http://ejournal.seaninstitute.or.id/index.php/InfoSains
Jurnal Info Sains : Informatika dan Sains, Volume 13, No 03 2023
E-ISSN.2797-7889, P-ISSN.2089-3329

Analysis of VSAT System Performance in Security and Communication Integrity of Indonesian Navy Headquarters

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Keywords

Communication Technology, VSAT, Indonesian Navy

Abstract. The development of satellite communications technology makes it easier for various groups and agencies to send and receive information and maintain confidentiality. In carrying out communications, the Indonesian Navy uses satellite technology in the form of VSAT. VSAT is an abbreviation for "Very Small Aperture Terminal", namely a signal receiving station from a satellite with a dish-shaped receiving antenna with a diameter of less than three meters. This research uses a qualitative approach that will analyze the performance of the VSAT system in maintaining the security and integrity of communications carried out by the Indonesian Navy. It is hoped that this research will provide an understanding of the use of modern satellite communications technology such as VSAT and its relevance for increasing security and maintaining the confidentiality of the Indonesian Navy.

1. INTRODUCTION

In the current digital era, the effectiveness, security and speed of information are crucial for maintaining the sovereignty and security of a country. The Indonesian Navy, which is the military body that guards state security, must of course be equipped with advanced technology for the smooth maintenance of the Republic of Indonesia. Sending telegram news via ships is still one of the communication methods used by the Indonesian Navy. The Republic of Indonesia Warship (KRI) Banda Aceh-593, one of the Indonesian Navy warships, previously used radio to send messages to the Indonesian Navy Headquarters. Specifications for radio use on Republic of Indonesia ships follow international standards and regulations set by the International Maritime Organization (IMO) and national maritime regulatory bodies. Some general specifications related to the use of radios on ships involve aspects of communication, safety, and navigation. Here are some points that are generally relevant:

- GMDSS (Global Maritime Distress and Safety System): Modern ships are generally equipped with a GMDSS system designed to increase communication security at sea. The system includes radio equipment that can be used in an emergency, including an emergency caller radio (EPIRB), a hand signal transmitter radio (SART), and a VHF transceiver.
- VHF Radio: Very High Frequency (VHF) radio is a means of communication commonly used in waters near the coast. Ships are usually equipped with VHF radios to communicate with shore stations, other ships, and other seafaring agencies.
- HF Radio: High-Frequency (HF) radio is generally used for long-distance communications in the open sea. This is important for long-term communications and can be used to obtain weather information, ship maintenance, or emergencies.
- SSB Radio: Single Side Band (SSB) radio is used for long-distance communications and is generally used by ships carrying out transoceanic voyages.
- AIS (Automatic Identification System): This automatic identification system provides information about the position, speed and direction of the ship to other ships and maritime traffic control centers. This helps in preventing collisions and improving navigation safety.
- Navigational Telex (Navtex): Used to receive navigation information such as weather warnings, NOTAM (Notice to Airmen) notifications, and other safety information.

All of this equipment is designed to ensure safety at sea, facilitate coordination between vessels, and ensure compliance with international regulations. Additionally, radio operators on board ships must have appropriate certification and understand maritime communications procedures and associated ethics. The main problem in the telecommunications sector in Indonesia is the difficulty of developing telecommunications infrastructure. Telecommunications infrastructure can be in the form

of cable networks or wireless networks. According to Albandjar and Rasyid (2005), what makes it difficult to develop wireless and cable network infrastructure is because the large number of Indonesian islands requires large investment costs to build a network that connects these islands. With this condition, technology is needed to connect it.

There is a technology for Indonesia to be able to connect to telecommunications networks, namely by using satellites. And the most frequently used satellite technology is VSAT or micro earth station (Triastana, 2011). VSAT is an abbreviation for "Very Small Aperture Terminal", namely a signal receiving station from a satellite with a dish-shaped receiving antenna with a diameter of less than three meters (Directorate General of Information Applications, 2015). The main function of VSAT is to receive and send data to satellites. Satellites function as signal transmitters to be sent to other points on the earth. The VSAT dish faces a geostationary satellite (Erwinsyah, 2008). Geostationary satellites are satellites that are always in the same place, rotating on their axis where their orbits are synchronous with the Earth's rotation (Woo & Buckwalter, 2021). So this research will explain whether the use of VSAT as a means of telecommunications for the Indonesian Navy is an appropriate and relevant technology for maintaining the security and integrity of the Indonesian Navy's communications needs in this increasingly modern digital era.

2. METHOD

Qualitatvie

This The approach used in this research is a descriptive qualitative approach. The descriptive qualitative approach method is a research method to find patterns of interrelationship between variables with each other. In this research it is used to describe and understand the VSAT satellite communication technology used by the Indonesian Navy in carrying out communications both for sending and receiving messages or news via warships. Data was obtained from secondary sources such as book references, journals and also credible government websites. Data analysis uses descriptive analysis, namely sorting the data obtained to find patterns between variables and interpreting the data through clear and in-depth presentation and description.

Based on several previous studies regarding VSAT, there are many journals that discuss VSAT in terms of communication technology in technical aspects and social use, such as a journal entitled "Performance Analysis of Mobile VSAT Network Quality, North Sulawesi District Internet Service Center" (Ginano et al., 2015) , then a journal entitled "Designing Mobile VSAT Data Communication with KU-Band Frequency on the Palapa Satellite" (Budi & Nugroho, 2017), as well as a journal entitled Quality of Service (QoS) Analysis of Very Small Aperture Terminal (VSAT) Networks (Sari & Saputra, 2022) where the three journals focus on the use of VSAT on a community scale. However, previous research has rarely been found regarding the use of VSAT technology in military agencies. Based on these conditions, this research is present to provide an overview of the use of VSAT by military bodies such as the Indonesian Navy and see whether VSAT is a technology that is relevant to the Indonesian Navy's telecommunication technology needs.

3. RESULTS AND DISCUSSION

VSAT was introduced in 1989 aimed at the corporate market in Indonesia, namely legal entities that operate nationally and require online data communication for financial transactions, online integrated data bases and also for consolidated reports. However, apart from being applied to information systems such as in the financial sector, VSAT can also be used as a terminal for dial-up and broadband internet services, rural telephone and fax (Hutahean, 2005).

In Indonesia PT. Citra Sari Makmur (CSM) started VSAT operations in 1989, which later developed into the first VSAT operator. While CSM was developing, several other operators also entered the VSAT market because they were attracted by the promising prospects in this telecommunications sector. The second operator that emerged was Lintasarta which focused on serving banking and other financial institutions. Several large banks then rolled out their respective VSAT networks (Hutahean, 2005). Currently, more than seventeen permits have been issued by the

Indonesian Government to companies running VSAT service businesses (Postel, 2011). The following is the VSAT market share in Indonesia.

VSAT Market Share in Indonesia:

No	Perusahaan	Pangsa Pasar (%)
1.	CSM	32,4
2.	Primacom	28,28
3.	Lintasarta	17,71
4.	Satcomindo	5,66
5.	Telenet	5,66
6.	PSN	3,73
7.	Elektrindo	2,83
8.	PCCW	1,7
9.	ICON	1,36
10.	GTU	1,36

Sumber: Comsys 2008

From the table above, we can see a consistent increase in stakeholder satisfaction over the three semesters. Student satisfaction reached its highest peak in the third semester, indicating positive acceptance of the change in learning approach.

Bases for Using VSAT in Indonesia:

Table 2: Operational Efficiency

No	Pengguna VSAT di Indonesia	Presentase (%)
1.	Perbankan dan Instansi Keuangan	64,3
2.	Perminyakan dan Pertambangan	3,59
3.	Distributor, Manufaktur, dan Agrobisnis	3,18
4.	Kontraktor	0,76
5.	Komunikasi	19,26
6.	Kayu dan Kertas	1,07
7.	IT dan Transportasi	0,27
8.	Lain-lain	7,56

Hutahean (2005) stated that CSM is one of the big players in the Asia Pacific region. Apart from being filled by local providers, the VSAT market in Indonesia is also being entered by other providers from abroad. The following is the VSAT market share in Asia Pacific:

VSAT Market Share in the Asia Pacific Region:

Table 3: VSAT Market Share in the Asia Pacific Region

No	Perusahaan	Pangsa Pasar (%)
1.	IPSTAR	19,7
2.	Bharti BB	16,9
3.	HNS India	15,3
4.	HCL Comnet	13
5.	Tatanet	3,9
6.	Telstra	3,6
7.	CSM	2
8.	Delta	1,7
9.	Primacom	1,6
10.	BSNL	1,5
11.	Essel	1,4
12.	Jaring	1,3
13.	Telekom Malaysia	1,2
14.	Lain-lain	17,1

KRI Banda Aceh has experience in a number of humanitarian operations, one of which is the AirAsia QZ 8501 SAR operation. At that time, KRI Banda Aceh was the command center for the search operation for Air Asia QZ8501 which crashed in the waters of the Karimata Strait, Pangkalan Bun, Central Kalimantan in December 2014. Then, This ship was relied on for the evacuation of the Lion Air JT 610 Jakarta-Bangka Belitung fuselage which crashed in Karawang waters. Of the hundreds of warship units in the Indonesian Navy, KRI Banda Aceh-593 was selected as the second-ranked Exemplary KRI in 2018. The awarding of this exemplary KRI was in the context of the 2018 Fleet Anniversary (HUT) which took place in Pondok Dayung, Tanjung Priok, North Jakarta. KRI Banda Aceh-593 has adequate specifications to support sending telegram news. This ship is 22 meters long and weighs 7,286 tons (Bramasta & Kurniawan, 2022).

Apart from that, this ship is also equipped with a modern communications room and VSAT technology which allows sending telegram news at high speed when the signal is bad due to weather, voice messages are not conveyed properly from the sending side to the receiving side, namely the Naval Headquarters. Therefore, it is necessary to send very detailed news, so that the news is conveyed well by the recipient of the news, namely to the Indonesian Navy Headquarters. Therefore, it must be equipped with Very Small Aperture Terminal (VSAT) technology which allows sending telegram news quickly, effectively and efficiently to the Indonesian Navy Headquarters. The communication technology that is often used by the Indonesian Navy in carrying out communications in the form of sending and receiving news is radio, but with all its limitations radio has been replaced by VSAT.

VSAT (Very Small Aperture Terminal)

VSAT (Very Small Aperture Terminal) is a satellite communications system that uses small antennas to communicate with geostationary satellites. This system is generally used to provide internet services, voice communications and data transmission in locations that are remote or difficult to reach by cable infrastructure. VSAT is a satellite communications system that uses a small parabolic antenna at the receiver (terminal) to communicate with geostationary satellites (Elbert, 2017). Basic.

Structure of VSAT

VSAT consists of a user terminal, modulator/demodulator, small parabolic antenna, RF transceiver, and geostationary satellite. The basic structure of a VSAT (Very Small Aperture Terminal) system involves several main components that work together to provide communication services via satellite. Following are the key elements in the basic structure of VSAT:

1. VSAT antenna

The antenna is the most visible physical element in a VSAT system. VSAT antennas are typically small, with diameters ranging from a few inches to several feet depending on the need and application. This antenna is designed to be able to direct signals precisely to related satellites in geostationary orbit.

2. Transceiver (Transmitter-Receiver) or VSAT Modem

The VSAT modem is responsible for modulation (at the time of transmission) and demodulation (at the time of reception) of the signal. The data signal to be sent or received is converted by the modem into a format that matches the characteristics of transmission via satellite. Modems also play a role in protocol management and access control to the network.

3. Hub (Central Hub)

In a star network topology, VSAT can be connected to a control center or central earth station called a hub. A hub is a control center that manages and routes data between various VSAT terminals in a network. The VSAT terminal communicates with the hub to transmit and receive data.

4. Geostationary Satellites

VSAT communications primarily involve satellites that are in geostationary orbit, which means they are in a fixed position in the sky above a specific geographic location. The satellite acts as a central point in the VSAT system, receiving signals from the VSAT antenna and sending them back to the sending terminal or to a receiving terminal elsewhere.

5. Teleport

Teleport is a facility that includes equipment and infrastructure to manage, control, and monitor the operations of multiple VSAT terminals. Teleport sometimes refers to a control center or central ground station that manages multiple VSAT terminals.

6. Backhaul Connection

A backhaul connection connects the teleport to a larger network infrastructure, such as the internet or a service provider's core network. This allows access to various services and applications outside the VSAT local network.

7. Power Supply and Supporting Devices

VSAT systems require a stable power supply to operate. This may involve a local power source or backup power supply for emergency situations. Other supporting software and hardware, such as routers, switches, and security devices, are necessary for effective network operation and management.

This basic structure can vary depending on the network topology implemented (star, mesh, or hybrid) and the scale of the particular VSAT system. VSAT has become an effective communications solution for applications that require connectivity in remote locations or that are difficult to reach by land telecommunications infrastructure (Maral & Bousquet, 2009).

VSAT Hub

A VSAT hub is a control center that manages communication traffic between user terminals and ground stations or internet services. In the context of a VSAT (Very Small Aperture Terminal) network, the term "VSAT hub" refers to a central station that functions as the control and management center for the entire VSAT network. VSAT hubs have a key role in managing data traffic, routing signals between different VSAT terminals, and providing connectivity with other networks or data center infrastructure. The main function of the VSAT Hub is as network management which is responsible for managing and controlling the operations of the entire VSAT network, as data routing which directs data between various VSAT terminals on the network, as well as as a control protocol to handle control protocols for traffic coordination and management. A VSAT hub provides a backhaul connection to the core network or data center infrastructure. This allows access to a wider range of services outside the VSAT's local network, such as the internet, data service providers, or other services (White & Elbert, 2003).

Advantages of VSAT

The advantages of VSAT include fast internet access in remote locations, reliable connections, and the ability to provide telecommunications and data services. The use of a VSAT (Very Small Aperture Terminal) system brings several advantages, especially in the context of communications in remote areas or those that are difficult to reach by land telecommunications infrastructure. Following are some of the main advantages and benefits of using VSAT:

1. Communication access in remote areas
   VSAT allows communication access in remote locations, such as inland areas, remote islands, or areas with difficult topography. VSAT enables the provision of communication services in remote areas or difficult to reach by traditional communications infrastructure. This can support communications in rural locations, mountain slopes, or other isolated areas.
2. Wide Geographic Coverage
   VSAT utilizes geostationary satellites which provide wide geographic coverage, making it suitable for connecting locations spread throughout the region.
3. Fast implementation
   VSAT systems can be implemented quickly without the need for complex land cable infrastructure. This enables fast connections in new locations or in emergency situations. VSAT provides fairly fast broadband internet access.
4. Low operational costs
   In some cases, operational costs to maintain and manage a VSAT network can be lower than developing other telecommunications infrastructure.
5. Consistent connectivity

Connectivity via geostationary satellites provides signal consistency because the satellites remain in the same location in the sky.

6. Two-way connection (Two-way Communication)
   VSAT allows bidirectional connections, meaning it can be used to transmit data to and from the VSAT terminal. It supports applications that require two-way interaction, such as voice calls or video conferencing.
7. Fast data delivery
   The use of high frequencies and the latest technology, such as High Throughput Satellites (HTS), allows fast data transmission and good performance.
8. Corporate Network and Branch Office Connections
   Companies can use VSAT to form a corporate network that connects head offices with branch offices in various geographic locations. This enables fast and efficient data exchange between business locations.
9. Satellite Phone
   VSAT supports satellite telephone services, enabling voice communications in hard-to-reach areas. This is useful in emergencies or in locations where landline telecommunications infrastructure is inoperable.
10. Internet for Ships and Airplanes
    VSAT can be used to provide internet services on ships and airplanes. This allows the crew or passengers to stay connected to the outside world during the journey.
11. Security and Surveillance
    VSAT is used in security systems for monitoring and surveillance at various locations. This can include border surveillance, critical infrastructure monitoring, and corporate security.
12. Disaster Recovery and Emergency Services
    VSAT has an important role in supporting disaster recovery operations and emergency services. Fast and reliable connections are crucial in emergency situations.

The advantages of VSAT may vary depending on specific needs and context of use. These benefits make VSAT a flexible and effective solution to overcome connectivity challenges in various contexts, especially in areas that are difficult to reach by landline telecommunications infrastructure. (Maral & Bousquet, 2009).

Modulation and Demodulation in VSAT

Modulation and demodulation (modem) are the two main components in a VSAT (Very Small Aperture Terminal) system which are responsible for converting digital data signals into analog signals for transmission over communication channels and returning the received analog signals into digital data on the receiving side. The modulator in the VSAT terminal converts the digital data signal into an analog signal that matches the characteristics of transmission over the satellite channel. This modulator prepares the signal to be transmitted via the VSAT antenna to the satellite. The demodulator at the VSAT terminal is responsible for taking the analog signal received through the antenna, identifying the information signal in it, and converting it back into a form of digital data that can be understood by the device or computer system at the receiving end. Some commonly used modulation techniques include:

a. QPSK (Quadrate Phase Shift Keying), is used to transmit two bits per symbol.
b. SPSK (8-Phase Shift Keying), using eight different phases, allows transmitting three bits per symbol.

Demodulation in VSAT occurs when the receiving party, the demodulator, identifies the phase or amplitude of the received signal to decode the information contained in the signal. Demodulator performance is very important because it can affect transmission speed and data integrity. The modulation and demodulation processes involve accurate synchronization between the sending and receiving systems. This includes synchronization with respect to frequency, phase, and time to avoid signal distortion. VSAT systems can use adaptive modulation techniques to adapt to changing channel conditions, such as attenuation or interference, and ensure connection stability and quality. The choice of modulation in a VSAT system can also affect the security and speed of data transmission. For

example, more complex modulation techniques can increase transmission speed but can be more susceptible to interference. The choice of modulation and demodulation techniques in a VSAT system must be adjusted to network conditions, throughput requirements, and the characteristics of the satellite communications environment used. The accuracy and efficiency of modulation and demodulation play an important role in maintaining the quality and speed of communications in a VSAT system (Roddy, 2006).

Disadvantages of VSAT

A technology must have defects in operation. So, besides the many advantages of using VSAT, there are several obstacles to using VSAT (Geeks, 2022), namely:

1. When information is sent via VSAT and is in transit, it is vulnerable to hacking.
2. Not waterproof.
3. Transmission Latency: VSAT technology uses satellites in Geosynchronous orbit. This type of data transmission has an estimated delay of about 500 milliseconds for each round trip. This creates problems in applications that require consistent transmission.
4. Environmental conditions: Like other satellite systems, VSAT networks can also be affected by weather and other environmental conditions. Signal strength can sometimes be weak, although this depends on antenna size, frequency band, and transmitter power.
5. Clear view: Since VSAT requires an external antenna, to contact the satellite, the location must have a clear view of the sky.
6. Not waterproof.

Of the shortcomings mentioned, the above is very crucial when compared with the telecommunications needs of military agencies, which are often in poor condition, inevitably exposed to water, requiring fairly fast message transmission. So, if we look at it from the perspective of the TNI AL's communication process needs and the benefits of VSAT in general, it can be said that VSAT, if it stands alone, is very vulnerable and less relevant, so the TNI AL needs much more sophisticated telecommunications technology. The need for more modern technology for the Indonesian Navy is even supported by research results which state that existing homogeneous wireless networks, such as cellular and satellite networks, may not be able to meet these requirements individually, especially in remote areas, including sea and mountains (Tirmizi et al ., 2022). One possible solution is to use a diversified wireless network that can utilize interconnectivity between satellites, air base stations (BS), and terrestrial BSs through interconnected space, ground, and air networks. Therefore, enabling wireless communications in an integrated network has become a matter of development.

In this case, the data says that the use of VSAT and radio alone is less relevant, because the shortcomings of VSAT are limited to its dependence on weather conditions and being vulnerable to being hacked. So, in line with what Tirmizi has said, currently an integrated telecommunications system is needed starting from radio, satellite and even wireless networks so that the information exchange process can be maximized. The United States as a country with a strong military force also uses an integrated telecommunications network ranging from radio, satellite, shipboard, cloud, fiber-optic cables and even the integration of technologies such as digital sensors, Internet of Things (IoT) networks, quantum computing, intelligence artificial intelligence (AI) and big data analytics (Naval Technology, 2022) so that the information transmission process occurs quickly, precisely and efficiently.

4. CONCLUSION

In It is felt that the performance of the Very Small Aperture Terminal (VSAT) system in the context of security and communications integrity at the Indonesian Navy Headquarters is starting to become less relevant. A thorough evaluation of the efficiency and reliability of VSAT in protecting military communications shows that this technology plays a crucial role in ensuring the security and operational continuity of the Indonesian Navy Headquarters. The crucial shortage of VSAT is proof that the Indonesian Navy needs much more capable telecommunications technology to increase the security capabilities of its communications system. Apart from that, demands from the development

of digital threats that endanger the sovereignty of the Indonesian state must be suppressed and minimized, one of which is by providing high security telecommunications facilities.

REFERENCES

[1] Bramasta, D. B., & Kurniawan, R. F. (2022). *Spesifikasi dan Kecanggihan KRI Banda Aceh-593, Kapal Perang TNI AL Buatan PT PAL*.

[2] Budi, A., & Nugroho, R. (2017). Perancangan Komunikasi Data VSAT Mobile Dengan Frekuensi KU-Band Pada Satelit Palapa. *Jurnal Ilmiah Giga*, *20*(2), 64. https://doi.org/10.47313/jig.v20i2.554

[3] Direktorat Jenderal Aplikasi Informatika. (2015). *Sistem Jaringan Internet di Indonesia*. KOMINFO. https://aptika.kominfo.go.id/2015/12/sistem-jaringan-internet-di-indonesia/

[4] Elbert, B. (2017). *Introduction to Satellite Communication*.

[5] Geeks, G. for. (2022). *VSAT (Very Small Aperture Terminal)*. Geeks for Geeks. https://www.geeksforgeeks.org/vsat-very-small-aperture-terminal/

[6] Ginano, M., Sengkey, R., & Karouw, S. D. S. (2015). Analisa Performa Kualitas Jaringan Vsat Mobil Pusat Layanan Internet Kecamatan Sulawesi Utara. *Jurnal Teknik Elektro Dan Komputer*, *4*(1), 72–79.

[7] Maral, G., & Bousquet, M. (2009). *Satellite Communications Systems: Systems, Techniques and Technology*. John Wiley & Sons.

[8] Naval Technology. (2022). Military communications systems and equipment suppliers for the naval defence industry. *Naval Technology*. https://www.naval-technology.com/buyers-guide/military-communications-systems-equipment/

[9] Roddy, D. (2006). *Satellite Communications*. McGraw-Hill.

[10] Sari, M. R., & Saputra, H. K. (2022). Analisis Quality of Service (QoS) Jaringan Very Small Aperture Terminal (VSAT). *Voteteknika (Vocational Teknik Elektronika Dan Informatika)*, *10*(1), 38. https://doi.org/10.24036/voteteknika.v10i1.116480

[11] Tirmizi, S. B. R., Chen, Y., Lakshminarayana, S., Feng, W., & Khuwaja, A. A. (2022). Hybrid Satellite–Terrestrial Networks toward 6G: Key Technologies and Open Issues. *Sensors*, *22*(21), 8544. https://doi.org/10.3390/s22218544

[12] A. Smith, B. Johnson, C. Lee (2017) "Enhancing Educational Effectiveness through Process Optimization in Nonprofit Organizations"

[13] Alijoyo, A., & Susanto, H. (2021). "Perkembangan Ekonomi Digital di Indonesia: Sebuah Analisis." *Jurnal Ekonomi dan Bisnis Indonesia*, 36(2), 150-165.