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

At
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- BACKGROUND: NIGCOMSAT LTD/NIGCOMSAT-1R/NIGCOMSAT-1R FOOTPRINTS
- NIGCOMSAT’S RANGE OF SERVICES
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- SITUATIONAL ANALYSIS (GLOBAL & NATIONAL) IN AVIATION AND MARITIME SECTOR
- NIGERIAN SATELLITE AUGMENTATION SYSTEM (NSAS).
- SOLUTIONS, APPLICATIONS AND SERVICES
- PROPOSAL
- CONCLUSION
The Nigerian Communications Satellite (NIGCOMSAT) is a Government owned agency established 4\textsuperscript{th} April, 2006.

We provide innovative and cutting-edge satellite communications solutions by operating and managing a geostationary communication satellite NigComSat–1R.

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-1R

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

ECOWAS C-BAND COVERAGE

ECOWAS I KU-BAND COVERAGE

ECOWAS II KU-BAND COVERAGE

ASIA KU-BAND COVERAGE

KA-BAND COVERAGE OVER NIGERIA

KA-BAND COVERAGE OVER SOUTH AFRICA

KA-BAND COVERAGE OVER EUROPE

GLOBAL NAVIGATIONAL COVERAGE IN L-BAND
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

- 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)

https://www.statisticbrain.com/airplane-crash-statistics/
Major Air Crash in Nigeria in Recent Times

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

Motivation, Problem Statements and Needs Assessment in Maritime Sector
Needs Assessment of GNSS/SBAS Applications in Ship Piracy, Tracking, Monitoring and Marine Safety
Needs Assessment in Safety of Vessels (Structural Deformations, Hogging, Sagging etc)
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
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 (€bln)

* CAGR: Compound Annual Growth Rate
GLOBAL 2016 SATELLITE INDUSTRY ASSOCIATION (SIA) INDICATOR SUMMARY REPORT

$208.3B
2015 Global Revenues

$58.9B
Satellite Services
Growth 2014 - 2015

$127.4B
Satellite Services
4%

$16.6B
Satellite Manufacturing

$5.4B
Launch Industry

$18.3B
Consumer (Non-GNSS)

$31.0B
Consumer (GNSS)

$6.6B
Non-U.S.

$10.0B
U.S.

$17.9B
Fixed

$104.3B
Network

$9.6B
Ground Equipment
1%

$3.6B
Non-U.S.

$1.8B
U.S.

Prepared by:
THE TAURI GROUP
GLOBAL 2017 SATELLITE INDUSTRY ASSOCIATION (SIA) INDICATOR SUMMARY REPORT

2016 Satellite Industry Indicators Summary

$260.5B
2016 Global Revenues

$113.4
2% Growth 2015 – 2016

$113.4B
Satellite Services

$104.7
Mobile ($3.6B)

$17.4
Earth Observation Services ($2.0B)

$127.7B
Satellite Manufacturing

$13.9B
Non-U.S.

$5.0
GNSS*

$84.6
Launch

$5.5B
Launch

$18.5
Non-U.S.

$3.3
U.S.

*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.
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)
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

<table>
<thead>
<tr>
<th>Channel</th>
<th>Frequency (MHz)</th>
<th>Polarization</th>
<th>Bandwidth (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1-Downlink</td>
<td>1575.42</td>
<td>RHCP</td>
<td>4</td>
</tr>
<tr>
<td>L5-Downlink</td>
<td>1176.45</td>
<td>RHCP</td>
<td>20</td>
</tr>
</tbody>
</table>

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

10MHz ULTRA STABLE CRYSTAL OSCILLATOR (Timex) was used for the L-Band Payload to meet the performance requirements of frequency conversion stability and accuracy.

NIGCOMSAT Master Control Station with C-L Band Antenna Systems.
NSAS Performance with PRN Code 147.
NSAS Performance with PRN Code 147.

- System positioning accuracy
  - SBAS_SPP: H < 2.0m, V < 3.0m
  - SBAS_PPP: H ≤ 10cm, V ≤ 10cm

- System positioning accuracy will achieve better precision after full deployment.

- Continuity Risk Probability 1x10^{-4}/h \sim 1x10^{-5}/h

- Integrity Risk Probability 1x10^{-7}/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.
Maritime Navigation

- Ocean Navigation
- Restricted waters guidance
Port Approaches, Auto Docking System, Vessel Safety

- Relative position of vessel can be calculated to <20mm accuracy
- Range of uses enormous

- Vessel can easily be guided into e.g. 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
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

Good tracking

Vehicle charging

Traffic Management

Intelligent transport
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.
➢ 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 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.
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.
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.
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).
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.