Feasibility Analysis of the Application of Project Loon as an Equitable Effort for Communication Infrastructure Development in Indonesia

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Abstract
In Indonesia, urban area internet users, between villages and cities, are arranged in the villages according to 72.41%, 49.5%, and 48.3%. Following are the composition of internet users in Indonesia: Java, Sumatra, Kalimantan, Sulawesi, Bali-Nusa Tenggara, and Maluku-Papua respectively 58.1%, 19%, 8%, 6.7%, 5.6%, and 2.5%. To overcome this problem, several attempts have been made to equalize internet access in Indonesia, and one of the efforts offered is Project Loon. Project Loon is a communication technology based on High Altitude Platform (HAPs). Research related to Project Loon feasibility testing is conducted using library study methods using SWOT analysis using strengths, weaknesses, advantages, and battles against Project Loon using various indicators such as systems, infrastructure, economy and regulation. The conclusion of this research is that Loon Project has the potential to be implemented not yet available in Indonesia. In terms of infrastructure and economy, Project Loon is quite effective and economical. However, it must still consider the population in the area to avoid operational costs.

Keywords: *Project Loon, HAPs, Swot Analysist*

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1. INTRODUCTION

A study conducted by Google's laboratory research revealed 4.5 billion people on this earth did not have access to the Internet. According to data from the Ministry of Communication and Information (Kominfo), in 2017, of the number of villages in Indonesia, 83,447, only around 60% were connected to the internet. 143.3 million people or 54.7% of the total Indonesian population can access the internet. However, around 60% of internet users are still centered on Java. In a survey conducted by the Association of Indonesian Internet Network Providers (APJII) in collaboration with Indonesian Technology, internet users are still not concentrated and concentrated only in urban areas. Where 72.41% of the population of the city can surf in cyberspace. Meanwhile, in rural-urban areas or between villages and cities, only 49.5% are connected to the internet. While in Rural areas only 48.3% are connected to the internet. By region, the composition of the biggest internet users in Java was 58.1%. After that in Sumatra with a composition of 19% and Kalimantan 8%. While other regions, namely Sulawesi, Bali-Nusa Tenggara, and Maluku-Papua each have a composition of 6.7%, 5.6%, and 2.5%. [1]

Meanwhile, data traffic has increased by 131% since 2011. The situation is has encouraged some mobile operators in Europe to invest in machine-to-machine communications. However, the existing mobile networks are not able to accommodate the exponential growth in data traffic [2]. It is a technology background offloading cellular traffic. Current condition, the provider always attempting to provide the best service to users. The condition affected the condition of the customer by utilizing WiFi offloading cellular traffic which is far away than the available infrastructure. Providers must continue to provide the best service to the customers by providing Wireless Access Gateway (WAG) to connect the user to the Gateway can be optimized [3] [4].

The presence of Project Loon is an offer of solutions to build Internet penetration throughout the world. Even according to Google's own internet balloon they made could reach remote areas and even remote areas [5]. Project Loon is a technology that adopts a HAP system that uses balloons as a vehicle to be flown at a stratospheric altitude of about 20 kilometers or equivalent to 6000 feet.

At the height of the stratosphere, Google balloons will form a broad network that is integrated with each balloon with other balloons. The balloon is equipped with advanced technology such as Artificial Intelligence which is able to read and adapt to the direction of the wind so that it can adjust its own position in a better direction. Not only that, Google's balloon is also equipped with electronic devices such as solar panels that function as chargers that guarantee electronic devices can still work for months.

As the name suggests, what distinguishes the project loon from other HAP technology is the use of a giant balloon with a length of 15 meters and a width of 12 meters as a component that makes it fly. The balloon is termed as a cover filled with helium gas which is equipped with an automatic system for pumping or releasing air following the ambient temperature. This balloon cover is specially designed from polyethylene plastic material which is claimed by Google itself to survive from UV rays to 100 days at altitude. This balloon cover will also become a routine expense if operated [5].

Google's balloon will form a mesh topology with a series of IEEE802.11s control specifications. There are two types of communication: 1) balloon to balloon communication, 2) balloon to land communication [6].

In 2016, a discourse emerged in Indonesia that Project Loon would conduct a trial. In the trial plan, Project Loon will use frequencies that have been licensed to cellular operators. In a review of the SDPPPI Research and Development Center, the Human Resources Research and Development Agency - the Ministry of Communication and Information Technology explained that the safety factor is the most important thing to consider in the implementation of this Loon Project, especially information security and air space. If these two things are not fulfilled, then the implementation of Project Loon is not possible to implement. There are other options for implementing this Loon Project, but there are several conditions that must be met, namely the launch and balloon control system must be carried out in the territory of Indonesia. However, it is still necessary to amend regulations or new regulations that explain in detail the standards and operations to ensure governance of national frequency, security and airspace [7].

This research was conducted to examine the feasibility of implementing Google Balloons in Indonesia by studying literature and using the swot analysis method. This research will look at strengths, weaknesses, opportunities and challenges with indicators on Loon Project such as systems, infrastructure, economics and regulation. Thus, this research is expected to be able to measure the potential implementation of Google balloons if implemented as an alternative communication system in Indonesia.

2. MATERIAL AND METHOD

2.1.High Altitude Platform (HAP)

Since 1990 several countries such as the United States, Japan, and South Korea have used HAPs technology for telecommunications and remote sensing. HAPs are vehicles that usually form airplanes, airplanes or balloons both manned or unmanned aired which are flown to make telecommunications networks or conduct remote sensing, for civil or military applications. HAPs are usually felled at stratospheric heights which start at 7 km at the poles and 18 km at the Equator, extending to about 50 km [8] [9].

Historically, it was conducted in 1930 pioneered by Swiss Auguste Piccard by making pressurized gondola balloons. Then in 1969 a company called Raven Company initiated an aircraft without HAPs called High Platform II. Some of the HAP projects developed by several countries in the world are: Helios (Erast Program), Hisentinel80, Stratospheric Platform (SPF), Stratospheric Airship, Zephyr, Hale-D (HAA Program), Integrated Sensor Is Structure (ISIS), Solar eagle (Vulture Program), Stratobus, Project Loon, Solara Project, and Aquila [8].

Figure 1. High Platform II Airship, 1970, Raven [8]

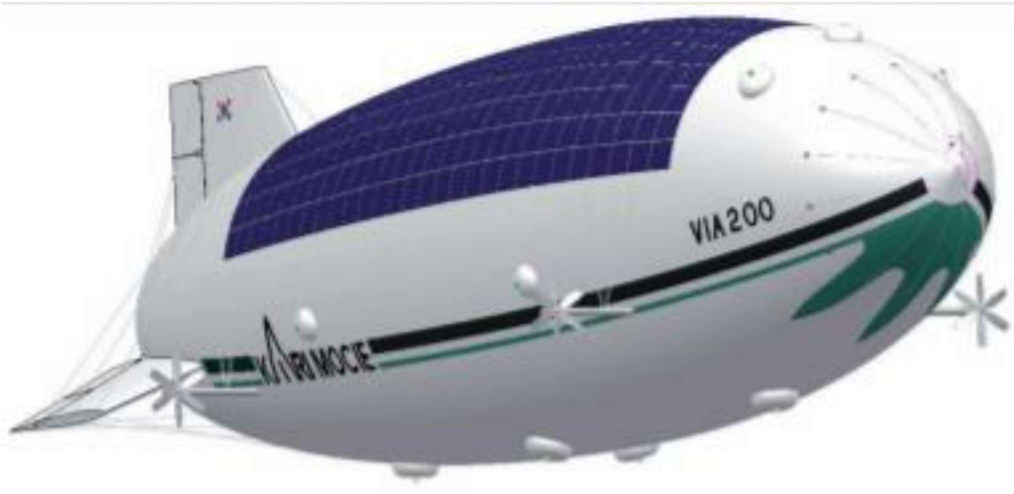

Figure 2. VIA 200 Airship, KARI [8]

Several terms have been used for this technology, such as: "High Altitude Powered Platform," "High Altitude Aeronautical Platform," "High Altitude Airship", "Stratospheric Platform," "Stratospheric Airship" and "Atmospheric Satellite". However, the term "High Altitude Platform (HAPs), adopted by ITU, is the most commonly used [9].

Figure 3. Proteus Manned Airplane, Scaled Composites, Angel Technologies [10]

HAPs in topology can be applied in several types, depending on conditions and needs. Some of the HAP network topology is terrestrial-HAP-satellite system, integrated terrestrial-HAP system, standalone HAP system [10].

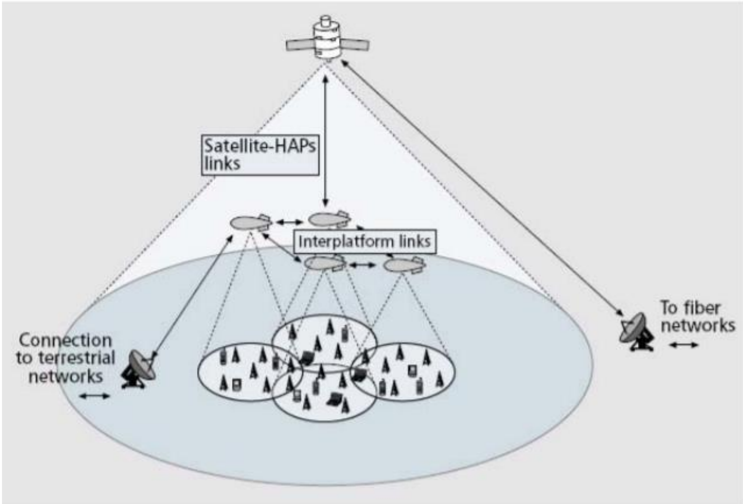

Figure 4. A terrestrial-HAP-Satellite System [10]

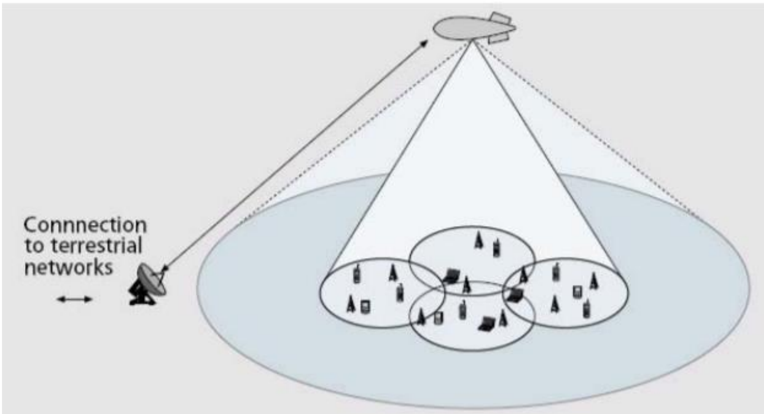

Figure 5. An integrated Terrestrial-HAP system [10]

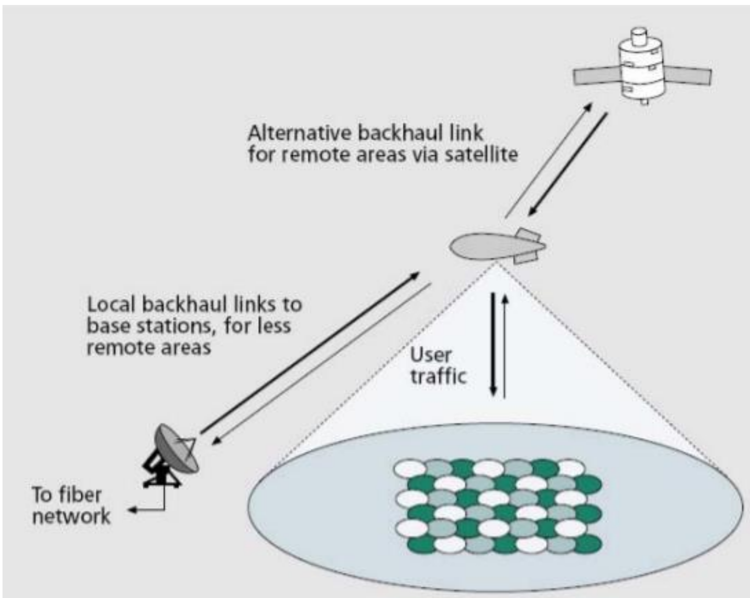

Figure 6. A standalone HAP system [10]

The advantages of this HAPs system are ease of placement, flexibility, low operating costs, low propagation delay, wide elevation angle, wide reach and can be used for broadband services, broadcasts, and in disaster conditions. Networks on HAP technology can use 2G, 3G or 4G services. HAPs can also function as an alternative wireless network to increase the capacity of existing networks due to limited coverage and natural disasters. However, HAPs also have limited in-vehicle monitoring, hot air balloon technology that still needs further development, and the on-board antenna stabilization is not good.

2.2.Project Loon

Project Loon is a technology that adopts a HAP system which uses balloons as a vehicle to be flown at a stratosphere height of about 20 kilometers or equivalent to 6000 feet. The Stasforfer layer was chosen because the wind speed and weather conditions are relatively stable. [11] [12].

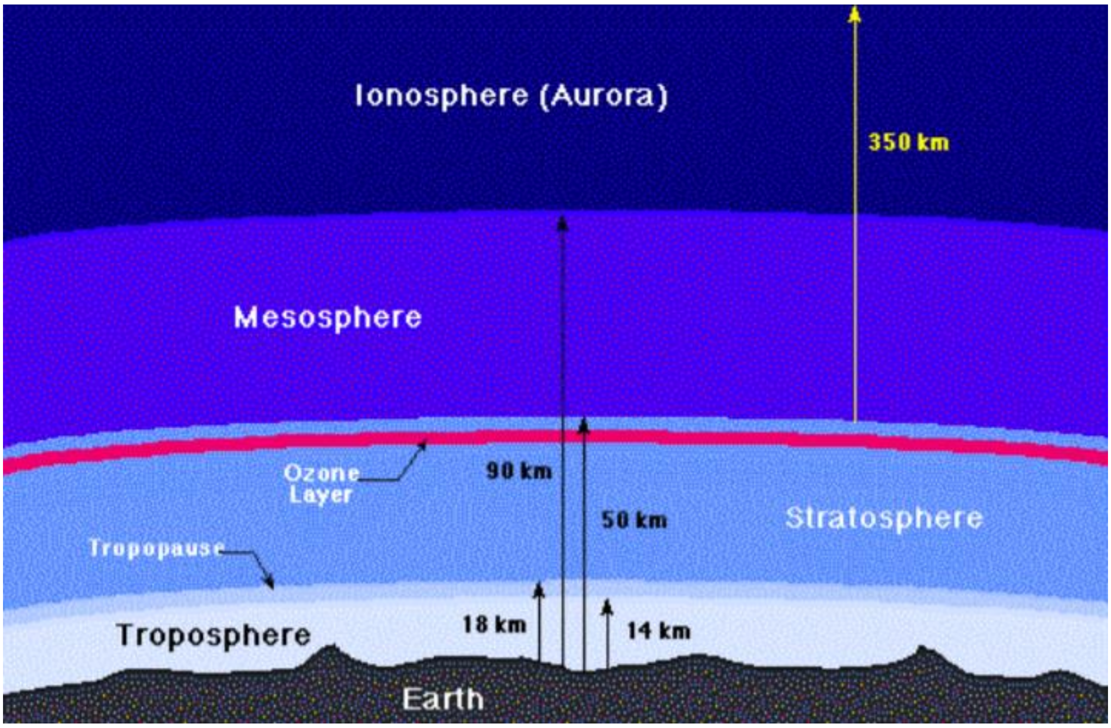

Figure 7. Layer of the earth's atmosphere [8]

At the height of the stratosphere, Google balloons will form a broad network that is integrated with each balloon with other balloons. The balloon is equipped with advanced technology such as Artificial Intelligence that is able to read and adapt to the direction of the wind so that it is able to regulate its own position in a better direction. Not only that, Google's balloon is also equipped with electronic devices such as solar panels that function as chargers that guarantee electronic devices can still work for months.

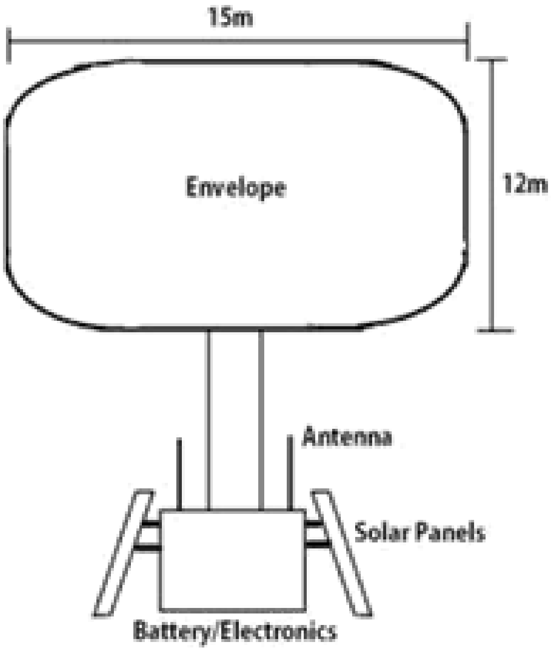

Figure 8. Google Balloon Components [7]

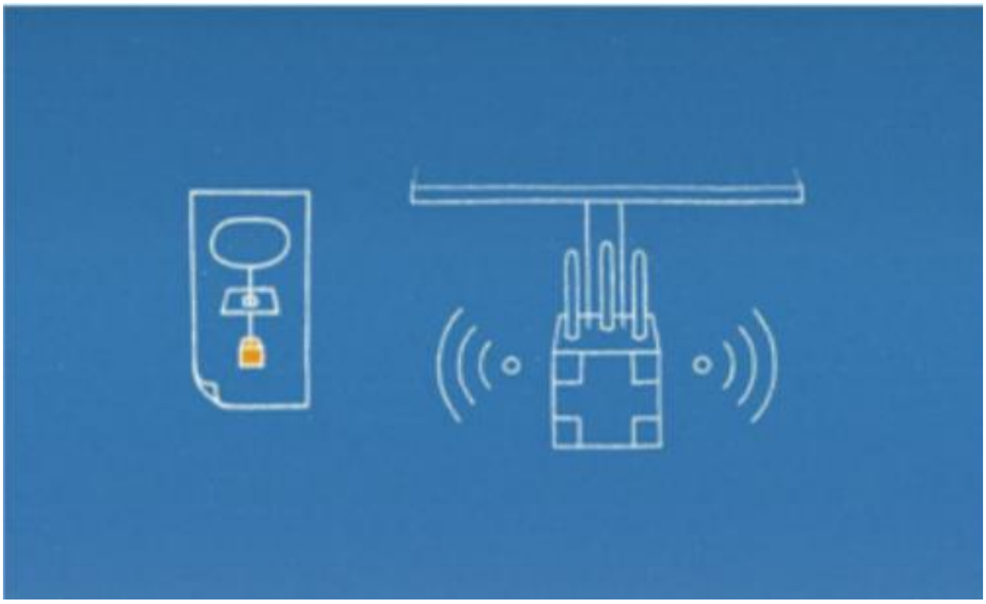

Figure 9. Loon Control Box [15]

As the name suggests, what distinguishes the project loon from other HAP technology is the use of a giant balloon with a length of 15 meters and a width of 12 meters as a component that makes it fly [13]. The balloon is termed as a cover filled with helium gas which is equipped with an automatic system for pumping or releasing air following the ambient temperature. The cover of this balloon is specially designed from polyethylene plastic material which is claimed by Google itself can survive from UV rays for up to 100 days at high altitudes. This balloon cover will also become a routine expense if operated [12] [13].

In its official release, Google states that each balloon has a diameter range of 40 kilometers above the ground surface which, if accumulated in a circular area of 1257 km square. Google's balloon will form a mesh topology with a series of IEEE802.11s control specifications. There are two types of communication: 1) balloon to balloon communication, 2) balloon to land communication [6].

Several countries have conducted Google Balloon flight trials, including New Zealand, Brazil, California and the United States.

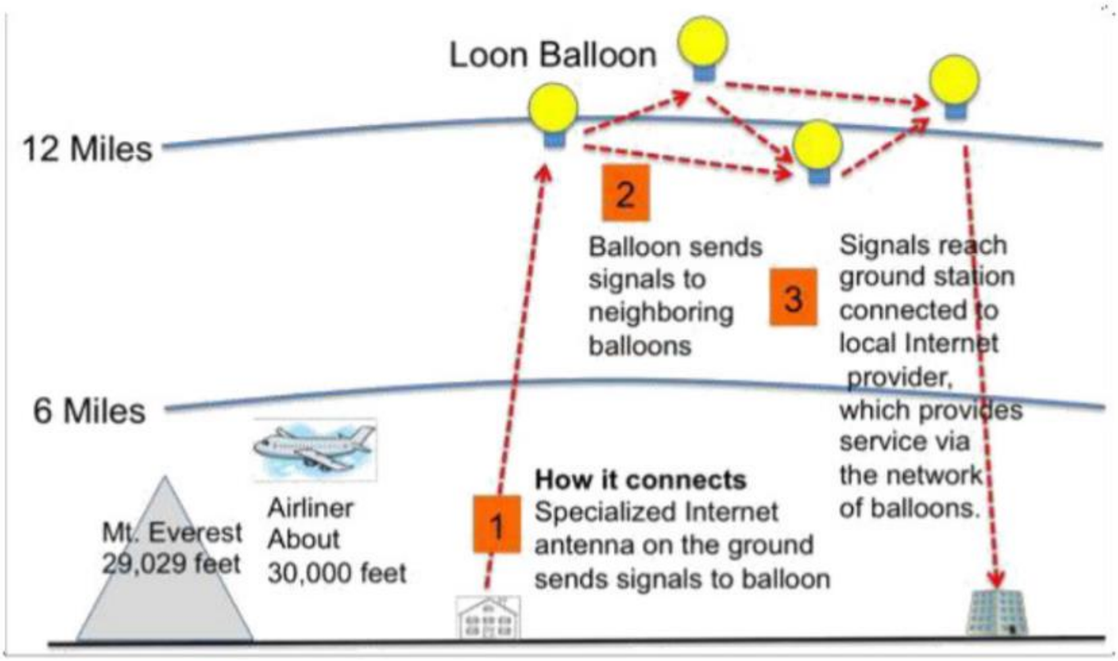

Figure 10. How Ballon Connect [15]

In Figure 10 we can see a balloon flown twice as high as a civil aircraft flight. Balloons interact with each other at the height of the stratosphere with algortima applications using wind movement. Balloons send signals between balloons and also to ground stations on land.

Project Loon raises several difficulties in its implementation. This is because some countries do not have good flight permits. Constraints also issue security issues by the state if the loon project is implemented [15].

In Indonesia, the SDPPPI Research and Development Center, Human Resources Research and Development Agency - Ministry of Communication and Information Technology explains the safety factor is the most important thing to facilitate the implementation of the Project, requiring information security and air space. If the second thing is not met, then the implementation of the Loon Project is not possible. There are other options for implementing this Loon Project, but there are a number of requirements that must be agreed upon, namely those that are approved and the balloon control system must be implemented in Indonesian territory. However, it is still necessary to change regulations or regulations that explain the standards and operations to regulate national frequency, security and airspace governance [7].

2.3.Related Research

Several researchers and academics have conducted studies on this looon project, some of which are as follows:

Ahmad Thariq Syawqi discusses the role of Project Loon in human life. In the discussion it was concluded that the Looon project had a positive impact on life by providing internet access to remote communities, but the negative impact of the Looon project could be minimized so that the benefits of the Google Balloon could be felt by humanity [12].

Diah Yuniarti and Hilarion Hamjen in 2017 discussed the development of the Loon Project in several countries. The study concluded that balloon experiments in several countries experienced problems mainly in licensing, frequency allocation and airspace [13].

Research by the National Aeronautics and Space Administration (NASA) in 2019 where Project Loon was included in global assimilation data to analyze the impact of wind on balloon performance in the air [14] .

Bhatt & Ambekar 2016 discusses the components of the project, such as the model, the device used and its connectivity. In this discussion also alludes to the constraints of the looon, which is a control system that has failed [15].

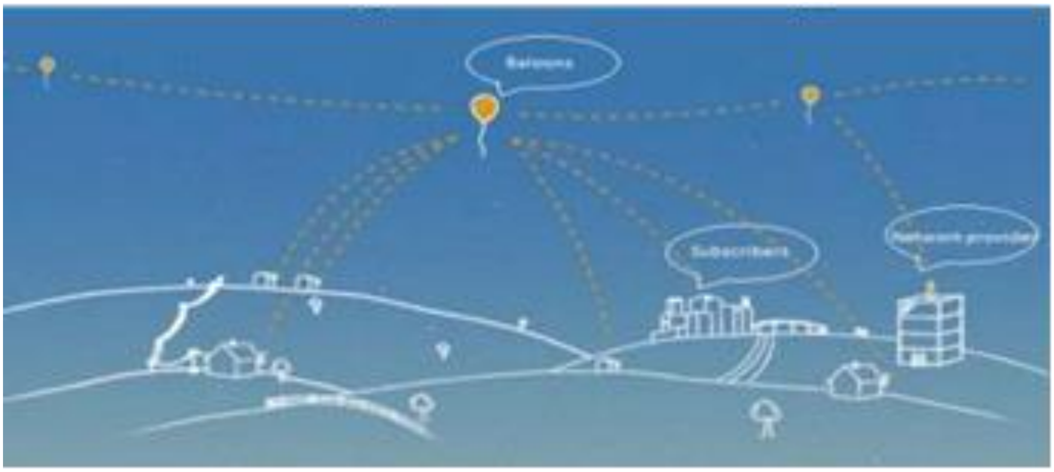

Figure 11.Google Balloon Transmission Signal [11]

Feasibility of Implementing High Altitude Platforms (HAPs) (Research Center for Research in SDPPPI, 2016) the Ministry of Communication And Informatics of the Republic of Indonesia,This study discusses the feasibility of implementing HAPs with google balloon case studies in Indonesia related to the design and modification of Google balloons, aspects of data security, aspects of aviation security and frequency regulation [7].

Mohil Pandey and Sumit Bhattacharya in 2014 discussed balloon wireless networks for free internet access. This discussion also alludes to the workings of the components and components that are owned [16] .

Julie Jin at the 2016 CANSO Latin America and Caribbean Conference discussed Project Loons. In the presentation, Project Loon Operational Steps were discussed, namely regarding navigation systems, safety requirements, and balloon connectivity [17].

Javier Cazorla Avilés conducted research on the technology of HAPs on UMTS networks. The study designed a stand alone HAP network by measuring the pathloss and coverage area of the HAPs.

2.4.Proposed Method

This research was carried out with systematic and structured work steps to get optimal results. The step of research work is a series of procedures and steps in researching in a structured and systematic manner so that the objectives of the research can be achieved properly. The steps used in this study are seen in Figure 12.

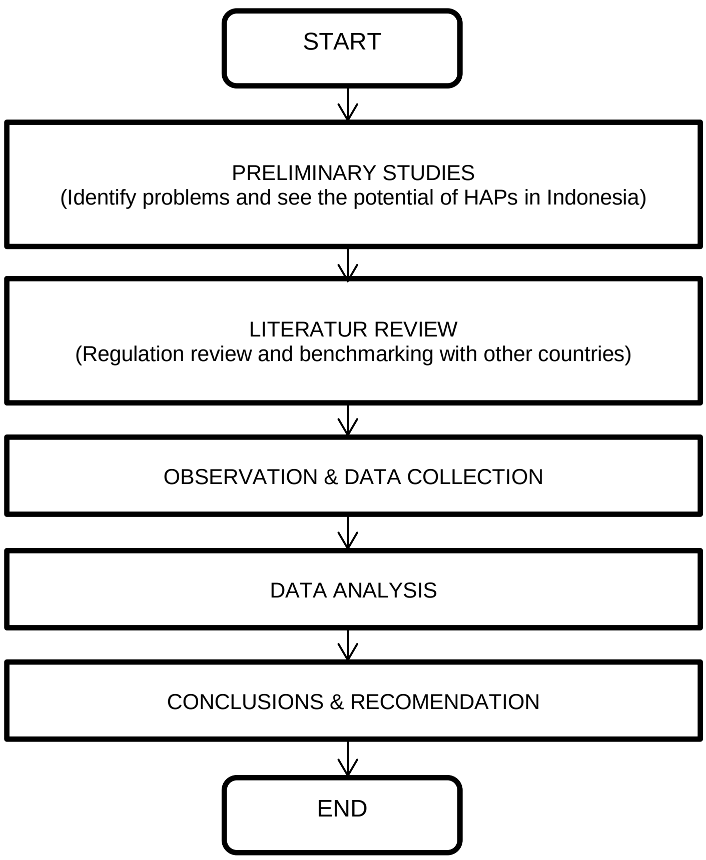

Figure 12. Proposed System Diagram Block

In conducting this research, using a literature study and then analyzing to see the strengths, weaknesses, opportunities and challenges of the Loon Project. As for the indicators that will be seen are the system, infrastructure, economy and regulation. Thus, this research is expected to be able to measure the potential implementation of Google balloons if implemented as an alternative communication system in Indonesia.

3. RESULTS AND DISCUSSION

3.1.Google Balloon Specification

By looking at the composition and specifications of the Google balloon we can imagine the investment and operational costs of this Project Loon.

Table 1. Material Audit for Each Balloon [6]

Component	Specification	Material	Total (kg)
Envolve		Plastic Polyethylene, density 0,95 g / cm3 (British Plastics, n.d.)	**111.5kg**
Electronics (antennas and other Transmission equipment)	Estimated as 4 desktop computers	Aluminum	4.368kg
		Plastic	7.176kg
		Steel	6.552kg
		Copper	2.184kg
		Glass	7.800kg
		Nickel	0.312kg
		Tin	0.312kg
		Lead	1.872kg
			30.577kg
Solar Panel	Estimated 2 Panel @20kg	Silicon	14kg
		Aluminum	16kg
		Copper	2kg
		Plastic	8kg
			40kg
Battery	12V Ion Lithium 200AH		**33kg**
Gas cylinders	Based on Praxair 128bar	Cylinder	30kg
	Pressurized cylinder	Hydrogen ($1.8m^3$ At 13.8MPa)	18.65kg
			48.65kg
Parachute	Based on Mills G-12E cargo parachute	Nylon (Victoria University, n.d.)	**57kg**
Total			**320.73kg**

By knowing the specifications of this google balloon, we can get an idea of the capacity of a balloon, the devices used, the mass load, so that the price needed to make and operate it can be estimated.

Table 2. Material Estimates for One Balloon Unit [6]

Component	Material	Total (kg)	Cost (Rp)
Enclave	Plastic Polyethylene, density 0,95 g / cm3 (British Plastics, n.d.)	**111.5kg**	15,660,000
Electronics (antennas and other	Aluminum	4.368kg	175,450,000
	Plastic	7.176kg	
	Steel	6.552kg	

Transmission equipment)	Copper	2.184kg	
	Glass	7.800kg	
	Nickel	0.312kg	
	Tin	0.312kg	
	Lead	1.872kg	
		30.577kg	
Solar Panel	Silicon	14kg	16,530.000
	Aluminum	16kg	
	Copper	2kg	
	Plastic	8kg	
		40kg	
Battery	12V Ion Lithium 200AH	**33kg**	34,800,000
Gas cylinders	Cylinder	30kg	9,425,000
	Hydrogen ($1.8m^3$ At 13.8MPa)	18.65kg	
		48.65kg	
Parachute	Nylon (Victoria University, n.d.)	**57kg**	7,250,000
Total		**320.73kg**	259,115,000

From Table 2, we can calculate how much it will cost to implement Google Balloons. Thus, we can also estimate the profit and loss from the implementation. Several countries have conducted google balloon trials that is indicated in Table 3.

Table 3. Google Balloon Benchmark in several countries

No	**Country**	**Number of Balloons**	**Coverage Area**	**Frequency**	**Number of Residents**	**Status**	**Year**
1	New Zealand	30 Pieces	20 km	ISM Band (2.4 GHz and 5.8 GHz	50	Trials	2013
2	Brazil	5 Pieces	30 km	Using the spectrum that is licensed for LTE		Trials	2014
3	Australia	20 Pieces		2.6 GHz		Trials	
4	Sri Lanka	3 Pieces		750 MHz		Trials	
5	India			2500 MHz		Trials	
6	Peru		40 km	Using the spectrum that is licensed for LTE	Tens of thousands	Disaster Management	2017

Table 3 shows a comparison of the application of google balloons in several countries. The average is still at the trial stage, and no country has implemented google balloons commercially.

3.2. Swot Analysist

After conducting a literature study of the project looon, it can be formulated into a swot analysis where conditions of strength and weakness, opportunities and threats can be observed.

From each of these aspects, 4 main indicators are made, namely system, infrastructure, economy and regulation.

Table 4. Swot Analysist Project Loon

Indikator	Strength	Weakness
System	• Google's commitment to develop and spread internet technology throughout	• There is no direction for the development of Project Loon as a reference for the development and application of technology in the future with a continuous and directed pattern
Infrastructure	• Project Loons have sophisticated and modern infrastructure. • Use inexpensive devices and materials.	• Loon's control system is still not well tested, with the discovery of falling balloons in several countries.
The economy	• Project Loons provide cheap internet facilities. • Project Loons can reach remote areas.	• Even though it is low cost, the project looon must still consider investment costs especially if you want to be charged to users. • Need to pay attention to the number of users / population density of an area so as not to cause operational losses.
Regulation	• There is a potential allocation of HAPs based on ITU's radio regulation	• In Indonesia, frequency sharing with telecommunications operators has not been regulated.
Indicator	**Opportunities**	**Thereats**
System	• The need for the internet for humans is greater. • The area of Indonesia is large enough so that it requires a broad range of internet services.	• New technologies are emerging. As currently Indonesia is developing the Palapa Ring project.

Infrastructure	• Improved infrastructure specifications and standardization.	• The rapid development of technology so that the existing hardware is fast out of date. • Advances in software technology have an impact on the need for sophisticated hardware.
The Economic	• Increased purchasing power of the people. • Dependence and human need for access to information and communication.	• The price of IT infrastructure is unstable. • The amount of population distribution in an area needs to be the main consideration.
Regulation	• The rules for using HAPs have been set in ITU's radio regulation	• There is a potential for interference with neighboring countries if the Loon Project is implemented.

From the swot analysis above, the Loon Project implementation strategy can be formulated, namely:

a. S-O Strategy
1. Improve communication with policy makers.
2. Improve the control function on Google balloons so that there is no malfunction.
3. Conduct a more in-depth study of the areas that will be targeted for implementation, regarding the distribution / population density and people's purchasing power.

b. S-T Strategy
1. Coordinate with neighboring countries so that potential interference with frequency does not occur.
2. Ensuring the quality of tissue that can reach remote areas.
3. With the Indonesian government's Palapa Ring project, the looon project can only be used as an alternative vehicle in an emergency.

c. W-O Strategy
1. Make adequate infrastructure supporting facilities.
2. Making an integrated system to ensure safety in operation.

d. W-T Strategy
1. Conduct HR training for operational and technical needs.
2. Perbaikaan, maintenance, and renewal of the network in accordance with the needs of technological development.
3. Maintain cheap and affordable services for the lower classes of society.

CONCLUSION

From the results and discussion above, the following conclusions can be obtained:

1. There are 4 indicators used in every aspect of the SWOT analysis conducted on the project looon. These indicators are system, infrastructure, economy and regulation.
2. In the system indicator, Project Loon has 1 strengths, 1 weakness, 2 opportunities, and 1 threat.
3. In infrastructure indicators, Project Loon has 2 strengths, 1 weakness, 1 opportunity, and 2 threats.
   1. On economic indicators, Project Loon has 2 strengths, 2 weaknesses, 1 (weaknesses), 2 opportunities (opportunities), and 2 challenges / obstacles (threats). And 3 challenges / obstacles (threats).
4. In the regulatory indicators, project loons have 1 strengths, 1 weaknesses, 1 opportunities, and 1 threats.
5. The results of the SWOT analysis formulation, found 3 strategies for SO (maximizing strengths and opportunities), 3 strategies for ST (maximizing strengths to overcome challenges / obstacles), 2 WO strategies (minimizing weaknesses by utilizing opportunities), and 3 WT strategies (minimize weaknesses and overcome challenges / obstacles).

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