Strategy of smart meter infrastructure implementation using LPWAN technology, pilot project PLN Bali Case Study

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Abstract. To realize the Bali Eco Smart Grid program, state electricity company (PLN) Bali implemented the advanced metering infrastructure (AMI) through the deployment of a pilot project of 1,000 2 ways smart meters based on LoRa WAN in the Kuta area, Bali. The selection of long range wide area network (LoRa WAN) as smart meter access technology is due to low costs, low power, ease of implementation and technology readiness. LoRa WAN is one of low power wide area network (LPWAN) technology. For deploying smart meter AMI based on LoRa WAN throughout Bali, the right strategy is needed. This research will analyze the strategy of deploying smart meter AMI based on LoRa WAN using strength, weakness, opportunity, and threat (SWOT) analysis. The stages of SWOT analysis are through the collection of internal and external factors obtained through techno-economic studies and surveys to customers, the general public, and PLN employees. Next, matching it by compiling an internal and external evaluation matrix, where an appropriate strategy is a progressive strategy (SO strategy). Components S and W are obtained from the survey while O and T are obtained from observing conditions outside of PLN. It is shown from the SWOT analysis results, obtained S-W = 5.95 and O-T = 2.59, so the strategy is in location (5.95, 2.59) quadrant I. Strategies for deploying smart meters based on WAN LoRa are progressive strategies.

1 Introduction

Decree of the Minister of Energy and Mineral Resources number: 1415K/20/MEM/2017 concerning the Electricity Supply Business Plan (RUPTL) 20117-2026 with one focus on developing new and renewable energy in Indonesia where Bali is used as a center of excellence for energy development. This is in line with the regional government of Bali who wants to make Bali a tourist Eco Green. To start the "Bali Clean and Green" program of the State Electricity Company (PLN) Bali together with the regional government of Bali inaugurated the program "Eco Smart Grid towards the province of Bali Clean and Green" in 2016 and held an advance meter infrastructure (AMI) pilot project on the electric power distribution system to customers based on low power wide area networks

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(LPWAN) since 2017 as a substitute for the existing automatic meter reading (AMR). Because, AMR raises several problems including high investment and operational costs, can only be used for prepaid and cannot be for postpaid customers. AMI is a solution for prepaid and postpaid systems, meter data can be accessed by customers, supports the utilization of new renewable energy, on-line billing systems, and many other features. It can be said that the deployment of a smart meter AMI based on LoRa WAN in order to improve customer service and internal efficiency of PLN. Fig 1. shows the evolution of PLN Bali towards Bali Eco Smart Grid, where PLN Bali has gradually developed an electrical system towards the integration of AMI and distribution automation system (DAS). It is seen that AMI will be fully integrated with DAS in 2025.

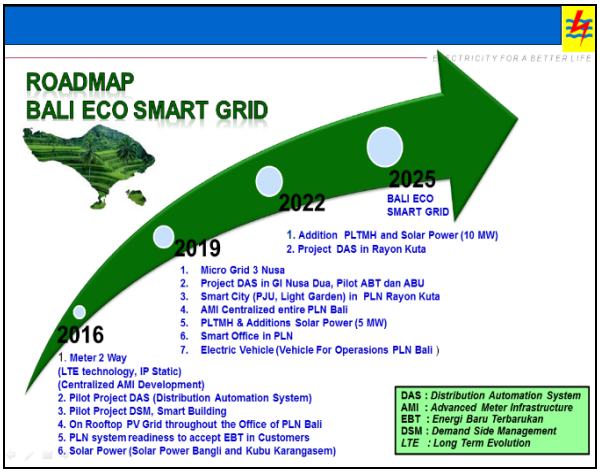

Fig 1. Roadmap Bali Eco Smart Grid [1]

The integration of AMI and DAS requires a large investment and impacts on the management and business of electricity, so a feasibility study that includes technical aspects, social aspects, economic and business aspects is needed. Techno-economic analysis of the application of smart meters based on LoRa WAN in PLN Bali has been carried out by [3]. In this research a feasibility study has been carried out which has resulted in 3 business models that can be used in the implementation of smart meter based on LoRa WAN by PLN Bali including the own build (BO), build operate transfer (BOT), and leasing. If the Bali PLN has sufficient costs, the BO business model is very profitable for PLN, because PLN Bali can utilize more of its network capacity to run smart utility services to PLN customers. This is because every gas and water utility customer is a PLN customer. The LoRa WAN PLN network can be used for other utility services. So that nationally it saves national LoRa WAN network. Research [3] has not reviewed the business model implementation strategy that is suitable for PLN.

Therefore, this research will evaluate the strategy of deploying AMI system based on LoRa WAN by PLN Bali. The first step is to identify internal strengths and weaknesses as well as opportunities and challenges from the external that can affect PLN. In the research used a SWOT analysis approach. Strength (S) and weakness (W) data are obtained from surveys of PLN customers both those who are already and those who have not enjoyed the AMI system based on LoRa WAN and PLN employees. Whereas opportunity (O) and threat (T) were obtained from interviews with PLN leaders and related resource persons. After all internal and external factors are collected and evaluated, then the SO, WO, ST, and WT strategies are compiled.

2 Implementation of smart meter based on lora wan pilot project

In 2017, PLN in the South Kuta region held a pilot project of 1000 smart meter AMI devices based on LoRa WAN in Puri Gading and Nusa Dua Bali. The LoRa WAN network installed has a star configuration, the gateway is installed on an electric pole to cover customers. The results of reading the data obtained in the AMI pilot project at PLN Bali for 1,000 installed devices with meter data readings every 30 minutes with a 100% success rate.

To find out the opinions of users and the general public on the implementation of LoRa-based WAN-based AMI smart meters and the internal readiness of PLN employees, a survey is conducted to customers who use AMI smart meters, the general public, and PLN employees. Of the 104 customers who have not used the AMI smart meter, 60% of customers want to replace the electricity meter with the AMI meter. 24% of customers do not want to change meters and 16% of customers answer normal. Of the 24% who refused to replace their electricity meters the respondents reasoned that they were more accustomed to using an existing electricity meter, while respondents who said they wanted to replace the electricity meter because they wanted to support the government program.

A survey of customers using the AMI smart meter obtained data including 45% of the people felt normal towards AMI, 31% of the people felt dislike of AMI, 21% of the people liked AMI, 2% of the people really liked AMI, and 1 % of the people said they were very dislike of AMI. Of the 45% of respondents who said that they were normal, their reasons were known because at this time there was no noticeable difference to customers using the AMI smart meter. Of the 30% of respondents who said they did not like it, felt that their electricity bill had increased since the change of the AMI smart meter. Of the 21% of respondents who said they liked it because they felt the ease in filling their electricity tokens so that they could regulate their electricity usage needs. A survey of knowledge about smart meter AMI and the enthusiasm of the application of AMI found that 90% of the public did not know about AMI, 8% of the community knew AMI, 1% of the public were very aware, and 1% of the public was normal to AMI. 90% of respondents said there was no socialization of the AMI smart meter from PLN. Of the 107 respondents, 2% strongly agreed, 60% agreed, 26% stated normal, 12% said they did not agree with the plan to implement AMI throughout Bali and Indonesia.

Seeing PLN's readiness in holding the WAN Loans-based smart meter AMI, 100% of the survey data agreed that the implementation of the AMI smart meter would benefit PLN, 100% of PLN employees said that the application of LoRa-based WAN smart meter AMI was more profitable than conventional systems because PLN could receive electricity usage data per customer in real time. Respondents of PLN employees stated that only 52% of PLN had conducted information dissemination to the public about the smart meter AMI system and 48% of respondents stated no. From the survey results to customers and the general public there are still shortcomings in deploying a pilot project for the WAN-based 1000 AMI smart meters in terms of socialization, the impact of using AMI smart meters, limited AMI features, customer resistance to the use of new technologies, concerns over tariff increases for use AMI. In terms of PLN employees, there is still a low level of knowledge about the smart meter AMI, technical capabilities and coordination among employees in working.

3 Swot analysis, results and evaluation

Before deploying a smart meter based on LoRa WAN, it is necessary to evaluate the investment needs and business opportunities that will arise. In the research [3] the needs of capital expenditure (capex), operational expenditure (opex), and investment return rate

(IRR) funds have been submitted for the period of 3 years of deploying the LoRa WAN network to reach the entire region of Bali. Also presented were 3 business models for deploying the Loans Loans Loans to support the implementation of the AMI, namely build own (BO), build operational transfers (BOT), and leasing. Determination of the business model that will be applied by PLN depends very much on the ability of PLN to finance. If PLN has strong financing, the BO model is very suitable. For low financing is rent, but the level of dependence on the party that rents is very large and if there is a problem it takes time to complete it and depends on the willingness of the party who rents out. For BOT, PLN can only have a LoRa WAN network after an agreed period. The BO business model allows PLN to obtain other revenue sources from deploying the WAN LoRa network by utilizing the excess capacity of the LoRa WAN network to serve PLN customers for water and gas utilities. Because water and gas customers are usually PLN customers. So that with one LoRa WAN network can be used for water, gas and electricity utility services.

Once it is known that the business model is suitable for deploying the smart meter based on LoRa WAN and obtaining input from customers, the public, and PLN employees through surveys, PLN needs to develop a strategy through a SWOT analysis to implement the smart meter based on LoRa WAN deployment on a broader and massive scale. Based on the results of the survey and literature study found external and internal factors for the application of smart meter based on LoRa WAN.

External factors include 5% customer growth every year; Bali Eco Smart Grid Roadmap; lack of public knowledge about AMI; Some people refuse, because they feel the price is expensive; error recording KWh Meter; frequency 923 - 925 is intended as SRD; frequency 920 - 925 is a frequency allocation that is widely used for LPWAN in Asian countries. Internal factors include large number of PLN customers; current LPWAN technology readiness; PLN is not a telecommunications company; human resources do not understand about LPWAN management; AMR communication system is not yet reliable; read meter error; inconsistency of billing periods.

These external and internal factors are then evaluated with resource persons and arranged in an external and internal evaluation matrix. The evaluation matrix of external and internal factors is shown in Table 1 and Table 2 respectively.

Table 1. Internal factors evaluation matrix

STRENGTH		Weight	Ranking	Score
1	PLN is state owned company	0.7.	4	2.8
2	The number of PLN customers is very large	0.6	4	2.4
3	Current LPWAN technology readiness	0.6	3	1.8
4	Coverage of LPWAN is very wide	0.7	3	2.1
				9.1
WEAKNESS		Weight	Ranking	Score
1	PLN isn't telecommunication company	0.5	2	1
2	pln employees have not understood LPWAN management	0.45	2	0.9
3	AMR communication system is not yet reliable	0.6	1	0.6
4	Billing periode is not consistent	0.65	1	0.65
				3.15

Table 2. External factors evaluation matrix

	OPPORTUNITY	Weight	Ranking	Score
1	LPWAN technology is growing up	0.3	3	0.9
2	LoRa Wan Alliance member	0.65	4	2.6
3	Frequency 920 - 925 MHz is a frequency allocation that is widely used for LPWAN in Asian countries	0.45	3	1.35
4	Customers grow 5% annually	0.35	3	1.05
5	PLN has many subsidiaries	0.35	4	1.4
6	Roadmap Bali Eco Smart Grid	0.55	4	2.2
				9.5
	THREAT	Weight	Ranking	Score
1	Frequency 923 – 925 MHz is allocated for SRD	0.55	3	1.65
2	Low public knowledge about AMI	0.63	2	1.26
3	Error reading KWh Meter	0.6	3	1.8
4	The resistance of some people, because they feel the price is expensive	0.55	4	2.2
				6.91

From the external and internal evaluation matrix, the location of the S-W and O-T quadrants will be determined. From Table 1, the S-W = 9.1 - 3.15 = 5.95 is obtained and from Table 2, the O-T value = 9.5 - 6.91 = 2.59. From the S-W and O-T values are in quadrant I, which is the category of progressive strategies. Strategies that can be developed are the S-O strategy was carried out by testing the implementation of AMI and strategic partnership for the procurement of smart meter modules. Improving HR capabilities through training and outsourcing to third parties is an WO strategy. PLN proposed frequency allocation for LoRa WAN to regulators as ST strategy and PLN conducts ongoing socialization of AMI features and accelerates AMI implementation as an WT strategy.

4 Conclusion

From the survey results found deficiencies in the deployment of a WAN-based smart meter pilot project regarding socialization, the impact of using AMI smart meters, limited AMI features, customer resistance to the use of new technology, concerns over tariff increases for the use of smart meters. In terms of PLN employees, there is still a lack of knowledge on smart meter based on WAN Loans, low technical capabilities and coordination among employees in working. Components S and W are obtained from the survey while O and T are obtained from observing conditions outside of PLN. From the SWOT analysis results obtained S-W = 5.95 and O-T = 2.59, so the strategy is in location (5.95.2.59) quadrant I. Strategies for deploying smart meters based on WAN LoRa are progressive strategies.

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