Open Charge Point Protocol (OCPP) Architecture

The Open Charge Point Protocol (OCPP) is a protocol developed by the Open Charge Alliance (OCA) based in of Netherlands. It is a communication protocol that enables communication between a charger and a backend system. The OCPP protocol is an internationally adopted open-source standard, enabling faster interoperability between chargers and backend systems provided by different vendors.

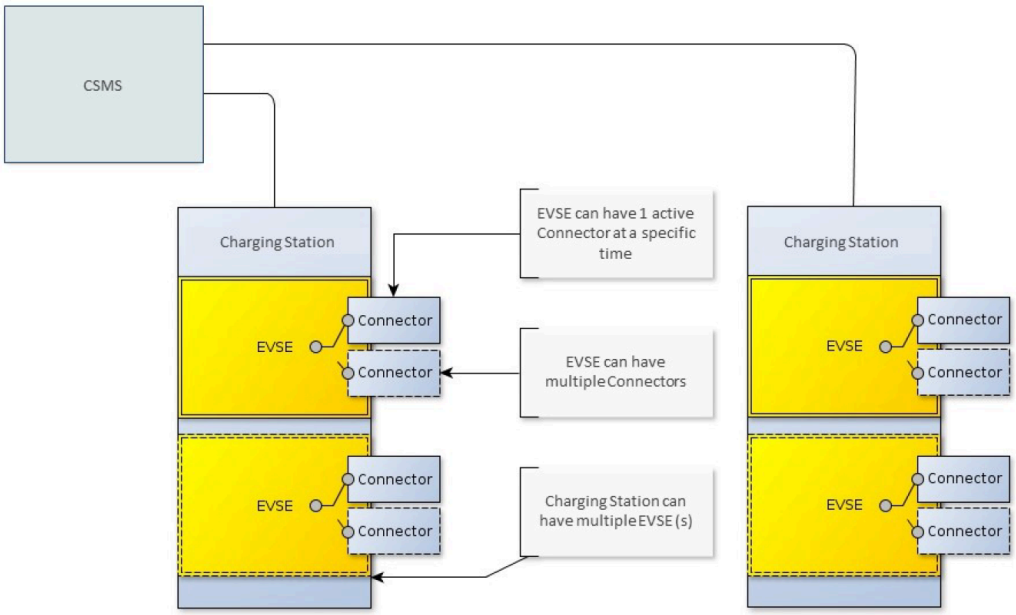
This report focuses on the version OCPP 2.1

Purpose Of OCPP
The OCPP was originally intended for two-way communication between a back office, in OCPP, the Charging Station Management System, and the Charging Station.

The documentation of OCPP treats the 3-tier Model as a starting point for the specification and describes the meanings of various terms.

3 Tier Model

The 3 Tiers have been explained below: ->
1) Charging Station: A Physical system where EVs can be charged. A charging station can have one or more EVSEs,
2)EVSE: An EVSE is considered to be a part of the charging station that can deliver energy to one EV at a time.
3)Connector: The term Connector, means an independently operated and managed electrical outlet at a charging station. In other words, this corresponds to a single physical Connector.



In some cases, an EVSE may have multiple physical socket types to facilitate different vehicle types (for example, 4-wheeled EVs and Electric Scooters) . A visual representation of such a system has been given above.

A charging location is a group of charging stations at the same place or building, but this concept has no meaning in OCPP, since OCPP is mainly concerned with communication between CSMS and the Charging station. However, the concept of a charging location may exist at the CSMS side for reporting purposes.

Device Model

A device model is the mechanism integrated into the **OCPP protoco**l that allows a **Charging Station to report how it is built. This will enable it to be managed from any OCPP-compliant CSMS**.

This version of the Device Model has a 3-Tier model as discussed previously, which means that any description of the device will follow this 3--tier structure.

A.Components

A charging station is modelled as a set of “Components”, which typically represent physical devices (including any external equipment which is connected for data gathering and/or control), Logical functionality, or logic data entries.

Components are primarily identified by a Component Name. This can be a name of a standardized component, or a custom/non- non-standardized component name.

ChargingStation(TopLevel), EVSE, and connector represent the 3 major “tiers” of a charging station, constituting an implicit **location-based addressing scheme** used in many OCPP data structures.

Each “Tier” has a component of the same name as that of the tier. This component is used to represent the whole tier. For example, EVSE 1 on the Charging Station is represented by the component name “EVSE” with “evseid=1”.In a similar manner, Connector 1 on EVS 1 is represented by the component named “Connector” with “evseid=1,connectorid=1”.

By default, all components are included under a Charging Station tier, but individual instances of any component can be associated with a specific EVSE or a specific Connector. The inclusion of EVSE and EVSE connector identification numbers helps in addressing particular components.

Is data stored in components?

No, components do not store any data; all the data associated with a component instance is stored in something known as variables.

Note -> *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.*

B.Variables

Each component has variables that can be used to hold,set or report all data applicable for that component, including configuration parameters and measured values (for example, current or temperature) and/or monitor changes to variable values.

It is obvious that some components will consist of variables that are specific to them, or that are specific component type. However, there is a minimum set of standardized variables that are beneficial to provide and a standardized approach for high-level notification and state. status reporting on a global and/or selective basis.

A Charging Station doesn't need to send the values **Present**, **Available**, and **Enabled** if they **can't be changed** (read-only) and are already **true**. If the Charging Station doesn't send these values, the Central System will **assume they are read only and set to true** by default.

Variables can be of any of the common general-purpose data types, but also can have their allowable values constrained to particular ranges, enumeration lists, sets, or ordered lists.

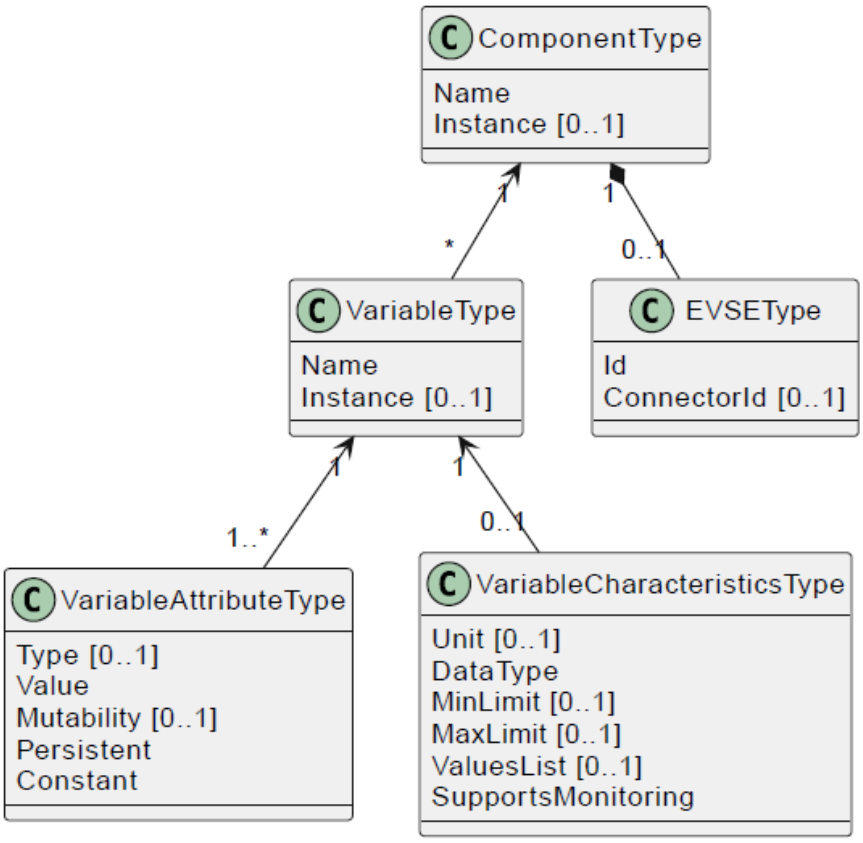
In order to support complex components, OCPP allows more than one instance of any variable to be associated with a component.

As it was with components, each distinct instance variable 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.

C. Characteristics and Attributes

Any variable, in addition to the value it possesses (the 'Actual Value'), can have a set of secondary data that is linked to the variable.

A visual representation of the Hierarchy till this point has been given below :



D.Monitoring

Optional monitoring settings can be associated with a variable, which allows changes to a variable's values to be reported to the CSMS as event notifications.

These include :

- Monitoring Values
- Monitoring Type :upper threshold, lower threshold, delta, periodic
- Severity Level while reporting the event,

The relationship between a variable and variable monitoring events is given below.

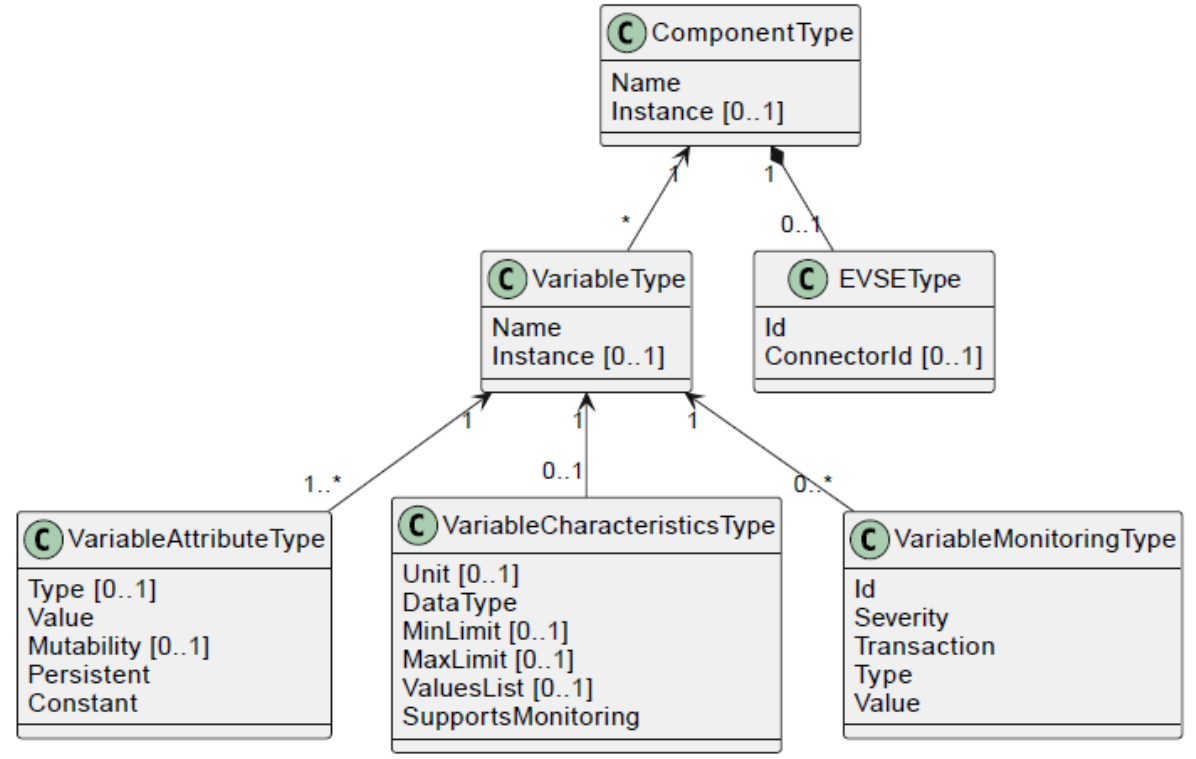


Figure 4. Variables and monitoring

E. Standardized Lists of Components and Variables

To provide some level of interoperability between different Charging stations and CSMS.The OCPP specifications provide a list of standardized names for Components and Variables. The idea of this list 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 Components or Variables that are not listed in the specification, bilateral appointments between the Charging Station manufacturer and CSMS are to be made.

F. Minimum Device Model

Since the device model is a generalized concept, it can be applied to any charging station, and the complexity of each of the stations can vary from one another. It consists of a number of use cases and messages that may not all be required.
A minimum device model describes the minimum part of a device model that needs to be implemented to create a working implementation of OCPP 2.1.

The basic 3-level Device Model in OCPP isn't enough when a Charging Station has many components connected in a complex hierarchy (e.g., fans inside power banks powered by an electrical feed).To describe this clearly, especially in a user interface (UI), the Charging Station can use four special read-only variables to show how parts are connected:

1. Communication Parent: Shows where the data is coming from.
2.ElectricalParent: Shows what supplies power to the component.
3.LogicalParent: Groups components logically (for better understanding).
4.PhysicalParent: Shows where the component is physically located (like in a box or container)

Numbering

EVSE Numbering

To enable a CSMS to effectively address all EVSEs of a charging station individually, the EVSEs MUST always be numbered in the same way.

EVSE numbering is done using the "evseid" and is defined as follows

1) The EVSEs should be sequentially numbered, starting from 1, and no numbers shall be skipped.
2) Evseid cannot go higher than the total number of EVSEs in a charging station, this is implicit if the first condition is followed.
3) For operations initiated by the CSMS, evseid 0 is reserved for addressing the entire charging station.
4) For operations initiated by the Charging Station(when reporting), evseid 0 is reserved for the Charging Station's main controller

Connector Numbers

To enable a CSMS to address all the connectors of a charging station, the connectors are to be numbered in a standardized manner.

The regulations for this are as follows:

1) The connectors are numbered(increasing), starting at connectorid 1 on every EVSE
2) Every connector per EVSE has a unique number
3) ID of the first connector in the EVSE must be 1
4) Additional connectors of the same EVSE must be sequentially numbered, and no numbers can be skipped.
5) Connectorids can never be higher than the total number of connectors on that EVSE.

Some more terms :

A. Transaction ID: Transaction IDs are generated by the Charging Station and must be unique on the particular charging station for every started transaction.
B. Information Model: It refers to the model of information structure, upon which messages and data types in OCPP are based.