

Asynchronous Distributed IOT-Enabled Customer Characterization in Distribution Networks: Theory and Hardware Implementation

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Abstract

This work proposes and implements an asynchronous distributed IoT (Internet of Things)-enabled customer characterization framework to classify customer's load consumption behaviors in electric distribution networks. More specifically, the proposed framework enables robust fully distributed clustering of customers' electricity consumption habits in a highly scalable and interoperable framework. The proposed clustering method also eliminates the need for hefty synchronization efforts typical to other distributed clustering algorithms. The theoretical foundations of designing the proposed framework are introduced. The orchestration of the layers and the applications integrated in the proposed framework are demonstrated in an experimental implementation on a real-time network adopting a data-centric databus architecture. The results of the experimental implementation on IoT development boards demonstrate that the proposed framework can characterize customer categories with a 95% accuracy compared to classical centralized k-means clustering, while ensuring seamless and interoperable peer-to-peer (P2P) information exchange. This proved to be highly scalable and applicable to the real-world.