Global System of Record and Framework to Preserve Energy-Usage Data with Blockchain

Gidean Bandaru and Puneet Paneri

Abstract In the current scenario of the energy market, the availability of the energy-usage data of a consumer is limited. Utilities maintain the historical energy-usage data to some extent but the data is at the service address level and not at the consumer level. The historical data is available only for the period the consumer stays with the utility and the consumer cannot carry along when he moves to a different utility in a different region. The data format and the period of historical data maintained is inconsistent and is dependent on the utilities. In this paper, we propose a solution to maintain the energy-usage history of a consumer at a global level independent and irrespective of the utilities and regions using Blockchain technology with an emphasis on the data standards. The consumer who is the owner of the historical data can authorise the market participants to access and utilise the data for a meaningful purpose.

Keywords Energy consumption · Consumption history · Blockchain

1 Introduction

The energy-usage data of the consumer is of immense value for different entities operating at different levels of the market.

- Utilities—utilities use the energy-usage history to uncover the consumer's usage pattern, estimate load forecasting and can work towards energy efficiency
- Retail Suppliers—retail suppliers identify the consumer energy-usage pattern and propose best-suited plans, prepare purchase plan.
- Consumer—assess and identify their own energy-usage pattern, compare their usage with the peers and can take steps to bring down consumption and improve efficiency in usage

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- Third party organizations—third parties apply data analytics on the consumer energy-usage and provide useful insights to the consumers, utilities and other market participants.

The advantage is high but the availability of the data is low. In the current market, Utilities and Retails Suppliers maintain the consumption history but there are many shortfalls.

Utilities maintain history for a meter point or service address—Utilities maintain historical energy-usage data specific to a service address. At a particular address; consumers may move in and move out. Therefore, the history data is the consolidated consumption of all the customers who have resided in that particular address over a period and is not the record of an individual consumer (Fig. 1).

Retail Suppliers maintain history at the consumer level but for a limited period—In the deregulated market Retail Suppliers maintain the history at the consumer level but the data is available only for the period of their contract with the consumer. Once the customer switches to a new supplier, the retailers discontinue recording the data (Fig. 2).

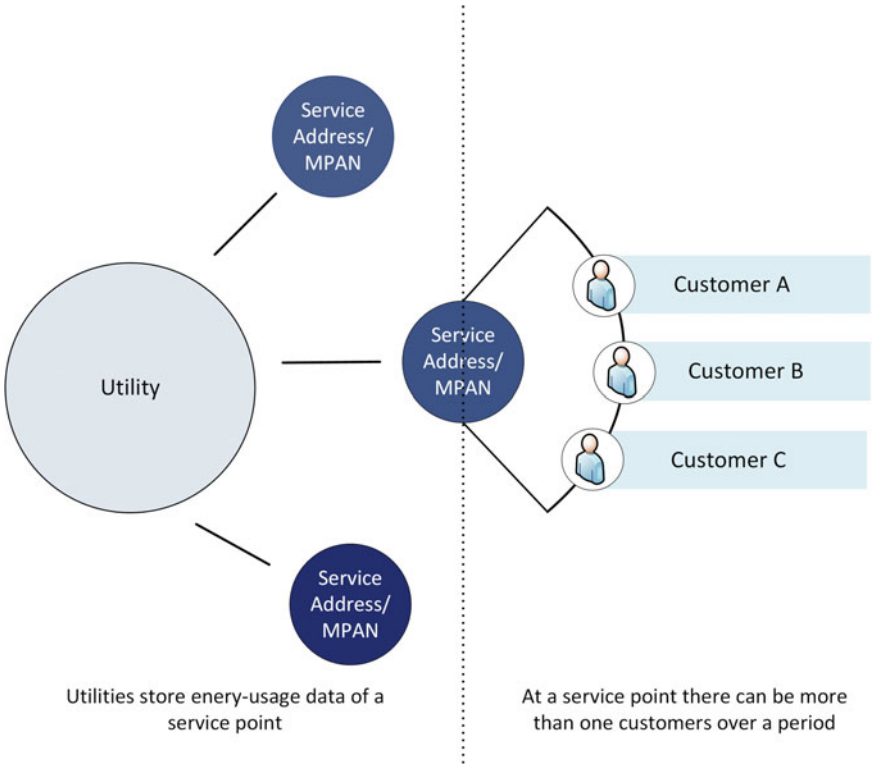

Fig. 1 Utilities maintain energy-usage history at the meter level and it can be a consolidation of multiple consumers resided in that address and consumed energy over a period

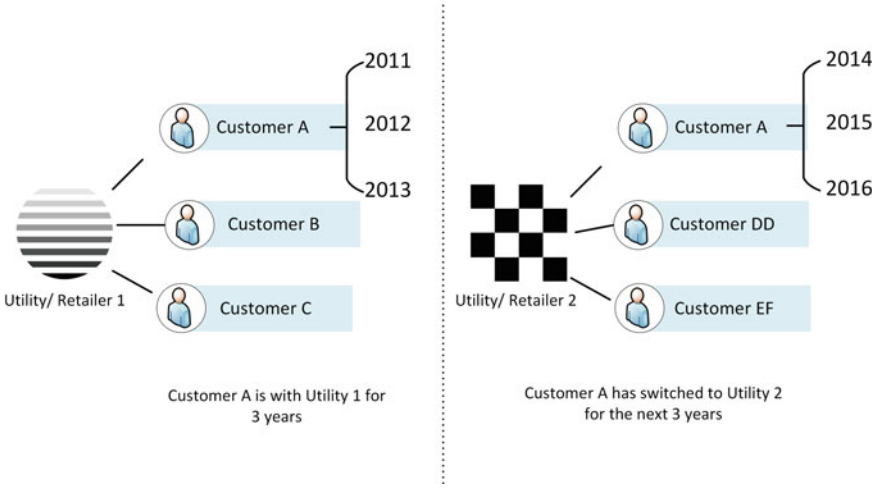

Fig. 2 Customer A is with the retailer AB energy for the years 2011, 2012, 2013, and switched to another retailer XY Energy for the years 2014, 2015 and 2016

No common global platform for the consumers to preserve their energy-usage data—There is no common global platform for the consumers to maintain and preserve their usage data received from the utilities or the retailers at one place.

2 Maintaining a Global Record of a Consumer Energy-Usage History

Considering the problem, we propose a global system of record and framework to store and preserve the energy-usage history of a consumer. This framework provides a platform for the consumer to record and store their energy-usage data for their entire energy journey (Fig. 3).

Using Blockchain to Preserve Consumer Energy-Usage History

The core of the system is preserving the consumer energy-usage history in a secure, efficient and transparent way. Out of the many choices, we propose Blockchain technology to satisfy the purpose.

What is Blockchain?

A Blockchain [1] is a growing list of records, called blocks, which are linked using cryptography. Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data. By design, a Blockchain is resistant to modification of the data. It is "an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way". Once recorded, the data in any given block cannot be altered retroactively without alteration of all subsequent blocks, which requires consensus of the network majority. Blockchain already

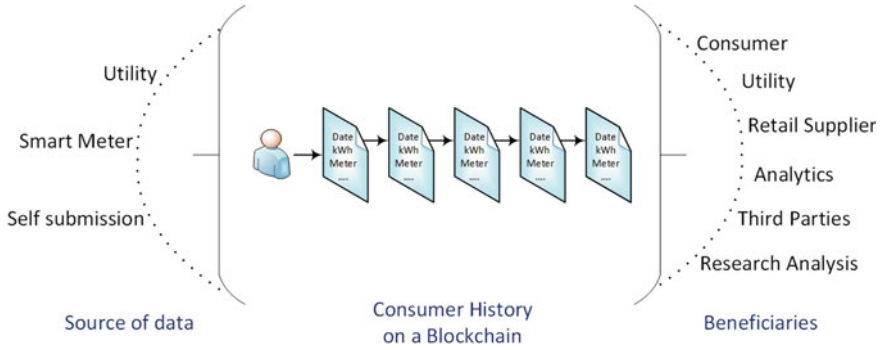

Fig. 3 Solution framework to record, preserve and share the energy-usage history of the consumer

have proven and meaningful implementations in areas of Crypto currencies, Smart contracts, Banks, Blockchain with video games.

Why Blockchain?

Blockchain has the potential to solve the following common business/IT pain points [2]:

- **Trust**: Blockchain eliminates the need for intermediaries and enables direct transactions among organizations. It establishes a distributed system that can be trusted inherently.
- **Security**: Blockchain ensures superior security for transactions compared with more traditional IT security mechanisms such as firewalls, encryption, intrusion detection systems and packet filters.
- **IT infrastructure overhead**: Because disparate systems today hold different copies of the same data, redundant effort is spent ensuring integration and reconciliation between IT systems. Blockchain-based solutions hold the potential to reduce this overhead significantly.
- **Integrated business process implementation challenges**: Blockchain could enable the next level of integrated business processes. For example, a metering solution based on Blockchain could ensure a meter-to-cash business process without third-party intervention.

3 Applying Blockchain

The functional components of the proposed framework constitute of three major areas in maintaining the historical data (Fig. 4).

1. Validation and Preparation of the data
2. Storing the data
3. Retrieval and Sharing the data.

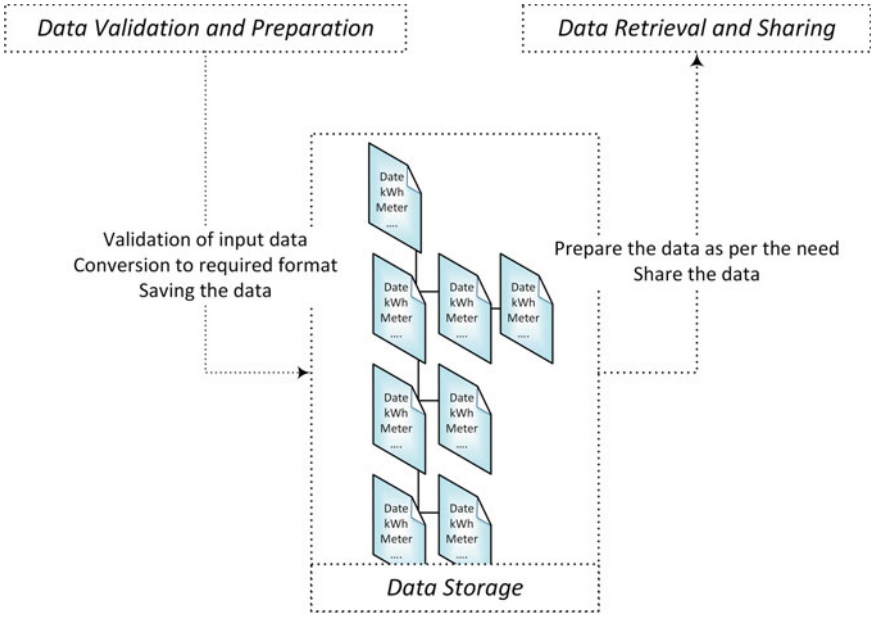

Fig. 4 Applying blockchain for validation, preparation, storage, retrieval and sharing of the energy-usage data

1. ***Validation and Preparation of data***

One of the core functional areas of the system is to acquire the energy-usage data of the consumer into the system. The energy-usage data can be available from different sources and in different formats. Validation and preparation of the data ensures that the incoming raw energy-usage data is stored in a consistent way irrespective of the format it is contained.

Sources of the energy-usage data

Few of the prominent sources of the energy-usage data are

- **Utility**—The utilities are the primary source and caretakers of the energy-usage data. The energy-usage data is recorded as a couple of fields per month for legacy meters and as a sequence of interval data for the smart meters.
  The data can be directly communicated by the utility to the proposed system using standard protocols and application interfaces.
- **Smart Meters**—Smart meters produce loads of interval data, which give important insights on the consumption pattern. The proposed system can have direct access to the smart meters and load the interval data into the system.
- **Self-submission**—The consumers submit the energy-usage data into the system. The consumers can capture the energy-usage data over a couple of fields, by uploading meter photographs or through the interval data files provided by a smart meter, utilities, retail suppliers, etc.

Preparation of the Data

In spite of the data received in different formats from different sources, all the data has to be translated and saved into a standard form. The standard format to save the data is designed in way that all the basic information required by the beneficiaries is constructed from the raw input provided irrespective of the data source.

Preparation of the data includes

- Identifying and understanding the data represented in multiple formats received from different sources. These include standard utility consumption file, smart meter interval data, green button data, consumer input, etc.
- Extracting the necessary information and saving in the standard format.
- Validating the data with the existing information especially for the dates for which the consumption is being uploaded.

Global standard format for data

A global standard to represent the energy-usage data is widely talked about and the impact will be immense and constructive if all the utilities deliver data in the same standard accepted across the globe. Few regions have taken a step forward in defining regional standards for the utilities and third party market participants to adopt and deliver the usage data in a standard format. **Green Button Data** [3] is one such initiative taken by the Green Button Alliance in US that is getting wide popularity. Most of the utilities are generating the energy-usage data in the Green Button format. Third party organizations are building applications around energy efficiency, forecasting and are effective in analyzing useful insights for the consumer and the utilities using analytics.

There is a strong need for a global standard across all the utilities of the globe, which helps in the efficient usage of the available information.

2. ***Storing the data***

The prepared data is stored on a Blockchain. Every new submission from a consumer is added to a new block linking it to the chain of blocks from the past submission (Fig. 5).

3. ***Retrieval and Sharing the data***

The trusted non-modifiable data can be retrieved and shared with the consent of the consumer. Depending on the search criteria, the data can be retrieved from multiple

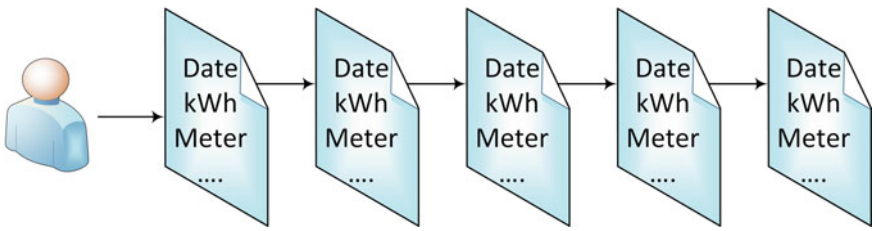

Fig. 5 Energy-usage details are added to the block linking to the chain of blocks from the past submission

blocks. The data can be shared by the consumers with utilities, retail suppliers and other third parties.

4 Benefits and Advantages

1. **Benefits of accessibility to the consumption data**

- **Utilities and Retail Suppliers**

The accessibility of the energy consumption data encourages the utilities and retail providers to facilitate evidence-based research for better understanding of electricity consumption pattern, improvement in energy consumption efficiency. The data is useful for energy model consumption model development, energy audit, load forecasting, energy management and tariff design.

- **Consumers**

The energy consumption data on the consumer side enables the consumer to identify the consumption pattern, strive towards the improvement of energy efficiency, compare with the peers, understand the bills paid and for cost savings if necessary change slabs or switch to other suppliers for better plans (in the case of deregulated markets).

- **Third Parties**

The third parties by applying new technologies on the energy-usage data provide meaningful insight and actionable tips for saving energy and money [4]. Provide Benchmarking, Energy Star scoring and compliance with transparency laws. Suggest cost savings by switching rate plans based on usage patterns.

1. ***Benefits of the Framework***

The availability of the energy-usage data of a consumer is definitely an advantage across the market participants.

- Availability of a ***common global platform***—the consumer has a platform to record, preserve and share his consumption data
- The energy-usage data is ***customer centric***—the consumption history is maintained at the consumer level and not at the meter/service address level
- The energy-usage data is ***continuous***—the energy-usage data of the customer is continuous irrespective of the consumer moving from one utility region to another or switches from one retailer to another in the case of a deregulated market
- The energy-usage data is ***secure***—unauthorized access to the energy-usage data is restricted
- The energy-usage data is ***owned by consumer***—consumer is the complete owner of the data

- The energy-usage data is ***shareable***—customer has the sole authority to share the data with any utility, retailer or any third party for the mutual benefit.

5 Conclusion

There is a definite need for a common platform for the consumers to record and preserve their energy-usage data. The global record of energy-usage data can clearly benefit consumers, utilities, retail suppliers, third party analytics enthusiasts. The security, transparency and integrity of the Blockchain adds advantage in offering this novel solution for empowering consumers in the energy sector. While there are few challenges in the standardization of data across the utilities, considering the advantage of availability of the historical energy-usage data, there will be a solution explored soon.

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