



OCPP & California Pricing Requirements

v1.0, 2020-07-14

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OCA Application Note

Relevant for OCPP version: 1.6 and 2.0.1.

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Version History

Version	Date	Author	Description
1.0	2020-07-14	Franc Buve OCA	1.0 version

1. Introduction

The National Conference on Weights and Measures in the USA has issued a document. [1: NCWM Publication No.14, National Type Evaluation Program: Technical Policy Checklists and Test Procedures, draft 201902] with checklists and test procedures for electric vehicle fueling systems, which has been adopted by the California Division of Measurement Standards (DMS). Many requirements in the checklists apply to capabilities of the charging station (e.g. having a display or how to display prices), but in some cases it poses requirements to information that is being exchanged between charging station and CSMS (back-office).

This document explains the features that are available in OCPP 2.0.1 to communicate price and cost information to the customer. It continues with an explanation how something similar can be achieved with OCPP 1.6 by creating custom extensions. Section [Checklist Items Requiring Attention](#) summarizes the items for which no direct support exists in OCPP and offers alternative solutions. Finally, the [Appendix: Relevant Requirements per Section](#) lists all requirements from the checklist that are relevant to OCPP.

2. Tariff and Cost Features in OCPP 2.0.1

Since tariffs can potentially be quite complex with prices depending on things like time of day, power, amount of energy and type of contract, OCPP 2.0.1 has adopted the approach of letting the CSMS calculate the cost and communicate this to the charging station. In a situation where CPO and eMSP are not the same party, we have to deal with two different prices: a wholesale price that CPO is charging to the eMSP and a retail price of eMSPs to the customer. It is the retail price that has to be communicated on the charging station. Note, that the eMSP retail price can vary from a simple surcharge on the wholesale price to something completely unrelated, like a flat rate. This is something that can only be provided by the CSMS, because the charging station does not have access to this data.

In a situation where CPO and eMSP are one and the same party and when a straightforward kWh-based or time-based price is used, then cost calculation can potentially be configured to be done locally on the charging station. That is not the type of situation that this document addresses.

2.1. Displaying Price and Cost in OCPP 2.0.1

OCPP 2.0.1 offers the following standard messages to communicate pricing information to the charging station:

SetDisplayMessageRequest

OCPP provides a mechanism to display messages on a charging station. This can be used to display generic (i.e. not customer-specific) pricing information.

AuthorizeResponse

Customer-specific pricing information can be returned upon successful authorization. CSMS requests this information at the eMSP of the associated charging contract that has just been authorized. It then formats this a 512 character message for display at the charging station.

CostUpdatedRequest

CSMS sends periodic updates of the running total cost of a session with the CostUpdated message, which is a single decimal value.

TransactionEventResponse (update)

When the tariff changes during the transaction, for example, in case of a 'time of use' based price, then CSMS sends the updated price in the *updatedPersonalMessage* of TransactionEventResponse.

TransactionEventResponse (ended)

CSMS shows the final total cost of a transaction in *totalCost* in the TransactionEvent message that marks the end of the transaction.

2.2. Device Model Settings for Tariff and Cost

The following device model variables on the component `TariffCostCtrlr` need to be set in order to activate the showing of tariff and cost on the charging station:

Variable	Instance	Description
Enabled	Tariff	When true this enables showing of tariffs

Variable	Instance	Description
TariffFallbackMessage	Tariff	Message (and/or tariff information) to be shown to an EV Driver when there is no driver specific tariff information
Enabled	Cost	When true this enables showing of cost
TotalCostFallbackMessage	Cost	Message to be shown to an EV Driver when the Charging Station cannot retrieve the cost for a transaction at the end of the transaction.
Currency	<none>	Currency used for tariff and cost information.

2.3. Idle fees

NOTE Idle fee calculation is not a DMS requirement.

A major difference between OCPP 2.0.1 and 1.6 is, that OCPP 2.0.1 allows the CSO to configure the start and stop moments of a transaction. When a CSO wishes to charge an idle fee for the period that an EV is not charging, but remains connected to the charging station, then it suffices to set the configuration variable

`TxCtrlr::TxStopPoint` to **EVConnected**. This will cause the transaction to remain active, until the EV disconnects. For a charging station that has parking bay occupancy detection, this can even be set to **ParkingBayOccupancy**, such that a fee can be charged for as long as the parking spot is occupied.

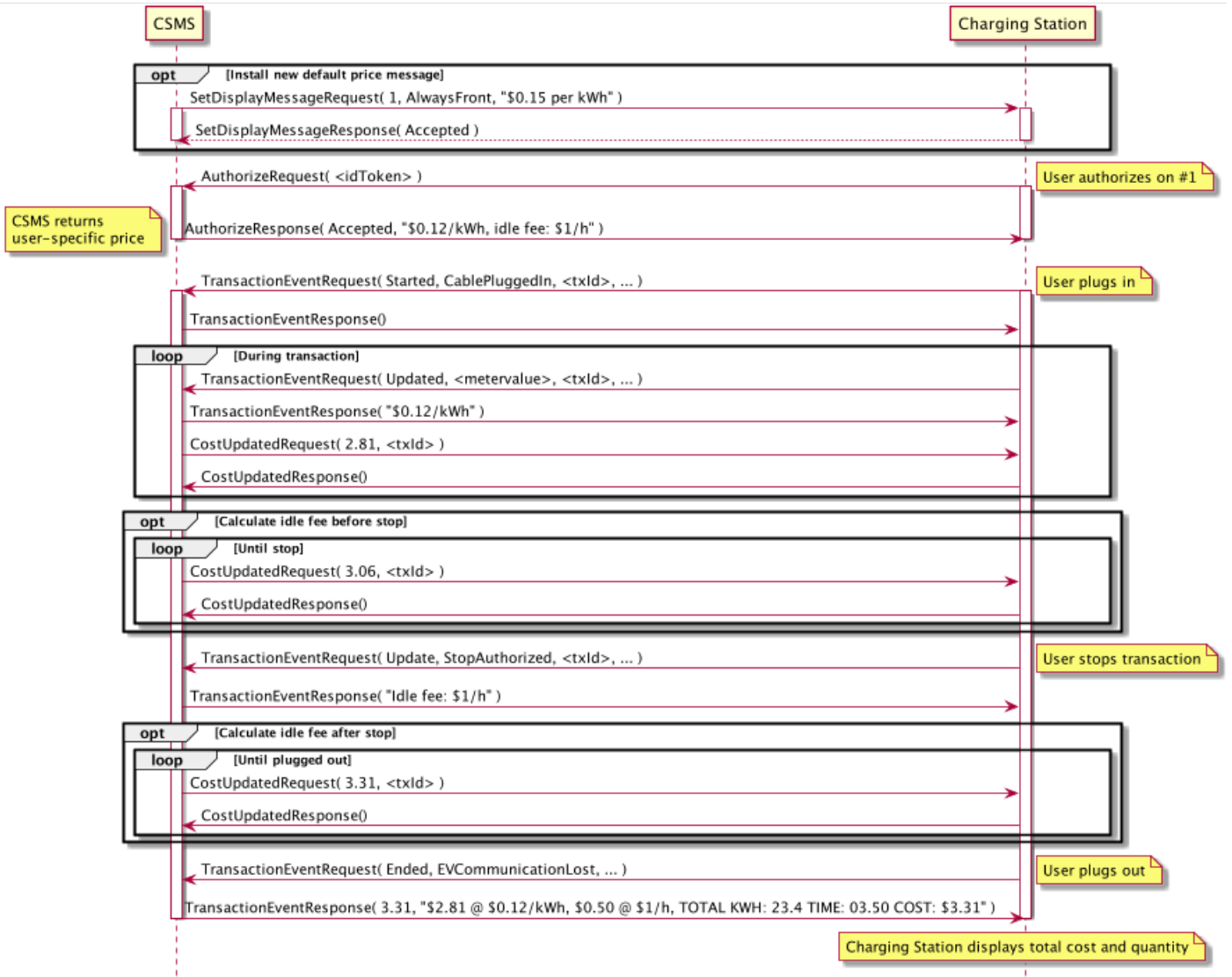
2.4. Direct Payment

Normally, it is the eMSP that invoices the customer, but in the event of direct payment with credit or debit card or other means, then the CPO acts as an eMSP. In that case there must be a way to make a printable receipt available to the customer upon request. (See [\[EVSE_5.2.6\]](#))

Since a charging station is not normally equipped with a printer, the solution is to display a message that directs the customer to a website where the receipt can be downloaded.

2.5. Sequence diagram showing OCPP 2.0.1 messages

The following diagram shows the sequence of events to report price and cost during a transaction, including the optional part to record an idle fee. This assumes that the `TxStartPoint` and `TxStopPoint` have both been set to **EVConnected**.



3. Tariff and Cost Features in OCPP 1.6

OCPP 1.6 does not provide any support for the communication of cost or prices. Therefore, extensive customization is needed on both Central System and charge point [2: In line with the terminology of OCPP 1.6 we will use Central System and charge point, instead of CSMS and charging station in this section.] to transfer the required data. These customizations on both ends need to be perfectly aligned or it will not work.

3.1. Displaying Price and Cost in OCPP 1.6

It is possible to use a `ChangeConfiguration` message to set a default price to be displayed at a charge point. This mechanism is, however, not suitable to display a running cost or final cost message, since these messages depend on the transaction in progress and must only be shown to the user of the transaction and at the right connector.

A better method is therefore to use `DataTransfer` messages to convey the pricing information to the charge point. A way to implement this, is to use a configuration key for the default price and create a custom `SetUserPrice` and a `RunningCost` and `FinalCost` message in OCPP 1.6 using `DataTransfer`. This makes it possible to link the pricing information to the user or the transaction.

The messages look like this:

Set a default price (only needed once, as long as it does not change):

```
ChangeConfiguration.req( "DefaultPrice", "0.15 $/kWh, idle fee after charging: 1 $/hr" )
```

Set a user-specific price, linked to the authorization token (at every transaction):

```
DataTransfer.req( "<vendorId>", "SetUserPrice", "{ \"idToken\": \"12345678\", \"price\": \"$0.12/kWh, no idle fee\" }" )
```

Update the running cost, linked to the transaction (during the transaction):

```
DataTransfer.req( "<vendorId>", "RunningCost", "{ \"txId\": 98765, \"description\": \"$0.12/kWh KWH: 23.4 TIME: 03:20 COST: $2.81\" }" )
```

Display the final cost, linked to the transaction (at end of transaction):

```
DataTransfer.req( "<vendorId>", "FinalCost", "{ \"txId\": 98765, \"description\": \"$2.81 @ $0.12/kWh, $0.50 @ $1/h, TOTAL KWH: 23.4 TIME: 03.50 COST: $3.31\" }" )
```

Even though `RunningCost` and `FinalCost` messages have the same structure (a *txId* and a *description*) they have a different message name. That way the charge point knows exactly which message holds the final cost.

Finally, it is good practice to define a boolean configuration key `CustomDisplayCostAndPrice`, that a Central System can query to find out if this customization is present and optionally use it to enable or disable the

customization:

```
GetConfiguration.req( "CustomDisplayCostAndPrice" )
```

3.2. Idle fees

NOTE Idle fee calculation is not a DMS requirement.

If the pricing model needs to calculate an idle fee, i.e. charge a fee for being connected after charging has completed, then there are two different scenarios that can occur. There is idle time within the transaction and idle time after the transaction has ended while the vehicle remains connected to the charge point. The first situation can easily be detected, because the received meter values do not change. Whereas the second situation can easily be handled in OCPP 2.0.1, this is not the case for OCPP 1.6, which was never designed to deal with this situation.

A tempting solution in OCPP 1.6 would be to wait for a StatusNotification **Available** to signal that the vehicle has been unplugged. This is, however, not reliable. In the event that the charge point is offline when the transaction is stopped, the StatusNotifications may never reach Central System, since they are not required to be queued by the charge point.

3.2.1. Reliable Connector Unplug Message

Using the StatusNotification to detect unplugging is not always reliable, since this message is not guaranteed to be queued when the charge point is offline. A work-around for this is to define a DataTransfer message "ConnectorUnplugged", which the charge point sends to signal that the connector has been unplugged and the idle fee calculation can be stopped.

Such a DataTransfer message looks like this:

```
DataTransfer.req( "<vendorId>", "ConnectorUnplugged", "{ \"idTx\": 123456, \"timestamp\": \"2020-06-01T12:34:00Z\"}" )
```

IMPORTANT

This DataTransfer "ConnectorUnplugged" message does not replace the existing StatusNotification.req message. The DataTransfer "ConnectorUnplugged" is sent as an additional reliable message that is queued as long as the charge point is offline, like other transaction-related messages.

A charge point still needs to send the StatusNotification.req when the connector becomes available, since a Central System might depend on it to report accurate connector status. It also ensures maximum compatibility in case a Central System does not support the new DataTransfer message.

A Central System normally ends a transaction upon receiving the StopTransaction.req message. If the customization to calculate an idle fee after a transaction has stopped (until connector is unplugged) has been implemented, then this must be reported in a boolean configuration key "CustomIdleFeeAfterStop" that reports "true" to the Central System, so that it knows, that it has to extend the transaction until receipt of the DataTransfer "ConnectorUnplugged".

```
GetConfiguration.req( "CustomIdleFeeAfterStop" )
```

This same configuration key can be used by the Central System to switch this behavior off, when it does not support the extending of a transaction after stop.

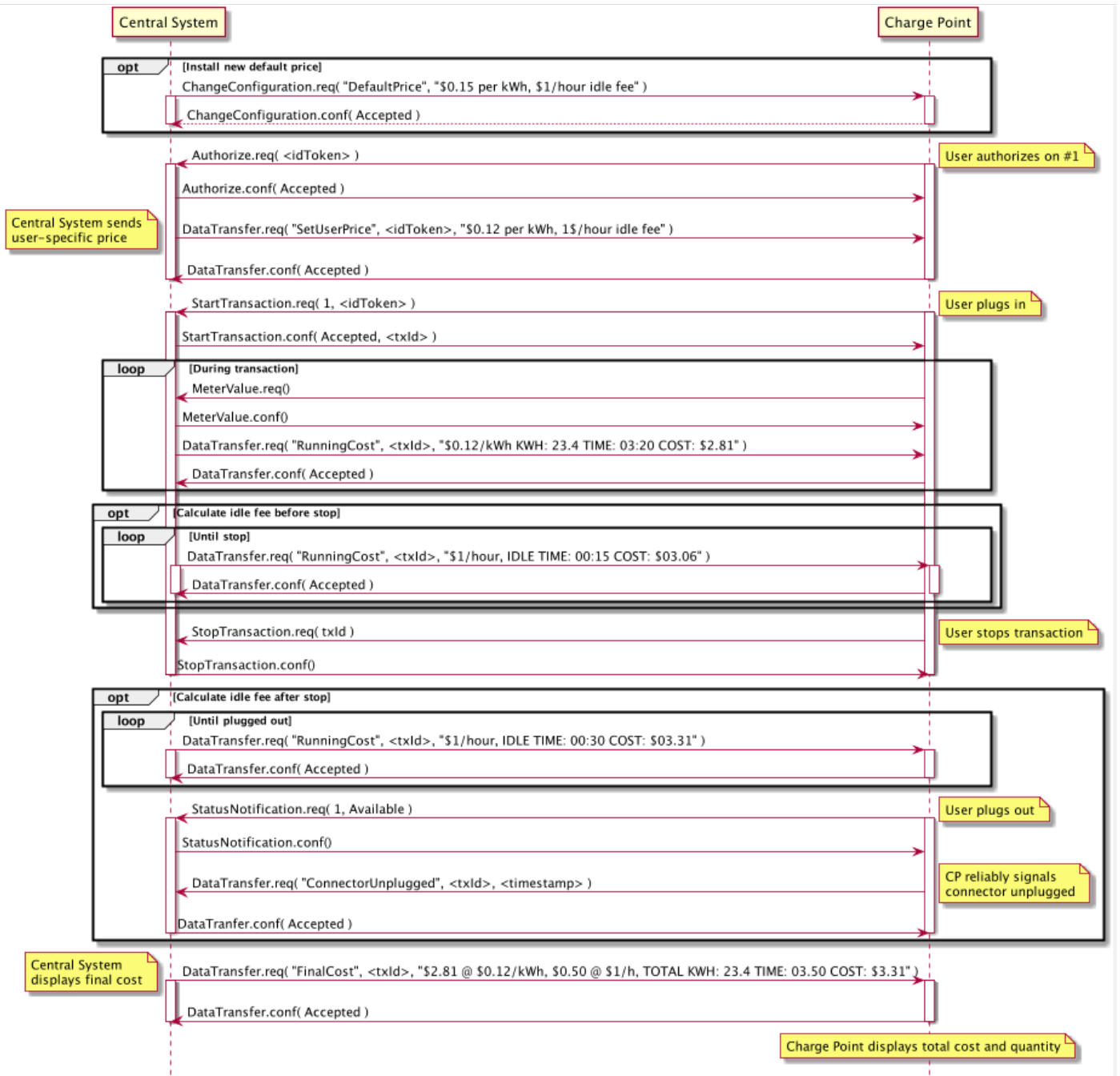
3.3. Direct Payment

Normally, it is the eMSP that invoices the customer, but in the event of direct payment with credit or debit card or other means, then the CPO acts as an eMSP. In that case there must be a way to make a printable receipt available to the customer upon request. (See [\[EVSE_S.2.6\]](#))

Since a charge point is not normally equipped with a printer, the solution is to display a message that directs the customer to a website where the receipt can be downloaded.

3.4. Sequence diagram showing the OCPP 1.6 customizations

The following diagram shows the sequence of events to report price and cost during a transaction.



4. Checklist Items Requiring Attention

Analysis of the checklist learns that almost all relevant information can be provided using the above-mentioned messages of OCPP.

The following checklist items require special attention, since they refer to data that cannot be transferred between charging station and CSMS using OCPP. The data can be communicated using other means, however.

Checklist item 1.7: Selection of Unit Price

There is no message in OCPP to communicate a choice of unit price if the charging station supports a choice between multiple unit prices. However, it is not required to be able to show multiple prices. In fact this is not needed for the most common situation, namely to distinguish credit card payment and eMSP charge card payment. The credit card tariff (for which the CPO acts as eMSP) can be shown as the default tariff on the charging station. Only when a customer authorizes using an eMSP charge card will CSMS retrieve the tariff that applies for that eMSP and communicate it on the charging station.

If there is a need to select a price from multiple unit prices, for example, to distinguish between regular charging and smart charging, then the following solutions are possible:

- Provide a mobile phone app to display and select the price to use. This app communicates the selected price with its own protocol to the CSMS.
- Create a customization using OCPP device model or DataTransfer to communicate the user's choice.

Checklist item 1.8: In case TOU unit price modifications are allowed

In case TOU unit price modifications are allowed, the following customer options shall be offered before a charging session could be started:

1. Customer accepts TOU based rate increases
2. Customer elects to terminate charge session when a TOU rate increase occurs.
3. Customer does not accept any TOU option.

There is no message in OCPP to communicate whether the customer accepts TOU based rate increases. This is, of course, only an issue when TOU based rate increases are present on the charging station. If that is the case, then one of the above-mentioned solutions, like a smartphone app or an OCPP customization, is needed.

Checklist item 1.31: The system must provide a receipt

For transactions conducted with point-of-sale systems or devices activated by credit cards, debit cards, electronic payment (ApplePay) or other electronic payment method recorded representation containing information about the transaction shall be available to the customer as outlined in the following items.

Printable receipt must always be available to the customer upon request. The system must provide a receipt to be made available to the customer at the completion of the transaction through either:

- a built-in recording element OR

-
- a separate recording element that is part of the system OR
 - an electronic device (phone, computer, etc.) accessible by the system.

Since a charging station is not normally equipped with a printer, the solution is to display a message that directs the customer to a website where the receipt can be downloaded.

5. Appendix: Relevant Requirements per Section

This section lists the checklist requirements that are relevant in relation to OCPP. A comment in *italic* font describes how OCPP can help to fulfill this checklist requirement.

Section 1. Indicating and Recording Elements

EVSE S.1.2 EVSE indicating Elements

1.1. An electronic digital indicating element shall either

- 1.1.3. All indications and representations of energy sold are clearly identified
- 1.1.4. All indications and representations of time-based charges are clearly identified

OCPP 1.6 *Can be achieved by setting a custom configuration key that holds the price description. [TODO] Prior: custom key, During/After: CostUpdated message. See [Displaying Price and Cost in OCPP 1.6](#)*

OCPP 2.0.1 *Can be achieved with DisplayMessageRequest or AuthorizeResponse.PersonalMessage. See [Displaying Price and Cost in OCPP 2.0.1](#)*

EVSE S.2.4.3 Selection of Unit Price

1.7. An EVSE may be equipped with means for selecting more than one unit price, provided that the selected unit price cannot be changed after the initial flow begins.

OCPP 1.6 & OCPP 2.0.1 *OCPP can provide a message for the selection of multiple prices, however, it does not provide a means for the user to select one price or the other. However, it is not required to be able to show multiple prices. In fact this is not needed for the most common situation to distinguish credit card payment and eMSP charge card payment. The credit card tariff (for which the CPO acts as eMSP) can be shown as the default tariff on the charging station. Only when a customer authorizes using an eMSP charge card will CSMS retrieve the tariff that applies for that eMSP and communicate it on the charging station.*

If there is a need to select a price from multiple unit prices, for example, to distinguish between regular charging and smart charging, then the following solutions are possible:

- *Provide a smartphone app to display and select the price to use. This app communicates the selected price with its own protocol to the CSMS.*
- *Create a customization using OCPP device model or DataTransfer to communicated the user's choice.*

1.8. The selected unit price must be made clearly evident on the EVSE. Once selected the unit price cannot be changed at the point of sales prior to or during the delivery except when the change is triggered by a notified Time Of Use (TOU) modification.

If TOU base rated increases are present on the charging station, then the customer must be allowed to select one of the following options:

- 1.8.1. Customer accepts TOU based rate increases
- 1.8.2. Customer elects to terminate charge session when a TOU rate increase occurs.
- 1.8.3. Customer does not accept any TOU option.

OCPP 1.6 & OCPP 2.0.1 *It is not required to support TOU based rate changes, but if they are implemented, then the solutions mentioned in the previous paragraph (1.7) can be used to facilitate this.*

1.10. When a delivery is completed, the total price and quantity for that transaction shall be displayed on the face of the EVSE for at least 5 minutes or until the next transaction is initiated by using controls on the device or other user-activated (e.g., customer-activated) controls.

OCPP 1.6 *The total price when delivery is complete is the last update of total price, that the charging station received via the custom message that was implemented for that purpose. Quantity in kWh and/or time is known by the charging station. Both can be displayed by charging station. See [Displaying Price and Cost in OCPP 1.6](#)*

OCPP 2.0.1 *The total price has been sent by CSMS as part of the last TransactionEventRequest message. Quantity in kWh and/or time is known by the charging station. Both can be displayed by charging station. See [Displaying Price and Cost in OCPP 2.0.1](#)*

EVSE S.2.3. Provisions for Power Loss

1.15. The quantity and total sales price shall be recallable for 15 minutes after the power failure.

OCPP 1.6 & OCPP 2.0.1 *Since price calculation is done at the CSMS, this information is not lost during a power failure at the charging station.*

1.17. The quantity and total sales price values shall be correct if the delivery is continued after a power failure.

OCPP 1.6 & OCPP 2.0.1 *Since price calculation is done at the CSMS, this information is not lost during a power failure at the charging station.*

EVSE S.2.4.1. Display of Unit Price

1.25. Means shall be provided to display the unit price on the face of the device.

OCPP 1.6 *Can be achieved by setting a custom configuration key that holds the price description. See [Displaying Price and Cost in OCPP 1.6](#)*

OCPP 2.0.1 *This can be displayed via the DisplayMessageRequest or AuthorizeResponse.PersonalMessage. The display can either display prices for all units as one message or let the user step through the various units. CSMS will send all information in one message, though. See [Displaying Price and Cost in OCPP 2.0.1](#)*

1.26. The unit price shall be expressed in dollars and decimals of dollars using a dollar sign.

OCPP 1.6 *Can be achieved by setting a custom configuration key that holds the currency.*

OCPP 2.0.1 *The currency is configured via the device model variable `TariffCostCtrlr::Currency`.*

EVSE S. 2.4.3. Selection of Unit Price

1.29. Prior to delivery using controls on the device. OR

1.30. Through deliberate action of the purchaser using

1. controls on the device;

-
2. personal or vehicle mounted electronic equipment communicating with the system; or
 3. verbal instructions

OCPP 1.6 & OCPP 2.0.1 *The same remarks as for checklist item 1.7 apply here.*

EVSE S.2.6. Recorded Representations

For transactions conducted with point-of-sale systems or devices activated by credit cards, debit cards, electronic payment (ApplePay) or other electronic payment method recorded representation containing information about the transaction shall be available to the customer as outlined in the following items. Printable receipt must always be available to the customer upon request.

1.31. The system must provide a receipt to be made available to the customer at the completion of the transaction through either

1.31.1. a built-in recording element OR a separate recording element that is part of the system OR an electronic device (phone, computer, etc.) accessible by the system.

OCPP 1.6 & OCPP 2.0.1 *Charging station can display a message to point the customer to a website where the receipt can be downloaded.*

Section 2. Computing

No requirements for OCPP.

Section 3. Measuring Elements

No requirements for OCPP.

Section 4. Test of the EVSE System (Hb44 N and T Sections)

No requirements for OCPP.

Annex # EVSEs with parking time charging functionality

1.1 The EVSE shall indicate and record, the time in minutes for time intervals of 60 minutes or less and in hours and minutes for time intervals greater than 60 minutes.

OCPP 1.6 & OCPP 2.0.1 *EVSE can display parking time continuously, since start of transaction. CSMS also knows when transaction starts and ends and can add this to the receipt.*