36th International Electric Vehicle Symposium and Exhibition (EVS36)
Sacramento, California, USA, June 11-14, 2023

CharIN e.V. – Improvement of charging quality by conformance testing and how an association can support

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Executive Summary

Under the CharIN umbrella, cross-industry stakeholders continue moving towards interoperable charging, where vehicles, chargers, and software systems work together and to make the user experience reliable, easy and smooth. CharIN´s international community is comprised of leading global companies representing every link to the e-mobility value chain and multiple experts who have been working together as a team to drive the requirements of charging all kinds of electric vehicles. As market ramp up leads to more and more product diversity also the number of interoperability issues will increase.

CharIN´s goal is to define requirements for the evolution of CCS related standards and for the certification of CCS based products. Therefore, a quality process was established to enable Conformance Testing all over the world under comparable conditions.

Keywords: testing processes, Regulations Codes and Standards (RCS), reliability, interoperability

1 Header

The Charging Interface Initiative e.V. - abbreviated to CharIN e. V. - is a registered association founded in 2015 to promote CCS as a standard worldwide. Since then, the association has grown to almost 300 international members along the whole value chain. 18 out of the top 20 car brands are already represented within CharIN, as well as the top 5 semiconductor companies and the leading EV charging station manufacturers.

Regional offices in Germany, Hongkong, China, India, Japan, Korea and the US supported by regional representatives in Brussels, Spain, Great Britain, New Zealand and in Dubai drive the positive membership development by organizing calls, presentations at events, workshops and member meetings in the international context, but also with respect to local requirements of the specific areas. One core asset of the CharIN association is the global network of experts from the member companies. With their help CharIN can collect field issues quickly and feed back the findings into related standardization committees.

As the market for charging technology is growing and thus the CharIN community is doing the same. This is presented by many studies an also highlighted in the picture below.

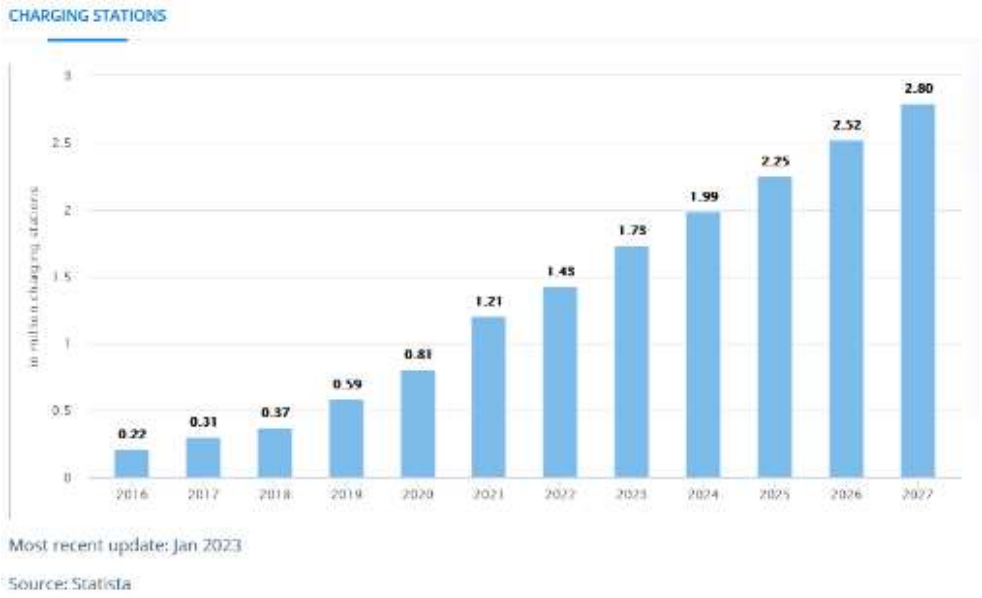

Figure 1 Charging station increase as indicator for market ramp up

As the technology is complex and several different standards are involved to build an Electric Vehicle (EV) or charging station it can be assumed that the potential for issues will increase as well. The following overview shall provide an overview of involved system architecture:

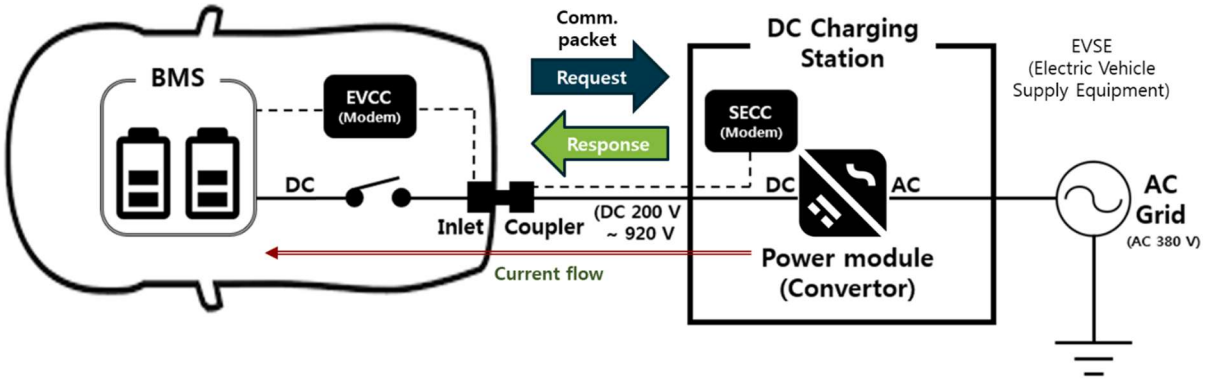

Figure 2 Overview of system architecture for EV charging

1.1. Harmonization of Standards

In five different international working groups as well as subgroups, task forces and project groups, members compile and discuss current challenges and develop common requirements regarding different topics of Charging Communication, Charging Infrastructure, Charging Connection, Grid Integration and Conformance Test/Interoperability. But also new topics as the requirements discussion for Mining machines and Cybersecurity is an area of work for the CharIN experts.

The path to fast and interoperable charging includes an international standard of a reliable, safe and powerful charging system. A simple and consistent customer interface that is used all over the world from low to high power charging and that is applicable for bikes, cars, trucks as well as for ships and planes. The worldwide alignment of requirements for EVs, EVSEs and its infrastructure is creating added value which will lead electro mobility to a success.

The Market is growing all over the different product ccategories thus will the potential faults that may occur.

That makes it even harder to test each individual combination of products as it would be the case for interoperability testing.

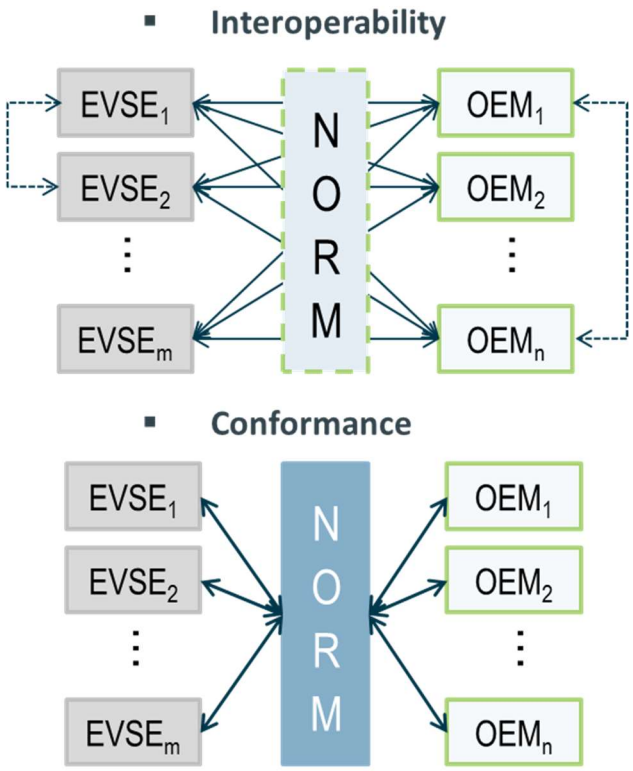

Figure 3 Testing scenarios (interop vs. conformance)

- **Interoperability** Testing (without CCTS, CharIN Conformance Testing System):
  Testing of EV with each EVSE and vice-versa is necessary
  to reach a full interoperability. Focus on selected EV
  and EVSE is needed to reduce the effort to an actionable level. This is **not feasible for growing market**

- **Conformance** Testing (with CCTS):
  Testing of every EV and/or EVSE against CCTS, which maps the current status of the development of charging-standards is **scalable for a growing market.**
  - One tool as reference for the standards
  - Cost saving through self-validation of EV and EVSE by manufacturer
  - Possibility of independent testing by third party

The harmonization of requirements of the international charging industry with a clear recommendation on technology and customer interface is a major deliverable of CharIN. Previously, various position papers,

recommendations and commitments were published and further will follow to promote the harmonization of requirements of the international charging industry. The position papers and recommendations can be found on the website of the CharIN e.V. at https://www.charin.global/technology/knowledge-base/.

1.1 Extended features for Charging EVs and new players

The Charging of EVs brings a lot of new advanced features besides regular recharging of the battery. In addition new Players enter the market and some of them start developments right from scratch which is always an opportunity and a challenge at once. Therefore, the CharIN e.V. focuses on the recommendation of requirements of a reliable, safe and powerful high-power charging system to support long range E-mobility – the Combined Charging System (CCS) and Megawatt Charging System (MCS). The challenge in charging is to do it as fast as possible that means the charging power has to be increased without ignoring the AC aspect and the overall one system approach of charging. The related international standards are compiled and referenced in an implementation Guide for CCS. CharIN is differentiating between different steps of the development. The mechanical as well as software related and time related availability of market ready functionalities are carefully reviewed by the experts of the CharIN members. With a clear target to describe an interoperable Charging system the related documents are chosen and referred to in the Guide for each maijor CCS step. Refer to CCS Steps model:
https://www.charin.global/media/pages/technology/170ce6f700-1641211134/ccs_big_picture.pdf

Moreover, the CharIN e.V. addresses the further development of features like plug and charge or conductive charging or wireless charging to make charging as comfortable as possible.

1.2 Relevance of a Quality Label

The different technical aspects on the charging interface are handled in dedicated working groups CharIN Focus Groups. They take care of the relevant market activities and challanges that need to be discussed on a industry platform.

For the existing and future products it will be inevitable to ensure a high quality level against the rising number of competitors. An aligned industry label can help to ensure visibility to the customers. Either end users at the charging stations or B2B customers that need to make strategic long-term decisions on products. Also, the integration of a industry quality check into public funding can be a supportive measure to ensure investment in reliable and safe charging products. So the benefits of such a label are dedicated for stakeholders of governmental bodies, Charge Point Operators (CPOs), Electric Vehicle (EV) manufacturers, Chargin station manufacturers, investors and finally end customers that can rely on the functionality.

As an example the Bluetooth and Wi-Fi Alliance can be mentioned as a success story for comparable approaches.

CharIN is focussing on interoperability and includes the most relevant specifications to a combination of relevant standards that need to be fulfilled to make sure charging of a CCS EV is working as expected. The fundamental legally binding and safety related certificates which are required in each market must be a pre requisite to this conformance check. This is not handled by the CharIN Conformace program.

Test Laborates arpound the globe are able to work according to the CharIN Quality Assurance Plan. In this way the market will benefit from the approach as it increases more competition with more testing Laborytories joing the CCS Conformance procedure.

2 Focus Group Conformance Test & Interoperability

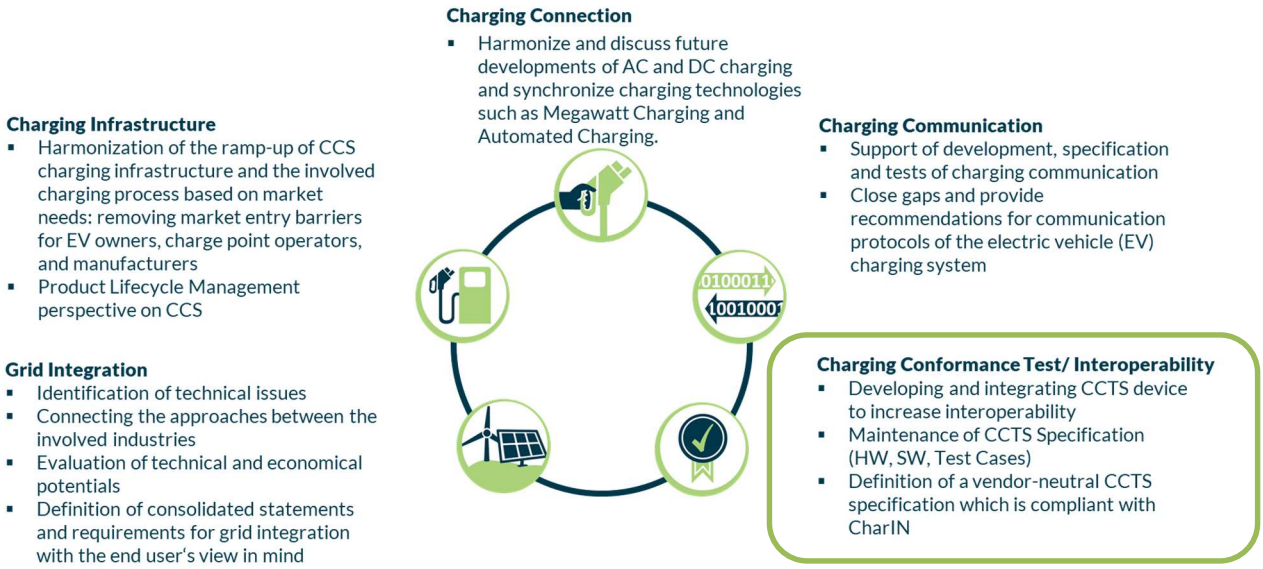

Figure 4 Overview of CharIN Focus Groups

The Focus Group Conformance Test & Interoperability (FG CT&IOP) is one of five technical working groups in CharIN. It consists of three teams:

- Team Development to work on requirements and test cases.
- Team Vendors to create and maintain the Specification the CharIN Conformance Test Systems (CCTS)
- Team Qualification to generate the process around the Conformance Testing and approval.

The following picture summarizes the working stream of each group which end up in a common goal of improved interoperability for CCS charging.

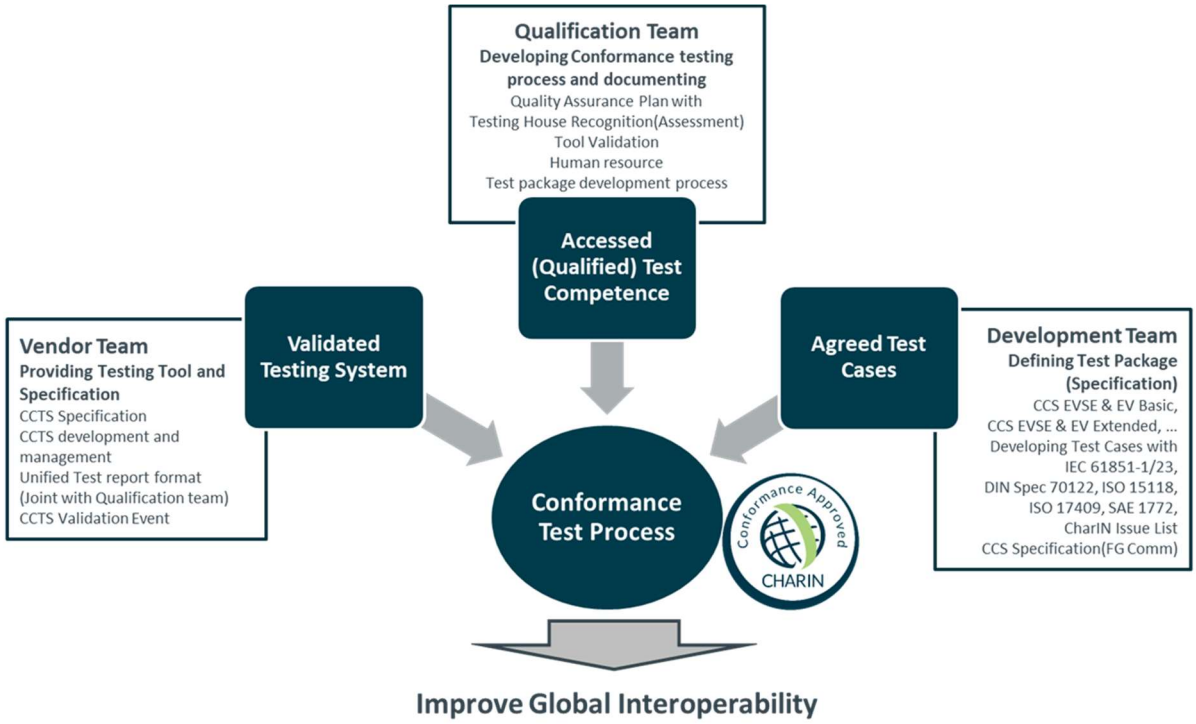

Figure 5 Building blocks of the Conformance Test process of CharIN

The Conformance Testing Scheme was published in a first step for "CCS Basic DC EVSE". A set of CharIN documents covering missing requirements and test cases related to existing standards are now available to improve the interoperability for charging stations.

3 Conformance Testing Scheme

The Baseline for the testing scheme was discussed jointly by the FG Conformane Test Experts. They also looked on the developments of the international Testing symposia of ISO (until 2019) which were taken over by CharIN as the so called “Testivals”. The increasing number of Test candidates and request underlined the necessity of more attention on this sensitive topic. The findings were analysed and merged with field issus from manufacturer reportings. After carefully reviewing the available interanional standards for CCS globally the FG started to work on additional CharIN guidelines where needed. This endevor was supported by a number of experts which worked jointly on technical requirements and test cases but also on a formal process that shall guide through the conformance program.

The main principle of the validation and recognition of Test Laboratories and CCTS Vendors is a peer to peer assessment. This ensures effective work even with a limited number of participants. Thanks to the available expertise of our members from the Testing business CharIN was operating along the lines of international industry approved principles according to testing norms.

The Building blocks of the Testing Scheme are highlighted below. QAP

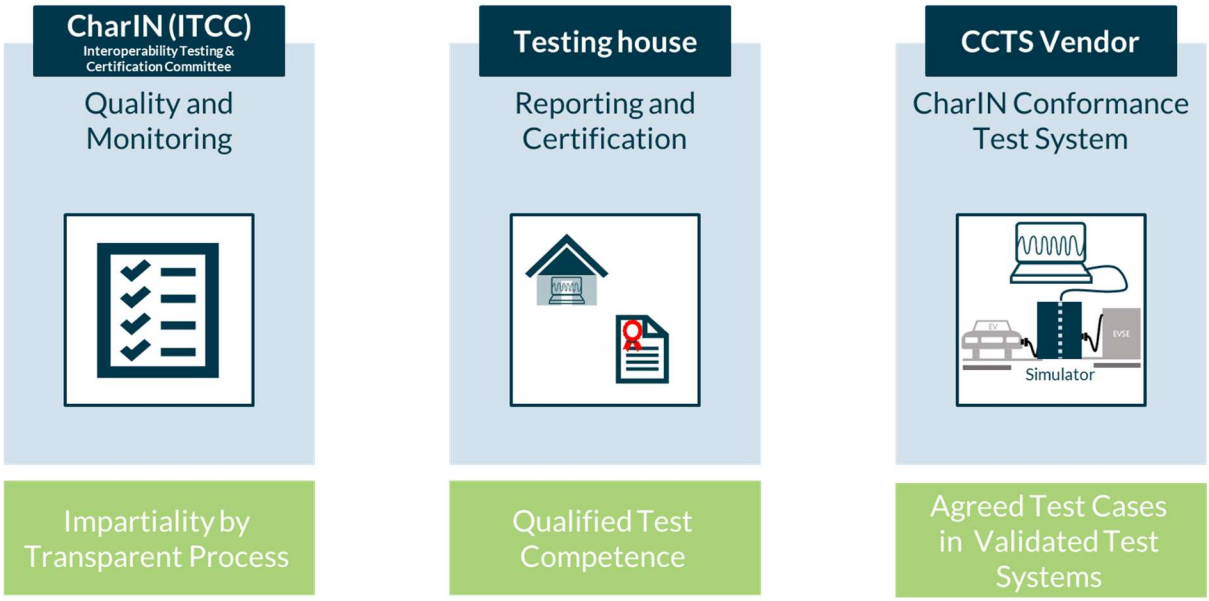

Figure 6 CharIN Conformance Testing Scheme by Quality Assurance Program

The available Test Scheme and CharIN Guides can now be used by industry players around the world.

4 Conlcusion and outlook

The vision of the CharIN e.V. is to develop and establish CCS and MCS as the global standards for charging battery powered electric vehicles. Therefore, the association continuously works on expanding its worldwide network by integrating companies on each level of the defined value chain to support and promote CCS. Moreover, drafting requirements to accelerate the evolution of charging related standards plays an important role. Based on this, the further extension to extended features of ISO 15118 communication protocol is envisioned in addition to the already established certification system.

CharIN promotes the Conformance approved label as a quality indicator for all CCS product. Together with experts of its members from all over the world this will be a key enabler for the success of CCS.

Future upgrades can be considered to also include functionalities behind the charging interface between Car and Charging station. More and more features build on a complex ecosystem integrations of several different standards which need to work together (Plug & Charge). CharIN can be a platform for the necessary discussion to improve the quality even beyond the connector interface.

As an additional value for the industry the monitoring of the issues from the field can be considered. The experts need to know if an issue in a standard A is mutually influencing a standard B. In this case people from different committees need to discuss about solutions. As CharIN is involving the whole value chain already it might be a reasonable next step to put efforts into this as well.

The CharIN Academy is facilitation the education of experts around the globe to enable more experts to create interoperable charging products. This is an additional impact we like to

References

[1] *CharIN e.V.,* www.charin.global, accessed on 2022-10-27

[2] *CharIN e.V.,* https://www.charin.global/technology/charin-conformance-testing/*, accessed on 2022-10-27*

Presenter Biography

Claas Bracklo is Policy Director at BMW and Chairman of the CharIN e. V.

Claas Bracklo joined BMW in March 2005 and held various positions in research and development with focus on E/E-architectures, system design, hardware/software components and in car networking. Before his current position in the powertrain development he was in charge of body electronics development. He also was Senior Consultant Electromobility at VDA from 2017-2022.

He started his career at Mercedes Benz and Daimler in the development of data bus systems. He led several teams and departments in the area of system test, E/E-architecture and ECU-development.

Claas Bracklo holds a degree in Electrical Engineering from the University of Dortmund.

Michael Keller

Before he joined Volkswagen in 2010 as head of “energy systems and functions development”, he was heading the traction battery technology and battery development at a Tier 1 (Continental).

Michael Keller received his engineer degree for electric in Karlsruhe and was awarded with the “Professor Ferdinand Porsche Preis” of the Technical University in Vienna in 2009 for the “first automotive application of a lithium-ion hybrid battery”