SIM introduced | High Security, International roaming | Speed, high speed hand-offs, global mobility         | Low latency, Extremely high speeds   |
| Applications              | Voice Calls                    | Voice Calls, Short Messages  | Video Conferencing, Mobile TVs, GPS  | High speed applications, Mobile TV, Wearable devices | High resolution video streaming remote control of vehicles, robots, M2M, IoT |

Data adapted from personal research, <http://net-informations.com/q/diff/generations.html> and <https://www.zseries.in/telecom%20lab/telecom%20generations/#.Y64XiuzM-KqC>;

### 1.3 Typical Mobile Telecommunication Network

In its simplest form, a telecommunication network is a system of interconnected nodes used to exchange messages between these nodes. Several technologies and methods are used in this message exchange. Without the possibility of information exchange across multiple nodes, telecommunications will be entirely useless.

“Mobility” is perhaps the most loved innovation in mobile communication networks. The ability to connect, transmit and receive signals without any wired connection is priceless. This has led to proliferation of mobile devices (phones & tablets) in the last two decades.

Unlike earlier telecommunication networks, today’s networks support voice & high-speed data rates with an inherent capability for interconnections across network technologies. The figure shows a visualization of a typical mobile telecommunication network.

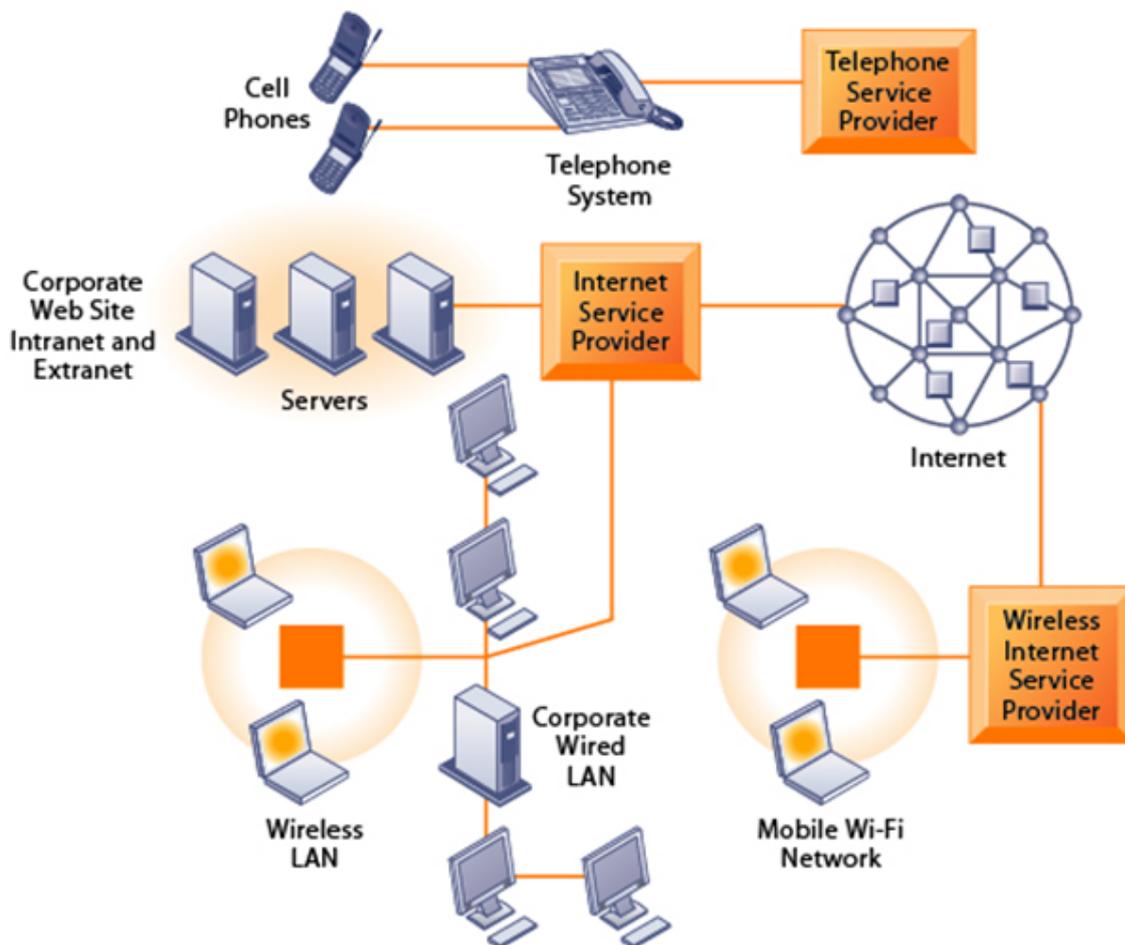


Figure 1: Basic Telecommunication Network Diagram showing Interconnections

Source: Telecommunications and Networking in Today's business World; Online available at: <https://paginas.fe.up.pt/~als/mis10e/ch7/chpt7-1bullettext.htm>

# 5th Generation Mobile Network (IMT-2020)

Each of the earlier generations of mobile telecommunication brought its set of innovation, new technologies and capabilities – increase in speed, performance and user experience were consistently observed transitioning from older to new generations; each new generation improved in some way over its predecessor.

*Evolving consumer demands are steering and shaping mobile broadband service – the need for superfast data rates, interconnection and split-seconds control of machines & devices are influencing innovation in the mobile broadband service delivery globally.*

The International Telecommunication Union (ITU), in its 2018 News channels, revealed that: **“When ready for deployment, 5G networks are expected to deliver more speed and capacity to support massive machine-to-machine communications and to provide low-latency, high-reliability service for time-critical applications”<sup>2</sup>**. The specifications for 5G requires much more spectrum beyond what is currently being used by 3G and 4G. The possibility of interference with already existing high frequency telecommunication services such as satellite communications and weather forecasting systems are also an area of concern. The Nigerian Communications Commission (NCC) on 13th of July 2020 tweeted that **“5G will transform our way of life. From education to agriculture, security to entertainment and governance in general. On education, 5G will transform our educational system. The availability of a**



Figure 2: The 17 Sustainable Development Goals (SDG)

<sup>2</sup> ITU (2018), “5G – Fifth Generation of Mobile Technologies”; online available at: <https://www.itu.int/web/pp-18/en/backgrounder/5g-fifth-generation-of-mobile-technologies#:~:text=Challenges%20and%20solutions%3A%20building%205G,service%20for%20time%2Dcritical%20applications>

**fast-wireless network will enable virtual learning.”** The ITU indeed attested that “5G intends to accelerate the achievement of all 17 Sustainable Development Goals (SDGs), from affordable and clean energy to zero hunger.” The figure below shows the 17 SDGs.

## 2.1 4G Versus 5G Network Capabilities

One of the commonest differences that pundits cite when comparing 4G and 5G networks is the high speed of 5G – often rated as 100 times faster than 4G.

***In lay terms, under ideal conditions, it will roughly take 164 seconds (a little over two and a half minutes) to download a 2GB file on a 100Mbps 4G connection; It will take approximately 2 seconds to download the same 2GB file on a 10Gbps 5G connection.***

The infographic shows key comparisons between 4G and 5G network capabilities.

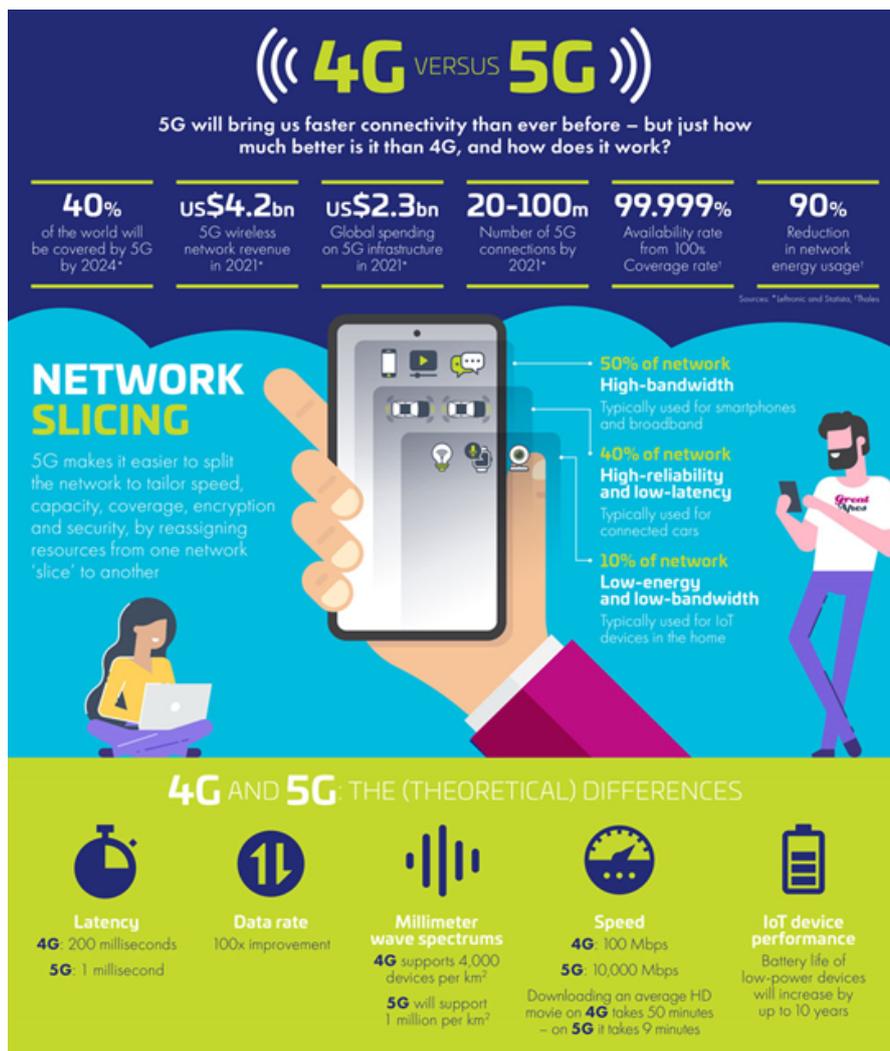


Figure 3: 4G Versus 5G

Image Source: Thales Group, “5G VS 4G: WHAT’S THE DIFFERENCE?”; online available at: <https://www.thalesgroup.com/en/worldwide-digital-identity-and-security/mobile/magazine/5g-vs-4g-whats-difference#:~:text=In%20the%20right%20conditions%205G,evolution%2C%20speeds%20are%20lightning%20fast>

## 2.2 5G Use-cases and Scenarios

The Radio Communications sector of ITU, have defined three (3) important categories of 5G use cases as shown below:

- a. **Enhanced Mobile Broadband (eMBB)** - enhanced indoor and outdoor broad band, enterprise collaboration, augmented and virtual reality (AR & VR)
- b. **Massive Machine-Type Communication (mMTC)** - IoT, asset tracking, smart agriculture, smart cities, energy monitoring, smart home, remote monitoring.
- c. **Ultra-reliable and Low-latency Communications (URLLC)** - autonomous vehicles, smart grids, remote patient monitoring and telehealth, industrial automation

From the cardinal use-cases referenced above, the figure below shows several potential applications of the 5G technology

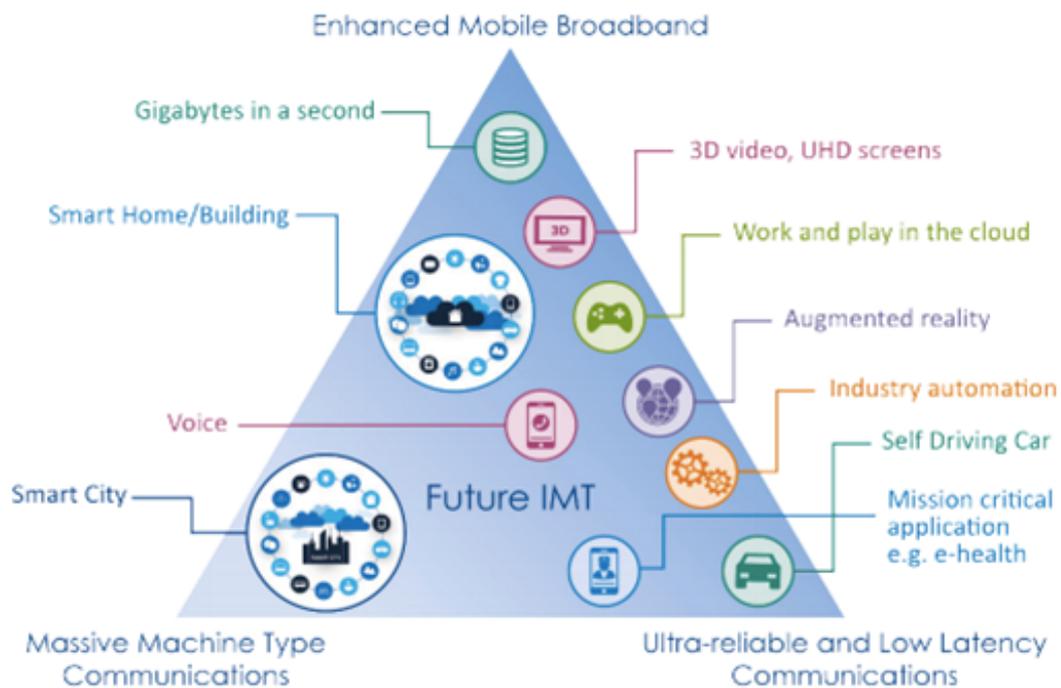


Figure 4: Usage Scenarios of 5G Technology

Image Source: Setting the Scene for 5G: Opportunities and Challenges p.7. Online available at [https://www.itu.int/en/ITU-D/Documents/ITU\\_5G\\_REPORT-2018.pdf](https://www.itu.int/en/ITU-D/Documents/ITU_5G_REPORT-2018.pdf)

## 2.3 Synopsis on Innovations around 5G Technology

Remarkable work has been done and is still on going around 5G technology. The major global players in this regard include:

- a. ITU (Study Group 13 (SG13), Focus Group on IMT-2020 (FGIMT2020) and Focus Group on Machine Learning for Future Networks (FGML5G)).

- b. 3rd Generation Partnership Project (3GPP).
- c. Institute of Electrical and Electronic Engineers (IEEE).
- d. National Regulatory Agencies (NRA) of different countries around the world.

Some of the inventions and innovations around 5G technology include:

- a. New and flexible network architectures (that are backward compatible with older generations of mobile telecommunication)
- b. New devices such as the 5G NR (New Radio) - which is a new Radio Access Technology (RAT) developed by 3GPP for the 5G network. It was designed to be the global standard for the air interface of 5G networks; it is the radio access technology beyond LTE having the capability to connect to 4G network core as well as 5G Networks.

ITU's contribution in the 5G journey cannot be overemphasized; it has played the leading role in managing the radio-frequency (RF) spectrum and developing globally applicable standards for IMT-2020. ITU activities has supported the development and implementation of international regulations and standards to ensure that 5G networks are secure, interoperable, stable and free from any form of interference.

At the World Radiocommunication conference of 2019 (WRC-19) held in Egypt (28th October, 2019 to 22nd November, 2019). The following additional frequency bands were identified for the deployment of 5G networks:

- a. 4.25 GHz - 27.5 GHz,
- b. 37.0 GHz - 43.5 GHz,
- c. 45.5 GHz - 47 GHz,
- d. 47.2 GHz - 48.2 and
- e. 66 GHz - 71 GHz

Improved security is also a critical aspect of 5G; three key areas of security have been identified and are an inherent characteristic of the 5G network (i.e. security by design).

- a. Confidentiality,
- b. Integrity and
- c. Availability

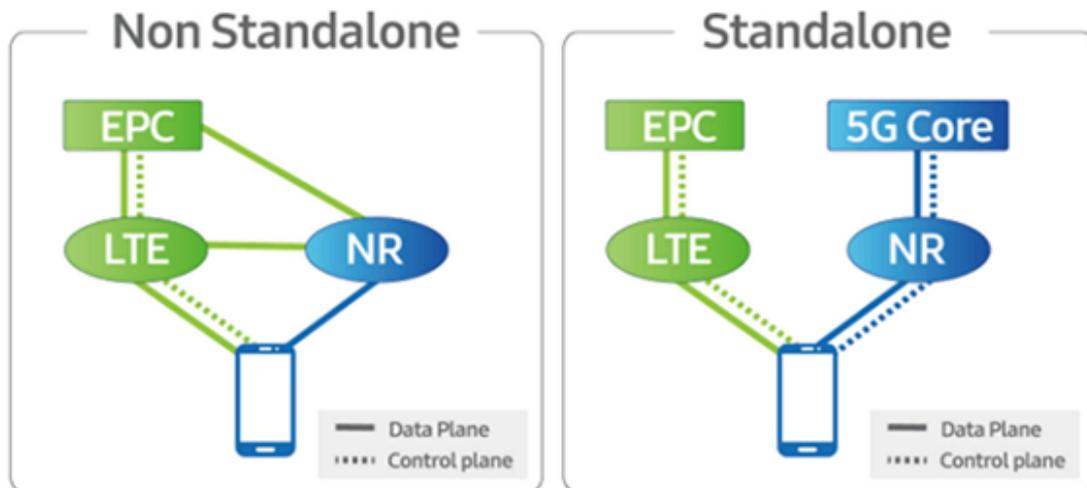
This implies that: unlike the 3G and 4G mobile networks, "security" is an implicit component (by design) of 5G network.

## 2.4 Migration Routes to 5G Mobile Network

The predominant mobile network in most countries are 3G and 4G. When not implementing the network from scratch, the transition to 5G requires the existence of at least a 4G mobile telecommunication network. There are two (2) popular models to 5G and both can be embarked on simultaneously. These are the:

- a. **Non-Standalone (NSA)** and
- b. **Standalone (SA)** modes

The figure below shows a simplified architecture diagram of the NSA and SA models for transitioning to 5G.



**Figure 5: Two Modes of 5G Network Architecture**

Image Source: <https://www.everythingrf.com/community/non-standalone-5g-nr-vs-standalone-5g-nr>  
LTE: Long Term Evolution (4G); NR: 5G New Radio; 5G Core (5GC):5G Network Backbone;  
EPC: Evolved Packet Core (4G Network Core).

#### 2.4.1 Non-Standalone (NSA) Mode (Leveraging Existing 4G LTE Network Backbone)

This architecture relies on 4G to establish the handshake between user devices and the core network; when that handshake is established, the connection is transferred to 5G network. Durga Malladi (2019), Qualcomm’s head of 5G revealed that: “With non-standalone mode, carriers retain the same 4G core network and simply add 5G radios”.

Hannes Ekstrom (2019), Head of Product Line 5G RAN of Ericsson noted the following as the key benefits of the non-standalone mode:

- a. “Be first to launch 5G and gain technology and market leadership
- b. Introduce new 5G spectrums to boost capacity and increase delivery efficiency
- c. Maximizes the use of the installed LTE base
- d. LTE anchor required for control plane communication and mobility management 5G
- e. Evolved Packet Core
- f. Provides early adopter with 5G-enabled devices
- g. Enables video streaming, AR/VR, an immersive media experience Opens up opportunities for new use cases such as Critical IoT”

#### 2.4.2 Standalone (SA) Mode (Implementing 5G Network from Scratch)

This mode does not rely on the existing 4G LTE infrastructure. The end-to-end architecture operates on mm-Waves and sub-GHz frequencies. The Standalone NR was standardized and finalized by 3GPP in 2018; It uses enhanced mobile broadband (eMBB), Ultra-reliable and low la-

tency communications (URLLC) and Massive machine type communications (mMTC) to provide multi-gigabit data rates with improved efficiency and lower costs.

Hannes Ekstrom (2019) noted the key benefits of the standalone mode as the following:

- a. Target 5G architecture option
- b. Simplified Radio Access Network (RAN) and device architecture
- c. New cloud-native 5G Core
- d. Brings ultra-low latency
- e. The only option to provide same 5G coverage for low band as legacy system
- f. Supports advanced network-slicing functions
- g. Facilitates a wider range of use cases for new devices”

The figure below shows a sample heterogenous network implemented in NSA mode with 4G and 5G components interoperating.

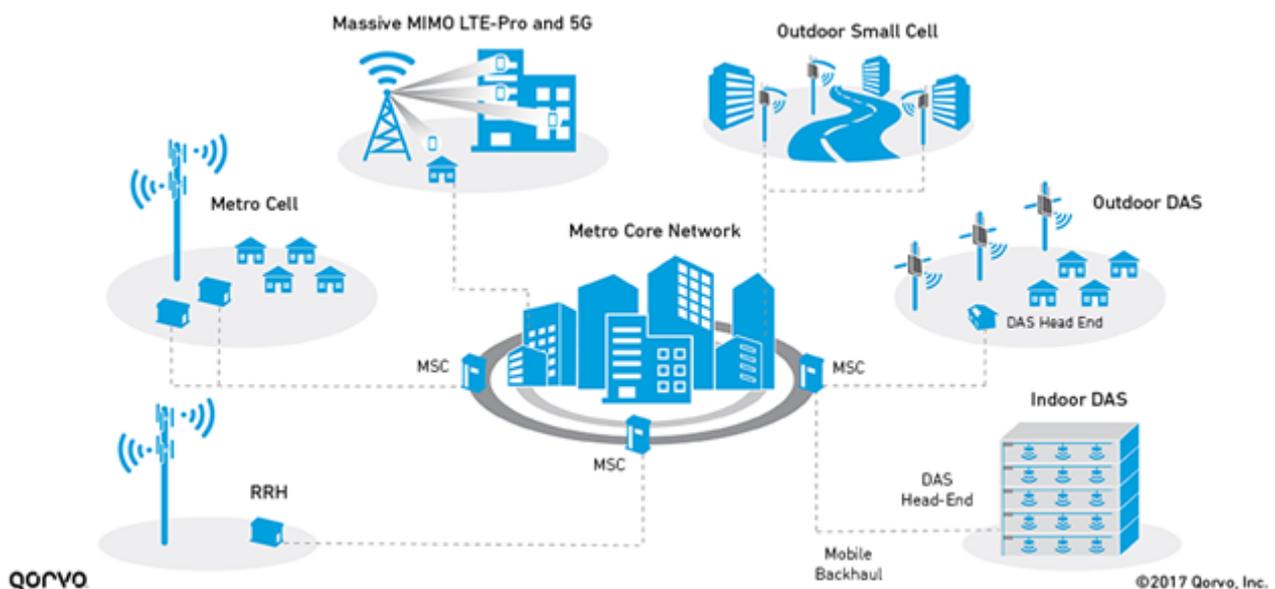


Figure 6: Sample Heterogenous Wireless Network with 4G and 5G Technologies

Image Source: Qorvo (2017), Small Cell Networks and the Evolution of 5G. Online available at: <https://www.qorvo.com/design-hub/blog/small-cell-networks-and-the-evolution-of-5g>

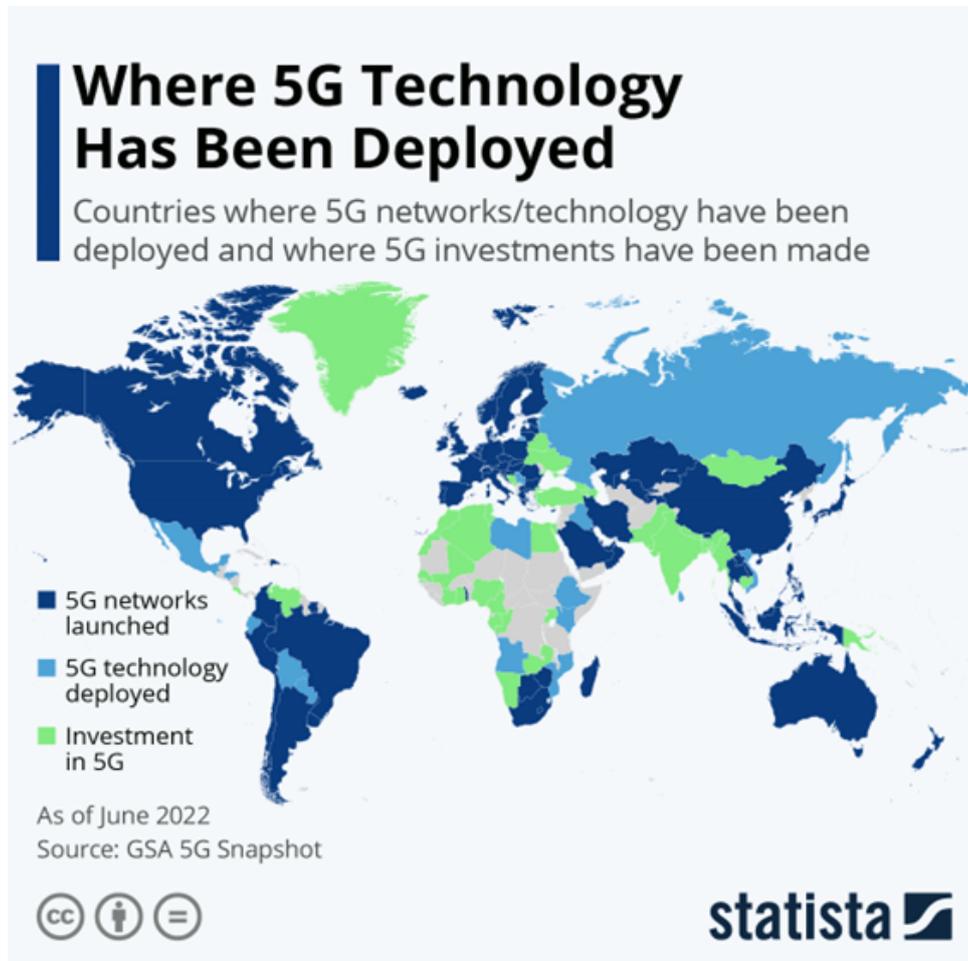
## 2.5 Global Commercial Deployment Trend of the 5G Network

A total of 34 countries and 61 operators launched 5G services by the end of 2019 after South Korea’s successful launch in 2018. RCR Wireless Report (2022) reported that, **“5G networks have been launched in 72 countries around the world, with 1,947 cities having 5G networks.”**<sup>3</sup>

<sup>3</sup> RCRWireless (2022), “5G by Numbers: 72 countries, nearly 2,000 cities, 24 Standalone networks”, Online available at <https://www.rcrwireless.com/20220503/5g/5g-by-the-numbers-72-countries-nearly-2000-cities-24-standalone-networks>; author: Kelly Hill; published on 3rd May, 2022.

According to the Developing Telecoms report of October 2019, **“Half of the 5G commercial launches in 2019 occurred in emerging markets and 35 new launches are planned by 2022 ”.**<sup>4</sup>

The figure below shows a graphical representation of where 5G technology and networks have been deployed around the world.



*Figure 7: Where 5G Technology and Network have been deployed as at June 2022.*

Image Source: <https://www.statista.com/chart/23194/5g-networks-deployment-world-map/>

<sup>4</sup> Developing Telecoms (2019), “5G in Emerging Markets”, Online available at <https://www.developingtelecoms.com/images/reports/5g-em-report-final-1023-4.pdf?isMambot=1> p8

The table below summarizes the top countries with 10 5G deployments globally by number of cities on 5G network.

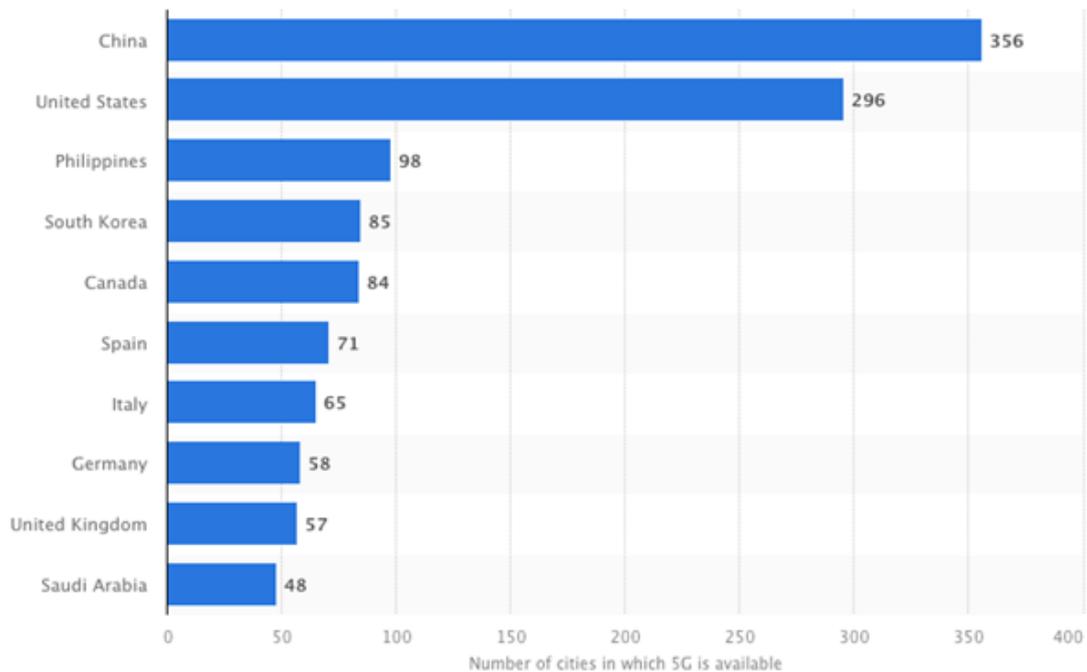
**Table 2: Top 10 Countries with 5G Deployments by Cities – 2022**

| Rank | Country        | Continent     | First Commercial 5G Launch | No. of Cities on 5G Network |
|------|----------------|---------------|----------------------------|-----------------------------|
| 1.   | China          | Asia          | October 2019               | 356                         |
| 2.   | United States  | North America | April 2019                 | 296                         |
| 3.   | Philippines    | Asia          | June 2019                  | 98                          |
| 4.   | South Korea    | Asia          | April 2019                 | 85                          |
| 5.   | Canada         | North America | September 2021             | 84                          |
| 6.   | Spain          | Europe        | March 2022                 | 71                          |
| 7.   | Italy          | Europe        | September 2022             | 65                          |
| 8.   | Germany        | Europe        | September 2022             | 58                          |
| 9.   | United Kingdom | Europe        | May 2019                   | 57                          |
| 10.  | Saudi Arabia   | Asia          | October 2019               | 48                          |

**NOTE: Data as at April 2022**

Data Source: Statista (2022) – Number of cities in which 5G is available 2022 by Country; online available at: <https://www.statista.com/statistics/1215456/5g-cities-by-country/>;

5G Observatory (2022) - Overview of commercial 5G launches; Online available at: <https://5gobservatory.eu/overview-5g-commercial-launches/>



**Figure 8: Top 10 Countries with 5G Deployments by Cities – 2022**

Image Source: Statista (2022) - <https://www.statista.com/statistics/1215456/5g-cities-by-country/>

## 2.5.1 Analysis and Inference from Top 10 Countries with Most Cities on 5G Network

- a. The earliest commercial rollout of 5G occurred in April 2019 in south Korea and then the United States.
- b. 6 (i.e. 60%) of the top 10 countries commercially launched 5G in 2019, 1 (i.e. 10%) launched in 2021 and 3(i.e. 30%) launched in 2022; there were no commercial 5G rollout occurred in 2020 - largely due to the COVID-19 pandemic.
- c. China tops the chart for countries with number of cities on the 5G network; United states comes second.
- d. China and the United States are far ahead of other countries in the 5G roll out journey with a total of 652 cities on the 5G network between both countries.
- e. Asia takes the lead for continents on 5G rollout with no fewer than 587 cities on the 5G network; North America comes in 2nd place with 381 cities on the 5G network. Europe comes in 3rd place with no fewer than 251 cities on the 5G network.
- f. Saudi Arabia is the only Middle East country on the top 10 list.
- g. No African or South-American country made it to the top 10 list.

## 2.5.2 5G Network Deployments in Africa

As at November 2022, about 10 African countries have commercially deployed 5G network. According to the GSMA (2022), ***“4G continues to expand in Africa, and 5G is on the operators’ radar. South Africa was the first country in the region to launch 5G, and has since been joined by a handful of countries: Seychelles, Zimbabwe, Botswana, Mauritius, Madagascar, and Togo”***<sup>5</sup>. MTN Nigeria rolled out 5G technology on its network on August 24, 2022.

***Most of the 5G deployments in Africa are targeted at major cities (largely for profit with a limited initial intent on bridging the digital divide for wider societal benefits); transition to 5G is also stifled by slow formulation of regulation and high costs of 5G enabled mobile devices.***

*Table 3: 5G Network Deployment Trend in Africa*

| SN | Country      | Region in Africa | First Commercial 5G Launch | Pioneer 5G Operators |
|----|--------------|------------------|----------------------------|----------------------|
| 1. | South Africa | Southern Africa  | May 2020                   | Vodacom, MTN         |
| 2. | Madagascar   | Southern Africa  | June 2020                  | Telma                |
| 3. | Seychelles   | East Africa      | July 2020                  | CWS                  |
| 4. | Togo         | West Africa      | November 2020              | Togocom              |
| 5. | Mauritius    | Southern Africa  | July 2021                  | Mauritius Telecom    |
| 6. | Botswana     | Southern Africa  | November 2022              | Orange               |
| 7. | Zimbabwe     | Southern Africa  | February 2022              | Econet               |
| 8. | Nigeria      | West Africa      | August 2022                | MTN                  |
| 9. | Kenya        | East Africa      | October 2022               | Safaricom            |

<sup>5</sup> GSMA (2022), *“South Africa Spearheads 5G in Africa, but the Road is Long and Windy for Others”*; Online available at: <https://www.gsma.com/membership/resources/south-africa-spearheads-5g-in-africa-but-the-road-is-long-and-windy-for-others/#:~:text=4G%20continues%20to%20expand%20in,Q1%202021;published%20on%2023rd%20June%202022>

**Five of the top Nine 5G network deployments in Africa are by Southern African countries.**

## 2.6 Nigeria's Journey to 5G Technology

A country's journey to 5G technology and network is a multi-stage and typically involves:

- Formulation of guidelines and regulations by the NRA
- Re-farming of existing or underutilized spectrum for 5G purposes
- Auctions of 5G spectrum bands
- CapEX investments by Operators for 5G Rollout
- Marketing and Promotions on 5G network benefits
- 5G network rollout

The figure below highlights notable events in Nigeria's journey to 5G



Figure 9: Timeline of notable events in Nigeria's journey to 5G

In August 2022, Nigeria joined the league of nations on the 5G network with MTN's rollout of 5G technology in Lagos Nigeria with a promise to expand to 6 more cities: Abuja, Port Harcourt, Ibadan, Kano, Owerri, and Maiduguri. As at November 2022, Nigeria's capital city, Abuja, had 5G network available from MTN.

Although MTN Nigeria and Mafab Communications Limited emerged as winners of the initial 3.5 GHz 5G spectrum auctions held by NCC in December 2021, Airtel emerged as the sole bidder for for 5G spectrum recently concluded by NCC in December 2022.

## 2.7 5G Technology: Facts and Myths

*From the turn of the new decade (year 2020), several perceptions and myths have surrounded 5G technology and network. Many unfounded theories were postulated and shared on different mass media and social media platforms – this sowed “seeds of doubts” in the minds of many telecommunications consumers around the world about the authenticity of the 5G technology.*

Table 4: Facts and Myths on 5G Technology

| SN | Popular Myths & Conspiracies                       | Facts and Realities  |
|----|--|--|
| 1. | <b>5G causes COVID-19</b>                          | COVID-19 is caused by infection with severe acute respiratory syndrome coronavirus 2, or SARS-CoV-2 which easily spreads among people. 5G technology or network does not cause or spread coronavirus; It has no link to COVID-19.  |
| 2. | <b>5G radio waves cause adverse health effects</b> | All telecommunication radio waves are electromagnetic in nature. 5G radio waves belong to the non-ionizing region of the electromagnetic spectrum – implying that these waves do not possess sufficient energy to cause health hazards.  |
| 3. | <b>5G is not secure</b>                            | 5G is more secure than previous generations of mobile networks. 5G networks adopt “security by design” architecture. Some key features include: <ul style="list-style-type: none"> <li>a. Enhanced subscriber identity protection</li> <li>b. New &amp; improved mutual authentication procedures.</li> <li>c. Improved cryptographic algorithm (up to 256 bits).</li> </ul>   |
| 4. | <b>5G is just a faster 4G</b>                      | 5G supersedes and differs from 4G in that it offers the following: <ul style="list-style-type: none"> <li>a. Enhanced Mobile Broadband (EMBB),</li> <li>b. Ultra-Low Latency Communication (URLCC) and a</li> <li>c. Higher number of connected devices</li> <li>d. More capable 5G NR (New Radio)</li> </ul> <p>Although 5G networks support backward compatibility with older generations, it is an entirely new technology and generation of mobile network</p> |

# 3 Potential Socio-economic Applications of 5G in Nigeria

*5G network is the serious much awaited game changer in every ramification and has the potential of accelerating actualization of the 17 SDGs.*

This chapter will map the different viable applications of 5G network to various sectors of the Nigerian economy.

*Table 5 : Potential Socio-economic Applications of 5G Network in the Nigeria Economy*

| SN | Application Area        | Viable Applications  |
|----|-------------------------|--|
| 1. | Communications          | <ul style="list-style-type: none"> <li>High quality 5G video and voice calls.</li> <li>Gigabytes upload and download in Seconds.</li> <li>Support for effective Remote Work.</li> </ul>  |
| 2. | Education               | <ul style="list-style-type: none"> <li>State-of-the-art e-Learning.</li> <li>Connectivity for cross-border Research &amp; Development activities.</li> <li>Improved access to Nigeria Research and Education Network (NgREN).</li> <li>UHD contents in AR/VR applications for learning.</li> </ul> |
| 3. | Financial Services      | <ul style="list-style-type: none"> <li>Backbone for deployment of AI systems for smart fraud detection, prevention and control.</li> <li>Backbone for Superfast and robust e-payment solutions.</li> </ul>   |
| 4. | Health                  | <ul style="list-style-type: none"> <li>e-Health and Telemedicine.</li> <li>Real time emergency response system.</li> </ul>   |
| 5. | Housing                 | <ul style="list-style-type: none"> <li>Backbone for Smart and Sustainable Cities (SSC) &amp; Smart Homes through massive inherent support for IoT.</li> </ul>  |
| 6. | Manufacturing           | <ul style="list-style-type: none"> <li>Highly Responsive industrial Control System for Process Automation.</li> </ul>  |
| 7. | Media & Entertainment   | <ul style="list-style-type: none"> <li>AR/VR entertainment solutions.</li> <li>Superfast Streaming Services for multi-media content.</li> </ul>  |
| 8. | Security & Surveillance | <ul style="list-style-type: none"> <li>Realtime and Robust Surveillance Networks.</li> <li>Intelligent Self-Driving Drones and drone swarms to combat crime.</li> <li>Improved identity management solutions for authentication &amp; verification.</li> </ul>                                     |
|    | Transportation          | <ul style="list-style-type: none"> <li>Self-driving cars (private and commercial).</li> <li>Real-time traffic control systems</li> </ul>   |



*Figure 10: Viable Applications of 5G Technology and Network in Nigeria*

As promising as these potential applications seem, they are however, not without challenges. The following points highlights the barriers to transition, adoption and use of 5G in Nigeria.

- a. Huge CapEx investments required by Carriers and Operators to deploy and integrate 5G technology to their existing networks.
- b. Low broadband penetration; the broadband penetration in Nigeria was 45.5% as at October 2022.
- c. Unclear direction of price regulations for 5G network service.
- d. High cost of 5G enabled mobile devices.
- e. Wrong consumer perceptions about 5G technology.

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