OCPP 2.1

Part 0 - Introduction

Edition 1, 2025-01-23

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Disclaimer

Version History

Version	Date	Description
2.1 Edition 1	2025-01-23	OCPP 2.1 Edition 1

Chapter 1. Introduction

Electric Vehicles (EVs) are becoming the new standard for mobility all over the world. This development is only possible with a good coverage of Charging Stations. To advance the roll out of charging infrastructure, open communication standards play a key role: to enable switching from charging network without necessarily replacing all the Charging Stations, to encourage innovation and cost effectiveness and to allow many and diverse players participate in this new industry.

Additionally, the EV charging infrastructure is part of the Smart Grid, a larger and still evolving ecosystem of actors, devices and protocols. In this Smart Grid ecosystem, open communications standards are key enablers for two-way power flows, real time information exchange, demand control and eMobility services.

The Open Charge Point Protocol (OCPP) is the industry-supported de facto standard for communication between a Charging Station and a Charging Station Management System (CSMS) and is designed to accommodate any type of charging technique. OCPP is an open standard with no cost or licensing barriers for adoption.

1.1. OCPP version 2.1

This specification defines version 2.1 of OCPP.

Version 2.1 is an extension of OCPP 2.0.1. OCPP 2.1 has its own JSON schemas, but the schemas are OCPP 2.0.1 schemas that have been extended with optional fields that are used by OCPP 2.1 functionality. With the minor exceptions mentioned below, all application logic developed for OCPP 2.0.1 will continue to work in OCPP 2.1 without any changes. The new features of OCPP 2.1, of course, require new application logic.

Use case A02 & A03

The application logic in a CSMS for OCPP 2.0.1 for use cases A02 & A03 requires a small change in order to work in OCPP 2.1.
The SignCertificateRequest message has been extended with a *requestId* field, such that the resulting CertificateSignedRequest message can be accurately mapped to the request that initiated it. Use of *requestId* is optional for Charging Station, but when present, CSMS will have to use it in the subsequent CertificateSignedRequest message.
Note, that the updated application logic remains valid to use in OCPP 2.0.1.

Use case N02

The application logic in a Charging Station for OCPP 2.0.1 for use case N02 requires a small change in order to work for OCPP 2.1.
The message NotifyMonitoringReportRequest has been extended with a required field in VariableMonitoringType: *eventNotificationType*. Charging Station has to provide this field. It provides essential information to CSMS about the type of monitor (HardWiredMonitor, PreconfiguredMonitor, CustomMonitor) that was missing in OCPP 2.0.1. Existing OCPP 2.0.1 logic in a CSMS that is not aware of this new field, will continue to work.

1.2. Terms and abbreviations

This section contains the terminology and abbreviations that are used throughout this document.

1.2.1. Terms

Term	Meaning
Charging Station	The Charging Station is the physical system where an EV can be charged. A Charging Station has one or more EVSEs.
Charging Station Management System (CSMS)	Charging Station Management System: manages Charging Stations and has the information for authorizing Users for using its Charging Stations.
Electric Vehicle Supply Equipment (EVSE)	An EVSE is considered as an independently operated and managed part of the Charging Station that can deliver energy to one EV at a time.
Energy Management System (EMS)	In this document this is defined as a device that manages the local loads (consumption and production) based on local and/or contractual constraints and/or contractual incentives. It has additional inputs, such as sensors and controls from e.g. PV, battery storage.

1.2.2. Abbreviations

Term	Meaning
CSO	Charging Station Operator
CSMS	Charging Station Management System
EMS	Energy Management System.
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
RFID	Radio-Frequency Identification

1.3. References

Table 1. References

Reference	Description
[IEC61851-1]	IEC 61851-1 2017: EV conductive charging system - Part 1: General requirements. https://webstore.iec.ch/publication/33644
[IEC62559-2:2015]	Definition of the templates for use cases, actor list and requirements list. https://webstore.iec.ch/publication/22349
[ISO15118-1]	ISO 15118-1 specifies terms and definitions, general requirements and use cases as the basis for the other parts of ISO 15118. It provides a general overview and a common understanding of aspects influencing the charge process, payment and load leveling. https://webstore.iec.ch/publication/9272
[OCPP1.5]	http://www.openchargealliance.org/downloads/
[OCPP1.6]	http://www.openchargealliance.org/downloads/

Chapter 2. New functionality in OCPP 2.1

OCPP 2.1 introduces new functionality compared to OCPP 2.0.1.
The application logic for OCPP 2.0.1 remains valid, but will have to be extended to support the new features of OCPP 2.1.

Most important new features of OCPP 2.1 include support for ISO 15118-20 and extensive support for bidirectional power transfer (V2X), and control of Charging Stations and EVs as Distributed Energy Resources (DER). New use cases have been added that describe ad hoc payment, and Charging Stations can now do local cost calculation based on tariff information from CSMS.

Below is a list of sections of Part 2 of the specification that have new or updated functionality.

A Security

A02/A03 A *requestId* has been added to SignCertificateRequest. Added support for ISO 15118-20 certificates.
A05 Downgrading from security profile 3 to 2 is no longer prohibited.

B Provisioning

B09 SetNetworkProfileRequest has been extended with *basicAuthPassword* and *identity*.
B13 New use case to support resuming transaction after a reset.

C Authorization

Length of IdToken has been extended to 255 characters.

IdToken type is now a predefined list instead of enumeration to allow for easier extension.

C07/C08 ISO 15118 authorization use cases updated with ISO 15118-20 flows.

C10 Explicit requirement added about expiration in authorization cache.

C17 New use case for authorization with prepaid card.

C18-C23 New use cases for ad hoc payment with integrated payment terminal.

C24 New use case for ad hoc payment via stand-alone payment terminal.
C25 New use case for ad hoc payment via dynamic QR code.

E Transactions

E16 New use case for transactions with cost, energy, time, SoC limit.

E17 New use case for resuming a transaction after forced reboot.

F Remote Control

F06 Added CustomTrigger to TriggerMessageRequest.

F07 Net use case for remote start of transaction with limits.

G Availability

Availability notification using NotifyEventRequest for component Connector is now the preferred method, instead of StatusNotification.

I Tariff and Cost

Introducing local cost calculation

I07-I11 New use cases to set default/user tariffs on charging station.

I12 New use case to report calculated cost during and at end of transaction.

J Metervalues

New metervalue location: Upstream.
New measurands for bidirectional charging.

K Smart Charging

New charging profile purposes PriorityCharging and LocalGeneration.

Added *operationMode* to ChargingSchedulePeriodType to facilitate bidirectional charging scenarios.

K01 Added dynamic charging profiles for frequent and unscheduled updates of limits.

K23-K27 New use cases for topologies with energy management systems.

K18-K20 New uses cases to support ISO 15118-20.

K21-K22 New uses cases for priority charging to allow user to overrule charging profile.

M Certificate Management

M01 Updated use case for ISO 15118-20.

N Diagnostics

N01 Added support for data collector log on charging station.

N02 Added monitoring types TargetDelta and TargetDeltaRelative.

N07 Added *severity* to NotifyEventRequest.

N11-14 New use cases for optimized frequent periodic variable monitoring via an event stream. This utilizes the new unconfirmed message type: SEND.

N15 Use case to set a frequent periodic monitoring via event stream.

O Display Message

O01 Added multi-language support.

Q Bidirectional Power Transfer

New section that describes control of bidirectional charging via charging profiles.

Q01-Q04 V2X control with centrally controlled charging profiles.

Q05-Q06 V2X control with externally controlled charging profiles.

Q07-Q08 Central can local frequency control.

Q09 Local load-balancing with V2X.

Q10-Q12 Idle state, offline and resuming after offline.

R DER Control

New section that describes grid control when EV and charging station are considered to be a Distributed Energy Resource (DER).

U01 DER control in EVSE.

U02 DER control in EV.

U03 Hybrid DER control in both EVSE and EV.

U04 Configure DER controls in charging station.

U05 Charging station reporting a DER event.

S Battery Swapping

New section that describes how to control a battery swap station.

S01 Battery Swap Local Autorization

S02 Battery Swap Remote Start

S03 Battery Swap In/Out

S04 Battery Swap Charging

Chapter 3. OCPP 2.1 Documentation Structure

3.1. Overview of Specification Parts

For readability and implementation purposes, OCPP 2.1 is divided in seven parts.

Table 2. Parts

Part 0	Introduction (this document)
Part 1	Architecture & Topology
Part 2	Specification: Use Cases and Requirements, Messages, Data Types and Referenced Components and Variables Appendices: Security Events, Standardized Units of Measure, Components and Variables
Part 3	Schemas
Part 4	Implementation Guide JSON
Part 5	Certification Profiles *(not yet available)*
Part 6	Test Cases *(not yet available)*

The OCPP 2.1 specification is written using a structure, based on [IEC62559-2:2015]: "Use case methodology - Part 2: Definition of the template for use cases, actor list and requirements list".

Part 2, the specification, is divided into 'Functional Blocks'. These Functional Blocks contain use cases and requirements. Messages, Data Types and Referenced Components and Variables are described at the end of the document. The Appendices can be found in the separate document: Part 2 - Appendices.

3.2. Functional Blocks

OCPP 2.1 consists of the following Functional Blocks.

Table 3. Functional Blocks

Clause	Functional Block Title	Description
A.	**Security**	This Functional Block describes a security specification for the OCPP protocol.
B.	**Provisioning**	This Functional Block describes all the functionalities that help a CSO provision their Charging Stations, allowing them to be registered and accepted on their network and retrieving basic configuration information from these Charging Stations.
C.	**Authorization**	This Functional Block describes all the authorization related functionality: AuthorizeRequest message handling/behavior and Authorization Cache functionality.
D.	**Local Authorization List Management**	This Functional Block describes functionality for managing the Local Authorization List.
E.	**Transactions**	This Functional Block describes the basic OCPP Transaction related functionality for transactions that are started/stopped on the Charging Station.
F.	**Remote Control**	This Functional Block describes three types of use cases for remote control management from the CSMS: Remote Transaction Control, Unlocking a Connector and Remote Trigger.
G.	**Availability**	This functional Block describes the functionality of sending status notification messages.
H.	**Reservation**	This Functional Block describes the reservation functionality of a Charging Station.
I.	**Tariff and Cost**	This Functional Block provides tariff and cost information to an EV Driver, when a Charging Station is capable of showing this on a display. Before a driver starts charging tariff information needs to be given, detailed prices for all the components that make up the tariff plan applicable to this driver at this Charging Station. During charging the EV Driver needs to be shown the running total cost, updated at a regular, fitting interval. When the EV Driver stops charging the total cost of this transaction needs to be shown.
J.	**Metering**	This Functional Block describes the functionality for sending meter values, on a periodic sampling and/or clock-aligned timing basis.
K.	**Smart Charging**	This Functional Block describes all the functionality that enables the CSO (or indirectly a third party) to influence the charging current/power of a charging session, or set limits to the amount of power/current a Charging Station can offer to an EV.
L.	**Firmware Management**	This Functional Block describes the functionality that enables a CSO to update the firmware of a Charging Station.
M.	**Certificate Management**	This Functional Block provides the installation and update of certificates.
N.	**Diagnostics**	This Functional Block describes the functionality that enables a CSO to request and track the upload of a diagnostics file from a Charging Station, and to manage the monitoring of Charging Station data.
O.	**Display Message**	With the DisplayMessage feature OCPP enables a CSO to display a message on a Charging Station, that is not part of the firmware of the Charging Station. The CSO gets control over these messages: the CSO can set, retrieve (get), replace and clear messages.
P.	**Data Transfer**	This Functional Block describes the functionality that enables a party to add custom commands to OCPP, enabling custom extension to OCPP.
Q	**Bidirectional Power Transfer**	This Functional block extends Smart Charging with bidirectional power transfer (V2X).
R	**DER Control**	This Functional Block describes how charging stations and EVs can be controlled as Distributed Energy Resources. It provides functions to configure grid code parameters on a charging station via CSMS. It is designed to support DER settings from IEC 61850 and IEEE 2030.5 on the grid side, and ISO 15118-20 Amendment 1 on the EV side.
S	**Battery Swapping**	This Functional block describes how to deal with battery swap stations in OCPP and adds the BatterySwap message.

3.3. All Functional Blocks and use cases

The following table shows the full list of use cases supported by OCPP 2.1 and which use cases were already supported by OCPP 1.6 [OCPP1.6] and OCPP 2.1 .

Clause	Functional Block	UC ID	Use case name	OCPP 1.6	New in OCPP 2.0.1	New in OCPP 2.1
A	Security	A01	Update Charging Station Password for HTTP Basic Authentication		o	
		A02	Update Charging Station Certificate by request of CSMS		o	
		A03	Update Charging Station Certificate initiated by the Charging Station		o	
		A04	Security Event Notification		o	
		A05	Upgrade Charging Station Security Profile		o	
B	Provisioning	B01	Cold Boot Charging Station	o		
		B02	Cold Boot Charging Station - Pending	o		
		B03	Cold Boot Charging Station - Rejected	o		
		B04	Offline Behavior Idle Charging Station	o		
		B05	Set Variables		o	
		B06	Get Variables		o	
		B07	Get Base Report		o	
		B08	Get Custom Report		o	
		B09	Setting a new NetworkConnectionProfile		o	
		B10	Migrate to new CSMS		o	
		B11	Reset - Without Ongoing Transaction	o		
		B12	Reset - With Ongoing Transaction	o		
		B13	Reset - With Ongoing Transaction - Resuming Transaction			o
C	Authorization	C01	EV Driver Authorization using RFID	o		
		C02	Authorization using a start button		o	
		C03	Authorization using credit/debit card		o	
		C04	Authorization using PIN-code		o	
		C05	Authorization for CSMS initiated transactions		o	
		C06	Authorization using local id type		o	
		C07	Authorization using Contract Certificates		o	
		C08	Authorization at EVSE using ISO 15118 External Identification Means (EIM)		o	
		C09	Authorization by GroupId	o		
		C10	Store Authorization Data in the Authorization Cache	o		
		C11	Clear Authorization Data in Authorization Cache	o		
		C12	Start Transaction - Cached Id	o		
		C13	Offline Authorization through Local Authorization List	o		
		C14	Online Authorization through Local Authorization List	o		
		C15	Offline Authorization of unknown Id	o		
		C16	Stop Transaction with a Master Pass		o	
		C17	Authorization with prepaid card			o
		C18	Authorization using locally connected payment terminal			o

Clause	Functional Block	UC ID	Use case name	OCPP 1.6	New in OCPP 2.0.1	New in OCPP 2.1
		C19	Cancelation prior to transaction			o
		C20	Cancelation after start of transaction, before costs have been incurred.			o
		C21	Settlement at end of transaction			o
		C22	Settlement is rejected or fails			o
		C23	Increasing authorization amount			o
		C24	Ad hoc payment via stand-alone payment terminal			o
		C25	Ad hoc payment via static or dynamic QR code			o
D	LocalAuthorizationList	D01	Send Local Authorization List	o		
		D02	Get Local List Version	o		
E	Transactions	E01	Start Transaction Options		o	
		E02	Start Transaction - Cable Plugin First	o		
		E03	Start Transaction - IdToken First	o		
		E04	Transaction started while Charging Station is offline	o		
		E05	Start Transaction - Id not Accepted	o		
		E06	Stop Transaction Options		o	
		E07	Transaction locally stopped by IdToken	o		
		E08	Transaction stopped while Charging Station is offline	o		
		E09	When cable disconnected on EV-side: Stop Transaction	o		
		E10	When cable disconnected on EV-side: Suspend Transaction	o		
		E11	Connection Loss During Transaction	o		
		E12	Inform CSMS of an Offline Occurred Transaction	o		
		E13	Transaction related message not accepted by CSMS	o		
		E14	Check transaction status		o	
		E15	End of charging process	o		
		E16	Transactions with fixed cost, energy, SoC or time			o
		E17	Resuming transaction after forced			o
		E18	Battery Swapping			o
F	RemoteControl	F01	Remote Start Transaction - Cable Plugin First	o		
		F02	Remote Start Transaction - Remote Start First	o		
		F03	Remote Stop Transaction	o		
		F04	Remote Stop ISO 15118 charging from CSMS		o	
		F05	Remotely Unlock Connector	o		
		F06	Trigger Message	o		
		F07	Remote start with fixed cost, energy or time			o
G	Availability	G01	Status Notification	o		
		G02	Heartbeat	o		
		G03	Change Availability EVSE	o		
		G04	Change Availability Charging Station	o		
		G05	Lock Failure	o		
H	Reservation	H01	Reservation	o		
		H02	Cancel Reservation	o		

Clause	Functional Block	UC ID	Use case name	OCPP 1.6	New in OCPP 2.0.1	New in OCPP 2.1
		H03	Use a reserved EVSE	o		
		H04	Reservation Ended, not used	o		
I	Tariff and Costs	I01	Show EV Driver-specific tariff information		o	
		I02	Show EV Driver running total cost during charging		o	
		I03	Show EV Driver final total cost after charging		o	
		I04	Show fallback tariff information		o	
		I05	Show fallback total cost message		o	
		I06	Update Tariff Information During Transaction		o	
		I07	Local Cost Calculation - Set Default Tariff			o
		I08	Local Cost Calculation - Receive User Tariff			o
		I09	Local Cost Calculation - Get Tariffs			o
		I10	Local Cost Calculation - Clear Tariffs			o
		I11	Local Cost Calculation - Change transaction tariff			o
		I12	Local Cost Calculation - Cost Details of Transaction			o
J	Metering	J01	Sending Meter Values not related to a transaction	o		
		J02	Sending transaction related Meter Values	o		
		J03	Charging Loop with metering information exchange		o	
K	SmartCharging	K01	SetChargingProfile	o		
		K02	Central Smart Charging	o		
		K03	Local Smart Charging	o		
		K04	Internal Load Balancing	o		
		K05	Remote Start Transaction with Charging Profile	o		
		K06	Offline Behavior Smart Charging During Transaction	o		
		K07	Offline Behavior Smart Charging at Start of Transaction	o		
		K08	Get Composite Schedule	o		
		K09	Get Charging Profiles		o	
		K10	Clear Charging Profile	o		
		K11	Set / Update External Charging Limit With Ongoing Transaction		o	
		K12	Set / Update External Charging Limit Without Ongoing Transaction		o	
		K13	Reset / release external charging limit		o	
		K14	External Charging Limit with Local Controller		o	
		K15	Charging with load leveling based on High Level Communication		o	
		K16	Optimized charging with scheduling to the CSMS		o	
		K17	Renegotiating a Charging Schedule		o	
		K18	ISO 15118-20 Scheduled Control Mode			o
		K19	ISO 15118-20 Dynamic Control Mode			o
		K20	Adjusting charging schedule when energy needs change			o
		K21	Requesting priority charging remotely			o

Clause	Functional Block	UC ID	Use case name	OCPP 1.6	New in OCPP 2.0.1	New in OCPP 2.1
		K22	Requesting priority charging locally			o
		K23	Smart Charging with EMS connected to Charging Stations			o
		K24	Smart Charging with EMS connected to Local Controller			o
		K25	Smart Charging with EMS acting as a Local Controller			o
		K26	Smart Charging with Hybrid Local & Cloud EMS			o
		K27	Smart Charging with EMS and LocalGeneration			o
		K28	Dynamic charging profiles			o
L	Firmware Management	L01	Secure Firmware Update		o	
		L02	Non-Secure Firmware Update	o		
		L03	Publish Firmware file on Local Controller		o	
		L04	Unpublish Firmware file on Local Controller		o	
M	Certificate Management	M01	Certificate Installation EV		o	
		M02	Certificate Update EV		o	
		M03	Retrieve list of available certificates from a Charging Station		o	
		M04	Delete a specific certificate from a Charging Station		o	
		M05	Install CA certificate in a Charging Station		o	
		M06	Get Charging Station Certificate status		o	
N	Diagnostics	N01	Retrieve Log Information	o		
		N02	Get Monitoring report		o	
		N03	Set Monitoring Base		o	
		N04	Set Variable Monitoring		o	
		N05	Set Monitoring Level		o	
		N06	Clear / Remove Monitoring		o	
		N07	Alert Event		o	
		N08	Periodic Event		o	
		N09	Get Customer Information		o	
		N10	Clear Customer Information		o	
		N11	Set Frequent Periodic Variable Monitoring			o
		N12	Get Periodic Event Streams			o
		N13	Close Periodic Event Streams			o
		N14	Adjust Periodic Event Streams			o
		N15	Periodic Event Streams			o
O	Display Message	O01	Set DisplayMessage		o	
		OO2	Set DisplayMessage for Transaction		o	
		O03	Get All DisplayMessages		o	
		O04	Get Specific DisplayMessages		o	
		O05	Clear a DisplayMessage		o	
		O06	Replace DisplayMessage		o	
P	DataTransfer	P01	Data Transfer to the Charging Station	o		
		P02	Data Transfer to the CSMS	o		
Q	Bidirectional Power Transfer	Q01	V2X Authorization			o

Clause	Functional Block	UC ID	Use case name	OCPP 1.6	New in OCPP 2.0.1	New in OCPP 2.1
		Q02	Charging only (V2X control) before starting V2X			o
		Q03	Central V2X control with charging schedule			o
		Q04	Central V2X control with dynamic CSMS setpoint			o
		Q05	External V2X setpoint control with a charging profile from CSMS			o
		Q06	External V2X control with a charging profile from an External System			o
		Q07	Central V2X control for frequency support			o
		Q08	Local V2X control for frequency support			o
		Q09	Local V2X control for load balancing			o
		Q10	Idle, minimizing energy consumption			o
		Q11	Going offline during V2X operation			o
		Q12	Resuming a V2X operation after an offline period			o
R	DER Control	R01	Starting a V2X session with DER control in EVSE			o
		R02	Starting a V2X session with DER control in EV			o
		R03	Starting a V2X session with hybrid DER control in both EV and EVSE			o
		R04	Configure DER control settings at Charging Station			o
		R05	Charging station reporting a DER event			o
S	Battery Swapping	S01	Battery swap local authorization			o
		S02	Battery swap remote start			o
		S03	Battery swap in/out			o
		R04	Battery swap charging			o

NOTE

OCPP is used in many different regions and for many different charging solutions. Not all functionalities offered by OCPP will be applicable to all implementations. Implementers can decide what specific functionalities apply to their charging solution.
For interoperability purposes, the Open Charge Alliance introduces Certification Profiles in Part 5 of the specification.

Chapter 4. Basic implementation of OCPP 2.1

This section is informative.

The OCPP protocol describes a large number of use cases and messages, which are not all needed to implement a basic Charging Station or CSMS. The table below lists messages that are typically implemented to deliver basic functionality for an OCPP managed Charging Station. The purpose of this list is to guide developers that are new to OCPP.

The basic implementation set for OCPP 2.1 is the same as for OCPP 2.0.1.

NOTE this table does *not* define what needs to be done to become OCPP 2.1 "certified". The functionality that is to be implemented to become OCPP 2.1 certified is described in Part 5 of the specification, "Certification Profiles".

Table 4. OCPP 2.1 Basic Implementation

Functionality	Use cases	Messages
Booting a Charging Station	B01-B04	BootNotification
Configuring a Charging Station	B05-B07	SetVariables, GetVariables and GetReportBase (respond correctly to requests with reportBase = ConfigurationInventory, FullInventory and SummaryInventory).
Resetting a Charging Station	B11-B12	Reset
Authorization options	One of C01, C02 and C04	Authorize
Transaction mechanism	E01 (one of S1-S6), E02-E03, E05, E06 (one of S1-S6), E07-E08, One of E09-E10, E11-E13	TransactionEvent
Availability	G01, G03-G04	Only ChangeAvailability and StatusNotification.
Monitoring Events	G05, N07	A basic implementation of the NotifyEvent message to be used to report operational state changes and problem/error conditions of the Charging Station, e.g. for Lock Failure. Also used for reporting built-in monitoring events.
Sending transaction related Meter values	J02	TransactionEvent
DataTransfer	P01-P02	Any OCPP implementations should at least be able to reject any request for DataTransfer if no (special) functionality is implemented.

NOTE Please also refer to the section on Minimum Device Model in part 1.