

NIEEE WEBINAR SERIES
TITLED

EXPERT INSIGHTS ON 5G CONCERNS

By

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**The Nigerian Institute of Electrical and Electronic Engineers
(NIEEE)**

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NIEEE
THE NIGERIAN INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (NIEEE)
Presents
Webinar

EXPERT INSIGHTS ON 5G CONCERNS

Date: Sat. May 9, 2020
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Speaker



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NIEEE At A Glance

- Established in 1984 as Electrical Division of The Nigerian Society of Engineers (NSE) as group of professional electrical engineers.
- Each member was licensed to practice by the then Council of Registered Engineers of Nigeria (COREN).
- As the association grows, it was later christened The Nigerian Institute of Electrical and Electronic Engineers (NIEEE)..
- Today, NIEEE has 28 Chapters across the country with 1,000s members within and outside the country.
- NIEEE housed all the specialties of Electrical Engineering.
- NIEEE is constitutionally structured into 3 broad sub-divisions of Electrical Engineering discipline, namely:
 - Power Engineering Section,
 - Telecoms & ICT Section and
 - Instrumentation & Control Section.

Introduction

- As a professional body with 36 years track record of professional excellence, we observed the growing intensity of global discussion on 5G mobile wireless technology.
- The Institute has taken note of the growing concerns particularly the impact of 5G operations on safety of people, things and applications, etc and wish to proffer expert insights into the subject particularly in the areas of concerns.
- This webinar is to complement our positions as published in major dailies.

Evolution of Mobile Network Generations



- **0G**: (mid 40s to late 70s) 1st as vehicular later mobile radio communication (IMTS).
- **1G**: Primitive analogue signals for voice (NMT; AMPS; TACS)
- **2G**: Digital voice, SMS later basic mobile internet.
- **3G**: Increased internet speed, more robust internet services.
- **4G**: Improved service speed bringing mobile internet to the masses. IP-based telephony.
- **5G**: ????????



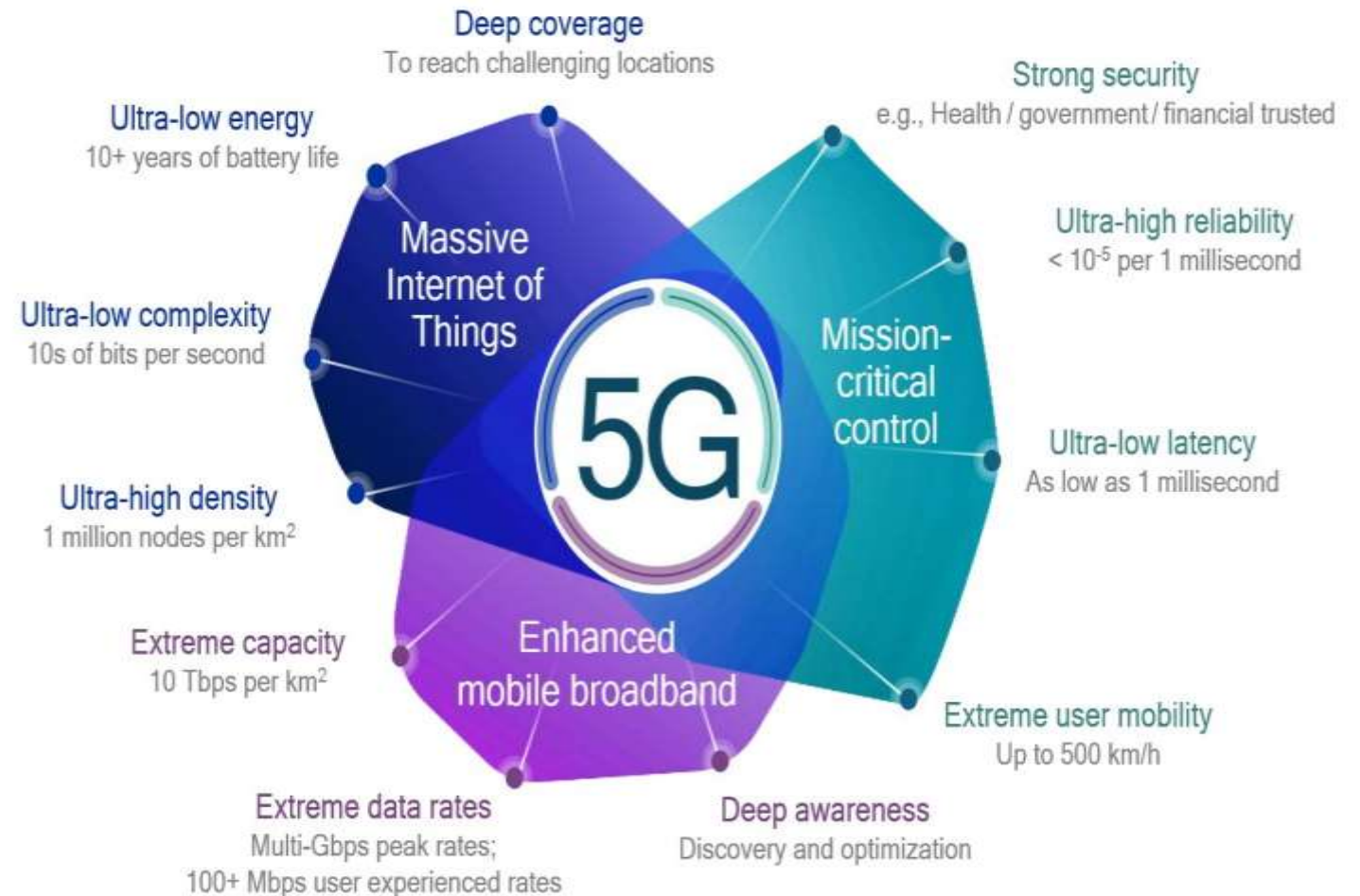
What is 5G?

- 5G is the next and fifth generation mobile network with over-the-air telecommunication standards.
- It has been a subject of intense research and discussion in the past few years.
- Tremendous improvement in data rates and significantly lowers latency to devices.
- 5G is undeniably one of the most exciting developments in mobile technology, delivering far faster speeds and more reliable connections than current options.
- Some earlier declared 2020 as the year of 5G.

Criteria for 5G

Internationally standardised criteria outlined for IMT-2020 (5G) by ITU:

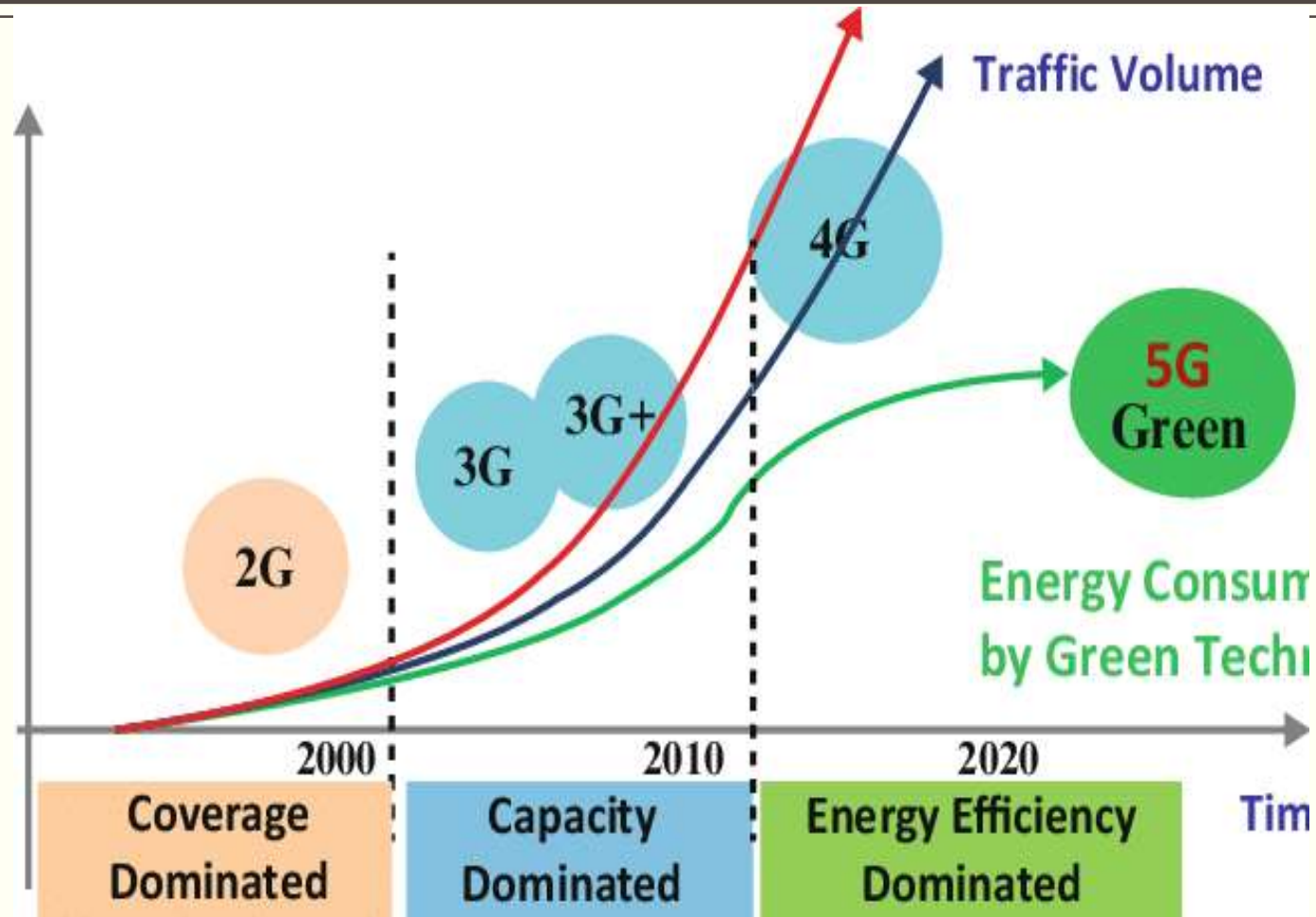
1. **Enhanced mobile broadband (eMBB):**
2. **Ultra-reliable and low latency communications (URLLC):**
3. **Massive machine-type communications (mMTC):**



Backend Technologies To Actualize 5G Criteria

- millimeter waves (mm waves),*
- Small cell network,*
- mMIMO*
- Advanced Beamforming,*
- NOMA and*
- MEC.*

Key Features of 2G, 3G & 4G



- (Image Source: UEB-Labex COMIN Labs, 2014)

5G Frequency Spectrum

Sub-bands spectrum for 5G services:

- (a) **<1 GHz** (Lower-band);
- (b) **1 to 6 GHz** (Mid-band) and
- (c) **> 6 GHz** (Upper-band),

The lower and mid bands are fully occupied. However, the upper band **new radio for 5G services (5G NR)** has abundant bandwidth availability but mm waves signals have *very weak propagating energy* resulting to *short coverage* distances.

5G SPECTRUM

Existing Mobile Spectrum

New Mobile Spectrum

Coverage & Capacity

Capacity

Below 1 GHz

1-6 GHz

30 GHz

mmWave band

100 GHz

TV

WiFi

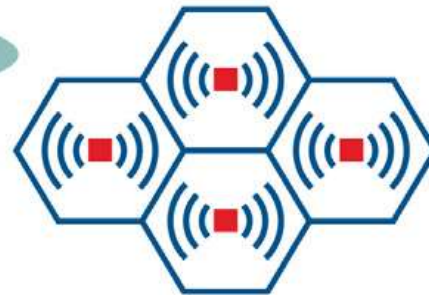
WiFi

Fixed links and Satellite

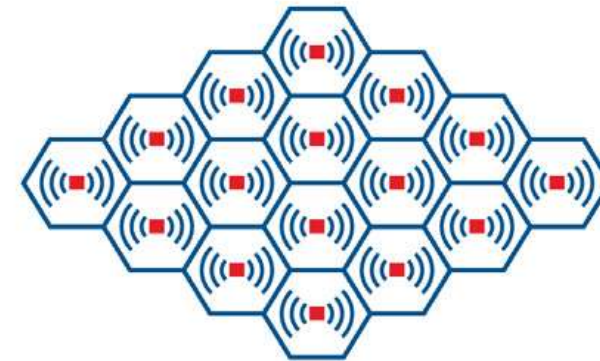
Existing Mobile



Macro cells



Macro and small cells



Small cells



Where is 5G in Electromagnetic Spectrum?

- WRC-19 identified Upper-band spectrum 24.25 – 27.5 GHz, 37 – 43.5 GHz, 45.5 – 47 GHz, 47.2 - 48.2 GHz and 66 – 71 GHz for the deployment of 5G networks.
- The natural behavior of radio waves obeys Newton's inverse-square law of electromagnetic propagation, meaning that, *each time the distance from the transmitter is doubled*, then the received power at that point is reduced to one-fourth of the power at the transmitter.

THE ELECTROMAGNETIC SPECTRUM

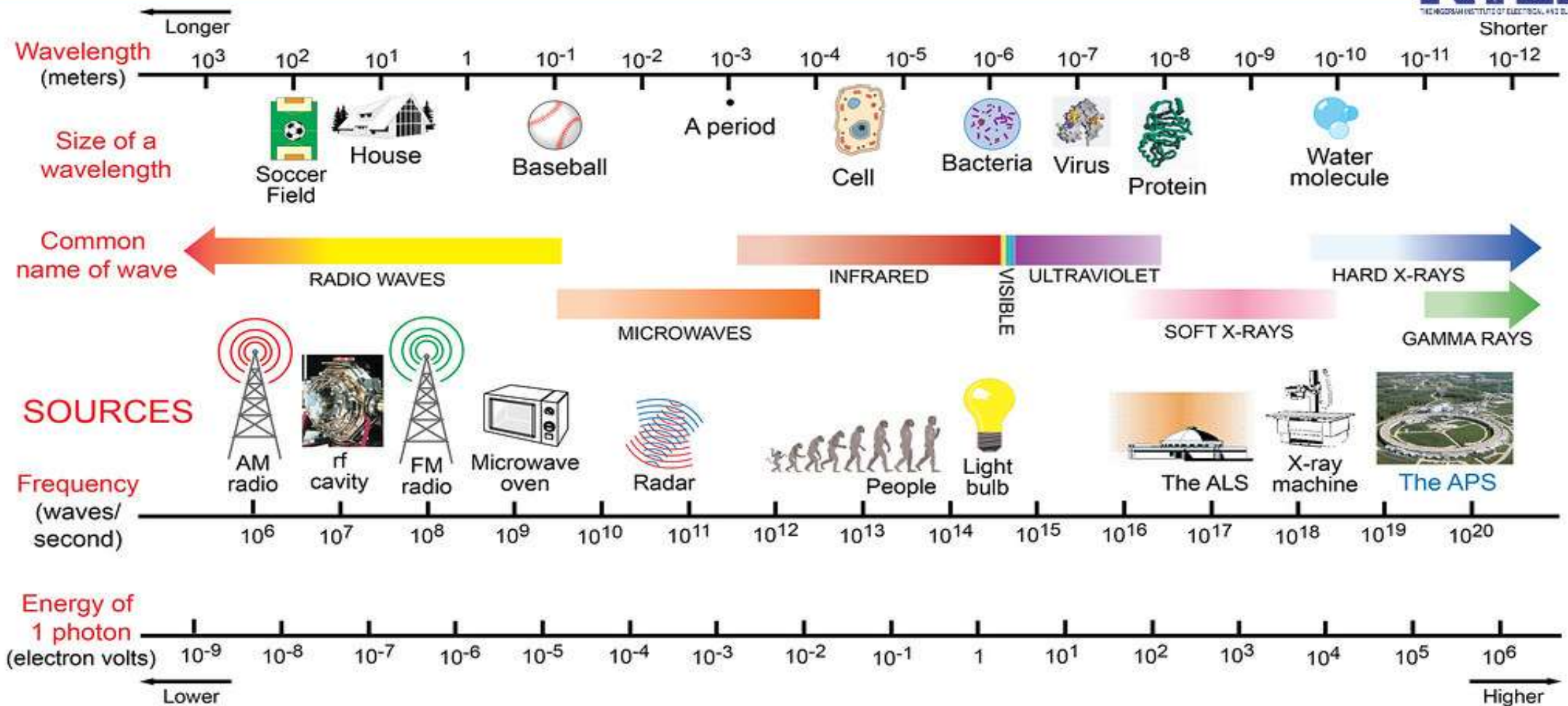


Image source: <https://www.flickr.com/photos/advancedphotonsource/5940581568/sizes/>

Ionizing and Non-Ionizing Radiations

- Since the 20th Century, artificial EMFs are added to existing natural EMFs.
- ***Ionizing radiation*** occur when EMF signals carry enough energy to break molecular bonds and consequently damage the DNA, e.g. medical X-ray. They occupy the higher portion of the EM spectrum.
- ***Non-ionizing radiations*** occupy lower part of EM spectrum, with no sufficient energy to break molecular bonds. Most common man-made sources of non-ionized radiations are electricity, telecommunications, radio and TV broadcasting antennas, etc.

5G NR Technologies and Health Concerns

- World Health Organization (WHO) defines Health as a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity. Staying alive and in good health have become major concerns of all.
- Virtually all the major concerns about 5G networks hover around safety radiation from mm waves networks.
- Typical radio frequencies of 1G, 2G, 3G, 4G and 5G are 150 MHz, 1800 MHz, 2100 MHz, 2500 MHz and 38000 MHz respectively.
- This comparatively high frequency difference between 5G NR and its predecessors drew the attention of non-technical stakeholders.

5G EMF Vs COVID-19 Alarm

- Every new generation of mobile networks has its excitements and skepticism.
- 5G signals are transmitted over the radio waves irrespective of the technology.
- Coronavirus are not transmitted by base station.
- 5G signals are not bio agent.
- As experts we cannot link coronavirus pandemic with 5G network.
- There are cases of coronavirus spread in countries without 5G networks.

Benefits of 5G

- 5G's benefits open up endless use cases.
- Billions of devices will be connected in smart homes, smart schools, smart cities, smart and safer vehicles, enhance health care and education, etc.
- Devices will have increased computing capabilities.



5G uses radio waves or radio frequency (RF) energy to transmit and receive voice and data connecting our communities.

Benefits of 5G

- It may seem too early to experience the real benefits, we expect more users, greater capacity and of course faster speed.
- 5G's benefits are far beyond just telecoms industry; it's designed as a unifying network that can help realize the true potential of IoTs; vehicle-to-infrastructure (V2X), far more robust virtual reality (VR) and extended reality (XR).
- The equipment is highly scalable according to traffic demand, laying the foundations for devices that have yet to be conceived.

How Will 5G Commence Roll-Out?

5G to evolve from 4G network. A mobile network has **Radio Access Network** and **Core Network**

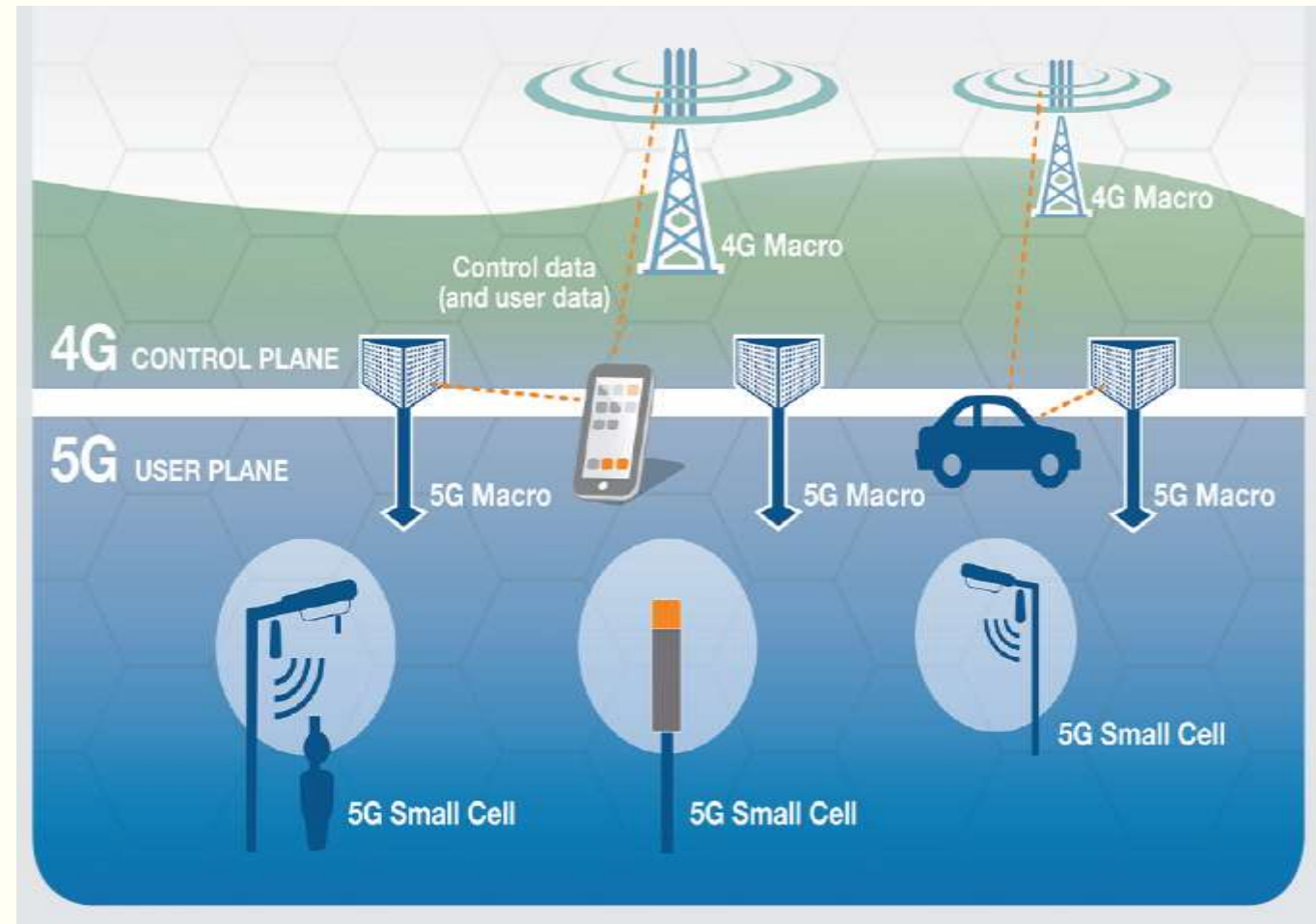
RAN

Core Network

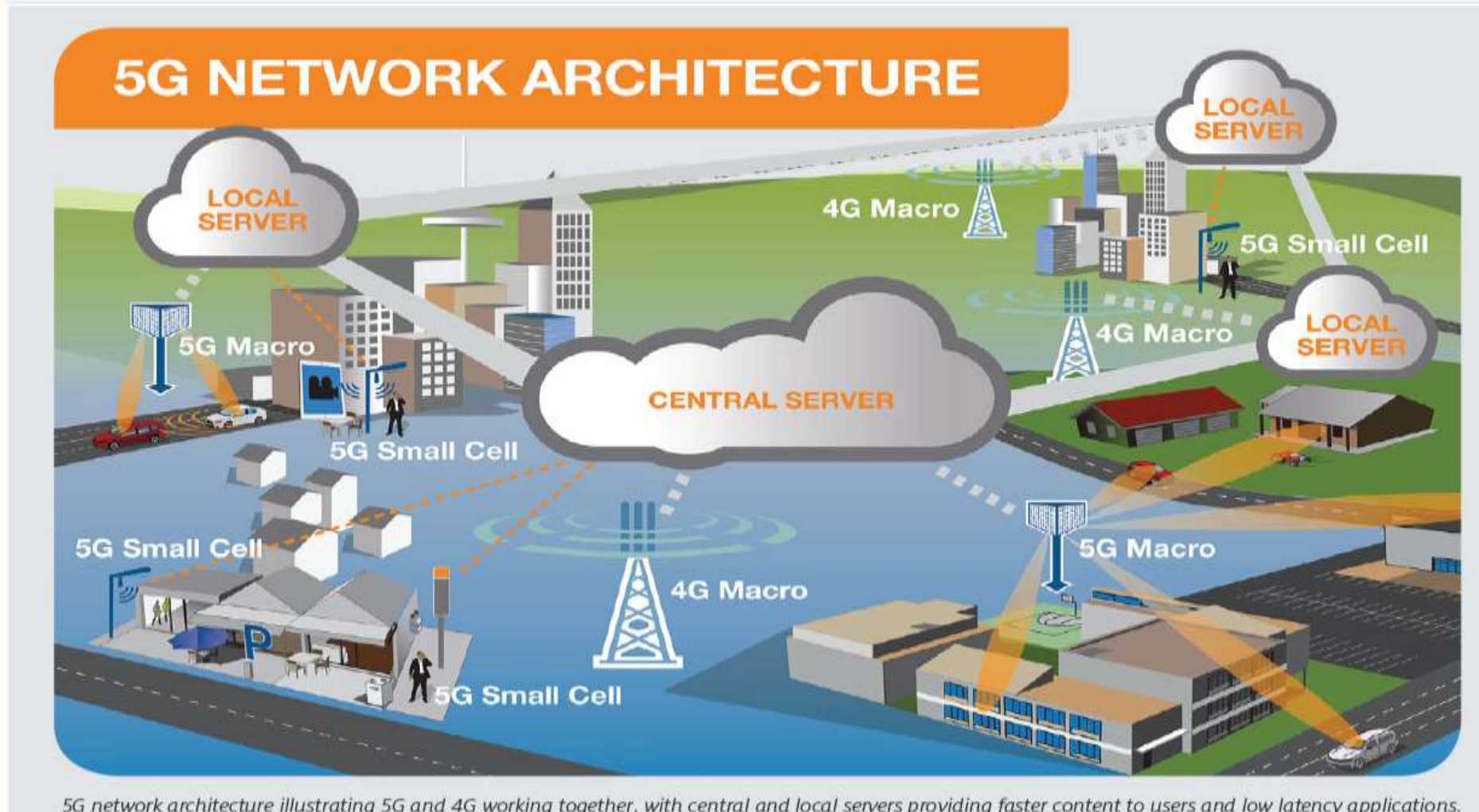
- Short range small cells (*mini base station*) are major 5G features due to mmwave frequencies.
 - To ensure continuous connectivity, small cells are distributed in clusters to complement the macro network that provides wide-area coverage.
 - 5G Macro Cells will use massive MIMO.
- Designed to better integrate with the internet and cloud based services and also includes **distributed servers** across the network to reduce latency.
 - Many of the advanced features of 5G including **NFV** and **network slicing** for different applications and services, will be managed in the core.

How Will 5G Commence Roll-Out?

- 5G networks are designed to work in conjunction with 4G networks.
- 4G → 4G LTE → LTE-Advanced → LTE-A (Pro) → 5G
- Small cells for very localised coverage to feed into macro network.
- The infrastructures are currently upgraded and modified.



5G Network Architecture



5G Challenges

Some major concerns to 5G operators are:

- Transition from 4G macro cells networks to 5G mMIMO will take time.
- Attenuation of mmwave signals due to inherent poor penetrating capabilities and attenuation due to rainfall (estimated to about 10 dB worse than low band signals). Increase CAPEX due to exponential increase in number of cell sites, coupled with challenge of site space in densely populated areas.
- Fronthauling huge volume of data traffic from 5G NR site require high-performance fiber optic network, but what about the hassles and costs.
- Operators need to contend with individual regulatory policies guiding each 5G Spectrum band.
- Manufacturers are to produce 5G-enabled phones with multiple antenna arrays.

Key Players in 5G Ecosystem: *bringing technology to Customers*



Image source: www.newzoo.com

Way Forward

- Successor technology does not necessarily have to supplant the predecessor technologies.
- Public awareness by major stakeholders.
- Establish strategies for 5G deployment.
- 5G networks to cover one-third of the world's population by 2025 – GSMA.
- ***The journey to 6G????***



Conclusion

- As professionals with authority in this subject, we stand by the side of conformance with globally approved radio communication regulations, standards, specifications and other guidelines developed for 5G networks.
- 5G NR has lot of bandwidth to deliver 5G visions.
- 5G NR signals are not bio agent, and as such cannot be linked to coronavirus.
- The international watchdog on radiation (ICNIRP) has released new EMF exposure safety limits which covers 5G..
- The roll-out of 5G networks is still at infancy stage globally.
- No 5G deployment in Nigeria as at the moment.
- GSMA made it clear that 4G network coverage in Nigeria is still below the average line, while the 3G network is far below full nationwide coverage.
- NIEEE has highest regard for health and safety of person in all its activities.
- The Institute will continue to advise government organizations and educate the public on matters within the jurisdiction of electrical and electronic engineering profession.

Appreciation

- Appreciation to every member of the **Independent RF Expert Group (IRFEG)** of NIEEE.
- Thanks to all our engineers on duty to provide essential services and giving sustaining life to the economy of our great nation during the lockdown season.
- Thanks to all the 28 Chapters of NIEEE across the country.
- Thanks to all the standards development related agencies in Nigeria for keep our society safe.

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