SATELLITE BASED AUGMENTATION SYSTEM (SBAS) FOR PRECISION AGRICULTURE

BY

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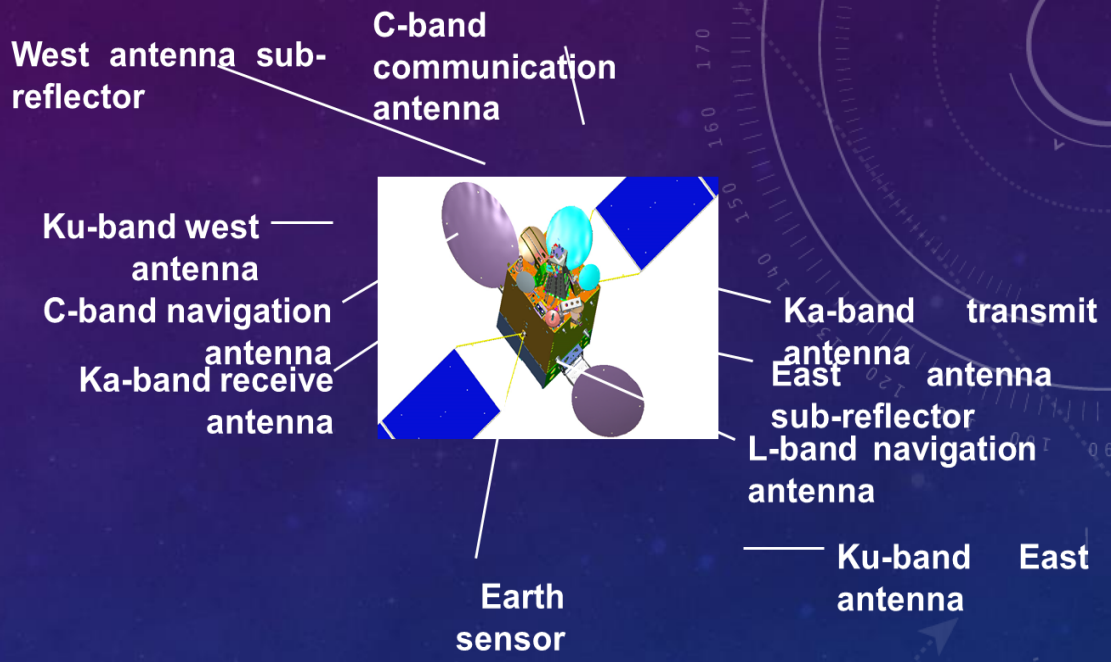
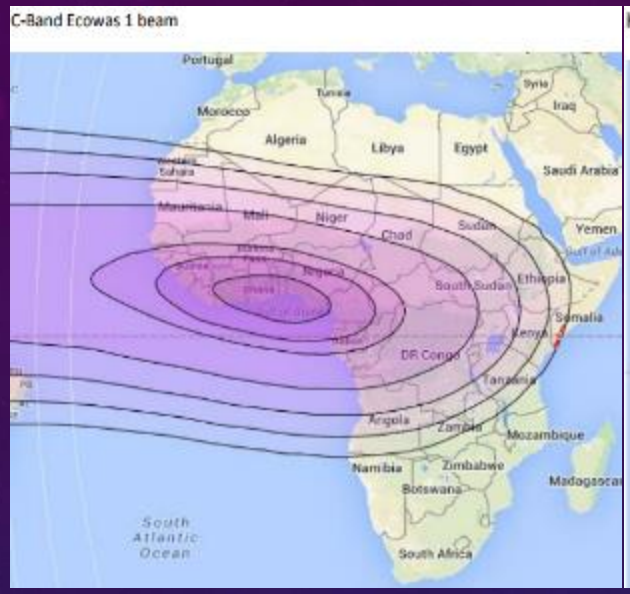
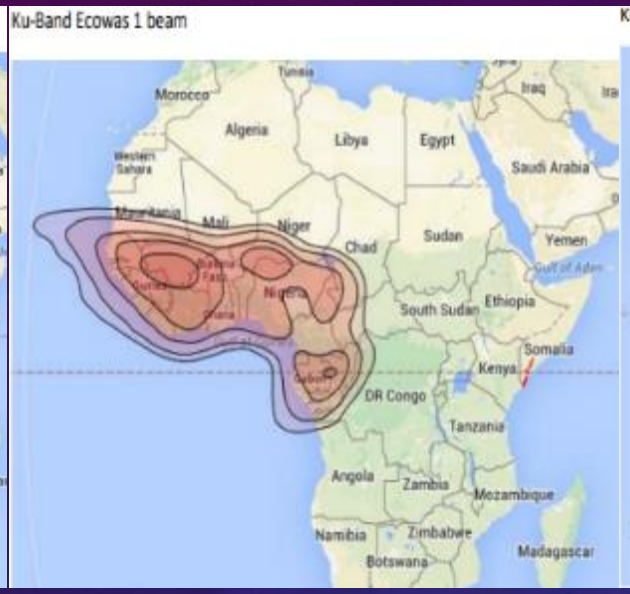
ABOUT NIGCOMSAT-1(R)

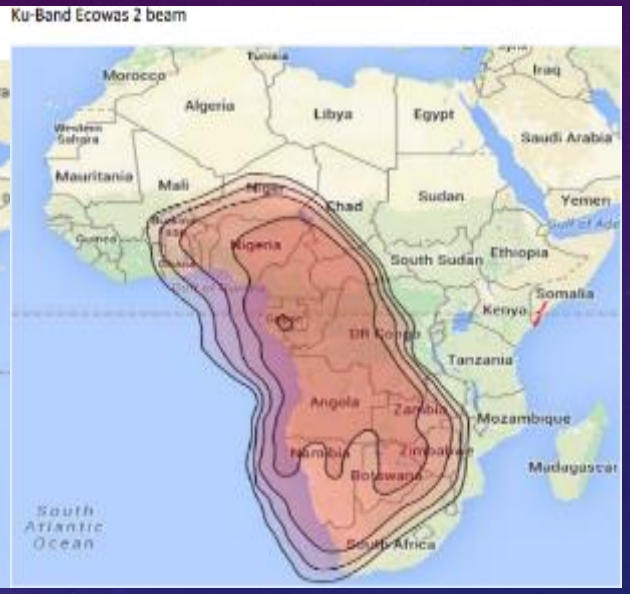
- Nigeria ' s first communication satellite (NIGCOMSAT-1), a quad-band high powered satellite with navigational capability and capacity was launched on 14th May, 2007.
- NIGCOMSAT-1 was Africa's first contribution to the Global Navigation Satellite System as regional Satellite-based Augmentation System (SBAS).
- NIGCOMSAT-1 was however de-orbited on the 10th of November, 2008 due to an irreparable single point of failure on-board the satellite.
- The **NIGCOMSAT-1R;** currently in orbit is the insurance replacement for NIGCOMSAT-1 satellite launched on 19th December, 2011.

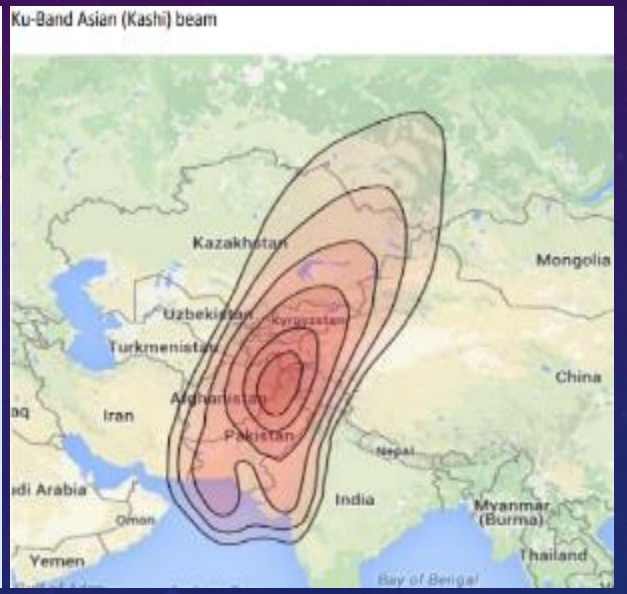


NIGCOMSAT-1R SATELLITE FOOT PRINT





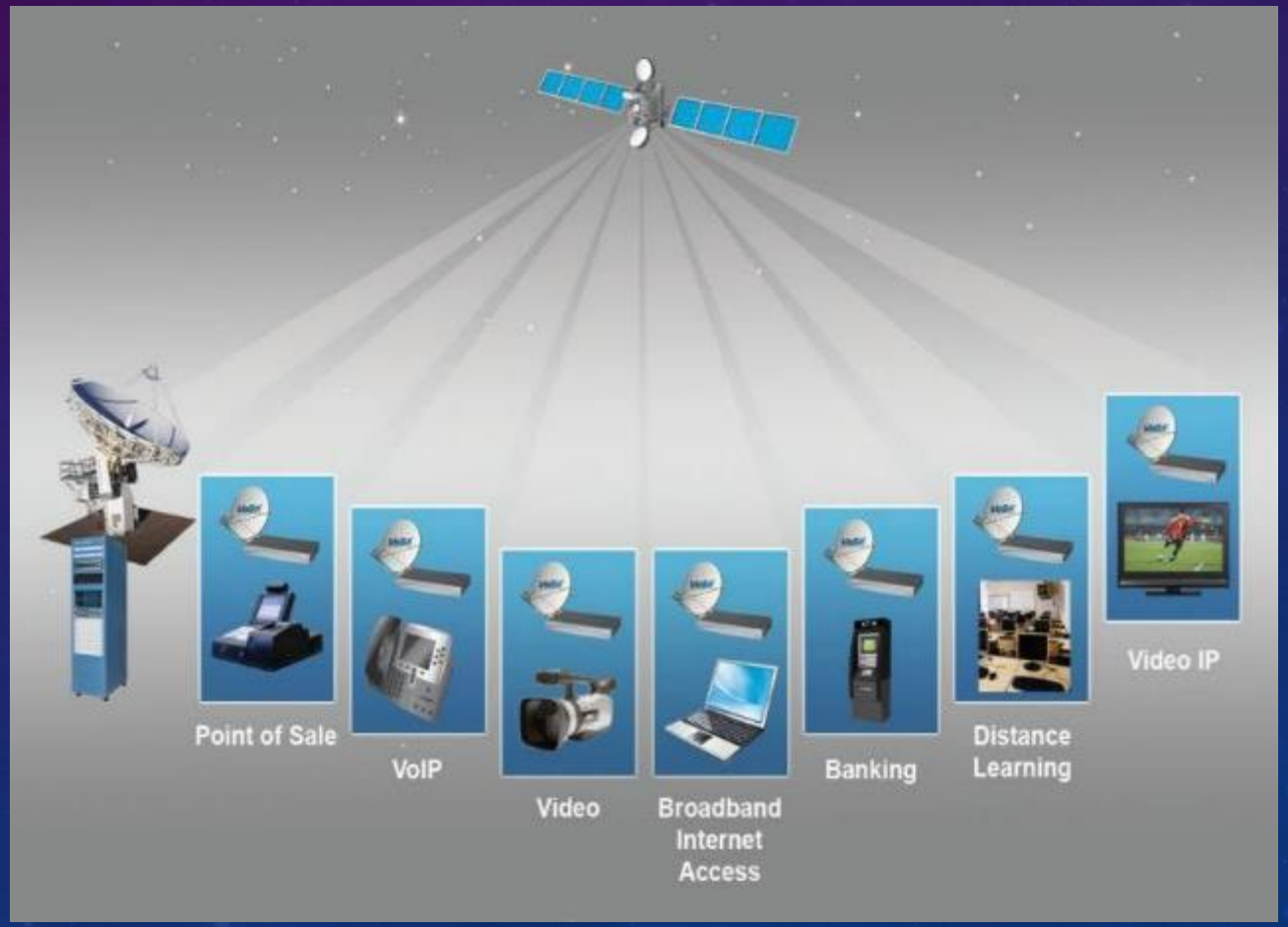




BEYOND NIGCOMSAT'S TRADITIONAL RANGE OF SERVICES IS SATELLITE-BASED NAVIGATION CAPABILITY.

NIGCOMSAT

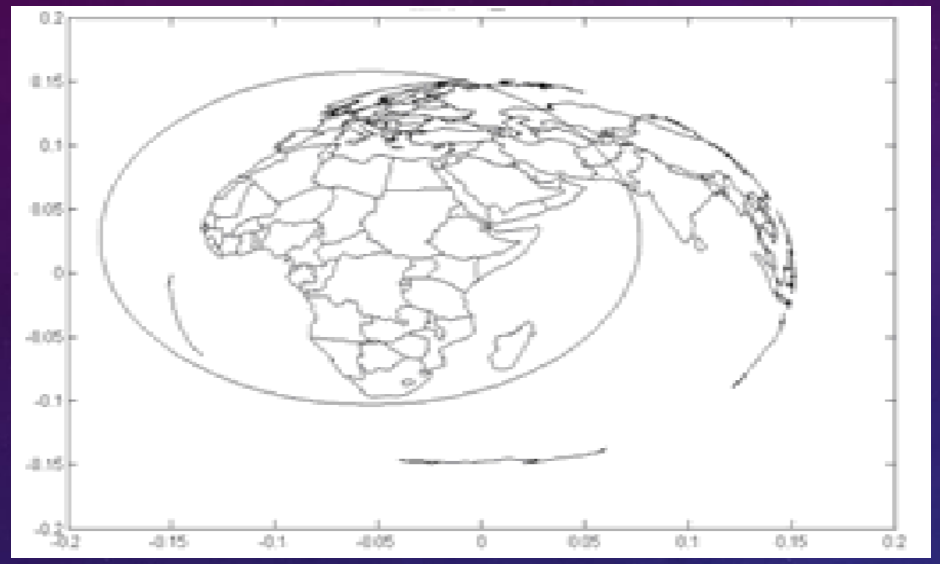
...African Rooted
Globally Positioned



AFRICA'S SBAS: NIGERIA'S CONTRIBUTION TO SBAS WITH PRN CODE 147.

- Satellite-Based Augmentation System (SBAS) arose from the need to provide Continuity, Availability, Integrity and Accuracy of GNSS signals to eliminate errors and compensate for discrepancies associated with GPS and other navigation systems signals.
- The NIGCOMSAT-1R Navigation (L-Band) payload is a Space-Based Augmentation System meant to provide a Navigation Overlay Service (NOS) similar to the European Geostationary Navigation Overlay Service (EGNOS).
- The SBAS compensates for errors of GNSS in terms of **Integrity** and **Accuracy** and provides **Continuity** and **Availability.**
- Makes differential corrections and then broadcast the integrity messages as an augmented signal of the original GNSS Signal in Space (SiS) through ***NigComSat-1R*** for a wide coverage.
- **Africa's SBAS in conjunction with ASECNA has Pseudo Random Noise (PRN) code 147.**
- Conforms to **global standard to enhance Interoperability, Compatibility and Zero Interference.**

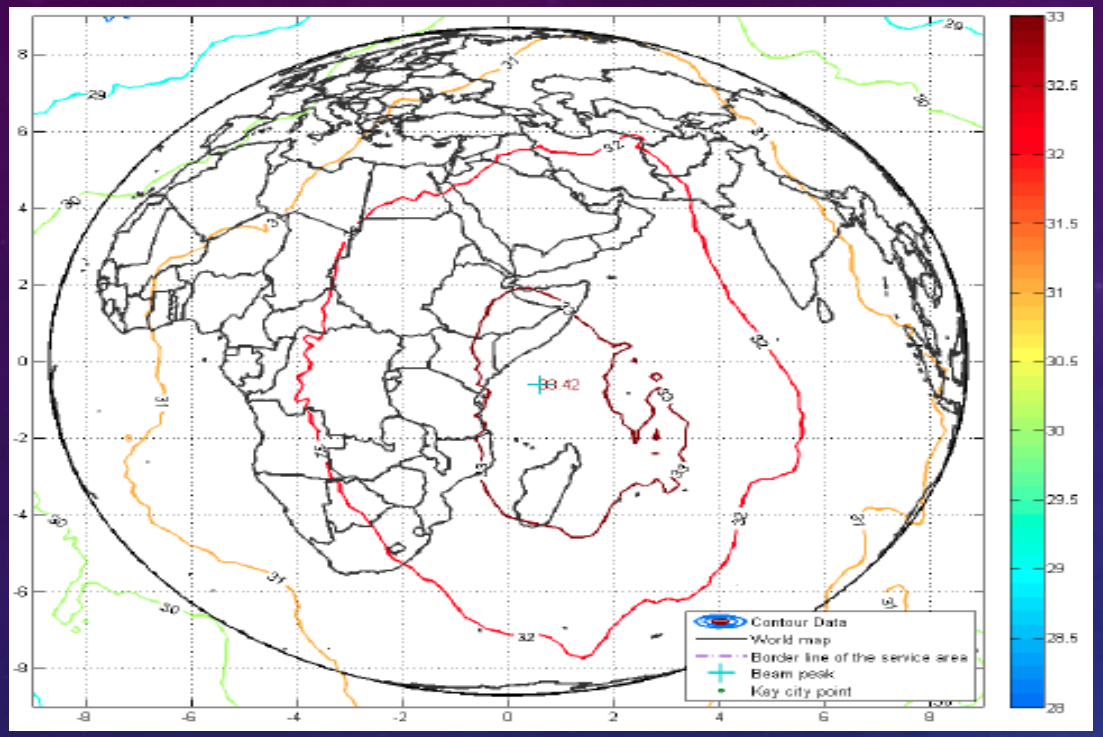
NIGCOMSAT-1R NAVIGATION PAYLOAD: AFRICA'S CONTRIBUTION TO SBAS



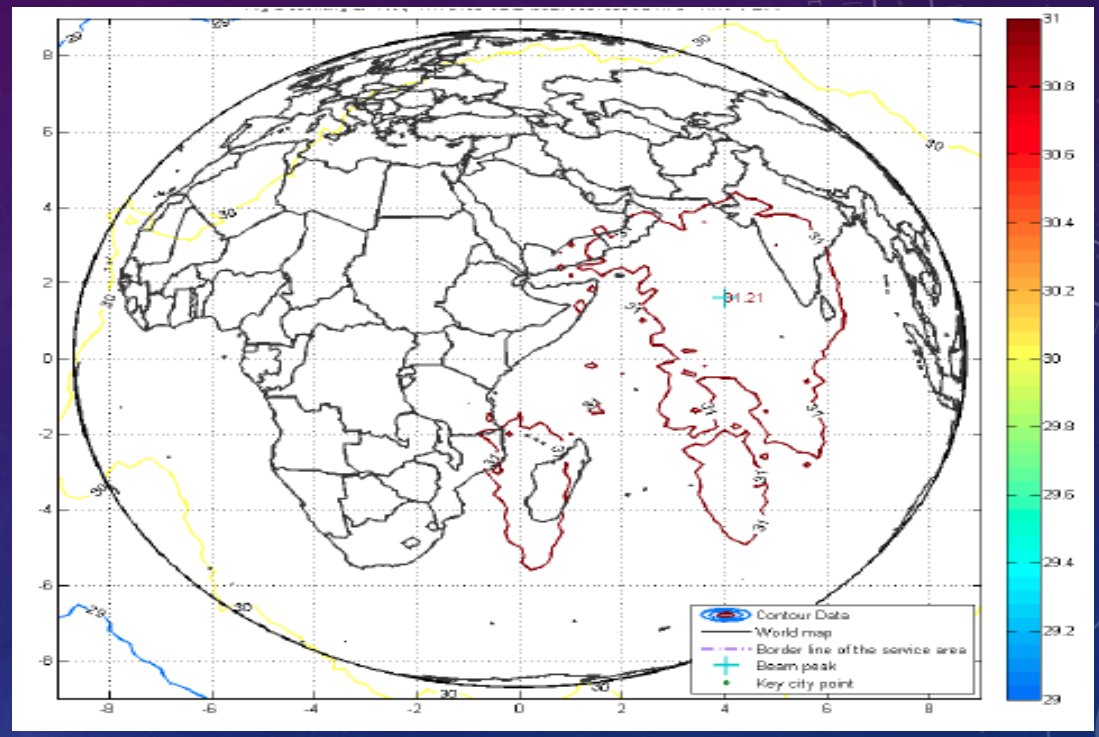
The Uplink coverage beam of NIGCOMSAT-1R Geo-Navigation Satellite using C –Band Horn Antenna.

NIGCOMSAT Master Control Station with C-L Band Antenna Systems

NIGCOMSAT-1R NAVIGATION PAYLOAD: AFRICA'S CONTRIBUTION TO SBAS AND GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS).



The downlink coverage beam of NIGCOMSAT-1R Geo-Navigation Satellite on L1 Frequency

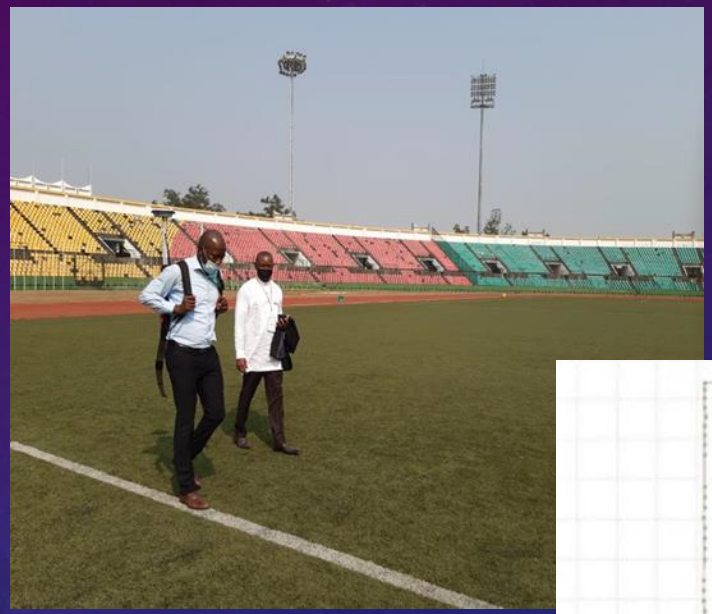


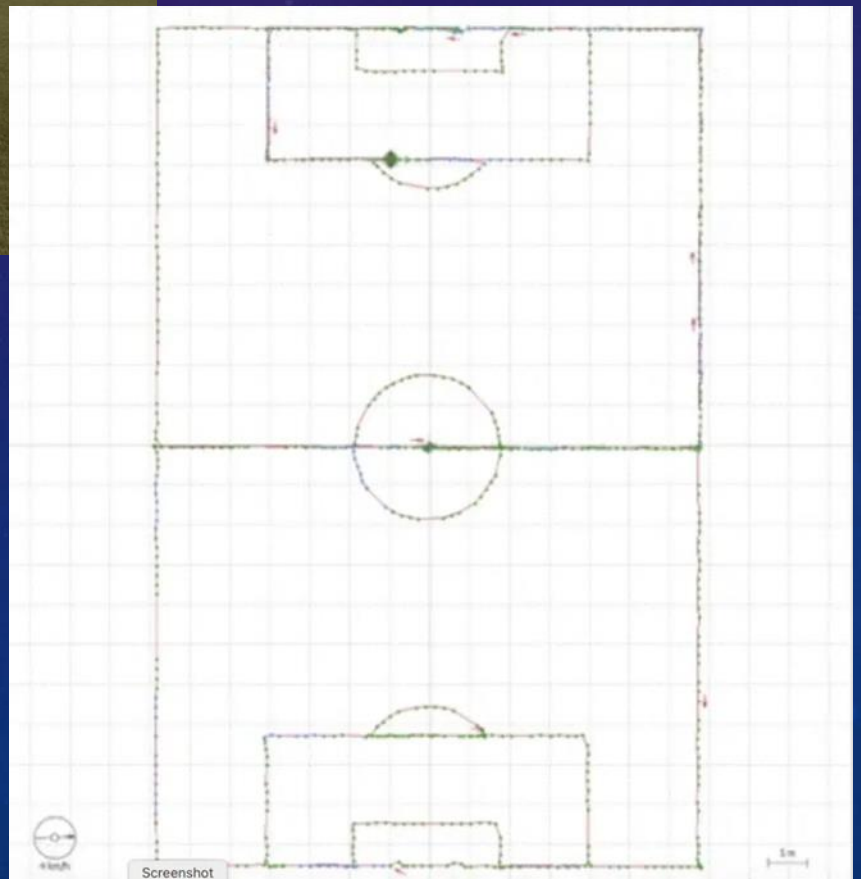
The downlink coverage beam of NIGCOMSAT-1R Geo-Navigation Satellite on L5 Frequency

Channel	Frequency (MHz)	Polarization	Bandwidth (MHz)
L1-Downlink	1575.42	RHCP	4
L5-Downlink	1176.45	RHCP	20

SBAS SIGNAL BROADCAST AND DEMONSTRATION EFFORTS IN AFRICA

- SBAS signal broadcast over Africa & Indian Ocean (AFI) region began since September 2020, providing the first SBAS open service in this part of the world via NIGCOMSAT-1R Satellite.
- Series of SBAS flight demonstrations were carried out in Togo and Cameroun (aviation sector), and Brazzaville (non-aviation sector **delivering precise point positioning (PPP) to centimeter level)**





NEEDS ASSESSMENT OF SBAS IN TRADITIONAL AGRICULTURAL PRACTICE

The disadvantages of traditional agriculture

- The field cannot be effectively divided for maximum yield per hectare.
- Spacing between plants cannot be controlled
- Chaotic Management of Agricultural Machinery and equipment
- Plant diseases cannot be found on time.
- Difficult to forecast production
- There is no basis for scientific and unified management.
- Can not guarantee food security and sufficiency for African growing population.

Inefficiency

Traditional Agriculture VS Precision Agriculture

Traditional agriculture without SBAS

Precision agriculture with SBAS

SBAS APPLICATIONS IN PRECISION AGRICULTURE

Automatic harvesting

Farmland planning

Automatic water spray

High efficiency

Enhances estimate on output of grains

UAV spraying

Agricultural machinery automatic navigation system

SBAS APPLICATION IN AGRICULTURE

- SBAS-based applications in precision farming are being used for farm planning, field mapping, tractor guidance, crop scouting, variable rate applications, and yield mapping.
- Precision agriculture is a highly effective farming strategy that allows farmers to better allocate inputs (e.g. seeds and fertilisers) and increase productivity, while lowering costs and minimising environmental impact.
- SBAS for Field Mapping saves farmers' and investors' money in tractor repairs by being able to record and map the location of rocks, potholes, power lines, broken drain tiles, poorly drained regions and other obstructions.

SBAS APPLICATION IN AGRICULTURE

Other GNSS/SBAS applications in Agriculture include:

(i) Farm Machinery Guidance:-

(ii) Automatic Steering

(iii) Variable Rate Technologies

(iv) Asset Management

SBAS DEMO for Agriculture

GNSS/SBAS APPLICATION IN LIVESTOCK

- GEO-FENCING And TRACKING: Virtual Fencing (or geo-fencing) uses the GNSS based location of an animal in combination with a sound or electrical stimulus to confine animals inside within a predefined geographic area without fixed fences to help eliminate predominate farmers/herdsmen in Nigeria and sub-sahara regions. They could also be tracked to provide location-based services.

GNSS/SBAS APPLICATION IN AGRICULTURE

Potential Application of SBAS in Agriculture includes:

- Harvest monitoring,
- Biomass monitoring,
- Soil condition monitoring,
- Yield Monitoring,
- Geo-traceability,
- Environmental and Forestry Management,
- More efficient management of farming activities such as spreading, spraying and harvesting.

SBAS INTEGRATION WITH UAV FOR PRECISION AGRICULTURE

Combining SBAS system with Unmanned Aerial vehicle (UAV) and Remote Sensing are upcoming method in providing farmers with (near) real time sensing information for precision agriculture applications such as:

(i) Water stress monitoring

(ii) Detection of nutrient deficiencies

(iii) Crop diseases

LESSONS FOR NIGERIA AND AFRICA IN GENERAL

Climatic conditions in most part of Nigeria are warm and humid and our arable land area accounts for more than 33% of our land area.

Before the rise of oil boom, Nigeria was not only an agricultural country, but also famous food warehouse in Africa. In 1960s, Nigeria's peanut exports ranked first in the world.

The oil boom and rise of the oil industries in 1970s led to pathetic decline in agriculture as a strategic economic industry for food sustainability, security and cash cow in export earnings for Nigeria.

Nigeria at a time was the world's largest importer of rice with about 11 billion dollars spent on foot imports per annum until recently considering the current efforts on Agriculture.

OTHER GNSS/SBAS APPLICATIONS

CONCLUSION

With the downturn of the black gold and oil market in 21st century considering rapid progress made in green energy, Nigerian President has repeatedly stressed the need to pay attention to agricultural sector as a pillar industry for Nigeria's economy including wealth creation for our teeming youths and thus the need to speed up the development of modern Agricultural practice to guarantee blotted needs of Nigeria expected to be the 3rd largest population in the world by United Nations in 2045.

SBAS presents a huge opportunity for precision agricultural practice beyond dominant subsistence farming not only in Nigeria but Africa to facilitate a new dawn of not just being a consumer but playing an important role of being producer of agricultural produce efficiently and sufficiently to end all forms of hunger and malnutrition by 2030 in the Continent in line with United Nations' Sustainable Development Goal 2 (SDG 2- Zero Poverty Agenda) to which African Governments are committed to.


Thank
you