



PRESENTATION ON NIGERIAN SATELLITE
AUGMENTATION SYSTEM (NSAS)
ROLE/CONTRIBUTIONS TO GNSS AND REQUEST
TO JOIN GNSS PROVIDERS' FORUM

At

ICG-13 Meeting, Xi'an, China.

By

Dr. LAWAL Salami Lasisi (NIGCOMSAT)

04-09 November, 2018



CONTENTS

- BACKGROUND: NIGCOMSAT LTD/NIGCOMSAT-1R/NIGCOMSAT-1R FOOTPRINTS
- NIGCOMSAT'S RANGE OF SERVICES
- MOTIVATION/PROBLEM STATEMENTS/NEEDS ASSESSMENTS
- SITUATIONAL ANALYSIS (GLOBAL & NATIONAL) IN AVIATION AND MARITIME SECTOR
- NIGERIAN SATELLITE AUGMENTATION SYSTEM (NSAS).
- SOLUTIONS, APPLICATIONS AND SERVICES
- PROPOSAL
- CONCLUSION

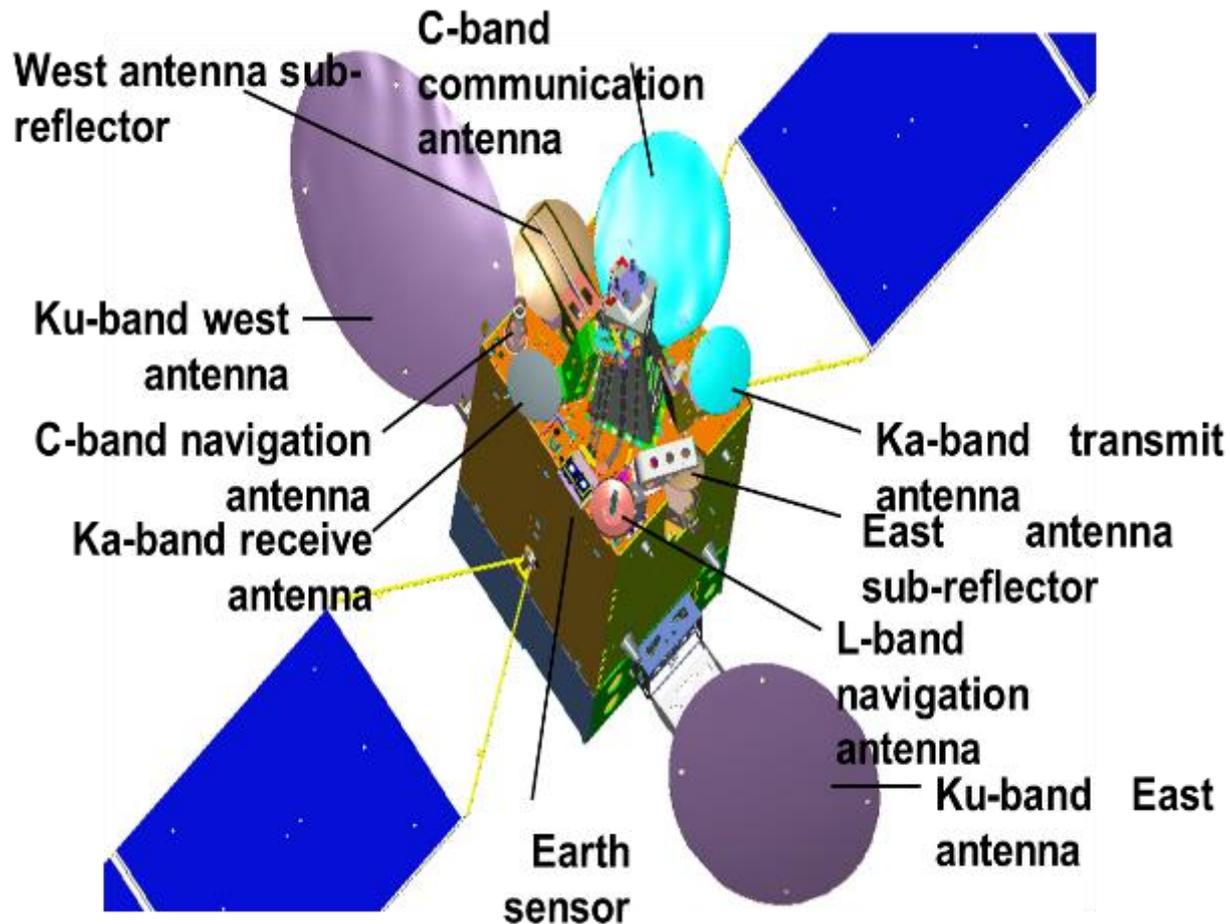
BACKGROUND: NIGCOMSAT LTD

- The Nigerian Communications Satellite (NIGCOMSAT) is a Government owned agency established 4th April, 2006.
- We provide **innovative** and **cutting-edge** satellite communications solutions by operating and managing a geostationary communication satellite-NigComSat-1 R.
- A **backup agreement** with National System of Satellite Communication and Broadcast of Republic of Belarus; owners of Belintersat-1.

BACKGROUND: SPACE/GROUND ASSETS OF NIGCOMSAT

- ❑ **NIGCOMSAT-1** was launched 13th May, 2007.
- ❑ **NIGCOMSAT-1** was de-orbited on 10th November, 2008
 - Nota Bene: All strategic intent of ground infrastructure implementation for Navigation Overlay Service (NOS) over Africa came to an abrupt end.*
- ❑ **NIGCOMSAT-1R** was launched on 19th December, 2011
- ❑ **NIGCOMSAT-1R**, is the insurance replacement for **NIGCOMSAT-1**
- ❑ Quad-band (Ku, Ka, C and L Bands) for Telecommunications, Broadcast and Navigation Services
- ❑ At Geostationary Orbit (42.5°E)
- ❑ Launch mass of 5,100 kg
- ❑ Service Life > 15 years
- ❑ Ground Infrastructure (Abuja and China)

BACKGROUND: NigComSat-1 R



Location: 42.5 Degrees East.

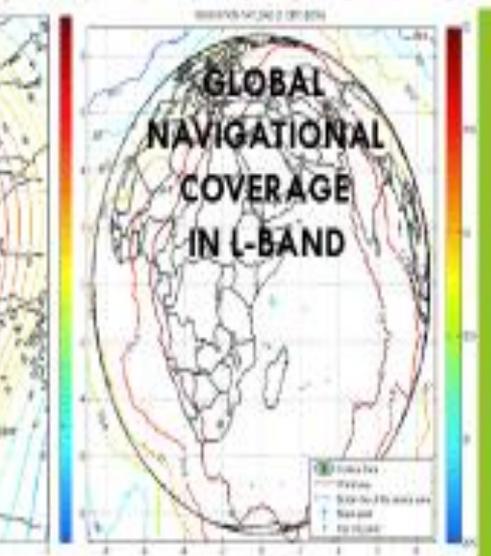
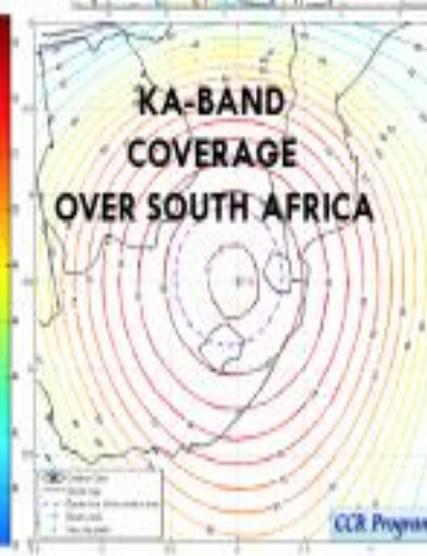
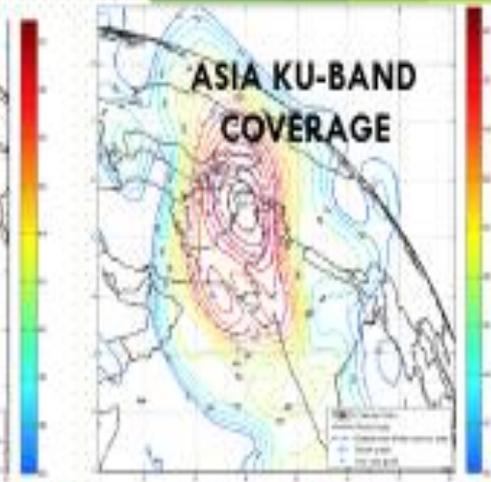
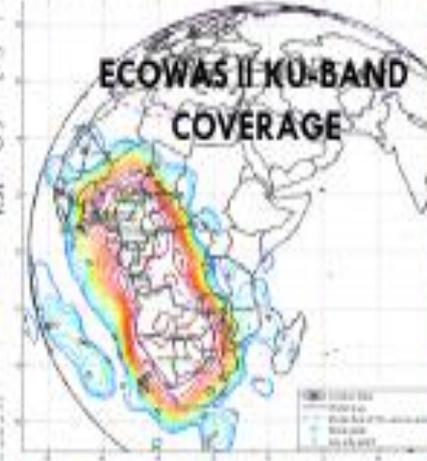
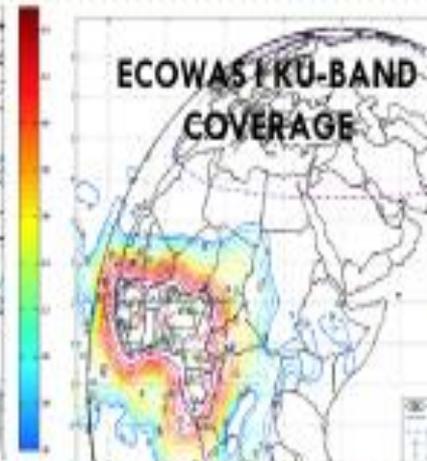
The communication Payload comprises of **28 transponders**:

- **C – band** 4 transponders
- **Ku – band** 14 transponders
- **Ka – band** 8 transponders
- **L – band** 2 transponders

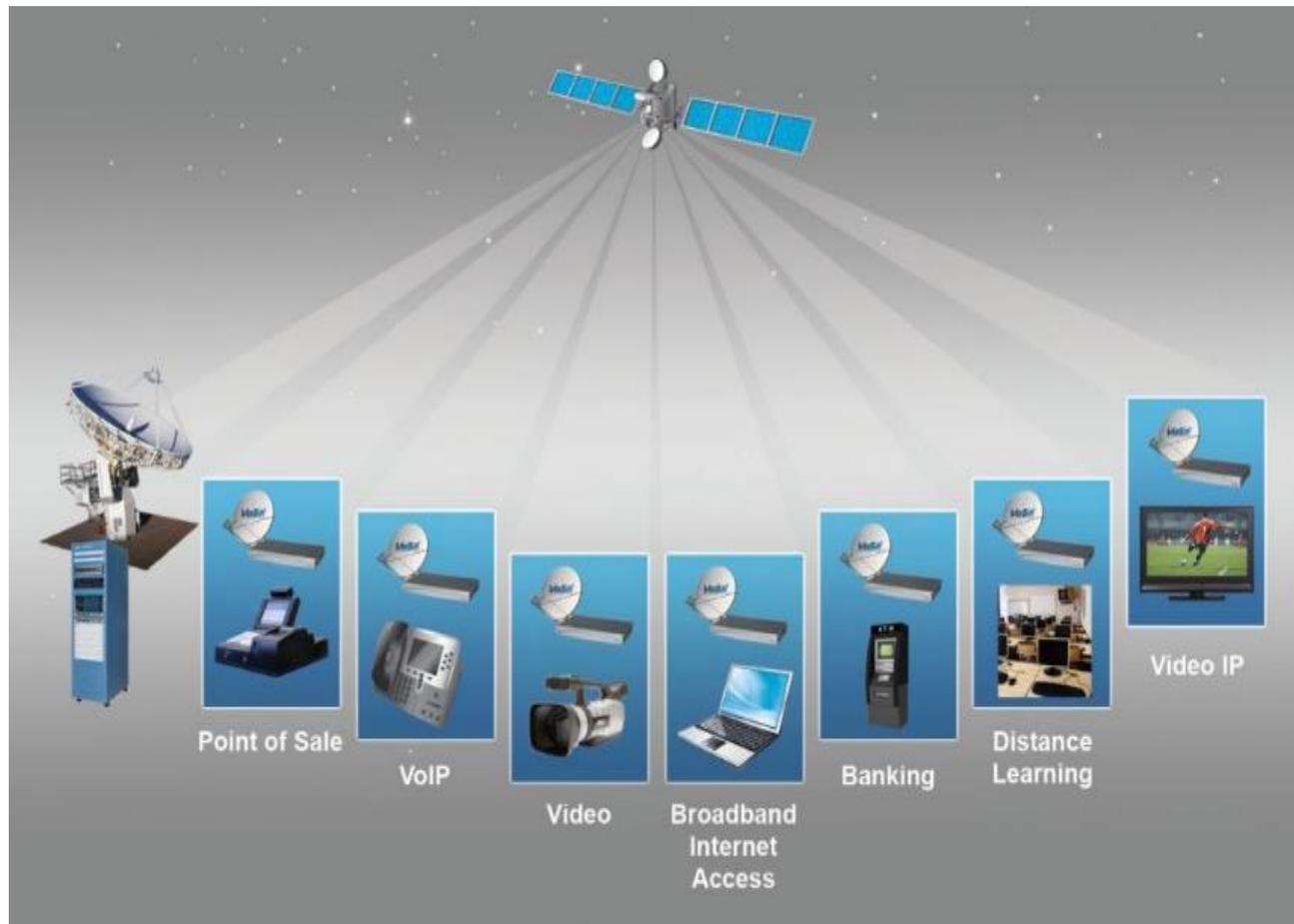




NIGCOMSAT-1R FOOTPRINTS AND COVERAGE



NIGCOMSAT Range of Services



SATELLITE BASED AUGMENTATION SYSTEM(SBAS)
AND
NIGERIAN SATELLITE AUGMENTATION SYSTEM
(NSAS)

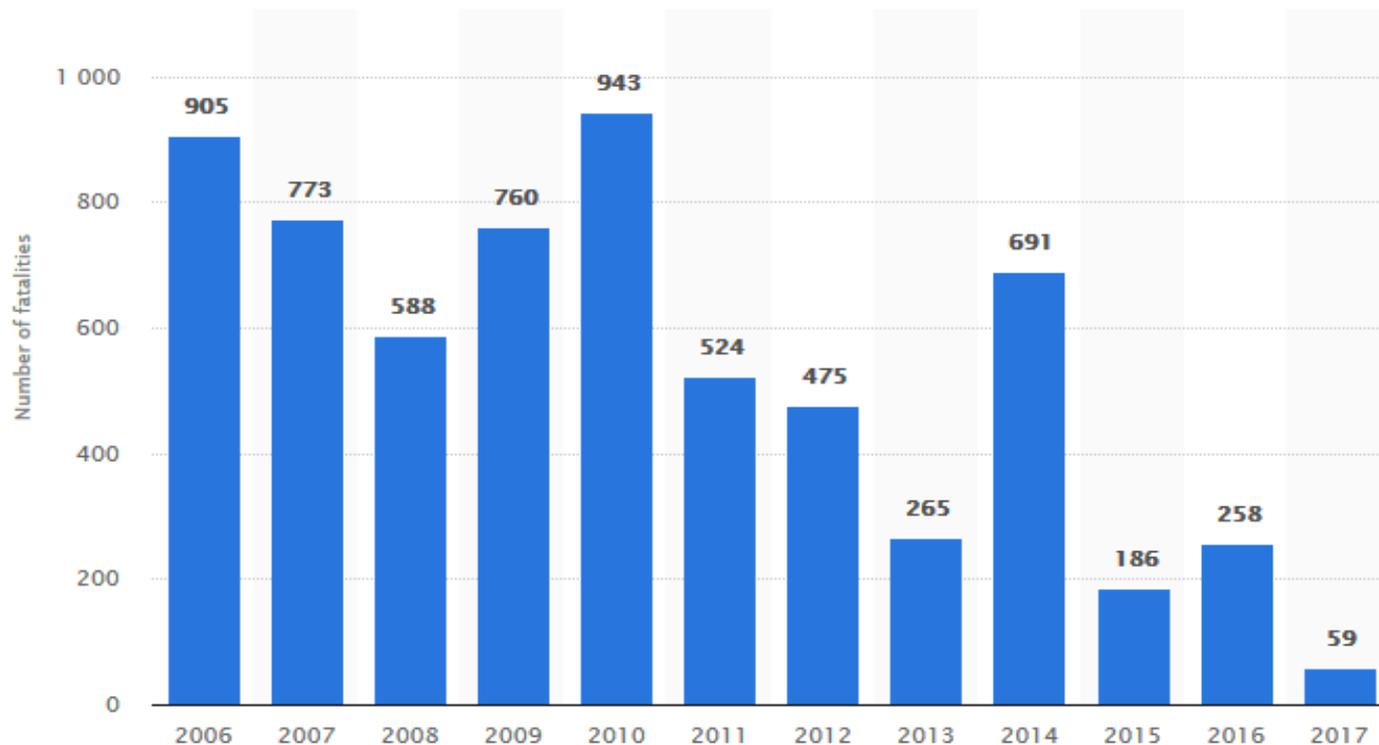
Motivation, Problem Statements and Needs Assessment in Aviation Sector



Global SBAS Precision Approach Coverage as at June, 2016.

Motivation, Problem Statements and Needs Assessment

Worldwide air traffic fatalities from 2006 through December 21, 2017



Airplane Crash/Fatalities by phase of Flight Statistics

11

- Odds of being killed on a single airline flight 1 in 29.4 million
- Number of fatalities per million flight hours 12.25
- Survival rate of passengers on a fatal crash 24 %
- Fatalities by Phase of Flight
 - ❖ 0% due to (Taxi, load/unload, parked, tow)
 - ❖ 16 % due to Take-offs
 - ❖ 27% due to Climb (flaps up+initial)
 - ❖ 20% due to (Descent and cruise)
 - ❖ **37 % due to(Initial Approach, Final Approach & Landing)**

Major Air Crash in Nigeria in Recent Times

12

Dana Air Flight 992 ,163 fatalities, June 3 2012, Approach Phase

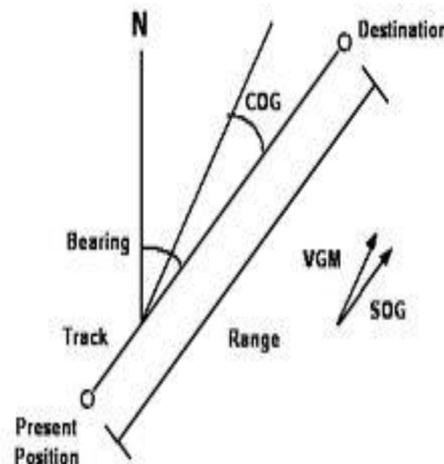
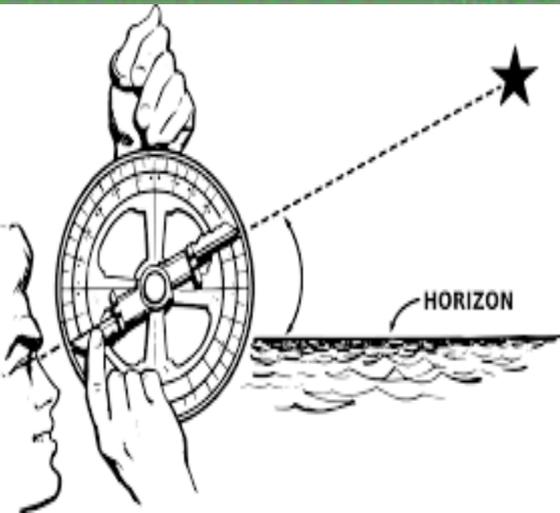
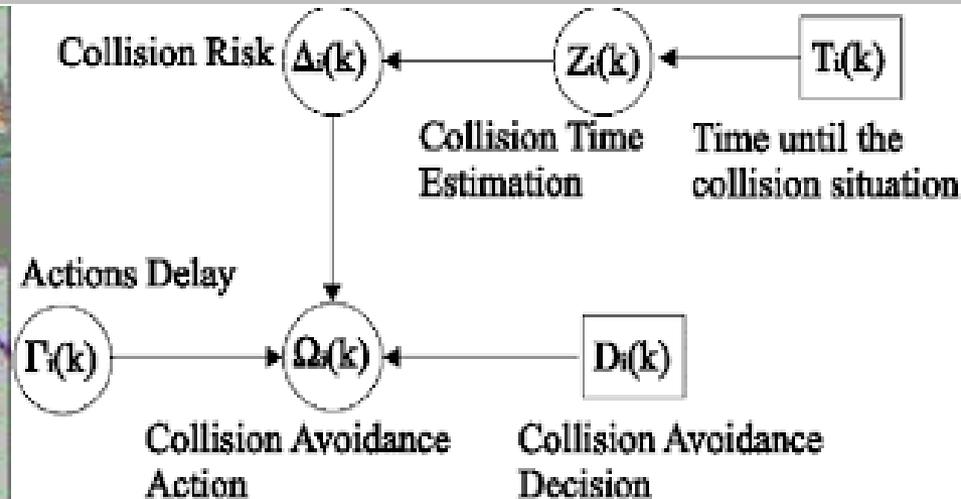
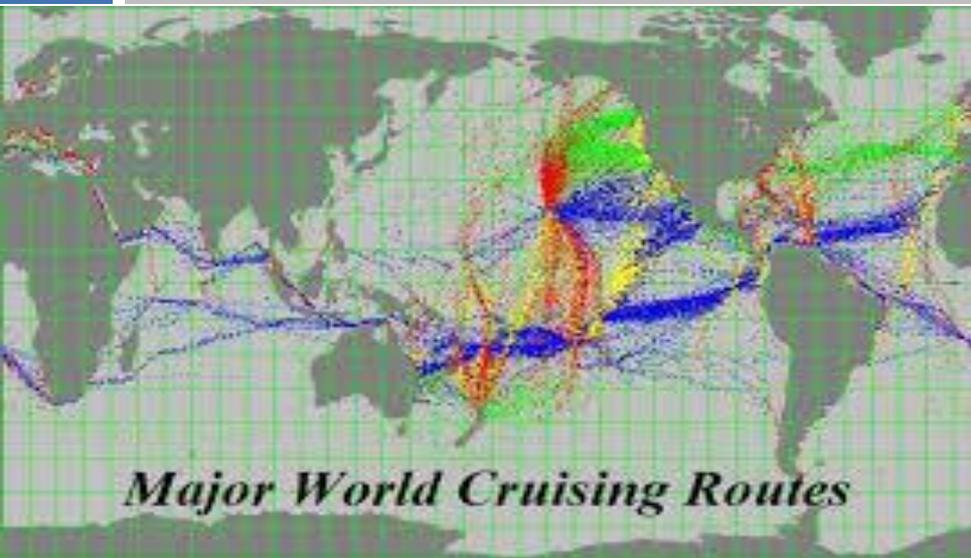


Sosoliso Airlines Flight 1145, 108 death, Dec 10,2005 Approach Phase



Motivation, Problem Statements and Needs Assessment in Maritime Sector

13



Needs Assessment of GNSS/SBAS Applications in Ship Piracy, Tracking, Monitoring and Marine Safety

14



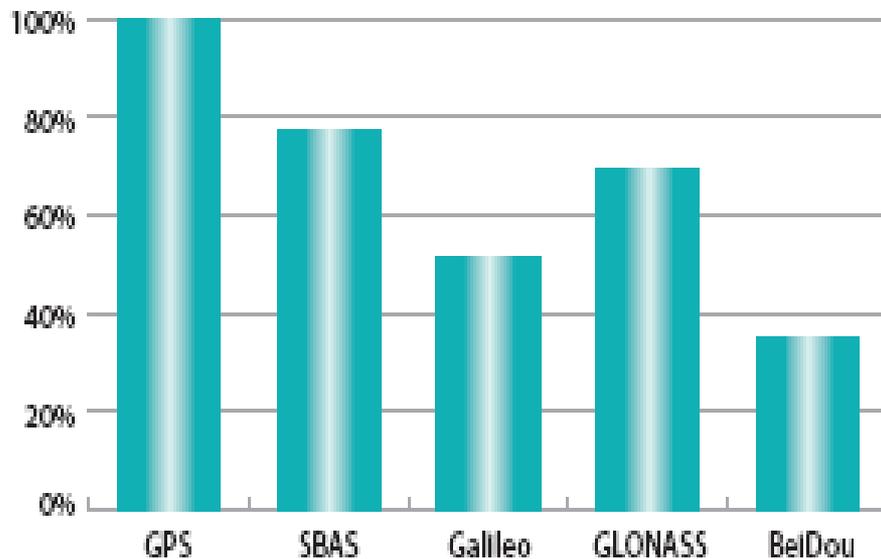
Needs Assessment in Safety of Vessels (Structural Deformations, Hogging, Sagging etc)



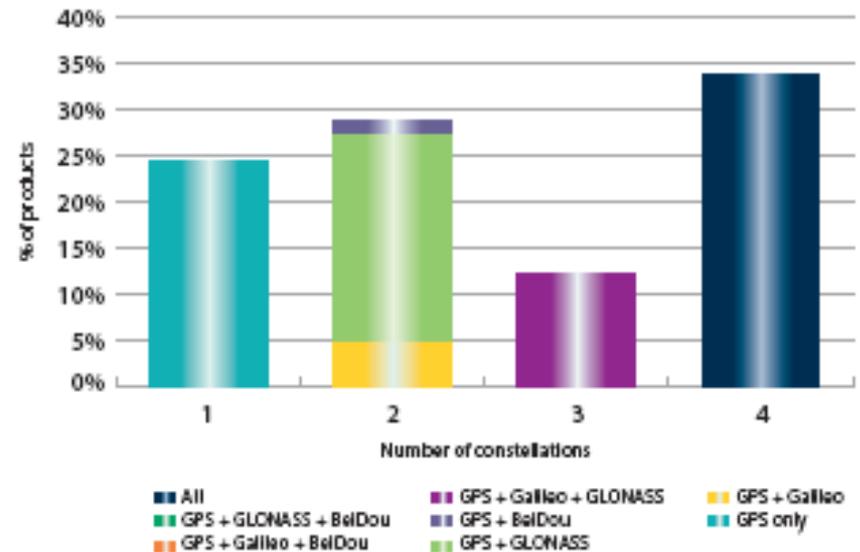
SITUATIONAL ANALYSIS OF GLOBAL BLUE ECONOMY (MARITIME)

16

Capability of GNSS receivers – Maritime segment



Supported constellations by receivers – Maritime segment



The IMO “Maritime Safety Committee 90” introduced the need to develop new performance standards for navigation receivers that will enable full use of the availability, continuity, integrity as well as increased accuracy of multi-constellation, terrestrial and augmentation systems.

Needs Assessment of GNSS/SBAS Applications in Fuel Smuggling and Diversion

17



Motivation, Problem Statements and Needs Assessment

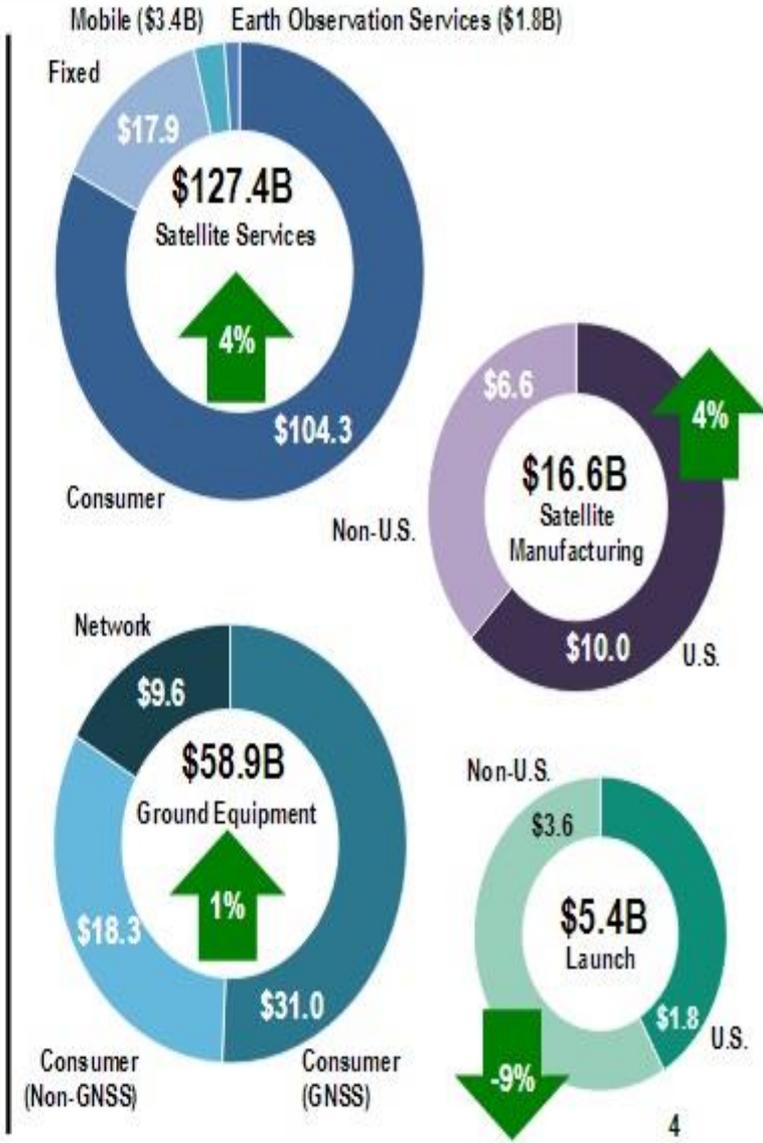
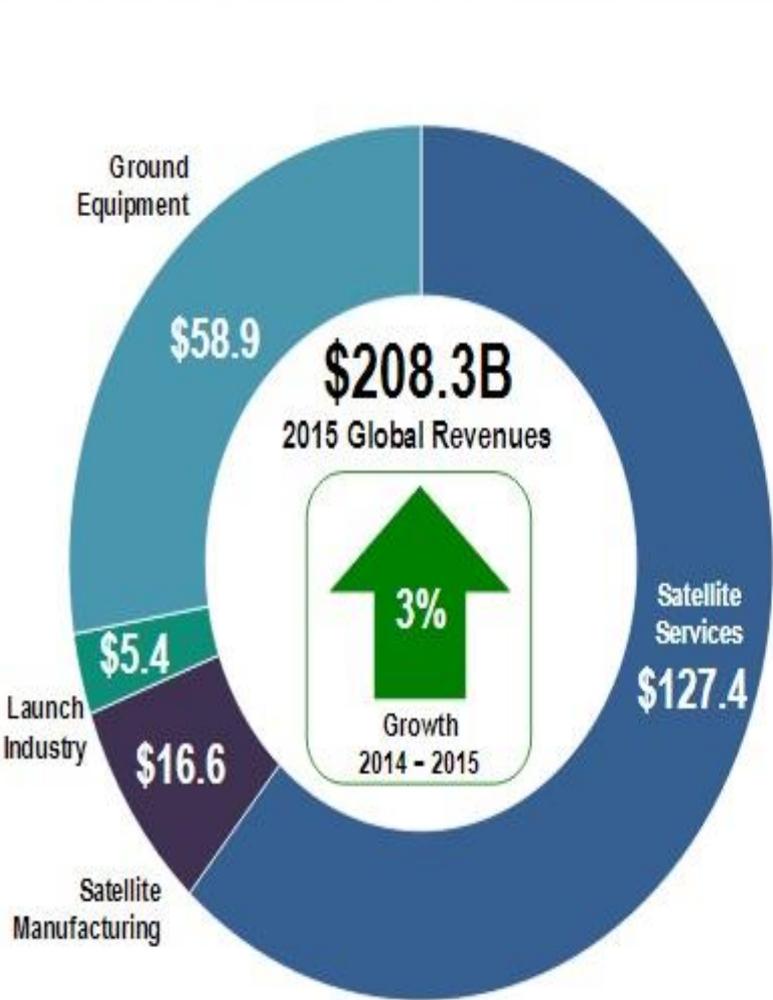
- * **Almost 4 billion GNSS devices used worldwide, Africa and Middle East are experiencing the FASTEST GROWTH**

Global GNSS market size (€bn)



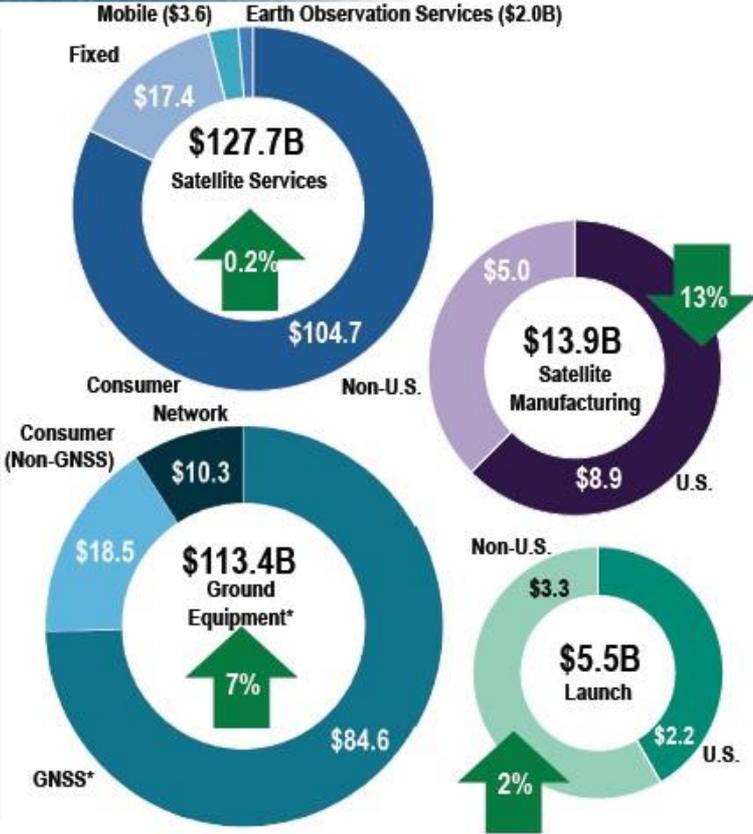
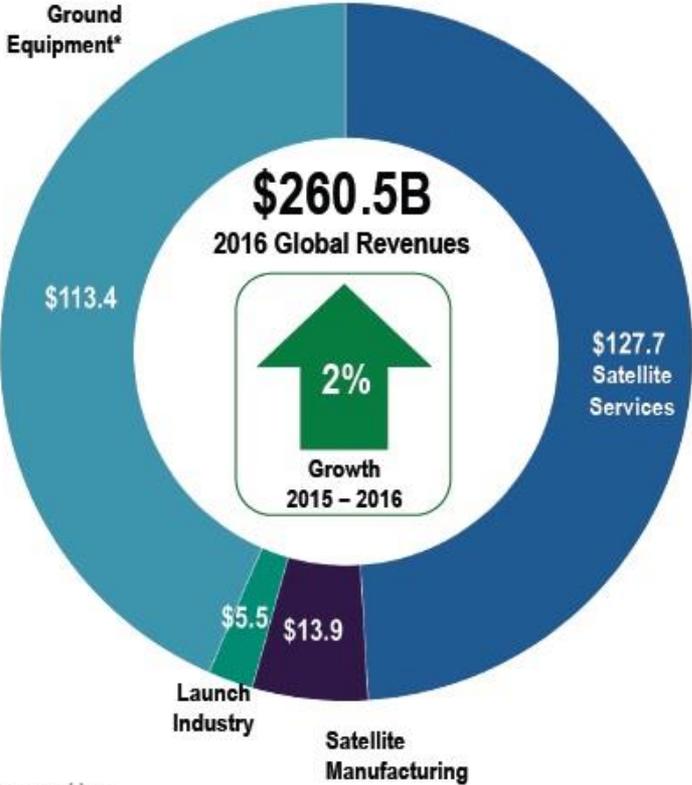
* CAGR: Compound Annual Growth Rate

GLOBAL 2016 SATELLITE INDUSTRY ASSOCIATION (SIA) INDICATOR SUMMARY REPORT



GLOBAL 2017 SATELLITE INDUSTRY ASSOCIATION (SIA) INDICATOR SUMMARY REPORT

2016 Satellite Industry Indicators Summary



Prepared by:
BRYCE
 Formerly Tauri Group Space and Technology

*Ground equipment revenues include the entire GNSS segment: stand-alone navigation devices and GNSS chipsets supporting location-based services in mobile devices; traffic information systems; aircraft avionics, maritime, surveying, and rail.

NIGERIAN SATELLITE AUGMENTATION SYSTEM (NSAS)

21

- SBAS compensates for errors of GNSS in terms of Integrity and Accuracy
- 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 Geostationary satellite (*NigComSat-1R*) for a wide coverage.
- Nigeria's SBAS is NSAS with Pseudo Random Noise (PRN) code 147.

OVERVIEW AND ARCHITECTURE OF NIGERIAN SATELLITE AUGMENTATION SYSTEM (NSAS)

22

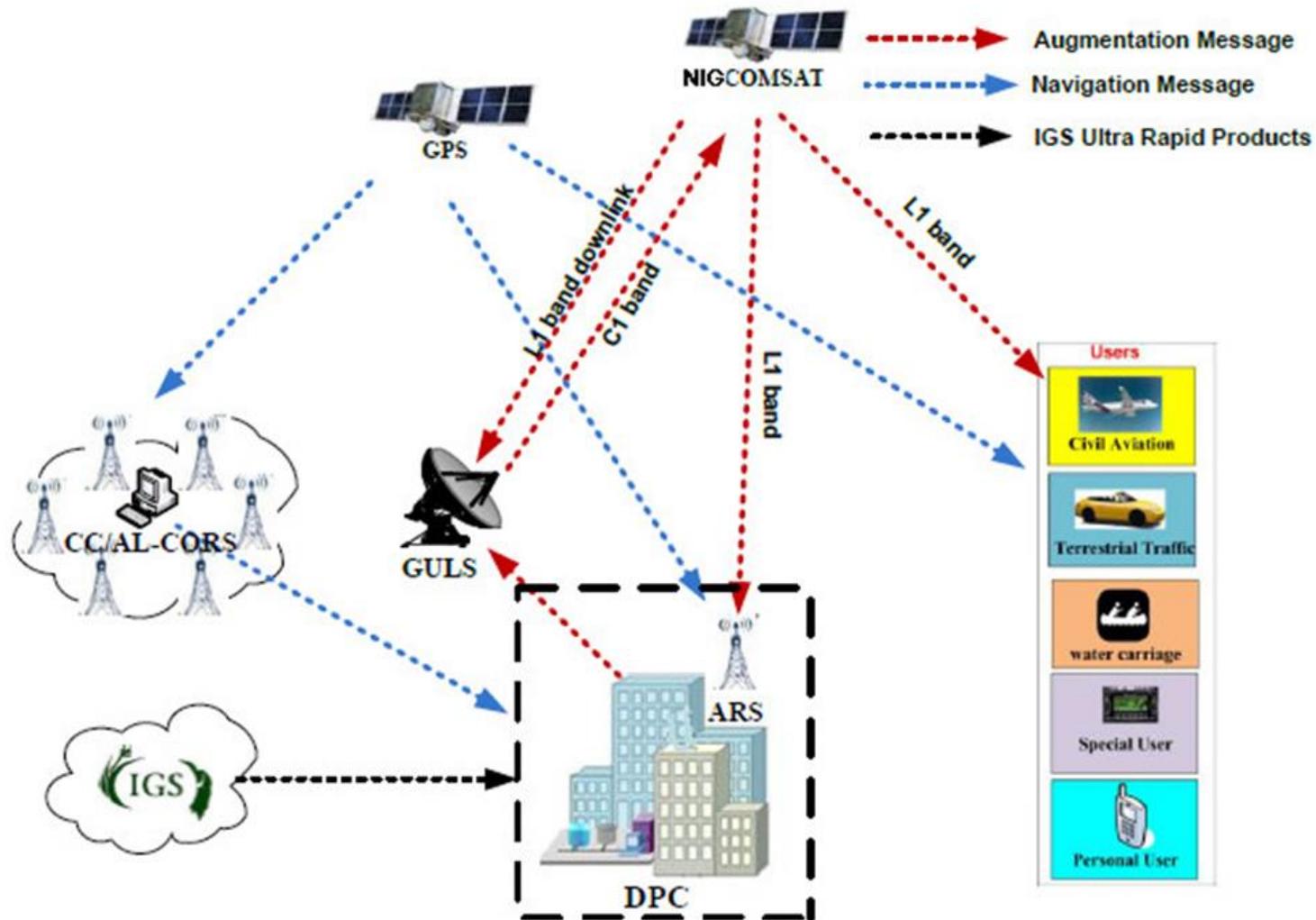
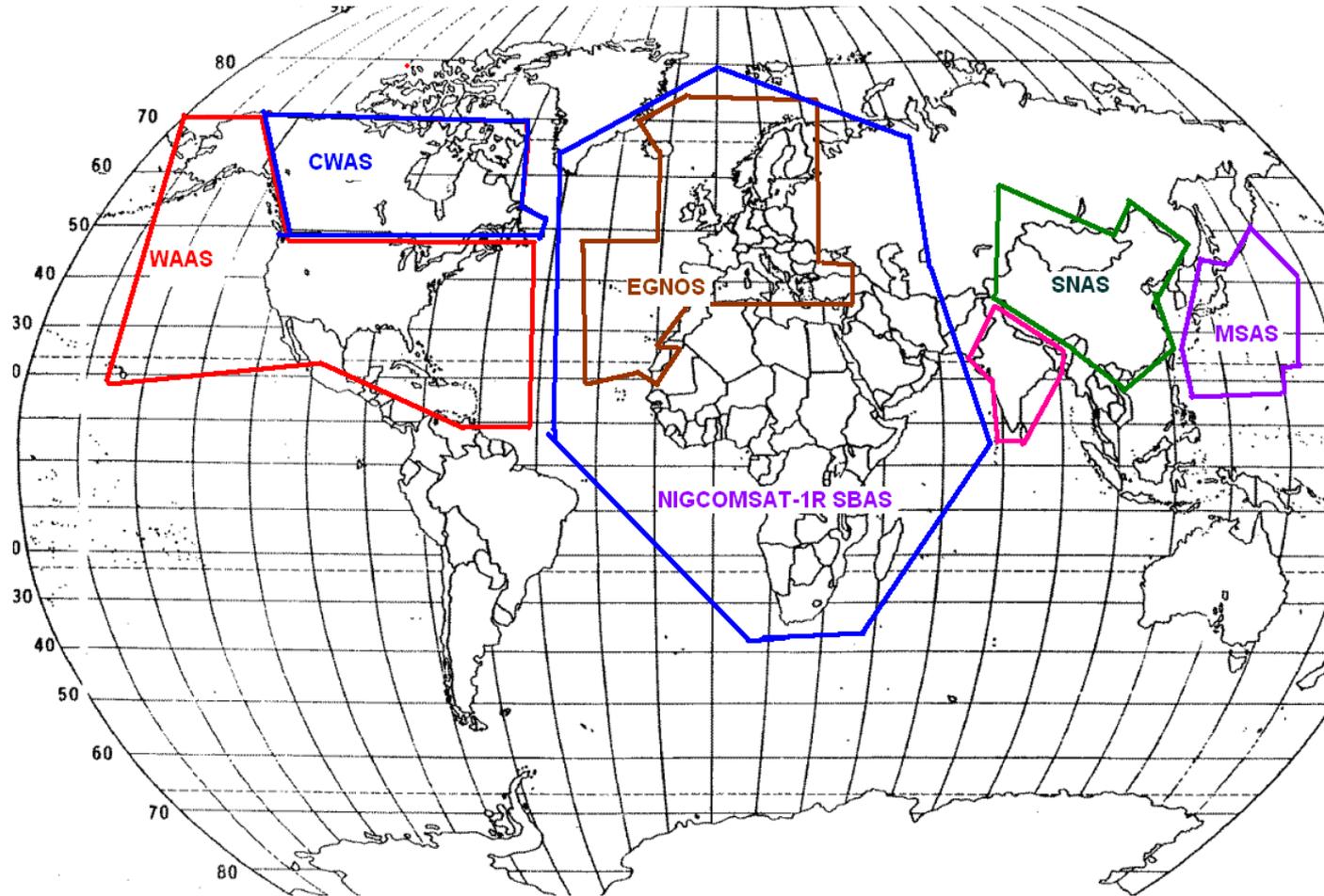


Illustration of Regional Satellite Based Augmentation System and NIGCOMSAT-1R SBAS as NSAS



WAAS: US Wide Area Augmentation System

EGNOS: European Geostationary Navigation Overlay Service

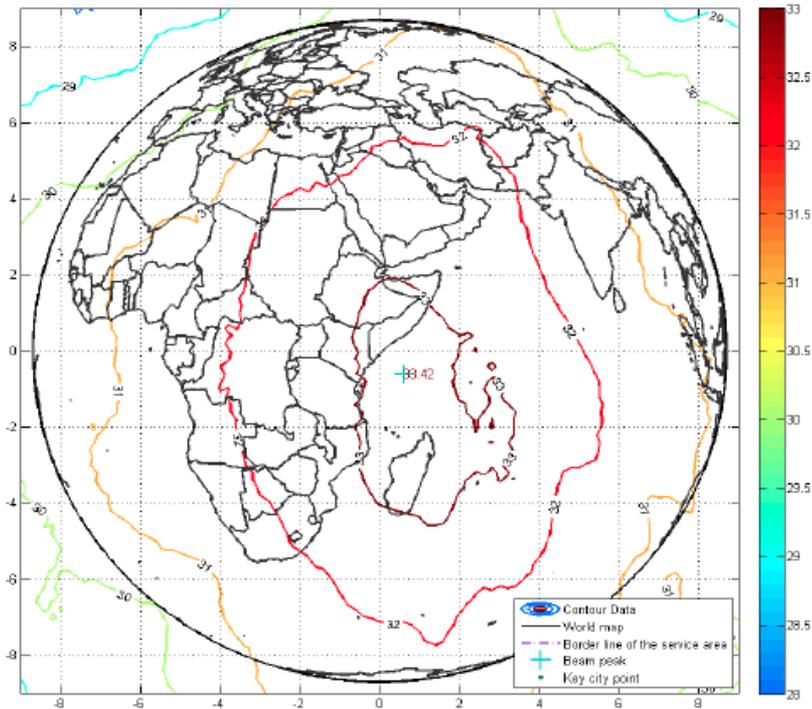
CWAAS: Canadian Wide Area Augmentation System

MSAS: Japanese MTSAT Satellite Augmentation System

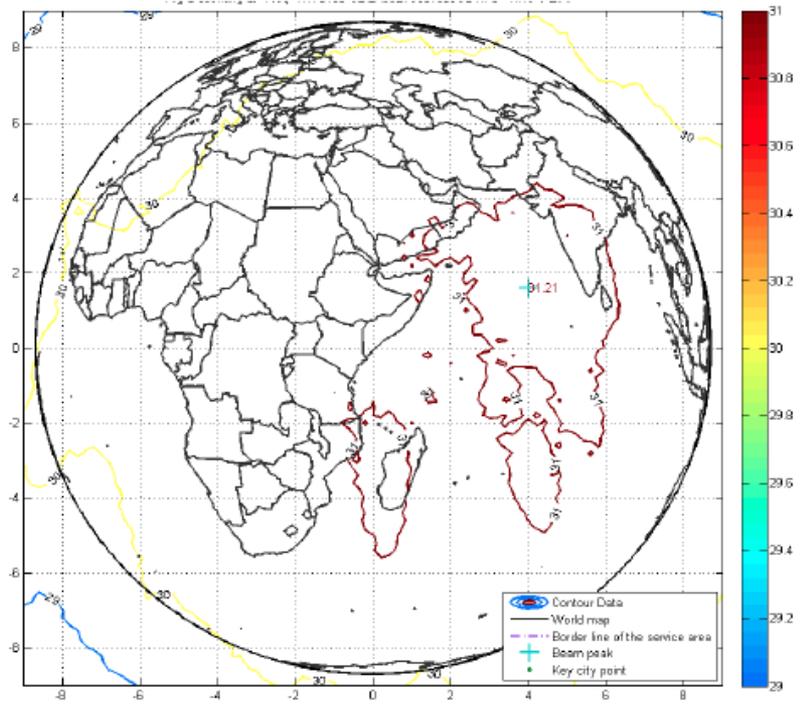
SNAS: Chinese Satellite Navigation Augmentation System

NSAS: Nigerian Satellite Augmentation System

NIGCOMSAT-1R NAVIGATION PAYLOAD: AFRICA'S PREMIER CONTRIBUTION TO SBAS AS A REGIONAL SATELLITE-BASED AUGMENTATION SYSTEM FOR THE CONTINENT.



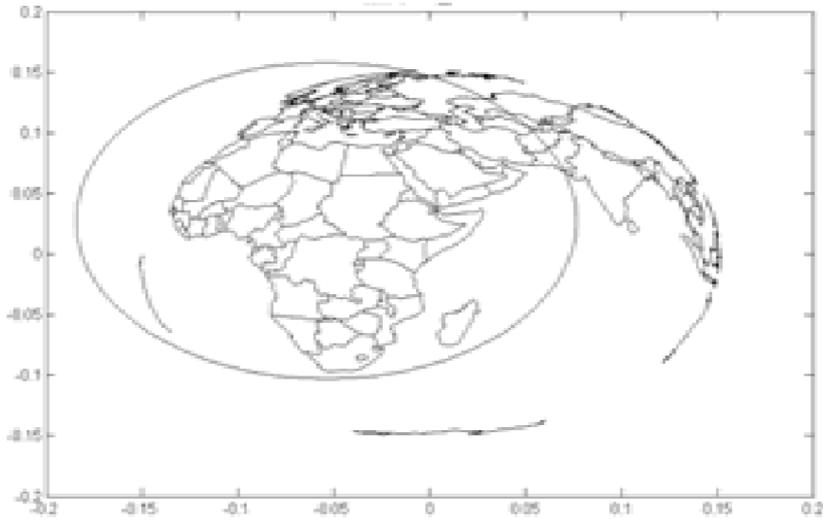
The downlink coverage beam of NIGCOMSAT-1R
Geo-Navigation Satellite in L1 Frequency



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

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

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



The uplink coverage beam of NIGCOMSAT-1R Geo-Navigation Satellite using L –Band Helix Antenna.



NIGCOMSAT Master Control Station with C-L Band Antenna Systems



10MHz Master Oscillator

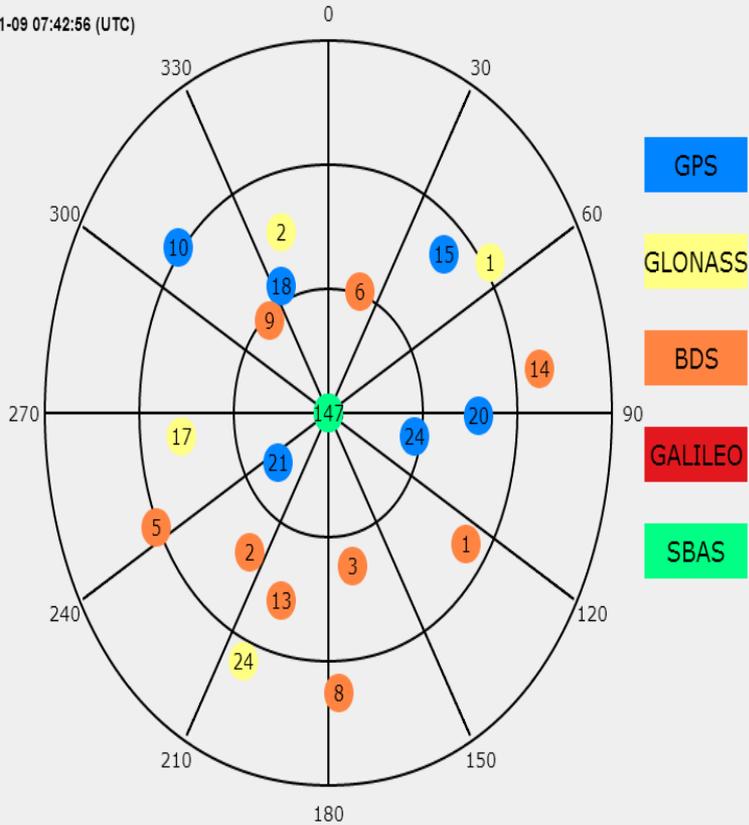
**10MHZ ULTRA STABLE
CRYSTAL OSCILLATOR (Timex)
WAS USED FOR THE L-BAND
PAYLOAD TO MEET THE
PERFORMANCE
REQUIREMENTS OF
FREQUENCY CONVERSION
STABILITY AND ACCURACY.**

NSAS Performance with PRN Code 147.

26

Tracking Skyplot

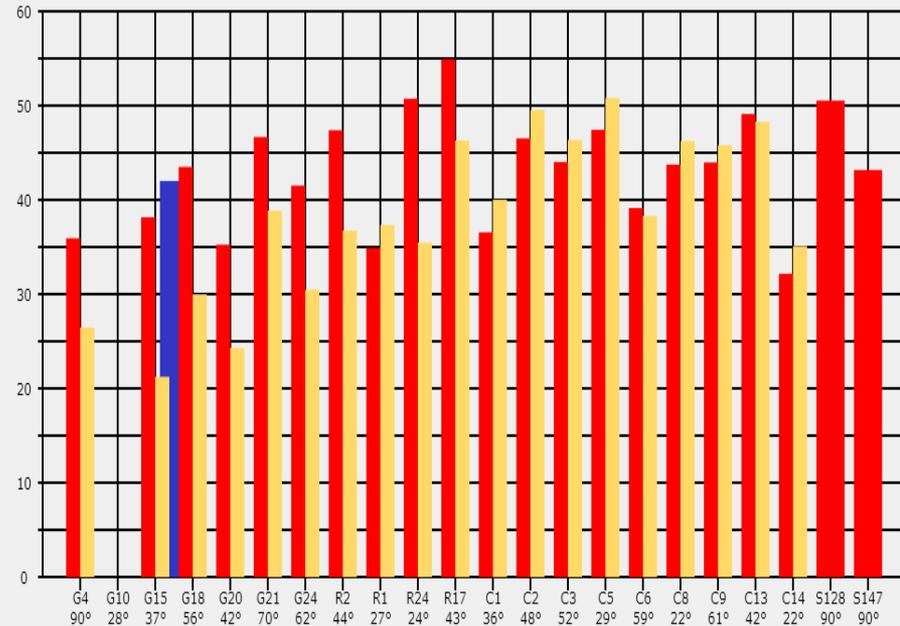
2017-11-09 07:42:56 (UTC)



Tracking Graph

Satellite Type: GPS (G) GLONASS (R) BDS (C) GALILEO (E) SBAS (S)

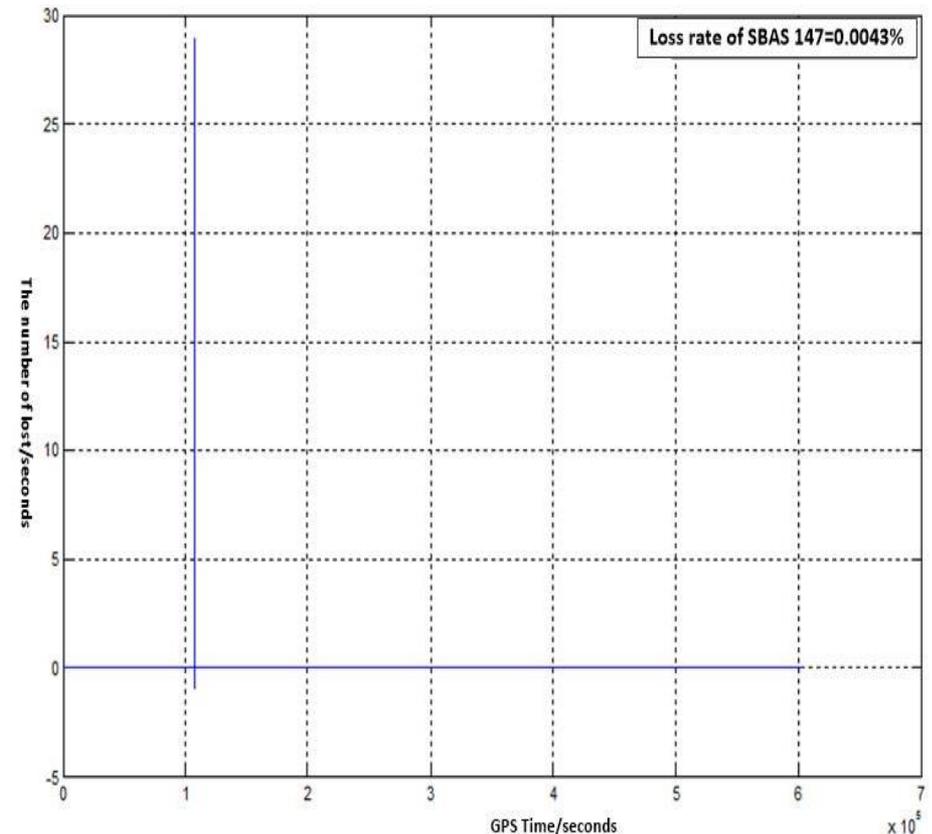
SNR: L1/B1 L2/B2 L5/B3



NSAS Performance with PRN Code 147.

27

- **System positioning accuracy**
SBAS_SPP: $H < 2.0\text{m}$, $V < 3.0\text{m}$
SBAS_PPP: $H \leq 10\text{cm}$, $V \leq 10\text{cm}$
- **System positioning accuracy will achieve better precision after full deployment.**
- **Continuity Risk Probability**
 $1 \times 10^{-4}/\text{h} \sim 1 \times 10^{-5}/\text{h}$
- **Integrity Risk Probability $1 \times 10^{-7}/\text{h}$**
- **Reliability: $> 99.99\%$**
- **Clock Estimation Accuracy: 0.3ns**



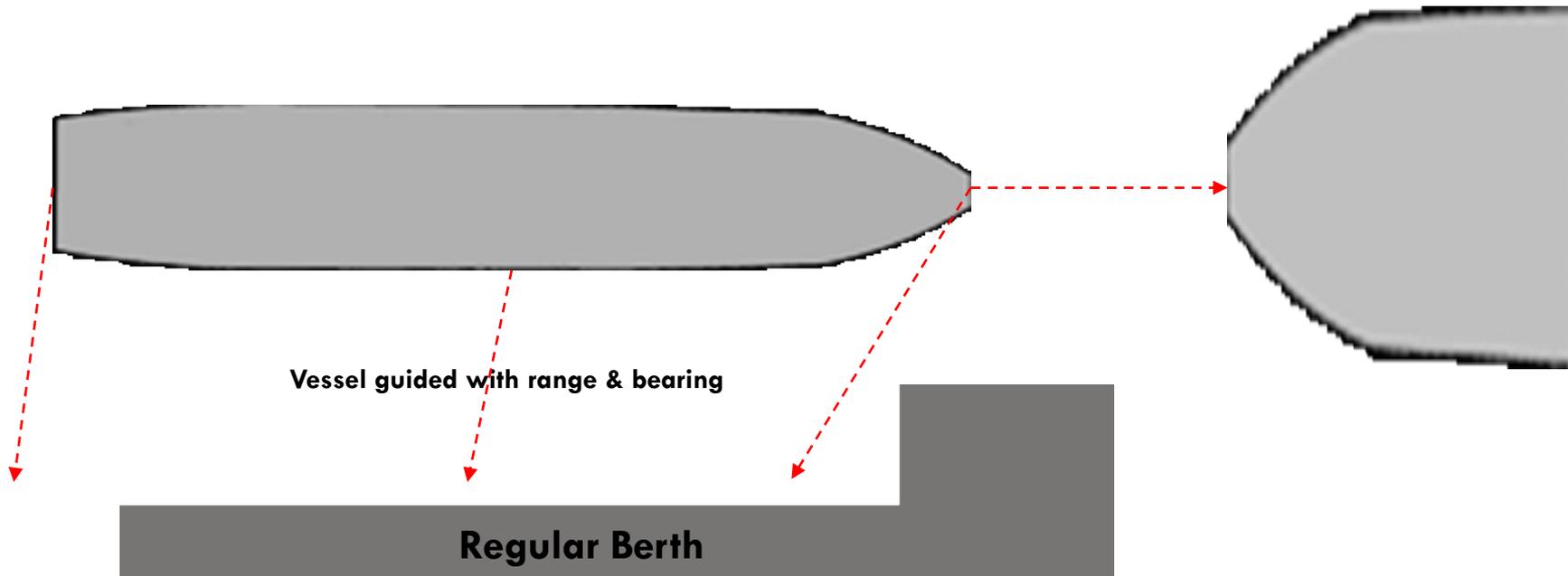
AVIATION

- Precision Approach Guidance.
- Positioning and Timing of Field Operations on dissidents (Boko Haram) to ensure security of life and properties particularly in North-Eastern Nigeria.
- Guidance for rescue operations.



Port Approaches, Auto Docking System, Vessel Safety

- Relative position of vessel can be calculated to $<20\text{mm}$ accuracy
- Range of uses enormous



- Vessel can easily be guided into eg. For liftings, or into a regular berth
- Range up to 10km

FLEET MANAGEMENT AND SAFETY OF ELECTORAL OFFICERS AND JOURNALISTS IN HOT SPOTS WITH HANDHELD, MANPACK, WRIST-BASED, CHIP-BASED & VEHICULAR BASED GNSS/SBAS

- Vehicle Tracking, Troops & Fleet Management with integrated GIS system.
- Demographic Information of Assets



Survey/Civil Engineering/Agriculture/GIS



Land Surveying



Land Slide



Precision Agriculture



GIS Collectio

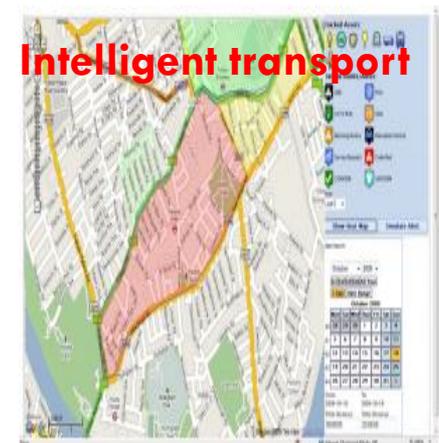
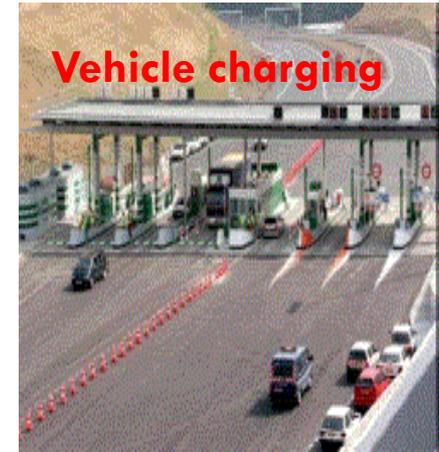
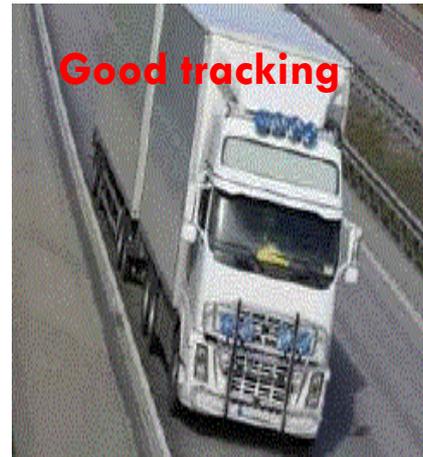


Cadastral & Construction Surveying

For the high precision applications, the GNSS/SBAS terminals with sub-meter level position accuracy can be used for land surveying, slide, etc.

Road Transportation

- Vehicle Tracking, Fleet management and Integration with GIS systems
- Demographic Information
- Infrastructure-less Tolling
- Telematics
- Traffic Management



Train Transportation

- Automatic tracking and inspections.
- The prevention of collisions, derailments, work zone incursions, and rail switch errors.
- Automatic speed control / braking
- The increasing of capacity and efficiency for all rail users.
- Position control, loading and unloading operations



OTHER GNSS/SBAS APPLICATIONS ARE:

- Aviation, Road and Rail Transportation
- Survey, Civil Engineering, Cadastral and Construction.
- Security of National Infrastructure: Pipelines, Power Lines, Gas Reservoirs, Strategic national Infrastructure.
- Improved Agricultural Practice with high yield.
- Improved Emergency Services, Recovery Services, Search & Rescue etc
- Utility Management: Energy and Communications Company for synchronization.
- Geographic Information System Companies
- Tourism
- Telematic Services i.e Insurance Companies
- Environmental Protection, Characterization and Demography
- Paramilitary Organizations, Security Agencies etc
- Scientific Research

STRATEGIC NATIONAL COLLABORATORS, AGENCIES, MINISTRIES AND CLIENTS.

- ❑ Ministry of Communications (our parent ministry and agencies)
- ❑ Ministry of Transportation (Aviation)
- ❑ Ministry of Agriculture and Rural Development
- ❑ Ministry of Defence
- ❑ Defence Headquarters
- ❑ Nigerian Army
- ❑ Nigerian Navy
- ❑ Nigeria Air Force
- ❑ Defence Space Administration
- ❑ Office of the Surveyor General of the Federation and State GIS Agencies
- ❑ NIMASA (Maritime)
- ❑ National Space Research and Development Agency
- ❑ Civil Engineering/Construction Firms
- ❑ ASECNA

ASECNA

- ASECNA is an agency for Aerial Navigation Safety in Africa and Madagascar and was established on December 12, 1959 at Saint Louis in Senegal.
- ASECNA still remains an accomplished model of collaborative management of airspaces after more than half a century with full financial autonomy.
- ASECNA is a big player and stakeholder in Africa's aviation sector particularly Francophone countries and they just launched an SBAS initiative and program starting with phase B.
- The purpose of this phase is to define the way SBAS system, a new performance-based Navigation shall be deployed at best for the needs of the ASECNA service areas and the continent as a whole over legacy systems in the aviation sector. Many other regions of the continent already raised interest on SBAS such as South Africa, Eastern Africa, West African countries and we are working hard with partners to ensure timely service delivery.

EAST AFRICA SBAS SENSITIZATION



WE WERE ACTIVE PARTICIPANT IN THE RECENT UNESCO 5TH AFRICA ENGINEERING WEEK HELD AT MOMBASSA-KENYA ON 17TH -21ST SEPTEMBER, 2018 AND NIGERIA USED THE OPPORTUNITY TO BECKON ON GOVERNMENT OF KENYA, EAST AFRICAN NATIONS, SENIOR GOVERNMENT OFFICIALS IN THE AVIATION AND MARITIME SECTOR, GOVERNMENT OF AFRICAN COUNTRIES AND INTERNATIONAL DELEGATES TO COLLABORATE/PARTNER WITH NIGCOMSAT FOR FULL IMPLEMENTATION OF NIGERIAN SATELLITE AUGMENTATION SYSTEM IN THE CONTINENT.

WEST AFRICA SBAS SENSITIZATION



WE WERE ACTIVE PARTICIPANT IN FINAL INTERNATIONAL CONFERENCE ON GLOBAL NAVIGATION SATELLITE SYSTEMS APPLICATIONS IN AFRICA (SBAS AFRIQUE) ON 17-18 MAY 2017, HOTEL SARAKAWA, LOMÉ –TOGO AND NIGERIA USED THE OPPORTUNITY TO BECKON ON WEST AFRICAN NATIONS, SENIOR GOVERNMENT OFFICIALS IN THE AVIATION SECTOR TO COLLABORATE/PARTNER WITH NIGCOMSAT FOR FULL IMPLEMENTATION OF NIGERIAN SATELLITE AUGMENTATION SYSTEM IN THE CONTINENT.

PROPOSAL TO JOIN GNSS PROVIDERS' FORUM DURING ICG-13 MEETING, XI'AN-CHINA.

Nigeria through NIGCOMSAT; operator/managers of NIGCOMSAT-1R Satellite with Navigation Overlay Service (NOS) officially request to join GNSS Providers' Forum as a Regional Satellite-Based Augmentation System Service provider with Coverage over African Continent and Surrounding Oceans (Atlantic and Indian).

CONCLUSION

Nigeria beckons on ICG, Members, Associate Members, GNSS/SBAS Technocrats and International delegates and National/International Institutions (Government & Private Enterprise) to collaborate/partner with Nigerian Communications Satellite for full implementation of Nigerian Satellite Augmentation System to fill the great hiatus in Augmentation System for Africa.

QUESTIONS ???

