# Standard-Charge Extended Abstract

Global warming created awareness against fossil-fuel use and a transition towards renewable energy-based power system. Citizens are more concerned about this topic and Governments, such as EU countries and Japan, have set ambitious goals towards cutting down CO2 emissions, and increasing the share of Renewables in the overall mix. This change in the power system creates unprecedented challenges such as intermittency, device control with higher resolution and demand side management for higher efficiency. All of these tasks require increased monitoring and communication for better decision-making. Connecting different equipment from hundreds of different manufacturers is impossible, unless a standard approach is taken for communication modeling and messaging. IEC 61850 is poised to fill this gap with its popularity and high-data transmission capability. It was developed for protection, automation and SCADA systems initially, but its domain has been extended with new models developed for PV panels, wind turbines, storage systems as well as Electric Vehicles.

Because it was historically used for protection only, and other models are being developed now, IEC 61850's use for full smartgrid automation and control requires a lot of investigations. For instance, mechanisms for smart energy management or electric vehicle charging control have been developed yet have not been implemented and tested. In theory, these models and mechanisms follow IEC 61850 rules, but there are no real devices to implement them for real-time demonstration and behavior investigation. When equipped with GTNET cards, RTDS can use IEC 61850 based models and send messages such as GOOSE and SV. Again, traditionally this capability has been mostly used for power system protection applications. New ideas, e.g. energy management systems, Smart meters, optimal control for Electric Vehicle charging via charging stations require more detailed models to be used and more sophisticated GOOSE/SV/MMS messages to be sent.

There is a clear lack of knowledge on how to do this kind of implementation, what are best practices in this field, what parameters impact the testing environment. The proposed research targets this research area by implementing Electric Vehicle and Charging Stations with IEC 61850 based models and data exchanges between them based on GOOSE/SV and MMS messages. MMS messages is, especially, of concern as GTNET cards have very limited support.

The main innovation of this research work is the ability to model novel devices that may not have been implemented commercially yet. IEC 61850 standardization work always leads the industry, therefore, lab testing requires models that can mimic the devices, i.e. on IEC61850 emulators. Furthermore, the coupling with RTDS enables realistic scenarios to be tested both in power and communication domains. Integration with CVC, also, exemplifies the benefits that can be reaped from this standard modeling.

The frameworks for standardized communication between EV and CS have been developed in past. The required information models of EV and CS according to IEC 61850 standards have been proposed. But there is a pressing need out validating these models for real life implementations. The outcome of this work would fill this knowledge gap and the results would serve as guidelines before the communication model is actually deployed in real life. Since, the frameworks are already developed according to a popular futuristic standard, the real time implementation and evaluation of these framework would definitely add to the scientific and technical value.

This project has been very instrumental in developing, implementing and validating IEC61850-based standard models for electric vehicles (EVs) and Charging Stations (CSs). RTDS has been utilized to emulate CS and the electrical components (utility grid and the microgrid) while a commercial software is utilized to model EVs. Required message exchanges are successfully mapped unto relevant IEC61850 messages. Correct exchange of these messages enables integration of EVs with power system controls such as voltage and frequency support.

To investigate this possibility, the communication set up is integrated with power system simulation run in RSCAD. The developed models and messages are utilized to exchange EV's SoC value and send necessary charge and discharge commands to them. The simulations showed that the developed system can be used with CVC and help support voltage profile of a microgrid.