Deliverable 7.2

Standardization issues and needs for standardization and interoperability

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Table of Contents

List of Figures

List of Tables

List of Abbreviations

A	ampere
AC	Alternating Current
ACEA	European Automobile Manufacturers Association
AMI	Advanced Metering Infrastructure
ANSI	American National Standards Institute
BCU	Battery Control Unit
BDSG	Bundesdatenschutzgesetz
BE	Back End
BMS	Battery Management System
B2B	Business to Business
CA	Consortium Agreement
CAN	Controller Area Network
CCS	Combined Charging System
CD	Committee Draft
CDR	Charge Detail Record
CEE	Certification of Electrotechnical Equipment
CHAdeMO	CHArge de MOve
CIP	Critical Infrastructure Protection
CLEPA	European Association of Automotive Suppliers
COSEM	Companion Specification for Energy Metering

CP	Charging Point
D	Deliverable
DC	Direct Current
DCR	Database Change Request
DER	Distributed Energy Recourse
DKE	Deutsche Kommission Elektrotechnik
DLMS	Device Language Message Specification
DoW	Description of Work (Annex I of Grant Agreement)
DSO	Distribution System Operator
ELV	Extra-Low Voltage
EMC	Electro Magnetic Compatibility
eMi3	eMobility ICT Interoperability Innovation
E-Mobility	Electro Mobility
ENTSO-E	European Network of Transmission System Operators for Electricity
EPS	Electric Power System
ESF	External Stakeholder Forum
ESO	European Standards Organization
EURELECTRIC	Union of the Electricity Industry
EV	Electric Vehicle
EVCOID	Electric Vehicle COntract IDentification
EVSE	Electric Vehicle Supply Equipment
EVSEID	Electric Vehicle Supply Equipment ID
EVSP	27 Electric Vehicle Service Provider
FPF	Forward Power Flow
GeM	Green eMotion
HAN	Home-Area Network
HEMS	Home Energy Management System
HV	High Voltage
Hz	hertz
ICT	Information and Communication Technology
ID	IDentification
IEC	International Electrotechnical Commission
IECEE	International Commission on the Rules for the Approval of Electrical Equipment
IREC	Institut de Recerca en Energia de Catalunya
ISM	Industrial, Scientific and Medical
ITS	Intelligent Transport Systems
JMS	Java Message Service
kVA	kilovoltampere
kW	kilowatt
LBC	Load Balancing Controller
LEV	Light Electric Vehicles
Li	Lithium
LV	Low Voltage
MHz	Megahertz
MP	Market Place
MV	Medium Voltage
NEC	National Electrical Code
NFPA	National Fire Protection Association
NPE	National Platform for Electric Mobility - Germany
NTA	Nederlands Technische Afspraak
NWIP	New Work Item Proposal

OEM	Original Equipment Manufacturer
OCHP	Open Clearing House Protocol
OCPP	Open Charge Point Protocol
PCD	Proximity Coupling Device
PFCV	Plug-in Fuel Cell Vehicles
PHEV	Plug-in Hybrid Electric Vehicle
PICC	Proximity Integrated Circuit Card
PLC	Power Line Communication
PoD	Point of Delivery
PODID	Point of Delivery IDentification
PWM	Pulse Width Modulation
RCCB	Residual Current Circuit Breaker
RESS	Rechargeable Energy Storage system
REST	Representational State Transfer
RFP	Reverse Power Flow
RFID	Radio Frequency IDentification
SAE	Society of Automotive Engineers
SCADA	Supervisory Control And Data Acquisition
SDM	Supply Demand Management
SDR	Service Detail Record
SEP	Smart Energy Profile
SG	Smart Grid
SOAP	Simple Object Access Protocol
SoC	State of Charge
T	Task
TOA	Time Of Arrival
TOD	Time Of Departure
TOR	Technical and Organisational Regulations
V	volt
VDE	Verband Der Elektrotechnik
V2G	Vehicle to Grid
V2H	Vehicle to Home
WG	Working Group
WP	Work Package
XML	Extensible Markup Language

1 Executive Summary

The harmonization of technology and standards is an essential issue for the mass rollout of EV and PHEV across the EU. After the first step in WP7 resulting in D7.1: "Review of Technologies and Standards in the Demonstration Projects"[1], a crucial next step and task of this harmonization (as aimed at in Task 7.2 of the Green eMotion Project) is monitoring and managing the collection of standardization issues and needs as emerged during the different development phases of the demonstration projects as well as the evolution of standards and standardization activities. This deliverable is the output of the third phase of this task, based on the third standardisation survey.

As originally defined the actual work comprises several surveys that contain a number of questions for collecting standardization issues and needs. The first survey addressed four different technological areas, being:

- Electric Vehicle,
- Charging Point,
- Connection to the Grid,
- Communication.

The second survey was done in order to gain more insight and details on technological areas:

- AC and DC Charging,
- Identification,
- Communication,
- Smart charging.

To be able to identify future trends, the third and last survey contains questions related to:

- the situation in 2011 when Green eMotion started, the current status in 2014,
- the expected trends and issues in the upcoming years, till 2020, and
- advice and input for guidelines for standardization and interoperability

The sections below summarize the outcome and conclusions of these standardization surveys.

1.1 Electric Vehicle

In the Electric Vehicle area several standards are available and applied, this area seems relatively developed and mature due to the urgent need for a standard and solutions. This does not mean that there are no issues anymore, but most became smaller. Several overlaps were identified in the used standards related with plugs and connectors in the car side. Different modes of charging and different type of connectors are still in use. Step by step the physical issues are fading away due to the use of IEC 62196 and the EU directive going for connectors of Type 2 for AC and Type Combo 2 for DC. But the communication standards towards EV are gaining more importance now (see 1.4).

1.2 Charging Point

In the standards used on charging points several overlaps and non-homogeneities have been identified, for charging modes as well for socket outlets. To achieve European interoperability the used and use of EV standards needs to be improved. This is in line with other top issues mentioned like a Pan-European charging standard is required and too many standards are proposed, e.g. for AC and DC charging. Important standards are IEC 61851 and more recently also ISO/IEC 15118 is being adopted, but these are still used partly and in different ways.

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[1] http://www.greenemotion-project.eu/dissemination/deliverables-standards.php

The Union of the Electricity Industry (EURELECTRIC), the European Association of Automotive Suppliers (CLEPA) and the European Automobile Manufacturers Association (ACEA) have agreed on the Combo Type 2 (Combo2) inlet/connector for electric vehicles, to use in the Combined Charging System (CCS).

This is in line with the more recent EU directive in this area: "Directive of the European Parliament and of the Council on the deployment of alternative fuels infrastructure" towards IEC 62196 Type 2 and Type "Combo 2".

According to the comments from the surveyed, currently, the existing volume of DC charging cars are based on CHAdeMO, but the market has now both CCS and CHAdeMO cars available in Europe. However, in general, the preference is CCS as a standard, as it serves both AC and DC, and follows the EU directive. Additionally, the surveyed propose to use the CCS Combined Charging system with Type 2 connector (Combo2)[2].

1.3 AC/DC Charging

Regarding the Fast DC charging Systems, some of the most important organisations in the European automotive sector have agreed on a harmonised plug system for electric vehicles in order to avoid the situation for AC charging (different technological solutions), with a standardization that adds DC wires to the existing AC connector types, such that there is only one "global envelope" that fits all DC charging stations. This has led to the CCS and Combo2 standard mentioned above.

For the installation of DC charging points in petrol stations some general National/European regulations apply but there is a need to define procedures and specific regulations regarding fast charging installation not only DC but also AC.

Inductive charging is considered as an emerging technology that might integrate the traditional conductive charging method but, at the moment, it suffers from a lack of standards even if besides some national technical documents, standardisation work is in progress at SAE and IEC level.

1.4 Identification / Communication

Since the communication area is the area which seems most open, in the second survey identification and communication were key areas for investigation. This brought several new recommendations.
First the recommendations in the physical layer/domain: EV, EVSE, EV user:

- In the identification area, because of short term requirements, a first choice is required. Identifiers, as now defined in ISO/IEC 15118, and the NWIP IEC 62831 "User identification in Electric vehicle Service Equipment using a smartcard" are currently the best starting points.
- With respect to communication between EVSE and EV via Power Line or PWM communication in this area IEC 61851 is the standard and ISO/IEC 15118 is likely to play an important role in the near future.

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[2] In Europe, the infrastructure is predominantly 3-phase, and the Combined Charging System builds on the existing Type 2 charge socket (IEC 62196-2). Two pins have been incorporated in the Type 2 plug to create the IEC 62196-3 Combo 2 plug for high-performance DC charging. On the other hand, in U.S. the existing charge socket (SAE J-1772™), designed to accommodate the 1-phase power supply, has been extended by two pins for high-performance DC charging.
So, "Combined Charging System" is not the same that "Combo2". That is correct just for Europe. However, as the Green eMotion project framework is the European countries, in this deliverable, the equivalence between CCS and Combo2 is proposed, in order to make easier the reading of the document.

- For EVSE to back-end communication GPRS or 3G is mostly used. For the protocol used, currently standardization work is ongoing in eMI3 working group 5 on backend communication protocols. They base themselves on protocols from DSOs, EV infrastructure and service providers and OCA (open charge allicance). They also are including enhancements derived from use cases from sources like ISO/IEC 15118.

With respect to communication to EVSP/Marketplace and between other backend systems (Clearing House, EV Power and Charge Management Systems)

- For other communication links there is not yet a clear need for standardization, these require more study. These will also be influenced by Smart Grid standards, further some surveyed mention that the need for a standard for the communication with the Clearing House becomes more important now. There are some Clearing House protocols available but also the interface with the Marketplace can be used in such a standard development.
- There is a need for overall communication architecture, it is recommended to start with defining that. This is taken up by eMI3 in their workgroup Architecture and Interfaces.
- More attention is also required on security and privacy for example by means of encryption.

1.5 Connection to the grid and Smart charging

Questions in the surveys on smart charging are on the combination of user friendly, grid friendly, battery friendly and energy friendly charging. Most of the respondents have indicated ISO/IEC 15118 as one of the standard available for smart charging with focus on bidirectional management. A general suggestion on smart charging proposes not to focus on it initially during the market introduction until 2014, but to focus on interoperability in combination with the eMI3 architecture and also containing Clearing Houses.

Besides some different types of smart charging, the survey has emerged the strong need to make use of the advantages of smart charging but it has to be clarified in which way they shall be used.

V2G is seen as a long-term option that does not economically make sense until EVs come to the market in millions. Efforts to get an overview of such topics are underway at IEC level. The suggestion is to refer also to their results. In the meantime, V2H is a good option to follow up, and standardisation and experimentation effort in the V2G/V2H areas are very welcome.

1.6 Future trends in eMobility and advices for standardisation guidelines

Market solutions, standards etc. are often behind state-of-the-art technological possibilities (as being used on other domains). Visibility of technological possibilities in these other domains is key to make the right decisions, solutions and standards. A good example is eMobility roadmaps' dependence on the Smart Grid roadmap.

To summarize in one recommendation: **create and manage an eMobility standards roadmap**, based on a unified Smart Grid ***and*** eMobility Reference Architecture and associated use cases and align this roadmap with roadmaps on

- Smart Grid technology (with active demand response)
- eMobility enabling services, smart phone and payment / technology and roadmaps. These will be useful for identification, roaming and clearing house services.
- Battery and power component and interfaces technology (battery, inductive, fast, AC/DC)
- and Vehicle2Grid and V2Home technology roadmaps

It would be good if this process (not content) was supported by the EU, e.g. by a new/another mandate (like M/469 and M/490).

1.7 Conclusion

Working on the standardization topic has led to our conclusion that standardization in Electro mobility is like an iceberg: you only can see the top of the total problem, often the plug and physical connection issue, but most of it is invisible and below the surface. It seems in general that enough technology and standards are available. It is now the time to make choices, to combine standards and to fill the remaining gaps. For that an overview of and accepted use cases for the complete system and architecture of as well eMobility as well Smart Grid is required.

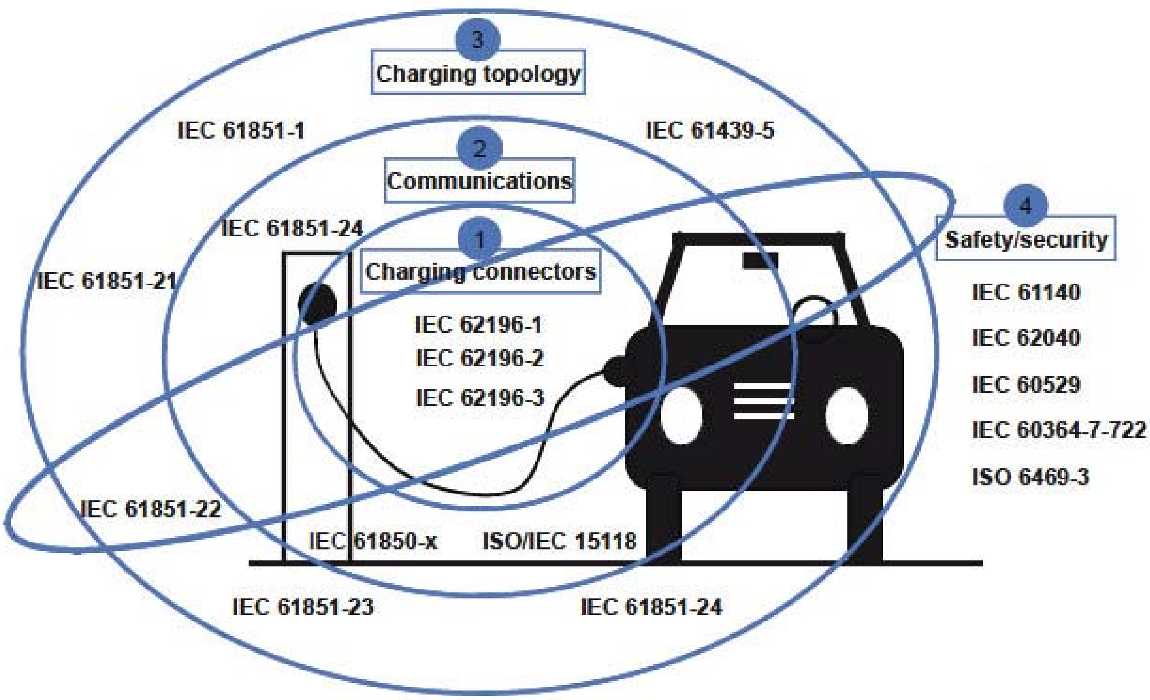
The surveys revealed that more standardisation activities are necessary. Several topics, like identification, communication and smart charging, are being covered by the eMi3 group (eMobility ICT Interoperability Innovation Group: http://emi3group.com/). eMI3 was founded with Green eMotion partners to ensure a broad basis for the standardisation work that needs to be done for a interoperable eMobility market. The standardisation work of several partners of the Green eMotion project (mainly from WP7, WP5 and WP3) was therefore shifted to eMI3, and as such leveraging the knowledge and effort gained in Green eMotion actively towards the eMobility community.

2 Introduction

The harmonization of standards is an essential issue for the mass rollout of Electric Vehicles (EVs) and Plug-in Hybrid Electric Vehicles (PHEVs) across the EU.
Standards increase the economic efficiency of the sector and increase the usability of electric vehicles and the recharging infrastructure. I.e. this would allow the user of the EV to use the same interfaces internationally for the connection of the vehicle to the recharging infrastructure and, for example, to address the payment of the recharging in similar ways as the roaming for his cell phone.

This is the reason why in Green eMotion a complete Work Package (WP) is devoted to the harmonisation of technology and standards.
In WP7 also other partners are involved, especially the ones working on related topics on other WPs like:

- WP3 Electromobility services / ICT solutions: T3.8 ICT standards and protocols
- WP4 Grid EV-olution: T4.2 EV charge management incl. Communication protocols
- WP5 Recharging infrastructures: T5.6 Infrastructure standardisation and interoperability
- WP6 Demonstration of EV Technology: T6.3 Standardization and requirements for future grid



Source: Report of CEN CENELEC Focus Group on EU Electro-Mobility (EU Mandate M/468)

Figure 2-1 Standardization areas used by CEN CENELEC Focus Group Electro-Mobility

After the initial review of used technologies and standards (in T7.1), we collected all standardization issues and needs (T7.2), which results in this deliverable (D7.2).

Aim of T7.2 is to monitor and manage the collection of standardization issues and needs

- as emerged in the other work packages during the different development phases of the demonstration projects
- as well as the evolution of standards and standardization activities

Collecting all standardization issues and needs is required in order to:

- Enable the gap analysis in T7.3
- Monitor where the issues are, and in which technology area
- But implicitly also to collect which demonstration projects have no issues in certain areas and maybe can provide solutions for issues and needs
- Monitor the progress in issue solving
- Collecting makes the gap concrete and gives evidence for improvement areas

The CEN CENELEC Focus Group on EU Electro-Mobility uses several standardization areas (see figure 2.1). Note that the security in this picture is not data security but security and safety for user and equipment. We analyse here the same different technological areas as in task 7.1, which focus more on the components and their interfaces; these are (see for architecture also figure 2.2):

- Vehicle (Power socket/Plug/Connectors, recharger, batteries)
- Charging Point (Socket/Plug/Connectors, Cable handling system, Converters)
- Connection to the grid (smart meter, smart grid, charging strategies)
- Communication (system, software, protocols (ICT), security).

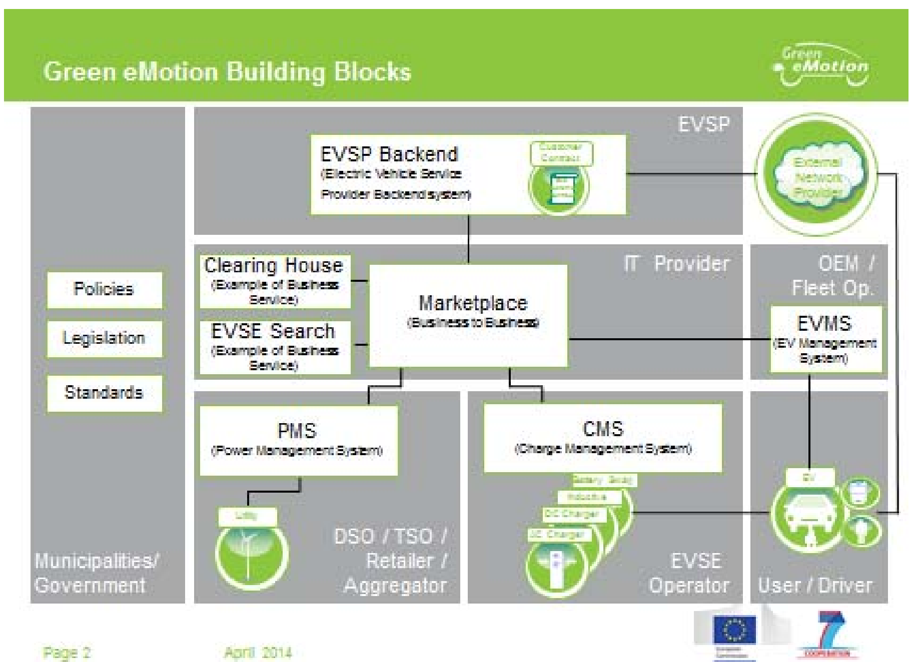


Figure 2-2 Building Blocks in Electromobility architecture

As originally defined we started with a survey to be filled in by all relevant partners and work packages. The survey contains questions and can capture all standardization issues and needs. Since we expected a lot of parties to fill in this survey with several issues and needs, we originally intended to make use of web survey tools and databases to manage this amount of information. But the overall number of standards related to EV is really large (first standards list of D7.1 has more than 200 entries), and therefore difficult to get a limited clear and user friendly list and overview in a tool or database. In this phase we want to have all standards related information with a broad view, therefore we created a 'Word' based survey, where easily extra information can be added. The surveys are listed in the appendix.

As a result D7.2 gives the status, whereas the next task T7.3 will investigate and point out the desired direction.

2.1 Additional use case used for further identification of issues and needs

For better identification of issues and needs an additional simplified use case has been defined and partially used in this deliverable, it is not intended to be complete but serves as an example to check if standards can support these events. The use case and its events are:

- Before driving: user (optionally) enters day schedule, locations (or distance)
- While driving: inside the car user needs to see state of charge for remaining distance
- How far to drive: user advice (based on driving statistics)
- User decision on next stop (location, and distance for area)
- Optional: look and if needed reserve a charging station and location (id, estimated Time Of Arrival (TOA), estimated Time Of Departure (TOD), required charge, location, range)
- Optional: user to give required next distance/charge required and required timing
- Park car at charging point
- Connect/Plug in (right plug and cable)
- Begin of charging process
- Communication setup (id, estimated TOD, required charge)
- Identification
- Authentication
- Exchange options and requirements from vehicle and Battery Management System (BMS)/battery (speed of charging, target setting and charge scheduling)
- Exchange options and requirements from grid (for example controlled/delayed charging)
- Start charging process (including charge controlling and rescheduling)
- Optionally: Value added services
- Metering
- Billing/payment, how (in case of no identification: cash, credit card)
- End charging, unplug
- Leave (final TOD)

This use case is broader but compatible with the use case function groups as defined in ISO IEC 15118-1, see the next figure.

A	Begin of charging process
B	Communication setup
C	Identification
D	Authorisation
E	Target setting and charge scheduling
F	Charge controlling and Re-scheduling
G	Value added services
H	End of charging process

Figure 2-3 Use case function groups as defined in ISO IEC 15118-1

For more detailed and accurate use cases we refer to the Green eMotion deliverable D3.3: Services use cases & requirements description[3].

2.2 eMobility ICT Interoperability Innovation Group (eMI3)

October 2012 eMI3 (eMobility ICT Interoperability Innovation Group) has been established by 25 companies, initiated by several members in Green eMotion, and the Green eMotion project itself joined and supports eMI3. eMI3 is promoting interoperability and cross-sector ICT standards and services for electric vehicle. See also their website: http://emi3group.com/ .

eMI3 is an open organisation of significant players in the global Electric Vehicles market who joined forces driven by a common vision:

- Enable global EV services interoperability by harmonizing existing and preparing standardisation of future ICT data standards & protocols including security and authentication.
- Enable global EV service development by harmonizing and improving implementation between all sectors.
- Coordinate and build upon the work of other EV initiatives and, especially, enable European projects to provide interoperability for EV users
- Support all required business processes and speed up introduction of new services to provide a richness of compelling services to EV users. Especially, EV users should be able to use any charging point.

The scope of this group includes all ICT interfaces, application level protocols and standardized software services supporting all required business models and platforms of the stakeholders within the EV market. Initially, eMI3 intends to focus on unique identifiers, data models, attribute lists and data structures including those to enable interoperability of market places and clearing houses.

The overall objectives are to harmonize the ICT data definitions, formats, interfaces, and exchange mechanisms to create and/or enhance eMobility ICT standards.

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[3] http://www.greenemotion-project.eu/dissemination/deliverables-ict-solutions.php

- The short term objective is to agree on the detailed scope and work plan including a methodology to achieve transparent and open processes.
- The medium term objective is to support EV market ramp-up and interoperability of major current EV initiatives by developing eMobility ICT de facto data standards to be jointly implemented.
- The long term objective is to involve more partners to achieve widespread international harmonization and globally accepted and implemented ICT standards for the EV markets.

Several partners of the Green eMotion project (especially from WP7, WP5 and WP3) participate and contribute heavily to eMI3, and as such leveraging the knowledge and effort gained in eMI3 actively towards the eMobility community.

This is also the reason that in this document often references are made to eMI3. Also several recommendations are given to eMI3, and most of these are already taken up by eMI3.

According to the current eMI3 roadmap (as of 10/2014) the following tasks are planned to be finished by the end of 2014:

- Finish “General overview & Applicable Use Cases” document
- Finish “eMobility Business Objects and related Unique Identifiers (incl EVSE Attributes) document
- Establish liaisons with other partners & projects
- Finish high level core architecture
- Establish eMI3 as AISBL organisation
- Development of Horizon 2020 proposal for eMI3 partners

In 2015 priorities are set to the following activities:

- Designing an architecture supporting different market places
- Finishing document on a standardized interface between EVSE and EVSE operator
- Designing an Interface between EVSE operator and clearing house / EVSP
- Designing an interface between an Lean Charging Provider and the EV
- Designing an interface for Smart Charging

3 Electric Vehicle standardization issues and needs

This chapter describes the standardization issues and needs around the Electric Vehicle. These are mainly related to the interface with the charging point, the communication infrastructure and the user, as depicted in figure 2-2.

3.1 Basic standards on Electric Vehicle Connector in use or intended use

In the initial survey we asked which of the 'basic' standards are being used such as:

- IEC 61851-X (EV conductive Charging System)
- IEC 62196-X (Type of connector/inlet vehicle side),
- J1772 (Conductive Charge Coupler),
- UL2251 (Safety of Plugs),
- IEC 61982-X (Secondary batteries for the propulsion)

Note that where is written as "being used", this can also mean as being used in the future.

Before describing the basic standard it is important to define the terminology used to indicate the different parts of the charging system and the connecting elements used for charging.

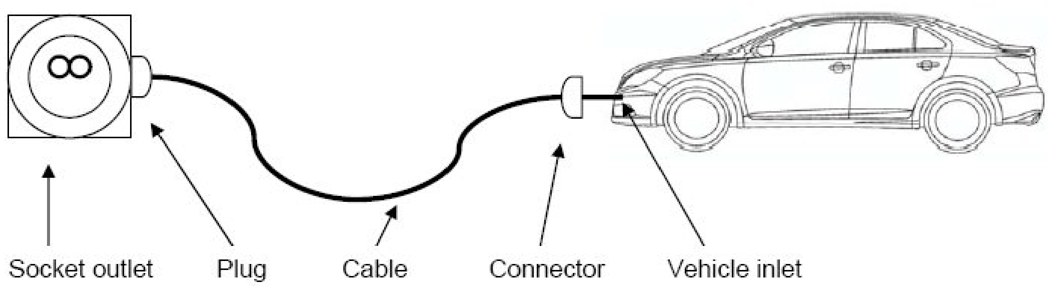


Figure 3-1 Terminology for connecting elements used for charging

3.1.1 IEC 61851 Series: Electric vehicle conductive charging system

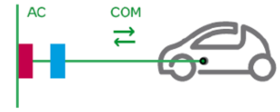
The IEC 61851-1 applies to on-board and off-board equipment for charging electric road vehicles at standard AC supply voltages (as per IEC 60038) up to 1000 V and at DC voltages up to 1500 V, and for providing electrical power for any additional services on the vehicle if required when connected to the supply network.

Charging modes are defined as follows:

- IEC 61851-1 "Mode 1" - slow charging from a household-type socket-outlet

This charging mode was mentioned one time in the survey as being used (by a demonstration project).

- IEC 61851-1 "Mode 2" - slow charging from a household-type socket-outlet with an in-cable protection device

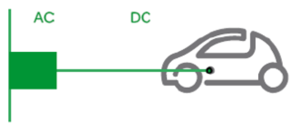


This charging mode was mentioned six times in the survey as being used (four demonstration projects and two car manufacturers).

- IEC 61851-1 "Mode 3" - slow or fast charging using a specific EV socket-outlet with control and protection function installed

This charging mode was mentioned ten times in the survey as being used (five demonstration projects, two car manufacturers and three electric utilities).

- IEC 61851-1 "Mode 4" - fast charging using an external charger



It was mentioned only twice as being used (by one demonstration project and by one car maker).

Additionally, the IEC 61851-1 is mentioned one time in the survey as being used, without information about the charging mode in use (by a utility).

The IEC 61851-21 is about the requirements towards the car, this is being changed at the moment. This part of IEC 61851 together with part 1 gives the electric vehicle requirements for conductive connection to an AC or DC supply, for AC voltages according to IEC 60038 up to 690 V and for DC voltages up to 1000 V, when the electric vehicle is connected to the supply network.

This standard was mentioned in the survey two times as being used (by one utility and one demonstration project).

As summary, these standards (IEC 61851 Series) were mentioned in all the surveys as being used or with intentions to use in the future.

3.1.2 IEC 62196 Series

Standard for set of electrical connectors and charging modes for electric vehicles.

- IEC 62196-1: Charging of electric vehicles up to 250 Ampere AC and 400 Ampere DC

The Part-1 of IEC 62196 is applicable to plugs, socket-outlets, connectors, inlets and cable assemblies for electric vehicles, intended for use in conductive charging systems (cables with copper or copper-alloy conductors) which incorporate control means, with a rated operating voltage not exceeding:

- 690 V AC, 50 – 60 Hz, at a rated current not exceeding 250 A;
- 600 V DC, at a rated current not exceeding 400 A.

The standard leverages the charging modes as defined in IEC61851-1.
This standard was mentioned in the survey two times as being used (by electric utilities).

- IEC 62196-2: Dimensional compatibility and interchange-ability requirements for AC pin and contact-tube accessories.

This standard covers the basic interface accessories for vehicle supply as specified in IEC 62196-1, and intended for use in conductive charging systems for circuits specified in IEC 61851-1:2010.
The IEC 62196-2 contains categorizations on plug types to be used in the charging process. The standardization process to choose plug types for public charging stations of electric vehicle networks came to a conclusion on Type2/Type2 Combo in Europe (EU directive on alternative fuels infrastructure) and same with Type 1 in the US.
The list of IEC 62196-2 plug types includes:

- IEC 62196-2 "Type 1" - single phase vehicle coupler - reflecting the SAE J1772/2009 automotive plug specifications,

Characteristics	Type 1
Nb of Phases	Single Phase
Current	32 A
Voltage	250 V
Nb of Pins	5
Shutters IPxxD	**No**
Socket Drawing	

Figure 3-2 Type 1 plug and receptacle

This plug type was mentioned three times in the survey as being used (two Demonstration Projects and one utility).

- IEC 62196-2 "Type 2" - single and three phase vehicle coupler - reflecting the VDE-AR-E 2623-2-2 plug specifications,

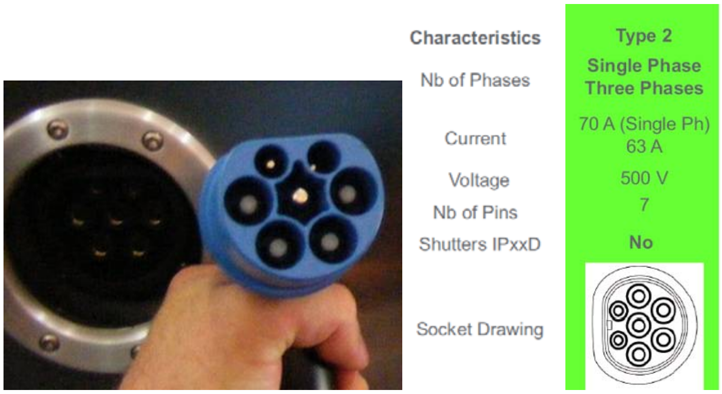


Figure 3-3 Type 2 automotive connector & Vehicle inlet

This plug type was mentioned six times in the survey as being used (three Demonstration Projects and three utilities).

- IEC 62196-2 "Type 3" - single and three phase vehicle coupler with shutters - reflecting the EV Plug Alliance proposal,

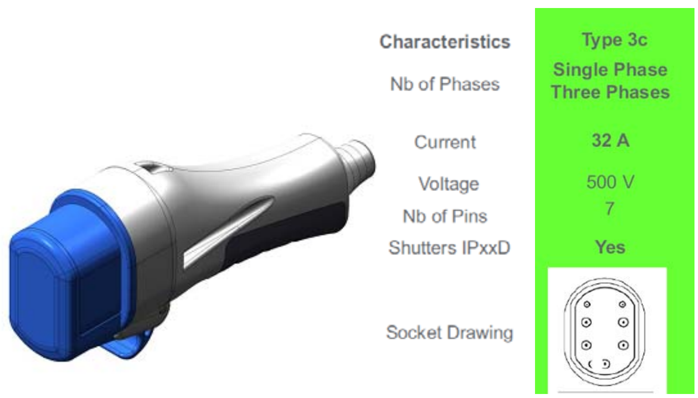


Figure 3-4 Type 3c Plug & inlet

This plug type was mentioned once in the survey as being used (one Demonstration).

Additionally, this standard was mentioned in the survey three times (three utilities) without information about the plug type in use.

- IEC 62196-3: Dimensional compatibility and interchange ability requirements for DC and AC/DC pin and tube-type contact vehicle couplers.

This part of IEC 62196 is applicable to vehicle couplers with pins and contact-tubes of standardized configuration, herein also referred to as “accessories”, intended for use in electric vehicle (EV) conductive charging systems which incorporate control means, with rated operating voltage:

- up to 1500V DC and rated current up to 250A, and
- 1000V AC and rated current up to 250A.

This standard applies to high power DC interfaces and combined AC/DC interfaces of vehicle couplers specified in IEC 62196-1:2011, and intended for use in conductive charging systems for circuits specified in IEC 61851-1 and IEC 61851-23.
The DC vehicle couplers covered by this standard shall be used only in charging mode 4, according to IEC 61851-1: These vehicle couplers are intended to be used for circuits similar to those specified in IEC 61851-23 which operate at different voltages and which may include ELV and communication signals (see sections 4.4.1 and 4.4.2).
This standard will contain a proposal for a DC charging / Mode 4 connector, promoted by the CHAdeMO association (see point 3.1.4.2). TEPCO has developed patented technology and a specification for high-voltage (up to 500V DC) high-current (125A) automotive fast charging via a JARI DC fast charge connector, which is the basis for the CHAdeMO protocol.

Figure 3-5 Figure Type 4 Plug & inlet

Regarding the Electric Vehicle standardization issues and needs, in the first version of the survey, nobody mentioned it directly. In some surveys, companies wrote about the IEC 62196 standards series, in general, or about IEC 62196-1/-2 standards in a specific way.
In the second version, several surveyed mentioned the CHAdeMO Charging System, but not specifically the IEC standards linked to this system.

According to the first survey and as summary, these standards (IEC 62196 Series) were mentioned in most of the surveys as being used or with intentions to use in the future.

3.1.3 SAE J1772 North American standard for electrical connectors for EVs

North American standard for electrical connectors for electric vehicles. It covers the general physical, electrical, communication protocol, and performance requirements for the electric vehicle conductive charge system and coupler. Actually SAE J1772 is not a standard but a recommended practice it covers almost all aspects of IEC 61851, ISO/IEC 15118 and IEC 62196.

J1772 was mentioned four times in the first survey by respondents as being used.

3.1.4 Additional and specific information (new in version 2).

In this section additional and specific information is given, taking into account the most relevant trends in the charging infrastructure. Two additional points are introduced:

- Combined Charging system,
- Chademo DC Charging system.

3.1.4.1 Combined Charging system (CCS)

For AC Charging Systems, Japan and North America have chosen a single-phase connector on their 100-120/240 Volt grid (Type 1), while the rest of the world including China and Europe is opting for a connector with single-phase 230 Volt and three-phase 400 Volt grid access (Type 2).

However, some of the most important organisations in the European automotive sector have agreed on a harmonised plug system for electric vehicles (Figure 3-5) in order to avoid the situation for DC charging, with a standardization that plans add DC wires to the existing AC connector types (Type 1 or Type 2), such that there is only one "global envelope" that fits all DC charging stations. The Union of the Electricity Industry (EURELECTRIC), the European Association of Automotive Suppliers (CLEPA) and the European Automobile Manufacturers Association (ACEA) have agreed on the Combo Type 2 (Combo2) inlet/connector for electric vehicles, to use in the Combined Charging System.

The Combo Type 2 vehicle inlet is the only solution that is able to combine standard AC, and both fast AC and DC charging in the short term.

Figure 3-6 Combo Type 2 inlet/connector

3.1.4.2 CHAdeMO

"CHAdeMO" is a trade name of quick charging method that this Association is proposing globally as an industry standard.

"CHAdeMO" is an abbreviation of "CHArge de MOve", equivalent to "charge for moving", and is a pun for "*O cha demo ikaga desuka*" in Japanese, meaning "*Let's have a tea while charging*" in English. CHAdeMO is in more detail described on http://www.chademo.com/.

In the following figures, an example of CHAdeMO DC charger and the proposed DC Connector are shown.

Figure 3-7 DC Charger

Regarding standards, CHAdeMO charging system is included in the following international standards (see specific sections in the document):

- IEC 61851-23 for charging system (Section 4.4.1),
- IEC 61851-24 for communication (Section 4.4.2) and
- IEC 62196-3 for connector (Section 3.1.4.2).

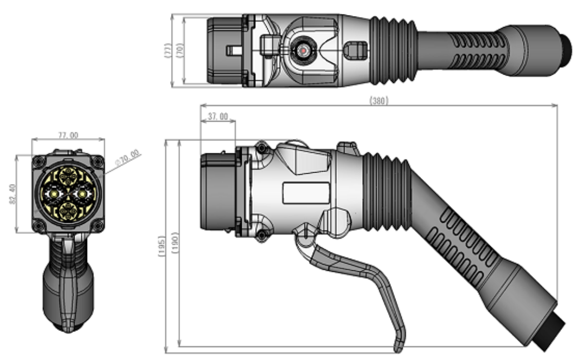


Figure 3-8 DC Connector

3.1.5 Requirement for public and semi-public AC Charging

In the area of AC Charging modes and Requirements, the following question was asked in the second survey:
What should be the requirements for public and semi-public AC charging points?

Most of the respondents mentioned that IEC 61851-1 ed. 2 charging Mode 3 in public/semi-public charging should be mandatory with IEC 62196-2 type 2 connector on the charge point side. Remarkable are the comments on the IEC 62196-2 type 3 connector, it was advised to not use this connector by some industrial parties, but others mentioned this type, as well as type 3a and the Combo2, as an option.

From Utilities and others, the following could be extracted: the IEC 60364-7-722:201X (64/1846/CDV) (EQV) "Low-voltage electrical installations - Part 7-722: Requirements for special installations or locations - Supply of electric vehicle" requires: in public areas charging modes 1 and 2 are not allowed. They are allowed only in restricted private areas not opened to third as, for example, locations where the access is possible only to the vehicle's user by means of dedicated key or tools".

Utilities also remarked that each charging post should be also equipped with a classic type E/F socket to allow charging for two-wheelers and previous generation EVs in mode 1 or the EVs charging with a mode 2 charging cable. Type 2 for car + Schuko type for bikes.

3.1.6 Requirement for public and semi-public DC Charging point

Regarding the question about the requirement for public and semi-public DC Charging point, the second survey shows the following comments.

According to the comments from a service provider, currently, the existing volume of DC charging cars are based on CHAdeMO. The future market will have both Combo2 and CHAdeMO cars available in Europe. However they would prefer Combo2 as a standard, as it serves both AC and DC.

Additionally others six surveyed propose to use the CCS Combined Charging system with Type 2 connector (Combo2).

One utility also propose the use of CHAdeMO + Combo2 (when available) in private facilities for public use with special conditions, for example gas stations, urban areas, parks, malls, parking lots, etc.

3.1.7 Potential quick EU decision/deployment to achieve a unified EU standard

Regarding the question in the second survey, about a potential quick EU decision/deployment to achieve a unified EU standard, the input and advice from the surveyed, on standards and approach with respect to DC charging, were the following.

The CHADEMO association comments that the EV drivers need to be assured the maximum level of flexibility in charging opportunities. If such opportunities are limited before the market matures and the proper infrastructure is fully implemented, it could destroy the market. The market should decide respecting the consumers' choice if technologies are listed in IEC standards.

A utility indicates that currently CHAdeMO is the only solution available, deployed and tested by the industry and the users. Also propose the acceptance of Fast Charge stations with two outputs: CHAdeMO + Combo2 and depending of the evolution of the market and EV sales.

An OEM proposes to use the so called Combo2 (Combined Charging System with Type 2 Connector). However, they recognise that DC fast charging station in the near and mid-term should not exclude existing EVs with CHAdeMO couplers and should offer both connectors.

Several utilities are aligned with this proposal, recommending allowing the CHAdeMO connector provisionally and suggesting implementing retrofit capability for upcoming Combo2 charging post. So, CHAdeMO connectors should be an interim solution but will be necessary to reach an agreement on a unique European proposal.

Other utility suggests to focus at this moment on AC fast charging at 43 kW using type 2 connector and thus using standards already defined and available (IEC 61851, IEC 62196-1, IEC 62196-2), for a potential quick development of fast charging in EU.

Other four surveyed propose directly to use a compatible connector for AC and DC charging (Type 2 - DC Combo2 connector should be used on the vehicle side).

Sometime after this survey and these replies, the EU came with a directive in this area: “Directive of the European Parliament and of the Council on the deployment of alternative fuels infrastructure” (see http://ec.europa.eu/transport/themes/urban/cpt/index_en.htm). This directive mentions:

- connectors of Type 2 (as described in 62196-2) for slow AC recharging points for EVs and
- connectors of Type 2 (as described in 62196-2) for fast AC recharging points for EVs and
- connectors of Type "Combo 2", for fast DC recharging points for EVs.

3.1.8 Cable requirements

This section describes cable requirements as long as the cable is a part of the EV. In this point of the report, the answer about the type of charging cables (Type, Dimensions, Material, and Standards) which are used in public or private areas (in your company products or demo sites) are shown.

3.1.8.1 AC

There are quite few answers about this issue in the second version of the survey (only three surveyed offer information). Additionally, all the answer were focused on the plug/connector used instead of cable requirement (IEC 62196, IEC 309-2 and Type E/F).

3.1.8.2 DC

A huge amount of the surveyed (seven surveys) say that DC charging has not been set up yet or do not give information about this issue.

One of them speak about one pilot project, but their infrastructure publicly available is based on AC charging.

A utility specify that currently CHAdeMO is the only solution available, deployed and tested by the industry and the users.

Additionally proposed is fast charge stations with two outputs: CHAdeMO + Combo2. However, information about cable requirement is not available in this survey.

Other utility give more information about this issue. They use CHAdeMO DC charging and accordingly cable and connector comply with the CHAdeMO specifications. In this case, power cable section is 35 mm^2, analog signal and CAN bus communication use a 0.75 mm^2 section cables.

Paradoxically CHAdeMO remark in their survey that no special regulation has to be created (used) for DC charging, simply follow the existing electricity safety regulation that is in place.

3.2 Additional information

3.2.1 Issues and needs on basic standards on Electric Vehicle Connector

The issues and needs found with Electric Vehicle Connector standards are given below.

Car manufacturers have got the following issues:

- Type 2 and type 3 connectors push us to develop many cables,
- Uncertainty on DC charge.

Demonstration Regions have got the following issues:

- Some vehicles delivered come with connections outside the standards adopted for the charging infrastructure (Reva, Micro-Vett and Allied Vehicles).

Demonstration Projects replied:

- Implementation of a simple uniform charging systems both for home and for publicly accessible charging places.
- A unified connecting system (socket outlet + plug) on public charging point
- Connectors allowing for both AC and DC charge at a unique vehicle inlet

Car manufacturers replied

- Development of the Type 2 Connector towards the Combo2 Connector

3.2.2 Basic standards on Electric Vehicle Safety (General and EMC)

3.2.2.1 UL 2251 Safety of Plugs, Receptacles, and Couplers for EVs

These requirements cover plugs, receptacles, vehicle inlets, vehicle connectors, and breakaway couplings, rated up to 800 A and up to 600 V, AC or DC, intended for conductive connection systems, for use with electric vehicles.

This standard was mentioned two times in the survey by respondents as being used.

3.2.3 IEC 61982 Series: Secondary batteries for the propulsion of electric road vehicles

- IEC 61982-1: Test parameters

This standard specifies the values of the various parameters such as voltage, current, power and temperature to be used in the testing of battery cells, monoblocks and modules used for the propulsion of electric road vehicles. The standard also defines certain test conditions and procedures.

- IEC 61982-2: Dynamic discharge performance test and dynamic endurance test.

This part specifies tests and requirements for capacity and endurance tests for secondary batteries used for vehicle propulsion applications. Its objective is to specify certain essential characteristics of cells and batteries used for propulsion of electric road vehicles together with the relevant test methods for their specification.

- IEC 61982-3: Performance and life testing (traffic compatible, urban use vehicles)

This part is applicable to performance and life testing of electrical energy storage systems for general purpose, traffic compatible, light urban use electric road vehicles that are designed for transportation of passengers or goods in city centre driving. For the purposes of this standard, the electrical energy storage system is defined as one that is recharged electrically though some of the test procedures may be applicable to fuel cells and other "mechanically" rechargeable systems. The test procedures may also be applicable to electrical energy storage systems used in some types of hybrid-electric vehicle though detailed consideration of electrical energy storage systems for hybrid vehicles will be addressed separately.

Only one Demonstration Project survey uses this standard.

3.2.4 Other standards or non-standard solutions on vehicle in use or planned use

These standards were just requested in the first version of the survey.

3.2.4.1 ISO 16750 Safety (General and EMC)

ISO 16750 Series Road vehicles - Environmental conditions and testing for electrical and electronic equipment (apply to electric and electronic systems/components for vehicles).

It describes the potential environmental stresses, and specifies tests and requirements recommended for the specific mounting location on/in the vehicle.

- ISO 16750-1: General.

It contains definitions and general notes. Electromagnetic compatibility (EMC) is not covered by ISO 16750. It describes the potential environmental stresses and specifies tests and requirements recommended for the specific mounting location on/in the vehicle.

- ISO 16750-2: Electrical loads.

It describes the electrical loads. Electrical loads are independent from the mounting location, but can vary due to the electrical resistance in the vehicle wiring harness and connection system.

- ISO 16750-3: Mechanical loads.

It describes the mechanical loads.

- ISO 16750-4: Climatic loads.

It describes climatic loads.

- ISO 16750-5: Chemical loads.

It describes chemical loads. It is not designed to evaluate whether an electrical/electronic system/component is suitable for performing during continuous contact with an agent.

Only one of the respondents (a research center) mentioned the standard series listed as being used.

3.2.4.2 EN 50065-1

Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148,5 kHz - Part 1: General requirements, frequency bands and electromagnetic disturbances

Only one of the respondents (a demonstration region) uses this standard.

3.2.4.3 UL 2594

This subject standard covers electric vehicle (EV) supply equipment, rated a maximum of 250 V AC, with a frequency of 60 Hz, and intended to provide power to an electric vehicle with an on-board charging unit.
Subject 2594 covers electric vehicle supply equipment intended for use where ventilation is not required. The products covered by Subject 2594 include EV Power Outlets, EV cord sets and EV charging stations, Level 1 & 2.
EV cord sets may be designated as portable cord sets or stationary cord sets and may be designated for indoor or outdoor use. EV charging stations may be designated as either movable or permanent charging stations and may be designated for indoor or outdoor use. The products covered by Subject 2594 are intended for use in accordance with the National Electrical Code (NEC), ANSI/NFPA 70.

Only one of the respondents (a demonstration region) uses this standard.

3.2.4.4 Human Machine Interface

The EV user interfaces mainly with the EV and its surrounding (like Charging Point). A Human Machine Interface is not referenced in the survey responses. But is at least useful and probably required not only on EV, but also one charging and communication to create some standards or guidelines.

We can even imagine that an EV user interfaces via his smart phone and the communication infrastructure to the electro mobility system.
See also one the remark of the CEN CENELEC Focus Group on communication (chapter 6.7):

- Standardization is required for the diagnosis protocol, human-machine interface and energy management system for the complete charging system. This new work has to be done in close relation to user groups and electro-mobility system integration (technical reports or white papers from user groups can be very useful for the ESOs).

3.2.5 Standards or extension to standards on vehicle missing

3.2.5.1 Safety

Demonstration regions have got the following issues:

- EMC regulation above harmonic range. The regulation and standards regarding EMC contain a gap in the applied frequency ranges. The on-board chargers in vehicles might operate in these ranges.

Demonstration regions replied:

- Battery safety labelling,
- Battery systems safety condition after a severe crash,
- Emergency rescue guideline.

3.2.5.2 Batteries and Switching / Swapping System

Swapping system developers have got the following issues:

- Standards about battery switch technology do not exist, at the moment,
- There is a lack of standards relating to battery switch station, especially for safety,
- Lack of standards for common interfaces for battery.

Demonstration Regions replied:

- Standardization of battery module sizes,
- Stored battery data should follow a standard format/coding specification.

3.2.5.3 Standards or recommendations for maintenance and EV repairing

The surveys did not reveal standards or recommendations for maintenance and EV repairing activities, likely because we focus on interoperability and this seems an OEM and component manufacturer issue. Considering a future broad diffusion of EVs which will involve a large range of servicing, it seems important to examine these issues with regards to the standards too.
The gap analysis performed in task 7.3 (deliverable to be published in last quarter of 2014) reveals some gaps and standards in this and adjacent areas like:

- Battery, guarantee the safety of users and operators during anomalous situations
- Battery, guarantee an effective communication among OEMs and not-OEMs vehicle components
- Battery, allow safe and effective battery swapping on different vehicles
- Safety, Events on accidents or in the case of fire

Currently the following standards are in play:

- ISO 6469-1:2009 Electrically propelled road vehicles -- Safety specifications -- Part 1: On-board rechargeable energy storage system (RESS)
- ISO 6469-2:2009 Electrically propelled road vehicles -- Safety specifications -- Part 2: Vehicle operational safety means and protection against failures
- ISO 6469-3:2011 Electrically propelled road vehicles -- Safety specifications -- Part 3: Protection of persons against electric shock
- ISO/DIS 6469-4.2 Electrically propelled road vehicles -- Safety specifications -- Part 4: Post crash electrical safety

3.3 Summary

3.3.1 Connector

To achieve European interoperability, several overlaps have been identified in the used standards related with plugs and connectors in the car side.
Different modes of charging (and also, different kind of electric current – AC vs. DC) and different types of connectors are in use.
It is recommendable to define a combined solution (Combo2), allowing for both AC and DC charge at a unique vehicle inlet.

3.3.2 Safety (General and EMC)

It is recommendable to harmonize the requirement in safety about energy feedback at the vehicle inlet during the connection to the grid (V2G).

Simple and reliable methods of identifying vehicles for rescue purposes (indicators for HV, Li+, hazardous substances etc.) need to be defined.

3.3.3 Batteries

An information model which defines semantics on battery data, which is easy to access, ensures correct interpretation of battery data.

It could be necessary to create a unique standard which clearly defines the interfaces of removable batteries, to allow for battery switching on electric vehicles that have been designed for this application. Such interfaces should define the mechanical fixation points, the electric power connectors, the data connectors, the cooling fluids and their interfaces and the data formats that could be used during the charging of the batteries.

3.3.4 Use case: user interaction

Standards for user interaction or the need for this were not mentioned by respondents. This should still get some attention and may not be neglected. For reference we list here the part of the use case where standardization in the EV would be recommended:

- Before driving user optionally enters day schedule, locations,
  - This consists of schedule locations and or distances,
- While driving: inside car user needs to see state of charge for remaining distance,

  - Requires standard for battery state of charge, consumption based on driving pattern, user interface,
- How far to drive: user advice (based on driving statistics),
- User decision on next stop (location, and distance for area),
- Leave charging location (TOD).

3.4 Comparison with external Stakeholders position

About **electrical safety at the vehicle inlet**, in the CEN-CENELEC Focus Group Report[4] it is commented that the coherence between regulations and requirements of electrical safety standards should be checked and the texts updated if necessary. The CEN-CENELEC Focus Group recommends that UN-ECE Regulations and existing standards are checked and possibly updated. The safety of energy feedback requires close correspondence between IEC 61851-21 (presently under revision) and ISO 6469-3-2. At European level, very close relations should be established between CENELEC TC 64, TC 23 BX, TC 69X and CEN TC 301.

CEN-CENELEC Focus Group Report reveals different OEM fast charge options will exist in the near future. Vehicles presently circulating in Europe provide Mode 3 (AC) up to 43 kW (e.g. the Renault ZOE) and a separate connector for Mode 4 (DC) fast charge. Connectors allowing for both AC and DC charge at a unique vehicle inlet (termed “Combo2”) are also available now (e.g. BMW i3).

About **batteries**, these are an essential element of the total cost and viability of electric vehicle technology. Also, other uses for batteries, fixed or removable, may also be envisaged, including their use to temporarily balance the grid (Vehicle-to-Grid reverse energy applications) or the re-use of these batteries at the end of their "vehicle" life for applications that may be outside the domain of electro-mobility. Switchable batteries may also add further possibilities for the increase of range, and should therefore be an integral part of the standardization work to be considered.
These additional technical aspects would impose supplementary requirements in terms of standards, such as supply chain and infrastructure interfaces, as the batteries will have an existence inside and outside of the vehicles. (Source: CEN-CENELEC Focus Group Report).

Also, in the “Standardization for Road Vehicle and Associated Infrastructure” report from the CEN-CENELEC Focus Group, the following recommendations about batteries are made:

- Parameters for state of health should be defined in standards to allow for re-use of batteries.
- Standardization of battery module sizes could be undertaken when the automobile industry considers the subject to be mature. This may lead to a need for standardization of interfaces. Standardization could also be undertaken for battery packs for battery exchange stations as well as for batteries for light electric vehicles.
- A set of minimum requirements for battery information should be collected, stored and extracted from the battery by BMS/BCU. Stored battery data should follow a standard format/coding specification to allow access and correct interpretation.
- A European Standard should be drafted for battery safety labelling (applying the Dresden Agreement).
- Create a battery switch station standard with safety, energy needs, exchangeability, accessibility, data and communication framework.

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[4] “Standardization for Road Vehicle and Associated Infrastructure” report from the CEN-CENELEC Focus Group (EC Mandate M/468)

- Create a unique standard that clearly defines the interfaces of removable batteries, to allow for battery switching on electric vehicles that have been designed for this application. Such interfaces should define the mechanical fixation points, the electric power connectors, the data connectors, the cooling fluids and their interfaces and the data formats that could be used during the charging of the batteries.

In addition, a recommendation by NPE[5]: Studies must be carried out to determine how battery systems can be brought into a **safe** condition after a severe crash, and the need for standardization is to be determined on the basis of these studies. Research results need to be implemented in standards, e.g. for defined interfaces for the safe discharging of damaged batteries, as quickly as possible.

Standardization of the structure of **emergency rescue guidelines** (including isolation of voltage sources by rescuers) is considered to be a medium-term requirement. Simple and reliable methods of identifying vehicles for rescue purposes (indicators for HV, Li+, hazardous substances etc.) need to be defined. Urgent action is considered necessary in this field in the German Standardization Roadmap Report (NPE).

[5] National Platform for Electric Mobility - Germany

4 Charging Point standardization issues and needs

This chapter describes issues and needs of the standards on charging point.

4.1 Basic standards on charging point in use or intended use

In the survey we asked which of the 'basic' standards are being used such as:

- IEC 61851-X (please specify Mode of charging)
- IEC 62196-X (please specify Type of plug/outlet)
- J1772 (Conductive Charge Coupler)
- IEC 60364-X-X (Protection)
- UL2594 (Safety of EV Supply Equipment)

In the following part of the paragraph we will list and describe the specific basic standards indicated in the surveys received; the results of the question "other standards intended to use" are addressed in paragraph 4.2. Note that where is written as being used, this can also mean as being used in the future.

4.1.1 IEC 61851 Series: Electric vehicle conductive charging system

For the detailed description of the basic standards included in this series please refer to chapter 3. Herein after we report the results of the surveys concerning charging modes:

- **Mode 1:** is mentioned by two utilities as being used.
- **Mode 2:** is mentioned four times by respondents as being used.
- **Mode 3:** is the most diffuse mode of charging, fairly spread in Europe; it is mentioned ten times by respondents as being used.
- **Mode 4:** is not explicitly mentioned by anyone. When the respondents refer to DC charging they sometimes speak of "CHAdeMO standard", but CHAdeMO and Mode 4 are not the same though, maybe CHAdeMO will become one version of mode 4.

4.1.2 IEC 62196 Series (conductive charging of electric vehicles)

This section complies: plugs, socket-outlets, vehicle connectors and vehicle inlets. For the detailed description of the basic standards included in this series please refer to chapter 3. Herein after we report the result of the surveys concerning the connector type:

- Type 1: is used by two car manufacturers for the American market.
- Type 2: is the most diffuse type of socket-outlet, it is used nine times by respondents.
- Type 3: is used two times by the respondents (utilized in an Italian pilot project).

4.1.3 SAE J1772 (Conductive Charge Coupler)

J1772 is the SAE Electric Vehicle Conductive Charge Coupler standard.
It covers the general physical, electrical, communication protocol, and performance requirements for the electric vehicle conductive charge system and coupler. For more details on this standard see chapter 3.

The standard is mentioned two times by car manufacturers as being used in reference to American market and other two times by utilities.

4.1.4 ISO/IEC 14443 (Identification card)

ISO/IEC 14443 Identification cards -- Contactless integrated circuit cards -- Proximity cards is a series of international standards for proximity RFID.
It operates on 13.56 MHz and uses magnetic coupling between the reader (PCD) and transponder (PICC). It consists of the following four parts:

- Part 1: Physical characteristics
  Defines the physical characteristics of PICCs, commonly known as proximity cards.

- Part 2: Radio frequency power and signal interface
  Specifies the characteristics of the fields to be provided for power and bi-directional communication between proximity coupling devices (PCDs) and proximity cards or objects (PICCs).

- Part 3: Initialization and anti-collision
  This part describes the data frames and the anti-collision layer used to discover all PICCs in the field.

- Part 4: Transmission protocol
  Specifies a half-duplex block transmission protocol featuring the special needs of a contactless environment and defines the activation and deactivation sequence of the protocol.

It has been demonstrated that some of these cards or the systems that use these are easy to clone or make misuse of it, this depends on the type of card (for an example and information see the site of the Radboud University Nijmegen[6], The Netherlands). Depending on the required security there is a need to describe the additional mechanisms to guarantee the 'authenticity' of the EV user.

IEC 62831 "User identification in Electric vehicle Service Equipment using a smartcard" – based on a NWIP made by Better Place – currently tries to overcome the limits of basic RFID technology by describing secure methods for user identification via smart cards and neighboring technologies like NFC.

4.1.5 IEC 60364-4-X Low-voltage electrical installations-Protection for safety

The safety requirements in low-voltage electrical installations are specified in IEC 60364-4-X series. In particular:

- IEC 60364-4-41
  Part 4-41: Protection for safety – Protection against electric shock-
  This part specifies essential requirements regarding protection against electric shock, including basic protection (protection against direct contact) and fault protection (protection

[6] http://www.ru.nl/ds/research/rfid/

against indirect contact) of persons and livestock. It deals also with the application and co-ordination of these requirements in relation to external influences.

- IEC 60364-4-43
  Part 4-43: Protection for safety – Protection against overcurrent
  IEC 60364-4-43:2008 provides requirements for the protection of live conductors from the effects of overcurrent.

- IEC 60364-4-44
  Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances
  The rules of this Part of IEC 60364 are intended to provide requirements for the safety of electrical installations in the event of voltage disturbances and electromagnetic disturbances generated for different specified reasons.

- IEC 60364-4-46 Electrical installations of buildings. Part 4: Protection for safety. Chapter 46: Isolation and switching
  Deals with non-automatic local and remote isolation and switching measures which prevent or remove dangers associated with electrical installations or electrically powered equipment and machines.

These standards are mentioned by three of the respondent partners as being used (two utilities and one research center).

4.1.6 IEC 60529 Degrees of protection provided by enclosures (IP code)

The IEC 60529 applies to the classification of degrees of protection provided by enclosures for electrical equipment with a rated voltage not exceeding 72,5 kV.

The object of this standard is to give:

- *Definitions* for degrees of protection provided by enclosures of electrical equipment as regards:
  - Protection of persons against access to hazardous parts inside the enclosure;
  - Protection of the equipment inside the enclosure against ingress of solid foreign objects;
  - Protection of the equipment inside the enclosure against harmful effects due to the ingress of water.
- *Designations* for these degrees of protection.
- *Requirements* for each designation.
- *Tests* to be performed to verify that the enclosure meets the requirements of this standard.

This standard is mentioned by two partners in the surveys, referring to enclosure of the charging point.

4.1.7 IEC 61008-1 Residual current operated circuit-breakers (RCCBs)

The standard IEC 61008-1 Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) - Part 1: general rules, was mentioned once in section charging point.

It applies to residual current operated circuit-breakers functionally independent of, or functionally dependent on, line voltage, for household and similar uses, not incorporating overcurrent protection (hereafter referred to as RCCBs), for rated voltages not exceeding 440 V AC with rated frequencies of 50 Hz, 60 Hz or 50/60 Hz and rated currents not exceeding 125 A, intended principally for protection against shock hazard.

This standard is mentioned only once in the answers as being used.

4.1.8 SCHUKO/Type F/CEE 7/4

SCHUKO is the colloquial name for a system of AC power plugs and sockets that is defined as "CEE 7/4". It is characterized by two round pins of 4.8 mm diameter for the live and neutral contacts, plus two flat contact areas on the top and bottom side of the plug for protective earth (ground).

Two Demonstration Regions and a Research Center indicate that Schuko sockets are used in Mode 2 and one of the two Demonstration Regions specifies that Schuko socket is used for electric bikes.

4.1.9 IEC 60309 Plugs, socket-outlets and couplers for industrial purposes

The standard IEC 60309 -2 Plugs, socket-outlets and couplers for industrial purposes - Part 2: Dimensional interchange ability requirements for pin and contact-tube accessories- applies to plugs and socket-outlets, cable couplers and appliance couplers, with a rated operating voltage not exceeding 690 V DC or AC and 500 Hz AC, and a rated current not exceeding 250 A, primarily intended for industrial use, either indoors or outdoors.

A utility reports the use of this socket-outlet in every charging point in modes 1 and 2 of charging.

4.1.10 IEC 60884 Plugs and socket-outlets for household and similar purposes

The standard IEC 60884-1 - Plugs and socket-outlets for household and similar purposes - Part 1: General requirements, applies to plugs and fixed or portable socket-outlets for AC only, with or without earthing contact, with a rated voltage greater than 50 V but not exceeding 440 V and a rated current not exceeding 32 A, intended for household and similar purposes, either indoors or outdoors.
The rated current is limited to 16 A maximum for fixed socket-outlets provided with screw-less terminals.

In the received surveys it is used only once, as socket-outlet.

4.1.11 IEC 61010 Safety requirements

The IEC 61010 – 1 Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements, specifies general safety requirements for the following types of electrical equipment and their accessories, wherever they are intended to be used.

- Electrical test and measurement equipment
- Electrical industrial process-control equipment
- Electrical laboratory equipment

It is used only once by a research center.

4.1.12 IEC 61439-1: Low-voltage switchgear and control gear assemblies

The standard IEC 61439-1: Low-voltage switchgear and control gear assemblies - Part 1: General rules lays down the definitions and states the service conditions, construction requirements, technical characteristics and verification requirements for low-voltage switchgear and control gear assemblies.

The standard is indicated by an electric utility in the surveys received.
This standard is also used in one demonstration project.

4.1.13 IEC 62262 Degrees of protection provided by enclosures

The standard refers to the classification of the degrees of protection provided by enclosures against external mechanical impacts (IK code) when the rated voltage of the protected equipment is not greater than 72,5 kV. This standard is only applicable to enclosures of equipment where the specific standard establishes degrees of protection of the enclosure against mechanical impacts (expressed in this standard as "impacts").

It is used only once by a research center.

4.1.14 UL Subject 2594, the Subject Standard for Safety of EV

This subject standard covers electric vehicle (EV) supply equipment, rated a maximum of 250 V AC, with a frequency of 60 Hz, and intended to provide power to an electric vehicle with an on-board charging unit. Subject 2594 covers electric vehicle supply equipment intended for use where ventilation is not required. The products covered by Subject 2594 include EV Power Outlets, EV cord sets and EV charging stations, Level 1 & 2. EV cord sets may be designated as portable cord sets or stationary cord sets and may be designated for indoor or outdoor use. EV charging stations may be designated as either movable or permanent charging stations and may be designated for indoor or outdoor use. The products covered by Subject 2594 are intended for use in accordance with the National Electrical Code (NEC), ANSI/NFPA 70.

None of the respondents of the survey mention this standard.

In the following some Directives related to charging point and/or some standards related to EMC will be described.

4.1.15 Directive 2006/95/CE - Low voltage Directive

The Directive covers electrical equipment with a voltage between 50 and 1000 V for alternating current and between 75 and 1500 V for direct current. It should be noted that these voltage ratings refer to **the voltage of the electrical input or output,** not to voltages that may appear inside the equipment. For most electrical equipment, the health aspects of emissions of Electromagnetic Fields are also under the domain of the Low Voltage Directive.

For electrical equipment within its scope, the Directive covers all health and safety risks, thus ensuring that electrical equipment is safe in its intended use.

4.1.16 Directive 2004/108/CE – EMC Directive

The EMC Directive 2004/108/EC applies to a vast range of equipment encompassing electrical and electronic appliances, systems and installations.

4.1.17 EN 55011: 2009 (EMC)

Industrial, scientific and medical (ISM) radio-frequency Equipment. Electromagnetic disturbance characteristics. Limits and methods of measurement.

4.1.18 EN 55022: 2006 (EMC)

Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement

4.1.19 IEC 61000 series (EMC)

The standards include terminology, descriptions of electromagnetic phenomena and the EM environment, measurement and testing techniques, and guidelines on installation and mitigation.

Some of the respondents use the EMC Directive and the EMC standards above mentioned.

4.1.20 Comments concerning standards with really or intended use

Here some other comments received by respondents concerning the standards really used or intended to use.

One utility put in evidence that in mode 3 they use a proprietary PLC communication (mentioned also in comments concerning paragraph 4.2)

Two respondents for socket/outlet specify the use of Type 3a.

A respondent specifies that:

- in the frame of the performed selection of a type of plug/outlet for use in The Netherlands, a Dutch Technical Agreement (Nederlands Technische Afspraak) with number 8623 (NTA 8623:2011, ‘Charging of electric vehicles - EVSE plugs and EVSE socket outlets’, May 2011) was developed within the Dutch normalisation committee for electric vehicles (NEC 069). This document is based on the German norm VDE-AR-E 2623-2-2 with some adjustments.

4.2 Charging installations requirements (new in version 2)

This new section is written on the basis of the replies given in technological areas “AC charging mode”, when relevant, and “New” and other areas in survey Year 2.

4.2.1 Low power charging solutions (new in version 2)

In the second survey we have asked: Which low power charging solutions for light EVs, PHEVs, e-bikes, … are you using and aware of, which should be promoted (or not) and why?

From the answers given we may derive that PHEVs are considered as EVs. The aim is a unique charging infrastructure. Therefore PHEV should be provided with a charging cable with IEC 62196 Type 2 connectors. The minimum power available is 3.7 kW.

Some respondents have reported the use of Schuko, Type E/F socket for Mode 1 for light EVs, e-bikes and Mode 2 for the vehicles but has pointed out that some extensive tests has revealed that type E/F sockets could face overheating when used on a daily basis even at low power level (first overheating occurs at 10 A).
Accordingly, at home while using a Mode 2 charging cable, the max available power will be limited to 8 A unless a specific socket dedicated to EV's is recognized thanks to a specific magnetic device implemented on both side of the plug and socket.
When a specific socket is identified maximum current could be raised up to 14 A.
This recognition system should be implemented in the upcoming months for the mode 2 charging cables. In the meantime, mode 2 cable charging power is limited to 10 A.

A research institute has reported the use of Schuko (that should not be used in medium term, except for motorcycles, Q-cycles and bikes as indicated by a utility) and Type 2 connectors for EV's. Besides he has suggested the promotion of Combo connectors.

In Italy Light EVs (LEV) could be connected to AC charging stations through type 2 and type 3a connectors and simplified pilot circuit up to 16 A single phase. The preferred solution for these LEVs is type 3a.
In case of charging by domestic socket outlets (mode 1 of charging and adaptors mode 3 to mode 1 are allowed whenever you are in restricted private areas not opened to third as, for example, locations where the access is possible only to the vehicle's user by means of dedicated key or tools) the charging current is limited to 10 A.

A respondent has suggested the installation of different charging points for supplying power to certain electric vehicles with decreased energy and power requirements.

4.2.2 Minimum power level for public and semi-public AC charging points (new in version 2)

EV users often implicitly expect that a (semi-) public AC charging points is able to charge faster than normal household outlets.

In order to assess if a minimum power level definition is required for public and semi-public AC charging points, in the second survey we have asked:

- Should there be a minimum power level for public and semi-public AC charging points?
- If so what is the minimum power required? "

In the following the feedbacks received.

Some respondents have indicated that 6A is the minimum charging current as described in IEC 61851-1, specifying, according to this value, a minimum power level of 4.2 kW for three phase systems.

An OEM has confirmed that, from vehicle side, the charging below 6A is not supported adding that 16A single phase AC charging (3,7 kW) is viewed as standard for AC public charging level. However depending on the business model of the EVSE Operator different regimes < 16 A could be possible (e.g. for free charging at retailers, …).

Another respondent has pointed out that there is no need to specify the minimum power level. The requirements could differ depending on the situation and any charging opportunity could help in case of emergency.

Five respondents have indicated that usually charging stations are connected to AC network and the power depends of power availability. There are three levels of power for public and semi-public AC charging points :

- normal charging (up to 3.7 kW (kVA) -16A) ;
- accelerated charge (22 kW (kVA) - 32A), for all vehicles that can handle it ;
- fast charging (43 kW (kVA) - 63A)

Accordingly, minimum available power for public and semi-public slow charging post is 3.7 kW.

One of them has added the indication of 3.7 kW for Motorcycles and Q-cycles in public and semi-public charging points and for domestic EVSE.

Two respondents have suggested that a minimum power level is necessary in order to avoid long charging periods in public and semi-public places and a utility has indicated that for the reason of usability and optimized service with short charging times, there should be a 32 amps supply resulting in either 7.4 kW single phase or 22 kW three phase charging power.

Two respondents have pointed out that it is not necessary to have a minimum power, but there should be probably a maximum power (43 kW) due to safety regulation, grid impact and also depending on the acceptance criteria of local grid operators.

Summarizing: From the answers given we can derive that the minimum power level for semi/public charging stations is 3.7kW, but 22kW is more suitable for the reason of usability and optimized service with short charging times. It seems important to define a maximum power level (43 kW) due to safety regulation and grid impact.

4.2.3 Requirements for AC charging cables (new in version 2)

In the second survey we have asked the following questions:

- What types of charging cables (Type, Dimensions, Material, and Standards) are used in public or private areas (in your company products or demo sites)?
- Are there already national standards for AC charging cables?

In order to get information about the type of charging cables and relevant technical characteristics, used in public and private installations, and to obtain an overview of national standards for AC charging cables.

Below the answers given:

For the cable itself:

- As a general comment it has been underlined that in each country/area there usually is an electricity safety regulation and the charging cables used have to be compliant to that regulation.

- There are differences in the section of charging cables used even for the same rated current as for example for 32A.
- At European level a first draft of standard for charging cables is in preparation

For the cable assemblies on charging post side:

- We find a wide use of Type 2, in some countries Type 3 and Schuko for light electric cars and as a fall back solution.

About national standards on AC charging cables:

- In Italy there is a dedicated pre-normative document CEI 20-106 for charging cables with rated voltage up to 750V valid for charging modes 2 and 3 case A, B, and C according IEC 61851-1,
- In Germany following standards apply to the charging cables:
  - DIN VDE 0282-4 for HV cables up to 750V,
  - DIN EN 1987-3 Electrically propelled road vehicles - Specific requirements for safety - Part 3: Protection of users against electrical hazards.
- In France a draft for a national standard for AC charging cable is currently under discussion.
- In Japan there is a national standard.
- In Spain the situation is: ITC-BT 52 (Low Voltage Regulation) is about to be approved.
  There are also several Normalization Committees in charge of defining connectors, safety issues, etc. Norms from these Committees are not mandatory unless they are included in the ITC-BT-52.
- For other Nations: No specific standard for AC charging cables at the moment.

We agree with the opinion, given by some respondents, that there is no need for national standards, this should be at least standardised on the European/international level.

4.2.4 Requirements for quick fast charging installation in petrol stations (new in version 2)

This section derived from the answers given to the following questions:

- What are the regulations of quick-fast charging installations in petrol stations, and in which areas need these regulations to be extended?
- Which of these requirements and regulations are country specific?

The purpose of these questions is to outline the regulations relating to DC fast charging installations in petrol stations, and obtain if possible an overview of the rules applied in the different countries.

Some respondents have reported that in general fast DC charging is specified in IEC 61851-23. This standard defines the requirements for DC fast charging stations in terms of electrical safety, harmonics, grid connections and communication architecture. Furthermore fire protection regulation of each country/region applies.

Most of the respondents have underlined that at the moment there is a lack of standards regarding quick-fast charging installation on petrol stations and pointed out that this topic needs to be investigated.
A respondent has also suggested contacting an oil company and another one has suggested asking ESB since this concept is mostly pursued in Ireland.

One of the Spanish respondents has listed, in addition to the national standards specified below, a European norm: EN 60079-10 (Explosive atmospheres - Part 10-1: Classification of areas - Explosive gas atmospheres).The regulation need to be extended in fire extinguishing.

A respondent has reported that regulations related to petrol stations seem to be country specific and in his opinion a universal educational effort to convince regulator about the safety of the state of art DC fast charging system is needed.

From the answers given emerged that country specific regulations on fast charging installations in petrol stations are:

In Spain:
- 842/2002 (Low Voltage Regulation),
- 31/1995 and 614/2001 (work-related risk of injury by electric hazard),
- 1627/1997 (safety and health recommendations),
- 2085/1994 and 2201/1995 (Petrol stations regulation),
- 10/1998 (waste), 9/2005 (Pollution).

In Germany general installation standards are covered by VDE 0100 series.

Summarizing: In general fast DC charging is specified in IEC 61851-23. For the installation of DC charging points in petrol stations some general national/European regulations apply (as Low Voltage, Explosive Atmospheres, work-related risk of injury by electric hazard, safety and health recommendations and Pollutions) but there is a need to define procedures and specific regulations regarding fast charging installation not only DC but also AC.

4.3 Inductive charging (new in version 2)

Inductive charging is considered an emerging technology that may integrate the traditional conductive charging method but, at the moment, it suffers from lack of standards.

The scope of following question included in the second survey is to draw the current situation about standards and regulations on inductive charging.

This section is written on the basis of the replies on the following question:
- What is the current status of standards and regulations on inductive charging?

The survey revealed that:
- There are different not interoperable wireless technologies under consideration (different frequencies, etc.);
- some European projects about the inductive charging are in progress;
- in general also EMC Directive 2004/108/EC, related to electromagnetic emissions by power electronics devices but not specific to EV charging.

At international level the standards on inductive charging are:
- in the US: SAE J2954
- In Germany: VDE AK 353.0.1
- at international level: IEC TC69 - PT 61980- is mostly in CD stage. IEC 61980 is planned to become publicly available in fall 2014,

Regarding communication for wireless charging there is work in progress in ISO/IEC 15118-6 (General information and use-case definition for wireless communication, CD status), -7 (Network and application protocol requirements for wireless communication) and -8 (Physical layer and data link layer requirements for wireless communication) documents..

4.4 Other standards or non-standard solutions on charging point in- or planned use

Besides the basic standards, in the following the other standards that were mentioned in the charging point area are described.

4.4.1 IEC 61851-23

This part of IEC 61851, together with part 1, gives requirements for DC electric vehicle (EV) charging or supply stations for conductive connection to the vehicle, with an AC or DC input voltage, up to 1000 V AC and up to 1500 V DC according to IEC 60038.
This part covers DC output voltages up to 1500 V.

4.4.2 IEC 61851-24

This part of IEC 61851, together with part 23, applies to control communication protocol between off-board DC charging system and electric road vehicle, with an AC supply input voltages up to 1000 V and DC output voltages up to 1500 V for the conductive charging procedure (for DC supply to DC charger, to be discussed).
The EV charging mode is mode 4, according to part 1 of this standard. Charging station supplied by high voltage AC supply is not covered by this standard.
This Standard will introduce DC Charging using ISO/IEC 15118 communication matters.

In the surveys this standard is used once by an electric utility.

4.4.3 IEC 60068-1 Environmental testing – Part 1: General and guidance

IEC 60068-1 enumerates a series of environmental tests and appropriate severities, and prescribes various atmospheric conditions for measurements for the ability of specimens to perform under normal conditions of transportation, storage and operational use.

In the surveys this standard is used once by an electric utility.

4.4.4 IEC 60664-1 Insulation

This part deals with IEC 60664-1 Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests. It applies to equipment for use up to 2000 m above sea level having a rated voltage up to AC 1000 V with rated frequencies up to 30 kHz, or a rated voltage up to DC 1500 V. It specifies the requirements for clearances, creepage distances and solid insulation for equipment based upon their performance criteria. It includes methods of electric testing with respect to insulation coordination. The minimum clearances specified in this standard do not apply where ionized gases occur. Special requirements for such situations may be specified at the discretion of the relevant technical committee. This standard does not deal with distances - through liquid insulation, - through gases other than air, - through compressed air.

In the survey this standard is used once by an electric utility.

4.4.5 IEC 60950 -1 Information technology equipment – Safety

IEC 60950 -1 Information technology equipment – Safety –Part 1: General requirements. This standard is applicable to mains-powered or battery-powered information technology equipment, including electrical business equipment and associated equipment, with a RATEDVOLTAGE not exceeding 600V.
This standard is also applicable to such information technology equipment:
− designed for use as telecommunication terminal equipment and TELECOMMUNICATION NETWORK infrastructure equipment, regardless of the source of power;
− designed and intended to be connected directly to, or used as infrastructure equipment in, a CABLE DISTRIBUTION SYSTEM, regardless of the source of power;
− designed to use the AC MAINS SUPPLY as a communication transmission medium

In the surveys this standard is used by one electric utility.

4.4.6 IEC 61980 inductive coupling

IEC 61980 Electric equipment for the supply of energy to electric road vehicles using an inductive coupling. Currently at IEC level we find an approved new work 69/194/RVN "Electric vehicle inductive charging systems", which is supposed to become standard IEC 61980-1 in fall 2014.

This future standard together with next item is mentioned once by a German partner.

4.4.7 DKE GAK 353.0.1: Inductive Charging

DKE GAK 353.0.1 is not a standard but a working group on inductive charging within the German standardization organization DKE. This working group is mentioned once by a German partner.

4.4.8 Standard or non-standard solutions used or planned to use

This section is about comments received by respondents concerning which standard or non-standard solution is used or is planned to use.

A utility highlights the following issue:
- Non-standard PLC communication developed on 20 EVs in a demonstration region.

Another utility points out:
- IEC 61851-1 ed.2.0, IEC 61851-22 ed.2.0 plan to use

A car manufacturer comments:
- Concerning serial products no non-standard solution is planned, since standardisation on charging points is the key issue for the successful implementation of a semi-/ public infrastructure.

- Due to the fact that some standards are or were still in draft status in some cases the demonstration projects have used non standardised equipment.

4.5 Standards or extension to standards on charging point missing (updated in version 2)

The following issues are highlighted in the surveys concerning standards missing:

By a utility:

- Frequency regulation between Harmonic and EMC ranges. The regulation and standards regarding frequency contain a gap of frequency ranges. The on-board chargers in vehicles and DC Chargers operate in these ranges.

By a car Manufacturer:

- A unified connecting system (socket outlet + plug) on public charging point

By a research centre:

- Within the Dutch normalization committee (NEC 069) for electric vehicles the topic of standards for metering equipment and communication in direct current (charging) systems was discussed. It was indicated that standards in this area are lacking. No standards development is currently in progress within NEC 069.

In the second survey the answer to question “Do you have other remarks on standards, interoperability or requirements with respect to “New” and other areas?” has received a remark concerning a lack in a common European identification of charging places that should define the lane markings and road signs.

Referring to AC charging the corresponding question: “Do you have other remarks on standards, interoperability or requirements with respect to AC Charging? “ has received the answers listed below.

On interoperability the answers given recognize that some work is being made for the use of only one type of identification (authentication) card in many countries. The opinion is that it should be mandatory. The recommended standard for the communications between charging stations and central management system is OCPP and also roaming should be considered.

About semi/ Public AC charging infrastructure the opinion is that it should either be usable via E-Mobility Service Contract (requires connection to a “market place” and access via standardized access tokens) such as RFID card (work to be done in IEC 62831 on this topic), Smartphone App (to be agreed on in eMI3) or ISO/IEC 15118 Plug&Charge or via cash-equivalent payment without contract.

With respect to requirements/standards it has been underlined that safety recommendations should be intensified in public areas because this kind of equipment with high voltages deployed in streets and urban areas should be regulated by a mandatory safety requirement.

Another respondent has pointed out that to enable features like load management high level communication between EV and EVSE is needed, this could be done according to ISO / IEC 15118, but also a more limited load management is possible with IEC 61851. To enable communication between the backend of systems of the EVSE Operator, the EVSP (Electric Vehicle

Service Provider) and the DSO (Distribution System Operator) it´s important to standardize facts like user contracts (which contracts can customers have? Which charging priority / service level is related to that? How can customers identify themselves e.g. using a standard EVCOID), grid structure (standardized identifiers for the PoD (point of delivery) and load area (some aggregated PoDs are needed e.g. PODID, load area ID), the communication / negotiation procedure and the message flow between all relevant participants.

Another suggestion is that ICT infrastructure should not express preference for any charging technology. The current standards are being assessed within the eMI3 group.

4.6 Other issues or needs with respect to standards on charging point

The following issues are highlighted in the surveys concerning other issues or needs:

By a Demonstration Region:

- There is a need to standardize battery switch stations

By a utility:

- It is desirable for the development of electric mobility to have one only standard connector.

By a car manufacturer:

- The current discussion on standardisation of charging points is led by technical needs. Here the focus on related standards to support business model needs to be addressed. A prominent example is the access to the charging point via RFID cards or other token. Here is an urgent need to agree on a common standard in order to ensure the Green eMotion overall goal of interoperability.

By a research centre:

- Currently the predominantly used method for access control in the Netherlands is the use of identification cards based on RFID technology. Within the Dutch interoperability platform for electric vehicles (‘interoperabiliteitsoverleg’, under auspices of Dutch government), the technical aspects of this method were discussed and an approach for interoperability based on specific use of RFID was established (M. Bayings, ‘Recommendation reader technology standard for authentication/identification at EV Charging stations to enable interoperability in The Netherlands’, May 2010). Further standardisation within the Dutch committee for electric vehicle related standards (NEC 069) of this agreement was stopped due to severe security risks. No further standardisation effort is active on this matter in The Netherlands: i.e. the approach with its security risks is being used within The Netherlands by the main operators of charging infrastructures. This means for now, first period of 3 years charging is fixed fee per year, it is not seen as an issue. But this needs to be solved when other business models are used.

4.6.1 Use case and charging point

For reference we list here the part of the use case where standardization for the charging point would be recommended, several parts are already available now:

- Park car at charging point
- Connect/Plug in (right plug and cable)
  - Requires standard plug, power, communication handshake interface, all available
- Begin of charging process

* Exchange options and requirements from vehicle and BMS/battery (speed of charging, target setting and charge scheduling)
    * Requires standard, e.g. ISO/IEC 15118 could be used here
* Start charging process (including charge controlling and rescheduling)
    * Requires standard for Battery Monitoring, can be battery/vehicle specific
* Metering
    * Used energy, and optionally maximum power
* Billing/payment, how (in case of no identity: cash, credit card)
    * Requires standard for Billing Data, Billing Information, covered partly in some of the standards
* End charging, unplug.

4.7 Summary

Also in the standards used on charging points several overlaps and non-homogeneities have been identified.
As for charging modes, although Mode 3 is the most diffuse and spread in Europe, all the different modes are still in use. This may be related to different kinds of charging points (public, semi-public, private, etc.), but it can anyway be an obstacle to interoperability, if it is not properly known and addressed.
At the same way, also concerning socket outlets, Type 2 (from 62196-2) is the most diffuse one, but also Type 1 and Type 3, as well as industrial (60309) and Schuko outlets are mentioned as used in some demonstration projects (mainly related to mode 2 of charging).

The second survey has given specific indication that Schuko and Type E/F sockets are used in Mode 1 for e-bikes, light EVs and Mode 2 for the vehicles pointing out that some extensive tests has revealed that sockets could face overheating when use on a daily basis even at low power , About Type 3a connector, in Italy is the preferred solution for charging LEVs.
The minimum power level for semi/public charging stations emerged from the survey is 3.7kW, but 22kW is considered more suitable for the reason of usability and optimized service with short charging times. It has been point out that is important to define a maximum power level (43 kW) due to safety regulation and grid impact.

For AC charging cables used (both public and private area) most of the respondents consider that there is no need for national standards but this type of cables should be at least standardised on European level.

In general fast DC charging is specified in IEC 61851-23. For the installation of DC charging points in petrol stations some general national/European regulations apply (as Low Voltage, Explosive Atmospheres, work-related risk of injury by electric hazard, safety and health recommendations and Pollutions) but there is a need to define procedures and specific regulations regarding fast charging installation not only DC but also AC.

The Inductive charging is considered an emerging technology that might integrate the traditional conductive charging method but, at the moment, it suffers from a lack of standards even if besides some national technical documents, some standardisation works are in progress at SAE, IEC and ISO level.

Also the issue about identification (ISO/IEC 14433 and ISO/IEC 15118) turns out to be very important toward interoperability and are addressed in WP7 and eMI3. Common identifiers are described in eMI3 and are already in use in ISO/IEC 15118. Identification with RFID and NFC is addressed in German DKE and has now started on IEC level in IEC 62831.

4.8 Comparison with external Stakeholders position

The already mentioned report of the CEN CENELEC Focus Group gives many recommendations both about charging and socket outlets.

Concerning the most critical case of public AC charging, it is recommended that this is done using mode 3 and that charging stations used by the general public should offer at least mode 3 AC charging to ensure interoperability. Additionally high power AC and/or DC charging might be offered.
Additional requirements for functional safety of the charging station should also be considered by the appropriate Technical Committees in future work on IEC 61851-1 and/or IEC 61851-22 (AC) and IEC 61851-23 (DC).

In the field of plugs and socket outlets, the Focus Group recommends to define one unique footprint with five power contacts covering applications from 1 phase to 3 phases & neutral (from 16 to 63 A minimum) with protective earth and additional 2 auxiliary contacts for control system according to mode 3 of a future EN 61851-1. Type 2 or Type 3-c of the future EN 62196-2 will correspond to this definition. However, small compact connector designs for vehicles of lower categories (L1 to L5) should also be considered).

Since for the near future an agreement on such a unique footprint appears difficult to be obtained, the Focus Group has also listed the following propositions as potential solutions to reach interoperability:

- Use of an additional charging cord-set in border districts (considering both socket-outlets feature a similar pin out, which means that with an adapted cord-set it will always be possible to charge in mode 3 on any charge spots either with a type 2 or a type 3c socket outlet);

- An exchangeable head plug on the cord-set, so that users can simply switch on a same base different plug heads when crossing a border;

- In public charging spots, including an additional attached cord-set, secured to the spot (through a fixed ring or similar) to be plugged on the spot socket-outlet and connected to the car, for cross-border users (the secured attached cord-set to the spot could also be used by the drivers who did not bring their own charging cord-set). This has been supported by some experts, whereas some other stakeholders have rejected this proposal, since a fixed cord-set on public charging station is strongly subjected to vandalism, thus reducing the availability and compromising interoperability;

- Use the type 2 socket-outlets as specified in IEC 62196-2 in combination with appropriate means to comply with existing and applicable (national) regulations. This might be achieved by adding external supplementary elements to existing charging station designs;

- For captive fleet vehicles in a mode 3 context, EN 60309-2 may be used, but this is not recommended as a candidate for a unique mode 3 charging system;

- Appropriate requirements and test for the robustness of accessories need to be investigated to achieve a high availability especially for outdoor applications. These requirements should be added to IEC 62196 standards by CENELEC SC 23BX and/or IEC SC 23H based on the experiences of field operational tests.

5 Connection to the Grid standardization issues and needs

This chapter describes the status, issues and needs of the standards on connection to the grid.

5.1 Smart charging in general (new in version 2)

This section is written on the basis of the replies from the following questions:

- *What standards protocols proposals are now available for use for smart charging, the combination of user friendly, grid friendly, battery friendly, and energy friendly charging?*
- What is your view on the types of smart charging and the needs of these?

A general suggestion proposes not to focus on smart charging initially during the market introduction until 2014 but to focus on interoperability in combination with the implementation of an eMI3 Market Place/Clearinghouse Reference Architecture.

Most of the respondents have indicated ISO/IEC 15118 as the standard available for smart charging with focus on bidirectional management.

A respondent has pointed out that smart charging as a business process requires two main technology developments: compliant communication protocols between EV and EVSE and between EVSE and EVSE Operator, and a specific exchange of information that should take place between EVSE Operator back-end system and other IT systems managed by ecosystem stakeholders, including EVSP and DSO.
On the first area, ISO/IEC 15118 addresses communication needs between EV and EVSE, while there is currently only a handful of proprietary backend communication protocols supporting smart charging. Standardization work is currently ongoing in eMI3 working group 5 on backend communication protocols.

A utility has referred that the European Union intends to develop a Grid Code for all loads that will be providing services to the electricity system similar to what exists for generators. This Grid code is called “Demand Connection Code” and its development is being coordinated by the ENTSO-E (Association of European transmission system operators). This code should define all the technical requirements for the provision of services to the electricity grid and is has been published in October 2013.

A respondent has expressed these opinions:
If the “time of use” menu is already available in the retail electricity market, we can regard EV as one of such electrical equipment, and relatively easily integrate it into the current HEMS (Home Energy Management System) system.
It would also be possible to set the EV exclusive special electricity rate and construct information/ communication route for EV smart charging, but it might take some time for realization of such ideas.
Effort to overview such attempts are underway at IEC TC8 use case groups. There is a discussion regarding EV in that group, and result will be coming out soon.

The view on types of smart charging and the needs of these, emerging from the answers, are the following:

- Smart charging means that a driver lets a portion of his on board battery used to absorb redundant electricity in exchange for its option value.

The types of smart charging will depend on the available time to charge, the pollution emission of the charge and the load management by EVSE, regarding requests from utility or EVSP.

The smart charging which establishes the most interesting value chain with a considerable impact on the LV/MV grid is the grid friendly smart charging, as it has been described in the deliverable 4.2[7] of Green eMotion project.

- Interruptible load in frequency / voltage response
- Restored load in frequency / voltage response
- Phase balancing through smart inverters
- Peak shaving, load shaping applicable in V2G or V2H scenarios

This are important topics for revision of or inclusion in IEC61851-21.

There is a strong need to make use of the advantages of smart charging. To handle all the mentioned combinations it has to be clarified in which way they shall be treated to further e-mobility, e.g. if user or grid topics shall be treated with high priority or not etc.

In the survey further questions on Smart Charging have been:
"In case you manage a Green eMotion "test cases" (in WP8), what types of Smart Charging do you apply and how? Which standards are involved?".

The types of Smart Charging applied in in test cases tare the following:

- Controlling the charging according to utility demands and customer service level agreements thereby starting and stopping the charging when needed

Mode 3 type 2 charging infrastructure connected with an EVSE Back-end System.
Mode 4 + Storage system with a peak reduction objective.

Grid-friendly smart charging test cases are being described by the partner, to be deployed within Task 8.1.4 as a Marketplace related demonstrator, put in the context of a Large Scale Load Management scenario in which (grid-friendly) smart charging (that is basically the load management from the user perspective) activities are deployed by EVSE Operators after receiving load management requests from DSOs though dedicated B2B services published on the Marketplace focused on smart charging processes to be happening in a specific subsection of the LV/MV grid operated by the DSO.

Within the load management scenario, there are also some V2G related B2B services designed as basic building block for future applications, e.g. the aggregation of SoC information from the EVs in a certain load area, the aggregation of usage information of charging points in a certain load area.

The partner that manages the test case, in a specific region, has deployed a Smart Grid at substation and customer level with installation of Smart Meters. The communication between the Smart Meter and switches/hubs is bidirectional and is carried through protocol PRIME (PLC protocol). The communication between the switch and the management system of charging is done via Ethernet. In this region, within the Smart Grid, the partner has an EVSE with a CP and an EV from the fleet car-sharing service for its employees.

The test cases on load management are not finalized yet. As soon as the test cases will be developed, available partners involved intent to apply them.

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[7] http://www.greenemotion-project.eu/upload/pdf/deliverables/D4.2_Recommendations_on_grid-supporting_opportunities_of_EVs_V1.2_March2013.pdf

At the last question of the Smart charging section*: "Do you have other remarks on standards, interoperability or requirements with respect to smart charging"* no one has reported any remarks.

In the section dedicated to new areas, it was asked: *Are there other/"new" areas with promising business models, that needs to be embedded in standards?*

The scope of the question was to bring out other "new" areas with promising business models but not, at the moment, not completely covered by standardization activities.

The answers given have pointed out the following topics:

Mobile DC charging devices for vehicles that have run out of energy**.**

A new business model for a fleet operator to smart charge EVs beyond EVSEs is emerging, and it should be considered as the installed base of metered grandmother plugs. This could, in short term, exceed EVSEs. Please see this link[8] for a proposed interface.

Load management functionality covering V2G topics, communication and identification

Battery switch systems (a new WG was recently established by IEC TC 69).

5.2 V2G (new in version 2)

This new paragraph is written on the basis of the answers given to the following question:
"We consider adding V2G as long-term option, but we can start to influence requirements, options and standards now. What should and can be defined for V2G now?".

As already indicated for smart charging, there is a general suggestion of addressing V2G longer term and to concentrate resources first on interoperability. Since DSO/utilities leads, initiatives are already moving forward. eMi3 (TNO and IBM) initiated an exchange and elaboration of a common view of the smart charging challenges between the different stakeholders (DSO, utilities, OEMs, Service Providers). So this is now explicitly on the eMI3 agenda.

V2G is seen as a long-term option that does not economically make sense until EVs come to the market in millions. Efforts to get an overview of such topics are underway at IEC level. There is a discussion at IEC TC8 EV use case group, and we should refer to their result which is coming out soon. In the meantime, V2H is a good option to follow up.

Another general suggestion is to include all the communication needs in the protocols, in order to be sure that the V2G connection should have all the information to be made in an optimal way.

From the answers given emerge that V2G should provide the possibility to gather the SoC from the EV as a basic step to understand the availability of energy that should be injected in the LV/MV grid as a consequence of the energy flow change of direction during the charging process. In any case the impact on the battery lifetime for V2G should be deeply analyzed.
Another aspect that has been pointed out in the answer to questionnaire is that the requirements need to depend on the services that will be provided. At least there should be an interaction with

[8] http://www.zurich.ibm.com/pdf/ecogrid/b2bprotocol_ver1.1.pdf

the electricity system actor that needs the service (or with an aggregator) in order to receive a signal asking to discharge energy and the ability to measure how much energy is discharged.
If the smart charging service is primary frequency response the EV should be able to measure the frequency locally in order to respond to frequency deviations.
The "Demand Connection Code" should define some requirements that can be translated to the V2G services.

A utility has reported that the communication EVSE – EV for V2G applications has been already developed by a CHAdeMO draft. A release of V2H Guideline 1.0 was done in November 2013 . This technology will be deployed in Japan in the short term, and in the medium term in Europe. In a Medium and Long Term scenario, the Load Management requests communication from the actors of e-mobility. The landscape should include V2G.

A respondent has pointed out interfaces, specifically the communication requirements, signals from the power utilities. The potential of V2G might be lower in individual cars than the potential of a larger pool of energy to grid, e.g. such as from a storage facility with many batteries rather than 'lifting' a few percent from different cars.

A utility has pointed out that reverse energy flow is actually investigated in some test cases and resulting safety requirements will consequently be introduced in the IEC 61851 series.

A respondent has indicated identifiers for the grid structure (PoD, load area) and basic conditions regarding to the grid impact (power quality etc. on EV and EVSE side).

A respondent has pointed out that it is quite well documented by Enel and Endesa in D3.3[9] Chapter 4 and D4.2[10]
One of the respondents has presented the V2G concept used in PowerUp Project in which has been implemented two possible approaches for V2G functionality:

- One is based on protocol ISO/IEC 15118-2 used for the communication between EV and Electric Vehicle Supply Equipment (EVSE) while for the communication between EVSE and the Load Balancing Controller (LBC), placed at the MV/LV substation, an extended form of DLMS/COSEM (IEC 62056) has been implemented
- In the other a direct communication between EV and LBC using the protocol ISO/IEC 15118-2 is foreseen.

[9] http://www.greenemotion-project.eu/upload/pdf/deliverables/D3_3-Business-Services-Use-Cases-and-Requirements-V1-5-submitted.pdf
[10] http://www.greenemotion-project.eu/upload/pdf/deliverables/D4.2_Recommendations_on_grid-supporting_opportunities_of_EVs_V1.2_March2013.pdf

5.2.1 Information from the PowerUp Project

Within PowerUp Project, the V2G concept is envisaged under the architecture presented in figure 5-1.

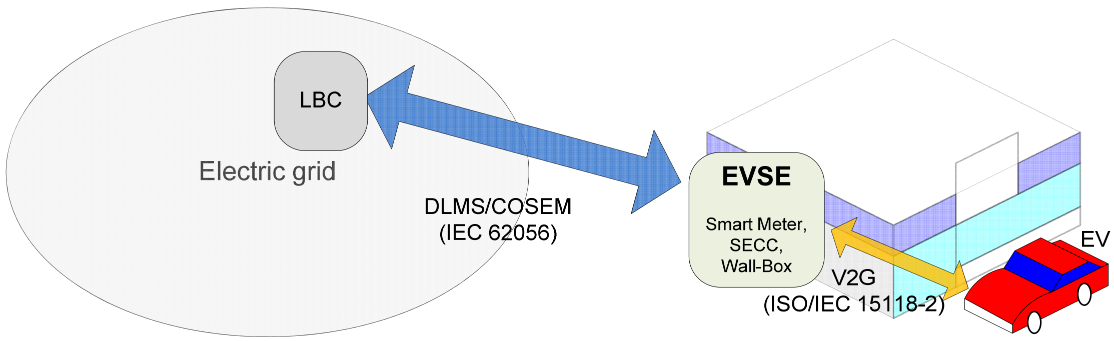


Figure 5-1 Architecture for charging controlled by V2G and DLMS/COSEM (PowerUp Del.3.2[11])

The protocol ISO/IEC 15118-2 has been used for the communication between EV and Electric Vehicle Supply Equipment (EVSE). For the communication between EVSE and the Load Balancing Controller (LBC), placed at the MV/LV substation, an extended form of DLMS/COSEM (IEC 62056) has been implemented.

A second approach for V2G functionality is presented in Figure 5-2. Here there is a direct communication between EV and LBC using the protocol ISO/IEC 15118-2.

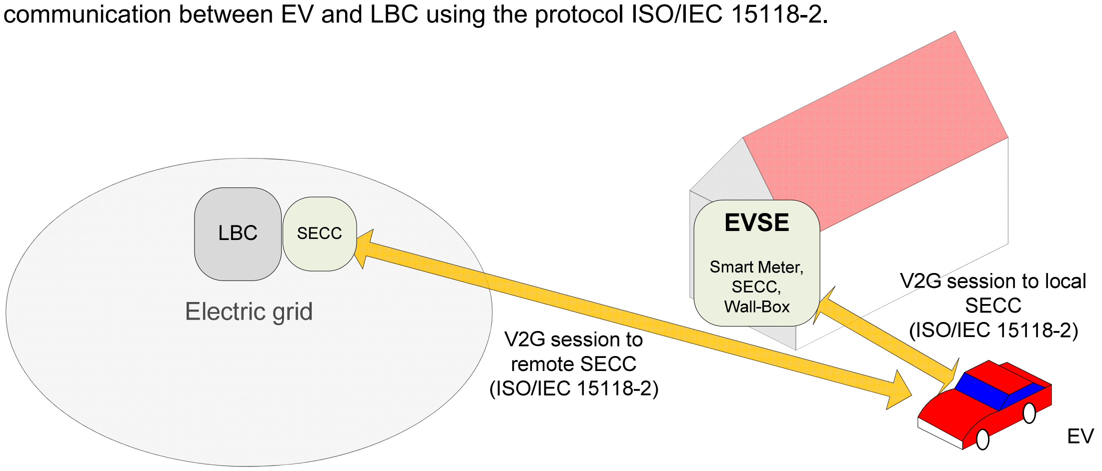
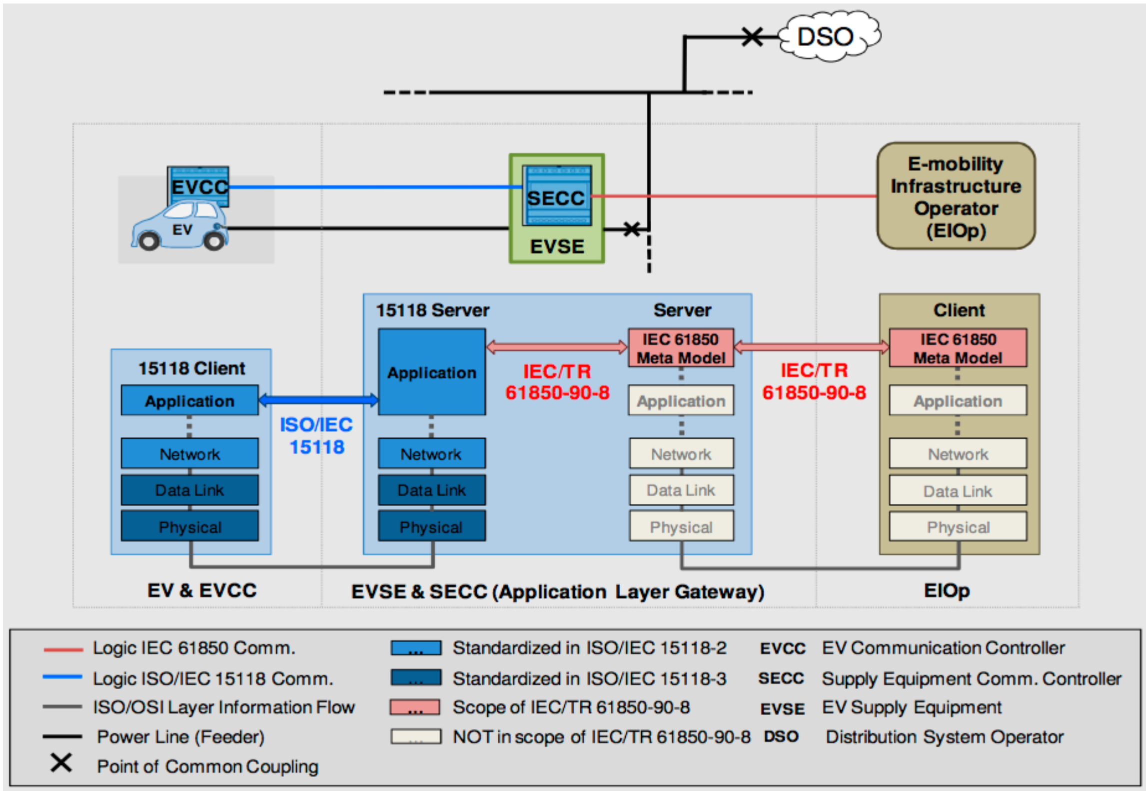


Figure 5-2 Architecture for charging controlled by V2G protocol only (PowerUp Del.3.2)

The second option, a V2G session directly to the LBC is - from a technical point of view - the simplest way of regionally managing EV recharging processes. As illustrated in Figure 5-3, this approach also allows the integration of 'Distributed Energy Resources' management framework, specified by the IEC 61850-90-8 standard.

[11] http://www.power-up.org/wp-content/uploads/2012/10/PowerUp_D3.2_Final_V2G_Architecture.pdf



(Source: 'Object Model for E-Mobility' presentation by Claus A. Andersen)
Figure 5-3 Architecture for a V2G session directly to the LBC

5.3 Basic standards on connection to the grid in use or intended use

In the survey we asked which of the 'basic' stands are being used like:

- J2847-X (Communication with EV)
- IEEE P1901 (Broadband over Power Line Networks)
- J1772 (Conductive Charge Coupler)
- IEC 60364-X-X (Protection)
- J2293-X (Energy Transfer System)
- IEEE P2030 (Draft Guide for Smart Grid Interoperability)

Only IEC 60364 and J1772 were often mentioned in the survey results. We will now list and describe these basic standards and the information received in the survey related to that, the other 4 will be described on section 5.2 on other standards. Note that where is written as being used, this can also mean as being used in the future.

5.3.1 IEC 60364-4 (Protection for Safety)

Concerning electrical installation of buildings, the LV installation shall be according the requirements of the IEC 60364 series of TC 64, Low-voltage electrical installations.

The following standards are seen to be important:

- IEC 60364-7-722, Electrical installations of buildings - Part 7-722: Requirements for special installations or locations - Supply of Electrical Vehicle
- IEC/ NP 60364-7-760, Electrical installations of buildings – Part 7-760: Electrical vehicle
- IEC 60364-4-41, Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock

In the survey most electric utilities explicitly mention the use of this standard.
Examples of mentioned standards are:

- IEC 60364-4-43, IEC 60364-4-443 over current, over voltage protection
- NFC 15100 Low voltage electrical installation, a French standard, related to IEC 60364
- IEC 60364-4-44 Protection for safety - Protection against voltage disturbances and electromagnetic disturbances
- IEC 60364-4-46 Isolation and switching

5.3.2 J1772 (Conductive Charge Coupler)

J1772 is the SAE Electric Vehicle Conductive Charge Coupler standard.
It covers the general physical, electrical, communication protocol, and performance requirements for the electric vehicle conductive charge system and coupler. For more details on this standard see chapter 3.

This standard is mentioned multiple times in the survey by respondents but most often in relation to the Electric Vehicle. The remarks related to connection to the grid are mainly from electric utilities but do not reveal more detail than that it is used as standard in their systems.

5.4 Other standards or non-standard solutions on connection to the grid

Other standards or non-standard solutions on connection to the grid in use or planned use. Besides the basic standards here the other standards that were mentioned in the connection to the grid area:

- ISO / IEC 15118 Vehicle to grid communication interface
- IEC 61850 Communication network and systems in substations
- J2847 Communication between Plug-in Vehicles and the Utility Grid
- J2293 Energy Transfer System for Electric Vehicles
- IEEE P2030 (Draft Guide for Smart Grid Interoperability)
- ET 101 National Rules for Electrical Installations
- CEI 0-16 technical rules for the connection
- CEI 0-21 technical requirements for connecting electrical users

5.4.1 ISO / IEC 15118 Vehicle to grid communication interface

This ISO/IEC 15118 Vehicle to grid communication interface consists of several parts; the details are described in chapter 6.1.1. ISO / IEC 15118 Vehicle to grid communication interface.

It is mentioned once in the survey as being used for connection to the grid in the area of developing BMS and charging systems.

5.4.2 IEC 61850 Communication network and systems in substations

The IEC 61850 Communication network and systems in substations is in detail described in chapter 6.1.2.

It is mentioned once by an electric utility in the survey as being used.

5.4.3 J2847 Communication between Plug-in Vehicles and the Utility Grid

J2847 Communication of EV consists of three parts.

- J2847-1 Communication between Plug-in Vehicles and the Utility Grid; Establishes requirements and specifications for communication between plug-in electric vehicles and the electric power grid, for energy transfer and other applications.
- J2847-2 Communication between Plug-in Vehicles and Off-Board DC Chargers establishes requirements and specifications for communication between plug-in electric vehicles and the DC Off-board charger.
- J2847-3 Communication between Plug-in Vehicles and the Utility Grid for Reverse Power Flow (RPF); Establishes the communication structure between plug-in electric vehicles and the electric power grid for reverse power flow.

Since J2847-1 J2847-3 focuses on communication with the Utility Grid these are described here further. J2847-2 is described in section 6.1.5.

The SAE J2847-1 establishes requirements and specifications for communication between plug-in electric vehicles and the electric power grid, for energy transfer and other applications. They describe it with:

“The SAE J2847-3 document supports RPF and this series is based upon requirements jointly developed by vehicle manufacturers, electric utilities, grid operators, technology suppliers, and other stakeholders.
These requirements are reflected in SAE Information Report SAE J2836-1™, Use Cases for Communication between Plug-in Vehicles and the Utility Grid. These requirements fulfil the use cases described in SAE J2836-2™, Use Cases for Communication between Plug-in Vehicles and Off-Board DC Charger. Whereas SAE J2293 focused on communication between the vehicle and local, off-board electric vehicle supply equipment (EVSE) with optional grid interaction, SAE J2847-1, SAE J2847-2 and SAE J2847-3 focuses on communication between the vehicle and grid, with the EVSE playing the role of local intermediary. Additionally, while SAE J2293 included support for SAE J1773-based inductive charging and SAE J1850-based communication, these are obsolete and hence not supported by SAE J2847. The latest specification includes several changes that have occurred since 1997 (when SAE J2293 was published) in the technologies of electric vehicles, the grid, and information processing, including: (1) support for bi-directional energy transfer between vehicle and grid (FPF and RPF, as defined above); (2) support for new local communications media between vehicle and EVSE (to replace SAE J1850), such as power line communication (PLC), Controller Area Network (CAN), and wireless transports (ZigBee, Wi-Fi, etc.); (3) synchronizing with a major revision of SAE J1772™ which includes new connectors and signals between the vehicle and EVSE, and additional AC and DC power levels; (4) support for new vehicle architectures such as plug-in hybrid (PHEV) and plug-in fuel cell (PFCV) vehicles; (5) support for new rechargeable energy storage system (RESS) technologies and packaging methods; (6) support for vehicle telematic communication transports; and (7) support for new developments in both utility and customer premises equipment, such as advanced metering infrastructure (AMI) and home-area network (HAN) technologies. The above changes and others require a new approach to vehicle-grid communications and provide the fundamental rationale for this specification. In the context of this, the DC Supply is considered an extension of the on-board

vehicle systems. For the most part, the DC supply acts in response to vehicle requests; it does not act autonomously. The DC Supply does not contain intelligence about the RESS system or specific vehicle operation. It only mitigates some safety related concerns that it is able to self-detect (isolation), and it conforms to the vehicle established charge session limits (from handshaking). Primary control of the charging output is dictated by the vehicle control system."

Car manufacturers mention in the survey that they support this standard.

5.4.4 J2293 Energy Transfer System for Electric Vehicles

J2293/1 Energy Transfer System for Electric Vehicles--Part 1: Functional Requirements and System Architectures handles communication between the vehicle and local, off-board electric vehicle supply equipment (EVSE) with optional grid interaction.
The standard describes:

- Bi-directional energy transfer from the vehicle to the utility grid (V2G),
- Updates the communication medium from SAE J1850 to either Power Line Communication (PLC) or wireless,
- Conforms to a major revision to SAE J1772. Plug-In Hybrid (PHEV) and Plug-In Fuel Cell Vehicles (PFCV) and may require unique communication aspects.

This standard is mentioned only once in the survey by respondents as being used.

5.4.5 IEEE P2030 (Draft Guide for Smart Grid Interoperability)

IEEE 2030 is an IEEE project developing Draft Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), and End-Use Applications and Loads. P2030 will provide guidelines for smart grid interoperability. It will provide a knowledge base addressing terminology, characteristics, functional performance and evaluation criteria, and the application of engineering principles for smart grid interoperability of the electric power system with end-use applications and loads. It will also discuss alternate approaches to best practices and how to minimize the impact of lagging participants on compliant ones.

This guideline is not mentioned in the survey by respondents.

5.4.6 ET 101 National Rules for Electrical Installations

ET 101: 2008 National Rules for Electrical Installations, 4th edition, is a standard in Ireland.
These Rules apply to electrical circuits supplied at nominal voltages up to and including 1000V AC or 1500V DC which form part of installations in residential, commercial, industrial or public premises, or of installations contained in prefabricated buildings, caravans and halting sites, as well as installations for specialised purposes, such as those in agricultural and horticultural holdings.

The pilot site in Ireland mentioned in the survey that they use this standard.

5.4.7 CEI 0-16 technical rules for the connection

CEI 0-16 Reference technical rules for the connection of active and passive consumers to the HV and MV electrical networks of distribution companies.

This national Italian standard is being used by an Italian grid utility as mentioned in the survey.

5.4.8 CEI 0-21 technical requirements for connecting electrical users

CEI 0-21 Reference technical requirements for connecting active and passive electrical users to LV networks of electrical supply companies

This national Italian standard is being used by an Italian grid utility as mentioned in the survey.

5.5 Standards or extension to standards on connection to the grid missing

None of the respondents of the survey mentioned that they miss standards or extension to standards on connection to the grid.

5.6 Other issues or needs with respect to standards on connection to the grid

No other issues or needs with respect to standards on connection to the grid were mentioned in the survey.

5.6.1 Use case and grid connection

From the use case mentioned in the first chapter we can define the need for:

- Exchange options and requirements from grid (for example controlled/delayed charging)
    - Requires standard for Supply Demand Management, charging options, Dynamic Electricity Rates, Vehicle 2 Grid Communication.

Within Green eMotion the task T4.2[12] "EV charge management incl. Communication protocols' will come up with proposals for implementing these use cases and the necessary standards.

5.7 Comparison with external Stakeholders position

The already mentioned report of the CEN CENELEC Focus Group gives also recommendations about smart charging and connection to the grid.

Recommendation they make which are related to connection to the grid are:

- For the optimisation of electro-mobility and energy use, it is deemed to be indispensable to move toward charging electric vehicles in a smart way. Standardization issues should be addressed by the CEN-CENELEC-ETSI Smart Grid Coordination Group, in liaison with the CEN-CENELEC Electro-Mobility Coordination Group. This reconfirms the need to follow standardisation activities in Smart Grids.
- It is recommended to analyse the rules for grid connection at national level. Over the most countries in Europe, there are regulations for the grid connection of electric equipment. As some examples, in Austria this is the TOR D (Technical and Organisational Regulations), in Switzerland, Germany, Czech Republic and Austria the DACH CZ Rules are used to estimate the system perturbation of electric equipment. All phenomena below 10 kHz such as flicker, unbalance, or harmonics are usually studied. It is important to deal with this topic, otherwise EV charging will not be permitted on a large scale.

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[12] http://www.greenemotion-project.eu/upload/pdf/deliverables/D4.2_Recommendations_on_grid-supporting_opportunities_of_EVs_V1.2_March2013.pdf

6 Communication standardization issues and needs

Besides standards for the connection between electric vehicle and charging point also standards regarding data communication between the electric vehicle and the charging infrastructure are a critical and important point in the harmonisation of technology and standards for electro-mobility.

CEN and CENELEC have therefore established a common Focus Group which was tasked with considering European requirements relating to electric vehicle standardization, and assessing ways to address them. The Focus Group, chaired by Dr Cyriacus Bleijs (EDF), finalized a Report on Standardization for road vehicles and associated infrastructure responding to Commission Standardisation Mandate M/468 concerning the charging of electric vehicles. A second version of this report "Standardization for road vehicles and associated infrastructure" is released, see this link.[13]

As reference here their figure with an overview of functions in electro-mobility data communication.

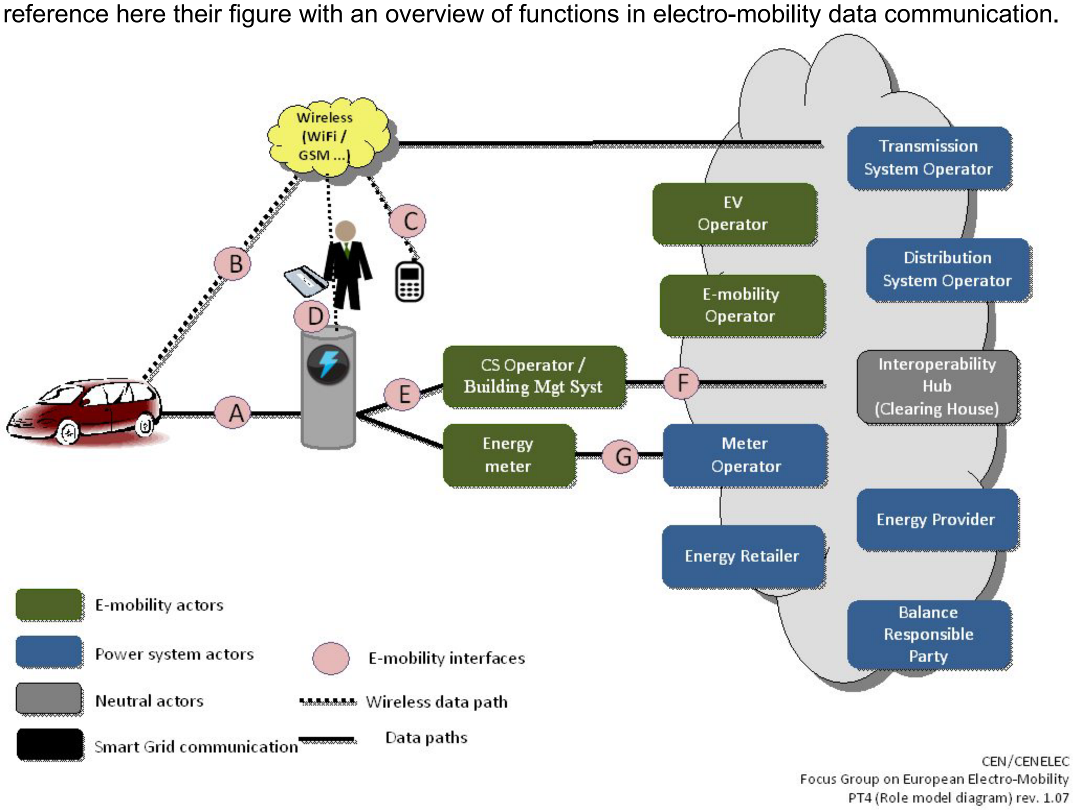

Figure 6-1 Overview of functions in electro-mobility data communication

This figure is not intended as a final actor list. For example some Service Providers might be players as well. In WP3 we speak about Value-Add-Services which might be offered by third parties. Also the community could be a relevant player (maybe as third party or CP Operator).
In this chapter we will describe the results of the survey in the area of communication standardization issues and needs. The description starts with the most common standards used, listing other standards used, missing standards and other issues and needs.

[13] ftp://ftp.cen.eu/cen/Sectors/List/Transport/Automobile/EV_Report_incl_annexes.pdf

6.1 Basic standards on communication in use or intended use

In the survey we asked which of the 'basic' standards are being used like:

- ISO / IEC 15118 Vehicle to grid communication interface
- IEC 61850 Communication network and systems in substations
- IEC 62056 Data exchange for meter reading
- J2931 Power Line Carrier Communications for Plug-in Electric Vehicles
- J2847 Communication of EV
- ZigBee SEP 2 Common messaging

Besides these also several other standards were frequently mentioned and can be seen as possible basic standards for communication like:

- Home Plug Green PHY, (HomePlug GP), a specification for smart grid / energy applications
- Wi-Fi IEEE 802.11, collection of standards for wireless networks
- OCPP Open Charge Point Protocol, a communication protocol
- GSM
- GPRS
- UMTS (3G)

We will now list and describe the basic standards and the related information received in the survey. Note that where is written as being used, this can also mean as being used in the future.

6.1.1 ISO / IEC 15118 Vehicle to grid communication interface

This ISO/IEC 15118 Vehicle to grid communication interface consists of 8 parts (first three are publically available, part 4/5 to become available shortly, rest is work in progress):

- Part 1: General information and use-case definition
- Part 2: Technical protocol description and Open Systems Interconnections (OSI) layer requirements
- Part 3: Wired physical and data link layer requirements
- Part 4: Network and application protocol conformance test
- Part 5: Physical layer and data link layer conformance test
- Part 6: General information and use-case definition for wireless communication
- Part 7: Network and application protocol requirements for wireless communication
- Part 8: Physical layer and data link layer requirements for wireless communication

Figure 6-2 (from Rich Scholer, Ford Motor Company, SAE J2836, J2847, and J2931 Task Force Chair) describes the location of these and similar SAE standards in the 7 layer OSI model.

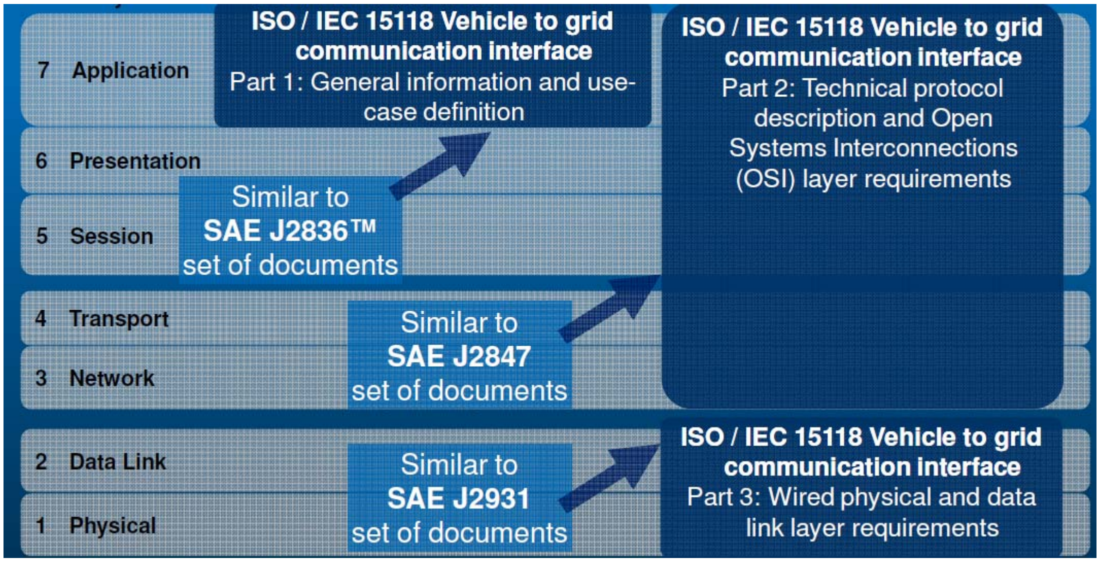

Figure 6-2 ISO/IEC 15118 and SAE standards in the 7 layer OSI model

Survey results on ISO/IEC 15118: several car manufacturers and utilities are contributing to the development of the ISO/IEC 15118-series and support for the identification process at the charging point ISO 15118-1 as authentication and authorisation as a valid and cost-effective alternative to an RFID card. Some are already in the process of implementing the ISO/IEC 15118 standard in all EVs from 2012/2013 onwards. Since the ISO 15118 series is closely aligned with the SAE J2931, J2847, some support these as well.

Electric utilities plan to use ISO / IEC 15118, some not yet; the protocol is being studied at research level to be eventually implemented, it will be used for AC as well as DC charging.

6.1.2 IEC 61850 Communication network and systems in substations

IEC 61850 Communication Networks and Systems in Substations. A substandard of this is IEC 61850-7-420 - Communications systems for Distributed Energy Resources (DER) - Logical nodes. This standard should be considered for smart grid integration of electric vehicles. Electric vehicles are basically battery storage systems that could act as a distributed power source to the grid or at least as controllable demand. When penetration of electric vehicles increases this can become an important feature or even a necessity.

More general EV standards need to be aligned with Smart Grids standards since Electric Vehicles are a complex and special component of the future Smart Grid. It uses electricity at different points in the electricity network, is not always connected, can store energy, can potentially feed energy back into the system, and has flexibility that can be used for Supply Demand Management (SDM).

In the survey only electric utilities mention IEC 61850 as being used. Some for communication from charging point and Network Operation Center, in other areas it is used at research level only. Specifically mentioned are:

- IEC 61850-1 (Introduction and overview)
- IEC 61850-2 (Glossary)
- IEC 61850-4 (System and project management)

6.1.3 IEC 62056 Data exchange for meter reading

IEC 62056 is the DLMS or Device Language Message Specification. The IEC TC13 WG 14 defines the DLMS specifications under the common heading: "Electricity metering - Data exchange for meter reading, tariff and load control."

In the survey it is not mentioned often but some EVSE plan to use IEC 62056 for the meter reading.
An electric utility mentions:

- IEC 62056-61 Object identification system
- IEC 62056-62 Interface classes, specifies a model of a meter as it is seen through its communication interface(s). Generic building blocks are defined using object-oriented methods, in the form of interface classes to model meters from simple up to very complex functionality.

In the survey a utility and an EVSE mention this standard.

6.1.4 J2931 Power Line Carrier Communications for Electric Vehicles

J2931 Power Line Carrier Communications for Plug-in Electric Vehicles is an SAE Recommended Practice that establishes the digital communication requirements for the Electric Vehicle Supply Equipment (EVSE) as it interfaces with a Home Area Network (HAN), Energy Management System (EMS) or the Utility grid systems. This Recommended Practice provides a knowledge base addressing the communication medium functional performance and characteristics, and interoperability to other EVSEs, Plug-In Vehicles (PEVs) and is intended to complement J1772™ but address the digital communication requirements associated with smart grid interoperability.

As mentioned in the description of the ISO/IEC 15118 series it is closely aligned with ISO/IEC 15118 Part 3.

The survey reveals that some electric utilities have implemented J2931 in the charging infrastructure but not used it. A car manufacturer comments: since the ISO/IEC 15118 series is closely aligned with the SAE J2931, J2847 we will support these as well.

6.1.5 SAE J2847/2 Communication of EV

J2847 Communication of EV consists of three parts.

- J2847/1 Communication between Plug-in Vehicles and the Utility Grid; Establishes requirements and specifications for communication between plug-in electric vehicles and the electric power grid, for energy transfer and other applications.
- J2847/2 Communication between Plug-in Vehicles and the Supply Equipment (EVSE); Establishes use cases for communication between plug-in electric vehicles and the electric power grid for reverse power flow.
- J2847/3 Communication between Plug-in Vehicles and the Utility Grid for Reverse Power Flow; Establishes the communication structure between plug-in electric vehicles and the electric power grid for reverse power flow.

Since J2847/1 J2847/3 focus on communication with the Utility Grid these are further described in paragraph 5.2.3.

This SAE Recommended Practice SAE J2847-2 establishes requirements and specifications for communication between plug-in electric vehicles and the DC Off-board charger. Where relevant, this standard notes, but does not formally specify, interactions between the vehicle and vehicle operator. This applies to the off-board DC charger for conductive charging, which supplies DC current to the vehicle Rechargeable Energy Storage System (RESS) of the electric vehicle through a SAE J1772™ Hybrid coupler or SAE J1772™ AC Level 2 type coupler on DC power lines, using the AC power lines or the pilot line for PLC communication, or dedicated communication lines. The specification supports DC energy transfer via Forward Power Flow (FPF) from source-to-vehicle.

The survey reveals that some car manufactures use J2847 since the ISO 15118 series is closely aligned with the SAE J2931, J2847 they support these as well.
Another car manufacturer writes: "In the future, we will implement PLC standard as defined by current working groups"
An electric utility has developed its own PLC communication protocol, available on 20 PHEVs.

6.1.6 ZigBee Smart Energy Profile 2 (SEP 2)

The ZigBee Alliance, an ecosystem for creating wireless solutions for the energy management use in commercial and consumer applications, and the Society of Automotive Engineers (SAE) announced begin 2011 their collaboration on ZigBee Smart Energy standard development.

The ZigBee Smart Energy V2.0 specifications define an IP-based protocol to monitor, control, inform and automate the delivery and use of energy and water. It is an enhancement of the ZigBee Smart Energy version 1 specifications, adding services for plug-in electric vehicle (PEV) charging, installation, configuration and firmware download, prepay services, user information and messaging, load control, demand response and common information and application profile interfaces for wired and wireless networks.

From a one of their press releases:
"The efforts by both the agencies are expected to make ZigBee Smart Energy the most sought after technology supporting Plug-In Electric Vehicles (PEV) and enabling essential vehicle to grid (V2G) communication and power capabilities, company officials said.
ZigBee Smart Energy is the home area network and metering infrastructure standard for the Smart Grid.
The association recognizes the important role SAE plays as the focal point for integrating automobile communication with emerging energy management requirements by defining how PEVs and the grid interact will be one of the goals of the two groups. For this, the groups will be using ZigBee Smart Energy.
The joint initiative will offer future PEV drivers with the real-time information to control their transportation energy use, manage their charging costs and receive utility incentives for participating in PEV programs. It will also provide the essential control functions to safely manage the charging of PEVs while maintaining grid integrity, company officials said."

Although not mentioned by respondents of the survey the ZigBee Smart Energy Profile 2 should be checked as a standard. Also because The Home Plug Green PHY is mentioned several times by also car manufacturers for future use and the HomePlug Powerline Alliance and the ZigBee Alliance have already taken the initiative last year to create a joint Smart Energy standard that wants to assure applications-level compatibility across both wired and wireless Smart Grid applications. Nevertheless, so far, there is no indication of an SEP2.0 implementation in the EU.

6.1.7 Home Plug Green PHY (HomePlug GP)

Based upon a series of on-going discussions that began years ago with leaders in the utility industry, the HomePlug Green PHY (HomePlug GP) Specification is a result of an intense standards development effort by the Smart Energy Technical Working Group within the HomePlug Powerline Alliance. Developed as a low-cost, low-power adaptation of the proven HomePlug AV standard, HomePlug GP also is compliant with the IEEE P1901 Draft Standard for Powerline Networks. In addition, HomePlug GP will benefit from the huge ecosystem of existing HomePlug AV technology solutions and the robust third-party certification systems already in place for assuring universal interoperability between HomePlug-enabled and IEEE P1901 devices.
Also this development is driven by (powerline-based) Smart Grid solutions and Home Area Network (HAN) solutions.

Car manufacturers and also electric utilities mention in their survey this Home Plug Green PHY. They will support the PLC technology Home Plug Green PHY, or as others state: PLC Homeplug 1.0 is in use, plan to use PLC homeplug Green PHY. Or a PLC solution (IEEE 1901 Profile Green PHY) is proposed when the vehicle is connected to an EVSE.

HomePlug GP is used as the communication layer in ISO/IEC 15118 and the corresponding SAE J2847.

6.1.8 Wi-Fi IEEE 802.11

"Wi-Fi" is a trademark of the Wi-Fi Alliance and the brand name for products using the IEEE 802.11 family of standards. Most of us do know IEEE 802.11, a set of standards for implementing wireless local area network (WLAN) computer communication based on 2.4 - 5 GHz frequency bands.

In the surveys it is not yet mentioned or used in Electric Vehicle communication. It is probably overkill on bandwidth and also not everywhere available. Most car manufacturers prefer a cellular-type network for communication between vehicle and ‘elsewhere’ (not being the EVSE).

6.1.9 OCPP Open Charge Point Protocol

Open Charge Point Protocol (OCPP) is an open protocol between charging stations and a managing central system (see also http://www.ocpp.nl/).
The protocol started as an initiative from E-Laad foundation in the Netherlands, aiming to create an open communication standard that would allow charging stations and central systems from different vendors to easily communicate with each other. Although initially intended for the 10,000 E-Laad charging stations in the Netherlands, the protocol has already been adopted by several similar initiatives in different countries. Consequently it has been embraced by a large number of charge point vendors and central system suppliers around the world.
OCPP charge points use several other standards like:

- IEC 61851 (mode 3)
- IEC 62196 (type 2)
- IEC 62153
- IEC 61000 EMC several parts and chapters
- EN 55022
- IEC 60529

The Open Charge Point Protocol is being used for communication between EVSE and their operators. The specification defines communications for status information, metering information, user/customer identification, firmware updates, etc.

The survey revealed that OCPP is used in two of the pilot countries and electric utilities.

Update from second survey: Open Charge Point Protocol (new in version 2):
Before summarizing here the answers we received on the question:
"How can/should Charge Point interfaces/standards ("OCPP", …) look like?"

- The OCPP 2.0 standardization will cover most of the requested requirements for a good performance and efficient communication. It will fulfil most relevant requirements for the usage of e-charging.
- From the point of view of a utility, the UNE-EN 61850 establishes a standard communications protocol that could be followed in the e-mobility landscape between EVSE, EV, EVSP and DSO.
- Charge Point Interfaces like "OCPP" should support all planned services of the GeM Market Place (see Green eMotion deliverables D3.3, D3.5, D3.6[14])
- It needs to be as business and technical oriented and should incorporate the lessons learned from projects all around the world. Furthermore it shall be developed by a known standardization body and not within consortia.
- We encourage the use of OCPP 1.2 and soon 1.5 with direct communication between the charging point and the CP operator. The alternative using REST web services between the CP provider and the CP operator should not be encouraged because of additional communication layers and operating costs.
- One reason why several current EVSE and EVSE operator back-end systems use proprietary protocols is that they can easily be enhanced. OCPP currently only covers basic functionality for managing EVSEs.
- For EVSE and Back End communication, we propose to use a protocol derived from ISO/IEC 15118 in order to enable all the services supported by this protocol.

Summarizing: OCPP could be a good starting point, but enhancements are certainly required: derived from ISO/IEC 15118, should support all planned services of the GeM Market Place, and it shall be developed by a known standardization body.
OCPP has now become part of the Open Charge Alliance. They are also member in the eMI3 group (via e-laad and Greenlots) and are willing to bring in OCPP 2.0 for standardization work on the backend communication protocol in the eMI3 working group 5.

6.1.10 OCHP Open Clearing House Protocol (new in version 2)

On the question: "How can/should Clearing House and other backend-services interfaces/standards ("OCHP", …) look like?" we received the following answers:

- It shall be evaluated, that the chosen protocols do not restrict/imply specific market place/ clearing house operational models. Multi-level market place and clearing house scenarios

[14] http://www.greenemotion-project.eu/dissemination/deliverables-ict-solutions.php

should be supported. Different strategies of maintaining white/black lists or not should be taken into account.

- From the point of view of a utility, the UNE-EN 61850 establishes a standard communications protocol that could be followed in the e-mobility landscape between EVSE, EV, EVSP and DSO.

- CH/BE Interfaces like “OCHP” or OICP should support all planned services of the GeM Market Place (see D3.3, D3.5, D3.6). Propose to take a look at the Hubject Interface Description too.

- These backend-services interfaces/standards are clearly business oriented. Therefore there is no strong need to standardize that kind of protocol. Several initiatives are already on their way, e.g. Hubject.

- This will depend on the solutions brought by the Clearing House service provider.

- A common standard for the communication should be identified to manage the different interfaces for the services. The communication is internet based.

The need for a Clearing House standard is less clear and needs more study. At least the Hubject Interface Description, OCHP and the planned services of the GeM Market Place needs to be studied in more detail, preferably in the eMi3 context.

6.1.11 GSM

GSM (Global System for Mobile Communications), is an ETSI standard, describe technologies for second generation (2G) digital cellular networks. The GSM standard originally described a digital, circuit switched network optimized for full duplex voice telephony.

The surveys mention that at least in one of the pilot sites GSM is used, but also several car manufacturers use GSM to support wireless communication with the EV.
In some cases the already available telematic services to conventional vehicles via a GSM connection to a central IT backend is used for services for e-mobility. For example for dynamic information on charging points when the vehicle is moving.

6.1.12 UMTS (3G)

The GSM standard is succeeded by the third generation (3G) UMTS (Universal Mobile Telecommunications System) standard developed by the 3rd Generation Partnership Project (3GPP).

From the survey we haven’t seen UMTS being used in the electric vehicle, but some charging stations are connected via UMTS. Grid related data can be transferred via UMTS as well.

6.1.13 GPRS

General packet radio service (GPRS) is a packet oriented mobile data service on the GSM and UMTS mobile communications systems. GPRS is maintained by the 3rd Generation Partnership Project (3GPP). 2G cellular technology combined with GPRS is sometimes described as 2.5G.

In the surveys GPRS is mentioned for General Communication and for Communication of the Charging Station with the Central control system.

For reference here a picture[15] which places some of the mentioned communication standards on a reference frame.

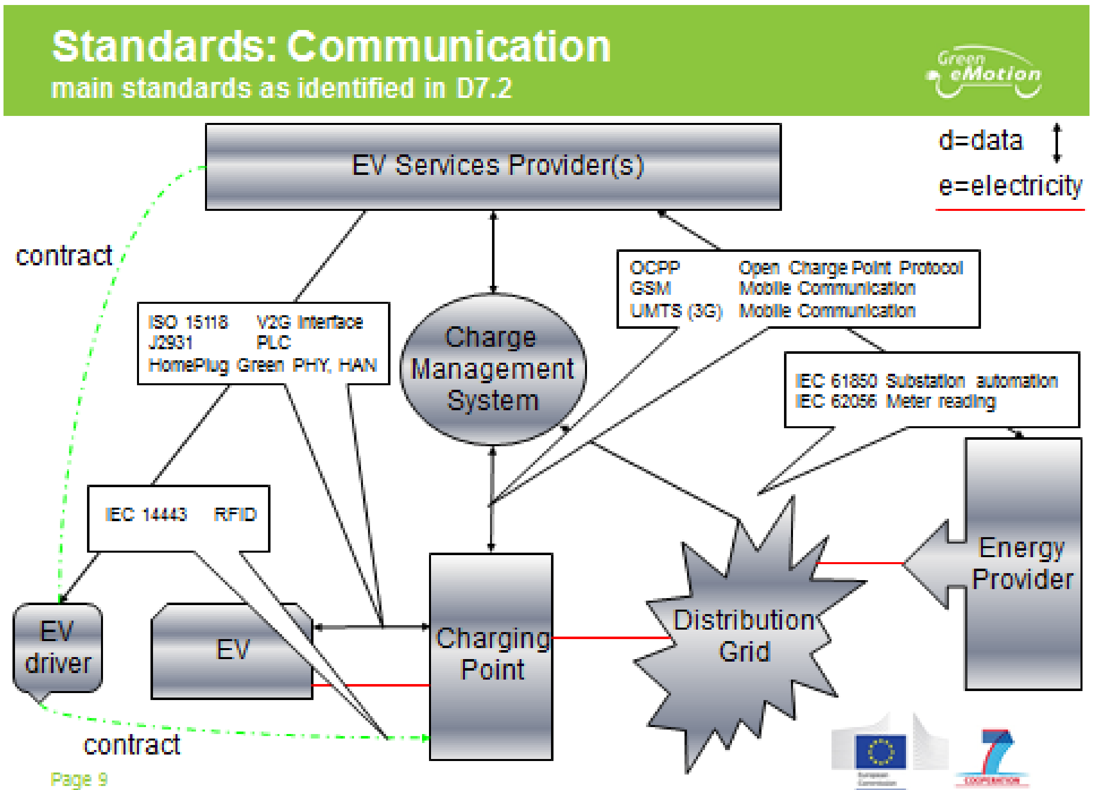

Figure 6-3 The main communication standards and their relations

6.1.14 Communication Overall View (new in version 2)

Communication is seen as an important aspect of the whole eMobility standardisation, and therefore has been given extra attention in the second version of the survey and this report.

This section is written based on the replies on the following questions:

[15] http://www.ev-charging-infrastructure.com/media/downloads/inline/cyriacus-bleijs-edf-17-00.1291376407.pdf

- How is/should/can the communication between EV or EVSE and all secondary actors (e.g. EVSE-backend) be handled?
- Which standards and communication protocols do you propose to be used?

Here the different replies:

Communication between :
- EVSE and back-end (BE) through GPRS communication
- EVSE and EV through Power line or PWM

EV – EVSE = ISO/IEC 15118 + IEC 61851
EVSE – BE = A new Standard needs to be developed leveraging from the lessons learned of all protocols used in Europe

Communication between EVSE and back end is handled out using a GPRS communication.
Communication between EVSE and EV can be carried out using Power line communication or PWM functionality.

It is more and more requested to encrypt all data communication between EVSE and operation center, software up and download.

The communications between EV and EVSE will be as standardised as possible, with the capabilities to do load management of the charging processes.

We support eMI3 consensus.

We encourage direct communication between charging point and the charging point operator.
Communication with secondary actors (CP manufacturer for instance) should be realized through servers by the appropriate means but with the intention of keeping the charging point operators in the center of the scheme.

We are currently using OCPP.

Encrypted data is sent through a GSM connection to a centralize operation centre, the operation centre can communicate with other companies.

For interoperability and e.g. roaming, interfaces are suggested to cope with ICT to ICT systems

In our “Plan Piloto” project, the communication is every 30 minutes or when an event occurs. So it is possible to know the status of the point in real time. We consider that this should be a good solution.

Integration with the currently available transaction methods, such as RFID, IC card, Smart phones should be taken into consideration. Communication technology, whether wired or wireless cloud computing, is already available for such existing services.

Which standards and communication protocols do you propose to be used?
- Use https for encryption
- IEC 61851-1 for PWM and ISO 15118 series for power line communication
- EV – EVSE: ISO 15118,CHAdeMO
- Standards for the communication between EVSE and EV are IEC 61851-1 for PWM functionalities or ISO15118 series for the power line communication.

- We propose OCPP
- OCPP and OCHP has not yet become a standard and they would need to be investigated in detail before any conclusions are made.
- OCPP

Summarizing: EVSE and back-end communication through GPRS is expected, and EVSE to EV through Power Line or PWM communication. In this area ISO/IEC 15118, IEC 61851 and OCPP are frequently mentioned. More attention is required to security and privacy for example by means of encryption. It is recommended to look into the communication solutions of currently available transaction methods (such as RFID, IC card, Smart phones)

As additional view, below the Eurelectric view on communication around the charging station:

	Private Domestic Socket	**Private dedicated E-mobility socket**	**Semi-Public AC**	**Public AC**	**Public DC**
Communication Vehicle to Charging station	No com. for domestic IEC61851-1 annex A (pilot function)	ISO/ IEC15118	ISO/ IEC15118	ISO/ IEC15118	IEC 61851-24 ISO/IEC 15118
Communication Charging station to Grid	EV is subjected to smart home and smart grid integration as this is introduced for households	IEC 61850-420	IEC 61850-420	IEC 61850-420	Not required as grid connection has to consider maxload and usage scenario does not comply with load management IEC 61850-420

Table 6-1 Communication around the charging station (source: Eurelectric)

6.1.15 Communication Overall Architecture needs (new in version 2)

The answers on the survey question:
How can the market place enable support for multiple communication channels (via CP or directly to EV (mobile), to back-end, etc., ...), are not all pointing in the same direction?

The Market place access is provided through interfaces. The interface itself does not imply the means of communication (direct, indirect through backend system etc.). Any communication structure would be possible but the operational issues represented by non-functional requirements (scalability, performance, security, …) needed to be addressed.
Communication stacks should be defined in layers, allowing reference to e.g. the OSI stack. Single layers, especially for media access, transport and container formats, should be represented by already established protocols/formats (e.g. TCP/IP, SOAP over HTTP(s), JMS, XML) instead of inventing new ones if possible.

MarketPlace shall give support to all actors of the eMobility landscape with all channels as possible.

There should be a clear “hierarchy” in communication.

- The respective IT Backends (EVSE, EVSP, CH) should serve as communication nodes

- The EVSE is an important gateway with direct connection to the EVSE IT Backend and can "link" the EV via PLC communication & ISO/IEC 15118 with the secondary actors.
- For mobile authentication e.g. via smart phone app the EV driver shall get a connection to his EVSP Backend which can initiate further actions such as remote start/ stop

We support the coexistence of multiple communications channels for the marketplace and also encourage coexistence of multiple interoperable marketplaces.

As defined in WP3, the marketplace should be a B2B hub where back ends connect in order to use services provided by all the stakeholders present in the marketplace (EVSE operators, EVSPs, service providers, Clearing House, DSOs). Different Business/ Software Components and Interfaces (as web services) would be built within the stakeholders' back ends and the Marketplace to provide services within main domains as established in WP3.

In addition to that the Marketplace is closely linked with the Clearing House for the validation of roaming agreements that will be managed within the Marketplace.
In addition to these service interfaces, the Marketplace offers functionality for the offering and contracting of services through user interfaces.

Summarizing: there is not yet an obvious need for standardisation around the market place enabling support for multiple communication channels, first there is a need for an overall architecture for the required communication. It is recommended to start with what has been already provided in WP3 on this. See the next figure from deliverable D3.2: "ICT reference architecture"[16].

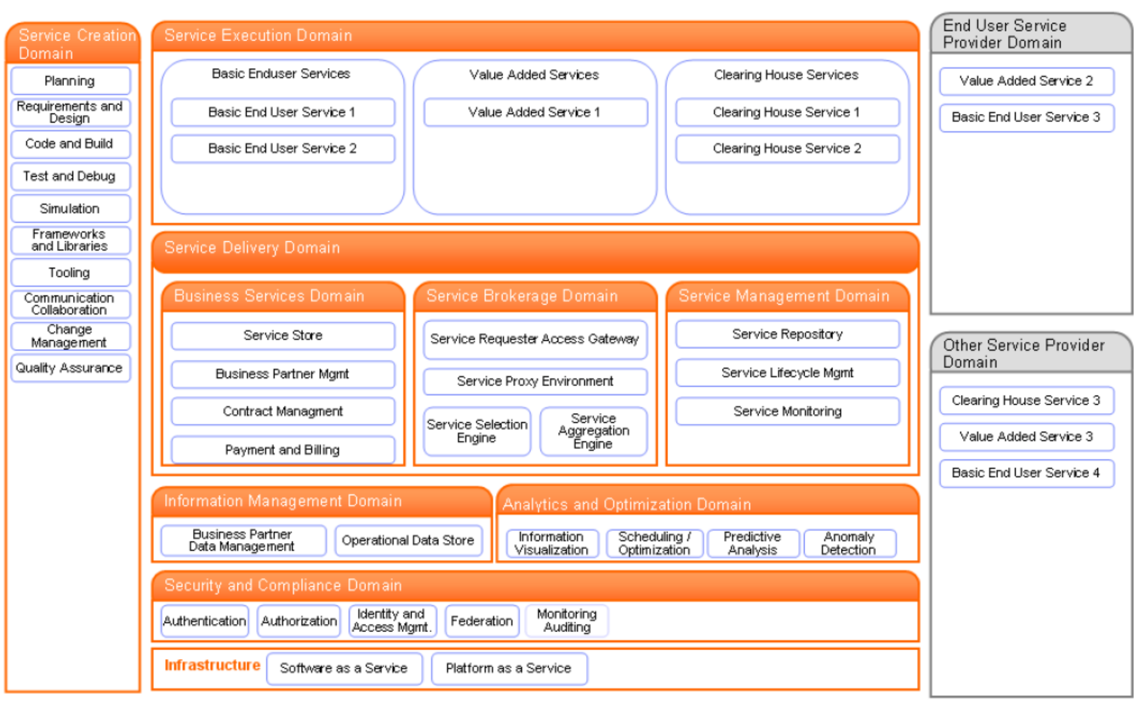

Figure 6-4 Architectural Overview Marketplace from D3.2

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[16] http://www.greenemotion-project.eu/dissemination/deliverables-ict-solutions.php

6.2 Other standards or non-standard solutions on communication

Other standards or non-standard solutions on communication or data collection in use or planned use. Besides these basic standards here other standards that were mentioned in the communication area:

- IEC 14443 (RFID)
- CHAdeMO
- Controller Area Network (CAN)
- IEEE P1901 Broadband over Power Line Networks
- NF EN 50065 Narrowband Low Frequency PLC
- ISM868
- Ethernet
- RS-485

6.2.1 IEC 14443 (RFID) Identification cards

ISO/IEC 14443 is a standard for Identification cards, contactless integrated circuit cards.
IEC 14443 (RFID) is in more detail described in chapter 4 (Charging Point standardization issues and needs).

Electric utilities and EVSEs mention in the survey that they use the ISO/IEC 14443 standards. As well ISO 14443A – RFID Reader as ISO 14443B – RFID Reader standard is in use for identification and authentication.
Some plan to use the multi-standard version (ISO 14443A-B).

6.2.2 Controller Area Network (CAN)

The Controller Area Network (CAN) is a serial bus communications protocol developed by Bosch in the early 1980s. The CAN standard data link layer protocol is the dominant communication system for embedded control systems in passenger cars, but also used in aircraft, medical equipment etc.
It is therefore also used in for example CHAdeMO. Further is has been mentioned in one of the surveys

6.2.3 IEEE P1901 Broadband over Power Line Networks

IEEE P1901 Broadband over Power Line Networks, defines data distribution among all classes of BPL (Broadband over Power Line) devices—for the Smart Grid, first-mile/last-mile service connections, in-building LANs, vehicle platforms and other security-sensitive applications.
Driven by the requirements of diverse end users, the standard is designed to ensure efficient use of the power-line communications channel, define coexistence and interoperability among multi-vendor BPL devices, deliver sufficient bandwidth and support Quality of Service (QoS).

6.2.4 EN 50065 Narrowband Low Frequency PLC

Another European PLC regulation norm is called CENELEC EN 50065-1: Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148.5 kHz. It defines the allowed frequency ranges of power-line communication, maximum signal amplitudes, as well as the limits of the interference to the surrounding frequency bands.

This is a Narrowband, Low Frequency PLC (NPL). In Europe, the frequency range and the output levels for NPL-PLC systems are regulated by the EN 50065-1 standard. Besides limiting the possibilities of NPL this standard protects the user of a NPL system from unjustifiable claims on disturbances by NPL systems. The existence of the EN50065-1 standard allows the manufacturer of any equipment operating in a LV network to design the equipment such that is immune against the signals emitted by an NPL-PLC system fulfilling EN50065-1.

One of the electric utilities mentioned the use if this standards in the survey:
EN 50065-1: Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148.5 kHz - Part 1: General requirements, frequency bands and electromagnetic disturbances.

PLC is the physical layer for higher communication protocols like for example defined in IEC 61851 and ISO/IEC 15118.

6.2.5 Wireless ISM868

The ISM (Industrial, Scientific and Medical) bands are open frequency bands, varying by region, that allow for operation without a license. These are also known as the unlicensed bands. In North America, these bands are the 260 ~ 470MHz, 902 ~ 928MHz, and 2.4GHz, among others. The 2.4GHz band is also utilized for worldwide operation. As a basis for unlicensed operation, these bands are often hosts for standardized and proprietary protocols such as Wi-Fi, Bluetooth, ZigBee, Z-Wave, etc.

In the survey once the Wireless ISM868 is mentioned, which is operating at 868 MHz.
This is related to ZigBee, which operates in the ISM radio bands 868 MHz in Europe.

6.2.6 Ethernet

Ethernet is the most widely-installed local area network (LAN) technology. Specified in a standard, IEEE 802.3. Is exists since 1973 and is still used in a large variety of applications. This would be the favoured protocol to use in the ICT world, particularly for B2B Communications and as the primary mechanism to access the Marketplace. But it is not needed to prescribe this standard, since system integrators are used to define and choose these themselves.

The survey results mention this standard. It will probably be used inside charging poles or as a connection to it. Car manufacturers can use high-performance Ethernet to for example diagnose complex vehicle electrical systems issues faster. It is not mentioned as an interface to EVs.

6.2.7 RS-485

RS-485 or TIA/EIA-48, is a standard on the electrical characteristics of drivers and receivers for use in balanced digital multipoint systems. Digital communications networks using the EIA-485 standard can be used over long distances and in electrically noisy environments. Multiple receivers may be connected to such a network in a linear, multi-drop configuration. These characteristics make such networks useful in industrial environments and similar applications like charging points.

The survey results mention this standard twice as being used. It will probably be used inside charging poles. It is not mentioned as an interface to EVs.

6.3 Identification (new in version 2)

Identification is seen as an important aspect of the whole eMobility standardisation, and therefore has been given extra attention in the second version of the survey and this report.

This section is written based on the replies on the following questions:

- What are the standards and data formats for identification of EVSE or EV contract that you are using or aware of?
- What would be the best standard or data format for identification of EVSE or EV contract?

The survey revealed the following:

> Supported are various formats, e.g. RFIDs Mifare Classic, Mifare Desfire, Calypso, Legic, RFID ISO 14443 type A, Mifare Classic 1k ISO 14443A 1kbyte (13,56 MHz), DESFIRE, RFID card, Mifare Plus X typology, IC card, smart phone.
>
> In some areas much more detail was given:

- IEDs according to DIN Spec 91286
  - EVSID: <country code 3 digits> <EVSE Operator code 3 digits> <unique meter number up to 18 digits>
  - EVCOID <country code 2 digits> <EVSP ID 3 digits> <contract number 6 digits plus checksum>
- the actually introduced IEC new work item on RFID identification should be strongly aligned with the ISO/IEC 15118 to avoid diverging data formats and requirement
- We are looking forward to use near field communication (NFC).
- A standard about the RFID interoperability was promoted by BetterPlace. This NWIP resulted in IEC 62831 User identification in Electric vehicle Service Equipment using a smartcard.
- “Movele” format, which consists in 20 digits: 3 for the country, 3 for the region, 3 for the electric distributor manager and 11 for the user identification. Note: Movele Project (http://movele.es/) is a Spanish program designed to promote electric cars, supported by the Ministry of Industry, Tourism and Trade.

6.3.1 Possible standards or data formats for identification (new in version 2)

The “best standard or data format for identification” would be from a systems integrators perspective, any standard which is agreed upon by a substantial group of market participants (e.g. the proposals being brought forward within GeM or eMI3).
Generally spoken the scheme should be hierarchical and extendible, avoiding the need for a central repository of all objects (similar to the domain name system). Extendible schemes (flexible number of levels, flexible number of characters) support sustainability. Reference of schema parts to already standardized components (like ISO country codes etc.) shall be preferred over new inventions.
eMi3 is actively discussing this and a proposal has been created in 2013 (e.g. eMI3 proposal to extend contract number from 6 to 9 digits plus checksum), which has also been used in ISO/IEC 15118.

Further suggestions for standards are:

- Mifare Classic
- A standard that gets eMI3 consensus
- DIN specification
- We are encouraging future normalized solutions
- We are pushing for a standard that simplifies identification, especially in a roaming perspective with sufficient available digits, appropriate security characteristics, and relevant data format (country, EVSP, customer).
- Most important point is to establish a standard as soon as possible.
- We should consider the ongoing technological innovation which could be hindered by reinforcing some particular standard too early.

A good closing remark we received is:

- This kind of technology such as identification/security is essential to e-commerce in general, not specific to e-mobility. So for e-mobility we need to align and look further into e-commerce solutions, discussions and standardisation efforts.

The need for a uniform identification is clear, the problem also needs to be solved on short term. A suggestion is, because of short term requirements, make a first initial choice, and allow easy upgradability of the system. A first choice could be the proposal from the WG3 Business Objects & Identification that is also aligning it with NEMA.
NEMA has also offered an update on the original Better Place RFID NWIP. This update is currently analyzed by the experts of the German DKE security group and is planned to be handed into IEC 62831 standardization. It will provide authentication methods for RFID and NFC means.

6.3.2 Security and encryption (new in version 2)

The survey question:
"What about inclusion of privacy/data protection and security issues, what are the requirements, standards and possibilities in this area?" Listed various remarks, and most are not contradictory:

- Especially in the last year more and more it's asked by customers how to encrypt the information on the RFID tags. Different solutions are possible but today no standardization is available.

- Standardization should include data protection and security issues.

- Data regarding the overall EV operation, such as driving routes, time periods of charging process, etc., need to be confidential. There are certain standards involved that protect utilities from cyber-attacks which may be used for this scope (e.g. NERC-CIP standards are related to grid operation, data collection).

- Regarding security, the requirements should be addressed through proper encryption, but not through obfuscation within id schemes.

- Regarding privacy it should be avoided to use ids related to individuals (ID card number, social security number, vehicle identification number) within (as part of) new ids.

- A data security and privacy model should be developed or adopted to EV corresponding to the Smart Grid Information Security WG. This would also help unifying the CEN/CENELEC standardisation of SG and EV area.

- EVSE and EVSP companies will share private information from users and this should be protected and managed efficiently. Standardization in communication between EVSE, EV driver, EV and EVSP should include data protection and security issues.

- eMI3 will address these issues based on national legal requirements (e.g. German BDSG Bundesdatenschutzgesetz)

- From the utilities perspective the charging infrastructure becomes an essential part of the smart grid and has to fulfil the general data security and data privacy requirements of the smart grid which are also covered in M/490.

- In the future in a commercial phase including payment, we will adopt more secured protocols.

- Personal data have not to be sent to an external clearing house, but managed by own back end. The algorithm to decrypt the data has not to be shared with other companies.

- There's a real need for privacy /data protection and security issues. In Spain we apply the LOPD (Data Protection Law). Companies are responsible for taken due care of personal data from their customers and employees.

- No information regarding the customer should be stored on the card. The information should be encrypted and must not be decrypted in the charge spot. The encrypted information should be sent to a central operation system and decrypted there, following a command for the charge spot to begin charging.

- The data treatment should agree totally with the European Privacy Politics.

- We can use several existing encryption technologies in the current IT network.

Summary: security and privacy are seen as important by all respondents and stakeholders. Several ideas exist but there is no overall view yet. ISO/IEC 15118, the eMI3 WG5 on communication protocols and IEC 62831 already address this topic on their own. Recommendation: combine a next step in security/privacy/encryption with an overall communication architecture,

6.4 Standards or extension to standards on communication missing

Not many of the respondents of the survey mentioned that they miss standards or extension to standards on communication. This needs to be checked in next round of surveys or questionnaires.

Survey feedback that was received:
From car manufacturer:

- We miss a standard for over the air communication (for spot booking for instance).

Survey feedback on charging points:
We miss a common standard on user identification at charging point.
First request is currently handled within ISO/IEC 15118-6/-7/-8. Second request is handled by IEC 62831.

6.5 Common Data Formats: like SDR/CDR (new in version 2)

This section is based on the survey question:
"Is there on short term a need for a standard/data format for other data elements? "
The following comments were received:

- There is a need to standardize customer contracts to give a clear understanding how customers shall be treated (regarding their charging priority). To enable communication with the DSO the identifiers for the load area and the point of delivery are necessary.

- In the near future, there is a need for standard/data format concerning identification of EVSE or EV. Possibly additional data format could be requested for pricing issues

- As also mentioned in the eMI3 group: ePOI coupled with EVSEID, CDR / SDR.

- SDR/ DCR need to be standardized as soon as possible. In addition standardized interfaces between EVSE Operator Backends, EVSP Backends, and a Market Place/ Clearing House are required by end of 2013. One of the proposals is to use the Hubject Interfaces.
- We believe that to enable roaming, standardization of the RFID and the data elements are a short term priority that needs to be addressed as soon as possible.

- The user identification should give information of the vehicle technical characteristics.

- Further we should consider the ongoing technological innovation which could be hindered by reinforcing some particular standard too early.

Activities in eMi3 (WG Business Objects) and Hubject (the Hubject Interfaces) seem main drivers towards more generic solutions and are now available,

6.5.1 Common Data Formats Roadmap (new in version 2)

This section lists the feedback on the question:
"What is your need for roadmap and work plan for common data formats within 2013 and beyond?"

- As roaming emerges already, the data formats required for data exchange needs to be agreed upon as soon as possible. A roadmap will be issued by eMI3

- A common data format concerns the scheduled charging process of EVs, i.e. defining the various levels of charging power according to the capacity of the grid, certain EV characteristics such as cabin preheating, etc.).

- As soon as possible

- Roadmap for these issues:
    - EVSEID & EVCOID consensus within eMI3,
    - SD/ CDR consensus within eMI3
    - Reference implementation including interfaces

- The work is already ongoing within the Hubject Foundation as well as the eMi3 Group

- We will participate in the eMI3 discussion group in order to specify this need and fully support the upcoming standardization effort.

- The roadmap should include the ability to identify the EVCOID at the charge point. The ability to carry out authorization and ensure energy recordings are delivered correctly between operators and clearing houses.

- We should consider the ongoing technological innovation which could be hindered by reinforcing some particular standard too early.

Recommendation: Await and influence the roadmap that will be issued by eMI3. Several topics are being addressed in eMI3, most of these in WG3 Business Objects & Identification and some in WG2 Architecture & Interfaces.

6.6 Other issues or needs with respect to standards on communication

The other issues received in the survey are from electric utilities:
- There is no clear standard
- It is desirable for the interoperability and roaming to have a common standard on user identification.

From car manufacturer:
- There is no identification standard at pole level (code and media)

From a body responsible for much of the data analysis in the demo regions:
- We find that receiving data in non-standard formats is time consuming. It would be beneficial to define a meta-standard of pertinent charging and vehicle data to be recorded for all events, regardless of the communication method.

6.6.1 Use case and communication

From the use case mentioned in the first chapter we can define the need for:
- Optional: look and if needed reserve a charging station and location (id, estimate TOA, estimated TOD, required charge, location, range)
  - Requires standard for reservation (expected arrival time etc.), User/Vehicle Identification Number, Vehicle Charging Location, Parking Incentives/Information
- Optional: user to give required next distance/charge required and required timing
  - Requires standard for Vehicle Charging Duration
- Communication setup (id, estimated TOD, required charge)(included in ISO/IEC 15118)
- Identify
  - Requires standard for identification mechanism (ways are defined in ISO/IEC 15118; For data structure a file is submitted)
- Authentication
  - IT infrastructure/backend to confirm identity etc. of user/vehicle (ways are defined in ISO/IEC 15118; For data structure a file is submitted)
- Optionally: Value added services
  - Car status exchange and communication (included in ISO/IEC 15118).

The overall use cases and necessary standards on communication are part of different work packages within Green eMotion. In order to discuss the needs identified here with the findings and proposals of the other work packages a Green eMotion workshop on standardization was held on 2012 May 10 in Brussels at a Green eMotion ESF (External Stakeholder Forum) with follow ups in 2013 and 2014.

6.7 Which type of EVSE management system planned to use

The question in the survey was: Which type of EVSE (EV Supply Equipment) management system (a centralized/de-centralized ICT infrastructure that gathers data from EVSE and EVs) do you plan to use?

The demonstration regions (often grid utilities) replied:

- IEC standard for Smart Grid appliances
- A proprietary standard
- Centralized and ownership management system, for the short-medium term, the existing one, a centralized architecture based on a web application server
- A supervisor (SCADA) to operate the EVSE based on PCVue (ArcInfo)
- Centralized and proprietary management system

Car manufacturers replied:

- Based on the Connected Drive Backend which provides today already telematic services to conventional vehicles via a GSM connection to a central IT backend, related services for e-mobility will be provided.
- Through the EVSE and with the use of the PLC interface, we can route messages to the Back-End server. The customer receives a “log-in” identification, where they can check relevant vehicle information.

This does not reveal a trend: as well standards as well proprietary standards are used.

6.8 What type of EVSE data is collected, communicated, and which standards

The question in the survey was: In this EVSE: what type of data do you collect, communicate, and which standards or solutions do you use for that (like transmission physical standard, network, information protocol, data content, financial services standards for billing, etc.)?

The demonstration regions (often grid utilities) replied:

- Own Protocol
- As most EVSE do, ISO 14443 for user authentication.
- Interoperation and management of ID Cards (identify customer, consumption)
- On-off operation system of the charging point
- The current list of GeM data requirements. In addition, user ID, charge curve, and events, incidences, alarms on CP status. Everything communicates internally through RS-485 and other proprietary protocols, and to the control center by TCP/IP through GPRS communications.
- We use 3G communication with Modbus protocol. We collect RFID and PLC ID information, date, energy, charge duration.
- Customer/Contract ID for identification and authorization.
- Energy consumption for billing
- Commands to open and enable the switch, to lock and unlock the sockets.

Car manufacturers replied:

- All customer related data should not be stored in the EVSE but either in the vehicle or the IT backend of the e-mobility provider. The EVSE will submit a CDR, contents to be defined in the standardisation process and GeM WP3.
- The transfer of data from EV to the EVSE is based upon the ISO 15118 standard, which includes descriptions for each OSI Model layer.

6.9 Comparison with external Stakeholders position

The already mentioned report of the CEN CENELEC Focus Group gives also recommendations about communication.

Recommendation they make which are related to communication are:

- It is recommended that end-to-end scenarios are considered between the involved European Standards Organisations (ESOs) in order to have a harmonised and interoperable link between the different communication standards for electro-mobility, security, safety and intelligent transport systems (ITS). Co-operation on data communication and data security - between EV, smart grid and ITS, is needed
- Electro-mobility-to-infrastructure for data communication and data security should be defined by: CEN and ETSI ITS committees (co-operative systems), ETSI M2M, ETSI SCP (Smart Card Platform), ISO (road vehicles) and IEC TC 57 for DER communication.
- Electro-mobility control signal and control pilot signal related communication should be defined by CLC TC 69X, CEN TC 301, IEC SC 65A and CLC TC 64 and ISO TC 22/SC3.
- It is recommended that user groups be established between the different ESOs and the market stakeholders, in order to specify conformance tests and implementation guidelines between the different domain areas.
- Standardization is required for the diagnosis protocol, human-machine interface and energy management system for the complete charging system. This new work has to be done in close relation to user groups and electro-mobility system integration (technical reports or white papers from user groups can be very useful for the ESOs).
- The CEN CENELEC Focus Group recommends that "a standards work be established concerning an "interoperability hub", which can be a generic and neutral concept for mediating between two partners to provide validation services for exchange of technical information, contract relations or security certificates. A joint working group including service providers should be formed within the ESOs to define a cross-border European concept for this hub. This project will contribute a lot to this recommendation." In Green eMotion we create a kind of "interoperability hub" (in WP3) but we call it European Marketplace. The Marketplace in Green eMotion supports the requisite business processes needed for European wide mobility of Electric Vehicles. The Marketplace will be public and based on open architecture, common standards and protocols and open standard interfaces with flexible, scalable and state of the art technology. The design specification of the Market place will be public available. This architecture proposal from Green eMotion will be disseminated within Europe and discussed with other consortia, e.g. the German B2B consortium with BMW Group, Bosch und Daimler, EnBW, RWE and Siemens or other demonstration projects.
- The work done in the European Commission Smart Grids Task Force should be expanded to create a security architecture also taking into account issues in relation to the interoperability hub and security issues for communication between charging system and Electric Vehicles

7 Generic and other standardization issues and needs

7.1 Use cases specifically important to be used in the standardization

The question in the survey was: According to your experience, which use cases are specifically important to be used in the standardization?

The survey respondents mention the following items:

- All charging scenarios to ensure interoperability.
- Charge at home and at work with load management initiated by the smart meter or by the user.
- Interoperability and roaming
- Charge on collective parking lots, with load management based on priority rules and tariffs.
- Payment with prepayment systems or RFID card.
- Temperature scenarios (hot/cold differences)
- ISO/IEC 15118-1 covers most of the relevant use cases.
- Condominium with one grid connection and sub-metering.
- Use cases which involve 'roaming' type of interactions between organisations / individuals, due to the large scale nature of personal and commercial mobility.
- Communication related to authentication of the various types of actors
- Remote control of the charging process as part of the charging service
- Exchange of information for financial settlement
- Where the party operating the EVSE is not the same party with which the charging service customer settles with in the financial sense.

This list shows already the various and different aspect that play a role in standardization and use cases seen from different viewpoints.

In another section of the survey one of the replies was:

- Spanish Industry Ministry has recently published a new regulation by means of which there will be specific entities entitled to manage electrical vehicle charging. This way, they will be able to act as the same time as electricity consumers and vendors, and will be in between energy distributors and end consumers.

This would be a nice case to add but then into a more generic use case that is not country (or regulatory) specific.

Further received in the first survey from RWE a document on DIN SPEC 91286 (2011-11) with title: "Electric mobility - Schemes of identifiers for E-Roaming - Contract ID and Electric Vehicle Supply Equipment ID". This was created by amongst others RWE, Bosch, RWTH, Siemens, KIT.
The document defines schemes that allow deriving identifiers for object in the area of E-mobility.
It is the output of the German Model Regions on electric mobility regarding the same constitution of an identifier.
This proposal was further used and worked on in Green eMotion. When it was agreed inside Green eMotion it was brought to the WG Business Objects in eMI3. Green eMotion and eMI3 brought it to IEC/ISO where it also found agreement and was adopted by ISO/IEC 15118.

7.2 Country standards with respect to EV that are (being) standardized

The question in the survey was: What are the standards with respect to EV that are (being) standardized in/for your country?

The survey feedback mentions the following:

- Standards for the Type 2 plug (VDE Anwendungsregel)
- France IEC 61851 and ISO/IEC 15118
- Italy: CEI 69-9
- Spain: Final version of the ITC-BT-52 (Low Voltage Regulation) is about to be approved
- In Italy the temporary "CEI 312-1" standard is currently being replaced by the latest edition of the corresponding IEC standard (i.e. IEC/EN 61851-1 Ed. 2)
- The Netherlands: there is a de facto standard for RFID access control passes
- A de-facto standard for communication between operators of EVSE's and charging service providers for exchange of e.g. metering data is under development.

Not mentioned by the answers in the survey but a remark received later is the missing perspective on security and privacy. Often not covered in standards but as a given law so still a kind of guidelines.

We received a similar remark: What is the local regulation in terms of energy resale.
Example: "I'm Carrefour and I have some poles and I want to resale energy to the customer but I cannot because I'm not energy retailer". So if there is no regulation to specify this, energy cannot be charged and then Carrefour has to charge a service, this could make roaming and clearing more complex.

And another one:
We are also interested to specify interaction between recharge grid managing platforms and OEM navigation, more specifically, the modelling of the public charging poles as POI on the MAP and the transfer of this data.

7.3 What are the top standardization topics

The question in the survey was: What are the top (three) standardization topics that really need to be addressed and that are the biggest challenges for the introduction of EVs?

Almost all respondents were able to make their top 3 clear. Since these implicitly reveal lot of information we have listed them all here:

The demonstration regions (often grid utilities) and a few others replied:

1. Communication of ISO/IEC 15118 (Link to the Smart Grid, Link for Smart Charging)
2. Interoperability of identifiers
3. Clarification of certain things within IEC 61851-1 / J1772

1. Plug

1. Connections
2. Communications
3. Roaming

1. Unified and standard connector
2. Unified and standard user identification

3. Unified and standard communication protocol

1. EMC
2. Load management in accordance with smart meters
3. Plug standardisation

1. Commercial interests are prevailing
2. Too many proposed standards
3. Definite decisions are not being made

1. Guarantee interoperability of charging points and vehicles all along Europe
2. Batteries technology: standardization in terms of size, dimensions, etc.
3. Standardization of payment infrastructure all along Europe

1. Pan-European charging (fast and slow)
2. Interoperability of ICT architectures to allow for simple roaming
3. Data exchange between utilities for cross boarder charging events

1. Physical connection
2. Authentication
3. Metering and payments

1. Confusion on Amp levels that should be allowed for mode-2 charging (advise: allow only up to 10A)
2. Standardisation initiatives that risk cost increase and lower flexibility and therefore hinders market development (such as unified payment platforms)
3. The spread of a third plug in Europe (Type-3) risks to confuse customers

1. Lack of a unified connecting system (socket outlet + plug) on public charging point
2. Lack of a common standard on user identification at charging point
3. Lack of a standard for DC charging

Car manufacturers and related companies replied:

1. Customer recognizing
2. Plug connection
3. Communication whit smart grid and control station

1. Ensuring physical interoperability (connectors, physical communication)
2. Ensuring interoperability on a business level, including access/ authentication, e-roaming and payment.
3. Ensuring backward compatibility for key features in order to avoid frustration of first users

1. Plug Standardisation
2. Charging system (which solutions are mandatory)
3. Standardisation on Protocols

1. Id for roaming
2. One connector spot side
3. standardize communication charging pole – It-management platform

Counting the mentioned topics this can be summarized with the highest topic count on top as:

- Plug standardization/connectors for physical interoperability
- Communications/standardization on protocols
- User identification/authentication
- Pan-European charging standard
- Payment interoperability on a business level
- Interoperability and roaming
- Too many proposed standards

This shows that in all areas there was a huge need for more clearness, standards (and decisions) when the survey was conducted. For the time now most of the issues have been addressed and have either been completed (identifiers within eMI3; ISO/IEC 15118) or are work in progress (IEC 62831 on RFID authentication, backend communication protocol within eMI3).

7.4 Methodologies or best practices

Methodologies or best practices used to assure development conforms to standards. The question in the survey was: What kind of methodologies or best practices do you use to assure that development conforms to standards?

Answers received were:

- For IEC 61851-1 there are no compliance test defined
- ISO/IEC 15118-X will have a part on that
- We have used call for tender for the charging stations that required the required standards.
- Quality system
- Continuous risk analysis and component testing

The variety of the answers show that more clearness is required and the goal behind the question needs to be clearer defined.

This question was added in the first survey as preparation for task T7.4 Definition and test of a methodology to assure compliance of developments with standards. This task already resulted in a first version of D7.6 (available at http://www.greenemotion-project.eu/dissemination/deliverables-standards.php), a second version will be published in last quarter of 2014.

8 Future trends in eMobility and advices for standardisation guidelines (new in version 3)

This chapter is new in this third version of this deliverable, it contains the outcome of the third survey that focussed on future trends in eMobility and advices for standardisation guidelines.

8.1 Introduction

The last year of the Green eMotion project started when the third standardisation survey was issued, not all detailed standardisation issues could be solved within the remaining timeframe of the project. Therefore the 3rd and last standardisation survey focusses on trends to be taken into account for harmonisation of technology and standards and advices for standardisation guidelines are collected. These trends and advices are further analysed and summarized in this chapter, so that these can be used within the project where possible, but also by other projects and roll-out activities in the eMobility domain.

To be able to identify trends, questions were put in the survey related to:

- The situation in 2011 when Green eMotion started, the current status in 2014.
- The expected trends and issues in the upcoming years, till 2020.
- Advice and input for guidelines for standardization and interoperability.

The survey results in chapter 8.2, 8.3 and 8.4 have also lead to small updates in the other chapters on standards, but no big changes were necessary. Some parts of 8.5 on conclusions and summary are used in the summary and conclusions chapter 9.
Around ten surveys were received, about half of these from industry, the others mainly from research institutes. Research institutes rate some issues lower than industry. This may be caused that solutions are available (e.g. in identification), but choices has not been made so still the market and industry suffers from that, so industry parties rate these issue as higher.

8.2 Current technology and standardization situation

The question in the survey was as follows: The first survey on the standardization issues in 2011 resulted in the following **top issues**. Could you give your short remark/**status** on these topics (solved, became smaller, bigger, …)?
The answers are collected per main issues as identified in the beginning of the Green eMotion project in 2011. The other (not main) issues were addressed in another question ("additional comments" see survey) and are still captured in this chapter. Here all the received answers and statements:

- Plug standardization/connectors.
  Responses were like: near or close to be solved, solved, became smaller.
  Comments made are:
  - Modes of charging and characteristics connectors are OK. No full finished standardization for the connectors in all vehicles (different by OEM).
  - Europe has chosen a connector for AC and DC conductive charging; CCS seems to be the agreed connector in Europe and US. Homogeneity is not total but, currently this does not seem to be a big issue.
- Communications/standardization on protocols
  A variety of answers: became smaller, decreased slightly, some advances done, but also became bigger
  Issues became more clear last years in this area, several were solved, but a lot is still to be

solved. Depending of the areas the respondents are involved the answers differ.
Comments made are:

- solved (EV-EVSE); bigger (EVSE-CMS); bigger (CMS-MP)
- conformance test specs missing
- progress with ISO 15118, a few points are still open
- ISO 15118 part 1 and 2 have been issued and so is OCPP V2. Other important initiatives like eMI3 are ongoing. Current standards permit a high number of services. Even if higher homogenization might be required, especially among different protocols participating within an end-to-end communication, at current EV penetration levels, communications (at least for conductive charging) should not be a barrier for EV development.

- User identification/authentication
  Also here a spread: same status, solved using RFID, became smaller, bigger, not smaller Issues became more clear last years in this area, progress is made, but not all issues are solved. Depending on the areas of involvement the answers differ.
  Related comments received are:
  - Other methods under study (phone, web, ...)
  - solved (EVCO-ID), bigger (NWIP)
  - unsolved, no common agreed use of smart cards or mobile phone
    The SG Focus Group recommends a global standardization, covering the ID numbering. Considering RFID technology, which is one of the most commonly deployed technology, other aspects should be agreed, such as number of data fields and their length, where the information is stored in the card.
    Each technology will have standardization aspects to be considered. It is one of the most important aspects of interoperability because it has influence on the most basic service: charging in public spaces.
  - A charging standard might be interesting in the medium term but the definition and agreement upon elementary use cases should be performed before, in order to allow a fast implementation of the most basic interoperability, such as that related to identification and authorization.
- Pan-European charging standard
  Here is much more agreement: became smaller, close to be solved, solved via EU directive
- Payment interoperability on a business level.
  Answers range from: same status, bigger, still an open issue, to became smaller
  Comments received
  - Very difficult to find business models due to the low spread of EVs
- Interoperability and roaming
  Answers are: became smaller. some advances done, first steps taken in eMI3, not bigger
  - There are partial solutions but not a general, commonly accepted way of working.
  - Smaller for roaming concept (tracked by eMI3;), but bigger on interoperability (see Betterplace NWIP)
  - It is an issue to be solved but "total" standardization is not required. Use cases should be considered and agreements on required data should be reached among players. It might be more a market issue.

- EU-wide and nation-wide roaming is only possible if inter clearing house (hub) and charge point operator/clearing house protocols are standardized. Different interfaces/protocols burden the players with additional costs for implementation and maintenance. See e.g. the answer to next questions: to many protocols in the area EVSE-backend

- Too many proposed standards
  Overall seems smaller issue, still remarks:
  - bigger regarding clearing protocols and EVSE-EVSE operator communication
  - The actors should agree upon use cases and information definition and "the market" will probably select the most suitable standards. The Smart Grid Coordination Group has performed a great work to identify existing standards and gaps.
  - in some areas yes (EVSE-Backend), in others no

To get a better view on the survey results we grouped answers that belong to the same topics. We did this manually since the topics require interpretation, for example roaming, authentication and identification belong to the same overall topic. Still we also created a tag-cloud for visual confirmation, see the figure below.

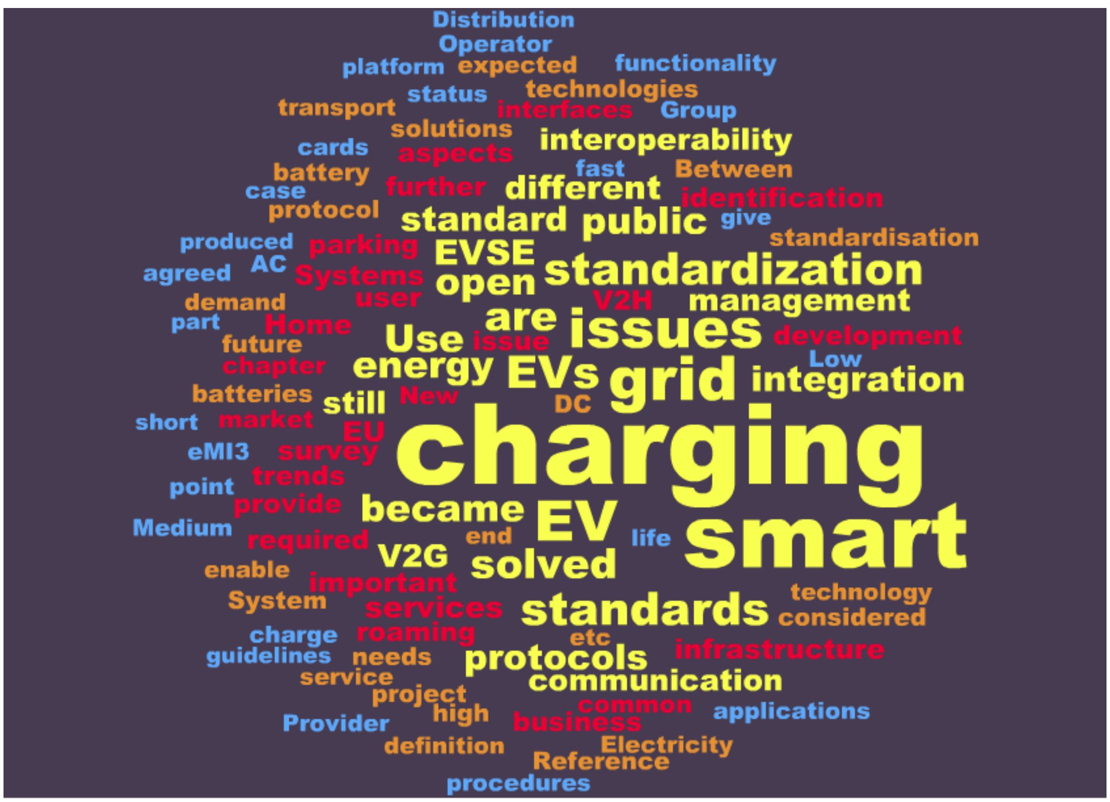

Figure 8-1 Tag-cloud of the responses on the answers in survey version 3.

The next survey question was: <u>Which key standardization **issues came up after 2011** and are still not solved. Could you give your short rating on the priority to solve it (e.g. High/Medium/Low)?</u>
Here follow the list of new issues after 2011 (preceded by a priority rating when available) and grouped per topics area (in bold):

- M: **Smart charging** is going to help to optimise the use of the electrical grid for efficient EV charging, while maximizing the use of renewable energy.
- As Lean **Smart Charging** (smart charging at home by using available communication channels) could cover ~80% of charging with minimum investments, the focus should be shifted to foster economically viable solutions (with valid business case) and to remove corresponding policy barriers. Only focussing on public charging infrastructure or on smart grid role out without a valid overall business case will not lead to efficient solutions.
- H: **Smart Charging**, Smart Grid Integration
- M: **Smart Charging** not at an EVSE (e.g. at home or office, than other communication means or channels are required)
- M: Controllability of all kinds of EV **charging modes**
- H: Direct communication protocol to the EV for lean **smart charging**

- M: **smart grid** integration (identification POD/Load group, Interfaces)
- M: **smart grid** integration
- H: **smart home** / home energy management systems
- H: There is still no agreed overall **Smart grid** and eMobility Reference Architecture, a lot has been achieved, but agreement is not completely there. Everyone needs to understand that a Reference Architecture is 'only' a reference. Deviations are allowed, but it also creates a basis for reference, testing, communication, etc. Better an agreement on the basics only, than no agreement at all. This should preferably be taken up by a group representing this industry.
- FP7 project COTEVOS task 1.2 results sums up Smart Grid Coordination Group outcomes.
- M: Harmonization between different standards including those developed for different scopes: **Smart Grids**, ICT, ITS and EVs. At residential level, the management of EVs though local energy management systems should be considered.
- M: OEM backend to Green eMotion MarketPlace; EV Integration
- 15118 requirements need to be reflected in business processes, e.g. Green eMotion MarketPlace (MP)

- H: Protocol for **roaming** and clearing between (national) hubs
- H: BetterPlace NWIP (user **authentication** for EVSE)
- L: Protocol for intermodal travelling integrating EVs & public transport

- H: EV/EVSE **interoperability**….
- H: Use case selection and definition (exchanged data definition) as start point for **interoperability** implementation.
- H: Open Charge Alliance (making OCPP versions) versus a potential NWIP (New Work Item Proposal) co create a **EVSE Back End** standard
- H: EVSE to EVSE Operator **back end protocol**

- H: CHAdeMO protocol for **V2G**/V2H applications

- M: Standardization of **Battery** Management Systems communications protocols and operation procedures
- **Batteries** technology: standardization in terms of size, dimensions, etc. This is an issue which dates back to 2011, and today is still unsolved, though some standards have been produced by CENELEC (EN 50272, EN 61982, EN 62281, EN 62660)
- With increasing EV reach (**battery** capacity) and the expected free charging while parking at companies like retailers, hotels, restaurants or at shared private home EVSEs, public charging will become less important and less used (see trends in California).

- M: Inductive charging

- M: **Quick** charging
- Different charging ways (**DC versus AC** in medium rate powers)
- H: Publicly Infrastructure: **rapid** charging

- H: Domestic charging must be made with specific connectors
- H: missing or non-harmonized standardisation regarding plug connector and charging communication in Asia

- M: **Safety** risks and electromagnetic compatibility of the charger of electric vehicles in the field of relevant Directives.
- M: **Safety** Requirements in Petrol Station with EVSEs

- M: **Driving Cycle standard** to determinate performance and realistic Range of EVs, including Regenerative braking strategies

- H: **regulatory** issues on governmental side regarding e.g. EV label, parking lot assignment and reservation for EVs, differentiation between parking and charging for EVs
- Electricity fare (domestic and vehicle use)
- Regulation for invoicing of energy open

To get more issues on the table a question was asked to collect views from the different stakeholder: <u>Probably you have not listed all issues yet. To further complete the list also add the issues that you are aware of from the **views of different stakeholders**, also provide a rating (you can fill in multiple issues if needed).</u>
The response are grouped per stakeholder, the issues that are still open from the view of the respondents are (preceded by the priority perceived, when available):

- EVSE manufacturers issues are:
  - H: clear standardization roadmap and EU directives
  - H: V2G/V2H and Smart Grid enabled Charge Point
  - M: stable standard for the protocol to the backend
  - M: EVSE backend protocol standard, identification standard

- DSO (Distribution System Operator) issues are:
  - H: providing favourable conditions for the EVs roll-out and another load.
  - H: Smart Grid Integration standard, which should include a universal demand response standard or mechanism.
- eMobility Service Provider issues are:
  - H: EVs as part of Smart Grids
  - H: Standards for a common platform or the interfaces are open and earliest available in 2015 (eMI3)
  - H: also need Smart Grid Integration standard
  - Roaming platform standards
  - M: Quality of charge point location data
- Utilities/retailers issues are:
  - M: providing smart charging solutions and facilitating to contract energy
  - H: management of local electrical systems (microgrids, communities)
- Car/EV OEMs issues are:
  - H: V2G and 2nd life batteries applications
  - preferably worldwide harmonizes standards
- Clearing House/IT companies issues are:
  - H: Inter clearing house protocol standards
- EV User/municipality issues are:
  - H: EV User/municipality are afraid of purchasing EVs due to the lack of convenient infrastructure (not just slow charging points, also quick ones are needed), electromobility promotion measures (e.g. parking), and above all, the high purchasing prices. Lock of incentives forwards clean mobility.
  - H: Optimised energy management systems
  - H: Optimal emplacement of fast charge stations
  - H: Open access, simple billing procedures, charging station density.
- EVSE operator, CPOs (charge point operator) issues are:
  - M: market model and incentives for EVSE operation
- Others issues are:
  - The approach should be end-to-end and stakeholder needs should be part of a general design stemming from use case implementation.
  - M: longer term car parking provider needs reservation functionality for fast charging, take a look into other domains (e.g. hotel business with credit cards).

8.3 Expected trends and issues in the years till 2020

In this section we asked questions focussing on issues and trends to be expected in the future till 2020: Which standardization key issues do you think **will or can come up in the next years** (till 2020) and again could you give your short rating on the priority to solve these (e.g. High/Medium/Low)?
Potential future issues have been collected and grouped per topic below.

Smart charging

- M: Smart charging technologies
- H: Controllability of all kinds of EV charging modes

Smart grid integration

- H: Integration of EVs in the smart grid: by 2020 there may be an important share of EVs in some EU countries.
- M: Smart grid: smart charging as previous step
- H: Smart Grid Integration, make sure it will cover smart devices in general to make the grid smart, and not only smart charging, that would only solve and provide a local solution for EV smart charging. In this anticipate on potential new business models that will further enable the use of smart charging (Time-of-Use tariffs are just one example of this).

Battery reuse and recycling

- L: Batteries recycling (after a second, third life, …)
- H: Battery reuse/recycle
- H: Standardization of Battery Management Systems communications protocols and operation procedures

Fast and inductive charging

- HM: Increase of charging power up to 200 kW
- HM: interoperability of inductive systems: high priority for public, medium for private usage
- M: Wireless/inductive charging
- H: availability of public DC infrastructure

V2G and V2H

- H: Home integration including V2H
- H: Common protocols for V2G/V2H applications
- V2G
- V2G but after 2020
- Common protocols for V2G/V2H applications beyond CHAdeMO

User interfacing

- HMI-EV
- H: What is the preferred or dominant user interface – car or mobile phone – and what are the OEM independent open interfaces to provide services to the user and EV?
- H: Standards will be required for the creation of an appropriate human-machine interface (HMI) in line with new drive technologies.

Others

- H: Charging infrastructure standardization: suitable metering technologies and billing systems currently in development
- M: OEMs must offer eMobility services together with the EVs
- H: power quality (DC EVSEs & AC EVs)
- H: Which are the common security & privacy standards for broad acceptance and reasonable costs?
- Interoperability should permit the EV market development, even if not all aspects are covered from the beginning, and homogenization should improve with time (allowing a stepwise development). Relevant aspects remain the same but it will be important to establish the steps in order for standardization not to become a barrier.
- H: RFID/NFC harmonization (no new standards)

- M: Identification of user for payment and other services is likely to merge with several other services: from public transport cards, to payments cards, to smart phone with this functionality. Or even EVs that have this functionality embedded. It is important to approach this with an open mind and prevent lock-in solutions that are not future proof, upgradable.

Also here to get more issues on the table a question was asked to collect views from the different stakeholder: Probably you have not listed all future issues yet, to further complete the list also add the issues that you think will or can come up in the next years of from the **views of different stakeholders**, also provide a rating (you can fill in multiple issues if needed).
Other issues likely to emerge in the coming years from the view of the different stakeholders are:

- EVSE manufacturers issues are: (preceded by the priority perceived, when available)
    - H: handling of proprietary interfaces (e.g. Tesla)
    - M: what type of grid services can they provide and require (hardware) functionality inside the EVSE
- DSO (Distribution System Operator) issues are:
    - H: Distribution System Operator must be prepared to integrate the EVs in the smart grid, V2G, once a critical mass of EVs has been reached, hopefully by 2020
    - M: new methodologies for aggregated demand characterization
- eMobility Service Provider issues are:
    - H: fleet management + advanced management for the participation in the electricity markets
    - H: Missing EU interface standard to manage demand & supply for energy and grid availability to enable smart charging
- Utilities/retailers issues are:
    - H: working for the interoperability between different EV Service Provider (EVSP).
    - M: common procedures for distribution network reinforcement
- Car/EV OEMs issues are:
    - H: 2nd life usage of batteries
- Clearing House/IT companies issues are:
    - None received here
- EV User/municipality issues are: (e.g. parking):
    - H: working to improve the environment (air quality, noise, etc.)
    - M: merging identification cards for EV and public transport should be considered. It offers EV drivers an easy connection to public transport, it lower the barrier for sharing EVs and using these by public transport users, it makes reuse of a payment infrastructure

Potential future issues were addressed with the question: Are you sure you listed all expected trends and issues? Have you considered and rated the **topics below**?

- Charge Spot reservation
  H M M M L M L M -> **Medium priority**
- Fast charging topics, DC versus AC
  H L H L H M H M -> **High/Medium priority**
- V2G or V2H (Vehicle to Grid or Home)
  L V2G low; V2H high H H M L L L; **Medium priority**
  In a non-DC situation V2* is not likely. Further this is not short term introduced.

- Smart Charging
  H H M H M H H H **High priority**
  H: Charging on locally/own produced energy can be important for several reasons (preventing peak loads, making use of own (cheaply) produced energy (by means of PV, microCHP, …or locally stored). To enable this not much physical infrastructure is needed. But this use case requires the system to mainly offer extra functionality on the different (communication) protocols. My preferred example is how charging on own solar panels: "PV2EV"can be established. This prevent export of own electricity and import of later more expensive electricity.
- Smart Grid integration
  L M M M L H H H **Medium priority**
- Roaming
  H H H M L M H M **High/Medium priority**

8.4 Advice and input for standardisation guidelines

In this chapter the responses on recommendations and advices are collected and grouped. The question was: If you revisit the answers you gave on 2011, today's status and the expected future, what are than **the key 3 (or more) *recommendation*** you can give us?
In which ***areas*** **guidelines for (further) standardisation or interoperability are required**?
This lead to the following recommendation and areas for guidelines list:

- Recommendation: Define the main issues for **smart charging** technologies (not only for vehicles)
- Recommendation: **Smart charging** integrated with smart metering
- Recommendation Focus on Lean **Smart Charging** to enable low cost charging covering >=80% and thus provide broad charging capabilities for faster EV acceptance.
- Recommendation: Make sure the standards and protocols are adapted to allow **smart charging.** As well different types of smart charging (cheap energy, on renewable energy, with grid congestion management, on locally/home produced electricity, etc.) but also at different locations (Home, Public, Office). This requires a smart grid integral approach. In that most ideas and concept needs come from the smart grid domain!
- Area: **Smart charging** technologies
- **Area Smart charging**

- Recommendation: Check the **outcomes of the SG-CG** and use them as starting point (COTEVOS task 1.2. summary)
- Recommendation: Think of the integration with the **smart grid** from the beginning, considering the EV as a flexible load: consider demand side/response implementations as reference (USA, Australia, the UK have experience in this)
- Recommendation: Agree, standardize and implement an **open** EU wide **EV services platform** integrating EV, Energy, **Grid** and travelling services.
- Recommendation: Define European agreed **eMobility reference architecture** (e.g. elaborate on the proposal made by M/468 and merge these with proposals from other projects and groups)
- Recommendation: In a user/industry group (e.g. eMI3) create a simple example (e.g. simulation tool) which shows how **smart charging in the eMobility system** is

envisioned to work. This will show and demonstrate how it works, and issues can be detected soon. It could be considered to make such a project part of a H2020 project and demand that the results and code will be made public (e.g. open source)

- Area: **smart grids**
- Area: EV – Energy - **Grid** – Mobility services platform integration
- Area: Between the (smart) **grid** and the EVSP (this concerns interfaces to at least the Energy Provider/retailer and the DSO)

- Area: Development of **upstream standardized protocols** for Intelligent Charging Points (CP) in order to provide them the ability to be connected to the **Smart Grid** and control the power flow remotely and smartly.
- Area: Standards are required between EVSP and EVSE operator
- Area: Ensure the compatibility with other international standardization committees in the United States and Japan for ensuring the **market** integration (e.g. communication protocols for **charging** control).

- Recommendation: Early establishment of **roaming** platforms driven by federal bodies would have allowed easy access and billing from the customers' perspective, plus faster time to market for mobility operators.
- Area: Early establishment of **roaming** platforms -- scope EU wide roaming.
- Area: **Clearing House** interfaces require a standard, but needs to be done carefully. Too quick settling this may lead to miss future requirements in this identification (service) related area.

- Recommendation: **Interoperability** is still an open issue which deserves and needs further attention
- Area: **conformance** test specifications
- Area: communication protocols

- Recommendation: Early **confirmation** of standards as an EU directive would have protected investments from the beginning on, e.g. on EV-EVSE side.
- Recommendation: Plan a **stepwise development of standardization** and consider which aspects do really need to be standardized and which can remain as proprietary solutions. (the process – roadmap)

- Recommendation: Find EU policy to enable **charging w/o expensive (smart) meters and processes** focussing on public and semi-public charging.
- Area: charging infrastructure

- Recommendation: Analyse the particularities of each country to advance in **V2G**….
- Area: **V2G**
- Area: Usage of **batteries** for advanced grid applications in both **V2G** and 2nd life batteries. This requires the standardization of charging/discharging protocols, the BMS communications system and the battery operation procedures (e.g. relay switch, wake up, etc.)

- Recommendation: **Batteries** related technologies will have evolved by 2020, making them more powerful (higher range), at lower prices and reduced size. This calls for standards and regulations, also regarding safety aspects. They can also have a second life as storage devices, becoming active elements in the smart grid. Again, this requires a proper regulation.
- Area: **Battery** reuse/recycle

- Recommendation: Standardization on **inductive** charging
- Area: **Inductive** charge

- Recommendation: Establishment of the basic rules for **fast charging** DC/AC
- Area: Common **fast charging** on highways

- Recommendation: Close the definition of a standard **plug**

The areas and recommendation are in line and fit with the gaps that were identified and listed in D7.5[17]. These gaps are spitted in the following sub-areas:

- battery
- range prediction and State of Charge
- regenerative braking;
- charging modes;
- connectors
- cables
- communication
- inductive charging;
- identification
- safety
- Electro Magnetic Compatibility
- security – data protection;
- privacy
- Power Quality
- DC metering
- Smart Charging – Load Management;
- Power Level
- data exchange; (including roaming)
- Marketplace Platform;
- Payment

Only a few areas are new like Standardisation process, V2G and V2H.

[17] Available autumn 2014 at http://www.greenemotion-project.eu/dissemination/deliverables-standards.php

8.5 Conclusion and summary third standardization survey

Several recommendations were received; these can be grouped in less than 20 issue areas. Several of these areas are the same as the standardisation gap areas identified in a workshop in Green eMotion WP7 (see deliverable D7.5).

We will group the conclusions in 3 main areas:

- Component related areas: related with a limited set of components (e.g. inductive charging, batteries, …)
- System related areas: communication protocols, business/use cases are part of this area, but also interoperability.
- Other areas: like Power Quality, EMC, User Interface, etc.

8.5.1 Conclusions and recommendations in system related areas

Smart charging: Is needed since this will help to optimize the use of the electrical grid for efficient EV charging, while maximizing the use of renewable energy; at public EVSEs and other places like at home or office, think also of charging on own solar panels (PV2EV) on these locations.

- Recommendation: Collect broad set of use cases covering smart charging. Different types of smart charging (cheap/renewable energy, with grid congestion management, on locally/home produced electricity, etc.) but also at different locations (home, public, office, ….). This requires integrated with smart metering and a smart grid integral approach.
- Recommendation: as follow up step: update all related (communication) standards and protocols to allow smart charging, and interoperability on this topic. This needs to be handled in parallel with the next topic on Smart Grid Integration.

Smart Grid integration, this is the most responded topic in this survey. A Smart Grid Integration standard is required; this should include a universal demand response mechanism. Also a Home Energy Management System (HEMS) is part of this scope. The missing interface standard to manage demand & supply for energy and grid availability is also needed to enable the smart charging as mentioned in previous point. Further this is also the place to take security and privacy into account.

- There is still no agreed overall eMobility Reference Architecture. A start has been made in the Ad Hoc Group on Smart Charging active under chairmanship of Claus Amtrup Andersen, this group is part of the CEN/CENELEC eMobility Coordination Group but also reports to M/490 on Smart Grids. Recommendation: Further follow up (in a new EU mandate that likely follows up on M/490 and M/468) and create a **Smart Grid *and* eMobility Reference Architecture.**
- Recommendation: In an industry/user group (e.g. eMI3) create a simple implemented example of such a reference architecture. This will show how it works, and issues can be detected soon. It could be considered to make such a project part of a H2020 project and demand that the results and code will be made public (e.g. open source).

Communication protocols and Interoperability: there is no agreed EVSE backend protocol, although OCPP has been mentioned a few times as one of the best starting point for this. Also upstream standardized protocols (around the EVSP and the Smart Grid) are required to ensure interoperability. The issue is likely not that industry partners cannot agree on how to implement the requirements, the main issue is likely that the full set of requirements for these interfaces are not clear. Further there is also need for upstream standardized protocols for Smart Grid interaction and Energy Market interaction. These can be worked out further when an agreed Smart Grid and eMobilty reference architecture is established.

- Recommendation: Raise an independent initiative that collects requirements and use cases that cover the full range of the EVSE back-end interface requirements. This recommendation is already been taken up by eMI3 in their WG5 on charge station communication protocol.
- After that there are several options to continue: that the industry takes this up themselves, that a user/industry group picks this up, or that a NWIP is created and handed over that will result in an international standardisation organization creating the standard.
- Recommendation: Define upstream standardized protocols for Smart Grid interaction and Energy Market interaction.
- Interoperability and conformance tests are required:
  Recommendation: Start creating interoperability & testing methodologies (e.g. as in M/490 WG Interoperability, and the FP7 project COTEVOS).

Identification and roaming. There are partial solutions but not a general commonly accepted way. Identification of user for payment and other services is likely to merge with several other services: from public transport cards, to payments cards, to smart phones with this functionality.

- A NEMA proposal (from USA) has been presented to eMI3 in June 2014, that together with the eMI3 proposal on unique identifiers could be the basis to feed into a next standard, as follow up of the by Better Place initiated NWIP. The NEMA nvid is also been analyzed by the German DKE experts and it is planned to hand it over to the IEC 62831 group, that will continue the work based on this.
- Identification and roaming/Clearing House interfaces require a standard, but this needs to be done carefully. To quick settling a standard may lead to miss future requirements in this identification (service) related area. Take protocol/solutions for intermodal travelling integrating EVs & public transport into account.

Charging Infrastructure: Most topics are solved via the related EU directive.
Still EVSE costs are too high to enable profitable business models. Costs remain an issue:
(EU) policy enabling charging without expensive (smart) meters and processes focussing on public and semi-public charging are required.

V2G and V2H. This are application areas that are not expected short term, but these are complex and have impact on most components and interfaces of the system (Smart Grid, vehicle, battery, (home) charging system, DC versus AC).

- Therefor the recommendation is to further look into this topic with a Smart Grid point of view and create use cases, options and a roadmap with likely applications, and a roadmap that shows possible paths towards that future direction. From this roadmap more short term conclusions and actions can then be derived.
- One of the short term actions would be to ask ISO/IEC 15118 to put the V2G/V2H feature also into their protocol, since V2G is already possible with CHAdeMO. This is planned to do in ISO/IEC 15118 when they start to work on an update on the 15118-2/-3 documents.

8.5.2 Conclusions and recommendations in component related areas

Battery standardisation issues are still mentioned in areas like BMS communication, standardization in terms of size, dimensions, etc. Also to enable battery reuse and recycling.

- Recommendation: Standards and regulations are required to support second life of batteries as storage devices, becoming active elements in the smart grid while maintaining supporting safety aspects.

- This requires also the standardization of charging/discharging protocols, the BMS communications system and the battery operation procedures, that should closely follow the research progress in battery technology

Inductive charging: more standards seem needed on interoperability of inductive systems. High priority for public and medium/high for private usage. Question is if technology is far enough to create a full set of standards. Recommendation: make an inventory of items in this area that requires standards, and when options could become available, the results can be an Inductive charging standards roadmap. Note that ISO/IEC 15118 already covers several inductive topics in the – 6,7,8 documents.

Fast charging topics, DC versus AC. Mentioned as issue area, but it is more likely that the technology is not far enough to make clear choices or standards here.

- A recommendation could be: Establishment of the basic rules for fast charging DC/AC area and common fast charging on highways.

Plugs and connectors: CCS with the combo connector seems to be the agreed connector in Europe (type 2) and US (type 1).

8.5.3 Conclusions and recommendations in other areas

Business models and related payment contract models. Very difficult to find business models due to the low spread of EVs.

- Recommendation: Promote potential new business models that will further enable the use of smart charging (Time-of-Use tariffs are just one example of this).
- Work out concepts for Charge Spot reservation.

Standardisation and the process including regulatory aspects

- Plan a stepwise development of standardization and consider which aspects do really need to be standardized and which can remain as proprietary solutions. This process can lead to a standardisation roadmap.
- Standards are needed but some areas are not ready for this (V2G) while others suffer from no choices/surfacing solutions (like smart charging).

EV range prediction: Driving Cycle standard to determinate performance and realistic Range of EVs would be beneficial.

8.5.4 Overall conclusions and recommendations

Market solutions, standards etc. are often behind state-of-the-art technological possibilities (as being used on other domains). Visibility of technological possibilities in these other domains is key to make the right decisions, solutions and standards. A good example is eMobility roadmaps' dependence on the Smart Grid roadmap.

To summarize in one recommendation: **create and manage an eMobility standards roadmap**, based on a unified Smart Grid **and** eMobility Reference Architecture and associated use cases and align this roadmap with roadmaps on

- Smart Grid technology (with active demand response)
- eMobility enabling services, smart phone and payment / technology and roadmaps. These will be useful for identification, roaming and clearing house services, but also other services like parking, vehicle, energy, traffic, search and find services.
- Battery and power component and interfaces technology (battery, inductive, fast, AC/DC) and

- Vehicle2Grid and V2Home technology roadmaps

It would be good if this process (not content) would be supported by the EU, e.g. by a new/another mandate (like M/469 and M/490)

9 Summary and conclusions

In the frame of Task 7.2 “Monitoring and managing the collection of standardization issues and needs” three surveys addressing the most important technological areas related to Electromobility was circulated within Green eMotion and to a few External Stakeholders.

Working on this standardisation topic has led to our conclusion that standardization in Electromobility is like an iceberg: you only can see the top of the total problem (often the plug issue), but most of it is invisible yet and below the surface. That is where standards for and issues communication and information reside. In general enough technology and standards are available, it is now the time to make choices, to combine standards and to fill the remaining gaps.

Although not all survey versions have a high response rate, it can be seen that the replies did come from a good sample of actors already practically involved in the development of Electro-mobility in Europe. Therefore activities have been started and good conclusions can be drawn to address the future activity about the harmonization of technology and standards in Work Package 7 and recommendations can start to be deeply analyzed in each technological area in the frame of the relevant technical Work Packages. For that reason the second version of the survey focussed more on AC/DC Charging, Identification and Communication requirements, Smart Charging needs, and some other new topics, while the third survey focussed on future trends in eMobility and advices for standardisation guidelines.

At the start of Work Package 7 we already discovered that over 200 standards are potentially being used in Electro-mobility. In the survey we have done to collect standardization issues and needs for standardization and interoperability, we only see limited sets of standards being mentioned and also used. Several standards are used by multiple demonstrations sites and companies, as expected, these are listed in the table below, the most mentioned standards are on top:

Standard	Related to	Electric Vehicle	Charging Point	Connection to Grid	Communication
IEC 61851	Conductive Charging	X	X		
IEC 62196	Connector and charging	X	X		
ISO 15118	V2G interface	X	X	X	X
J1772	Connector	X	X	X	
IEC 60364	Protection		X	X	
CHAdeMO	EV charging	X	X		X
IEC 14443	RFID		X		X
IEC 61850	Substation automation			X	X
IEC 61000	EMC		X	X	
OCPP	Open Charge Point Protocol				X
HomePlug Green PHY	Home Area Network		X		X
UL2251	Safety	X			
ISO 16750	Environmental	X			
J2931	PLC				X
IEC 62056	Meter reading				X
UMTS (3G)	Mobile Communication				X
GSM	Mobile Communication				X
EN 55011	Radio disturbance		X		
IEC 60529	Protection		X		
EN 62262	Mechanical protection		X		
IEC 61980	Inductive Charging		X		

RS-485	Multipoint systems	X

Table 9-1 List of basic standards for and used in Electromobility

This list cannot be treated yet as the list of most important standards. It is only a good starting point as a list of basic standards for and used in Electromobility. Some standards can be missing, or not defined yet. The standards of the table are also put in the reference picture, see Figure 9-9-1.

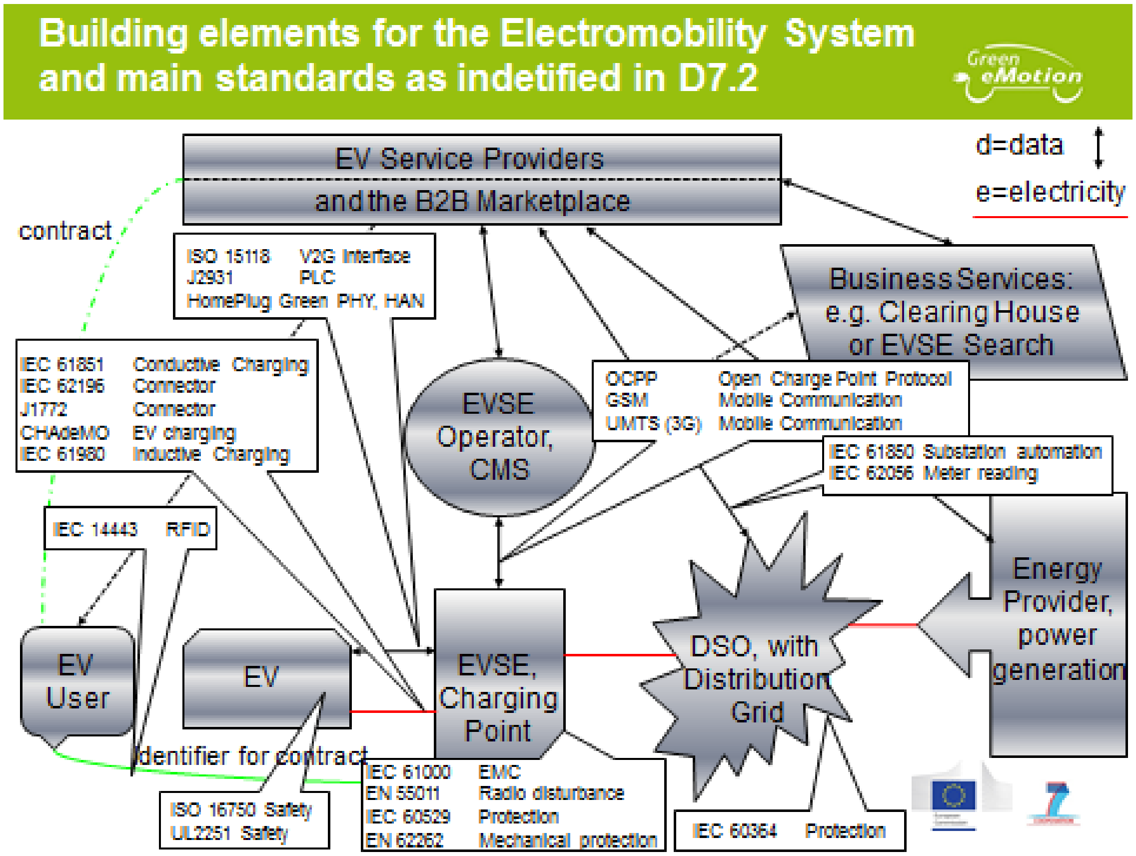

Figure 9-9-1 List of basic standards mapped into the architecture

Several overlaps have been identified in the used standards related with plugs and connectors in the car side. Different modes of charging (and also, different kind of electric current – AC vs. DC) and different types of connectors are in use. To achieve European Interoperability this needs to be improved.
Also in the standards used on charging points several overlaps and non-homogeneities have been identified. As for charging modes, although Mode 3 is the most diffuse and spread in Europe, all the different modes are still in use. This may be related to different kinds of charging points (public, semi-public, private, etc.), but it can anyway be an obstacle to interoperability, if it is not properly known and addressed. In the same way, also concerning socket outlets, Type 2 (from 62196-2) is the most used one, but also Type 1 and Type 3, as well as industrial (60309) and Schuko outlets are mentioned as used in some demonstration projects (mainly related to mode 2 of charging).

Regarding the results of the second survey, according to the question about a possible mandatory for public AC charging points, the most of the surveyed are aligned with the use of the type 2

connector (Mode 3). In some surveys the use of the Type 3 connector also is proposed. However in the meantime there is a European directive on this:
The proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the deployment of alternative fuels infrastructure writes:

> *1.2. Fast electric recharging points for motor vehicles*
> *Alternate Current (AC) fast recharging points for electric vehicles shall be equipped, for interoperability purposes, with connectors of Type 2 as described in standard EN62196-2:2012.*
> *Direct Current (DC) fast recharging points for electric vehicles shall be equipped, for interoperability purposes, with connectors of Type "Combo 2" as described in the relevant EN standard, to be adopted by 2014.*

Regarding a similar question about public DC charging points, it seems like the market will have both Combo 2 and CHAdeMO cars available in Europe. However, surveyed propose as general rule, to use the Combo2 (Combined Charging System (CCS) with type 2 connector).
One additional conclusion from the second survey is that the Modes 1 and 2 must be not allowed for public areas.

Also (according to the first survey), the issue about identification (ISO 14433 and ISO/IEC 15118) turns out to be very important towards interoperability and should be further addressed, this is already in scope of eMI3.

Regarding low power charging solutions (for public and semi-public areas) the second survey indicates that Schuko and Type E/F sockets are used in Mode 1 for e-bike and light EVs, in Mode 2 for the vehicles. In addition the surveys have pointed out that some extensive tests show a possible overheating of the sockets when used on a daily basis even at low power.
3.7kW is the minimum power level for semi/public charging stations emerged from the survey, but 22kW is considered to be more suitable for reason of usability and optimized service with short charging times. The respondents have pointed out that is important to define a maximum power level (43 kW) because of safety regulation and grid impact.

A general comment on AC charging cables used (both public and private area), is that there is no need for national standards but they should be at least standardised on European level.

In general fast DC charging is specified in IEC 61851-23. For the installation of DC charging points in petrol stations some general national/European regulations apply (as Low Voltage, Explosive Atmospheres, work-related risk of injury by electric hazard, safety and health recommendations and Pollutions) but there is a need to define procedures and specific regulations regarding fast charging installations on DC as well as AC.

Inductive charging is considered as an emerging technology that might integrate the traditional conductive charging method but, at the moment, it suffers from a lack of standards even if besides some national technical documents, standardization work is in progress at SAE, ISO and IEC level.

In the area connection to the grid not that many survey topics were received nor many issues. This is probably due to the fact that issues in the other areas are more short term. Still attention needs to be given to several Smart Grid standards that can find their way in the EV standards. Therefore these EV standards need to be aligned with Smart Grids standards since Electric Vehicles are a complex and special component of the future Smart Grid. It uses electricity at different points in the electricity network, is not always connected, can store energy, can potentially feed energy back into the system, and has flexibility that can be used for Supply Demand Management (SDM). Long term we expect that the EVs will be used for SDM and thus will pose requirements on the EV charging standards.

The answers given on Smart Charging section in the second survey, while recognizing smart charging as an area with high focus and potential, indicate a proposal of not focus on Smart charging initially during the market introduction until 2014 but to focus on interoperability in combination with the implementation of an eMI3 Marketplace/ Clearinghouse Reference Architecture.
About the standards protocols available for smart charging purposes most of the survey have indicated ISO/IEC 15118 as the standard that addresses communication needs between EV and EVSE while is not yet standardized the communication between EVSE and EVSE Operator back-end system where several approaches are currently deployed, mostly proprietary ones. But standardization is ongoing within eMI3 working group 5.

The question on types of smart charging and the needs of these has revealed that there is a strong need to make use of the advantages of smart charging but it should be clarified in which way it shall be treated: if user or grid topics shall be treated with high priority or not etc.
A first list of types of smart charging that can be derived from the answers, is the following:

- Interruptible load in frequency / voltage response
- Restored load in frequency / voltage response
- Phase balancing through smart invertors
- Peak shaving, load shaping applicable in V2G or V2H scenarios.

In particular the types of Smart Charging applied in GeM test cases emerged are:

- Control of the charging according to utility demands and customer service level agreements thereby starting and stopping the charging when needed
- Mode 4 + Storage system with a peak reduction objective
- Grid-friendly smart charging in a context of large scale load management scenario.

V2G is considered, in general, to be a long-term option that does not economically make sense until EVs come to market in millions. More specifically the suggestion is to address V2G longer term and to concentrate resources first on interoperability. Since DSO/ utility lead initiatives are already moving forward, eMI3 should initiate an exchange and elaboration of a common view of the smart charging challenges between the different stakeholders (DSO, utilities, OEMs, Service Providers). The answers on what should and can be defined for V2G now, indicate the necessity to include all the communication needs in the protocols, in order to be sure that the V2G connection should have all the information to be made in an optimal way.
In particular it emerges the need of identifiers for the grid structure (PoD, load area) and basic conditions regarding to the grid impact (power quality etc. on EV and EVSE side).

The communication area is the area which seems most open. Several options and standards are mentioned for communication of the EV towards the different backend systems: direct mobile communication, communication via the charging point as well as communication via and to the grid. Probably standards need to be worked out and combined to enable combinations of these options. For that reason in the second survey identification and communication where key areas for investigation. This brought several new recommendations.

With respect to communication: EVSE and back-end communication through GPRS is expected, and EVSE to EV through via Power Line or PWM communication. In this area ISO/IEC 15118, IEC 61851 and OCPP are frequently mentioned. For EVSE to back-end communication OCPP could be a good starting point, but enhancements are certainly required: derived from ISO/IEC 15118, should support all planned services of the GeM MarketPlace, and it shall be developed by a known standardization body. Because of this Green eMotion has written a NWIP (Electric Mobility

Infrastructure Open Protocol) for this EVSE to back-end communication, which is handed over to eMI3 to bring this topic forward.

For other communication links there is not yet an obvious or urgent need for standardization, this also holds for the communication with the Clearing House, which would require more study.

There is a need for an overall communication architecture, it is recommended to start with that. This is being addressed already by eMI3 and several Green eMotion partners are involved.
More attention is also required on security and privacy for example by means of encryption. It is recommended to look into the communication solutions of currently available payment/transaction methods (such as RFID, NFC, IC card, Smart Phones). Further the work of the Smart Grid Information Security WG should be taken as input. This can all be done in parallel with developing a communication architecture. Also this point is part of eMI3's agenda.

In the identification area, because of short term requirements, a first choice is required and made within Green eMotion, but easy upgradability of the identification method is required, since this kind of technology such as identification/security is essential to e-commerce in general, not specific to e-mobility. So for e-mobility we need to align and look further into e-commerce solutions, discussions and standardization efforts. By defining common identifiers within GeM and eMI3 which are already in use (e.g. in ISO/IEC 15118) and by providing a NWIP on authentication topics, which is now handled by IEC 62831 important steps have already been done.

On Common Data Formats (e.g. SDR/CDR) activities in eMi3 (WG Business Objects) and Hubject (the Hubject Interfaces) seem the main drivers towards more generic solutions. The recommendation is to await and influence the roadmap that will be issued by eMI3.

The survey question in version 1 on the top standardization topics that are challenges for the introduction of EVs resulted in the following top issues (with the most mentioned topics on top):

- Plug standardization/connectors for physical interoperability
- Communications/standardization on protocols
- User identification/authentication
- Pan-European charging standard
- Payment interoperability on a business level
- Interoperability and roaming
- Too many proposed standards.

The short term recommendations and conclusions given in this document were and are being followed up by the other WPs and more specific by WP7. The long term recommendations have been brought for follow-up in the eMi3 group. This ensures that it is being brought under the attention of more players in the eMobility market, and also eMI3 is open for more companies, has long term objectives, and is not bound to a particular end-date. Because Green eMotion is actively supporting eMI3, we leverage the knowledge and effort gained in Green eMotion actively towards the eMobility community. Again, as you look at the top issues above: a lot has already been accomplished since this first survey by the different stakeholders as already described.

The third and last survey on future trends in eMobility and advices for standardisation guidelines led the following overall conclusion and recommendation:
Market solutions, standards etc. are often behind state-of-the-art technological possibilities. Visibility of technological possibilities in other domains is key to make the right decisions, solutions and standards. A good example is eMobility roadmaps' dependence on the Smart Grid roadmap.
To summarize in one recommendation: create and manage an **eMobility standards roadmap**, based on a unified Smart Grid and eMobility Reference Architecture and associated use cases and align this roadmap with roadmaps on

- Smart Grid technology (with active demand response)
- Identification/payment/roaming/Clearing House/smart phone technology and roadmaps
- Battery and power component and interfaces technology (battery, inductive, fast, AC/DC)
- and Vehicle2Grid and V2Home technology roadmaps

It would be good if this process (not content) would be supported by the EU, e.g. by a new/another mandate (like M/469 and M/490)

Another EU FP7 project that works on eMobility standards and interoperability is COTEVOS (Concepts, Capacities and Methods for Testing EV systems and their interOperability within the Smartgrids, see http://cotevos.eu/). Several Green eMotion partners are also active in this project. In their WP2, Integration and alignment of testing methods with standards they sketched the following useful standardisation landscape:

- M/468 eMobility Co-ordination Group (http://www.cencenelec.eu/standards/Sectors/Transport/ElectricVehicles/Pages/default.aspx)
- E-Mobility WG Smart Charging
- M/490 Smart Grid Coordination Group, with new working groups (http://www.cencenelec.eu/standards/Sectors/SustainableEnergy/SmartGrids/Pages/default.aspx)
  - M/490 – WG Consistent set of standards
  - M/490 – WG New applications and Methodology
  - M/490 – WG Interoperability
  - M/490 – WG Information Security
- IEC TC 69 (http://www.iec.ch/)
- IEC 61851
- ISO/IEC 15118 (http://www.iso.org/)
- eMI3: eMobility ICT Interoperability Innovation Group (http://emi3group.com/)
- OCA: Open Charge Alliance (http://www.openchargealliance.org/
- Other organisations: ETSI CTI (http://www.etsi.org/about/how-we-work/testing-and-interoperability)
- Other projects
  - STARGRID (http://stargrid.eu/)
  - Green eMotion (http://www.greenemotion-project.eu/)
  - COTEVOS (http://cotevos.eu/)
  - PowerUp (http://www.power-up.org/)
  - …

This list provides several references with more information on standards in this field.

10 Appendix with original survey on EV Standardization

10.1 Green eMotion Survey on EV Standardization

Input for WP7.2

10.1.1 Survey version 1.1

Prepared by:

Joost Laarakkers
TNO
joost.laarakkers@tno.nl
Date: October 14, 2011
Version: 1.1

Why this survey?
The harmonization of standards is an essential issue for the mass rollout of Electric Vehicles (EVs) and Plug-in Hybrid Electric Vehicles (PHEVs) across the EU. This increases the economic efficiency of the sector and increases the usability of electric vehicles and the recharging infrastructure. I.e. this would allow the user of the EV to use the same interfaces internationally for the connection of the vehicle to the recharging infrastructure and, for example, to address the payment of the recharging in similar ways as the "roaming" for his cell phone. To support this harmonization by the Green eMotion project, we collect the standards being used and the issues and needs related to standardization. This survey is one of the first steps in this process. Green eMotion categorizes standards in 4 areas, which we also use in this survey: • Standards on vehicle • Standards on charging point • Standards on connection to the grid • Standards on communication
Instruction
Please use the text box below the questions for your answer and give additional information appropriate or related to the topic. For the updated list of standards please refer to the Excel table (as included in Green eMotion Deliverable 7.1 - Part1) that you will receive along with this survey template. Whenever possible, please specify the standard details involved in case of a standard series (i.e., IEC 61851-1 instead of only IEC 61851).
All your input on this topic is highly appreciated !

GENERAL INFORMATION
Company:
Country:
Date:
Project: (please specify if the project is inside or outside Green eMotion)**:**
Notes:

Standards on vehicle
Which of the following standards on vehicle do you already use or intend to use? IEC 61851-X (EV conductive Charging System), IEC 62196-X (please specify Type of connector/inlet vehicle side), J1772 (Conductive Charge Coupler), UL2251 (Safety of Plugs), IEC 61982-X (Secondary batteries for the propulsion)
Answer: Please also specify where and how you use it (which mode and type of socket).
Which other standards or non-standard solutions on vehicle do you (plan to) use?
Answer: Please also specify where and how.
Which standards or extension to standards on vehicle do you miss?
Answer:
Do you have other issues or needs with respect to standards on vehicle, and which ones?
Answer:

Standards on charging point

Which of the following standards on charging point do you already use or intend to use (in for example identification, charging, billing, wiring, power quality, protection)?

- IEC 61851-X (please specify Mode of charging),
- IEC 62196-X (please specify Type of plug/outlet),
- J1772 (Conductive Charge Coupler),
- IEC 60364-X-X (Protection),
- UL2594 (Safety of EV Supply Equipment)

Answer:

Please also specify where and how you use it (mode, type of socket, AC/DC, 1/3 phase).

Which standards or non-standard solutions on charging point
do you (plan to) use?

Answer:

Please also specify where and how.

Which standards or extension to standards on charging point do you miss?

Answer:

Do you have other issues or needs with respect to standards on charging point, and which ones?

Answer:

Standards on connection to the grid

Which of the following standards on connection to the grid do you already use or intend to use?

- J2847-X (Communication with EV),
- IEEE P1901 (Broadband over Power Line Networks),
- J1772 (Conductive Charge Coupler),
- IEC 60364-X-X (Protection),
- J2293-X (Energy Transfer System),
- IEEE P2030 (Draft Guide for Smart Grid Interoperability)

Answer:

Please also specify where and how.
Which other standards or non-standard solutions on connection to the grid do you (plan to) use?
Answer: Please also specify where and how.
Which standards or extension to standards on connection to the grid do you miss?
Answer:
Do you have other issues or needs with respect to standards on connection to the grid, and which ones?
Answer:
Standards on communication
Which of the following standards on communication do you already use or intend to use? ISO/IEC 15118-X (please specify..., V2G communication interface), IEC 61850-X (Communication network and systems in substations), ZigBee SEP 2 (Common messaging), J2931-X (PLC communications), J2847-X (Communication of EV), IEC 62056-X (data exchange for meter reading)
Answer: Please also specify where and how.
Which other standards or non-standard solutions on communication or data collection do you (plan to) use?
Answer: Please also specify where and how.
Which standards or extension to standards on communication do you miss?
Answer:

Do you have other issues or needs with respect to standards on communication, and which ones?
Answer:
Which type of EVSE (EV Supply Equipment) management system (a centralized/de-centralized ICT infrastructure that gathers data from EVSE and EVs) do you plan to use?
Answer:
In this EVSE: what type of data do you collect, communicate, and which standards or solutions do you use for that (like transmission physical standard, network, information protocol, data content, financial services standards for billing, etc.)?
Answer:

Other questions and comments
According to your experience, which use cases are specifically important to be used in the standardization?
Answer:
What are the standards with respect to EV that are (being) standardized in/for your country?
Answer:
What are the top (three) standardization topics that really need to be addressed and that are the biggest challenges for the introduction of EVs?
Answer: 1. 2. 3.
What kind of methodologies or best practices do you use to assure that development conforms to standards?
Answer::
Do you have any other comments, topics, issues or needs that have not been addressed with the previous questions?
Other comments:

Contact details
Maybe we need further information on the answers and comment you and your organisation has given. Please list below the person(s) and e-mail address(es) we can contact in case we like to have more information.
Your contact person(s):
Please return this survey to joost.laarakkers@tno.nl
Thank you for your effort!

10.1.2 Survey version 2.1

Prepared by:

Joost Laarakkers
TNO
joost.laarakkers@tno.nl
Date: October 30, 2012
Version: 2.1

Why this 2nd survey?
In first year's survey we collected the standards being used and the issues and needs related to standardization for 4 functional areas: standards on vehicle, on charging point, on connection to the grid and on communication. In this year's survey in order to gain more insight and details we focus on the following technological areas like: • AC Charging (for public and semi-public areas) • DC Charging • Identification requirements (for EV contract and EV Supply Equipment) • Communication (between EV or EVSE and all secondary actors) • Smart charging: the combination of user friendly, grid friendly, battery friendly and energy friendly charging • Other and "new" areas like: regulation of quick-fast charging installations in petrol stations; inductive charging, … These technological areas have been identified in the Green eMotion 18 Month Workshop on Standardization, October 4th 2012.
Instruction
Please use the text boxes of the questions for your answers and give additional information appropriate or related to the topic where relevant. We are sending in this survey to as well WP7 partners and GeM test case owners. So keep your specific GeM test case or company product/business in mind when answering the

questions.
All your input on this topic is highly appreciated !

GENERAL INFORMATION
Company/GeM test case:
Country/Demo site:
Date:
Project: (please specify if the project is outside Green eMotion)**:**
Notes:

AC Charging Mode
The answers on the questions in this part should help us to clarify AC Charging Modes and requirements, especially the need for Mode 3 in AC charging.
What should be the requirements for public and semi-public AC charging points?
Answer: E.g. should mode 3 be mandatory for public CPs, with ☐ Type 2 connector Ty☐ 3 connector C☐bo connector?
Should there be a minimum power level for public and semi-public AC charging points? If so what is the minimum power required?
Answer:
What type of charging cables (Type, Dimensions, Material, and Standards) are used in public or private areas (in your company products or demo sites)?
Answer: Are there already national standards for AC charging cables?
Which low power charging solutions for light EVs, PHEVs, e-bikes, … are you using and aware off, which should be promoted (or not) and why?
Answer:
Do you have other remarks on standards, interoperability or requirements with respect to AC Charging?

Answer:
DC Charging
The answers on the questions in this part should help us to clarify DC Charging requirements and areas for standardisation or harmonization.
What should be the requirements for public and semi-public DC charging points?
Answer: E.g. what type of DC Charging connectors should be used for DC charging?
For a potential quick EU decision/deployment to achieve a unified EU standard, what is your input and advice on standards and approach with respect to DC charging?
Answer:
What type of charging cables (Type, Dimensions, Material, and Standards) are/should be used (in your company products or demo sites)?
Answer:
Do you have other remarks on standards, interoperability or requirements with respect to DC Charging?
Answer:
Identification
The answers on the questions in this part should help us to clarify identification requirements, especially the need for and format of EVCOID (EV contract ID) and EVSEID, as also will soon discussed in the eMobility ICT Interoperability Interest Group, this Group targets to agree by end of 2012 on such an EVCOID and EVSEID.
What are the standards and data formats for identification of EVSE or EV contract that you are using or aware of?
Is there on short term a need for a standard/data format for other data elements?
Answer:

What is your need for roadmap and work plan for common data formats within 2013 and beyond?
Answer:
What about inclusion of privacy/data protection and security issues, what are the requirements, standards and possibilities in this area?
Answer:
Do you have other remarks on standards, interoperability or requirements with respect to identification?
Answer:

Communication
The answers on the questions in this part should help us to clarify communication standards options and requirements, especially the need for communication between EV or EVSE and all secondary actors.
How is/should/can the communication between EV or EVSE and all secondary actors (e.g. EVSE-backend) be handled?
Answer: Which standards and communication protocols do you propose to be used?
How can/should Charge Point interfaces/standards ("OCPP", …) look like?
Answer:
How can/should Clearing House and other backend-services interfaces/standards ("OCHP", …) look like?
Answer:
How can the market place enable support for multiple communication channels (via CP or directly to EV (mobile), to back-end, etc., ...)
Answer:

Do you have other remarks on standards, interoperability or requirements with respect to communication?
Answer:
Smart charging
The answers on the questions in this part should help us to clarify Smart Charging requirements/definitions/options. Our current "definition/view" on smart charging is in this context any combination of user friendly, grid friendly, battery friendly and energy friendly charging.
What standards protocols proposals are now available for use for smart charging, the combination of user friendly, grid friendly, battery friendly, and energy friendly charging?
Answer: What is your view on the types of smart charging and the needs of these?
We consider adding V2G as long-term option, but we can start to influence requirements, options and standards now. What should and can be defined for V2G now?
Answer:
In case you manage a Green eMotion "test cases" (in WP8), what types of Smart Charging to you apply and how? Which standards are involved?
Answer:
Do you have other remarks on standards, interoperability or requirements with respect to Smart Charging?
Answer:

"New" and other areas
The answers on the questions in this part should help us to clarify needs and requirements in "new" and other areas, like inductive charging and regulations for charging installations and charging places.

What are the regulations of quick-fast charging installations in petrol stations, and in which areas need these regulations to be extended?
Answer: Which of these requirements and regulations are country specific?
What is the current status of standards and regulations on inductive charging?
Answer:
Are there other/"new" areas with promising business models, that needs to be embedded in standards?
Answer:
Do you have other remarks on standards, interoperability or requirements with respect to "New" and other areas?
Answer::
Do you have any other comments, topics, issues or needs that have not been addressed with the previous questions of this survey?
Other comments:
Contact details
Maybe we need further information on the answers and comment you and your organisation has given. Please list below the person(s) and e-mail address(es) we can contact in case we like to have more information.
Your contact person(s):
Please return this survey **To: joost.laarakkers@tno.nl and CC: silvia.celaschi@rse-web.it**
Thank you for your effort!

10.1.3 Survey version 3.3

Green eMotion 3-page survey on EV deployment and standardization issues, version 2014

Input for Work Package, 7 Task 2, year 2014
Date: March 24, 2014
Version: 3.3

Why this 3rd survey?
In first year's survey we collected the standards being used and the issues and needs related to standardization for 4 functional areas: standards on vehicle, on charging point, on connection to the grid and on communication. To gain more insight and detail in the second year's survey we focused on the following technological areas: AC Charging, DC Charging, Identification requirements, Communication, Smart Charging, and "new" areas like: regulations for quick-fast charging. Since the last year of the Green eMotion project has started we will not be able to solve all detailed standardisation issues within this project, therefor now in this 3rd and last survey we will ***focus on trends*** to be taken into account for harmonisation of technology and standards and are ***seeking for advice***. These trends and advices will be analysed and summarized so that these can be used within the project where possible, but also by other projects and roll-out activities in eMobility. To be able to identify trends we will ask questions related to: • the situation in 2011 when Green eMotion started, the current status in 2014 • the expected trends and issues in the upcoming years, till 2020 • advice and input for guidelines for standardization and interoperability. **Note: you do not have to be an expert in EV standardisation to fill in this survey personal opinions and experiences are just as valuable!**
Instruction
Please fill in the text boxes of the questions below the green bars for your answers and give additional information where appropriate or related to the topic where relevant. To make it easier to process the answers, please leave or set Word "track changes" function on.
All and any of your input on this topic is highly appreciated !

GENERAL INFORMATION
Company:
Country/Demo site (if applicable):
Date:
Project: (please specify if the project is outside Green eMotion)**:**
Notes:

<table>
<tr><th colspan="2">Current technology and standardisation situation</th></tr>
<tr><td colspan="2">The answers on the questions in this part should help us to judge if the issues that were found in 2011, the year we started the Green eMotion project, were over- or underestimated. Further this part should help us to update the issues that are still there now in 2014 and what the priority is to solve these.</td></tr>
<tr><td colspan="2">The first survey on the standardization issues in 2011 resulted in the following top issues. Could you give your short remark on these topics (solved, became smaller, bigger, …)?</td></tr>
<tr><td>Main issues from 2011:
• Plug standardization/connectors
• Communications/standardization on protocols
• User identification/authentication
• Pan-European charging standard
• Payment interoperability on a business level
• Interoperability and roaming
• Too many proposed standards</td><td>Answer:
• ….
• ….
• ….
• ….
• ….
• ….
• ….</td></tr>
<tr><td colspan="2">Which key standardization issues came up after 2011 and are still not solved.
Could you give your short rating on the priority to solve it (e.g. High/Medium/Low)?</td></tr>
<tr><td>New issues after 2011:
• ….
• ….
• ….
• ….
• ….</td><td>Rating
• H/M/L
• H/M/L
• H/M/L
• H/M/L
• H/M/L</td></tr>
<tr><td colspan="2">If you have additional comments or input on these issues, please mention them in the next text box:</td></tr>
<tr><td colspan="2">Additional comments:</td></tr>
<tr><td colspan="2">Probably you have not listed all issues yet. To further complete the list also add the issues that you are aware of from the views of different stakeholders, also provide a rating (you can fill in multiple issues if needed).
At least fill in this question for your own role in the eMobility domain.</td></tr>
<tr><td>Other issues that are still open from the view of the:
• EVSE manufacturers are: …..
• DSO (Distribution System Operator) are: …..
• eMobility Service Provider are: …..
• Utilities/retailers are: …..
• Car/EV OEMs are: ….
• Clearing House/IT companies are:…..
• EV User/municipality are: (e.g. parking)…..
• Stakeholder … are: …..</td><td>Rating
• H/M/L
• H/M/L
• H/M/L
• H/M/L
• H/M/L
• H/M/L
• H/M/L
• …</td></tr>
</table>

Expected trends and issues in the years till 2020	
The answers on the questions in this part should help us to identify issues that may or are likely to arise in the years till 2020.	
Which standardization key issues do you think will or can come up in the next years (till 2020) and again could you give your short rating on the priority to solve these (e.g. High/Medium/Low)?	
Potential future issues: • …. • …. • …. • …. • ….	**Rating** • H/M/L • H/M/L • H/M/L • H/M/L • H/M/L
If you have additional comments or input on these issues, please mention them in the next text box.	
Additional comments:	
Probably you have not listed all future issues yet, to further complete the list also add the issues that you think will or can come up in the next years of from the views of different stakeholders, also provide a rating (you can fill in multiple issues if needed). ***At least fill in this question for your own role in the eMobility domain.***	
Other issues that are still open from the view of the: • EVSE manufacturers are: …. • Distribution System Operator are: … • eMobility Service Provider are: …. • Utilities/retailers are: …. • Car/EV OEM are: …. • Clearing House/IT companies are:…. • EV User/municipality are: …. • Stakeholder … are: ….	**Rating** • H/M/L • H/M/L • H/M/L • H/M/L • H/M/L • H/M/L • H/M/L •
Are you sure you listed all expected trends and issues? Have you considered the topics below?	
Potential future issues: • Charge Spot reservation • Fast charging topics, DC versus AC • V2G or V2H (Vehicle to Grid or Home) • Smart Charging • Smart Grid integration • Roaming ... • ..	**Rating** • H/M/L • H/M/L • H/M/L • H/M/L • H/M/L • H/M/L • H/M/L

Your advice and input for standardisation guidelines
The answers on the questions in this part should give us advice and guidelines for further standardisation and topics to take into account.
If you revisit the answers you gave on 2011, today's status and the expected future, what are than the key 3 (or more) recommendation you can give us?
Answer: • Recommendation 1: …. • Recommendation 2: …. • Recommendation 3: …. • ….
In which areas guidelines for (further) standardisation or interoperability are required?
Answer: • Area: …. • Area: …. • Area: …. • ….
Do you have a final suggestion or remark?
Answer:
Contact details
Maybe we need further information on the answers and comment you and your organisation has given. Please list below the person(s) and e-mail address(es) we can contact in case we like to have more information.
Your contact person(s):
Please return this survey **To: joost.laarakkers@tno.nl and CC: silvia.celaschi@rse-web.it**
Thank you very much for your effort!