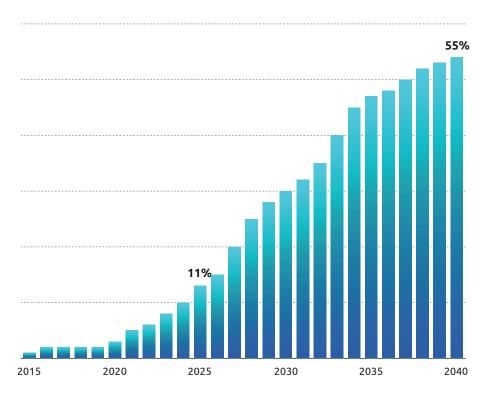Open Standards–Based Networks White Papers

Open vs. Closed Charging Stations: Advantages and Disadvantages

greenlots

Open vs. Closed Charging Stations: Advantages and Disadvantages

The transition to electrified transportation is accelerating rapidly as electric vehicles (EVs) are expected to be more than half of new car sales and 33% of the global car fleet by 2040. As EVs are becoming more affordable and can go longer distances on a single charge, more and more people are converting to electric cars. These trends are augmented by recent announcements from countries around the globe to phase out petrol and diesel cars. Countries such as China, the United Kingdom, France, Norway, and the Netherlands have all announced plans to transition towards emission-free vehicles. To meet this growing demand for EVs, automakers are investing at least $90 billion in EVs and will introduce new battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV) over the next five years.[2]

Car manufacturers have announced significant investments in electrifying their line up and allocating resources to R&D. This growing demand for EVs is expected to continue as analysts believe that by 2040, **54% of new car sales** and **33% of the global car fleet** will be electric.

55%

11%

2015   2020   2025   2030   2035   2040

Source: Bloomberg New Energy Finance, May 2018

RENAULT NISSAN MITSUBISHI — **12 new** pure electric vehicles to be launched by 2022 and will invest $1 billion into EVs

GM — **20 EV models** by 2023

Ford — Invest to $11BN in EVs. **40 EV models** by 2022

NISSAN / INFINITI — Will introduce **only EVs** starting 2021

JAGUAR — **Electrify entire lineup** by 2020

Toyota — **10 EV models** by early 2020s

VW — Will invest $84BN in R&D & **300 EV models** by early 2030

With more EVs on the road, investments in EV charging infrastructure must take place to reduce range anxiety and ensure that drivers have access to reliable charging regardless of location and distance. This requires a multi-stakeholder approach to planning and investment, one that encourages standardization and interoperability of infrastructures.

Governments, utilities, automotive companies and corporations are at work planning for this massive transformation in mobility. Decisions made today will have long-term consequences for the future. Chief among those considerations is a need to facilitate open and flexible networks so drivers can easily charge regardless of network or vehicle.

[1] (Long-Term Electric Vehicle Outlook , 2017)
[2] (Lienert, 2018)

Today's challenges in public EV charging infrastructure

Much of the EV infrastructure that we know today has been developed by private network operators that lacked coordination and a shared vision of optimally placed charging infrastructure. This fragmented approach has resulted in a market that requires EV drivers to have a variety of memberships, accounts, and RFID cards to access all publicly available chargers.

The lack of widely agreed upon standards for back-end communication networks can also hinder the ability to effectively integrate the charging stations into the energy infrastructure and leverage the latest grid-edge technologies. To ensure fully optimized EV infrastructure, network operators will need to have the ability to integrate charging stations into the power grid to enable additional energy-related services. Interoperable and open networks will allow data to be easily accessed, shared and collected to improve charging services and plan for infrastructure development.

What is OCPP?

Digital devices and systems communicate with each other to accomplish complex tasks together. This back and forth communication happens nearly instantaneously and seamlessly in the background, allowing users to be productive without thinking about the enabling technology. This is known as interoperability: one of the fundamental building blocks of our digital world. Interoperability is enabled by communication standards known as protocols.

Open Charge Point Protocol (OCPP) is an internationally recognized initiative with the purpose of creating an open application protocol that allows EV charging stations and central management systems from different vendors to communicate with each other.

OCPP acts as the intermediary between the charging station and the back-end or network management software. An EV charging network is needed to allow network owners to communicate with their EV charging stations and to allow the EV charging stations to communicate with the power grid. An advanced EV charging network will allow operators to obtain real-time information on the performance of their EV charging stations, manage charging status, enable dynamic pricing tools, process payments, and instantly detect faults and issue tickets for servicing. The network management software takes the information from the charging station and communicates it to the back-office server at a utility, municipality or other administrator. On the consumer side, this allows for services such as billing, access control, authentication and payment. For the site host, it allows the site host to set pricing and usage policies, as well as use data

Three types of charging station networks

In addition to the three different charging levels, there are three types of charging station networks being developed to support electric vehicle (EV) charging: non-networked, closed and open

Non-networked

These stations are not connected to any network. Typically used in residential applications.
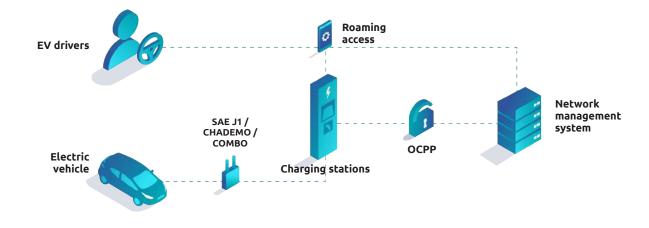
Closed networks

Closed networks use proprietary communication protocols to communicate between the charging station and the network server. Owners of charging stations must use this proprietary network's services and compliant hardware. They cannot switch networks using the same charging equipment, and they cannot use electric vehicle supply equipment (EVSE) based on open standards.

Open networks

Open networks use standard communications to allow the owners of compliant charging stations to connect to multiple open networks. Owners can run different open standards–based networking providers on the same piece of hardware without the need for significant upgrades to existing hardware.

Having smart EV charging infrastructure that can easily communicate with the power grid requires open and interoperable communication protocols which can support all the functionality needed by today's advanced charge management.

to understand the behaviors and preferences of charging customers. The charging stations needs to communicate with the car, the network operator, and the utility suppling power.

If your charging stations are OCPP compliant, you can easily connect them to an OCPP-compliant back-end network.

Open Charge Point Protocol (OCPP) allows communication between charging stations and central systems, regardless of vendors

What are the advantages of proprietary charging networks?

Proprietary networks allow the software developer or owner to control all aspects of the charging ecosystem. This can ensure a seamless experience for users. It is analogous to the world of personal computing, for example, where Apple maintains much tighter control over its operating system and applications, but Microsoft Windows is licensed for use by numerous manufacturers.

The downside to proprietary systems is vendor lock-in. An apt analogy is between Android and Apple iOS devices. When you have a device that runs on iOS, or charging hardware that runs on a non-OCPP network management system, you are limited to using that vendor's hardware. Likewise, proprietary network management systems only run on that vendor's charging infrastructure. If the network management system becomes unavailable, it renders the charging stations useless, or at least turns it into a non-networked station.

What are the advantages of open standards–based charging networks?

The advantages of open standards –based charging networks are flexibility and choice. Open standards allow users to choose from many different hardware and network providers. When you install OCPP-compliant charging stations, you are free to select the charging network provider that meets your needs.
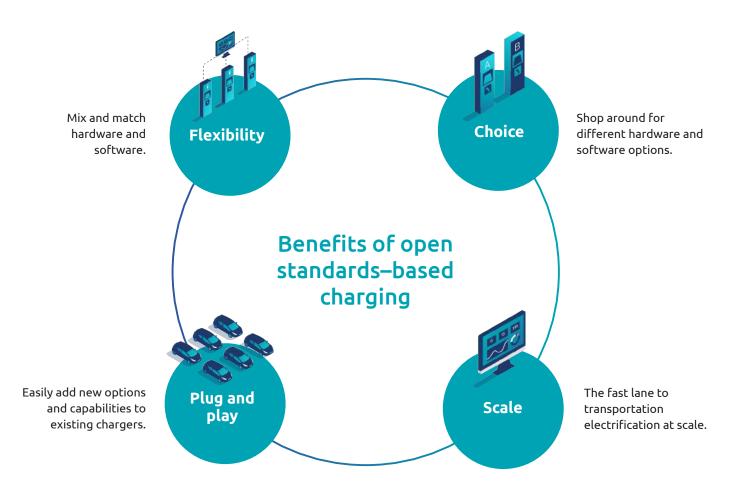
Open systems offer the flexibility to mix and match charging hardware with the network management system on the back-end. When your needs change or you want to scale your

network, you can shop around for another OCPP-compliant network provider, or you can add charging stations from different OCPP-compliant manufacturers. This allows charging station owners to optimize the cost and risk of networked infrastructure investments.

Open networks enable interoperability, allowing the broadest possible set of products to work together. In turn, interoperability promotes the expansion of existing infrastructure. Open, universal standards make it easy to introduce new hardware options that connect to the existing network and are transparent to site hosts and EV drivers. In a similar vein, utilities that invest in smart meter infrastructure based on open standards are able to add smart grid applications for outage management, demand response, thermostat integration, street light integration and more.

The Open Charge Alliance has developed a hardware-certification process to ensure seamless integration between all OCPP-enabled devices and the back-end network management systems. Open standards vendors are investing significantly in building this technology.

Charging networks based on open communications standards stimulate technical innovation by allowing free-market competition to push down the costs of both charging station hardware and back-end software, while dramatically lowering the risks of hardware purchase for site hosts.

Beyond the benefits to the individual charging station owner, networks based on open standards represent the best path forward to large-scale transportation electrification. Drivers will certainly need more charging stations to relieve their range anxiety, and as more EVs hit the road, the most practical and convenient approach will be charging networks based on open standards.

Benefits of open standards–based charging

Flexibility
Mix and match hardware and software.

Choice
Shop around for different hardware and software options.

Plug and play
Easily add new options and capabilities to existing chargers.

Scale
The fast lane to transportation electrification at scale.

Are non-OCPP networks truly open?

The short answer is no. Some charging companies claim to use an open protocol because they have published their application programming interface (API). Further, they claim that their charging stations "speak" OCPP.

In many of these cases, the charging companies are still using a closed, proprietary protocol between their back-office networks and charging stations. They build an interface between their server and another OCPP-compliant server to translate between their proprietary protocol and OCPP.

A closed network will not allow another network provider to run organically on its hardware. Instead, it channels the communications from the EVSE through their cloud to another network's cloud. This means that even if a charging station could run another back-end network service, the station owner would need to pay for network services from both the original service and the new service.

Only those charging stations with a native or organic connection from the hardware to the back-office network are truly open. The station itself needs to speak in OCPP so that it can talk with any OCPP-compliant server.

Background on Open Standards and OCPP

The Open Charge Alliance (OCA) is a global consortium of public and private EV infrastructure leaders that have come together to promote open standards, including OCPP and the Open Smart Charging Protocol (OSCP). OCA provides open and interoperable communication protocols for EV charging infrastructure to support the functionality needed by today's advanced charge management systems. Its mission is to foster global development, adoption and compliance of EV charging communication protocols and related standards through collaboration, education, testing and certification. Its membership includes more than 50 participants spanning all sectors of the industry, including charging equipment manufacturers, software and systems providers, charging network operators, and research organizations.

OCA provides open and interoperable communication protocols for EV charging infrastructure to support the functionality needed by today's advanced charge management systems

Countries that are currently using OCPP

OCPP is the de facto network protocol throughout Europe and is used in 78 countries on every continent.
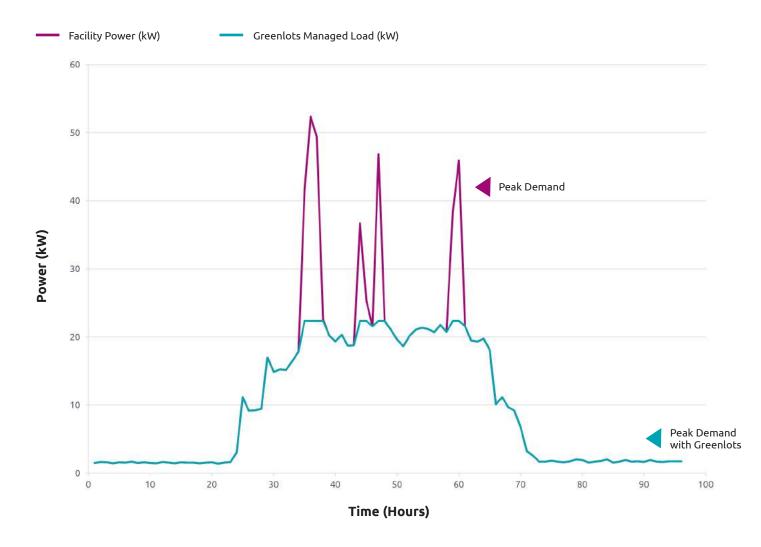

Open Standards and Grid Reliability

The growing adoption of EVs brings new and unprecedented challenges for electrical utilities and the power grid. As one of the most complex energy loads to date, demand placed on the grid from EV charging is unpredictable and can spike at a moment's notice.

The clustering effect of electric vehicles

As certain geographical areas provide additional support to encourage the use of EVs, such as incentives, targets, or subsidies, that area may experience a clustering of EVs within a neighborhood or community.   The National Renewable Energy Laboratory's (NRELs) recent report found that clustering may "significantly increase the peak demand seen by distribution transformers and might require upgrades to the electricity distribution infrastructure."[3] However, coordinated EV charging that is properly managed can help reduce the impacts of EV clustering by prioritizing and scheduling charging during off peak hours.

In order to safely integrate EV charging into the grid, electrical utilities and EV charging stations need to be able to communicate with each other.   To facilitate this communication, a 130-member consortium dedicated to open standards for the smart grid, called OpenADR Alliance, has established a communications protocol that standardizes messaging for price and reliability signals used by utilities.

OpenADR is a global Smart Grid interoperability standard developed to optimize electric supply and demand. This occurs through standardization of the interface between electricity markets and end customers, and automation of customer response to high energy prices and grid instability. OpenADR 2.0 provides secure two-way communication between DR servers, which publish information, and the automated DR clients, which subscribe to the information. Using OpenADR enables both peak electric demand reduction and load shifting at client locations, according to customer needs and preferences, by continuously communicating dynamic price signals, such as hourly day-ahead or day-of real time pricing.[4]

This is where OCPP compliant EV charging networks can help. OCPP enabled charging stations allow network operators to communicate with and control their charging stations. OCPP allows for smart charging capabilities to throttle or post-pone charging during grid events or moments when electricity prices are high. Combining OCPP and OpenADR will transform EV charging stations into flexible grid resources that can instantly respond to grid events and change behavior based on the local grid requirements.

[3] (Muratori 2018)
[4] (OpenADR Alliance, 2018)

Typical load profile of a facility with EV charging stations

— Facility Power (kW)   — Greenlots Managed Load (kW)

To prevent overload of our current electrical power infrastructure, energy demand from EV charging needs to be managed properly.

There are several ways to better mange EV load , such as leveraging Demand Response (DR) techniques or integrating local power generation sources (solar, wind, or energy storage). However, in order to transform EV load into a flexible grid resource that can participate in utility-led DR programs or communicate with the utility to instantly respond to changing grid conditions, the hardware and software needs

OCPP gives charging station owners the ability to not only monitor the condition of their charging stations, but to remotely authorize usage. The most recent version of the Open Charge Point Protocol is the OCPP 2.0

to function on open standard communication protocols. Then, it can communicate with third party IT infrastructure. OCPP gives charging station owners the ability to not only monitor the condition of their charging stations, but to remotely authorize usage. The most recent version of the Open Charge Point Protocol is the OCPP 2.0, which allows for a controlled charging process. This means that the EV charging station and/or the central network system can set constraints to the amount of power that is delivered during a specific charge. OCPP can be used at a local or global level to adjust or limit the total amount power that may used by a group of EV charging stations. OCPP can also be used to adjust the power consumption of multiple stations to match the power generation capacity of the grid. OCPP supports the Mode 3 PWM signal as well as more advanced smart charging, such as the ISO/IEC 15118 standard that allows for vehicle-to-charging station and vehicle-to-grid communication.

The Open Charge Point Protocol Roadmap

OCPP 1.5 released in 2013	OCPP 1.6 released in 2015	OCPP 2.0 released in 2018

OCPP 1.5 is a SOAP over HTTP based protocol for operating a Charge Point from a Central System. This allows data to be exchanged from both charge point to the central system over the internet. OCPP 1.5 supports the following key functionalities:

- Charging station is able to make contact with the central system upon startup
- Authorizes the start and stop of charging sessions
- When a firmware update is ready, the central system will send a message to the charge point
- Communicates technical errors or failures to central system
- The central system can ask a charge point to send diagnostic data
- There is the option of reserving a charge point
- Change Configuration enables a central system to modify different charge point settings

OCPP 1.6 introduces new features to accommodate the market: Smart Charging, OCPP using JSON over WebSocket's, better diagnostics possibilities (Reason), more Charge Point Statuses and TriggerMessage:

- Support OCPP 1.5 functionality
- Firmware Management (updates and diagnostic log)
- Local Authorization list management - manages the local authorization list in the charge points
- Supports the reservation of a charge point
- The TriggerMessage message is added, giving the Central System the possibility to request information from the Charge Point
- Smart Charging - allowing the central system to influence the charging power or current of a specific EV, or the total allowed energy consumption on an entire charge point

OCPP 2.0 introduces new features to accommodate the market; mainly to improve handling large amounts of transactions, increase cyber security, extend smart charging functionality, and to include Plug & Charge ISO standards. New features include:

- Extended security (i.e. security profiles, certificate handling, encryption, security logging, etc.)
- Device Management of the Charge Point for improved provisioning, monitoring and maintenance. This also allows a Charge Point Operator to monitor, configure alarms etc. on a lot of parameters in a Charge Point
- Improved Smart Charging support including:
  - Vehicle to grid
  - External local smart charging signals (HEMS)
  - Support for ISO/IEC 15118 including Plug-and-Charge
- Support for displaying tariffs & costs

Conclusion

As we transition away form internal combustion engines to electric vehicles, adequate infrastructure that can be responsive to the demands of drivers needs to be put in place. In order for the charging infrastructure to meet the demands of the market and consumers, the adoption of open standards and interoperability will be necessary. Open standards will not only allow flexibility with charging equipment, ensuring that the EV charging networks stays up to date with the latest technology, but will also allow for open communication between the driver, the vehicle, the charging station and the grid. An open network facilitates dynamic load management that can sync with the grid operator pricing signals, integration of renewables, easy exchange of vehicle information and streamline payment and other transactions. Ultimately, open standards would allow for an EV charging infrastructure that is accessible, more reliable, and enables an enhanced driver experience.

About Greenlots

Greenlots is unlocking the possibilities of the new electric mobility future by delivering innovative software and services that empowers utilities, cities, communities and automakers to deploy EV charging infrastructure at scale. Our technology is connecting people to their destinations in a safer, cleaner, and smarter way. Headquartered in Los Angeles, CA, the company's global footprint spans across three continents with deployments in 13 different countries.

For more information contact us at **+1-888 751 8560** or email at **info@greenlots.com**

- www.greenlots.com
- www.facebook.com/greenlots
- www.twitter.com/greenlots
- www.linkedin.com/company/greenlots