BROADBAND COMMUNICATIONS IN AFRICA: SPECTRUM, SOLUTIONS & OBJECTIVES

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BROADBAND COMMUNICATIONS IN AFRICA: SPECTRUM, SOLUTIONS & OBJECTIVES

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EXECUTIVE SUMMARY

Countries around the world have focused on the rollout of 5G mobile networks in the past years. In Africa, a few countries have also jumped on the bandwagon, such as South Africa, Kenya, and Nigeria. A fundamental purpose of connectivity is to serve some other purposes that end users require to go about their day and operations. Communications and connectivity have become fundamental drivers of economic growth and empowering the social lives of our societies.

Africa, the world's second largest continent with 16% of the global population will still heavily rely on 3G and 4G mobile networks for some time to come. ABI Research forecasts about 95% of Africa's mobile subscribers will still be on 4G, 3G, and 2G connections by 2026. The deployment of 5G mobile networks will need to come down in cost and demonstrate justifiable returns for African mobile networks. 5G mobile networks aside, African Mobile Network Operators (MNOs) would be better served by optimizing their 4G mobile networks, addressing the digital divide and then pivoting into 5G deployment. The Mobile Economy Sub-Saharan Africa report from the GSM Association (GSMA) forecasts 3% penetration for 5G connections by 2025.

One fundamental to understanding the development of 5G is the spectrum activities. Spectrum access is paramount for any wireless communication technology, terrestrial and satellite alike. Of the 54 countries in Africa, only a handful have started to commercialize 5G, with a large majority focusing on using the mid-band (e.g., 3.5 GHz band). By 2025, it is expected that less than 20% of all African countries will have 5G spectrum allocated. 4G/LTE will be the focus for many Africans over the next few years.

Spectrum allocation heavily influences the rollout of cell sites and the devices that could be supported in the African region. ABI Research forecasts that, by 2026, 5G cell sites that use sub-6 GHz make up about 99% of total 5G cell sites in Africa while Millimeter Wave (mmWave)-capable sites will be limited to the dense urban areas. The sub-6 GHz bands are optimal for both coverage (e.g., with low bands) and additional capacity compared to 4G and, especially, 3G spectrum (e.g., with 3.5 GHz band, spectrum channels are ~100 MHz to 150 MHz wide). The majority of smartphone brands that are present in Africa, such as Infinix, Tecno, Samsung, Oppo, and Xiaomi, have released their 5G-capable mobile devices, but with sub-6 GHz support only. By 2026, ABI Research forecasts that sub-6 GHz-capable 5G handsets shipments will reach 3.2 million in the African market.

Non-terrestrial network solutions, such as satellite communication, have become an integral part of The 3rd Generation Partnership Project (3GPP) ecosystem with Release 17 (finalized in March 2022). As satellite communication links have grown in capacity, reduced cost of service, and improved antenna sensitivity, satellite communication has been assisting African countries address their challenges with high throughput connectivity, helping to close the digital divide. Satellite communications are also being used by local businesses and enterprises in various industries to enhance operational efficiencies. In particular, the aeronautical, maritime, and land transportation sectors have been able to leverage the universal and wide area connectivity provided by satellites.

Increased broadband penetration brings benefits both to consumers and the economy. Terrestrial and satellite communications have their respective roles to play in enabling the future economic development in Africa. Therefore, there is a need to ensure both industries have the necessary spectrum and infrastructure to maximize the rollout of connectivity for all markets.

BROADBAND OUTLOOK IN AFRICA

Africa is the world's second largest continent, after Asia, with more than 1.3 billion people accounting for 16% of the global population. The region is made up of a total of 54 countries with 16 of them being landlocked. While 4G adoption and deployment in Africa has begun to pick up pace, the majority of the countries are still heavily reliant on 3G networks. At the same time, smartphone adoption is likely to grow with the availability of more affordable models in the region.

Current Cellular Market Outlook

3G and 4G Status and Coverage in Africa

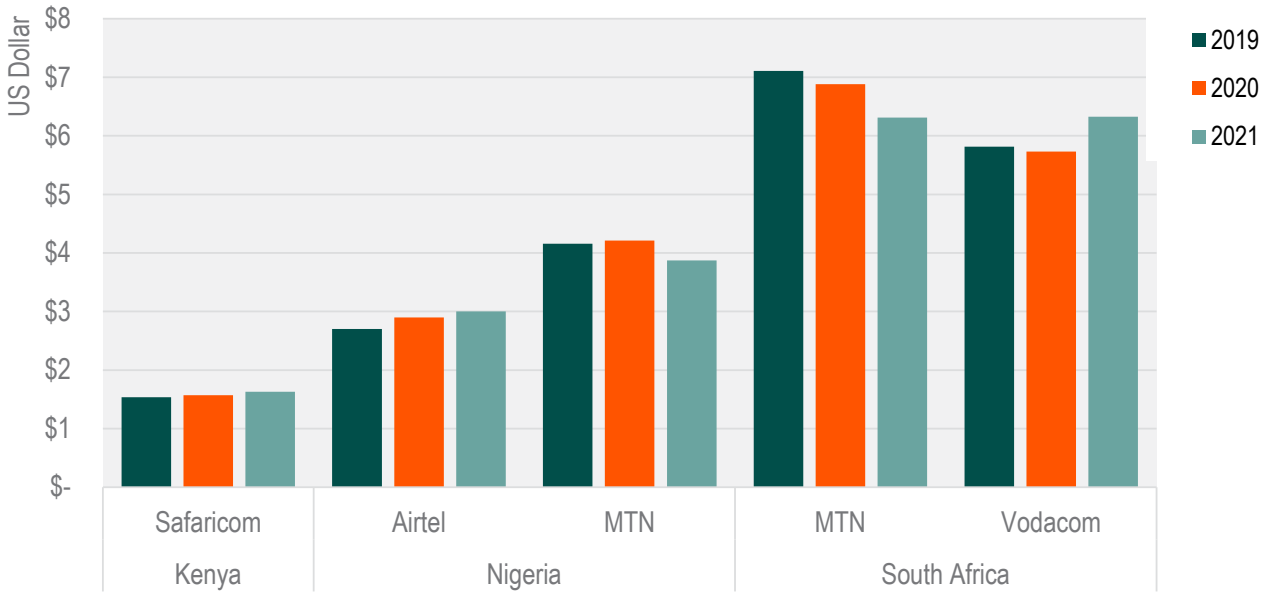
Based on The Mobile Economy Sub-Saharan Africa report by the GSMA, only 46% of the region's population were connected in 2020. Of those connected, 3G connections remain prevalent. Indeed, 3G is expected to grow to 600 million connections in 2024 before starting to decline. 4G connections are expected to grow 28% or more than 300 million by 2025.

A report by the International Telecommunication Union (ITU) in 2021 on mobile network coverage stated that 49% of the African population has access to 4G and another 33% has access to 3G. Of the remaining 18%, only 7% has access to 2G, and the remaining do not have mobile network coverage whatsoever. The majority of 4G population coverage is in urban areas (88%), while in rural areas, only 21% have 4G coverage.

Average Revenue Per User in Africa

Average Revenue Per User (ARPU) is an important financial metric for MNOs. It provides an indication on the level of revenue being spent per user and the trajectory provides the future outlook. African MNOs vary in ARPU from country to country and between MNOs. South African MNOs, such as Vodacom and MTN, have higher ARPU than others in Nigeria and Kenya.

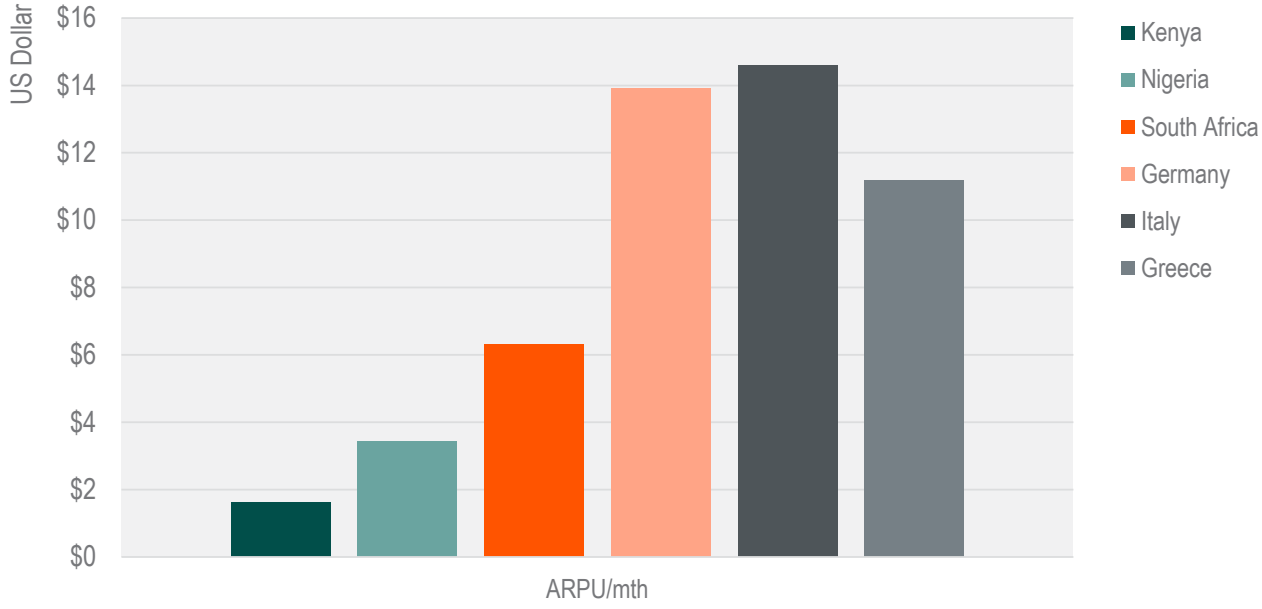
CHART 1: AFRICAN MNO'S ARPU PER MONTH



(Source: ABI Research/MNOs)

Comparing African MNOs with Vodafone brands in Europe, as a snapshot, shows the regional differences and where Africa stands at a macro-level. European MNOs, on average, have an ARPU almost twice as much as African MNOs. This implies that African MNOs would have a smaller pool of capital and need to use their funding optimally to invest in matching market demands.

CHART 2: AFRICAN MNOS' ARPU VERSUS EUROPEAN MNOS' ARPU — A COMPARISON



(Source: ABI Research/MNOs)

5G Outlook in Africa

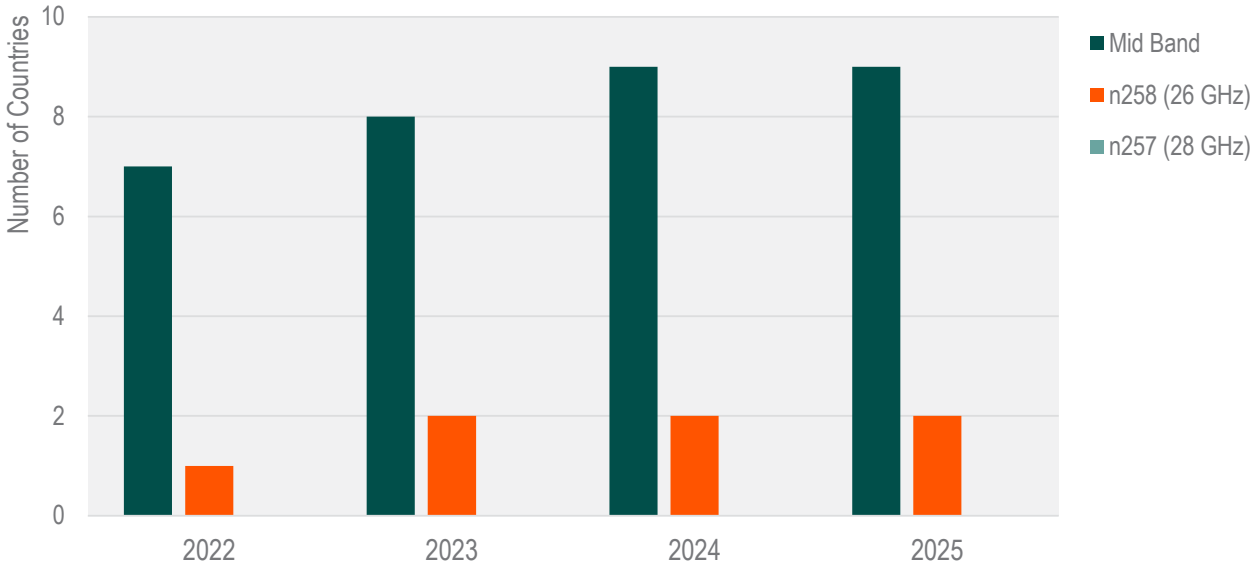
Based on The Mobile Economy Sub-Saharan Africa report from the GSMA, 5G connections will make up no more than 3% of the total mobile connections for the region by 2025. As MNOs seek to maximize their ongoing investment in 4G/LTE, 5G is likely to be on a much slower adoption profile over the 5-year forecast period.

Nonetheless, in Africa, MNOs have started to experiment and deploy 5G technology. For example, in South Africa, Vodacom launched its 5G network in South Africa back in May 2020 in three major cities. Vodacom's 5G launch used the 3.5 GHz band issued by the South African regulator. Safaricom in Kenya then launched its 5G network trial in April 2021. More recently, Nigeria's regulator has completed its 3.5 GHz band auction with MTN and Mafab having won the license.

Regulation and Spectrum Snapshot in Africa

Of the 54 countries in Africa, only a few have initiated their spectrum auctions. These countries represent the frontrunners for 5G adoption. South Africa will be awarding its 5G spectrum bands to the South African MNOs in an auction held in March 2022. The South African regulator initially allocated additional spectrum to its operators to cope with the increasing demand created by COVID-19. Nigeria also recently allocated its 3.5 GHz band to MTN and Mafab, and the country's government is expecting to have the widest 5G coverage in the region by the end of 2022.

CHART 3: EXPECTED SPECTRUM ALLOCATIONS, OUT OF 54 COUNTRIES IN AFRICA



(Source: ABI Research)

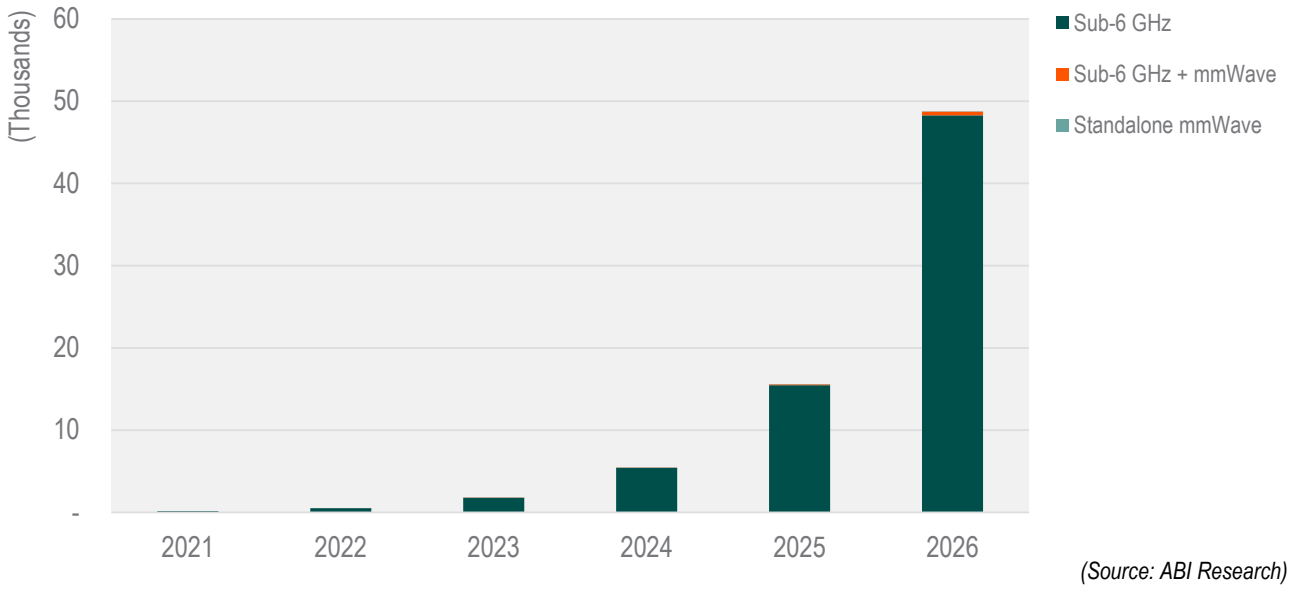
In terms of the expected 5G spectrum allocation from regulators to MNOs, Africa will see a total of eight to nine countries with mid-band allocation (e.g., in the 3.5 GHz band) by 2025. On the other hand, mmWave allocation in Africa has been very limited (Kenya and Zambia) and focused primarily on the 26 GHz band. By 2025, it is expected that less than 20% of all African countries will have 5G spectrum allocated to MNOs.

5G Cell Sites Roll Out in Africa

5G cell site buildout in Africa will only pick up in the 2025 to 2030 time frame. This is largely due to the limited number of countries adopting 5G in the region and the fact that 4G/LTE handset pricing is affordable, given the disposable income constraints in many countries in Africa. A similar viewpoint can be identified in a GSMA report[1] where MNOs are recommended to optimize their existing network infrastructure:

- "Before investing in 5G it is crucial (that) existing networks are optimized – 5G initially runs alongside LTE-A networks in non-standalone mode."
- "4G will continue to play key role in mobile networks as 2G and 3G are phased out and 5G introduced."

CHART 4: DEPLOYMENT OF 5G CELL SITES BY SPECTRUM, AFRICA: 2021 TO 2027



(Source: ABI Research)

Even by 2026, it is expected that sub-6 GHz 5G cell sites will still make up 99% of total 5G cell sites in Africa. Cell sites capable of both sub-6 GHz and mmWave will make up about 1% of 5G cell sites, with the majority in dense urban or urban areas. Standalone mmWave 5G cell sites (i.e., likely to be small cells in Central Business District (CBD) areas) will be extremely rare and limited, making up less than 1% of total 5G cell sites in Africa.

To date, the focus of MNOs in Africa has not been on 5G rollouts; for example, Airtel Kenya signed a 3-year deal (until May 2023) with Nokia to modernize its existing 2G, 3G, and 4G cell sites with high-speed 4G and lay the groundwork for future 5G migration. At the end of 2021, Safaricom had deployed around 200 5G cell sites. Safaricom's 4G cell site deployments have grown to 5,000.

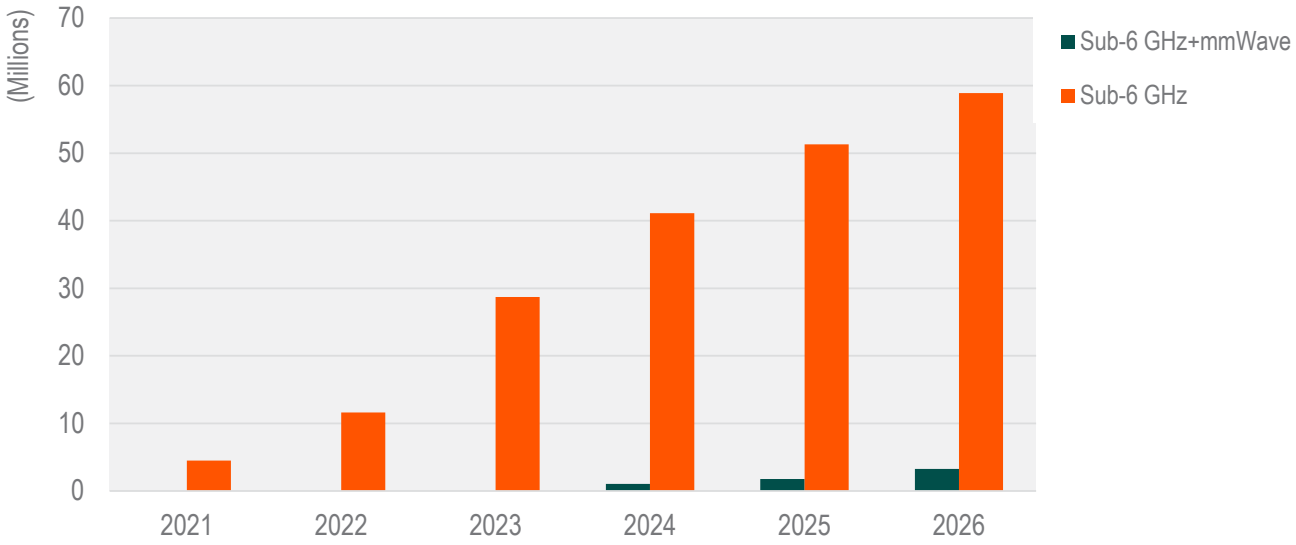
5G Mobile Cellular Devices Outlook

The availability of devices is one key indicator of adoption for 5G. As of this writing, in March, there is a limited number of five mobile devices that supports mmWave capabilities. Major brands, such as Infinix, Tecno, Samsung, Oppo, and Xiaomi, have released their 5G-capable mobile devices with sub-6 GHz support only.

[1] GSMA's SSA 5G Spectrum Building a Roadmap for Success Roundtable presentation (August 2021)

By 2026, it is expected that sub-6 GHz-capable 5G handsets will reach 3.2 million units shipped, representing about 5.6% of the total 5G capable handsets sold into the African market. 5G handsets capable of mmWave are not expected to gain mass traction during the forecast period.

CHART 5: 5G HANDSET SHIPMENTS BY TECHNOLOGY, AFRICA: 2021 TO 2026



(Source: ABI Research)

For the Africa region, the majority of the handsets will remain 3G- or 4G/LTE-capable over the forecast period. It is unlikely that consumers in Africa will jump ahead to purchase a 5G mmWave-capable handset until clear indication of the following:

- MNOs commit to build out 5G mmWave networks with a significant level of population coverage (e.g., urban and dense urban areas).
- Availability of affordable 5G mmWave-capable handsets.

Key Research Takeaways

- 3G and 4G mobile network coverage takes center stage in Africa. While the urban areas are covered by 4G, the rural areas are covered mainly by 3G.
- African MNOs need to optimize their investment into mobile network rollouts considering the financial returns they could obtain. The low ARPU (US$2 to US$6 per month in many markets) indicates the tight fiscal constraints MNOs face in supporting the rollout and upgrade of telco infrastructure.
- Africa is expected to focus on 4G/LTE over 5G during the next few years to better optimize its investment in mobile networks and match market demands.
- The majority of spectrum activities in Africa center around the sub-6 GHz bands. What mmWave activities there are, focus on the 26 GHz band.
- By 2026, it is expected that 99% of total 5G cell sites will be carrying sub-6 GHz bands and most of the remaining 1% will be in conjunction with mmWave.
- Given the disposable income pressures in Africa, end users are likely to prefer more affordable sub-6 GHz band handsets compared to 5G handsets capable of mmWave.

ROLE OF SATELLITE COMMUNICATIONS IN AFRICA

Africa has a landmass of 30 million Square Kilometers (km2), the second largest in the world. Populations are often dispersed throughout the geography and small towns line up along the major trade routes between and within countries. Africa has a population density of about 47 people per km2 of land area, based on World Bank Data, way below South Asia (389.2 people per km2) or the European Union (111.9 people per km2), despite it being the second most populated region. There are, therefore, significant challenges providing telecommunication services to every community. Even in smaller towns on the periphery of cities, access to broadband services via fixed and mobile cellular coverage is poor or intermittent.

Introduction to Satcom

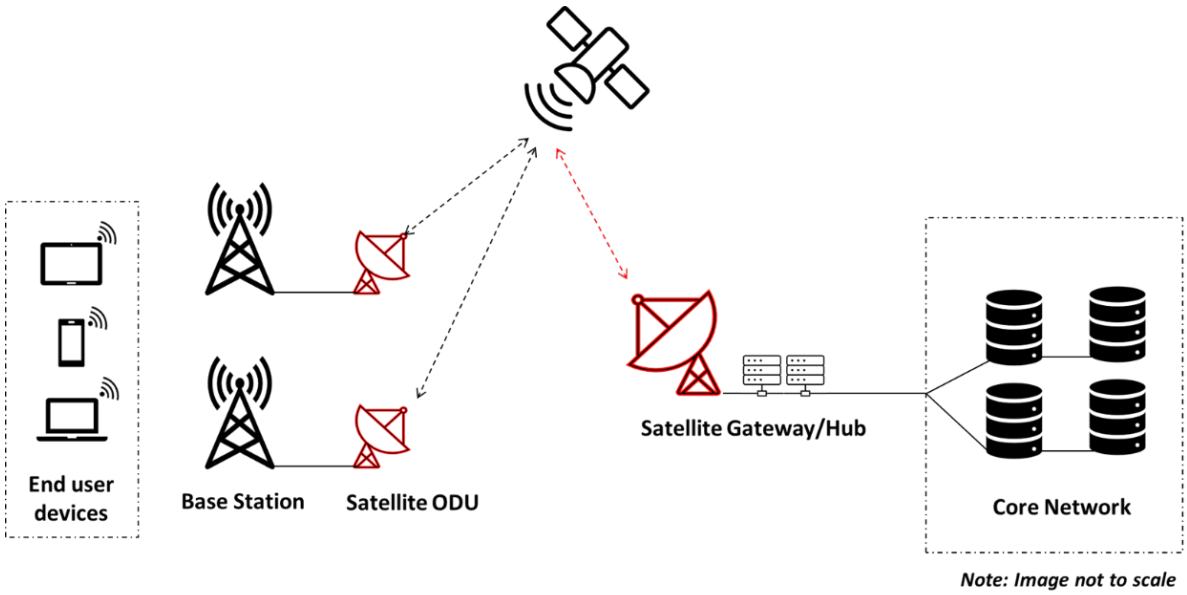
Over the past 5 to 7 years, upgrades in satellite bandwidth, more sensitive antennas, and lower costs of terminal production have now repositioned satellite as an attractive solution for deployment in a number of use case scenarios in Africa. Therefore, satellite communications play an important role in providing the essential connectivity for people living without access or limited access to terrestrial networks. It also plays a role in enabling enterprises and industries with connectivity to help bolster and tap into digitalization transformation. For example, Vodacom DRC harnessed satellite communication services to improve connectivity for the estimated 100 million customers living in areas that are underserved or unserved by reliable mobile cellular coverage.

Case Studies

Providing High-Capacity Backhaul for Terrestrial Networks

Often in remote and rural regions, terrestrial networks struggle to deploy optimal coverage and capacity. This stems from the business and economic considerations of deploying backhaul infrastructure with less optimal revenue and returns. Such challenges can be resolved by tapping onto satellite communication services for cost-effective and high-capacity backhaul.

FIGURE 1: SATELLITE BACKHAUL FOR TERRESTRIAL NETWORKS



(Source: ABI Research)

Use in Industries—Broadcasting and Streaming Services

SES and InterSAT helped Next Media Services deliver broadcasting and streaming services for the public. In the remote regions of East Africa, broadcasting crews often face challenges in delivering news coverage fast and in real time due to lack of connectivity. These can be resolved with the support of satellite connectivity, enabling the delivery of content to audiences.

Use in Industries—Agriculture

Lentera Africa is a technology company in the agricultural industry. Tapping into the capabilities of SES and InterSAT for high-throughput and fast Internet speeds, Lentera Africa was able to constantly obtain information from the farm to make critical decisions and improve farm productivity. Weather patterns have become increasingly unpredictable as the world experiences the impacts brought by climate change. Satellite connectivity also allows farms to access accurate and updated weather information to protect farms from being damaged by drastic impacts from uncertain weather conditions.

Use in Industries—Mining and Oil & Gas

Mines are often located far in remote areas of a country where terrestrial telecommunication infrastructure is not available. This is a huge challenge for the mining company needing accurate and effective communication between sites and the main office, which are crucial for their operation. SatADSL, a satellite communication provider, was tasked with supplying a mining company with reliable and easy to deploy satellite communications solutions.

FIGURE 2: USING SATELLITE COMMUNICATIONS IN THE OIL & GAS INDUSTRY

Oil & gas rigs have to rely on satellite communications for critical connectivity. Communications and operational monitoring on an oil rig are important to ensure efficiency and safety for both personnel and the environment. Using satellite communications, critical data can be exchanged with onshore specialists to detect any areas of concerns. Furthermore, remote e-health services can be provided to the crews onboard the rigs.

Satellite Communications: Integral Part of 3GPP Ecosystem

There has been significant headway in including satellite communications within the telecommunications 3GPP 5G standards process and ecosystem, as part of 3GPP's efforts in facilitating a plurality of network connectivity solutions to cater to the diverse applications that "5G" aims to achieve. Satellite communication brings forward distinct strengths in providing:

- **Service Ubiquity:** Broadband anywhere, anytime
- **Service Mobility:** Broadband to serve all mobility requirements via Earth Stations in Motion (ESIM) (by air, sea, and land)
- **Simultaneous Multicast:** Ensuring global connectivity across multiple use cases

3GPP Release 14, which studied the roles and benefits of satellites in 5G, has led to further development within the standards organization. 3GPP has explored the potential of satellite communications' integration within the wider ecosystem of wireless infrastructure in TR 22.822 and identified notable satellite use cases for 5G, between 5G New Radio (NR) and 5G Core, 5G Mobile-Access Edge Compute (MEC), and extending network coverage of 5G NR. This has led to the latest development, with input on satellites from Non-Terrestrial Network (NTN) groups included in the upcoming Release 17.

Today, satellite-enabled broadband bridges the digital divide, connecting the unconnected in underserved and unserved areas across the world with affordable connectivity that would not be available otherwise. These broadband services are made possible globally because of the harmonization of the spectrum used for the networks and devices through the ITU's International Table of Frequency Allocations, known as the ITU Radio Regulations. For example, the ITU Radio Regulations globally validate and harmonize the availability of the 27.5-31 GHz (Earth-to-space) and 17.7-21.2 GHz (space-to-Earth) bands for satellite broadband services to end users.

This international harmonization of bands allows countries to enjoy the benefits of the international consensus and harmonization of the spectrum, while ensuring domestic availability of advanced satellite broadband services through small, easy to install satellite terminals. The 26 GHz band was globally harmonized for International Mobile Telecommunications (IMT) use at the ITU World Radiocommunication Conference 2019 (WRC-19). Meanwhile, the 28 GHz band has not been identified for IMT use by the ITU and has been widely protected for satellite use, including ESIM, at WRC-15 and WRC-19.

Terrestrial VSAT Applications and the IoT

Very Small Aperture Terminal (VSAT) is a small-sized Earth station terminal used in two-way communications with a satellite. VSAT is widely used to deploy and support connectivity in remote locations for both enterprise and consumer applications. It is also a key piece of equipment to provide connectivity for the maritime industry and ensure safety of navigation. With its portability and relatively smaller size, the VSAT is also suitable to provide end users consistent and reliable support. Additionally, VSAT with its relatively low-cost terminals are crucial in providing affordable broadband.

Satellite communication is not for all Internet of Things (IoT) applications; however, there are IoT applications that could not be supported by terrestrial cellular networks. These include shipping, trucking, airlines, and agricultural and environmental monitoring, which are better served by satellite communications.

Satellite communications plays an important role where terrestrial infrastructure is missing and where it is easier to use satellite communication instead. Using haulage as an example, satellite communication has the advantage of wide coverage. When traveling cross borders, supported by satellite communications, there will not be a need to pay two or more telco carrier roaming fees for coverage. This makes satellite communication a better option for cost-effective and reliable connectivity solution.

Agriculture is an essential economic sector in Africa, with the increase of cultivated yields always a goal for the farmers. The IoT can be used for precision farming and the information and data needed for agriculture can be collected via satellite IoT links. Satellite IoT sensors can monitor water level, temperature, soil condition, and several other parameters.

Earth Stations In Motion Applications

ESIMs communicate with Geostationary-Satellite Orbit (GSO) systems. There are at least three types of ESIMs that exists in the aeronautical industry, maritime industry, and on-land vehicles industry. ESIM is an application of the Fixed Satellite Service (FSS) and can use mmWave frequencies in the Ka-band: 17.7–20.2 GHz (space-to-Earth) and 27.5–31 GHz (Earth-to-Space). At WRC-23, the member states will meet to further consider harmonized frequency arrangements in the Ka-band for ESIMs using Non-GSO (NGSO) systems.

Aeronautical ESIM

In 2019, the region witnessed approximately 155 million passengers travel to, from, and within Africa, according to the International Air Transport Association (IATA). While COVID-19 greatly reduced that number, the IATA expects the region to see recovery by 2025. The Boeing Company, in its 2021 Africa Commercial Market Outlook, projected that airlines in Africa will continue growing their fleets by 3.6% per year as they cope with increasing passenger traffic demand. Boeing projected that it would have a total of 1,030 commercial airplanes delivered by 2040.

With ESIMs, passengers, crews, and businesses can tap into the in-flight connectivity to stay updated. For the pilots and crews, the latest information on the weather and climate could help the pilots navigate the flight more smoothly. Additionally, data connectivity for work and entertainment is also increasingly demanded by airline passengers.

Maritime ESIM

The maritime industry is the backbone of the global trade system, accounting for about 80% of the transport of the world's goods. Today's mariners use technologies like as radio, radar, and other electronic and satellite navigation systems for accurate information and to achieve safe navigation. Connectivity and communications are key to ensuring the safety of the seas, which is one of the United Nations Sustainable Development Goals (SDGs). While Africa contributes 7% and 5% of maritime exports and imports by volume, initiatives like the African Continental Free Trade Area (AfCFTA) could drive up volume.

ESIMs provide broadband communications on cruise ships, the largest of which can accommodate several thousand passengers. In addition, ESIM stations can provide broadband communications for managing ship operations, such as for transmission of engine diagnostics, as well as for access to the corporate network and for crew communications. With more than 80,00 merchant, cruise, and government vessels on the seas at any time, there is a need for connectivity to enable safe navigation. Additionally, according to a United Nations Conference on Trade and Development (UNCTAD) report, the global commercial fleet grew from 89,000 vessels in 2015 to almost 100,000 vessels in 2021. This strong growth has created greater demand for connectivity and spectrum for ESIM.

Land Vehicle ESIM

Land vehicles traveling across the African continental would benefit from connectivity as well. Road and weather conditions could be provided to drivers to help them better navigate or prepare for harsh weather conditions. The future of connected cars will also require ubiquitous coverage throughout the region. Connectivity is the bedrock to enabling connected cars, especially in areas where terrestrial networks are absent.

While Africa's railway network has been underinvested, they provide vital supply and passenger links that crisscross the continent. In an African Development Bank Group's report[2] , the policy group believes that developing railways and high-capacity freight corridors are essential to boosting African intraregional trade. Therefore, there is a need to meet demands for connectivity from railway moving within and between countries.

Key Research Takeaways

- Africa benefits from satellite communications as an additional communication "tool" in each country's communications toolbox to enable connectivity for both consumers and enterprises.
- Satellite is being used in many industries, such as agriculture, mining, and construction, aside from being a connectivity provider.
- Satellite communications will be part of the 3GGP's Release 17 and remain an integral part of the ecosystem.
- Some of the key technologies and applications for Satcom include the use of VSAT, Satcom in the IoT, and ESIM for connecting maritime, land, aeronautical transport, and logistics.
- ESIMs (land, sea, or air) are crucial in supporting many various critical industries for the global trade and economic system.

[2] Rail Infrastructure in Africa Financing Policy Options, African Development Bank Group

RECOMMENDATIONS

Importance of Enhanced Broadband Services in Africa

Broadband services and connectivity are paramount to economic growth. In a 2019 ITU report, Economic Contribution of Broadband, Digitization and ICT Regulation, a crucial finding was that an increase of 10% in mobile broadband penetration in Africa would yield an increase in 2.5% in Gross Domestic Product (GDP) per capita. The benefits of a more connected society have created downstream effects on the digital proficiencies and subsequent mobile data consumption behavior of citizens. There is still great potential for Africa and its countries to benefit from broadband and connectivity.

Role of Satellite Communications and Its Growing Contribution to Broadband

For the underserved and unconnected population in Africa, alternative solutions are required for connectivity. Satellite communications is increasingly sought after to address coverage and connectivity needs. Ultra-High Throughout (UHT) satellite broadband can be made available via residential VSAT user terminals and satellite-powered solutions to provide Wi-Fi to individual users. UHT satellites can also serve as satellite-powered 5G, unleashing high-speed mobile broadband beyond urban centers, or where there is no fiber network . For example, Orange announced in March 2022 that it will use a satellite communications partner to plug coverage gaps in its African markets.

Agile broadband solutions are needed to match the surge in broadband demands from the population. This is especially crucial for underserved rural regions that would not have sufficient network resources to accommodate the healthcare and education needs of citizens. The current global pandemic is a key example of the need to secure broadband to continue providing services when demand shifts from urban to suburban areas and beyond. Operators and regulators need a diverse range of connectivity solutions to provide inclusive broadband connectivity and ensure digital resiliency.

Role of Sub-6 GHz Bands

The sub-6 GHz bands have several characteristics that make the spectrum invaluable for mobile networks. Sub-6 GHz can deliver both "capacity" (e.g., 500 MHz channels in the 3.5 GHz band, for example) and "best-in-class propagation" distance (e.g., sub-1 GHz). The sub-6 GHz is, therefore, a versatile and invaluable block of spectrum for rolling out 5G without overspending to achieve optimal coverage and capacity.

Additionally, at the upcoming WRC-23, frequency bands up to the 6 GHz bands are part of spectrum roadmap and take the main stage for IMT. These can be seen in WRC-23 agenda Items 1.1, 1.2, 1.3, and 1.5. For the full details, please refer to Annex A at the end of the report. These highlight the near-term objectives of terrestrial networks.

Role of mmWave

mmWave spectrum, for example, 27.5 GHz–31 GHz can support high data rates. However, mmWave bands for terrestrial communications, such as 5G, are very limited in terms of propagation and the distance these bands can travel, typically in the order of 100 Meters (m) to 200 m. Therefore, mmWave for terrestrial mobile communications is often unable to provide connectivity beyond localized and indoor settings. This constrains terrestrial uses of mmWave to short distance links and hot spot deployments (e.g., within a stadium or shopping mall).

In contrast, satellite use of mmWave bands is not constrained by propagation, as communications from space benefit from unobstructed free-space propagation. Satellites also provides a much greater area coverage. For example, only three UHTS geostationary satellites are needed to provide global coverage for ubiquitous connectivity across land, sea, and air. Therefore, global spectrum allocations for satellite (such as the Ka-band uplink in 27.5-31 GHz, also known as "28 GHz band") have been harmonized across regions for satellite communications to benefit users.

26 GHz for Cellular, 28 GHz for Satellite

The global attitude toward the 28 GHz can be seen from the Radio Spectrum Policy Group (RSPG) and the CEPT Roadmap for 5G, in which they identify the 28 GHz frequency band as an essential one for satellite-based mobility services (e.g., ESIMs) and not for 5G networks. The 26 GHz, on the other hand, is more suitable for 5G networks. The 26 GHz band has 3.25 GHz of spectrum for 5G networks to realize the enhanced benefits of a modern 5G network. Overall, there has already been a substantial allocation of spectrum (a total of 17.25 GHz assigned for IMT in WRC-19) that has already been assigned for terrestrial 5G. The 5G spectrum allocation, 5G chipset/handset, 5G cell site, and research conducted in this report demonstrate a clear momentum for sub-6 GHz bands and movement toward the 26 GHz band for 5G terrestrial in Africa.

Additionally, the European Union (EU) also has a new plan for launching satellite communications in 2023. The satellite communication plan amounts to US$6.8 billion and seeks to improve the security and resilience of the communication networks, including the African region. "Our new connectivity infrastructure will deliver high-speed internet access, serve as a back-up to our current internet infrastructure, increase our resilience and cyber security, and provide connectivity to the whole of Europe and Africa," said Thierry Breton, EU Commissioner for the Internal Market.

Key Research Takeaways

- Increases in broadband penetration increase GDP growth, and African economies can benefit from better connectivity.
- Satellite communications is another essential communication tool in a country's communication toolbox to deliver better and more extensive connectivity for its citizens and businesses.
- The properties of spectrum assets make them suitable for certain use cases and thus their role in the arsenal of spectrum holders. There are distinctive roles for sub-6 GHz and mmWave for terrestrial MNOs, as much as mmWave has done for the satellite communication industry.
- Africa will be set to benefit from affordable UHT satellite technology in the 28 GHz band for the delivery of quality broadband to the entire continent and closing the digital divide across rural and urban areas.
- UHT satellites using the 28 GHz band is an ideal form of communication to provide ubiquitous broadband connectivity across land, sea, and air with a cost-effective infrastructure.

ANNEX A

- **Item 1.1:** To consider the frequencies 4,800–4,990 MHz as a good option for supplementary mobile spectrum and support the development of this band for IMT.

- **Item 1.2:** To consider the identification for IMT of the following frequency bands: 3,300–3,400 MHz (sub-Reg.1 & Reg.2), 3,600–3,800 MHz (Reg.2 - Americas), 6,425–7,025 MHz (Reg.1), 7,025–7,125 MHz (globally) and 10.0–10.5 GHz (Reg.2) – Res.245 (WRC-19).

- **Item 1.3:** To consider a primary allocation of the band 3,600–3,800 MHz to the mobile service within Region 1 (Europe, Africa, the former Soviet Union, Mongolia, and the Middle East west of the Persian Gulf, including Iraq) – Res.246 (WRC-19).

- **Item 1.4:** To consider use of High-Altitude Platform Stations (HIBSs) as IMT base stations in the mobile service in some bands below 2.7 GHz. In particular, these bands are as follows:

  - 694–960 MHz
  - 1,710–1,885 MHz (1,710–1,815 MHz for uplink only in Region 3 (Asia east of and including Iran, and most of Oceania))
  - 2,500–2,690 MHz (2,500–2,535 MHz for uplink only in Region 3 except 2,655–2,690 MHz in Region 3)

RELATED RESEARCH

AN-5464	LEO Satellite Constellations and Broadband Access Implications
WP-WNGH-188	Satellite Communications: Enabling Universal Broadband Connectivity
AN-5213	Satellite Services in IoT: How the Use of Satellite Has Evolved for IoT
AN-5211	Satellite in IoT: New Satellite Networks for New Wave of IoT Investment
MD-STB-174	Set-Top Box and Broadband CPE

GLOSSARY

WORD	DESCRIPTION
2G	Second Generation Cellular Network
3G	Third Generation Cellular Network
3GPP	3rd Generation Partnership Project
4G	Fourth Generation Cellular Network
5G	Fifth Generation Cellular Network
AfCFTA	African Continental Free Trade Area
ARPU	Average Revenue Per User
CAPEX	Capital Expenditure
CEPT	The European Conference of Postal and Telecommunications Administrations (CEPT) is an organization of policy makers and regulators from 48 countries across Europe
CPE	Consumer Premise Equipment
DSL	Digital Subscriber Line
ESIM	Earth Stations in Motion
FSS	Fixed Service Satellite
GDP	Gross Domestic Product
GNI	Gross National Income
GSA	Global Mobile Suppliers Association
GSMA	GSM Association
HTS	High Throughput Satellite
IATA	International Air Transport Association
IMF	International Monetary Fund
IoT	Internet of Things
ITU	International Telecommunication Union
LTE	Long Term Evolution
LTE-Advanced	Long Term Evolution - Advanced
MEC	Multi-access Edge Computing
MNO	Mobile Network Operator
mmWave	Millimeter wave - frequency band
NGSO	Non-geostationary orbit
NSA	Non-Standalone Architecture- 5G network mode with 4G Core Network
NTN	Non-terrestial Network - refers to satellite and high-altitude platform systems (HAPS) among others
RSPG	Radio Spectrum Policy Group - an advisory group for European Commision on related radio spectrum matters
SA	Standalone Architecture - 5G network mode with 5G Core Network
UNCTAD	United Nations Conference on Trade and Development
UHTS	Ultra-High Throughput Satellite
VSAT	Very Small Aperture Satellite
WRC-19	2019 World Radiocommunication Conference - an event by ITU
WRC-23	2023 World Radiocommunication Conference - an event by ITU

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