



Final Report

Publishable summary

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Abbreviations and Acronyms

CH	Clearing House
CMS	Charging Management System
DR	Demand Response
DSO	Distribution System Operator
DUT	Device Under Test
EMS	Energy Management System
EMSP	Electro-Mobility Service Provider
EV	Electric Vehicle
EVSE	EV Supply Equipment
EVSEO	EVSE Operator (CSO)
GUI	Graphical User Interface
ID	identifier, identification (number)
ICT	Information and Communications Technology
IOP	Interoperability
OCHP	Open Clearing House Protocol
OCPP	Open Charge Point Protocol
OEM	Original Equipment Manufacturer
OSCP	Open Smart Charging Protocol
PLC	Power Line Communication
QAP	Quality Assurance Procedure
RFID	Radio Frequency Identification
SGAM	Smart Grid Reference Architecture Model
V2G	Vehicle to Grid



1. Final publishable summary report

This section has been duly covered with the publication of COTEVOS' White Book “**Business Opportunities and Interoperability Assessment for EV Integration**”, available in paper, as well as PDF format, in COTEVOS website:

www.cotevos.eu

At that web location all the public material developed during the project, such as videos, deliverables, reports, etc., is also available.

Next the relevant activities over COTEVOS' life and its achievements are summarized.

1.1. SUMMARY

COTEVOS' team has worked to establish the optimal laboratory infrastructure and capabilities able to assess the interoperability between electric vehicle (EV) systems and the smart grid.

The interoperability between different electromobility devices is key for lower prices and extended services availability for final users. In addition, the smart grid integration of EVs is highly dependent on the interoperability of electromobility solutions with electric network management procedures. The benefits of an increased interoperability are expected to push the deployment of EVs in Europe.

The EU-funded project COTEVOS (Concepts, capacities and methods for testing EV systems and their interoperability within the smart grids) addresses the issue of interoperability. As one of its main objectives, COTEVOS developed plans and schemes for the assessment, validation and certification of the interoperability of electromobility systems. The interoperability assessment infrastructure has been developed from the standpoint of business: testing services, while supporting EV deployment and smart grid progress, should be designed to be profitable.

Along the project, partners have defined methods and procedures to test, analyse and simulate the impact of EV integration in the power grid. Testing will help assess and solve potential issues regarding the suitability of existing protocols and standards. In addition, technology interoperability across providers and countries is crucial in the establishment of efficient interactions among stakeholders, so that they can plan their market approach in the best way and contribute consistently to the regulatory framework. Real testing environments, along with the corresponding testing principles and procedures, allow technology providers to demonstrate that their new products do really fulfil the expected features and help them improve their designs at different stages of the development process.

Project reports, most of them available at COTEVOS website, present in detail the path and findings of the developed work, including:

- The analysis of the state of the art and the identification of needs.
- The situation, needs and gaps according to the standardization bodies and the relevant industry stakeholders.

- The design of a common laboratory reference architecture and the different COTEVOS' infrastructures.
- The testing procedures and the multiple interoperability tests carried out by the partners;
- The vision of the exploitation of interoperability assessment services according to EU priorities and market expectations, etc.

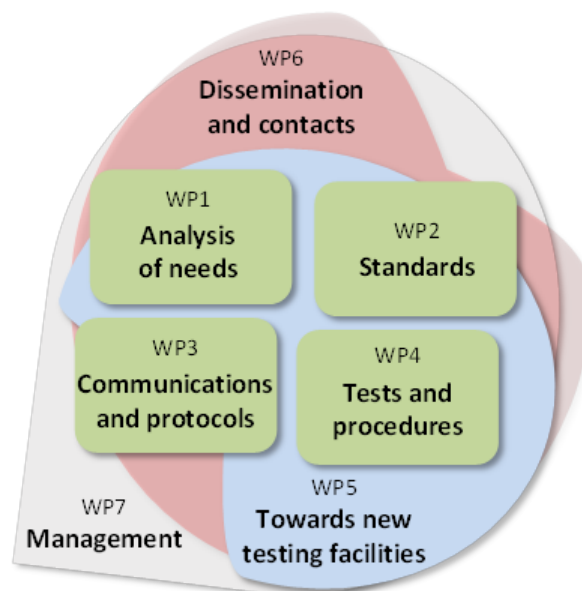
COTEVOS implemented a remarkable network activity with stakeholders. Around 400 contacts (mainly OEMs, DSOs, Electro Mobility Service Providers, Charging Station Operators, Laboratories and R&D stakeholders) have been regularly informed and invited to participate in the Workshops, the Industry Summit and the Interoperability PlugtestTM in ISPRA, where the JRC has been again a relevant support.

The interaction and exchange of information with the main actors has been the basis to place COTEVOS in the focus of EV integration in the smart grid in the international ground.

COTEVOS was conceived as an electromobility project with 11 partners from 9 member states and 3 third parties, one of them from the USA.

1.2. ACTIVITIES AND ACHIEVEMENTS

COTEVOS' main objectives have been followed according to the Work Packages' structure below.



The principal objective of WP1 was to analyze the actual and foreseen future situations and requirements in the scope of EV systems and their interaction with the electrical power grid. The conditions for the EV deployment, considering potential business models, were analyzed and the envisaged interoperability needs were defined. Some challenges, which contribute to the optimization of energy use within smart grids, were identified and the needs for new testing procedures were indicated. The achievements were the following:

- Analysis of actual and foreseen future potential in EV mobility.



- Study and definition of the reference networks and models to be used for the testing.
- Specification of needs for interoperability between EVs and electrical power system.
- Roadmap for the new services and facilities to be implemented within COTEVOS.

The objective of WP2 “Integration and alignment of testing methods with standards (and standardization needs)” was to incorporate COTEVOS into the relevant ongoing and realized agreements dealing with the integration of EVs within the electricity infrastructure, mainly with standardization issues as highlighted by all described Coordination Groups. The following specific objectives were fulfilled:

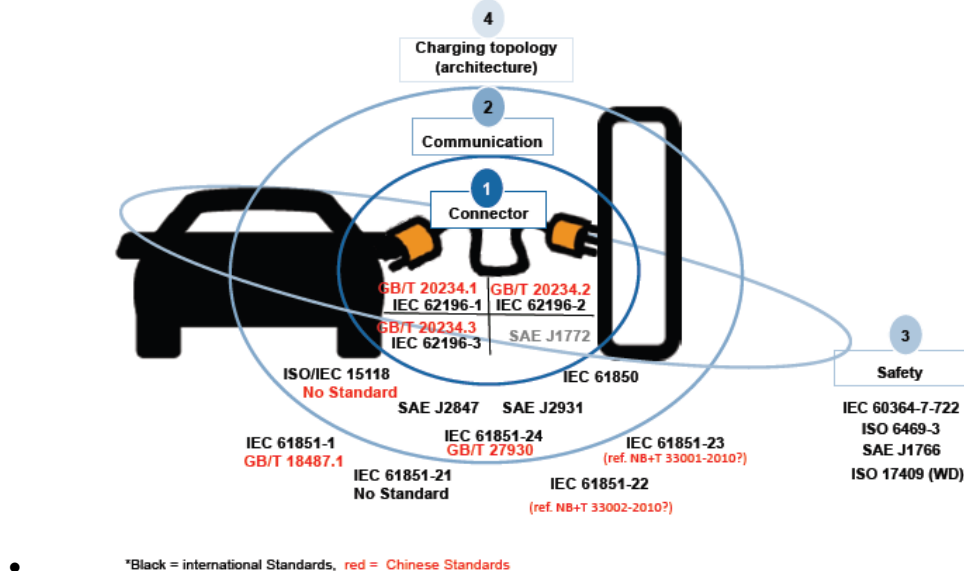
- Analysis and alignment of new tests and conformance test procedures with existing standards, regulations, standardization activities and standardization needs at European level, concerning the interaction between EVs and grid infrastructure. Collaboration with standardization working groups has been relevant.
- Design of a complete COTEVOS Standardisation Table, with references to the related e-mobility standards and groups. This has been the basis for the further definition of the test procedures and the selection of the IOP tests that were performed within WP4.
- COTEVOS agrees that, at this moment, the current set of standardisation groups should be able to cover the needs that are currently present, and also those to be expected in the near future, without any need for new groups. So this should be a joint effort of TC 69/TC 57, OCA and eMI3.
- Definition of priorities for new tests and conformance testing methods with broad consensus at European level (both inside and outside COTEVOS).
- Proposal of the COTEVOS reference architecture, defined in WP3, as a tool for the methodology for standards and interoperability, together with other methods as described in M/490 SGAM (Smart Grid Architecture Model) or in the “Common methodology to make developments in accordance with EV/ infrastructure standards”.
- Recommendations on standardization, such as the need for deepening in the current international cooperation, especially with TC 57/69, OCA and eMI3.

The figure below summarizes the results of the standardisation analysis and the comparison with the international standardisation scenario. The different continents have different standards, but they can be mapped on each other, since the main structure, areas, and topics are similar. This led to the recommendation to extend international (US) cooperation from the current NREL - JRC cooperation to also TC 57/TC 69, OCA, eMI3 and selected COTEVOS partners in a kind of “Open Joint Working Group”.

Overview Standardization IEC, SAE and GB

Relevant IEC/SAE and GB Standards for charging systems

The charging system is covered by a set of standards.

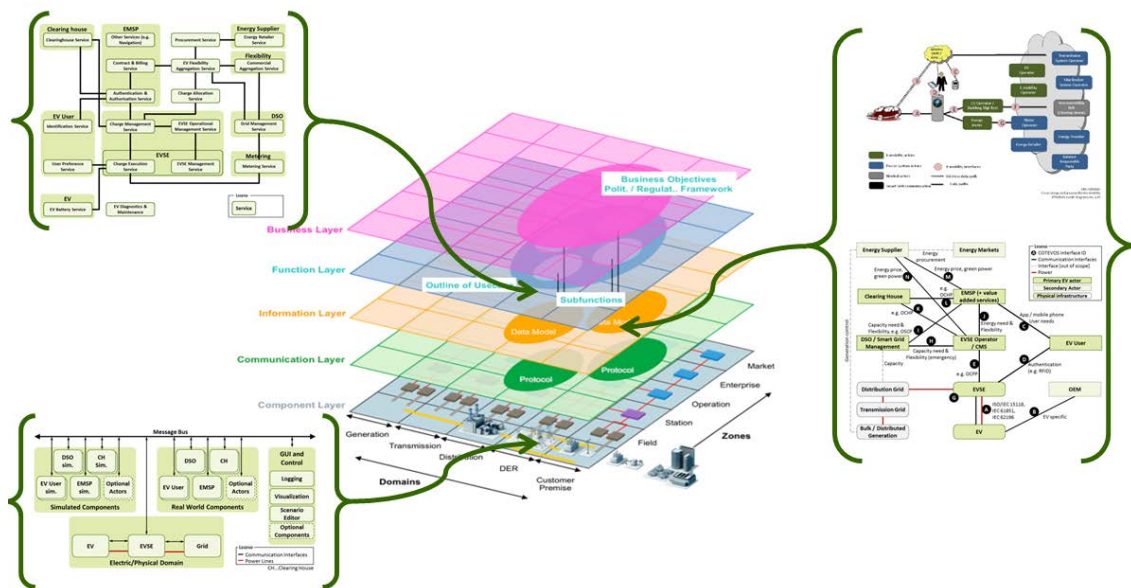


The objective of WP3 was to analyze, define and develop the reference architecture to assess that EV/EVSE systems can interoperate and be used by the smart grid actors, as defined in M/468 (Standardization for road vehicles and associated infrastructure) and M/490. This architecture provides a broad tool for the assessment of interoperability tests as well as an instrument to exchange and generate use-cases and test-cases. The following objectives were achieved:

- Identification of the protocols used by (smart) grid actors.
- Evaluation of the current level of interoperability for charging interfaces.
- Definition of smart grid environments as charging infrastructure.
- Correlation of input/output parameters for test setups (together with WP 4 and 5).
- Definition of data transfer infrastructure (data transfer protocols).
- Development of the software interfaces.

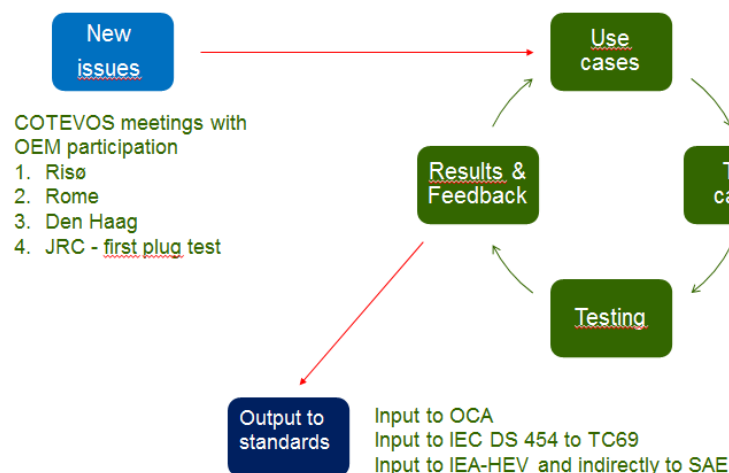
The reference architecture was duly validated, as an indicator for assessing the implementability of the reference architecture, as a very theoretic tool, through an exemplary validation utilizing one of COTEVOS' laboratory infrastructures.

Next figure shows the mapping of COTEVOS' architecture to the SGAM.



The objective of WP4 was to create and propose cost effective interoperability test procedures based on ideas, suggestions and findings from the standardization groups, ICTs and the state of the art in general. These test procedures have been designed to be commonly accepted and agreed among EVs, EV infrastructure manufacturers and power utilities, in a way that they can be used to assess the interoperability of the different systems to be implemented. The following objectives have been fulfilled:

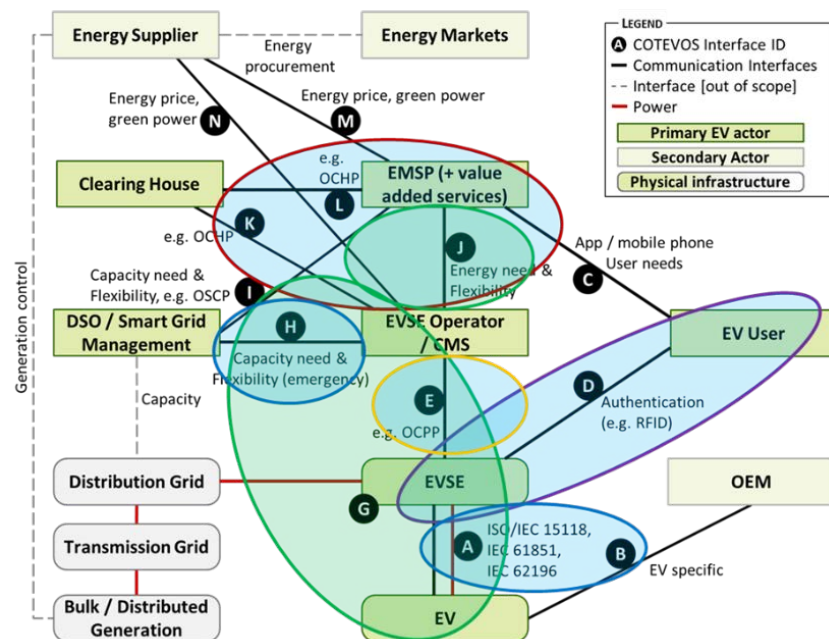
- Design of procedures for doing cost efficient interoperability testing smart charging of EV's, in order to facilitate load management in the smart grid, including as well back end systems to a basic set of functions. The procedures cover interoperability testing based on standards and interoperability testing based on informational objects and functions when standards are not available



- Testing of different products and devices according to those procedures. To cover the whole scene of e-mobility, a COTEVOS methodology for developing test cases was envisioned and developed.



The methodology ensures that future input from e-mobility stakeholders can be processed and used for future test cases.



- Implementation of interoperability round robin test according to a selection of test cases. According to that approach, when the round robin tests results agree, customers could be confident to test their products for interoperability in any of the participant laboratories.



- Identification of the potential approach towards a unified interoperability testing facility distributed across Europe.
- Analysis of the preliminary conditions to test wireless charging.

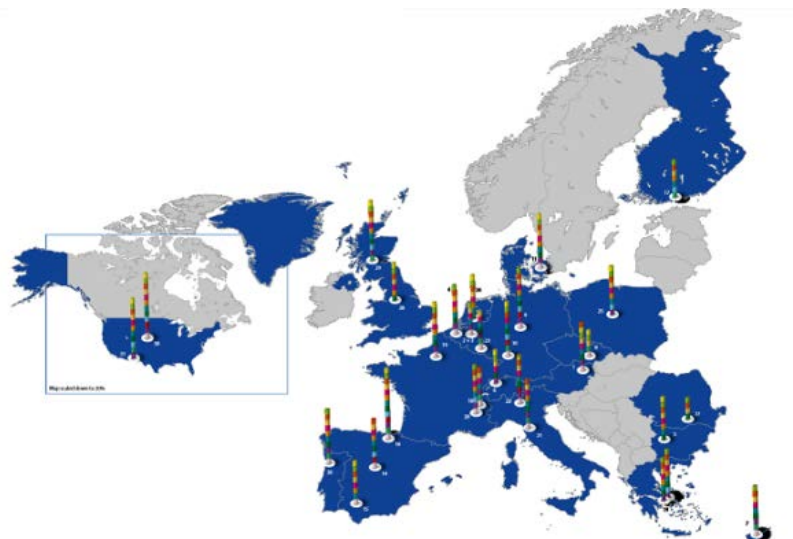


- Reporting of test results, with suggestions for future improvement of standardized test procedures. Several ways for validating the test cases are described. With the developed methodology, the set of test cases can be expanded to any level within the available test facilities.

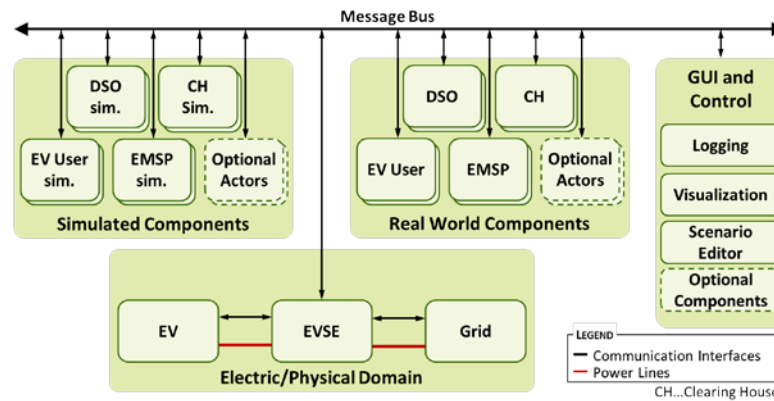
WP5 aimed at the creation of the appropriate capacities for testing within the COTEVOS partnership. A more ambitious result is to generalize the outcomes of the project to be applied in the EU and also at the international level, in order to facilitate the adequate EV deployment and its integration into the management of the electricity network.

The following objectives have been achieved:

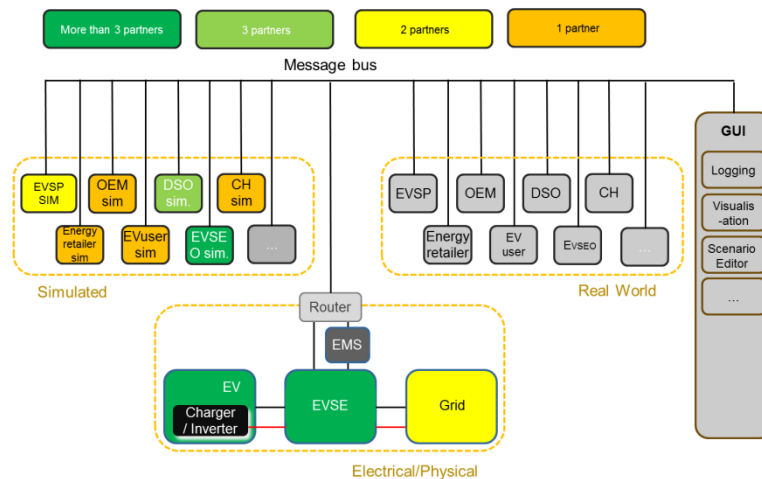
- Setting up a unified infrastructure for conformance and interoperability testing. The different laboratories have implemented the most relevant parts of the common reference architecture that was developed within WP3.
- Setting up a unified infrastructure for integrated functional testing of EV and EVSE, power network and communication interfaces.
- Specification of the convenient way for assessing interoperability and conformance testing through COTEVOS' implementations looking at a common approach. Each individual facility being different to the others, one major achievement has been to maintain a common approach to interoperability testing.
- Development of a unified strategic vision and approach. DERlab Association will be the core to drive and bring together the efforts for exploitation of interoperability testing services. EV integration into the smart grid has also become a strategic area for DERlab. It is expected that DERlab, also supported by COTEVOS' outcomes, be recognised worldwide as a node for EV interoperability assessment.



The following figure show COTEVOS' common approach based upon the physical layer of the COTEVOS reference architecture developed within WP3.



The figure below depicts how the different partners laboratories have implemented respective parts of the architecture, stating the current testing capabilities of the COTEVOS consortium utilizing a depiction of the 3rd layer of the COTEVOS common reference architecture.



The main objective of WP6 has been to create and support an international network to guarantee that COTEVOS' development of interoperability specifications and facilities was realized in the best way according to the ongoing efforts for EV deployment and properly integrated in the smart grid environment, looking forward to facilitating that the newly developed knowledge will be exploited on a broad international scale among industry, key users, local or national authorities, decision-makers, standardization bodies and other relevant stakeholders in Europe and the U.S. In this way the achievements have been:

- Promotion of COTEVOS' results and newly developed testing services among project partners to different target groups using the dissemination potential of the project partners and to gain feedback on the project results and activities.
- Creation of a strong project image and establish the right dissemination tools (e.g. COTEVOS' website).
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- Raising of awareness and lesson learned about future EV business and product developments as well as influence decision-makers in EV business fields.
- Interaction with the networking structure developed in the first period, with around 400 contacts and some dozens of key contacts. This network has been extensively used, informing and



encouraging COTEVOS' contacts to participate in the Workshops, Industry Summit and PlugTest Festival.

- Dissemination of the project outcomes for the right target audiences.