WORKSHOP ON BLOCKCHAIN TECHNOLOGY IN THE ENERGY SECTOR

The "Blockchain Technology in the Energy Sector" Workshop, is the first one in its topic, discussed how we can use blockchain technology in fields such as data analysis, barter, independent market monitoring, risk in wholesale energy trade in Turkey.

INTRODUCTION

Nowadays, we call technologies that rapidly replace previous technologies "destructive technologies". The price volatility caused by energy commodities in the energy sector has led to an increase in demand for renewable resources, and the rapid decline in unit costs for the installation of renewable resources has increased the installed power of these resources. Storage systems and smarter grids were needed for meeting demand accurately with the supply from renewable sources. It was at this period of rapid growth in this technology that "blockchain" technology's first examples were set into motion in the energy sector.

Before anything else, let's answer the question "What is blockchain technology?". By definition, "blockchain" is the record of a transaction data into a decentralised, distributed digital record book. This way, past copies of the data are saved on all network servers in the system, increasing the security of data by not putting "all the eggs in the same basket".

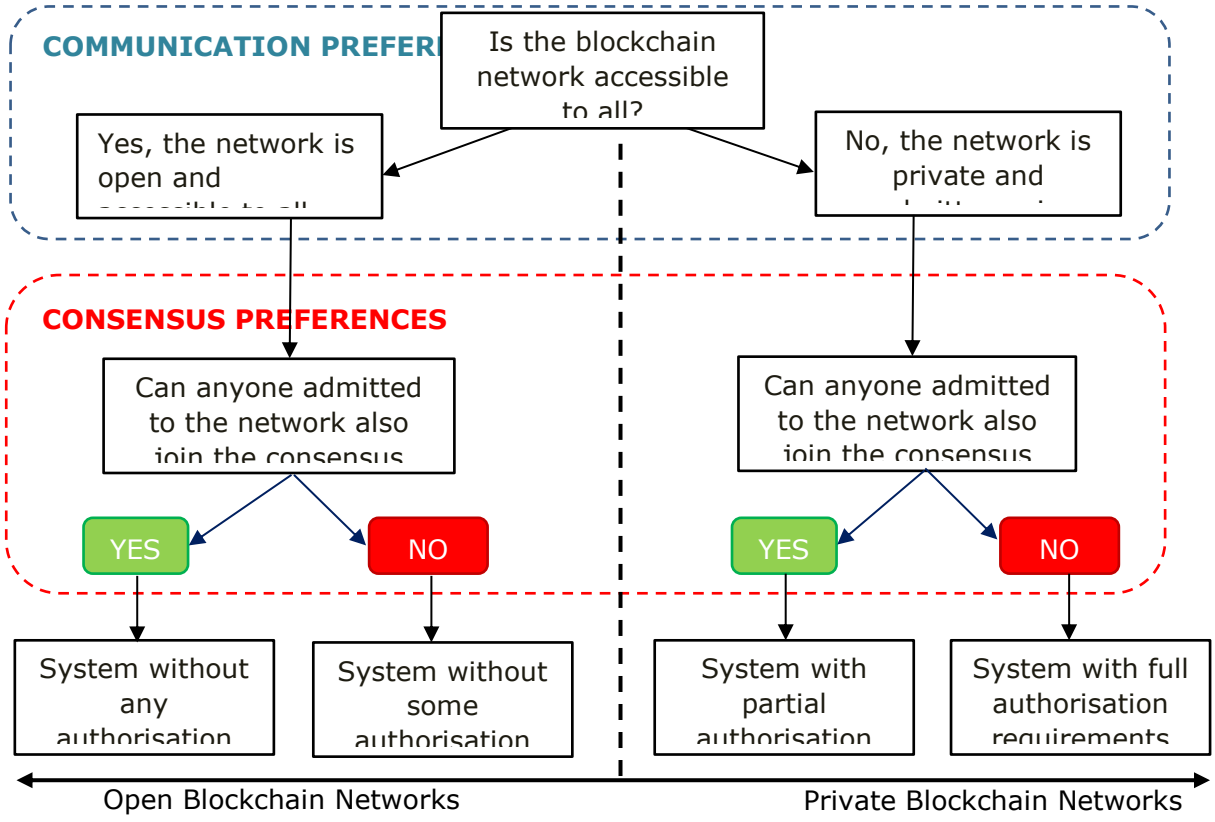
Parties that accept to store the data form the network endpoints with their own servers. These end points are responsible for keeping the data.

It is necessary for us to check the system's compliance with the rules of the system at large so that the data can be accepted as valid; to ensure the data that is to be distributed remains identical at all distribution points. This process of controlling and reaching an eventual agreement is called "consensus".

Before installing a blockchain system, we need to make two choices: Communication Preference and Consensus Preference. These preferences then form four different blockchain systems. To briefly summarize these systems, we'll use the book "Blockchain 101" authored by Ahmet Usta and Serkan Doğantekin:

BLOCKCHAIN FEATURES:

Figure 1 – Blockhain Features (Usta ve Doğantekin)



Systems without any Authorisation Requirements:

Anyone who wishes will be able to join the network, reach all the data and be included in the consensus system. Operation of such a system requires a common purpose or an incentive mechanism for everyone on the network to participate in the consensus system. The best example of an open blockchain network that provides benefits for all is the **Bitcoin Blockchain** system itself.

System without some Authorisation Requirements:

Anyone who wishes will be able to join the network, reach all the data; but will not be included in the consensus system. The reconciliation system will be governed only by the authorized parties, so that the data will be accessible to its users only after the authorised parties have reached a consensus; that's to say only after the proving the accuracy and the singularity of the data. An example for "systems without some authorisation requirements" is the **Ethereum Blockchain**, which can serve a myriad of purposes.

System with Partial Authorisation Requirements:

Only permitted parties may be included to the network. The authorized parties can reach all the data and be included in the consensus system. An example to this would be the internal money order system of banks. All branches of the bank can be part of this network. So, authorisation is necessary to enter this network, and the bank only

provides it to its branches. For a transaction within a branch or between branches, all branches should be included in the consensus system.

System with Full Authorisation Requirements:

Only permitted parties may be included to the network, which would not be enough for the parties to be included in the consensus system. Only parties allowed in the consensus system may carry out its operations.

An example to this is EFT transactions between banks. Let's assume that all banks are registered to a common private Blockchain network for an EFT operation. Only banks are permitted to this system. In this network, assume performing an EFT transaction from bank A to bank B. The data concerning this transaction can be accessed by all authorized banks included in the system "when necessary". However, only the A and B banks have been authorized to carry out the transaction here.

Let's examine other features of blockchain technology with examples that are beginning to be implemented in the energy sector.

BLOCKCHAIN TECHNOLOGY IN THE ENERGY SECTOR

In today's energy sector, blockchain technologies have begun to be applied in the areas of Wholesale Trade, Distributed Networks and Certification Mechanisms of Renewable Resources. We will examine these practices and their basic principles.

Blockchain Technology in Wholesale Energy Trade:

Ponton GmbH software company has developed a platform using blockchain technology for inter-enterprise (B2B) energy trading. Two scenarios were developed in the "Potential of Blockchain Technology in Energy Trading" report. It lists which features and how they matter in the blockchain technology in the two markets of today's wholesale energy trade and the possible fully distributed peer-to-peer (P2P) trade of 2030:

Table 1- Ponton GMBH Blockhain Technology (Merz)

Features	Importence For Energy Trade
Persistence	Essential for storage of transaction data
Data exchange / Data synchronization	Essential for processes such as the exchange of order and transactions, nominations, useful for regulatory reporting
Immutability	Essential if the storage of transaction data is to be secured cryptographically. Useful for regulatory reporting and to detect insider trading, e.g., around unplanned downtime
Permissioned blockchain	The blockchain is fundamentally "closed", i.e. it is limited to the participants of traditional energy wholesale trading. For the 2030 scenario, where anyone can participate in the energy market, a public blockchain might be considered

Proof of work / proof of stake, block formation	Essential (prerequisite for immutability), in case of a permissioned blockchain a "proof of stake" is sufficient, permission for block formation is handled through authentication of the node operators
Availability	This is essential, the moment processes such as nomination and request of balancing energy are included, and certainly in the case of the 2030 scenario. Security of supply remains the ultimate goal in 2030.
Block time	The following characteristics are essential: The mutual exchange of transactions should occur in less than one second, the block time may be 5–10 seconds.
Throughput	For medium-term usage (trading, schedule notification) a throughput of 500 to 1000 transactions per second is required, the throughput required for the 2030 scenario can only be achieved with a hierarchical blockchain.
Anonymity / pseudonymity	Essential for the medium-term scenario, but with mechanisms for lifting by authorized third parties. In the 2030 scenario, anonymization may no longer be a needed.
Trustlessness	Not required, as it is assumed that all node operators are trustworthy and therefore any fraud by the operators themselves can be excluded.
Node operator = market participant?	Useful: As the number of participants increases, it becomes less and less necessary for participants to operate a full node themselves. A "core group" of 20–50 operators is probably sufficient, while the rest would access nodes remotely using something like a trading front end. In the 2030 scenario, the number of nodes could go up to a few thousand, but they would be organized hierarchically.
Smart contracts	Not required: Presumably, smart contracts are less necessary for mass transactions in a closed system than for a public, multipurpose blockchain that supports individual transactions by its users.
Integrated payment process	Useful: The 1:1 coupling to a settlement currency would make a centralized financial management process unnecessary.
Currency	Not required: The 1:1 binding to a reference currency such as the Euro would facilitate the settlement process. A free currency with potential exchange rate fluctuation (like Bitcoin) may be difficult for participants to handle.
Creation of Money	Not required for market participants themselves (in the sense of "mining"); in the 2030 scenario, money creation is carried out by the designated banks or operators.

Ewald Hesse, founder of **Grid Singularity**, has set out with the idea that "technical and financial data can be used to evaluate real-time assets of plants; this way the assessment process will take place live when the production assets are re-credited or sold to a new investor ". Grid Singularity, an Austrian initiative, taking a step further than the energy trade platform, works on distributed mechanisms for energy data analysis, smart grid management, green certificate trading decisions.

Blockchain Technology in the Distributed Networks:

The **LO3** energy company has created a platform for electricity trading among neighbours with the help of micro-network in Brooklyn, USA. In this platform "System without some authorisation requirements" was preferred. Anyone involved in the micro-network can view the data within the network; but the network manager only provides reconciliation.

The **Power Ledger** energy company first applied a peer-to-peer trading platform in a housing estate made up by 15 houses in Australia, in the 3rd quarter of 2016; in the fourth quarter of 2016, with a distribution company from New Zealand, Vector Ltd., a project was carried out for a solution that would not interrupt the market participants; in the second quarter of 2017, it launched its flat money Sparkz; then signed a partnership agreement with west Australian retail company Snergy for developing a trade platform for charge units for electrical cars in the 3rd quarter of 2017. there was a public institution, Western Australia Retail companies agreed to develop the trading platform chargers for electric vehicles with Synergy in the quarter.

Blockchain Technology in the Certification of Renewable Resources:

ElectriCChain Society, with the Internet of Objects Data Collector (IOT dataloggers) method, and using a tool built in solar panels, has started storing user information, temperature, information related to the energy produced in other network participants' servers, and created a virtual presence unit in this way. This virtual asset unit is actually aimed at providing awards from renewable resources for producers at a market value.

There are currently ongoing projects with UNDP, UNFCC, UNAlt / Fin and solar panel manufacturers. SolarCoin is also being used by the International Renewable Energy Agency (IRENA) to award solar energy producers.

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