CHAPTER I
INTRODUCTION

1.1. Background

The Internet of things (IoT) wireless network is evolving to help meet the needs of a wide variety of connected devices. With such a wide variety of potential applications, it will be difficult to bring a one-size approach to all solution [1]. To support the development of IoT, the mobile industry has developed and standardized a new class of low power wide area (LPWA) technologies that help network operators to address the challenge of typical IoT characteristics. LPWA networks could grow to 3.5 billion connections in 2025, with several sectors contributing to growth [9], including utilities such as smart metering. LPWA-based technologies divided into 3GPP-standard technologies that work in licensed spectrum and non-3GPP technologies that work in a licensed-exempt spectrum. Narrowband IoT (NB-IoT) and Long Range (LoRa) Wide Area Network (WAN) are the example of the leading technologies of 3GPP and non-3GPP technology, respectively.

Smart metering is an application of IoT for energy management to improve efficiency that is predicted to be implemented massively in the near future. The smart meter will involve 2 (two)-way flow of electricity and information to enable automated and distributed energy delivery [2]. The smart meter will replace existing electricity meter and offer scheduled and/or on-demand remote reading. It can be used both prepaid and postpaid [3]. Smart metering is an application that potential to use LPWA technology and categorized into massive IoT because of its characteristics requirements like massive connectivity, low data rate, low power consumption, and low-cost device. With the help of LPWA connectivity technology, a two-way communications infrastructure for smart metering is created, enabling interaction between the utility operations and the monitoring through control devices.

This study aims to provide techno-economic analysis of LPWA-based IoT for smart metering application with the technologies to be assessed are NB-IoT and LoRa WAN. Therefore, it can be a reference for regulator or policymaker to determine the best-suited technology for IoT smart metering implementation by considering the importance of technical and economic aspects.

1.2. Problem Identification

Problem Identification of this research are :

1. What is relevant candidate solutions of IoT technology for massive IoT like smart metering?
2. What would be the difference between 3GPP-standard and non-3GPP standard technology?
3. How to identify and quantify cost and benefit of IoT deployment for smart metering to assist decision makers inefficient allocation resources?
4. What would be the critical factors to the deployment success of smart meter?
5. What would be the differences recommendations of smart meter deployment between stakeholders related to regulation, utility company, and telecom company?

1.3. Objectives

The objectives of this research are :

1. Identify the technical and economic constraints of two relevant candidates of LPWA-based technology: Narrowband IoT (NB-IoT) and Long Range (LoRa) Wide Area Network (WAN) to implement the smart metering network.
2. Calculate technical requirements of 3GPP-standard: NB-IoT and non-3GPP standard: LoRa WAN technology implementation.
3. Identify and quantify the costs and benefits of NB-IoT and LoRa WAN implementation to make rational investment decision of smart metering implementation.
4. Identify critical factors to the deployment success of smart meter, and provide recommendations to regulator or policymakers to determine the best-suited LPWA-based technology for smart metering implementation.

1.4. Scope of Work

The author limits the problem only the following :

1. The network deployment areas considered in this study are defined area of high density and low density which represents the difference in density of smart meters.
2. 3GPP-Standard technology narrowband IoT (NB-IoT) and Non-3GPP technology Long Range (LoRa) Wide Area Network (WAN) is wireless connectivity technologies used in the analysis of this study.

3. IoT application that will be analyzed is smart metering in terms of the electricity meter, features are defined.
4. The base station or gateway locations are based on the commercially deployed of telecommunication provider in Indonesia for 4G LTE Network.
5. The base station or gateway is assumed to be used for smart metering application only.

1.5. Research Method

The method used in this research are :

1. Study of Literature

   Study of Literature is done by a study from several kinds of references like the research paper, academic journal, textbook, survey analysis result, government or companies report and other references that can support this study.
2. Collecting Data

   Data is collected from the telecom service provider, national utility company, and/or other parties related to the smart metering application and LPWA-based technology implementation.
3. Calculate Technical Requirements

   This step starts with identifying a potential customer, identify technical requirements of the smart meter, calculation of traffic capacity and initial numbers of the gateway, projecting customer growth into 10 years implementation, calculation of path loss and prediction of coverage.
4. Cost-Benefit Analysis

   Analysis of investment value consists of capital expenditure (capex), operational expenditure (opex), net present value (NPV), and potential model business implementation.
5. Conclusion

   Analysis result that has been concluded from the research along with the suggestion for regulator or policymaker to determine the best-suited LPWA-based technology for IoT smart metering network implementation.

1.6. Hypothesis

IoT covering a wide variety of use cases, therefore no single communication technology that fits all application. LPWA-based technologies are considered as relevant candidate solutions that help network operators to address the challenge of typical IoT characteristics like smart metering. Long Range (LoRa) Wide Area Network (WAN) as non-3GPP technology is expected to be a cost-effective technology for smart metering implementation and faster time-to-market deployment because LoRa WAN is an open standard and the given spectrum is free. While, in other aspects narrowband IoT (NB-IoT) as 3GPP-Standard technology is expected to be the best option for large-scale deployments because it is a global standard technology that can guarantee security, interoperability, scalability, quality of service and longevity [5]. In the end, it is predicted that the decision of technology selection will depend on the stakeholders perspective related to smart meter deployment. Each stakeholder can take LoRa WAN or NB-IoT into consideration differently based on their priority factors. However, there will be opportunities for co-existence between 3GPP and non-3GPP standard technologies, thus it can be divided into the different ecosystem to create successful IoT implementation as a whole.