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Increasing 4G Internet Coverage in Maluku

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A B S T R A C T

The availability of reliable internet connection is getting more important recently because of its vital role in helping people to access information. Private and public sectors use the internet as a medium to deliver their service to consumers. Online business in Indonesia has become more popular and probably will get a more significant share of retail transactions in the future. Indonesia faces a disparity in internet connection coverage. Compared to the western part of Indonesia, people in the eastern part, especially Maluku, have difficulty accessing affordable and good-quality internet access. There is a less competitive internet service market in this area due to the low demand for internet service and high infrastructure cost, so that holds the service price higher than other areas. The merger between internet service providers will help establish compatible competitors and improve internet connection quality in the eastern part of Indonesia.

Keywords: Maluku, Internet Connection, Perfect Competition.

1. Overview of the Problem

Since introduced in 1985, the internet has encouraged movement into digitalization. Many sectors such as trade, education, entertainment, and finance have moved their services into a digital platform and will increase demand for internet bandwidth. In Indonesia, where private consumption accounted for 58.7% of its nominal GDP in December 2020 [1], the online market has become more popular and as of 2017, has created an $8 billion a year market and 30 million online shoppers (Das et al., 2018, p.11). During the COVID-19 pandemic, the role of the internet is increasing which enables people to perform their activities. The number of internet users in Indonesia has increased by 15.5%, about 27 million new users, in 2021.

However, the quality of internet speed is dispersed across Indonesian regions. Overall, 55.71% of Indonesian territory can access the latest generation of internet connection (4G) (Statistics Indonesia, 2020), but it is mainly located on Java and Sumatera islands. If these two islands are excluded, 4G coverage in other areas is 39.8%. Maluku is among the regions with a 4G coverage ratio that is considered low compared to other regions, with only 27.38%. Maluku faces several challenges to provide good quality and affordable internet connection. These challenges are similar to other small island territories in the world, such as the high cost of crossing the open sea and small populations (Internet Society, 2017).

The low coverage of the 4G internet network hinders Maluku from reaching its potential economic productivity. GDP per capita in these regions is the lowest compared to other regions in Indonesia. Based on the 2018 data, GDP per capita in Maluku province was 1,675 USD, and North Maluku was 2,041 USD. The national GDP per capita at that time was 3,863 USD[2]. Most people in Maluku work in the agricultural sector. This sector supplies enough jobs in this area but provides the lowest wages to its worker[3].

The bad quality of the internet also makes it difficult for the regional government to perform services for its citizen. In the 2020 election, several districts in Maluku faced a problem updating the election results due to internet connection problems.

Improving the quality of the internet would provide possibilities to improve the socio-economic condition in Maluku. Strong internet quality is required to improve

[1] Calculated by author from https://www.ceicdata.com, accessed on March 13, 2021

[2] Calculated by the author, https://www.bps.go.id/indicator/52/288/1/-seri-2010-produk-domestik-regional-bruto-per-kapita.html, data accessed and processed on March 13, 2021

[3] 34% of total job In Maluku Province an 43% in North Maluku Province is in Agricultural sector.

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several sectors in the small island territory, such as agriculture, tourism, public administration, education, health, financial services, disaster relief, and emergency preparedness (Internet Society, 2017). The wider adoption of Information and Communication Technology (ICT) in the region has significant potential for sustainable development (UN ESCAP, 2018).

Using study literature from articles, government publications, and international best practices, this paper discusses the problem behind the problem of bad quality internet coverage and quality in Maluku regions and the option that the government should take to increase internet coverage in Maluku.

2. Problem Context

2.1. Socio-politic aspect regarding infrastructure development

Maluku is rich in agriculture and had an important role in ancient Indonesia. Maluku has been known as the Spice Islands since the 13th century when the first Arabian voyager visited the area (Pattikayhatu, 2012). The main commodities are clove and nutmeg, and people used them as ancient medicine. Maluku became the gate for international traders in the 16th and 17th centuries, such as the Dutch and Portuguese, who later colonialize Indonesia. Until now, Maluku province places as the second region that produces most of the clove production in Indonesia. In 2020, Maluku produced 14.52% of national clove production, slightly below the South Sulawesi province, which contributes 14.78% of total production[4].

Maluku's high potential for agriculture products is not accompanied by adequate infrastructure development. In the New Order Administration under President Soeharto (1967-1998), the central government did not prioritize infrastructure development in East Indonesia, including Maluku (Safi, 2017, p.2). During his 31 years tenure, the development highly focused on Java Island and the western part of Indonesia.

Infrastructure development also did not become the priority program in Indonesia under President Susilo Bambang Yudhoyono (2004 – 2014) since he focused on restoring and maintaining political and economic stability (Negara, 2016, p.3). After the Asian Financial Crisis in 1998, several conflicts happened in Indonesia, including Maluku. Deadly riots happened in Maluku in 1999-2002 and resulted in 2,793 people who lost their life, 5,057 were injured, 13,843 buildings had been damaged, and one-third of the population has been displaced (Barron, 2019, p.65). This conflict between Muslim and Christian communities drove social and economic disparities between both communities (p.65). This conflict started in the province's capital city, Ambon, and spread to other areas in Maluku. After 2000 conflicts, several riots happened in Maluku, at least four in 2011-2012 triggered by a similar reason (Nainggolan, 2012; Barron, 2019). These conflicts decrease physical security, weaken macroeconomic stability, threaten the rule of law, decrease access to credit and financial services, destroy infrastructures, reduce labor markets, disables the regulatory framework, and destroy the tax system (Mills and Fan, 2006). These situations might discourage the investment climate in the Maluku islands.

The infrastructure development in east Indonesia became part of President Jokowi Administration's priority (2014 – 2024) (Negara, 2016, pg.8). However, Information and Communication Technology (ICT) development has not been placed as the highest priority. According to Medium Term Budgeting Framework (2015-2019), the central government placed ICT as its 9th priority among 12 priorities in Indonesia's Infrastructure Investment Plan (pg.9).

The lack of members from Maluku in the House of Representatives also is a problem for prioritizing the infrastructure development in this area. In the 2019-2020 tenure, there were only seven of the total 575 House of Representatives members from Maluku regions; four members represent Maluku Province, and three members represent North Maluku Province (House of Representative, 2019). "It is not easy to fight for Maluku's interest in Jakarta," said Mr. Hendrik Lewerissa, one of the representatives from Maluku Province (Lewerissa, 2020).

2.2. The potential demand and risk of internet service provision in Maluku

Several aspects should be analyzed regarding internet connection infrastructure in the archipelagic territory that affects the economic feasibility of internet provision, such as demographic, isolation, and vulnerability (Internet Society, 2017). The demographic factor sees the size of the population and the income rate. The Maluku population is only three million, 1.16% of the total population in Indonesia. The population per district is also considered low in several areas. For example, the Aru Islands district and southwest Maluku district have 13 and 18 people per kilometer square, respectively (Statistics Indonesia, 2021). As most people work in the agricultural sector, they have limited sources of income to meet their consumption. These characteristics create low demand for internet service and cause a low return on investment rate. Figure 1 shows that the percentage of households owning a cellular phone is increasing from 2017 to 2019. There is a potential of increasing demand for telecommunication and internet service, even though it is still below the national average.

[4] Calculated by the author https://www.pertanian.go.id/home/index.php?show=repo&fileNum=210, accessed in March 14, 2021

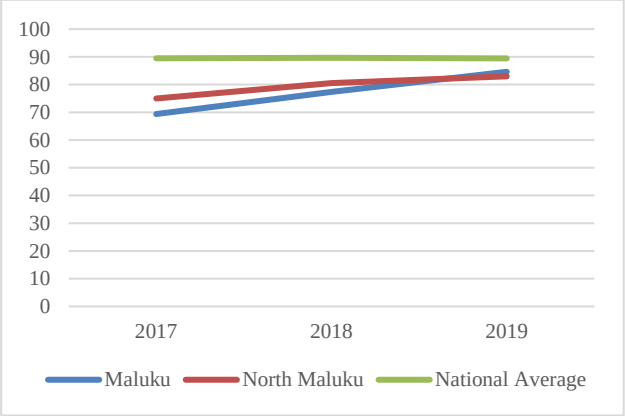

Fig. 1. Percentage of households owning a cellular phone.
Note. The graph was prepared by the author from Statistics Indonesia in 2020.

In terms of the isolation of each island, Maluku has several seaports that connect islands in its territory. Maluku has 36 seaports that connect 11 cities and districts in this province (Siswoyo, 2016, p.4). In 2014, 17,529 ships arrived, and 17,503 departed from Maluku seaports. This situation indicates that most areas in Maluku are not isolated, and mobility between the island in the Maluku islands is supported by seaports and ships' availability.

Maluku islands are among the area in Indonesia that are vulnerable to natural disasters. In North Maluku province, the Morotai district suffered from the earthquake that happened in February 2019. In July 2019, the same type of disaster happened in the South Halmahera district (Statistics Indonesia, 2021). The vulnerability to natural disasters can damage the communication infrastructure and increase concern to provide reliable, redundant, and robust communication systems to accelerate response to disasters (Internet Society, 2017).

2.3. The technological challenge in improving internet connection quality and coverage in the small islands' territory

The Ministry of Communication and Information Technology implemented several methods to develop the internet infrastructure backbone in Maluku. Up until 2013, internet service in Maluku depended on satellite infrastructure with limited capacity and low quality (Oktarini & Kawano, 2019, p.2). The high operation and maintenance cost of satellites caused the high price of internet service in this area. The high price and inconsistent quality created low internet customers in this area.

2.4. The environmental challenge related to providing a place to build internet infrastructure

Maluku society has managed environmental conservation efforts since ancient times. The original Maluku tribe has a traditional law named "Sasi" that restricts people to access land and coastline to harvest agricultural and fishery products (Judge and Nurizka, 2008; Satria and Mony, 2019). This law enables natural resources to grow, and people can continuously get benefit from nature. Sasi law allows people to harvest natural resources every three or four months depending on each area (Judge & Nurizka, 2008, p.3). The implementation of this law ignites conflicts when the cultural land is utilized for other functions. For example, a conflict happened when the government intended to build gas mining in Yamdena island in Maluku province (Riyandi, 2016).

2.5. Impact of the inadequacy of internet connection on the household, regional, and national levels

The low coverage of internet access in Maluku affects how individuals and households access information. The percentage of households in Maluku that have accessed the internet in the last three months is presented in Figure 2. It shows that the rate increased from 2017 to 2019, but it still falls behind the national average. This situation affects how individuals and households in Maluku access adequate information for education, health, financial, and other services.

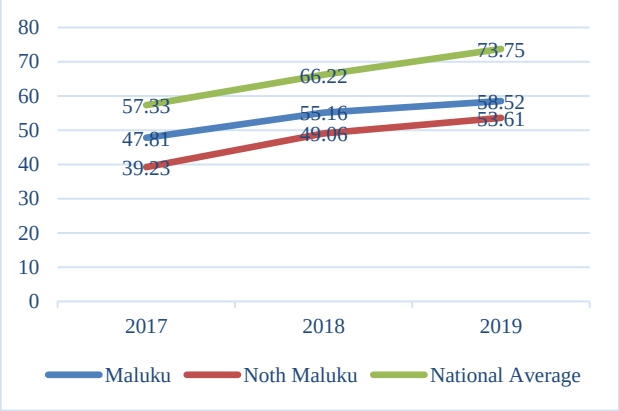

Fig. 2. Percentage of households having access to the internet in the last three months.
Note. The graph was prepared by the author from Statistics Indonesia in 2020.

In the time of the COVID-19 pandemic, the households' access to the internet affects households members' productivity under the social distancing policy to minimize the spread of the disease. Based on the percentage above, 40% of students potentially do not have access to education during this pandemic. The absence of an adequate internet connection possibly exacerbates the education quality in this area. Based on UNICEF data, before the pandemic, only 33% of primary school children in Maluku Province and 25% of primary school children in North Maluku Service achieved the minimum national benchmark in reading (UNICEF, 2019).

At the regional level, the absence of the internet affects several business sectors. In the tourism sector, the lack of information related to the tourist destination site hinders national and international tourists from visiting. Based on visitor data in 2016, 52% of the total visitors are local

tourists, 42% are national tourists, and only 5% are international tourists (Saimima, Zpalanzani, & Mutiaz, 2018, p.2). The utilization of below-the-line media such as radio, television, billboard, and other traditional media to promote tourist destinations in Maluku explains the low share of national and international tourists. Maluku province should use above-the-line media such as mobile apps, video advertising in video sharing platforms, and other advertising models in the social media environment (Saimima, Zpalanzani, & Mutiaz, 2018, p.8).

At the national level, internet infrastructure development is important to create regional economic value. Internet access through mobile technology can derive economic value in regional development (Purnama & Mitomo, 2018, p.1). The effect is different and depends on the level of income and the rate of economic growth for each region. The positive relationship of mobile penetration and economic growth is displayed in the province with the lower gross regional domestic product per capita. This fact indicates that mobile technology's penetration will be beneficial for the disadvantaged community with a low level of income. And on the other hand, there is no effect of ICT in the area that already has a high level of income per capita (Purnama & Mitomo, 2018, p.8).

The internet is also important in delivering government programs, for example, the unemployment benefits program during COVID-19 that uses the internet to distribute the benefit.[5] As shown in Figure 3, the percentage of the population who have access to the Internet in the Maluku and North Maluku provinces is considered low compared to the national average. These circumstances can limit people in Maluku to get the benefit from this kind of government program. Therefore, the provision of equal access to the internet potentially closes the economic disparities between regions.

2.6. Previous attempts to address the problem and their results

The Ministry of National Development Plan arranged a project named Indonesia Broad Plan 2014-2019. This plan is a product of a partnership between the Indonesian Government and USAID's Global Broadband Innovations (GBI) (USAID, 2014, p.3). This program covers six flagships that include completing construction on the Palapa Ring, adopting national telecommunication policies that allow multiple operators to use the same infrastructure, linking all government networks and services through a shared data center and common software platforms, launching a digital literacy program, delivering broadband access to rural and isolated communities, and implementing the recommended reforms to the Universal Service Obligation (USO) fund to provide funding for rural broadband rollout (USAID, 2014,p.4).

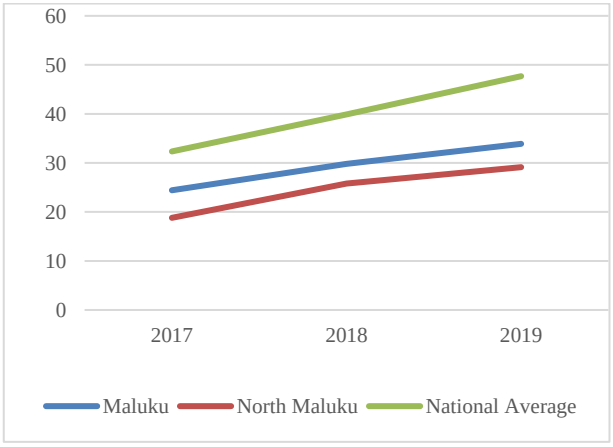

Fig. 3. Percentage of the population having access to the internet. *Note.* The graph was prepared by the author from Statistics Indonesia in 2020.

The development of the Palapa Ring is the priority in the Indonesia Broadband Plan. The development has been finished in 2018 and started to operate in 2019, and it has focused on providing connectivity in the non-commercial area (BAKTI, 2018). Palapa Ring in the Maluku region can be seen in Figure 4 which shows the availability of fiber optic cable in the Maluku islands. The Palapa Ring is shown as the blue line, serves the south and north part of Maluku. The central part of Maluku is served by the green line, the fiber-optic network owned by the state-owned telecommunication service provider, Telkomsel.

In 2020, the utilization of the Palapa Ring by the internet service provider was considered low (Primasiswi, 2020, par.1). Palapa Ring only provides the backbone infrastructure to be used by the internet service providers (ISP) to deliver their service to the customer (Primasiswi, 2020,par.2). Therefore, the existing backbone infrastructure has not been maximized to increase the internet coverage in Maluku.

3. Problem Analysis

3.1. Stakeholders' analysis

Several actors are involved in internet infrastructure development in the Maluku region. They come from the public and private sectors, and each actor has its scope of authority to influence the development process.

The key stakeholder in the Central Government is The Ministry of Communication and Information Technology (MoCIT). MoCIT has a mandate from the president to design national policies in the field of communication and information technology. MoCIT has the authority to regulate the postal service, telecommunication, broadcasting, information, and communication technology (ICT), multimedia services, and information dissemination. MoCIT's budget increased significantly from 4,393 Billion

[5] Known as Pre-work card program, https://www.prakerja.go.id/.

Rupiah (USD 305,2 Million) in 2015 to 6,671 Billion (USD 463,4 Million) in 2019 (MoCIT, 2020, p.14). MoCIT also generates non-tax revenue from several services: frequency user fee, universal service obligation, telecommunication equipment certification, broadcasting operation license, and other revenue. In 2019, MoCIT obtained 22,806 Billion Rupiah (USD 1,584,4 Million) in revenue (MoCIT, 2020,p.15).

Fig. 4. Fiber Optic Network in the Maluku Islands.
Note. The image was taken from BAKTI (2018).

Universal service obligation (USO) collected by the MoCIT is managed by the Information and Telecommunication Accessibility Agency (BAKTI), a government entity under the MoCIT. USO is collected from internet service providers by deducting 1.25% from their annual gross profit (MoCIT, 2016). In 2019, BAKTI obtained 3,830 billion Rupiah (USD 265,9 Million). BAKTI has a significant role in developing, managing, and building internet infrastructure development across the Indonesian region. This role includes the development of a Base Transceiver Station (BTS), Backbone Fiber Optic cable, and high-speed internet satellite for areas that cannot be reached by fiber optic cable. In 2020, BAKTI's target was providing 100% signal coverage in Indonesia (BAKTI, 2019).

The key stakeholder at the Regional and Local Government level is the Office of Communication and Information Technology at the province, city, or district level. This office has authority in performing the regional and local government's role related to communication and information technology. As mentioned in Maluku Governor Regulation Number 26 the Year 2016 Article 39, the local communication and information technology is in charge of policy formulation, evaluation and monitoring, technical support, and coaching and development in communication, information technology, statistics, and coding. In the process of internet infrastructure development, the local government authorities provide information about the locations with no telecommunication infrastructure (blank spot) in their region. The local authorities build communication with local communities about the location where the infrastructure development takes place. The local authorities are also responsible for guiding local communities to maximize the role of the internet in their area. For example, in 2021, Maluku province has a program named "Micro-Small Enterprise Go Digital (UMKM Go Digital)"[6].

Besides running a supporting function to assist the Central Government in developing internet infrastructure, the Local Government will also benefit from the internet connection improvement in their area. The local government can use the internet to deliver services for citizens, such as issuing a business license, building permit, or other services. The internet also can ease the local government's internal administration. For example, in North Maluku province, all government employees should use internet-based applications to measure their performance[7].

The primary stakeholders that will be affected by the change in the condition of internet infrastructure are farmers and fishermen in Maluku Regions. In the Agriculture and Fishery sector, the internet has become a tool to gather relevant information, such as the price for inputs, outputs, better cultivation or production methods, and better responses to diseases or pets. Supported by the local authority, farmers or fishermen can access data about price change and stock availability to increase their sales revenue (Internet Society, 2017).

The other primary stakeholder that will be affected by the internet connection improvement is business owners, such as those in the trade and tourism sectors. For example, in the tourism sector, the internet can help promote the tourist destinations in Maluku Province, which includes 440 marine tourist sites, 222 cultural destinations, 39 human-made tourist spots, and six attractions (Saimima et al., 2018, p.1). The well-designed and attractive user interface website containing these tourism destinations will attract many visitors to visit.

A secondary stakeholder in this issue is the Association of Internet Service Providers (Asosiasi Penyedia Jasa Internet Indonesia - APJII). APJII has the intention to expand the internet user market to increase its member's revenue and also to increase the awareness of digital adoption in many sectors. With the financial resources that

[6] Addressed by the head of Maluku Province Communication and Information Technology agency at Nov 20, 2020 in the seminar "The Benefit of National Economic Recovery Program for UMKM". https://www.youtube.com/watch?v=VZ97ZmEQWEo, accessed in March 14, 2021

[7] Known as online performance measurement program, http://diskominfosan.malutprov.go.id/artikel-pemprov-malut-siap-terapkan-aplikasi-skp-online-, "North Maluku province is ready to implement online performance measurement", accessed in March 16, 2021

come from its member fee, APJII can be the government's partner to increase the internet quality in Maluku islands. Currently, APJII has a program called Independent Internet Village (Desa Internet Mandiri) to help communities in rural areas access the internet (APJII, 2020).

One of the external stakeholders concerned with this issue is the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP). UN ESCAP argues that the utilization of information and communication technology has significant potential for sustainable development by increasing the supply of information and access to education, finance, health, and other services (UN ESCAP, 2018). Therefore, UN ESCAP keeps promoting the expansion of internet connection in the Asia Pacific countries, including Indonesia.

3.2. The reason for policy intervention: market and government failure

a. The nature of internet and internet connection service

At the beginning of the creation of the internet, it is intended to be a public good. 97% of the resources came from US universities and the remaining cost came from government funding. This cost structure enables the Internet can be offered to users for free (Hallgren & Mcadams, 1995, p.13). The increasing of internet users number creates congestion and shifts the interned become "impeded public good" (p.13). Currently, the internet and internet access is a toll good, that has excludable but non-rivalrous characteristics (Melgarejo-Heredia, Carr and Halford, 2016). It means that when a user accesses the internet, it does not preclude others from doing the same thing as long as the other users pay the service fee. The more customer that uses the internet service, the more positive externalities obtained by the communities in term of broad connectivity and cost-sharing (McKnight and Bailey, 1997). The exclusion characteristic of internet connection service allows it becomes economically feasible, therefore private suppliers might willing to provide the service (Weimer and Vining, 2017b).

b. The disparity in provider power to build internet connection

Currently, the market share of the internet providers in the Maluku islands is dominated by Telkomsel. In 2014, Telkomsel covered 97% mobile internet users in Maluku (Supratman, 2018). Since 2015, Telkomsel established the internet backbone named Sulawesi Maluku Papua Cable System (SMPCS), a submarine cable network that brings more stable and lower latency internet connection (MoCIT, 2015). Telkomsel did not allow other providers to rent its infrastructure with consideration of the limited capacity of the existing infrastructure (Wahyudi, 2016). Other competitors who lack resources to build submarine cables depend on satellites to deliver their service to customers, bringing unstable connection, high latency, high cost, and that is greatly influenced by the weather (Internet Society, 2017). By considering the development of the SMPCS as an investment, Telkomsel can produce the internet connection service at a lower cost and better quality than any other competitors.

c. Government Failure

Since the Indonesian political system reform in 1998, the Maluku representative in the legislative and executive part is minor. On the legislative side, seven members in the current structure of the House of Representative (HoR) does not have enough power to push the Government to prioritize the development in Maluku (Lewerissa, 2020). Minority in the direct democracy bears a high cost from the majority since the voting mechanism hinders people to express the intensity of their interest (Weimer and Vining, 2017a). No matter how big the interest of Maluku representatives in the HoR to propose the development in Maluku, they only get one vote to propose it. On the executive side, for the last 41 years of the Indonesian government, there is no representative from the Maluku region who is appointed to be a Minister (Ariandono, 2019, par.1). This situation increases concern about the inadequacy of Maluku's human capital, and also how Maluku's interest can be proposed in the decision-making process.

In terms of internet infrastructure development, the Indonesia Broadband Plan (IBP), which has been finished by completing the Palapa Ring in 2018, increase the internet service provider's expenditure to deliver internet access to the end-users (Fabian, 2020). The providers need to pay a higher rate of rent to contribute to the cost of Palapa Ring development since the government used the Public-Private-Partnership mechanism to finance the infrastructure (MoCIT, 2020).

4. Policy interventions

Developing policy interventions in this issue needs several considerations related to financing and technological options. Financial options consider the internal and external sources of project funding. Technological options discuss the type of network that can be implemented to expand the coverage of the 4G network in Maluku.

4.1. Financial options

Regarding the financial options, two different forms can be used to finance this project based on the source of the fund. The first is the consolidation among internet providers that could generate higher capital from the private sector. The average revenue per user (ARPU) of internet providers in Indonesia is among the lowest in the world due to the crowded market (oxfordbusinessgroup, 2014). Consolidation or mergers between internet providers is expected can stabilize the price, raise the investment rate, and improve service quality, resulting in more usage and better margins of profit.

Second, the government can take action by providing an additional budget to expand the existing broadband infrastructure. The government's intervention can be performed using three options; public-private partnership, universal service obligation fund (USOF), and direct provision from the general budget (Gunaratne *et al.*, 2015).

Malaysia implemented a combination between public-private partnership and direct provision to subsidize their High-Speed Broadband (HSBB) Network in 2008. As project implementers, the Malaysian government agreed to grant MYR 2.4 billion (USD 750 million) to Telekom Malaysia. The government contribution is a part of MYR 11.3 billion (USD 3.5 billion) Public-Private Partnership between the Malaysian government and Telekom Malaysia. Indian government funded the National Optical Fiber Network (NOFN) using Universal Service Obligation Fund (USOF). In India, the USOF is financed by collecting approximately five percent of the operator's revenue. Compared to Indonesia, the tariff of USOF is 1.25 percent of the operator's revenue. Australian government-funded their National Broadband Network (NBN) using government equity until NBN had sufficient cash flows to function without government support.

At this point, the options that can be implemented if they choose to provide additional funding for internet infrastructure development are by increasing the USOF tariff and allocating additional funding from the government budget. Based on the current USOF tariff, the Ministry of Communication Information and Technology collected IDR 3,830 Billion (USD 265,9 Million) in 2020 (MoCIT, 2020). Doubling the tariff to 2.5 percent would generate more than USD 500 Million to support internet infrastructure in Maluku and another part of east Indonesia.

4.2. Technological options

In terms of technological options, there are four options of connection type that can be developed to expand the internet connection in Maluku. The first option is fiber optics. Fiber optics provided the highest speed performance, the highest reliability, and the best security (Oktarini & Kawano, 2019, p.388). This best connection service comes with the highest installation cost and subscription. The second option is cellular or mobile. The cellular network as a point to multipoint technology is the most suitable infrastructure regarding mobile phones as the most common access media or equipment used by internet users in Maluku. In Indonesia, the 4G LTE has been developed in many regions with reliable services to internet users. This service offers lower installation and subscription costs than fiber optics.

The third option is mixing between fiber optics and wireless technologies. Wireless technologies that can be adopted are WIMAX which stands for Worldwide Interoperability for Microwave Access. WiMAX also delivers point-to-multipoint connections like cellular or mobile. This technology can be mixed with fiber optics to support long-term usage.

For further analysis, this paper will use two technology options; 4G/LTE cellular and mixed between optics and wireless LAN.

4.3. Policy recommendation

Based on the explanation of financial and technological options, four policy interventions can be implemented by the government to expand the 4G internet coverage in Maluku. Based on Figure 5, including the status quo option, we finally ended with five options: 1) status quo; 2) consolidation among providers to install 4G/LTE Cellular network, 3) consolidation among providers to install mixed fiber optics and wireless LAN, 4) extending Indonesia Broad Plan to install 4G/LTE Cellular network, and 5) extending Indonesia Broadband Plan to install mixed fiber optics and wireless LAN.

Each policy option has advantages and disadvantages based on the policy evaluative criteria. Evaluative criteria are used to weigh policy options or judge the merits of existing policies or programs (Kraft and Furlong, 2018). The use of explicit evaluative criteria develops relatively clear standards that can keep policy analysis objective and focused on the issues of greatest concern to the analyst, the intended audience, or the client.

To define which is the best option to solve the lack of internet connection in Maluku, four evaluative criteria need to be analyzed: effectiveness, efficiency, political feasibility, and technical feasibility. The effectiveness emphasizes the likelihood that internet access can be reached from every area where people stay and work. Efficiency criteria focus on cost-benefit analysis and cost-efficiency, which option gives a low implementation cost. Political feasibility analyzes the extent to which political actors in Indonesia accept and support the policy proposal. And the last criterion, the technical feasibility, focuses on the availability and reliability of technology needed to expand internet coverage in Maluku.

The evaluation criteria for each policy option can be seen in Appendix A. From the effectiveness perspective, option 2 (Consolidation among providers to install 4G/LTE Cellular network) and Option 4 (Extending Indonesia Broadband Plan to install 4G/LTE Celluar network) is considered the most effective. This is because the technology that these options use could cover the most area, including residency, workplace, and outdoor. Therefore, internet access can be accessed anywhere using mobile devices.

From the efficiency point of view, option 2 is considered the best since it allows providers to join their financial resources to expand coverage and get more consumers. They potentially get more revenue due to market expansion and the possibility to charge a lower and more flexible rate to customers. In this criterion, option 3 (Consolidation among providers to install mixed fiber optics and wireless LAN) is considered as medium-high since the high cost of fiber optics installation and the possibility to less flexible in charging rate to customers. The efficiency of option 4 (Extending Indonesia Broadband Plan to install 4G/LTE Celluar network) and option 5 (Extending Indonesia Broadband Plan to install mixed fiber optics and wireless LAN) is considered low since it needs an additional budget that could be financed by implementing a higher rate

of Universal Service Obligation Fund (USOF) and allocating government expenditure to this project.

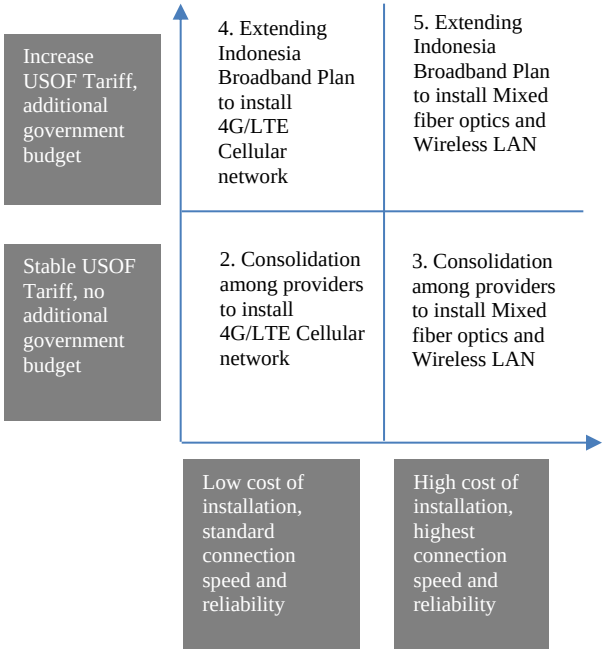

Fig. 5. Policy Intervention Options.
Note. The image was prepared by the author from the abovementioned information.

Based on the political feasibility criterion, option 1 (Status quo) is considered the highest political feasibility since it will be easy to obtain government support by accepting the current condition with existing infrastructure developed through Indonesia Broadband Plan. This means the government will maintain existing policies without any intervention. Option 2 and option 3 are considered as a medium due to the necessity to adjust a set of regulations that can attract internet provider companies to consolidate each other. Option 4 and option 5 are considered low in this perspective due to the low possibility of getting an additional budget for internet infrastructure development. During pandemic and post-pandemic situations, the government budget will focus more on economic stability efforts and create a strong economic foundation.

Based on technical feasibility, option 2 and option 4 is considered to be the most possible option due to the less complex installation compared to fiber-optics installation. These options use Base Transceiver System (BTS) as the medium to deliver an internet connection to the customer. Option 1 has medium feasibility since I considered the possibility of future technological innovation that might ease the internet connection distribution. The feasibility of options 2 and 5 are considered to be the lowest since the installation of fiber optic is expensive and could affect the price level of the internet connection service.

According to all considerations, option 2 (Consolidation among providers to install 4G/LTE Cellular network is considered the best recommendation. The expectation from the implementation of this option is the 4G internet in Maluku will cover 60 percent of the total villages. It increases more than double compared to the existing situation that only covers 27 percent of the total villages. Implementing 4G/LTE Cellular will give a stable and reliable internet connection speed with a similar price compared to Java and Sumatera islands. The important point is that internet penetration can increase from 55 percent to 80 percent of households in Maluku.

5. Conclusion

Infrastructure development, especially in the archipelagic area, faces several challenges related to financial and technological options. In other highly populated areas with a high demand for telecommunication services, telecommunication infrastructure is fully provided by the private sectors due to the high possibility to obtain a return on investment in this type of project. Maluku regions with low population density and low wage levels compared to other areas could not attract the private sectors to contribute more to telecommunication infrastructure development. The limited financial power that the private sector has and the uncertainty of getting a return on investment hinder the private sector's contribution to this development project.

The government's intervention is needed to expedite the internet infrastructure development process. However, the pandemic limits the government's flexibility to support telecommunication infrastructure development. The existing infrastructure available, Palapa Ring Submarine Cable, needs to be extended to reach the nearest point to the internet service consumers. Moreover, the internet service providers who want to access this infrastructure need to pay rent that vary based on the location. The high level of rate adds the burden to expand the internet connection in this area.

Consolidation of internet providers companies in Indonesia could become the best option to accelerate internet infrastructure development in Maluku, among other options available. This collaboration will combine internet providers companies' resources to strengthen their financial power to expand the internet network in this area. Moreover, strong financial power will create a more competitive market and will result in more affordable market prices that can be accessed by most internet service consumers in Maluku. By applying a 4G/LTE Cellular network rather than installing fiber optics, it will result in a lower price and high possibility to be afforded by the consumers.

This recommendation is not coming free without cost. It takes time to lobby and get the same understanding between providers. This effort needs adjustment in regulation that relates to mergers or consolidation between enterprises. The government should give more facilities to ease this consolidation process. Furthermore, the government can give more incentives to companies that want to expand their service to Maluku and other parts of eastern Indonesia, such as a lower rent rate of using Palapa Ring Submarine Cable.

References

APJII (2020) *Survey Internet Report 2019 - 2020 (Laporan Survei Internet APJII 2019 – 2020), Asosiasi Penyelenggara Jasa Internet Indonesia*. Available at: https://apjii.or.id/survei.

Ariandono (2019) 'Tiga Tokoh Asal Maluku Ini Diusulkan Jadi Menteri Kabinet Jokowi', *Tempo.co*, 8 July. Available at: https://pilpres.tempo.co/read/1222517/tiga-tokoh-asal-maluku-ini-diusulkan-jadi-menteri-kabinet-jokowi/full&view=ok.

BAKTI (2018) *Palapa Ring : Unify Indonesia*. Jakarta. Available at: https://www.baktikominfo.id/assets/uploads/peraturan/infografis_pb3ti-portrait.pdf (Accessed: 25 April 2021).

BAKTI (2019) *Signal for All 2020, 2018 BAKTI Annual Report*. Available at: https://cloud.baktikominfo.id/doc/AR.pdf.

Barron, P. (2019) *When Violence Works: Postconflict Violence And Peace in Indonesia*. Cornelll University Press: Cornelll University Press. Available at: http://ebookcentral.proquest.com/lib/duke/detail.action?docID=5732977.

Das, K. *et al.* (2018) 'The Digital Archipelago: How Online Commerce is Driving Indonesia's Economic Development', *McKinsey & Company*, (August), pp. 1–72. Available at: www.mckinsey.com/featured-insights/asia-pacific/the-digital-archipelago-how-online-.

Fabian, T. V. (2020) 'The Irony of Palapa Ring: Not Used When Indonesia Has Internet Problems (Ironi Palapa Ring: Tak Terpakai Saat Indonesia Kesulitan Internet)', *Tirto.Id*, 4 September. Available at: https://tirto.id/ironi-palapa-ring-tak-terpakai-saat-indonesia-kesulitan-internet-f3fQ.

Gunaratne, R. L. *et al.* (2015) 'National Broadband Networks of Malaysia, India, Indonesia and Australia: A comparative study', *Competition and Regulation in Network Industries*, 16(1), pp. 23–46. doi: 10.1177/178359171501600102.

Hallgren, M. M. and Mcadams, A. K. (1995) 'The Economic Efficiency of Internet Public Goods', in *Internet Economics*. The MIT Press. Available at: https://direct-mit-edu.proxy.lib.duke.edu/books/book/2655/Internet-Economics.

House of Representative (2019) *House of Representative Members*. Available at: https://www.dpr.go.id/anggota/index/dapil/53.

Internet Society (2017) 'Ensuring sustainable connectivity in Small Island Developing States'. Available at: https://www.internetsociety.org/wp-content/uploads/2017/08/ISOC_Small_Island_Developing_States-201706015.pdf.

Judge, Z. and Nurizka, M. (2008) 'The Role Of Traditional Laws "Sasi Laut" in Protecting Environmental Sustainability in Eti Village, Seram Barat Sub-District, Seram Bagian Barat District', *Lex Jurnalica*, 6(1), pp. 1–32.

Kraft, M. E. and Furlong, S. R. (2018) 'Public Policy: Politics, Analysis, and Alternatives, 6th edition'. California: SAGE Publications Ltd.

Lewerissa, H. (2020) 'Evaluation of a Year of Service at the House of Representative of Republic of Indonesia (Evaluasi Setahun Pengabdian di DPR RI)', *porostimur.com*, 1 October. Available at: https://porostimur.com/evaluasi-1-tahun-pengabdian-di-dpr-ri/amp/.

McKnight, L. W. and Bailey, J. P. (1997) 'An introduction to Internet Economics', in *Internet Economics*. The MIT Press. doi: https://doi-org.proxy.lib.duke.edu/10.7551/mitpress/3867.001.0001.

Melgarejo-Heredia, R., Carr, L. and Halford, S. (2016) 'The public Web and the public good', *WebSci 2016 - Proceedings of the 2016 ACM Web Science Conference*, pp. 330–332. doi: 10.1145/2908131.2908181.

Mills, R. and Fan, Q. (2006) 'The Investment Climate in Post-Conflict Situations', *World Bank Policy Research Working Paper*, (4055). Available at: https://openknowledge.worldbank.org/handle/10986/9029.

MoCIT (2015) 'Jokowi Resmikan Kabel Optik Bawah Laut Sulawesi-Maluku-Papua Rp 3,6 Triliun (President Jokowi Inaugurates IDR 3.6 Trillion Underwater Optical Cable for Sulawesi-Maluku-Papua)', *Ministry of Communication and Information Technology*, 11 May. Available at: https://www.kominfo.go.id/content/detail/4952/jokowi-resmikan-kabel-optik-bawah-laut-sulawesi-maluku-papua-rp-36-triliun/0/sorotan_media.

MoCIT (2016) *Ministry of Communication and Information Technology Regulation Number 17 Year 2018*. Available at: https://jdih.kominfo.go.id/produk_hukum/view/id/552/t/peraturan+menteri+komunikasi+dan+informatika+nomor+17+tahun+2016+tanggal+26+september+2016.

MoCIT (2020) *Laporan Tahunan 2019 Kementrian Komunikasi dan Informatika Republik Indonesia (2019 Annual Report: Ministry of Communication and Information Technology), Kominfo*. Available at: https://kominfo.go.id/content/detail/6095/indonesia-raksasa-teknologi-digital-asia/0/sorotan_media%0Ahttps://kominfo.go.id/index.php/content/detail/3415/Kominfo+%3A+Pengguna+Internet+di+Indonesia+63+Juta+Orang/0/berita_satker.

Nainggolan, P. P. (2012) 'Mengapa Konflik Berulang Terjadi Di Kota Ambon? Tinjauan Demografi Dan Keamanan Atas Konflik Horizontal Perkotaan (Why Do Conflicts Recurrent in Ambon City? Demographic and Security Overview of Urban Horizontal Conflict)', *Politica*, 3(2), pp. 163–193. Available at: http://jurnal.dpr.go.id/index.php/politica/article/view/313.

Negara, S. D. (2016) 'Indonesia's Infrastructure Development Under the Jokowi Administration', *South Asian Affairs*, pp. 145–166. Available at: https://www.jstor.org/stable/10.2307/26466924.

Oktarini, L. and Kawano, H. (2019) 'Telecommunication access business model options in Maluku and Papua, the less-favored business regions in Indonesia', *Digital Policy, Regulation and Governance* , 21(4), pp. 384–401. doi: 10.1108/DPRG-10-2018-0061.

oxfordbusinessgroup (2014) *Consolidate to accumulate: A reduction in the number of players could help shore up ARPU | Indonesia 2014*. Available at: http://www.oxfordbusinessgroup.com/overview/consolidate-accumulate-reduction-number-players-could-help-shore-arpu.

Pattikayhatu, J. A. (2012) 'Bandar Niaga di Perairan Maluku dan Perdagangan Rempah-Rempah Commercial Port in the Moluccas Territorial Water and Spice Trade', *Kapata Arkeologi*, 8(1), pp. 1–8. Available at: http://kapata-arkeologi.kemdikbud.go.id/index.php/kapata/article/view/175.

Primasiswi, A. (2020) 'The Utilization of East Palapa Ring is Still Low, This is the Cause', *suaramerdeka.com*, 28 September. Available at: https://www.suaramerdeka.com/news/nasional/241856-utilisasi-palapa-ring-timur-masih-rendah-ini-penyebabnya?page=all.

Purnama, Y. A. and Mitomo, H. (2018) 'The impact of ICT on regional economic growth: Empirical evidence from 34 provinces of Indonesia', in *29th European Regional Conference of the International*

Telecommunications Society (ITS): 'Towards a Digital Future: Turning Technology into Markets?' Calgary.

Riyandi, D. E. (2016) 'Land Conflict Could Hinder Masela Block Development', *Liputan6.com*, 15 February, pp. 4–7. Available at: https://www.liputan6.com/regional/read/2416940/dkn-maluku-konflik-tanah-bisa-hambat-pembangunan-blok-masela.

Safi, J. (2017) 'Communcal Conflict: Maluku 1999-2000', *ISTORIA: Jurnal Pendidikan dan Ilmu Sejarah*, 13(1). doi: 10.21831/istoria.v13i1.17615.

Saimima, R. M. M., Zpalanzani, A. and Mutiaz, I. R. (2018) 'Mapping of the Maluku Tourism Industry as the Foundation for the Design of the Brand Baronda Maluku Strategy (Pemetaan Industri Pariwisata Maluku sebagai Landasan Perancangan Strategi Brand Baronda Maluku)', *Barista : Jurnal Kajian Bahasa dan Pariwisata*, 5(2), pp. 145–157. doi: 10.34013/barista.v5i2.117.

Satria, A. and Mony, A. (2019) 'Dynamics of Sasi Laut Practices in the Middle of Local Economic and Political Transformations', *Jurnal Sosiologi Pedesaan*, 7(2), pp. 143–152.

Siswoyo, B. (2016) 'Public Perception of Safety Equipment Marine Vessel and Ferry in the Maluku Province', 28(April), pp. 146–156. Available at: https://ojs.balitbanghub.dephub.go.id/index.php/warlit/article/view/690/417.

Statistics Indonesia (2020) '2019 Telecommunication Statistics in Indonesia'. Available at: https://www.bps.go.id/publication/2020/12/02/be999725b7aeee62d84c6660/statistik-telekomunikasi-indonesia-2019.html.

Statistics Indonesia (2021) *Maluku Province in Figures 2021*. Jakarta. Available at: https://maluku.bps.go.id/publication/2021/02/26/972e698a6e9a5506eabfdf7d/provinsi-maluku-dalam-angka-2021.html.

Supratman, L. P. (2018) 'Pola Komunikasi Organisasi Kepemimpinan Strategis di PT Telkomsel (Communication Patterns of Strategic Leadership Organizations at PT Telkomsel)', *Jurnal Ilmu Komunikasi*, 16(1), p. 31. doi: 10.31315/jik.v16i1.2680.

UN ESCAP (2018) 'Broadband Connectivity in Pacific Island Countries', *Asia-Pacif Information Superhighway (AP-IS) Working Paper Series*. Available at: https://www.unescap.org/sites/default/files/Broadband Connectivity in Pacific Island Countries.pdf.

USAID (2014) *Connecting people. Transforming Nations*. doi: 10.7591/cornell/9781501726101.003.0004.

Wahyudi, R. (2016) 'Indosat Tuding Telkom " Anak Emaskan " Telkomsel di Luar Jawa', *Kompas.com*, 23 June, pp. 1–7. Available at: https://tekno.kompas.com/read/2016/06/23/10510607/indosat.tuding.telkom.anak.emaskan.telkomsel.di.luar.jawa.

Weimer, D. L. and Vining, A. R. (2017a) 'Limits to Public Intervention: Government Failures', *Policy Analysis : Concepts and Practice*, 22(1), pp. 149–181. doi: 10.4324/9781315442129-8.

Weimer, D. L. and Vining, A. R. (2017b) 'Rationales for Public Policy: Market Failures', in *Policy Analysis : Concepts and Practice*. Taylor & Francis, pp. 91–132. doi: 10.4324/9781315663289-13.

Appendix A. Evaluation of policy intervention options based on evaluative criteria

Criteria	OPTION 1: Status Quo	OPTION 2: Consolidation among providers to install 4G/LTE Cellular network	OPTION 3: Consolidation among providers to install Mixed fiber optics and Wireless LAN	OPTION 4: Extending Indonesia Broadband Plan to install 4G/LTE Cellular network	OPTION 5: Extending Indonesia Broadband Plan to install Mixed fiber optics and Wireless LAN
Effective-ness	Low: Providers need time to accumulate their capital before joining in Maluku internet service market	High: Cover most areas: residency, workplace, and outdoor It can be accessed through a mobile device	Medium: Cover only indoor area: residency and workplace It can be assessed through a mobile device by adding routers	High: Cover most areas: residency, workplace, and outdoor It can be accessed through a mobile device	Medium: Cover only indoor area: residency and workplace It can be assessed through a mobile device by adding routers
Efficiency	Medium: no need to provide government budget or rise USOF tariff, but the providers lost the opportunity to expand their coverage	High: - providers join their financial resources to expand coverage - potentially get more revenue due to market expansion - possibility to charge a lower and more flexible rate to customers	Medium-High: - providers join their financial resources to expand coverage - potentially get more revenue due to market expansion - need a higher installation cost compared to option 2 - charge less flexible rate to customers, and additional rent fee	Low: - providers pay higher USOF - government need to provide an additional budget - potentially get more revenue due to market expansion - possibility to charge a lower and more flexible rate to customers	Low: - Providers pay higher USOF - government need to provide an additional budget - potentially get more revenue due to market expansion - need a higher installation cost compared to option 2 - charge less flexible rate to customers, and additional rent fee
Political feasibility	High: - easy to government support - political pressure from society to accelerate connection coverage	Medium - easy to get political support from society and representative - need regulation change, but it is possible	Medium - easy to get political support from society and representative - need regulation change, but it is possible	Low - hard to get an additional budget, especially in the pandemic situation - potentially obtain objection from providers	Low - hard to get an additional budget, especially in the pandemic situation - potentially obtain objection from providers
Technical feasibility	Medium: providers may use more advanced technology in the future	High: use BTS, easier installation effort compared to fiber optics	Low: complex effort, need to expand fiber cable optic to end-user	High: use BTS, easier installation effort compared to fiber optics	Low: complex effort, need to expand fiber cable optic to end-user