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Electric Vehicles Management for carbon neutrality in Europe

Deliverable D10.7
Standardisation activities plan

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Disclaimer

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[1] https://ev4eu.eu/

Executive Summary

The *Standardisation activities plan (Deliverable D10.7)* provides an overview of the project plan for contribution to the standardization bodies and activities related with the Vehicle-to-Everything (V2X) ecosystem. The deliverable is based on the activities that are carried out in task T10.4 "Standardisation", which aims at disseminating the project results towards the standardization bodies and hence contributing to the development of the standards, in order to be compliant with the needs of the V2X ecosystem.

The deliverable, first provides a background on the V2X ecosystem along with the organizations and standardization bodies that are involved in it. Then, it focuses on presenting the activities of the main standardization bodies that are relevant for the EV4EU project. The activities of the Open Charge Alliance (OCA) are initially presented along with the associated working groups for V2X interfaces and communication mechanisms definition as well as for integration and compliancy testing. As a next step, the focus lies on the International Electrotechnical Commission (IEC) and its current as well as planned activities for the coming years. Accordingly, the standards related to the Distribution System Operator (DSO) activities are presented, as they are very relevant for the charging and discharging scenarios in the V2X ecosystem.

Apart from the activities of the main standardization bodies though, there are further associations where EV4EU is a member and can contribute to. Specifically, the deliverable presents Charging Interface Initiative (CharIn), the association that is responsible for the development of the Combined Charging System (CCS) interface. Then, the BRIDGE initiative contribution is also explained which allows the collaboration with other projects in order to facilitate information, experience, knowledge, and best practice exchange that leads to the development of technical documents, such as whitepapers and technical reports. Such could potentially lead to a contribution towards the standardization bodies.

The envisioned plan of the EV4EU project for the contribution towards the standardization bodies is presented as summary, gathering all the activities of the standardization bodies. The plan that is reflected in this deliverable will serve as a basis for the standardization activity contributions during the EV4EU project.

This deliverable has been prepared by PPC with the participation of: INESC ID (coordinator & WP10 leader), HEDNO and UL.

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Acronyms

CCS	Combined Charging System
CCTS	CCS Test System
CIM	Common Information Model
CEM	Customer Energy Management
CharIN	Charging Interface Initiative
CPO	Charge Point Operator
CS	Charging Station
CSMS	CS Management System
CWG	Compliancy Working Group
DER	Distributed Energy Resources
DRMS	Demand Response Management System
DMS	Distribution Management System
DSO	Distribution System Operator
DUT	Device Under Test
EMS	Energy Management System
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
eMSP	eMobility Managed Service Provider
ESB	Electricity Supply Board
IEC	International and Electrotechnical Commission
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JSON	JavaScript Object Notation
MCS	Megawatt Charging System
OpenADR	Open Automated Demand Response
OCPI	Open Charge Point Interface
OCPP	Open Charge Point Protocol
OCTT	OCPP Compliance Testing Tool
PKI	Public Key Infrastructure
PMU	Phase Measurement Unit
PWG	Promotional Working Group
RES	Renewable Energy Sources
RFC	Request for Contribution
RFID	Radio-Frequency Identification
SCADA	Supervisory Control and Data Acquisition
SOAP	Simple Object Access Protocol
TSO	Transmission System Operator
TWG	Technology Working Group
V2G	Vehicle-to-Grid
V2X	Vehicle-to-Everything
WP	Work Package
WPT	Wireless Power Transfer

1 Introduction

1.1 Scope and Objectives

This deliverable provides the project plan for the dissemination of the project results in the standardization bodies. This dissemination will extend the project's impact and allow to contribute to the development of the standards in order to be compliant with the needs of V2X. An additional profit for EV4EU is the participation of the working groups of standardization bodies and the identification of common needs for the V2X ecosystem at a global level.

1.2 Structure

The current document is divided into seven sections. Section 1 introduces and describes D10.7. Section 2 provides background information on the standards that are applicable for Electric Vehicle (EV) charging and discharging architectures in the V2X ecosystem. Section 3 provides an overview of the relevant activities for the Open Charge Alliance group that standardizes the communication between the Charging Stations (CSs) and the management platform. Section 4 describes the International Electrotechnical Commission activities related to the communication between the CSs and the EVs. Then, Section 5 details the standardization activities of the Distribution System Operator (DSO) and Section 6 explains the further standardization activities that can be part of the EV4EU project. An indicative plan where EV4EU could potentially contribute to is listed in Section 7 and finally, Section 8 presents overall conclusions and considerations about this deliverable.

1.3 Relationship with other deliverables

Deliverable D10.7 describes the plan for the contribution of EV4EU results to standardization organizations. Hence, it receives input from D5.2 “Standardization gap analysis for new V2X related Business Models” [1]. In addition, the plan and initial results of the contribution to standardization bodies that will be carried out within the duration of the project shall also be reported in D10.2 “Plan for the dissemination and exploitation of results including communication activities - Update” and in D10.6 “Exploitation Plan - Update” in June 2024 and June 2025 respectively.

2 Background

One of the main obstacles to V2X is the standardisation of devices and communication protocols. EVs are not always connected to the grid, and if they are, they are not always connected to the same CS. This requirement for consistency creates the need for standardised connectors, standardised infrastructure and a standardised communication platform. Indeed, without common standards across the V2X value chain, access to Vehicle-to-Grid (V2G) services can be limited. And with common standards, harnessing the full potential of EVs delivering ancillary services to the entire power system, local grid, businesses, and buildings is made possible.

The standards currently in use and relevant to the EV4EU project, which will be used for the practical tests within the project, were presented and detailed in deliverable D5.2 [1]. This deliverable presents the international bodies that could standardize the procedures for V2X charging and discharging scenarios. The current activities of these bodies in the field of V2X are discussed and the procedures for adopting existing standards or proposing new ones are presented.

An overview of the standards for charging and discharging infrastructures including the associated entities is provided in Figure 1. The figure includes the entities that are involved in EV communications, such as the Electric Vehicle Supply Equipment (EVSE), Charge Point Operator (CPO), the eMobility Managed Service Provider (eMSP), the DSO and the Clearing House. The EVSE is used to supply electric energy to charge/discharge EVs and includes the equipment (i.e., sockets) necessary to charge an EV. The EVSE can have more than one socket for charging/discharging the EVs. The CPO owns and manages the CSs. The eMSP holds the relationship with the Driver and provides Radio-Frequency Identification (RFID) cards. The DSO is responsible for delivering the electricity load through the distribution network. Finally, the Clearing House offers roaming services. Roaming services allow transaction possibilities with partners throughout the Europe, so that EV drivers have the possibility to charge in the network of partners, but also the drivers of other eMSPs to charge into the charging network.

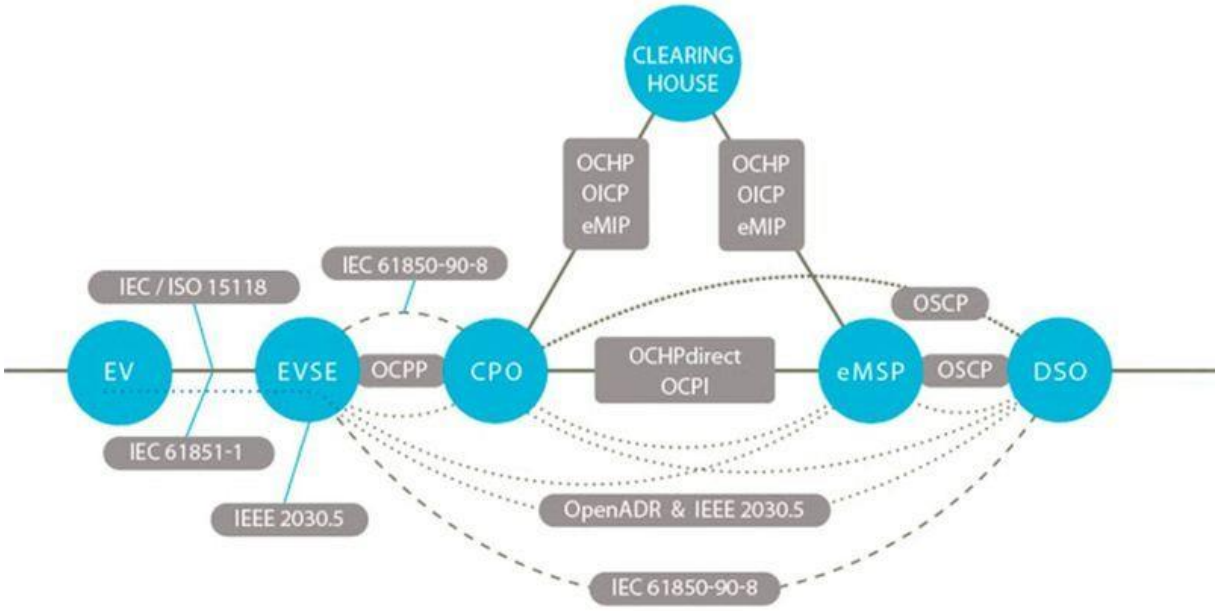

Figure 1 - Entities and standards involved in charging and discharging infrastructures (based on [3])

As depicted by Figure 1, the main organizations leading the efforts for the standardization activities are the Open Charge Alliance (OCA) developing the Open Charge Point Protocol (OCPP) protocol, the Institute of Electrical and Electronic Engineers (IEEE), the International and Electrotechnical Commission (IEC), and the International Organization for Standardization (ISO).

3 Open Charge Alliance activities

The OCA is a global consortium of public and private EV infrastructure leaders. Its mission lies in fostering global development, adoption, and compliance of communication protocols in the EV charging infrastructure and related standards through collaboration, education, testing, and certification. It includes more than 120 participants spanning across all industrial sectors, including charging equipment manufacturers, software and systems providers, CPOs, utilities, DSOs and research organizations. Currently, the OCA board members are: Shell Recharge, ESB (Electricity Supply Board), TotalEnergies, Compleo Charging and ElaadNL. The members are elected democratically every two years. Furthermore, the members represent all OCA participants and are a reflection of the different participant groups of OCA.

The OCA standardization activities are carried out in working groups which are divided as follows:

1) *Technology Working Group (TWG):* This technology group includes the:
    a. *V2X Technology Task Group*, which focuses on the technical development of V2X use cases for the future version of OCPP.
    b. *OCPP & Fueling Stations Task Group*, which investigates how OCPP can be used to integrate CSs within a fueling station infrastructure.
    c. *OCPP Networking Task Group*, which focuses on finding a solution for local communication and for discovering the topology of a local cluster, with a minimal impact on backwards compatibility.
2) *Compliancy Working Group (CWG):* This technology group includes the OCPP Compliance Testing Tool (OCTT) for both the Chargin Station Management System (CSMS) and the CS side.
3) *Promotional Working Group (PWG):* This technology group is consulted for commercial questions.

Based on OCA's principles, task groups work with a limited number of persons on new developments or a specific problem. Additionally, the working groups may also decide to create a dedicated task group. The OCA working groups are also depicted in Figure 2.

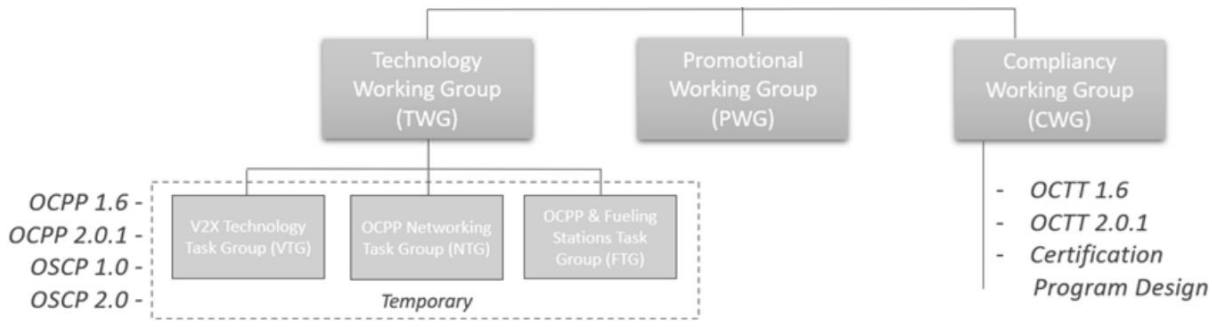

Figure 2 - Open Charge Alliance working groups (based on [24])

From the TWG activities, the only one that is relevant for the EV4EU project is the V2X Technology Task Group that is further described in Section 3.1. Additionally, the CWG activities are relevant for the project and hence are described in Section 3.2. On the other hand, the PWG activities are not research-oriented and hence are not presented further.

3.1 V2X Technology Task Group

The V2X Technology Task Group focuses on the development of the OCPP standard. Currently the version of OCPP that is being developed within the group is 2.1, which is based on the 2.0.1 specification [4] and has the same format. The use cases below are trialed by OCA participants to finalize the draft OCPP 2.1 specifications within the first quarter of 2024:

1) Central V2X control with setpoint → the CSMS determines the setpoint or profile
2) External V2X control with setpoint → an EMS determines the setpoint or profile
3) Central V2X control for frequency support → the CSMS determines the setpoint or profile for charging and/or discharging based on the frequency
4) Local V2X control for frequency support → The power setpoint for frequency support is determined from a power/frequency table, and based on the locally measured frequency
5) Local V2X control for load-balancing → the CS determines when to charge or discharge

Further details about these use-cases are provided in [1]. Additionally, the following use cases are current Work-in-Progress:

- V2H vehicle-to-home → provide power from the EV to the home
- V2L vehicle-to-load → provide power from the EV to a specific load
- Other control functions (besides frequency - power)
- Voltage – power → when the voltage drops, provide power to the grid
- Voltage – reactive power → when the voltage drops, provide reactive power to the grid
- Power - reactive power → at a certain power level, provide reactive power

The current activities also involve the Distributed Energy Resources (DER) Control using OCPP and IEC 61850 [13] (described in Section 4).

The V2X task group contributions are based on fields tests that are leading the incremental improvement of the standard based on the current RFC. This is depicted in Figure 3.

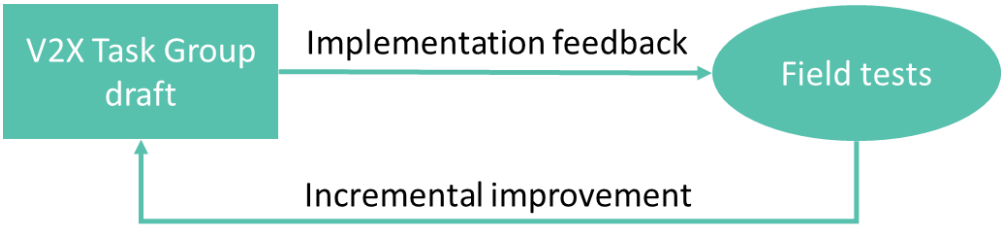

Figure 3 - Lifecycle for V2X task group contributions

OCA has a Workflow Engine where each member has access to document repositories for file sharing as well as discussion boards, calendars, tasks lists, wikis, surveys. Based on all this material, members can contribute to the standardization activities by joining the discussion boards, contributing to the wiki and finally the contributed content will be discussed in weekly teleconferences, in order to be a potential candidate for inclusion in the RFC.

3.2 Compliancy Working Group

OCPP has developed a compliancy OCPP Compliance Testing Tool (OCTT) as a part of the CWG. This tool can be used to self-test OCPP implementations for OCPP version 1.6 compliance. The tool supports both Simple Object Access Protocol (SOAP) and JavaScript Object Notation (JSON) and can be used to test a CSMS and CS. Moreover, it currently covers all the basic OCPP 1.6 Core Profile functions and other OCPP functionalities such as:

- Reservation
- Local Authorization List
- Remote Trigger
- Smart Charging
- Authorization Cache
- Data Transfer
- Diagnostics
- Firmware Management
- Security

Specifically, the profiles that can be tested through the OCTT are described in Figure 4.

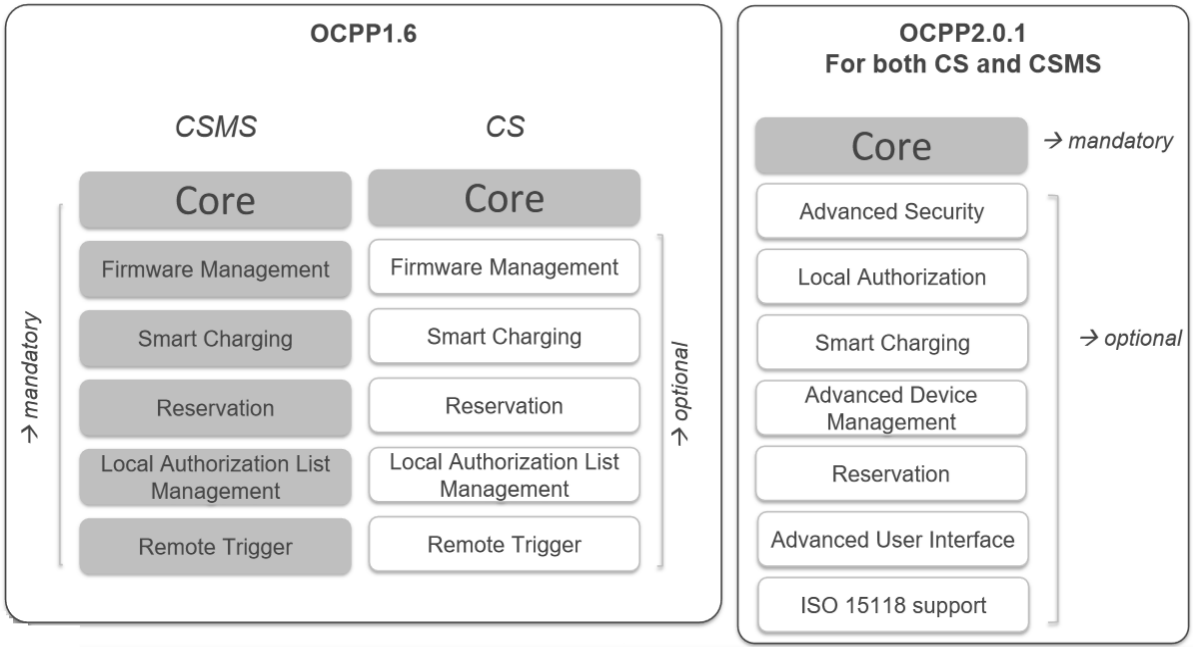

Figure 4 - OCTT main certification profiles (based on [29])

To be certified, a tested Device Under Test (DUT) must successfully pass:

- *Conformance tests*: the DUT is tested against the OCTT. The tool has built-in validations that should not fail during certification tests. With these validations, the Tool verifies whether the DUT has implemented the OCPP specification correctly. The optional features of the OCPP protocol are also covered by the certification, if supported by the DUT.
- *Performance measurements*: a number of performance values of the tested DUT are measured and give an idea how the device behaves in a lab environment. The performance parameters are stated by the vendor in the Protocol Implementation Conformance Statement (PICS) and are verified by a test lab, where the OCTT is deployed.

The OCTT is deployed in PPC R&D facility premises and its operation is described in Figure 5.

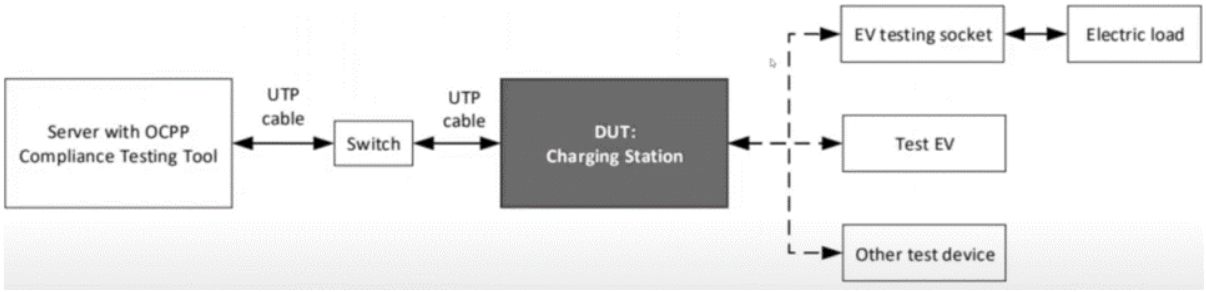

Figure 5 - OCTT testing tool (based on [30])

OCA is currently extending the OCTT in order to include support for OCPP 2.0.1. Contributions from different entities are needed during the development of the tool, as the V2X communication scenarios haven't been tested in real scenarios. Specifically, PICS for OCPP 2.0.1 certification are currently reviewed in the scope of the Compliancy Working Group.

3.3 OCPP Plugfest

Additionally, EV4EU participates in OCPP PlugFests where the OCTT is used in order to test CSs or CSMS systems. The OCPP Plugfest has been initiated in 2019 with the intention of providing CSs and CSMS developers with EV charging space to test out their OCPP implementations. The Plugfest occurs multiple times a year. In 2023 the first OCPP Plugfest happened in March with EV4EU's participation, being part of the Global EV charging Test, which included a symposium on Vehicle-To-Grid (V2G) technologies.

The OCPP Plugfest can be attended both online and in person at the event location, the Elaad Testlab in Arnhem, the Netherlands. In-person attendees have the chance to check out EVs, EMSE, communication controllers and OCPP Testing Tools up close.

4 International Electrotechnical Commission activities

IEC is the world's leading organisation that prepares and publishes international standards in the field of electrical and electronic technologies. In its work, it cooperates with other institutions such as ISO, the International Telecommunication Union (ITU) and the IEEE, to name just a few of the major players in the field of standardisation.

As the electrotechnical field is very broad, the standards issued by the IEC cover a wide range of technologies, from power generation, transmission and distribution to devices and equipment, but especially technologies related to the EVs.

Table 1 lists the standards related to V2X that the IEC is currently working on along with their brief description, advantages, and disadvantages, as they are presented in [5].

Table 1 - V2X related IEC standards

Standard	Description	Protocols
ISO/IEC 15118-1: 2018	Describes the communication interface between vehicle and power grid and contains general information and definitions of use cases. It enables secure and efficient communication between the EVs and the charging infrastructure. It is limited by lack of standardised communication protocols.	ISO/IEC 15118
ISO/IEC 15118-2: 2020	Describes the communication interface between the vehicle and the power grid and the requirements for the application protocol. It enables secure and efficient communication between the EVs and the charging infrastructure. Poor interoperability between different charging infrastructures is an obstacle.	ISO/IEC 15118
ISO/IEC 15118-3: 2020	Describes the communication interface between the vehicle and the power grid and defines the requirements for the physical and data transmission layers. It enables secure and efficient communication between the EVs and the charging infrastructure. Poor interoperability between different charging infrastructures is an obstacle.	ISO/IEC 15118
IEC/TR 61851-23: 2019	Describes communication protocol between the EVs and DC CSs. Enables efficient and safe charging of electric vehicles with DC, but is limited by the lack of standardised protocols.	ISO/IEC 15118, IEC 61850, IEC 61851
IEC 63151: 2019	General requirements and procedures for wireless power transfer systems for EVs. Even though it enables efficient and safe charging of electric vehicles, there is a lack of specific requirements for different types of vehicles.	Wireless power transfer
IEC/TR 63069: 2020	It defines the communication between the EVs and the CSs, the bidirectional flow of electricity between them and enables V2G services. It enables secure and efficient communication between electric vehicles and the charging infrastructure. It is limited by the lack of standardised communication protocols.	ISO/IEC 15118, IEC 61850, IEC 61851, and others
IEC 63192-1: 2020	It establishes the general requirements and procedures for Wireless Power Transfer (WPT) systems for EVs. Enables efficient and safe charging of EVs without physical connections. Lack of interoperability between different WPT systems.	Wireless power transfer

IEC 63192-2: 2020	It sets out the specific requirements for WPT systems for light-duty vehicles. Enables efficient and safe charging of EVs without physical connections. Lack of interoperability between different WPT systems.	Wireless power transfer

The standards listed in Table 1 enable the exchange of messages about electric vehicle charging, CS availability, prices, network status, etc. More detailed descriptions of the standards relevant to the EV4EU project can be found in Deliverable D5.2 [1].

The adoption of the standards listed here, except for IEC/TR 61851-23:2019 and IEC 63151:2019, is still limited and under development to be better tailored to real situations. In addition, new standards can be proposed to the IEC. The preparation of a new IEC standard takes place in the following main phases [6]:

1. *Preliminary phase*: The preparatory phase includes projects that are planned but are not yet ready for immediate development. In this phase, a proposal for a new work topic can be developed and a first draft can be developed.
2. *Proposal (NP):* A proposal for a new work item usually arises from a specific need of a stakeholder group in one or more countries. It is brought to the attention of the relevant IEC Technical Committee/Subcommittee (TC / SC) via a National Committee (NC) using a special form. Proposals are made for a new standard, a new part of an existing standard or a technical specification.
3. *Preparatory phase (WD)*: The IEC forms a technical committee or subcommittee to prepare a draft of the proposed standard. The committee includes experts from relevant industries and other stakeholders.
4. *Committee drafting phase (CD):* The committee prepares a draft standard that is circulated to national committees and other interested parties for review and comment.
5. *Enquiry stage (CDV):* This is the final stage where technical comments on an International Standard can be considered. The committee reviews the comments and produces a revised draft standard, which is submitted to the IEC member organisations for a formal vote.
6. *Approval stage*: If the draft standard receives enough votes, it is approved as an International Standard.
7. *Publication*: The approved standard is published by the IEC and made available for purchase.

To the phases listed above we can add another one that is of interest to EV4EU, namely implementation. Once a standard is published, it can be used by organisations and industry as a guide for the development of products and services. And one of the outcomes of the project, one of the goals, is the widespread implementation of standards based on the practical tests carried out in this project.

Despite the existing standards, several initiatives are in development. Based on the description presented in [7] the standards that will be published by IEC in the next years are presented in Table 2.

Table 2 - V2X related IEC standards – Future Publication (based on [7])

Standard	Replacement for	Advantages (selected features)	Expected timing	
			Publication	Implementation
ISO/IEC 15118-20:2022 [8]	IEC 61851 (as only communication method) or ISO 15118-2.	• Improved – Charging experience; – Smart charging services; – Grid services; – Cybersecurity. • Bidirectional power flow for – More renewable energy uptake – Grid stability; • Grid code support features.	Published in 2022	2023/2024
IEC 63110 [22]	OCPP or proprietary protocols	• De jure standard; • Support for bidirectional power flow; • Fast frequency response services.	2025	2026
IEC 63119 [23]	OCPI or proprietary protocols	• De jure standard; • Alignment with other EV-related IEC standards	2026	2027
EN 50491-12 [9]	Proprietary protocols	• Integration of EV into Energy Management Systems (EMS); • Large-scale smart charging; • Improved interoperability countering proprietary solutions.	EN 50491-12-2 published in 2022	Through IEC 63110
IEC 63402 [21]	Proprietary protocols	• International version of EN 50491-12.	2024	Through IEC 63110

IEC 63119 is another critical standard for ensuring the proper functioning of a smart EV charging ecosystem. Its primary objective is to establish an internationally harmonized and secure method for payment services and roaming. This allows charging service contracts to remain valid across borders and CS operators. E-mobility roaming hubs ensure that relevant information is exchanged between all actors involved in the charging process. Standardized communication between all parties is necessary to ensure a seamless charging experience for EV drivers. For instance, since EV drivers receive electricity from CSOs but pay for the charging service to eMSPs, it is crucial that providers and operators trust and connect with each other to enable drivers to charge their vehicles at multiple locations internationally. Ultimately, the goal is to enable all EV drivers to charge their vehicles at any charging location. IEC 63119 is still in the early drafting phase. Currently, charging services are often managed through the Open Charge Point Interface (OCPI), which is an open-source protocol that enables eMSPs to communicate with CSOs. This communication can cover aspects such as authorization, charging details, and electricity prices.

The standards mentioned above are essential for public EVSEs. In such cases, smart charging is managed through the building's Energy Management System (EMS) that coordinates energy demand and supply within the building and ensures that energy is used at the most optimal moment. The European standard EN 50491-12, also known as the Customer Energy Management (CEM) standard, enables seamless integration of EVs into the EMS, allowing for interoperability of electrical devices and energy management systems developed by different manufacturers. The CEM standard represents various categories of energy flexibility, simplifying the implementation of energy management systems and reducing costs for consumers. After being published as a European standard, the CEM standard is currently being discussed at the international level and may become the international standard IEC 63402 by 2024.

Based in the IEC initiatives, it is possible to foresee the future of EV ecosystem in terms of communications, as presented in Figure 6.

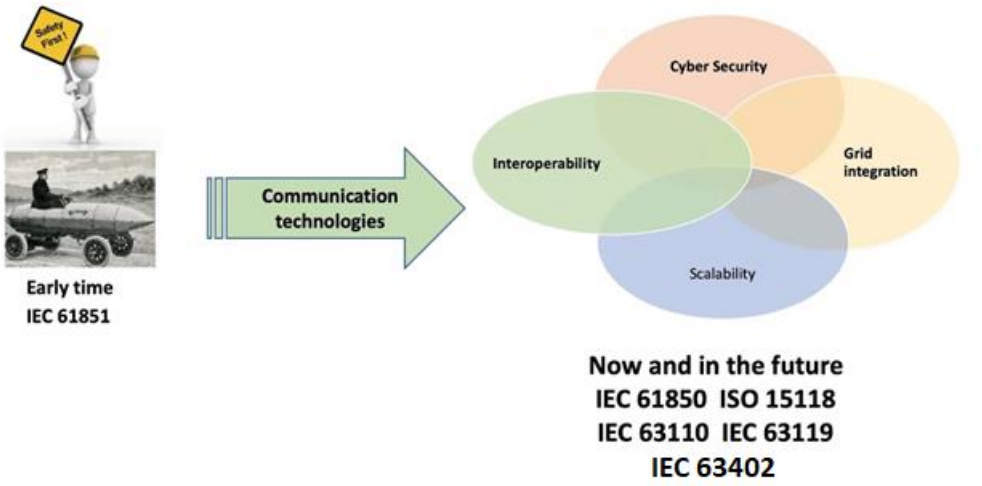

Figure 6 – IEC standards overview (based on [25])

5 DSO standardization activities

The distribution of the energy for charging and discharging scenarios in the V2X ecosystem also involves the DSO operators using different systems that are also based on distribution network standards and associated activities. An overview of these standards is provided in Figure 7.

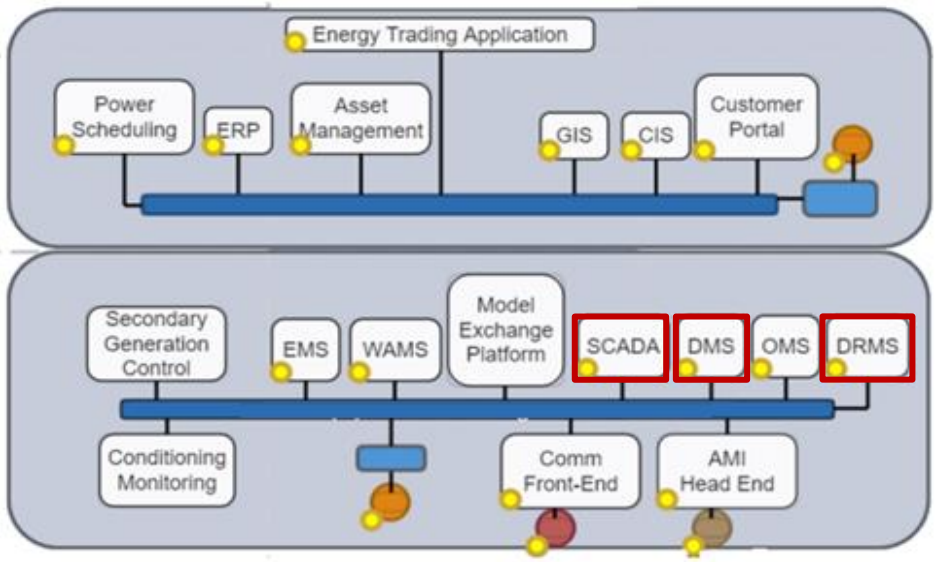

Figure 7 – DSO standardization activities overview (based on [26])

Even though many standardization bodies are listed in this figure, this section focuses only on the activities that are relevant for the project and cover the DSO activities in the V2X ecosystem.

5.1 Supervisory Control and Data Acquisition systems

The Supervisory Control and Data Acquisition (SCADA) systems utilize IEC 60870–5 [11] and IEC 60870–6 [12] standards. Distribution Network measurements obtained from DSO's SCADA system are employed in all use cases and are communicated to other systems, devices, and tools (such as the DSO Data Server) following the guidelines outlined in these standards. Measurements obtained from DSO's SCADA systems will be utilized to provide the required information to a state estimation tool. This tool aims to achieve a reasonably accurate representation of the distribution network's state. Additionally, the measurements will be supplemented with data from Phase Measurement Unit (PMU) devices, which will also contribute to the state estimation tool.

5.2 Demand Response Management Systems

A typical Demand Response Management System (DRMS) is built upon a foundation of industry standards that ensure interoperability, reliability, and efficiency. Several key standards are commonly employed in DRMS implementations. One such standard is IEC 61850 [13], which provides a comprehensive framework for power utility automation. It enables seamless communication and integration between various components of the power system, including demand response resources. Open Automated Demand Response (OpenADR) [14] is another important standard that facilitates the exchange of demand response signals and data between utilities and end-users. It defines a common language and protocol for enabling automated demand response interactions.

The IEEE 1547 [15] focuses on the interconnection of DERs with electric power systems, ensuring safe and reliable integration of these resources. IEEE P2030 [16] and IEEE P2030.4 [17] provide guidelines and frameworks for smart grid interoperability, enabling the integration of energy technologies and information technology with the electric power system. Lastly, IEEE P1815.1 [18] standardizes the exchange of information between networks implementing IEC 61850 and IEEE 1815, facilitating seamless communication between different network protocols within the distribution network. These standards collectively form the backbone of a DRMS, ensuring compatibility, interoperability, and efficient management of demand response resources within the power system.

5.3 Distribution Management Systems

The focus of the discussion on managing electrical networks revolves around the Common Information Model (CIM), which is an application-level ecosystem. At its core, the CIM encompasses the IEC 61970 [19] and IEC 61968 [20] standards. IEC 61968 is a developing standard suite that establishes interfaces for key components of a Distribution Management System's (DMS) interface architecture. As an integral part of the CIM, it defines various packages and objects specific to the demonstration use-cases of the DMS. Within the Customer package, objects such as pricing structures and tariffs hold significance as they provide signals that Renewable Energy Sources (RES) and their Aggregators consider when maximizing their profits from resource exploitation. IEC 61968 can facilitate the exchange of information on electricity pricing, given the presence of Aggregators operating in a functional wholesale market and actual billing practices.

IEC 61968 and IEC 61970 aim to achieve several key objectives. Firstly, they facilitate the integration of applications developed by different suppliers within the control center environment. This integration ensures that various software systems can seamlessly work together, enhancing operational efficiency. Secondly, these standards enable the exchange of information with external systems, including transmission, distribution, and generation systems located outside the control center. This real-time data exchange ensures effective communication and coordination between different entities involved in the power system. Lastly, IEC 61968 and IEC 61970 provide suitable interfaces to facilitate data exchange between legacy systems and new systems. This compatibility ensures smooth transition and interoperability between existing infrastructure and modernized systems, avoiding any disruption in data management and control operations.

Regarding Energy Management Systems (EMS) and IEC 61970, the scope extends beyond network tariffs to encompass the collaboration between customer-driven cost flexibility and additional energy-based flexibility offered by proprietary resources controlled directly by a DSO.

6 Further standardization activities

Apart from OCA and the IEC standardization bodies, there are further activities where EV4EU can contribute to. These activities are related to the Combined Charging System (CCS) where the CharIN association is involved in the standardization activities (Section 6.1) and the BRIDGE initiative for the information exchange between EU funded projects (Section 6.2).

6.1 Charging Interface Initiative

The EV4EU project is also a member of the Charging Interface Initiative e. V. (CharIN) activities. CharIN has over 300 members dedicated to promoting interoperability based on CCS as the global standard for charging vehicles of all kinds.

Within CharIN, a multitude of international technical experts work together in focus groups on advanced subjects around e-mobility and charging. Under the CharIN umbrella, cross-industry stakeholders like automakers, CS manufacturers, component suppliers, energy providers, grid operators, and many others continue moving towards interoperable charging, where vehicles, chargers, and software systems work together to make the user experience reliable, easy and smooth. CharIN is a non-profit organization and open to any company worldwide being involved in the business around e-mobility.

The CharIN association is comprised of two types of members: Core Members and Regular Members.

1) *Core Members* are particularly closely involved in global activities relating to the CCS and have a set of rights and duties within the association's framework. All the founding members are automatically Core Members, but any member can become a Core Member if they fulfil certain criteria.
2) *Regular Members*, as the name implies, are those who are not Core Members. They may be people or companies in relevant organizations, such as automotive component suppliers, power utilities, public authorities, IT and communications, non-profit organizations etc. They support the rollout of the CCS and participate in one or more working groups together with the Core Members.

The target of CharIN is to continuously and competently advance the combined charging system (CCS), with the aim to establish this system as the leading standard for charging battery-powered electric vehicles. CCS combines the advantages of existing charging systems into one single solution that can handle any charging scenario. There are five groups focused in the development of the CharIN standard, called CharIN Focus Groups. They also include specialized subgroups and task forces concentrating only on one defined topic. Focus Groups develop industry-aligned position papers as well as recommendations for industries as a worldwide baseline for standardization. The five focus groups of CharIN are as follows:

1) Charging Infrastructure
    a. Harmonization of the ramp-up of CCS charging infrastructure and the involved charging process based on the market needs: removing market entry barriers for EV owners, charge point operators and manufacturers.
    b. Product Lifecycle Management perspective on CCS.
2) Charging Connection
    a. Harmonize and discuss future developments of Combo coupler for AC and DC charging according to IEC61851 / IEC 62196 / SAE 1772 as a part of the CCS Clamp and synchronize charging technologies for the CCS system as a common CCS development roadmap.
    b. Develop synchronized recommendations in alignment with the CCS step model for standardization parties.

3) Charging Communication
    a. Support of development, specification and test of charging communication.
    b. Close gaps and provide recommendations for communication protocols of the EV charging system.
4) Grid Integration
    a. Identification of technical issues.
    b. Harmonization of approaches between the involved industries.
    c. Evaluation of technical and economical potentials.
    d. Definition of consolidated statements and requirements for grid integration with the end user 's view in mind.
5) Conformance Test / Interoperability
    a. Agree on requirements for CharIN CCS Test System (CCTS).
    b. Define processes on how to qualify CCTS, agile IOP, test houses, EV and EVSE based on the different compliance levels and profiles.
    c. Interoperability of customer use cases beyond scope of CCTS (e.g. authentication sequence).
    d. Maintenance of CCTS Specification (hardware, software, Test Cases).
    e. Definition of a vendor neutral CCTS specification which is compliant with CharIN.

The projects in which CharIN is currently involved are as follows:

a. *Megawatt Charging System (MCS):* Batteries with larger capacities need to be taken in consideration. To charge those large capacity batteries in comparable times as today available or even faster, the charging power needs to be increased. Besides the charging voltage also the charging current needs to be increased to boost the charging power. The larger charging current leads to: (i) larger conductor cross sections for the cable assembly according to existing standards, or (ii) additional measures in the cable assembly; both still allow for manual charging by the customer/ driver without the help of a supporting machine or robot. Therefore, to tackle the above, CharIN is developing the MCS. To satisfy the market demand CharIN helps the industry create a common solution for charging their electric heavy-duty vehicles (e.g., Truck, Bus, Marine and Air vessels) within a reasonable time. Applications as maritime and air vessels may use this charging system to fulfil their needs. High Power Charging is the key to increase the acceptance of e-mobility also in this area. CharIN launched the Megawatt Charging System at Testival & Conference NORTH AMERICA 2022[2]. For the first time in its history, CharIN brought together a dozen medium- and heavy-duty vehicles for an interoperability testing event at DTNA Electric Island in Portland, Oregon giving a strong signal for the expansion of electrification into other duty-cycles. It will help meet climate and sustainability goals and offer maximized customer flexibility. Besides several further topics and activities, during the last three years, a special Task Force has been extending the scope to Commercial Vehicles and thus, setting requirements and standards for the development of the MCS. In the close future, the MCS shall also be used to charge other heavy-duty vehicles like e-ferries, ships, and planes.

b) *Plug & Charge feature:* In order to enhance the customer experience for uncomplicated charging via CCS, the feature Plug & Charge has been developed. Plug & Charge allows automated communication and billing processes between the EV and the CS without any need of external identification (e.g. RFID cards, Debit/credit cards or charging apps) while ensuring high IT security at the same time. The necessary interfaces have been defined in the ISO standard 15118. The goal of the project "Plug & Charge Europe" is to set up a Public Key

[2] https://www.charin.global/events/testival-conference-north-america-2022/

Infrastructure (PKI), a technology needed to enable secure authentication and authorization via Plug & Charge in accordance to ISO 15118, with CharIN as operator and provider of required services. CharIN, as a neutral and international authority, shall ensure fairness as well as openness and guarantees a level playing field for operating the PKI across all stakeholders. Thus, "Plug & Charge Europe" shall successfully overcome previous hurdles in the implementation. The team currently consists of 15 active members, namely BMW AG, BP, ElaadNL, EDF, EnBW, Groupe Renault, IBIL, Ingeteam, Innogy eMobility Solutions, Porsche AG, Shell Global Solutions Deutschland GmbH, Stellantis, Total, Tritium and Volkswagen AG, and additional supporters. With the aim of a Europe-wide rollout, further international automotive companies, charge point operators, technology and mobility service providers are expected to join or support the project.

c) *CCS*: CCS is extensively based on the international standard ISO/IEC 15118. The global interoperability based on CCS and MCS will create economy of scale and healthy competition at the same time. In the long run, our targets can be achieved using CCS as common connector, and ISO 15118 as communication standard enabling all different use cases. CharIN promotes the awareness that a consistent charging standard is needed globally. They are developing specifications for Interoperability testing, certification, and auditing of charging related processes that can be adopted worldwide. As a result, complexity and costs will be reduced, and the user experience can be significantly improved.

6.2 Impact creation through the BRIDGE initiative

The EV4EU project has recently joined the BRIDGE initiative. The BRIDGE initiative includes Horizon 2020 and Horizon Europe Smart Grid, Energy Storage, Islands, and Digitalization Projects aiming the continuous exchange of information, experience, knowledge, and best practices among the participating projects in order to overcome barriers and to achieve innovation. Currently, it has 90 projects (58 ongoing). The initiative includes four working groups:

1) *Regulation*, which includes the following activities:
    a. Energy storage, the regulatory framework needs to provide clear rules and responsibilities concerning ownership, competition, technical modalities and financial conditions, for island and mainland cases.
    b. In terms of smart grids, regulatory challenges arise regarding the incentives for demand-side response, commercial arrangements, cooperation with Transmission System Operator (TSO) and DSO, smart meter date, etc.
2) *Data management*, which includes the following activities:
    a. Communication Infrastructure, embracing the technical and non-technical aspects of the communication infrastructure needed to exchange data and the related requirements, including issues faced by TSO and DSO.
    b. Cybersecurity and Data Privacy, entailing data integrity, customer privacy and protection.
    c. Data Handling, including the framework for data exchange and related roles and responsibilities, together with the technical issues supporting the exchange of data in a secure and interoperable manner, and the data analytics techniques for data processing.
3) *Consumer and citizen engagement*, which includes the following activities:
    a. Consumer Segmentation, analysis of cultural, geographical and social dimensions.
    b. Value systems – Understanding Customers.
    c. Drivers for Consumer and Citizen Engagement.
    d. Effectiveness of Engagement Activities.
    e. Identification of what triggers behavioral changes (e.g., via incentives).

f. The Regulatory Innovation to Empower Consumers.

4) *Business models*, which includes the following activities:
   a. Defining common language and frameworks around business model description and valuation.
   b. Identifying and evaluating existing and new or innovative business models from the project demonstrations or use cases.
   c. The development of a simulation tool allowing for the comparison of the profitability of different business models applicable to smart grids and energy storage solutions is being developed and tested by the Working Group members.

Additionally, it publishes frequently case-study reports related to Battery Energy Storage Systems, TSO-DSO cooperation and Energy Communities. An overview of the BRIDGE project list as of 2021 is illustrated in Figure 8.

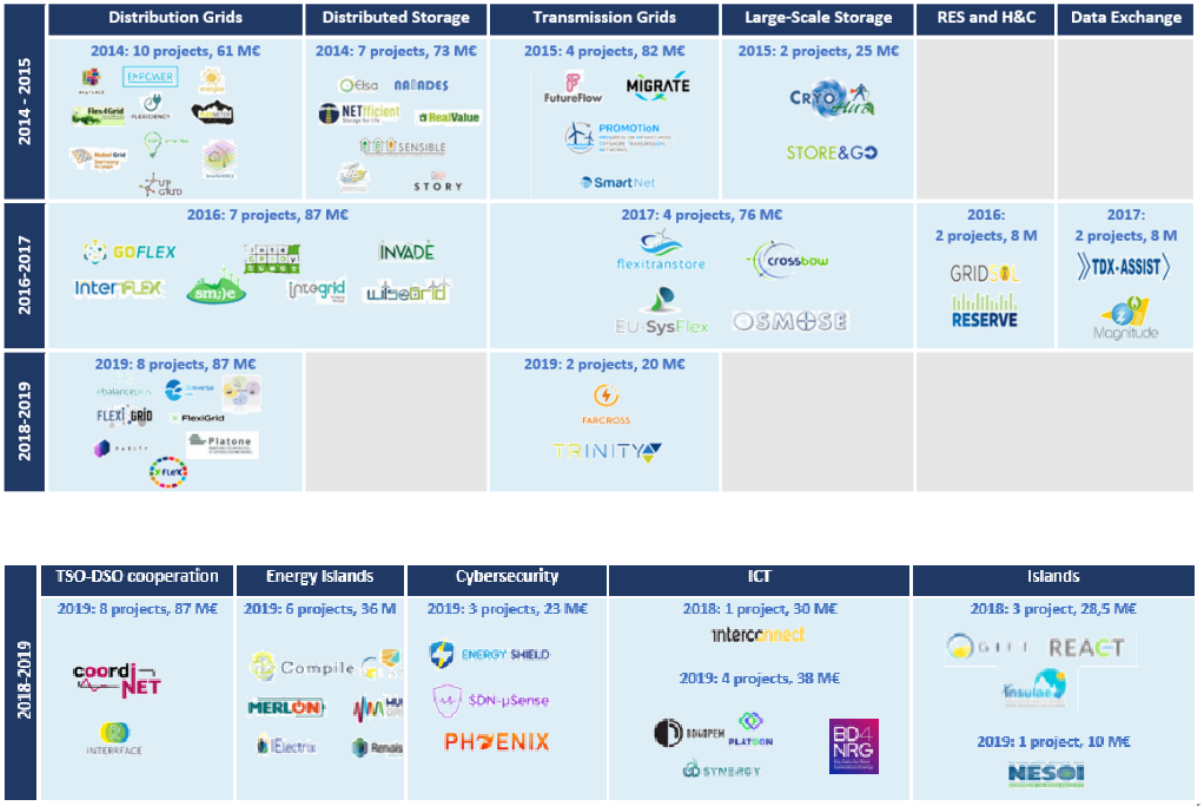

Figure 8 – List of BRIDGE projects as of 2021 (based on [5])

7 Contribution plan

In the previous sections an overview of the standardization bodies that are involved in the V2X ecosystem for charging and discharging scenarios was presented. The relevance of these entities to the EV4EU project was introduced, together with potential contributions of the project. In this section, we summarize the potential contributions, in order to derive the project's contribution plan. Hence, the proposed plan is summarized in Table 3:

Table 3 – EV4EU standardization activities contribution plan

Standardization entity	Planned contribution	Provisioned timing
OCA	1) Contribution to V2X Task Group activities including the OCPP 2.0 development and tests 2) Integration testing of OCTT tool for OCPP 2.0 3) Revision of Certification Documents for OCPP 2.1 certification	1) March 2024 for OCPP 2.1 contribution 2) October 2023 for OCTT tool testing March 2024 3) Ongoing contribution for the revision of the OCPP 2.1 certification documents
IEC	1) Contribution for the integration of IEC 61850 with OCPP 2) Contribution to the discussions on the IEC 63110 integration with OCPP	1) February 2024 for integration of IEC 61850 with OCPP 2) Ongoing contribution for the IEC 63110 and OCPP integration
CharIN	Contribution to the focus groups	Ongoing contribution
BRIDGE	Contribution to the use-case reports	January 2025 (using the available results from the execution of the BUCs)

The table above provides the list of contributions that EV4EU can do in different standardization entities. Nevertheless, a more detailed plan and a contribution Gantt chart will be developed as soon as the EV4EU project BUCs will evolve and experimental results will be available. Based on the current EV4EU project and demonstration plan, all the provisioned BUCs in D1.5 [27] will be able to provide contributions for the activities of Table 3.

8 Conclusions

This deliverable provides an overview of the project plan for the dissemination of the project results in the standardisation bodies. First, it provides a background on the protocols and standards that are involved between the different entities in the V2X ecosystem. Then, it analyses the OCA activities and its working groups for the development of the communication interfaces and commands for the V2X ecosystem. Additionally, the IEC activities are presented in terms of the existing and upcoming standards. Moreover, an overview of the DSO standardization activities is provided and the ones that are relevant for the use cases and scenarios of the EV4EU project are further detailed. Further standardization activities related to charging/discharging associations such as CharIN, and relevant initiatives such as BRIDGE, are detailed in terms of their working groups and ongoing activities. Finally, a summary for all the listed activities is presented in terms of a contribution plan for the EV4EU project.

As the EV4EU project is still at its initial stage, the presented plan gathers the activities that are currently relevant. However, as the project advances and the developments and tests produce experimental results, the contribution plan might be affected. Hence, a more detailed contribution overview will follow at a later stage with concrete contributions to standardization bodies and activities, which will be reported in D10.2 “Plan for the dissemination and exploitation of results including communication activities - Update” and in D10.6 “Exploitation Plan - Update” in June 2024 and June 2025 respectively.

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