Human Resource Management Research 2013, 3(5): 178-187
DOI: 10.5923/j.hrmr.20130305.02

# The Role of Communication Satellites in Public Management, Education, Governance and Business in Nigeria

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**Abstract** Existing communication infrastructure in the African hinterlands is grossly inadequate, thus there is a need to develop national, regional and sub-regional carrier of carriers and digital links with cross-border inter-connectivity. Although, the continent has adequate capacity on submarine fibre optic cables along the shores of the African coastline, it lacks an adequate infrastructure within African countries including cross-border connectivity. The demand projection suggests that there is a need for a robust passive infrastructure built in and around Africa to address the large un-met demand for information and communication services. This paper examines NigComSat Ltd (a government company) strategic plan for ICT development in Nigeria as a vehicle to drive the National ICT revolution in pursuit of: national e-readiness, ICT self-reliance and the skills acquisition required for engineering and technology domestication to enable the socio-economic development of Nigeria.

**Keywords** Communication Satellite, E-Education, E-Government, ICT, Knowledge-Economy, NIGCOMSAT-1R

## 1. Introduction: What are ICTs and how should It be implemented in a Developing Nation?

The term information and communications technology (ICT) was coined to reflect the seamless convergence of digital processing and telecommunications.

ICTs include hardware, processes, and systems that are used for storing, managing, communicating and sharing information. These tools can be either manual or computerized (digital). This definition of ICTs extends to older non-digital devices such as analogue radio and television. Beyond hardware, i.e., computers, wireless devices, telecommunications towers etc.

ICTs include computer software and associated systems such as management methods and practices.

An ICT with a profound impact is the Internet, a worldwide network of computers connected through a robust digital technology called the IP protocol (Internet protocol), which permits the efficient routing, transmission and management of information between computers. Mobile devices such as cellular or mobile phones are also an essential class of ICTs.

E-Governance, short for Electronic Governance, is the use of ICT to modernize governance and transform it into a service-oriented public enterprise that works for the public good using online tools to connect to government agencies. An effective e-governance system can make a significant impact in creating a strong national identity, when the public can see that the national government is working on their behalf to improve their economic opportunities and living conditions. For countries that have lagged behind in developing their ICT infrastructure satellite technologies offer a rapid low-cost way of catching up with the developed economies; furthermore, such systems are less susceptible to criminal activities and sabotage than optical fibre land lines, which are also too expensive for sparsely populated areas. Current satellite power systems based on silicon photovoltaics have risen to power levels of 15kW, which along with quad band (Ku, Ka, C, L Band) and other technology enhancements has significantly increased the bandwidth that can be delivered via satellite. With the development of multi-junction gallium arsenide photovoltaic solar arrays delivering efficiencies as high as 44%, communications satellites are set to rise to the 50kW power level, with lifetimes of 20 years. When combined with space-based routers, these systems can compete very effectively with terrestrial landlines;[1],[2],[3],[4].

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Published online at http://journal.sapub.org/hrmr

## 2. Background Driver

Historically, there has been inequality in the access to basic infrastructure between those who live in urban centers and those in the rural areas.

This imbalance is now more evident with ICT infrastructure because of the increasing role that ICT applications play in the development sectors.

When the international community met at the Millennium Summit, they adopted the Millennium Declaration which recognizes: "the wide consensus that information and communication technologies (ICT) are central to the creation of the emerging global knowledge-based economy and can play an important role in accelerating growth, in promoting sustainable development and eradicating poverty in developing countries as well as countries with economies in transition and in facilitating their effective integration into the global economy"[5],[6].

### 2.1. Challenges in Accessing Information and Delivering Affordable Solutions

The challenges facing rural areas in Nigeria are enormous and the digital divide in Africa generally is huge.

African leaders and stakeholders have recognized the many challenges that confront their countries and have addressed them with adventurous development programs.

In addition to the recent launch of a communications satellite covering Africa and other regions, shown in figure 1, other telecommunication infrastructure such as optical fiber, microwave and base stations are growing through national development and regulatory policies involving the private sector and investors as shown in figure 2.

**Figure 1.** Shows NIGCOMSAT-1R and the Master Ground Station in Abuja for satellite control and resource management[7]

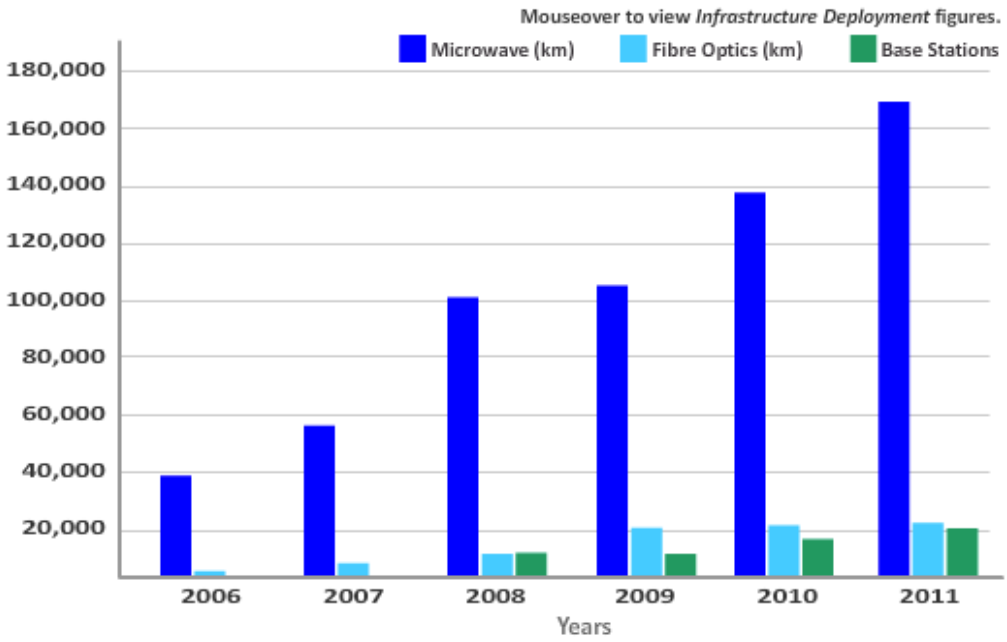


**Figure 2.** Shows growing telecommunication infrastructure (Fiber, Microwave and Base Stations) from 2006 to 2011 in Nigeria with distance in kilometers on the vertical axis[10]

Because of their crosscutting nature, ICTs are seen as crucial for the speedy implementation of all development projects and programmes that are meant to have a visible and positive effect on the lives of ordinary Africans.

Presently the major shortfalls identified are in the areas of ***infrastructures, technologies, finance and human resources*** related to ICTs.

ICT infrastructure is seen as capable of solving other shortfalls through rapid transformational and multiplier effects on other development sectors resulting in revenue generation.

As a means of catching up on the infrastructural gap, communications via satellite and terrestrial wireless systems have had significant success in facilitating information technology policies and infrastructures for most African nations especially Nigeria. Figure 3 shows the percentage contribution of different wireless systems (GSM, CDMA and Fixed wireless) in Nigeria while figure 4 shows the growing percentage contribution of telecoms to Nigeria's GDP for the period 2001 to 2011.

Initiatives at both regional and national levels have been taken with appropriate policies and frameworks relating to ICT network infrastructures and ICT related projects including a campaign of pilot projects to showcase its benefits to the people.

Governments develop policies: Legislation enshrines the policies in law. Government strategies including multi-agency round-table strategy development consultations; which guide decision makers and a body of policies to provide a framework for policy implementation. Individual policies themselves are rather meaningless when they are not based on an underlying national agenda.

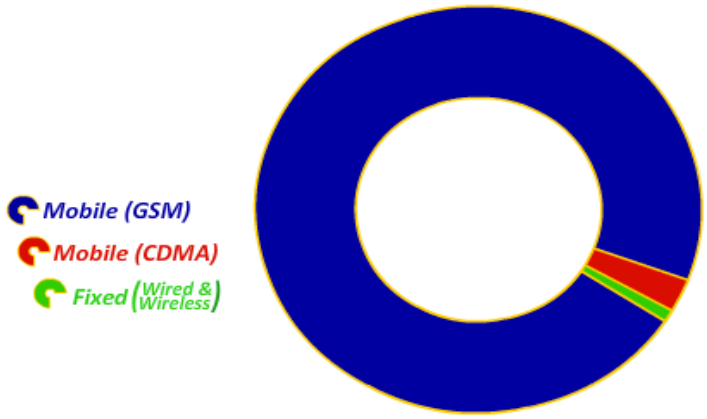


**Figure 3.** A chart showing the percentage contribution by variants of wireless systems[10]

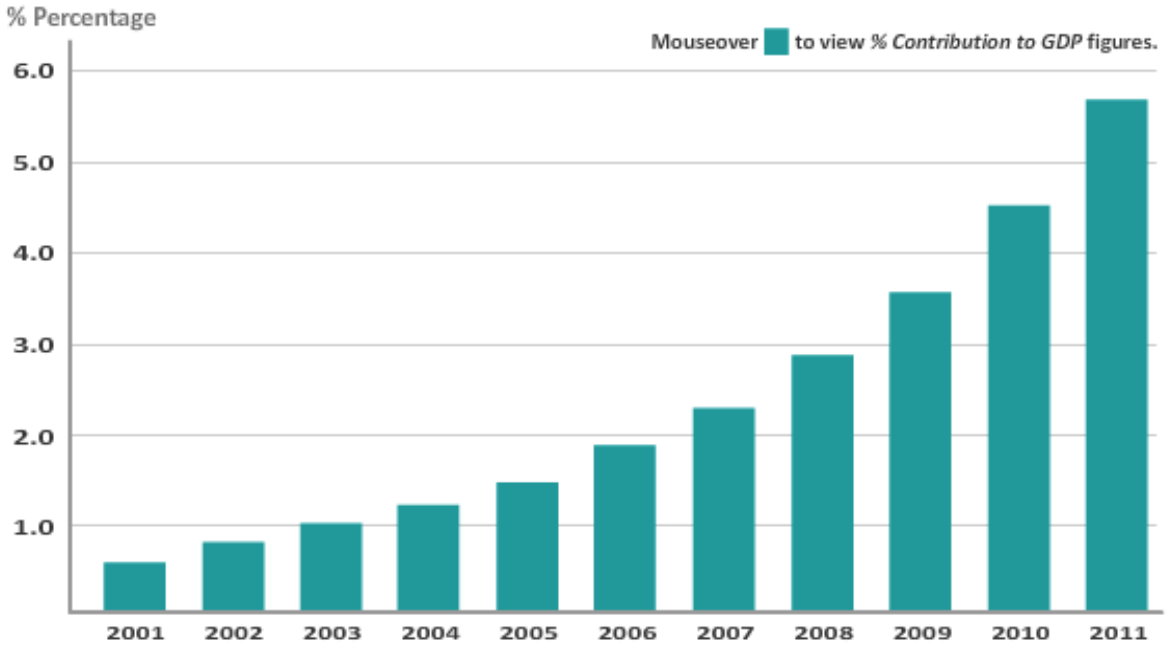


**Figure 4.** Growing percentage contribution of Telecoms to Nigeria's GDP for the period 2001 to 2011[10]

A strategic ICT framework is better piloted in Local Government Areas, Councils and States, which are necessary to help explain policy decisions and choices, and to give policies personality, direction and support from tax payers.

Strong leaders and governments in many countries especially in the Asia-Pacific region have developed ambitious ICT strategies in rural areas. In these countries, there are regulations and supervision mechanisms to ensure compliance. Policy statements and laws in themselves may not be sufficient to bring about the change that is sometimes necessary to transform business practices and objectives for the greatest possible diffusion of ICTs. While government sets policies, people need to be involved in developing, implementing and supporting these policies through effective availability of information; a prerequisite for successful implementation of development policies is inclusivity.

### 2.2. What are the Development Objectives of E-Government?

One objective is the modernization of the government and its transformation into a service-oriented public enterprise that works for the public good. A planned and stepwise introduction and use of ICTs in government can lead to the transformation of the public sector into an open, accessible, informative, helpful and user-friendly service for the people. The result is increased productivity and revenue streams. Collaborative software combined with awareness promotion, training and mentoring, as well as a strong commitment to openness and transparency, are the cornerstones of successful e-government. Political Leaders, local authorities and traditional leaders must show the way and encourage this transformation. The full benefits of e-government require policy-makers and planners to assess the state of government readiness for transformation into a service-based and client-focused enterprise for the public good. There is a tendency in planning for e-government to assume that the introduction of ICTs will lead automatically to changes in behavior.

## 3. Solutions and Applications Using Communication Satellite in Africa

Access to information and knowledge opens up more opportunities for people; empowering them to become more self-sufficient. ICT make information acquisition and management easier and more efficient and opens up possibilities for universal access to knowledge and markets. Community-based access centres or telecentres such as the NIGCOMSAT CTCs as shown in figures 5, 6 and 7 provide access to government information, commerce, online training, onsite training etc. The aim is to provide public access to the Internet within walking distance for everyone. This in turn provides access to information, government activities and services for the public, which are readily available through state and Local Government Area (LGA) web portals.

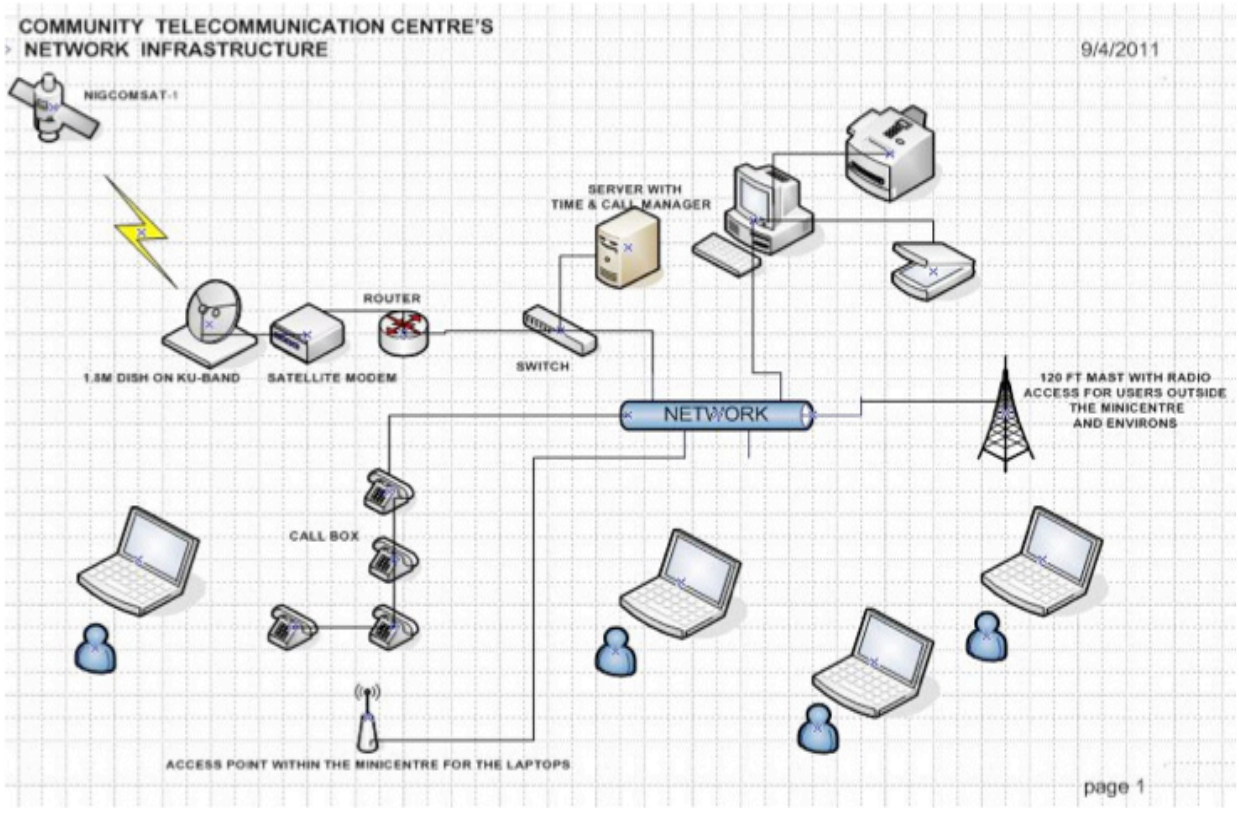


**Figure 5.** Schematic Diagram of NIGCOMSAT Ltd Community Telecommunication Center (CTC) through NIGCOMSAT-1R Communications Satellite[7]

**Figure 6.** A picture of NIGCOMSAT Ltd Community Telecommunication Center (CTC) with Solar Panels on the Roof Top of the Center and a 200ft tower with Radio for wireless Internet Access within the community[7]

**Figure 7.** A Community Telecommunication Center showing Table Design which seats 4 people with 4 Laptop computers, which also serves as vocational training center on ICT and VSAT Installations[7]

The service availability will result in higher rates of information retrieval, followed by an increased collection of associated fees and charges including license renewals, birth registrations etc. The benefit of having a centralized ICT hub is that it improves productivity, efficient utilization of satellite resources (power and bandwidth), and provides revenue streams for the local government, states and the nation in general; above all it increases trust in government, reinforcing a stronger national identity[8].

Figures 8 shows a typical picture of a Broadband Internet Service recently deployed by NIGCOMSAT LTD via its NIGCOMSAT-1R Satellite to Ondo State Government for use in Hospitals, Schools, Government and their legislative House with immeasurable benefits and increased trust in the government's developmental program through information dissemination.

**Figure 8.** Governor's Lodge, Akure; Capital City of Ondo State in Nigeria

E-government, E-education, E-Commerce services, programs and applications are being promoted and effectively implemented via the following investments:

**3.1. Web portals in English and local languages** (being planned) at both local government and state level with ICT infrastructures as exemplified in figure 5 to 8 providing the enabling environment.

**3.2. Brochure portals:** static information etc

**3.3. Knowledge portals:** Educational, Business and investment portal containing agro-allied products, mineral resources and economic activities of the people as exemplified in figure 9 and 10. Figure 9 shows a sample of the easy-learning card offering access to the internet super highway to gain knowledge using a registered user name and passwords to the link below: http://www.campus.easylearning.org/nigeria/

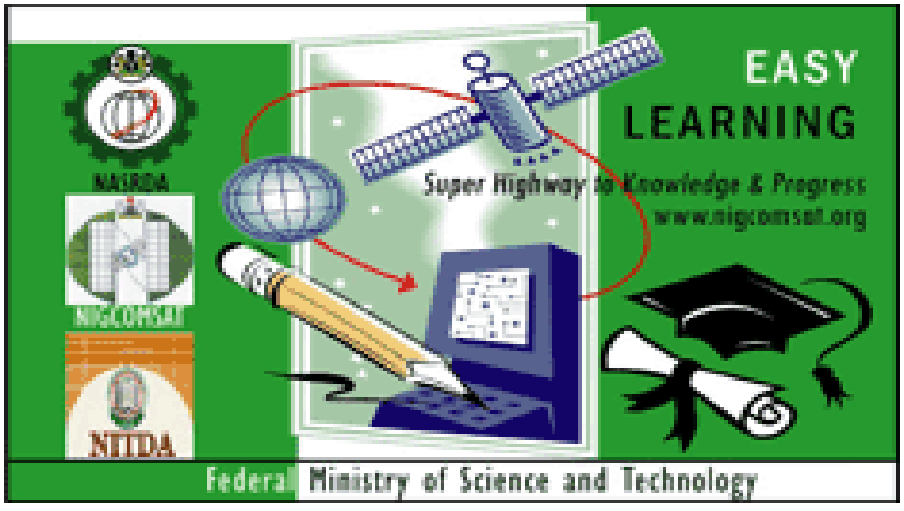


**Figure 9.** Easy Learning Pin-Code Based Card[7]

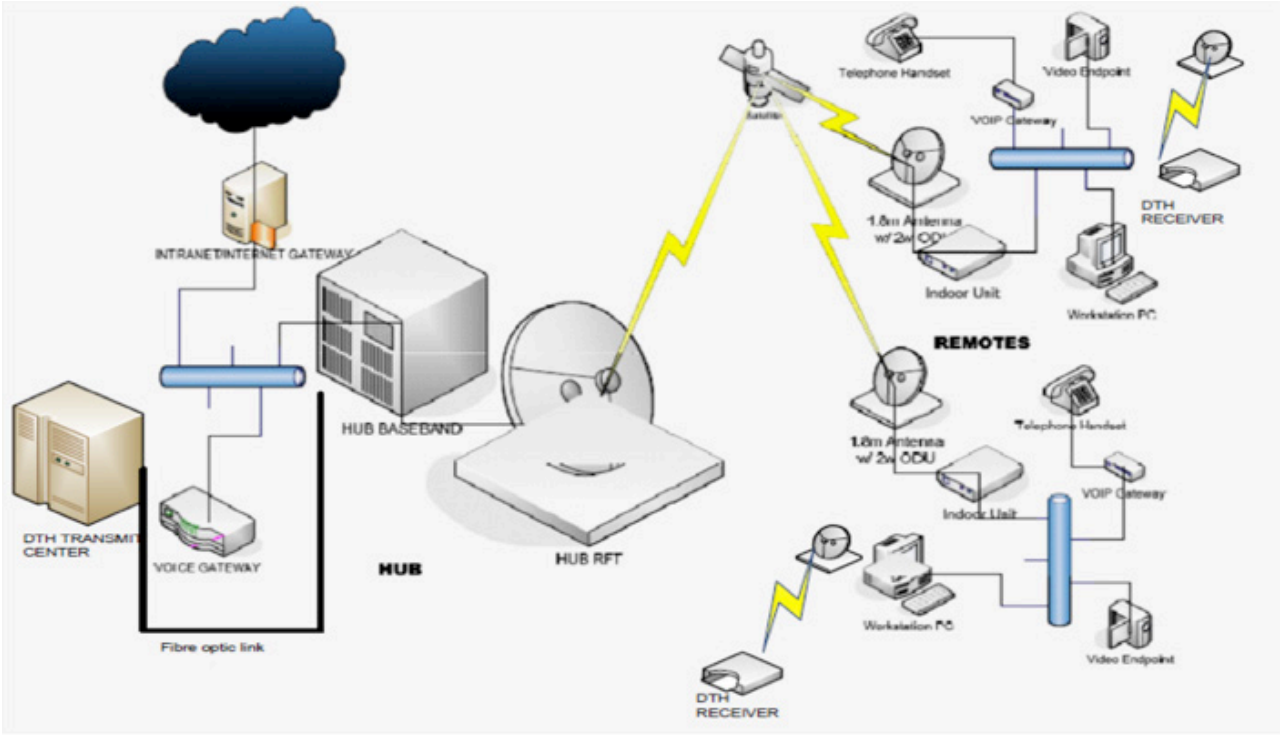


**Figure 10.** Schematic Diagram showing the use of NIGCOMSAT-1R to promote ICT in education (E-learning)[7]

Figure 10 shows a schematic of the tele-education hub operated through NIGCOMSAT-1R to promote human capacity building and the entrepreneurship required to catalyse and promote e-readiness in the nation through accessibility to high quality education for remote and rural regions and enhance the efficiency, resourcefulness, and competency of teachers and students alike - for the effective transformation of Nigeria into a Knowledge-based economy before the year 2020.

**3.4. Interactive service portals** (interactive forms: Land applications, renewals, licenses, birth and death registrations including population count, voting card registration etc).

To promote transparency in land planning, applications, renewals and avoid waste and corruption in revenue collections, NIGCOMSAT Ltd developed a new product, the Development Control Information System (DevCIS) for the Development Control Department, Abuja - implemented on NIGCOMSAT-1R VSAT services to the department under the Federal Capital Development Authority. DevCIS is an integrated solution that has been assisting the Department in automating its functions and activities to facilitate Urban Planning and Development Control Processes through a common platform that is timely and resource sensitive. The system is flexible, easy to use, easy to maintain and provides a simple operational environment.

**3.5. Ancillary services** such as e-mail, mailing lists of their wards, Councilors, Governors, data and databases etc - resulting from the availability of access to the super highway.

**3.6. Transactional portals** (online tax filing and receipt issuance, online banking applications, online public procurement services, online revenue collection and filing etc.)

**3.7. Smart communities:** Municipalities and other communities are getting connected with mainstream ICTs using Community Telecommunication Centers as exemplified in figure 11 for local and community development.

**Figure 11.** 1.8m VSAT Based Internet access in an abandoned community library in Bida, Niger State (Northern Nigeria)

The picture in figure 11 shows implementation of 1.8m VSAT Based Internet access system in an abandoned community library in Bida, Niger State (Northern Nigeria). During deployment, an elected local council leader of the community, youths and good people of the community watched with great enthusiasm delivery of instant access to the internet super highway in the un-cleared grasslands. The community members with support from their paramount ruler and emir of Bida have since cleared the surroundings of

the dilapidated library; there is a greatly increased reading culture and patronage of the library. Plans are ongoing with Niger State Government through the Ministry of Science and Technology to renovate the center and extend similar facilities to villages and communities around the state[11], [12],[13],[14].

**3.8. Community resources and services**, including local shopping opportunities, available online to encourage local shopping and spending through information accessed using the satellite ICT facilities shown. This has increased the digital opportunity index penetrating across villages, local government and states across the country.

**3.9. Creation of a community database** where all community-based events are logged and available to access. This includes a community calendar increasing ICT usage, which is creating an information-based society.

**3.10. A people database and calendar of events** that tracks important dates such as date of renewal of permits, licenses, passports and other documents and authorizations, etc., for users.

**3.11. Internet access to opportunities:** ICTs empower individuals, businesses, especially SMEs, local and community groups, women and marginalized or disenfranchised people or groups to do what they do, only better. With ICTs and the capacity to use ICTs, these groups can access the same information that government and large corporations use.

**3.12. Internet access to information** can help level the playing field by increasing participation in economic and human development activities and in those applications that depend on information such as markets[15].

**3.13. Access to information for private and professional decision-making:** ICTs expand the range of choices and opportunities by facilitating greater access to economic, educational and development-related information. It helps inform investors of the availability of natural resources in local government areas and verification of such through local government owned-portals thus enhancing and simplifying internal revenue collection in local government areas with rich mineral and agro-allied products.

**3.14. Greater ability to learn:** Distance learning permits students to get accreditations online from recognized universities, vocational ICT centers geared towards achieving the required human capital and capacity. Figure 12 shows pictures of 1.8M VSAT-Based Internet access deployment at SirBen Limited in Bayelsa state; a Niger Delta Development Commission Certified ICT vocational training center in a swampy terrain with graduands in various ICT fields. This in no small way has contributed to the reduction of militancy through the amnesty programme of the Federal Government of Nigeria. The vocational center is also an Internet Service Provider (ISP) reselling NIGCOMSAT-1R satellite resources to offices, homes, schools and the adjacent communities through radio and wifi access, thus increasing the digital opportunity index and access of the citizens in Bayelsa State including access to government information as well as promotion of small business enterprises (SMEs).

**Figure 12.** 1.8M VSAT-Based Internet access deployment at SirBen Limited in Bayelsa state; a Niger Delta Development Commission Certified ICT vocational training center in a swampy terrain[7]

**3.15. Greater environmental awareness:** Information about the weather and the environment is more readily available. It can help to predict and prepare for environmental perturbations and catastrophes. In Sub Saharan Africa, earth observation is used to predict crop failure, flood and prepare for emergency food relief. The National Space Research and Development Agency (NASRDA) of Nigeria, a sister agency to NIGCOMSAT Ltd, operates a fleet of observation satellites: Nigeriasat-1, Nigeriasat-2 and Nigeriasat-X for environmental monitoring and urban development including emergencies. NigeriaSat-2, Nigeria's highly advanced Earth observation satellite built by SSTL won the 2012 Sir Arthur Clarke award for "Best Space Activity - Industry / project.

**Figure 13.** Snap shot of an urban area by NIGERIASAT-2 observation satellite[16]

NigeriaSat-2 was launched in 2011 for Nigeria's space agency (NASRDA). It was cited as being "the most powerful UK-built Earth Observation satellite in orbit" providing a very high 2.5m resolution imaging service for natural resource management and urban planning amongst other applications. The satellite has significantly advanced Nigeria's Earth Observation capability. NigeriaSat-2, the first of SSTL's 300kg class satellites, is a major asset in the Disaster Monitoring Constellation (DMC), to which it belongs. Information on urban development, floods and emergencies is provided and distributed using the internet

superhighway to even the remotest part of the country using the NIGCOMSAT-1R Communication Satellite data networks and internet facility. Figure 13 shows a picture taken by NIGERIASAT-2 satellite for regional and urban planning.

**3.16.** More awareness of factors affecting individual well-being on health and fitness through information access.

**3.17.** Greater ability to influence and participate in decision-making

**3.18. Improved trade:** ICTs enhance and facilitate trade. ICTs make markets more accessible and efficient. Commerce is enabled and extended. With ICTs, all markets have the potential to be international or of being selective, depending on their requirements. Gradually, ICT impact and the intensity of usage via the NIGCOMSAT-1R Communication Satellite as well as private sector investments as Internet Service Providers and resellers are being felt and acknowledged.

**3.19. ICTs** have been used to help fishermen, farmers and herdsmen to locate schools of fish, or manage land, or identify prime grazing areas. In Africa, drought prediction is based on satellite imagery. In Bangladesh, storm early warning systems use ICTs, including radio, to warn fishermen in the Gulf of Bengal. The data from earth observation platforms (i.e NIGERIASAT-1, 2 and X Satellite) are increasingly integrated into data networks and the Internet and are thus readily made available to resource users and managers.

**3.20. ICTs are already contributing to significant job creation** as shown earlier in Figure 12, while figure 14 shows a demonstration site for practicals on how to install very small aperture antenna (VSAT) systems at customer and client's premises. At the end of the two weeks successful training, graduands are awarded certificates as NIGCOMSAT Ltd certified VSAT installers creating job opportunities and providing sufficient manpower resources across the country. For women, ICTs have created employment opportunities in back-office services and call centres. Earlier in the paper, the Nigerian Communications Commission shows the growing percentage contribution of Telecoms to Nigeria's GDP, illustrated in figure 4.

**Figure 14.** VSAT Demonstration site at NIGCOMSAT Ground Station for vocational training of VSAT Installers across the country[7]

**3.21. Electronic government, government online services, e-Commerce across the board and efficient public sector service delivery.** NIGCOMSAT Ltd Development Control Information System (DevCIS) for the Development Control Department, Abuja has demonstrated how government online services can impact on transparency, revenue optimization and better urban and regional development. The Development Control package is a mechanism that maintains standards. It ensures the orderly and rational development of land to create sustainable human settlement, which accommodates a variety of land uses to meet the needs of the people who live in these settlements and safeguard their lives and environment.

The project has ensured projects/buildings have the necessary facilities (car parking, sewage treatment plant) or infrastructure (access roads, drainage, and water supply). Buildings that are structurally weak and are easily damaged during floods or other disaster events can easily be identified. Also, development projects, which have serious negative impacts on the environment, can be identified and prevented.

The effectiveness and efficiency of Development Control has improved using an integrated platform that allows for creation, updating and tracking of Planning Authorizations, Building Control Authorizations, Geospatial and Planning Information, monitoring and supervision of construction sites and grants all approvals electronically. The system also provides housing reports on onsite investigations, issues warning notices, control actions and reports on specific decisions made by Development Control online and in real time using the communication channels provided by NIGCOMSAT-1R. Enquiries from such a database are made possible from Desktops at various offices over the Internet.

DevCIS has a good user management and administration interface, with strong built-in system access and security standards, information available to users is based on their roles in the system, it is easy to use and has user-friendly Graphical User Interfaces (GUI) requiring minimal user effort in data capture, data migration and quality check module in/out of the system and can link to other systems provided the systems support an open standard. Other states of Nigeria have expressed interest in deploying DevCIS to leverage the successes achieved in Abuja (Federal Capital City of Nigeria); the knowledge gained in Abuja project will allow smooth and easy implementation in other locations.

**3.22. The NIGCOMSAT-1R satellite has improved communications, productivity and the access to knowledge** by Nigerians who subscribe to its services through the installation of VSAT equipment on customer premises including homes. Figure 15 shows one of the writers deploying and commissioning a 1.2m VSAT Internet access system on the Ku-band using an iDirect X3 evolution modem at his residence. The commissioned VSAT system, with wireless router, has increased his productive hours on his official work, communication ability and his research activity as a distance learner with the University of Sussex.

**Figure 15.** Deployment of 1.2m VSAT Antenna using NIGCOMSAT-1R Satellite

In order to catalyze and promote the e-readiness of the nation, enhance skill development for the 21st century economy and provide access to high quality education; NIGCOMSAT Ltd is collaborating with other key ICT stakeholders to develop an easy learning environment for our youths, workers and government officials to build and equip themselves with the required and necessary 21st century skills with more opportunities through an affordable e-learning environment from the comfort of their homes. In order to ensure optimal utilization of Nigeria's Communications satellite resources and domestication of technologies that will deliver import substitution, self-reliance, and development of critical sustainable ICT infrastructure, the company successfully trained over 50 Engineers in the Know-How Technology Training program (KHTT), which formed a key aspect of a crucial element in the Nigerian Communications Satellite Project (NIGCOMSAT-1 project).

To date the trained Nigerian engineers have developed a range of integrated Software Packages comprising of Electronic Voting Registration and Voting System, RFID-Based Electronic Attendance System, Tracking and Fleet Management System, Link Budget Calculator, PCB Development Boards and e-Message Display System amongst others.

To increase its economic leverage and provide backup to the present satellite, Nigeria is planning to launch an additional two satellites that will enhance capacity, reliability and ensure business continuity.

## 4. Conclusions

The success of Nigeria's information technology policy and infrastructure depends greatly on satellite communications and its supporting technologies. Satellite Communications have a competitive advantage as they complement the present sparsely distributed terrestrial links (fiber optic) and radio link extensions contributing to accelerated economic growth, secure communications for security agencies, socio-economic development, good governance encouraged through transparent processes of e-governance with effective public management as exemplified in figure 16; the big picture of broadband internet access and connectivity in Nigeria and Africa as a whole[12],[13],[14],[17].

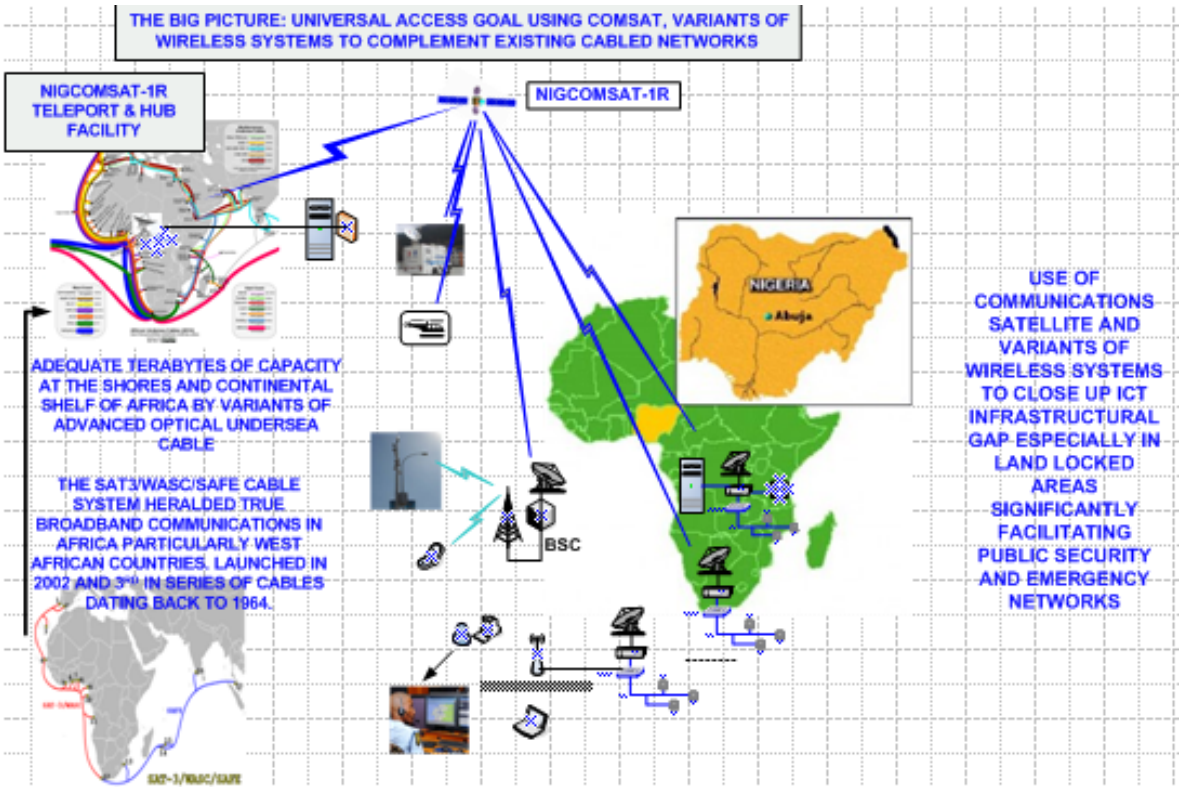


**Figure 16.** The big picture of broadband Internet access and connectivity in Nigeria and Africa as a whole

ICT is a development enabler. The ICT development process, and a country's transformation to becoming an information society, can be described using the following three-stage model and contexts:

- Stage 1: ICT readiness (reflecting the level of networked infrastructure and access to ICTs);
- Stage 2: ICT intensity (reflecting the level of use of ICTs in the society);
- Stage 3: ICT impact (reflecting the result/outcome of efficient and effective ICT use)

Nigeria's digital opportunity index and access is low due to inadequate networked ICT infrastructure around the country. The NIGCOMSAT-1R Communication satellite as a passive global ICT infrastructure and its supporting technologies is fast-tracking development and playing a critical role in delivering ICT readiness in terms of making internet access available to unserved and underserved areas with spin-off benefits in technology transfer, wealth and job creation, e-governance, e-education and facilitating the deployment of ICTs.

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