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Blockchain Technology in Electricity Distribution and Consumption

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What is Blockchain? Blockchain is one of the most promising technologies that have great potential to transform a range of branches of peoples' lives and make them more efficient, faster, and secure. That is to say, blockchain is a database of transactions but it differs from traditional databases as we know them. Talking of traditional databases, data is stored on the main server with a single authority empowered to delete or change the data whereas blockchain data is shared across a network of users. All consumers have special software that ensures all data remains identical. Cryptography guarantees data to be secured and can be edited only by authorized people.

But what is the block? A block is a kind of piece of information that is made up of data. The block contains so-called a time stamp which is used to create the hash of the block. The hash is the unique identity of a block much like the fingerprint of a human being. Every block also contains the hash of the previous block. It creates a chain of interconnected blocks, as it is shown in Figure 1, and gives this technology its name. Every time a new block is added, a time stamp is added to all the transactions.

There are various kinds of data that can be stored at a block. The data can be related to medical records, election information, smart contracts, or land records. And this technology has found its usage in power engineering as well.

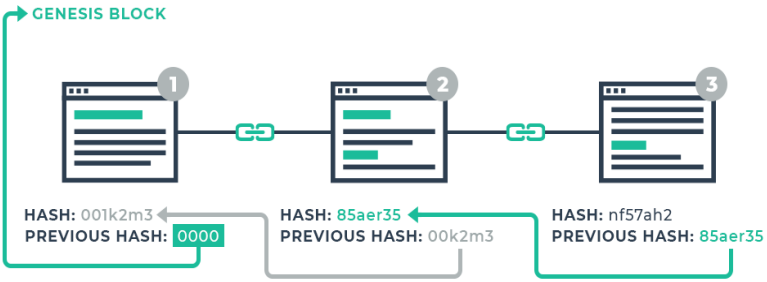

Figure 1. The Chain of Interconnected Blocks

The Usage in Current Power Grids. The current market of energy trade has a centralized structure. Blockchain-based trading infrastructure can offer Peer-to-Peer (P2P) trade which means a decentralized secure organization of electric energy sale between consumers and prosumers (Figure 2). A consumer would be allowed to register as a prospective buyer and a prosumer as a prospective seller. In fact, the UK based Energy Networks Association has plans to invest the amount of 17 billion € in the local energy markets using the smart grid [1].

In P2P trade the block structure consists of the Block ID (unique identification), header, transaction and lock time, which plays the role of time indicator when that particular block was added into the network. Transaction part is generated after the request of the buyer. It consists of Transaction ID (TID), Meter ID (MID), Amount of Energy Requested (AER), Amount of Energy Granted (AEG) for the requesting buyer by the supervisory nodes based on the available energy from the sellers, Energy coins Transferred (ET) by the buyer for the transaction, Digital Signature of the Seller (DSS) indicating a successful transaction, and Digital

Signature of the Processing node (DSP) indicating validation of the transaction.

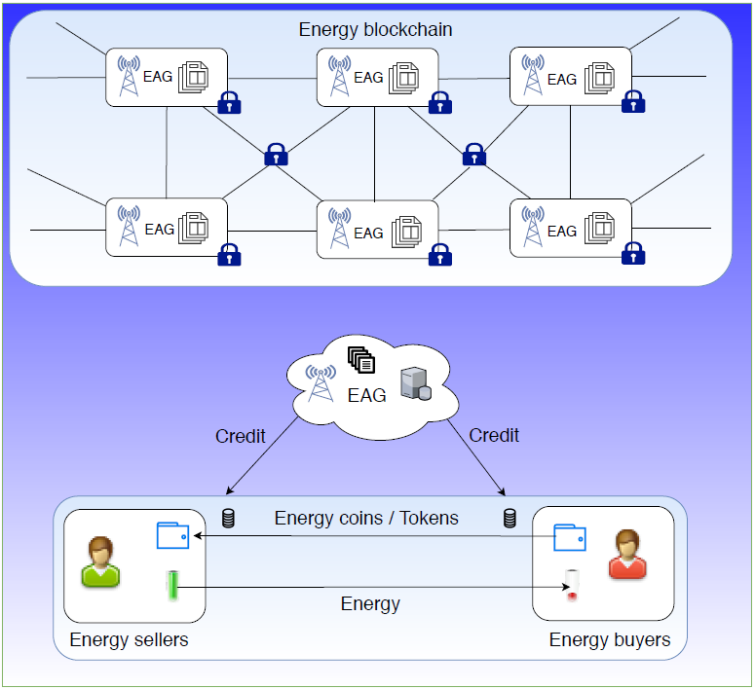

Figure 2. Architecture for P2P Energy Trading

It also includes time stamps indicating Time of Request (TR) and Time taken for Transaction (TT). In other words, it contains all specific data for each transaction [1].

At the same time, blockchain technology has potential applications such as:

1) Automation of billing for consumers and distributed generators;
2) Improvement of the control of decentralized energy systems and microgrids;
3) Potential use for communication of smart devices, data transmission or storage [2];

4) Assistance to grid management;
5) Simplification and speed up of switching of energy suppliers by smart contracts;
6) Protection of transactions and secure data privacy;
7) The auditing and regulatory compliance's improvement.

Potential Challenges. During the process of implementing this technology into current grids there will be several issues and doubts that must be tackled:

1) A need for reinterpretation of a considerable number of aspects of the law;
2) Can the applications be made that match the inherent security of the blockchain?
3) Challenges of legacy infrastructure and technical understanding.

On the whole, blockchain is prospective technology for the digitalization of the current distribution and consumption of electric energy. It will allow the current energy market to increase the efficiency, safety, and management level of power grids. Anyway, there are several problems which must be solved in order to transform the whole system.

References:

1. Tejasvi Alladi. Blockchain in Smart Grids: A Review on Different Use Cases [Electronic resource]. – Mode of access: https://www.researchgate.net/publication/337120813_Blockchain_in_Smart_Grids_A_Review_on_Different_Use_Cases. – Date of access: 30.01.2021.
2. Merlinda Andoni. Blockchain Technology in the Energy Sector: A Systematic Review of Challenges and Opportunities [Electronic resource]. – Mode of access: https://www.sciencedirect.com/science/article/pii/S1364032118307184. – Date of access: 13.03.2021.