## NeMo D1.2 Report on latest technological and market developments in electromobility

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<tr>
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## Revision and history chart

<table>
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# List of abbreviations and acronyms

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<th>Meaning</th>
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<tbody>
<tr>
<td>B2B</td>
<td>Business to Business</td>
</tr>
<tr>
<td>BEV</td>
<td>Battery Electric Vehicle</td>
</tr>
<tr>
<td>C-ITS</td>
<td>Cooperative Intelligent Transport Systems</td>
</tr>
<tr>
<td>CP</td>
<td>Charge Point</td>
</tr>
<tr>
<td>CPO</td>
<td>Charge Point Operator</td>
</tr>
<tr>
<td>DSO</td>
<td>Distribution System Operator</td>
</tr>
<tr>
<td>eMIP</td>
<td>eMobility Protocol Inter-Operation</td>
</tr>
<tr>
<td>EMSP</td>
<td>Electromobility service Provider</td>
</tr>
<tr>
<td>EV</td>
<td>Electric Vehicle</td>
</tr>
<tr>
<td>EVSE</td>
<td>Electric Vehicle Supply Equipment</td>
</tr>
<tr>
<td>GDC</td>
<td>General Data Centre</td>
</tr>
<tr>
<td>ICE</td>
<td>Internal Combustion Engine</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication technologies</td>
</tr>
<tr>
<td>IoT</td>
<td>Internet of Things</td>
</tr>
<tr>
<td>IVR</td>
<td>Interactive Voice Response</td>
</tr>
<tr>
<td>OBD</td>
<td>On-Board Diagnostics</td>
</tr>
<tr>
<td>OCPP</td>
<td>Open Charge Point Protocol</td>
</tr>
<tr>
<td>OEM</td>
<td>Original Equipment Manufacturer, refers to the Vehicle Manufacturer</td>
</tr>
<tr>
<td>POD</td>
<td>Point Of Delivery</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Meaning</td>
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<tr>
<td>--------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>SoC</td>
<td>State of Charge</td>
</tr>
<tr>
<td>TCO</td>
<td>Total Cost of Ownership</td>
</tr>
<tr>
<td>TCU</td>
<td>TeleCommunication Unit</td>
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Executive Summary

With the increase of the Electric Vehicles sales worldwide and particularly in Europe, the ecosystem stakeholders have to monitor the evolution of the market, anticipate the coming trends and evaluate the impact of this new mobility on our environment. This is the goal of this document.

With a strong rise, the electric vehicle market counts in 2016 almost 500,000 new zero emission cars. And several factors, such as new car models coming, the increase in their autonomy, urban restrictions or CO₂ standards show us that the EV market has just started.

In order to support this evolution, the actors have to develop and install the needed new charging infrastructures. This is why Europe has set an objective of 120,000 public charging points installed by the end of 2017.

Next to that, the products, cars and charging stations, will evolve in parallel to the coming technologies. One can quote for instance the car connectivity, which permits the car manufacturers to propose new kinds of services to their customers.

Finally, in order to keep a coherence in this market, one can point out the importance of standardization, such as the coming ISO 15-118, which will permit the actors to develop interoperable new services based on the same communication protocol.
1. Introduction

This Deliverable is the outcome of Task 1.2 of NeMo project which aims to monitor the latest developments in the electric vehicles (EVs) market, trends and new technologies adoption, aiming to derive requirements and specifications for the NeMo project developments.

The European Union has issued the Alternative fuel Directive in September 2014 to push the roll out of charging infrastructure and ensure its interoperability and has requested Member States to provide accurate information about the current public charging infrastructure network. The European Union has also set up an Alternative Fuel Observatory to gather information regarding the roll out of the Directive.

However, so far, no official accurate repository exists. Therefore the methodology followed in this deliverable to capture the current status of the available charging infrastructure was based on stakeholders’ interviews, including experts from:

- Vehicle manufacturers
- eRoaming platforms
- Major charge points operators
- E-mobility associations

In order to overview the global ecosystem of electric vehicles (EVs), this document is split into several parts. First, we will focus on current and expected sales of EVs and on the Electric Vehicle Supply Equipment (EVSE) roll out. Then, we will investigate the vehicle technologies which permit the EVs to be part of the ecosystem, being adaptable and connected. We will treat the EVSE features with the same logic. The deliverable concludes with a quick overview on grid intelligence and smart meters, EV standards and eRoaming platforms.
2. Market overview

2.1 Global EV sales overview

In 2016, the worldwide sales of EVs was estimated at 464,000 units\(^1\), with an increase of +59% compared to 2015.

China is the biggest EV market with approximately 257,000 units, and has raised its sales by 136% compared to 2015. This is even more impressive when we consider that this market didn’t exist 3 years ago.

If we focus on Europe, 102,000 EVs have been sold last year which represent an increase by 5%. To sum up, the map below shows the repartition of the EV market.

\(1\) All figures come from Renault internal statistics

Figure 1: Worldwide EV sales in 2016
If we go more in details in the European market, we can point out that the percentage of EV sales begins to be quite significant for several countries. The top 5 countries in Europe are shown in the following table.

<table>
<thead>
<tr>
<th>Countries</th>
<th>BEV Market share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td>15,67%</td>
</tr>
<tr>
<td>Iceland</td>
<td>2,04%</td>
</tr>
<tr>
<td>Austria</td>
<td>1,16%</td>
</tr>
<tr>
<td>France</td>
<td>1,08%</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1,05%</td>
</tr>
</tbody>
</table>

Table 1: Top 5 BEV Market share for 2016 in Europe (source: EAFO)

Now if we look at the brands, this market is led by the Alliance Renault-Nissan with a market share of 50%. On the European market, Renault is leader with a market share of 25%. The French car manufacturer has sold 112,627 electric cars since the beginning of the EV mass market in 2011. The sales volumes have multiplied by 17 between 2011 and 2016.

Figure 2: Top European sales in 2016 and evolution since 2011
As regards vehicle models, the Renault ZOE is the top private vehicle (VP) model sold, with more than 20,000 units in 2016. Its sales have constantly increased since its launch in 2011. France and Germany are the two top markets for the Renault ZOE. For the vehicle utility (VU) market, the Renault Kangoo is the leader. Here below a summary of the figures.

- **BRANDS:**

![Brands Bar Chart](chart.png)

- **MODELS:**

![Models Bar Chart](chart.png)

**Figure 3: Top sales models in 2016**

To sum up, the EV market is increasing. Even if the percentage of EV penetration is still weak compared to ICE cars, we can notice that there is more and more EV sales. This increasing trend is expected to stay dynamic thanks to some factors explained further in section 2.3, but principally due to the development of the infrastructure network. To support this argument, here are some quotes from some OEM’s and consulting firms about the EV evolution:

- “We are targeting 2m to 3m EV sales per year by 2025”: Volkswagen AG
- “BEV to reach TCO parity by 2021”: UBS estimates
- “BEV market share of more than 20% by 2025”: UBS Evidence Lab
- “Global EV sales from 2.5m in 2021 to 9.7m in 2025”: J.P Morgan

### 2.2 Global overview on EVSE

In 2016, Europe counted 83,892 EVSE\(^2\) and plans to have 120,000 EVSE by the end of 2017.

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\(^2\) Renault internal statistics. Only accessible public EVSE
In 2016, in Europe, there are **2,4 EVs for 1 public EVSE**, which is a comfortable ratio for the users.

In 2017, Europe plans to have 300,000 EV on the roads and will reach 120,000 EVSE, which means **2,5 EV for 1 EVSE** (considering fleet + retail).

In order to reach the ratio of 0,6 - which is considered as the optimal ratio - the number of EVSE should be equal to 180,000.

The following figure shows the repartition of EVSE in Europe. We point out that the normal charging EVSE (between 7 and 22 kW) represent the majority (98%) of existing EVSE, compared to quick charge ones (43 kW).

![EVSE in Europe](image)

**Figure 4: EVSE in Europe**

To conclude, if the EV market remains this successful and continue its rise, the number of EVSE must follow its development and keep an acceptable ratio\(^3\) in order to allow each EV driver to charge easily, without being in trouble with unavailable EVSE due to not enough charging points. There will be a focus on EVSE a little further in this document to explain the technology.

---

\(^3\)This ratio include also private EVSE
Information from the EAFO (European Alternative Fuels Observatory) is a bit different:

In 2016, Europe counts 103.672 EVSE

In 2016, in Europe, there are **6,6 EVs for 1 public EVSE**.

The differences with the Renault statistics are caused by different factors:

- EAFO is counting the EVSE for all Europe (EU + EFTA + Turkey) while Renault doesn't include Iceland or Turkey.
- Renault data include only public EVSE, while EAFO data include EVSE installed in private parking areas of companies or parking operators.

### 2.3 Factors accelerating EV market

Some factors will boost the EV market. We have identified 4 factors that will have a positive impact on EV sales.

**Line Up:**

Within 2022, 30 new electric car models will come on the EV market, which equals an increase of 150% of the models available compared to 2016. As the offer of EV models will increase, the sales will go up too.

![Figure 5: EV models availability in 2022](image)

**Autonomy:**

Currently, the maximum autonomy is offered by Tesla with 550km. However, in 2022, Audi and Renault have planned to go beyond this, with a battery offering 650km autonomy.
Moreover, in 2016, the average autonomy available on the EV market is 270km. In 2022, the average autonomy planned is 377km.

Figure 6: EV current and planned autonomy

As we can see, the autonomy is going to increase and the number of different models too. Each manufacturer is going to launch its own EV model due to the demand. Therefore, the offer to the consumers will be larger and their needs will be better satisfied.

Moreover, concerning Renault, the new Zoe with the LR (Long Range) battery competes a lot with Clio, another Renault car. Indeed, their price positioning is the same, while the cost of electricity is much cheaper than the oil cost. Moreover, Zoe and Clio are used in the same way by the consumers, they are small vehicles destined for an urban environment and daily trips such as home-work trips. The cannibalization effect has already started between Zoe and Clio and will get wider.

Urban restrictions:

In Europe, several cities have already taken measures restraining the usage for ICE cars and this trend will raise in order to provide a better air quality to the urban population. The map below gives an overview of all cities which have enforced some restrictions, like LEZ (Low Emission Zone) or a fee to reach the city centre.
In most cases, EV are not included in such restrictive measures. This is another reason to switch from ICE to electric vehicles.

**CO2 standard (CAFE) linked to global warming:**

In order to tackle the global warming, strict measures have been taken to reduce CO$_2$ emissions, in particularly for the automotive sector, which contributes to 14% of the total CO$_2$ emissions worldwide. It is in this perspective that the European parliament has voted in 2014
new standards for OEM's, like CAFE (Corporate Average Fuel Economy). The objective is to have an average of 95g CO₂/km for the global range of car manufacturers for 2020.

We understand that to reach this goal, the OEM’s are forced to develop low emission vehicles. Electric cars, being zero emission cars, are the best candidate to contribute to lowering the CO₂ average. This will permit car manufacturers to still sell ICE cars which are above the limit of 95g CO2/km for several years before developing new technologies (very low consumption engines, hydrogen, etc.).
3. Picture of technologies

3.1 EV features

Connectivity

Today, navigation systems are turning into global HMI (Human Machine Interface), with navigation being just one feature of it. Indeed, navigation is standard on new vehicles, except on delivery cars where the take up rate is below 5%. Current EVs have connected functionalities, except from Mitsubishi and VW (Nissan as an option).

The table below shows the connectivity status per brand:

<table>
<thead>
<tr>
<th>Brand</th>
<th>RENAULT</th>
<th>KIA</th>
<th>Volkswagen</th>
<th>NISSAN</th>
<th>BMW</th>
<th>Tesla Motors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected application name</td>
<td>ZE Services</td>
<td>UVO EV Services</td>
<td>Car-net</td>
<td>NissanConnect EV</td>
<td>BMW Remote / iRemote</td>
<td>Tesla Motors / Tesla Model S &amp; Model X</td>
</tr>
<tr>
<td>Availability</td>
<td>Zoé, Kangoo and Fluence</td>
<td>Kia Soul EV, Kia Optima Hybrid and Kia Niro</td>
<td>BEV : e-up et e-Golf</td>
<td>LEAF, E-NV200 EVALIA, NISSAN E-NV200 FOURGON</td>
<td>BMW i3, BMW i8</td>
<td>Model S, Model X, Model 3</td>
</tr>
<tr>
<td>Pricing</td>
<td>3 years free</td>
<td>Free</td>
<td>3 years free</td>
<td>Free</td>
<td>3 years free</td>
<td>Free</td>
</tr>
</tbody>
</table>

Table 2: Connectivity status per vehicle brand

In vehicle Smartphone Integration

The use of smartphones and their integration in the vehicle is also offered by many vehicle manufacturers since many years. Starting first with audio integration for hands-free phone via Bluetooth and media accessing of music using USB connection, it has been recently extended to enable using the driver’s smartphone as an app-platform for additional features. Such features include navigation, music streaming and other apps, which the vehicle owner wishes to use while driving.

Currently there are several smartphone integration technologies which are available in today’s vehicles.

1. Google Android Auto (only Android)
2. Apple Carplay (Only iOS devices from Apple)
3. Mirrorlink from Car-Connectivity-Consortium (Android and Windows devices)
4. MySpin (by Bosch for Android and iOS devices)
5. SmartDeviceLink (SDL) (by Ford and Toyota for Android and iOS devices)
In order to use smartphone navigation apps to find and navigate to charge points (CPs), the smartphone integration is a valuable feature as there are some apps which can be safely used while driving to avoid driver distraction. However, currently there is no in-vehicle data access possible using smartphone integration technology provided by vehicle manufacturers. This in-vehicle data access would allow the apps running on the smartphone to use data from the vehicle, such as state of charge (SoC) or remaining distance of the battery capacity while searching for CPs.

**EU Platform C-ITS and Access to In-Vehicle Data**

The need to access in-vehicle data has been recognised by the EU Platform C-ITS, moderated by DG MOVE, in its working group WG6 and was noted in February 2016 in its report of phase 1. From the independent services providers' perspective (for example: insurance companies, repair and maintenance companies and others) the access to in-vehicle data can be provided via:

1. In-Vehicle Interface connector (OBD+)
2. In-Vehicle Application Platform
3. Extended Vehicle (Connected Vehicle Backend Access)

![Diagram](source: The ExVe ISO 20078 Daimler AG Dr. Christian Scheiblich, Dr. Thomas Raith, November 2014)

**Figure 9: Access to in-vehicle data**

The following sections will describe the three possibilities in more details.
In-Vehicle Interface

Access to a limited set of in-vehicle data can be performed using an OBD adapter connected to the OBD port of today’s vehicles. This OBD port allows for example access to vehicle data such as vehicle distance, oil temperature and other data. The EU Platform C-ITS recommended to leverage this interface and to provide other vehicle data requested by independent service providers. A first set of vehicle data has been documented as part of the phase 1 report published in February 2016 which should be part of this new OBD+ standard extension.

![OBD Adaptor](image)

Using such an OBD adaptor, data from EVs, such as battery State of Charge, can be read by a smartphone. However it is noticed that this market is currently fragmented and based on proprietary data, as there is no standard data set being defined across all the vehicle manufactures.

In-Vehicle Application Platform

Some vehicle manufacturers provide today some way to load and install new “apps” in the in-vehicle application platform of their brands. As this is different for each vehicle manufacturer, each developer needs to develop, test and provide the “app” to the vehicle manufacturer for certification before it can be made available for download by the customer from the vehicle manufacturer “App-Store”.

One example for such an in-vehicle application platform and app-store is the one from TOYOTA, that partnered with IBM to provide the T-Connect systems. See figure for more details below.
Most of the members of the EU C-ITS Platform have proposed a standard in-vehicle application platform which would allow 3rd party developers to develop apps for a broader customer base. This would enable innovative apps to be provided by 3rd party developers who would be able to directly access in-vehicle data, where there is a need for low latency of data.

**Extended Vehicle (Connected Vehicle Backend Connectivity)**

The standardization of the Extended Vehicle has started in 2014 in the ISO committees. The main use case is related to Repair and Maintenance Information (RMI), however the IT interface should allow also other vehicle data to be accessed. The relevant ISO standards are ISO 20077 (overall process), 20078 (Web Service Interface) and 20050 (RMI use case). The Extended Vehicle interface is quite advanced from a standardization point of view, while the other means for accessing in-vehicle data, using the in-vehicle interface or application platform, are fragmented across all the vehicle manufactures.

**IT Technology Trends**

In a world where the Internet of Things (IoT) and cloud concepts are mainstream concepts, the OEMs tend to keep their vehicle under the umbrella of an in-house OEM server and manage data exchange in a cautious way.

The main reasons are:

- Privacy regulation making the VIN (Vehicle Identification Number) a private data on the one hand and a key entry point for OEMs on the other
- Vehicle hardware and software are changing continuously and OEMs don’t want to manage updates of software by every backend using car connectivity
- Access to EVs is a key business enabler

For this, NeMo should not consider EVs as directly accessible by services and connected to IoT, but as always connected to network through an OEM backend.

### 3.2 EVSE features

#### Charging station feature overview

Renault did an analysis based on 10,000 field tests with EVSE in October 2016, which shows that:

- 100% of connected charge points are equipped with 1 meter per EVSE
- 90% are equipped with RFID readers
- 20% have a screen (100% of Quick Charge)

Out of those charge points equipped with screen, slow charge points have basic small 4 lines screens while QC (Quick Charge) charge points have bigger screens. Still, these screens aim to support the charging process (under authentication, charging, charge not allowed …) and display the kWh. They are by no means a dynamic display allowing to offer more specific services. In other words, texts are pre-embedded in the hardware and cannot be transmitted via Open Charge Point Protocol (OCPP). Moreover, the number of languages supported is very limited.

**This means that NeMo should not consider that there are available screens on the charge points, via which the customer may interact with a service.**

Another outcome of the analysis is that less than 2% of the charge points are equipped with credit card device for ad hoc payment. Remote access is more and more spread but almost none exists in the majority of countries, except Germany which seems a bit ahead. The alternative charge point activation means are presented in the Appendix.
We can also point out the diversity in the data update. Indeed, remote monitoring status is between 1 s and 15 min, depending on the operator and connectivity coverage.

Finally, even though a car presence sensor is not so costly, less than 1% of charge points are linked to such a sensor.

**Charging station connectivity**

Although OCPP is broadly adopted, this protocol does not allow real-time information. OCPP 1.2 was just considering remote start stop, OCPP 1.5 added remote diagnostic and load management tackling.

OCPP 1.6 is introducing load management, in which case the charge point (pole) is modulating the maximum current allowed to the car according to back end requests. A new ISO/IEC standard has just been initiated under number 63-110.

In further developments, OCPP should be considered as the only standard broadly rolled out for the coming years.
4. Grid intelligence: roll out of smart meters

Master Slave

With increasing number of charge points, a master slave structure appears. In such cases, the Master Unit is managing the global connection to the backend and sometimes the global intelligence and protections (Cf Allego’s charging plaza). The Master unit is also managing the load by splitting the available power among sockets.

Smart metering

A smart meter is the official meter placed by the Distribution System Operator (DSO). Although every charge point has a meter inside, it is barely a Point of Delivery (POD). Moreover, the meter accuracy and position are not standardized (whether it is considering pole efficiency or not ….) and there is no regulation on this.

Three countries are currently considering a charge point as asset of the grid (POD), Luxembourg, Slovenia and Italy. Spain has a similar approach, Gestor de red de carga should have a dedicated POD for the poles.

This leads to different pricing models per country. In countries where charge points are asses, the price is based on kWh consumed. In the other countries submetering is not allowed, so the price is not based on kWh consumed but can only be based on time.

Paying with time has disadvantages for both the customer with slow charging vehicles, who will pay much more for the same amount of energy, and for the charge point operator, since slow charging cars need to stay too long connected to quick chargers.

Finally, we need to keep in mind that the installation cost for a quick charger is between 40k€ and 80k€ (plus in some countries an annual capacity subscription between 2 and 4k€/y). This means that the charging price on QC cannot be equal to home electricity price.
5. Overview of EV standards

5.1 Expansion of existing and adoption of new eRoaming platforms

The eRoaming possibility per European country at the end of October 2016 is shown below.

Only few countries have not initiated a “roaming step” yet, among them Spain and UK are the most problematic since the EV market is quite developed.

An overview of the Roaming connectivity of charge point operators, as forecasted in early 2017 per country is given below.

<table>
<thead>
<tr>
<th>Country</th>
<th>IT</th>
<th>IE</th>
<th>UK</th>
<th>DE</th>
<th>AT</th>
<th>CH</th>
<th>NL</th>
<th>BE</th>
<th>FR</th>
<th>NO</th>
<th>SE</th>
<th>FI</th>
<th>ES</th>
<th>LU</th>
<th>CZ</th>
<th>Baltic</th>
<th>SK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of eRoaming connected charging points</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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It must be noted that public authorities investing in infrastructure are the most reluctant to connect due to several reasons, one of them being that they don’t want to enter into B2B relationships.

There are two possibilities for payment, either direct payment (without a service contract) and subscription-based billing. One issue is that there are different eRoaming standards in Europe for subscription-based billing and communication between charge point operators and service providers in Europe needs to be harmonised.

A unique ID generation Association for EVSE-ID and EVSP-ID across Europe is required to support “eRoaming” across Europe, to identify EVSE connected either via eRoaming “Hub” providers or involved in bilateral contracts between service providers and charge points operators without eRoaming providers.
5.2 EV standards

The different communication protocols between electromobility actors are presented below.

![Communication protocols between electromobility actors](image)

**Figure 15: Communication protocols between electromobility actors**
6. Conclusions

Task 1.2 of NeMo project aims to monitor the latest developments in the electric vehicles (EVs) market, trends and new technologies adoption, so as to adequately guide the NeMo developments. This document is the first deliverable of this task and aims to derive requirements and specifications for the NeMo project, according to the current market status and trends.

The deliverable presented the market status as regards electric vehicles which is expected to grow and the actors’ vision to install the appropriate number of EVSE. As regards technical features of EVs, it was found that current EVs have connected functionalities and there are several smartphone integration technologies available, which could be used to access in-vehicle data needed by service providers. Reviewing the trends in this area, it is advised that the NeMo developments do not consider EVs as directly accessible by services and connected to IoT, but as always connected to network through an OEM backend.

As regards EVSE, NeMo services and developments should not be based on screen interface on the charge point. Several authentication methods are used currently in different countries. OCPP should be considered as the most widely used standard.

Although this is not the case today, charge points should be considered as Points of Delivery and smart meters should be installed on them. This has to be communicated to regulation bodies and manufacturers, so that they agree and enforce on the necessary measures.

eRoaming is expanding in European countries, still there are different standards and the communication between charge point operators and service providers needs to be harmonised. A unique ID generation Association for EVSE-ID and EVSP-ID needs to be established across Europe.
Appendix: Identification means

Various identification means used for charge point authentication are described below (source STF / SGEMS / Deliverable 1.1 / Hubject).

LOCAL RFID-Card

![Diagram of RFID-card authentication process]

**Figure 16: Subscription-based authentication (local) via RFID-card**

The driver requests the activation of a charge point with its specific EVSE ID at the CPO by holding a RFID-card in front of the charging station. The CPO requests the verification of the authentication at the eRoaming platform. The authentication data is either provided by the EMP as user data or an online authentication between eRoaming platform and EMP is set up. The CPO gets feedback of the eRoaming platform on whether the contract is allowed to charge at this charge point and the charging session is started. The driver stops the charging session by holding the RFID-card a second time in front of the charging station.
The activation of a charge point with its specific EVSE ID at the CPO is ensured by a direct communication between the car and the charge point. The CPO requests the verifying of the authentication at the eRoaming platform. The authentication data is either provided by the EMP as user data or an online authentication between eRoaming platform and EMP is set up. The CPO gets feedback of the eRoaming platform on whether the contract is allowed to charge at this charge point and the charging session is started. The driver stops the charging session by disconnecting the charging cable vehicle-sided.

Figure 17: Subscription-based authentication (local) via Plug&Charge
The driver requests the activation of a charge point with its specific EVSE ID at his EMP via the mobile website or app either by scanning a QR code at the charge point or by selecting the charge point on the map of the website/app. The EMP then requests the activation of the charge point via an eRoaming platform at the authorized CPO, who then starts the charging session. The driver stops the session using the mobile application or website.

Figure 18: Subscription-based authentication (remote) via app or mobile website
Figure 19: Subscription-based authentication (remote) via call centre

The driver requests the activation of a charge point with its specific EVSE ID at a call centre payment service provider by calling a call centre. The payment service provider then requests the activation of the charge point with a specific charging product via an eRoaming platform at the authorized CPO, who then starts the charging process. The driver stops the charging session by disconnecting the charging cable vehicle-sided.
REMOTE via SMS

Ad-hoc charging becomes possible through mobile phone authentication by means of an SMS payment.

In the first variant of SMS payment is the driver able to choose the mobile phone provider. The driver requests the activation of a specific charge point with EVSE ID and sends a message from his mobile phone number to the EMP. The payment will be made via the mobile phone contract. The EMP then requests the activation of the charge point via the eRoaming platform at the authorized CPO, who then starts the charging process. The driver stops the charging session by disconnecting the charging cable vehicle-sided.
In the second variant of SMS payment inherits the CPO at the same time the role of the EMP and chooses the mobile phone provider. The driver requests the activation of a specific charge point with EVSE ID and sends a message from his mobile phone number to the CPO. The payment will be made via the mobile phone contract. The authorized CPO starts the charging process. The driver stops the charging session by disconnecting the charging cable vehicle-sided.
Figure 22: Ad-hoc authentication (remote) via mobile website

The driver requests the activation of a charge point with its specific EVSE ID at a payment service provider via the mobile website either by scanning a QR code at the charge point or by selecting the charge point on the map of the website. The payment is made either by Paypal or credit card. The payment service provider then requests the activation of the charge point via an eRoaming platform at the authorized CPO, who then starts the charging. The driver stops the session using the mobile website.
The driver requests the activation of a charge point with its specific EVSE ID at a IVR payment service provider by calling an IVR system. The payment service provider then requests the activation of the charge point via an eRoaming platform at the authorized CPO, who then starts the charging. The driver stops the charging session by disconnecting the charging cable vehicle-sided.

Figure 23: Ad-hoc authentication (remote) via IVR
Figure 24: Ad-hoc authentication (local) via CC reader variant 1

The driver starts the activation by paying with his credit card at the CC reader of the charging station for a specific charging time period. When the CC reader receives the payment, the charging session is started. The CDR of this session is sent to the CPO, who functions in this case as the EMP. A separate backend for payment services CC issuing companies is needed. As soon as the preselected time period run off, the charging process is stopped automatically.
The driver starts the activation by paying with his credit card at the CC reader of the charging station for a specific charging time period. The CPO here also inherits the role of the EMP. When the CPO receives the payment, the charge point is activated and the session is started. As soon as the preselected time period run off, the charging process is stopped automatically.