DEDICATED MILITARY SATELLITE MODEL AND REQUIREMENTS FOR NIGERIA

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Abstract: *Information and communications technologies are now integral to the conduct of military operations. Forces around the world are committing to constant technological innovation, especially since the attacks of September 11, 2001 (9/11), and the subsequent War on Terror. Robust satellite communications are important to achieving decision superiority, timely response and precision by the military. This is what is required by the military at this time of serious security threat confronting the nation from within and outside the country to wriggle out of the present security challenges. Information coordination that is made available and accessible to all command involved in a theater of operation is key to a successful operation. Consolidating the military strength under a dedicated satellite will be a new path to having interconnectivity and coordination of military powers and resources at any location responding to centralized command and control as well as information sharing across the globe. To achieve this, there is need to leverage both mature and emerging space technologies such as optical and laser communications technologies, dedicated military satellite, constellations of miniaturized satellite so as to overcome dependence on resource-intensive, limited coverage area, and increasingly vulnerable application of line of sight radio communication. This paper proposes what a dedicated military satellite for our nation should composed of with other possible mature and emerging technologies to confront the security challenges that have bedeviled the nation*

Keywords: *Satellite, Model, Communication, Military, Command, Control.*

Introduction

The high rate of fatalities related to cardiovascular diseases is partly linked to poor monitoring culture. An estimated 17 million The military strength of a nation can be determined by the presence of that nation in space and it is an indication of great technological breakthrough in the nation's military capacity. Adoption of a dedicated nation's military satellite and space technology remain the key that unlock the capacity of military operations and prompt responses across territorial boarders. Adopting space capability in military operation will increase the technology strength of the military. Space technology has the potential of laying the bedrock for effective communication structure when provided with relevant infrastructure for information communication (Nkanga, 2007). Attention has been given to satellite communication due to its wide area coverage and the speed to deliver new services (Stallings, 2003; Theodore 2005).The past/previous regime of government approved the deployment of drones and geospatial technology to monitor Nigeria boarders. Shortly after this pronouncement and commencement, drone related programs started sprouting across the country. Satellites are the main focus of military space activities widely used to provide support for military or security related activities such as verifying compliance with munitions control treaties and increasingly used to provide direct support for military operations and security operatives. Records have shown that nations in the forefront of space and satellite program have benefitted immensely in areas like communication, security, health, ICT, Agriculture and environmental observation (weather forecasting) and Nigeria has spent a lot of money on all these. War is first executed in space before taking it to the Earth and the successes displayed on land, creating indigenous space competence will boost the confidence of our military personnel and security operatives. Satellite communications is growing exponentially due to demand from government and private use across the globe (Agbaje, 2010; Alleman, 2010; Lele, 2018; Ate and Talabi, 2012; Capzza et al. 2000; Chatterjee, and Surendra 1993; Dai, W., Qiao, C., Wang and Zhou 2016; Hanawal et al. 2016; Cosumano 2002; Garino and Gibson 2020; Hanlon 2005; Ndukwe 2015; Nkanga, 2007; Nwajiobi, 2012; Rausch, 2006; Reiffen and Sherman, 1964; Schneider, 2007; Shraub, 2012; Teh, et al., (2000; Wang, et al., 2014).

NigeriaSat-1

In 1999, the federal government of Nigeria took a decision to join the league of nations in the world that have made mark in space by adopting satellite communication system as a new means of communication. A framework was developed to lead the country into actualizing the goal of developing a satellite program that will culminate into launching of satellite in space. To achieve these, National Space Research and Development Agency (NASRDA) were established. The National space policy in 2001 granted approval to Nigeria through NASRDA to launch an earth observation satellite (Nigeriasat-1), the launching of Nigeriasat-1into orbit was actualized in Russia on 27thSeptember 2003as part of five satellites which will make up a network called the Disaster

Monitoring Constellation. Apart from Nigeria, other partners in the international consortium were UK, China, Algeria, Turkey, Thailand and Vietnam with one satellite each. The purpose of this constellation of satellite is to share information with each other when disaster monitoring is needed and controlling desertification especially in the northern part of Nigeria, to establish relationship between malaria vectors and the environment that breeds malaria and to give alert in case of outbreak of meningitis.

NigeriaSat-2

The second satellite is the Nigeriasat-2 which was built by surrey space Technology limited with high-resolution having the receiving station in Abuja. Thespecific objective of the NigeriaSat-2 assignment is to furnish with high-resolution (Pan and MS) imagery in a swath width of about 20 km. In addition to this, the spacecraft also carries a DMC continuity payload to provide observation continuity with NigeriaSat-1. The imagery of both spacecraft will serve as a substance that accelerates the development of Nigeria's NGDI (National Geospatial Data Infrastructure) program. With all its potentials, it was reportedly relegated to parking orbit in 2008. The Chief of Defense Staff expressed his displeasure in the process of satellite development in the country as no relevant provision was made for military requirement during the design conception but the country later spurred into actionable steps at actualizing the dream of a dedicated military satellite in view of the hydra headed security challenges confronting the nation from all her geospatial space. Combating insurgence means that an internalized declaration of war against act of insurgency is actionable. War on terror is conventionally used to connote the intelligence gathering and military operations. Space facilities in form of dedicated satellite for military and allied security operations should be adopted. Nigeria’s most intimidating problem is security; this risk is undoubtedly terrorism and violent extremism leading to abductions and kidnappings of fellow human beings. These acts are now a form of business in Nigeria as a result of ransom paid by victims’ families to kidnappers and bandits, so as to secure the release of their family members in captivityNigeria has launched three satellites; Nigeriasat-1, 2,and NICOMSAT-1satellites with no one designed with consideration for military operation and security operatives, if not until recently that the idea of building a military satellite was conceived (Agbaje, 2010; Alleman, 2010; Lele, 2018; Ate and Talabi, 2012; Capzza et al. 2000; Chatterjee, and Surendra 1993; Dai, W., Qiao, C., Wang and Zhou 2016; Hanawal et al. 2016; Cosumano 2002; Garino and Gibson 2020; Hanlon 2005; Ndukwe 2015; Nkanga, 2007; Nwajiobi, 2012; Rausch, 2006; Reiffen and Sherman, 1964; Schneider, 2007; Shraub, 2012; Teh, et al., (2000; Wang, et al., 2014).

DELSAT-1

Federal Government of Nigeria tried to encourage the military, rekindle the hope and to give them the assurance that government is indeed ready to give technological support for military operations to enhance their productivity. In a bid to join the countries of the world with imprint in space applications to further strengthen their military capability, the Federal Government of Nigeria inaugurated an integrated satellite called ***DELSAT-1*** to increase the tempo of forces against insecurity.DELSAT-1 aids the National Counter Terrorism Strategy (NACTEST) in ensuring public safety through the established implementation strategy; Forestall, Secure, Identify, Prepare and Implement (FSIPI).The country has witnessed traditional and non-traditional security challenges that will demand a proactive approach in solving and preventing a repeat of these challenges. This will require the applications of space-based technological approach in solving this horrible security threat especially to lives and properties (Michael 2005). This will also assist the military and the country as a whole in achieving the nation’s strategies in combating recognized threats within and outside the country (Agbaje, 2010; Alleman, 2010; Lele, 2018; Ate and Talabi, 2012; Capzza et al. 2000; Chatterjee, and Surendra 1993; Dai, W., Qiao, C., Wang and Zhou 2016; Hanawal et al. 2016; Cosumano 2002; Garino and Gibson 2020; Hanlon 2005; Ndukwe 2015; Nkanga, 2007; Nwajiobi, 2012; Rausch, 2006; Reiffen and Sherman, 1964; Schneider, 2007; Shraub, 2012; Teh, et al., (2000; Wang, et al., 2014).

Dedicated Satellite

In view of prevailing security risk witnessed across the country, having dedicated military space assisted technology will help the country to liberate herself from the incessant security quagmire. A military satellite is an artificial satellite used for intelligence gathering, navigation and military communications. A military satellite is that satellite launched in orbit for communications, navigation reconnaissance for the optimal operation performance of the military and security operatives. Development in microelectronics has created the ease of developing a miniaturized satellite (Underwood et al, 2001).Military satellites provide a wide range of services including gathering intelligence data, providing navigation information, communication services, weather forecasting, early warning, and timing data. Defense Space Administration (DSA) is better positioned to use space-based services and technologies with the launch of DelSat-1. The need to provide survivability of communication under different types of threats makes dedicated military satellite different from commercial or multipurpose satellite system. Development of miniaturized satellites symbolizes a departure from the conventional ways of doing things. Small satellites are capable of achieving the same purpose with the large and very expensive ones (Stramb 2012). Recent development in the field of electronics has made miniaturization of equipment easy and functions effectively even better than the larger old equipment and the manpower is readily available. After all, Nanosatellite was built by graduate and undergraduate students to form part of ionosphere observation (Craig et al, 2005).Advances in miniaturization technologies have had dramatic impacts and consequences on our lives. Radios, computers, telephones and other amenities that once occupied large volumes and spaces now fit in the palm of a hand. Uncountable numbers of sensors are deployed and sent on spacecraft to the planets and on instruments into the human body systems. Electronic brains are in everything from bombs to washing machines and other equipment (OTA 1999). It is economical to deploy miniaturized satellite that can solve different problems similar to what a large and expensive satellite can do (James et al 1992).Adoption of military satellite that will be dedicated in nature will not gulp the fortune of our nation. The dedicated satellite will have the capacity to capture high resolution photographs of designated areas on the land within the area where security measure is required. Through military, satellites can be based on the requirement that depend on quite large satellite but basically, the functions of this satellite is achievable by telecommunications satellites and surveillance satellite can be replaced by small military satellites that will fulfill a number of these needs (Agbaje, 2010; Alleman, 2010; Lele, 2018; Ate and Talabi, 2012; Capzza et al. 2000; Chatterjee, and Surendra 1993; Dai, W., Qiao, C., Wang and Zhou 2016; Hanawal et al. 2016; Cosumano 2002; Garino and Gibson 2020; Hanlon 2005; Ndukwe 2015; Nkanga, 2007; Nwajiobi, 2012; Rausch, 2006; Reiffen and Sherman, 1964; Schneider, 2007; Shraub, 2012; Teh, et al., (2000; Wang, et al., 2014).

Architectural Considerations for a Military Satellite

Provision for Mobile Units

Satellite systems should be built around lower frequencies (UHF) to fill the critical need of tactical communications. UHF will be accommodated on mobile platforms and does not require accuracy beam pointing mechanisms. This provision will ensure that the architecture guarantee services for both strategic and tactical users. Design of military satellite used to be restricted to fixed terminals or network of fixed terminals without any consideration for the orbital body to be in constant interaction with earth mobile terminals especially in war situations. Military satellite system in modern days should have an infusion of mobile terminals both on ground and in air so as to have a complete military tactical communication. This should be strengthened by the provision of small road and air transportable terminals that can quickly be moved and deployed to another location within a short time under field condition. This is required to sustain constant communication between the moving units, the satellite and the commanding officers. Moving units and commanding officer do not necessarily need to be within the same spatial boundaries especially during operations. Distance is not a barrier to satellite (Reiffen et al 1964), therefore, military space operations based on satellite technology, the space operations are expected to be more complex and operate partially masked from Earth. To achieve this, an autonomous network system capable of operating in a real world environment without any form of external control for extended periods of time and configured with minimal human involvement especially from ground base is required. This means an on-board satellite operation that put resources in place against radio frequency sharing jamming detection for transponders and downlink from aircraft or similar platform (Agbaje, 2010; Alleman, 2010; Lele, 2018; Ate and Talabi, 2012; Capzza et al. 2000; Chatterjee, and Surendra 1993; Dai, W., Qiao, C., Wang and Zhou 2016; Hanawal et al. 2016; Cosumano 2002; Garino and Gibson 2020; Hanlon 2005; Ndukwe 2015; Nkanga, 2007; Nwajiobi, 2012; Rausch, 2006; Reiffen and Sherman, 1964; Schneider, 2007; Shraub, 2012; Teh, et al., (2000; Wang, et al., 2014).

Inclusion of very Strong Anti-Jamming Technique

For the purpose of data secrecy and the protection of the integrity of information that all combine together in the determination of the strength of success recorded after an operation, there is the need to have a very strong anti-jamming technique for both downlink and uplink information transfer. Jamming should be anticipated at this level of operation therefore, protection against jamming for large number of tactical terminals should be provided as anti-jamming techniques and should be strictly considered as one of the features of a dedicated military satellite. More so, on-board processing should take into account of demodulation to baseband and data routing. To counter jamming, spread-spectrum techniques and antenna nulling should be provided (Chatter et al 1993);Transverse filters (Milstein et al, 1982), singular-value decomposition (SVD) (Teh et al, 2000). Other anti-jamming techniques in adaptive category are the use of adaptive antenna array (Wang et al 2014) and frequency/ time domain filtering (Capozza et al 2000).The use of spread-spectrum approach like frequency hopping pattern to reduce frequency of error (Kanawal et al, 2016) and use of notch filters on the base band (Dai et al, 2016) are suggested techniques for anti-jamming.

Optical Communication

It is a known fact that satellite communication dwells in the high frequency region of electromagnetic spectrum and this is prone to attenuation from precipitations. Many researchers have reported on this claim, it is therefore imperative that a medium should be devised to cater for signal transmission during precipitation so as to prevent attenuation and to uphold the integrity of information and real-time delivery within the spatial and temporal window that facilitate effective performance of the military. Space-to-ground communication that will eliminate the effects of rain cloud should be encouraged by the introduction of optical communication. In addition, the blue-green laser should be incorporated to allow information transfer with submarines below the sea level. This requires a low orbiting satellite using wavelength that is in harmony with transmission in sea water with a very narrow receiver optical filter for the rejection of interference (Agbaje, 2010; Alleman, 2010; Lele, 2018; Ate and Talabi, 2012; Capzza et al. 2000; Chatterjee, and Surendra 1993; Dai, W., Qiao, C., Wang and Zhou 2016; Hanawal et al. 2016; Cosumano 2002; Garino and Gibson

2020; Hanlon 2005; Ndukwe 2015; Nkanga, 2007; Nwajiobi, 2012; Rausch, 2006; Reiffen and Sherman, 1964; Schneider, 2007; Shraub, 2012; Teh, et al., (2000; Wang, et al., 2014).

Satellite Command and Control

This involves how military personnel control and communicate with satellites. Control center adopts the uplink to the satellite to deliver commands. The downlink is bothered on how data is transferred from the satellite to a ground station that is equipped with the required antennas, transmitters and receivers to receive the data. Relay satellite can be applied in case of satellite constellation that allows communication between satellites outside the reception area of a ground station (Seller, 2015).

Software

Military software application domain is based on fully or partially constrained dynamic networks, this is, a result of technical, physical and many other limitations that bother on financial and regulatory modes (Vasileios, 2018).Comprehensive and effective software for the military should be hinged on decoupling hardware from software, network management, and ease of programming, debugging and management (Horsath et al 2015).

Provision for antenna nulling

This is an anti-jam mechanism provided so that the receiving antenna has a nulling technique on board the satellite. It is configured so as to provide spatial discrimination between the user and any available jamming sources.

Cancellation of Possible Radiation

The satellite for this purpose must be constructed with appropriate shielding materials to prevent radiation, atmospheric scintillation, ionization and other nuclear threat from other on-board satellite that have been militarized or weaponized (Agbaje, 2010; Alleman, 2010; Lele, 2018; Ate and Talabi, 2012; Capzza et al. 2000; Chatterjee, and Surendra 1993; Dai, W., Qiao, C., Wang and Zhou 2016; Hanawal et al. 2016; Cosumano 2002; Garino and Gibson 2020; Hanlon 2005; Ndukwe 2015; Nkanga, 2007; Nwajiobi, 2012; Rausch, 2006; Reiffen and Sherman, 1964; Schneider, 2007; Shraub, 2012; Teh, et al., (2000; Wang, et al., 2014).

Anti-satellite threat

The implementation of anti-satellite threat should be considered right from the conception stage. This is necessary so that all phases of the design will consider this destructive mechanism so as to avoid destruction or failure to the performance of the system during its life span. Satellite design that will survive this threat should incorporate some satellite in geosynchronous orbit and at higher altitudes and put small satellites in lower orbits. Operations of the satellite will not be affected when there is a threat to a few of these orbiting satellites. Space threats include; tracking and monitoring satellite transmissions, physical attack to electronic system against space based services. This affects both the satellite and the equipment at the users' terminals. The last one is the attack on the satellite itself in space by kinetic energy weapons. The totality of this threat is recorded as ground segment threat, communication (link) segment threat (electronic attack, uplink and downlink jamming).One terrible threat that should be prevented is spoofing; this has to do with capturing, altering and retransmitting information in a manner that confuses or misleads the recipient. This will prevent the recipient from appropriately analyzing the message received (Agbaje, 2010; Alleman, 2010; Lele, 2018; Ate and Talabi, 2012; Capzza et al. 2000; Chatterjee, and Surendra 1993; Dai, W., Qiao, C., Wang and Zhou 2016; Hanawal et al. 2016; Cosumano 2002; Garino and Gibson 2020; Hanlon 2005; Ndukwe 2015; Nkanga, 2007; Nwajiobi, 2012; Rausch, 2006; Reiffen and Sherman, 1964; Schneider, 2007; Shraub, 2012; Teh, et al., (2000; Wang, et al., 2014).

Conclusion

This paper has highlighted and reviewed the various satellites that has been used and that could be used to combat security challenges by the military and other security outfits in Nigeria. The satellites include NigeriaSat-1, NigeriaSat-2, DELSAT-1 and Dedicated Satellite. In addition to this, various architectural considerations for a military satellite were also extensively discussed. Finally, this paper proposes what a dedicated military satellite for our nation should composed of with other possible mature and emerging technologies to confront the security challenges that have bedeviled the nation (Agbaje, 2010; Alleman, 2010; Lele, 2018; Ate and Talabi, 2012; Capzza et al. 2000; Chatterjee, and Surendra 1993; Dai, W., Qiao, C., Wang and Zhou 2016; Hanawal et al. 2016; Cosumano 2002; Garino and Gibson 2020; Hanlon 2005; Ndukwe 2015; Nkanga, 2007; Nwajiobi, 2012; Rausch, 2006; Reiffen and Sherman, 1964; Schneider, 2007; Shraub, 2012; Teh, et al., (2000; Wang, et al., 2014).

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