

AN INTRODUCTION TO SMART METERING TECHNOLOGIES

What is meter

Meter is an electronic energy measurement device that measures energy consumption of a customer.



What is smart metering?

Smart Meter is an energy measurement device that measures the real time consumed energy by a customer and enable bidirectional flow of energy and information for better monitoring and billing while added information to the utility is taken into consideration. [1] [2]

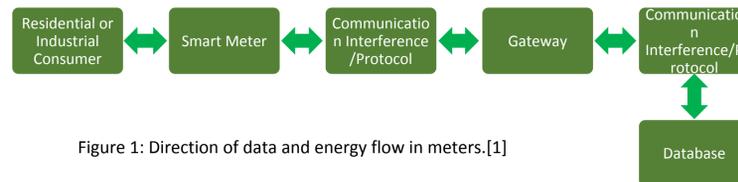


Figure 1: Direction of data and energy flow in meters.[1]

The need for smart metering

With the emergence of humans in the world energy emerged in their life as well. Humankind always used many energy forms and has been refined the form of energy for safety cleanness and reliability reasons while discovery of new sources are taken in to consideration. Energy use by humans started from biomass energy continued to fuel and gas as main sources of energy further in the past two centuries new energy forms such as electricity, nuclear and renewable sources have been discovered. Thus energy consumption become and important subject. Consumers' interest society benefits, climate change and business profitability issues arisen which all lead to better control of energy consumption and emergence of energy measurement in the 19th century. [2]

Energy meters started to play a key function in the energy measurement systems. Many researches has been started for development of meters and new parameters were added for measurement, information, data collection and effective planning during research period. Meters became boundary for utility and customer. New technologies has been applied for remote managing and communication in order to reduce operation losses, decrease electricity theft while opening of new opportunities for the utilities are taken into consideration.[2]

Smart metering system is "an advanced, flexible, interoperable, future proofing system" [2] that connects all energy market participants such as customers, utilities and regulators.

Functions of Smart Meters

The most common functions of smart meters are as follows:

- Bidirectional communication
- Collection of data
- Recording of data
- Storing of data
- Controlling of load
- Programming
- Security protection
- Display parameters for billing.[1][2]



Figure 2: Picture of a Smart Meter.[5]

Features of smart meters

The most common features of smart meters are as follows:

- Real time energy consumption data
- High measurement efficiency
- Prevention of electricity theft
- Remote disconnect and reconnect
- Collection of diagnostic information
- Sending optimization commands for billing.[1][2]

References

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- [2] F. Toledo, *Smart Metering Handbook*. 1991 Available: [https://ebookcentral.proquest.com/lib/\[SITE_ID\]/detail.action?docID=3385350](https://ebookcentral.proquest.com/lib/[SITE_ID]/detail.action?docID=3385350).
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- [4] Kuan Zhang *et al*, "Security and Privacy in Smart City Applications: Challenges and Solutions," *Com-M*, vol. 55, (1), pp. 122-129, 2017. Available: <https://ieeexplore.ieee.org/document/7823349>. DOI: 10.1109/MCOM.2017.1600267CM.
- [5] The pictures are downloaded from link https://www.google.com/search?q=smart+meters&source=lnms&tbn=isch&sa=X&ved=0ahUKEwj1-4Og1vHjAhVrS98KHSwkDFIQ_AUIESgC&biw=1504&bih=885&dpr=1.5#imgrc=

Smart metering communication systems

One of the smart metering goals is the use of energy levels based on the following four mechanisms during peak loads. [3]

- Providing feedback for home users to reduce energy consumption
- Real time residential consumption management
- Use of solar and wind microgeneration as distributed generation form of energy
- Real time demand side management

In order to reach the above goals a robust communication system for effective and reliable flow of data through the network and smart meters is required for developing of strategic plans based on available data to save energy, reduce the cost while availability of reliable and transparent energy is taken into consideration. [3] [2]

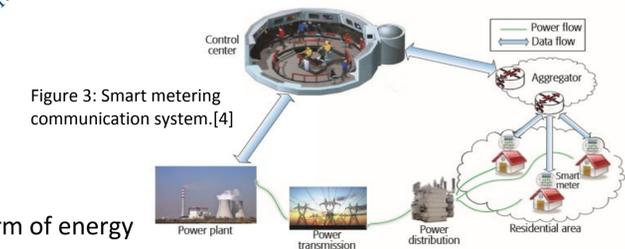


Figure 3: Smart metering communication system.[4]

Smart metering communication system is a logic structure that provides ways of interaction between network components in both sides of source and load, which is consist of the following components: [2]

Home Area Network (Han):

HAN is an information and communication network between home appliances.

Neighborhood Area Network (NAN):

NAN is an information and communication network that collects data from multiple HANs and delivers to the concentrator (data center branches).

Wide Area Network (WAN):

WAN is a data transfer network that transfers data to and from data center.

Gateway: Gateway is a system of communication that transfers data to individual parties and collects/measures energy consumption information from HANs. [3]

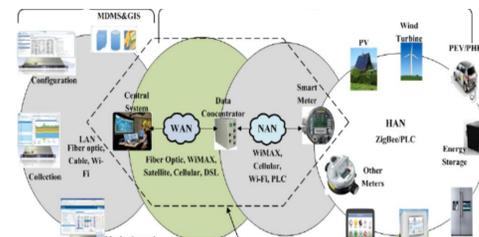


Figure 4: Communication systems.[5]

Interoperability feature of smart grids is the interconnection between a large number of individual energy sources and load centers which are composed of many components in each part. These components need an independent communication way in the grid. The most common communication networks which are used in smart networks are as follows. [3]

Power Line Carrier (PLC)

PLC transfers data on a high frequency signal in the existing low and medium voltage power lines which can be received and decoded by data receivers. The controversial issue in this technology is that power lines are for electric energy supply not for telecom signals. The disadvantage of this network is interference of potential technical and environmental noises which distract the signals. [1] [2]

Low Power RF (Radio Frequency) Technology

This communication system is an architecture of mesh or star communication networks for smart metering technologies. The disadvantages of such communication networks are availability of many ranges of frequency in the market of smart meters, bandwidth limitation due to regulatory issues which differs in every country and requirement of many data concentrators according to location topologies. [1] [2]

Mobile Networks

The most common mobile network used for smart meter communication systems is GSM (Global System for Mobile). Every mobile network company provides a separate VPN (Virtual Private Network) for power utilities. The disadvantages of this networks are dependence on a single operator, small life span and rare changes in location after installation. In practice the most effectively developed and convenient system is hybrid communication system for utilities which uses a combination of above networks according to landscape and topology of load and source centers. [1] [2]

Figure 5: High frequency signal of GSM, PLC and RF. [5]

Security Protection in Smart Metering

In smart metering system meters are considered as an element of a large system which is responsible for specific tasks like other elements in the system. Thus the management of every element with respect to security is important in a system. To solve the security issue the following process must be completed: [2] [3] [4]

- Vulnerabilities study system
- Identification of threats
- Risk analysis
- Data security review
- Compliance with the new environment
- Taking security actions

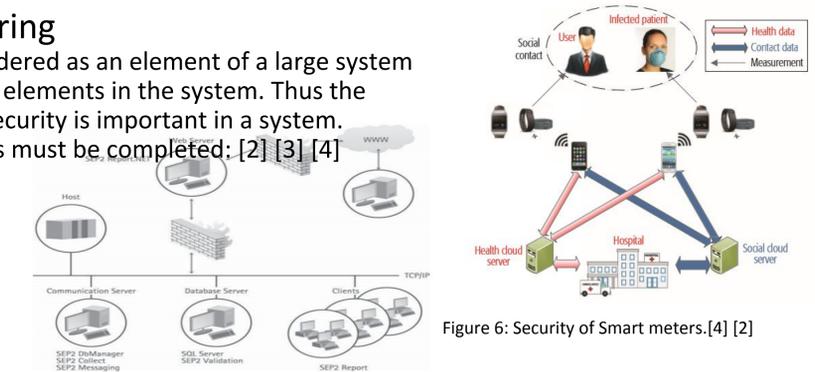


Figure 6: Security of Smart meters.[4] [2]

CONCLUSION:

This poster provides some important information about smart metering. It presents the advantages of smart metering system from the points of view of all stakeholders in the energy market as well as customers. In addition, many kinds of typical technologies for smart meter communication system is presented with their disadvantages. Moreover features and function of smart meters are discussed and finally the process of security protection of data and energy flow in the system is presented.