32nd Electric Vehicle Symposium (EVS32)
Lyon, France, May 19 - 22, 2019

Business potential and impact of the ISO 15118 standard

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Summary

ISO 15118 promises a considerably improved user experience for vehicle operators and drivers as well as new possibilities for new services, which suggests a faster penetration for electric mobility in the mass market and new opportunities and changing roles in the mobility value chains. The resulting additional revenue from these new services can potentially accelerate the amortization of the charging infrastructure.

Following an introduction of the ISO Standard 15118, this paper discusses the business potential to be brought up by this standard, which are qualified and quantified through selected use cases.

KEY WORDS: electric mobility, ISO 15118, value-added-services, proximity marketing, charging

1 Introduction

The transformation from combustion engines to electric powertrains brings along the necessity to establish new energy infrastructures and value-chains for the mobility of the people and goods. Besides the necessary investments in hardware and construction, an underlying challenge is to develop the standardized interfaces between the battery electric vehicle (EV), the charging points and the grid to ensure a seamless and user-friendly customer experience. While a standard like Open Charge Point Protocol (OCPP), which regulates of the communication between the electric vehicle supply equipment (EVSE)[1] and charging station networks has found a relatively wide adoption, the communication between the EVSE and the EVs is yet in its infancy. The standard ISO 15118 is meant to fill this gap (among its other uses) and it is making constant progress. [1]

Beyond its technical content, ISO 15118 is a very promising prospect in terms of its business potential. It offers the means to overcome barriers to a seamless EV charging experience and yet others to create additional revenue streams in the infrastructure domain. For instance, the system capabilities to enable reservations for charging spots from inside the vehicles would be an enormous boon to increase the quality of charging experience. Furthermore, the complementary services beyond charging, like proximity-marketing or loyalty schemes in cooperation with the retail domain in urban areas, would create additional revenue streams [2]. It is hardly a secret that revenue through electricity sales alone can merely suffice to offset the high investments in charging infrastructure and such additional revenues are necessary to ensure the economic sustainability of the electric charging infrastructure.

[1] EVSE refers to charging stations and other fixtures outside of the EV that provide the electricity required to charge the vehicle's batteries.

2 Background

2.1 A brief introduction to ISO 15118

ISO 15118 is an international standard that defines the communication interface between the EV and EVSE. The most well-known use case that comes with this standard is Plug & Charge (P&C), which enables the electric vehicle to automatically identify and authorize itself to the charging station on behalf of the driver to initiate the charging process. On simplified technical terms, based on a digital certificate-based communication and authentication approach, ISO 15118 promises to remove the use of smartphones apps or charging cards out of the equation, so to speak. The ISO 15118 proposes a system that handles the creation, storage, exchange and revocation of certificates, which in turn verify the identity of a certain person or object[2]. Herein lies also a real benefit of ISO 15118 besides the obvious convenience, namely an added layer of security in the charging process.

Smart charging is a further opportunity that arises with the deployment of ISO 15118 standard. Thanks to the communication between the infrastructure and the vehicle, the information pertaining the charging needs of the vehicle, pricing, and infrastructure capacity can be exchanged and for instance optimized, schedule-based charging processes - for both AC and DC charging - implemented. Hence with a better match between the demand and supply of electricity, especially from renewable resources, a grid stabilizing load management capability can be turned into a standard process for the case of energy consumption in the transport sector.

This standard has yet further functionality in store, for instance, bi-directional charging/discharging capabilities and potentially enabling of additional value-added services attached to the charging process. As mentioned earlier, this paper will focus on the latter and will seek to quantify the related business potential. These (internet based) services are enabled via separate HTTP(s) and FTP based communication channels, whereas not specified in detail, open up an area of opportunity in terms of customer experience and additional revenue streams on top of electricity.

2.2 EV-Charging ecosystem according to ISO 15188 and the involved players and roles

Perhaps the most significant effect of the large-scale deployment of ISO 15118 will be the end-to-end digitalization of charging processes and thus the enablement of a seamless ecosystem of services around charging process – be it in public or private domain. To be granted, such an ecosystem can only take effect and survive, when the security of the sensitive personal data involved is ensured at an industrial scale. While this paper will not dwell into the technical details of the IT infrastructure and systems essential to the operation of this ecosystem [Public Key Infrastructure (PKI)[3]], it is necessary to illustrate the key players and roles involved, which provide the means for the business potential discussed later.

2.2.1 The (end) customer

In ISO 15118, the (end) customer is the entity with the request for the automated authentication and authorization as well as an automated billing process.

[2] See: https://v2g-clarity.com/iso15118-manual/

[3] PKI is a common practice for managing digital certificates that are used for securing digital communication.

2.2.2 OEM, the vehicle manufacturer

The OEM is required by the customer to enable an automated charging and billing process. Many OEMs aim to fulfill further roles in the ecosystem (for instance MO or CPO, see below), as they try to expand into new business areas and try new business models.

2.2.3 The mobility operator (MO)

The mobility operator (MO) is also known by other “trade names”: EMP (e-Mobility Provider) or EMSP (E-Mobility Service Provider). The MO would like to be able to offer the end customer an electricity supply contract with which s/he can carry out automated charging and billing processes with the broadest possible charging infrastructure coverage. The MO is the contractual partner with whom the end customer enters a contract with for the delivery of electricity for charging and who issues the respective digital contract certificate, with which the customer can authenticate and authorize his vehicle at the charging point(s). The main motivation of an MO, which usually is an energy utility, lies obviously in the selling electricity.

2.2.4 Charge Point Operator (CPO)

A CPO is the operator of the charging infrastructure, which has no direct contract with the end customer. In the ISO 15118 context, two CPO-functions are possible, which may also be carried out by a single entity. First is a commercial one, where the purchasing of electricity to be sold to the end customer and the provision of the charging hardware and parking spot are involved. Here the main motivation is the maximization of the electricity sold. Secondly, there are the technical operations relating to the charging infrastructure, including the IT-backend that governs and monitors the charging points. Not surprisingly, the necessary certificates for ISO 15118 implementation, for instance for the charging point itself, are to be provided by the CPO to the respective charging point [3].

2.2.5 Contract Clearing House (CCH)

CCH is the entity that mediates between two clearing partners to provide validation services for roaming regarding contracts of different MOs for the purpose of collecting all necessary contract information and the confirmation that an MO will pay for a given contract ID and to transfer the transaction records after each charging session to the respective MO for the identified contract [3].

2.2.6 Proximity Marketing Intermediary (PMI)

The agent that identifies, consolidates the value-added offers at a given charging point. PMI manages the transaction with the party that delivers the respective value-added service, collects the fees and transfer them to the respective party, like the MO.

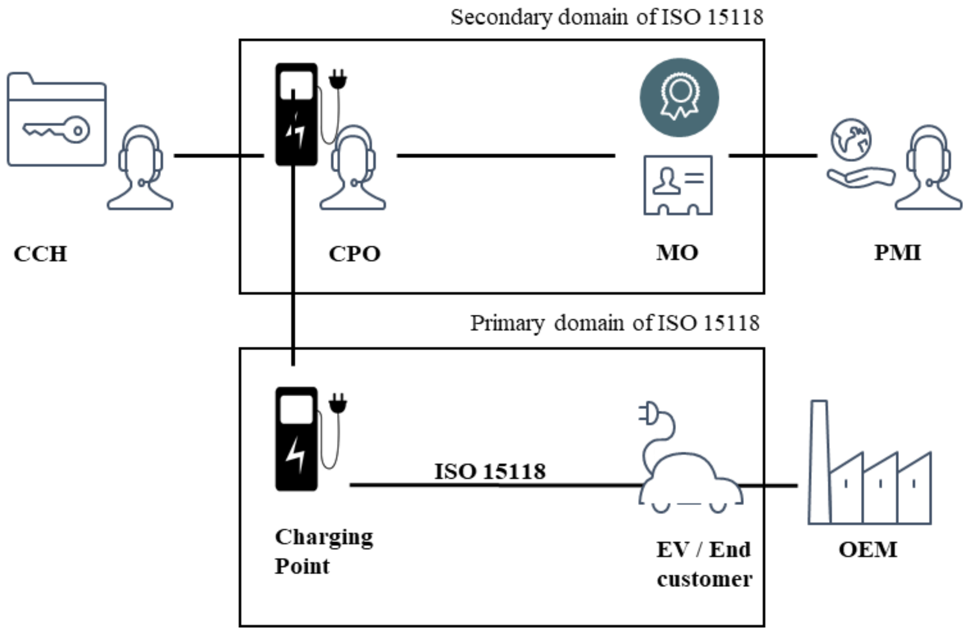

Figure 1 Main players in ISO 15118 domain [4, own illustration]

2.3 ISO 15118 Compatibility of infrastructure and the vehicles

While few EVs currently on the market have built-in ISO 15118 capability, several significant new products to be launched in 2019, for instance, Audi E-tron and Porsche Taycan, are announced to have it on-board. On the infrastructure side, an increasing number of EVSE manufacturers will be offering the ISO 15118 compatibility. It is interesting to note the leading role the eroaming platform Hubject is striving for. Beyond ISO 15118 enabling solutions offered for CPOs and MOs, Hubject also seeking partnerships aggressively, for instance with different solution providers in the US like Greenlots, Electrify America and ReCharge[4].

3 Methodology

This paper aims to provide insights into the business potential of value-added services through ISO 15118 on two levels. At the outset, the basic mechanics of such services will be laid out through the illustration of selected use cases – charge point reservation and proximity marketing -, to assist the basic understanding of the actors and relations involved. With a model that is deliberately kept simple and data available about the Stuttgart Region in Germany, the paper will stake out to quantify the potential revenue through these selected value-added services. For the set of data to be used for an educated estimation the resources, steps, and assumptions as defined below are taken:

- For the forecasts of future revenues, an estimation of customer contacts with the charging infrastructure, expressed in the number of charging sessions, is required, which defines the window of opportunity for the value-added services.
- The next step is to define a calculation basis for the average charging rhythm per vehicle. A selection of the popular electric vehicles on the German market, their respective real-world driving range values and the driving behavior of the "average" driver in Germany provide the basis for the estimation for the number of charging sessions required. It is assumed that the vehicles would be driven until 40 Km of the range remains, which is admittedly on the conservative side.

[4] See: https://www.electrive.net/tag/iso-15118/

- To estimate the ramp-up of the number of electric vehicles on the road, a mix of numbers in published studies and own calculations are used. Thereon this proposed growth rate has been used to estimate the electric vehicle fleet in Stuttgart Region in years 2018, 2025 and 2030.
- To reach an estimation beyond a single region of Germany, the results for the Stuttgart Region are additionally projected on to the 15 German cities with at least half a million inhabitants, proportional to the respective number of vehicles registered.

4 The use cases: charge point reservation and proximity-marketing

4.1 Charge point reservation

Despite the stunningly high growth in the number of charging stations[5], it continues to be an issue for EV-drivers to allocate and gain access to charging infrastructure conveniently. Coupled with the so-called range-anxiety, the feat of not having insufficient range to reach the destination and consequently getting stranded, the question mark of the availability of charging points hang over the potential EV driver switching over from combustion-engine-based mobility. It would be an enormous boon for EV drivers to have the inner comfort of securing a charge point at their destination, or on the way thereof, and avoiding the risk of losing time in traffic in search for a charging spot. Today reservation services are technically available but hardly deployed. This paper argues that combined with the convenience of reservations over the vehicle cockpit and the expected growth mismatch between the number of vehicles and charging point, the authors of this paper believe that there is a good use case to come. Such services are standard issue in floating carsharing services.

In the practice, the prosed service would offer the reservation of a charging point for a pre-defined duration ahead of time in return for a nominal charge. This reservation could be then triggered through the HMI in the vehicle, in an app or a browser. Through the P&G functionality would the customer start the charging process by plugging in within the defined time slot, with invoicing carried out automatically.

Involved actors: End User, CPO, MO, CCH, EV

4.2 Proximity-marketing:

Given the permission of the respective EV-driver, the information regarding the geo-position at a given time the and duration of stay can enable the facilitation and offering of additional services. In simple terms, a mix of "foursquare[6] and Groupon[7] for electric mobility" is a suitable analogy to this end. The proposed additional income would result from the intermediary services matching the external offers and the EV-drivers' schedules, needs, and interests. The details of possible services are not in focus of this document, suffice to say that these services would offer anything and everything that relates to the position and stay of the EV driver at the given location.

Involved actors: End User, CPO, MO, CCH, EV, PMI

5 Results

As mentioned in Section 3, a list of selected popular EVs containing models of different size and offering different range values is the starting point of the model (Figure 1). By taking the average distance driven in Germany per day per vehicle, which is 36,3 Km[8], and assuming that the average EV driver would charge his/her vehicle when a remaining range of 40 Km left, the total n.o. charging sessions p.a. per vehicle is

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[5] See: https://de.statista.com/statistik/daten/studie/460234/umfrage/ladestationen-fuer-elektroautos-in-deutschland-monatlich/
[6] See: https://en.wikipedia.org/wiki/Foursquare_(company)
[7] See: https://en.wikipedia.org/wiki/Groupon
[8] Source "Kraftfahrtbundesamt", for year 2017 the total n.o. Km driven 13.257, see: https://www.kba.de/DE/Statistik/Kraftverkehr/VerkehrKilometer/verkehr_in_kilometern_node.html

estimated. The paper deliberately ignores the range reducing effects of winter to keep the data model simple. While using the values mentioned above for the baseline for the year 2018, the paper assumes that the average range of the registered vehicles will increase by 30% until 2025 wrt. 2018 (from 253Km. to 329,7 Km) and a further 25% from 2025 to 2030 (to 412 Km).

Figure 2. The overview of selected EVs, their respective ranges and the calculated number of charging circles[9].

Model	**Range under real-life conditions (ADAC, Km)**	**Range - adjusted (Km)**	**Number of charging circles in year**
Hyundai Ioniq Elektro Style	211,0	171,0	77,5
VW e-Golf	201,0	161,0	82,3
BMW i3 (94 Ah)	188,0	148,0	89,5
Smart Fortwo Coupé EQ Prime	112,0	82,0	161,6
Hyundai Kona Elektro (64 kWh) Trend	375,0	335,0	39,6
Opel Ampera-e First Edition	342,0	302,0	43,9
Renault Zoe Intens	243,0	203,0	65,3
Nissan Leaf I Acenta (30 kWh)	159,0	119,0	111,3
Nissan Leaf II Acenta	201,0	161,0	82,3
Tesla Model S P90D	393,0	353,0	37,5
Tesla Model X 100D	451,0	411,0	32,2
Nissan e-NV200 Evalia	167,0	127,0	104,3
Average values per vehicle	253,6	214,4	**77,3**

For the reference values for the size of the EV fleet in the Stuttgart Region, the estimated growth rate for Germany has been used [5]. Accordingly, based on the values in Figure 3, the total number of charging sessions for Stuttgart Region has been calculated.

Figure 3 Estimated n.o. EVs and charging sessions

	2018	**2025**	**2030**
Number of EVs in Germany	509.663	4.980.739	10.541.992
Number of EVs in Stuttgart Region	3.325	32.490	68.767
N.o. Charging sessions per vehicles p.a.	77	59	48
N.o. charging sessions in Stuttgart Region p.a.	256.911	1.931.301	3.270.160

[9] Measured under real-life conditions, see: https://www.adac.de/rund-ums-fahrzeug/tests/stromverbrauch-elektroautos-adac-test/

For the calculation of the revenues from charging spot reservations, a distinction has been made between on-street charging spots and off-street ones (located in parking lots), the assumption being that the latter would cost more than the former. The distribution of the charging sessions between these two options is carried out based on the respective number of available parking spots in the Stuttgart Region.[10]

Figure 4 Development of revenues from Use Case 1, "Reservation"

	2018	2025	2030
N.o. Charging sessions per vehicles p.a.	77	59	48
N.o. charging sessions in Stuttgart Region p.a.	256.911	1.931.301	3.270.160
on-street charging	133.594	1.004.277	1.700.483
off-street charging (e.g. in parking lots)	102.764	772.521	1.308.064
Reservation fees - on-street charging	0,50 €	0,75 €	1,10 €
Reservation fees - off-street charging	1,00 €	1,50 €	2,20 €
Use Case 1.1 "Reservation" - revenues from on-street charging	33.398 €	753.208 €	1.870.531 €
Reservation rate - on-street parking	50%	55%	60%
Use Case 1.2 "Reservation" - revenues from off-street charging	51.382 €	637.329 €	1.726.644 €
Reservation rate - off-street parking	50%	55%	60%
Total revenue Use Case 1	84.781 €	1.390.538 €	3.597.176 €

For the Use Case 2, a combination of ads and ad-triggered coupons for services in the surroundings of the charging spot taken as an example. Here location-based services like foursquare or Groupon are taken as examples. In this two-tiered approach, the customer would be – given his/her consent – shown targeted and personalised ads on the HMI of the vehicle, in an app or in a browser, for which a fee of 25 cents would be generated. In this scenario, it is assumed that only 30% of EV-drivers would accept to be shown ads. In the second step, the approval of the customer to cash-in one of the displayed ads would trigger the second layer, which would mean an additional 1 Euro. In this case, it is assumed that a higher acceptance rate at 25% would be realistic, given that the EV driver had accepted to be shown the coupons. Both fees, 25 cents and 1 Euro5, would be increased through the years, reflecting the inflation rate.

Figure 5 Development of revenues from Use Case 2

	2018	2025	2030
N.o. customer contacts	70.907	533.039	902.564
Customer consent	30,00%	30,00%	30,00%
Revenue per coupon-ad (€)	0,25 €	0,30 €	0,33 €

[10] See: http://www.mobilitaet-in-deutschland.de/MiT2017.html

Use Case 2.1 - Revenue from displaying of coupon-ads	17.727 €	159.912 €	297.846 €
N.o. coupons	17.727	133.260	225.641
Revenue per coupon (€)	1,00 €	1,20 €	1,32 €
Customer consent for coupons, based on displayed ads	25,00%	25,00%	25,00%
Use Case 2.2. - Revenue from validated coupons	17.727 €	159.912 €	297.846 €
Total revenue Use Case 2	35.454 €	319.824 €	595.692 €

To put these numbers into perspective, the revenues by the utility sector through the assumed charging processes for the Use Cases 1 & 2 is also estimated. The Figure 6 displays the respective values through the years and provide a comparison of the traditional income through charging vs value-added services. Here the reference values are calculated with approximately 16 cents per kWh. This is the amount calculated based on the price for the domestic power, after deducting the various fees[11]. The expected development of the price of electricity is also reflected in the respective values for 2025 and 2030[12]. The results show that an additional revenue of approximately 10% is possible. The projection of these values onto the 15 German cities of at least half a million inhabitants Germany indicated an estimated total revenue of 90 million Euros.

Table 6 Comparison of revenues through value-added services and electricity

	2018	**2025**	**2030**
Amount of energy per vehicle p.a. (kWh)	3693,8	3693,8	3693,8
Amount of energy for all vehicles p.a. (kWh)	12.280.350,6	120.011.074,4	254.009.654,8
Net revenue after all fees per kWh	1.986.961 €	18.446.902 €	35.139.442 €
Total revenue from Use Cases 1 and 2	120.234 €	1.710.361 €	4.192.868 €
Revenue from value-added services, as measured in terms of energy income	6,1%	9,3%	11,9%

[11] See: https://1-stromvergleich.com/strom-report/strompreis#strompreis-2017

[12] See: https://www.bmwi.de/Redaktion/DE/Publikationen/Studien/entwicklung-der-energiemaerkte-energiereferenzprognose-endbericht.pdf?__blob=publicationFile&v=7 (pg. 227)

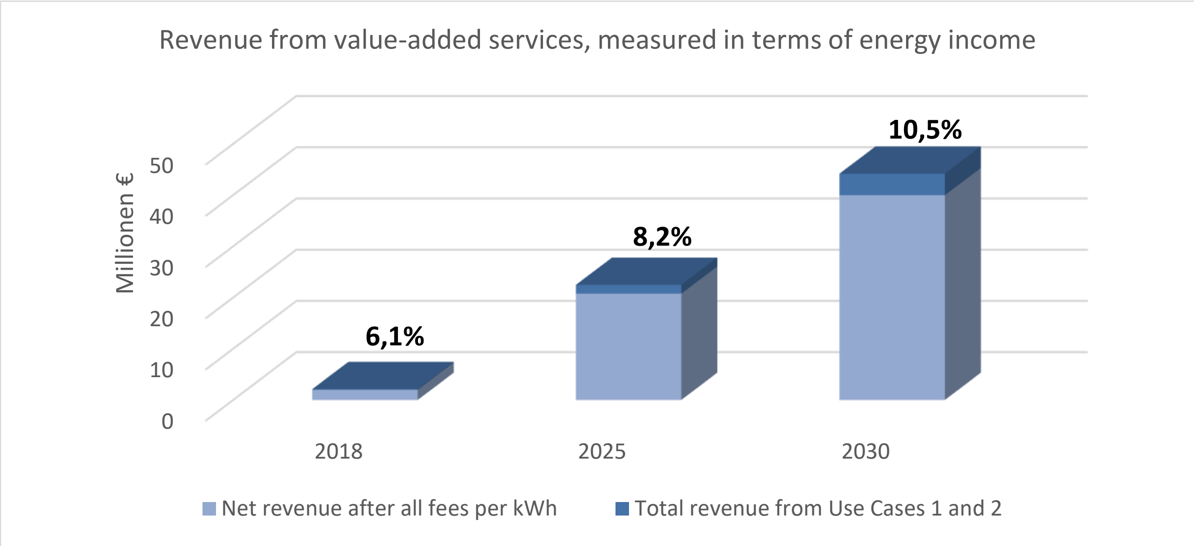

Figure 7 Comparison of revenues through value-added services and electricity

6 Conclusion

The potential of ISO 15118 is not a well-kept secret, yet this standard is mostly discussed in the context of convenience it promises for the charging experience. The model discussed in this paper shows a significant business potential for the ISO 1118. Even estimated on conservative terms as done in this paper, an additional revenue of approximately 10% wrt. the sale of electricity for charging is to be expected. In fact, for many EV drivers lacking the opportunity to charge at home, hence having to be dependent on public infrastructure and EV drivers tending to top up their vehicles at each opportunity, the n.o. contacts of EV drivers with EVSE, which defines the envelop of business opportunity, is expected to be significantly higher. The increasing scarcity of parking and charging space in urban areas is very likely to vouch for higher reservation fees, thus higher revenues.

To sum up, next to the P&G functionality, ISO 15118 is an enabler of new business models. The future possibilities offered by automated driving will only amplify the possiblities.

List of abbreviations

AC: Alternative current (electricity)

CCH: Contract Clearing House

CPO: Charge point operator

DC: Direct current (electricity)

EV: Battery electric vehicle

EVSE: Electric vehicle supply equipment

FTP: File Transfer Protocol

HMI: Human machine interface

HTTP(s): Hypertext Transfer Protocol Secure

MO: Mobility operator

OEM: Original equipment manufacturer (vehicle manufacturer)

P&C: Plug & Charge

PKI: Public Key Infrastructure

PMI: Proximity marketing intermediary

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