Ad hoc Technical Working Group on Non-Geostationary Satellite Orbit (NGSO) Services in West African Countries

WATRA NGSO Framework

Bamako, Mali, June 2024

Reference: WATRA/WG/NGSO/2024/001

Contents

1 Introduction

1.1 Background

The introduction of new Non-Geostationary Satellite Orbits (NGSO) services has resulted in some WATRA Member States being confronted with the challenge of regulating their operations. Some Member States, however, have licensed these NGSO services within their jurisdiction. Other Member States are witnessing the unauthorized usage of these NGSO services within their territories. Among the issues arising from the introduction of NGSO services in Member States are:

a. The issue of security posed by the transborder nature of the NGSO coverage and its infringement on the territorial integrity of some members as a result of the usage of these unlicensed services.
b. The potential economic losses suffered by members due to the transborder coverage of NGSO services and the need for protection of investments in the territories of Member States.
c. The need to protect the sector investments, preservation of jobs in the sector, impact on the income of licensed operators, etc.
d. The opportunities and benefits provided by this technology and ways to maximize the deployment of these services.
e. The need to come up with recommendations for the regulation of NGSO services to ensure a stable and attractive market for the benefit of all actors.

In view of the above challenges, the 21st Annual General Meeting in Freetown, Sierra Leone, through Resolution AGM21/CR/24/R06, approved the establishment of an Ad hoc Technical Working Group to critically address the operational issues of NGSO services in the sub-region and advise the Assembly accordingly.

The Ad hoc Technical Working Group is mandated to look into the operations of NGSO services and make appropriate recommendations for the optimal use and development of these services in the sector. The Ad hoc Group serves as a platform for discussions, exchange of ideas and coordination between WATRA members and other key stakeholders and will also play an advisory role to the Conference of Regulators and the Executive Committee on the regulatory issues arising out of the operations of NGSO services in West African countries.

1.2 Project Definition, Scope and Purpose

a. Assess the operations of NGSO services within Member States and other countries in which similar services are in operation.
b. Analyse all the issues in relation with the introduction of NGSO services in WATRA Member States.
c. Identify gaps and areas of improvements in the use of NGSO kits in WATRA Members States.
d. Explore experiences of countries and organization within and outside Africa such as CRASA, FRATEL, CTO, ATU, ITU, etc.
e. Submit recommendations to regulate the use of NGSO services.

1.3 Introduction to Non-Geostationary Satellite Orbit

Non-Geostationary Orbit (NGSO) refers to a type of orbit used by satellites in which the satellite is not stationary relative to the surface of the Earth.

The ITU Radio Regulations describes and defines satellite orbits and systems as follows:

i. **No 1.188** defines a geosynchronous satellite as an earth satellite whose period of revolution is equal to the period of rotation of the Earth about its axis.
ii. **No 1.189** defines a geostationary satellite as a geosynchronous satellite whose circular and direct orbit lies in the plane of the Earth's equator and which thus remains fixed relative to the Earth; by extension, a geosynchronous satellite which remains approximately fixed relative to the Earth (WRC-03).
iii. **No 1.190** defines a geostationary-satellite orbit; the orbit of a geosynchronous satellite whose circular and direct orbit lies in the plane of the Earth's equator.

There are two satellite orbits whose operations are not stationary relative to the surface of the Earth. These are:

- **LEO** - Low Earth Orbit
- **MEO** - Medium Earth Orbit

Figure 1: Illustration of LEO, MEO and GEO Satellite Systems

(Source: Eutelsat OneWeb)

2 NGSO Services Operating in West Africa

2.1 Operations of OneWeb

2.1.1 About Eutelsat OneWeb

Eutelsat OneWeb is part of the Eutelsat Group, the world's first integrated GEO-LEO satellite communications operator, transforming space communications.

OneWeb's satellite deployment initiative began in earnest with its partnership with Airbus in 2015 to manufacture satellites. The company aimed to create a vast constellation of LEO satellites to provide global broadband coverage. In 2019, OneWeb launched its first six satellites as part of its initial deployment phase, marking a significant milestone in its mission. OneWeb resumed satellite launches in 2021 with a renewed focus on expanding its constellation. OneWeb continues to deploy satellites to further its goal of bridging the digital divide and providing internet access to underserved communities worldwide.

OneWeb plans to deploy a large constellation of LEO satellites. These satellites orbit the Earth at altitudes ranging from around 1,200 km to 1,300 km, much closer to the Earth than traditional geostationary satellites. This proximity helps reduce latency and improve the responsiveness of the internet connection. The OneWeb satellite constellation is designed to provide global coverage, reaching even remote and underserved areas where terrestrial infrastructure is limited or nonexistent. By deploying a large number of satellites in a constellation, OneWeb aims to ensure continuous coverage and redundancy.

The OneWeb satellite network is designed to be highly interconnected, with satellites communicating with each other as well as with ground stations and user terminals. This interconnectedness helps optimize the routing of data and improve the efficiency of the network. Users connect to the OneWeb satellite internet service via user terminals, which consist of a small satellite dish or antenna installed at their location. These terminals communicate with the nearest satellites overhead to send and receive data.

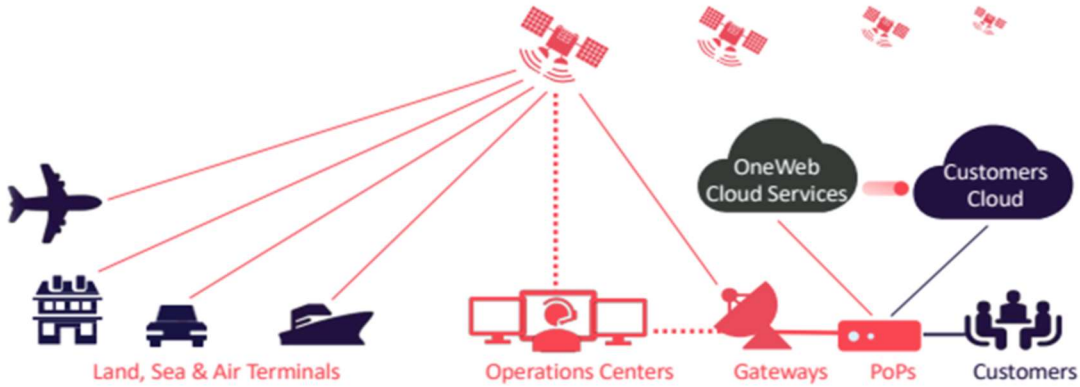

Figure 2: OneWeb Network Architecture

When a user sends a request for data, such as accessing a website or streaming video, the request is transmitted from the user terminal to the nearest OneWeb satellite. The satellite then relays the request to other satellites in the constellation or directly to a ground station.

Ground stations serve as gateways between the satellite network and the internet backbone. They receive data from the satellites and route it to its destination on the internet, and they also transmit data from the internet to the satellites for relay to user terminals. OneWeb's satellite constellation offers several advantages over traditional satellite internet systems, including lower latency due to the closer proximity of the satellites to the Earth, higher data transfer speeds, and global coverage. These advantages make it particularly well-suited for providing internet access to remote and underserved areas.

OneWeb has been deploying its satellite constellation in phases as shown in the Figure 3 below, with plans to eventually have thousands of satellites in orbit. As the constellation grows, OneWeb aims to further improve the speed, reliability, and accessibility of its satellite internet service.

Figures 4 and 5 show OneWeb's Gateway in Ghana and their Satellite Network respectively

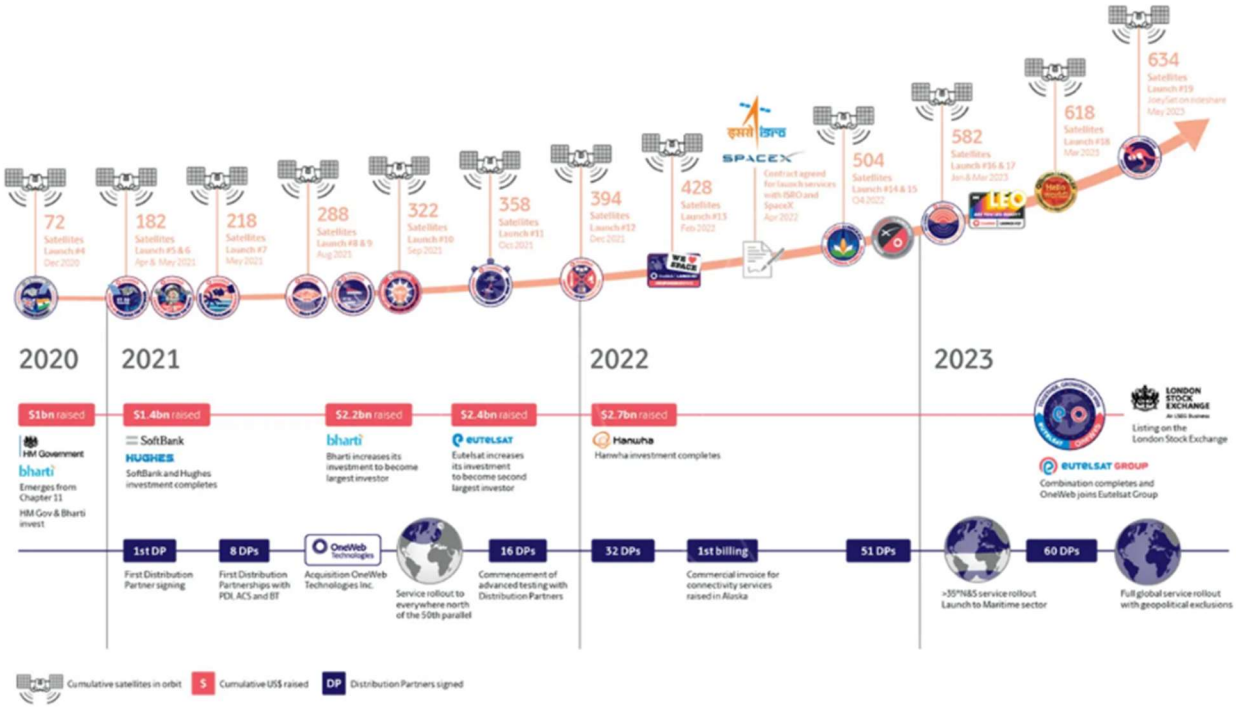

Figure 3: OneWeb's Satellite Constellation Roll Out (Source: https://oneweb.net/about-us/our-story)

Figure 4: OneWeb's Gateway in Ghana

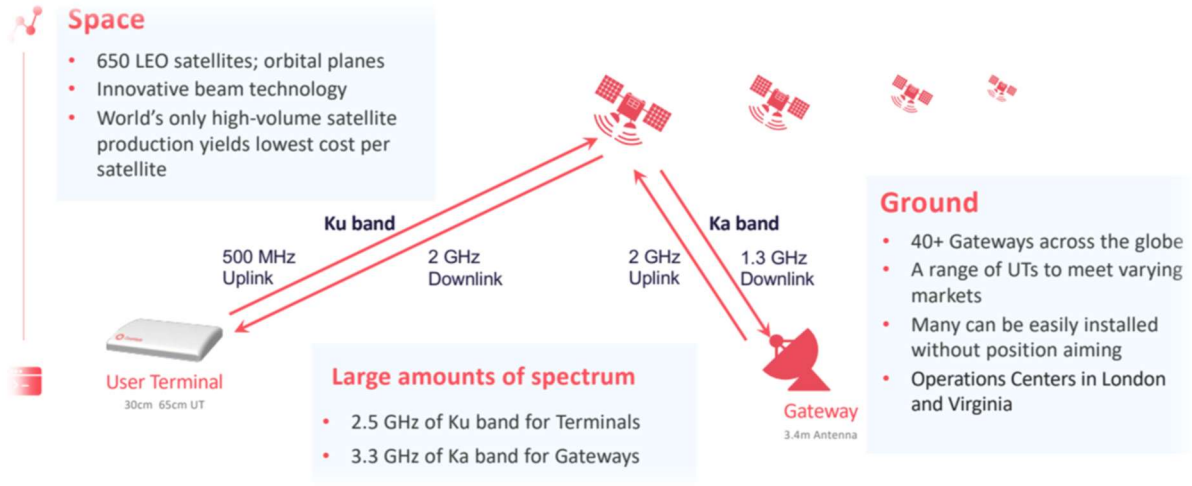

Figure 5: OneWeb's Satellite Network

2.2 Operations of Starlink

2.2.1 About SpaceX and Starlink

SpaceX was founded in 2002 with the vision of making humanity an interplanetary species. For over 20 years, it has provided reliable and affordable launch services to space agencies, satellite manufacturers, and operators from around the world with its family of launch vehicles. Having become the world's largest launch services provider, SpaceX is now using its engineering and manufacturing prowess, along with its launch capacity, to design, deploy and operate Starlink, a LEO satellite broadband communications constellation comprised of over 5,000 satellites working in unison.

Unlike traditional satellite internet services, Starlink provides fiber-like connectivity with speeds averaging 120 Mbps download and 30 Mbps upload. By operating at 550 km above the surface of the planet, Starlink provides low latency connectivity (<30 ms) that enables video calls, streaming, and other high data rate activities. With latencies that are comparable to terrestrial connections, even online gaming can be enjoyed on the Starlink network. Most importantly, however, because the constellation forms a shell encompassing the entire planet, this connectivity can be made available to nearly every location on earth, even over oceans and as far north and south as the polar ice caps. For the first time in history, broadband internet can be available with parity whether a user is on a remote island in the South Pacific, across the expanses of Africa, or in any major city around the world.

To connect to the Starlink network, customers will use a SpaceX designed and manufactured phased array antenna called a Starlink User Terminal. This phased array technology is, for the first ever, being made affordably available and it is what enables the high throughput of the Starlink system. SpaceX has taken extreme care to ensure that the User Terminal was designed to be self-installable and require little to no maintenance. Once powered up, the User Terminal will automatically align itself with the Starlink constellation and within only minutes of unboxing the system, a customer can be connected to broadband internet.

Coupled with this revolutionary technology is a commercial model that offers Starlink services with complete transparency. There are no data caps, no fair use policies, no long-term contracts, no early termination fees, no hidden fees, no installation fees, and no cancellation charges. Should a customer not be satisfied with the quality of service they are receiving from Starlink, they simply stop paying and the service will be disconnected. This model has been adopted because it aligns the interests of the customer and SpaceX by placing the focus on provision of high-quality broadband internet.

2.2.2 Starlink Market

Since launching commercial services in October of 2020, Starlink has expanded to more than 90 markets and now has over 2,000,000 customers spanning every continent. Around the globe, communities have used Starlink to gain access to education and health services, enable remote work, and provide critical communications support during natural disasters. With Starlink, rural and remote classrooms have been able to reap the same educational benefits of those in urban areas. Hotels, restaurants, and other local employers have been empowered to provide the best possible internet to their guests. Digital nomads have been able to work and explore without being tethered to areas with fiber. And, when natural disasters have struck - such as in Tonga where a subsea volcanic eruption severed the only fiber optic cable connecting the island - Starlink was rapidly deployed and able to bring the country back online to support emergency responders and enable communication for those impacted.

Figures 6 and 7 depict the Starlink Community Gateway and Starlink Satellite Network respectively.

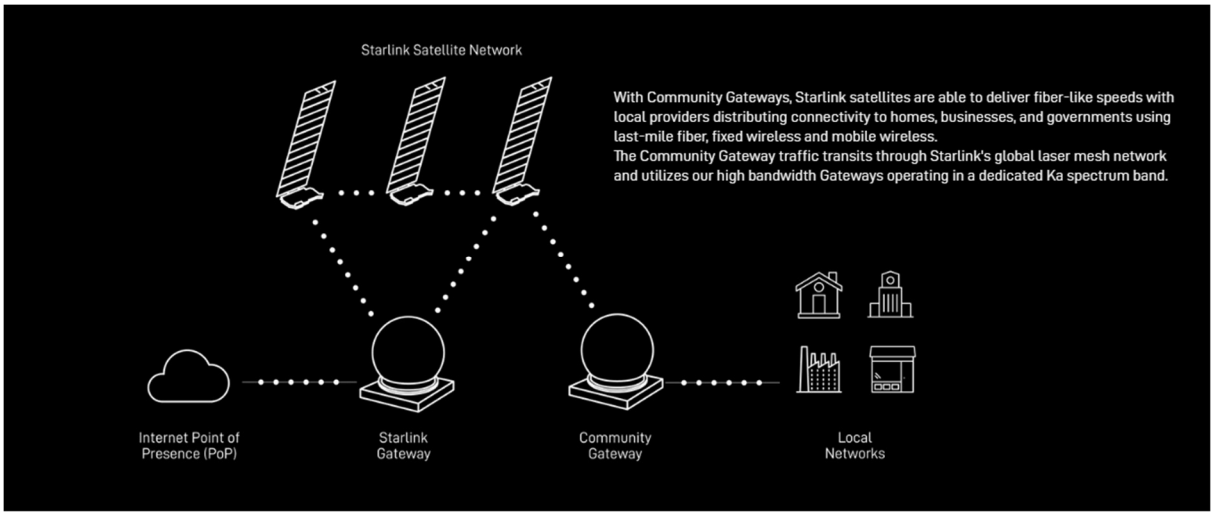

Figure 6: Starlink Community Gateway
(Source: https://www.starlinkinternet.info/community-gateway)

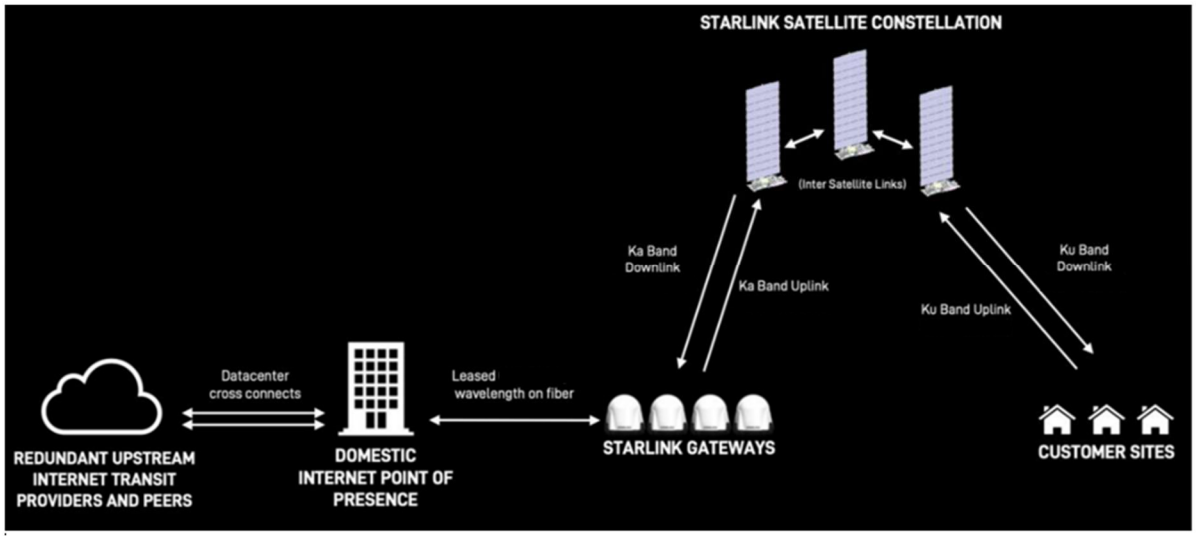

Figure 7: Starlink Satellite Network

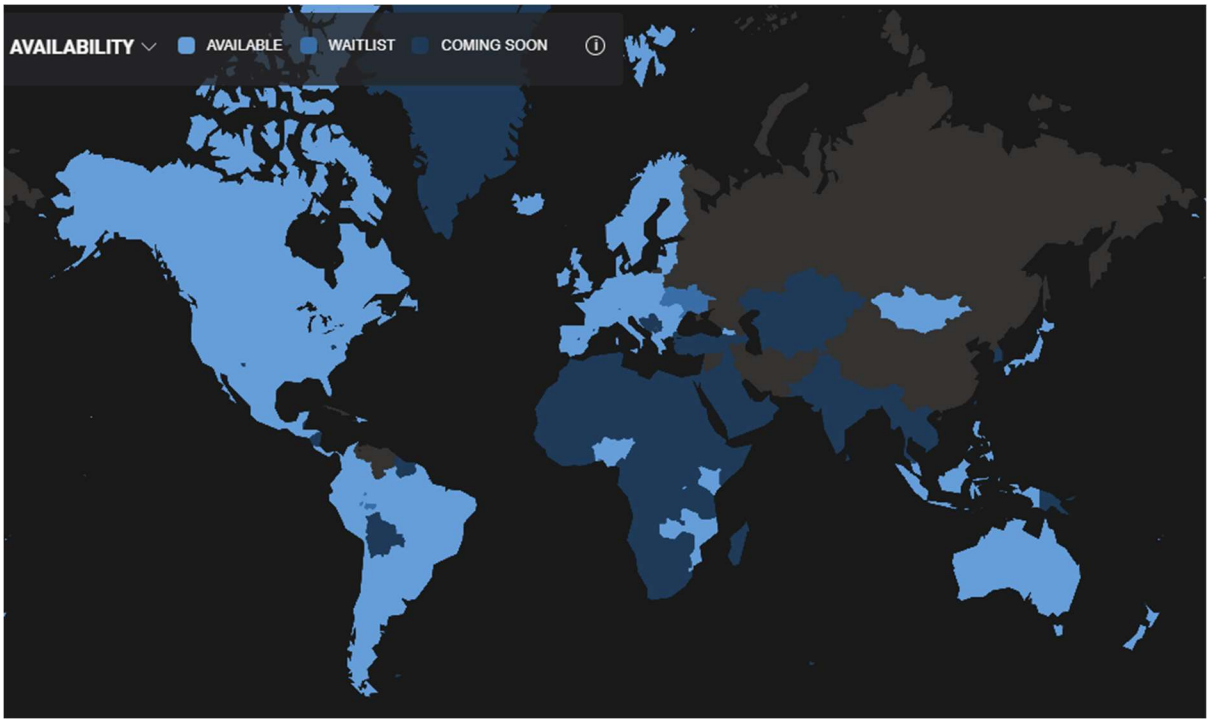

Figure 8: Starlink Availability Map
(Source: https://www.starlink.com/gh/map)

Figure 8 shows areas where Starlink is licensed to operate in the world. Starlink is currently operational in eight (8) countries in Africa, namely:

1. Eswatini
2. Kenya
3. Malawi
4. Mozambique
5. Nigeria
6. Rwanda
7. Sierra Leone
8. Zambia

Figure 9 is the picture of the Starlink Community Gateway on the Remote Island of Unalaska, Alaska, USA.

Figure 9: Starlink Community Gateway on the Remote Island of Unalaska, Alaska

2.3 Operations of E-Space

2.3.1 About E-Space

E-Space is an ESA (European Space Agency) project that focuses on Earth observation. It aims to enhance our understanding of our planet by collecting data from space-based sensors and satellites. These observations help monitor environmental changes, track climate patterns, and improve disaster management. E-Space contributes valuable insights for scientific research, policy-making, and sustainable development.

E-Space, an initiative by ESA provides valuable services to Africa through Earth observation. These services include:

a. Environmental Monitoring: E-Space helps track deforestation, land degradation, and water resources. It monitors ecosystems, wildlife habitats, and climate change impacts.
b. Agriculture and Food Security: By analyzing satellite data, E-Space assists in crop monitoring, yield prediction, and early warning systems for droughts or pests.

c. Disaster Management: E-Space aids in disaster response by assessing floods, wildfires, and other natural calamities. It provides real-time information to support relief efforts.
d. Urban Planning and Infrastructure: Satellite imagery helps plan sustainable cities, manage transportation networks, and monitor construction projects.
e. Health and Epidemic Control: E-Space contributes to disease surveillance, mapping disease vectors, and assessing health risks.

Overall, E-Space enhances Africa's resilience, development, and sustainable management of its resources.

Delivering Actionable Intelligence from Space: E-Space is developing novel satellite and terminal technology to provide Essential and Smart-IoT capabilities from basic messaging services up to voice, video and data for specialized applications. They plan to launch a few thousand satellites over the next few years to meet customer requirements across a wide range of industries.

E-Space, a startup led by Greg Wyler, aims to launch a constellation of 300,000 satellites into low Earth orbit. While the specifics of the upcoming mission remain undisclosed, E-Space has raised $50 million for test satellite launches in 2024. The company focuses on developing satellites with smaller cross-sections to reduce vulnerability to collisions and minimize debris generation. Their goal is to create a foundational platform for governments and large companies to build space-based applications in a capital-efficient manner.

Rwanda's backing of E-Space underscores its commitment to space sustainability and innovative satellite technology.

E-Space is an example of a next-generation low Earth orbit (NGSO) satellite system. It aims to enable hyper-scaled deployments of Internet of Things (IoT) solutions and services. Here are some key points about E-Space:

Company Overview:

- E-Space bridges Earth and space, fundamentally changing the design, economics, manufacturing, coverage limitations, and service delivery of space-powered IoT connectivity.
- Their advanced, sustainable LEO space infrastructure blurs the line between satellite and terrestrial communication networks.

- E-Space's goal is to create a new class of ubiquitous, real-time communication capabilities for end-users worldwide.

Feasibility Study with CNES:

- E-Space completed a five-month feasibility study commissioned by the French Space Agency, CNES (Centre National D'Etudes Spatiales).
- The study assessed and validated the technical capabilities of E-Space's satellite system, including the space platform, communication payload, guidance, navigation, and control (GNC), as well as the long-term viability of their business model.
- It also identified technical opportunities for future collaborations between CNES, E-Space, and the French space ecosystem.

Global LEO Constellation:

- E-Space plans to operationalize a global LEO constellation, investing in key regions, including France.
- By expanding regional presence and bringing on local talent, they aim to set the standard in designing, developing, manufacturing, and commercializing sustainable LEO systems.

In summary, E-Space exemplifies the NGSO trend by leveraging LEO satellites to enhance IoT connectivity and create innovative solutions for various applications on Earth.

2.4 Operations of Amazon

2.4.1 About Project Kuiper

Project Kuiper is Amazon's initiative to provide fast, affordable broadband to communities around the world that are currently unserved or underserved by traditional internet and communications options. To achieve this goal, Amazon will deploy thousands of satellites in low Earth orbit (LEO) linked to a global network of antennas, fiber, and internet connection points on the ground. This will help close the digital divide by delivering fast, affordable broadband to a wide range of customers, including consumers businesses, government agencies, and other organizations operating in places without reliable connectivity.

Project Kuiper has three main parts: ground infrastructure, satellites, and customer terminals. Amazon's ground infrastructure includes gateway antennas that securely send and receive customer data to and from satellites, along with telemetry, tracking, and control (TT&C) antennas that keep the satellites properly operating. Global networking connects those gateway antennas to the internet, public cloud, or private networks. Satellites make up the second part of the project. They operate in low Earth orbit (LEO) and relay data traffic to and from their gateway antennas and customers. Lastly, customer terminals are the technology that customers use to receive broadband service. The terminals combine antennas and processors into a single, compact system to deliver connectivity. The initial satellite constellation design includes 3,232 satellites.

Project Kuiper is a long-term initiative. Amazon's Federal Communications Commission (FCC) licence requires that they deploy and operate at least half of its satellite constellation by July 2026. The first two prototype satellites were launched on October 6, 2023, and after achieving 100% success with that mission, the expectation is to begin deploying the satellite constellation in 2024 and rolling out commercial services in 2025.

Amazon works with commercial launch providers to send Project Kuiper satellites into space. They have secured 77 heavy lift launches with commercial launch providers Arianespace, ULA, SpaceX and Blue Origin, and have options for additional launches with Blue Origin, which provides the capacity to deploy the majority of its satellite constellation.

The system is being designed to balance performance and affordability, and plan to provide choice and flexibility by offering a range of options for customers. In March 2023, early engineering models of three customer terminals that strike that balance was revealed. Amazon's ultra-compact model provides speeds of up to 100 megabits per second (Mbps), the standard model delivers up to 400 Mbps, and the largest model, which is intended for enterprise, government, and telecommunications applications, delivers up to 1 gigabit per second (Gbps).

Amazon has not announced pricing details yet, but affordability is a key principle of Project Kuiper. Amazon has a longstanding commitment to low prices, and lots of experience building popular, low-cost devices like Echo Dot and Fire TV Stick. Amazon is applying a similar approach with Project Kuiper. Since customer needs vary quite a bit around the world, service offerings may vary from country to country with the right pricing and service for customers in each region.

Source: https://www.aboutamazon.com/news/innovation-at-amazon/what-is-amazon-project-kuiper

Figures 10 and 11 display the KuiperSat Test Sequence and Amazon's Project Kuiper Architecture respectively.

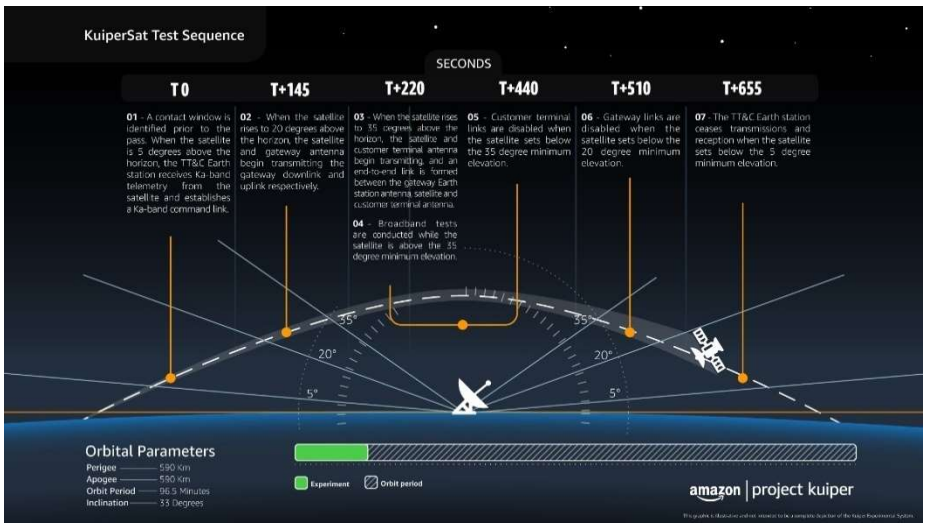

Figure 10: KuiperSat Test Sequence

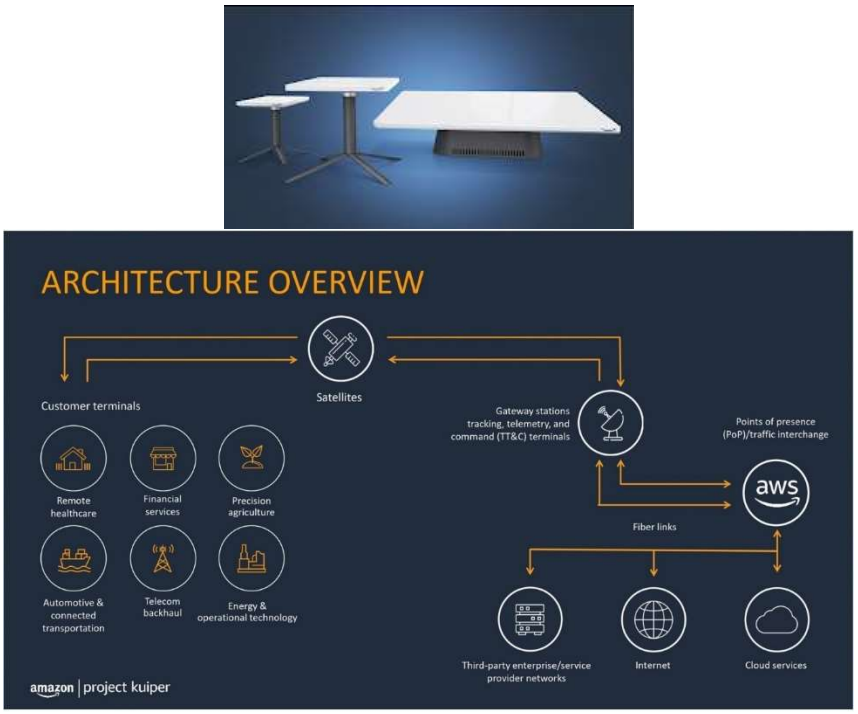

Figure 11: Amazon's Project Kuiper Architecture

Source: https://newspaceeconomy.ca/2024/04/15/connecting-the-world-amazons-ambitious-project-kuiper/

3 Regulating the Operations of NGSO Services

The introduction of NGSO services poses a new challenge to regulators around the globe, and especially developing countries, including WATRA Member States. This calls for a new paradigm in the way satellite services are regulated. Below are examples of how some WATRA Member States have licensed the operations of NGSO services.

3.1 Ghana

Ghana has licensed two (2) NGSO operators – OneWeb and Starlink, to operate various services in the country. These operators are yet to launch full commercial operations. Ghana developed a Satellite Licensing framework to guide the introduction of NGSO services. The document provides the policies and rules relating to the application for frequency authorizations for satellite services in Ghana. It outlines the various categories of satellite services, the licensing requirements and their associated fees. The draft framework was subjected to stakeholders' review before finalization.

The framework is designed to provide clarity to all stakeholders in the satellite services industry in Ghana. The main body of the framework includes:

- The legal framework for regulating satellite services in Ghana
- The scope of application of the framework
- General requirements for applying for Satellite Licenses and Authorizations in Ghana
- Categories of satellite services in Ghana
- Frequency bands for satellite services in Ghana
- Licensing procedure for all applications
- Electronic Communications Equipment Authorization (Type Approval) requirements

In addition to the framework, several engagements were held with Starlink and OneWeb, where issues of concern from all parties were discussed and measures put in place to address same. Some of the issues discussed include:

- Explanation of the entire licensing process
- Review of the conditions of the various licenses

- A request for Starlink to demonstrate how they handle security and quality of service issues
- Clarification on Starlink security processes

The Satellite Licensing Framework for Ghana can be accessed at the following link:

https://nca.org.gh/wp-content/uploads/2024/06/Satellite-Licensing-Framework-in-Ghana-2.pdf.

3.1.1 Licenses Issued for NGSO Services in Ghana

The following are the licenses issued to OneWeb and Starlink in Ghana:

OneWeb

Satellite Gateway Earth Station License: Satellite Gateway Earth Stations are large hubs that connect the satellite network to the internet and/or to private networks and cloud services. The Licensee is authorized to use its Gateway to provide telephony and data backhaul, broadcast feeder links, private networks and Telemetry, Tracking, Commanding and Monitoring of satellite networks.

Starlink

Satellite Gateway Earth Station License: As defined above for OneWeb.

Landing Rights License (FSS) - Provisional: This License grants rights to the Space Segment Satellite Operator to use spectrum in Ghana subject to the ITU Radio Bureau publication of notice for the system in the BR International Frequency Information Circular (Space Services) [BR IFIC] towards the successful registration into the ITU Master International Frequency Register (MIFR). This License grants the Licensee the authorization to provide services to NGSO terminals on-board foreign registered Aircrafts and Vessels while passing Ghana's airspace and territorial waters in the licensed frequency bands. The License does not authorize Space Segment Satellite Operators to retail their services in Ghana without the requisite license.

Satellite Earth Station License – Provisional: Satellite Earth Station Network (SESN) refers to any fixed earth station network (including Very Small Aperture Terminals - VSATs) comprising of Multiple Terminals linked to a satellite system for the provision of internet access, connectivity solutions or satellite broadband services via satellite

frequency bands. SESN may route traffic via satellite to and from a hub or Gateway Earth Station in-country or outside Ghana.

The framework for licensing NGSO services in Ghana is attached in Annex 1 of this report.

3.2 Nigeria

The Nigerian Communications Commission pursuant to its powers under Section 2 and Section 70 (2) of the Nigerian Communications Act 2003 issued Guidelines in 2018 to regulate the provision and use of all satellite communications services and networks, in whole or in part within Nigeria or on a ship or aircraft registered in Nigeria.

The Guidelines provide the requirements for each license, the license tenure, Licensee obligations, license renewal, processing time, evaluation criteria and fees among others

The provisions of these Guidelines apply to the following:

a. All Commercial Satellite Services, i.e., those that provide services to third parties or own satellite space segments or Earth Station for self-provision support of their businesses.
b. Operators of Space Segments and Earth Stations, Satellite Gateway service providers, Global Mobile Personal Communications by Satellite (GMPCS) providers, and Sales and Installation of Satellite Terminal Equipment.
c. GSO and non-GSO satellites including satellites in LEO, MEO, HEO, HAPS, and other similar orbits that may be developed in the future.
d. The Guidelines do not apply to military and non-commercial government satellites, radio navigation satellites, amateur satellites, earth observation and space research satellites, and receive-only Earth Stations.

The Commission developed the Licensing Frameworks to facilitate investments and entry into the Nigerian market for the provision of communications services.

The details of the Licensing Framework are as follows:

3.2.1 Periodic Publication of list of Authorized Space Stations

a. The list of Space Segment Operators provides information about the Space Station Landing Permits issued to the Space Segment Operators such as Space Station's name, Home Administration, Orbital Type, Orbital Location/Altitude of Satellite constellation, Frequency bands, Frequency range, Service types including Fixed, Broadcasting or Mobile Satellite Service. It also includes available Satellite Bandwidth and Landing Permit duration.

b. The list of Ground Segment Operators provides information about the Operator including the type of Satellite Frequency licence held by the Operator, effective and expiry dates of the Frequency licence, associated Space Segment provider, Bandwidth, coverage area as well as the type of Individual Licence held by the Operator.

3.2.2 Space Station Landing Permit Application Form

All applicants for Space Landing permit are required to complete and submit an application form.

3.2.3 Space-based Network Frequency Licence Application Forms

a. VSAT Earth Station Network Frequency Licence Application Form
b. ESIM Network Frequency Licence Application Form
c. MSS Network Frequency Licence Application Form
d. HAPS Network Frequency Licence Application Form
e. UAV/DRONE Network Frequency Application Form
f. GATEWAY Earth Station Frequency Licence Application Form

3.2.4 Reporting Template

As part of continuing efforts towards providing efficient management of the radio frequency spectrum in Nigeria, detailed information is required about current and continuing utilization of frequencies assigned to telecommunications operators, equipment operating on those frequencies and sites/locations where they are deployed, etc.

This information is required to create a database on the utilization of frequencies and associated information that will be periodically updated. The records will provide an invaluable resource for:

i. Facilitating resolution of interference

ii. Spectrum planning, policy; and

iii. The overall spectrum management strategy of the Commission.

All telecommunications operators are accordingly required to furnish the Commission with the relevant information **twice** every year. Updates should be submitted on **January 7** and **July 7** of each year according to the prescribed template specified by the Commission.

Accordingly, telecommunications operators are to download the prescribed and relevant templates and fill in the required data and thereafter forward the completed forms via email to spectrum-space@ncc.gov.ng.

3.2.5 General Terms and Conditions

Service providers wishing to provide service or obtain landing rights in Nigeria must complete and submit the relevant Application Form. In addition to licensing of the space segment, Authorization requirements for satellite service providers and individual licensing for Earth Station facilities is mandatory before the installation or use of any Satellite Ground Equipment.

The Guidelines as published by the NCC can be accessed at:

www.ncc.gov.ng/docman-main/legal-regulatory/guidelines/819-guidelines-on-commercial-satellite-communications-2018/file

3.3 Sierra Leone

Sierra Leone has licensed one (1) NGSO operator – Starlink Internet Service (SL) Ltd., to operate as a Satellite Broadband Internet Service Provider in the country. This operator is yet to launch full commercial operations.

The National Communications Authority (NatCA) used the Telecommunications Licensing Regulations of 2020 as a guide for the regulation of NGSO services. Hence Starlink Internet Service (SL) Ltd. was given a suitable license to start its operations in Sierra Leone. NatCA also did a benchmark with a related licensing framework from Rwanda.

Another potential NGSO has expressed its intent to NatCA to apply for a similar license. E-Space has been engaging NatCA to introduce its IoT services based on NGSO applications.

3.3.1 Licenses Issued for NGSO Services in Sierra Leone

The following is the license issued to Starlink Internet Service (SL) Ltd.:

Starlink

Starlink Internet Service (SL) Ltd. was initially licensed in May 2023 based on the NatCA Licensing Regulations of 2020 for Satellite Services.

According to ITU RR, the requested bands 10.7-12.75 and 14.0-14.5 GHz are allocated on the Worldwide bands for Fixed-Satellite Service (FSS) [Earth to Space] and are generally available for Satellite Services.

The following charges were levied for Starlink:

Starlink & Swarm Data Service Provider - Application Fees: NLe100,000 (≈ $4,400)

Starlink & Swarm Data Service Provider - Initial License Fees: NLe400,000 (≈ $17,700)

Starlink & Swarm Data Service Provider - Annual Regulatory Fees: NLe400,000 (≈ $17,700)

The proposed tariff chart for Starlink Internet Service (SL) Ltd. in is:

User Terminal: SLL 11,463,215 (≈ $ 510.6)

Monthly Cost: SLL 822,018 (≈ $ 36.6)

First Year Total Cost: SLL 20,505,410 (≈ $913.4)

Starlink Internet Service (SL) Ltd. referenced their license obtained from Rwanda. As such, the NatCA Management revised the fees structure to a flat rate as shown in the charges above.

E-Space

E-Space has expressed interest in applying for a license from NatCA for Mobile Satellite Services for Smart-IoT applications.

The specific spectral bands are listed below:

Spectrum Utilization	Uplink	Core bands	335.4 MHz – 399.9 MHz (64.5 MHz)
		supplementary	399.9 MHz – 400.05 MHz
	Downlink	Core bands	235.0 MHz – 322.0 MHz (87.0 MHz)
		supplementary	400.15 MHz – 401 MHz
	Channel Bandwidth		20.0 MHz
	Polarization		Left. Right, Circular
	Frequency Reuse		Yes
	Center Frequency		Variable

The Authority is currently considering their intention to see if the band requested can be apportioned whereby a specific band can be given to E-Space on a dedicated basis.

The fees structure for licensing E-Space services in Sierra Leone is yet to be determined by NatCA.

4 Recommendations on the Regulation of NGSO Services

For Administrations intending to license the operations of NGSO services, the following recommendations are proposed:

4.1 Regulatory Aspects

a. Develop a framework to guide the licensing of Satellite Services. This provides clarity on the expectations for all stakeholders. The framework should be clear about the requirements, fees, application processing timelines and scope of the License from the Administration. The dynamic nature of NGSOs, their increased accessibility, and the technological innovations they bring to humanity emphasize the need for a robust regulatory framework. This framework must balance the interests of diverse stakeholders, from private enterprises to nations, ensuring equitable access and avoiding harmful interference.
b. Since these NGSO services promise enhanced connectivity and data capabilities, regulations need to address not just technical aspects but also issues related to security, privacy, and cross-border harmonization. As the potential of NGSO constellations grows, so does the complexity of effectively regulating them. However, with international cooperation among regulatory bodies, and an industry-wide commitment to best practices, these challenges can be addressed by Administrations.
c. The complexity and swift progression of space technologies require cautious regulatory approaches possibly emulating the ITU model of utilizing general, and at times legally binding, treaties as foundational guidelines, with subsequent periodic updates to keep pace with technological innovations.
d. There should be continuous dialogue and engagements between National Regulatory Authorities and NGSO operators before licensing them.
e. Administrations may conduct benchmarking studies of the licensing regimes for those that have already licensed NGSO services. In that regard, the licensing regimes included in this report may serve as a basis and guide for the licensing of NGSOs.
f. Furthermore, promoting the deployment of innovative technologies while maintaining technologically neutral goals, and fostering international cooperation on anti-competitive behaviours ensures that the regulatory

ecosystem promotes innovation while safeguarding equitable and efficient spectrum use.

g. Administrations are invited to consider the key elements of the African Telecommunications Union's recommendation on emerging technologies (ATU-R Recommendation 005). The Recommendation is available at: https://atuuat.africa/wp-content/uploads/2021/08/En_ATU-R-Recommendation-005-0.pdf.
h. All Space Segment Satellite Services (SSSS) may be covered by the satellite regulatory framework of National Regulatory Authorities.
i. Administrations may require that the interests of consumers are incorporated into the licensing agreements for NGSO services.
j. It is fundamental to foster international harmonization of spectrum allocations, adhere to ITU Radio Regulations, and ensure timely and fair policy adjustments to cope with operators' technological and operational constraints.
k. Given the potential delay in establishing a comprehensive regulatory framework for NGSO operations, Administrations may opt to issue temporary licences.
l. NGSO service operators are encouraged to facilitate universal access, particularly in underserved and unserved areas.

4.2 Security Aspects

a. In cases where there is need for the establishment of a local Earth Station for the purposes of lawful interception, National Regulatory Authorities are encouraged to develop innovative approaches to better suit the requirements of NGSO global constellations.
b. The requirement(s) for lawful interception should be embedded in the licensing conditions for NGSO operators and they should provide remote access to information by an Administration using, for example, dashboards that provide information on the network and user terminals.
c. Administrations could mandate NGSO operators to establish a common monitoring platform in collaboration with Administrations for the purposes of subscription management including subscriber database and statistics.
d. Administrations are encouraged to coordinate to help address the issue of cross-border use of NGSO terminals.

e. Administrations are invited to incorporate relevant Cybersecurity, Data Protection and all applicable national security laws into their NGSO Frameworks and Licences.
f. Administrations could require proof of user identification prior to activation of NGSO services to help identify individual users.
g. Administrations may consider invoking diplomatic channels in order to draw the attention of the notifying Administration of the NGSO operators who are not addressing security concerns in a timely manner.
h. To address the transborder use of NGSO kits, Administrations may require NGSO operators to deactivate kits procured and activated from other jurisdictions within a specific time frame.
i. Administrations may obtain support on addressing security concerns by leveraging on Satellite Gateway infrastructure in neighbouring countries based on established protocols.

4.3 Economic Aspects

a. Regulators are encouraged to tailor licensing fees to the business model of satellite services to encourage the market entry of NGSO operators.
b. Geographical coverage restrictions may be used to address market access and competition issues between NGSO operators and terrestrial operators.

Annex 1–Ghana NGSO Framework

4.4 Scope of Application in Ghana

The provisions in this document shall be read and applied together with all applicable laws currently in force and with such modifications as subsequent legislations and directives issued by the Authority may prescribe.

4.5 General Requirements for all Applicants

a. The applying Entity must be legally registered and duly certified to operate in Ghana. Applicants shall be required to show proof of their Certificate of Incorporation issued by the Registrar of Companies in Ghana, the Register of members, indicating the shareholding structure, and a Copy of the Company's Regulations. However, for entities applying for Satellite Landing Rights Licence, evidence of registration as a body corporate other than in Ghana is acceptable.

b. An applicant shall complete the relevant sections of the NCA Customer Registration Form and provide the required technical information specified in this document, and submitted together with the requisite non-refundable application fee payable by Banker's Draft to the NCA or by Bank transfer.

4.6 Categorisation of Satellite Services in Ghana

The table shows services which require licensing as specified by the Satellite Licensing Framework in Ghana.

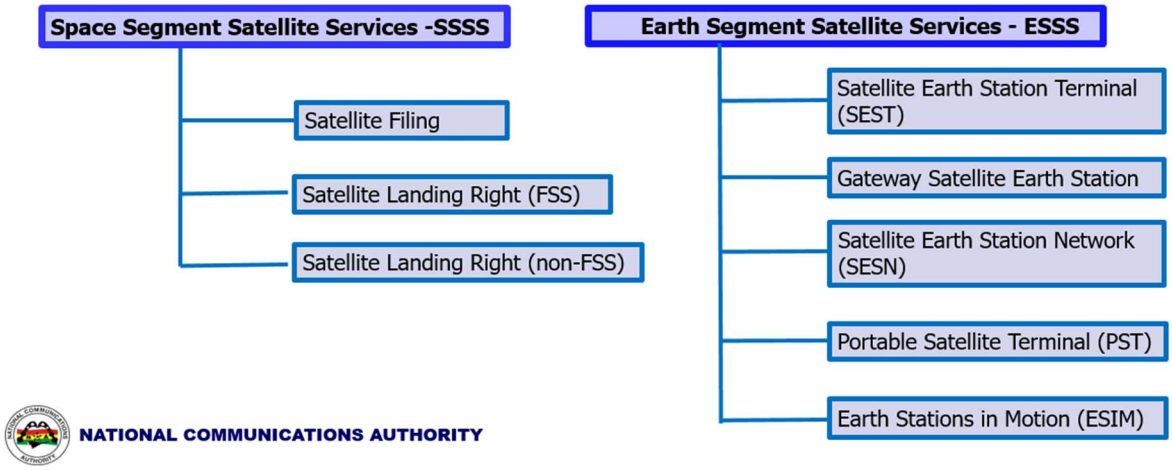

Table 1: Satellite Services Requiring Licensing from NCA Ghana

4.7 Satellite Landing Rights (FSS)

4.7.1 Overview

This License grants market access rights to a space segment satellite operating in the Fixed Satellite Service (FSS) and to use spectrum and orbital resources in Ghana subject to the ITU Radio Bureau publication of notice for the system in the BR International Frequency Information Circular (Space Services) (BR IFIC) towards the successful registration into the MIFR.

This includes authorization for recorded Space networks to operate Aircrafts and Vessels while passing Ghana's airspace and territorial waters for a limited period.

The Satellite Landing Rights does not authorize Space Segment Operators to provide Satellite based communications services directly to last mile users, they can provide services only through Authorised/Licenced telecom service operators in Ghana including direct connectivity between space stations and International Mobile Telecommunications (IMT) user equipment. These operators must be entities with any of the following Authorization/Licence:

- Internet/Public Data Service and Satellite Earth Station Network
- Mobile Network Operators
- Broadband Wireless Access Operators
- Satellite Earth Station Terminal

4.7.2 Direct Connectivity between Space Stations and International Mobile Telecommunications (IMT) user equipment

A Satellite Landing Right **does not** authorize a satellite operator to establish direct connections between space stations and International Mobile Telecommunications (IMT) devices, such as mobile phones or tablets, unless a formal agreement has been made with a licensed Mobile Network Operator (MNO) and with prior approval of the NCA.

4.7.3 Application Requirements

A satellite operator applying for Landing Rights shall be required to provide the following in addition to the requirements under Section 2:

a. A copy of the license from the applicant's home country in which the satellite is registered as well as ITU Coordination procedure status, i.e., the CRC special

section number and BR IFIC number in which the satellite network was published.

b. Technical information on the satellite system including frequencies used, orbiting parameters,and coverage footprint as provided to the ITU or the country of satellite registration.
c. An overview of the applicant's intended services of operations in Ghana.
d. Completed Technical Satellite application form.

4.7.4 Licence Validity Period

The license shall be valid for up to ten (10) years, renewable subject to continued compliance with the licence conditions/obligations.

4.7.5 Fees

The fees payable shall consist of:

- Application Fees: US$1,000.00
- Licence Fees: US$10,000.00 per satellite system (*A Satellite system used here refers to the number of sets of satellite(s) working together in unison in the same constellation within the same frequency band and with footprint over the territory of Ghana)*
- Annual Regulatory Fees: no charges

4.7.6 Special Conditions of licence

a. The Licensee shall furnish the NCA with subscription of its Distribution Partners/Wholesale Customers and/or its activities in Ghana.
b. The Licensee shall under no circumstance undertake termination of international voice traffic on the public switch telephone networks without an arrangement with a licensed international wholesale carrier (IWCL) or international gateway (IGW) license holder. The operations should avoid causing financial or technical harm or compromise national security.

4.8 Satellite Gateway Earth Station

4.8.1 Overview

Satellite Gateway Earth Stations are large hubs that connect the satellite network to the internet and/or to private networks and cloud services. The Gateway may be used to provide telephony and data backhaul, broadcast feeder links, private networks and Telemetry, Tracking, Commanding and Monitoring of satellite networks.

4.8.2 Application Requirements

A Satellite Earth Segment Operator applying for Satellite Gateway Earth Station License shall be required to provide the following in addition to the requirements under Section 2:

a. Technical information on the satellite system including frequencies used, orbiting parameters, and coverage footprint as provided to the ITU or the country of satellite registration.
b. Technical plans showing the architecture of the Station and overview of the applicant's intended operations in Ghana.
c. Completed technical application form.

4.8.3 Licence Validity Period

The licence shall be valid for up to ten (10) years, renewable subject to continued compliance with the license terms and conditions/obligations.

4.8.4 Fees

a. Application Fees: US$2,000.00
b. Licence Fees: US$20,000.00
c. Regulatory fees: US$1,500.00/per terminal/year

4.9 Satellite Earth Station Network

4.9.1 Overview

Satellite Earth Station Network (SESN) refers to any Fixed Earth Station Network (including VSATs) comprising of Multiple Terminals linked to a satellite system for the provision of internet access, connectivity solutions or satellite broadband services via satellite frequency bands. SESN may route traffic via satellite to and from a hub or Gateway Earth Station in country or outside Ghana. The procedure for licensing under this category may include a public hearing in accordance with Regulation 94 of the Electronic Communications Regulations, 2011, LI 1991 (i.e., Procedure on receipt of application for a Class I licence).

SESN Licence authorizes Earth Segment Satellite Operators to provide Satellite based communications and broadband services directly to last mile users including Authorised/Licensed telecom operators.

The scope of the Authorization shall allow the Authorization Holder to:

- Establish and operate a nationwide Satellite Internet/Public Data Service network in the Republic of Ghana.
- Provide internet and public data services to the general public using its own satellite constellation or that of a third party's.
- Use other **approved** transport facilities such as Microwave and Fibre Optic Cables to provide the services.
- Establish Points of Presence to interconnect with the Public and Private networks to provide authorized services to the general public.
- Interconnect with other transport facility operators to carry user traffic.

Notwithstanding the above, this Authorization does not permit the Authorization Holder to use any frequency spectrum or any other transport facilities without obtaining the relevant Authorizations/Licence from the Authority.

4.9.2 Application Requirement

A Satellite Earth Segment Operator applying for License to operate a SESN within the territory of Ghana shall be required to provide the following in addition to the requirements under Section 2:

a. A brief description of the network architecture and underlying technologies (where applicable or as shall be required).
b. Copies of technical specifications of all equipment planned for deployment as provided by the equipment manufacturer.
c. Completed technical application form.

4.9.3 Licence Validity Period

The License tenure for an SESN shall be for 5 years subject to the payment of yearly regulatory fees and the continued compliance with the license terms and conditions.

4.9.4 Fees

Satellite Earth Station Network			
SESN	**APPLICATION FEES (GHS)**	**LICENCE FEES (GHS)**	**ANNUAL REGULATORY FEES (GHS)**
Class 1 (Unlimited Terminals, 1001+)	96,250.00	385,000.00	1% of Net Revenue or 192,500.00 whichever is greater
Class 2 (501-1000 Terminals)	19,250.00	96,250.00	77,000.00
Class 3 (101- 500 Terminals)	7,700.00	70,000.00	50,000.00
Class 2 (51-100 Terminals)		50,000.00	38,500.0
Class 5 (Less/=50 Terminals)		38,500.00	

4.9.5 Procedure for Upgrade/Downgrade of SESN and PST

The procedure for the upgrade of the class of SESN or PST shall be based on the analysis made on the biannual reports of the number of active terminals under the

license. The fees for the corresponding upgrade shall be prorated. In cases of downgrade, the corresponding annual regulatory fees shall apply during the invoicing cycle for the succeeding year.

4.10 Frequency Authorization for Satellite Services

All frequency bands allocated to satellite services per Ghana's National Frequency Allocation Table are available for use subject to the grant of a Landing Rights License or the requisite Earth Segment Satellite Service License. There are no additional charges for the use of the frequencies.

About this Report

This report was developed by a WATRA Ad hoc Technical Working Group on Non-Geostationary Satellite Orbit (NGSO) Services from 7th May to 12th July 2024. This group comprises the following:

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