

Safe and Scalable Framework for Participation of Nodes in Smart Grid Networks in a P2P Exchange of Short-Term Products

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Abstract : Traditional utility value chain is being transformed during last few years into unbundled markets. Increased distributed generation of energy is one of considerable challenges faced by Smart Grid networks. New sources of energy introduce volatile demand response which has a considerable impact on traditional middlemen in E&U market. The purpose of this research is to search for ways to allow near-real-time electricity markets to transact with surplus energy based on accurate time synchronous measurements. A proposed framework evaluates the use of secure peer-2-peer (P2P) communication and distributed transaction ledgers to provide flat hierarchy, and allow real-time insights into present and forecasted grid operations, as well as state and health of the network. An objective is to achieve dynamic grid operations with more efficient resource usage, higher security of supply and longer grid infrastructure life cycle. Methods used for this study are based on comparative analysis of different distributed ledger technologies in terms of scalability, transaction performance, pluggability with external data sources, data transparency, privacy, end-to-end security and adaptability to various market topologies. An intended output of this research is a design of a framework for safer, more efficient and scalable Smart Grid network which is bridging a gap between traditional components of the energy network and individual energy producers. Results of this study are ready for detailed measurement testing, a likely follow-up in separate studies. New platforms for Smart Grid achieving measurable efficiencies will allow for development of new types of Grid KPI, multi-smart grid branches, markets, and businesses.

Keywords : autonomous agents, Distributed computing, distributed ledger technologies, large scale systems, micro grids, peer-to-peer networks, Self-organization, self-stabilization, smart grids

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