Importance of Open Charge Point Protocol for the Electric Vehicle Industry

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Electric vehicles (EV) are becoming the new standard for mobility all over the world. This development is only possible with a good coverage of charging stations. The challenges for the EV market is not only the charging infrastructure, but also the openness of communication protocols to ensure the possibility of switching from charging network without necessarily replacing all the charging stations, including their interoperability for electric grid services. Open Charge Point Protocol (OCPP) addresses this challenge by being the industry-supported de facto standard for communication between EV charging station and electric grid stakeholders. OCPP is an open standard with no cost or licensing barriers for adoption.

When we look more closely at some of the past failures of the EV industry, the reason tends to be the inability of the charging stations to respond to the changes and needs of the industry at that particular time due to specific lock-in effects they face by virtue of proprietary protocol.[1]

Introduction

Open communications standards are key enablers for the Smart Grid where two-way power flows, real time information and control play a key role. Open standards are key enablers for open interoperable platforms and encourage innovations.[2] Standards enable cost effectiveness with interoperability and scalability of the electric grid transformation with decentralised and renewable generation resources and clean transportation to lower greenhouse gas emissions.

The EV charging infrastructure is part of a larger and still evolving ecosystem of actors, devices and protocols. In this ecosystem, various new actors and new use cases are introduced and the future will tell what roles and what use cases will be successful and widely adopted in which market structures.

What is Open Charge Point Protocol?

The Open Charge Point Protocol (OCPP) offers a uniform solution for the method of communication between charge stations and any central system. With this protocol, it is possible to connect any central system with any charge station, regardless of the vendor. With more than 20,000 installations and participants in 16 different countries[3], OCPP has become the de facto open standard for open charger to network communications in both Europe and parts of the United States. Figure 1 below shows the generic EV network topology of OCPP between a distribution system operator (DSO) or a utility, electric mobility service provider (EMSP), charge point operator (CMO) or site hosts and charging stations.

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[1] Deniz, S; *An Empirical Analysis of the Openness Dimension of OCPP Standard*, Lund University, December 2015, Sweden.

[2] Ghatikar G; *Decoding the Electric Mobility and Power Systems Interoperability for Clean Transportation and Decarbonized Electric Grid*, To be submitted at the proceedings of the India Smart Grid Week, March 2016, India.

[3] http://www.openchargealliance.org/participants/

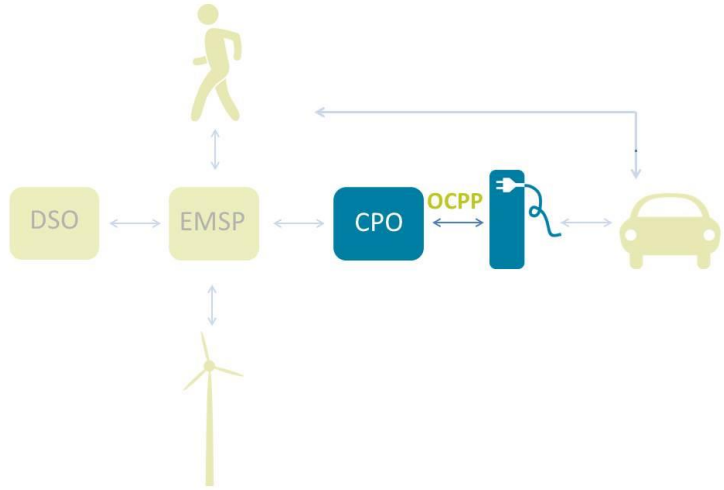

Figure 1: Architecture and Generic Implementation of Open Charge Point Protocol

Current status and features of Open Charge Point Protocol

OCPP v1.6 is the most recent version of OCPP. It based on years of experience in the field with OCPP and builds upon successful adoption and experiences of OCPP 1.5. The earlier version, OCPP 1.5, has been widely used around the world since 2012 and many vendors and utilities have supported and implemented OCPP 1.5 in their products. OCPP 1.6 version is supported by a compliance testing tool for self-testing and the Open Charge Alliance is preparing for an official Certification Programme. This will guarantee interoperability between products from different vendors, thus making OCPP 1.6 more valuable for its users.

OCPP 1.6 brings new features, such as Smart Charging and besides SOAP also JSON over WebSockets. It contains many small enhancements that will benefit CPOs around the world and improve service to EV drivers in the field. Various sections have been rewritten to increase their clarity. This greatly improves the interoperability between products from different vendors.

> ***SOAP*** *stands for Simple Object Access Protocol. SOAP is a framework, which enables messages to be sent between components over the Internet. The advantage of SOAP is that the facilities for sending and receiving messages are covered by the standard. This makes rapid implementation possible.*
>
> ***JSON*** *(JavaScript Object Notation) is a lightweight data-interchange format which is easy for humans to read and write and for machines to parse and generate. It is based on a subset of JavaScript.*

Differentiators between open standards and proprietary protocols

OCPP is a universal open communication standard to respond to the challenges associated with proprietary networks. An open protocol allows the charge station and backend to interoperate without the need for a proprietary interface or gateway. They talk the same language and no translation is

needed. A closed protocol is one that is proprietary and not open to communication with other products without an interface or gateway[4].
OCPP was developed by many different partners and is owned by the alliance of these partners, the Open Charge Alliance (OCA). All these partners work together to improve the protocol on an equal basis.

"OCPP provides a mature, open model in which all stakeholders collaborate in support of a common standard," says Onoph Caron, Co-founder and Chair of the Open Charge Alliance.

Benefits and Impacts of Open Charge Point Protocol

"In simple terms, achieving such interoperability relies either on a proprietary standard or on an open standard. The main difference between these two types of standards is that open standard movement aims at establishing industry-wide or nationwide interoperability among its stakeholders by preventing the rise of any monopolistic power in functioning the interoperability".[5]

Some of the main advantages of OCPP are:

- Support a charge point owner to change network operator when it wants, thus preventing the charge station assets from being stranded.[6] [7]
- Allow the common communications between charge station and network service provider to be also leveraged for providing grid services (e.g., demand response) cost effectively.
- Encourage customers to own EVs by enabling uniform access to charging stations, roaming and billing services.

Benefits for Distribution System Operators and Utilities

The ownership models of charge stations and location are used to understand the network management needs of EV infrastructure and spatial and temporal availability of EVs, as a grid resource. These ownership models and use of OCPP apply to different charging levels currently available for charge stations (level 1, level 2 and direct current fast charging or DCFC). The three evolving ownership and operating models of charge stations in the US are shown in table 1 below.[8]

Table 1 Electric Vehicle Charge station Ownership Models

Customer	Most widely used model for level 1 with any available 108-120 V outlets and partially for level 2 charging by the owners of homes, buildings and campus
Third-Party	Increasingly popular model for level 2 and DCFCs, where a charging station OEM or a city/county deploys charging infrastructure in public spaces for BEV adoption.
Utility	Evolving business model to deploy level 2 and DCFCs in public spaces, along highway corridors and disadvantaged communities to support aggressive national and state level BEV adoption and zero emission vehicle mandates.

[4] http://searchnetworking.techtarget.com/answer/What-is-open-and-close-protocol-What-is-the-difference
[5] Deniz, S; *An Empirical Analysis of the Openness Dimension of OCPP Standard*, Lund University, December 2015, Sweden.
[6] Deniz, S; *An Empirical Analysis of the Openness Dimension of OCPP Standard*, Lund University, December 2015, Sweden.
[7] http://www.evconnect.com/ocpp/
[8] Ghatikar G; *Decoding the Electric Mobility and Power Systems Interoperability for Clean Transportation and Decarbonized Electric Grid*, To be submitted at the proceedings of the India Smart Grid Week, March 2016, India.

Use Cases for Distribution System Operators and Utilities

OCPP gives the owners of charge stations amongst others the ability to manage the charging speed, the available capacity at the charge stations. The new version 1.6 makes it easy to introduce so-called smart charging. Smart charging means that you can postpone or throttle charging behaviour based on grid load and the availability of cheap and clean intermittent energy. Smart charging of EVs is useful because it is more powerful and flexible than any other end user appliance connected to the (low voltage) grid see table 2.

Table 2 Facts based on Dutch situation

Average power demand	The average power demand of a Dutch household is 1.3 kW. Assuming an average charging capacity of 5 kW, 1 million electric cars charge with 5 GW of power. On an average day in the Netherlands, the total Dutch power demand is 8-9 GW. The power demand of electric vehicles is potentially very large (with the potential of seven million EVs in the Netherlands, the power demand is 35 GW!).
Average usage of car	In the Netherlands, a car drives on average 37 km a day[9] and is thus stationary for average 23.5 hours. The trip of 37 km requires about 8 kW. This is around 2.5 hours using the lowest charge speed (1st phase 16A, 3,7 kW). If the car is stationary for 23.5 hours and 2.5 hours is required for charging in order to drive the average distance, a great deal of variation in charging time (starting time of charging) and speed (power level) is possible. This offers great opportunities to recharge at the best time.

As shown in Table 2, there are many unprecedented opportunities for flexible charging / storage because demand, the time of charging and the power demand can be adjusted.

Smart or Managed Charging

When it is possible to use electric car batteries as demand response or even vehicle to grid (V2G) assets, they could help to balance the grid and charge at the cheapest (or greenest) time. This would improve resilience, prevent blackouts, enable larger amounts of renewable energy and reduce costs. This management of charging, smart charging, can be done by using OCPP at EVSE (outlet) level, at station level or at group/location level. These functionalities provide multiple opportunities to manage the load from the grid, home grid and generation perspective.

Remote Connectivity and Management Of Charging Stations

OCPP gives the owners of charge stations amongst others the ability to monitor their charge stations remotely. OCPP provides the opportunity to set multiple measurands, including voltage level. Voltage levels per phase can be measured and communicated to the back office system. From there, this

[9] CBS Webmagazine, http://www.cbs.nl/nl-nl/menu/themas/verkeer-vervoer/publicaties/artikelen/archief/2012/2012-3579-wm.htm, Tuesday 6 march 2012, the Netherlands

information can be provided to the DSO or Utility system as part of monitoring and managing the grid. This kind of measurement could be considered as smart meter information.

OCPP also provides possibilities for (autonomous) voltage control. Using the measurand possibilities, it is possible to communicate voltage level to the back office, from where it is possible to control the power level to (attempt to) reset the power level at LV level. It is also possible to set boundaries of measured voltage at the station. These boundaries can be set using OCPP and the station can be 'instructed' to adapt the power level when voltage level exceeds the set boundaries.

Applications in the United States

In the US, OCPP has been successfully adopted and commercialised by the utilities and charge station owners for network and charging management and in harmonisation with other key grid-facing standards, leveraged as a grid resources for electric grid reliability. Below are two key utilities in the US that have successfully implemented OCPP.

Table 3 Key utilities that successfully implemented OCPP

Southern California Edison	One of the largest workplace DR charging study projects leverages the networked EV charging point management services to extend them for DR. Using Open-ADR and OCPP, the project successfully demonstrated the value of standards for utility power system interoperability and DR with successful network management and smart charging of level 2 stations.
Sacramento Municipal Utility District	The project by Sacramento Municipal Utility District (SMUD) focused on residential level 1 and 2 charging infrastructure and evaluation of technical performance and grid impacts using time-of-use and dynamic rate. The project results showed high customer satisfaction and issues with driver behaviour and meter-to-charging station interoperability using OCPP.

As stated above, utilities will have many opportunities to use the flexibility that is offered by EVs. This can best been done by using OCPP: an open protocol that is supported and developed by all the different market actors in the EV industry.

What is Next for Open Charge Point Protocol?

Standardisation

Although the outlines of the EV charging infrastructure have not yet been settled in detail, OCA recognises that formal standardisation of OCPP will help the market forward, since upcoming large investments require industry confidence and a formal standard will increase industry confidence and the adoption rate.

To this end, OCA will standardise OCPP within OASIS (formal standard planned for 2017), with the end goal of standardising within IEC. To prepare for this future transition into the IEC standards framework, aligning OCPP with the relevant IEC standards is explicitly part of the scope of the OASIS TC proposal.

Contextual Deployment of OCPP for the US and Global Markets

Many US companies have already joined the OCA to work with us on developing the OCPP. To improve and extend OCPP to fit it seamlessly in the US market, we welcome all US market players as part of the open charge alliance.

More on Open Charge Point Protocol

For more information about membership of OCA or downloads and information of OCPP, please visit our website: www.openchargealliance.org