

The Need For Satellite-Based Interoperability To Strengthen Maritime Security A Study Of Indonesian Border Defense

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Abstract – Various border issues in the maritime border area are indeed ongoing, as are the rapid dynamics of the strategic environment. Therefore, strengthening defense and security along the sea border is essential. To ensure optimal military power, the defense concept must adapt to technological advances. A vast sea border area necessitates collaboration and coordination between military and civilian maritime elements to ensure maritime security. The success of the joint operation is dependent on interoperability. This research aims to describe an analysis of the need for satellite-based interoperability that can ensure defense and security in maritime border areas. This study utilized a case study of Indonesian maritime borders. The descriptive qualitative method was used in this study. In-depth interviews and literature reviews on sources relevant to the research objectives were used to collect data. The findings indicate interoperability between military units supported by coastguards in several maritime areas. However, its implementation necessitates an efficient and responsive command system based on electronic communication. As a result, an independent defense satellite is expected to achieve satellite-based interoperability, allowing quick response to various threats along Indonesia's maritime border areas.

Keywords – Interoperability, Satellite, Maritime Border, Joint Operation

I. INTRODUCTION

The border area has a crucial role that can affect the survival of a country because it involves aspects of national security, economy, politics, and socio-culture [1]. The management of this border area necessitates intense coordination and synergy among the institutions involved in maintaining security stability in the border area. Land, sea, and air border areas have all been vulnerable to a variety of potential threats and illegal activities. Furthermore, this research will be limited to studying maritime border security and defense. Various maritime border issues continue to exist today. One of them is the conflict in the South China Sea area, which remains the most serious and interesting international discussion.

Geographically, the location of the country of Indonesia is adjacent to the South China Sea region, to be precise it borders the North Natuna Sea. As an archipelagic country and the largest maritime country in the world, Indonesia should be concerned with maritime defense and security. Referring to the map of maritime operation areas (Fig. 1), 6 areas with high priority require maritime security operations, partnerships, and inter-agency cooperation, including the North Natuna Sea (area D). This is evidenced by the increase in sea violations in the region, especially IUUF (Illegal, Unreported, and Unregulated Fishing).

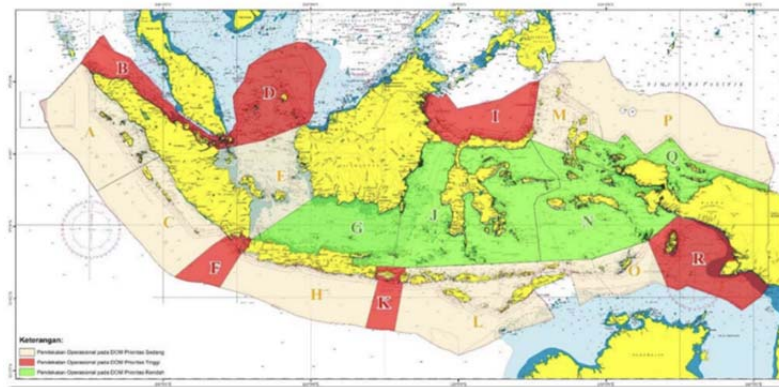


Fig. 1. The Map of Maritime Operation Area in Indonesia

Source: Bakamla RI (2020)

Border Security Operations command and control authorities must be well integrated and coordinated to make decisions on necessary actions and effectively control them. For this reason, information system interoperability that allows for the rapid and accurate distribution of information between related institutions in support of border security operations is needed [2]. When aligned with the strategic environment and rapid technological advancements in the military field, multidimensional operations based on Network Centric Warfare (NCW) technology are encouraged. In order to meet the challenges of future wars that prioritize the NCW system, interoperability must be properly realized in all aspects of combat operations [3]. When connected with the strategic environment and rapid technological developments in the military field, of course, it also encourages multidimensional operations involving Network Centric Warfare (NCW) technology.

The main factors in military information and communication systems are completeness, speed, accuracy, and security [4]. For this reason, it is necessary to have technology that can fulfill these 4 factors. The satellite communication system makes it possible to transmit information between commands and units operating in the field. In this case, satellites have a crucial role in building interoperability [5]. As a consequence, the study of satellites capable of supporting interoperability is considered crucial. This study aims to describe the essential role of satellite-based interoperability in strengthening maritime border defense and security. The research focuses on defense technology for the Indonesian sea area.

II. LITERATURE REVIEW

2.1. National Defense and Security for Maritime Area

National security is the actual state of a country in which there is no threat to its internal stability and sovereignty [6]. It does not always lead to national security and totality, but instead focuses on threats to vital national interests and objectives. While the national defense is a component of national security, which includes civil and military efforts to combat both direct and indirect threats [7]. That is, resistance to threats can be achieved through diplomatic and defense efforts in a variety of fields, including the economy, infrastructure, communications, transportation, cyberspace, etc.

According to the White Paper on National Defense of the Republic of Indonesia, the defense strategy has five strategic objectives in achieving its objectives, two of which are realizing national defense capable of dealing with threats, as well as realizing national defense capable of handling security in the maritime area, security in the land area, and security in the aerospace area [8]. Based on this strategic target, Indonesia's maritime territorial defense must be reinforced immediately to deal with threats to maritime security, particularly in the high-priority areas shown in fig. 1. The study of defense strengthening in this paper is focused on the application of technology to joint operations.

In terms of securing maritime border areas, there are statutory regulations that form the basis for Indonesia in setting boundaries as well as managing these areas. These laws and regulations include Law of the Republic of Indonesia Number 17 of 1985 concerning the Ratification of UNCLOS 1982, Law Number 6 of 1996 concerning Indonesian Waters, and Law Number 43 of 2008 concerning State Territories. This regulation is the basis for Indonesia in defending its maritime territorial sovereignty in the international space.

2.2. Military Interoperability

The ability of people, organizations, and equipment or devices to operate together effectively and efficiently is known as interoperability. It also refers to a procedure for equipment, doctrine, and training [9]. The Federal Research Division defines interoperability as the ability to exchange information between, across processes, or related to negotiations with the key to having a common understanding regarding this information. Its implementation is dependent on the availability of integrated resources and documented procedures for agreement outcomes to align the motivations of the parties involved [10].

NATO defines interoperability in the military as a capability that refers to joint operations by various military organizations and various armed forces (army, navy, and air force) to facilitate the formation of increased strength between units or systems to conduct operations (known as Joint operations) [11]. The Department of Defense Directive explains that the conditions established between electronic communication systems determine the level of interoperability within the military [12]. Interoperability specifications must be developed using integrated architectures, updated over the course of the system's life, and centered on capabilities.

Interoperability in military operations is essential given the characteristics of Network Centric Warfare, such as:

- *Systems of systems*, connecting the base system to a different system. The need for technical interoperability arises from the possibility that the systems connected to the network may have different technical characteristics.
- *Networked*, both wired and wireless are the dominant features that require connectivity, for that interoperability is needed.
- *Information sharing*, exchange of information from one system to another.
- *Collaboration*, aims to accomplish shared objectives more quickly and precisely by empowering one another's systems.
- *Shared situation awareness*. if interoperability is established, situation awareness from field dynamics information can be obtained simultaneously, quickly, and precisely.

The ability of various military simulation systems to operate together and create a shared simulation environment depends on interoperability between them. However, interoperability is more than just a technical issue; it also includes many difficult-to-achieve attributes. Some studies in NCW simulation demonstrate that interoperability involves other variables such as the simulation system's application environment, modeling mechanisms, and human behavior, which quickly enhances the performance of interoperability [13]. This refers to the main components of interoperability, namely hardware, software, and brainware.

2.3. Satellite Technology for Defense

Satellites are spacecraft that orbit the Earth and are developed to send and receive data from other satellites or earth stations. The information carried is in the form of voice, audio, video, or other data [14]. Satellite technology is one of the most advanced technologies that humans have discovered. This enables humans to have a wide coverage in terms of information collection and dissemination [15].

Essentially, a satellite in orbit serves a specific purpose throughout its lifetime. A communications satellite, for example, is a type of repeater station that receives signals from the ground, processes them, and then transmits them back to the ground. While Earth observation satellites photograph areas of interest as they move through space on a regular basis. In this regard, satellites, such as some military satellites or rovers, can effectively carry out spying work if properly equipped and launched for astrophysical applications [16]. As a result, the role of satellite technology in the military is crucial and strategic, and it must be considered when developing defense technology concepts.

In military operations, its ability to facilitate the rapid collection, transmission and dissemination of information makes defense satellites considered a 'Power Multiplier'. Global coverage, high readiness, discrete forward presence, quick response, and inherent flexibility are just a few benefits offered by space-based systems. These capabilities enable them to offer real-time or nearly real-time support for military operations during times of peace, emergencies, and various types of conflict. Satellites can provide details about enemy battle plans, precise geographic coordinates, and threat locations during the planning stage of

military operations [16]. Therefore, the C4ISR System can effectively use military satellite technology (Command, Control, Computer, Communications, Intelligence, Surveillance, and Reconnaissance)

Inefficiencies and latency in TCP and application protocol are inherent in military satellite communications that use Internet technologies. In this case, environmental factors may interfere with network performance, reliability, and bandwidth utilization. Open-source standards are necessary to ensure the complete interoperability of transport protocols between different military networks. Non-essential traffic over a satellite WAN can be significantly reduced by WAN optimization and acceleration solutions that incorporate SCPS (Space Communications Protocol Standards). This solution can provide military personnel with quick, dependable, and secure access to mission-critical information [17].

In relation to the interoperability studied in this study, of course, communication satellites play a major role in building interoperability technologies. However, satellite technology for defense can also be applied to other missions. One of them is reconnaissance satellite or spy satellite which can provide various intelligence information, such as GEOINT, IMINT, and SIGINT. The existence of this satellite can also support the early warning system.

III. RESEARCH METHOD

This study employs a descriptive qualitative research method. In-depth interviews and a study of the literature were used to collect data. This research uses a case study of maritime border defense in Indonesia. The discussion was held with military units and maritime components operating on Indonesia's maritime borders. Other data sources used included focus group discussions at overseas work lectures at the Defense University of the Republic of Indonesia. The topic of discussion was *Leveraging Satellite Innovation to Support Indonesia's Development and National Defense Capability*, with lecturers from Airbus Defense and Space. While a literature review refers to sources that are relevant to the research objectives. Therefore, the keywords used in reference searches are interoperability, joint operations, maritime security, and defense satellites. This study will analyze and describe the information or findings obtained to develop a defense concept.

IV. RESULT & DISCUSSION

As an archipelagic country and the largest maritime country in the world, Indonesia should strengthen its defense in the maritime area. Moreover, Indonesia has planned to become the World Maritime Axis. Defense strengthening needs to take into account violations that often occur in the maritime area, especially in the High Priority Maritime Operations Areas. The existence of Indonesia's EEZ boundaries that are still not agreed upon by neighboring countries also triggers violations, such as in the North Natuna Sea. In addition, anticipation is needed to deal with various potential threats that will come in this era of rapid technological advances. Thus, it can be said that in order to secure such a vast maritime area, defense technology can be a solution in strengthening national defense.

The change in the strategic environment could perhaps pose complex and multifaceted threats to a country. According to empirical data, the problem of territorial boundaries is one of the factors that cause war. At least, this border issue has the potential to cause tension and conflict between countries that can disrupt national security stability. In dealing with potential maritime threats, it can refer to the military defense architecture for defense posture (Fig. 2) in realizing Indonesia's World Maritime Axis.

This defense architecture describes the dynamic combination of warfare functions between forces so as to produce a solid military force to face threats. The functions in question include sensor functions, mobility functions, support functions, hitting functions, and force projection functions. These five functions are important variables for Command and Control. In this case the sensor function will integrate each sensor from the Tri Matra and civil sensors in accordance with applicable laws. To ensure integration between dimensions requires up-to-date and qualified technology that can be a solution for the realization of this defense architecture. In this case the use of satellites to support defense posture can expand the scope of information with a high level of confidentiality.

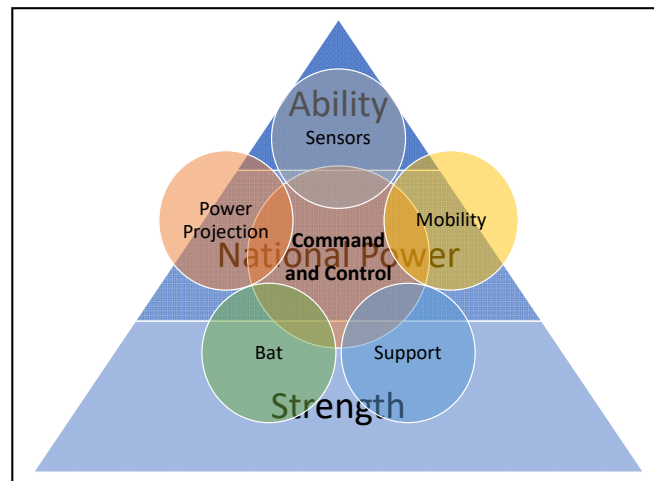


Fig. 2. Military Defense Architecture in Defense Posture
Source: Military of Defense of the Republic of Indonesia

Indonesia has the Maritime Security Agency of the Republic of Indonesia, which was established as a result of research on civil maritime elements (Bakamla RI). In addition to patrolling for maritime security in Indonesia. Bakamla RI, as the leading sector, has also been designated as the Indonesia Maritime Information Center, an integrated maritime information center (IMIC). The establishment of IMIC is focused on developing the monitoring system's capacity and capability, as well as building an information sharing network with other maritime information agencies at both the regional and global levels. This system contains up-to-date maritime situation information. Data optimization in this system can be used to support interoperability between agencies, which can strengthen defense in Indonesia's maritime border areas.

Furthermore, based on the results of research on military maritime elements, the TNI AL is tasked with enforcing the law and maintaining security in the maritime area of national jurisdiction in accordance with the provisions of national law and ratified international law. Interoperability has taken place between divisions in this maritime dimension. The Electronic Communications Unit is responsible for establishing interoperability between units in the navy, including in border security.

The Satellite Communication System (Siskomsat) was inaugurated in 2015, and it was used for surveillance operations on the outer islands. The Indonesian Navy's Siskomsat has allocated one Ku-Band transponder via BRISAT because it does not yet have a special defense satellite. The Indonesian Navy's Siskomsat is used on the KRI to help the commander of the operating unit in charge speed up command and control. Data, PTSN (Public Switch Telephone Network), and Vicom have assisted applications on KRI (Visual Communication). Radar and an AIS (Automatic Identification System) Transponder have also been installed on KRI, including the previously described KRI Usman Harun-359. The presence of a satellite communication system linked to the KRI as a down strike element enables the implementation of military defense architecture for defense posture in the realization of the World Maritime Axis.

Meanwhile, the navy has a role as a supporting element to monitor the sea area. Coordination with the navy is still done manually and has not been systemized. This makes it difficult to respond quickly to violations or potential threats that occur in the maritime border area. Even though the navy's defense equipment makes it possible to reach the area quickly. Another obstacle is the lack of implementation of a one-command system for border security in the maritime area. Therefore, an interoperability system needs to be realized immediately to build a command system that can provide a quick response to threats.

Based on the results of an overseas study with Airbus Defense and Space. Airbus has developed a Satellite-based Maritime Solution. In creating surveillance and providing access to relevant information from time to time, we cannot rely on just one satellite. Airbus carries a fleet of more than 10-12 satellites which are used for ocean surveillance. If you rely on one system, you will not be able to monitor such a large area of sea for a larger contribution. Unhindered access to a large number of satellites with different resolutions and different acquisitions, as well as with different technologies is essential. Therefore, if the satellite is intended for maritime surveillance, we cannot rely on earth observation satellites.

Indonesia needs satellites, but it needs to combine various types of information if it wants to really see the phenomena that are happening in the sea. In this case, it means the need to connect to all open-source databases that are managed or accessible on the web. Thus, it will be effective for maritime surveillance and even awareness at night. The point is the ability to combine and connect everything to a state-of-the-art data center. It is this solution that has always been practiced in the field, namely connecting different sensors and sources, minimizing access to outside information, and combining disparate information to the Command and Control Center so that it becomes a series of maritime surveillance systems that Airbus does.

As a representative of an aerospace and space company, satellite components are key. Besides that, there is a data center that has the ability to absorb a lot of information from various different sources to be connected to the data center between different entities in Indonesia. A highly effective and efficient data center that can be accessed by various different organizations in Indonesia is an important component going forward, so as to create a very sophisticated maritime surveillance center. Until now, Lapan (Republic of Indonesia Aviation Institute) has been working with Airbus to support the Indonesian space sector.

Satellite cloud services from one location to another will assist in the development of interoperability between systems, allowing them to provide information in real-time without being constrained by space and time. Satellite technology also enables spatial data interoperability, which is useful in monitoring a country's sovereign areas that are difficult to reach. Furthermore, this spatial data is transformed into GEOINT (Geospatial Intelligence), which commanders can utilize to make decisions.

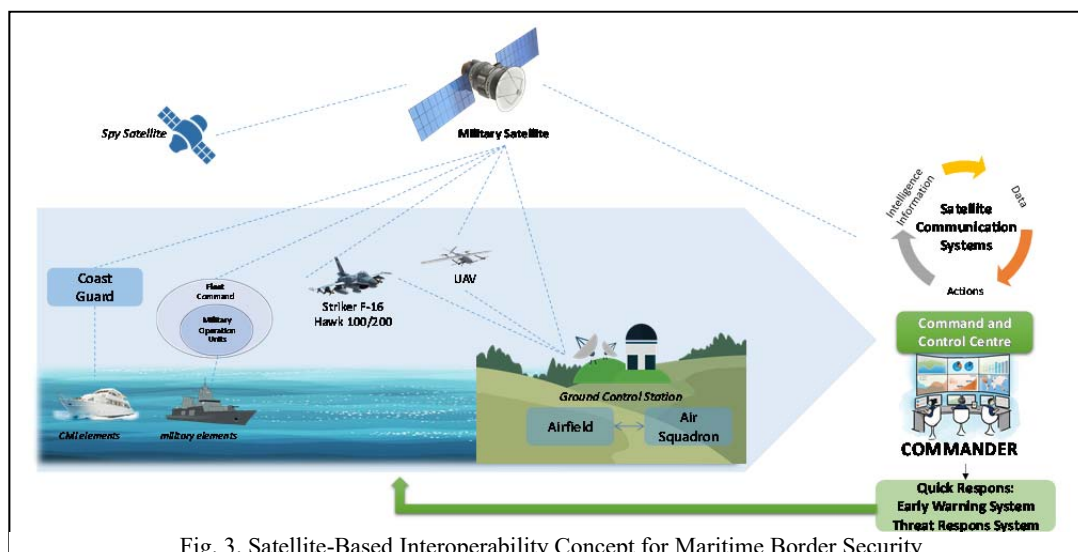


Fig. 3. Satellite-Based Interoperability Concept for Maritime Border Security

Based on the results of the research that has been done, the researchers made a conceptual satellite-based interoperability design. This defense concept combines inter-military (navy and army) and civilian forces. As long as interoperability between maritime elements is running even though it is not optimal. This is evidenced by the security operation that has not been carried out by a single command. In this concept, the navy acts as an optimizing element in the hope of providing a wider range of training. This concept utilizes the infrastructure already available by each agency, namely coast guard ships by Bakamla, KRI by the navy, as well as F-16 fighting falcons, UAVs and Hawk 100/200 by the air force. The Satellite Communications System that has been running to support maritime military operations is also expected to be the basis for the development of a satellite-based interoperability system.

The concept of securing maritime borders also relies on IMIC Bakamla to provide maritime security data. The Command

and Control Center plays a strategic role in making decisions for the joint operation so as to produce a quick response to threats. This system still requires further technical studies to be able to develop an optimal satellite-based information system interoperability architecture. It is also necessary to make adjustments to the available devices for this system.

V. CONCLUSION

The maritime defense system needs dependable technological support, particularly when dealing with potential threats near the sea border. Interoperability technology has been applied in border security operations in Indonesia even though it is not yet optimal. In this case, satellites have the potential to optimize interoperability between maritime components in order to build long-term electronic communication systems. Satellites are needed not only for communication purposes but also to obtain spatial data that support intelligence. It will be quite essential in the military decision-making process for difficult-to-reach maritime border areas. The resulting satellite-based optimization design concept must be supported by an independent special defense satellite to maintain the privacy or protect the nation's vital data. Indonesia urgently requires defense satellites.

Based on the findings of this study, stakeholders can be advised to make adjustments to the equipment available in the naval, air force, and coast guard operational units to improve interoperability. Further research can examine and measure interoperability quantitatively as a technical basis for the development of satellite-based interoperability technology that can be realized in the future.

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