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IOT Based Power Grid Monitoring System

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ABSTRACT :

Smart Grid and Internet of Things (IoT) are two technologies that become highly developed lately. In the perspective of energy saving, smart grid is an excellent solution to optimize the energy consumption while the IoT can be a solution that offers consumers the convenience of having a real- time method to control and monitor energy usage in a home. In this paper the authors propose the design of smart grid system design based on IoT for smart home. The architecture of the proposed protocols to be used, the working of the system, and the challenge in the system design are analyzed so that the proposed design can improve the optimization of the system Smart grid itself

Keywords: smart grid; IoT; smart home; system design

INTRODUCTION :

At this time, the conventional electrical network system is arguably outdated to be able to pursue the rapid growth of demand for electrical energy availability. Global climate change is getting more severe each year, this make the scientists of the electric power industry are competing to make the innovation system to replace the existing electricity network today.

The technology that is currently being developed intensively is smart grid or smart electrical grid system. According to D. Subagio [1] in his presentation, it is explained that the smart grid especially in Indonesia, is driven by several important factors, including increased use of energy, especially electrical energy average of 3% per year. Energy use continues to increase in line with economic and population growth. In Indonesia's energy outlook 2013, according to [1] explained that the increase in the average energy requirement is estimated at 4.7% per year during the years of 2011 to 2030. Fuel Subsidy usage continues to increase each year, population growth is estimated by Bappenas and BPS for the period of 2011-2030 the average growth of 1.23% per year.

Moreover, according to T. D.Atmaja, D. R. Saleh [2], the development of renewable energy is one of seven national focus and is included in one of the national research agenda. According to [2], also ensure that the use of systems that implement intelligent or smart grid system is a promising development in the future so as to increase the effective use of energy. In a smart grid system, all the variables from the power plant to the end-user side will be monitored and controlled continuously. This means there must be a thorough control involving bulk power generators, transmission parts, parts distribution, and the customer.

In order for all the variables from the power plant to the side of the end user can be monitored in real-time then it takes a communication system that can send data in real-time, and communication technologies are being intensively developed this is the IoT in which this system allows all to be connected together with the internet service [5].

In this paper we make a design of network systems smart grid based IoT to be monitored and controlled continuously. There will be some part of the paper, a literature review that describes the theoretical foundations, design models which explain about the proposed design in this paper, the challenge in the smart grid system with IoT based which describes some of the challenges that occur in system design, and conclusion

LITERATURE REVIEW

Smart Grid System

Smart grid will be one of the most important applications in the last century [3]. According to M. Hamed [4], he explained that the smart grid has several definitions including quotes from (IEC 2010) smart grid is a network of smart electricity capable of integrating actions or activities of all users, ranging from power plants to consumers in order to make efficient, sustainable, economical and supply electrical safety. Meanwhile, according to another excerpt is from the United States Department of Energy, that the smart grid technologies are made possible by two-way communication technologies, control systems, and computer processing. These advanced technologies include advanced sensors known as Phasor Measurement Units (PMUs) that allow operators to assess grid stability, advanced digital meters that give consumers better information and automatically report outages, relays that sense and recover from faults in the substation automatically, automated feeder switches that re-route power around problems, and batteries that store excess energy and make it available later to the grid to meet customer demand.

From some of these definitions it can be concluded that the smart grid is a system that aims to improve the efficiency of electricity supply which consists of reading technology, control, and communications.
In addition to the smart grid system can function when electricity demand decreases by shifting the peak load in every home, the demand for transmission and distribution capacity can be reduced, and therefore it can reduce the investment in the electrical system. Meanwhile, the housing peak load shifting to industrial and commercial users is able
to help increase the income of a corporate network without increasing the power plant capacity.

Internet of Things

IoT is a new paradigm in communications technology in recent times this. IoT concept that is "anywhere, anytime, any media" encourages the development of communication technology.
According to M. Yun, B. Yuxin [5], the growth of communication technology between devices raises some questions and new demands for the optimization of the working of the system itself, and the IoT system is very possible to be used as a system that can perform the optimization. This explain why IoT is very desirable recently, where the IoT technology with millions of devices to be easily interconnected in a network.
M. Yun, B. Yuxin [5] explained that the basic concept of an IoT is all connected together in internet services. Components such as Radio Frequency Identification Devices (RFID), infrared sensors, global positioning system (GPS), laser scanners, and the internet network are connected to the internet all in one protocol and is used for information exchange and communication between devices that is quick and smart to identify the location, track, and monitor system. IoT system expands from a small-scale internet network.
IoT system has three important characteristics [5]:

1. Comprehensive sense: such as the use of RFID, sensors, and two-dimensional code to collect information from the object whenever and wherever.
2. Reliable transmission: providing accurate data to provide real-time information from the object through meshing a variety of telecommunications networks and the Internet.
3. Intelligent processing: using intelligent computing such as cloud computing and fuzzy identification to analyze and process large amounts of data and information, for the purpose of implementing intelligent control for the object.

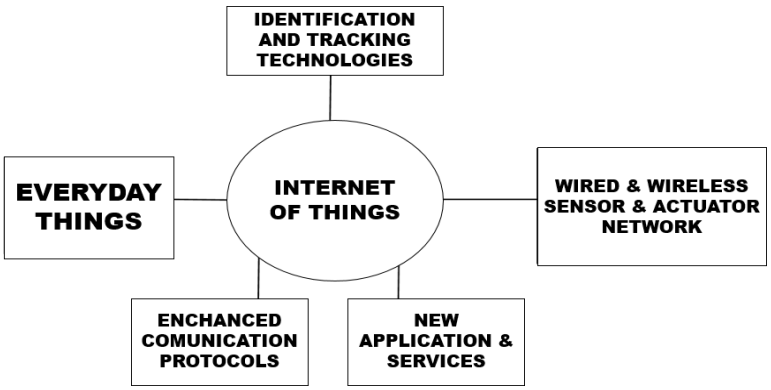

Figure 1. IoT technology Diagram [5].

IoT outline has three basic concepts, namely: "things oriented", "internet oriented", and "semantic oriented" [6]. "Things oriented" is described as all sorts of devices connected to the IoT system, for example, the sensor, the tag, and the actuator are part of the "things-oriented". While everything related to the Internet network, such as internet protocol and a web of things including "internet oriented" and the latter "semantic oriented" are the network of all the objects in the IoT.

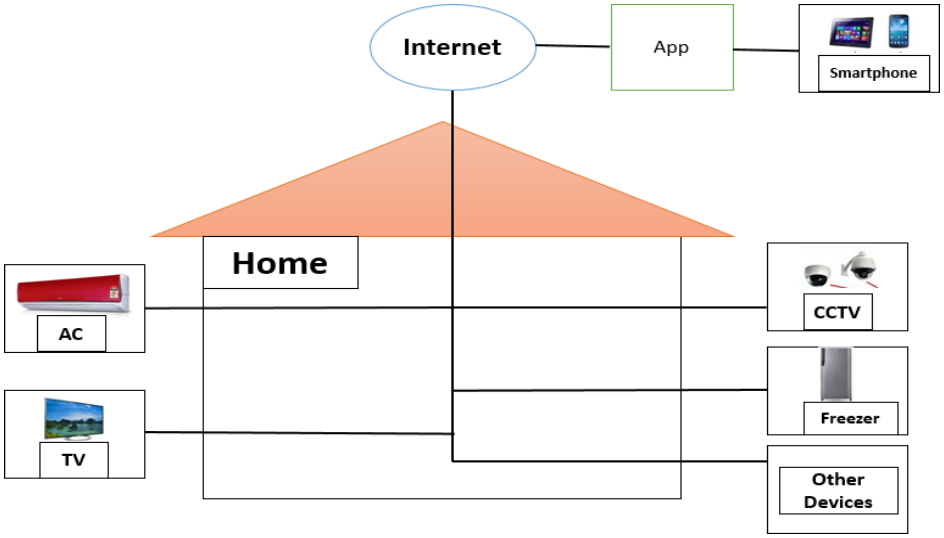

Figure 2. Smart Home System

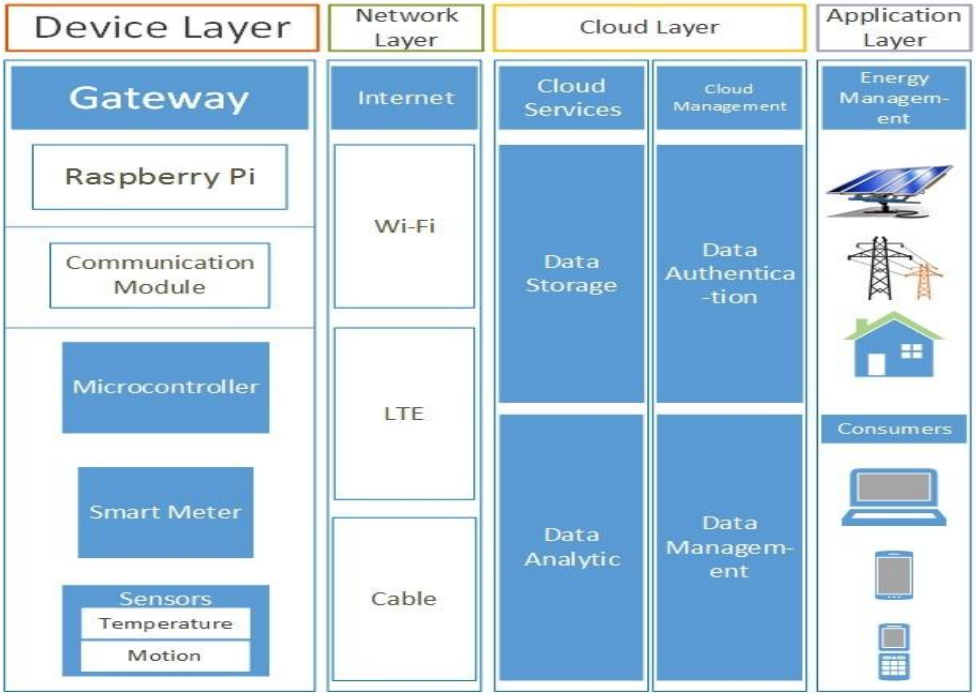

Figure 3. IoT Layer

Model Design

Design implementation of IoT in this paper will focus on IoT implementation in smart grid and smart home, where the two are unable to be separated. In general, the service is between grid server and consumers. Grid server is responsible for everything related to energy supply. In this case when electricity usage in an area is not too high, then the energy will be redistributed to other areas.

The design model IoT in smart grid is illustrated in Figure 4.

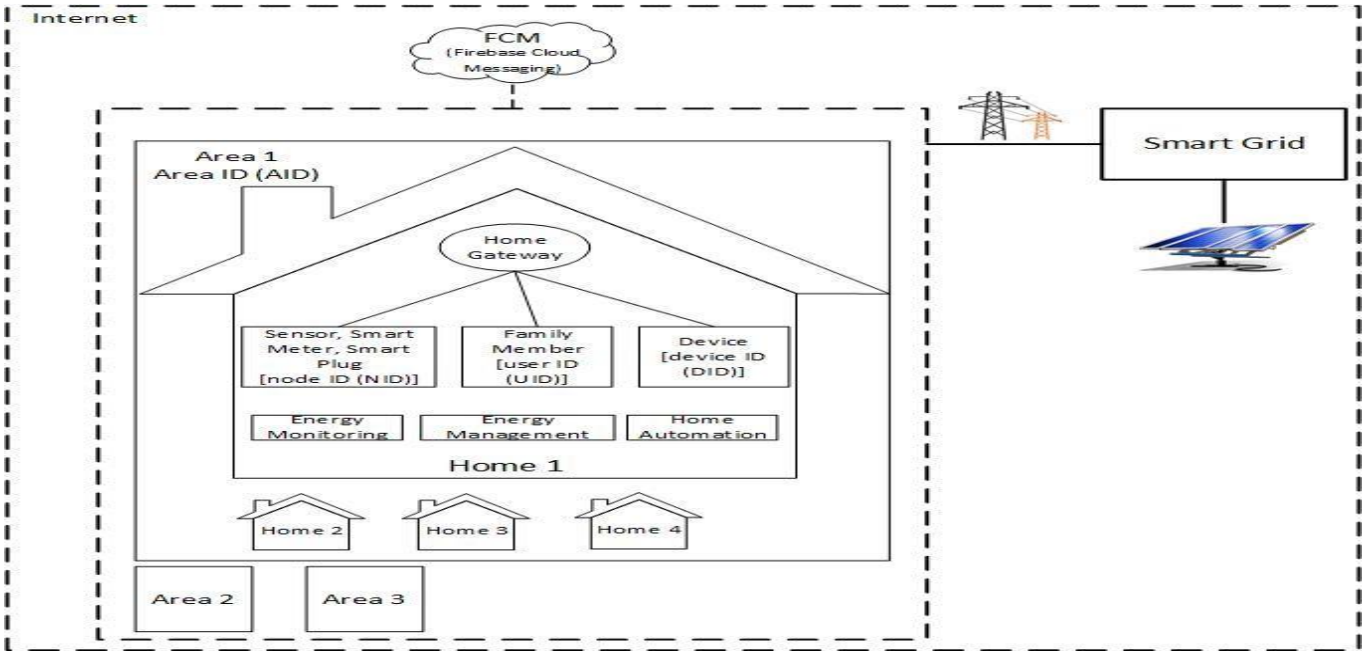

Figure 4. Model Design IoT in Smart Grid

Topology

Every house within one area will be connected through Home Gateway with mesh network topology. Using this network topology, implementation Radio Frequency (RF) in communication between Home Gateway or commonly referred to as Wireless Mesh Network (WMN) can be possible and then can reduce implementation cost. In larger scope we can use LoRa technology to support WMN. Network topology is illustrated in Figure 5 below.

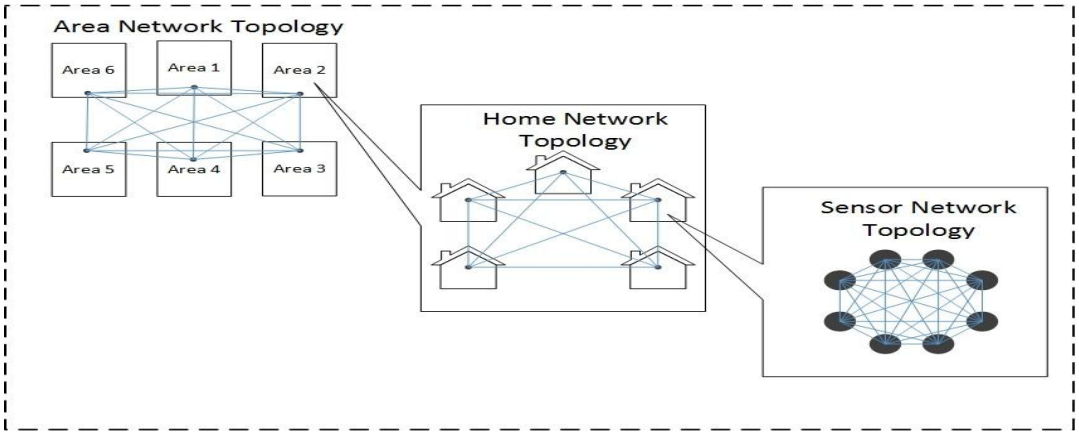

Figure 5. Network Topology

Network Protocol

There are several protocols which are used in this paper. For example the device layer is using IEEE 1901.2010 standard, while sensors device is using BLE or ZigBee. All of the protocols will be connected and processed further by a home gateway based on Raspberry Pi minicomputer. Various kind of sensors device will be implemented to support a home automation and energy management. As an example, when motion sensor doesn't detect the user in a room, then some electronic devices can be turned off automatically.

Home gateway periodically uploads the sensors data from smart meter to the cloud through HTTP protocol about the energy usage. On the other hand, home gateway can handle the command from consumers through XMPP, so consumers through their devices can send command to control their home appliances. The architecture of Firebase Cloud Messaging is illustrated.
HTTP and XMPP implementation is done in this section and works to communicate with FCM connection server. App server will send messages to FCM connection server then the messages will be sent to Client App.

FCM/GCM Connection Server

FCM/GCM connection server works to receive messages from app server then forward them to client app.

Client App

The messages from FCM/GCM connection server will be received by client app. Every client app must be registered first to get an ID before it can be used.
Through this system, users would be able to know the energy consumption of their houses and could control it so they could optimize the energy usage.

Conclusion

IoT has revolutionized information and telecommunication technologies and brought the possibility of smart grid and smart home technologies. This paper has addressed an overview of the IoT that support smart grid and smart home technologies. Furthermore, the implementation of IoT in smart grid could reduce the energy consumption, but many more challenges must be faced before we get there. Currently, Indonesia is in the development of smart grid and Indonesian Agency for The Assessment and Application of Technology (BPPT) said that before 2025, smart grid technology could be implemented at least 50% to support the existence of smart city [17].

REFERENCES:

[1] D. Subagio , "Smart grid Jaringan Listrik Pintar di Masa Depan", Polman Astra Malang, 2014. [Online].

Available : http://www.pelangi91.org/wp-content/uploads/2014/11/Pengantar- smart-grid-rev2-part-1-total.pdf,

[2] T. D.Atmaja, D. R. Saleh, "Cloud Computing untuk Mendukung Aplikasi Smart grid " , Konferensi Teknologi Informasi dan Komunikasi untuk Indonesia, PP. 158-163, 2011

[3] Hazenberg W, Huisman M. Meta Products: Building the Internet of Things. Amsterdam, NL: BIS Publishers; 2011.

[4] Mohsenian-Rad. Hamed , "Introduction to Smart grid" , Department of Electrical & Computer Engineering Texas Tech University 2012. [Online].Available: www.ee.ucr.edu/~hamed/Smart_Grid_Topic_2_Smart_Grid.pdf

[5] M. Yun, B. Yuxin," Research on the Architecture and Key Technology of Internet of Things (loT) Applied on Smart grid" , International Conference on Advances in Energy Engineering, PP. 69 - 72 , 2010.

[6] Luigi Atzori, Antonio Iera , and GiacomoMorabito. The Internet of Things: A survey. ComuputerNetworks ,54(15):2787-2805,2010.

[7] X. Chen, J. Liu, X. Li, L. Sun, Y. Zhen, " INTEGRATION OF IOT WITH SMART GRID " , Proceedings of ICCTA, 2011

[8] Maninder Kaur, Sheetal Kalra, "A Review on IOT Based Smart grid", International Journal of Energy, Information and Communications,
Vol.7, Issue 3 , pp.11-22, 2016

[9] S.K. Viswanath, C. Yuen, W. Tushar, W.T. Li, C.K. Wen, K. Hu, C. Chen, X. Liu, "System Design of The Internet of Things for Residential Smart Grid", IEEE Wireless Communications, Vol. 23, Oct. 2016.

[10] The ZigBee Alliance. [Online]. Available: www.zigbee.org

[11] Bluetooth Low Energy. [Online]. Available:https://www.bluetooth.com/what-is-bluetooth- technology/how-it-works/low-energy

[12] HomePlug Support for IEEE Standards. [Online].
Available: https://www.lora-alliance.org/What-Is-LoRa/Technology

[13] LoRa Alliance Technology. [Online].
Available: http://www.homeplug.org/tech-resources/ieee/

[14] An Overview of XMPP. [Online].
Available: https://xmpp.org/about/technology-overview.html

[15] M. Adita, Suwadi, A. Affandi, Endroyono, "HTTP Communication Latency Via Cellular Network for Intelligent Transportation System Applications", International Conference on Information & Communication Technology and Systems (ICTS), Oct. 2016.

[16] Google Cloud Messaging. [Online]. Available: https://developers.google.com/cloud-messaging/gcm

[17] Prof. Martin Djamin, Ir., M.Sc., Ph.D., APU dkk, " Teknologi Smart grid Untuk Smart City ", BPPT Press, 2012

[18] Duta. Achyut K, "Prospect of nanotechnology for high eficiency solar cells", IEEE Vol 978-1-4673-1436-7, 2012

[19] A. B. Setiawan, A. Syamsudin, and Y. Rosmansyah, "Peningkatan Keamanan Supervisory Control and Data Acquisition (Scada) pada Smart grid Sebagai Infrastruktur Kritis (Studi Kasus Pada Sistem Scada Ketenagalistrikan)," Jurnal e-indonesia initiatives, Available: http://eii- forum.or.id/repositori

[20] K. Kaur and N. Kumar, "Smart grid with Cloud Computing: Architecture, Security Issues and Defense Mechanism," International Conference on Industrial and Information Systems (ICIIS), vol. 9, pp. 1-6, 2014.

[21] M. B. Line, I. A. Tondel, and M. G. Jaatun, "Cyber security challenges in smart grids," Proc. ISGT Europe'11, pp. 1-8, Dec. 2011

[22] Y. Yang, T. Littler, S. Sezer and H. F. Wang, "Impact of Cyber- Security Issues on Smart grid," *Innovative Smart Grid, Dec. 2001.*