Plug & Charge: Deployment & interoperability challenges of cardless charging

Daniel Quiles – IDIADA 07/11/2024

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Introduction to PnC

- EV users may be forced to having several phone charging apps and several RFID cards for travelling with their EVs. This creates **friction** for the electrification.

- **Plug and Charge** proposes to allow the user to charge seamlessly, independently from any user interaction.
  - This technology is comprehended in international technical standards (ISO15118) and opensource standards (OCPP).

- **Alternative technologies** have also entered the market to address these usability issues, such as **Autocharge**.
  - The specifications of the alternative do not ensure the security of the payment information of the user.
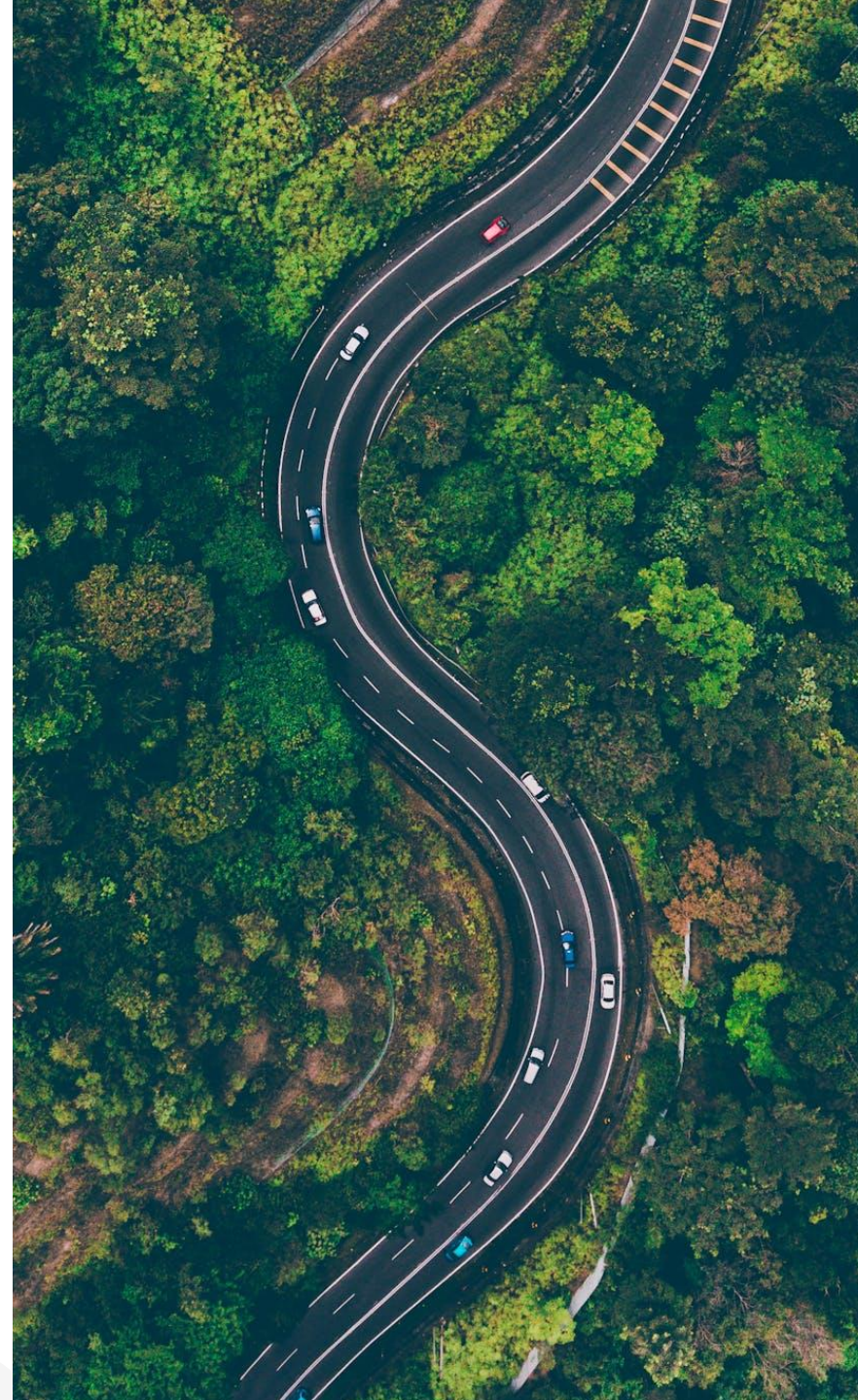
Trade-offs of the technology

Each of the benefits may be linked to a drawback

- **Benefits**
  - Enhanced user experience
  - Interoperability across manufacturers and networks
  - Improved security
  - Faster and simpler transactions

- **Drawbacks**
  - Complexity of the initial set up for the user
  - Infrastructure and products readiness
  - Increased technical complexity and potential incompatibilities
  - Potential privacy concerns

Readiness level evaluation

- The described **complexity** requires for a correct technical implementation.

- The project aims for the **evaluation of the PnC solutions** of the collaborators.

- **Key factors** to ensure**:**
    1. Technical **compliance** to the standard.
    2. Technical **compatibility** with other actors of the ecosystem.

- **Validation scenarios** considered in the project**:**
    1. **Conformance testing:** Validation of the Device under Test by using a test system that runs test cases.
    2. **Interoperability testing:** Validation of the PnC integration between the solutions of the different collaborators.

Testing tools and procedures

During the project the readiness of some PnC developments was evaluated:

- **Development of a methodology** to test the end-to-end communication of Vehicles, OEMs, operators, roaming platforms and service providers.
  - Check-sheets for **Conformance & Interoperability** testing of ISO15118-2
  - Procedures for the **onboarding into Hubject certificate ecosystem**

- **Development of the tools** that will perform the tests (EV/charger simulation tool).
  - Modular Charging Test System (**MCTS**)

- Organization of **real case Interoperability scenarios**
  - **Collaborators:** ABB, BMW, BFS, Hubject, Route220, SMATRICS, Volvo Cars, ZES

Interoperability challenges

- **Interoperability scenarios that were performed**

Laboratory Interoperability 1	OEM1	OEM2	operator1	Service provider
Laboratory Interoperability 2	OEM3	OEM2	operator1	Service provider
In field Interoperability 1	OEM1		operator1	Service provider
In field Interoperability 2	OEM3		operator1	Service provider

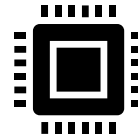# Interoperability challenges

- **Conformance scenarios that were performed**

Conformance EV 1
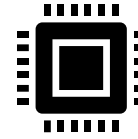
OEM1   Charger simulator   Service provider
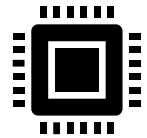
Conformance EV 2

OEM3   Charger simulator   Service provider

Conformance EVSE & CPO1
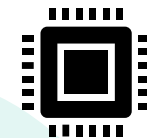
EV simulator   OEM2   operator1   Service provider

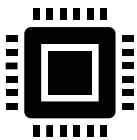**Conformance EVSE & CPO2**

EV simulator   OEM2   operator2   Service provider

Interoperability challenges

- **Conformance scenarios that were performed**

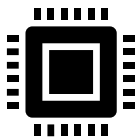**Conformance EVSE & CPO1**

EV simulator   OEM2   operator3   Service provider

Conformance EVSE & CPO2

EV simulator   OEM2   operator4   Service provider

Interoperability outcomes

- **Validation outcomes**

EV

EVs must validate the identity of the charger.
EVs must be capable of handling large messages with certificate data.
EVs should provide means to the user to charge with and without PnC.

Chargers

Chargers must manage correctly their identificator.
Chargers must validate the contract used for the payment.
Chargers must understand the error situations and codes of operators
Chargers must implement the standards as described in the Technical norms

Operator

Operators may have problems for managing multiple charger models
Periodical check of the certificates in the field chargers recommended
Recommended to implement the Contract Update and Installation on EV
Operators must be prepared for the audit of the connection to the PKI
QA environment was considered for the Test Environment (not Production)
Operators may have connectivity and networking issues
Operators may have problems with PnC certificates complexity

Interoperability outcomes

- **Validation outcomes**

Laboratory Interoperability	Expiry dates from the contracts must be checked by operator and charger The validity of the contract received by an operator must be checked Operator and charger must be using the error codes according to the standards
In field Interoperability	Smaller number of scenarios but most of them were successful Error was more difficult to diagnose

KEY OUTCOMES:

1. **Correct and secure authentication of the identity of the actors**
2. **Enhance the reliability and quality of the developments**
3. **Follow the technical standard diagnose codes and procedures**
4. **Consider all the use cases and avoid corner error cases**

ISO15118 future challenges

- ISO15118-20 released **enhancing the cybersecurity** of the charging.

- ISO15118-20 considers **multiple service providers and certificate authorities.**

- ISO15118-20 adds **bidirectional charging.**

- **Multiple service provider companies** will be providing their certificate-signing services.

- **Charger control technology (OCPP)** is moving from an opensource specification to an **international standard (IEC63584)**, enhancing standardization.

Thank you for your attention

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