Capitol Graduate Research Summit

Modeling and Evaluating the Effect of Data Aggregation Interval on Smart Power Distribution System

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The modernization of the power grid is expected to enable retail consumers to be active participants via data sharing information between the consumers and the operator. This initiative allows two-way communication by means of distributed intelligent devices, which allows better controlling and monitoring of the distribution system. Advanced metering infrastructure by means of a smart meter has become a reality in Kansas with consumers having access to their information via a provider dashboard. Control accuracy using this information will be affected by the granularity or level of detail of the smart meter data. Therefore, an optimal data sharing framework based on the control accuracy, infrastructure cost and consumer privacy is required to modernize the power system in Kansas. This work bridges the gap of quantifying the control accuracy based on the data granularity. A framework is proposed in this work to quantify the relationship between the required consumer data and the estimation accuracy of power system quantities. Voltage drop in a feeder and total power loss are used as two power system quantities in this work to illustrate the importance of the proposed framework. To better understand the effects, a model is evaluated in the presence of residential solar photo-voltaic modules. Standard test systems are used to evaluate the effect of data-granularity based on the proposed framework. A tool to estimate the maximum data-granularity to limit the estimation error is proposed. This framework can be used to determine the optimal consumer data-granularity by the utilities to enhance their performance.