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DELAY DISTRIBUTION OF RESPONSES WITHIN A HOME AREA NETWORK USING WI-FI

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The Smart Grid is conceptually divided into seven subdomains by the National Institute of Standards and Technology (NIST) of US Department of Commerce for the purpose of planning and organisation of the diverse functionalities of the Smart Grid. Out of these seven subdomains, the customer domain is of special interest since it is the most visible part of the Smart Grid to the consumer. Home Area Networks are the most important ingredient of the customer domain of the Smart Grid. They are responsible for communicating with devices in the household and controlling their operations according to the needs of the Grid as part of the Demand-Response function of the Smart Grid. A Home Area Network should optimise the communications within the household with respect to energy and delay constraints. Responding to requests within an acceptable delay is the key functional requirement of such networks. Additionally, it is necessary to minimise the energy footprint created by the Home Area Network itself. In this research we studied the delay distribution of responses for simplified requests sent by a central controller in a simulated environment. A *MATLAB* model is built for this simulation. Our simulation environment consisted of a central controller that sends requests of three types (load, generation and storage) to 25 nodes simulating household devices. All nodes were arranged in a flat configuration since this is the simplest arrangement. Each node was designed to respond at most for one type of request and be at a distance of 100 m from the central controller. The mode of communication was through Wi-Fi with CSMA/CA at a bandwidth of 56 Mbps. Physical sensing as well as virtual sensing were used to avoid collisions. Requests were broadcasted while responses were sent directly to the central controller. Each request and response was acknowledged. Any response not acknowledged was retransmitted after a timeout. Both the transmission delay and propagation delays were taken into account. Delay of the acknowledgments and the responses were measured separately and the values were used to build a distribution that could be used to derive general statistics such as the mean and variance. These parameters then can be used in optimisation of communications. It is necessary to study the delay of responses with different network topologies and in-network data aggregation before this distribution can be fully utilised. The same model can also be used to study parameters such as packet loss that would be useful in optimisations.

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