Deliverable D7.6

Common methodology for development conformity with standards – 2nd updated version

Prepared by:

Joost Laarakkers, TNO
joost.laarakkers@tno.nl

Date: **September 2, 2014**

Version: **2.2**

Document Information

Authors

	Name	Company
Key author	Joost Laarakkers	TNO
Further authors	Holger Braess	BMW
	Fainan Hassan	Alstom
	Bart Benders	FKA
	Andreas Zwirlein	Siemens
	Ewoud Werkman	TNO

Distribution

Dissemination level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Revision history

Version	Date	Author	Description
0.1	November 12, 2012	Joost Laarakkers	Initial version and structure, and draft chapter 3 introduction of the structure
0.2	November 25, 2012	Holger Braess, Fainan Hassan, Bart Benders, Andreas Zwirlein, Joost Laarakkers	Contributions (without changes) placed in different chapters (5, 6, 7), and started chapter 4 on the framework
0.3	January 22, 2013	Joost Laarakkers	Started with chapters on 8 common methodology options and 9 recommendation
0.4	February 11, 2013	Joost Laarakkers	Continued with chapters on common methodology options and recommendation, further updated chapters with text and to-be-done items, towards a first readable version
0.5	February 27, 2013	Joost Laarakkers	Version for WP7 partner feedback
0.9	April 26, 2013	Holger Braess, Fainan Hassan, Andreas Zwirlein, Joost Laarakkers	Contributions from partners integrated. Version ready for review by another GeM party.
1.0	July 19, 2013	Joost Laarakkers Silvio Weeren	Final version after review input.
1.1	September 29, 2013	Joost Laarakkers	Final version for approval after review input from Heike Barlag
1.2	December 5, 2013	Joost Laarakkers	Final version for Submission for Approval
2.0	July 11, 2014	Joost Laarakkers, Ewoud Werkman	Update on different aspects, based on new insights and lesson learned from last year
2.1	August 5, 2014	Joost Laarakkers	Final version of V2 after review input IREC.
2.2	September 2, 2014	Joost Laarakkers	Version after coordinator review

Status	
For Information	
Draft Version	
Final Version (Internal document)	
Submission for Approval (deliverable)	X
Final Version (deliverable, approved on)	

Contents

1 Executive Summary 6

2 Introduction 10

2.1 eMobility ICT Interoperability Innovation Group (eMI3) 10

3 Towards a common methodology 12

4 SGAM Smart Grid Framework 18

5 System Layers 22

5.1 Business Layer 22

5.2 Function Layer 23

5.3 Information Layer 24

5.3.1 Charging Standards 24

5.4 Communication Layer 26

5.4.1 Vehicle related issues (Autosar, GENIVI and MOST) 27

5.4.2 Charging Points (EVSE) 29

5.4.3 Charge Management System 30

6 Physical Layer 32

6.1 How to ensure compliance with standards and connection codes 32

6.1.1 Dynamics of compliance today 32

6.1.2 Assurance of compliance tomorrow 34

6.2 EV User HMI – Recommendations for best practice & standards 35

6.3 Housing and Grid Connection requirements 38

7 Cross Cutting Issues 39

7.1 Safety of EV components 39

7.2 System security and privacy 41

8 Towards a Common Methodology 44

8.1 Common Basic Architecture 44

8.2 Developing a service architecture on the EV ecosystem 48

8.2.1 Component Layer View 49

8.2.2 Business layer View 49

8.2.3 Function layer 50

8.3 Data models of semantic models for business procedures / objectives 51

8.4 Interoperability and Methodology 52

8.5 Common Methodology 53

9 Recommendations 54
9.1 Main recommendations 54
9.2 Collected and more detailed recommendations 55
9.3 Recommendation plan 56

List of Figures

Figure 1-1 Basic system building blocks used in an electromobility architecture............................. 8
Figure 3-1 SG-CG Smart Grid Architecture Model (SGAM) 15
Figure 3-2 Smart Grid pictorial as used in Dutch Smart Grid innovation domain............................ 15
Figure 3-3 Interoperability Context-Setting Framework.. 16
Figure 3-4 Simplified Interoperability Framework for SG IMM.. 16
Figure 3-5 Refinement of GWAC Framework to SGAM layer associations................................... 17
Figure 4-1 Methodology elements positioned in the SGAM Smart Grid Framework 18
Figure 4-2 Collected best practises positioned in the SGAM Smart Grid Framework 19
Figure 4-3 Use case mapping process (source: SGCG: Smart Grid Reference Architecture)........ 21
Figure 5-1 Example of a business model as being assessed in Green eMotion 22
Figure 6-1 Smart grid compliance methodology... 35
Figure 6-2 OEM view on use case roaming 36
Figure 6-3 App Connectivity Technology “xlink” Application level 37
Figure 7-1 Schedule for implementing safe and secure EV recommendations 39
Figure 7-2 Charging systems approaches in Germany 40
Figure 7-3 Charging plug approach from BMW.. 41
Figure 7-4 SGIS- Security Levels Description.. 42
Figure 7-5 Smart Grid Data Protection Classes 43
Figure 8-1 Basic system building blocks used in an electromobility architecture............................ 44
Figure 8-2 Basic Architecture and building elements for the Electromobility System 45
Figure 8-3 CEN/CENELEC Draft WG Smart Charging Role Model for E-mobility.......................... 46
Figure 8-4 eMI3 first basic architecture and interfaces... 47
Figure 8-5 Actors related to the physical layer (example with four EVs and four EVSEs) 49
Figure 8-6: Actors on the business layer showing possible money flows (backed by contracts) 49
Figure 8-7 Service view of the EV ecosystem with respect to smart charging 50
Figure 8-8: Example of mapping services on actors in the EV ecosystem 51
Figure 8-9 Road from Use-case to Interoperability on SGAM layers... 52
Figure 9-1 Methodology elements positioned in the SGAM Smart Grid Framework 54

List of Tables

Table 5-1 Charging Standards... 25
Table 5-2 Overview on automotive incar software initiatives Autosar, GENIVI and MOST 27
Table 6-1 Standards compliance methodology today 33
Table 8-1 GeM Building elements compared with eMI3 and CEN CENELEC WG SC................... 48

List of Abbreviations

BAP	Basic Application Profiles
BMS	Battery Management System
CA	Consortium Agreement
CMS	Charge Management System
CP	Charge Point
DoW	Description of Work (Annex I of Grant Agreement)
DSO	Distribution System Operator
ECU	Electronic Control Unit
eMA	eMobility Account
eMI3	eMobility ICT Interoperability Interest Innovation Group
ePOI	eMobility Point of Interest
ETSI	European Telecommunications Standards Institute
EV	Electric Vehicle
EVCO	EV Contract
EVMS	EV Management System, OEM backend, Fleet operator
EVSE	EV Supply Equipment
EVSP	EV Service Provider
GWAC	GridWise Architecture Council
HMI	Human Machine Interface
ID	Identifier
IEC	International Electrotechnical Commission
ICT	Information and Communication Technology
ISO	International Organization for Standardization
NFC	Near Field Communication
OCPP	Open Charge Point Protocol
OEMs	Original Equipment Manufacturers (in this context car manufacturers)
OSCP	Open Smart Charging Protocol
PHEV	Plug-in Hybrid Electric Vehicle
POI	Point of Interest
PV	PhotoVoltaic, as in solar cells
REX	Range Extender
RFID	Radio Frequency Identification
SGAM	Smart Grid Architecture Model
SGCG	Smart Grid Coordination Group
SGIS	Smart Grid Information Security
SoC	State of Charge
WGI	Working Group Interoperability, part of the M/490 Smart Grid Coordination Group
WP	Work Package

1 Executive Summary

The harmonization of standards is an essential issue for the mass rollout of EV and PHEV across the EU. This would allow the user of the EV to find all over the continent the same interfaces for the connection of the vehicle to the recharging infrastructure, but also for related eMobility services This has lead in Green eMotion WP7 to the task, as described in the DoW:

> *define a methodology to assure compliance of product developments with existing and new standards.*

The task aims for a common methodology that enables that different product developments can be done in accordance with existing, upcoming, or new standards.

The task started with making an inventory of the methodologies used for standardization in the different development areas. Soon it became clear that not many methodologies are used and available for standardization. It was noticed that the development of systems and products is aligned with and often runs parallel to standardization. Standards are almost developed and designed in the same way and pace as the systems and products they are used in. This was the main reason for diving into system design and systems engineering methodologies such as architecture frameworks models and system architectures.
Collected were several system architectures, architecture frameworks, views, models and pictures, most of these models or frameworks are layered to enable different abstraction levels and views.

Concluded was that the methodology can best be based on an architecture model or architecture framework, since this enables use case definition and verification, making interfaces between different system elements clear, supporting multiple levels of abstractions etc. A choice was made for the SGAM (Smart Grid Architecture Model) Framework, since the GWAC Stack, that would be a good alternative, can easily be mapped on this Smart Grid Architecture Model. SGAM is developed in and for the Smart Grid world, and eMobility cannot be seen isolated from, is even part of the Smart Grid context, since an EV is a large electrical load that can be charged smart. As next step best practises and other input related to standardisation and methodology were mapped onto the SGAM Smart Grid Framework. The component/physical layer was given more explicitly attention, since several components of the eMobility Architecture reside in that physical domain.

The next step made was explaining and diving further into the different system layers (business, function, information, communication, and physical layer). This led to recommendations like:

- To support interoperability of charging services all OEMs should support the same basic functionalities such as the display of POI-Data for EVSE in the vehicles or authentication at the EVSE. It is recommended that eMI3 addresses this issue when a Business & IT Reference Architecture for eMobility Services is being developed.
- A new work item proposal about RFID identifiers for the RFID authentication in the EVSE environment (originally created by Better Place) was accepted by the IEC. The corresponding standard will be named IEC 62831: “User identification in Electric Vehicle Service Equipment using a smartcard”. Since Better Place was no longer available as a chair for the committee, the work was temporarily taken over by the German DKE. Currently the experts are coming both from Green eMotion/eMI3 and from other companies in the industry. They are working on developing the original proposal towards a possible standard. An important piece in this work is a document provided by NEMA through eMI3, which is currently analysed by the experts. The work covers both the original RFID interoperability idea by Better Place and more modern identification means like NFC. DKE plans to hand over the work back to IEC as soon as the working group is established. IEC is currently preparing an international meeting for fall 2014.

- Consider to initiate a new work item proposal for a (ISO or IEC) standard on communication between the EVSE and the EVSE backend system. This has already been taken up by the Green eMotion project and is now driven in eMI3 where the Working Group Communication Protocol is currently collecting requirements from protocols in use and market needs in order to develop a future industry standard.
- Green eMotion B2B Marketplace interfaces (eMobility Service Provider area) are oriented towards market needs. Since the interfaces are purely ICT related an IEC or ISO standard might not be necessary. What is necessary is that the Marketplace interfaces are made public, the basics are already made public in Green eMotion Deliverable 3.5 (http://www.greenemotion-project.eu/dissemination/deliverables-ict-solutions.php).
- Define an eMobility data model that complies with the needs of the semantic models (information layer) but also the envisioned business procedures/objectives (in the business and function layer). This will also help in aligning all standardisation and development activities, and is a good way to support detailing of the use cases. This is taken up by the WG Business Objects and Identification of eMI3.

In the Information layer reside most bottlenecks for standardisation around smart charging and eMobility. Also in eMI3 a working group is active on business objects (like Token Id, EVSE ID, ePOI, Pool ID, and other attributes). The creation of a set of *coherent and* ***consistent*** *business objects and data models* is crucial since they help in detailing and verifying use cases, and at the same time they abstract the technical interfaces. This creation process also forces choices to be made. These choices, detailing and verification will make the models more robust and future proof.
Since use cases are crucial in all stages of the development of products and standards another recommendation is to share the use cases as much and open as possible. Preferably (parts of these) public, else open for user groups or industry alliances.

Separately, the physical layer was addressed, resulting in:

- Equipment manufacturers (e.g. of EVSE) have to acknowledge the evolution in standards and regulations in the energy domain and establish processes and procedures for compliance. Active participation of them in (Smart Grid) standardisation efforts ensure that most standards can be met without compromise of quality nor cost of service.
- Since smart phone technology has a significant shorter innovation cycle than the automotive industry with 5-7 years of model life time, it is recommend to further monitor the development roadmap of the smartphone and its connectivity technology, since this is expected to be the driving force behind innovation in this area.

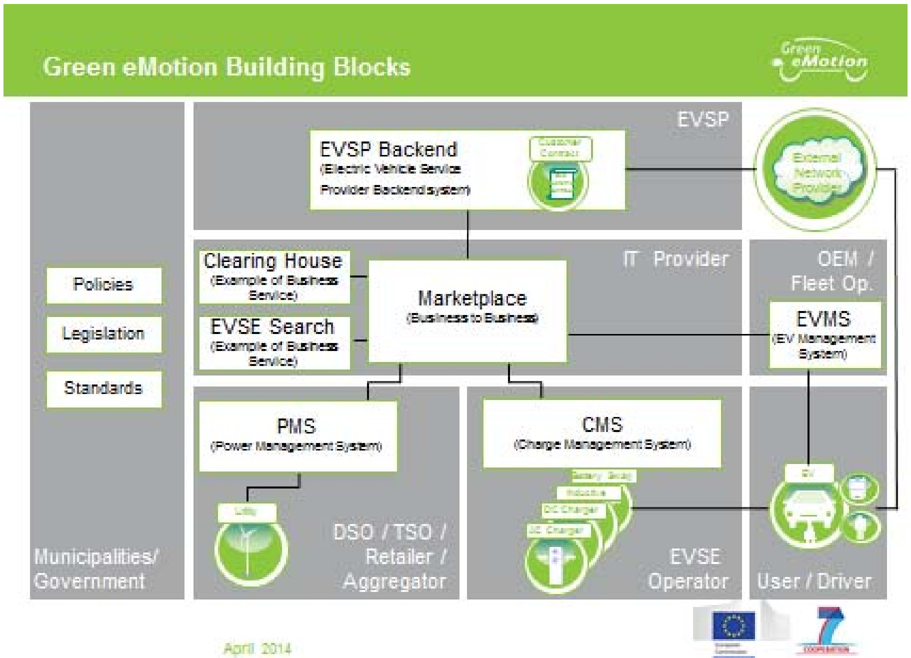

Figure 1-1 Basic system building blocks used in an electromobility architecture

As third step a short look into cross cutting issues was done. Which are the issues that cut through the different layers, such as security and privacy? This led to the recommendation:

- Further investigation is needed in privacy and security. It is often mentioned as important, also since the information is used for billing the customers and potential also to control the smart charging of the EVs, but little structural design approaches are known and used so far. A further look can be taken into SGIS (Smart Grid Information Security).

These three steps enable working towards a Common Methodology which is based on a Common Basic Architecture derived from the electromobility building blocks picture (the figure above). The creation of a common basic *architecture* will, if managed well, lead to convergence and ultimately to standards and compliancy. Even before the common basic architecture has led to standards it already converge the choices made during product development and implementation. It is advised to create a service view (in the function layer), since this view separates the concerns from the business layer and is independent of the actual implementation but still makes the requirements for the information layer clear.

As Common Methodology was defined:

> *"For eMobility industry should agree on a Common Basic Architecture and define data models compliant with the semantic models and the business context/procedures and objectives. This Basic Architecture and data models will ensure use cases to be implemented and technical interfaces to be aligned."*

It needs to be made sure that eMI3, Green eMotion, and CEN/CENELEC WG Smart Charging converge further to an accepted Common Basic Architecture. Several partners of the Green eMotion project (especially from WP7, WP5 and WP3) participate and contribute heavily to eMI3, and as such this recommendation is already being executed. The many Green eMotion partners participating in eMI3 are leveraging the knowledge and effort gained in Green eMotion actively

towards the broad eMobility community. Further it is advised to follow, align and study the results of the M490/WGI proposed interoperability methodology.
Several recommendation are 'handed' over to eMI3, this is also done since Green eMotion is a project that has an end, while eMI3 is an eMobility community user group that has a longer scope and objective and is long term better suited to follow up and digest these recommendation.

In the three steps mentioned above no explicit recommendations were given in the energy provider or grid domain. But smart charging was very explicit mentioned in the results of the third standardisation survey deliverable. So therefore as recommendation: better define smart charging (e.g. multigoal charging: user, battery, energy and grid friendly charging) and work out in more detail smart charging use cases (preferably with simulation tooling), as well what the functionality of the different blocks in the architecture, and the data to be communicated between these blocks. This has already been followed up by eMI3, where September 2013 a session on smart charging was held, with presentations from several Green eMotion and non-Green eMotion partners.

The third standardisation survey deliverable also contains a recommendation that we like to adopt: **create and manage an eMobility standards roadmap**, based on a unified Smart Grid ***and*** eMobility Reference Architecture, 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.

Since all these recommendations are not by nature aligned and further work is required in this domain, preferably also in cooperation with parties outside Green eMotion, an open organisation such as eMI3, also a Recommendation Plan was created, that stepwise can guide eMobility related standardisation activities towards one of the objectives of WP7 task: Guidelines for Standardization and Interoperability (see also D7.8, available spring 2015 at http://www.greenemotion-project.eu/dissemination/deliverables-standards.php). This recommendation plan addresses steps and activities ranging from terms and definitions, Common Basic Architecture, simple and advanced use cases, interfaces and standards, implementation in demonstration sites, smart charging, generic test cases, compliance or certification, and creating guidelines for standardization and interoperability.

We concluded that in this task of WP7 we did set a high target for ourselves:
"a common methodology for developments conformity with standards", especially since the parties involved in this eMobility and Smart Grid domain are very diverse: car manufactures, energy utilities/retailers/DSOs, IT companies, etc.
Still we were able to come up with a Common Methodology based on a Common Basic Architecture and a known Framework that can serve as reference in the definition for data models. It is not a simple recipe, it requires involvement of external groups of experts active in this field and other standardisation activities, such as eMI3, the Focus Group on Electro Mobility (M/468) and Joint Working Group on Standards for the Smart Grid (M/490).

2 Introduction

The main goal of the task that has led to this deliverable is, as described in the DOW:

Define a methodology to assure compliance of product developments with existing and new standards.

The task aims at a common methodology that enables that the different product developments can be done in accordance with existing, upcoming or new standards.

The task started with making an inventory of the methodologies used for standardization in the different development areas (vehicle, charging and grid infrastructure, communication and services) since it became clear soon that not many methodologies are used or available for standardization. But it was also noticed that standards are almost developed and designed in the same way and pace as the systems and products they are used in. This was the main reason for investigating further the system design and systems engineering methodologies, as a basis for next steps towards a common methodology for developments' conformity with standards. A choice will be made for one of the Smart Grid related architecture frameworks. Since this Architecture Framework is developed in and for the Smart Grid world, and eMobility cannot be seen isolated from its Smart Grid context, the next chapter continues with referencing the Smart Grid Framework and defining how we will use it.

The next step to be made is explaining and dive further into the different system abstraction layers (like business, function, information, communication and physical layer).
The physical layer is separately addressed, since several eMobilty components reside there.
The third step is a short look into cross cutting issues, which are issues that cut through the different layers, such as safety, security and privacy.

These steps enable us to work towards the Common Methodology, which is based on a Common Basic Architecture. The need to further work on data models compliant with the semantic models and business procedures / objectives is identified. Then the Common Methodology itself is defined.

Finally in the last chapter several recommendations and a recommendation plan are defined based on the results of the different chapters.

2.1 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.

- 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. eMI3 is organised into several working groups:

- WG1 Use Cases & Services, this Working Group is in charge of describing the use cases and services which are in scope for eMI3 group. The use cases provide a common "language" and understanding within the group and are the basis to derive the architecture and interfaces for WG2
- WG2 Architecture & Interfaces, this Working Group is in charge of creating/ freezing the reference architecture and creating interface descriptions
- WG3 Business Objects & Identification, this Working Group is in charge of describing the business objects that will be used during service transactions between EVSE and EV Service Providers.
- WG4 Stakeholder Management & Liaison & Organisation, the objective of this Working Group is the execution (of agreed) and creation of proposals for eMI3 board and GA concerning: stakeholder management, liaison creation and management, eMI3 organizational and legal structure
- WG5 Charge Station Communication Protocol, this Working Group is responsible for the definition of a communication protocol between EVSEs and backend systems. The work is based on the new work item proposal on backend communication prepared in Green eMotion.

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

3 Towards a common methodology

At the start of this Green eMotion project task, to create a common methodology for developments to conform to standards, first the basic objectives of standardisation and the accepted principles and processes to create standards were investigated.

Basic objectives of standardisation, or as Haimowitz calls it: “The Economic Rationale for Standards” (from: Haimowitz, J., Warren, J. 2007. “Economic Value of Standards.” Standards Council of Canada) are:

- **Compatibility** provides what economists call network externalities. In the presence of network externalities the economic benefit one person receives from a product increases as the number of other users increases. In this context also independence of a single supplier and interoperability are part of this objective.
- Provide minimum **admissible** attributes. These standards may be safety standards or minimum quality standards.
- Provide **information** and product descriptions, these could be called technical reference standards.
- **Reduce variety**, this enables businesses to operate on a larger, more efficient scale of production, and it provides more certainty to producers about the future direction of the industry.
- Rationales for governments to be involved in standardization processes are prevention of market failure and **strategic trade purposes**.

Often for accepted principles and processes to create standards people refer to the WTO Principles in Standardization:
Transparency, openness, impartiality, consensus, efficiency, relevance and consistency are key elements for the development of standards, no matter if on a national or international level.
In more detail:

- **Transparency**: information and procedures should be made easily accessible to at least all interested parties.
- **Openness**: membership of an international standardizing body should be open on a non-discriminatory basis to relevant bodies.
- **Impartiality**: all parties should be provided with opportunities to contribute to the elaboration of a standard so that the standard development process will not give privilege to, or favour the interests of a specific party.
- **Consensus**: procedures should be established that seek to take into account the view of all parties concerned.
- **Efficiency and relevance**: standards need to be relevant and effectively respond to regulatory and market needs, as well as scientific and technological developments.
- **Consistency**: in order to avoid the development of conflicting standards, it is important that standardizing bodies avoid duplication of, or overlap with, the work of other standardizing bodies. In this respect, cooperation and coordination with other relevant international bodies is essential.

This deliverable is one of the main results of de task T7.4. In the DoW this task is defined as:
“This task is aimed at defining a common methodology to enable that the different product developments can be done in accordance with existing and new standards. In this context product development also includes development stages like requirements/specifications definition phase in the project, the demo regions, but possibly also outside and after the project.”
“This task will start with making an inventory of the methodologies used for standardization in the different areas (vehicle, charging and grid infrastructure, communication and services). Besides

collecting best practices also issues of the methodologies used so far will be collected. This collection will be the basis for the definition of a proposed common methodology to assure that development conforms to standards."

As initial preparation a question was added to the standardisation survey of end 2011: "What kind of methodologies or best practices do you use to assure that development conforms to standards?" The answers received are short and contained no real methodologies:

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

After this the topic of methodologies used for standardization was further studied. It was noticed that several tools and methodologies are available for technical development, that also several type of standards are used in the requirements for development specifications and conformance tests of the product or system, but very limited little and explicit methodologies used for standardization are available.

So a step back was made to get an overview of the task and role of standardisation. Also since standardisation is a means and not a goal on itself. In the beginning of this introduction the basic objectives of standardisation and the accepted principles and processes to create standards were listed.
For example in software development, often there is felt the need for standardization (as a means), but the true goal is not really standardization at all, but most often interoperability and compatibility. Further very often initial standards evolve and mature during and with developments. So it seems that the development of systems and products is aligned and partly parallel with standardization. Standards are almost developed and designed in the same way and pace as the systems and products they are used for. This was the main reason for diving into system design and systems engineering methodologies.

In this context systems engineering is defined as interdisciplinary engineering (software, system, electronics, mechanics, power electronics, …) focusing on how complex engineering systems should be designed. Several known methods and tools are discovered like:

- System architecture, architecture frameworks, Systems Modeling Language, use case diagrams
- Unified Modeling Language (UML), Functional Block Diagram, Data Flow Diagram (DFD), sequence diagram
- System analysis, system modeling, system simulation, safety engineering
  - Specific models for system development or software lifecycle models are:
    - Waterfall Model (requirements, design, implementation, verification, maintenance)
    - V-Model (customer requirements, functional system requirements, design, implementation, design integration and test, system verification, system operation)
    - Agile Models (a combination of an iterative method and an incremental build model for development)

To be able to build complex systems and not have to design all components from scratch, standards are being used. A standard is a set of rules or requirements that is determined by a consensus opinion of users and that prescribes the accepted (common denominator) and (theoretically) best criteria for a product, process, test, or procedure. The general benefits of a standard are safety, quality, interchange-ability, interoperability of parts or systems, and consistency across international borders.

A general issue in defining standards is the identification of all the relevant stakeholders in a standard. In order to be sure all views from all the stakeholders are captured and make the standard useable for these stakeholders, e.g. all interfaces between the stakeholders are clearly defined, normally all stakeholders need to participate in its definition. For the Electricity market in the European Union this is a difficult challenge, since the legislation in each country is different, e.g. RWE in Germany is (among others) both a grid operator and an electricity producer. In the Netherlands there is a strict separation between management of the power system and the production, trade and supply of electricity and two distinct business roles are defined to accommodate this: a grid operator and a balance responsible party, respectively and both roles are implemented by different companies. Consequently, an extra interface must be defined to exchange information between these companies in the Netherlands.

More differences are present in the European Union, and to mitigate possible problems in applying the standards in all EU counties, the ENTSO-E, ebIX and EFET have developed a harmonized electricity market model, defined in [http://www.ebix.org/Documents/role_model_v2011_01.pdf]. This model provides a common definition of the roles (and domains) currently present in the electricity market in Europe, which enables people to use a common language in the development of information exchange.

The Reference Architecture Work Group (RAWG) of the Smart Grids Coordination Group (SG-SC) mandated by the European Commission has also identified this issue and provides more information in the document in Annex C: Business Architecture and Conceptual Model http://ec.europa.eu/energy/gas_electricity/smartgrids/doc/xpert_group1_reference_architecture.pdf

Since the harmonized electricity role model captures the current situation, it might be necessary to add new roles to the model to accommodate the roles present in the electrical vehicle charging processes. But for current roles, this model should be used to define a common vocabulary for all the stakeholders of the standard.

With this context above of systems engineering and standardisation in mind, some partners involved in this task collected system architectures, architecture frameworks, views and pictures that could be used as a potential basis for a common methodology. Most of these models or frameworks are layered to enable different abstraction levels and views, also so that it can be used by all the different interdisciplinary people involved in the design of the system.

The CEN-CENELEC-ETSI Smart Grids Coordination Group (SG-CG) has been raised in response to the M/490, the Smart Grid standardization European Commission mandate to European Standardisation Organisations (ESOs) to support European Smart Grid deployment. One of the 4 Working Groups of SG-CG is the Working Group Reference Architecture; the conceptual model developed by this SG-CG is called the Smart Grid Architecture Model (SGAM) can be seen in the following figure.

This architecture is based on different layers, which is a well-known and good concept since it enables higher layers not to be bothered by details of the lower layers. In the higher layer complex system functionality and services can then be created. It also allows components of the lowest/physical layer to be replaced without changing the other layers. Above the physical layer is the communication layer that enables the communication with information layer (on a server, in the cloud, or another solution). On that computing infrastructure services and functions can be executed, that serve a certain stakeholder or business.

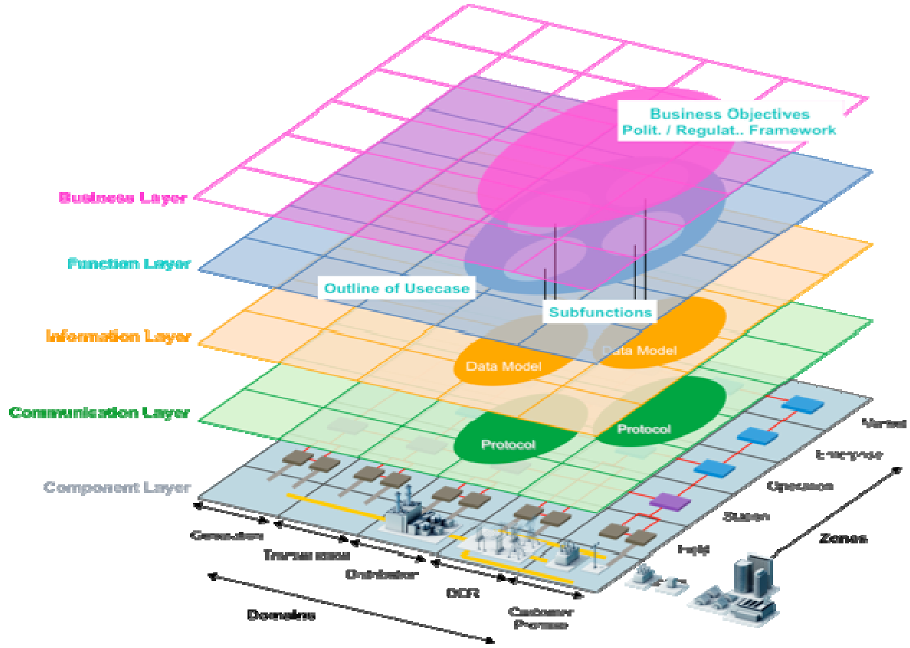

Figure 3-1 SG-CG Smart Grid Architecture Model (SGAM)

For more information see:
http://www.cen.eu/cen/Sectors/Sectors/UtilitiesAndEnergy/SmartGrids/Pages/default.aspx

Another, partly more pictorial, picture made by TNO is used in the Dutch Smart Grid research domain, and also the Dutch Governmental Innovation topsector area energy:

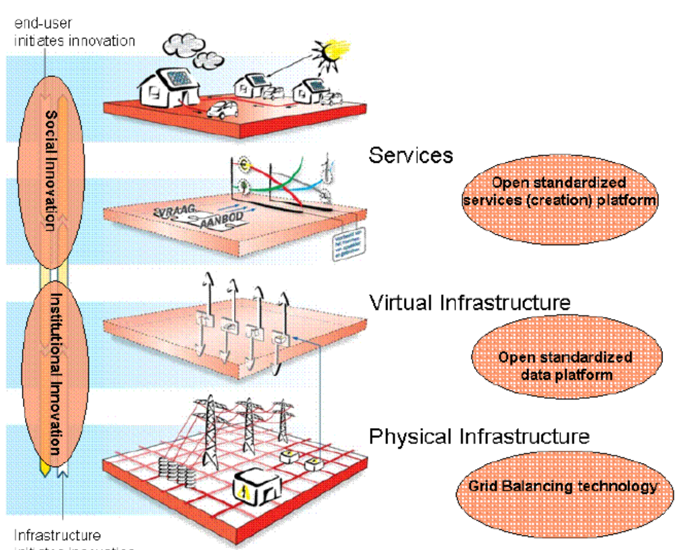

Figure 3-2 Smart Grid pictorial as used in Dutch Smart Grid innovation domain

For more information see: http://www.top-sectoren.nl/energie/sites/default/files/documents/4%20-%20IC%20Smart%20Grids_compl.pdf. The virtual infrastructure layer in that figure combines the communication and information layer of the SGAM.

A more extensive model is the GridWise® Interoperability Context-Setting Framework:

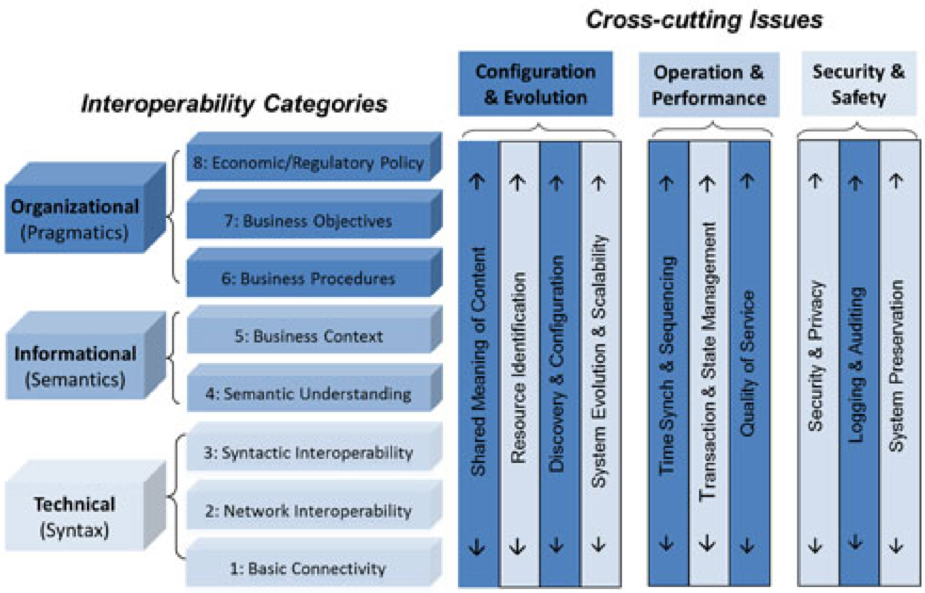

Figure 3-3 Interoperability Context-Setting Framework

The GridWise® Interoperability Context-Setting Framework is a work of the GridWise Architecture Council (GWAC). The complete GridWise® Interoperability Context-Setting Framework (v1.1) can be found on http://www.gridwiseac.org/about/publications.aspx.

There is also the related and valuable Interoperability Maturity Model (IMM) document.

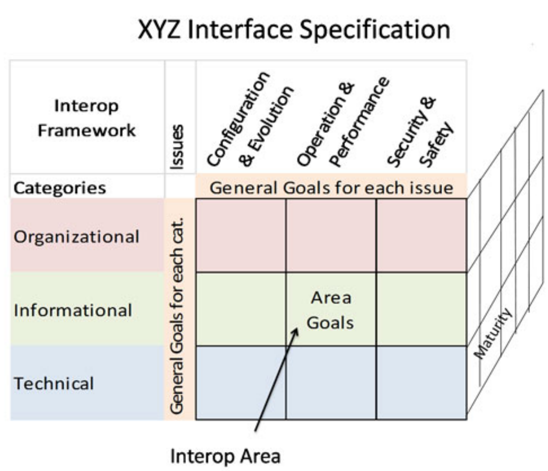

Figure 3-4 Simplified Interoperability Framework for SG IMM

The GWAC Interoperability Context-Setting Framework, also known as GWAC Framework has been worked out very detailed. It is based on clear and documented principles: Business, Usability, Information Technology, Regulatory, Policy and Governance principles. It also addresses cross cutting issues like security that cannot be solved in one layer alone. Further is has taken into account the EICTA White Paper on Standardisation and Interoperability (EICTA = European Information & Communications Technology Industry Association, now DigitalEurope).

The GWAC framework uses in the 3 lower layers the very well accepted 7 layers of the Open Systems Interconnection (OSI) model (ISO/IEC 7498-1), a product of the Open Systems Interconnection effort of the International Organization for Standardization.
The maturity model is inspired by the process improvement aspects of the SEI's Capability Maturity Model for Integration (CMMI), a very well-known and used model in the software industry.

The GWAC Framework does not have an explicit physical layer, although this is often being mapped on the basic connectivity. In a Joint meeting of NIST-SGAC and EU-M.490 RAWG on Architectural Methodology they came to the following refinement of GWAC Framework to SGAM layer associations:

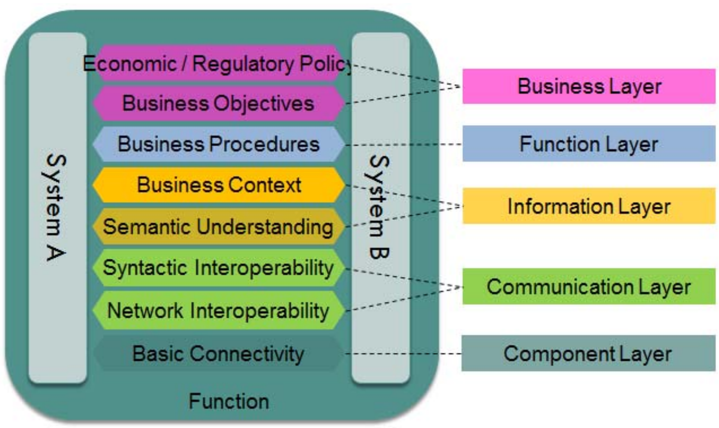

Figure 3-5 Refinement of GWAC Framework to SGAM layer associations

In the first version of this document, the GWAC Framework served as the basis for the remaining chapters, since this framework can be mapped easily on the other models, but less easy the other way around, and also the GWAC Framework has a well worked out maturity model. But 8 layers is often too complex to follow and maintain, and even in the first version of this document we focussed on the three Interoperability Categories from GWAC and added a physical layer for completeness. Therefor in this second version of the document we will use the five SGAM layers. The main difference with the previous version is that the Organisational Interoperability category has been split into a Business layer and a Function Layer.

The next chapter will therefore address SGAM in more detail, after which the best methods and practises will be collected and mapped on the different layers. As mentioned the physical (component) layer will be addressed in a separate chapter; otherwise the focus is too much on communication and interoperability and not for example on mechanical and electrical compatibility and safety. After that the cross cutting issues will be addressed.
After these chapters a first common methodology will be defined and recommendations formulated.

4 SGAM Smart Grid Framework

As explained in the previous chapter in this document the SGAM Smart Grid Framework will be used as a basis. We call the lowest layer Physical layer (Component layer in SGAM) since all physical elements should reside on that layer (components, but also physical systems, users, user equipment, etc.), Further we still use the cross-cutting issues from the GWAC framework. This results in the figure below.
A standard is nothing without its context. A simplistic example: “We will leave at 12.”, 12 can be a location (floor), a time (noon or night), and who is we?
Another example: “The EV will be charged smart”. For the EV-BMS this could mean do not overload the battery, but for the DSO this probably means congestion management, for the user charge full before departure time, and for the energy provider charge when there is a surplus of electricity (e.g. from PV or wind). This is maybe obvious but the definition of the context, roles, actors and terms is key: so a document where Terms & Definitions are collected, described and agreed is a good and required starting point. This is often recognised and done, also in Green eMotion, eMI3 and M/490, but there are still some difference between these.

When Terms & Definitions are clear, the first step that can be made is to identify the physical elements (like EV, Grid, Power Plant, EVSE, User) and the actors/roles (like DSO, Utility, EVSE-Operator, User, EVSP, Clearing House, OEM). The next step is often to define or apply use cases or scenarios, which depend on business models. These are in Green eMotion collected in D3.3: Services use cases & requirements description (see the Green eMotion website: http://www.greenemotion-project.eu/dissemination/deliverables-ict-solutions.php).

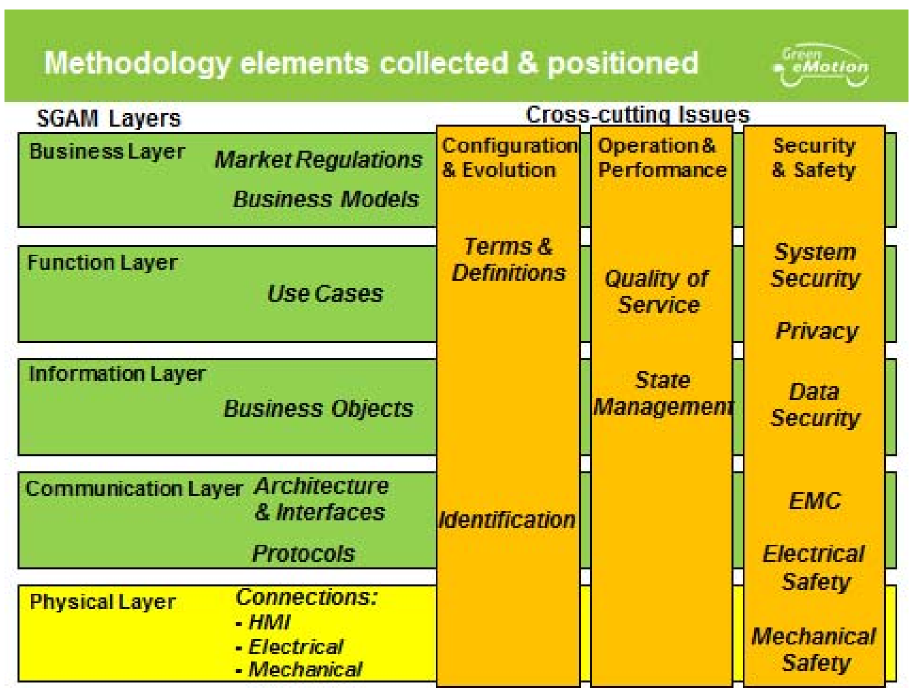

Figure 4-1 Methodology elements positioned in the SGAM Smart Grid Framework

In the eMobility ICT Interoperability Innovation Group (eMI3) a similar approach is taken (http://emi3group.com/). In eMI3 several Working Groups are defined to deal with topics like Use Cases, Business Objects, Identification, Architecture and Interfaces, and Communication

Protocols. These elements are also plotted in the SGAM layers in the picture above. Green are the 4 upper SGAM layers, the fifth layer is mentioned physical layer and coloured yellow. The cross cutting issues are made orange. An area for protocols was also added (used in interfaces) and also one for connections (electrical and mechanical). This last element seems minor at first sight but is still under discussion, but decisions are being made on EU level (http://www.plugincars.com/single-plug-europe-specifications-and-reactions-combos-still-126351.html)

Further Quality of Service and State Management are added to the Operation & Performance cross cutting issue. In Security & Safety cross cutting issue placed are: system security, privacy, data security, EMC, Electrical Safety and Mechanical Safety.

This picture allows us to create one overview of the most important elements for standardisation and their relations and areas. Both Green eMotion as well as external activities (eMI3) fit in here. For example the till end 2013 active CEN/CENELEC Working Group on Smart Charging starts with defining what Smart Charging is, continues with the aim and role/actor model for eMobility (use case/business model) and also shows the interfaces in between.

Within WP7 of Green eMotion we collected a variety of best practises and other input related to standardisation and methodology. These are placed in the next 3 chapters. These topics on best practises and other input are added to the picture figure 4-1 and result in figure 4-2 below. It is clear that most examples reside in the lower layers of SGAM.

The contributions on the grid are put in chapter 6 Physical Layer. Contributions on EV components are put in chapter 7 Cross Cutting issues, due to the mainly safety content. Contribution on EV, CP and CMS are split between chapter 6 Physical Layer and chapter 5 System layers. See also the picture below:

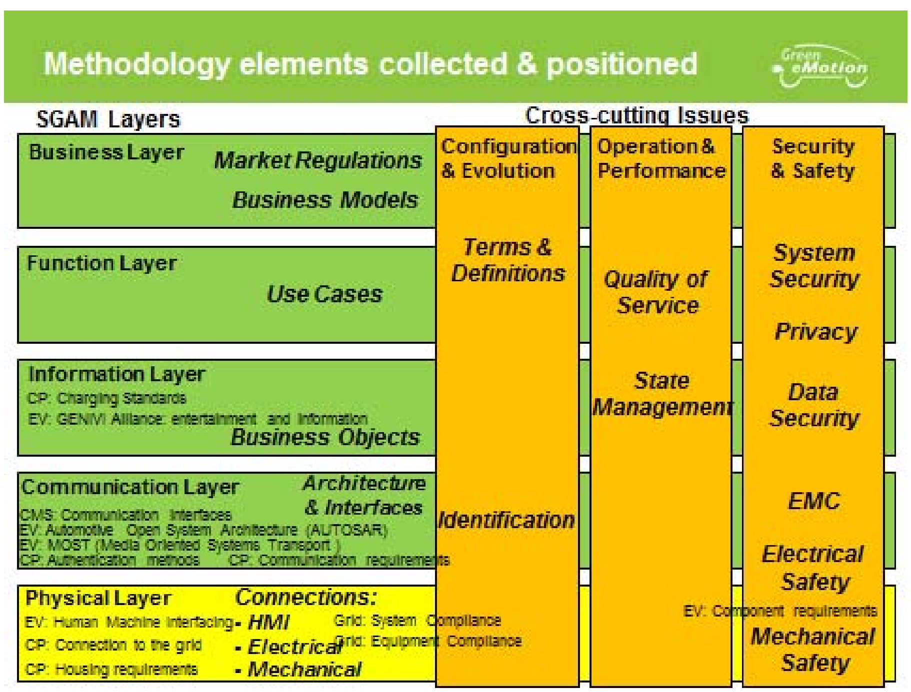

Figure 4-2 Collected best practises positioned in the SGAM Smart Grid Framework

We need to elaborate more on use cases. These are crucial in good and consistent development of complex systems. A good use case contains physical elements, actors, functions performed, information elements, communication flows/means, these are all required for the different layers above. It also explains in plain text what the system for this particular use case or scenario should do, as such it can be used for communication between the designers of the system, the users, the customer, etc.

This is also recognised, described and further detailed in the report of the CEN-CENELEC-ETSI Smart Grid Coordination Group on Sustainable Processes (document can be found on the public reference:
http://www.cencenelec.eu/standards/Sectors/SustainableEnergy/Management/SmartGrids/Pages/default.aspx).

As they mention in that document in chapter 6 Use case methodology in standardization:

> "The concept of use cases originates from software engineering and the main focus is on the description of general functionalities of systems under design and their environment. The description of use cases is independent of design specifics and allows the identification of requirements. They provide links to artefacts from different development viewpoints and due to that, they support a common understanding between experts from different domains and technical/IT experts who have to implement these functions. Moreover the concept of use cases is also supported by the Unified Modelling Language (UML) which provides use case diagrams to support the description of use cases."

The document also lists EV related use cases, which roughly can be divided into 5 categories based on use cases received:

1. WGSP-1100 Uncontrolled charging:
   This category provides only the possibility for connecting the EV to the grid at different locations. The aim is to recharge at any location where necessary. Low power or high power AC and DC are foreseen. This implies no charge control. For further information, refer to IEC 61851-1 mode 1 and mode 3.
2. WGSP-1200 Charging with demand response:
   This category provides the possibility to connect the EV recharge at any place via EVSE (Electric Vehicle Supply Equipment) and / or with an additional special IEC-15118 compliant communication device. The extra communication makes it possible to receive price signals or other incentives so that a customer reaction is possible. This provides the possibility for demand response in the same way as for other loads connected to the grid.
3. WGSP-1300 Smart (re- / de) charging:
   Smart recharging provides a more controlled way of EV charging. This opens a real possibility for smart charging and even V2G possibilities based on flexible contracts and technical signals for load control. This can be realized via EVSE (Electric Vehicle Supply Equipment) and / or with an additional special IEC-15118 compliant communication device. For further information on load control, refer to IEC 61851-1 mode 3.
4. WGSP-1400 Ensuring interoperability and settlement:
   This use case describes interoperability related matters and settlement such as identification, billing etc. between different actors.
5. WGSP-1500 Manage charge infrastructure:
   This use case describes the complete system necessary for intelligent charge equipment management, including identification, status reports, malfunction management etc. and for supplying all information for smart charging and settlement.

A use case description should contain (reused from M/490 Reference Architecture):

- Name, scope, objective, and administrative information (e.g. version management)
- Use case diagram
- Actor names, types
- Preconditions, assumptions, post conditions
- Use case steps
  - o With actors linked to the function and the step
- Information which is exchanged (communicated) among actors
- Functional and non-functional requirements.
  - o Description of the function(s) (e.g. general narrative description, pictures, detailed description within the scenarios and activities)

One, preferably several use cases, can then be mapped on the architecture framework, as described in the picture below.

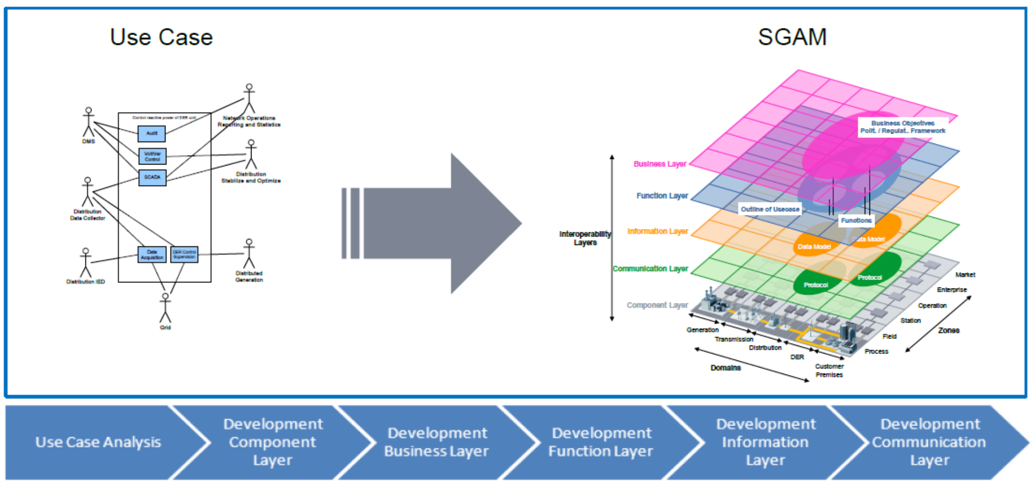

Figure 4-3 Use case mapping process (source: SGCG: Smart Grid Reference Architecture)

The use case lists all physical elements and actors. That is enough to detail the physical layer (component layer) and after that the business layer. Based on most use cases known this leads to a physical layer with elements like EV, Grid, Power Plant, EVSE, and User. For the business layer the actors/roles are then DSO, Utility, EVSE-Operator, User (these own the physical elements), extended with EVSP, OEM and Clearing House (results from use cases that use roaming or the OEM backend as EV management system).

The further details of the use case will identify the required functions to be performed (function layer). The use case steps identify the information produced and exchanged (information layer). The use case steps also identify the communication channels required. This will make it possible to design the communication architecture, the basis for the communication layer.

5 System Layers

In this chapter the collected information on the business, information, function and communication layer are described.

5.1 Business Layer

In the first version of this document the business layer and function layer were packed in one section, in this version this has been split in Business Layer and a Function Layer (see also chapter 3). Although the business layer implicitly describes the why (e.g. with business models, in GWAC with economic/regulatory policy and business objectives), the function layer describes the how (e.g. with use cases, in GWAC with business procedures).

This layer was identified in Green eMotion picture on Electromobility Building blocks (left side of figure 1-1) as policies, legislation, standards. This layer was also identified in the Dutch Smart Grid innovation pictorial (left side of figure 3-2) as social and institutional innovation.
Green eMotion project addresses business models in deliverable D9.4 “Envisaged EU mobility models, role of involved entities, and Cost Benefit Analysis in the context of the European Clearing House mechanism” (see http://www.greenemotion-project.eu/dissemination/deliverables-evaluations-demonstrations.php). The figure below gives an example of a business model for basic charging.

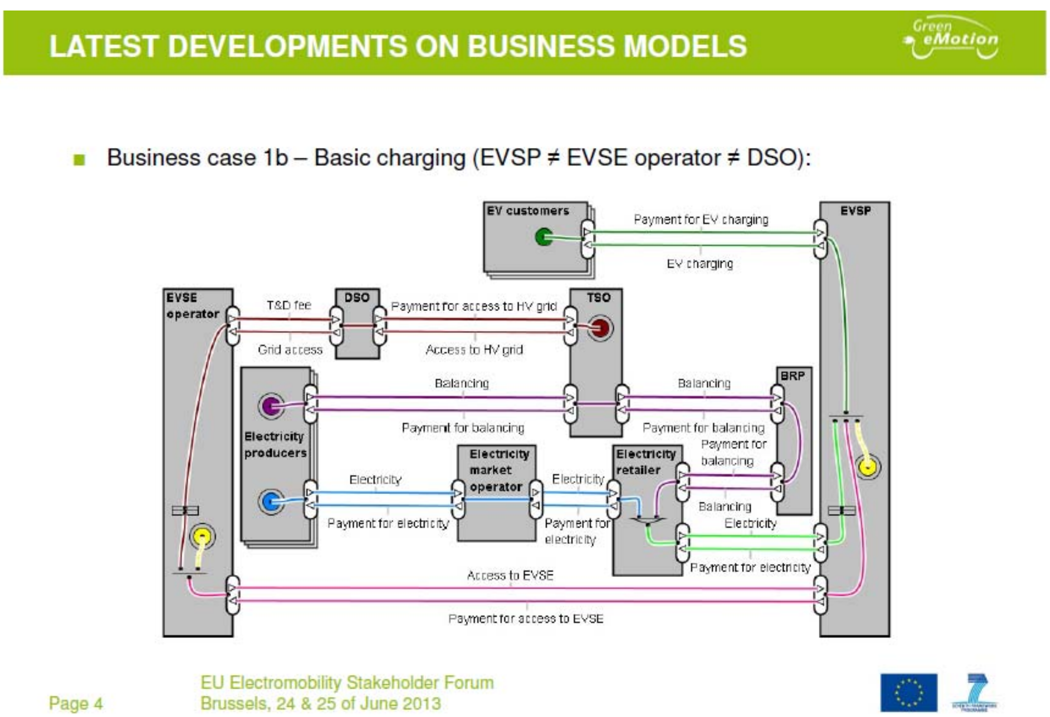

Figure 5-1 Example of a business model as being assessed in Green eMotion

As already mentioned in previous chapters for the business layer the most likely actors/roles are DSO, Utility/Retailer, EVSE-Operator, User/EV customer, EVSP, OEM/EVMS and Clearing House.

A current complexity in eMobility is the lack of clear and stable profitable business models for all stakeholders and actors involved. When this would be solved, it will also be much easier (due to the market pull) to address potential issues in the other layers.

5.2 Function Layer

As defined in the SG-CG Reference Architecture document a functional architecture is intended to describe the functional elements of a system and their relationship independent from physical implementation, applied technology or assigned actor. In the context of Smart Grid a functional architecture consists of functions that enable Smart Grid use cases. The functional layer of the SGAM model hosts functional architectures of Smart Grids. For this layer the most important input is use cases (such as eMobility roaming). In Green eMotion these are collected in deliverable D3.3: Services use cases & requirements description, and can be found on http://www.greenemotion-project.eu/dissemination/deliverables-ict-solutions.php.

Another important source for use cases is the Working Group "Sustainable Processes" of the Smart Grid Coordination Group http://www.cencenelec.eu/standards/sectors/sustainableenergy/management/smartgrids/pages/default.aspx. A third key source of eMobility use cases being developed is in eMI3, in their WG1 on Use Cases and Services

Typical functions in eMobility that are expected on this layer are (list far from complete, just to give an impression of functions):

- Car Information and EV user preferences collection
- Validation of Contract
- Authentication
- Forwarding Charge Details Record
- Peak shaving on LV level
- Capacity negotiation & clearance
- EVSE Search and Find service
- Energy price and availability check
- EVSE identification
- Customer-optimized smart charge plan calculation
- Smart Charge plan execution
- Customer feedback

The functions or services that reside in the function layer are often clustered into systems that are being operated by the different actors, or are present in one of the physical elements. Based on the use cases referred to in the previous chapter these systems and physical elements are likely:

- EVSP System
- Clearing House System
- EVSE-Operator System
- DSO System
- Utility/Retailer System
- Power Plant
- Electricity Grid
- Electric Vehicle Supply Equipment
- Electric Vehicle
- EVMS/OEM Backend
- User's Smart Phone or Users ID Card

Most (eMobility) architectures are representation of the function layer, they often also list the type of information exchanged and the communication channels. In chapter 8 this will be further described.

5.3 Information Layer

The informational layer emphasizes the semantic aspects of interoperation. It focusses on what information is being exchanged and its meaning. This layer deals with business context and semantic understanding. This is currently one of the bottlenecks in the standardisation around smart charging and eMobility in a wider scope.

This is also the reason why eMI3 tackles business objects (like eMobility Account (eMA, previously called EV Contract, EVCO) ID, Token ID, EVSE ID, ePOI, Pool ID, and other attributes). And on a higher level the CEN/CENELEC Working Group on Smart Charging is defining several elements (like stakeholder, role models). Both are still in discussion and did not release yet their final documents and proposals. However, as a first step, ISO 15118 adopted the changed definitions of EVCOID and EVSE ID from eMI3.

To give a few examples of information that could be exchanged in the eMobility system:

- User ID, Time of Departure
- EV State of Charge, or EV Energy Demand
- EVSE ID, EVSE location, EVSE location in the grid
- Authorization confirmation
- Energy price, energy price forecast
- Charge Detail Record
- Grid limitation, maximum power

5.3.1 Charging Standards

A very important decision is about what charging standards should be supporting. This is not only the very basic decision between AC and DC but also the different approaches within: meaning socket types, communication methods, load management abilities etc. Especially load management abilities create a high demand for interoperability, information and therefore standards.

Several approaches are (being) standardized so the development can be done according to ISO or IEC standards or industry standards like CHAdeMO.

A few topics can be found below

Context	AC with Household Plug	AC with Signalization (IEC 61851-1)	AC with High-Level Communication (ISO/IEC 15118)	DC (CHAdeMO)	DC (DIN 70121)	DC (ISO/IEC 15118)
Authentication	External Authentication (e.g. Phone, RFID,…)	External Authentication	Contract based & external Authentication	External Authentication	External Authentication	Contract based & external Authentication
Maximum Power	3,6kW	43kW	43kW	50kW	currently 50kW, more possible	currently 50kW, more possible
Communication	n/a	PWM	PWM and PLC	CAN	PLC	PLC
Load Limitation at start of Charging	n/a	0A, 6-70A	flexible limits	flexible limits	flexible limits	flexible limits
Load Limitation during charging	n/a	Yes	Yes	n/a	limited	Yes
Tariffs	n/a	n/a	Yes	n/a	limited	Yes
Charge Schedule	n/a	n/a	Yes	n/a	Yes	Yes
Charge Schedule Renegotiation	n/a	n/a	Yes	n/a	n/a	Yes
Forecast of energy needed	n/a	n/a	Yes	Yes	Yes	Yes
Extra Services	n/a	n/a	Yes	n/a	n/a	Yes

Table 5-1 Charging Standards

Maximum Power
It describes the maximum charging power possible with the mentioned standard. Household plug limits are very much depended on the national electric code. E.g. for Germany this would be 16A at 230V single phase. 3-phase AC Charging is described with a maximum of 63A independent of what communication standard is used.
With DC charging CHAdeMO limits the maximum power to 50kW. The maximum power available at a DC charger using DIN or ISO is only limited by the EVSE and connector design.

Communication
There is no direct communication available when charging via household plug (alternatives could go via car/smartphone to EVSP to DSO). Signalization is used for basic AC charging in IEC 61851-1. The information is transmitted via an analog PLC signal. CHAdeMo, DIN 70121 and ISO/IEC use digital high level communication via CAN or PLC GreenPhy.
Note: What the current standards as mentioned in the table 'forget' is that there are in the total system very often other options for communication. For example charge management via smartphone or internet from the EV are important options for the future. It should be taken into account that this could be a good alternative for communication. So on the informational layer the same information will arrive only via another communication channel.

Load Limitation
-at the start of the charging process
Again with the household plug there is no possibility of limiting the load (only in the car itself). All other charging technologies do allow to limit the maximum charging power at the beginning of the charging process.
-during the charging process
During the charging process limitation of the load is only possible with AC according to IEC 61851-1, AC with ISO 15118, and DC with ISO 15118. Functionality in DIN 70121 is only available on a limited basis. CHAdeMO does not allow managing the load during charging.

Tariffs
Tariff tables from which the EV can choose from are available in DIN 70121 and ISO 15118 compatible chargers. An EVSE can offer different tariff models e.g. based on the contract or based on the network load. Only in ISO 15118 pricing information is available.

Charge schedule & renegotiation
EVs supporting DIN 70121 or ISO 15118 will provide a charge schedule. This schedule describes the timeslots and the amount of energy the EV is planning to charge. The schedule is provided at the beginning of the charge session.
ISO 15118 compatible EVSEs and EVs can renegotiate the charge schedule any time during the charging process.
CHAdeMO does not support charge schedules. Also AC charging with household plug does not offer such functionality.

Energy Forecast
AC charging via household plug and AC charging using only signalization according to 61851-1 does not provide any information about how much energy the car is going to consume. Also no time interval is given. All other standards will provide the needed amount of energy and the corresponding timeframe.

Extra Services
ISO/IEC 15118 offers the possibility to transmit more information via additional services. Currently there are no additional services defined.

The items like load limitations, tariffs, charge schedule and energy forecast all require a clear business context and semantic understanding to achieve interoperability.

5.4 Communication Layer

The communication layer emphasizes the syntax or format and the communication of the information. It focuses on how information is represented within a message exchange and on the communications medium. This layer deals with the syntactic and network interoperability and the basic connectivity.

To give a few examples of communication interfaces that could be used in the eMobility system:

- RFID or GSM for User ID (e.g. ISO/IEC 14443)
- IEC 61851 and/or ISO/IEC 15118 for EV-EVSE communication (e.g. for Energy Demand)
- OCPP toward the EVSE backend system (e.g. for EVSE ID, EVSE location)
- OCPP alike communication from EVSE operator to EVSP (e.g. for authorization confirmation)
- Energy market related protocol (e.g. for energy price, energy price forecast), maybe ENTSO-E Market Data Exchange Standard (MADES) can play a role
- OHCP and/or OICP for Clearing House communication (Charge Detail Record)

- A Smart Grid related standard/protocol (e.g. for grid maximum power). Maybe IEC 61850 can play a role.

Note that the interface towards physical elements of the system often have or require (de-facto) standards (e.g. ISO/IEC 14443, IEC 61851 and/or ISO/IEC 15118, OCPP, IEC 61850).
The more backend/'upstream' interfaces have this requirement less. The reason is that modification and upgrading is easier since most of these interfaces are in software (and not hardware of physical elements) and also the number of systems/products in this areas is much less (charging poles compared with a CMS).

This communication layer is the area with most standards and proposals. Not all will be repeated, but focus will be put on a few areas that cover a wider scope and are important for the bigger picture and methodology.

5.4.1 Vehicle related issues (Autosar, GENIVI and MOST)

In the last years, 3 major consortia have been formed to address the needs of in-car communication, navigation and infotainment systems. Namely (in alphabetical order) Autosar, GENIVI and MOST can be identified. All three initiatives have in common to offer a kind of standardized platform with protocols and interfaces that reduce transaction efforts between OEMs and suppliers and increase collaboration and competition. In the following table, a short overview on scope, goals and supported functions is giving in brief. Also the W3C Automotive Web Platform (http://www.w3.org/community/autowebplatform/automotive-and-web-platform-business-group-charter/) needs to be taken into account as one of their goals is to "Create specifications, starting with the Vehicle Data API Specification", which should offer an open approach to access via HTML5 in-vehicle data.

	Autosar	**GENIVI**	**MOST**
Acronym	Automotive Open System Architecture (AUTOSAR)	concatenation of Geneva, and the acronym IVI	Media Oriented Systems Transport (MOST)
Scope	Industry collaboration standardizing all software based functions on-board a vehicle	Industry alliance standardizing" In-Vehicle Infotainment" (IVI) open-source development platform	de-facto standard for multimedia and infotainment networking in the automotive industry
Goal	Definition of an open system architecture; support of applicable automotive international standards and state-of-the-art technologies	open-source platform consisting of Linux-based core services, middleware, and open application layer interfaces	Hardware independent standard for content provision inside vehicles
Functions supported	Standardization of basic software functionality of automotive ECUs	covers vehicle infotainment applications including music, news and multimedia, navigation and location services, telephony, internet services and more	Transmission of audio, video, data and control information between any devices attached to the vehicle

Table 5-2 Overview on automotive incar software initiatives Autosar, GENIVI and MOST
(sources: http://www.autosar.org , http://www.genivi.org/ http://www.mostcooperation.com/home/index.html)

Autosar

“Leading OEMs and Tier 1 suppliers have recognized that automotive architectures have reached a level of complexity that are an industry-wide challenge, and so decided to work together to address it. Their common objective is to create a basis for industry collaboration on basic functions while providing a platform which continues to encourage competition on innovative functions. To this end a development partnership called Automotive Open System Architecture (AUTOSAR) has been formed with the goals of Standardization of basic software functionality of automotive ECUs:

- Scalability to different vehicle and platform variants
- Transferability of software
- Support of different functional domains
- Definition of an open architecture
- Collaboration between various partners
- Development of highly dependable systems
- Sustainable utilization of natural resources
- Support of applicable automotive international standards and state-of-the-art technologies

The AUTOSAR scope includes all vehicle domains. The AUTOSAR standard will serve as a platform upon which future vehicle applications will be implemented and will also serve to minimize the current barriers between functional domains. It will, therefore, be possible to map functions and functional networks to different control nodes in the system, almost independently from the associated hardware” (source Autosar, http://www.autosar.org)”

GENIVI

“The GENIVI Alliance is a non-profit industry alliance committed to driving the broad adoption of an In-Vehicle Infotainment (IVI) open-source development platform. GENIVI is a rapidly growing and evolving field that covers entertainment and information features and functionality available in automobiles.
IVI covers many types of vehicle infotainment applications including music, news and multimedia, navigation and location services, telephony, internet services and more.
Automobile manufacturers and their suppliers must develop, test, deploy and support IVI products and services across multiple automobile models and generations. This process is increasingly complex and expensive as the rate of innovation and number of applications rapidly expands. GENIVI is leading the way by developing a reusable, open-source IVI platform.

GENIVI's objective is to foster a vibrant open-source IVI community by:

- Delivering a reusable, open-source platform consisting of Linux-based core services, middleware, and open application layer interfaces
- Engaging developers to deliver compliant applications
- Sponsoring technical, marketing and compliance programs.

“Our mission is to drive the broad adoption of an open-source development platform by aligning automotive OEM requirements and delivering specifications, reference implementations, and certification programs that form a consistent basis for further open source and ISV development.” (source: Genivi Alliance, http://www.genivi.org/) ”

A reason for connecting to GENIVI is to connect to the car application domain, especially for open-source platforms, connection to car OEM developers and compliancy activities.

MOST

”MOST – Media Oriented Systems Transport – is the de-facto standard for multimedia and infotainment networking in the automotive industry. The technology was designed from the ground up to provide an efficient and cost-effective fabric to transmit audio, video, data and control information between any devices attached even to the harsh environment of an automobile.

Its synchronous nature allows for simple devices to be able to provide content and others to render that content with the minimum of hardware. At the same time it provides unique quality of service for transmission of audio and video services. Although its roots are in the automotive industry, MOST can be used for applications in other areas such as other transportation applications, A/V networking, security and industrial applications.

The MOST Cooperation is the organization through which the technology is standardized and refined so that it continues to stay abreast of the latest technology requirements. Today it consists of 16 international carmakers and more than 60 key component suppliers. They have joined together to work with the MOST Technology and to contribute to its innovation. The MOST Cooperation is also prepared to embrace efforts to further develop and standardize the technology for other industries and to establish the corresponding work structures. (source MOST Cooperation, http://www.mostcooperation.com/home/index.html) "

Recommendation:
While the OEMs deploy their proprietary systems for navigation and infotainment systems successfully, it is recommended that basic functionalities such as the display of POI-Data for EVSEs in the vehicles or authentication at the EVSE via ISO 15118 certificates will be supported by all automotive communication standards in order to support interoperability of charging services. It is recommended that eMI3 addresses this issue when a Business & IT Reference Architecture for E-Mobility Services has been developed.

5.4.2 Charging Points (EVSE)

In the development process of a charging point a few topics have to be considered:

- Housing requirements (part of Chapter 6: Physical layer)
- Connection to the grid (part of Chapter 6: Physical layer)
- Charging Standards (covered above)
- Communication requirements
- Authentication methods

Authentication Methods
The user, respectively the user's contract, has to be verified to allow charging. Traditionally this is done via a RFID card or via a call center. Also a smart phone application or a short message service based authentication is possible, for example EVCOID via Smartphone and EVSP to Clearing House and EVSE-Operator Push service (see also the soon to be released project deliverable D3.8). Those authentication methods are called external means of authentication. With the ISO/IEC 15118 standard it is also possible to have the contract reference stored in the EV. So when the EV is connected to the EVSE contract information is transmitted directly between the EV and the EVSE without any need for external means of authentication.

Recommendation: a new work item proposal about RFID identifiers by BetterPlace was accepted by the IEC. It proposes a common standard for the RFID authentication in the EVSE environment. This work should be monitored and taken care of including more modern means of authentication like NFC technologies are also considered within this upcoming standard. As BetterPlace went out of business, this activity is open and eMI3 is considering this as they have several activities on identifiers (like token ID and contract ID).

Communication Requirements
This will be covered in the next section Charge Management System in *Communication with the EVSE*.

5.4.3 Charge Management System

The functionality of a Charge Management System is not exactly defined. In general, supposed functionality covers controlling and supervising the EVSEs, managing EVSEs, enable authentication and charging process, enable billing process etc. As such it can be regarded as the EVSE-operator system.
As also further described in chapter 8, the CMS plays a crucial role to support the different EVSPs accessing the eMobility physical infrastructure. For smart charging the CMS can play a role towards the physical electricity grid and the DSO. This could also be covered by the EVSP but not in roaming situation or grid emergency situations.

A charge management system will be used by a charge point/EVSE operator.
The exact functionalities depend on the operator's requirements and cannot be generalized.
On the other hand the interface functionalities which have to be considered can be described in more detail. Interfaces needs are:

- Interface for communication with the EVSEs
- Interface for communication with central systems like the GeM Marketplace
- Interface for local applications like load management

Communication with the EVSE

The communication between the EVSE and the CMS (Charge Management System) is still one of the controversial topics. There is currently no ISO or IEC standard describing this kind of communication. Consequently there are a lot of proprietary protocols available for this purpose.
One more or less open approach is the Open Charge Point Protocol OCPP. In general it might be a good idea to support OCPP for all the basic features so that interoperability is assured.
A lot of possible features of an EVSE are currently not supported by OCPP. So for a full featured approach the CMS and EVSE developers apply a proprietary protocol.
When developing an EVSE it might be a good idea to create the communication layer in a way that the communication language can be adapted in an easy way.

Recommendation: Consider to initiate a proposal for a (ISO or IEC) standard on communication between the EVSE and the CMS from the EVSE Operator.
A corresponding new work item proposal (NWIP) draft was created within Workpackages 5 and 7 in cooperation with OCPP and eMI3 members and handed over to the new WG CP (Charge Station Communication Protocol) in eMI3 to further deal with this draft NWIP.

Communication with higher/north bound systems

Since roaming (use case) is an essential part of electro mobility not every authentication or billing process can be done "in house". Consequently the CMS of EVSP-Operators has to be connected to other systems and stakeholders. Within Green eMotion the system for inter-connection is the B2B Marketplace developed in WP3. The communication interface for this is also described in that work package. This B2B Marketplace enables multiple EVSPs backend systems from various service providers to use common services, such as Clearing House and to exchange information with multiple EVSP-Operators and CMS systems.

Further a Green eMotion open clearing house protocol enables standard communication between EVSPs, EVSE-Operators and B2B Marketplace Clearing House service to have a standardised interface for a.o. authentication or billing.
A lot of other proprietary protocols are available for example for authentication and billing via mobile phone. In general the communication interface for the northbound communication should be kept flexible so that different communication models can be implemented easily.

Recommendation:
Green eMotion B2B Marketplace and Clearing House interfaces (EVSE-Operator and eMobility Service Provider area) are oriented towards market needs. Since the interfaces are purely ICT related an IEC or ISO standard might not be necessary. What is necessary is that the Marketplace interfaces are made public (see Green eMotion D3.5 Core services and transactions design specification: see Green eMotion website: http://www.greenemotion-project.eu/dissemination/deliverables-ict-solutions.php) and they will also be improved during the Green eMotion project. eMI3 should consider the Clearing House interface for standardisation.

Local communication
Some local communication might be necessary too, e.g. to access local authentication lists, billing systems or load management systems. There might be a separate interface for those "in house" services. But with an appropriate interface design all those interfaces can also be integrated in the northbound part. Again: there are no standards here which could be observed for this kind of interface.

This chapter on System Layers touches on the different scopes of these system layers. But in the end these system layers are connected to each other and form together one system.

Recommendation:
Define a data model that complies with the needs of the semantic models (information layer) but also the envisioned business procedures /objectives (in the business layer). This will also help in aligning all standardisation and development activities, and is a good way to support detailing of the use cases. This is taken up by the eMI3 WG Business Objects and Identification further developing the GeM identifiers. A first identifier modeling is already aligned and also transferred to ISO/IEC 15118 and NEMA.

6 Physical Layer

As mentioned in the introduction the physical layer will be addressed separately, in this chapter. The main reason is that this enables more focus specifically on mechanical and electrical compatibility and safety such as:

- Physical compatibility: connector, plugs, grid
- Electrical compatibility
- Physical communication means for user (wireless, wired, RFID)
- Human Machine Interface (HMI) between EV user and the EV but also the EVSE

The physical elements already listed in chapter five are: Power Plant, Electricity Grid, Electric Vehicle Supply Equipment, Electric Vehicle, and User's Smart Phone or Users ID Card. Communication interfaces have been covered in the previous chapter, the remaining interfaces are the physical identification or user interface to for example EVSE (can be RFID), the electrical interface including plug and connector between EV and EVSE (IEC 62196 and IEC 61851) and the electrical interface between EVSE and Electricity Grid.

Details on standards for plugs, connectors, and physical identification are described in Green eMotion deliverable D7.2: "Standardization issues and needs for standardization and interoperability" available at http://www.greenemotion-project.eu/dissemination/deliverables-standards.php.

With respect to grid compliance the perspective from the smart grid has been taken and described in the first section.

6.1 How to ensure compliance with standards and connection codes

This section describes how standards-compliance is achieved today and how to assure compliance tomorrow with the fast-evolving smart grid.

6.1.1 Dynamics of compliance today

The primary function of the electric grid is to ensure that acceptable reliability and high quality of power is delivered to all network users (consumers or producers); with as low intervention as possible with the unplanned power flows that may result from the evolving electricity market (in this context; the charging of EVs).
Hence, traditionally, the energy provider main aim was to ensure delivering high quality power to the customers. In this sense the energy provider has an active role while the electricity customers have a passive role in maintaining high power quality of the grid. Most of the connection standards were then developed taking this assumption into account and consequently limit the impact of the grid connected equipment. This is changing however, due to customer equipment becoming more active due to the use of power electronics interfaces. This equipment can improve or degrade the quality of power depending on its function. This in turn has forced a new scenario today where both the energy provider (or grid operator) and the electricity customer do have active roles in the electricity grid compliance with standards and connection codes. Grid codes and standards compliance methodology can then be split into two main categories as shown in the next table: equipment compliance and grid compliance.

Compliance category	Assurance of Compliance	Prevention of non-compliance
Equipment	■ Factory testing and equipment certifications ■ All regulatory standards are identified and mapped into processes, controls, activities and even documentations – companies are audited ■ Commissioning (on-field tests)	■ Businesses monitor non-compliance to ensure business continuity ■ Penalties may apply in case of non-compliance
Grid (aggregated impact measurement)	■ Planning levels higher than compatibility levels higher than equipment immunity ■ Monitoring (performance indicators)	■ Grid reinforcement (common practice) ■ Dynamic operation (test cases – limited to dispatcheable equipment) ■ Penalties may apply in case of non-compliance

Table 6-1 Standards compliance methodology today

Equipment compliance

To assure continuation of the business, manufacturers usually identify all regulatory standards related to their market and required by their customers and map such regulations into all processes, controls, activities and even documentations. Products are tested, in the manufacturers own test labs or sent to independent test labs, and certified before being commissioned. In the electricity grid case, the certifications are approved by an accredited organisation. Certificates of conformance, calibrations and tests are supplied as requested/necessary to customers, and the equipment supplier usually provides summary of standards to which products comply, or processes to which samples or equipment have been subjected. Conformance marks are usually stamped on the product enclosure (e.g. CE marking for compliance with EU product safety regulations), following predefined procedures. Upon commissioning, all required markings and documentations are inspected by the hosting grid operator. Also, pre-defined field tests are carried out. These requirements vary from one operator to the other, and also vary depending on the intended use of the equipment. Penalties usually apply if non-compliance has been experienced after commissioning.

Grid Compliance

Ensuring product compliance with electromagnetic interference (EMI) directives, for instance, does not result in overall grid compliance. Accepted voltage quality level (which is a measure of EMC) at an equipment connection point may penetrate through the grid and build up unwanted EMI levels at other locations of the grid, resulting in degraded services to other grid users. The first measure to ensure overall grid compliance is done at the planning stage. Planning levels are usually selected higher than equipment compatibility levels, which in turn are higher than equipment immunity levels (to ensure that other grid users are less affected by the aggregated EMI levels – this is again the traditional role where the grid operator is being active and customers are passive towards keeping a clean grid).

The second measure is done through monitoring performance indicators. Traditionally, the continuity of supply and voltage quality have been used as performance indicators of how well the grid achieves its aim. These indicators are also used to help the grid operator making the right investment decision for grid reinforcement if not satisfied. Audits are usually conducted by different authorities (depending on the country) of the distribution companies. The auditing authority usually informs the audited company of what indices will be audited. Generally, the audits result in fines in cases of non-compliance.
More information about how different EU countries carry out audits are available from the Council of European Energy Regulators (CEER), as periodical surveys and analysis of the quality of supply in the EU is carried out and publically available [CEER reports are available on: www.energy-regulators.eu].

6.1.2 Assurance of compliance tomorrow

With the evolution towards the smart grids, the performance indicators used today will not ensure that the grid achieves its aim. This is mainly because of the new core functionalities of the smart grids.
The European Energy Regulators have proposed 34 performance indicators in a position paper on Smart Grids [Position paper on smart grids – An ERGEG conclusions paper, European Regulatory Group on Electricity and Gas (ERGEG), Ref E10-EQS-38-05, 10 June 2010. www.energy-regulators.eu]. These indicators will be used by national regulatory authorities to assess the performance of network operators. These indicators can also be used to assess the R&D and demonstration projects on smart grids as a first step towards the compliance of the smart grids.
Here, it is worth highlighting one group of these performance indicators, as they reflect the smart grid core functionalities (and also relevant to GeM): “Enhanced customer awareness and participation in the market by new players”. There are six indicators under this group; as follows:

1) Demand side participation in electricity markets and in energy efficiency measures
2) Percentage of consumers on time-of-use/critical peak/hourly pricing
3) Measured modifications of electricity consumption patterns after new pricing schemes
4) Percentage of users available to behave as interruptible load
5) Percentage of load demand participating in market-like schemes for demand flexibility
6) Percentage participation of users connected to lower voltage levels to ancillary services.

To monitor the above indicators, the Smart Grid needs to incorporate distributed functionality where controllers need to discover, add or remove actors as the grid evolves. In the context of GeM, Smart charging, smart billing and smart grid services have to be taken into account as additional performance indicators on top of the EMC requirements. EVs are capable of influencing all six indicators as mentioned above, but the complete smart grid system should enable that.

To implement that, smart grid solutions may require:

- More real time information
- Bi-directional communication of data to multiple actors
- Distributed autonomous solutions
- Market regulations that incentivize the contribution of network users.

The figure below represents a generic compliance methodology regarding the grid, where actors (to the right of the figure), actions (to the left of the figure) and implementation (arrows) are dependent on the country.

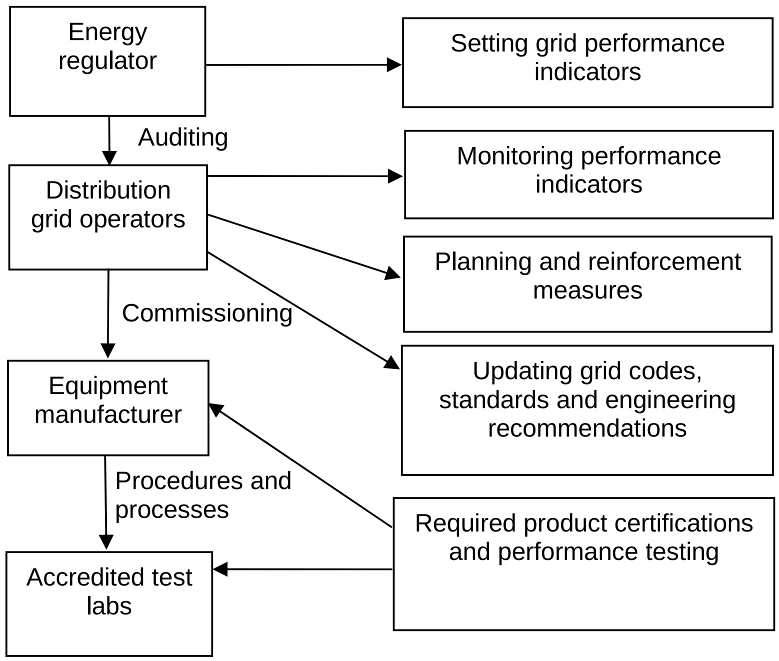

Figure 6-1 Smart grid compliance methodology

Recommendation: Equipment manufacturers (e.g. of Charging Poles) have to acknowledge the evolution in standards and regulations in the energy and smart grid domain and establish processes and procedures for compliance. Active participation of them in standardisation efforts ensure that most standards can be met without compromise of quality or cost of service.

6.2 EV User HMI – Recommendations for best practice & standards

This section covers Human Machine Interface (HMI) between EV user and the EV but also the EVSE.

From EV User perspective the usage of the electric vehicle including all related processes such as charging, searching for charging stations or the usage of other value added services need to be as convenient as possible and should be as easy as possible and the usages of the functions should not require any training.

Within GeM WP3 the distinction of “Basic End User Services” and “Value added Services” has been made. This distinction could be used to discuss recommendation and best practices for “Basic End User Requirements” and additional “Value added Services”.

Basic End User requirements

Concerning vehicle operation it can be stated that driving an EV is as easy as driving a conventional vehicle with automatic transmission.

Since an EV can recuperate energy during braking this feature has been controlled by the EV Driver and eventually feedback (e.g. in visual form) has to be given in order to utilize this function best. Concerning the activation of recuperation of energy two concepts can be foreseen:

- One pedal (recuperation via speed pedal, requires to press the pedal midway for "sailing" which changes driving experience a little)
- Activation via brake pedal (requires smooth transition from recuperation only to recuperation plus braking)

While charging the vehicle the user has to interact with different actors and related HMIs such as the EV, the charging point (EVSE) and eventually a mobile device like a smart phone as displayed in the picture below. The use case from this picture shows several HMIs and objects that needs to be displayed at these HMIs to the user.

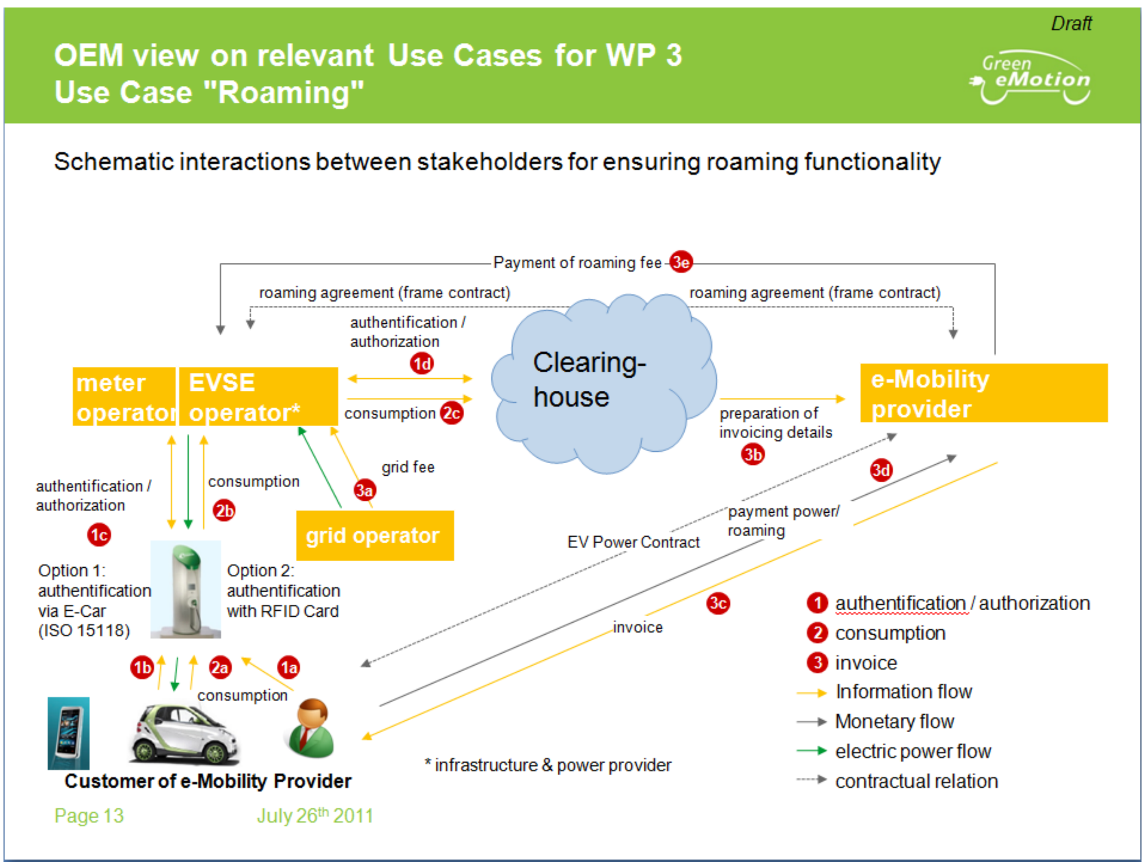

Figure 6-2 OEM view on use case roaming
(source: Green eMotion WP3 OEM Workshop, July 26th 2011)

Based on the use cases also a Reference Architecture has been developed in WP3 (see Green eMotion deliverable D3.2 Figure 3-5: Reference Architecture - Demonstration Focus at http://www.greenemotion-project.eu/dissemination/deliverables-ict-solutions.php).

Value added services

While the basic end user requirements just allow the operation of an EV, convenience to the Driver is brought by further so called "value added services" such as

- search & reservation of EVSE,
- navigation services including eco-routing,
- advanced navigation services for PHEV/ REX (Range Extender) including topology information (e.g. adaption of charge/ discharge strategy in dependence of up-hill/ downhill on next miles).

In this context the EV Driver expects intuitive and easy usage of these services, independent from the distinction whether he starts a service from a web based portal, smart phone App or via the incar HMI. Considering the requirements from e-Car-Sharing and EV rental cars, the EV driver would like to use his well-known GUI for instance in an electric rental car as well. One solution is the xlink-technology which allows running a smartphone app via the incar HMI.

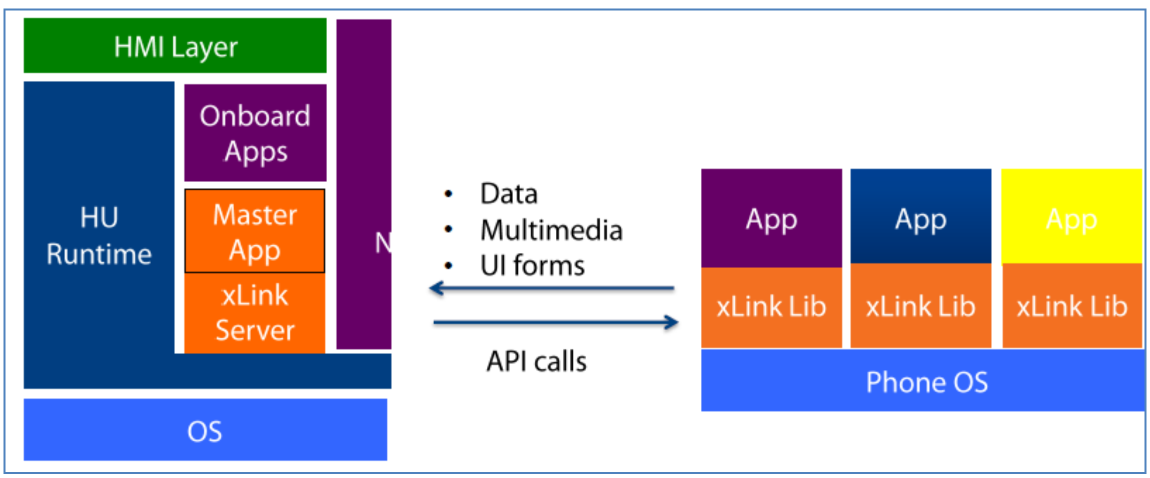

Figure 6-3 App Connectivity Technology "xlink" Application level
(Source: Vasiliy Suvorov, Bringing Apps into the Car, Telematic Update Conference 2012, Munich)

While each OEM has own concepts for the HMI interfaces in the vehicle and supporting web based or mobile app based interfaces, the underlying ICT technology can be aggregated under some de-facto standards for the case of in vehicle communication and infotainment systems.

The acceptance of eMobility solutions requires also consistent user interfaces. In the beginning this can probably be limited to the basic parameters (in smart charging) that a user needs to provide, like: - time of next departure, - next trip distance. Maybe other options can be: - time of charge completion, - kWh to be charged, or target SoC (State of Charge e.g. 70%).

Recommendation: Since smart phone technology has a significant shorter innovation cycle than the automotive industry with 5-7 years of model life time, it is recommend to monitor the development roadmap of the smartphone and its connectivity technology, since this is expected to be the driving force behind innovation in this area. In the next years the EV user is shifting from a user of a car that pushes some buttons in the car to a mobility user that is already mobile digitally connected and could also establish a several kinds of connections with the car and its environment for applications like navigation, communication, identification, authorization, payment etc..

6.3 Housing and Grid Connection requirements

The housing of an EVSE mainly depends on two topics: local installation codes and customer requirements. No general rules or standards can be applied here for a European approach.

Grid Connection

The connection to the grid is mainly dependent on the local grid code. In general it should be considered that there are many different approaches. A flexible electrical design can help to make the need for local customization as low as possible.

Grid concerns are already covered in various country specific grid codes. It is unlikely to achieve a universal European grid code. Therefore it seems that no extra standardization effort is necessary.

7 Cross Cutting Issues

The three cross-cutting issue areas as defined in the GWAC Smart Grid Framework are Configuration & Evolution, Operation & Performance and Security & Safety. Most needs are currently in the Security & Safety cross cutting issue area: such as system security, privacy, data security, EMC, Electrical Safety and Mechanical Safety. That will be the focus of this chapter.

7.1 Safety of EV components

As can be seen in the roadmap below the basic areas of EV components and standardisation are already covered on battery, EMC, mechanical safety in case of accidents, external interface and communication, electric safety and functional safety.

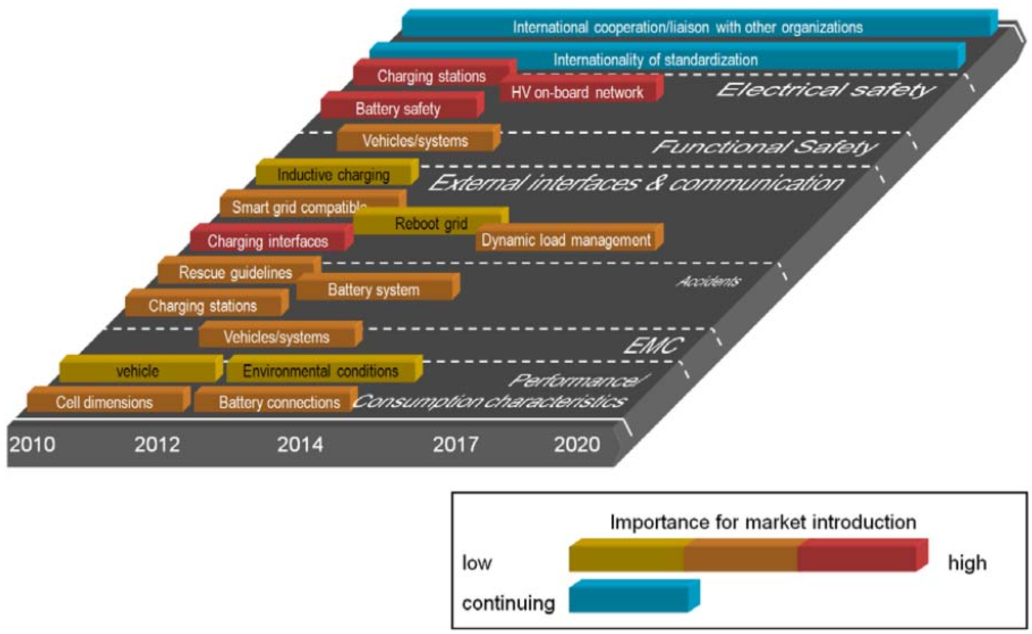

Figure 7-1 Schedule for implementing safe and secure EV recommendations
(source: The German Standardization Roadmap)

For EV components a stepwise approach/methodology to assure compliance of developments with standards of components is:

1. Define the components that should be changed by the upcoming development
2. Search for existing standards that effect the components that should be improved
3. Define out of the existing standards the limits which the changed component must not exceed
4. Use testing results to optimise components due to their area of appliance
5. Control the parts respective to the safety requirements
6. Test the changed parts by integrating them in existing systems
7. Check whether all changes match with the existing standards
8. Adopt the changes

This approach is good for components and their safety requirements, but it is not broad enough for a system wide approach since it does not take the overall system needs into account, but it contains several steps that can be used. With respect to methodology a structured and systematic approach is required.

Two other examples can be found below on charging systems approaches in Germany and charging plug approach from BMW.

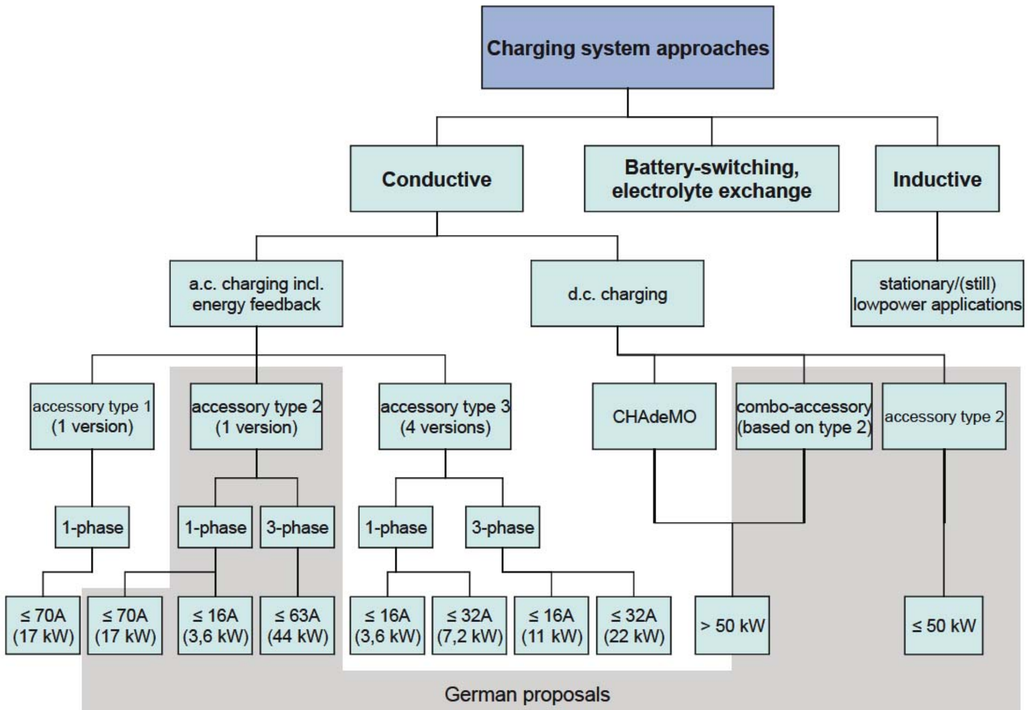

Figure 7-2 Charging systems approaches in Germany

Such a tree based picture ensures that all types of charging are known, clear and selectable, a basis for consistence of choices and compatibility and interoperability.

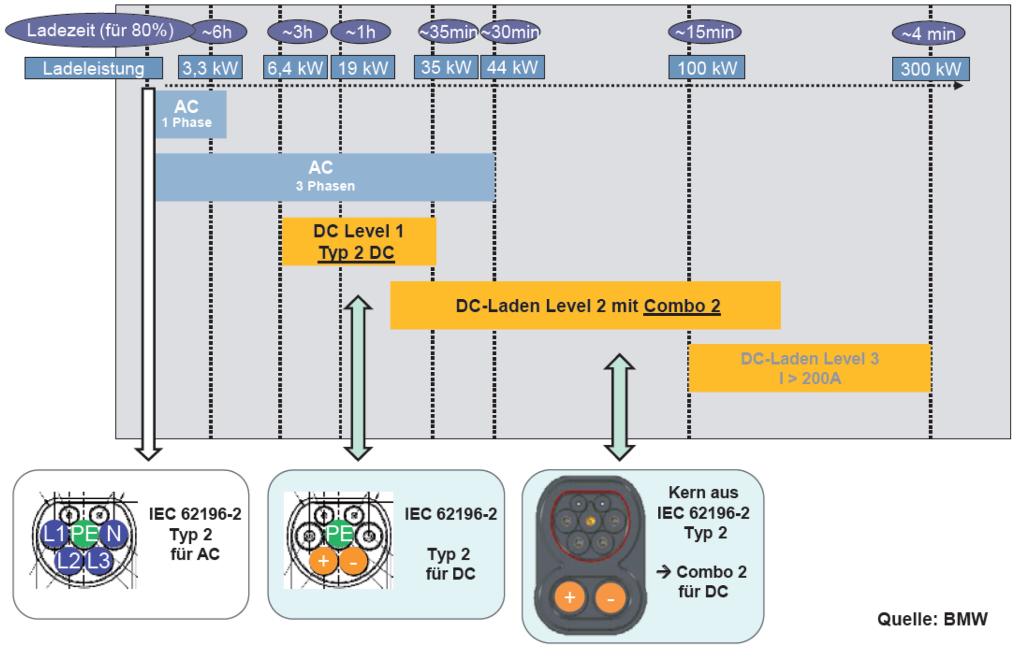

Figure 7-3 Charging plug approach from BMW

The overview of charging system types approached of figure 7-2, enables a next step: the charging plug selection and approach as depicted in figure 7-3.

Safety is almost by nature a key attribute for vehicle manufacturers. Because of this EV manufacturers have inherited the demanding safety standards of ICE vehicles and have adapted and extended these to electric powertrains and their components. Therefore we see that the safety of EV components in general is well addressed.

7.2 System security and privacy

System security aspects are much less developed, therefor the following recommendation:
Recommendation:
The area of cross cutting issues that needs some further investigation is in privacy, data security and system security. It is often mentioned as important, also since the information is used for billing customers and potentially also to control the smart charging of the EVs, but little structural design approaches are used so far. A further look needs to be taken into SGIS (Smart Grid Information Security), especially into the document “Smart Grid Information Security”, November 2012, by the CEN-CENELEC-ETSI Smart Grid Coordination Group.

Information Security is defined in that document as in ISO/IEC 27002:2005 “Information security is the protection of information from a wide range of threats in order to ensure business continuity, minimize business risk, and maximize return on investments and business opportunities.”

Based on this document we list here some aspects of this SGIS document that needs to be taken into account and considered.

First the key SGIS elements used and defined are:

- the SGAM (Smart Grid Architecture Model), and a Security View per SGAM layers
- Security Levels (SGIS-SL) have been defined based on the European Electrical Grid stability as reference, see the figure below.

Security Level	Security Level Name	Europeans Grid Stability Scenario Security Level Examples
5	Highly Critical	Assets whose disruption could lead to a power loss above 10 GW Pan European Incident
4	Critical	Assets whose disruption could lead to a power loss from above 1 GW to 10 GW European / Country Incident
3	High	Assets whose disruption could lead to a power loss from above 100 MW to 1 GW Country / Regional Incident
2	Medium	Assets whose disruption could lead to a power loss from 1 MW to 100 MW Regional / Town Incident
1	Low	Assets whose disruption could lead to a power loss under 1 MW Town / Neighborhood Incident

Figure 7-4 SGIS- Security Levels Description

- Smart Grid Data Protection Classes (SG-DPC): Use Cases describe intended usage of all information (received, processed, stored, transmitted or erased) as well as the role/actor (human or technical) that is allowed to do this. Assessing security risk starts with the information asset involved. Since data models "travel" through a very diverse information system at different locations and with varying ownerships it is recommended to classify and tag the data models. This classification is called Smart Grid Data Protection Classes (SG-DPC), see the figure below.

SG-DPC 1 Personal Information
Sensitive Personal Information
Personal Information
De-personalized Pseudonym zed Personal information
No Personal information

SG-DPC 2 System Information
System Data (i.e. Firmware), Configuration Data, Customer Credentials, Private & Public Keys, Roles /Actor IDs
Governance & Reporting Information, Logging and Audit Information
Audit & Log required information
Information to administrate remotely
Information to operate remotely (Control signals)
Business Information
Measurement data

Figure 7-5 Smart Grid Data Protection Classes

The document also gives a SGIS Toolbox overview, and a Quick Guide for the use of the SGIS Toolbox. The steps to be done in this quick guide are:

- Collect and classify use cases by SGAM domain and zones
- Analyse each use case identifying information assets, owners and actors
- Determine the SGIS Risk Impact Levels for every information asset
- Identify components supporting each information asset and group them determining their effective likelihood
- Determine the SGIS Security Levels for every information asset after executing the three corresponding inherent risk analysis (CIA: Confidentiality, Integrity and Availability)
- Select the appropriate standards to protect every information asset depending on its security level and taking into account the four SGIS standards areas.
- Establish the minimum set of security controls list that has to be deployed according to every security level, domain and zone
- Identify and analyse new use case periodically or when process suffer major changes in order to detect new requirements per domain and zone, up[dating security level criteria and the minimum set of security control

One of the conclusions of that report is that the standards needed to establish the basis of the Smart Grid Information Security are available today. Nevertheless there is a need for enhancement and for additional standards to integrate Smart Grid specific needs with a particular attention paid implementing them at organizations and in system components.
A final thought mentioned in the report is that “outside of standardization, the risks of connecting Smart Grid critical infrastructures equipment to public networks should be carefully considered in all implementations”.

This security approach fits well with the approach and methodology used in this document. Especially since both use the SGAM model and both focus on data models and the information therein.

8 Towards a Common Methodology

To start with a common approach the best is to create a common picture, since as they say: “Use a picture. It's worth a thousand words”, and it is able to describe a complex system or situation. That is what will be covered in 8.1 Common Basic Architecture, 8.2 describes developing a service view, 8.3 continues with the need for data models and 8.4 describes current activities on Interoperability Methodology and Testing.

A common basic architecture is a good method to agree on the key stakeholders and elements present in an electromobility system. This agreement also helps to further detail the system with the help of use cases. This agreement and further detailing will, if managed well, lead to further convergence and ultimately to standards, compliancy and interoperability. Even before the common basic architecture has led to standards it already will converge the choices made during development and implementation. Some examples below will show that several groups create these basic architectures, they are already converging, but they did not yet agree on one overall architecture.

A pure top down approach cannot work since not all future use cases are known, and also the importance of these is at this moment not always clear (for example the importance of V2G is on short-term low, but can on long-term be crucial). A pure bottom up approach will also not work, or at least lead to a suboptimal system since maybe congestion management possibilities are later on difficult or impossible to implement efficiently.

8.1 Common Basic Architecture

The first step to come to a common methodology is to define a common basic architecture. In this context of standardization interfaces and communication this is a picture showing the interfaces between the different stakeholder groups / physical systems and components. In practice, architectures can differ, but therefore a Common Basis Architecture has been defined that serves as starting point for different architecture implementations.

The first starting point is the Electromobility Building Blocks picture in the next figure. This shows the basic building blocks used in an electromobility system, and is defined in Green eMotion for the purpose of a common element to the reader in all Green eMotion deliverables.

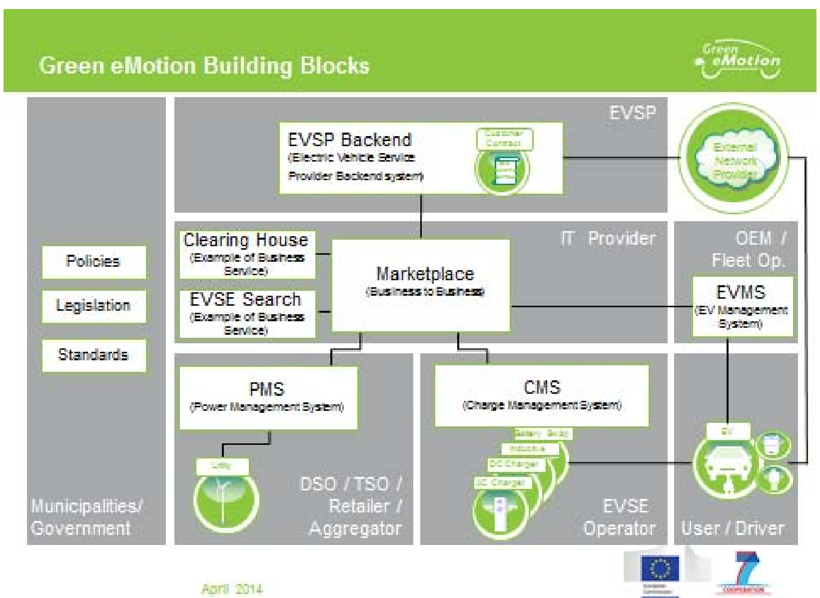

Figure 8-1 Basic system building blocks used in an electromobility architecture

For that reason we refer to the building block picture above and have added more detail in the physical layer. The lower 3 blocks have been separated into 6 to make interfaces between physical building blocks more explicit: on that level this results than in: Energy Provider (Retailer/Aggregator), DSO/Distribution Grid, EVSE-Operator/CMS, EVSE/Charging Point, EV and EV user. See also section 5.1 and 5.2 for the reasoning of these systems and physical elements. The result is illustrated further in the picture below. EVSPs and the B2B Marketplace are combined in one building element since the organisations we align with for standardisation have not made the separation between EVSP and the B2B MarketPlace. Also EVSE Search is not made explicit in the picture and is part of the more generic cluster Business Services.
To the first WP7 building elements picture (as shown in the Green eMotion ESF in Brussels in May 2012) the Backend Services element and EVMS/OEM has been added (as likely but not mandatory elements, therefor with dashed borders), this leads then to the architecture shown in the picture below.

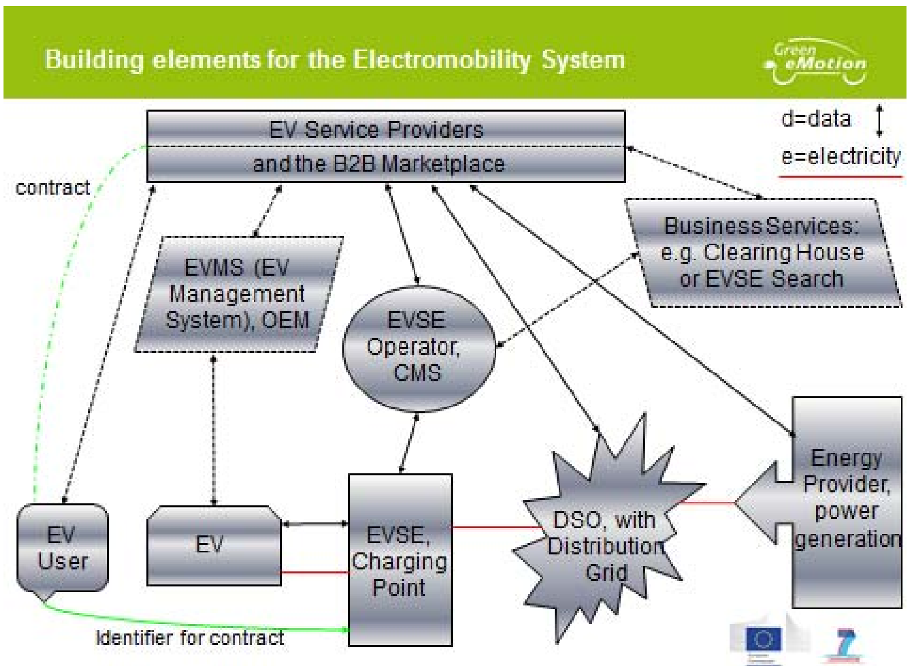

Figure 8-2 Basic Architecture and building elements for the Electromobility System

To summarize the required connections from figure 8-2:

- Three electrical connections between the blocks in the physical layer, these are clearly necessary for the electricity connection for charging (inductive charging would also be seen as a connection in this view).
- Then two user related connections with the EVSP (a contract relation and possible also a mobile phone connection), these are likely but optional since this depends on business models context and identification requirements.
- Further a minimum of 6 data connections is required. Most other architectures contain more interfaces, but these 6 is really the minimum to connect the 7 elements or stakeholders (more connections are required if the likely but not mandatory elements are connected like Clearing House or OEM backend).

To verify that this is a good starting point for the common basic architecture, a comparison has been made with activities outside the Green eMotion project in related activities and standardization.

As first reference the picture Role Model for E-mobility from the draft version of the CEN/CENELEC WG Smart Charging has been taken. This WG is reporting to both E-Mobility Coordination Group (M/468) and CEN-CENELEC-ETSI Smart Grid Coordination Group (M/490). Although drawn in a different way and some names are different the basics could be regarded as more or less the same. Within this group they made a split between the Charging Service Operator and the Customer Energy Management System. We regard this only as a further detailing of the backend of the EVSE.

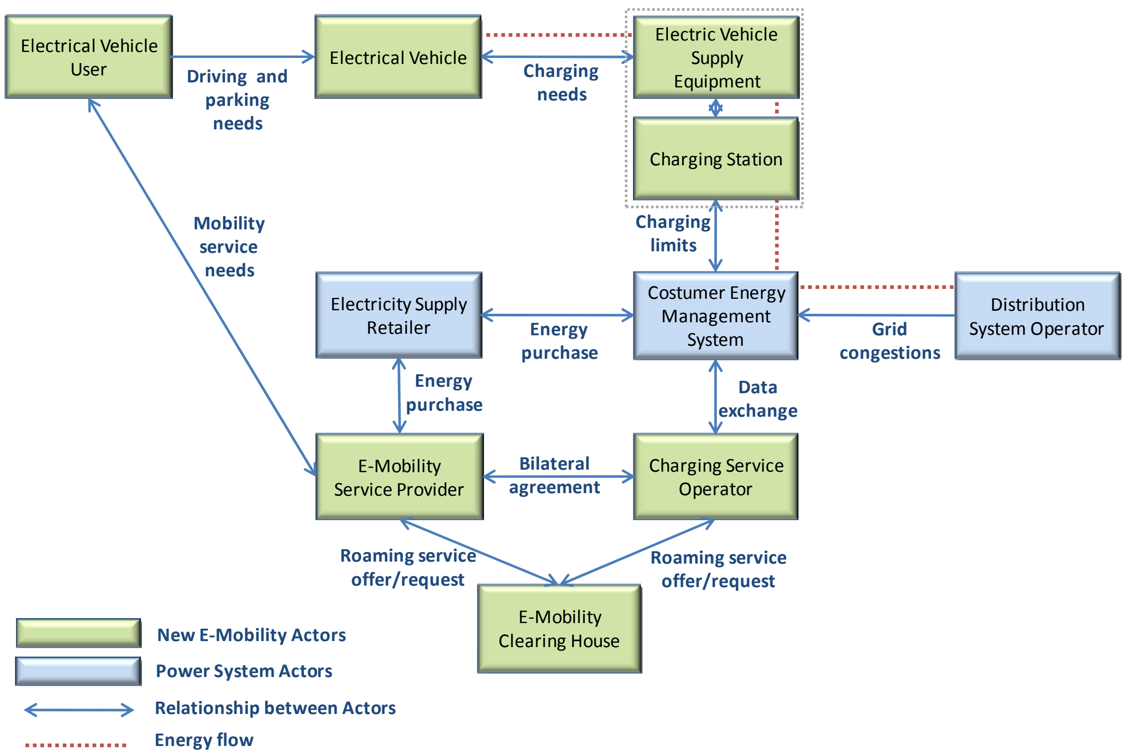

Figure 8-3 CEN/CENELEC Draft WG Smart Charging Role Model for E-mobility

Green eMotion deliverable D7.2 (http://www.greenemotion-project.eu/dissemination/deliverables-standards.php) also made clear that Smart Charging, Smart Grid Integration, Communication Protocols and Interoperability; and Identification and Roaming are key areas that require special attention and standardisation. From that perspective it is good to see that there is quite some similarity between figure 8-2 and 8-3.

Due to the importance of Smart Charging here the definition of the CEN/CENELEC WG Smart Charging:

> "Smart Charging of an EV is when the charging cycle can be altered by external events, allowing for adaptive charging habits, providing the EV with the ability to integrate into the whole power system in a grid and a user friendly way. Smart Charging must facilitate the security (reliability) of supply and while meeting the mobility constraints and requirements of the user. To achieve those goals in a safe, secure, reliable, sustainable and efficient manner information needs to be exchanged between different stakeholders."

Another example is the architecture as made by the Working Group Architecture & Interfaces from eMI3. Again although drawn in a different way and some names are slightly different the basics are the same again, and they added a navigation information role, this to enable search and reservation business services. This is still work-in-progress; a final version is not released yet, but expected to be released in the 2nd half of 2014 (for more information on this see http://emi3group.com). This final version will also include an EV OEM, so includes the latest Green eMotion addition of an EVMS.

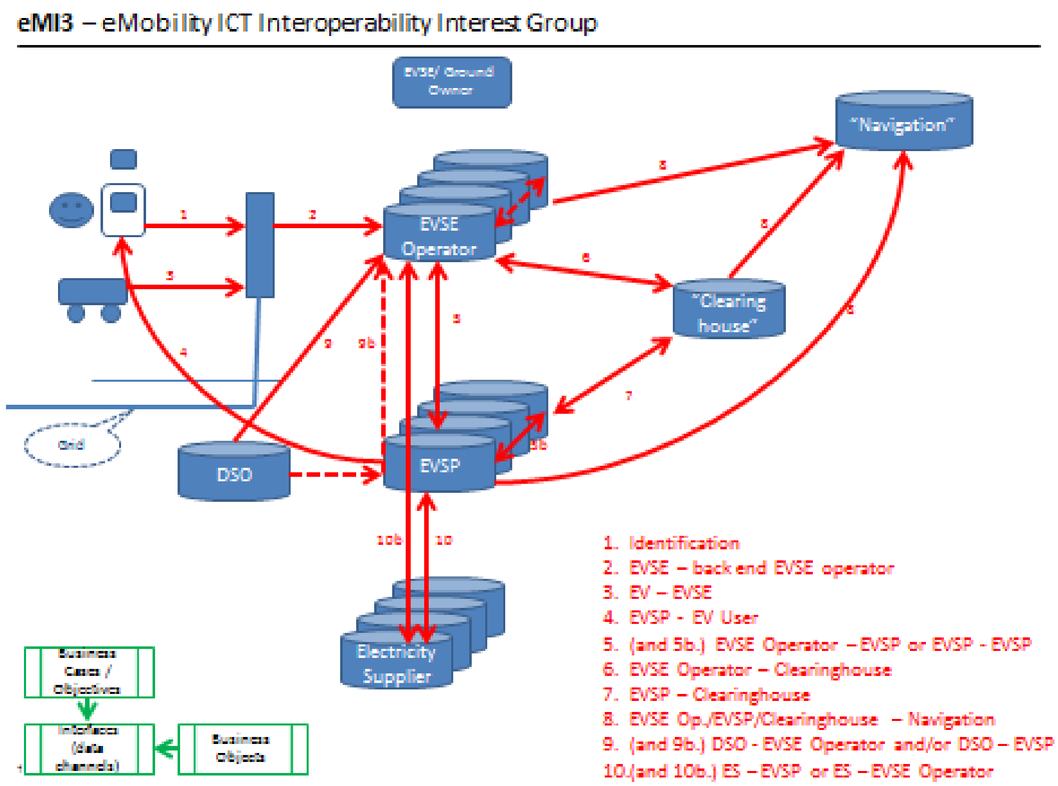

Figure 8-4 eMI3 first basic architecture and interfaces

In the table below the building elements for the electromobility system are compared. We will further use in this document the GeM Building elements for the electromobility picture and naming.

Green eMotion Building Elements	eMI3	CEN/CENELEC WG Smart Charging
EV user	EV user	EV user
EV	EV	EV
EVSE (Charging Point)	EVSE	EVSE (and Charging Station)
DSO (with Distribution Grid)	DSO	DSO
Energy Provider (with power generation)	Electricity Supplier	Electricity Supply Retailer
EVSE Operator (CMS)	EVSE Operator	Charging Service Operator and CEMS
EVSPs and B2B MarketPlace	EVSP	E-Mobility Service Provider (EMSP)
EVMS (EV Management System) OEM	EV OEM	----
Clearing House (a business service)	Clearing House	E-Mobility Clearing House
and other Services like search and reservation	Navigation	----

Table 8-1 GeM Building elements compared with eMI3 and CEN CENELEC WG SC

Recommendation: Make sure eMI3, Green eMotion, and CEN/CENELEC WG Smart Charging converge further to an accepted basic architecture and interconnections. There will be probably multiple architecture views: the physical domain (with EV, EVSE and Grid), the stakeholder domain (User, DSO, Energy Provider, EVSP, EVSE-Operator System, OEM backend and Clearing House), the business service domain (Smart Charging, Congestion Management, VPP operation), the ICT architecture and design domain.
The CEN/CENELEC WG Smart Charging will release their view in 2014. eMI3 did already start using one of their views in a use case. In eMI3 WG Architecture and Interfaces a next step is being prepared including the EV OEM. The presence of several Green eMotion partners in that WG ensures that the Green eMotion vision, architecture and experience will be taken into account.

8.2 Developing a service architecture on the EV ecosystem

One of the reasons why the figures above differ is the fact that they try to depict different interoperability layers in a single figure, without referring to these layers. Consequently IT systems are mixed with market parties interacting with these systems and mixed with other entities in the EV ecosystem. This adds to the confusion of what the function is of each of the entities in the figures and how they relate to each other. For example in figure 8-3 arrows represent relationships between actors (business layer), while in figure 8-2 (and 8-4) arrows represent data flows (or interfaces) and is more focussed at function and also information layer.

At the eMI3 meeting in Amsterdam on the 17th of September 2013 another example was presented, separating the different layers from each other (based on the interoperability layers presented in Chapter 4, such as SGAM) and only focussing on the services required to implement certain use-cases. This means that ‘who’ owns or implements a service is less relevant and can be decided by the market in the upcoming years, while still being able to develop stable standards for the interfaces between services. Consequently this analysis is independent from any future market structure.

The analysis starts with the physical layer (or component layer, which is the lowest layer in SGAM), since the physical entities are a given in all use cases. Subsequently the business layer is analysed in the context of a use case, which shows the business actors in the system and their possible interactions among each other. From that analysis the functional layer is developed. This analysis is input for a service view on the use case, which is independent from the actors, but can easily be mapped back to actors in the system. Based on the services the information and subsequently the communication layer can be developed, showing the business objects and communication protocols required to implement the use case.

8.2.1 Component Layer View

The physical component layer is depicted in Figure 8-5 and shows the physical entities or system actors in the use case: an EV, an EVSE (or charge pole), a grid and a power supply/power plant. It is important to take the ownership of the physical power infrastructure into account, thus linking physical entities to businesses. The figure shows four (business) actors that are present in any use case related to electrical vehicles: EV User, EVSE Operator, DSO and Energy Provider. From a physical point of view the electricity is supplied by an Energy Provider. From a business point of view this is the actor where one would contractually get electricity. As a side note: the owner of the EV is not always the user of the EV, therefore the EV user is used in this figure.

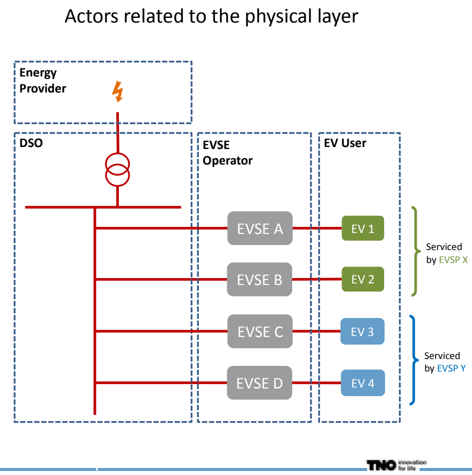

Figure 8-5 Actors related to the physical layer (example with four EVs and four EVSEs)

8.2.2 Business layer View

The physical layer and its link to the business actors is input for the business layer, so the same actors are present in this view and extended with two actors:

1) EVSP, a service provider actor that links all other actors (business-wise) together within the context of the smart charging use case.
2) Clearing House, an actor that supports the financial settlement of all business transactions, specifically in scenarios when different EVSP need to work together (e.g. for roaming).

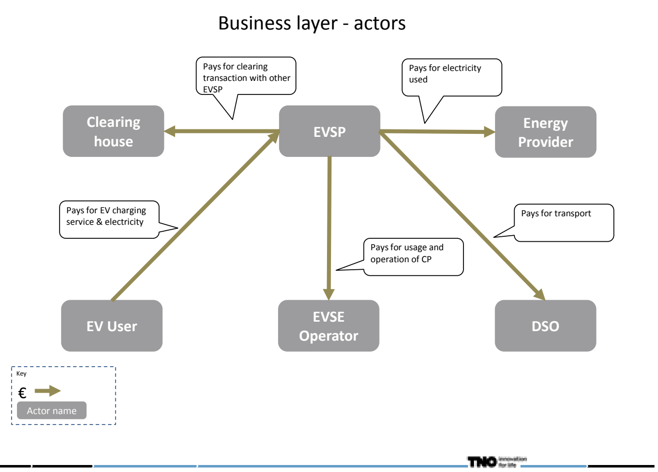

Figure 8-6: Actors on the business layer showing possible money flows (backed by contracts)

Key in Figure 8-6 is the role of the EVSP actor. Multiple parties could take on this role: e.g. the energy provider could provide this service to EV user allowing them to choose from a certain renewable energy mix, but also a DSO could provide this service incorporating grid congestion mechanisms, or similarly the EVSE operator could provide charge pole reservation services. To make all these different service combinations possible, separation of concerns[1] is key, and therefore the EVSP is decoupled from any currently existing actor.

8.2.3 Function layer

The figure below shows the business services and functions in these services for the EV smart charging use case using separation of concerns.

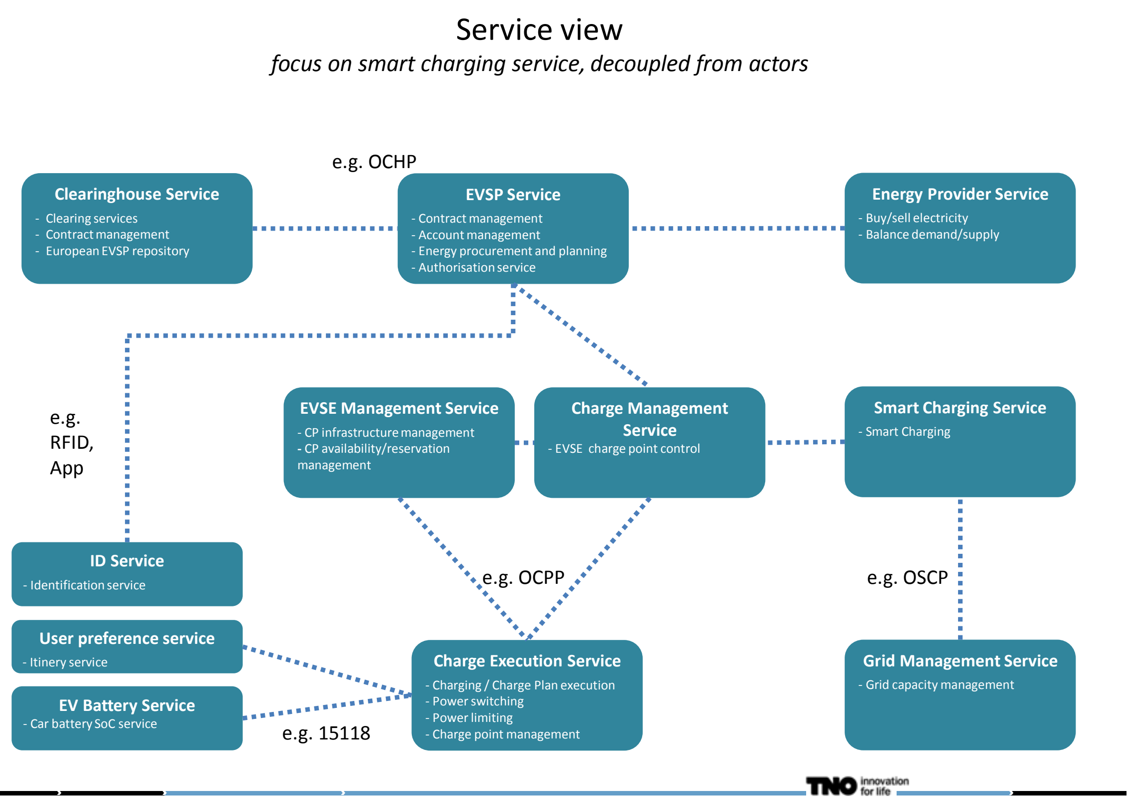

Figure 8-7 Service view of the EV ecosystem with respect to smart charging

Figure 8-7 shows which main services and interfaces are required when dealing with smart charging (i.e. it combines the functional layer and the communication layer). Each service provides specific functions, described in the boxes and which other services are needed to implement those functions. The view allows people to define the use cases in terms of services instead of actors or physical power infrastructure making the solution independent from the deployment. This means that the interfaces between the services are stable, without knowing the actual allocation of service to the actors in the (changing) market. Furthermore, the figure shows the actual gaps with respect to interfaces between services.

A possible mapping of service on actors is depicted in the following figure:

[1] http://en.wikipedia.org/wiki/Separation_of_concerns for a detailed description

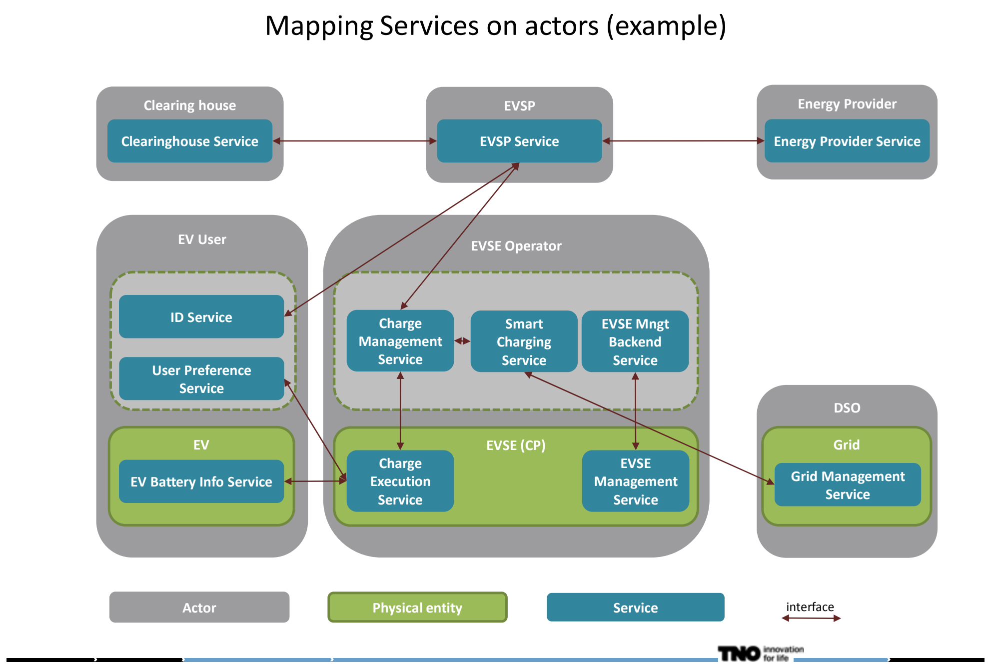

Figure 8-8: Example of mapping services on actors in the EV ecosystem

Figure 8-8 shows a logical mapping of services on the GeM building elements, but other mappings can be thought of too, such as a DSO providing the Smart Charging Service, instead of the EVSE Operator. In all cases, the interfaces between the services stay the same.

8.3 Data models of semantic models for business procedures / objectives

In section 5.3 on Information Layer it was already mentioned that this category is currently one of the bottlenecks in the standardisation around smart charging and eMobility in a wider scope. Also in eMI3 a working group is active on business objects (like Token Id, EVSE ID, ePOI, Pool ID, and other attributes).

An important recommendation was made in section 5.4 that we will therefore include in the common methodology: define a data model that complies with the needs of the semantic models (information layer) but also the envisioned business procedures /objectives (in the business layer).

The creation of a set of coherent and *consistent* business objects and data models is crucial since they help in detailing and verifying use cases, and at the same time they help to abstract the technical interfaces. This creation process also forces choices to be made. These choices, detailing and verification will make the models more robust and future proof.

Here is an initial long list of elements that requires data models: EV driver's contract, EV charging requirements and flexibility options (SoC, next departure time), distribution grid limitations and requirements (peak power, power quality, …), charge details record (energy used, time, location, type of smart charge, …), energy price from energy provider, bill from energy provider to EV contract owner, EV identification, EVSE/Charge Point identification and attributes (location ePOI, status), , …).

8.4 Interoperability and Methodology

Within the Smart Grid Coordination Group / Mandate M/490 the Working Group Interoperability (WGI) is creating a report: “Methodologies to facilitate Smart Grid system interoperability through standardization, system design and testing”. This report is expected end of 2014.
The WGI definition of interoperability is:

> *Interoperability is the ability of two or more networks, systems, applications, components, or devices from the same vendor, or different vendors, to exchange and subsequently use that information in order to perform required functions*

They also make use of SGAM in their methodology. They defined a process that start with a use case, and via application functions, they define profiles, see the figure below.

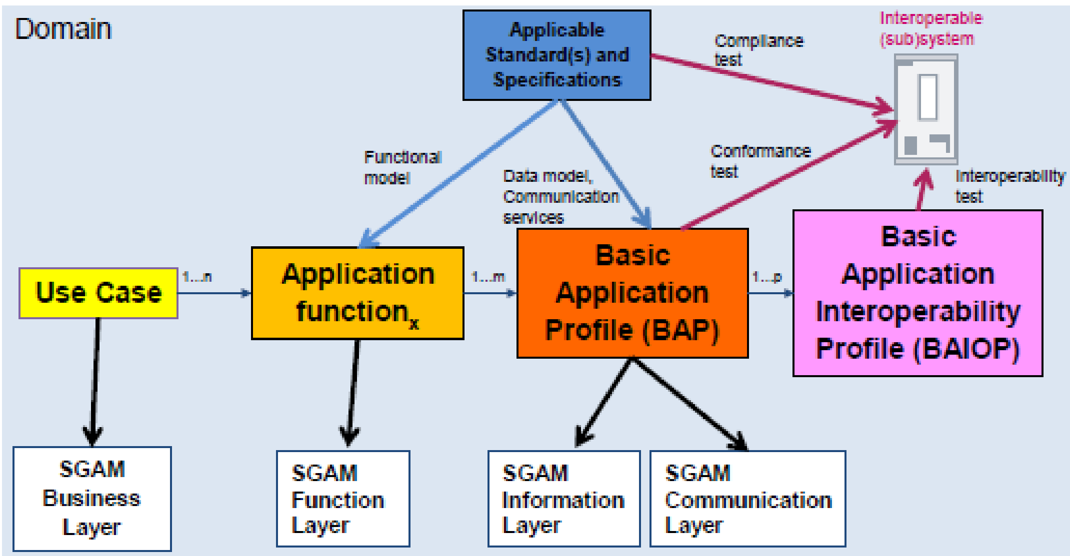

Figure 8-9 Road from Use-case to Interoperability on SGAM layers
(Source M/490 WGI, André Postma, at Green eMotion Standardization Workshop, Brussels, 6.05.2014)

A Basic Application Profiles (BAP) is an agreed-upon selection and interpretation of relevant parts of the applicable standards and specifications and is intended to be used as building blocks for interoperable user/project specifications. Where standards contain options (sometimes implemented and sometimes not) a BAP does not have options, this to ensure interoperability.
In their testing view/methodology they base themselves on the V-Model, applying the BAP on the left side (specification) of the V-Model and applying a Basic Application Interoperability Profile (BAIOP) on the right side of the V-Model. A BAIOP is a BAP extended for interoperability testing. BAPs and BAIOPs needs to be created by user groups, so the users of the equipment, not the manufacturers.

It is good to see that although the first version of this document, deliverable D7.6 and methodology was worked out independent from M/490 and the WG Interoperability there are several similarities and overlap like: systems engineering, system architecture, architecture frameworks, layered architectures, business cases, stakeholder and actor identification, use case based methods, models for system development or software lifecycle models (like the V-Model) function and service orientation, etc.

A project that is investigating the use of the M490/WGI proposed interoperability methodology is COTEVOS (see also http://cotevos.eu). COTEVOS is an abbreviation of COTEVOS = Concepts, Capacities and Methods for Testing EV systems and their interOperability within the Smartgrids.

Several partners of COTEVOS are also partner of Green eMotion (and WP7), this ensures that standardisation knowledge gained in Green eMotion can and will be reused in COTEVOS.

8.5 Common Methodology

This all leads to the following Common Methodology:

> "For eMobility agree on a Common Basic Architecture and define Data Models compliant with the semantic models and the business context/procedures and objectives.
> This Basic Architecture and Data Models will ensure use cases to be implemented and technical interfaces to be aligned."

The creation of a common basic architecture will, if managed well, lead to convergence and ultimately to standards and compliancy. Even before the common basic architecture has led to standards, it already converge the choices made during product development and implementation. A good starting point would be figure 8 2 Basic Architecture and building elements for the Electromobility System, also since it is currently the best common denominator of the different architectures.

The third standardisation survey on "Future trends in eMobility and advices for standardisation guidelines" (see deliverable D7.2 version 3 at http://www.greenemotion-project.eu/dissemination/deliverables-standards.php) led to a recommendation that fits the methodology proposed above:
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 roadmap (with active demand response, Smart Charging)
- Identification/payment/roaming/Clearing House/smart phone technology roadmaps
- Battery and power component and interface technology (battery, inductive, fast, AC/DC)
- and Vehicle2Grid and V2Home technology roadmaps

Where applicable use tooling, for example models and simulations, this ensures convergence and agreement since it requires details, which will lead to questions and decisions. These tools will also speed up development since (the use/results of) the tools and simulations will be shared and open for others. The tools should for example be capable of running the use cases.

Use cases are crucial in all stages of the development of products and standards. For customer communication, for creating requirements, for verifying architectures, as starting point for interoperability etc. To enable fast convergence of ideas and easy sharing of information and terminology it is advised to share the use cases as much and open as possible. Preferably (parts of these) public, else open for user groups or industry alliances. If these will not be shared, they will not be used, and as such not lead to or influence standards.

9 Recommendations

The key recommendation is:
Execute the Common Methodology:

> "For eMobility *agree* on a Common Basic Architecture and *define* Data Models compliant with the semantic models and the business context/procedures and objectives.
> This Basic Architecture and Data Models will ensure use cases to be implemented and technical interfaces to be aligned."

9.1 Main recommendations

Execute the Common Methodology, but since it is not a simple recipe, do this with and make use of other **external groups of experts** active in this field, and other standardisation activities, such as eMI3 and the CEN/CENELEC WG Smart Charging. Although different viewpoints and use cases are regarded, cooperation will lead to convergence and as result an easier standardisation process. Since use cases are crucial in all stages of the development of products and standards, another recommendation is to share the use cases as much and open as possible.
Preferably (parts of these) public, else open for user groups or industry alliances.

When working on the overall architecture and its communication interfaces, align with related and adjacent activities (see picture below), this improves own activities and those of others.
So when working on Business Objects: align with use cases and the protocols in the technical layer, but also check with terms & definitions, QoS requirements, and data security aspects.

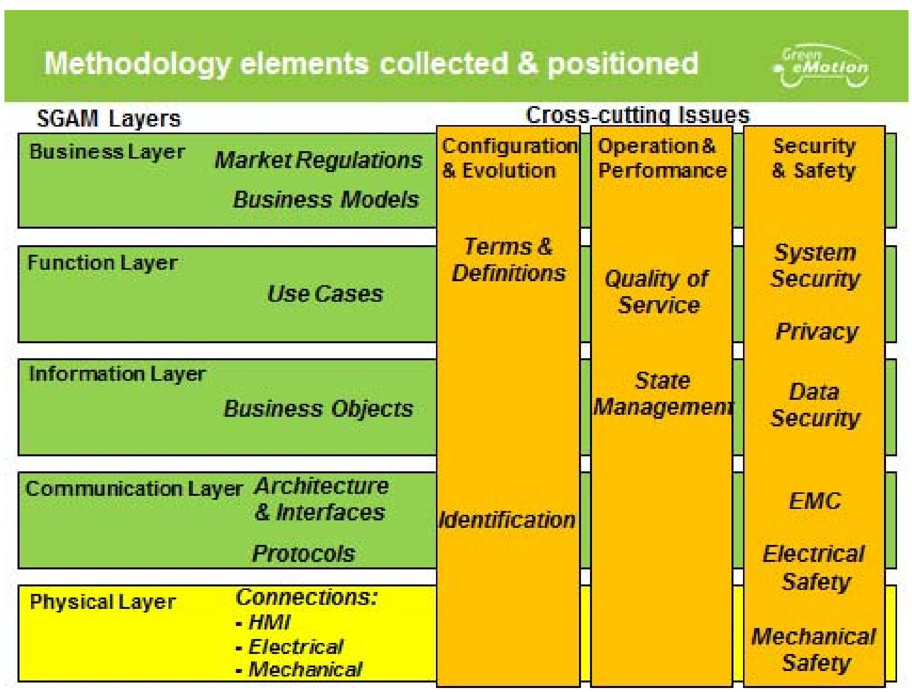

Figure 9-1 Methodology elements positioned in the SGAM Smart Grid Framework

The Functional and Information layer are very important and crucial since influenced by use cases and also the technical layer. Agreement on Business Objects definitions, being performed also in eMI3, is necessary for progress.
Further it is advised to follow, align and study the results of the M490/WGI proposed interoperability methodology.

Recommendation: Use a SGAM based model (or at least a layered framework/model) in new and future architecture activities in eMobility and Smart Grid projects, since this model can be mapped easily on the other models. Since Green eMotion and other projects and products are already ongoing, more detailed recommendations and a recommendation plan is worked out in the next two sections. It is advised to create a business service view , since this view separates the concerns from the different actors in the business layer and is independent of the actual implementation but still makes the requirements from the information layer clear.

We also like to adopt a recommendation from the third standardisation survey deliverable D7.2 version 3 (http://www.greenemotion-project.eu/dissemination/deliverables-standards.php) **create and manage an eMobility standards roadmap**, based on a unified Smart Grid ***and*** eMobility Reference Architecture, 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.

9.2 Collected and more detailed recommendations

In the different chapters several other recommendations have been given. Here we list the most important recommendations These recommendation address evolution in standards of energy domain, authentication, POI-Data, EVSE to CMS communication, smart phone technology, privacy & security, use cases & data modelling, Marketplace/eMobility Service Provider interfaces, and Common Basic Architecture. A recommendation on Smart Charging was added.

While the OEMs deploy their proprietary systems for navigation and infotainment systems successfully, it is recommended that basic functionalities such as the display of POI-Data for EVSE in the vehicles or authentication at the EVSE via ISO 15118 certificates will be supported by all automotive communication standards in order to support interoperability of charging services.

It is recommended that eMI3 addresses this issue when a Business & IT Reference Architecture for eMobility Services is being developed.

A new work item proposal about RFID identifiers was accepted by the IEC in IEC 62831. It proposes a common standard for the RFID authentication in the EVSE environment. This work should be monitored and care taken that also more modern means of authentication like NFC technologies are also considered within this upcoming standard. This is done in eMI3, since they have several activities on identifiers (like token ID and contract ID).

Consider to initiate a new work item proposal for a (ISO or IEC) standard on communication between the EVSE and the CMS. This has already been taken up by the Green eMotion project and is now driven in eMI3 where the Working Group Communication Protocol is collecting requirements from the market and developing a future industry standard which might finally well lead to an ISO or IEC standard NWIP.

Green eMotion B2B Marketplace interfaces (eMobility Service Provider area) are oriented towards market needs. Since the interfaces are purely ICT related an IEC or ISO standard might not be necessary. What is necessary is that the Marketplace interfaces are made public and they should also be improved and aligned after the Green eMotion project. The basics are already made public in Deliverable 3.5 Core services and transactions design specification (see http://www.greenemotion-project.eu/dissemination/deliverables-ict-solutions.php). Maintaining these interfaces in the time after Green eMotion could for example be done in eMI3, more specifically the Working Group Architecture and Interfaces.

Define an eMobility data model that complies with the needs of the semantic models (information layer) but also the envisioned business procedures/objectives (in the organizational layer). This will also help in aligning all standardisation and development activities, and is a good way to support detailing of the use cases. This is taken up by the WG Business Objects and Identification of eMI3, but since the reference set of generic use cases in eMI3 is being finalized in Q3 2014, this model has not been released yet.

Equipment manufacturers (e.g. of EVSE) have to acknowledge the evolution in standards and regulations in the energy domain and establish processes and procedures for compliance. Active participation of them in (Smart Grid) standardisation efforts ensure that most standards can be met without compromise of quality nor cost of service.

Since smart phone technology has a significant shorter innovation cycle than the automotive industry with 5-7 years of model life time, it is recommend to further monitor the development roadmap of the smartphone and its connectivity technology, since this is expected to be the driving force behind innovation in this area.

The area from cross cutting issues that needs some further investigation is in privacy, data security and system security. It is often mentioned as important, also since the information is used for billing the customers and potential also to control the smart charging of the EVs, but little structural design approaches are known and used so far. A further look can be taken into SGIS (Smart Grid Information Security).

Make sure that eMI3, Green eMotion, and CEN/CENELEC WG Smart Charging converge further to an accepted Common Basic Architecture. Also involve or align with other organisations where applicable. Several partners of the Green eMotion project (especially from WP7, WP5 and WP3) participate and contribute heavily to eMI3, and as such this recommendation is already being executed. The many Green eMotion partners participating in eMI3 are leveraging the knowledge and effort gained in Green eMotion actively towards the eMobility community.

No clear recommendations were given in the energy provider or grid domain. This is likely caused by the fact that only recently more effort is put in smart charging options and needs, and that this area is heavily influenced by smart grid development, which is still ongoing and maturing. So therefore as last recommendation: better define smart charging (e.g. multigoal charging: user, battery, energy and grid friendly charging). Work out in more detail some smart charging use cases (preferably with simulation tooling), as well what the functionality of the different blocks in the architecture fulfil, and what will be communicated on the different interfaces between these architecture elements. This is taken up by eMI3, where mid-September 2013 they organised a session in their General Assembly on smart charging, with presentations from several Green eMotion and non-Green eMotion partners. Also smart charging use cases are used in eMI3 and other projects like COTEVOS. This also needs alignment with the SGCG from M/490.

9.3 Recommendation plan

Besides several recommendations in 9.1 and 9.2 in this section a more clear tangible consistent recommendation almost in the form of a plan/procedure has been made. This general standardisation recommendation is already partly being followed by Green eMotion and eMI3.

With respect to Green eMotion and eMI3: Due to the required convergence of mobility, energy grid, and communication technology for eMobility, the standardisation in this eMobility field is complex and takes a lot of time. Green eMotion WP 3.8 and WP 7 are focussing and advancing on the standardisation issues. To ensure best efficiency also beyond the duration of Green eMotion, eMI3 has been founded and is strongly supported by Green eMotion and its partners. Nov 18th 2013, eMI3 has been launched as a formal organisation and is now well positioned as open and global player to bring forward standardisation in eMobility. Further, eMI3 strives to liaise and cooperate with major projects and organisations, so far covering Green eMotion, Mobi-Europe and NEMA and others are in preparation (like SmartCEM, Molecules, and COTEVOS).

The recommendation plan is to use the Common Methodology, describe a Common Basic Architecture and Data Models, and execute the next 10 step plan:

1. Agree on **Terms and Definitions** and overall system objectives, requirements and architecture, at least a Common Basic **Architecture**. This is in progress in eMI3 WG2 Architecture and Interfaces, and started with Green eMotion terms and definitions.
2. Agree on two **simple use cases** and work these out on functional/semantic level, also describe business objects). For example a direct payment and a roaming charging case. This enables short-term needs and fast adoption of use cases and architecture. Several use case are available from Green eMotion and new ones created in eMI3 WG1 Use Cases.
3. Define the **interfaces and standards to be used** for this and add the additional required details. Details are required since especially here “the devil is in the details”.
   Take care of the HMI and standardise the data elements a user is required to fill in (and preferably standardise a part of the advanced and optional items). In progress in eMI3 WG3 Business Objects & Identification.
   Align this with other **standardisation** activities. This is covered by eMI3 liaising with NEMA, several EU projects, etc.
4. **Implement** this in a demonstration site and where needed update previous documents. eMI3 could learn and follow up from the smart charging Green eMotion demo regions.
5. Agree on two to five **advanced use cases** (e.g. with **Smart Charging** and roaming, and one long distance case with **charging spot reservation**) and work these out on functional/semantic level and business objects). These advanced cases ensure long-term viability, upgradability and prevention of wrong directions in standardisation. Consider to use tooling for this, to ensure reuse and consistency. This has been started in eMI3 WG1 Use Cases, and also the Smart Grid Coordination Group on Sustainable Processes has defined several use cases categories and examples.
6. Define the interfaces and standards to be used for this and add the additional required details (for all layers). Align this with other standardisation activities and initiatives (like the **CEN/CENELEC** WG on Smart Charging that closes in 2014 and **eMI3** that has started with this, but more work is still required. Further on initiative of Green eMotion and in cooperation with OCPP and eMI3 members a new eMI3 WG5 CP (Charge Station Communication Protocol) was formed with as goal to “Defining and standardizing a communication protocol between EVSE and backend systems”. This group is still active and analysing the requirements of three proposed protocols and collecting new requirements needed for the future.
7. **Implement** these new interfaces and standards also in a demonstration site and where needed update previous documents. This cannot be done on short term, but Green eMotion demonstration regions and eMI3 member coverage ensures visibility of demo activities and opportunities
8. When working properly expand to and **share with other projects** (EV, eMobility, or Smart Grid) and in new standard products (EVs, CPs)
9. Convert use cases in **generic test cases** and if these work in demonstration sites, then consider release for **compliance** and certification of EVs and related infrastructure, follow the recommendation of the M490/ Working Group Interoperability. For eMI3, get in contact with the EU project COTEVOS (Concepts, Capacities and Methods for Testing EV systems and their interOperability within the Smartgrids). This project includes several Green eMotion partners.
10. **Release** all above as **guidelines for standardization and interoperability**. Where appropriate, create NWIPs to be brought into standardisation bodies.