Peer-to-Peer Optimal Solar Energy Trading using Proof-of-Authority Blockchain Technology

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***Abstract*—The abstract goes here.**

***Index Terms*—IEEE, IEEEtran, IEEE Transactions on Peer to Peer Optimal Energy Trading using Blockchain Technology.**

I. Introduction

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II. Methods

A. Double Auction Mechanism for Optimal Allocation

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B. Blockchain

As shown in Fig.1, the blockchain uses a Proof of Authority(PoA) consensus mechanism where only validators are given the authority to mine new blocks and add new ones to the blockchain. We also have a new kind of users called clerks who are there for validator accountability checks. This is to ensure that validators do not conspire to work against public interest.

1) Different Aspects of the Blockchain:

- *Validator*: A validator is one who has been granted the right to verify transactions, mine new blocks, add and discard blocks. Since we are using a Proof of Authority consensus mechanism, the validators undergo a rigorous

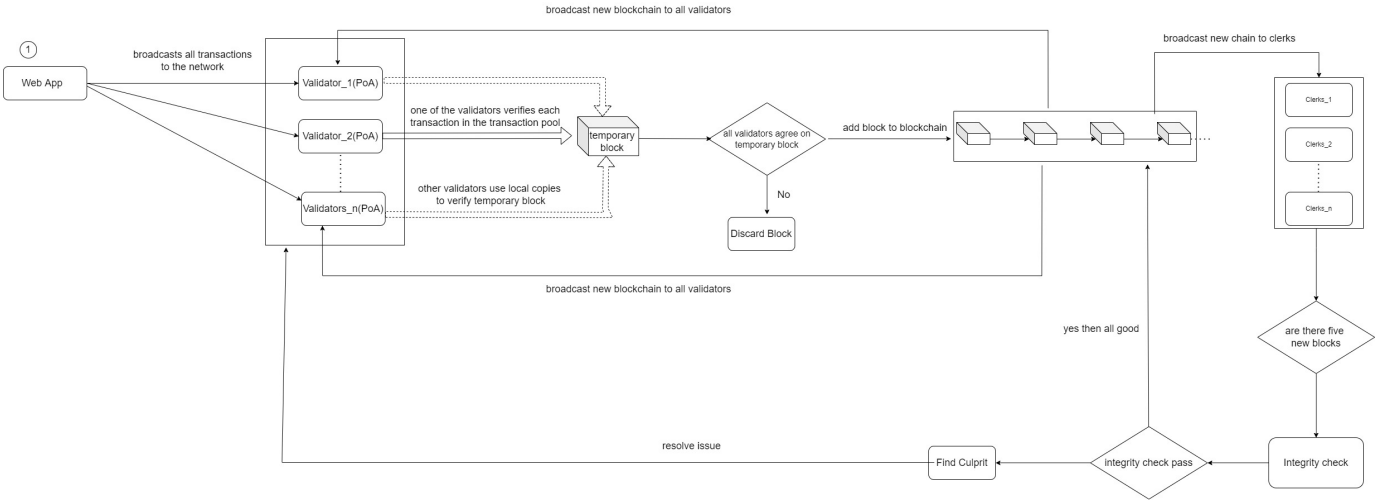

Fig. 1. Proof of Authority Blockchain with accountability check via clerks

registration process where they need to reveal their identities. Their reputation is at stake which means if they go against the interest of the normal nodes on the chain, then their status as validators will be revoked and made known to the greater community.

- *Clerk*: Clerks provide an additional layer of integrity check on the blockchain to ensure that validators do not conspire against the community. After the addition of every new block, they receive an updated local copy of the blockchain and user accounts. They will use their local copies to check whether the nonce of the last block from the central blockchain provides the same hash when they use it on the transactions in their local blockchain copy. If the match does not happen for more than 50% of the clerks, then an integrity check is triggered. Unlike validators, any normal node can be made a clerk and they do not need to be rigorously identified.

2) Blockchain pipeline:

- *Transaction Verification and Signing*: After the double auction is run every 30 minutes, the new pool of transactions are broadcasted over the network to all the validators. The validator who receives the transaction pool first, will verify each transaction where they check whether the buyer has sufficient balance or not. If so, then that transaction is marked as verified and made part of a temporary block. If a buyer does not have the required balance then the transaction is marked invalid. Once all the transactions have been checked, and added to the temporary block, it is then broadcasted to all the remaining validators. These validators use their local copy of user accounts to verify each transaction in the temporary block. They then use the nonce of the temporary block to hash the transactions from the latest block in their local blockchain. If this hash matches with that of the temporary block for all validators then the temporary one is made permanent and added to the central blockchain.
- *Discarding Blocks*: If there is a validator who does not find a match for the hash, then their local copies of user accounts and blockchain is updated. Then the check is done again. If the hash fails to match a second time, then that block is discarded. The non-match signifies that a transaction was manipulated in the central blockchain and so the block discarding is justified.
- *Integrity Check*: After the formation of 5 new blocks, an accountability check is triggered where the clerks verify each transaction in the latest permanent block in the central blockchain. They use their local copy of user accounts to verify each transaction in the latest block, then use the nonce of the latest block to hash the transactions from the latest block in their local blockchain. If the hash matches that in the central blockchain for more than 50 percent of the clerks, then there is no issue but if the match is less than 50 percent, then an integrity check is issued. This goes the through the local blockchain copy of each validator and compares the hash of the latest block. The validator(s) whose hash has a mismatch is then flagged. In this case the validator access may be revoked. This guarantees that validators do not work against public interest.