
K. SmartCharging

1. Introduction

This Functional Block describes all the functionalities that enable the CSO (or a third party) to influence the charging current/power transferred during a transaction, or set limits to the amount of current/power a Charging Station can draw from the grid.

Smart Charging in general has more than one definition. It can mean that the grid capacity is used in such a manner that consumers are able to charge their batteries fully at any time, even if large groups of consumers wish to 'fill up' simultaneously. Smart can also mean that energy prices can be taken into consideration when charging. Or again smart can be taken as using a local supply of sustainable energy from solar panels. And it is even 'smarter' when the Electric Vehicle (EV) driver wishes to be part of the solution. Within OCPP, Smart Charging means that a CSMS gains the ability to influence the (de-)charging power or current of a specific EV, or the total allowed energy consumption on an entire Charging Station / a group of Charging Stations. Different setups can be used. The following four typical kinds of smart charging will be used to illustrate the possible behavior of smart charging using OCPP:

- Internal Load Balancing
- Central Smart Charging
- Local Smart Charging
- External Smart Charging Control Signals

These types will be explained in [Types of Smart Charging](#). Of course, more complex use cases are possible in which two or more of the above use cases are combined into one more complex system.

NOTE	A mapping of the ISO 15118 and OCPP terminology is provided in ISO 15118 and OCPP terminology mapping
-------------	---

2. Types of Smart Charging

This section is informative.

2.1. Internal Load Balancing

The simplest form of smart charging is the Load Balancing use case. This concerns internal load balancing within the Charging Station, where the Charging Station controls current/power per EVSE. The Charging Station is configured with a fixed limit, e.g. the maximum current of the connection to the grid. The Charging Station in this case is responsible for optimizing charging for all its EVSEs. When a charging station is not directly connected to the grid, the energy system of a client will be responsible for the power supply.

This setup is typically used to set limits that are necessary due to known physical limits.

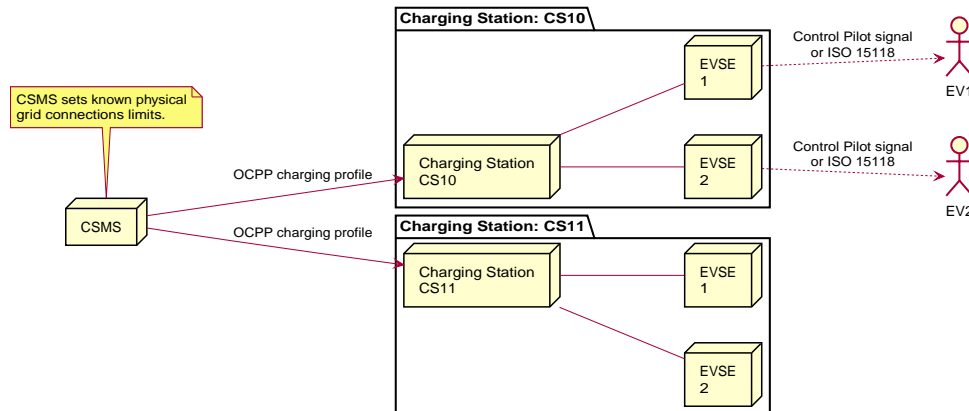


Figure 93. Internal Load Balancing Smart Charging Topology

2.2. Central Smart Charging

The next level in smart charging is when the CSMS has the ability to influence the charging power or current of a specific EV, the total allowed energy consumption on an entire Charging Station or a group of Charging Stations. Central Smart Charging assumes that charge limits are controlled by the CSMS. This could for example be based on a grid connection, energy availability on the grid (e.g. capacity forecast from the grid operator (DSO)) or the wiring of a building. In this setup, the CSMS can optimize charging not only on one Charging Station, but one level "up": it can optimize more than one Charging Station that share a connection and thus calculate a more efficient schedule for charging.

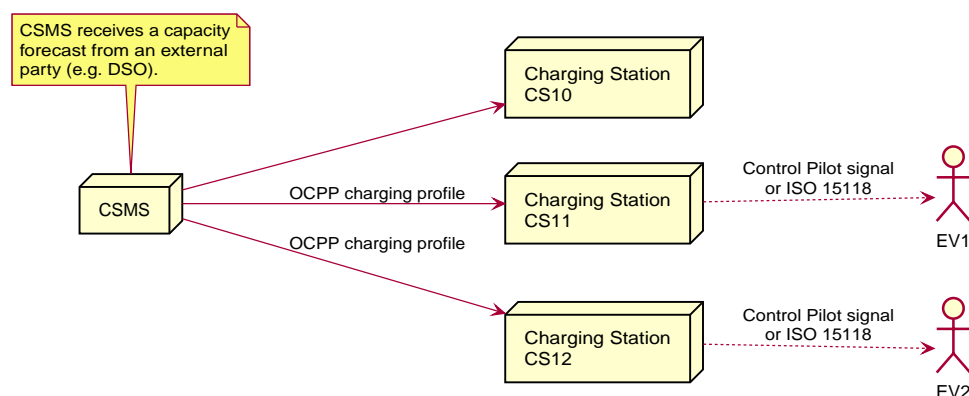


Figure 94. Central Smart Charging Topology

Central Smart Charging can be done with a Control Pilot signal, albeit with some limitations, because an EV cannot communicate its charging needs via the Control Pilot signal. In analogy to the [Local Smart Charging](#) use case, an EVSE can execute a charging schedule by the Control Pilot signal.

2.3. Local Smart Charging

Local Smart Charging describes a use case in which smart charging enabled Charging Stations have charging limits controlled locally by a Local Controller, not the CSMS. This type of smart charging assumes the existence of a Local Controller, which is a logical component that controls a group of Charging Stations. A typical use would be a number of Charging Stations in a parking

garage where the rating of the connection to the grid is less than the sum the ratings of the Charging Stations. Another application might be that the Local Controller receives information about the availability of power from a DSO or a local smart grid node.

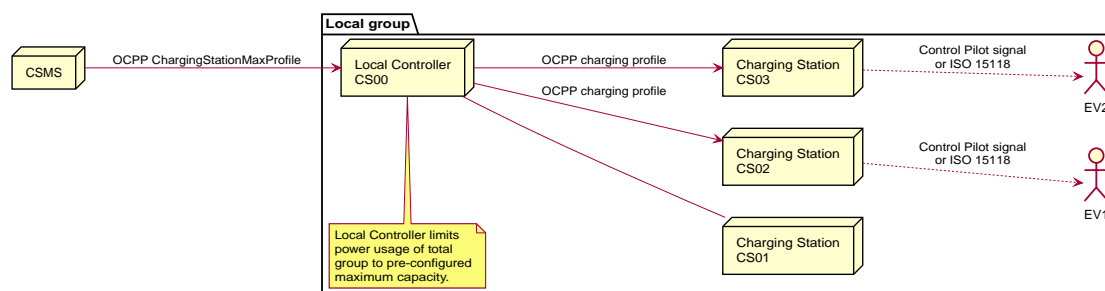


Figure 95. Local Smart Charging Topology

2.4. External Smart Charging Control Signals

The OCPP protocol is originally developed for communication between a CSMS and one or more Charging Stations. As described in the above, this means that a Charging Station Operator (CSO) CSMS controls a Charging Station and, based on the charging limits of both the EV and the Charging Station, the CSO determines how fast the EV is charged. However, in some situations / applications of OCPP enabled Charging Stations, these are not the only 2 factors that determine the charging speed. Other inputs that determine charging speed could be DSO signals (e.g. via IEC 61850 [IEC61850-7-420], IEC 60870 [IEC60870-5-104], DNP3 [DNP3] or OpenADR [OPENADR]) or signals from a Building / Home Energy Management System. Although these signals are out of scope for OCPP, it seems clear from an OCPP perspective that the CSMS is to be informed of changes in charging by external signals. However, this also leads to a number of questions, such as how to deal with conflicting signals. The figure below presents an example setup with an Energy Management System, where the external signals are visualized both in a setup with direct communication to the Charging Station as well as a multiple Charging Station setup using a Local Controller:

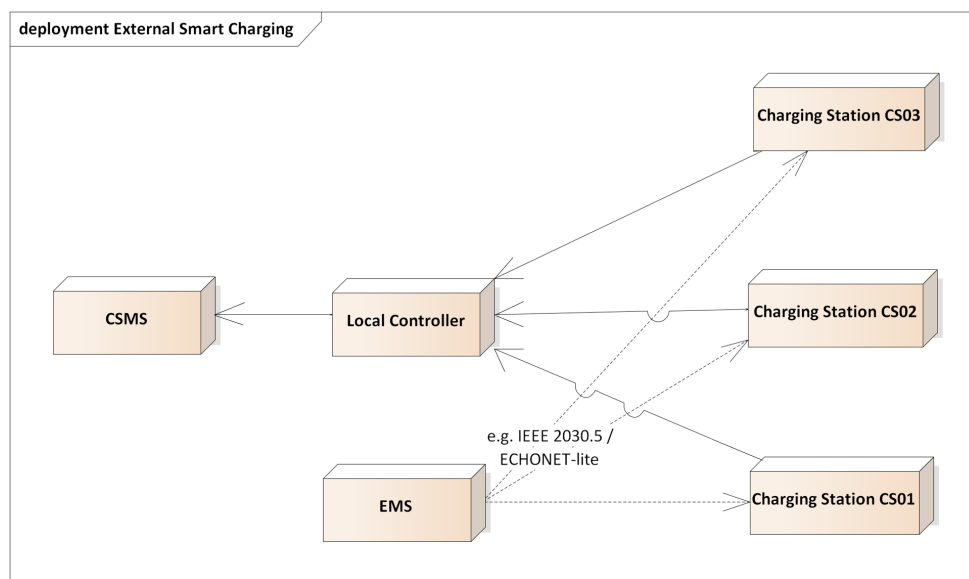


Figure 96. External Smart Charging

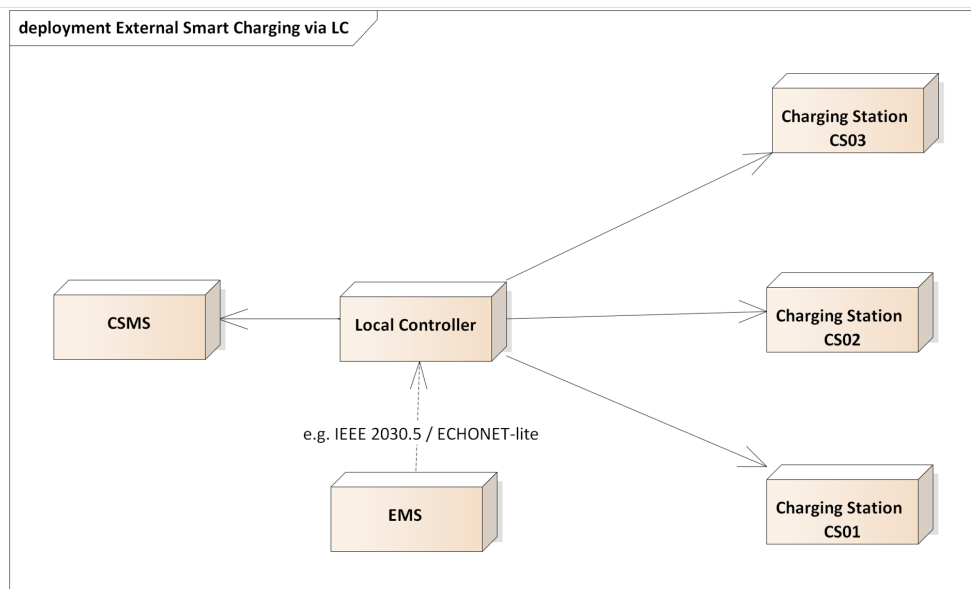


Figure 97. External Smart Charging via LC

If a Charging Station is connected both to the outside world as well as to an Energy Management System (EMS), this could result in a situation where the EMS, for whatever reason, decides that charging is not opportune, despite a charging schedule it might have received from the CSMS. This means that the Charging Station will not behave as expected by the CSMS. To prevent this, the Charging Station will have to be able to notify the CSMS that it has received a command from the EMS. An example reason could be an airconditioning system that is given preference / priority instead of charging an EV by a home user (in this case assuming that using the airconditioning and EV charging at the same time is not possible). This EMS might be in place to manage the maximum limit of a connection, but this can also be externally controlled.

3. Charging profiles

3.1. Introduction

Influencing the charge power or current is based on sending energy transfer limits at specific points in time to a Charging Station. Those limits are combined in a [ChargingProfile](#). A [ChargingProfile](#) holds the [ChargingSchedule](#) which defines a block of charging Power or Current limits and can contain a start time and duration. These can be applied to Charging Stations as well as to EVSEs of the Charging Stations. In [Example ChargingProfile](#) an example of a [ChargingProfile](#) is given to illustrate how these charging profiles can be used.

A CSMS can send a charging profile to a Charging Station using the message [SetChargingProfileRequest](#), in the following situations:

- At the start of a transaction to set the charging profile for the transaction
- In a RequestStartTransaction request sent to a Charging Station
- During a transaction to change the active profile for the transaction
- Outside the context of a transaction as a separate message to set a charging profile to a local controller, Charging Station, or a default charging profile to an EVSE.

3.2. Charging profile purposes

This section describes a number of types of charging profiles that are supported in OCPP. There are four different types of charging profiles, depending on their *purpose*:

ChargingProfile Purpose	Description
ChargingStationMaxProfile	In internal load balancing scenarios, the Charging Station has one or more local charging profiles that limit the power or current to be shared by all EVSEs of the Charging Station. The CSMS SHALL configure such a profile with <code>ChargingProfilePurpose</code> set to " <i>ChargingStationMaxProfile</i> ". <i>ChargingStationMaxProfile</i> can only be set at Charging Station evseld 0.
TxProfile	A transaction-specific profile with purpose <i>TxProfile</i> overrules the default charging profile with purpose TxDefaultProfile for the duration of the current transaction only.
TxDefaultProfile	Default schedules for new transactions that MAY be used to impose charging policies. An example could be a policy that prevents charging during the day.
ChargingStationExternalConstraints	When an external system, not the CSMS, sets a charging limit or schedule, the Charging Station uses this purpose to report such a limit/schedule.

3.3. Charging profile recurrency

This section explains the different kinds of charging schedules that can be use in a charging profile, as defined by the value of the attribute *chargingProfileKind*:

ChargingProfile Kind	Description
Absolute	The charging schedule periods are relative to an absolute point in time defined in the schedule. This requires that <i>startSchedule</i> is set to a starting point in time. Use this, for example, to define a schedule that reduces charging between 17:00h and 21:00h, regardless of when charging session was started.
Recurring	The charging schedule restarts periodically at the first schedule period. To be most useful, this requires that <i>startSchedule</i> is set to a starting point in time. Use this in combination with <i>recurrencyKind</i> = <code>Daily</code> , for example, to define a schedule that reduces charging between 17:00h and 21:00h every day, regardless of when charging session was started.
Relative	Charging schedule periods start when ChargingProfile is activated. In most cases this will be at start of the power delivery. When a ChargingProfile is received for a transaction in progress, then it should activate immediately. No value for <i>startSchedule</i> should be supplied.

3.4. Stacking charging profiles

It is allowed to stack charging profiles of the same [ChargingProfile](#) purpose in order to describe complex calendars. For example, one can define [ChargingProfile](#) of purpose [TxDefaultProfile](#) with a duration and recurrence of one week that allows full power or current charging on weekdays from 23:00h to 06:00h and from 00:00h to 24:00h in weekends and reduced power or current charging at other times. On top of that, one can define other [TxDefaultProfiles](#) that define exceptions to this rule, for example for holidays.

A [ChargingProfile](#) holds a [ChargingSchedule](#) that defines limits for a certain time interval. Precedence of [ChargingSchedules](#) is determined by the *stackLevel* of their [ChargingProfile](#). When more than one [ChargingProfile](#) with the same [chargingProfilePurpose](#) is valid, then a [ChargingSchedule](#) of a [ChargingProfile](#) with a higher stack level overrules a [ChargingSchedule](#) from a [ChargingProfile](#) with a lower stack level.

To avoid conflicts, it is not allowed to have multiple charging profiles with the same *stackLevel* and same *chargingProfilePurpose* to be valid on the same EVSE at a given time. Note, that a charging profile for EVSE #0 is considered to be active on all EVSEs!

3.5. Combining Charging Profile Purposes

The Composite Schedule that will guide the charging level is a combination of the prevailing Charging Profiles of the different [chargingProfilePurposes](#) and stack levels.

As mentioned before, for each charging profile purpose, at any point in time, the leading charging schedule for that purpose is the charging schedule that has a schedule period defined for that time and that belongs to a charging profile with the highest stack level that is valid at that time, as determined by their *validFrom* and *validTo* parameters. The Composite Schedule is then calculated by taking the lowest charging limit (taking the different [chargingRateUnits](#) into account) among the leading profiles of the different purposes for each time interval.

The only exception is when both a [TxDefaultProfile](#) and a [TxProfile](#) are valid. In that case, the [TxProfile](#) will always overrule the [TxDefaultProfile](#), hence the Composite Schedule will not take the leading profile of purpose [TxDefaultProfile](#) into account in this specific situation. Note that time intervals do not have to be of fixed length, nor do they have to be the same for every [ChargingProfile](#) purpose. This means that a resulting Composite Schedule MAY contain intervals of different lengths.

In case the Charging Station is equipped with more than one EVSE, the limit value of [ChargingStationMaxProfile](#) is the limit for all EVSEs combined.

The two figures below will be used to give an example of combining multiple charging profiles with different stackLevels and Purposes.

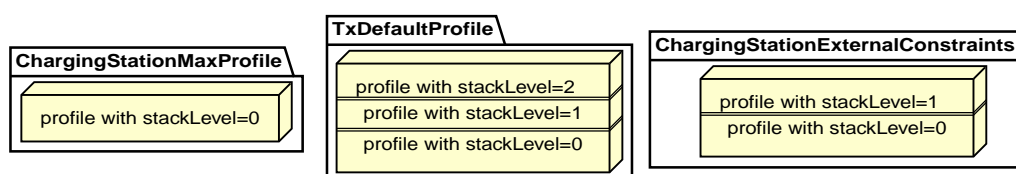


Figure 98. Multiple valid charging profiles - situation 1

Suppose that at a certain time interval the valid charging profiles are as in the above figure (situation 1). The composite schedule for this time interval will then be the lowest of the charging limits given in the [ChargingStationMaxProfile](#) with stackLevel 0, the [TxDefaultProfile](#) with stackLevel 2 and the [ChargingStationExternalConstraints](#) profile with stackLevel 1.

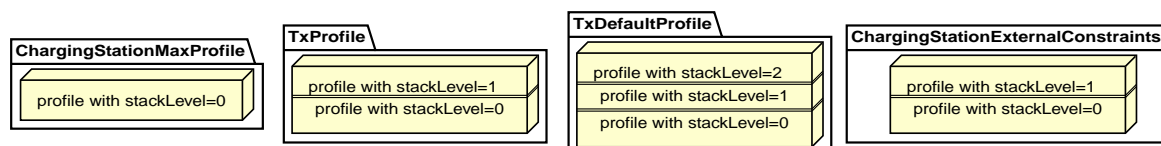


Figure 99. Multiple valid charging profiles - situation 2

On the other hand, consider the situation in which for a certain time interval the valid charging profiles are as in the above figure (situation 2). The composite schedule for this time interval will then be the lowest of the charging limits given in the [ChargingStationMaxProfile](#) with stackLevel 0, the [TxProfile](#) with stackLevel 1 and the [ChargingStationExternalConstraints](#) profile with stackLevel 1. Note that in this situation the [TxProfile](#) overrules the [TxDefaultProfile](#).

3.6. Example Charging Profile

This section is informative.

The following data structure describes a daily default profile that limits the power to 6 kW between 08:00h and 20:00h and to 11 kW between 00:00h and 08:00h and between 20:00h and 00:00h.

ChargingProfile			
chargingProfileId	100		
stackLevel	0		
chargingProfilePurpose	TxDefaultProfile		
chargingProfileKind	Recurring		
recurrencyKind	Daily		
chargingSchedule	(List of 1 ChargingSchedule elements)		
	ChargingSchedule		
	duration	86400 (= 24 hours)	
	startSchedule	2013-01-01T00:00Z	
	chargingRateUnit	W	
	chargingSchedulePeriod	(List of 3 ChargingSchedulePeriod elements)	
		ChargingSchedulePeriod	
		startPeriod	0 (=00:00)
		limit	11000
		numberPhases	3
		ChargingSchedulePeriod	
		startPeriod	28800 (=08:00)
		limit	6000
		numberPhases	3
		ChargingSchedulePeriod	
		startPeriod	72000 (=20:00)
		limit	11000
		numberPhases	3

IMPORTANT

The amount of phases used during charging is limited by the capabilities of: The Charging Station, EV and Cable between CS and EV. If any of these three is not capable of 3 phase charging, the EV will be charged using the number of phases that is supported by all three.

IMPORTANT

Switching the number of used phases during a schedule or transaction should be done with care. Some EVs MAY not support this and changing the amount of phases MAY result in physical damage. With the Configuration Variable: [Phases3to1](#) The Charging Station can tell if it supports switching the amount of phases during a transaction.

TIP

On days on which daylight saving goes into or out of effect, a special profile might be needed (e.g. for relative profiles).

3.6.1. Example Using Stacked Charging Profiles

A CSO wishes to limit charging to 2 kW during the peak hours of the day from 17:00h to 20:00h. This limit does not apply to Sundays and this limit does not apply to Christmas Day either.

If this applies to a large number of charging stations, then it is not practical to delete the charging profile every Sunday and then add it again on Monday. A possible solution is to add profiles with higher stack level for the exceptions to the base profile. See the following JSON examples where stack levels #2 and #3 are used to define exceptions for Sunday and Christmas.

(1) **TxDefaultProfile, stack #1**: time-of-day limitation to 2 kW, recurring every day from 17:00h to 20:00h.


```
"chargingProfile": {
  "id": 10, "stackLevel": 1, "chargingProfilePurpose": "TxDefaultProfile",
  "chargingProfileKind": "Recurring", "recurrencyKind": "Daily",
  "chargingSchedule": {
    "startSchedule": "2020-01-09T17:00:00", "duration": 1080,
    "chargingRateUnit": "W",
    "chargingSchedulePeriod": [ { "startPeriod": 0, "limit": 2000 } ]
  }
}
```

(2) TxDefaultProfile, stack #2: overruling Sundays to no limit, recurring every week starting 2020-01-05.

```
"chargingProfile": {
  "id": 11, "stackLevel": 2, "chargingProfilePurpose": "TxDefaultProfile",
  "chargingProfileKind": "Recurring", "recurrencyKind": "Weekly",
  "chargingSchedule": {
    "startSchedule": "2020-01-05T00:00:00", "duration": 86400,
    "chargingRateUnit": "W",
    "chargingSchedulePeriod": [ { "startPeriod": 0, "limit": 999999 } ]
  }
}
```

(3) TxDefaultProfile, stack #3: overruling Christmas Day 2020 to no limit, fixed date 2020-12-25.

Note, that this profile is only valid in the year 2020.

```
"chargingProfile": {
  "id": 12, "stackLevel": 3, "chargingProfilePurpose": "TxDefaultProfile",
  "chargingProfileKind": "Absolute",
  "validFrom": "2020-01-01T00:00:00", "validTo": "2021-01-01T00:00:00",
  "chargingSchedule": {
    "startSchedule": "2020-12-25T00:00:00", "duration": 86400,
    "chargingRateUnit": "W",
    "chargingSchedulePeriod": [ { "startPeriod": 0, "limit": 999999 } ]
  }
}
```

NOTE

Normally, when no limits are desired for charging, one will not define a charging schedule period for those hours (see stack level #1 for hours outside 17:00h - 20:00h). However, when overruling a charging schedule by one from a profile with a higher stack level, it is not possible to define a charging schedule period that has no limit. Therefore, the charging schedules for stack #2 and #3 in the above example use a (arbitrary) high value of 999999.

4. Smart Charging Signals to a Charging Station from Multiple Actors

This section is normative.

Within OCPP, multiple mechanism are supported for Smart Charging, i.e. multiple mechanisms are available that can add a limit when charging an EV:

1. The CSMS can influence charging by sending a SetChargingProfile message to the Charging Station. See [K01 - SetChargingProfile](#).
2. The EV can influence charging based on the PlugAndCharge functionality: the ISO 15118 enables EV initiated Charging Limits. See Section [5.3. ISO 15118 based Smart Charging](#).
3. Some local input, for example a Home Energy Management System (HEMS) or DSO, can influence the charging, for example via an External Smart Charging Control signal. See [K11 - Set / Update External Charging Limit](#).
4. A Charging Station can limit charging when it is load balancing when more than 1 EV is charging.

The assumption is that all parties that might be involved in setting limits for charging an EV will use one of the above mechanisms directly or indirectly.

To determine how a Charging Station should respond to simultaneous smart charging signals from multiple actors, the following rules should be followed:

Table 158. Smart Charging rules for multiple actor situation

ID	Precondition	Requirement definition	Note
SC.01		At any point in time, the charging limit, which is the result of merging the schedules from external sources and the OCPP charging profiles with the highest stackLevel from each of the purposes ChargingStationMaxProfile, ChargingStationExternalConstraints and TxDefaultProfile (or TxProfile), SHALL be less than or equal to the lowest value of available power or current in any of the merged schedules.	For safety purposes.
SC.02	When the ChargingProfile has changed	The Charging Station SHALL always inform the CSMS.	The message used for this varies depending on the which of the mechanisms mentioned at the start of this section is applicable: 1. n/a 2. NotifyEVChargingScheduleRequest 3. NotifyChargingLimitRequest 4. TransactionEventRequest
SC.03		Reporting to the CSMS concerning a changed limit in the ChargingProfile for mechanisms 3 and 4 as described in SC.02 MAY be skipped if the change in the limit is smaller than the percentage defined in the Configuration Variable: LimitChangeSignificance .	This is to prevent the Charging Station to send a lot of messages for small fluctuations (e.g. due to HEMS / smart meter input at the Charging Station)
SC.04		The GetCompositeScheduleResponse message SHALL always report the expected charging schedule, i.e. the lowest <i>limit</i> for charging. This means that when an EV has a charging limit X and indicates (e.g. using the ISO 15118 protocol) that it will use less energy than offered, amount Y, the Charging Station SHALL report limit Y.	

5. Use cases & Requirements

5.1. General Smart Charging

K01 - SetChargingProfile

Table 159. K01 - Central Smart Charging

No.	Type	Description
1	Name	SetChargingProfile
2	ID	K01
	Functional block	K. Smart Charging
3	Objective(s)	To enable the CSMS to influence the charging power or current drawn from a specific EVSE or the entire Charging Station over a period of time.
4	Description	The CSMS sends a SetChargingProfileRequest to the Charging Station to influence the power or current drawn by EVs. The CSMS calculates a ChargingSchedule to stay within certain limits, which MAY be imposed by any external system.
	Actors	Charging Station, CSMS, EV
	Scenario description	<ol style="list-style-type: none"> 1. The CSMS sets charging limits by sending SetChargingProfileRequest to the Charging Station. 2. The Charging Station responds with SetChargingProfileResponse.
5	Prerequisite(s)	n/a
6	Postcondition(s)	<p>Successful postcondition: The Charging Station <i>Successfully</i> influences the charging power or current of a specific EV, following the SetChargingProfileRequest sent by the CSMS.</p> <p>Failure postcondition: The Charging Station was <i>not</i> able to influence the charging power or current of a specific EV, following the SetChargingProfileRequest sent by the CSMS.</p>

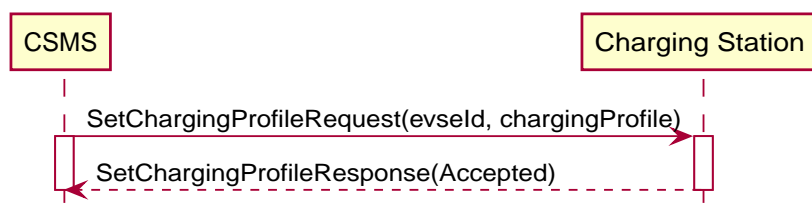


Figure 100. Sequence Diagram: SetChargingProfile

7	Error handling	n/a
8	Remark(s)	n/a

K01 - SetChargingProfile - Requirements

Table 160. K01 - Requirements

ID	Precondition	Requirement definition	Note
K01.FR.01		The CSMS MAY choose to set charging limits to a transaction using TxProfile .	
K01.FR.02		The CSMS MAY send a new charging profile for the EVSE that SHALL be used as a limit schedule for the EV.	
K01.FR.03		The CSMS SHALL include the <i>transactionId</i> in the SetChargingProfileRequest when setting a TxProfile .	The transactionId is used to match the profile to a specific transaction.
K01.FR.04	K01.FR.03 AND the given <i>transactionId</i> is known	The Charging Station SHALL apply the sent TxProfile to the transaction with the specified <i>transactionId</i> .	

ID	Precondition	Requirement definition	Note
K01.FR.05	When a SetChargingProfileRequest with an already known ChargingProfile.id is received.	The Charging Station SHALL replace the existing ChargingProfile with the one specified.	External charging limits can change during transaction, therefore updates should be possible.
K01.FR.06	When chargingProfilePurpose is NOT TxProfile	The CSMS SHALL NOT send a ChargingProfile with a stackLevel - chargingProfilePurpose - evseld combination that already exists in another ChargingProfile (with different id) on the Charging Station and has an overlapping validity period.	This is to ensure that no two charging profiles with same stack level and purpose can be valid at the same time.
K01.FR.07	When the Charging Station accepts a SetChargingProfileRequest	The Charging Station SHALL re-evaluate its collection of charging profiles to determine which ChargingProfile will become active.	
K01.FR.08		The CSMS MAY send charging profiles to a Charging Station that are to be used as default charging profiles.	
K01.FR.09	When a SetChargingProfileRequest with a TxProfile is received AND there is no transaction active on the specified EVSE	The Charging Station SHALL send a SetChargingProfileResponse with status Rejected .	
K01.FR.10	When validFrom and validTo of a ChargingProfile are not set	The Charging Station SHALL consider the ChargingProfile to be valid indefinitely until it is explicitly replaced.	
K01.FR.11	If ChargingSchedule has a duration AND ChargingSchedulePeriod.startPeriod >= ChargingSchedule.duration	The Charging Station SHALL not execute the ChargingSchedulePeriod , because it is past the duration of the ChargingSchedule .	
K01.FR.12		A ChargingSchedulePeriod remains active until the next ChargingSchedulePeriod in the list starts or until ChargingSchedule.duration has elapsed.	
K01.FR.13	When recurrencyKind is used in combination with a ChargingSchedule duration shorter than recurrencyKind period.	The Charging Station SHALL fall back to default behavior after ChargingSchedule duration ends.	
K01.FR.14	When a SetChargingProfileRequest with a TxDefaultProfile and evseld = 0 is received.	The Charging Station SHALL apply this profile to all EVSEs.	
K01.FR.15	When a SetChargingProfileRequest with a TxDefaultProfile and evseld > 0 is received.	The Charging Station SHALL only apply this profile to the specified EVSE.	
K01.FR.16		TxProfile SHALL only be used with evseld > 0.	
K01.FR.17		When more than one ChargingProfile with the same chargingProfilePurpose is valid, as determined by their validFrom and validTo fields, then a ChargingSchedule from a ChargingProfile with a higher stackLevel overrules a ChargingSchedule from a ChargingProfile with a lower stackLevel .	
K01.FR.18		For AC charging, the CSMS SHALL NOT set numberPhases different from the EVSE capabilities in a SetChargingProfileRequest , otherwise the Charging Station SHOULD respond with Rejected .	When a ChargingProfile asks for 3 phases and the Charging Station is able to charge 3 phases, it is not guaranteed that the EV and/or cable are able to charge 3 phases. Based on MeterValues the CSMS can determine the phases used.
K01.FR.19		The CSMS SHALL NOT set phaseToUse in a SetChargingProfileRequest when numberPhases is other than 1.	

ID	Precondition	Requirement definition	Note
K01.FR.20		The CSMS SHALL NOT set phaseToUse in a SetChargingProfileRequest when the EVSE does not have ACPhaseSwitchingSupported defined and set to true.	
K01.FR.21		The optional ChargingSchedule field minChargingRate MAY be used by the Charging Station to optimize the power distribution between the EVSEs.	The parameter informs the Local Controller that charging below minChargingRate is inefficient, giving the possibility to select another balancing strategy.
K01.FR.22		The CSMS SHALL NOT set chargingProfilePurpose to ChargingStationExternalConstraints in a SetChargingProfileRequest .	This purpose is only used when an external system has set a charging limit/schedule.
K01.FR.26	When a SetChargingProfileRequest is received with a value for chargingRateUnit , that is not configured in the configuration variable ChargingScheduleChargingRateUnit .	Charging Station SHALL respond with SetChargingProfileResponse with status <code>Rejected</code> .	
K01.FR.27		ChargingProfiles set via SetChargingProfileRequest SHALL be persistent across reboots/power cycles.	
K01.FR.28	When a SetChargingProfileRequest is received for an evseld that does not exist.	Charging Station SHALL respond with SetChargingProfileResponse with status <code>Rejected</code>	
K01.FR.29	When Charging Station does not support smart charging.	Charging Station SHALL respond with RPC Framework CALLERROR: <code>NotSupported</code> .	
K01.FR.30	chargingProfile has a chargingSchedule with startSchedule set to a time in the future	The Charging Station SHALL only start imposing the limitation of this schedule as of point in time set by startSchedule	
K01.FR.31		The startPeriod of the first chargingSchedulePeriod in a chargingSchedule SHALL always be 0.	
K01.FR.32	(K01.FR.14 OR K01.FR.15) AND a transaction is active on the specified EVSE(s) (evseld = 0 refers to all EVSEs.)	The Charging Station SHALL continue the transaction on the specified EVSE(s), but switch to using the new/updated TxDefaultProfile .	
K01.FR.33	K01.FR.03 AND the given transactionId is not known	The Charging Station SHALL reject the SetChargingProfileRequest .	
K01.FR.34	The CSMS has not received a NotifyEVChargingNeedsRequest for the current transaction, i.e. charging session is not using ISO 15118	The SetChargingProfileRequest SHALL contain at most one ChargingSchedulePeriodType and no SalesTariffType elements.	See use cases K15-K17 for ISO 15118 smart charging.
K01.FR.35		The list of ChargingSchedulePeriod elements in a chargingSchedule SHALL be ordered by increasing values of ChargingSchedulePeriod.startPeriod .	This means the list is in chronological order
K01.FR.36	When validFrom of a ChargingProfile is set	The Charging Station SHALL consider the ChargingProfile to be valid when current time \geq validFrom .	
K01.FR.37	When validTo of a ChargingProfile is set	The Charging Station SHALL consider the ChargingProfile to be valid when current time $<$ validTo .	
K01.FR.38	When chargingProfilePurpose = ChargingStationMaxProfile	chargingProfileKind SHALL NOT be <code>Relative</code>	

ID	Precondition	Requirement definition	Note
K01.FR.39	When <i>chargingProfilePurpose</i> is <i>TxProfile</i>	The CSMS SHALL NOT send a ChargingProfile with a <i>stackLevel</i> - <i>transactionId</i> combination that already exists in another ChargingProfile (with different <i>id</i>) with purpose <i>TxProfile</i> .	This is to ensure that no two charging profiles with same stack level and purpose can be valid at the same time.

K02 - Central Smart Charging

Table 161. K02 - Central Smart Charging

No.	Type	Description
1	Name	Central Smart Charging
2	ID	K02
	Functional block	K. Smart Charging
3	Objective(s)	To enable the CSMS to influence the charging power or current drawn from a specific EVSE or the entire Charging Station over a period of time.
4	Description	<p>The CSMS sends a SetChargingProfileRequest to the Charging Station to influence the power or current drawn by the EV. The CSMS calculates a ChargingSchedule to stay within limits which MAY be imposed by any external system.</p> <p>See: Central Smart Charging</p>
	Actors	Charging Station, CSMS, EV, EV Driver
	Scenario description	<ol style="list-style-type: none"> 1. After authorization the Charging Station will set a maximum current, that an EV might draw via the Control Pilot signal. This limit is based on (default) ChargingProfiles that the Charging Station previously received from the CSMS. 2. The EV starts charging and a TransactionEventRequest is sent to the CSMS. 3. The CSMS responds with a TransactionEventResponse. 4. In response to a TransactionEventRequest the CSMS MAY choose to set charging limits to the transaction using a SetChargingProfileRequest. 5. The Charging Station responds with a SetChargingProfileResponse. 6. While charging is in progress the EVSE will continuously adapt the maximum current or power according to the installed ChargingProfiles.
	Alternative scenario(s)	K03 - Local Smart Charging K04 - Internal Load Balancing
5	Prerequisite(s)	The Functional Block <i>Smart Charging</i> is installed.
6	Postcondition(s)	<p>Successful postcondition: The Charging Station <i>Successfully</i> influences the charging power or current of a specific EV, following the SetChargingProfileRequest sent by the CSMS.</p> <p>Failure postcondition: The Charging Station was <i>not</i> able to influence the charging power or current of a specific EV, following the SetChargingProfileRequest sent by the CSMS.</p>

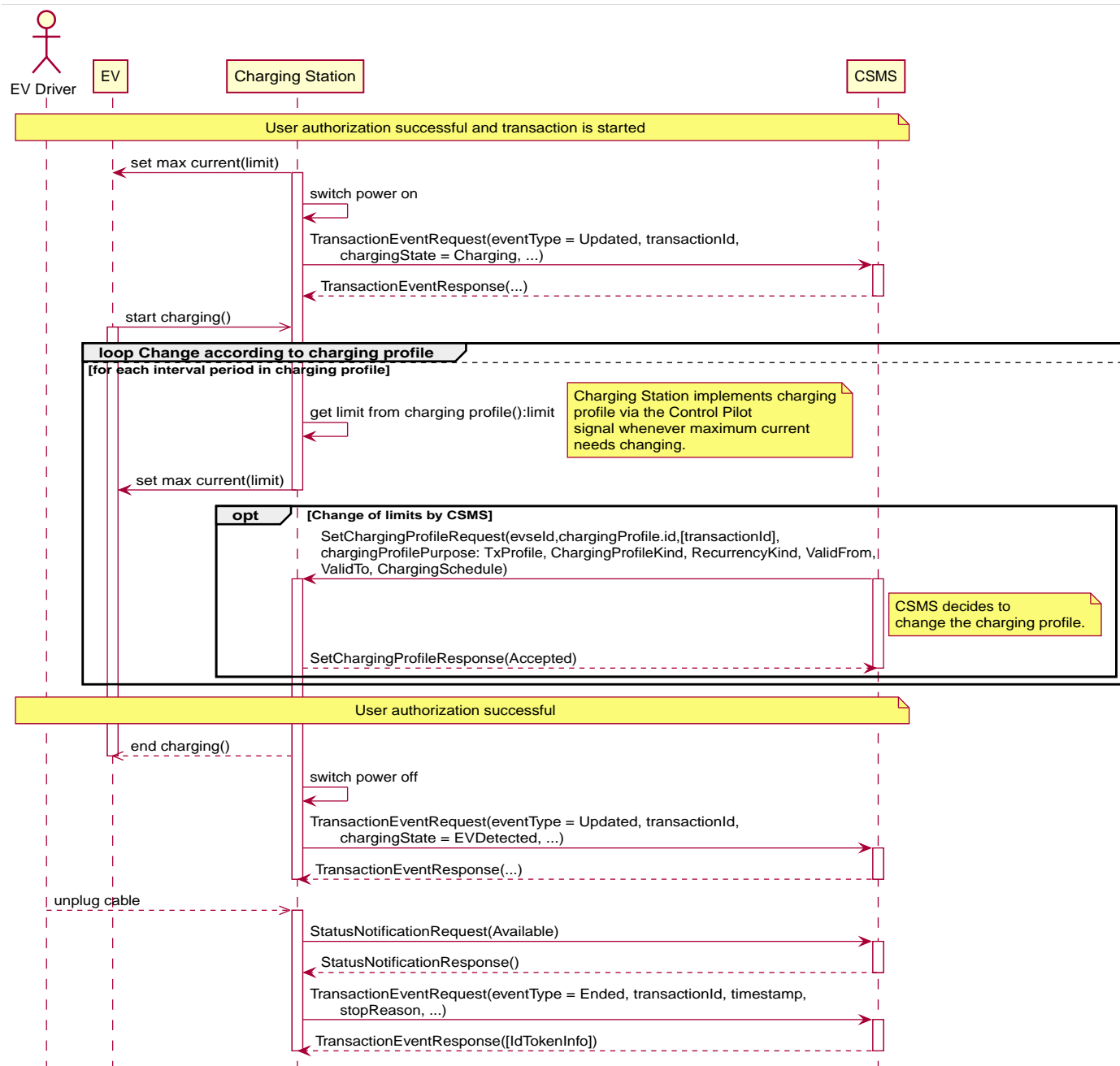


Figure 101. Sequence Diagram: Central Smart Charging

Explanation for the above figure:

- After authorization the EVSE will set a maximum current to use via the Control Pilot signal. This limit is based on a (default) charging profile that the EVSE had previously received from the CSMS. The EV starts charging and a [TransactionEventRequest](#) is sent to the CSMS.
- While charging is in progress the EVSE will continuously adapt the maximum current or power according to the charging profile. Optionally, at any point in time the CSMS may send a new charging profile for the EVSE. The Charging Station will then also take this new schedule into account when calculating a new composite schedule. This way the CSMS can influence the charging of an ongoing transaction.

7	Error handling	n/a
---	----------------	-----

8	Remark(s)	<p>The CSMS determines the constraints on ChargingSchedule per transaction.</p> <p>The CSMS imposes charging limits on EVSEs. In response to a TransactionEventRequest the CSMS may choose to set charging limits to the transaction using the TxProfile. It is RECOMMENDED to check the <i>offline</i> flag in TransactionEventRequest prior to sending a charging profile to check if the transaction is likely to be still ongoing, the TransactionEventRequest might have been cached during an <i>Offline</i> period.</p> <p>The final schedule constraints that apply to a transaction are determined by merging the profiles with purposes ChargingStationMaxProfile with the profile TxProfile or TxDefaultProfile in case no profile of purpose TxProfile is provided. Zero or more of the following ChargingProfile purposes MAY have been previously received from the CSMS: ChargingStationMaxProfile or TxDefaultProfile.</p> <p>The scenario description and sequence diagram above are based on the Configuration Variable for start transaction being configured as follows: TxStartPoint: Authorized, DataSigned, PowerPathClosed, EnergyTransfer</p> <p>This use-case is also valid for other configurations, but then the transaction might start/stop at another moment, which might change the sequence in which message are send. For more details see the use case: E01 - Start Transaction options.</p>
---	-----------	--

K02 - Central Smart Charging - Requirements

Table 162. K02 - Requirements

ID	Precondition	Requirement definition	Note
K02.FR.01		The CSMS SHALL use charging profiles to stay within the limits imposed by any external system.	
K02.FR.02	After authorization.	The EVSE will set a maximum current to use via the Control Pilot signal.	This requirement only applies to AC chargers that use 61851. The limit may be based on a (default) charging profile that the EVSE previously received from the CSMS.
K02.FR.03		In order to ensure that an updated ChargingProfile applies only to the current transaction, the CSMS SHALL set the chargingProfilePurpose of the ChargingProfile to TxProfile .	An updated charging profile can be sent by the CSMS by sending a ChargingProfile with the same chargingProfileId , or the same combination of stackLevel / ChargingProfilePurpose .
K02.FR.04	If a transaction-specific profile with purpose TxProfile is present.	The TxProfile SHALL overrule the default charging profile with purpose TxDefaultProfile for the duration of the current transaction only.	
K02.FR.05	K02.FR.04 After the transaction is stopped	The TxProfile SHALL be deleted.	
K02.FR.06		The optional ChargingSchedule field minChargingRate MAY be used by the Charging Station to optimize the power distribution between the EVSEs.	The parameter informs the Local Controller that charging below minChargingRate is inefficient, giving the possibility to select another balancing strategy.
K02.FR.07		The CSMS SHALL NOT set chargingProfilePurpose to ChargingStationExternalConstraints in a SetChargingProfileRequest .	This purpose is only used when an external system has set a charging limit/schedule.

K03 - Local Smart Charging

Table 163. K03 - Local Smart Charging

No.	Type	Description
1	Name	Local Smart Charging
2	ID	K03
	Functional block	K. Smart Charging
3	Objective(s)	To enable charging limits to be set at the Charging Station by a Local Controller.
4	Description	<p>Local Smart Charging describes a use case in which smart charging enabled Charging Stations have charging limits controlled locally by a Local Controller, not directly by the CSMS. The charging limits MAY either be pre-configured in the Local Controller in one way or another, or they can be set by the CSMS. The Local Controller SHALL contain the logic to distribute this capacity among the connected EVSEs by adjusting their limits as needed.</p> <p>This use case for Local Smart Charging is about limiting the amount of power that can be used by a group of Charging Stations, to a certain maximum.</p> <p>See Figure Local Smart Charging Topology</p>
	Actors	Charging Station, CSMS, EV, Local Controller, EV Driver
	Scenario description	<ol style="list-style-type: none"> 1. After authorization the Charging Station will set a maximum current, an EV might draw, via the Control Pilot signal. This limit is based on a TxDefaultProfile that the Charging Station previously received from the CSMS. 2. The EV starts charging, the Charging Station sends a TransactionEventRequest. 3. A TransactionEventRequest is sent to the CSMS via the Local Controller, so that the Local Controller knows a transaction has started. 4. During the transaction, the Local Controller sends a SetChargingProfileRequest to influence the charging current/power. 5. The Charging Station calculates the charging limits based on the installed ChargingProfiles. 6. The Local Controller just passes on the messages between Charging Station and CSMS, so that the CSMS can address all the Local Smart Charging group members individually. 7. While charging is in progress the EVSE will continuously adapt the maximum current according to the installed ChargingProfiles.
5	Prerequisite(s)	The Functional Block <i>Smart Charging</i> is installed.
6	Postcondition(s)	<p>Successful postcondition:</p> <p>The Local Controller <i>Successfully</i> controls maximum charging limits via the Control Pilot Signal.</p> <p>Failure postcondition:</p> <p>n/a</p>

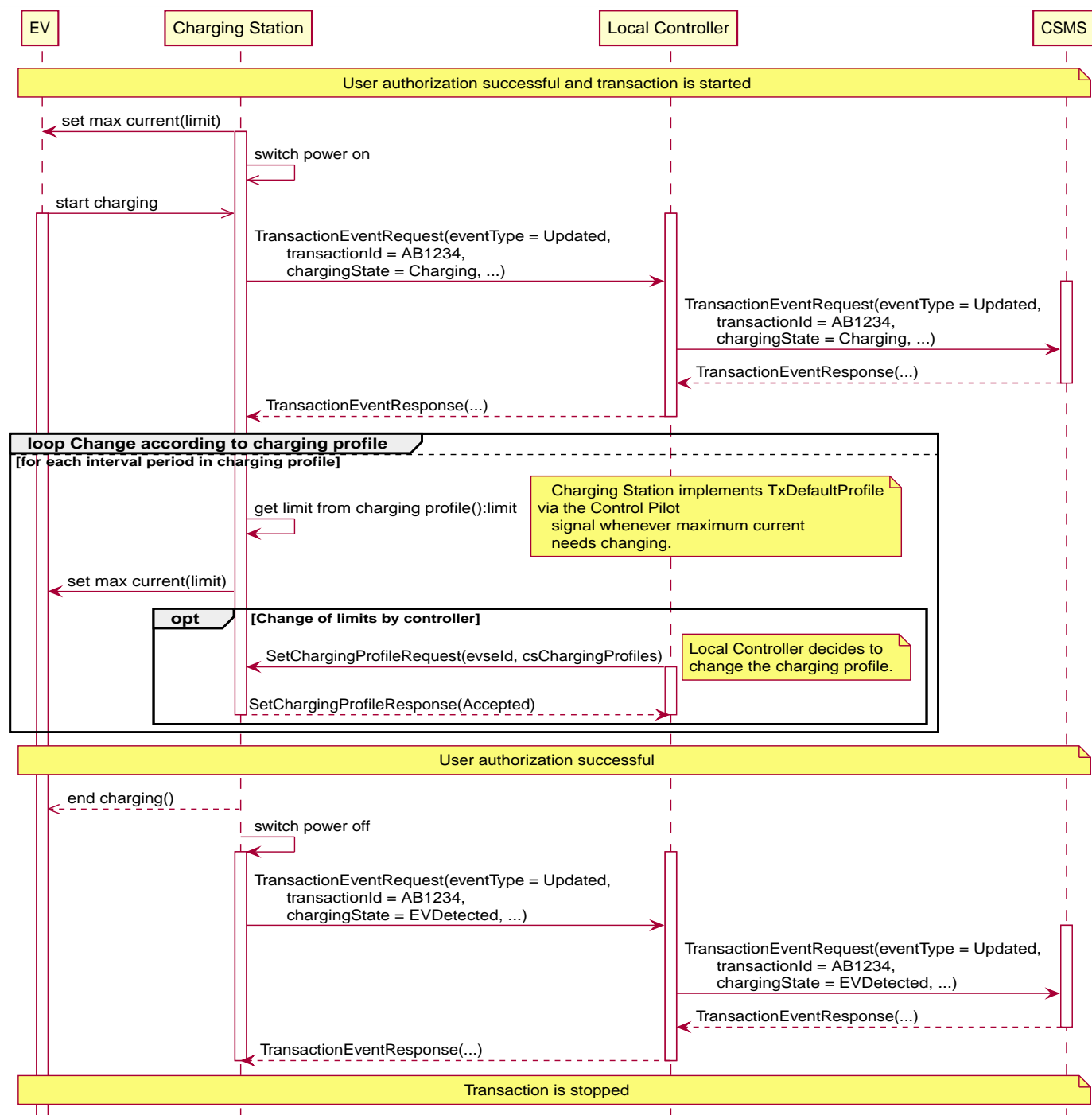


Figure 102. Sequence Diagram: Local Smart Charging

7	Error handling	n/a
8	Remark(s)	<p>The Local Controller for Local Smart Charging can be implemented in different ways, for example: as a separate physical component or as part of a 'master' Charging Station controlling a number of other Charging Stations.</p> <p>The Local Controller MAY or MAY NOT have any EVSEs of its own.</p> <p>The limits on Charging Stations in a Local Smart Charging group can either be pre-configured in the Local Controller in one way or another, or they can be set by the CSMS. The Local Controller contains the logic to distribute this capacity among the connected EVSEs by adjusting their limits as needed.</p>

K03 - Local Smart Charging - Requirements

Table 164. K03 - Requirements

ID	Precondition	Requirement definition	Note
K03.FR.01		The Local Controller MAY impose charging limits on a Charging Station.	
K03.FR.02	K03.FR.01	These limits MAY be changed dynamically during the charging process in order to keep the power consumption of the group of Charging Stations within the group limits.	
K03.FR.03	If at any point in time the Local Controller sends a new ChargingProfile to an EVSE	The Charging Station SHALL take this new ChargingProfile into account when calculating a new composite schedule that it will use to charge the EV.	
K03.FR.04		A Transaction with a chargingPriority that is higher than other transactions SHALL be fulfilled as long as possible, even if other transactions have to be suspended.	
K03.FR.05	If a chargingPriority is given in a TransactionEventResponse that is different from the chargingPriority in the IdTokenInfo .	The chargingPriority from the TransactionEventResponse SHALL be used for this transaction and for this transaction only.	It shall therefore not be stored e.g. in the Authorization Cache.
K03.FR.06	When no chargingPriority is known.	The Transaction or IdToken SHALL be assumed to have chargingPriority 0.	
K03.FR.07		The optional ChargingSchedule field minChargingRate MAY be used by the Charging Station to optimize the power distribution between the EVSEs.	The parameter informs the Local Controller that charging below minChargingRate is inefficient, giving the possibility to select another balancing strategy.
K03.FR.08		The Local Controller SHALL NOT set chargingProfilePurpose to ChargingStationExternalConstraints in a SetChargingProfileRequest .	This purpose is only used when an external system has set a charging limit/schedule.

K04 - Internal Load Balancing

Table 165. K04 - Internal Load Balancing

No.	Type	Description
1	Name	Internal Load Balancing
2	ID	K04
	Functional block	K. Smart Charging
3	Objective(s)	To enable internal load balancing within the Charging Station and between EVSEs.
4	Description	<p>The Load Balancing use case is about internal load balancing within the Charging Station, where the Charging Station controls current/power per EVSE.</p> <p>The Charging Station is configured with a fixed limit, e.g. the maximum current of the connection to the grid.</p> <p>See K01 - Set Charging Profile</p>
	Actors	Charging Station, CSMS, EVSE
	Scenario description	<ol style="list-style-type: none"> 1. The CSMS sets known physical grid connection limits by sending a ChargingProfile. 2. The Charging Station controls current/power per EVSE. 3. The EVSE sends a Control Pilot signal to the EV.
5	Prerequisite(s)	The Functional Block <i>Smart Charging</i> is installed.
6	Postcondition(s)	<p>Successful postcondition: The Charging Station <i>Successfully</i> balances the current/power between the different EVSEs, based on what the CSMS is sending.</p> <p>Failure postcondition: ChargingProfile is <i>not Accepted</i>. Charging is possible, although the Charging Station will <i>not</i> adhere to the ChargingProfile.</p>
7	Error handling	n/a
8	Remark(s)	n/a

K04 - Internal Load Balancing - Requirements

Table 166. K04 - Requirements

ID	Precondition	Requirement definition	Note
K04.FR.01		The Charging Station SHALL control the ChargingSchedule per EVSE.	
K04.FR.02		The Charging Station SHALL be configured with a fixed limit.	e.g. the maximum current of the connection to the grid.
K04.FR.03		A ChargingProfile with the purpose ChargingStationMaxProfile can only be set at Charging Station EVSE with Id 0.	
K04.FR.04		The optional ChargingSchedule field minChargingRate MAY be used by the Charging Station to optimize the power distribution between the EVSEs.	The parameter informs the Local Controller that charging below minChargingRate is inefficient, giving the possibility to select another balancing strategy.
K04.FR.05		The combined energy flow of all EVSEs (and the Charging Station hardware itself) SHALL NOT be greater than the limit set by ChargingStationMaxProfile .	

K05 - Remote Start Transaction with Charging Profile

Table 167. K05 - Remote Start Transaction with Charging Profile

No.	Type	Description
1	Name	Remote Start Transaction with Charging Profile
2	ID	K05
	Functional block	K. Smart Charging
3	Objective(s)	To enable the CSMS to remotely start a transaction by directly including a ChargingProfile , in order to assure that the transaction will use the right ChargingProfile .
4	Description	<p>This use case covers how the CSMS can remotely start a transaction with purpose TxProfile. This assures that the right TxProfile is used. Also, when the Charging Station goes <i>Offline</i> after receiving RequestStartTransactionRequest.</p> <p>This is also needed, as switching from three phase- to one phase charging is not always possible and the transaction needs to start at the right phase.</p>
	Actors	Charging Station, CSMS, External Trigger
	Scenario description	<ol style="list-style-type: none"> 1. The CSMS requests a Charging Station to remotely start a transaction by sending a RequestStartTransactionRequest with a ChargingProfile with purpose TxProfile. 2. The Charging Station responds with a RequestStartTransactionResponse indicating that it is able to start the transaction and will use the ChargingProfile. 3. The Charging Station informs the CSMS that a transaction has started by sending a TransactionEventRequest (eventType = Started) message. 4. The transaction is started in the same way as described in E. Transaction. 5. The Charging Station sends a TransactionEventRequest (eventType = Updated) to inform the CSMS that it is charging. 6. The Charging Station continues the regular smart charging session, following the set ChargingProfiles.
5	Prerequisite(s)	The Functional Block <i>Smart Charging</i> is installed.
6	Postcondition(s)	<p>Successful postcondition:</p> <p>The Charging Station <i>Successfully</i> charges taking into account the provided ChargingProfile.</p> <p>Failure postcondition:</p> <p>The transaction is <i>not</i> started.</p> <p>The Charging Station <i>Unsuccessfully</i> charges taking into account the provided ChargingProfile.</p>

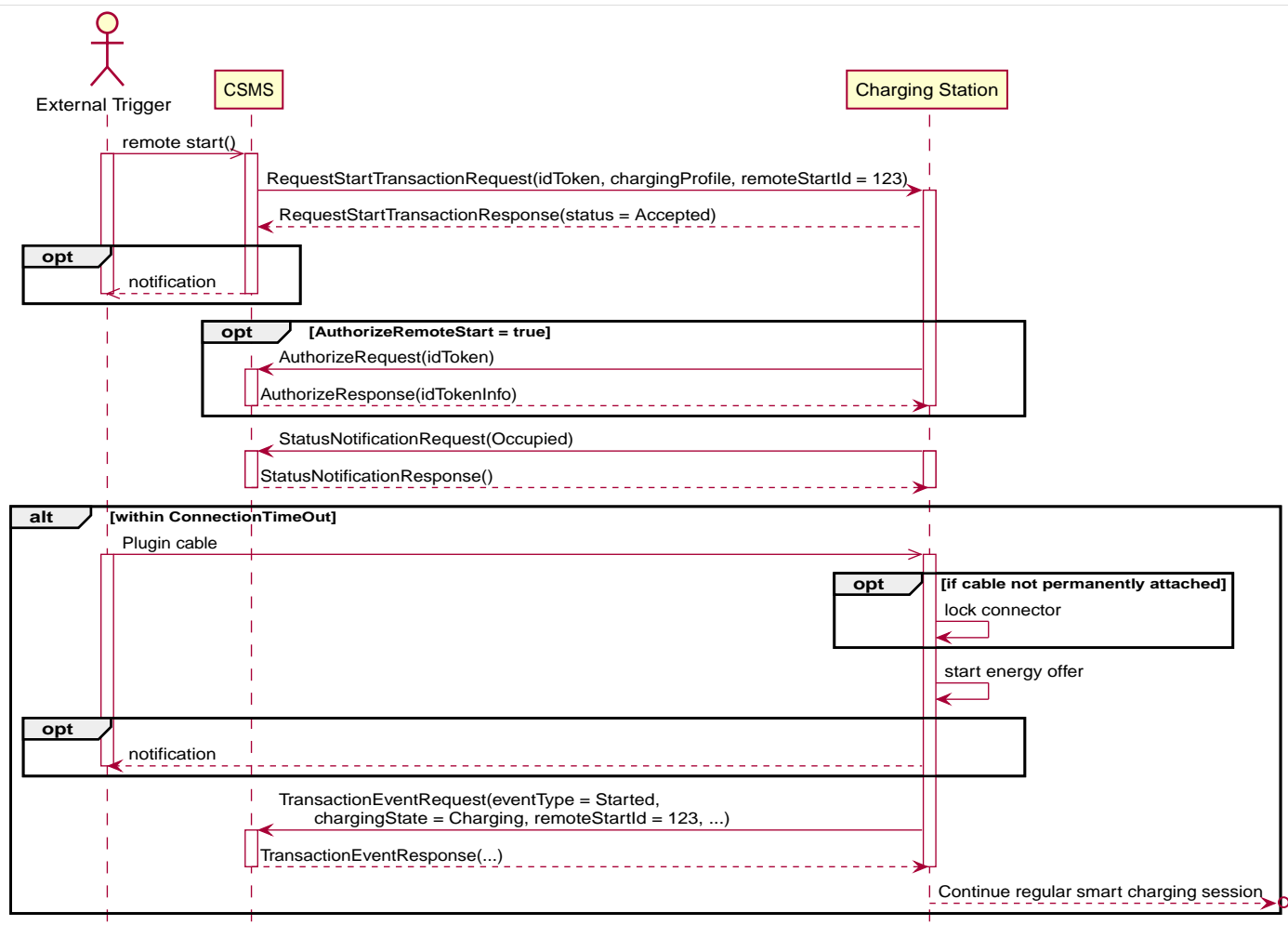


Figure 103. Sequence Diagram: Remote Start Transaction with Charging Profile

7	Error handling	n/a
8	Remark(s)	<p>The scenario description and sequence diagram above are based on the Configuration Variable for start transaction being configured as follows:</p> <p>TxStartPoint: EVConnected, Authorized, DataSigned, PowerPathClosed, EnergyTransfer</p> <p>This use-case is also valid for other configurations, but then the transaction might start/stop at another moment, which might change the sequence in which message are send. For more details see the use case: E01 - Start Transaction options.</p>

K05 - Remote Start Transaction with Charging Profile - Requirements

Table 168. K05 - Requirements

ID	Precondition	Requirement definition
K05.FR.01		The CSMS MAY include a ChargingProfile in a RequestStartTransactionRequest .
K05.FR.02	K05.FR.01	The Purpose of the ChargingProfile SHALL always be TxProfile .
K05.FR.03	K05.FR.01	The Charging Station SHALL use the given profile to calculate its composite schedule.

K06 - Offline Behavior Smart Charging During Transaction

Table 169. K06 - Offline Behavior Smart Charging During Transaction

No.	Type	Description
1	Name	Offline Behavior Smart Charging During Transaction
2	ID	K06
	Functional block	K. Smart Charging
3	Objective(s)	To enable the Charging Station to continue to use the current ChargingProfile for the duration of the transaction while it is <i>Offline</i> .
4	Description	If a Charging Station goes <i>Offline</i> after having received a transaction-specific ChargingProfile with purpose TxProfile , then it continues to use this profile for the duration of the transaction.
	Actors	Charging Station, CSMS, EV
	Scenario description	<ol style="list-style-type: none"> 1. The CSMS sends a SetChargingProfileRequest to the Charging Station with a TxProfile. 2. The Charging Station responds with a SetChargingProfileResponse. 3. While charging is in progress the EVSE will continuously adapt the maximum current or power according to the installed ChargingProfiles. 4. The Charging Station is <i>Offline</i> and operates stand-alone. 5. While charging is in progress the EVSE will continuously adapt the maximum current or power according to the already installed ChargingProfiles.
5	Prerequisite(s)	<p>A transaction is ongoing.</p> <p>The Functional Block <i>Smart Charging</i> is installed.</p>
6	Postcondition(s)	<p>Successful postcondition:</p> <p>The Charging Station continues to use the charging profiles which are available.</p> <p>Failure postcondition:</p> <p>n/a</p>

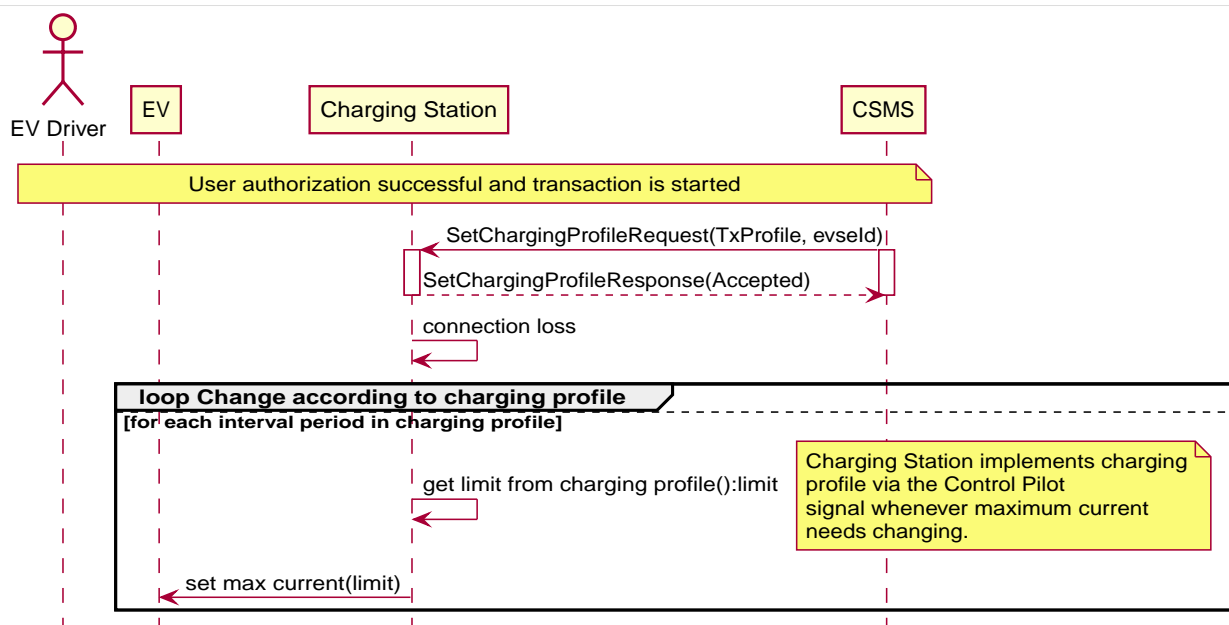


Figure 104. Sequence Diagram: Offline Behavior Smart Charging

7	Error handling	n/a
8	Remark(s)	n/a

K06 - Offline Behavior Smart Charging During Transaction - Requirements

Table 170. K06 - Requirements

ID	Precondition	Requirement definition
K06.FR.01	If the Charging Station goes <i>Offline</i> after having received a transaction-specific ChargingProfile with purpose TxProfile .	The Charging Station SHALL continue to use this profile for the duration of the transaction.
K06.FR.02	If the Charging Station goes <i>Offline</i> , without having any charging profiles.	The Charging Station SHALL execute the transaction as if no constraints apply.

K07 - Offline Behavior Smart Charging at Start of Transaction

Table 171. K07 - Offline Behavior Smart Charging at Start of Transaction

No.	Type	Description
1	Name	Offline Behavior Smart Charging at Start of Transaction
2	ID	K07
	Functional block	K. Smart Charging
3	Objective(s)	To enable the Charging Station to continue to use a ChargingProfile for a transaction which is started <i>Offline</i> .
4	Description	By setting a TxDefaultProfile on a Charging Station, the CSMS can assure that any transaction, which is started while the communication with the CSMS is <i>Offline</i> , uses this profile.
	Actors	Charging Station, CSMS, EV, EV Driver

No.	Type	Description
	<i>Scenario description</i>	<ol style="list-style-type: none"> 1. The CSMS sends a SetChargingProfileRequest to the Charging Station with a TxDefaultProfile. 2. The Charging Station responds with a SetChargingProfileResponse. 3. The Charging Station goes <i>Offline</i> and operates stand-alone. 4. The Charging Station allows automatic authorization of any presented IdToken by either: <ol style="list-style-type: none"> a. The Local Authorization List; a list of identifiers that can be synchronized with the CSMS. b. Authorization Cache entries; which autonomously maintains a record of previously presented identifiers that have been successfully authorized by the CSMS. (Successfully meaning: a response received on a message containing an IdToken). c. Configuration Variable: OfflineTxForUnknownIdEnabled = TRUE 5. The transaction is started in the same way as described in E. Transactions. 6. While charging is in progress the EVSE will continuously adapt the maximum current or power according to the already installed ChargingProfiles.
5	Prerequisite(s)	<p>The Charging Station is <i>Offline</i>.</p> <p>The Functional Block <i>Smart Charging</i> is installed.</p> <p>The IdToken is known in the Local Authorization List, the IdToken is known in the Authorization Cache, or unknown offline authorization is enabled.</p>
6	Postcondition(s)	<p>Successful postcondition:</p> <p>The Charging Station uses the installed TxDefaultProfile which are available for the <i>Offline</i> started transaction.</p> <p>Failure postcondition: n/a</p>

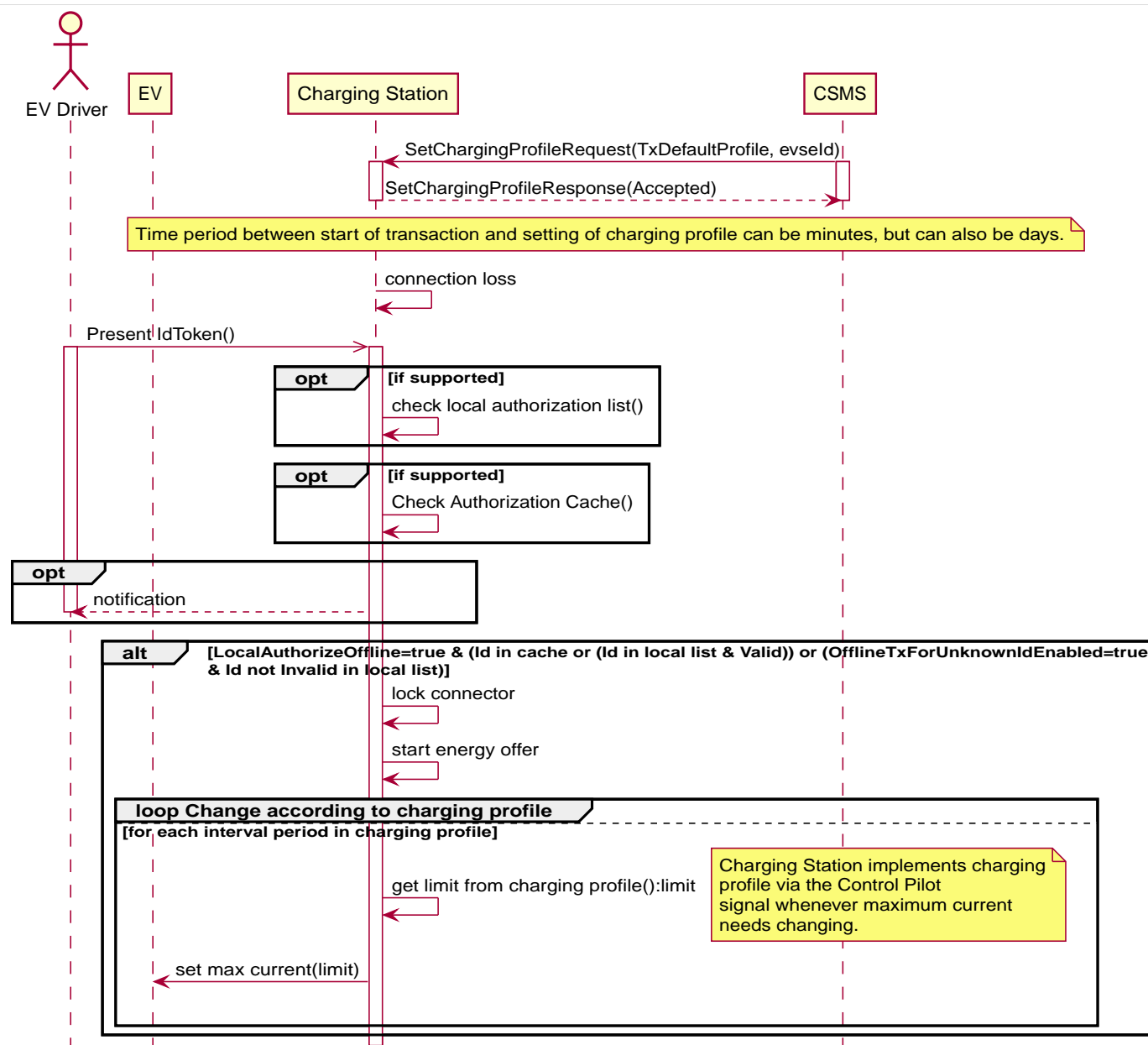


Figure 105. Sequence Diagram: Offline Behavior Smart Charging

7	Error handling	n/a
8	Remark(s)	See section Combining Charging Profile Purposes for a description on how to combine different charging profile purposes.

K07 - Offline Behavior Smart Charging at Start of Transaction - Requirements

Table 172. K07 - Requirements

ID	Precondition	Requirement definition	Note
K07.FR.01	If a Charging Station goes <i>Offline</i> before a transaction is started or before a transaction-specific ChargingProfile with purpose TxProfile was received.	The Charging Station SHALL use the charging profiles which are available.	With purpose TxDefaultProfile for the duration of the current transaction only.

K08 - Get Composite Schedule

Table 173. K08 - Get Composite Schedule

No.	Type	Description
1	Name	Get Composite Schedule
2	ID	K08
	Functional block	K. Smart Charging
3	Objective(s)	To request the Charging Station to report the composite charging schedule.
4	Description	<p>This use cases describes how the CSMS requests the Charging Station to report the Composite Charging Schedule, as calculated by the Charging Station, by sending GetCompositeScheduleRequest.</p> <p>The CompositeSchedule is the result of the calculation of all active schedules and possible local limits present in the Charging Station.</p>
	Actors	Charging Station, CSMS
	Scenario description	<p>1. The CSMS requests the Charging Station to report the Composite Charging Schedule by sending a GetCompositeScheduleRequest.</p> <p>2. The Charging Station calculates the schedule.</p> <p>3. The Charging Station responds with a GetCompositeScheduleResponse with the status and ChargingSchedule.</p>
5	Prerequisite(s)	The Functional Block <i>Smart Charging</i> is installed.
6	Postcondition(s)	<p>Successful postcondition: The CSMS <i>Successfully</i> received the composite schedule from the Charging Station.</p> <p>Failure postcondition: The CSMS did <i>not</i> receive the composite schedule from the Charging Station.</p>

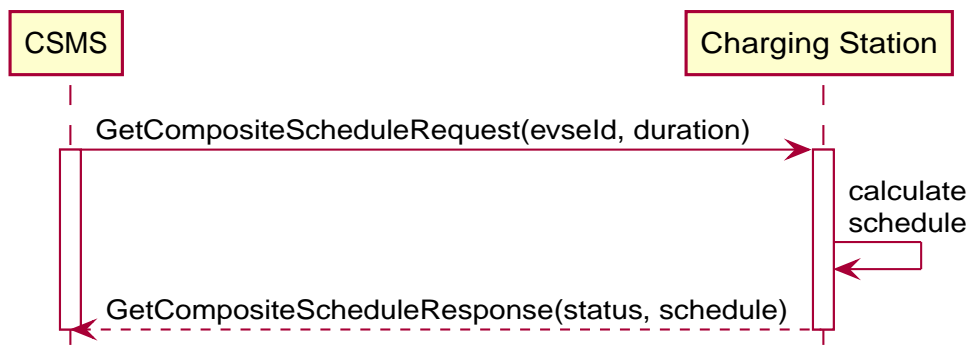


Figure 106. Sequence Diagram: Get Composite Schedule

7	Error handling	n/a
8	Remark(s)	<p>Please note that the charging schedule sent by the Charging Station is only indicative for that point in time. This schedule might change over time due to external causes (e.g. local balancing based on grid connection capacity is active and one EVSE becomes available).</p> <p>The Composite Schedule that will guide the charging level is a combination of the prevailing Charging Profiles of the different chargingProfilePurposes.</p> <p>This Composite Schedule is calculated by taking the minimum value for each time interval (see: Smart Charging signals to a Charging Station from multiple actors). Time intervals do not have to be of fixed length, nor do they have to be the same for every charging profile purpose. This means that a resulting Composite Schedule MAY contain intervals of different lengths.</p> <p>The reported schedule, in GetCompositeScheduleResponse, is the result of the calculation of all active schedules and possible local limits present in the Charging Station. The composite schedule reports the expected power or current the Charging Station expects to consume from the grid, for the requested EVSE, during the requested time period. When requested for evseid=0, the Charging Station will calculate the total expected consumption for the grid connection.</p>

K08 - Get Composite Schedule - Requirements

Table 174. K08 - Requirements

ID	Precondition	Requirement definition
K08.FR.01		The CSMS MAY request the Charging Station to report the CompositeSchedule by sending GetCompositeScheduleRequest .
K08.FR.02	Upon receipt of GetCompositeScheduleRequest .	The Charging Station SHALL calculate the scheduled time intervals, from the moment of message receipt up to the Duration (in seconds) and send them to the CSMS.
K08.FR.03	If the evseld in the GetCompositeScheduleRequest is set to '0'	The Charging Station SHALL report the total expected power or current the Charging Station expects to consume from the grid during the requested time period.
K08.FR.04		At any point in time, the available power or current in the CompositeSchedule , which is the result of merging the schedules of charging profiles ChargingStationMaxProfile , ChargingStationExternalConstraints and TxDefaultProfile (or TxProfile), SHALL be less than or equal to lowest value of available power or current in any of the merged schedules.
K08.FR.05	If the Charging Station is not able to report the requested schedule, for instance if the evseld is unknown	The Charging Station SHALL respond with the status Rejected .
K08.FR.06	When there is no transaction active on an EVSE	The Charging Station SHALL calculate the CompositeSchedule as if there is a transaction ongoing on the EVSE that is using the TxDefaultProfile (if this profile purpose is set)
K08.FR.07	When receiving a GetCompositeScheduleRequest with a chargingRateUnit , which is not configured in the configuration variable ChargingScheduleChargingRateUnit	The Charging Station SHALL respond with GetCompositeScheduleResponse with status Rejected .

K09 - Get Charging Profiles

Table 175. K09 - Get Charging Profiles

No.	Type	Description
1	Name	Get Charging Profile
2	ID	K09
	Functional block	K. Smart Charging
3	Objectives	To enable the CSMS to view the Charging Schedules/limits installed in a Charging Station, these can be installed by the CSMS or some other source.
4	Description	With the GetChargingProfilesRequest message the CSMS can ask a Charging Station to report all, or a subset of all the install Charging Profiles from the different possible sources. This can be used for some automatic smart charging control system, or for debug purposes by a CSO.
	Actors	Charging Station, CSMS
	Scenario description	<ol style="list-style-type: none"> 1 The CSMS asks the Charging Station for the installed charging profiles by sending a GetChargingProfilesRequest message. 2 The Charging Station responds, indicating if it can report Charging Schedules by sending a GetChargingProfilesResponse message. 3 Charging Station sends a number of ReportChargingProfilesRequest messages to CSMS. 4 The CSMS acknowledges reception of the reports by sending a ReportChargingProfilesResponse to the Charging Station for every ReportChargingProfilesRequest.
5	Prerequisites	n/a
6	Postcondition(s)	The CSMS knows which charging profiles have been installed in the Charging Station that match the requested parameters.

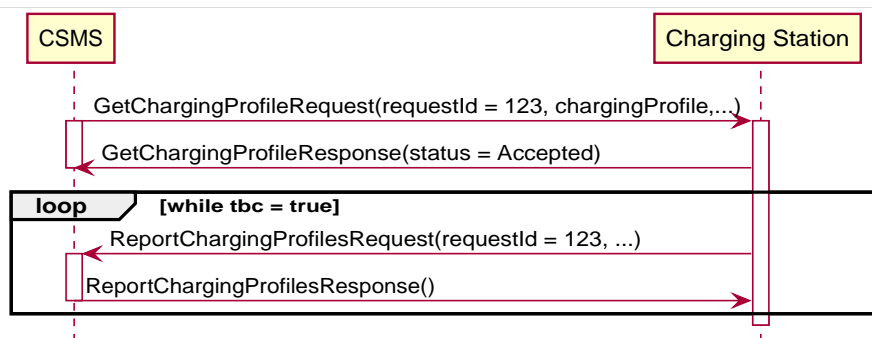


Figure 107. Sequence diagram of the use case "Get Charging Profiles"

7	Error Handling	When the Charging Station has no charging profiles that match the parameters in the GetChargingProfilesRequest the Charging Station SHALL respond with: NoProfiles.
8	Remarks	The charging profiles report can be split over multiple ReportChargingProfilesRequest messages, this can be because charging profiles for different charging sources need to be reported, or because there is just too much data for one message. To indicate that more reports will follow the flag tbc can be used.

K09 - Get Charging Profiles - Requirements

Table 176. K09 - Requirements

ID	Precondition	Requirements
K09.FR.01	When <i>requestId</i> is set in the GetChargingProfilesRequest	The Charging Station SHALL set the <i>requestId</i> in every ReportChargingProfilesRequest that is sent as a result of this GetChargingProfilesRequest .
K09.FR.02	When the charging profiles are reported in more than one ReportChargingProfilesRequest	The Charging Station SHALL set the <i>tbc</i> flag to true for all ReportChargingProfilesRequest messages except the last.
K09.FR.03		The CSMS SHALL either specify a (list of) <i>chargingProfileId(s)</i> OR include one or more of the fields <i>stackLevel</i> , <i>evseld</i> , <i>chargingLimitSource</i> and <i>chargingProfilePurpose</i> in the GetChargingProfilesRequest (that are matched as a logical AND) to specify which Charging Profiles need to be reported.
K09.FR.04	If <i>evseld</i> is set to a value greater than 0 in the GetChargingProfilesRequest	The Charging Station SHALL report the installed charging profiles for the specified EVSE.
K09.FR.05	If <i>evseld</i> is set to 0 in the GetChargingProfilesRequest	The Charging Station SHALL only report charging profiles installed on the Charging Station itself (the grid connection).
K09.FR.06	If <i>evseld</i> is NOT set in the GetChargingProfilesRequest	The Charging Station SHALL report all installed charging profiles.

K10 - Clear Charging Profile

Table 177. K10 - Clear Charging Profile

No.	Type	Description
1	Name	Clear Charging Profile
2	ID	K10
	<i>Functional block</i>	K. Smart Charging
3	Objective(s)	To clear some or all of the charging profiles.
4	Description	If the CSMS wishes to clear some or all of the charging profiles that were previously sent to the Charging Station, then the CSMS sends a ClearChargingProfileRequest to the Charging Station.
	<i>Actors</i>	Charging Station, CSMS
	<i>Scenario description</i>	<ol style="list-style-type: none"> 1. The CSMS sends a ClearChargingProfileRequest to the Charging Station. 2. The Charging Station responds with a ClearChargingProfileResponse specifying whether it was able to process the request in the status.
5	Prerequisite(s)	One or more ChargingProfiles are installed.

No.	Type	Description
6	Postcondition(s)	<p>Successful postcondition: The requested charging profiles are <i>Successfully</i> cleared.</p> <p>Failure postcondition: The requested charging profiles are <i>not</i> cleared, as no ChargingProfile is found.</p>

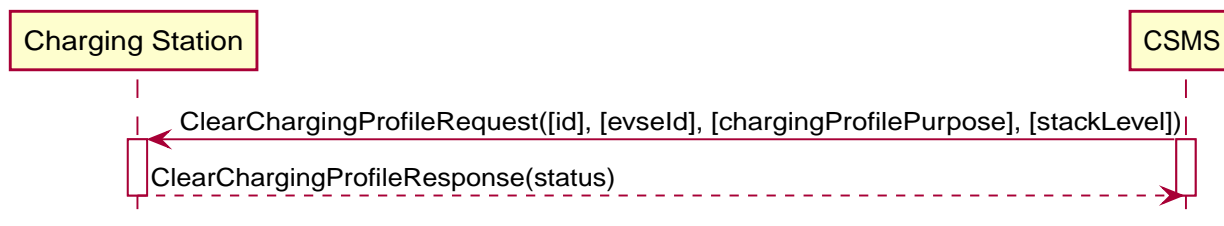


Figure 108. Sequence Diagram of the use case "Clear Charging Profile"

7	Error handling	n/a
8	Remark(s)	n/a

K10 - Clear Charging Profile - Requirements

Table 178. K10 - Requirements

ID	Precondition	Requirement definition
K10.FR.01	If the Charging Station does not have any matching ChargingProfile .	Upon receipt of a ClearChargingProfileRequest , the Charging Station SHALL respond with the status <i>Unknown</i> .
K10.FR.02		The CSMS SHALL either specify a chargingProfile.id OR include one or more of the fields stackLevel , evseld and chargingProfilePurpose in the ClearChargingProfileRequest to specify which Charging Profiles need to be cleared.
K10.FR.03	Upon receipt of a ClearChargingProfileRequest with a specified id .	The Charging Station SHALL clear the Charging Profile with the matching id and respond with a ClearChargingProfileResponse message.
K10.FR.04	NOT K10.FR.03 AND Upon receipt of a ClearChargingProfileRequest , with optional values for evseld , chargingProfilePurpose , stackLevel	The Charging Station SHALL clear the Charging Profiles that match (as logical AND) the values in the request and respond with a ClearChargingProfileResponse message.
K10.FR.05	After clearing one or more Charging Profiles.	The Charging Station SHALL recalculate its composite schedule and set the resulting maximum power/current values to all ongoing transactions.
K10.FR.06		The CSMS SHALL NOT set chargingProfilePurpose to ChargingStationExternalConstraints in a ClearChargingProfileRequest .
K10.FR.07	K10.FR.05 AND the cleared profile has chargingProfilePurpose = TxDefaultProfile	The Charging Station SHALL continue any active transaction, that started with a TxDefaultProfile , as if it was started without a TxDefaultProfile .

5.2. External Charging Limit based Smart Charging

K11 - Set / Update External Charging Limit With Ongoing Transaction

Table 179. K11 - Set / update external charging limit with ongoing transaction

No.	Type	Description
1	Name	Set / Update External Charging Limit With Ongoing Transaction
2	ID	K11
	Functional block	K. Smart Charging

No.	Type	Description
3	Objectives	To inform the CSMS of a charging schedule or charging limit imposed by an External Control System on the Charging Station with ongoing transaction(s).
4	Description	An External Control System sends a charging limit/schedule to a Charging Station. This limit is sent to the CSMS.
	Actors	External Control System, Charging Station, CSMS
	Scenario description	<ol style="list-style-type: none"> 1. External control system sends charging limit/schedule to Charging Station. 2. Optional: Charging Station calculates new charging schedule. 3. Charging Station adjusts the charging speed of the ongoing transaction(s). 4. If the charging limit changed by more than: <i>LimitChangeSignificance</i>, the Charging Station sends a <i>NotifyChargingLimitRequest</i> message to CSMS with optionally the set charging limit/schedule. 5. The CSMS responds with <i>NotifyChargingLimitResponse</i> to the Charging Station. 6. If the charging rate changes by more than: <i>LimitChangeSignificance</i>, the Charging Station sends a <i>TransactionEventRequest</i> message to inform the CSMS. 7. The CSMS responds with <i>TransactionEventResponse</i> to the Charging Station.
5	Prerequisites	<p>Charging Station is not in error state.</p> <p>An external system can set/clear a charging limit/schedule on the Charging Station via another connection than OCPP.</p>
6	Postcondition(s)	<p>The ongoing transaction will be limited by the received charging limit from the external system.</p> <p>The CSMS is informed of the new limit/schedule imposed by the external system.</p>

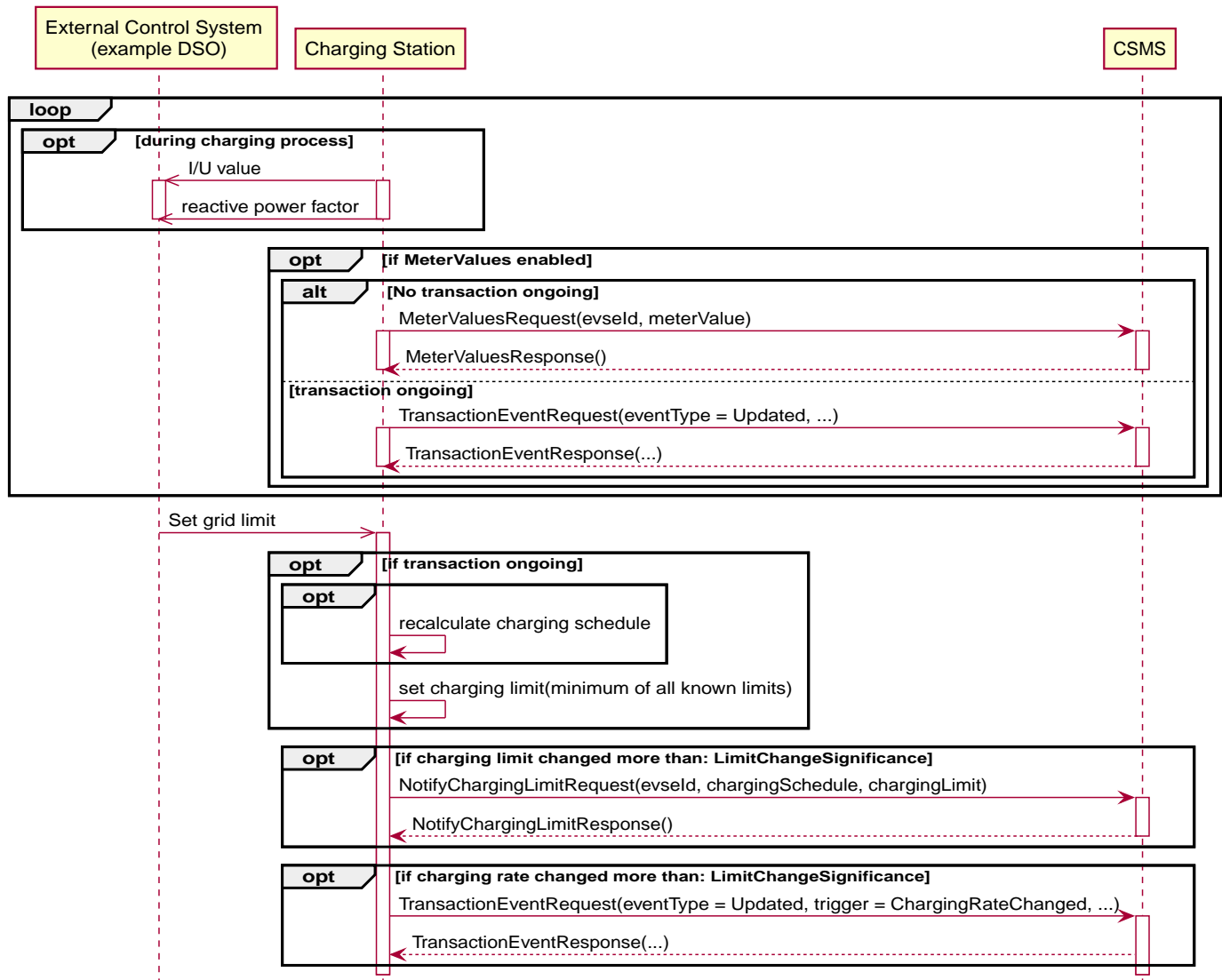


Figure 109. Sequence diagram of the use case "Setting / Updating External Charging Limit with Ongoing Transaction"

7	Error Handling	n/a
8	Remarks	The external system could, for example, use IEC 61850 [IEC61850-7-420] or OpenADR [OPENADR] to communicate the grid limit to the Charging Station, but this could be any protocol. Furthermore, an example of an external system is given, in this case a DSO that might set an external charging limit in case of grid problems, but this could be any other external system or reason to set a charging limit.

K11 - Set / Update External Charging Limit With Ongoing Transaction - Requirements

Table 180. K11 - Requirements

ID	Precondition	Requirements
K11.FR.01	When an external charging limit/schedule is received during an ongoing transaction	The Charging Station SHALL NOT charge the ongoing transaction faster than this given limit/schedule.
K11.FR.02	K11.FR.01 AND Charging limit changed by more than: LimitChangeSignificance	The Charging Station SHALL inform the CSMS of the new charging limit/schedule imposed by the external system by sending a NotifyChargingLimitRequest .
K11.FR.03	K11.FR.02 AND EnableNotifyChargingLimitWithSchedules is true	The NotifyChargingLimitRequest SHALL contain the charging limits/schedules as set by the external system.
K11.FR.04	K11.FR.01 AND Charging rate changed by more than: LimitChangeSignificance	The Charging Station SHALL send a TransactionEventRequest message to the CSMS with trigger = ChargingRateChanged
K11.FR.05	K11.FR.02	The Charging Station SHALL NOT set the chargingLimitSource to CSO in the NotifyChargingLimitRequest .
K11.FR.06	When an external charging limit/schedule is received	The Charging Station SHALL use purpose ChargingStationExternalConstraints when reporting about this limit (e.g. in a ReportChargingProfilesRequest).

K12 - Set / Update External Charging Limit Without Ongoing Transaction

Table 181. K12 - Set / update external charging limit without ongoing transaction

No.	Type	Description
1	Name	Set / Update External Charging Limit Without Ongoing Transaction
2	ID	K12
	Functional block	K. Smart Charging
3	Objectives	To inform the CSMS of a charging schedule or charging limit imposed by an external system on the Charging Station for new transactions or on the grid connection.
4	Description	An External Control System sends a charging limit to a Charging Station. This limit is sent to the CSMS.
	Actors	External Control System, Charging Station, CSMS
	Scenario description	<ol style="list-style-type: none"> 1. External Control System sends a charging limit to Charging Station (not during a transaction). 2. Optional: Charging Station calculates new charging schedule. 3. Charging Station adjusts the charging speed. 4. If the charging limit changed by more than: LimitChangeSignificance, the Charging Station sends a NotifyChargingLimitRequest message to CSMS with optionally the set charging limit/schedule. 5. The CSMS responds with a NotifyChargingLimitResponse to the Charging Station.
5	Prerequisites	Charging Station is not in error state. An external system that can set/clear a charging limit/schedule on the Charging Station via another connection than OCPP.

No.	Type	Description
6	Postcondition(s)	New transactions will be limited by the received charging limit from the external system. The CSMS is informed of the new limit/schedule imposed by the external system.

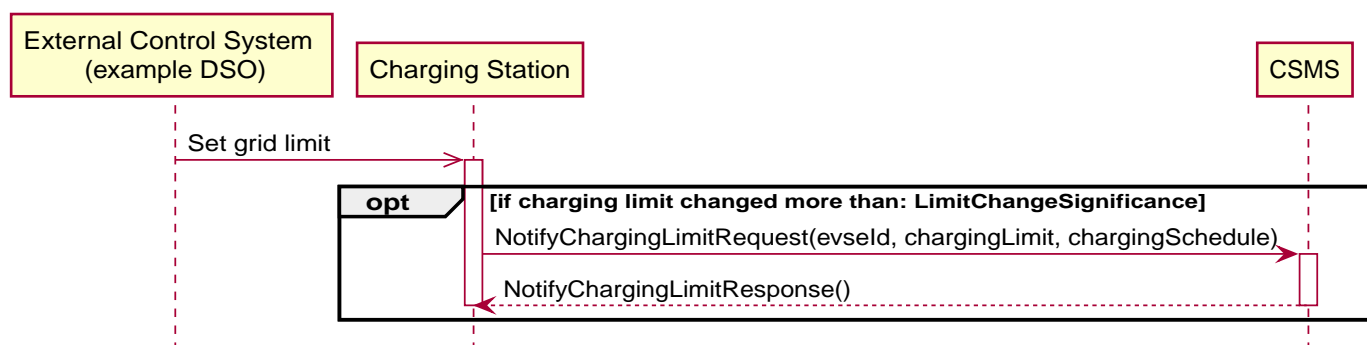


Figure 110. Sequence diagram of the use case "Set / Update External Charging Limit Without Ongoing Transaction"

7	Error Handling	n/a
8	Remarks	The external system could, for example, use IEC 61850 [IEC61850-7-420] or OpenADR [OPENADR] to communicate the grid limit to the Charging Station, but this could be any protocol. Furthermore, an example of an external system is given, in this case a DSO that might set an external charging limit in case of grid problems, but this could be any other external system or reason to set a charging limit.

K12 - Set / Update External Charging Limit Without Ongoing Transaction - Requirements

Table 182. K12 - Requirements

ID	Precondition	Requirements
K12.FR.01	When an external charging limit/schedule is received while no transactions are ongoing	The total load of all EVSEs SHALL NOT exceed this given limit.
K12.FR.02	K12.FR.01 AND Charging limit changed by more than: LimitChangeSignificance	The Charging Station SHALL inform the CSMS of the new charging limit/schedule imposed by the external system by sending a NotifyChargingLimitRequest .
K12.FR.03	K12.FR.02 AND EnableNotifyChargingLimitWithSchedules is true	The NotifyChargingLimitRequest SHALL contain the charging limit/schedule as set by the external system.
K12.FR.04	K12.FR.02	The Charging Station SHALL NOT set the chargingLimitSource to CSO in the NotifyChargingLimitRequest .
K12.FR.05	When an external charging limit/schedule is received	The Charging Station SHALL use purpose ChargingStationExternalConstraints when reporting about this limit (e.g. in a ReportChargingProfilesRequest).

K13 - Reset / Release External Charging Limit

Table 183. K13 - Reset / Release External Charging Limit

No.	Type	Description
1	Name	Reset / Release External Charging Limit
2	ID	K13
	Functional block	K. Smart Charging
3	Objectives	To release a charging limit that was previously imposed.
4	Description	An external control system sends a signal to release a previously imposed charging limit to a Charging Station. The Charging Station notifies the CSMS about this.
	Actors	External control system, Charging Station, CSMS

No.	Type	Description
	Scenario description	<ol style="list-style-type: none"> 1. External control system release/removes a charging limit/schedule on the Charging Station 2. When a transaction is ongoing, the Charging Station calculates the new Charging Schedule and adjusts charging speed. 3. The Charging Station sends a ClearedChargingLimitRequest to notify the CSMS. 4. The CSMS acknowledges with a ClearedChargingLimitResponse to the Charging Station. 5. When the change has impact on an ongoing charging transaction and is more than: LimitChangeSignificance, the Charging Station sends a TransactionEventRequest to notify the CSMS. 6. The CSMS acknowledges with a TransactionEventResponse to the Charging Station.
5	Prerequisites	Previously, a charging limit was sent to the Charging Station under consideration. An external system that can set/clear a charging limit/schedule on the Charging Station via another connection than OCPP.
6	Postcondition(s)	The previously received charging limit is not limiting charging anymore.

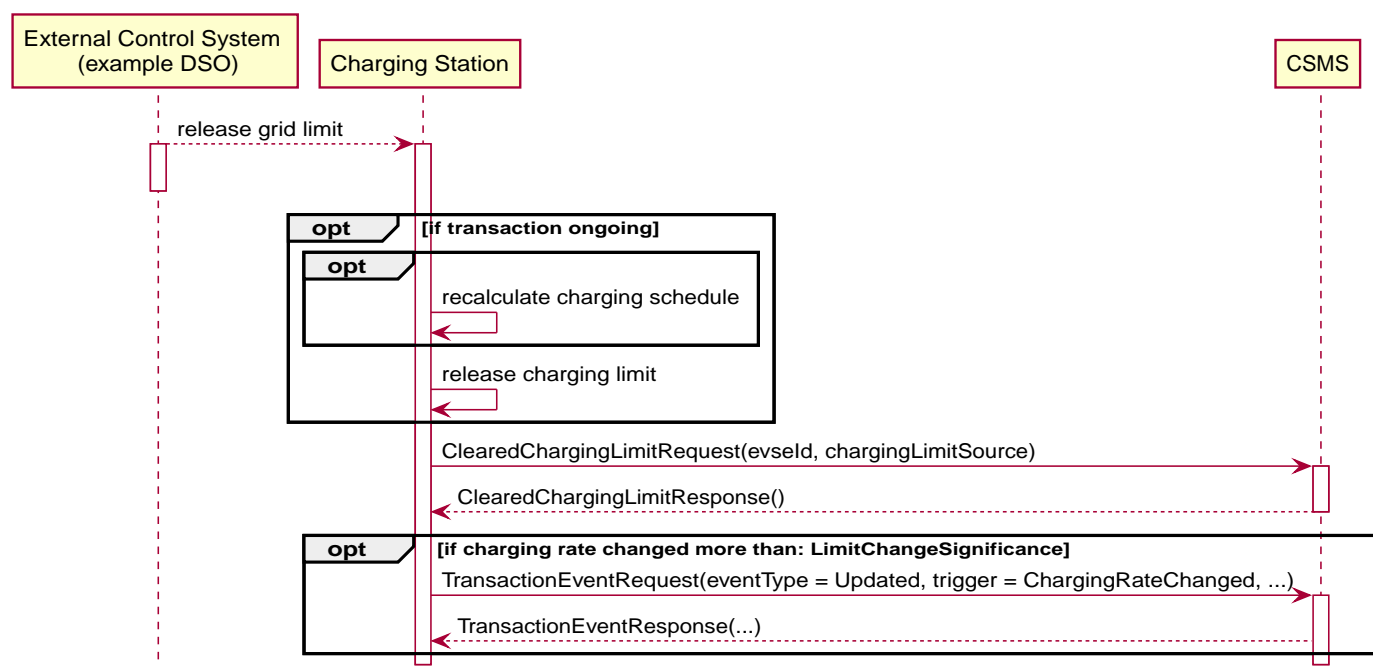


Figure 111. Sequence diagram of the use case "Release / Reset External Charging Limit"

7	Error Handling	n/a
8	Remarks	The external system could, for example, IEC 61850 [IEC61850-7-420] or OpenADR [OPENADR] to release the grid limit, but this could be any protocol. Furthermore, an example of an external system is given, in this case a DSO that might set an external charging limit in case of grid problems, but this could be any other external system or reason to set a charging limit.

K13 - Reset / Release External Charging Limit - Requirements

Table 184. K13 - Requirements

ID	Precondition	Requirements
K13.FR.01	A transaction is ongoing AND External charging limit is released/removed	The Charging Station SHALL NOT limit charging anymore based on the previously received limit.
K13.FR.02	K13.FR.01	The Charging Station SHALL notify the CSMS by sending a ClearedChargingLimitRequest message.
K13.FR.03	K13.FR.01 AND Charging rate changed by more than: LimitChangeSignificance	The Charging Station SHALL send a TransactionEventRequest message to the CSMS with trigger = ChargingRateChanged .

K14 - External Charging Limit with Local Controller

Table 185. K14 - External Charging Limit with Local Controller

No.	Type	Description
1	Name	Handle external charging limit with a local controller
2	ID	K14
	Functional block	K. Smart Charging
3	Objective(s)	To adjust the charging limits according to the External Control System requirements.
4	Description	An external control system sends a charging limit to the Local Controller. The Local Controller notifies the CSMS, calculates the new charging schedules and sends a SetChargingProfileRequest messages to all Charging Stations for which the charging profile has changed.
	Actors	External control system, Local Controller, Charging Station, CSMS
	Scenario description	<ol style="list-style-type: none"> 1. External control system sends a charging limit/schedule to Local Controller. 2. Local Controller sends a NotifyChargingLimitRequest message to the CSMS. 3. Local Controller calculates new Charging Profiles for all connected Charging Stations. 4. Local Controller sends a SetChargingProfileRequest message to all Charging Stations for which the charging profile has changed. 5. External control system sends a charging limit/schedule to Local Controller. 6. Local Controller sends a ClearedChargingLimitRequest message to the CSMS. 7. Local Controller calculates new Charging Profiles for all connected Charging Stations. 8. Local Controller sends a ClearChargingProfileRequest messages to all affected Charging Stations.
5	Prerequisite(s)	<p>Ongoing transaction(s).</p> <p>An external system that can set/clear a charging limit/schedule on Local Controller via another connection than OCPP.</p>
6	Postcondition(s)	<p>Successful postcondition:</p> <p>The ongoing transactions will be limited by the received charging limit from the external system. The CSMS is informed of the new limit/schedule imposed by the external system.</p> <p>Failure postcondition:</p> <p>The CSMS is not informed about the changed charging limit.</p> <p>The External Control System is not able to change the charging limit.</p>

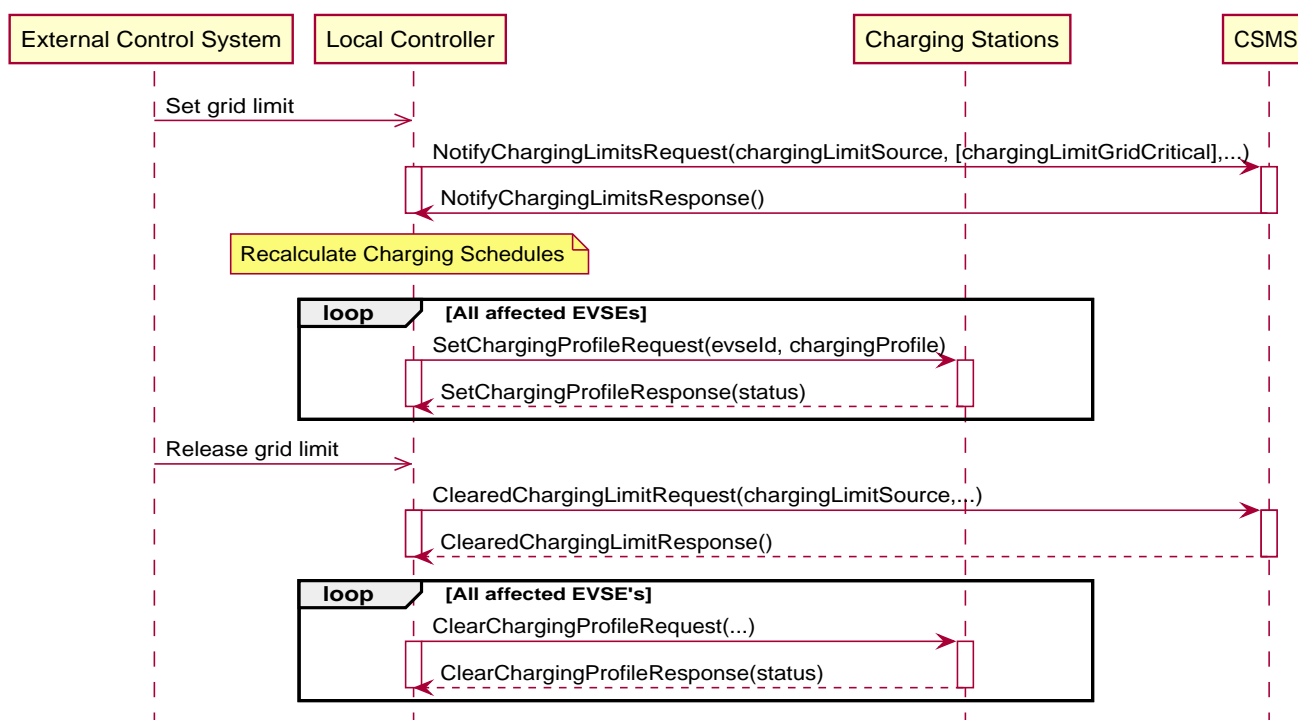


Figure 112. Sequence Diagram: External Charging Limit with Local Controller.

7	Error handling	n/a
8	Remark(s)	n/a

K14 - External Charging Limit with Local Controller - Requirements

Table 186. K14 - Requirements

ID	Precondition	Requirement definition
K14.FR.01	When an external charging limit/schedule is received	The total load of all Charging Stations SHALL NOT exceed this given limit.
K14.FR.02	K14.FR.01 AND Charging limit changed by more than: LimitChangeSignificance	The Local Controller SHALL inform the CSMS of the new charging limit/schedule imposed by the external system by sending a NotifyChargingLimitRequest .
K14.FR.03	When an external charging limit/schedule is released	The local controller SHALL notify the CSMS by sending a ClearedChargingLimitRequest .
K14.FR.04	K14.FR.03	The local controller SHALL clear the hard limit on Charging Stations by sending a ClearChargingProfileRequest message to the Charging Stations.
K14.FR.05	When the Local Controller receives an external charging limit/schedule	It SHALL send a SetChargingProfileRequest to all Charging Stations for which the charging profile has changed.
K14.FR.06	K14.FR.05	The Local Controller SHALL NOT set chargingProfilePurpose to ChargingStationExternalConstraints .

5.3. ISO 15118 based Smart Charging

K15 - Charging with load leveling based on High Level Communication

Table 187. K15 - Charging with load leveling based on High Level Communication

No.	Type	Description
1	Name	Charging with load leveling based on High Level Communication.
2	ID	K15
	Functional block	K. Smart Charging
	Reference	ISO15118-1 E1 AC Charging with load leveling based on High Level Communication, and E4 DC charging with load leveling based on High Level Communication.
3	Objectives	See ISO15118-1, use case Objective E1, page 29.
4	Description	See ISO15118-1, use case Description E1, page 29.
5	Actors	EV, Charging Station, CSMS.
6	Combined scenario description	<ol style="list-style-type: none"> 1. The EV sends a ChargeParameterDiscoveryReq message to the Charging Station. 2. The Charging Station sends a NotifyEVChargingNeedsRequest message to the CSMS. 3. The CSMS sends a NotifyEVChargingNeedsResponse message to the Charging Station. 4. The CSMS sends a SetChargingProfileRequest message to the Charging Station. 5. The Charging Station sends a SetChargingProfileResponse message to the CSMS. 6. The Charging Station responds to the EV with a ChargeParameterDiscoveryRes message to the EV. 7. The EV sends a PowerDeliveryReq message to the Charging Station with ChargeProgress=Start. This marks the point in time when the EVSE provides voltage to its output power outlet and the EV can start to recharge its battery. 8. The contactor is closed. 9. The transaction is updated with a TransactionEventRequest message. 10. A PowerdeliveryRes message is sent to the EV. 11. Optionally, the Charging Station sends a NotifyEVChargingScheduleRequest message to the CSMS.
7	Prerequisites	Both the Charging Station and the EV support ISO 15118.
8	Postcondition(s)	See ISO15118-1, use case End conditions E1, page 29.

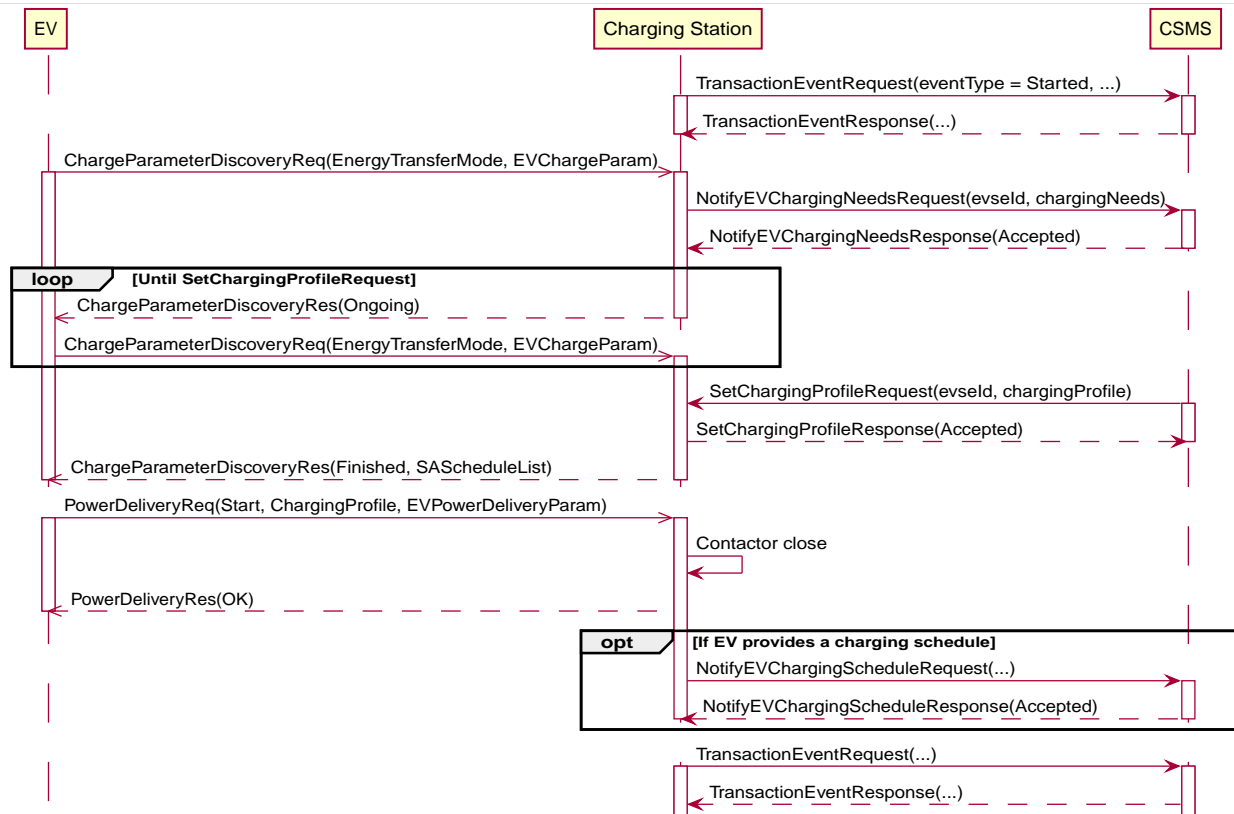


Figure 113. Sequence Diagram: Charging with load leveling based on High Level Communication

9	Error handling	A hard requirement from ISO 15118 is that the response should be sent within the timeout (thus OCPP messaging should have an even lower timeout). If the timeout has been reached, the EV will stop and does not do a retry according to ISO 15118. Therefore, if the SalesTariff cannot be handled fast enough, the Charging Station should start charging by delivering the mandatory PMaxSchedule parameter and in parallel it should handle the optional SalesTariff and start a ISO 15118 renegotiation according to K17 - Renegotiating a Charging Schedule .
10	Remark(s)	Signed SalesTariffs are currently not supported. If these are needed please use P01 - Data Transfer to the Charging Station to send these to the Charging Station.

K15 - Charging with load leveling based on High Level Communication - Requirements

Table 188. K15 - Requirements

ID	Precondition	Requirements	Note
K15.FR.01	When the Charging Station receives charging needs from the EV	The Charging Station SHALL send a NotifyEVChargingNeedsRequest to the CSMS.	
K15.FR.02	K15.FR.01	In response to a NotifyEVChargingNeedsRequest the CSMS SHALL send a NotifyEVChargingNeedsResponse .	
K15.FR.03	K15.FR.02	If the CSMS is able to provide a charging schedule, it SHALL indicate this by setting the <i>status</i> field in the NotifyEVChargingNeedsResponse to 'Accepted'.	
K15.FR.04	K15.FR.02	If the CSMS is not able to provide a charging schedule, it SHALL indicate this by setting the <i>status</i> field in the NotifyEVChargingNeedsResponse to 'Rejected'.	

ID	Precondition	Requirements	Note
K15.FR.05	K15.FR.02	If the CSMS is able to provide a charging schedule; but needs processing time, it SHALL indicate this by setting the <i>status</i> field in the NotifyEVChargingNeedsResponse to 'Processing'.	
K15.FR.06		A NotifyEVChargingNeedsRequest SHALL contain either <i>ACChargingParameters</i> or <i>DCChargingParameters</i> .	
K15.FR.07	K15.FR.03 or K15.FR.05	The CSMS SHALL send a SetChargingProfileRequest with <i>chargingProfilePurpose</i> = <i>TxProfile</i> and a <i>transactionId</i> and at most three <i>chargingSchedule</i> and optional <i>salesTariff</i> elements, that each contain no more periods than specified by <i>maxScheduleTuples</i> in NotifyEVChargingNeedsRequest and by device model variable <code>SmartChargingCtrlr.PeriodsPerSchedule</code> .	
K15.FR.08	K15.FR.01	The CSMS SHOULD send a SetChargingProfileRequest to the Charging Station within 60 seconds.	This is to satisfy the ISO 15118 <i>ChargeParameterDiscoveryReq</i> timeout.
K15.FR.09	K15.FR.07 AND EV returns a charging profile	Charging Station SHALL verify that provided charging profile is within boundaries of the <i>ChargingSchedule</i> from CSMS.	In ISO 15118 EV can sent its charging profile as part of <i>PowerDeliveryReq</i> .
K15.FR.10	K15.FR.09	Charging Station SHALL send the EV charging profile in a NotifyEVChargingScheduleRequest message to CSMS.	
K15.FR.11	K15.FR.10 AND EV charging profile is within limits of CSMS <i>ChargingSchedule</i>	CSMS responds with NotifyEVChargingScheduleResponse with <i>status</i> <i>Accepted</i> to Charging Station.	Note: Already checked by Charging Station, but CSMS does its own check.
K15.FR.12	K15.FR.10 AND EV charging profile is NOT within limits of CSMS <i>ChargingSchedule</i>	CSMS responds with NotifyEVChargingScheduleResponse with <i>status</i> <i>Rejected</i> to Charging Station.	
K15.FR.13	K15.FR.12	CSMS starts new renegotiation as per use case K16.	
K15.FR.14	K15.FR.11	The Charging Station SHOULD take the schedule from the NotifyEVChargingScheduleRequest into account when calculating the actual Composite schedule.	
K15.FR.15	K15.FR.03 AND Charging Station is offline	The Charging Station SHALL use the <i>TxDefaultProfile</i> (if present) and generate a charging schedule within the limits of its composite schedule.	
K15.FR.16	K15.FR.07	It is RECOMMENDED to configure the Charging Station, such that a <i>TransactionEvent</i> with <i>idToken</i> has been sent prior to the NotifyEVChargingNeedsRequest Message, so that CSMS can take the user into account when creating a charging schedule.	
K15.FR.17	When Charging Station receives a SetChargingProfileRequest before EV has sent charging needs	The Charging Station SHALL respond with SetChargingProfileResponse with <i>status</i> = <i>Accepted</i> and ignore the information.	CSMS sent profile too early and will send a profile again in response to NotifyEVChargingNeedsRequest .

K16 - Renegotiation initiated by CSMS

Table 189. K16 - Renegotiation initiated by CSMS

No.	Type	Description
1	Name	Renegotiation initiated by CSMS.
2	ID	K16
	Functional block	K. Smart Charging
3	Objectives	To control the charging power or current of a Charging Station
4	Description	<p>The CSMS sends a SetChargingProfileRequest to the Charging Station to influence the power or current drawn by the EV. The CSMS calculates a ChargingSchedule to stay within limits which MAY be imposed by an external system.</p> <p>Note: Description of actions between EV and Charging Station is informative only and not mandated by OCPP.</p>
	Actors	EV, Charging Station, CSMS
	Scenario description	<p>1 CSMS sends a SetChargingProfileRequest to the Charging Station.</p> <p>2 Charging Station responds with a SetChargingProfileResponse to the CSMS.</p> <p>3 When EV sends the next CurrentDemandReq (for DC) or ChargingStatusReq (for AC), the Charging Station will respond with <i>evseNotification</i> = ReNegotiation.</p> <p>4 EV sends a PowerDeliveryReq with <i>chargeProgress</i> = ReNegotiate to confirm this.</p> <p>5 Charging Station responds with a PowerDeliveryRes.</p> <p>6 EV sends a ChargeParameterDiscoveryReq.</p> <p>7 Charging Station responds with a ChargeParameterDiscoveryRes with an SAScheduleList that contains the ChargingSchedule data from the SetChargingProfileRequest.</p> <p>8 EV sends a PowerDeliveryReq with <i>chargeProgress</i> = Start (with an optional charging profile) to confirm this.</p> <p>9 Charging Station responds with PowerDeliveryRes and, if charging was suspended at start of the renegotiation, will resume power delivery.</p> <p>10 If EV provided a charging profile in the previous step, then Charging Station will send a NotifyEVChargingScheduleRequest to the CSMS.</p>
5	Prerequisites	Charging session started according to use case K15.
6	Postcondition(s)	Charging session uses the new charging profile.

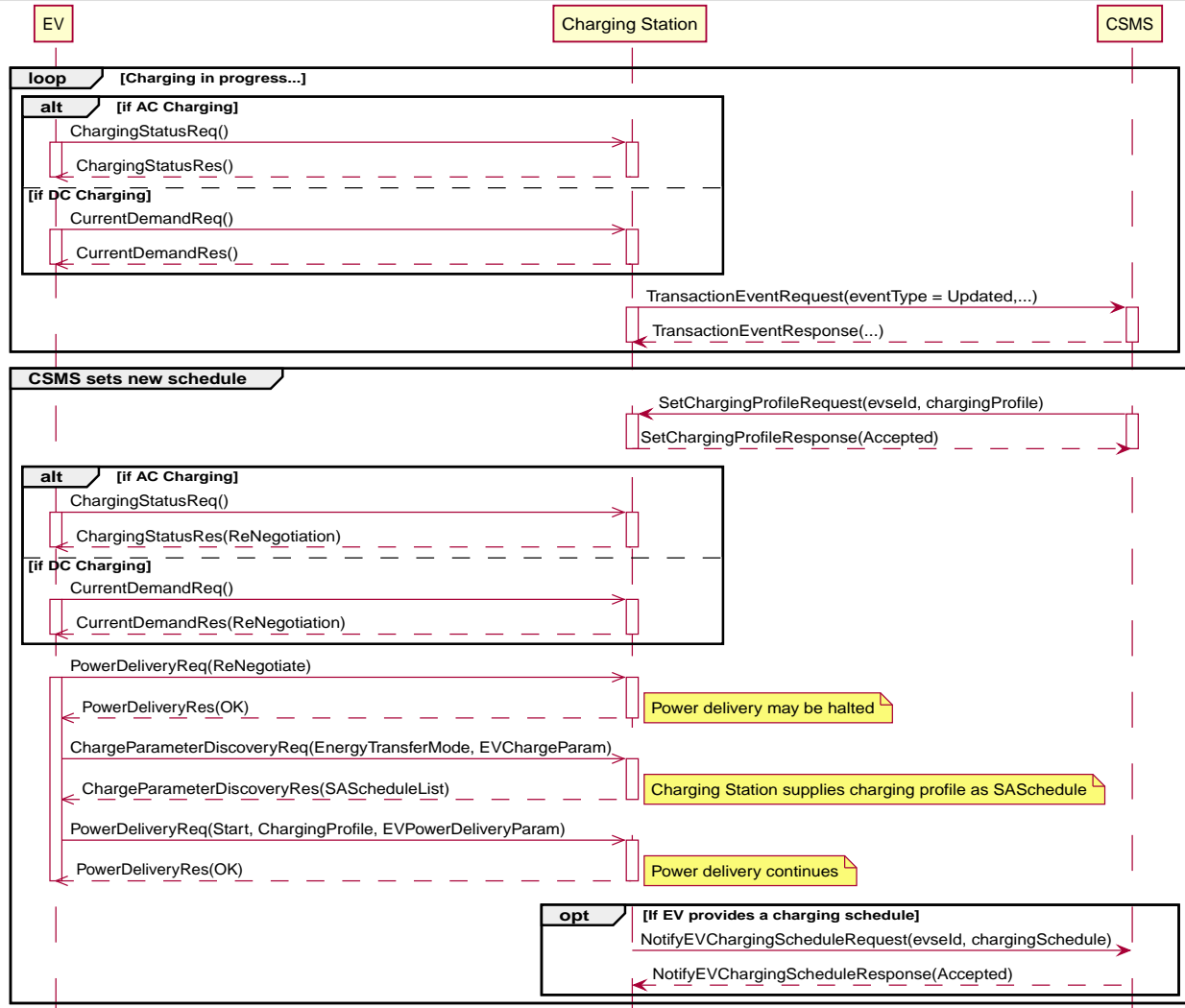


Figure 114. Renegotiation initiated by CSMS

7	Remark(s)	Signed SalesTariffs are currently not supported. If these are needed please use P01 - Data Transfer to the Charging Station to send these to the Charging Station.
---	-----------	--

K16 - Renegotiation initiated by CSMS - Requirements

ID	Precondition	Requirements	NOTE
K16.FR.01	CSMS sends a new SetChargingProfileRequest	Charging Station SHALL respond with a SetChargingProfileResponse with status = Accepted.	
K16.FR.02	K16.FR.01	Charging Station SHALL initiate schedule renegotiation with EV.	In ISO 15118 this is done by replying with EVSENotification=ReNegotiation to a CurrentDemandReq (for DC) or ChargingStatusReq (for AC) message.
K16.FR.03	K16.FR.02	Charging Station SHALL provide the ChargingSchedule data to the EV.	In ISO 15118 this is done in the ChargeParameterDiscoverRes message.
K16.FR.04	EV returns a charging profile	Charging Station SHALL verify that provided charging profile is within boundaries of the ChargingSchedule from CSMS.	In ISO 15118 EV may provide this as part of the PowerDeliveryReq message.
K16.FR.05	K16.FR.04	Charging Station SHALL send the EV charging profile in a NotifyEVChargingScheduleRequest message to CSMS.	
K16.FR.06	K16.FR.05 AND EV charging profile is within limits of CSMS ChargingSchedule	CSMS responds with NotifyEVChargingScheduleResponse with status Accepted to Charging Station.	Note: Already checked by Charging Station, but CSMS does its own check.

ID	Precondition	Requirements	NOTE
K16.FR.07	K16.FR.05 AND EV charging profile is NOT within limits of CSMS ChargingSchedule	CSMS responds with NotifyEVChargingScheduleResponse with <i>status Rejected</i> to Charging Station.	
K16.FR.08	K16.FR.07	CSMS starts new renegotiation as per use case K16.	
K16.FR.09	When the Charging Station receives charging needs from the EV	The Charging Station SHOULD NOT send a NotifyEVChargingNeedsRequest to the CSMS.	CSMS initiated the renegotiation and has just sent a new charging profile, based on the initial charging needs from EV, energy already consumed by EV and whatever information has caused CSMS to update the charging profile. In ISO 15118 charging needs are sent via ChargeParameter-DiscoveryReq.
K16.FR.10	K16.FR.04	The Charging Station SHOULD take the schedule from the NotifyEVChargingScheduleRequest into account when calculating the actual Composite schedule.	
K16.FR.11	K16.FR.02 AND current or power in new charging schedule is lower than actual current or power	The Charging Station SHALL request EV to lower current or power to a value matching the new charging schedule at the first possible opportunity.	In ISO 15118 this can be communicated in CurrentDemandRes (for DC) or ChargingStatusRes (for AC).
K16.FR.12	K16.FR.09 AND Charging Station sends a NotifyEVChargingScheduleRequest	The CSMS SHALL send a SetChargingProfileRequest .	This situation is not desirable, because charging profile will likely be the same as in K16.FR.01, but this is added for robustness when Charging Station is not adhering to K16.FR.09.

K17 - Renegotiation initiated by EV

Table 190. K17 - Renegotiation initiated by EV

No.	Type	Description
1	Name	Renegotiation initiated by EV.
2	ID	K16
	Functional block	K. Smart Charging
3	Objectives	To let an EV request a new charging schedule.
4	Description	The EV signals the Charging Station that it wants to renegotiate and it provides new charging needs, which the Charging Station sends to the CSMS. Based on this and other parameters, the CSMS calculates a new charging schedule and sends it via SetChargingProfileRequest to Charging Station, which communicates it to the EV. Note: Description of actions between EV and Charging Station is informative only and not mandated by OCPP.
	Actors	EV, Charging Station, CSMS

No.	Type	Description
	Scenario description	<p>1 When EV sends a ChargeParameterDiscoveryReq with with charging needs parameters, then Charging Station sends this information in a NotifyEVChargingNeedsRequest to CSMS.</p> <p>2 CSMS responds with NotifyEVChargingNeedsResponse to Charging Station.</p> <p>3 CSMS calculates new charging schedule, that tries to accomodate the EV charging needs and still fits within the schedule boundaries imposed by other parameters.</p> <p>4 CSMS sends a SetChargingProfileRequest with the new schedule to the Charging Station.</p> <p>5 Charging Station responds with SetChargingProfileResponse with status <i>Accepted</i>.</p> <p>6 Charging Station sends new charging schedule to EV in a ChargeParameterDiscoveryRes message.</p> <p>7 EV sends a PowerDeliveryReq with <i>chargeProgress</i> = <i>Start</i> (with an optional charging profile) to confirm this.</p> <p>8 Charging Station responds with PowerDeliveryRes and, if charging was suspended at start of the renegotiation, will resume power delivery.</p> <p>9 If EV provided a charging profile in the previous step, then Charging Station will send a NotifyEVChargingScheduleRequest to the CSMS.</p>
5	Prerequisites	Charging session started according to use case K15.
6	Postcondition(s)	Charging session uses the new charging profile.

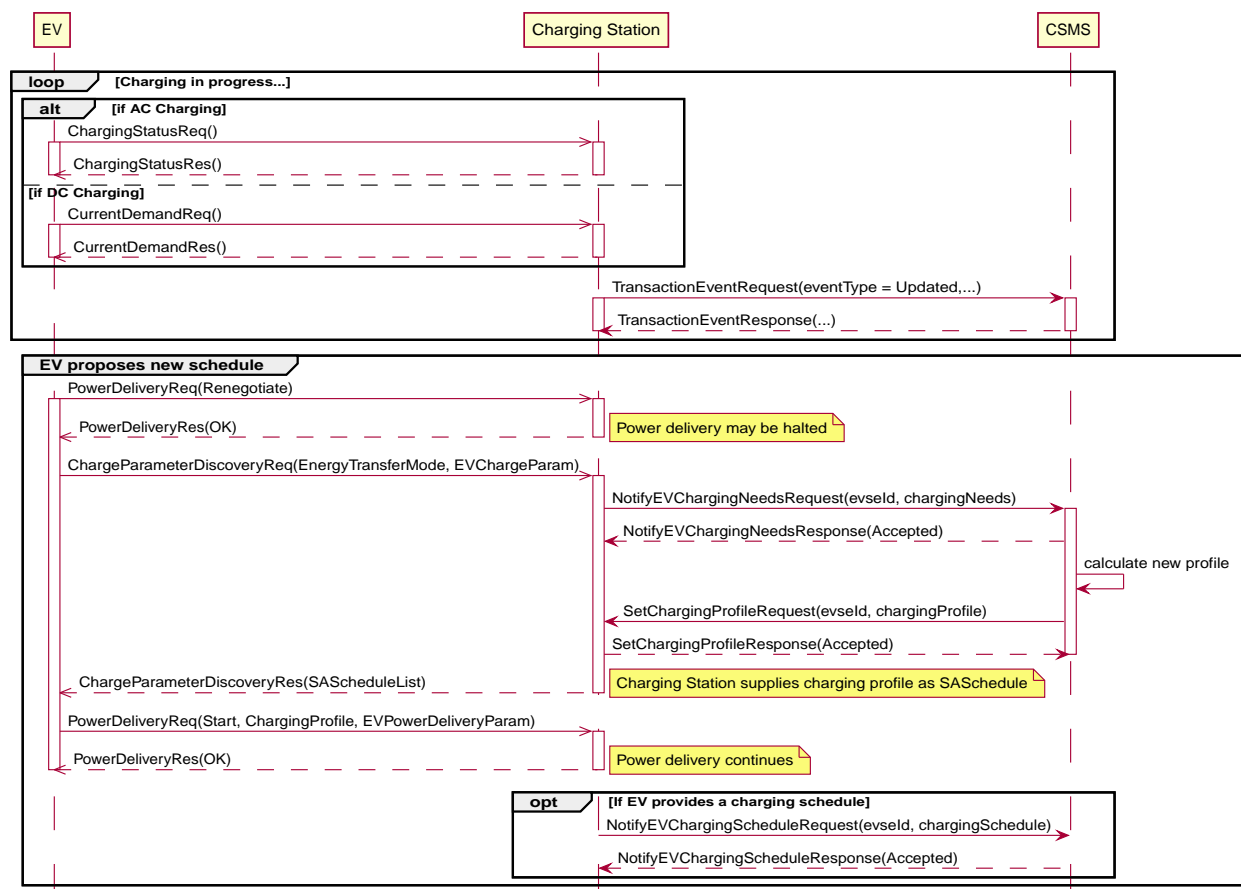


Figure 115. Renegotiation initiated by EV

7	Remark(s)	Signed SalesTariffs are currently not supported. If these are needed please use P01 - Data Transfer to the Charging Station to send these to the Charging Station.
---	-----------	--

K17 - Renegotiation initiated by EV - Requirements

Table 191. K17 - Requirements

ID	Precondition	Requirements	Note
K17.FR.01	EV triggers a renegotiation and sends new charging needs	The Charging Station SHALL send a NotifyEVChargingNeedsRequest to the CSMS.	

ID	Precondition	Requirements	Note
K17.FR.02	K17.FR.01	In response to a NotifyEVChargingNeedsRequest the CSMS SHALL send a NotifyEVChargingNeedsResponse .	
K17.FR.03	K17.FR.02	If the CSMS is able to provide a charging schedule, it SHALL indicate this by setting the <i>status</i> field in the NotifyEVChargingNeedsResponse to 'Accepted'.	
K17.FR.04	K17.FR.02	If the CSMS is not able to provide a charging schedule, it SHALL indicate this by setting the <i>status</i> field in the NotifyEVChargingNeedsResponse to 'Rejected'.	
K17.FR.05	K17.FR.02	If the CSMS is able to provide a charging schedule; but needs processing time, it SHALL indicate this by setting the <i>status</i> field in the NotifyEVChargingNeedsResponse to 'Processing'.	
K17.FR.06		A NotifyEVChargingNeedsRequest SHALL contain either ACChargingParameters or DCChargingParameters.	
K17.FR.07	K17.FR.03 or K17.FR.05	The CSMS SHALL send a SetChargingProfileRequest with <i>chargingProfilePurpose</i> = TxProfile and at most three <i>chargingSchedule</i> and optional <i>salesTariff</i> elements, that each contain no more periods than specified by <i>maxScheduleTuples</i> in NotifyEVChargingNeedsRequest and by device model variable SmartChargingCtrlr.PeriodsPerSchedule.	
K17.FR.08	K17.FR.01	The CSMS SHOULD send a SetChargingProfileRequest to the Charging Station within 60 seconds.	This is to satisfy the ISO 15118 ChargeParameterDiscoveryReq timeout.
K17.FR.09	K17.FR.07 AND EV returns a charging profile	Charging Station SHALL verify that provided charging profile is within boundaries of the ChargingSchedule from CSMS.	In ISO 15118 EV can sent its charging profile as part of PowerDeliveryReq.
K17.FR.10	K17.FR.09	Charging Station SHALL send the EV charging profile in a NotifyEVChargingScheduleRequest message to CSMS.	
K17.FR.11	K17.FR.10 AND EV charging profile is within limits of CSMS ChargingSchedule	CSMS responds with NotifyEVChargingScheduleResponse with <i>status</i> Accepted to Charging Station.	Note: Already checked by Charging Station, but CSMS does its own check.
K17.FR.12	K17.FR.10 AND EV charging profile is NOT within limits of CSMS ChargingSchedule	CSMS responds with NotifyEVChargingScheduleResponse with <i>status</i> Rejected to Charging Station.	
K17.FR.13	K17.FR.12	CSMS starts new renegotiation as per use case K16.	
K17.FR.14	K17.FR.11	The Charging Station SHOULD take the schedule from the NotifyEVChargingScheduleRequest into account when calculating the actual Composite schedule.	

ID	Precondition	Requirements	Note
K17.FR.15	K17.FR.01 AND Charging Station is offline	The Charging Station SHALL use the TxDefaultProfile (if present) and generate a charging schedule within the limits of its composite schedule.	