SPACE UNITES THE WORLD

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"Today's world is not driven by wealth of nations in terms of natural resources, but by technological advancement which has space technology as one of its drivers." - Rabiu (2006).

1.0. Introduction

This very week the world commemorates the launch of the first satellite, named Sputnik by the Soviet Union, into elliptical low Earth orbit on 4th October 1957 at about 7:28 pm universal time. The launch signified the beginning of the Space Age and triggered the Space Race. Apart from the global excitement attached to it, Sputnik itself provided scientists with valuable information such as: the density of the upper atmosphere deductible from its drag on the orbit, and information about the ionosphere through the propagation of its radio signals. The launch of the satellite was preceded by a well-planned global initiative known as 'International Geophysical Year IGY and its cooperation which ran from 1957 through 1959. Rabiu (2006) reported that the 'International Geophysical Year (IGY) in 1957 was an international multidisciplinary programme to study global phenomena of the Earth and geospace, and was inspired by the success of the International Polar Years of 1882–83 and 1932–33. The spectrum of investigation covered by IGY included meteorology, geomagnetism, airglows, aurorae, ionospheric physics, solar activity, cosmic rays, glaciology, oceanography, seismology and gravimetry. The IGY involved about 60 000 scientists from 66 nations, working at thousands of stations from pole to pole to obtain simultaneous, global observations on Earth and in space. The years preceding the IGY witnessed the establishment of new geophysical observatory sites all over the world in a global cooperation effort. Geophysical activities were closely coordinated for the first time in history. The extension programme to IGY in 1958 was called the International Geophysical Cooperation (IGC).'

It was just few months into the beginning of the highly successful IGY that the Soviet Union dazzled the world with the launch of SPUTNIK. Ever since the launch of Sputnik, there has been increasing attempt by humans to harness the space environment to improve the lots of man on earth. The 1970s was a landmark decade for sustained observation from space and for progress towards a capability for integrated modelling of the Earth system (Simmons et al., 2016). 1972 in particular saw the launch of the first of what is now known as the Landsat series of Earth-imaging satellites, of which the latest is the currently operational Landsat 8. It also saw the launch of NOAA-2, the first of an unbroken series of operational satellites carrying instruments that provide soundings of atmospheric temperature and humidity. Nowadays we have numerous satellites that bear probes capable of monitoring magnetic field of the earth, landslides, land motion, and earth's interior. So far, according to the NASA National Space

Science Data Center NSSDC Master Catalog, over 40,000 tracked objects including about 7000 Satellites had been launched into space environment and sustained in their orbits by laws of Physics (Rabiu, 2015). As at today, over 1,000 operating satellites orbit the Earth; about 59% of satellites are used for communication, 8% for navigation and 7% for military surveillance.

In our quest for better life on earth, space scientists and engineers have been able to transcend beyond the terrestrial and found home in space (the extra-terrestrials) setting up varieties of satellites and even transit abode known as the International Space Station in Space. This ISS was set up by US NASA in collaboration with ESA and JAXA. The Chinese Space Program is setting up a similar structure in space called 'Shenzhou' targeted for completion by 2020

Today, virtually all the technological systems of the world is being driven by space entity. The theme of this year's World Space Week is "Space Unites the World" and focuses on how space brings people around the world together. Thus in this paper, attempt is made to show case how space is being engaged to unite the world via promotion of peace and sustainable development.

2.0. Space-dependent Technology and space products

Space technology is defined as any technology that takes advantage of knowledge of unique properties/conditions of space environment to set up machines/tools in space in order to deploy deliverables for benefit of man on earth or other planets. I prefer the term: "space dependent technology". Space products are products of space dependent technology. A satellite is any object or body which revolve in orbit about a planetary body. A satellite could be a natural satellite like the moon which is the only natural satellite of planet Earth, while planet Jupiter has up to 16 satellites or moons. Today space activity, via satellite technology, is an essential component of the information age, enabling the global gathering, distribution and use of data and information, creating and sharing knowledge about the world and its environment on an unprecedented scale. This information age is having a profound influence on the world. Timely exchange of information is very vital for maintenance of peace and unity.

Space-dependent technologies are technologies which depend on use of satellites that are in orbits. These include satellite technology, navigation technology, information technology, and communication technology among others. Products of space-dependent technologies include tropospheric weather report, GSM telephony, transaction of business with credit/ATM cards, online/mobile banking, navigation by GNSS – personal, air, sea, land, surfing the Internet, cable (Satellite) television services, and modern military warfare.

Today, space technology has become a major driver of financial transactions, food security (agriculture, precision farming etc), education, tourism, health, land administration, military, social security /public safety, navigational systems (autonomous navigations, UAV etc, air, land & sea navigation), communication, boundary mapping, disaster management, emergency response, wild life management. The application of space technology is on increasing level. Apart from tremendous derivable socio-economic benefits, it is no gainsaying that space technology promotes peaceful co-existence among nations of the world and promote unity among mankind.

2.1. Communication Technology

Communication technology mostly depend on Earth-satellite communication system whereby transmitting signals, which may be voice or data (Imageries), pass through space environment to be received on Earth. Today Global System for Mobile communication 'GSM' means of communication is dependent on space technology as it is sustained by communication satellites

and other allied systems. Several years ago, Nikola Tesla, a great physicist, precisely in 1926 in his scientific imagination stated that:" "when wireless is perfectly applied the whole earth will be converted into a huge brain, which in fact it is, all things being particles of a real and rhythmic whole. We shall be able to communicate with one another instantly, irrespective of distance. Not only this, but through television and telephony we shall see and hear one another as perfectly as though we were face to face, despite intervening distances of thousands of miles, and the instruments through which we shall be able to do all of this, will fit in our vest pockets."

Today, we communicate freely with GSM and maintain contacts with every of our loved ones in a free society where distance and time pose no barrier. we exchange pictures and movies on real time basis. What a sense of unity we share as we talk and behold ourselves face to face via all manners of call systems such as skype, whats app, facebook, snap chats etc. Space dependent telephony system has indeed unified the world made it a global village.

One could only imagine the homes that would have been broken without such communication tools, or even the wars that would have erupted without such telephone conversations. It is easy to recall the famous phone conversation initiated by the immediate former president of the Federal Republic of Nigeria, His Excellency Goodluck Jonathan, to the then presidential candidate of the All Propgressive Party APC, conceding defeat even before the conclusion of the 2015 presidential election. Such peace-making phone conversations preserve the unity of nations.

2.2. *Space and Information dissemination*

All forms of broadcasting had become space dependent. Television services are now satellite based. Today we have DSTV, GOTV, TSTV etc operating all around us. Even television service providers that cannot afford to own satellites are now aligning with satellite TV service providers. The implication is enormous. Information now comes to us at real time and news - voice or print - are no longer stale anymore! Live broadcast of events from any location on earth has become a reality with satellite television. Imagine the joy of the whole world watching the world cup matches live. Imagine the population of Japanese people that glued to their television sets when Naomi Osaka, at 20, won the US open in women's singles on 8th September 2018 and became the first Japanese woman to ever win a grand slam. No thanks to the umpire-provoked outburst by Serena Williams.

Still, in the world of sports, the video assistant referee VAR technology being engaged by FIFA and widely used at the just concluded world cup would not have been possible without space technology. The video assistant referee (VAR) is a football assistant referee who reviews decisions made by the head referee with the use of video footage and a headset for communication. Today we watch live matches in company of friends and relatives. These live matches come with uniting force. For example great soccer nations of the world, such as ours and all South American countries, are always bound together during great tournament or matches. Live broadcasts of the 2018 world cup brought so much unity and joy to Nigeria; and douse tension during the tournament. It is sufficient to say that apart from the entertaining tendency, such live broadcast of sports activities has unifying force.

The FIFA World Cup Russia 2018 has seen record breaking online viewing figures, thanks to advances in space technology and the unprecedented mobile media streaming market. The 2014 FIFA World Cup Final between Germany and Argentina was watched by 562 million people on average during the 120 minutes of play (Richter, 2018). Nearly 700 million people watched at least 20 minutes of the game at home and more than a billion watched it at home or at a public place.

Tobin (2018) has revealed that during the first week of the World Cup, 393 million plays of matches were successfully streamed, the equivalent of 6.9 billion viewing minutes, via 59 million unique video streaming apps. Cloud delivery platform Akamai reports that viewers of the first round of Russia 2018 streamed 65% more data over the Akamai Intelligent Platform than they did during the whole of the Rio World Cup just four years earlier. The number of streams running concurrently hit a record 9.7 million, when Mexico played Sweden at the same time as South Korea played Germany on June 27, 2018. The viewing peak the company recorded hit 5 million for the entire tournament in Rio 2014. This also occurred when two games were played simultaneously – the US versus Germany and Portugal versus Ghana.

2.3. Global Navigation Satellite Systems GNSS

Global Navigation Satellite System, GNSS, is the standard generic term for satellite navigation systems that provide autonomous geo-spatial positioning with global coverage. A satellite navigation is a system of satellites that provide autonomous geo-spatial positioning with global coverage and allow small electronic receivers to determine location (longitude, latitude, altitude/elevation and time) using time signals transmitted along a line of sight by radio from satellites. Today we have GPS, GLONASS, GALILEO, BEIDOU, QZSS and IRNSS**.** Such a system consists of three segments: Space Segment, Control Segment and User Segment. For example, the space segments of the US GPS is made of constellation of satellites at about 22,000 km altitudes. GNSS - a space-dependent technology- has wide applications in surveying, land administration, road transport, aviation, personal navigation, environment and agriculture, civil protection and surveillance, maritime transport, and wildlife conservation.

In Nigeria, GNSS is engaged in various Geographical Information System used in land administration which also help in settling land dispute. It is being engaged at moment to develop the African Geodetic Reference Frame AFREF, a unified geodetic reference frame which shall be fully consistent and homogeneous with the International Terrestrial Reference Frame ITRF. Such a geodetic reference frame is capable of solving issues problems of boundary disputes among nations and towns, such as Bakassi crisis between Nigeria and Cameroon. Land disputes is a major source of clash between nations and neighboring communities. It is clear that application of GNSS in land administration is capable of uniting neighbouring nations and communities.

2.4. Modern Military defense systems and Peace Keeping missions

Today military defense systems is space-dependent. Signal transmission is done using space dependent systems. Robotics are engaged in military operations and space commands are being created everywhere. Navigation for defense purpose is space based and drones are often engaged in military surveillance and general operations. The Federal Government of Nigeria established the Defence Space Administration DSA on 9 October 2014. The DSA Act 2016 was enacted by the 8th National Assembly and signed into law on 3 February 2017. Early this year, 3 years after Nigeria has set the pace, the United States government established the 'Space Force'. The military operation that was used to eliminate the master mind of the 9-11 terrorist attached in the USA, Osama Bin Laden was largely space-dependent.

2.5. Space and Financial Transactions

All manners of financial transactions are now largely dependent on space-based technology. E-banking is gaining prominence. The volume of e-transaction has cumulatively outgrown cash-at-hand transaction. Indeed we are heading towards an era of cashless economy as financial transaction is increasingly becoming space-dependent. Thus space is fast becoming the ultimate

financial platform. Space products had made financial transaction to become a fun. Exchange of fund from dependants to breadwinners has never been a fun as well.

2.6. Healthcare

Telemedicine, a medical practice that utilizes product of space technology and ICT in health care delivery, makes it possible to treat disease or injury by consultation with a specialist in a remote area by means of a computer or satellite link. It makes health care readily available at all levels of demand irrespective of the remoteness of the location. Telemedicine readily unites medical practitioners and their patients irrespective of the distances between them.

2.7. GPS for tracking purpose

GSM telecommunication system is synchronized with GPS systems. GSM users are now track-able – position and time. Location identification is enabled on mobile phones nowadays. GSM is now engaged in crime control and public safety. It was the tracking of GSM phone that led to the arrest of Mallam Kabiru Sokoto, a bomber, at Mutum-Biu, in Gassol LGA Area of Taraba, where he was hiding inside a wardrobe [http://www.naijaurban.com/phone-call-to-abu-qaqa-gave-kabiru-sokoto-].

As far back as about 2008, school children in Japan wear GPS chips under their collars for tracking purpose. Smart shoes are now being equipped with GPS chips. The shoe is ideal for keeping an eye on Alzheimer's patients from afar via the convenient online Viewing Portal. If the wearer wanders out of the designated area, you will receive a warning via text message [http://www.gpsshoe.com/]. what a way of bringing people together!

2.8. Public safety and space technology

Public safety is of great economic concern when it comes to investment in any nation. Citizenry dwell in peace and in one accord when there is assurance of safety. Patronage of space-dependent technology holds the key to solving our present security crisis in Nigeria. Kidnappings, armed robbery, vandalisation of public infrastructure and terrorism are menaces that space technology has solutions to. For instance, an effective aerial surveillance which can be achieved with constellation of high resolution Earth Observation Satellites EO's in network with some Unmanned Aerial Vehicles UAV, distributed surface mounted cameras, some ground control rooms equipped with customised ICT and experts, are all we need to effectively man our country land and borders. This kind of system would complement our security outfits and build confidence in any investor. Have you wondered how Brussels and United States detected terrorists behind the bombings of the Brussels airport of 22nd March 2016 and Boston marathon of April 15, 2013 respectively within few hours?

It has recently been disclosed that the Federal Government has acquired Unmanned Aerial System, UAS, technology at the border town of Daura, Katisna State, with a view to aiding security and intelligent agencies across the country to track criminals and miscreants that operate within the border communities (Ochayi, 2018)

3.0 Monitoring of space environment

Satellites are located in space environment at altitudes of 400 km and above. This unique environment deserves real-time routine monitoring as any instability in space environment can lead to any of the following: poor performance of satellites, signal loss/fade-out/scintillation/signal degradation, navigational errors, Geomagnetically induced current GICs, satellite loss, satellite drag, and interruptions of space-dependent services. Unavailability of all of these services can actually lead to loss of lives and properties defined as disasters

4.0. Capabilities of space technology products

Capabilities of space technology products include good governance, inhibition of corruption, creation of job opportunities, advancement of wealth creation, promotion of quality of living, Security of society/public safety, control of emigration, engagement of active mind, and provision of platform for sustainable manpower and socio-economic development

5.0. Nigeria & Space Technology

Nigeria has been involved in elements of space science and research since 1950s; and joined the space race in 1999 with the establishment of the National Space Research and Development Agency as a parastatal of the Federal Ministry of Science and Technology. Nigeria launched her first satellite in 2003. NASRDA has developed indigenous capabilities in space technology and its applications to advancing the course of our nation in different sectors. As at today, 3 Earth Observation Satellites have been launched into space - two operational: NigerSat 2 and NigerSat X ; NigerSat 1 de-orbited. Two communication satellites had been launched into orbits – 1 operational: NigComSat 1R ; NigComSat 1 de-orbited. It is evident that space technological capability has been acquired by Nigerians and a critical mass of native experts are available in the country to effect the needed sustainable development vis - a - vis via application of space technology.

5.1. Benefits of Nigeria Satellites (absolutely a private communication with the Department of Strategic Space Application of the National Space Research and Development Agency)

The contributions of the Nigerian space assets are enormous.

- Currently, NigeriaSat-X imageries are being used by more than 18 universities, 6 MDAs, and over 100 academic researchers across Nigeria, Africa, Europe, Asia and other parts of the Globe. For example: In 2012 during the flooding disaster in Adamawa and Kogi NASRDA produced maps that was used by NEMA to rehabilitate those affected by the flood.
- Provision of Laboratories- 21 Geographic Information Laboratories have been established in 21 Nigerian Universities and polytechnics with the aim of building their capacity to use NigeriaSat-2 and NigeriaSat-X satellite images.
- Training of over 1000 Nigerians across MDAs and Donation of Satellite Imageries for research to several Nigeria tertiary institutions worth N3 Billion
- NigeriaSat-2 provides high-resolution imagery in a swath width of 20km, carrying a Disaster Monitoring Constellation (DMC) continuity payload that provides observation for global disaster monitoring.
- Nigeriasat-2 is part of the satellite platforms for the African Resources Monitoring Constellation (ARMC). Due to its high multi-spectral and geometrical resolutions, high radiometric sensitivity, revisit capabilities, wide area imaged by a single frame and the accurate geometrical processing that can be achieved.

NigeriaSat-1, 2 and X data are key sources of information for a wide range of applications related to urban areas. In the past 15 years, the satellites have provided relevant satellite datasets for resource monitoring/mapping and socio-economic and intelligence mapping across Nigeria and other parts of the globe, whilst also supporting our military with valuable satellite data set. These satellites in their life spans would prove effective and efficient in solutions to human questions in environmental and natural resource exploration and in Nigeria and Africa.

5.2. *List of Projects carried out by Using Nigeriasat 1, 2 and X are (absolutely a private communication with the Department of Strategic Space Application of the National Space Research and Development Agency):*

- Development of Early Warning Systems for Food Security in Nigeria Using NigeriaSat-1 and Other Satellite Data:
- Development of Models for Cassava Yield Prediction: An Exploratory Remote Sensing Option
- Abuja Image Map using Nigeriasat-1
- Mapping of Settlements and Major Roads in Nigeria
- Satellite-based Environmental Change Research in Niger Delta using Nigeriasat-1and other satellites
- Monitoring deforestation and implications for biodiversity in Nigeria using data from Nigeriasat-1 and other satellites
- Development of RS and GIS Predictive Models for Desertification Early Warning
- Mapping and Monitoring of the Impact of Gully Erosion in South East Nigeria:
- Development of Fadama Land Information Management System (FLIMS): To Boost Rice Production in Nigeria
- Using NigeriaSat-1 Images to Update Nigerian 1:250,000 National Topographic Maps
- Feasibility studies of integrated surface - ground water management of Lake Chad Basin using satellite images, climate data and hydrologic modelling
- Spatial-Temporal and Climate-Induced Water Resources Management in Kainji Lake Area
- Satellite Mapping and Monitoring of Irrigation Command Areas in Northern Nigeria.
- Mapping of Drivers Of Deforestation in Cross-River State (N2 & Nx) by NASRDA Collaboration with FAO (UNREDD)
- Assessment Of Effects Of Terrorism In North-West, Nigeria using Nigeriasat-2
- Mapping and monitoring of slum development in Abuja, Nigeria with satellite Remote Sensing and Geographical Information System
- Geo-spatial Technologies for Nigerian Urban Security and Crime Management - a study of Abuja Crime Hotspot/Coldspot Mapping and Analysis
- Automated Population Estimation using Remote Sensing/GIS Techniques using Nigeriasat 2 and other satellites
- Assessment of Vegetation cover in the Federal Capital Territory (FCT) using Geospatial Technique
- Monitoring the Human Impact Hotspot in Six Area Councils of FCT using Nigeriasat X and Landsat
- Dasymetric Approach to Population Estimation of Abuja Municipal Area Council Using NigeriaSat-X Satellite Image
- Parce-Based Urban Land Use/Landcover Classification of Abuja Using Medium Resolution Satellite Imagery (NigeriaSat-X).
- Developing Real Time Model For Road Safety Measures In Nigeria Using Geographical Information Systems And Remote Sensing (Nigeriasat-2)

5.3 Some Contributions of the NASRDA's Centre for Atmospheric Research 'CAR'

The Centre for Atmospheric Research 'CAR' is one of the seven autonomous specialized R & D centres of National Space Research and Development Agency 'NASRDA' - a parastatal of

the Federal Ministry of Science and Technology. CAR was established in January 2013 with a compelling mission to improve our understanding of the behaviour of the entire spectrum of the Earth's atmosphere; promote capacity development in relevant atmospheric sciences as a way of facilitating international competitiveness in research being conducted by atmospheric scientists; and disseminate atmospheric data/products to users towards socio-economic development of the Nation.

Our present research activities border on quality of the air around us, the annexation of solar energy, strengthening the accuracy of prediction of atmospheric and allied parameters for socio-economic purpose, safety of space environment over us and the improvement of the earth-satellite radio-communication systems which include tele-communication and all manners of ICT-dependent systems. Precisely, on 6th January 2018, we started the first daily nowcasting of the space weather condition in Sub-Sahara Africa. We continue to maintain our ways by engaging in field observations, promoting research and capacity building. Our activities are documented in our annual report series freely available in the public domain at our webpage - www.carnasrda.com.

In addition, over the years we have also established the following network of observatories: National Air Quality Research Laboratory, University of Ilorin (2014); Space Environment Research Laboratory SERL, NASRDA, Abuja (June 2015); Space-Earth environment Research Laboratory SEERL, University of Benin (September, 2016); the Atmospheric and Space Weather Research Laboratory ASWeR Lab, Osun State University, Osogbo (February 2017); and the Space Weather and Atmospheric Physics Laboratory SWAP Lab, Bayero University Kano (April 2017).

Our team of engineers at CAR had successfully worked with our local collaborators to develop an hybrid of weather stations and air quality monitors, as well as magnetometers. Also, our team of engineers had produced an unmanned aerial vehicle UAV with sensors capable of monitoring the altitudinal profile of atmospheric parameters including some GHGs from the ground level to pre-defined altitude of about 300 metres. These facilities operate with telemetry component, thus send data to dedicated server in our laboratory and compare well with imported products. Therefore, indigenous development of atmospheric facilities at CAR is already yielding results. Such innovation will play a technical supporting role in the development and industrialization that will promote our National Development.

6.0. Recommendations

The following are hereby recommended:

- Nigeria should embrace space technology to solve her numerous socio-economic and national security challenges
- Space program is a global cooperation that require active global participation
- Introduction of relevant courses that can enhance manpower development in space science and technology into our University curriculum – space physics, aeronautical engineering, space geodesy, remote sensing and GIS, etc
- Densification of ground based facilities for monitoring space environment: Instability in the space environment can lead to any of the following: interruption of space based services, poor performance of satellites, signal loss/fade-out/scintillation/signal degradation, navigational errors, geomagnetically induced currents, satellite loss, satellite drag among others.
- Domestication of satellite technology, the completion of the NASRDA's Assembly-Integration and Testing Laboratory should be seen as a priority
- increase in patronage of space-dependent technology

- review of our existing laws to permit patronage of space dependent products at all levels of development
- Review of present budgetary systems and procurement laws to favour Space science and technology

7.0. Conclusions

I hereby conclude that advances in space technology has made the Earth a better and more comfortable place to live in. With myriads of operational satellites domiciled in the space environment, space-dependent technologies have continued to ease the burden of terrestrial men in almost all human endeavours.

Today, virtually, every system has gone electronic and space-dependent, such that: we have e-commerce; e-agriculture; precision farming; autonomous navigation being used in air (auto-piloting), land and sea navigation; unmanned aerial vehicles; e-health, tele-medicine, autonomous aerial surveillance; Global System for Mobile Communication GSM, e-banking including the use of popular Automatic Teller Machines ATM and all sorts of credit/debit cards. It is obvious that human ability to harness the space technology has made the present day man more comfortable than any of his ancestors (Rabiu, 2015)

It is obvious that patronage of space-dependent products is capable of bringing people together and promoting peaceful co-existence among the people of the world.

Nigeria has the critical mass of experts within her borders that can actively harness space technology and its products to solve her present numerous challenges.

Space unites the world!

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