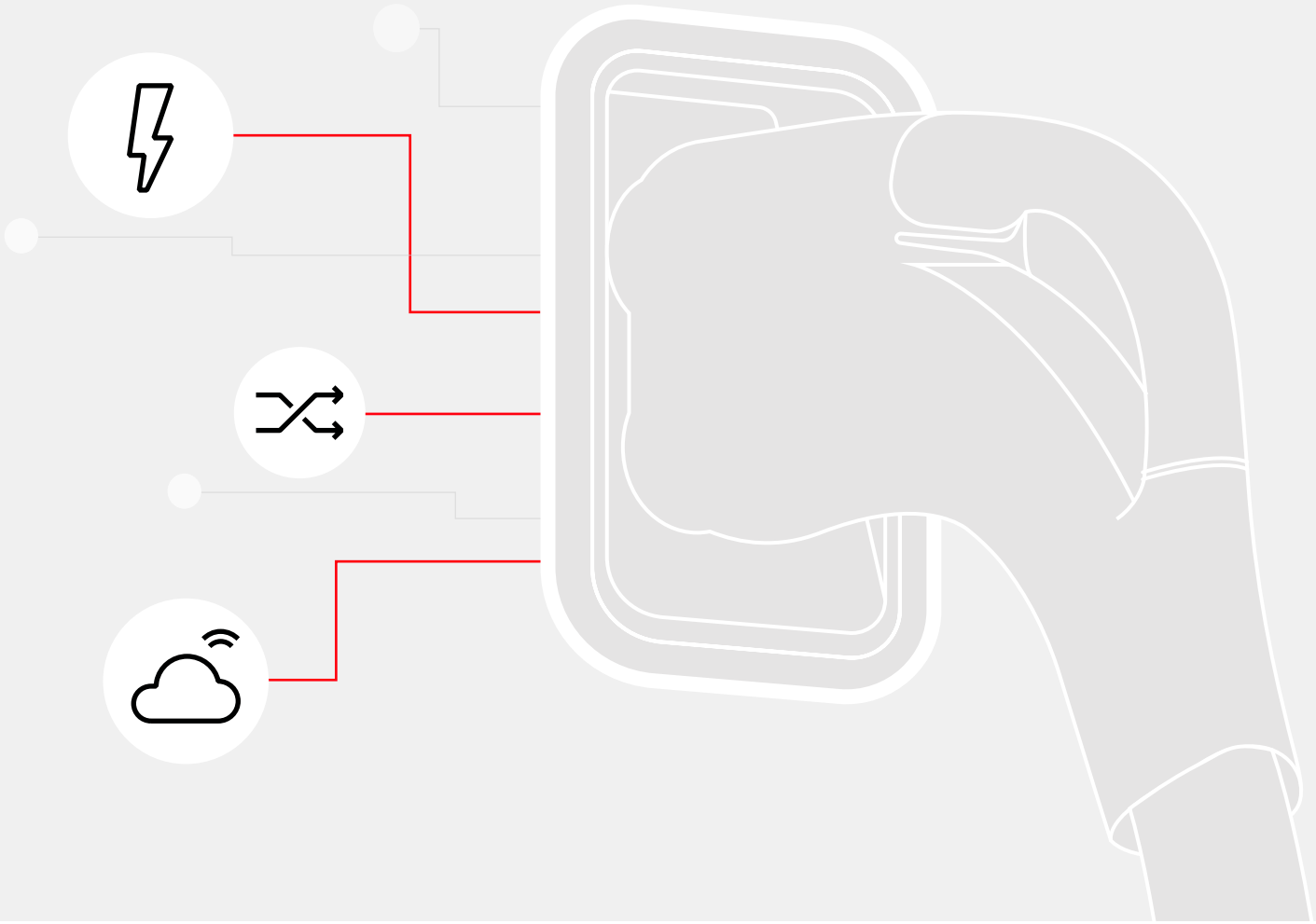


The Digital Side of Charging:

the Future of OCPP and ISO 15118

ABB E-mobility

Inside this Guide

01

Digital Protocols Underpin a Seamless Charging Experience

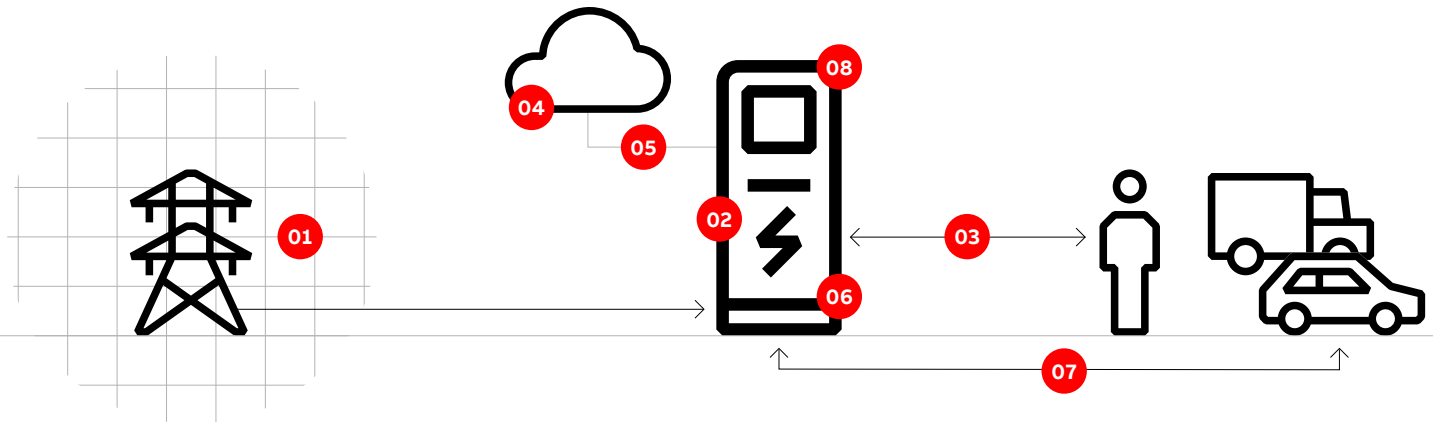
Unlike traditional liquid fueling, which is primarily a mechanical endeavor, charging an electric vehicle is, unsurprisingly, an electronic task. While you still "plug in," the process of delivering a charge happens in the background and is decidedly digital. In order to deliver a seamless charging experience, communication between charger, car, and charge point operator must be flawless.

The digital framework of charging is evolving to make charging easier and smoother, with the two primary standards and protocols that set the parameters for charging sessions undergoing major upgrades. This primer provides an overview of the digital foundation today, what the upgrades include and will provide, as well as recommendations on how the transition should be implemented to ensure successful charging experiences for all.

Seamless Charging
Charging success depends on flawless communications between the charger, vehicle, operator, and driver.

Navigating Upcoming Upgrades
Upgrades to EV charging protocols can enhance the user experience if phased in properly.

8 Challenges to Reliable and Scalable E-Mobility Charging



01
Not ‘Big’ Enough
Grid Connection

02
Lack of
System Thinking

03
Complex End-
User Experience

04
Different
OCPP Backends

05
Broken Digital
Payment Flow

06
TCO of
Power Electronics

07
Weak Protocols
Software Stacks

08
Poor
Asset Managment

As the e-mobility industry continues to grow, the challenges we must overcome to deliver efficient and reliable charging at scale are coming into focus. At ABB E-mobility, we see **eight core challenges** today that are inhibiting electric transportation from delivering its full promise to vehicle owners and operators.

These eight pain points are often intertwined, and digital communications systems and protocols are no different. **Improving the communication pathways** between vehicle, charger, and network will help simplify the complex user experience (3), enable seamless operation with different **OCPP** backends (4), repair broken digital payment flows (5), and address weak protocols and software stacks (7). In this paper, we'll show you how.

02

Two Digital Conversations, One Charging Experience

When you plug a charging connector into a vehicle, two separate digital conversations occur with the charger sitting in between the two. The first conversation is between the vehicle and the charger, where the vehicle asks the charger for power and the charger must understand the request in order to deliver. This conversation tends to be guided either by ISO 15118, which was developed by the International Standardization Organization (ISO), or by DIN SPEC 70121, where DIN stands for "Deutsches Institut für Normung" (German Institute for Standardization), a non-profit organization serving as the national body for standardization. On the other side, the charger talks to the network operator to authorize payments, track the charging session, provide status updates to the driver's phone app, and allow the operator to see any problems with the charging session. This communication process is typically guided by a protocol developed by the Open Charge Alliance (OCA) called Open Charge Point Protocol (OCPP).

Vehicle to Charger
DIN SPEC 70121
ISO 15118

Charger to Network
Open Charge Point Protocol (OCPP)

When a charging connector is plugged in, two digital conversations occur:

01

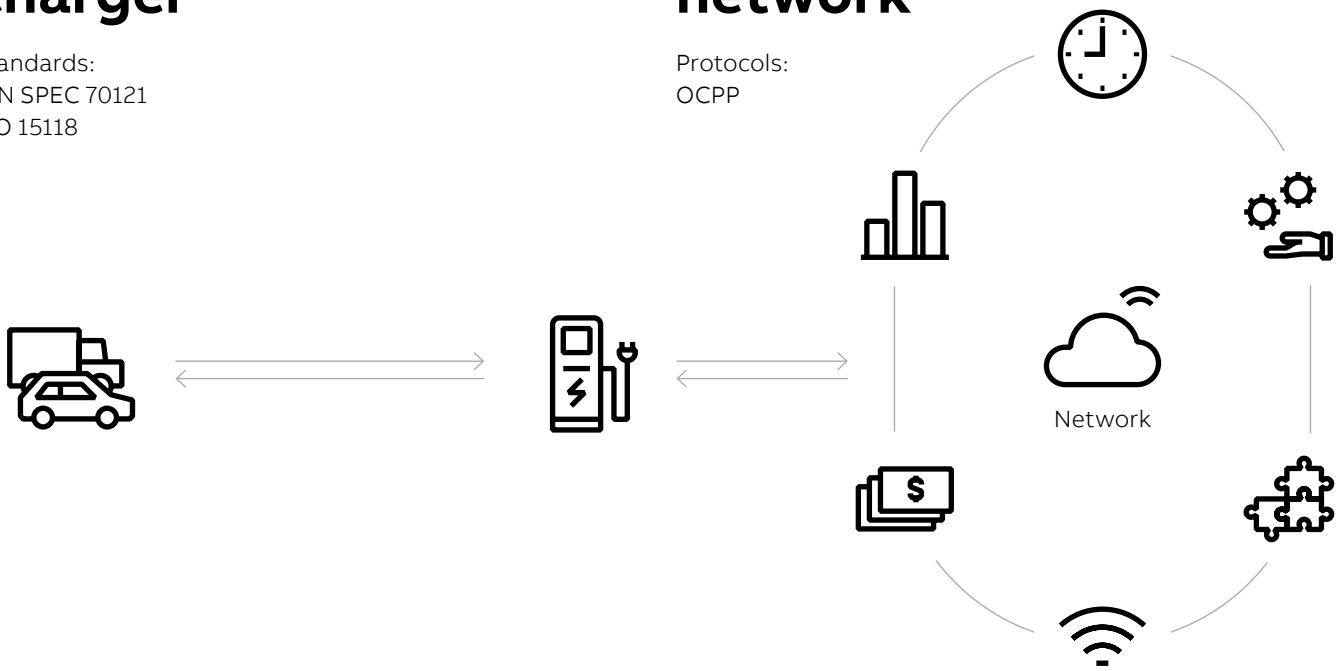
Vehicle to charger

Standards:
DIN SPEC 70121
ISO 15118

02

Charger to network

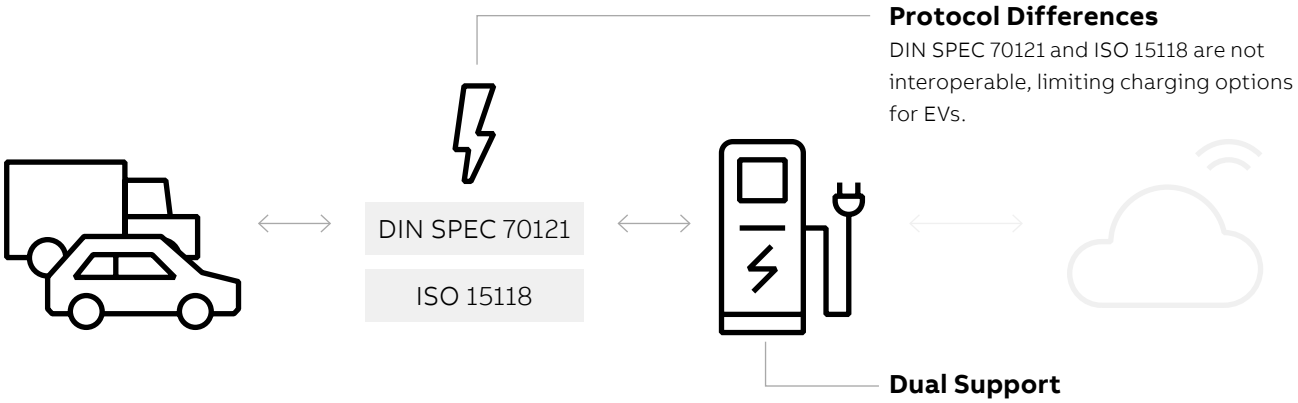
Protocols:
OCPP



When both conversations go smoothly, drivers can enjoy a seamless charging session. However, the languages and processes that define these communications are rapidly evolving as technology improves, EV adoption grows, and user needs expand. To deliver successful charging sessions, numerous **charging manufacturers, vehicle manufacturers, and operators must agree to speak the same language and work in lockstep.** Working in lockstep involves a monumental process of agreeing to, implementing, and improving global and regional industry-wide standards and protocols. **This process is emerging from its first phase, which began about a decade ago and is now transitioning to the next phase of advanced digital communications, software, and hardware.**

Since the early days of the EV industry, **ABB E-mobility has led the development** of these standards and protocols, continuously pursuing advancements toward a seamless charging experience for drivers.

Vehicle to Charger Communication



Protocol Differences
DIN SPEC 70121 and ISO 15118 are not interoperable, limiting charging options for EVs.

Dual Support
ABB E-mobility chargers support both standards, allowing vehicles to choose their communication protocol.

Traditionally, EV to EV charger communication is covered by two standards: DIN SPEC 70121 and ISO 15118. DIN SPEC 70121 is more prevalent in the field because it was published earlier than the current version of ISO 15118-2, but ISO 15118-2 has much richer capabilities, including 'Plug and Charge', encryption, and digital certificates.

Due to differing functionalities and capabilities, the protocols are not interoperable. This means that an EV that only supports DIN SPEC 70121 cannot be charged by a charger that only supports ISO 15118, and vice versa. Fortunately, many EV chargers including those made by ABB E-mobility, support both standards. So when a vehicle plugs in to one of these chargers, it tells the charger which language it would like to speak and the charger can respond accordingly. However, while many EV chargers support ISO 15118, many EVs do not, and those vehicle manufacturers will need time to implement ISO 15118-2 protocols.

Protocol	DIN SPEC 70121	ISO 15118-2
Data Format	DC only	AC & DC
Plug & Charge	—	✓
Communication Security	—	TLS, digital certificates, digital signatures
Smart Charging	—	✓
Bi-Directional Power Transfer	—	—

DIN SPEC 70121

This German standard defines the communication between a DC charging station and the electric vehicle, incorporating technical specifications based on an early version of ISO 15118-2.
DIN SPEC 70121 was published to provide standardized communication requirements for EVs while ISO 15118-2 was being finalized. Still prevalent today, DIN SPEC 70121 has several limitations, including no support for AC charging, Transport Layer Security (TLS), digital certificates, 'Plug and Charge', or digital signatures. The simpler, easier-to-implement protocol of DIN SPEC 70121 is partly why it's still common in the market and why the transition to ISO 15118-2 has been slower than expected.

Easy to Implement

Less Capable

Fewer Features

ISO 15118

This is a standard family that defines communications requirements for the EV to grid interface.
ISO 15118 consists of multiple parts, each addressing different aspects of communication, and offers improvements over DIN SPEC 70121. Key features like 'Plug and Charge' and TLS enable a more secure charging experience. Plug and Charge securely exchanges certificates between the EV and the charger, allowing the charger to authenticate the vehicle and automatically authorize payment without swiping a credit card. This simplifies the process for EV drivers, who can just plug in the charging cable and start the session automatically.

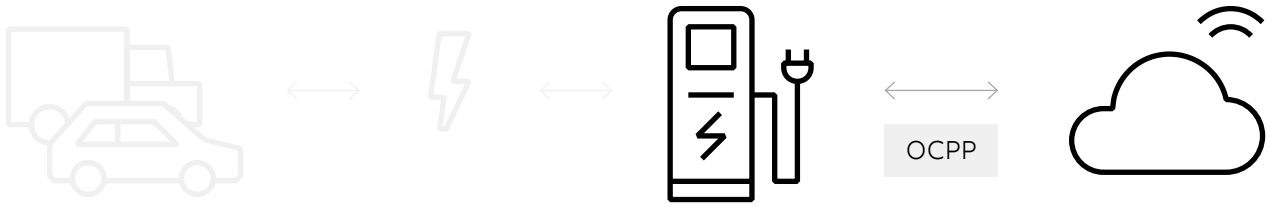
Plug and Charge

Smart Charging

To ensure consistent charging experiences across the various manufacturers, the ISO 15118 standard family includes conformance tests with a pass or fail criteria to verify whether an implementation meets the standards.

Requirements	Conformance Tests
ISO 15118-1 General information and use case definition	Not applicable
ISO 15118-2 Network and application protocol requirements	ISO 15118-4 Network and application protocol conformance tests
ISO 15118-3 Physical and data link layer requirements	ISO 15118-5 Physical and data link layer conformance tests
ISO 15118-8 Physical and data link layer requirements for wireless communication	ISO 15118-9 Physical and data link layer requirements for wireless communication
ISO 15118-20 Second generation network and application protocol requirements	Under development

Network Operator Communications



EVSE to Charge Point Operator (CPO) or network operator communication functionality is covered by Open Charge Point Protocol (OCPP). OCPP is an open-source communication protocol developed and curated by the Open Charge Alliance (OCA) so that EV chargers can communicate with network operators. OCPP enables communication between EVSE and CPO by providing the network architecture as well as the structure of messages between the charger and the network. While OCPP is used by most charging networks, it is technically not a standard, as it does not follow the same development and approval process as a typical standard.

OCPP 1.6J

The most common version of OCPP that is implemented in the field is OCPP 1.6J, which was released in 2015.

In addition to SOAP (Simple Object Access Protocol), one of the main features is the support for JSON (JavaScript Object Notation), which is reflected by the J in 1.6J. JSON is a lightweight data exchange format that is human, readable and easier to implement.

OCPP enables CPOs and charging networks to manage their charger and provide key information to drivers, like charging session data.

Additionally, OCPP 1.6J includes smart charging support for load balancing, enables the use of charge profiles, and supports reporting statuses and messages.

JSON Support

Smart Charging

03

Upgrading for the Next Generation of Charging

Building upon lesson learned, market maturation, and advances in charging technology, both protocols are undergoing significant upgrades to unlock benefits that will improve the charging experience. However, the transition to the latest versions of OCPP and ISO 15118 is not without its challenges, so we recommend a phased transition as detailed below.

ISO 15118-2
upgrade to
ISO 15118-20

OCPP 1.6J
upgrade to
OCPP 2.0.1

Upgrade ISO 15118-2 » **15118-20**

Upgrades

Enhanced Functionalities	Improves Plug and Charge, and introduces Bidirectional Power Transfer (BPT)
Real-Time Pricing	Supports real-time pricing capabilities
Improved Security	Features enhanced communications security with TLS version 1.3
Additional Power Modes	
BPT Bidirectional power transfer	Allows EVs to discharge power back to the grid
WPT Wireless Power Transfer	Uses inductive charging
ACD Automatic Connection Device	Automates charging for buses via pantograph

Challenges

Computing Power	Older chargers may lack the necessary computing power for ISO 15118-20
Compatibility Issues	Chargers can run both ISO 15118-2 and -20, but vehicles can't currently specify which version to use
Conflicting Requirements	Compatibility challenges exist due to conflicting requirements between ISO 15118-20 and -2
Incomplete MCS Address	ISO 15118-20 does not fully address the Megawatt Charging Standard (MCS)
Standard Not Finalized	ISO 15118-20 standard is still in development. An amendment is expected to be finalized in 2025

Protocol	ISO 15118-2	ISO 15118-20
Data Format	AC & DC	AC & DC
Plug & Charge	✓ (limited)	✓
Communication Security	TLS 1.2	TLS 1.3
Smart Charging	✓	✓
Bi-Directional Power Transfer	—	✓

Upgrade OCPP 1.6J » **2.0.1**

The EV charging industry is beginning to transition from OCPP 1.6J to OCPP 2.0.1, which will unlock new capabilities and functionality, but will not be without its challenges considering they are currently **incompatible with each other.** The incompatibility between the two versions exists at the software and hardware levels, as older chargers often lack the power or architecture to run OCPP 2.0.1. CPOs will likely need to maintain two separate backend networks for OCPP 1.6J and OCPP 2.0.1.

Upgrades

OCPP 2.0.1 Release	Introduced in 2020 as a major enhancement over OCPP 1.6J
Enhanced Management Features	Enables CPOs to configure and monitor EV chargers
Improved Reliability	Increases plug-in success rates by supporting ISO 15118 messages for better EV-charger communication
Improved Transaction Handling and Security	Enhances management of charging sessions and ensures secure transactions
Not Backward Compatible with OCPP 1.6J	Cannot manage chargers that operate on 1.6J

Challenges

Separate Backend Networks	Charging operators must maintain two distinct backend systems for OCPP 1.6J and OCPP 2.0.1, increasing costs, complicating management, efficiency, and customer experience
Challenges in Upgrading	Many older chargers may not support OCPP 2.0.1, requiring both versions to coexist and a careful transition strategy

Protocol	OCPP 1.6J	OCPP 2.0.1
Data Format	SOAP and JSON	JSON
Communication Security	Password authentication	TLS 1.2 or higher
Smart Charging	Load balancing and charge pro-files	Improved transaction handling and support for ISO 15118
Bi-Directional Power Transfer	—	✓

OCPP 2.0.1 is broken down into **multiple profiles** (listed below) offering additional functionalities. The profiles beyond Core are **optional features** that can be implemented if they are operationally desirable. Not all profiles are needed for OCA certification, and OCA considers Core profile as the only mandatory requirement for compliance.

Profile	Conformance Tests
Core	Mandatory
Advanced Security	Optional
Local Authorization List Management	Optional
Smart Charging	Optional
Advanced Device Management	Optional
Reservation	Optional
Advance User Interface	Optional
ISO 15118 Support	Optional

04

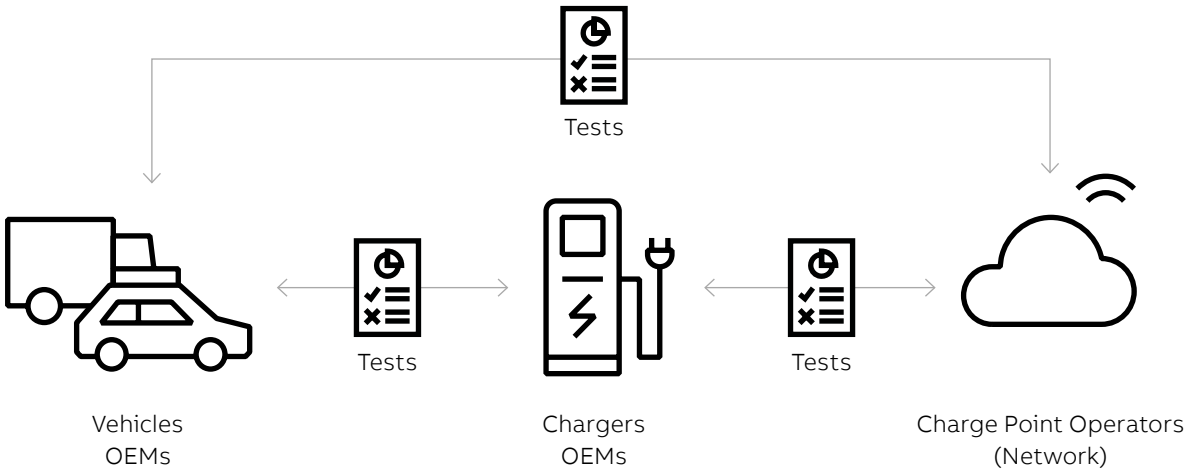
Interoperability Testing Ensures Seamless Charging

Just because two parties or types of technology, like a vehicle and charger, support the same version of a protocol or standard, does not mean they will operate seamlessly; rather, there are interpretations of how protocols can be implemented. These differences of interpretation or 'dialects' of the same language can impact their ability to communicate. The way to solve this problem is for various vehicles and chargers to conduct 'interoperability testing' with each other. Interoperability testing allows vehicles and chargers to try their implementations of the standards with each other to uncover and fix any misunderstandings.

Ensuring Seamless Technology Communication

Protocol differences disrupt communication, requiring testing to resolve compatibility.

Interoperability Testing Across the EV Ecosystem



Interoperability testing is needed on multiple levels, with the vehicle Original Equipment Manufacturers (OEM), charger OEM, and CPO or network. There are dedicated testing events such as CharIN Testivals that bring together different OEMs, hardware and software providers, and CPOs to conduct testing over a couple days in a single location. This type of event is useful because it enables interoperability testing with multiple parties within a short period of time. It also provides a snapshot of the different communication protocols currently implemented in the field. However, testing events are not a substitute for one-on-one interoperability testing.

Through our OEM interoperability program, ABB E-mobility conducts extensive testing with **customers and partners** to ensure seamless integration of our systems. We also participate in **CharIN Testivals** where we test our implementation with others to benchmark interoperability and maturity of the communication protocols.

CharIN Testival

Unite OEMs, charger OEMs, and CPOs for rapid interoperability testing and benchmarking

OEM Interoperability Program

One-on-one testing with vehicle OEMs to ensure seamless charger integration

Certification Facilitates Interoperability, but Faces Challenges

In the complex and evolving landscape of software communications standards and protocols, maintaining consistency across the industry is important for seamless charging experiences. One way to do this is through certification programs, which ensure that the mandatory features and functions of each standard or protocol are implemented correctly. Certification regimes in the EV charging industry are still in their early stages of maturity and hold promise. We support their development to meet current needs and scale with industry growth.

There are three different types of certifications – first party, second party, and third party. **First party** certification is when the producer of the product self-declares conformance to the requirements of a standard. **Second party** certification is when the user of the product declares conformance to the standard. An example is when a utility laboratory certifies a product before deploying it on their system. **Third party** certification is when an independent and accredited laboratory tests and certifies a product. An example is the EnergyStar certification, where a product is tested by an authorized and accredited laboratory and receives an EnergyStar certification mark.

Third-party certification is desirable for independent, high-quality testing and validation, but is still in its early stages. ISO 15118 lacks a third-party certification program, and OCA's is just beginning. There are various challenges that come with establishing such programs: (a) limited accredited test labs can lead to long wait times; (b) limited third party expertise requires companies to expend resources to educate test personal, which can result in inefficient testing; (c) the creation of industry approved test cases takes resources and industry collaboration; (d) inconsistencies continue to exist in some of the protocols and standards; (e) some relevant EV charging protocols require re-certification every time charger software is updated, which can happen every few weeks.

At the moment, there are no accredited and approved third party test laboratories for ISO 15118 or DIN SPEC 70121. As such, ABB E-mobility is self-certified for ISO 15118-2 conformance. OCPP offers a certification program, but it faces some growing pains, as highlighted above. That said, ABB E-mobility has OCPP 1.6J certification from OCA and is actively pursuing OCPP 2.0.1 certification for certain products.

First-party

Company

Second-party

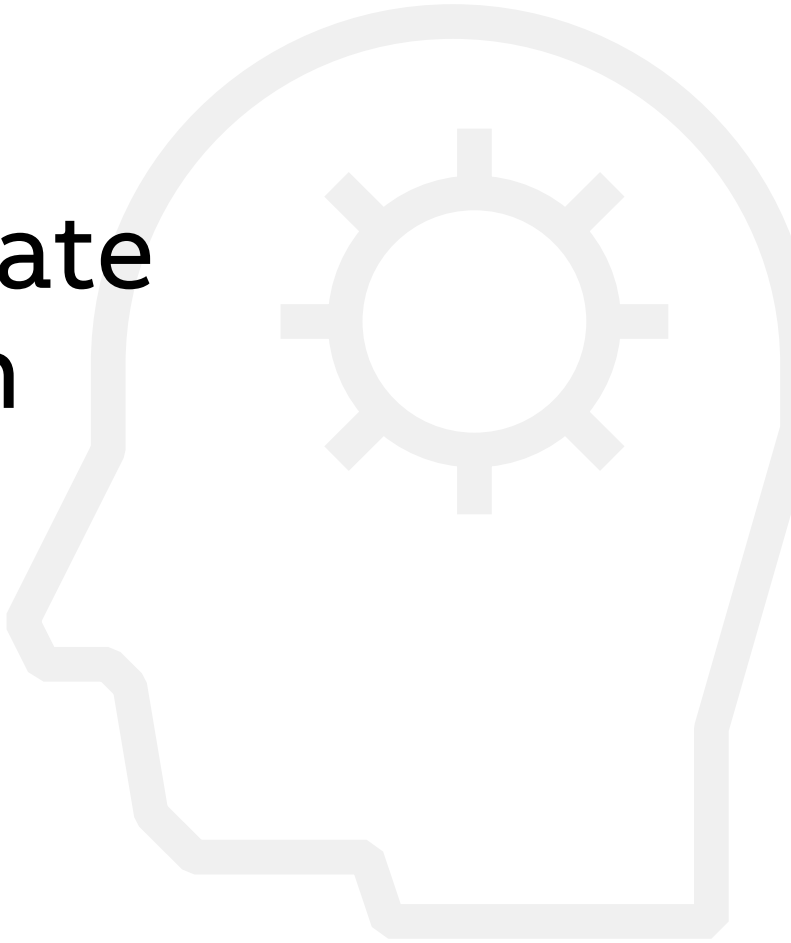
User

Third-party

Independent lab

05

How to Navigate the Transition



The next generation of EV communications digital platforms holds significant promise, with new features and functionality that will improve the charging experience across the board, from more seamless charging sessions to more reliable chargers. However, the **complexity and nuance of how industry policy makers and regulators** manage this transition cannot be understated.

ABB E-mobility recommends a **phased transition to the next generation of software protocols**, to mitigate potentially negative impacts on drivers and network operators, and allow for a successful transition. If managed thoughtfully, the transitions from OCPP 1.6J to OCPP 2.0.1, DIN SPEC 70121 to ISO 15118-2, and ISO 15118-2 to ISO 15118-20 can accelerate the development and deployment of efficient and reliable charging experiences.

Phased Transition

Facilitate the shift to next-generation communication protocols, to ensure a seamless charging experience for users

ISO 15118

For the transition of ISO 15118, ABB E-mobility recommends the following implementation timeline:

Now	06/2025	24 months after amendment completion
• **Hardware readiness** for ISO 15118-2 and ISO 15118-20 • **EV and EVSE compatible** with ISO 15118-2 • ISO 15118-4 and ISO 15118-5 **conformance self certification**	**Plug and Charge with multiple PKI support**	**ISO 15118-20 support**

Importantly, the hardware readiness for ISO 15118-2 and ISO 15118-20 should not be applied retroactively to chargers already deployed in the field because there is often additional hardware capability needed to support these protocols. ISO 15118-20 support should also not be applied retroactively since it is not compatible with ISO 15118-2.

OCPP

For the transition to OCPP 2.0.1, ABB E-mobility recommends the following transition period:

01/2025	06/2025	10/2026
OCPP 2.0.1 conformance capability • Core and Advanced Security Profiles • OCTT Self-Test Tool Verification	**OCPP 2.0.1 certification** • Core and Advanced Security Profiles	**EVSE and Network implement OCPP 2.0.1 on chargers**

Importantly, EVSE that is installed prior to January 2026 should be grandfathered and exempt from implementing OCPP 2.0.1 because it is not backward compatible with OCPP 1.6J.

In Summary

The digital frontier is a key foundation for a seamless charging experience. With lessons learned over the past decade, advances in technology, and increases in deployment, the EV charging industry is evolving the digital side of charging. We should move toward the second generation of digital communications in a way that improves customer satisfaction, reduces complexity, and enhances reliability. We think the best way to do that is with a thoughtful and phased transition.

Get in touch
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