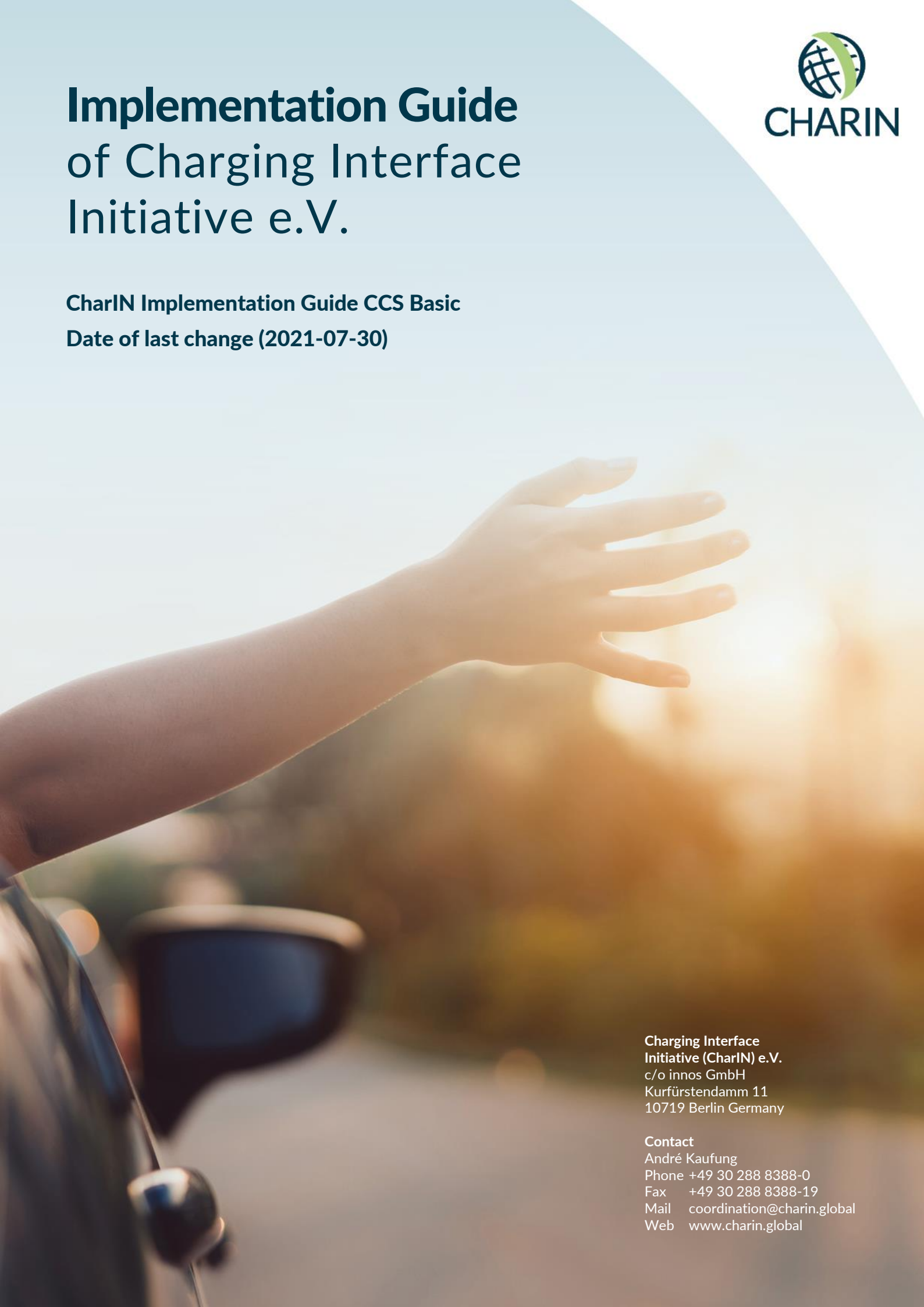
Implementation Guide of Charging Interface Initiative e.V.

CharIN Implementation Guide CCS Basic

Date of last change (2021-07-30)



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Abbreviations

AC	Alternating current
BS	Basic Signaling
CCS	Combined Charging System
CCTS	CharIN CCS Test System
CP	Control Pilot
CPO	Charge Point Operator
DC	Direct current
DIN	German Institute for Standardization
Ed	Edition
EIM	External Identification Means (External payment)
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
HLC	High Level Communication
IC-CPD	In-Cable Control and Protection Device
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
OEM	Original Equipment Manufacturer, here automotive manufacturers
PE	Protective Earth
PHEV	Plug-in Hybrid Electric Vehicle
PLC	Power Line Communication
PWM	Pulse Width Modulation
RFID	Radio Frequency Identification
SAE	Society of Automotive Engineers
UL	Underwriters Laboratories
US	United States of America

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Definitions

CCS Application Profile: is defined by a set of CCS charging functions and customer features and the related system requirement specifications and test specifications.

CCS charging function: CCS specific implementation of a technical charging function of the charging interface that is essential to run a charging process.

Charging Technology: is defined by the method of coupling between EV and EVSE to enable energy transfer (manual, automatic or wireless), by the position of the coupling and by the type of charging coupler (e.g. uncooled/cooled CCS vehicle connector and Combo vehicle inlet, coils on EV and EVSE, pantograph coupler). Note: The CCS charging technologies are not identical with the charging modes as defined in IEC 61851-1 Ed.3, but they do comprise these. For example, the charging technology “manual conductive charging” comprises the charging modes 2, 3 and 4.

Note: The CCS charging technologies are not identical with the charging modes as defined in IEC 61851-1 Ed.3, but they do comprise these charging modes. For example, the charging technology “manual conductive charging” comprises the charging modes 2, 3 and 4.

Customer Feature: charging feature or service that is experienced by the customer that uses CCS charging products, e.g. an EV driver (e.g. Plug&Charge, or optimized charging to lower the cost), a fleet operator (resumed charging, pre-conditioning) or a charge point operator (load levelling).

1. Introduction

1.1. The Role of CharIN and the CCS Roadmap

More and more countries push the development of electromobility solutions to substitute road vehicles with traditional combustion engines and therewith lower the overall CO2 fingerprint. To ensure a flexible and long-distance mobility to the user of an electric vehicle (EV) or plug-in hybrid electric vehicle (PHEV), EVs, PHEVs and electric vehicle supply equipment (EVSE) needs to be implemented using a suitable charging technology which conforms to standards. The trust of EV users in the ecosystem of electromobility can only be gained, if charging is safe, does always work, performs reliably and does not disturb other electrical equipment.

Hence, national and international standardization efforts have experienced considerable progress in recent years to specify technical system requirements for the charging interface and according conformance tests that ensure safety and interoperability at the EV/EVSE interface, a reliable performance of the charging process and electromagnetic compatibility of the charger.

CharIN has the mission to develop and establish the Combined Charging System (CCS) as a global standard for charging EVs. CCS is based on open and universal standards for EVs and EVSEs that are developed in several different national and international standardization bodies. The development and launch of CCS charging products, like electric vehicles, charging stations, charging system components or charging services, is based on the parallel interconnected work in different organizations, which can be assigned to five areas of activities:

a) Legislation
b) Standardization
c) Representation of interests (stakeholders of the charging ecosystem)
d) Research (cooperation of companies and universities) and
e) Product development (of manufacturers of charging products)

The output of all these activities contributes to the successful implementation and worldwide distribution of CCS. CharIN is representing the interests of around 180 member companies from all over the world and is therefore contributing to the activities in area C.

CCS and the corresponding standards evolve with time, thereby enabling the development and launch of new CCS charging functions and related charging technologies as well as additional customer features based on CCS at different points in time. Due to the mutual dependencies between different market players in the charging ecosystem, it is essential to consolidate the parallel activities in the different organizations, in order to introduce CCS charging products into the market at a given point in time. In particular, for a series production of EVs and EVSEs that use CCS for the charging interface or other CCS charging products, a need is given to:

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- fix a set of technical CCS charging functions that can be implemented,
- fix (a set of) related charging technologies,
- fix a set of related additional customer features (charging services, such as Plug&Charge),
- and fix the matching set of standards as an implementation and test baseline at a defined point in time.

As an independent association - outside of the standardization activities - CharIN is defining the overall application profile to establish CCS in the market based on the existing standards and is therewith building a bridge between different standards and the markets.

CharIN is defining several steps at which an evolutionary stage of CCS is fixed. In a modular approach, six different charging technologies are identified, covering the currently available manual conductive charging technologies as well as future automated charging technologies. In a first attempt, CharIN distinguishes three major development steps of CCS, denoted as "CCS Basic", "CCS Extended" and "CCS Advanced". At each step, new CCS charging technologies and customer features are enabled through new CCS charging functions, which are specified in certain releases of standards. For each of these steps, CharIN is defining an application profile based on existing standards that are relevant for the respective charging technologies and customer features, and that serve as implementation and test baseline for manufacturers of charging products. Where considered necessary, e.g. due to gaps in the existing standards, CharIN provides implementation guides as well as test case specifications.

Figure 1 shows a big picture that illustrates the stepwise development of CCS, which leads to a CCS roadmap, in which parallel interconnected work is performed in the five areas mentioned above.

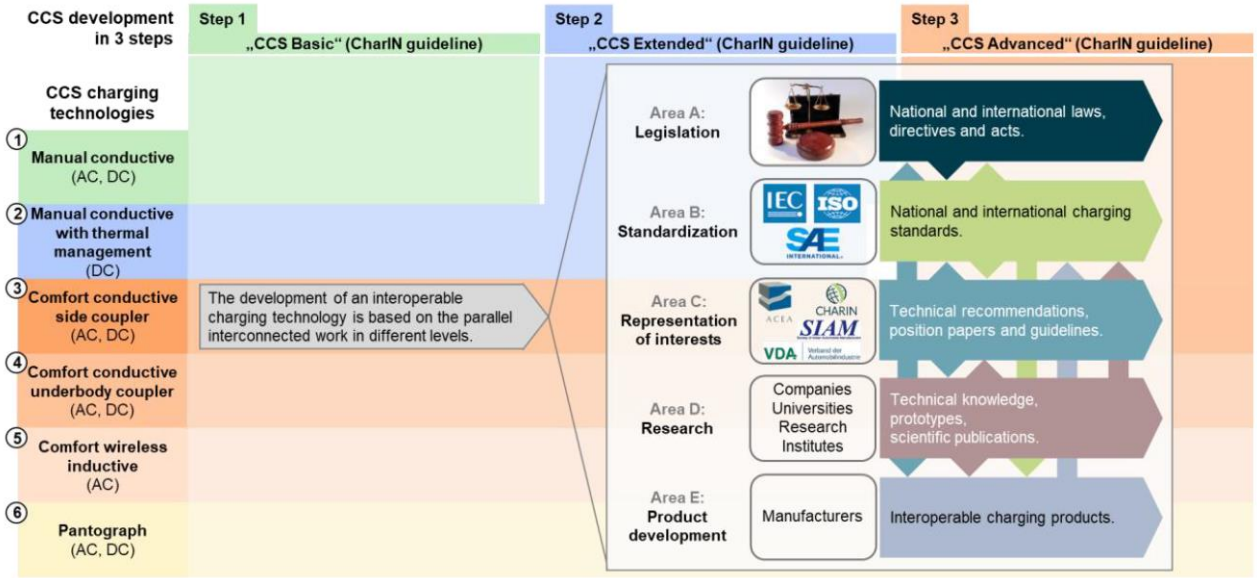

Figure 1: Big picture that shows the development of the combined charging system (CCS) within three steps and the parallel interconnected work that drives the development of CCS charging technologies from manual conductive charging today to automated charging in in the future.

The success of the CCS relies on system requirement specifications that ensure the following essential charging system properties:

- Electrical safety
- Interoperability
- Performance (including reliability and robustness) and
- Electromagnetic compatibility (EMC)

Furthermore, for each CCS development step, CCS charging functions, i.e. the specific implementation of the technical charging functions

- charging communication (digital communication and/or basic signaling)
- power transfer (charging sequences and power quality)
- physical coupling (through a charging coupler and a charging cable)

need to be specified.

For the convenience of the customer, also proper customer labels of CCS charging products need to be defined, which contain e.g. information about the available charging power.

CharIN relies on the technical specification work that is done in the standardization committees and focuses on providing guidance, combining the technical specifications that are relevant for a certain CCS development step into an application profile. Each CCS application profile comprises specifications of CCS charging functions as well as requirements that ensure the essential charging system properties.

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Conformance, robustness and interoperability tests of CCS charging products of different manufacturers at the charging interface are considered essential to ensure a safe and reliable charging experience for the customer (EV user) of these products. .

To facilitate conformance testing of the charging process, CharIN is developing a HW and SW specification for a CharIN CCS Test System (CCTS) that is intended to be used for partially or fully automatable tests of the CCS charging functions related to the respective CCS development step. The test system is able to emulate the behavior of an EV (EVSE) which allows to test the behavior of an EVSE (EV) with almost every possible sequence of a charging process at the charging interface.

Furthermore, CharIN is defining a qualification process for testing houses that can test and certify CCS charging products using recognized CCTS. The aim of the CharIN Quality Assurance Program is to ensure a high level of interoperability and to protect the value of the CharIN brand and CCS technology. This is achieved through a combination of charging system interoperability and performance testing with a recognized CCTS and manufacturer declaration of conformity.

1.2. Scope and Audience of the Document

This document provides an Implementation Guide for the CCS Basic Application Profile (CCS Basic), i.e. the first step in the CCS roadmap. The core charging technology of CCS Basic is manual conductive charging.

CharIN understands CCS Basic as the overall application profile spanning a set of published standards, as fixed on the 31st of January 2020, which comprise system requirement specifications and test case specifications that are relevant for the CCS Basic charging functions and customer labels, and ensure above listed charging system properties. The referenced standards constitute the baseline for the implementation and according conformance tests of the CCS Basic charging products

- DC EVSE
- DC EV
- AC EVSE
- AC EV (with Combo inlet)

that are used for manual conductive charging.

In addition to the listed standards (i.e. the baseline CCS Basic V1.0), CharIN is providing implementation guides to standards and according test case specifications, where considered necessary.

The scope of this document is to provide all relevant information related to the CharIN CCS Basic Application Profile, as well as information on the CharIN CCS test system and the CharIN Qualification Process to

- Implementors of CCS Basic charging products (EV, EVSE, charging system components or charging services)
- Implementors of test equipment
- Institutions that are executing tests (e.g. testing houses)

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The document is structured according to the different audiences.

In the present document, CharIN

- defines the application profile CCS Basic, which comprises the CCS charging technology Manual Conductive Charging (AC and DC) with the charging modes 2, 3 and 4 (as defined in IEC 61851-1 Ed.3);
- defines the CCS charging functions and CCS customer features related to CCS Basic, provides the corresponding technical implementation and test baseline for manufacturers of charging products (EV, EVSE), referencing the relevant standards for CCS Basic;
- provides information on not relevant sections/content of the referenced standards, if necessary;
- references the relevant CharIN documents, that contain guidelines of how to implement the requirements in the standards or CharIN test case specifications
- references the relevant CharIN guides for conformance testing that specify which conformance tests need to be implemented by CCTS manufacturers and which conformance tests need to be passed by a particular CCS Basic charging product (e.g. a DC EVSE with CCS Basic charging functions)
- provides the reference to the hardware specification for a CCTS for manufacturers of test equipment, and
- provides the reference to the Quality Assurance Plan, which describes how testing houses can be accredited by CharIN to test charging products with CharIN certified CCTS.

To close the most critical gaps in the standards and improve product quality, the currently available additional CharIN documents focus on the interoperable implementation and automated conformance test of the **charging communication and power transfer of DC CCS Basic EVSE.**

For the purpose of charging product certification, CharIN provides according test case specifications for tests that can be conducted with a CCTS.. The CCS Basic certificate will be granted after successful testing of DC EVSE if the manufacturers, respectively applicants for the CharIN CCS Basic Conformance Test label provide a declaration that all safety and EMC, as well as other relevant requirements comprised in the implementation baseline CCS Basic V1.0 are fulfilled, which are not tested by the CCTS. The CharIN test cases that have to be passed by a DC EVSE to obtain a CCS Basic V1.0 certificate are defined in the document “CharIN Conformance Test for DC CCS Basic EVSE”.

CharIN implementation guides and test case specifications for DC CCS Basic EV, as well as AC CCS Basic EVSE and EV are under consideration. Furthermore, other charging system properties, such as EMC of the charger, and requirements of other CCS Basic charging functions, such as the interoperability and robustness of the vehicle connectors and inlets, or robustness of the charging cables, may be addressed in future CharIN implementation guides and test case specifications.

2. The CCS Basic Application Profile

2.1. CCS Basic charging functions

In this section an overview of the characteristics of CCS Basic and of the CCS Basic charging functions and customer features is given.

2.1.1. General characteristics of CCS Basic

Within CCS Basic, conductive AC and DC charging is combined in a single vehicle inlet. The CCS includes the connector and inlet combination as well as all the charging control functions. It also manages the communication between the electric vehicle and the infrastructure.

The key features of the CCS for manual conductive charging using the CCS Basic application profile will be explained in the following chapters.

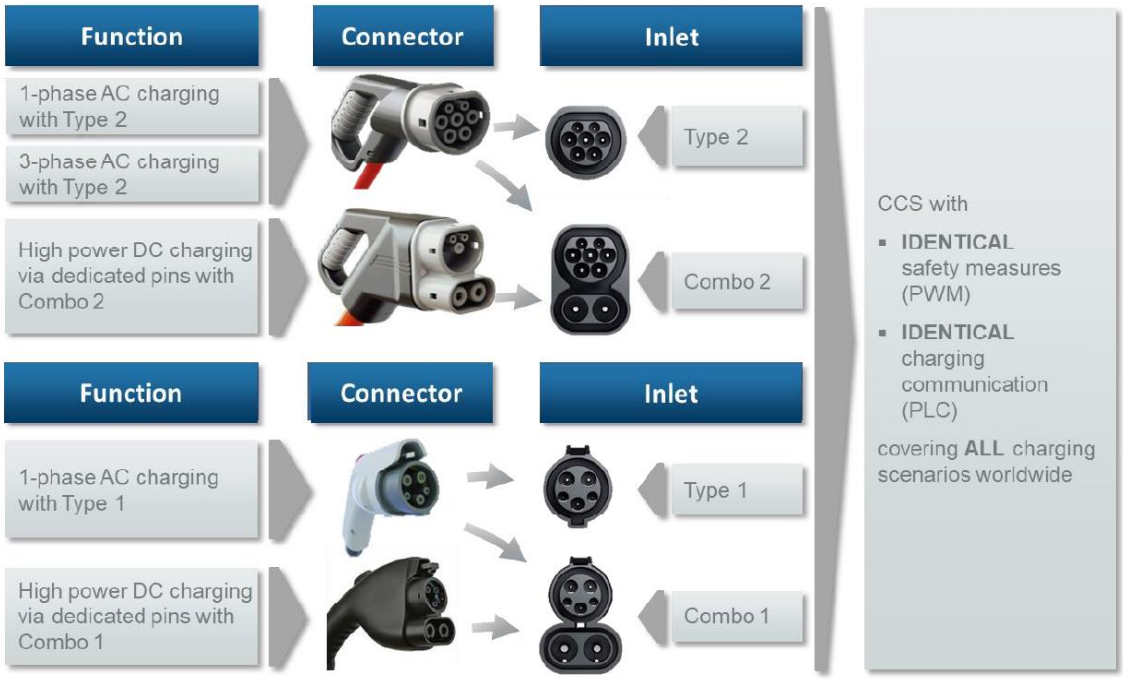

Figure 2: Charging Interface of CCS

The combined inlet of CCS is designed as a universal charging interface. The vehicle inlet for AC charging, as described in IEC 62196-2 has been extended by two pins for DC charging to allow high power charging in a very short period of time.

CCS is therefore an integrated solution for AC- and DC-charging. EVs are "CCS-capable" if they support either

- AC charging with Type 1 (US) or Type 2 (Europe) Connector according to IEC 62196-2 or

- DC charging with Combo 1 (US) or Combo 2 (Europe) Connector in IEC 62196-3

The vehicle inlet features protective mechanisms for safe charging and is fitted with all the necessary pins for charging scenarios worldwide. A lock system prevents the connector from being accidentally pulled out of the inlet while charging. The charging process is controlled by special electrical signals from the moment the connector is connected to the inlet until the end of charging. The system also features digital communication via power line communication (PLC) between vehicle and charging station. This allows charging control for complex charging scenarios and is prepared for future demands.

2.1.2. Charging modes used with CCS Basic

Four charging modes are defined in IEC 61851-1 Ed.1. Modes 1 to 3 relates to charging with a charger unit installed in the vehicle (on-board charger), Mode 4 describes the use of an “off-board charger”.

The charging Mode 2, Mode 3 and Mode 4 are part of the CCS Basic Application Profile.

Mode 2 is characterized as follows:

- AC charging at normal mains outlets
- charger cable with integrated safety devices in an in-cable control box comprising RCD, control pilot and proximity detection

Figure 3a – Mode 2 Charging

Mode 3 is characterized as follows:

- AC charging at Type 1/2 interfaces
- safety equipment is not always in the charging station but often in the electrical installation, no in-cable control box required in the cable
- Type 2 plug interlock permits unsupervised operation, even in a public space

Figure 3b – Mode 3 Charging

Mode 4 is characterized as follows:

- DC charging stations
- Charging system can manage various charging currents and charging voltages to adopt various battery systems
- For charging control HLC is required

Figure 3c – Mode 4 Charging

The designation codes in Table 4 are used to name the features for the Charging Modes.

Table 1: Designation Code for Charging Modes Description Designation Co

Description	Designation Code
Mode 2 Charging	Mode 2
Mode 3 Charging	Mode 3
Mode 4 Charging	Mode 4

2.1.3. Charging Communication

The following charging control methods are part of CCS Basic:

- basic signaling (BS) based on pulse width modulation (PWM) on one control pilot (CP) line
- digital communication (high level communication – HLC) based on power line communication (PLC) on the CP line using HomePlug GreenPHY (HPGP) technology as specified in DIN SPEC 70121.

Table 1 list the charging process control methods which are part of the CCS Basic Application Profile.

Table 2: Charging Process Control Methods Charging method PWM PLC

Charging method	PWM	PLC
Manual conductive AC charging	mandatory	not part of CCS Basic
Manual conductive DC charging	mandatory	mandatory

2.1.4. Vehicle Connector and Inlet

For AC charging in Europe the CCS uses the Type 2 Inlet or the Combo 2 Inlet mated with the Type 2 Connector. For DC charging according to the CCS Basic Application Profile in Europe the CCS uses the Combo 2 Inlet mated with the Combo 2 Connector. Mainly in US according to the CCS Basic Application Profile the Type 1 Connector is used for AC and the Combo 1 is used for DC charging. The designation codes in Table 3 are used to name the features for the Charging Connector and Inlet.

Table 3: Designation Code for Charging Connector and Inlet

Description	Designation Code
Type 1/2 AC Vehicle Inlet	Type 1/2 Inlet
Combo 1/2 AC and DC Vehicle Inlet	Combo 1/2 Inlet
Type 1/2 AC Vehicle Connector	Type 1/2 Connector

Combo 1/2 DC Vehicle Connector	Combo 1/2 Connector

2.2. CCS Basic Customer Features

2.2.1. Load Balancing

Addressed Customer: fleet operator, CPO.

The CCS Basic Application Profile supports unscheduled load balancing.

Unscheduled Load Balancing is characterized as follows:

The EVSE can change the maximum current / power during the charging process:

- for AC charging through adjustment of the duty cycle (according to IEC 61851-1 Ed.3, Annex A),
- for DC charging through digital communication of the new maximum current and power limits, which can be lower but not higher than the current and power limits communicated at the beginning of the charging session (refer to DIN SPEC 70121:2014).

2.2.2. 2Charge Authorization Mode

Addressed Customer: EV user.

The CCS Basic Application Profile supports the authorization with External Identification Means, if required (e.g. for public charging).

External Identification Means (EIM) is characterized as follows:

- Any mechanism not involving the EV, that authorizes a user for charging (e.g. RFID, QR code, mobile app, credit card, cash payment…)

Note: In an upcoming CCS application profile, the charge authorization will become seamless for the customer using PnC, where data security is ensured through encryption.

2.2.3. 2Indication of charging power

Addressed Customer: EV user.

The CCS Basic Application Profile provides a rough indication of the DC charging power through CharIN Power Class Labels.

CharIN Power Class Labels: CharIN has defined DC CCS Power Classes, which are assigned to DC EVSE based on the operating range of the DC EVSE.

2.2.4. Diagnostics of faults/errors

Addressed Customer: fleet operator, CPO.

The CCS Basic Application Profile allows Basic Diagnostics of faults and errors of the EVSE and of the EV.

Basic Diagnostics is realized through the definition of different states that can be signaled by EV and EVSE using the control pilot line (refer to IEC 61851-1 Ed.3, Annex A):

- The EVSE can signal state E for error, state F for fault, and a state change X2 → X1 to indicate e.g. an emergency shutdown.

The EV can signal a state change B C to indicate that the EV is not ready for charging or to trigger an emergency shutdown.

2.2.5. Safety and EMC

The current document focuses on interoperability aspects of the CCS. Apart from interoperability charging systems must also comply with safety and electromagnetic compatibility requirements to ensure a safe and reliable operation.

Safety standards prescribe various safety measures to avoid;

- Electric Shock
- Fire
- Electric Arc and
- Overheating

under normal use und certain fault condition including charging and non-charging operation. Table 4 gives non exhaustive overview of some of the major safety standards. In addition, regional or national requirements might apply.

Table 4: Non –exhaustive list of Safety standards related to CCS

Description	International standards	US standards
Electrical safety of the EVSE	IEC 61851-1 IEC 61851-23	UL 2202 UL 2231-1/2
Plugs, outlets, connector & inlets for EVSE (Safety)	IEC 62196-1	SAE 1772, UL 2251 IEC 62196-1
Plugs, outlets, connector & inlets for EVSE (Dimensions)	IEC 62196-3	SAE 1772, IEC 62196-3
Cables	IEC 62893	UL 62
Electrical safety of the EV	ISO 6469-3	UL 2202 UL 2231-1/2
Connection to an external electric power supply	ISO 17409	ISO 17409
In-cable control and protection device for mode 2 charging of electric road vehicles (IC-CPD)	IEC 62752	N/A

EMC standards prescribe various requirements to protect essential radio service and ensure safe operation even when the charging system is exposed to interference from other sources.

Amongst other the following effects are addressed;

- Conducted emission on mains and control and signal ports
- Radiated emission
- Electrostatic discharge
- Overvoltage and surges on mains
- Exposure to RF sources such as mobile phones
- Power quality

under normal use condition including charging and non-charging operation. Table 5 gives non exhaustive overview of some of the major EMC standards. In addition, regional or national requirements might apply.

Table 5: Non – exhaustive list of EMC standards related to CCS

Description	International standards	US standards
EMC of On-Board Charger		
Emission	IEC 61851-21-2	tbd
Immunity	IEC 61851-21-2	SAE 1772, UL 2231-2
Power quality	IEC 61851-21-2	SAE 1772, UL 2231-2
Immunity	tbd	SAE 1772, UL 2231-2

The user of this document has the responsibility to make sure that all legal requirements that may apply to the charging system for the target market are considered.

2.3. Technical specification of the CCS Basic application profile

CharIN defines CCS Application Profiles based on sets of existing standards with focus on the charging interface The following tables show the set of standards, as fixed by CharIN at January, 31st, 2020, that constitute the baseline for the implementation and according conformance tests related to the CCS Basic Application profile. The complete overview of related standards and CharIN documents can be found here.

2.3.1. Implementation baseline

Table 6: List of standards that contain system requirement specifications relevant for CCS Basic

INTERNATIO-NALLY valid documents		ADDITIONAL documents that are ONLY relevant for individual MARKETS								Charging Technology & Mode			Eco-System		Cluster Categories								Documents			
Combo 1 Type 1	Combo 2 Type 2	EU	US	DE	CA	AU	KR	SG	IN	Manual conductive AC Mode 2	Manual conductive AC Mode 3	Manual conductive DC without thermal management Mode 4	EV	EVSE	Safety	Interoperability	Performance	EMC	Label (power)	BS & HLC	Power Transfer	Coupler design	Cable design	CCS Bas. V1 Doc No.	Document Name	Edition/ year	Short description
n.a.	n.a.	X								X	X	X	n.a.	X										1	EN 17186	Ed.1	Electricity fuel labelling
n.a.	n.a.	X								X	X	X	X	X										2	EN 50620	2017	Charging cables for EVs
X	X									n.a.	n.a.	X	X	X										3	DIN SPEC 70121	2014	DC PLC
X	X									X	X	X	n.a.	X										4	IEC 60364-7-722	Ed.2	AC/DC, local installation
X	X									X	X	X	X	X										5	IEC 61851-1	Ed.3	general requirements conductive charging, CP, PP [Annex B], PWM, AC sequences [Annex A]
X	X									X	X	n.a.	X	n.a.										6	IEC 61851-21-1	Ed.1	On-board charger EMC
X	X									n.a.	n.a.	X	n.a.	X										7	IEC 61851-21-2	Ed.1	Off-board charger EMC
X	X									n.a.	n.a.	X	n.a.	X										8	IEC 61851-23	Ed.1	DC safety, sequences, power transfer [System C]
X	X									n.a.	n.a.	X	n.a.	X										9	IEC 61851-23	Ed.1 Cor.1	DC safety, sequences, power transfer [System C]
n.a.	n.a.			X						n.a.	n.a.	X	n.a.	X										10	DIN EN 61851-23 Berichtigung 2 (VDE 0122-2-3 Berichtigung 2)	2018	DC electrical safety related to DIN EN 61851-23 (VDE 0122-2-3):2014-11
X	X									n.a.	n.a.	X	X	X										11	IEC 61851-24	Ed.1	DC digital communication [System C]
X	X									n.a.	n.a.	X	X	X										12	IEC 61851-24	Ed.1 Cor.1	DC digital communication [System C]
X	X									X	X	X	X	X										13	IEC 62196-1	Ed.3	AC/DC plugs, couplers general [Type 1 & 2 basic interface, Configuration EE & FF combined interface]
X	X									X	X	n.a.	X	X										14	IEC 62196-2	Ed.2	AC Type 1/2 plugs, couplers [basic interface]
X	X									n.a.	n.a.	X	X	X										15	IEC 62196-3	Ed.1	DC Combo 1/2 plugs couplers [Configuration EE & FF combined interface] (max d.c. current 200A)
X	X									X	n.a.	n.a.	n.a.	X										16	IEC 62752 + AMD1	Ed.1.1	IC-CPD (AC mode 2) cable
X	X									X	n.a.	n.a.	n.a.	X										17	IEC 62752	Ed.1 Cor.1	IC-CPD (AC mode 2) cable
X	X									X	X	X	X	X										18	IEC 62893-1	Ed.1	AC/DC charging cable general
X	X									X	X	n.a.	X	X										19	IEC 62893-3	Ed.1	AC mode 1,2,3 charging cable
X	X									X	X	X	X	n.a.										20	ISO 6469-3	Ed.3	EV AC/DC electr. Safety
X	X									X	X	X	X	n.a.										21	ISO 17409	Ed.1	EV AC/DC electr. Safety [general req. and particular req. for system C]
X	X									n.a.	n.a.	X	X	X										22	ISO Important information related to IEC 61851-23:2014 and ISO 17409:2015	2017	Information on requirements related to the safety objective "protection against electric shock"
n.a.	n.a.		X							X	X	X	X	X										23	SAE J1772	2017	AC/DC, PWM, Type 1, Combo 1
n.a.	n.a.		X							X	X	X	X	X										24	SAE J2953/1	2013	AC/DC (IOP CP + Prox)
n.a.	n.a.		X							X	X	X	n.a.	X										25	UL 2202	Ed.2	EVSE general
n.a.	n.a.		X							X	X	X	n.a.	X										26	UL 2231-1	Ed.2	Protection systems for EVSE
n.a.	n.a.		X							X	X	X	n.a.	X										27	UL 2231-2	Ed.2	Protection devices for EVSE
n.a.	n.a.		X							X	X	X	X	X										28	UL 2251	Ed.4	EV plugs, couplers
n.a.	n.a.		X							X	X	n.a.	n.a.	X										29	UL 2594	Ed.2	AC EVSE
n.a.	n.a.		X							X	X	X	X	X										30	UL 62	Ed.20	Flexible cords and cables

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2.3.2. Test Baseline

Table 7: List of standards that are the baseline for test case specifications relevant for CCS Basic.

INTERNATIO-NALLY valid documents		ADDITIONAL documents that are ONLY relevant for individual MARKETS								Charging Technology & Mode				Eco-System		Cluster Categories								Documents			
Combo 1 Type 1	Combo 2 Type 2	EU	US	DE	CA	AU	KR	SG	IN	Manual conductive AC	Manual conductive AC Mode 2	Manual conductive AC Mode 3	Manual conductive DC without thermal management Mode 4	EV	EVSE	Safety	Interoperability	Performance	EMC	Label (power)	BS & HLC	Power Transfer	Coupler design	Cable design	CCS Bas. V1 Doc No.	Document Name	Edition/ year	Short description
n.a.	n.a.	X								X	X	X	X	X	X										2	EN 50620	2017	Charging cables for EVs
X	X									n.a.	n.a.	n.a.	X	X	X										31	DIN SPEC 70122	2018	DC PLC
X	X									X	X	X	X	n.a.	X										4	IEC 60364-7-722	Ed.2	AC/DC, local installation
X	X									X	X	X	X	X	X										5	IEC 61851-1	Ed.3	general requirements conductive charging, CP, PP [Annex B], PWM, AC sequences [Annex A]
X	X									X	X	X	n.a.	X	n.a.										6	IEC 61851-21-1	Ed.1	On-board charger EMC
X	X									n.a.	n.a.	n.a.	X	n.a.	X										7	IEC 61851-21-2	Ed.1	Off-board charger EMC
X	X									n.a.	n.a.	n.a.	X	n.a.	X										32	DIN VDE V 0122-2-300	2016	DC sequences, power transfer [System C]
X	X									X	X	X	X	X	X										13	IEC 62196-1	Ed.3	AC/DC plugs, couplers general [Type 1 & 2 basic interface, Configuration EE & FF combined interface]
X	X									X	X	X	n.a.	X	X										14	IEC 62196-2	Ed.2	AC Type 1/2 plugs, couplers [basic interface]
X	X									n.a.	n.a.	n.a.	X	X	X										15	IEC 62196-3	Ed.1	DC Combo 1/2 plugs couplers [Configuration EE & FF combined interface] (max d.c. current 200A)
X	X									X	X	n.a.	n.a.	n.a.	X										16	IEC 62752 + AMD1	Ed.1.1	IC-CPD (AC mode 2) cable
X	X									X	X	X	X	X	X										18	IEC 62893-1	Ed.1	AC/DC charging cable general
X	X									X	X	X	n.a.	X	X										33	IEC 62893-2	Ed.1	AC mode 1,2,3 charging cable
X	X									X	X	X	X	X	n.a.										20	ISO 6469-3	Ed.3	EV AC/DC electr. Safety
X	X									X	X	X	X	X	n.a.										21	ISO 17409	Ed.1	EV AC/DC electr. Safety [general req. and particular req. for system C]
n.a.	n.a.		X							X	X	X	X	X	X										23	SAE J1772	2017	AC/DC, PWM, Type 1, Combo 1
n.a.	n.a.		X							X	X	X	X	X	X										34	SAE J2953/2	2014	AC/DC (IOP CP + Prox) test procedures
n.a.	n.a.		X							X	X	X	X	n.a.	X										25	UL 2202	Ed.2	EVSE general
n.a.	n.a.		X							X	X	X	X	n.a.	X										26	UL 2231-1	Ed.2	Protection systems for EVSE
n.a.	n.a.		X							X	X	X	X	n.a.	X										27	UL 2231-2	Ed.2	Protection devices for EVSE
n.a.	n.a.		X							X	X	X	X	X	X										28	UL 2251	Ed.4	EV plugs, couplers
n.a.	n.a.		X							X	X	X	n.a.	n.a.	X										29	UL 2594	Ed.2	AC EVSE
n.a.	n.a.		X							X	X	X	X	X	X										30	UL 62	Ed.20	Flexible cords and cables

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Disclaimer: this implementation Guide for CCS Basic provides an overview of some of the CCS related international standards and additional CharIN recommended documents. It does not claim completeness. For completeness and full description of requirements the relevant national and international standards shall be taken into account

2.3.3. Restrictions to referred documents

The following sections and contents are not part of the CCS Basic application profile.

Table 8: Restrictions to Basic specs

IEC 61851-1 Ed.3	Annex D
IEC 61851-23 Ed.1	System A and B
IEC 62196-1 Ed.3	Configuration AA, BB, CC, DD
IEC 62196-3 Ed.1	Configuration AA, BB, CC, DD

2.3.4. Additional CharIN Guideline Documents

Table 9: CharIN Guidelines

Document	Spec. related	Test related	Version 1.0, as of 31.03.2020	Version 1.1, as of 01.08.2021
CharIN Implementation Guide for CCS Basic	X	X	1.0	1.1
CharIN Conformance Test for DC CCS Basic EVSE		X	1.1.1	1.1.5
CharIN Implementation Guide to DIN 70121	X		0.95	0.95
CharIN TC for DIN 70121 Implementation Guide		X	1.1.0	1.1.2
CharIN DC CCS Power Classes	X		6.0	6.0
CharIN TC for IEC 61851-1 & -23		X	0.7	1.0.0
CharIN CCTS Specification	X		0.4.0	0.4.0
CharIN IEC61851-23:2014 Implementation guide for system C*	X		1.0.0	1.2.0
CharIN CCS design guide for CCS	X		7.0	7.0
CharIN Guideline DC CCS 1.0 (related to DIN SPEC 70121)	X		1.6	1.6
CharIN Conformance Tests – Vehicle Coupler		X	-	4.0

Disclaimer: this implementation Guide for CCS Basic provides an overview of some of the CCS related international standards and additional CharIN recommended documents. It does not claim completeness. For completeness and full description of requirements the relevant national and international standards shall be taken into account

The CharIN guideline documents are available for members only. The experts in the technical working groups have worked out the necessary details to create an interoperable charging system by following the above listed additional recommendations. Please contact the CharIN Coordination Office in terms of questions about the membership application.

2.3.5. DC EV test

Under preparation.

2.3.6. AC EV test

Under preparation.

2.3.7. DC EVSE test

The test system specification focuses on DC EVSE conformity with the related documents of interoperability and safety of the charging communication, the power transfer and the charging sequence. Future documents will contain DC EV (for DC charged electric vehicles) as well as AC charged EV and the related EVSE as described in the picture below. For a complete list of required test cases the "CharIN Conformance Test DC CCS Basic EVSE" document is mandatory.

A charging station supporting DC CCS Basic must pass the selected test cases from:

- DIN SPEC 70122:2017 -> for SECC side.
- DIN VDE V 0122-2-300 -> DC CCS Basic EVSE Test cases
- CharIN TC for DIN 70121 Implementation Guide
- "CharIN TC for IEC 61851-1 & -23" -> CharIN Test Cases for AC charging with PWM (IEC 61851-1) and DC charging with system C (IEC 61851-23)
- IEC61851-21-2

2.3.8. AC EVSE test

Under preparation

3. CCS Basic Conformance Testing Quality Assurance Plan

CharIN establishes and operates the global conformance testing process to provide the minimum level of CCS EV charging system interoperability and safety by performing test cases from

- *CharIN_Conformance_Test_DC_CCS_Basic_EVSE*
- *CharIN_Conformance_Test_DC_CCS_Basic_EV [under development]*
- *CharIN_Conformance_Test_AC_CCS_Basic_EVSE [under development]*
- *CharIN_Conformance_Test_AC_CCS_Basic_EV [under development]*

In terms of conformance testing, the mandatory elements are

- Qualified testing houses
- Validated test systems

QAP (Quality Assurance Plan) is the process to make assure that the above elements have the consistent interpretation and verdicts.

Quality Assurance Plan for CharIN Conformance Testing of Charging System document describe this process with impartial and transparent manner. The main activities are defined as

- Conformance testing: activities for the supply chain between EV OEM/EVSE manufacturer and Customer
- Tool Validation: activities for the supply chain between tool vendor and tool customer such as testing house, EV OEM, EVSE manufacturer, Service operator, …
- Recognition (Evaluation): activities for the supply chain between testing house and testing service customers such as EV OEM, EVSE manufacturer, …

CharIN test certificate for conformance testing can be issued only by CharIN recognized testing house with CharIN validated CCTS. After the successful completion of recognition and validation, CharIN approves and provides labels of “CharIN recognized testing house” and “CCTS”, respectively.

For this commitment, CharIN organizes the governance structure for CCTS validation as well as testing house recognition. PAC (Peer Assessment Committee), which is the main actor to execute the main activities. It is established to evaluate the competence of testing house and the capability/functionality of CCTS under the name of CharIN.

The main objective of CharIN QAP is to achieve >95% EV-EVSE interoperability and safety by the conformance testing for happy charging experience of users.

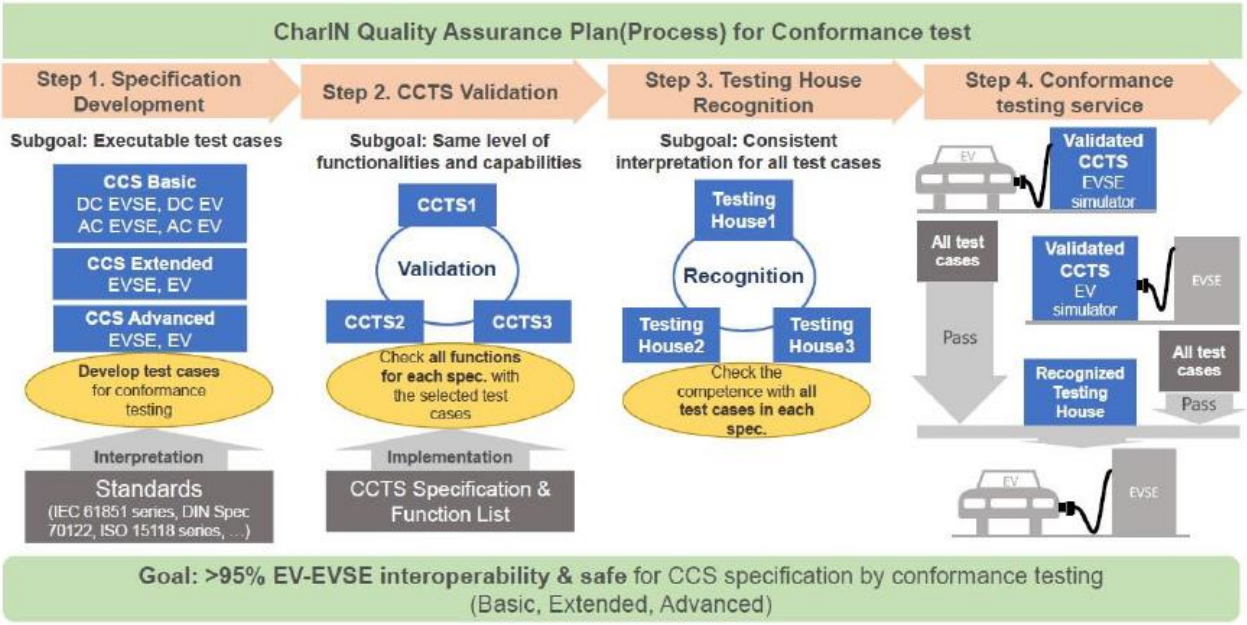

Figure 4: CharIN quality assurance plan (big picture)

3.1. Recognition of CharIN testing house

QAP document specifies how to evaluate the competence of testing house as the recognition process of testing houses including assessment scheme, criteria, process detail with expected schedule and re-recognition process.

All details about the recognition process are described in the document

Quality Assurance Plan for CharIN Conformance Testing of Charging System.

If testing house want to offer Conformance Testing for DC CCS Basic, it has to apply at CharIN

(coordination@charin.global) to get recognized.

3.2. CharIN CCS Test Systems (CCTS)

To significantly reduce the amount of required testing in the field, CharIN is specifying a CharIN CCS Test System. The CCTS are used to test either the EVSE or the EV part. There are several vendors in CharIN that provide Test systems for this purpose. Some of them are for component testing only.

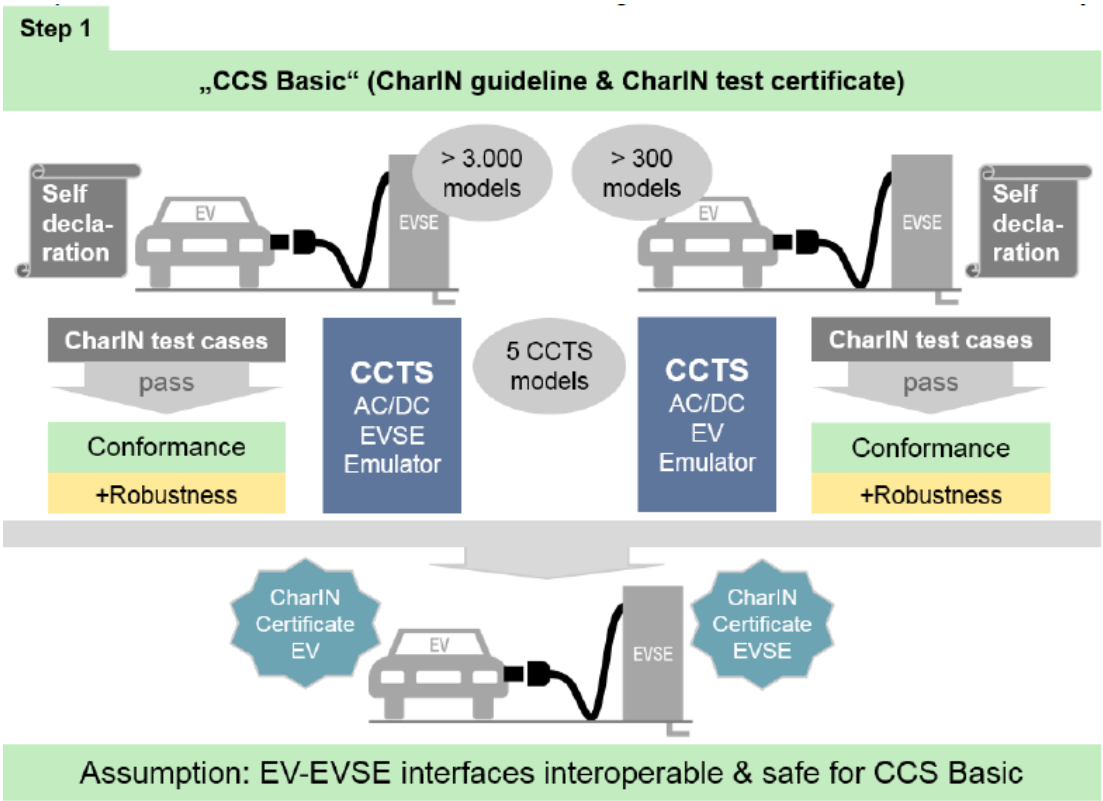

Figure 5: Motivation for the CharIN CCS Test System

CCTS Open Requirements Specification

An open and free of Charge Test equipment specification was developed by the members of CharIN. This enables a willing vendor to develop their own product with that common document as a basis.

CCTS architecture

Basic architecture of CCTS is proposed in CharIN_CCTS_Specification document and is composed of the below components;

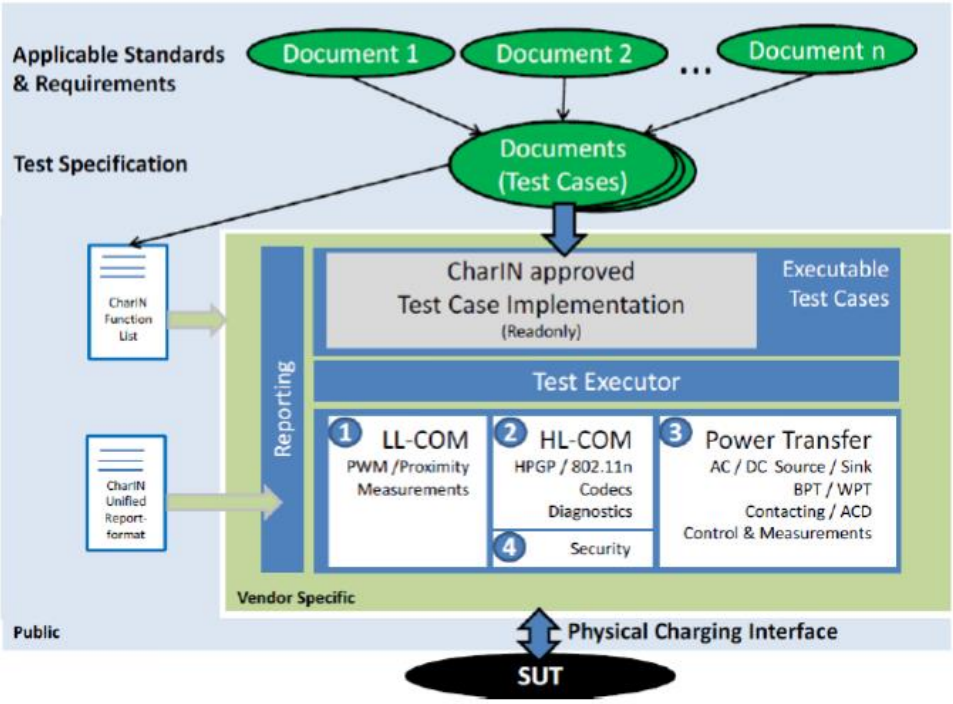

Figure 6: CCTS architecture

CCTS Validation

To assure the capability and functionality of CCTS, the validation of it is necessary and will be done under CharIN QAP. The validation of CCTS HW/SW is executed following the "Quality Assurance Plan for CharIN Conformance Testing of Charging System".

Appendix

The following SAE standards are synchronized with DIN SPEC 70121:2014:

Table 10: SAE documents synchronized with DIN SPEC 70121:2014

Standard	Edition	Title	Short description
SAE J2847/2	2015-04	Communication Between Plug-In Vehicles and Off-Board DC Chargers	PLC messages & signals
SAE J2931/1	2014-12	Digital Communications for Plug-in Electric Vehicles	high level requirements plus definition of com stack and SLAC
SAE J2931/4	2014-10	Broadband PLC Communication for Plug-in Electric Vehicles	PLC HPGP info