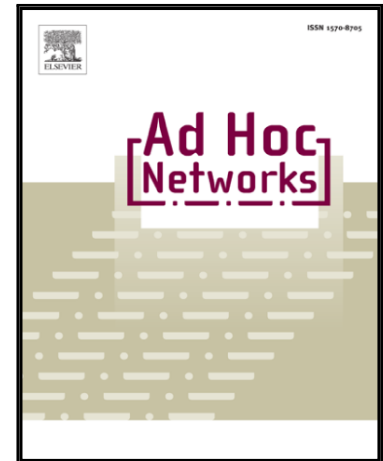


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Time Synchronization over Heterogeneous Network for Smart Grid
Application: Design and Characterization of a Real Case

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Time Synchronization over Heterogeneous Network for Smart Grid

Application: Design and Characterization of a Real Case

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Distributed monitoring and control systems are mandatory for the efficient management of the distribution grid, due to the growing presence of renewable energy sources. Time synchronization among devices deployed in distribution grid plays a key role, since a common time reference is essential to correlate power quality and high sampling frequency measure, and generally coordinate any distributed actions. The design and the deployment of a time synchronization system over an existing heterogeneous network is investigated in the paper. The Network Time Protocol (NTP) has been chosen due to its backward compatibility, the good security level, and the intrinsically robust hierarchy. Several NTP synchronization architectures have been proposed and then applied to a real (operating) distribution grid, both at Medium Voltage (MV) and Low Voltage (LV). The experimental validation was carried out during several weeks on the live system. The results in the MV grid highlight the trade-off existing between synchronization accuracy and availability: the synchronization accuracy over Medium Voltage Broadband Power Line (BPL) links decreases from 20 ms to 50 ms when a more reliable architecture, from the point of view of time synchronization, is used. On the other hand, experimental results show as end-nodes connected on LV grid by means of BPL have a mean offset typically below 50 ms, and a synchronization accuracy on the order of 150 ms. These results are due to the limitation of the synchronization protocol deployed in the LV end-nodes and to scalability issues of power line communication networks when the number of nodes increases.

Keywords— Heterogeneous Network; Time Synchronization; Smart Grid.

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