



BSI Standards Publication

Open Charge Point Protocol (OCPP)

National foreword

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The UK participation in its preparation was entrusted to Technical Committee PEL/69, Electric vehicles.

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Open Charge Point Protocol (OCPP)
(IEC 63584:2024)

Protocole de point de charge ouvert (OCPP)
(IEC 63584:2024)

Open Charge Point Protocol (OCPP)
(IEC 63584:2024)

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European foreword

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OPEN CHARGE POINT PROTOCOL (OCP)

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The text of this International Standard is based on the following documents:

Draft	Report on voting
69/964/CDV	69/1028/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

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OCPP 2.0.1

Part 0 - Introduction

Edition 30 November 2024

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Version History

Version	Date	Description
2.0.1 Edition 3	2024-05-06	OCPP 2.0.1 Edition 3. All errata from OCPP 2.0.1 Part 0 until and including Errata 2024-04 have been merged into this version of the specification.
2.0.1	2020-03-31	Final version of OCPP 2.0.1
2.0	2018-04-11	OCPP 2.0 April 2018 First release of this Introduction document

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 2.0.1

This specification defines version 2.0.1 of OCPP.

After the release of OCPP 2.0, some issues were found in OCPP 2.0. Some of these issues could not be fixed issuing errata to the specification text only, as has been done with OCPP 1.6, but required changes to the protocol's machine-readable schema definition files that cannot be backward compatible.

To prevent confusion in the market and possible interoperability issues in the field, OCA has decided to name this version: 2.0.1. OCPP 2.0.1 contains fixes for all the known issues, to date, not only the fixes to the messages.

This version replaces OCPP 2.0. OCA advises implementers of OCPP to no longer implement OCPP 2.0 and only use version 2.0.1 going forward.

Any mentions of "OCPP 2.0" refers to revision 2.0.1 unless specifically stated otherwise.

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/

2. New functionalities in OCPP2.0.1

OCPP 2.0.1 introduces new functionalities compared to OCPP 1.6 [\[OCPP1.6\]](#).

Due to improvements and new features, OCPP 2.0.1 is not backward compatible with OCPP 1.6 [\[OCPP1.6\]](#) or OCPP 1.5 [\[OCPP1.5\]](#).

2.1. Device Management

Device Management (also known as Device Model) is a long awaited feature especially welcomed by CSOs who manage a network of (complex) charging stations (from different vendors).

It provides the following functionality:

- Inventory reporting
- Improved error and state reporting
- Improved configuration
- Customizable Monitoring

This all should help CSOs to reduce the costs of operating a Charging Station network.

Charging Station Manufacturers are free to decide themselves how much details about a Charging Station they want to publish via Device Management: for example, they can decide what can be monitored, and what not.

2.2. Improvements for better handling of large amounts of transactions

2.2.1. One message for all transaction related functionalities

With the growing of the EV charging market, the number of Charging Stations and transactions that the CSMS needs to manage also grows. The structure and method for reporting transaction is unified in OCPP 2.0. In OCPP 1.x, the reporting of transaction data is split over the messages StartTransaction, StopTransaction, MeterValue and StatusNotification. With the market progressing towards more enhanced scheduling, a need is born for more sophisticated handling of transaction data. All the StartTransaction, StopTransaction, and transaction related MeterValue and StatusNotification messages are replaced by 'TransactionEvent'. The StatusNotification message still exists, but only for non-transaction related status notifications about connector availability.

2.2.2. Data reduction

With the introduction of JSON over Websockets in OCPP 1.6 [\[OCPP1.6\]](#) a great reduction of mobile data cost can be achieved. With OCPP 2.0, support for WebSocket Compression is introduced, which reduces the amount of data even more.

2.3. Improvements regarding cyber security

The following improvements have been added to harden OCPP against cyber attacks:

- Security profiles (3 levels) for Charging Station and/or CSMS authentication and Communication Security
- Key management for Client-Side certificates
- Secure firmware updates
- Security event log

2.4. Extended Smart Charging

In OCPP 2.0.1 Smart Charging functionality has been extended (compared to OCPP 1.6 [\[OCPP1.6\]](#)) to support:

- Direct Smart Charging inputs from an Energy Management System (EMS) to a Charging Station
- Improved Smart Charging with a local controller
- Support for integrated smart charging of the CSMS, Charging Station and EV ([\[ISO15118-1\]](#)).

2.5. Support for ISO 15118

The ISO 15118 standard [\[ISO15118-1\]](#) is a newer protocol for EVSE to EV communication, compared to IEC 61851 [\[IEC61851-1\]](#). ISO 15118 allows a lot of new features and more secure communication between EVSE and EV. OCPP 2.0.1 supports the ISO 15118 standard, the newly added features are:

- Plug & Charge
- Smart Charging including input from the EV

2.6. Improvements for customer experience

2.6.1. More authorization options

OCPP 1.x was designed (mainly) for Charging Stations that authorize an EV driver via an RFID card/token. If other authorization systems or a mix of systems are used, the CSMS needs to know what system is used for which authorization. OCPP 2.0.1 has been extended to support things like: 15118 Plug & Charge [\[ISO15118-1\]](#), Payment Terminals, local mechanical key, Smart-phones, etc.

2.6.2. Display Messages

This provides Charging Station Operators with the possibility to configure - from the CSMS - a message on a Charging Station to be displayed to EV drivers. Messages can be transaction related or global.

2.6.3. EV Driver preferred languages

To be able to show messages to an EV driver in a language the driver understands best, OCPP 2.0.1 provides the possibility to send the language preference of a driver to a Charging Station.

2.6.4. Tariff and Costs

OCPP 2.0.1 allows Charging Stations to show the applicable tariff/price before an EV driver starts charging, to show the running total cost during a charging transaction and/or to show the final total cost after the transaction is finished.

2.7. Transport Protocols: OCPP-J Improvements

2.7.1. Simple Message routing

A description has been added on how to create a simple solution for OCPP message routing in, for example, a Local Controller. This is defined in Part 4, Section 6: OCPP Routing.

2.7.2. No SOAP Support

OCPP 2.0.1 no longer supports SOAP as a transport protocol. This decision was taken by the OCA members, who believe that the protocol does no longer lend itself for constrained computing resources that many Charging Stations operate under. The verbosity of the protocol could lead to slower performance and requires a higher bandwidth, which, in many cases, leads to higher cellular costs. SOAP is also difficult to support when communication is via local site networking.

2.8. Minor changes/extensions

2.8.1. Renamed messages

In the OCPP 1.x series, the names of all messages were kept unchanged for backward compatibility, even though some message names were found to be confusing or misleading in practice. In OCPP 2.0.1 message names have been changed, where appropriate, to improve clarity and understanding.

Example: RemoteStartTransaction.req: a lot of implementers thought it meant the Charging Station should start the transaction, but in fact it is a request to try to start a transaction. However, for example, if no cable is plugged in, no transaction can be started. Since the message was always intended to be a request, it has been changed to a more logical name: RequestStartTransactionRequest.

2.8.2. TransactionId Identification & Message Sequencing

In OCPP 2.0, transaction identifiers are generated by the Charging Station, to facilitate offline charging sessions, in contrast to OCPP 1.x, where transaction identifiers were generated at the CSMS and sent to the Charging Station. In addition, all messages relating to a transaction are assigned incremental sequence numbering, to facilitate transaction data completeness checking at the CSMS.

2.8.3. Extended enumerations

Many enumerations have been extended to support more use cases, provide more options etc.

2.8.4. Offline Transaction Event Indication

Charging Stations can optionally indicate in transaction messages that a transaction event occurred while the Charging Station was Offline. This can assist a CSMS with the processing of transactions.

2.8.5. Personal message

Message that can be shown to the EV Driver and can be used for tariff information, user greetings and for indicating why a driver is not authorized to charge. When a driver uses an authorization method (RFID for example) and the CSMS does not authorize the driver to start charging, this field can thus contain additional reasons to provide the driver with a meaningful explanation why (s)he is not allowed to charge.

3. OCPP 2.0.1 Documentation Structure

3.1. Overview of Specification Parts

The overall structure of the standard has been improved, making the new specification easier to read, implement and test.

For readability and implementation purposes, OCPP 2.0.1 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
Part 6	Test Cases

In contrast to OCPP 1.6 [OCPP1.6], the OCPP 2.0.1 specification is written in a different 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. Messages and Data Types are structured in almost the same way as the previous OCPP specification [OCPP1.6].

3.2. Functional Blocks

OCPP 2.0.1 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.	ISO 15118 Certificate Management	This Functional Block provides the installation and update of ISO 15118 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.

3.3. All Functional Blocks and use cases

The following table shows the full list of use cases supported by OCPP 2.0.1 and which use cases were already supported by OCPP 1.6 [\[OCPP1.6\]](#).

Clause	Functional Block	UC ID	Use case name	OCPP 1.6	New in OCPP 2.0.1
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
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	
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
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	

Clause	Functional Block	UC ID	Use case name	OCPP 1.6	New in OCPP 2.0.1
		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	
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	
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	
		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
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		

Clause	Functional Block	UC ID	Use case name	OCPP 1.6	New in OCPP 2.0.1
		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
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	ISO 15118 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
O	Display Message	O01	Set DisplayMessage		o
		O02	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	

NOTE

OCPP is used in many different regions and for many different charging solutions. Not all functionalities offered by OCPP 2.0.1 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.

4. Basic implementation of OCPP 2.0.1

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.

Please note: this table does *not* define what needs to be done to become OCPP 2.0.1 "certified". The functionality that is to be implemented to become OCPP 2.0.1 certified is described in Part 5 of the specification, "Certification Profiles".

Table 4. OCPP 2.0.1 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.



OCPP 2.0.1

Part 1 - Architecture & Topology

Edition 3.0 November 2024

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Version History

Version	Date	Description
2.0.1 Edition 3	2024-05-06	OCPP 2.0.1 Edition 3. All errata from OCPP 2.0.1 Part 1 until and including Errata 2024-04 have been merged into this version of the specification.
2.0.1	2020-03-31	Final version of OCPP 2.0.1
2.0	2018-04-11	OCPP 2.0 April 2018 First release of this Architecture & Topology document

1. Introduction

1.1. Goal of this document

The goal of this document is to describe a number of architecture related topics for OCPP 2.0.1.

OCPP was originally intended for two way communication between a backoffice, in OCPP the *Charging Station Management System* (in this document: CSMS) and a Charging Station. The protocol has become more advanced and with every new revision new functionalities and options are added. It has evolved into a protocol that can be used in different architectures for different types of Charging Stations.

This document describes, in addition to the original "simple" setup CSMS <> Charging Station, a number of topologies as an additional explanation for using OCPP. Furthermore, the Device Management concept to configure and monitor any type of Charging Station, the OCPP Information Model and the 3-tier model are explained.

This document is partially **informative** and partially **normative** and is not intended to limit the use of OCPP. However, it does add an explanation what kind of use of OCPP the creators of OCPP had in mind when creating this version of the specification. This document is therefore also intended to support the reader of the protocol specification in Part 2 of OCPP to understand how it can be used.

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 EVs can be charged. A Charging Station has one or more EVSEs.
Connector	The term Connector, as used in this specification, refers to an independently operated and managed electrical outlet on a Charging Station. In other words, this corresponds to a single physical Connector. In some cases an EVSE may have multiple physical socket types and/or tethered cable/Connector arrangements(i.e. Connectors) to facilitate different vehicle types (e.g. four-wheeled EVs and electric scooters).
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.
Local port Smart Meter	The Local port on a Smart Meter is a port (for example serial) on a digital electricity meter that provides access to information about meter readings and usage.

1.2.2. Abbreviations

Abbreviation	Meaning
DSO	Distribution System Operator
CSO	Charging Station Operator
CSMS	Charging Station Management System
EMS	Energy Management System. 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.
EVSE	Electric Vehicle Supply Equipment
LC	Local Controller. In this document this is defined as a device that can send messages to its Charging Stations, independently of the CSMS. A typical usage for this is the local smart charging case described in the Smart Charging chapter of Part 2 of OCPP, where a Local Controller can impose charge limits on its Charging Stations.
LP	Local Proxy. Acts as a message router.

2. 3-tier model

This section is informative.

To understand the terminology in the OCPP specification, it is important to understand the starting point of this specification. The OCPP specification uses the term Charging Station as the physical system where EVs can be charged. A Charging Station can have one or more EVSEs (Electric Vehicle Supply Equipment). An EVSE is considered as a part of the Charging Station that can deliver energy to one EV at a time. The term Connector, as used in this specification, refers to an independently operated and managed electrical outlet on a Charging Station, in other words, this corresponds to a single physical Connector. In some cases an EVSE may have multiple physical socket types and/or tethered cable/connector arrangements to facilitate different vehicle types (e.g. four-wheeled EVs and electric scooters). This setup is referred to as the 3-tier model and visualized in the figure below.

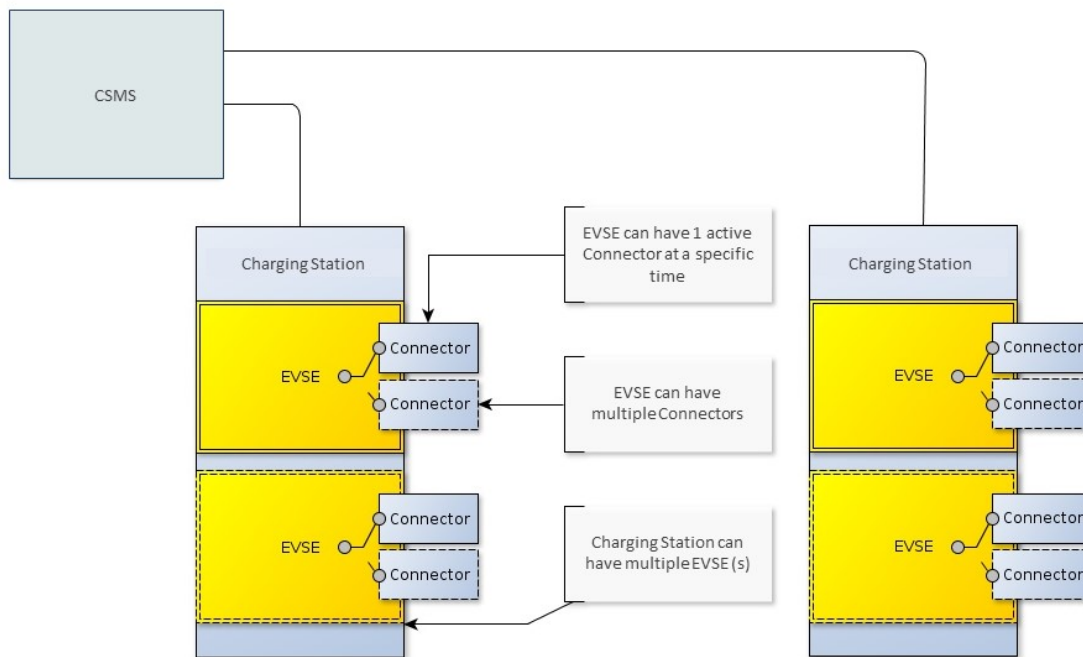


Figure 1. 3-tier model as used in OCPP

NOTE

This section describes the charging infrastructure on a logical level for communication purposes. We do not wish to impose a mapping onto physical hardware. This is a manufacturer's choice. For example, the EVSE might be integrated into a Charging Station and to look as just a part of that device, but it might just as well have its own casing and live outside of the physical entity Charging Station, for example a charging plaza with 20 EVSEs and Connectors which communicates via 1 modem as 1 Charging Station to the CSMS is seen by OCPP as 1 Charging Station.

3. Information Model

This section is informative.

Given the growing complexity of the messages of OCPP, OCPP 2.0.1 is based on an *Information Model* as a blueprint for the messages and inherent schemas of OCPP. With an information model, we mean a logical object set, describing real objects with all their properties. This provides an informative representation of information structure in the protocol. Furthermore, it enables making objects within OCPP reusable and enables consistent definition of messages and automatically generated message schemas (Part 3).

The Information Model is a model, also called Domain Model or Core Model, based on which the OCPP messages and datatypes are generated. These datatypes are extracted from the the OCPP 1.6 specification and are named Core DataTypes and Qualified DataTypes. The figure below illustrates how the DataTypes in the information model are built up.

In part 2 - Specification, chapter DataTypes, some DataTypes have the Common: prefix. This originates from the Information Model. It means that the DataType is able to be shared among other DataTypes and Messages. This has no impact on the OCPP implementation of a device.

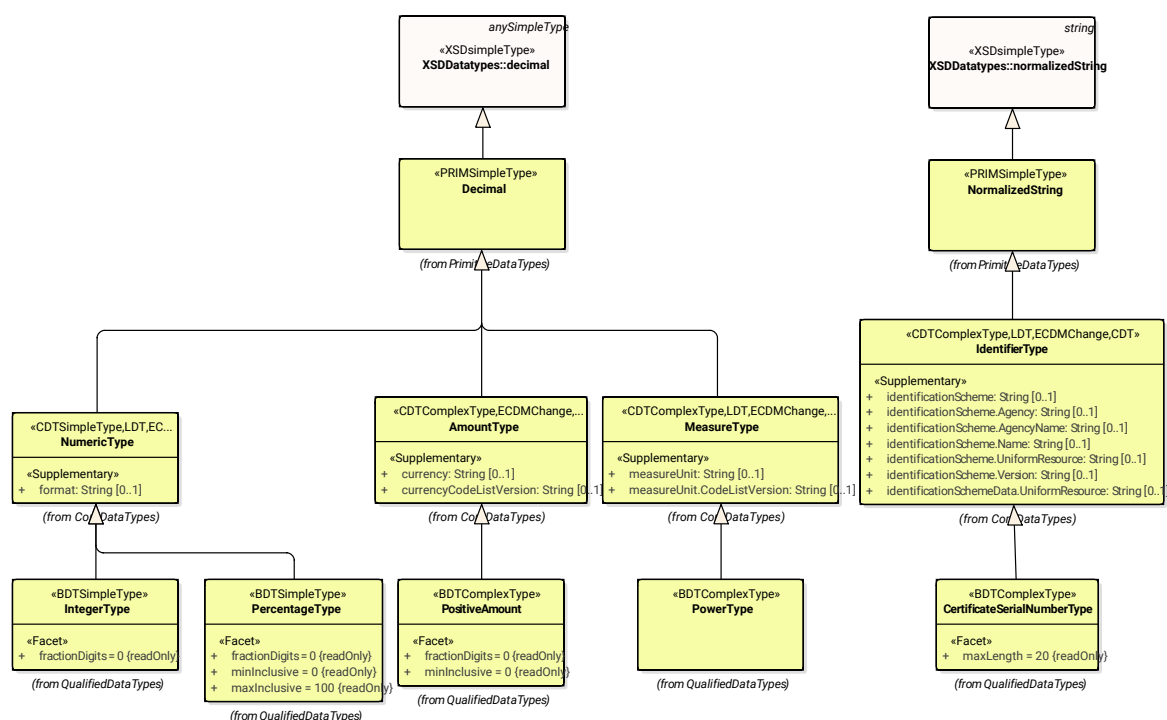


Figure 2. Example datatypes

The Information Model is divided into a number of "functions" to have a better overview of the model (thus for readability):

- Transactions
- SmartCharging
- Metering
- Security (Profiles/Authorization)
- Communication
- SecondaryActorSchedule

For more details about the actual model per function, please refer to the appendix.

4. Device Model: Addressing Components and Variables

The Device Model refers to a generalized mechanism within OCPP to enable any model of Charging Station to report how it is build up, so it can be managed from any CSMS. To manage a Charging Station with the Device Model (i.e. "to manage a device") a number of messages and use cases is defined to configure and monitor a Charging Station in detail, without defining the structure of the Charging Station in advance. To be able to do this, OCPP provides a generalized mechanism to allow the exchange of a wide range of information about Charging Station. This version of the Device Model has the 3-tier model (Charging Station, EVSE, Connector) as its starting point, which means that any description created with the Device Model follows these three tiers. The remainder of this chapter describes how the data (and associated meta-data) looks like that can be exchanged between a Charging Station and a CSMS. The use cases and messages that are used to manage a device are *not* described here, but in Part 2 of the specification. This chapter only focuses on the data model.

4.1. Components

In OCPP 2.0.1, a Charging Station is modelled as a set of "*Components*", typically representing physical devices (including any external equipment to which it is connected for data gathering and/or control), logical functionality, or logical data entities. *Components* of different types are primarily identified by a *ComponentName*, that is either the name of a *standardized* component (see OCPP part 2c), or a custom/non-standardized component name, for new, pre-standardized equipment, vendor specific extensions, etc.

ChargingStation (TopLevel), *EVSE*, and *Connector* represent the three major "tiers" of a Charging Station, and constitute an implicit "location-based" addressing scheme that is widely used in many OCPP data structures. Each "tier" has a component of the same name, which represents the tier. For example, EVSE 1 on a Charging Station is represented by the component named "EVSE" (no instance name) with "evseId = 1". In the same manner, Connector 1 on EVSE 1 is represented by the component named "Connector" (no instance name) with "evseId = 1, connectorId = 1".

By default, all *components* are located at the *ChargingStation* tier, but individual instances of any component can be associated with a specific *EVSE*, or a specific *Connector* (on a specific *EVSE*) by including *EVSE* or *EVSE* and *Connector* identification numbers as part of a component addressing reference.

Additionally, there can be more than one instance of a component (in the functional dimension), representing multi-occurrence physical or logical components (e.g. power converter modules, fan banks, resident firmware images, etc.).

Each distinct *component* instance is uniquely identified by an (optional) *componentInstance* addressing key. When no *componentInstance* is provided, then the default or only instance of a *component* is referenced.

Components do not in themselves hold data: all externally accessible data associated with each component instance is represented by a set of *variables* that can be read, set, and/or monitored for changes. The relationship of a *Component* with one or more *Variables* is illustrated in below.

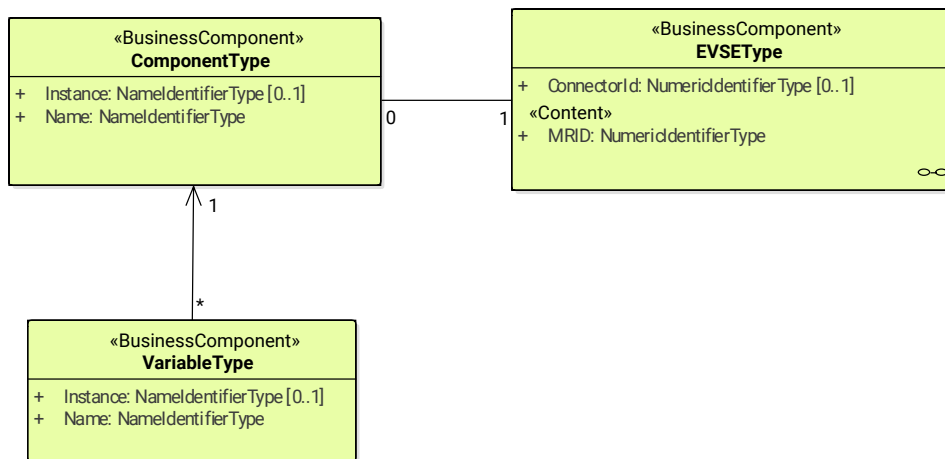


Figure 3. Component and variables

The table below illustrates some common components (by their standardized component-names), and examples of the hierarchical location levels at which they typically occur for a basic home charger and a typical public Charging Station.

Basic home charger example configuration		
ChargingStation tier	EVSE tier	Connector tier
ChargingStation (itself, as a whole)	EVSE (itself, as a whole)	Connector (itself, as a whole)
RadioLink	ControlMetering	PlugRetentionLock
TokenReader	OverCurrentBreaker	
Controller	RCD	

Basic home charger example configuration		
	ChargingStatusIndicator	

Public Charging Station example configuration		
ChargingStation tier	EVSE tier	Connector tier
ChargingStation (itself, as a whole)	EVSE (itself, as a whole)	Connector (itself, as a whole)
ElectricalFeed	ElectricalFeed	AccessProtection
TokenReader	TokenReader	PlugRetentionLock
Display	Display	
FiscalMetering	FiscalMetering	
Clock	ControlMetering	
Controller	OverCurrentBreaker	
	RCD	
	ChargingStatusIndicator	

4.2. Variables

Every *component* has a number of *variables*, that can, as appropriate, be used to hold, set, read, and/or report on all (externally visible) data applicable to that *component*, including configuration parameters, measured values (e.g. a current or a temperature) and/or monitored changes to variable values.

Although many *components* can have associated *variables* that are, by their nature, specific to the component type (e.g. *ConnectorType* for a *Connector* component), there are a minimal set of standardized *variables* that are used to provide standardized high level event notification and state/status reporting (e.g. *Problem*, *Active*) on a global and/or selective basis, and also to report component presence, availability, etc. during the inventorying/discovery process (e.g. *Available*, *Enabled*). A Charging Station is not required to report the base variables: *Present*, *Available* and *Enabled* when they are readonly and set to *true*. When a Charging Station does not report: *Present*, *Available* and/or *Enabled* the Central System SHALL assume them to be readonly and set to *true*

Variables can be any of a range of common general-purpose data types (boolean, integer, decimal, date-time, string), but also can have their allowable values constrained to particular ranges, enumeration lists, sets, or ordered lists.

To support complex components, there can be more than one instance of any given variable name associated with any components (e.g. power converter modules reporting temperature, current, or voltage at multiple points). Each distinct *variable* instance is uniquely identified by an (optional) *variableInstance* addressing key string value. When no *variableInstance* is provided, then the default or only instance of a *variable* is referenced.

4.3. Characteristics and Attributes

Each *variable*, in addition to its primary ("Actual") value, can have a set of associated secondary data that is linked to the same primary *variable* name and *variableInstance*.

This greatly avoids cluttering the *variables* namespace with confusing clusters of ancillary variable names (e.g. FanSpeed, FanSpeedUnits, MinimumFanSpeed, BaseFanSpeed) that lack consistence and discoverability.

The ancillary variable data includes:

- Variable characteristics meta-data (read-only)
 - Unit of measure (V,W,kW,kWh, etc.)
 - Data type (Integer, Decimal, String, Date, OptionList, etc.)
 - Lower limit
 - Upper limit
 - List of allowed values for enumerated variables
- Variable attributes (read-write):
 - Actual value
 - Target value
 - Configured lower limit
 - Configured upper limit
 - Mutability (whether the value can be altered or not, e.g. ReadOnly or ReadWrite)
 - Persistence (whether the value is preserved in case of a reboot or power loss)

The relationship of a Variable with one or more VariableAttributes is illustrated in the figure below.

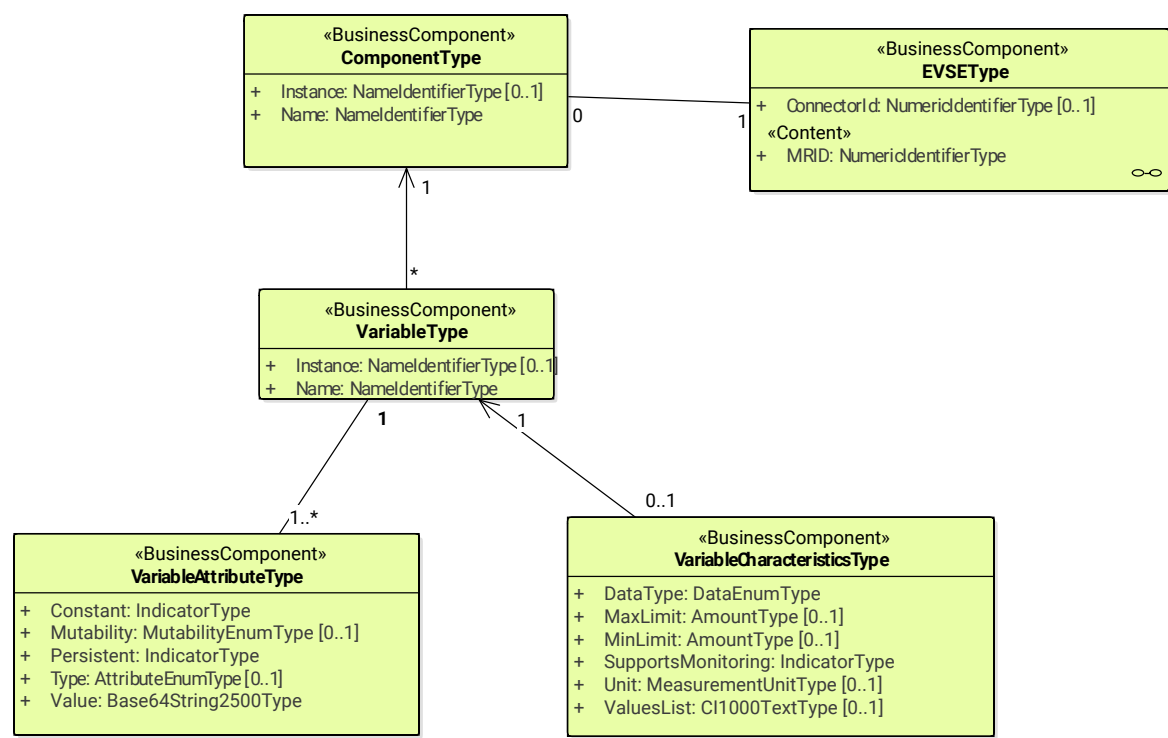


Figure 4. Variable attributes and characteristics

There is a difference between how to implement (physical) devices and (virtual) controller components, using the DeviceModel. A (virtual) controller component has to be implementing as described in part 2 chapter the "Referenced Components and Variables". These kind of components/variables are only using the variableAttribute type 'Actual'. Depending on if this variableAttribute is writable, the CSMS can use this to set a new value.

(Physical) devices are a bit more complex to implement. For example, there is a fan with a fan speed, that has a (physical) limit with a range of 0 - 1000. But it should not be allowed to set the value below 200, because the fan can stop functioning. And it should not be set above 500, because that would be bad for the fan on the long run. When implementing this device using the DeviceModel, it can be defined as follows:

Component	name	Fan	
Variable	name	FanSpeed	
	variableAttribute 1	type	Actual
		value	<The current fan speed value of the fan.>
		mutability	ReadOnly
	variableAttribute 2	type	Target
		value	<The CSMS can use this value to adjust the fan speed. The Charging Station SHALL try to keep the actual value at the target value.>
		mutability	ReadWrite
	variableAttribute 3	type	MaxSet
		value	<The value '500' from the example. The target may not be set above this value.>
	variableAttribute 4	type	MinSet
		value	<The value '200' from the example. The target may not be set below this value.>
	variableCharacteristics	maxLimit	<The value '1000' from the example. This could be the physical max limit of the fan.>
		minLimit	<The value '0' from the example. This could be the physical min limit of the fan. This could also be -1000, if the fan is also able to rotate in the other direction.>
Description	This is an example of how a fan could be defined using the DeviceModel.		

When trying to set the target with value 600, the Charging Station will first check the allowed min and max values/limits and reject

the set. If the target value is set to 500, the value is within range and the Charging Station will allow the set and start to adjust the actual fan speed. If the actual fan speed is measured to be 502, it's out of range. But it should be reported to the CSMS, so the actual value of a physical component should be updated without checking the min and max values/limits.

4.4. Monitoring

Optional monitoring settings can be associated with a variable, that allow changes to *variable (Actual)* values are to be reported to the CSMS as event notifications.
These include:

- Monitoring value
- Monitoring type: upper threshold, lower threshold, delta, periodic
- Severity level when reporting the event

The following table show which MonitorType/dataType combinations are possible.

	string	decimal	integer	dateTime	boolean	OptionList	SequenceList	MemberList
UpperThresh old		X	X					
LowerThresh old		X	X					
Delta	X	X	X	X	X	X	X	X
Periodic	X	X	X		X	X	X	X
PeriodicCloc kAligned	X	X	X		X	X	X	X

- For *UpperThreshold* and *LowerThreshold* the value represents the to be exceeded value by the actual value of the variable.
- For *Delta* this value represents the change in value comparing with the actual value from the moment the monitor was set.
 - When the dataType of the variable is integer or decimal, this value represents the difference to be reached to trigger the monitor.
 - When the dataType of the variable is dateTime the unit of measure will be in seconds.
 - When the dataType of the variable is string, boolean, OptionList, SequenceList or MemberList, this value is ignored. The monitor will be triggered by every change in the actual value.
- When a delta monitor is triggered OR when the Charging Station has rebooted, the Charging Station shall set a new momentary value.
- For *Periodic* and *PeriodicClockAligned* the value represents the interval in seconds.

The relationship between a Variable and one or more VariableMonitoring elements is illustrated in the figure below.

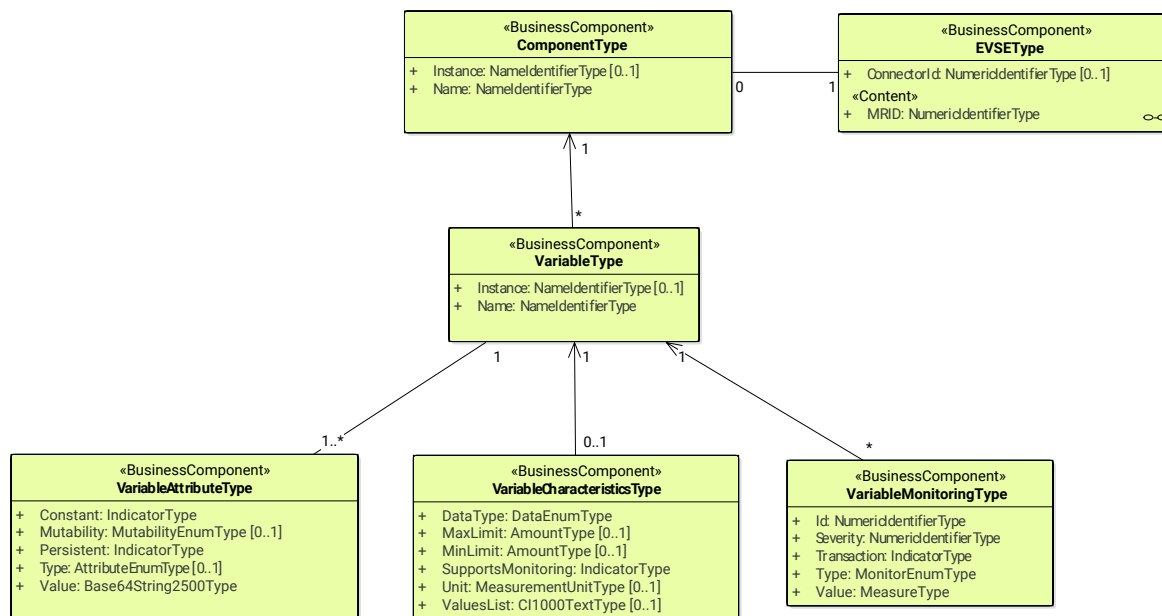


Figure 5. Variables and monitoring

4.5. Standardized lists of Components and Variables

To provide some level of interoperability between different Charging Stations and CSMSs, besides the above defined model of *Components* and *Variables*, part 2 - appendices of the OCPP specification provides a list of standardized names for Components and Variables. The idea of this lists is to make sure that *if* a Charging Station and CSMS want to exchange information about a component, they both use the same name and description *if* it is listed in the OCPP specification. For names of a *Components* or *Variables* that are not listed in the specification, bilateral appointments between Charging Station manufacturer and CSMS are to be made. In these cases it is advised to provide feedback to the Open Charge Alliance to be able to include new/additional *Components* and *Variables* in new versions of OCPP.

4.6. Minimum Device Model

Since the Device Model is a *generalized* mechanism which can be applied to any model of Charging Station, the complexity of different implementations can vary. It consists of a number of use cases and messages that are not all required. This section describes the minimum part of the Device Model that needs to be implemented to create a working implementation of OCPP 2.0.1.

The Device Model introduces Components and Variables that can be used for configuring and monitoring a Charging Station. A number of these Components and Variables are included in the list of *Referenced Components and Variables* (grouped by Functional Block) in Part 2 of the specification. When implementing a Functional Block, ALL required Configuration Variables that belong to a Functional Block SHALL be implemented. The required Configuration Variables from the *General* section SHALL also be implemented for all implementations of OCPP 2.0.1.

The following table describes which messages are required or optional to implement for all use cases that are part of the Device Model implementation.

Use cases / messages that are part of a minimum Device Model implementation	
Use case	Messages
B05 Set Variables	SetVariables message MUST be implemented
B06 Get Variables	GetVariables message MUST be implemented.
B07 Get Base Report	GetBaseReport message MUST be implemented and MUST support ConfigurationInventory and FullInventory. The content of these reports depends on the implementation of the Charging Station. It is up to the implementer to decide which components and variables exist in the implementation.
Additional use cases / messages that are <i>not</i> part of a minimum Device Model implementation	
Use case	Messages
B08 Get Custom Report	GetCustomReport message is optional.
N02 Get Monitoring Report	GetMonitoringReportRequest message is optional.
N03 Set Monitoring Base	SetMonitoringBaseRequest message is optional.
N04 Set Variable Monitoring	SetVariableMonitoringRequest message is optional.

Use cases / messages that are part of a minimum Device Model implementation	
N05 Set Monitoring Level	SetMonitoringLevelRequest message is optional.
N06 Clear/Remove Monitoring	ClearVariableMonitoringRequest message is optional.
N07 Alert Event	it is RECOMMENDED that NotifyEventRequest is implemented in the Charging Station even when monitoring is not implemented, so that this can be used to report built-in monitoring events.
N08 Periodic Event	see N07.

5. Information Model vs. Device Model

As described above, the terms Information Model and Device Model refer to different concepts. The Information Model refers to a model of the information structure upon which the messages and datatypes in OCPP are based, whereas the Device Model refers to a generalized mechanism within OCPP to enable any model of Charging Station to report how it is build up so, it can be managed from any CSMS without defining the structure of the Charging Station in advance.

The messages that are used for Device Management are therefore part of the Information Model and the objects that are used for modelling a device ('*Component*' and '*Variable*') are also part of the Information Model.

6. Using OCPP for other purposes than EV charging

As indicated in the introduction of this document, OCPP is primarily intended for two way communication between a CSMS and a Charging Station. However, with the addition of the Device Model as described in the chapter [Device Model](#), OCPP can additionally be used for other purposes. For example, the reporting of Events or Status changes in transformers or stand-alone battery packs might also be useful for companies that are rolling out EV charging infrastructure. In this example, a BootNotification could be used to connect these devices to a management system. In the device model a device that is not a Charging Station, can be recognized by the fact that the component Charging Station is not present at the top level. At the moment the OCPP specification does not provide use cases for non Charging Station devices. However, they may be added in a future version of OCPP.

7. Numbering

This section is normative.

7.1. EVSE numbering

To enable the CSMS to address all the EVSEs of a Charging Station, EVSEs MUST always be numbered in the same way.

EVSEs numbering (evselds) MUST be as follows:

- The EVSEs MUST be sequentially numbered, starting from 1 at every Charging Station (no numbers may be skipped).
- evselds MUST never be higher than the total number of EVSEs of a Charging Station
- For operations initiated by the CSMS, evseld 0 is reserved for addressing the entire Charging Station.
- For operations initiated by the Charging Station (when reporting), evseld 0 is reserved for the Charging Station main controller.

Example: A Charging Station with 3 EVSEs: All EVSEs MUST be numbered with the IDs: 1, 2 and 3. It is advisable to number the EVSEs of a Charging Station in a logical way: from left to right, top to bottom incrementing.

7.2. Connector numbering

To enable the CSMS to address all the Connectors of a Charging Station, Connectors MUST always be numbered in the same way.

Connector numbering (connectorIds) MUST be as follows:

- The connectors are numbered (increasing) starting at connectorId 1 on every EVSE
- Every connector per EVSE has a unique number
- ID of the first Connector of an EVSE MUST be 1
- Additional Connectors of the same EVSE MUST be sequentially numbered (no numbers may be skipped)
- connectorIds MUST never be higher than the total number of connectors on that EVSE

Example: A Charging Station with 3 EVSEs that each have 2 connectors, is numbered as follows:

- EVSE 1 has connectors with connectorId 1 and 2
- EVSE 2 has connectors with connectorId 1 and 2
- EVSE 3 has connectors with connectorId 1 and 2

7.3. Transaction IDs

TransactionIds are now generated by the Charging Station and MUST be unique on this Charging Station for every started transaction.

In OCPP 1.x this was done by the CSMS.

The format of the transaction ID is left to implementation. This MAY for example be an incremental number or an UUID.

8. Topologies supported by OCPP

This chapter shows a number of topologies for using OCPP. As indicated in the introduction, OCPP was originally used for a setup where each Charging Station communicates directly with the CSMS. It is important to keep in mind that OCPP has no knowledge of the topology of the Charging Station network. The following figure shows the possible components in a setup using OCPP and the relations between these components:

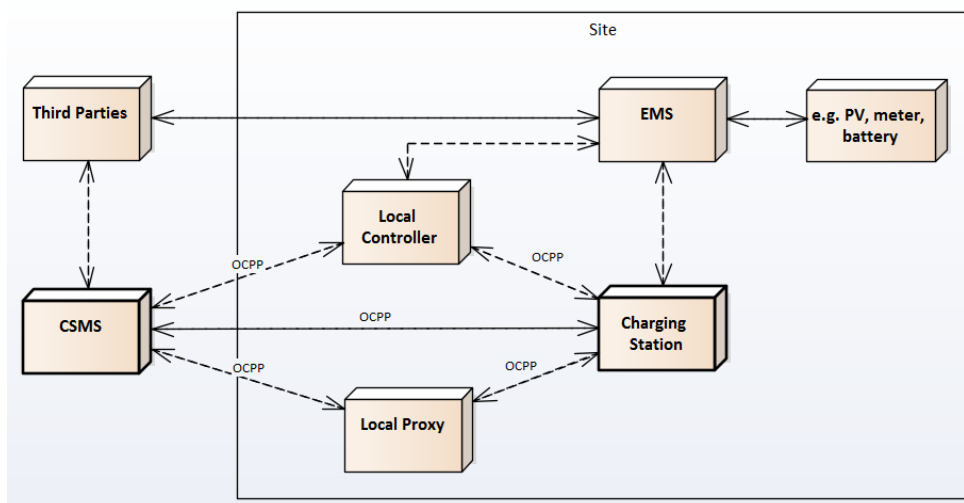


Figure 6. Possible components in a setup using OCPP

8.1. Charging Station(s) directly connected to CSMS

Description

This is the basic setup for using OCPP.

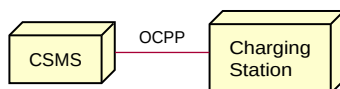


Figure 7. Charging Station directly connected to CSMS

8.2. Multiple Charging Stations connected to CSMS via Local Proxy

Description

In some situations it is desirable to route all communications for a group of Charging Stations through a single network node (i.e. modem, router, etc.). A typical example is the situation where a number of a Charging Stations are located in an underground parking garage with little or no access to the mobile network. In order to provide access to mobile data the Charging Stations are linked to a central data communications unit over a LAN. This central unit connects to the mobile network and acts as a proxy between CSMS and Charging Stations. Such a unit is called a "local proxy" (LP) in OCPP. A local proxy acts as a message router. Neither the CSMS nor the Charging Stations are aware of the topology of the network. For the Charging Stations in the group the local proxy "is" the CSMS. Similarly, for the CSMS the local proxy "is" the Charging Station. The diagram below illustrates this configuration.

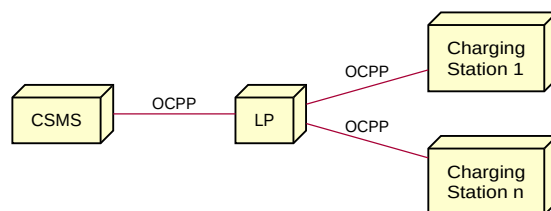


Figure 8. Multiple Charging Stations connected to CSMS via Local Proxy

8.3. Multiple Charging Stations connected to CSMS via Local Controller

Description

Whereas a [local proxy](#) does little more than route OCPP messages, a Local Controller can send messages to its Charging Stations, independently of the CSMS. A typical usage for this is the local smart charging case described in the Smart Charging chapter of Part 2 of OCPP, where a Local Controller can impose charge limits on its Charging Stations. In order for a Local Controller to be addressed by the CSMS, it needs to have its own Charging Station identity. From the point of view from OCPP, the Local Controller will just be a Charging Station (without any EVSEs/Connectors). The CSMS will possess the logic to deal with the Local Controller in order to support, for example, local smart charging. It is up to the implementation of the CSMS, whether the group topology is manually configured or deduced from the network based on IP addresses and information in BootNotifications. The diagram below illustrates this configuration.

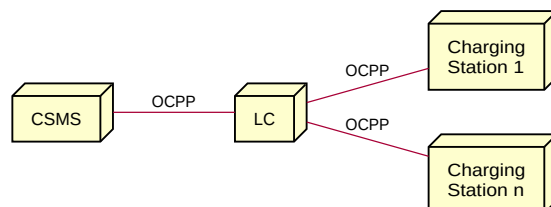


Figure 9. Multiple Charging Stations connected to CSMS via Local Controller

NOTE

Technically this topology can be realized in multiple ways. When using this setup with websockets, this implies that when a Charging Station connects to the Local Controller, it should open a websocket connection with the same address to the CSMS. The advantages of this approach is that the Local Controller can see all the messages and act on it, messages don't have to wait, firmware updates etc. on the Charging Stations are possible and the CSMS does not need special software. It could (in big installations) lead to a lot of websocket connections between CSMS and LC needed. For further information, please refer to OCPP implementation guide in Part 4.

8.4. Non-OCPP Charging Stations connected to CSMS via OCPP Local Controller

Description

This setup has multiple non-OCPP Charging Stations that are abstracted away using a OCPP enabled Local Controller. When applying OCPP in this situation, the LC should be considered as a Charging Station with many EVSEs or the LC should act as multiple OCPP Charging Stations (having their own Charging Station Identity).

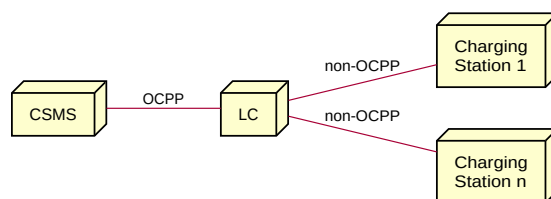


Figure 10. Multiple non-OCPP Charging Stations connected to CSMS via Local Controller

8.5. DSO control signals to CSMS

Description

This is a set up in which the CSMS is the only application sending signals to its Charging Stations, but the CSMS receives smart charging signals from a DSO based on (most likely) grid constraints. This means that a non-OCPP signal such as OpenADR or OSCP is received and based on this signal, the CSMS limits charging on its Charging Stations. CSOs that want full control over their Charging Station use this architecture, this way they are in control of the amount of energy being used by their Charging Stations. This can be done by sending charging profiles / charging schedules to Charging Stations.



Figure 11. Smart Charging - DSO control signals to CSMS

8.6. Parallel control by CSMS and EMS

Description

In a (semi-)private situation where a Charging Station is not only connected to the CSMS, but also to an Energy Management System, some form of parallel control should be supported. OCPP should at least be used for Charging Station maintenance, but OCPP 2.0.1 also supports reporting external smart charging control limits. So if the Energy Management System decides that charging at a later time is "better", the Energy Management System can impose an external limit (e.g. 0) to a Charging Station, which the Charging Station in turn can report to the CSMS via OCPP. The Energy Management System might get input from e.g. Local port of Smart Meter to prevent overloading connection but can also have other reasons for not charging (e.g. weather conditions).

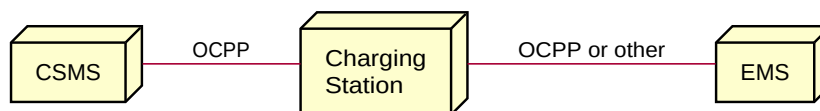


Figure 12. Parallel control by CSMS and EMS

9. Part 1 Appendix: OCPP Information Model

9.1. Explanation of UML representation and message generation

In the next paragraph, the UML schemes of the OCPP Information Model are shown. The model is based on the Common Information Model (CIM) and to some extent to the CEFAC naming standards (only part of the standard). The objects in the model are named *BusinessComponents* and inherit properties from the CIM *IdentifiedObject*, such as MRID and Name. In the UML diagrams the attributes that are inherited from *IdentifiedObject* are shown under the *IdentifiedObject* stereotype (between < > >).

Other attributes are listed under the stereotype < < Content > >.

The messages in OCPP are derived from the model represented in the next paragraph, in a 3 step process:

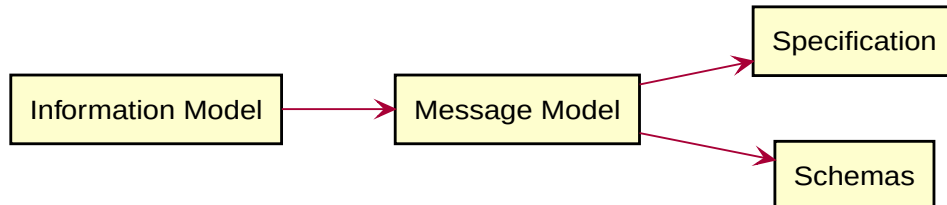


Figure 13. Process from information Model to Messages / schemes

After creating the Information Model, the messages are created based on the Information Model. However, in this transition (first arrow), some rules are (manually) applied for modelling messages. The most important rule that is applied, is that messages containing a reference to a <class> with only one <field>, are replaced by a field with the name <class><field>. For example, if a message contains a Transaction, with only an Id, this is replaced by a transactionId.

In the next step, when generating the messages and datatypes section of Part 2 of the specification, for readability, all Core DataTypes such as *CounterType*, are replaced by the Primitive DataType they refer to (except for enumerations) in this example *integer*.

9.2. Visual Representation of OCPP Information Model

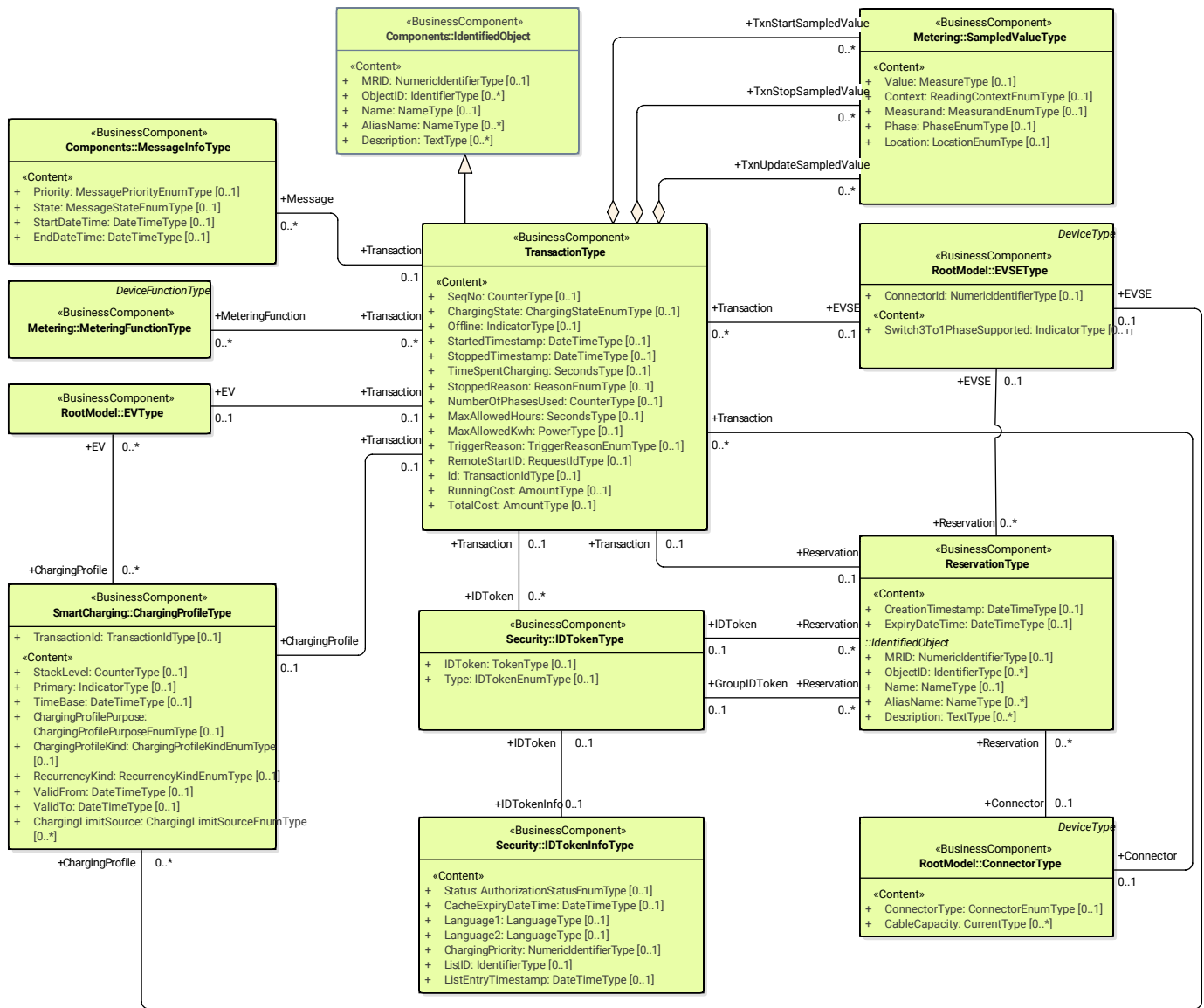


Figure 14. OCPP Information Model: Transactions



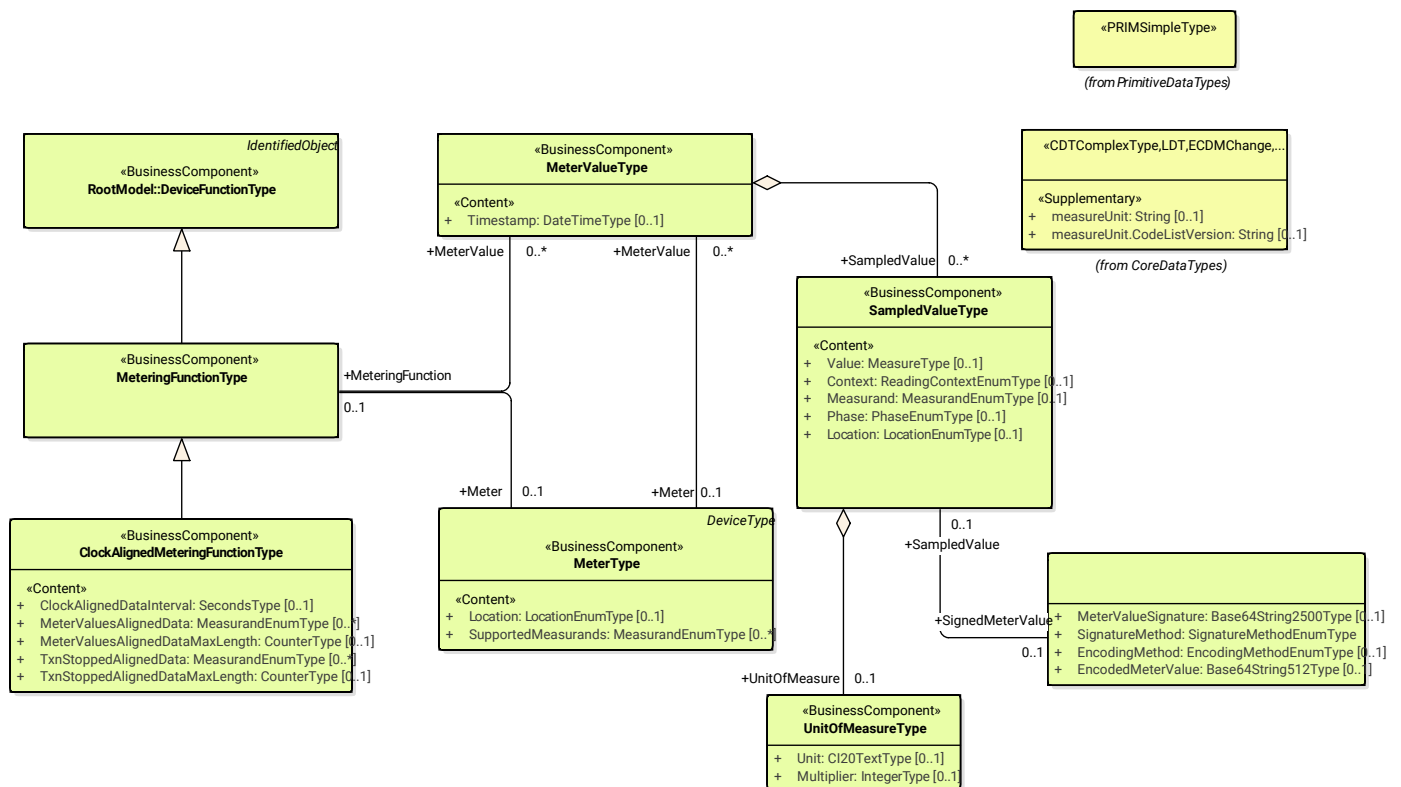


Figure 16. OCPP Information Model: Metering

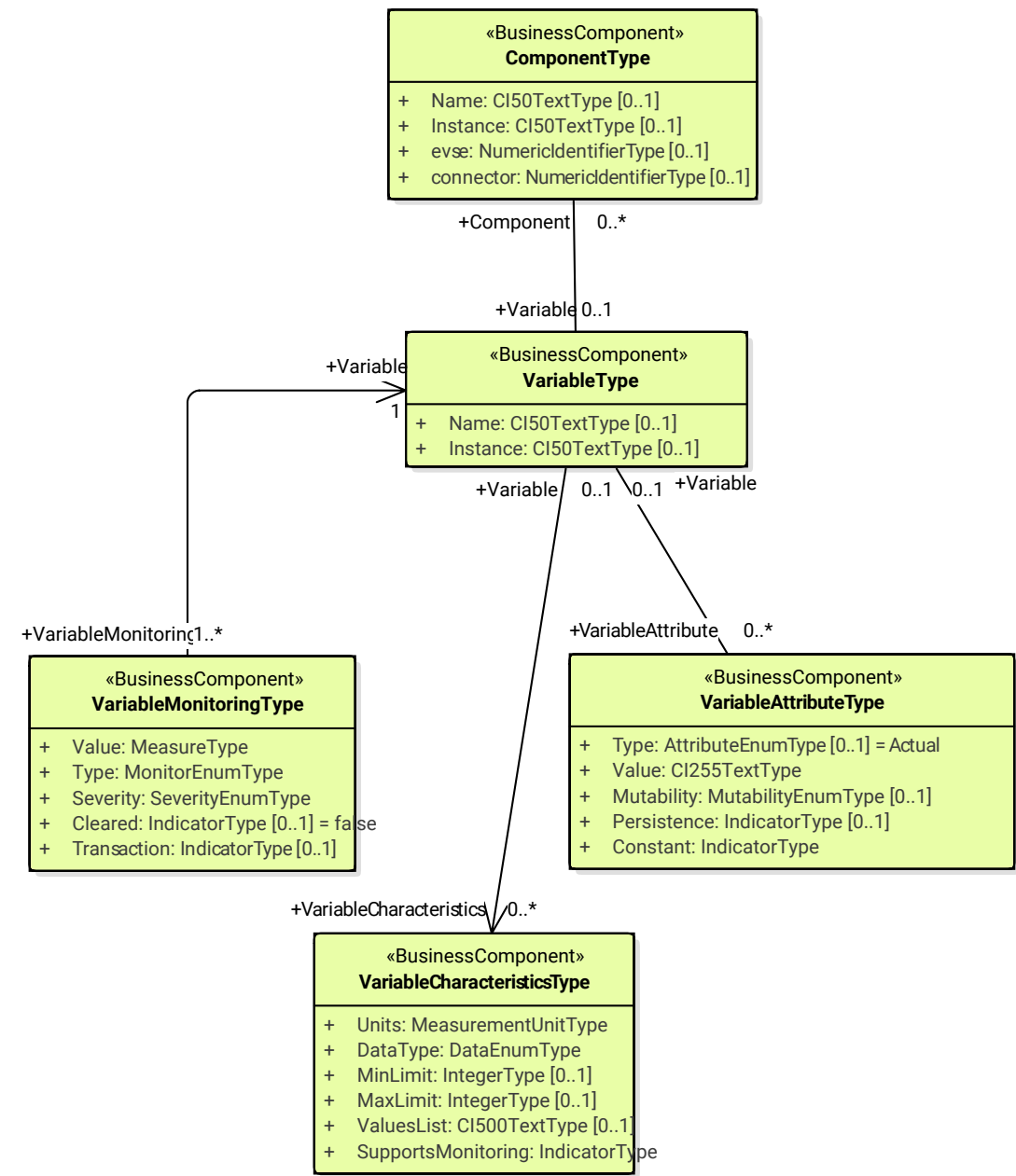


Figure 17. OCPP Information Model: Device Model



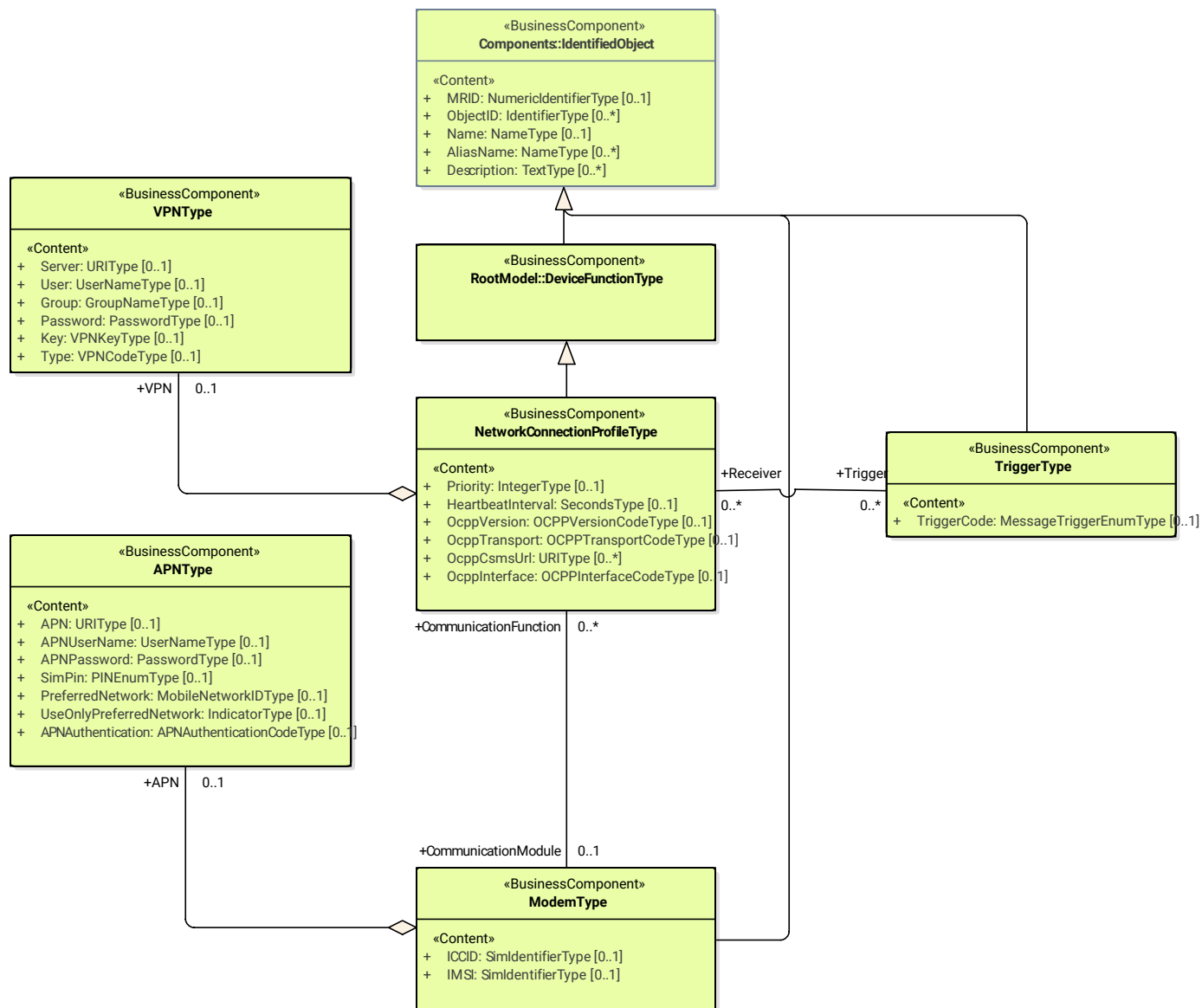


Figure 20. OCPP Information Model: Communication

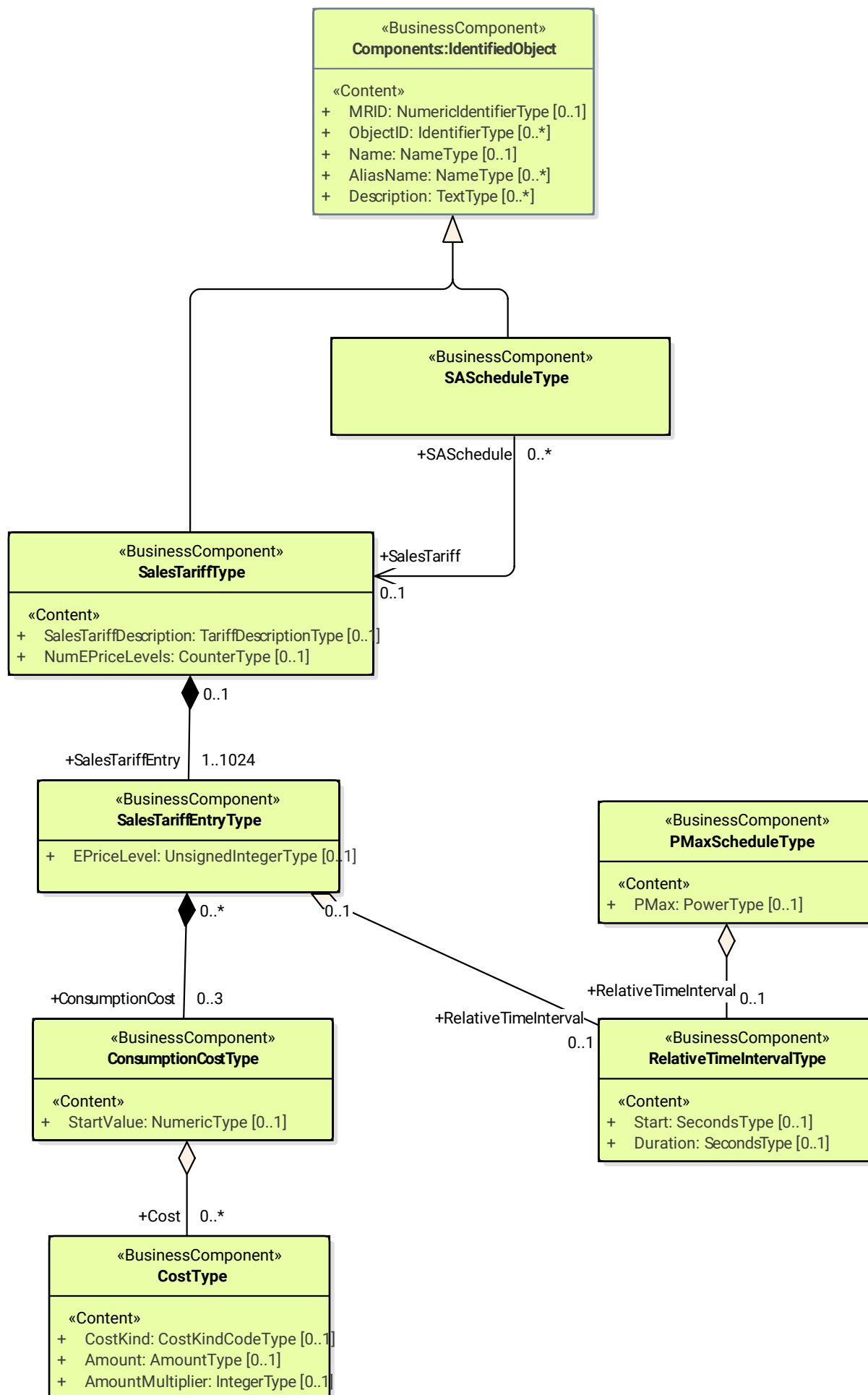


Figure 21. OCPP Information Model: SecondaryActorSchedule



OCPP 2.0.1

Part 2 - Specification

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