

CharIN Recommendations for EV-EVSE Communication & Interoperability

Advancing EV-EVSE Communication & Interoperability

North America Charging Interoperability Task Force Communications & Security
Subgroup

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1. Current State of Industry

Today, one of the primary challenges for electric vehicle (“EV”) adoption is the complex charging experience faced by drivers. The eMobility industry is going through significant changes with standardization of protocols, consolidation of connector plugs, federal and state regulations, etc. This will require alignment in the market between industry stakeholders such as automotive OEMs, charging network operators (CPO) and federal and state government agencies to ensure that a common set of rules is adopted by all players to improve the charging experience for EV drivers. To that end, the Communications and Security subgroup, operating under the CharIN North America Charging Interoperability task force (NACI TF), was created to advance interoperability between the EV and EVSE (electric vehicle supply equipment) through a consistent and seamless driver charging experience.

2. Communications & Security Charter

The purpose of NACI TF is to ensure seamless interoperability through industry aligned system-level charging specifications and definitions. The Communication & Security Sub-Group, operating under the NACI TF, is dedicated to advancing the integration of EV and EVSE communication and security.

This subgroup will advance the integration of SAE J3400-related EV and EVSE communication and security systems and accelerate the adoption of reliable and secure charging solutions. The outcomes of this working group will serve as recommendations to SAE, CharIN organization members, and stakeholders in the broader eMobility ecosystem to support the alignment and acceleration of all standardization activities.

The Communication & Security Sub-Group focused on the following objectives:

2.1. Standardization

Collaborate with relevant standardization bodies, organizations, and task force members to ensure alignment with existing and emerging communication and security standards.

2.2. Guideline Development

Produce best practices for implementation and testing between DIN 70121 and ISO 15118 devices, including Plug&Charge. o Produce guidance for SAE J1772 development as well as any V2X standards relevant to SAE J3400.

2.3. Testing and Certification Framework

Support development of testing and certification frameworks with a focus on SAE J3400 in the form of whitepapers or collaborate with groups already developing testing and certification frameworks.

2.4. Education and Awareness

Foster collaboration by organizing webinars, workshops, and educational materials to enhance understanding of communication and security standards among industry stakeholders, regulators, etc. and drive adoption of secure and interoperable EV charging systems.

3. Key Topics

To ensure a consistent charging experience for the EV driver, it is imperative that the various platforms in the ecosystem should use standard communication protocols for interoperability. The following topics related to communications were prioritized by the subgroup –

3.1. ISO 15118

Over the past few years, the majority of the market has aligned on the ISO 15118 -2 standard for secure authentication between the EV and the EVSE. ISO 15118 -20, the next available version, will enable additional use cases including bidirectional power transfer, smart charging, etc. In tandem with market alignment, federal and state regulatory policies have been influential to promote adoption. Notably, the National Electric Vehicle Infrastructure (NEVI) program requires ISO 15118 and Plug&Charge to be supported by charging networks. An overview of the current communication protocols & use cases supported is shown below

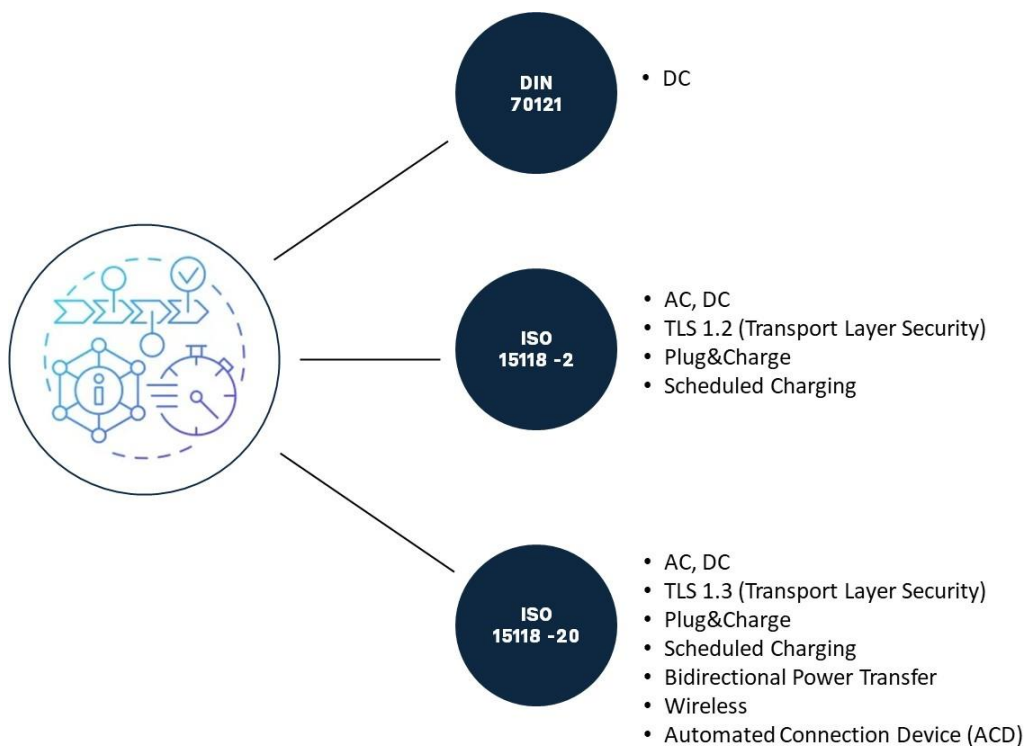


Figure 1 overview of the current communication protocols & use cases

3.2. NACS / SAE J3400

Starting in 2023, most major automotive OEMs have decided to adopt Tesla's North American Charging Standard (NACS) to gain access to Tesla's Supercharger network. Since then, SAE International formed a task force to standardize the NACS connector, called J3400, and plans to formally publish the J3400 standard in 2024. Given that Tesla does not currently support ISO 15118, it is critical to ensure that J3400 requires ISO 15118 -2 with the option to support ISO 15118 -20 in the future. This will enable EV drivers to have the same consistent, charging experience on all charging networks (Tesla and non-Tesla).

3.3. Plug&Charge

Plug&Charge is currently the most widely adopted feature in the ISO 15118 -2 standard. Plug&Charge enables the most seamless charging experience for the EV driver – start charging without having to use a mobile app, credit card or an RFID card. Plug&Charge is currently supported by most major automotive OEMs such as Porsche, Ford, BMW, Audi, Mercedes, etc. and most major charging networks such as Chargepoint, Electrify America, EVgo, EVConnect, Francis Energy, etc. As adoption of Plug&Charge grows in the industry, there are a couple of key questions that need to be addressed going forward –

3.3.1. How to ensure interoperability with potentially multiple V2G PKI providers entering the North American market?

Today, the majority of automotive OEMs and charging network operators use the Subject V2G Public Key Infrastructure (PKI) to provide Plug&Charge with ISO 15118 for their customers. To provide more options to the market, other V2G-PKI providers are expected to emerge in North America. SAE Industry Technologies Consortia (SAE ITC), an affiliate of SAE International has been working to launch the Electric Vehicle PKI Consortium (SAE EVPKI), creating a framework and establishing guidelines for a PKI platform for the eMobility industry. The SAE EVPKI Consortium will be open to members of the EV public charging industry, and it is also expected that other V2G-PKI providers will join the consortium. As such, there will be multiple V2G-PKIs available and it is critical that all available PKIs can be interoperable to ensure a consistent, seamless and secure charging experience for the EV driver. To that end, the Multi-PKI subgroup, operating under the CharIN North America Charging Interoperability (NACI) task force was created to advance interoperability between the EV and EVSE in a multi-V2G-PKI environment.

The Multi-PKI subgroup successfully demonstrated TLS authentication with cross-recognition between 3 V2G Root certificates at the CharIN North America Festival in November 2023 without any proprietary software changes in the EV and EVSE. In 2024, the plan is to test contract certificate authentication with multiple MO/V2G PKIs.

An overview of the Multi-PKI testing at Festival is shown below –

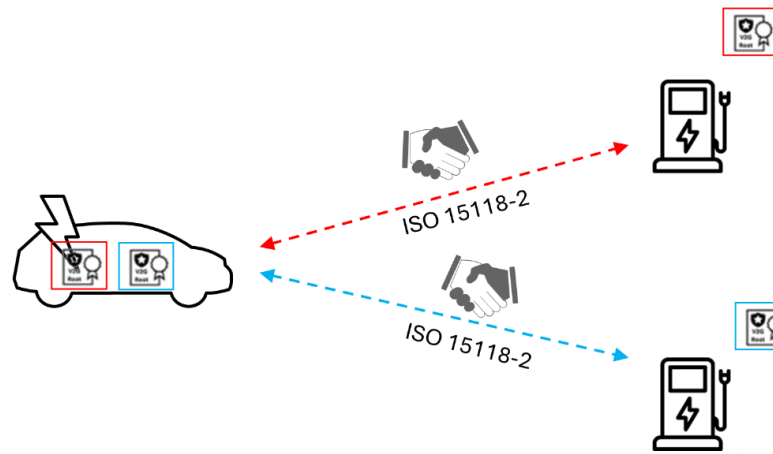


Figure 2 overview of the Multi-PKI testing at Festival

Later in 2024, SAE EVPKI plans to publish a Certificate Trust List (CTL) that will provide the processes and governance of multiple V2G-PKI providers and enable interoperability and digital trust between the EVs, charging stations and charging networks in the market. With ISO 15118 -20, interoperability via cross-certification between different V2G PKIs is defined but will require additional alignment between industry stakeholders and is most likely a topic for the future.

3.3.2. How to ensure interoperability with Plug&Charge between Tesla & non-Tesla EVs and EVSEs?

TLS with 2 V2G-PKIs using cross-recognition With the adoption of NACS by most automotive OEMs, the industry seems to be moving towards a new common connector in North America. Also, most major charging networks have announced that they will support both the Charging Combined Standard (CCS) and NACS on their charging stations. However, the communication protocol for NACS is being finalized and will be published in the J3400 standard. The SAE J3400 Technical Information Report (TIR) currently requires DIN 70121 with ISO 15118 -2 as optional - ISO 15118 -2 is required only for Plug&Charge. However, this does not ensure a consistent charging experience for Tesla and non-Tesla EV drivers when charging at Tesla and non-Tesla chargers

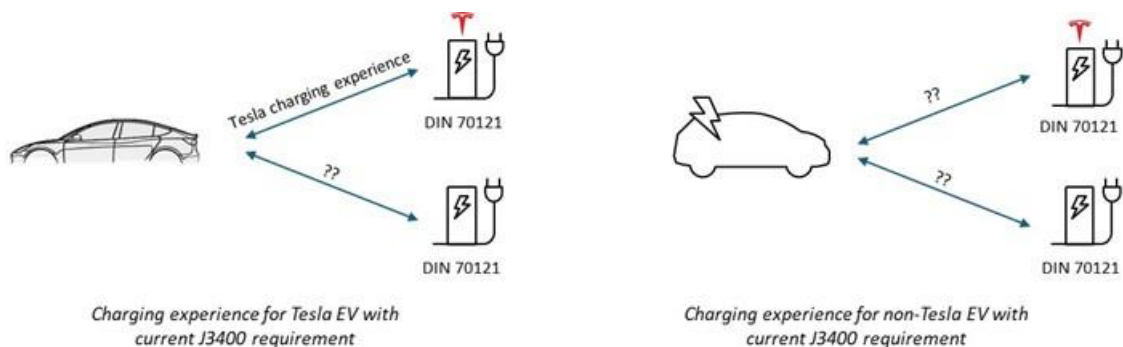


Figure 3 Overview charging experience Tesla driver and non-Tesla EV driver with Din 70121

With the majority of the industry adopting ISO 15118 -2 and regulatory policies driving it as a requirement, it is important to make sure that the charging experience is driven by ISO 15118 for communication between the EV and EVSE. This will enable a consistent experience with greater reliability for the driver.

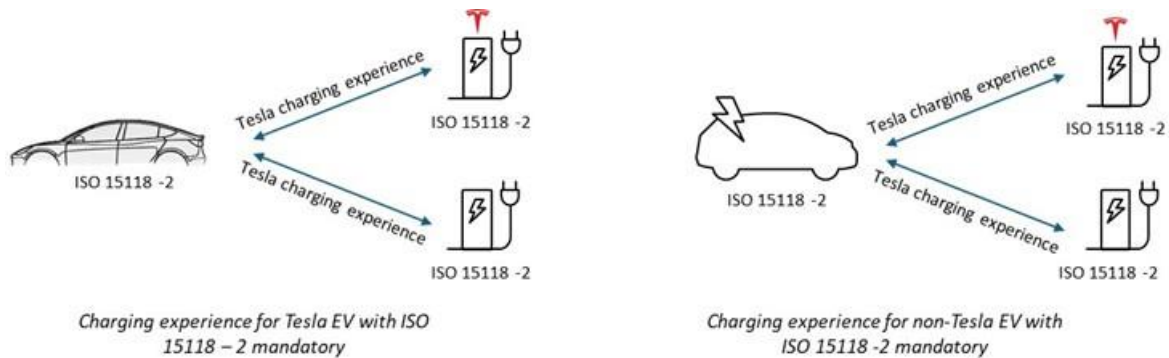


Figure 4 Overview charging experience Tesla driver and non-Tesla EV driver with

3.3.3. Support for EVs with 800V architecture

Today, there are a few EVs in the market that use 800V architecture which allows them to charge at faster speeds (up to 350 kW). However, this is only possible if the EVSE can support these speeds – only the High Power DC charging locations today can meet the charging speeds requested by these EVs. To ensure safety and a consistent experience, it is important to align on how.

4. Recommendations

Given that these topics will be important for interoperability and providing a seamless charging experience for the driver, the subgroup has the following recommendations –

4.1. Recommendation 1

The J3400 Recommended Practice (RP) should require ISO 15118 -2 as mandatory with ISO 15118 - 20 as optional until the conformance tests are available.

4.2. Recommendation 2

When Plug&Charge is requested, ISO 15118 -2 Edition 2 should be used along with the Service Discovery Protocol (SDP) request defined in that version for the Mobility Operator (MO) certificate hints.

4.3. Recommendation 3

Cross-recognition should be used to enable interoperability between multiple V2G PKIs for a successful TLS handshake between the EV and the EVSE.

4.4. Recommendation 4

When an EV with battery pack greater than 500V plugs into a EVSE that can only support 500V, charging is allowed if the EV voltage is below 500V and an appropriate warning is provided to the EV. o When an EV with battery pack greater than 500V plugs into a EVSE that can only support 500V, charging is not allowed if the EV voltage is above 500V and an error (Failed_ChargingSystemIncompatibility) is provided to the EV