Implementation of High Altitude Platform System in Development of National Defense Telecommunication Technology

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ABSTRACT-*This article will explain the concept of implementing High Altitude Platforms (HAPS) as the Main Backbone of military telecommunications in Indonesia. In the scientific map, this study is mainly included in defense science and defense technology in minor contexts which are within the scope of the field of sensing study in the sub field of remote sensing. This research uses exploratory research methods with a qualitative approach. Research data were collected using literature studies and analyzed with qualitative techniques consisting of three stages, namely data reduction, data presentation, and drawing conclusions. The results of the study explain the factors of information security, signaling, regulatory requirements, topology, and cost factors needed to implement HAPs in the military realm to enhance national defense.*

Keywords- *High Altitude Platforms (HAPs), Telecommunications, Defense Technology, System Topology.*

I INTRODUCTION

National security is the main goal to be achieved and sustained through efforts to improve and develop a comprehensive line of defense. One dimension that has a significant contribution to this effort is the integration of technological aspects into the national defense system, which acts as a basis and direction for development to ensure that the state has an ever-increasing defense force and is able to cope with various external threats that are also always developing from time to time.

Indonesia is a country that upholds world peace, which does not hesitate to intervene in efforts to create peace by deploying national resources as part of a mediating force or reconciliation in various international scale conflicts and in crises caused by natural disasters. Indonesia's efforts in maintaining world peace are also manifested in the form of national defense development to increase its undaunted effect, so as to reduce the intentions of countries that want to confront Indonesia. This is in accordance with the classic adagium "civispacemparra bellum", that the desire for peace must be balanced with readiness for war. In a sense, fighting to maintain peace or push towards the creation of peace, and the readiness of war which is manifested in a strong defense(Www.bphn.go.id, 2010).

Efforts to increase national defense in the digital age cannot rule out the important position of telecommunications technology. As stated earlier, the integration of technology into the defense system has

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become a major part of the national defense improvement strategy. Specifically regarding communication technology, which is the basis of the birth of the cyber world, is a top priority in the study of defense science and technology. This is based on the great potential of telecommunications technology products to be an important aspect of defense reinforcement, or even to be the seeds of latent threats to national defense (Arianto & Anggraini, 2019).

Utilization of telecommunications technology for the development of national defense systems also includes efforts to overcome the limitations currently faced, mainly related to the lack of telecommunications infrastructure support. If efforts to improve connectivity are carried out through the construction of terrestrial telecommunications infrastructure, the main obstacle lies in infrastructure development that is difficult to do in remote areas. As for using a satellite system, the launch and operation cost factors are the main obstacles faced by the government. Therefore, the development of High Altitude Platforms (HAPs) is the best option that can be implemented (Gultom & Yuniarti, 2016).

HAPs are vehicles, both in the form of airplanes and air balloons, which are flown at an altitude of 17-22 km above the earth's surface. The main advantages of the HAPs system are ease of placement, flexibility, low operating costs, low propagation delay, wide elevation angle, wide coverage and can be used for broadband services, broadcasts, and in disaster conditions. However, HAPs have flaws in terms of vehicle monitoring, air balloon technology which still requires further development, as well as the stabilization of the on-board antenna (SDPPPI, 2016).

Some differences in characteristics between HAP, Terrestrial and Satellite are as follows:

Table 1: Characteristics of HAP, Terrestrial and Satellite

Dimension	HAP	Terestrial	Satellite
Cell diameter	1 – 10 km	0,1 – 1 km	50 km (LEO Satellite *) 400 km (GEO Satellite **)
Coverage area	30 km	5 km	A few hundred km (LEO Satellite)
Elevation angles	High	Low	High
Propagation delay	Loew	Loew	Noticeable
BS*** maintenance	Simpler according to the coverage area	Quite complicated, when several BSs need to be updated	Can't be done
BS cost	More economical (cheaper) according to the coverage area	Depends on the company	Very expensive (around 5 billion dollars for Iridium)
Operational cost	Intermediate (mainly for airship operations)	Medium to high according to the number of BS	High
Complexity of	Low (mainly in remote	Medium (more	High

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Dimension	HAP	Terestrial	Satellite
Deployment	areas and areas with high population density)	complicated when applied in urban areas)	

Source: Gultom & Yuniarti (2016); Karapantazis & Pavlidou (2005)

*LEO : Low Earth Orbit satellites, i.e. satellites that orbit at an altitude of 1.000 km above the earth's surface (including low orbits)

**GEO :Geostationary or Geosynchronous satellites, satellites orbiting at an altitude of 35.900 km above the earth's surface

***BS : Basic Station

Based on its characteristics and advantages compared to satellite and terrestrial systems, HAPs are considered to be very suitable to be applied in Indonesia, both as one of the important instruments used to enhance national defense and to overcome various communication problems in order to overcome crises due to natural disasters that occur. However, a study of the implementation of HAPs in the realm of telecommunications technology development relating to its contribution to the improvement of the national defense system has never been conducted. Therefore, the purposes of this study are to explore the application of HAPs which include aspects of communication security, regulation, signaling, integration, governance authority for control and operation and the deployment of network backbone models using balloon satellites in the Republic of Indonesia, especially in the border areas of the country and rural areas with supporting data regarding budget requirements, technical specifications and military specifications needed.

II LITERATURE REVIEW

Some of the previous studies that have examined HAPs include: Gultom & Yuniarti (2016)entitled "High Altitude Platform (HAP) technology review". The research objective is to determine the potential of HAP for broadband communication and its development in Indonesia. The analysis was done descriptively by processing the literature data obtained. The results showed that there is potential for the application of HAP technology in Indonesia for broadband communication with 2x300 MHz bandwidth in the 27.9-28.2 GHz and 31-31.3 GHz bands. The first potential of HAP is related to HAP coverage which can replace terrestrial Base Transceiver Station (BTS) with cost-effective deployment in suburban and rural areas, where a HAP at an altitude of 20 to 25 km can provide a coverage area with a diameter of 300 km. The second potential is related to HAP applications that can be applied to telecommunications applications such as fixed communications, Broadband Wireless Access (BWA) applications, for integration with 3G / 4 mobile systems, to provide multicast/broadcast services, military communications, and emergency and medical communications. However, there are two main obstacles to the implementation of HAP in Indonesia, namely related to the absence of regulations governing frequency allocation for HAP specifically in Indonesia and regulations governing HAP platform flight permits.

Subsequent research byD'Oliveira, Melo, & Devezas (2016)entitled *"High altitude platforms-present situation and technology trends"*.The research aims to explore the history of HAP technology, describe the development of HAP until April 2016, as well as the trends and technological challenges of implementing HAP. The focus of the research is on technology directly related to the aerial platform of HAP by not elaborating more deeply on aspects in the telecommunications field. The results of research on the history of HAP stated that the technology had actually begun to emerge since the early 2000s, which was followed by the emergence of several HAP projects such as airplanes in Japan and South Korea, ERAST aircraft in the US, which as a whole did not have a continuation. Several accidents in the HAP project, such as the HELIOS accident in 2003 and the HALE-D accident in 2011, are a sign that HAP technology still has a low level of maturity. Based on this, there are challenges ahead that need to be overcome for the continuation of the HAP project. The first challenge is related to technological aspects, such as the need for lightweight structure discovery, energy storage with Regenerative Fuel Cells (RFC), thermal airship management, low altitude operations, and increased system reliability. The second challenge is related to the availability of financial resources to fund HAP technology development projects.

The third previous research was conducted by the Center for Research and Development of Resources, Equipment and Organization of Post and Information Technology (SDPPPI) Research and Development Agency for Human Resources of the Ministry of Communication and Information Technology (2016) with the title "Feasibility of implementing High Altitude Platforms (HAPs)". The research objective is to examine the feasibility of implementing HAPs from the regulatory side by using Regulatory Impact Analysis (RIA) in the aspects of frequency, information security and airspace management with supporting data on the description of telecommunications needs in rural areas. The results showed that overall existing regulations, especially regulations related to information security and airspace, did not allow Loon implementation. The first option is the Status Quo option, which is not to implement Loon. The next option is the option to implement Loon with regulatory changes and several requirements, namely the control and operation of the Loon vehicle must be in authority of Indonesian telecommunications operators and the launch, operation and landing must be carried out in Indonesian territory.

III RESEARCH METHODS

The research approach used is qualitative, which is an approach to explore and understand a central phenomenon based on data or information in the form of words or texts. The data is analyzed to produce a picture or description or themes interpreted by researchers to get a deep understanding of the research phenomenon (Creswell, 2014). Qualitative research results are strongly influenced by the subjectivity of researchers, where the thoughts, views, and knowledge of researchers determine the interpretation of the phenomenon and information analyzed.

The type of this research is descriptive, research that aims to produce systematic, factual and accurate descriptions of the facts, traits and relationships between aspects of the research focus (Rukajat, 2018). The implementation of descriptive research requires open thinking, broad insight and high sensitivity from researchers in analyzing phenomena and interpreting data obtained in the form of an accurate, critical and relevant explanation.(Wibowo, 2011).

The research data is in the form of secondary data, that is data obtained from literature studies by gathering information related to research topics from various sources on the internet (Silalahi, 2009). The data is then analyzed using qualitative methods with three stages of analysis consisting of data reduction, data presentation, and drawing conclusions. Data reduction is conducted by summarizing and focusing important things about

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research by looking for themes and patterns to provide a clearer picture, and make it easier for researchers to do further data collection and look for it if necessary. Stages of data presentation are carried out with the aim to make it easier to understand the data that has been obtained during the study. Presentation of data is carried out in the form of narrative descriptions or text, charts or tables. The final stage of qualitative analysis is drawing conclusions to answer the problem statements raised in the study(Bungin, 2017).

IV DISCUSSION

High Altitude Platforms (HAPs) are platforms placed in the stratosphere layer with a height of about 20 km above the earth's surface. The choice of the stratosphere layer is based on its characteristics which have the lowest wind turbulence and influence compared to other air layers (Karapantazis & Pavlidou, 2005). Based on the placement, the HAPs are able to overcome the limitations of the terrestrial system that requires land infrastructure development, which is difficult to realize in remote areas. In addition, the location of HAPs in the stratosphere also allows their use in special situations, such as when natural disasters or conflicts occur, which generally cause damage to terrestrial installations. When compared to satellite systems, HAPs have advantages in terms of much lower launch and operational costs. This allows more intense use of HAPs according to the needs of the coverage area and launch time. In addition, HAPs are also able to overcome the shortcomings of the satellite system in terms of high time delay for interactive voice and data (Ferdinan, Santoso, & Darjat, 2009).

The superiority of the characteristics of HAPs also needs to be accompanied by the fulfillment of the most important aspect of the communication network, which is related to information security. Moreover, the development of HAPs aimed at strengthening national defense systems requires a much higher level of information security because it involves the interests of the state and the wider community. Related to the information security aspect, according to the results of research conducted by the Center for Research and Development of Resources, Equipment and Organization of Post and Information Technology (SDPPPI) Research and Development Agency for Human Resources of the Ministry of Communication and Information Technology (2016) who took the object of the Loon project, it can be seen that there are at least three information security categories that must be met by the HAPs system that can be measured through three information security indicators. Three categories of information security include confidentiality, integrity, and availability of data, as measured by physical, technical, and organizational indicators(SDPPPI, 2016).

The Loon Project is a project that began in 2011 under the incubation of GoogleX. Furthermore, Google officially inaugurated Project Loon as a Google project on June 14, 2013. The Loon Project uses HAPs in the form of a series of balloons floating through space, designed to connect communities in rural and remote areas, helping to fill gaps in network coverage areas, and allows communities to stay connected online after a disaster. Loon project trials were conducted by Google in collaboration with several countries, such as New Zealand, Brazil, Australia, Sri Lanka, India and Indonesia. (Yuniarti & Hamjen, 2017).

Cooperation between Google and Indonesia in the Loon project began in 2015, which was marked by the signing of a collaboration between Google representatives and three CEOs of telecommunications operators, namely Telkomsel, XL and Indosat(Yuniarti & Hamjen, 2017).However, a feasibility analysis of the application

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of HAPs conducted by SDPPPI (2016) states that the Loon project has a high information security risk. In accordance with the two collaboration options in the Loon project, it turns out that information security in physical, technical and organizational indicators is in the low category to be able to carry out the functions of confidentiality, integrity and availability of data. Information security threats measured using physical indicators include the difficulty of taking over hijacked information and threats from the strengthening of the internet of things (IoT). Threats according to technical indicators include low availability and the possibility of high system vulnerability. Threats according to organizational indicators relate to the unavailability of special security standards for communication carried in the Loon project.

Based on the results of the study, the best option that can be taken is to cancel the Loon project with two considerations, namely: first, no country has implemented a Loon or Loon is not ready for commercialization so the technology is not yet mature; and second, existing regulations, especially regulations regarding frequency licenses, do not allow Loons to be implemented.

In addition to testing the feasibility of HAPs in terms of information security, SDPPPI (2016) also examines two other important aspects, namely regarding information governance and air space. Based on a study of aspects of information governance, a decision was made that cooperation in the Loon project could be done by placing Google only as a technology vendor with project operations and control in the hands of Indonesian operators. However, given the HAP technology in the Loon project which is still in the trial phase, it is hoped that Google can provide assistance to Indonesian operators in operating the Loon at an early stage. In addition, to avoid information leakage due to widespread cooperation involving neighboring countries, therefore, launching, operating and landing vehicles in the Loon project can only be carried out in Indonesian territory.

The final aspect reviewed in the implementation of HAPs, specifically the Loon project, is related to regulations governing the air space where HAPs operate. As known, a vehicle in the HAPs system can be in the form of air balloons, airship, and airplane that are flown unmanned at an altitude of 20-50 km (Gultom & Yuniarti, 2016). This turned out to be incompatible with Indonesian regulations governing unmanned aircraft contained in Minister of Transportation (PM) Regulation of the Republic of Indonesia No. 180 of 2015 concerning Control of Operating an Unmanned Aircraft System inthe Air Space Served by Indonesia; and regulations related to the maximum weight of unmanned aircraft contained in the Minister of Transportation Regulation No. 163 of 2015 concerning Civil Aviation Safety Regulations Part 107 concerning Small Aircraft Systems without Crew.

The Loon Project is an example of efforts to implement HAP technology in Indonesia that can be used as learning material to further implemention of HAPs, including in the military sphere to increase the independence and competitiveness of the nation in the field of defense telecommunications technology. Based on the analysis of the Loon project, several important things to ensure the implementation of HAPs can produce optimal benefits can be drawn. First, independence is needed in implementing HAPs. In a sense, Indonesia must possess the technology of HAPs, so that the development of HAPs projects in the military realm does not involve technology vendors such as the Loon project that requires Google as the technology vendor of HAPs.

Relating to the need of HAPs technology possession, Anwar (2015)in his research entitled "Mastery of defense technology by Indonesian Defense Human Resources in the context of facing future wars" develops a framework in the preparation of the Defense Technology Curriculum which includes the education component of "study of advanced technology". The possession of HAP technology can be classified into these components,

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namely with the aim of creating human resources who have special knowledge and expertise in the field of HAPs and their applications in the military sphere. This step in the realm of HAPs technology education can be considered a basic step that must be taken if Indonesia really wants to integrate HAPs technology into the national defense system in the future.

The second important thing that can be known from the Loon project that can be taken into consideration in the implementation of HAPs in the military sphere is related to regulations that support the technology. This is an issue that has been followed up slowly by the government, which can be seen from the absence of regulations that facilitate the implementation of HAPs. Even though the need to formulate the regulation has been stated since 2016 in a study of the Loon project. But until now, the effort to examine the safety and layout of unmanned aircraft as a basis for the formulation of regulations is still a discourse planned to be carried out in 2020 (Pradana, 2019).Therefore, the second step that must be taken in order to integrate HAPs technology into the defense system is to propose regulations regarding unmanned aircraft specifically operated by the defense department, not for the public or for commercial purposes. This is intended to increase the speed of licensing drone trials for the benefit of national defense.

Relating to the frequency spectrum needed for the application of HAPs in Indonesia, Gultom & Yuniarti (2016)use the International Telecommunications Union (ITU) reference which issues the provisions of the operation of HAPs in several regions of the country including Indonesia in the band frequency spectrum of 27.9-28.2 GHz and 31-31.3 GHz. This was subsequently adapted into Minister of Communications and Information Technology Regulation No. 25 of 2014 concerning the Indonesian Radio Frequency Allocation Table, which regulates frequency allocation for HAP to be used in the band 27.5-228.5 GHz and 31-31.3 GHz. Thus, the third important thing in the implementation of HAPs, which is related to signaling has been overcome by the provision of ITU which was derived in Ministerial Regulation 25/2014 concerning Indonesian Radio Frequency Allocation Table.

Basically there are three types of topology of HAPs, namely the stand-alone HAP system; HAP system that is integrated with terrestrial; and HAP systems that are integrated with terrestrial and satellite (Gultom&Yuniarti, 2016). Among the three types of topologies, the most appropriate for the need for defense enhancement is the first topography, which is a stand-alone HAP system. This topography can be illustrated as follows:

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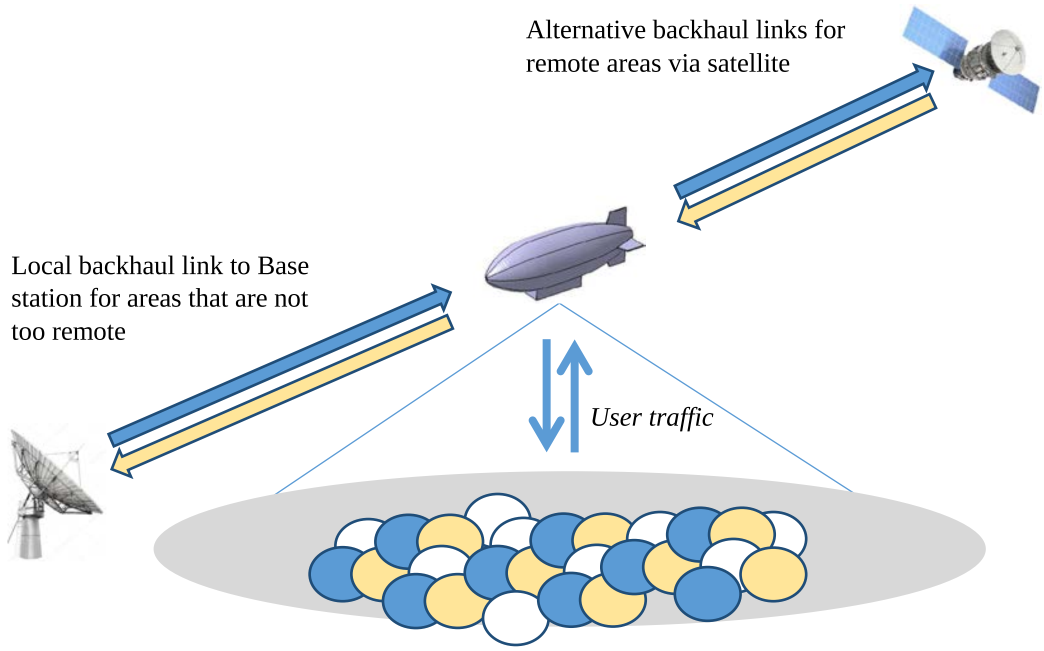

Figure1: Standalone HAPs SystemSource: Gultom & Yuniarti (2016)

The standalone HAPs system topology is very suitable to be applied for the purpose of environmental monitoring, both for disaster management purposes and for the collection of defense data; and increased connectivity in remote areas. This topography enables the utilization of the advantages of HAPs over satellite and terrestrial technology, both in terms of land infrastructure needs and in terms of cost.

The cost factor in implementing HAPs with stand-alone system topologies can be said to be the greatest advantage over satellite and terrestrial systems. In this topology, HAPs do not require complicated maintenance and operations, so it has lower maintenance and operational costs compared to satellite and terrestrial. Its use also does not require special time as satellite and terrestrial systems are bound by launch calculations (satellite) or infrastructure development (terrestrial). HAPs can beoperated according to needs, both related to the launch time and location. However, considering that HAPs are still in the development stage and there are no parties that have high success in their application, the biggest costs are needed in the study and trial of HAPs until the results are in line with expectations. The estimated costs for implementing HAPs are mentioned byKarapantazis & Pavlidou (2005)are around 50 million dollars. These costs are much lower than the cost to implement the Leo satellite system (Iridium costs around 5 billion dollars, Teledesk costs around 9 billion dollars) and Geo satellites (around 200 million dollars), and is still cheaper when compared to the cost for the installation of terrestrial systems with many base stations.

V CONCLUSIONS AND RECOMMENDATIONS

The selection of HAPs as a telecommunications technology product to be integrated into the Indonesian defense system can be an effective and efficient solution to address the needs of national defense development in anticipating threats in the digital age. In addition, the implementation of HAPs also allows environmental monitoring in an effort to anticipate and or overcome the impact of natural disasters, and to obtain important information as input to defense data.

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As a future technology that continues to be developed, there are some important things that must be known and implemented to be able to integrate HAPs into the national defense system. First, related to data security, that the implementation of HAPs for the purposes of defense development cannot be done by involving foreign intervention. Indonesia must have the technology, so it does not require technology vendors like the Loon project that uses Google as a vendor of HAPs technology. Therefore, the first step that must be taken is to direct the educational component to integrate HAPs technology material in the learning process.

The second important thing is related to the absence of regulations that support the implementation of HAPs, in addition to Ministerial Regulation 25/2014 on the Indonesian Radio Frequency Allocation Table which contains ITU derivative provisions regarding frequency spectrum that can be used by HAPs. The use of unmanned aircraft as a vehicle for HAPs and the height of the airspace where HAPs operate is still collided with the Minister of Transportation (PM) Regulation of the Republic of Indonesia No. 180 of 2015 concerning Control of Operating an Unmanned Aircraft System in the Air Space Served by Indonesia; and regulations related to the maximum weight of unmanned aircraft contained in the Minister of Transportation Regulation No. 163 of 2015 concerning Civil Aviation Safety Regulations Part 107 concerning Small Aircraft Systems without Crew. Therefore, it is necessary to propose regulations that can facilitate military interests related to operational HAPs that are specific to the military realm.

The third important thing is related to the technical specifications of the most appropriate HAPs to be applied to the needs of increasing national defense, namely the standalone topology of HAPs. This type of topology allows HAPs to be operated flexibly, both in terms of the time of use and the location of the launch, so that it can be adapted to the military agenda. The estimated cost needed to implement HAPs is around 50 million dollars or around 700 billion rupiah (at an exchange rate of 1 dollar = Rp14,000).

Based on these conclusions, the recommendations that can be given are related to the need to establish a national defense system development framework oriented to the integration of HAPs technology. This framework can be used as a guideline and an evaluation reference for the progress of development undertaken. In addition, comparative studies need to be conducted with several other countries that have tested the implementation of HAPs in the military realm to gain practical knowledge that is useful for the implementation and integration of HAPs in the Indonesian defense system..

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