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Energy Trading between Virtual Power Plants on a Peer-to-Peer Basis Using Decentralized Finance Instruments

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Introduction

Modern electric power systems have been undergoing a revolution as a result of the rising global energy demand, mounting political pressure, and public awareness regarding reducing carbon emissions, incorporating large-scale Renewable Energy Sources (RESs), and contouring power system operation with Information and Communication Technologies (ICT). The microgrid concept was developed in response to these worries, and over the past ten years, with the aid of smart grid technologies, it has undergone considerable advances and modifications [2]. Despite the clear advantages of microgrids, there are a number of technical challenges, including as problems with stability and dependability because RESs are inherently volatile and unpredictable. Theoretically, they are used for DER consolidation in order to be fully dispatchable units, processing data from a variety of DER physical infrastructure, market operations, and Distribution System Operators (DSOs). Additionally, VPPs can act as a middleman between DERs and the wholesale market by trading energy on behalf of small-scale DERs that are unable to participate in the electrical market. The entire available ICT infrastructure is frequently used inside VPPs to oversee the architecture. The appropriate data required for VPP operations is stored using conventional cloud or fog computing technologies. Electricity users were formerly just consumers of the traditional central energy networks. However, the situation has altered. Customers can now create electricity from DERs, the majority of which are typically RESs, under the new idea, which is referred to as prosumers (combinations of producers and consumers). On the basis of net metering and Feed-in Tariff (FiT) billing methods, extra energy is being exported back to the grid. Under net metering, a prosumer is given credit in kilowatt hours for the energy they export to the grid. The prosumer's credit is then reduced by the amount of electricity they used, which was provided by the main grid. The prosumer can export excess energy under the FiT plan at a fixed price in exchange for a monetary credit as opposed to kilowatt-hours.

Description

In this study, a flow and scheme for an inter-VPP trading platform were designed to enable efficient, economical, and transparent peer-to-peer energy trading between the same or distinct block chains based VPP frameworks. The implementation, in contrast to other studies and applications in the existing literature, makes use of a DEX (Pangolin) that is running on a public block chain platform (Avalanche). This study's main goal is to show that P2P trading is feasible using currently available professional Defi instruments. To do this, transactions on the Avalanche Platform's Fuji test network and token swaps *via* Pangolin were performed to test the complete flow. The MILP based power optimization model results from the case study were used to guide these transactions. Clearly, the starting ratios of the pools on the DEX and the supply demand equilibrium that develops after the swaps influence the parity of the tokens with respect to one another. Graphs displaying these token parity variations during swapping transactions are essential for supporting the proposed scheme's results. Trading advertisement requirements for sellers and buyers are still present in this scheme and flow because the focus of this study was on the applicability and execution of inter-VPP trading with DeFi blessings, but they are readily addressed by off-chain alternatives. It may be essential for the buyer and seller to peer with one another *via* software under the control of an authority or a decentralized, intermediary free block chain framework with SCs. Future research can look into this problem, intra-VPP optimization, and more technical drawbacks and effects of DEXs on energy trading.

Conclusion

In contrast to early P2P energy trading research in the literature, the scheme and flow are very similar to those of the open market. The examination of the literature demonstrates unequivocally that auctions or other bidding mechanisms are a part of the energy price negotiation process now used for P2P trading. Depicts a broad viewpoint that exemplifies this scheme's capabilities. As in our earlier study, an ETH-AVAX bridge, like AB, enables trading between an ETH-based VPP and an AVAX based VPP. When trading with one another, AVAX based VPPs just need to use a DEX, like Pangolin, to exchange their tokens. It is anticipated that a wide variety of microgrids and VPPs based on the block chain would be operational. These will be able to communicate with one another and conduct trade among themselves.

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