



Electro mobility – Interoperability Challenges

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Version Control

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Authors

Jean-Charles Pandazis, Ertico

Kai Weber, Bosch

Sébastien Albertus, Renault

Christian Hahn, Hubject

Sebastian Crusius, Hubject

Hauke Hinrichs, Smartlab

Bruno Lebrun, Gireve

Gilles Bernard, Gireve

Jean-Marc Rives, Gireve

Heimo Aichmaier, Austrian Mobile Power

Bettina Fuchs, Austrian Mobile Power

Giovanni Coppola, Enel

Janine Soppa, BMW

Torsten Andre, BMW

Joost Laarakkers, TNO

Laurent Bloch, Schneider Electric

Ludovic Coutant, CNR

Luis Reis, CEijA

Marco Marijewycz, E.ON

Michel Bayings, ELAAD

Paul Bertrand, EDF

Ton Karelse, Allego

Eduardo Garcia, Ibil

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1. Introduction

Over the last 18 months a number of legislative changes, regulatory drivers and standardization efforts can be observed which have positively impacted the prospects for electric vehicle uptake in Europe. These legislative developments frame the market for electric mobility (eMobility) in Europe, and the implementation of integrated services could drive the uptake of electric vehicles across all EU

Member States.

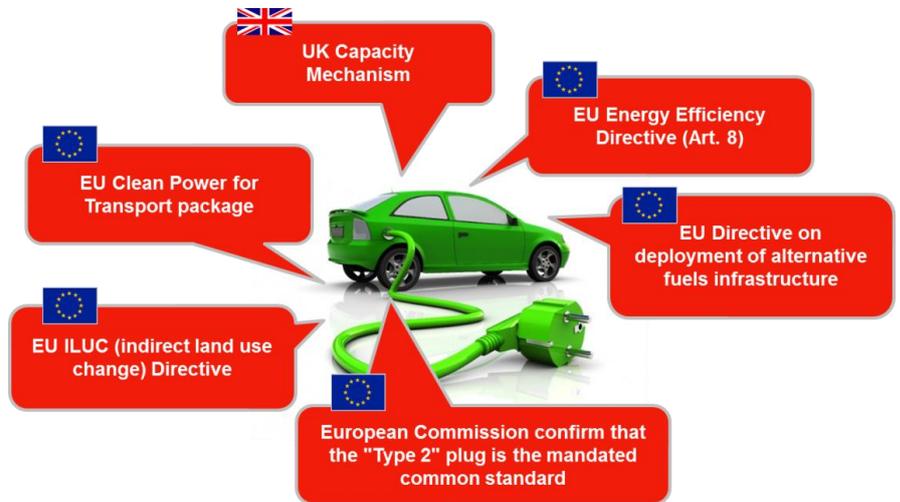


Figure 1 EU Electric Vehicle Techno-political landscape

What makes the eMobility market so unique is the fact that it aligns two systems which traditionally have not been so intertwined, namely the transportation system and the electricity system. E-Mobility is radically realigning the relationship between these two sectors and systems, both of which are required to contribute to the EU Commissions ambitious climate goals. The development of eMobility must also be in line with EU Commission policy goals in term of climate action contributing to the reduction of CO² emissions and all the actions taken by eMI³ are committed to that. Figure 1 below illustrates some of the key legislative developments recently implemented and highlights the mix of energy and transport related policies, packages and Directives which will impact upon eMobility market development in Europe.

A fundamental enabler of the eMobility market development and growth is to insure that recharging your plug-in electric vehicle is as convenient as fuelling a petroleum-powered vehicle today. A significant number of companies and organizations, from global corporations to innovative start-ups, are developing services for EV drivers, deploying charging infrastructure, and overall, working on products and services that will make driving and charging an electric vehicle as convenient as its petroleum-powered counterpart.

What is the eMobility eco-system?

eMobility constitutes a complex ecosystem, including energy systems, cities (comprising urban management, transportation systems and other), where infrastructure and an array EV related services emerge and vehicle manufacturers and service players interact with one another. As more EVs are introduced in the market, the relevant interactions will grow, with more complex use cases likely to emerge.

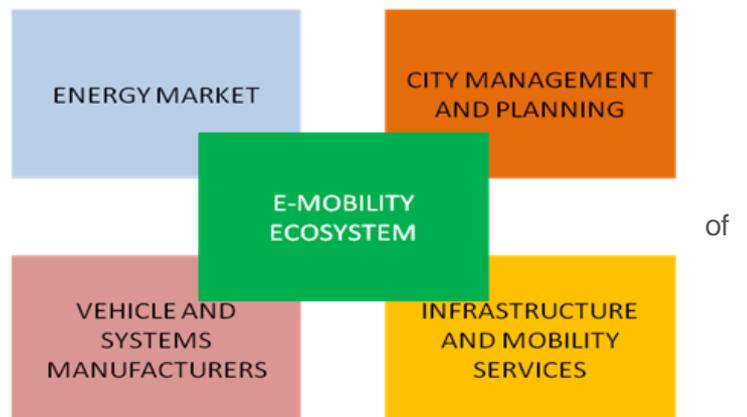


Figure 2 eMobility ecosystem (simplified)

Main challenges

Interoperability is a key challenge for the global eMobility industry and, if left unresolved, will continue holding back the uptake of electric driving.

In this paper the eMI³ describes challenges regarding eMobility in three main areas. For each specific challenge possible actions for DG Move and the eMI³ are proposed. Details can be found in Chapter 4 “Challenges, barriers and solutions”. The three main areas are:

- Set up a fair business case for all actors respecting investments and operating costs
- Define clear interoperability rules and pieces of evidence
- Ensure pan-European coherent and equivalent service level

Within these areas an urgent need was identified namely to enable a harmonized ID issuing process in all EU member states. Please see Chapter 4.3.1 for more details.

eMI³ is committed to support DG Move in order to overcome these challenges with the following actions (more details in Chapter 4):

- Support DG Move in providing a pragmatic and effective solution for ID issuing in all EU member states
- Provide an open reference market framework, typical players, roles, use cases and interfaces and ensure that this is continuously updated with input from eMobility stakeholders.
- Draft a set of functional or non-functional requirements for interoperability of charging.
- Maintain a list of critical services related to interoperability and a short set of requirements and checks to prove those services are interoperable.
- Provide the guidelines for charging infrastructure dictionaries.
- Support DG Move by organizing a round table with Eurelectric and DG Energy.

2. Current Status

EV-users have a contract with one or more Mobility Service Providers (MSP). MSP's have contracts with Charge Point Operators (CPO)¹. There are hundreds of MSP's and CPO's all over Europe. An EV-user can only use the Charging Infrastructure of a CPO if and when "their" MSP has a contract with that CPO to enable charging. But EV-Users want to use their EV's anytime anywhere. To reduce complexity and costs in the market there is the new role of interoperability or eRoaming providers, who help reduce the needed numbers of connections and contracts. In order to enable EV-users to ad-hoc charge at other CPO infrastructure, we need interoperability between providers.

This chapter focuses on existing examples that may have an added value for common technical approaches that could serve as an input for a European Directive.

- In Spain, thanks to the European project ICT4EVEU, Iberdrola and IBIL (both with roles of CPO and MSP) have developed a software platform to enable the interoperability between the companies.
- In Germany "customer-friendly-charging" has been defined by the National Platform of Electric mobility (NPE). The NPE has defined recommendations on ad-hoc charging. Definitions like those may help to realize European Interoperability in accordance with directive 2014/94/EU. Hubject in Germany is an interoperability provider that applies the NPE's and also the European commission's recommendations. Hubject states: Our open hub enables a barrier-free access to the charging infrastructure for electric vehicles on a trans-European basis and moreover connects different players of the emerging market of electric mobility. The BDEW – an association of energy distributors and grid operating companies in Germany - provides uniform ID-Numbers for Charge Point Operators and more²
- There was also a new initiative deployed in Germany: The initiative for "absolutely customer friendly charging", which aims for a rule set for all market participants to enable a customer friendly charging by ad-hoc access and/or contract based access to charging points³.
- The Portuguese example "MOBI.E" is a national initiative launched in 2010, set to ensure full business and service interoperability of the electric vehicle charging infrastructure across the country.
- In The Netherlands the Central Interoperability Register is in place. In CIR, 15 different charge point and service operators work together and 100% of the public charging infrastructure can be used by any EV driver. CIR is managed by branch organisation eViolin.
- In other countries we see similar organizations offering similar services or parts of them: GIREVE in France, e-clearing.net in the Netherlands, Enel in Spain and MOBI2Grid (cross border Portugal/Spain).
- In addition, parts of the Green eMotion and MOBI.Europe projects concern this issue.
- Please see the ANNEX to Chapter 2. For more details on this topic.

All these initiatives have led to fully working systems in Europe. They are a good basis for a next step which is connecting all of these existing systems with each other.

¹ CPO: the operator of charging infrastructure

² <https://bdew-emobility.de/> only available in German Language

³ <http://www.bmwi.de/DE/Presse/pressemitteilungen.did=714520.html> only available in German Language

Recently, several roaming providers took the initiative to connect the different systems with each other in order to provide reliable status info from charge points for EV drivers and to exchange EV driver contract information for supporting access across the different providers (the so called pan-European eRoaming initiative⁴).

When designing and implementing a European Directive, the definition of common standards will be a key element. It will then be possible to re-use the “best practices” of the existing interoperability systems in the current situation which have been described in this chapter.

⁴

http://www.hubject.com/pdf/PM_hubject_20150324_EN.pdf

3. What is interoperability?

Interoperability is the ability to enable various systems to work together. For the eMobility market, interoperability leads to non-discriminatory eMobility services, such as charging and navigation, and makes it available through-out a defined territory (in this case Europe) without limitation and with a coherent service quality level at an optimized price.

From customers point of view, interoperability is the ability to use the Electric Vehicle Charging Infrastructure (EVCI) wherever it is located, whichever EV the customer uses, whoever operates the charging Point, etc.

The typical user or customer journey is a long list of questions, of difficulties and likely of blocking points:

- “Where are the available charging Points around me?”
- “How can I use this charging Point? Swipe my badge? Where? Push a button? Plug the cable first?”
- “Is my authentication media compatible with the reader?”
- “Am I authorized to access to the service on this charging point?”
- “May I use my contract with my recharge services provider to use and pay this charging Point?”
- “Is the socket of the charging Point compliant with the cable I have?”

To meet these customer requirements, the ecosystem has to provide features that can be segmented in four groups:

- Charging points technical features (authentication media, plug and socket compliancy ...)
- Charging points functional features (markings, how to use ...)
- System (system interconnection, data exchanges ...)
- Business & legal features (roaming agreements between operators ...)

From an operator point of view, interoperability is the ability of an eMobility service provider to deliver its own services (search and find, charge, book, etc.) to its customers, using the infrastructure of any charging operator under the umbrella of a B2B relationship at negotiated prices.

4. Challenges, barriers and solutions

Interoperability is a request referred to by all public authorities in their regulations or their tenders, hence it's a major customer "must have". However, this is still not achieved.

There are three kinds of interoperability concerns:

- Establishing a fair business case for all actors respecting investments and operating costs
- Define clear interoperability rules and pieces of evidence
- Ensure pan-European coherent and equivalent service level

4.1. Establishing a fair business case for all actors

Charging transactions are low-value, which inhibits the use of common payment systems (the transaction fee can be higher than the charging transaction costs). Therefore interoperability needs to be low-cost in order to retain the bankability of innovative and sustainable models.

The following problems are faced:

- The yearly power capacity subscription per charging point is high in many countries (equivalent to the operating costs of the charging point per year)
- CPO and EVSP propose discriminatory prices (especially when they play both roles)
- Some CPO sub-contractors or Charging Point owners have no benefit from increasing the usage of their Charging Points

4.1.1. No clear business case for CPOs

Description:

It is necessary to make the public infrastructure investment attractive by widening the number of EV users that could use the infrastructure (interoperability between MSPs and CPOs) and reducing the operational costs of the whole system.

Action proposal for DG Move:

- Develop an EU eMobility interoperability framework which offers guidance to EU Member States in developing national policies that encourage CPOs to invest in fully interoperable public infrastructure, allowing combined business models including interoperable mobility services.
- Promote this EU interoperability framework to all key stakeholder groups to encourage innovation in value added services to reduce costs and increase revenues.

Action proposal eMI³:

- Provide an interoperability framework to achieve value added services to reduce costs and increase revenues. Value added services can be for example parking reservation, smart charging, energy clearing or multimodal transport.

4.1.2. Prices for end customers should be acceptable



Description:

A key element in the acceptance of public charging infrastructure by the consumers is clearly an acceptable price per kWh. Most consumers are seeking the equivalent price as they pay at home for electricity but they are aware that there are some expenses by the owners of charging infrastructure and therefore are willing to pay a slightly higher price. Due to the high levels of investment and operating costs associated with public charging infrastructure, charging asset owners are left with little option but seeking to recover investment cost through a higher price that consumers are not willing to pay for. This cost recovery challenge often increases significantly when the charge point operator opens their network to other service providers. Typically, the prices which are applied in the B2B contract between the service and the network operator are often the same price as the network operator charges in his own B2C context. The external service provider typically then adds a further transaction cost which pushes the price of charging even higher for the end consumer. As a result of the cost recovery challenges facing market actors delivering a competitive price to consumers becomes ever more challenging. This issue is part is also down to the fact that unlocking additional revenue streams which could reduce costs to consumers which could be accessed from the provision of flexibility through ancillary markets to local electricity system operations is difficult to access

Action proposal for DG Move:

- Provide a guideline to the member states and initiate a discussion process (which should be public to include consumers).

Action proposal eMI³:

- None since this is not part of the eMI³ focus

4.1.3. Lower the Investment on charging stations and operation cost**Description:**

Among costs there are different challenges due to investment and operation costs:

- Very high operating costs: A new grid connection point for every new public charging point is needed, which means - at least most of the times - expensive civil works to complete this connection. Letting the CPO connect to existing customer electric network would reduce the civil works and reduce investments. For example, to install a charging point in a hotel means expensive civil works to build the infrastructure to connect to the grid outside the hotel instead of easy and cheap connection to the hotel electric network (after a commercial agreement signed between hotel and CPO).
- Electricity invoices are divided in two parts:
 - a) the variable part which is the amount of energy consumed and
 - b) the fixed part that depends on the power hired by the customer who pays the power reservation in the grid for that customer.

This fixed part is a very high component and is one of the biggest barriers for public (in Spain the cost is EUR 4.000/year for a 43kW power point) and private (a customer pays for a power reservation but is normally charging during the night, the lowest power demand moment of the

day) charging points. This fixed part of the electric invoice should be reduced or eliminated for EV businesses at least during this initial phase of eMobility.

- There are still different protocols which are not standardized or opened that can increase costs and decrease functionality. There is further standardization and work on interoperability needed.

Action proposal for DG Move:

- Involve DG Energy to help the national governments to fit the grid regulations to the needs of charging businesses which should leverage the usage of the flexibility of smart EV charging solutions to reduce costs or generate new value.

Action proposal eMI³:

- Provide use cases in line with standard organisations and ICT definitions (system architecture with concrete interface description) for smart charging scenarios to ensure interoperability. This involve the needs of standard organisations and energy stakeholders especially EURELECTRIC.

4.1.4. Heterogeneous regulation increases system complexity and costs

Description:

Regulations are country-specific and when we look at this from an EU-wide perspective the services have to be implemented different in every country. On one side this leads to heterogeneous services for the end-user which is clearly a barrier in understanding and relying on eMobility. On the other side the complexity on deploying EU-wide services is increased which – in general -leads to higher costs and more complex business and/or IT systems. Altogether this is a barrier for bringing electric vehicles out of the niche to a mass market. Business solutions for smart charging are in some cases even impossible.

Action proposal for DG Move:

- Set up a round table with DG Move, DG Energy, EURELECTRIC and eMI³.
- Make member states aware of the situation and initiate a thought/discussion process on national level (but still linked to the EU). Deliver guidelines on specific regulatory aspects of eMobility to ensure the interoperability on EU level. Transfer those guidelines into a directive.

Action proposal eMI³:

- The eMI³ can work together with the EU on those regulatory guidelines. As the focus of the eMI³ is on ICT Standards, other expert groups which are more familiar with the specific regulations have to be involved.

4.2. Define clear interoperability rules and pieces of evidence

There is no pan-European vision on interoperability and, interoperability can be real at local level but not at national/international level. For instance, ID issuing authorities are only national (when existing), authentication means have different implementation (RFID tag VS remote access....). The lack of shared rules is making this even worse.

Charging pole owners or public authorities have no technical reference/easy piece of evidence to check if interoperability is respected as stated in their requirements in a coherent way, according to rules mentioned above.

4.2.1. Harmonised roles

Description:

On top of services description, a harmonized approach at eMobility roles (who is who and who does what, while understanding that different players can assume different roles) in the eMobility value chain is determinant. A common definition of roles and responsibilities is crucial in order to tackle the interoperability of the different service layers, systems and interfaces, thus ensuring the principles of a competitive market.

Action proposal for DG Move:

- Adopt an open reference market framework (players, roles and interfaces) that is widely accepted and that can evolve in time;
- Push for the adoption of this market framework as a reference in terms of policy efforts led at EC level;
- Coordinate with national bodies in order to ensure and maintain coherence.

Action proposal eMI³:

- Provide an open reference market framework, typical players, roles, use cases and interfaces and ensure that this is continuously updated with input from eMobility stakeholders.
- Liaise with a wide array of eMobility stakeholders and national bodies in order to ensure and maintain coherence of framework implementation.

4.2.2. Harmonised list of services

Description:

As described above, interoperability can be interpreted in different ways. However, a basic step is to agree on a critical list of services that are mandatory for EV drivers and that require interoperability to be realised. Those which should be contained within a minimum current set include: search and find an available and compatible charging station, authenticate and charge on any pole

Action proposal for DG Move:

- Push interoperability guidelines describing mandatory services that should be included in national plans to be submitted for directive alternative fuel infrastructure (EU/2014/94) compliance and propose a method to ensure this service interoperability.

Action proposal eMI³:

- Maintain a list of critical services related to interoperability and a short set of requirements and checks to prove those services are interoperable.

- Support national plans to ensure coherence and give advice to national stakeholders and responsible authorities.

4.2.3. Interoperability requirements in public tenders

Description:

In a number of countries subsidized investments in charging infrastructure drive the market. Thanks to this public momentum charging poles are increasing in number all over Europe.

Indeed, OCPP has become a de facto standard to describe functional communication requirements between EVSE and back-end systems and in public tenders there's often or even always referred to it.

In the field of inter-operator communication unfortunately, no protocol can be cited as a de facto standard in Europe. The existing options developed by Hubject, GIREVE or eClearing.net are similar but different and none is common enough to be recognized as a reference in a tender. Instead, in order to issue a clear, non ambiguous and comprehensive set of requirements, it is still necessary to explicitly describe what such a protocol is actually doing. This kind of task is often seen as a burden by public authorities where the level of internal ICT capabilities vary significantly but also because -given the immaturity of the market - interoperability of eMobility-services are not in the main focus.

Action proposal for DG Move:

- Provide guidelines to member states.

Action proposal eMI³:

- Draft a set of functional or non-functional requirements for interoperability of charging.

4.3. Ensure pan-European coherent and equivalent service level

Up until now, even if a standard is defining data exchange between CPOs and EVSPs, there is no globally coherent quality of data that can be provided by CPOs to allow easy navigation towards charging stations pricing information for customer

The interval between data-updates and response time in the case of authentication is also not standardized. Lately, in terms of service level, EU is investing in pan-European corridors but cross boarder service is not ensured everywhere.

4.3.1. Identifying the players and issuing IDs

Description:

Unique Identification Numbers (IDs) for Electric Vehicle Service Provider (EVSP) and Electric Vehicle Service Equipment Operators (EVSE operators) are vital to offer market compliant charging and clearing services. Therefore ID-issuing has to be foreseen in a harmonized way in Europe.

In principle, the issuing process of IDs can be organized in a bottom-up or top-down approach. This means that either this task is open and offered by various market participants according to joint rules or this will be processed by national governments. If market participants should take over this service, the

government has to decide whether to assign the process to a specific market participant or leave it open to the free market. In addition to this, the question of a mandatory or a voluntary distribution of IDs to EVSPs and EVSE operators has to be considered.

Clear regulations on a European wide industrial basis in accordance with member states are highly recommendable to guarantee a certain degree of planning and investment security for market participants.

Action proposal for DG Move:

- There is an urgent need by the end of 2015 to set up a pragmatic solution implemented to get IDs issued in all EU member states.

Action proposal eMI³:

- Support DG Move in providing a pragmatic and effective solution.

4.3.2. Information on the condition of national charging infrastructure

Description:

In the most EU member states there is no complete reliable information about the state of the national charging infrastructure which is publicly accessible.

The information, that should be available, is:

- Number of public charge points
- Localisation of public charge points
- Status of the charge point
- Owner of the charge point

This fact has different effects:

- National governments don't have the overview of specific local measures (e.g. funding) that are increasing the geographical coverage of charging infrastructure.
- It is hard to provide EV drivers an aggregated view on the complete national charging infrastructure.
- Every electric vehicle service provider has high costs on research which usually leads to high costs for end users.

Action proposal for DG Move:

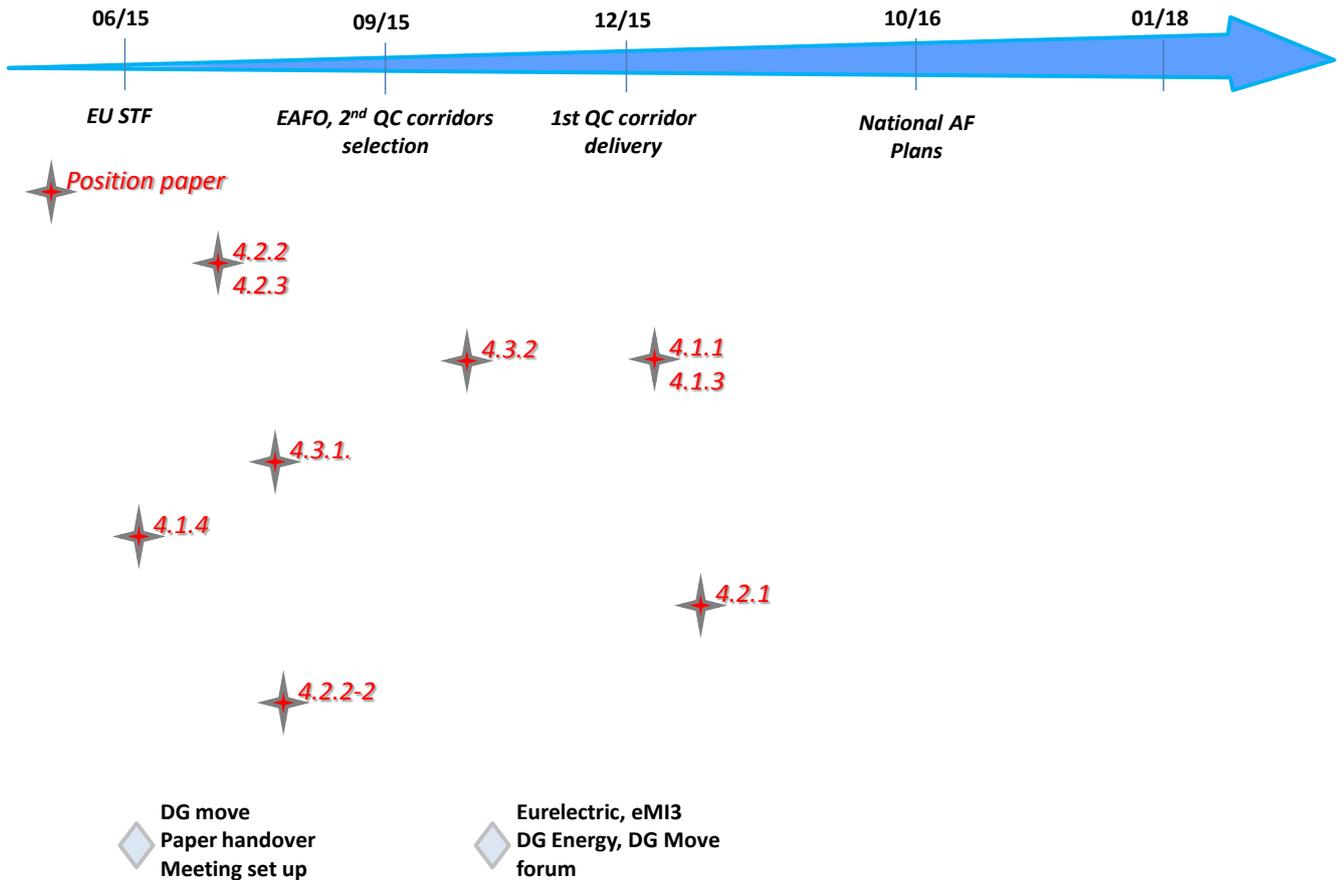
- Provide the eMI³ proposal to member states for setting up the national charging infrastructure dictionary as requested by EU/94/2014

Action proposal eMI³:

- Provide the guidelines for charging infrastructure dictionaries.

5. Next steps

The timeline below describes the future major milestones and the eMI³ deliverables proposed in this document. Subject to discussion with DG Move



Annex 1: eMI³

Recognizing that the ecosystem is at a fundamental crossroad in its development and that the quasi absence of common ICT interfaces to exchange data amongst all the actors of the ecosystem is a critical issue that must be addressed together, a collective of 38 (and growing) organisations joined forces and formed the "eMobility ICT Interoperability Innovation" platform, eMI³ (www.eMI3group.com) under the umbrella of ERTICO, which is a "spin-off" the EC funded Green eMotion project.

eMI³ action is committed to ensure that the development of the eMobility industry will be fully in line with the ambitious climate action of the European Commission.

In this context the main purposes of eMI³ is to

- Enable global "Electric Vehicles" (EV) service interoperability by harmonizing existing ICT data and protocols, and proposing new ones where none are yet defined.
- harmonize, promote and improve cross-sector implementation
- Coordinate and build upon the work of existing EV initiatives and projects.
- Strive to rapidly grow a large market by supporting all required business processes to ease and speed-up the introduction of new services and provide a richness of compelling services to EV users.
- Liaise and coordinate with other EV organizations and initiatives to maximize interoperability and minimize effort.
- Cooperate with standardization and regulation bodies to reduce organizational, technical and commercial barriers.

Annex 2: Country specific examples on current status

We see local Interoperability providers in countries in the EU. The challenge for the local Interoperability Providers is to create European Interoperability. Current local projects have an added value here. All these initiatives have led to working systems. They are a good basis for a next step, connecting all of these existing systems with each other. Some noteworthy examples are:

In Spain, thanks to the European project ICT4EVEU, Iberdrola and IBIL (both with roles of CPO and MSP) have developed a software platform to enable the interoperability between both companies, to let the users to charge in their infrastructure installed in two cities in the north of Spain. The platform is prepared to extend the interoperability to Spain and more companies (both CPO's and MSP's).

In Germany “customer-friendly-charging” has been defined by the National Platform of Electric mobility (NPE). The NPE has defined recommendations on ad-hoc charging:

As of mid-2015, newly built charging infrastructure should be designated “publicly accessible”, making it available for ad-hoc use by customers. Ad-hoc use refers to spontaneous, open system charging using a medium that enables access to charging and (where relevant) suitable payment options directly at the charging station (e.g. mobile phones or smart phones, special charging cables, parking tickets, card terminals, etc. Existing public charging infrastructure should be upgraded. We see in Germany how a common understanding of terms like “customer-friendly use of charging infrastructure” helps. Definitions like those may help realize European Interoperability, in accordance with directive 2014/94/EU.

Hubject in Germany is an Interoperability Provider that applies the NPE's recommendations. Hubject states: *Our open hub enables a barrier-free access to the charging infrastructure for electric vehicles on a trans-European basis and moreover connects different players of the emerging market of electric mobility. As a result of this, e-mobility gets more attractive from the perspective of the end-user and hence turns out to be a proper alternative to conventional vehicles.*

The BDEW in Germany provides uniform ID-Numbers for Charge Points and more.

The Portuguese example “MOBI.E” is a national initiative launched in 2010, set to ensure full business and service interoperability of the electric vehicle charging infrastructure across the country. The Partners CEiiA and MOBI.E provide CPO's and MSP's with full IT systems and business operations support, while ensuring integration with the electricity grid management. MOBI.E integrates more than 1200 charging points, based on a unified authentication and payment system. The Portuguese government has issued specific legislation and regulations for this market, including on the definition of e-mobility roles:

- Setting a national B2B/B2C clearing entity, with centralized ID issuing responsibility;
- Setting a coherent approach at publicly accessible infrastructure;
- Setting specific rules for private EV charging;
- Standardizing the interaction / integration with the electric system.

In the Netherlands since 2010 there is the Central Interoperability Register in place. This is worldwide the only system where 15 different charge point and service operators work together, and where 100% of the public charge infrastructure can be used by any EV driver independent from the service operator and independent who operates the charge point. This is CIR is managed by branch-organization eViolin.

In other countries we see similar organizations offering similar services, or part of these: GIREVE in France, e-clearing.net also in Germany, Enel also in Spain and MOBI2Grid (cross border Portugal / Spain).

Annex 3: Abbreviations and definitions

Abbreviation	Definition
B2C	Business to Customer
B2B	Business to Business
BDEW	Bundesverband der Energie- und Wasserwirtschaft
CIR	Charging Infrastructure Repository
CPO	Charge Point Operator
EU	European Union
EV	Electric Vehicle
EVCI	Electric Vehicle Charging Infrastructure
EVSP	Electric Vehicle Service Provider
MSP	Mobility Service Provider
NPE	National Platform Electro mobility