



# COTEVOS

## Report on the needs for interoperability between EVs and electrical power system

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### Abstract

The Deliverable 1.1 provides information about the state of the art in the Electrical Vehicles (EV) and Electrical Vehicle Supply Equipment (EVSE) market with the aim to assess the functionalities of different products and their interoperability.

The e-mobility market is continuously developing and – as a consequence – new approaches/solutions regarding EVs and EVSE technologies are continuously introduced. In the report the EV technologies are described with special attention focused on EV components and systems related to battery charging. Market available products and their main characteristics (that might affect interoperability) are assessed.

This report also presents the state-of-the-art in EVSE technologies, including charging equipment and charging technologies. Possible issues related to the connection between the EVSE and the electricity grid and the impact of the charging process on the electricity network operation is also considered and assessed from a Distribution System Operator (DSO) perspective. The most likely scenarios of EV usage are defined based on the analysis of user behaviour patterns. These scenarios served as a reference for the analysis of functionalities of different system that have to interoperate. The functionalities are assessed taking into account issues such as safety and protection, charging procedure and communication between different actors.

Separate parts of this report are devoted to Smart Charging and Vehicles-to-Grid services (V2G). In these parts, various e-mobility future scenarios and their impact on the infrastructure are considered. Envisioned Smart Charging functionalities are described regarding user services as well as distribution grid services and Smart Charging requirements are specified from both EV user and grid operator point of view. Special attention is paid on communication issues, as these seem to be the most challenging ones to resolve.

A major part of this report considers the identification of needs related to the interoperability between EVs and the electrical power system (i.e. EVSE and related interaction with the (smart) grid). The followed approach was based on the Smart Grid Reference Architecture Methodology (SGAM).





R&D is highly needed.

EV chargers are classified as A-class equipment. In spite of a variety of charging modes, which may affect the grid in different ways, it is recommended to introduce a dedicated class for them within IEC 61000-3-2. It is worth mentioning that basic EMC standards do not include any information about the usage of EV's batteries as energy storage for ancillary services.

Any kind of grid adjustment related to EV development requires real time data exchange between all systems involved in charging process (EV, EVSE, EVSP, SCADA). A dominant tool for network management among DSOs is SCADA. Therefore, communication for e-mobility needs to be coherent with currently existing system.

Concerning the communication interface between EV/EVSE and system operator, IEC 61850, SAE J2847 and OCPP are used. The Interface between EV/EVSE and the grid could be employed with IEC 61859, OCPP and SAE J2847, while the interface between EV/EVSE and backend (e.g. system operator, clearing house) could be done by OCPP. However, the standardized interface between EV/EVSE to backend is still open.

- further scenarios in e-mobility - according to the analysis presented in D1.1, the presented scenario of e-mobility seems to be adequate. The scenario assumes sustainable development of e-mobility as well as the increasing role of EVs in the operation of electrical power networks with high penetration of Distributed Generation and Renewable Energy Sources (RES). The future scenario distinguishes two cases of EV use:

- travelling/commercial use (20%),
- EV used for commuting (80%).

In the nearest future, if the share of EV in mobility market will exceed 10%, then the demand side response of charged EVs is vital to keep technical standards of network operation. Additionally, taking into account additional services (V2G and Smart Charging), the network should be enhanced and a novel approach to the grid operation would be indispensable.

- e-mobility services – V2G and Smart Charging - further development of the e-mobility is subjected to the introduction of novel services such as Vehicle to Grid (V2G) and Smart Charging. Supporting technologies are (at the moment of reporting) still at the demonstration stage. Both types of solutions require the cooperation of network and system operators with EVSE Operators according to usage of EVs for services. It is very important for V2G and Smart Charging development is business model, which should answer several questions about financial flows, responsibilities, organization etc. Currently, the detailed final business model for V2G and Smart Charging is not defined. There are a few, simultaneously existing but without any implementation.

Despite the technical aspect, there is also an important social aspect. The surveys show that current and potential EV owners worry about the impact of V2G on the condition of batteries. They also highly appreciate an access to a fully charged EV. This means that a workable business case around V2G services is important but far from trivial!

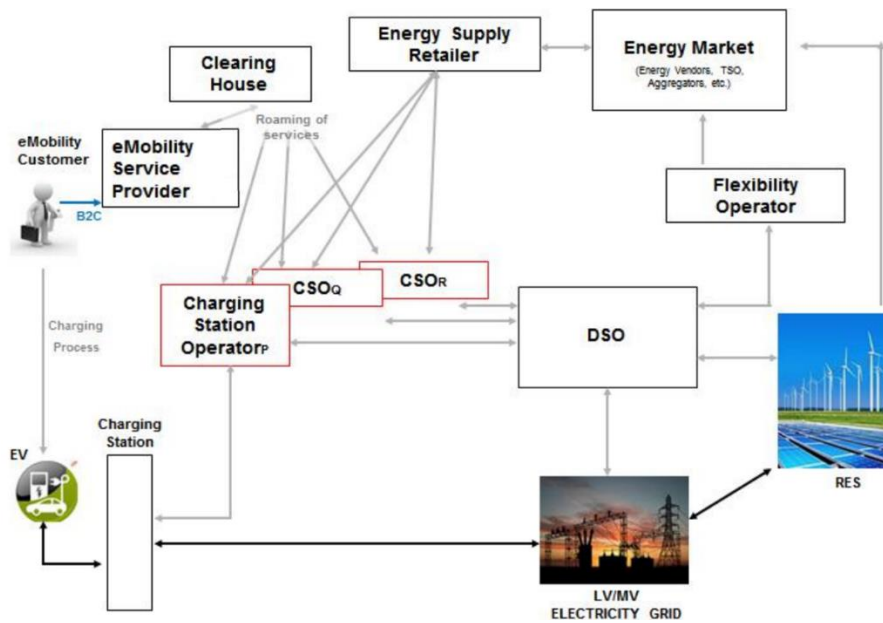


Figure 1. Eurelectric - Roaming of electricity and service [74]

- **Interoperability assessment methodology** - various initiatives, which have been taken by the European Commission and EV manufacturers, have already led to cover most of the standardization gaps. The uncovered yet or not published can be found in the SGAM. Most of these gaps involve communication with DSO or any new stakeholders such as flexibility aggregators. Additionally, the smart grid trend in power electricity causes evolution of existing standards related to EV, supporting integration of EVs with smart grids.

The methodology of use cases definition is crucial to ensure interoperability in e-mobility. The testing methodology is also already presented by the SG-CG and the process based on profile specification, use case identification and the V-model method. With respect to the identified testing capabilities of COTEVOS and DERlab consortium infrastructures, some testing requirements, procedures and infrastructures are still needed. Therefore, the external partners (i.e. outside COTEVOS) and the DERlab consortium will be also taken into account in order to identify any gaps in EV-related testing infrastructures.

COTEVOS consortium has identified research infrastructures outside its consortium in Europe and the US and DERlab is an operating agent of Smart Grid International Research Facility Network (SIFRN), part of IEA Smart Grids Action Network (ISGAN), COTEVOS will approach all international testing infrastructures with a proposal for laboratory cooperation.

- **interoperability assessment** - energy distribution and transmission as a part of the electricity sector is highly dependent on regulations. Thus regulation aspects are crucial for new business models and will affect functionalities and services that can be developed. Consideration of all possibilities is difficult due to a high number of use cases and interaction between actors and systems. Although existing standards can already provide many added value services, the Smart Charging process involves EV user and the network, which expands several actors and data sources. The OCCP v2.0, with respect to previous versions, achieved to support new use cases that were defined by the ISO 15118 standard and, as consequence, it extends the communication domain from the EVSE towards the EVSEO. Unfortunately, there are also existing protocols which when combined with the solution proposed may result in inconsistencies causing interoperability issues in the future. The problem seems to involve complex procedures which require more complex testing procedures definition and implementation. Nevertheless, it is necessary to observe the market approach in a certain environment in order to be able to provide most adequate services at lower cost. Therefore, an attention should be drawn to standard development and market adoption of standards to ensure adequacy of services to foster interoperability and market development of e-mobility.



**Some identified interoperability issues in the component layer (SGAM) to be considered in COTEVOS**

- ✓ *External mobile device (EV user) - HMI platform (EV)* - the external communication is essential for the EV user to get remote access to information about EV. The interoperability is related with establishment of the connection between EV user mobile device and EV HMI platform, and their cooperation.
- ✓ *Customer portal (EVSP) - External mobile device (EV user)* - because of discrepancies in the available software of mobile devices it may happen that EV user will not be able to log in into the EVSP customer portal.
- ✓ *HMI Platform (EVSE) - ID Card (EV user)* - EV users commonly use loyalty cards for identification. However, the number of EVSPs providing loyalty programs is wide and ID cards may not be compatible with any HMI platform at EVSE.
- ✓ *Billing system (EVSEO) - Energy Trading Application (EVSP)* - if the ID card is compatible with HMI platform but EVSE operator does not have suitable equipment for communication with EVSP.
- ✓ *Energy Management Gateway (EVSEO) - Energy Management Gateway (DSO)* - this is one of most important interoperability issues which should be considered within COTEVOS. Real time communication between EVSEO and DSO is crucial for V2G and Smart Charging services. Such services will not be able to be provided until all interoperability issues are eliminated. For this purpose, existing DSO's SCADA systems should be consistent with e-mobility systems that are currently under development. The IEC 61850 protocol could be suitable for the needs.

**Recommendations to be addressed in the further COTEVOS Work Packages**

- ✓ the COTEVOS project should come up with concrete solutions for above listed interoperability issues within Europe,
- ✓ effort shall be put on ensuring that the proposed solutions will be well received by standardization committees, OEMs, DSOs, e-mobility operators/providers and other stakeholders,
- ✓ the COTEVOS consortium shall be aligned with other currently performed initiatives in the field of e-mobility in order to maintain open and broad view on today's interoperability issues.