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IoT-Based Advanced Metering Infrastructure (AMI) for Residential KWH Meter Measurement

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ABSTRACT
An advancement in electrical technology that combines information and communication technology (ICT) is called Advanced Metering Infrastructure (AMI). A two-way communication network connects the Smart Meter's whole architecture to the controllers of the center's equipment and all applications that allow for the gathering and transfer of energy consumption data almost instantly. This paper discussed about a smart meters can be supported by a few communication technologies, including radio link, fiber optic, and power line carrier (PLC). A meter data management system is needed to accommodate and analyze the data base so that information on customer power metering results is obtained. With the usage of AMI, a utility that was previously limited to automatically reading meters will now be able to monitor and control significant portions of the energy consumption..

Keywords **:** ***Field of Systems Engineering, IoT, AMI, Center for Energy Conversion and Conservation Technology (PTKKE) Technology Assessment and Application Agency***

INTRODUCTION

Internet of things adalah suatu konsep dimana sebuah objek berkemampuan untuk mentransmisikan data melalui jaringan tanpa bantuan perangkat komputer dan manusia. Internet of things atau IoT telah mengalami banyak perkembangan. Perkembangan IoT dapat dilihat mulai dari tingkat konvergensi teknologi nirkabel, microelectron mechanical (MEMS), internet, dan QR (Quick Responses) Code. IoT juga sering diidentifikasi dengan RFID (Radio Frequency Identification) sebagai metode komunikasi. Selain itu, juga mencakup teknologi berbasis sensor, seperti teknologi QR Code yang sering kita jumpai.

Saat ini, perkembangan teknologi telah membawa transformasi signifikan dalam pengukuran konsumsi listrik rumah tangga melalui Advanced Metering Infrastructure (AMI) berbasis Internet of Things (IoT). AMI memungkinkan pengukuran kilowatt-hour (KWh) meter perumahan menjadi lebih canggih dan efisien. Dalam tulisan ini, kita akan menjelajahi bagaimana implementasi AMI berbasis IoT memberikan kontribusi pada pemantauan dan manajemen konsumsi energi yang lebih presisi, memberikan pemilik rumah kontrol yang lebih baik atas pengeluaran energi mereka.

LITERATURE REVIEW

Smart Average Energy

Smart Average Energy or GSM-based smart energy meter systems (global system for mobile communication) eliminate the need for manual meter reading collection and provide an alternative to traditional energy meters. They can be part of an AMR system and transmit data over a GSM network to mobile devices. This smart energy meter utilizes a relay to remotely cut off the electricity supply that can be used by the power supply. Furthermore, the meter displays the necessary information on its internal LCD in addition to sending it via

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GSM communication.

Energy meters are mostly limited to one-way communication and only one-way Cut or joint-dash features can be done remotely via two-way communication to operate over GSM. The meter readings obtained are not real-time because the data is sent to users via short message services (SMS) that limit the frequency of data updates. In addition, the energy meter lacks important information such as current, voltage, and measuring power. The process of adding more users or recipients of energy meter data is also very complicated because it requires modification of the source code of the system due to the use of SMS for data transmission.

IoT-based smart energy meters offer a better solution compared to GSM-based energy meters because they support fully functional two-way communication which is an essential part of AMI. The proposed system uses LoRa LPWAN technology for data transmission that provides a fast and reliable connection. The meter can provide real-time information to its users through application software and can detect energy consumption as well as theft. However, the system developed does not utilize external sensors to detect interference or theft, but rather predicts the occurrence of theft using current sensors, which can sometimes lead to unreliable detection and false alarms.

Advanced Metering Infrastructure (AMI)

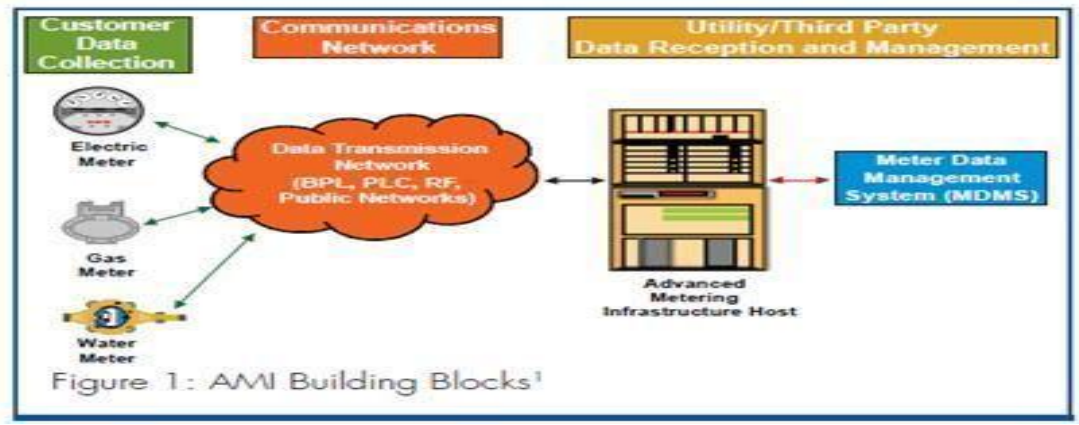

Figure 1. Advanced Metering Infrastructure

Advanced Metering Infrastructure (AMI) is a system that uses information and communication technology to collect, transmit, and manage real-time energy consumption measurement data. AMI enables energy users, electricity service providers, and other relevant parties to monitor and manage energy use efficiently. The way AMI works begins with the installation of smart meters in the house or building to be measured. This smart meter is equipped with an energy measurement sensor that measures and records energy consumption periodically and accurately. This measurement data is then sent over a communication network such as an internet network, wired network, or wireless network (e.g. via wireless technology such as Zigbee or Wi-Fi) to the AMI management system.

In the AMI management system, energy measurement data from smart meters is collected and analyzed. This information is used to generate detailed energy consumption reports that are accessible to energy users and electricity service providers. In addition, AMI

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management systems also enable the provision of real-time information about energy usage to users, giving them a better understanding of how and when they use energy. In addition to collecting and analyzing energy measurement data, AMI also functions in damage management and monitors the quality of electrical voltage. AMI systems can detect failures or interruptions in the power grid and notify power service providers in real-time, so problems can be immediately identified and fixed.

METHODS

The method used in this study is an experimental method. This method involves collecting data directly from residential kWh meters using IoT-based AMI technology. Researchers can make direct measurements using measuring equipment connected to kWh meters through IoT networks. The data obtained can then be analyzed to evaluate the effectiveness of AMI in measuring and collecting data on electrical energy consumption.

RESULTS AND DISCUSSION

- Advanced Metering Infrastructure (AMI) is the entire electrical infrastructure consisting of smart meters, two-way communication systems, data management system meters, and good control systems to be able to help control and control electricity use in realtime.
- The implementation of AMI supported by SCADA and ICT control systems in smartgrids can help overcome the urgency of electricity in Indonesia.
- The application of AMI with the use of smart meters has been applied in several countries in the world, such as America, Sweden, China, and Japan.
- PLN as a electricity provider in Indonesia has implemented AMR and smart electricity programs as one of the steps of the electricity system in Indonesia towards AMI.

Comparison of Smart Average Energy and non-IoT KWH metering

The difference between kWh measurement of IoT (Internet of Things) and non-IoT electricity lies in the way data is collected and the interoperability of systems. Here are some of the advantages of IoT compared to non-IoT in measuring kWh of electricity:

1. Data Collection Automation: In IoT systems, smart meters are directly connected to the communication network and can send measurement data automatically. This eliminates the need to send attendants to read the meters manually, saving time and money.
2. Real-time and Accurate: IoT enables real-time collection and monitoring of measurement data. The information received can be directly used by energy users and electricity service providers to understand current energy usage, identify energy-consuming habits, and take necessary action. In addition, because measurements can be done more accurately, errors in measurements can be minimized.
3. Advanced Data Analytics: IoT systems have the ability to analyze measurement data in depth. Historical data and trends can be used to track energy consumption patterns and identify potential savings. For example, by using intelligent algorithms, IoT systems can provide users with more efficient energy usage recommendations.
4. Flexibility and Scalability: IoT networks can be easily expanded and customized by

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connecting new devices to the system. This allows further integration with other smart devices, such as smart thermostats, smart apps, or renewable energy systems. With interoperability, energy users can optimize and control energy use holistically.

5. Quick Response Service Support: IoT systems enable power service providers to detect and respond quickly to problems. For example, if there is a power outage, the system can notify the service provider automatically and speed up the repair process. This can reduce disruption time and impact on energy users.

These advantages make IoT a more efficient, effective, and intelligent solution in measuring kWh of electricity compared to non-IoT ones.

CONCLUSION

Based on the discussion above, it can be concluded that:

1. Advanced Metering Infrastructure (AMI) is the entire electricity infrastructure consisting of smart meters, two-way communication systems, data management system meters, and a good control system to be able to help control and control electricity usage in realtime.
2. The implementation of AMI supported by SCADA and ICT control systems in smartgrids can help overcome the urgency of electricity in Indonesia.
3. The application of AMI with the use of smart meters has been implemented in several countries in the world, such as America, Sweden, China, and Japan.
4. PLN as an electricity provider in Indonesia has implemented AMR and smart electricity programs as one of the steps of the electricity system in Indonesia towards AMI.

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