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SATELLITES SYSTEMS AND NIGERIAN COMMUNICATION SATELLITES (NIGCOMSAT): AN OVERVIEW

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Abstract: Satellites are specific or multipurpose man – made systems that operate in the space for various technologically related applications. This paper attempts a review of satellites systems and Nigerian Communication Satellites (NigComSat). Sub themes covered include: how satellites works, frequency bands, benefits of NigComSat 1R and that of satellites in general. The paper concluded by advocating a reformation of educational curriculum to make space technology a priority, supported with appropriate infrastructure; and effective marketing of the satellites communication facility. This is believed would place the country among the fore-runners in space technology.
Keywords: Satellites system; Frequency bands; NigComSat

1 INTRODUCTION

Satellites are man-made systems that operate in space as compared with the broadest definition of “satellites” includes celestial bodies (such as moon) orbiting around planet [1]. In this article, the definition of “satellites” is limited to man-made spacecraft only.

Since the launch of the first satellites in 1957 people have found diverse applications for these systems and have made significant technical advances and innovation to increase their efficiency. Currently, millions of people around the world rely on satellites for telecommunication, navigation, weather forecast, military intelligence, space exploration, and scientific studies of the atmosphere and beyond. As of March 2006, there are approximately 800 operational satellites orbiting earth, of which about half are operated by the United States and the remaining half operated by forty other countries and seven multinational organizations.

Of the operational satellites, more than half are dedicated to telecommunication purpose. These satellites are used around the globe for telephone, fax machine, emails, internet, financial transaction, television (TV), radio broadcast and much more. Compared to terrestrial communication system, satellites have the unique advantage of being able to provide coverage to large geographical areas. A single satellite can connect users on different continent across the Atlantic or Pacific Ocean. Moreover, satellites can provide communication service for mobile users anywhere in the coverage region including land, ocean, and air.

Although satellite services are not available to the same extent to every individual in the world, many rely on satellite as the only economical feasible mode of communication. Currently, many communities in developing countries and remotes areas are not within the reach of terrestrial communication network but all are within the coverage’s of at least one satellite. In addition, during period of natural disasters or war when terrestrial communication facilities are either destroyed or unavailable, disaster relieve workers, military personnel and news cast agencies depend on satellites to provide continuous information flow among each other and with the rest of the world. For nearly half a century, satellites technologies and application have continuously evolved in response to changing ways of life; in turn, many people have come to depend on satellites in their daily lives.

This article gives an overview of the following sub-themes: how satellite works, frequency bands, NigComSat 1R and the benefits of NigComSat 1R and satellites.

2 HOW SATELLITE WORKS

Communications satellite is a satellite located in space for the purposes of telecommunications. There are three altitude classifications for satellite orbits [2]:

2.1 LEO – Low Earth Orbit

LEO satellites orbit from 160-2000km above the earth, take approximately 1.5 hrs for a full orbit and only cover a portion of the earth’s surface, therefore requiring a network or constellation of satellites to provide global, continual coverage. Due to the proximity to Earth, LEO satellites have a lower latency (latency is the time between the moment a packet is transmitted and the moment it reaches its destination) and require less amplification for transmission.

2.2 MEO – Medium Earth Orbit

MEO satellites are located above LEO and below GEO satellites and typically travel in an elliptical orbit over the North and South Pole or in an equatorial orbit. These satellites are traditionally used for GPS navigation systems and are sometimes used by satellite operators for voice and data communications. MEO satellites require a constellation of satellites to provide continuous coverage. Tracking antennas are needed to maintain the link as satellites move in and out of the antenna range.

2.3 GEO – Geostationary Orbit

GEO satellites orbit at 35,786 km (22,282 mi) above the equator in the same direction and speed as the earth rotates on its axis. This makes it appear to the earth station as fixed in the sky. The majority of commercial communications satellites operate in this orbit; however, due to the distance from the earth there is a longer latency.

3 FREQUENCY BANDS

There are four radio frequency bands that most satellites operate within [3]:

3.1 C Band – Uplink

5.925-6.425 GHz; downlink 3.7-4.2 GHz. The C band is primarily used for voice and data communications as well as backhauling. Because of its weaker power it requires a larger antenna, usually above 1.8m (6ft). However, due to the lower frequency range, it performs better under adverse weather conditions on the ground.

3.2 X Band – Uplink

7.9- 8.4 GHz, downlink 7.25 – 7.75 GHz. The X band is used mainly for military communications and Wideband Global SATCOM (WGS) systems. With relatively few satellites in orbit in this band, there is a wider separation between adjacent satellites, making it ideal for Comms-on-the Move (COTM) applications. This band is less susceptible to rain fade than the Ku Band due to the lower frequency range, resulting in a higher performance level under adverse weather conditions.

3.3 Ku Band– Uplink

14 GHz; downlink 10.9-12.75 GHz. Ku band is used typically for consumer direct-to-home access, distance learning applications, retail and enterprise connectivity. The antenna sizes, ranging from 0.9m -1.2m (~3ft), are much smaller than C band because the higher frequency means that higher gain can be achieved with small antenna sizes than C-band. Networks in this band are more susceptible to rain fade, especially in tropical areas.

3.4 Ka Band – Uplink

26.5-40GHz; downlink 18-20 GHZ. The Ka band is primarily used for two-way consumer broadband and military networks. Ka band dishes can be much smaller and typically range from 60cm-1.2m (2' to 4') in diameter. Transmission power is much greater compared to the C, X or Ku band beams. Due to the higher frequencies of this band, it can be more vulnerable to signal quality problems caused by rain fade.

4 NIGERIAN COMMUNICATION SATELLITES

4.1 NigComSat I & NigComSat-1R

NigComSat-1 was a Nigerian communication satellite. The initial contract to build the satellite was signed in 2004. It became the first African geosynchronous communication satellite, when it was launched at 16:01 GMT on 13 May 2007, aboard a Chinese Long March 3B carrier rocket, from the Xichang Satellite Launch Centre in China. The spacecraft was operated by Nigerian Communication Satellite Ltd (NIGCOMSAT).
On November 11, 2008, NigComSat-1 failed in orbit after running out of power due to an anomaly in its solar array.
The satellite, which is placed into orbit, was launched into a geosynchronous transfer orbit and subsequently it was successfully inserted into a geosynchronous orbit, positioned at 42.5ºE. It had a launch mass of 5,150 kg, and had an expected service life of 15 years.
It was based on the Chinese DFH-4 satellite bus, and carries a variety of transponders:

- 4 C-band
- 14 Ku-band
- 8 Ka-band

• 2 L-band

It design was to provide coverage to many parts of Africa, and the Ka-band transponders would also cover Italy.

NigcomSat-1 represented a milestone for China's satellite export business. For the first time the China Great Wall Industry Corporation provided all aspects of in-orbit delivery of a satellite to an international customer. This included satellite manufacture, launch services, ground station construction, project financing, insurance and training [4].

On 10 November 2008 (0900 GMT), the satellite was reportedly switched off for analysis and to avoid a possible collision with other satellites. According to Nigerian Communications Satellite Limited, it was put into "emergency mode operation in order to effect mitigation and repairs" [5]. The satellite eventually failed after losing power on 11 November 2008.

On March 24, 2009, the Nigerian Federal Ministry of Science and Technology, NigComSat Ltd and CGWIC signed a further contract for the in-orbit delivery of the NigComSat-1R satellite. NigComSat-1R is also a DFH-4 satellite with improvements over the previous satellite, and was delivered in the fourth quarter of 2011 as a replacement for the failed NigComSat-1. It was successfully launched on December 19, 2011[6].

Plans are underway to ensure the launch of NIGCOMSAT-2 and 3 within a couple of years.

4.2 Benefits of Nigcomsat 1R to Nigeria

The launch of NigComjSat-1R and the In-Orbit-Delivery (IOD), with average life span of about 15 years marks the beginning of Nigeria's sustainable presence in the global communications satellite industry. The facility portends the following [7]:

i) NIGCOMSAT-1R satellite is a strategic communication infrastructure, which will provide the various communication solutions for Nigerians. The benefits of the satellite to Nigerians flow from the services to be provided through the satellite in both the downstream and upstream sectors. In the upstream sector, the company is concerned with leasing of bandwidth, trucking services and the provision of satellite networking, operation and management services.

In the downstream, the company's business objects include telecommunications, broadcasting, provision of broadband Internet, tele-education, tele-medicine, E-government, E-commerce, real time monitoring services, geographical mapping, landmass delineation, GIS, navigation and global positioning services.

In simple terms, the satellite would be used to provide affordable and excellent Internet and Direct-To-Home (DTH) broadcast services to Nigerians. Therefore, the current buildup of these facilities for broadcast and telecommunications through the state of the art integrated system deployment and co-location with submarine cable owners at the shore of Africa will have a far reaching impact in achieving telecommunications, broadcasting, the Internet, real time monitoring services in Africa including transforming Nigeria from just being a consumer of satellite bandwidth to a provider.

ii) The successful launch of the insurance replacement satellite has strongly signaled Nigeria's determination to be a significant player in today's fast globalizing knowledge and technology-driven world. For instance, NigComSat Direct-To-Home Project is meant to provide platform and open up media business services in Africa for Direct-to Home TV broadcasting entrepreneurs and new entrants in Nigeria and Africa in general with revenue potential of over $10 Million dollars per annum.

iii) Other business opportunities will be open to entrepreneurs through the launch of NIGCOMSAT-1R in telecommunication and broadcasting operations. In telecommunication, the voice and data services for Internet Service Providers (ISPs). For example it is a well-known fact how the emergence of companies like MTN, Etisalat and HiTv have stimulated economic growth in the country. Entrepreneurs also have the opportunity to utilize the satellite for tele-medicine services in remote areas, to mention but a few.

4.2 Benefits of Satellites - Overview

Satellite connectivity has the power to drive communications advances across a broad range of industries and geographies. Whether it is ship-to-shore maritime communications, Internet access for remote, rural classrooms, or vital data and communications for petroleum operations, satellite applications meet a broad range of needs. iDirect's communication platform enables any IP application to run reliably and efficiently over satellite. iDirect's advanced technology provides organizations with immediate global reach – making mission critical communications possible in the most challenging and diverse environments. Communication satellites are used in fixed or mobile wireless communications to receive and transmit radio signals from an orbiting satellite to another terrestrial location. There have been such advances in bandwidth utilization and reliability of communications that satellite service now provides affordable, always-on, high-speed, quality connectivity [7].

5 GLOBAL COVERAGE

Satellite communication can deliver a terrestrial-grade experience with voice, video, and data that can be accessed anywhere in the world. Ubiquitous coverage can be obtained with a global network of multiple satellites all tying into one central network management system.

5.1 Reliability

Satellite networks are dependable, providing constant connectivity even when terrestrial networks fail. With satellite networks, enterprises can maintain business continuity with built-in redundancy and automatic back-up service.

5.2 Security

Satellite networks already constitute a private network. By adding encryption technology, satellite can provide a more secure connection than terrestrial networks, making it an ideal solution for government, military and enterprise VPN (virtual private network) solutions.

5.3 Scalability

The modularity of VSAT systems allows for quick time-to-market and fast upgrades. VSAT remotes can be deployed rapidly and new remote locations are easily added to a network where limited terrestrial infrastructure exists simply by configuring bandwidth to the site and having ground equipment installed.

5.4 Fast Deployment

Satellite technology is an ideal solution for quick deployment, immune to the challenges posed by difficult terrain, remote locations, harsh weather, and terrestrial obstacles. In this rapidly expanding market, satellite allows a service provider to get to market quickly and efficiently and provide immediate connectivity in disaster and emergency relief scenarios.

5.5 Cost Savings

Satellite technology can deliver a communications infrastructure to areas where terrestrial alternatives are unavailable, unreliable or simply too expensive. Satellite allows service providers to insure scalability, profitability and maintain low operating expenses, all while overcoming a lack of existing infrastructure.

5.6 Future Projections

i) The planned launching of two backups (NigComSat-2 and 3) in view of the success of NigComSat-1R.
ii) Further launching of varieties of specific or integrated technological based satellites into the orbit. Such as for defense, telemedicine, navigational etc.
This effort if meticulously implemented will place Nigeria in the fore front of satellite technology provider and consumer in the world.

6 CONCLUSION

Satellite technology has revolutionized the information, tele – communication and several other disciplines in human life to a great extent. The earlier Nigeria key into this paradigm by reforming her educational curriculum, supported with appropriate infrastructure, the better the citizenry benefits and the more the nation control her share of global revenue from space technology.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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