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OCPP 1.6

Implementation Overview

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Revisions

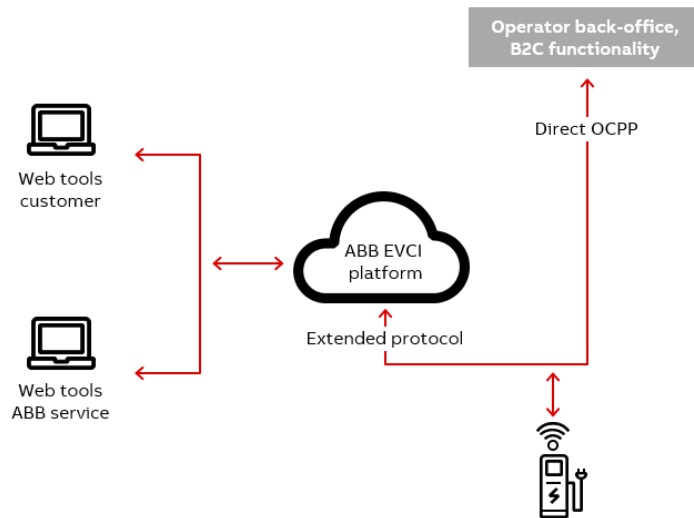
Revision	Description	Date	Author
A	First issue	12 February 2019	Mikhail Kireev
1.2	Added description for new messages and additional Measurands. First part of document is re-structured	06 January 2020	Mikhail Kireev
1.3	<ul style="list-style-type: none"> • Added TriggerMessage in “Supported functionality” • Added chapter “Smart Charging custom configuration key DiscardTxProfile-WhenConenctionLoss” • Added chapter “Reference to payment session for payment terminal authorized session in idTag of StartTransaction” • Added part “ABB implementation choices for some of OCPP 1.6 unspecified areas” • Added part “Known issues” 	15 February 2021	Mikhail Kireev

Overview

ABB DC chargers support OCPP 1.6 in a Dual-Uplink setup. With this OCPP 1.6 can be enabled on multiple ABB DC Fast Charging products.

This document describes OCPP 1.6 functionality supported by ABB DC chargers according to OCPP protocol specification and ABB’s specific extensions of OCPP 1.6

ABB has implemented OCPP 1.6-J version, which means using JSON over Websockets. The charger is connecting to an OCPP Server directly from the charger. In parallel the charger is connecting to the ABB Ability™ Platform which allows for efficient remote support and offerings in parallel to OCPP. This concept is referred to as Dual Uplink.



Supported functionality

The implementation is following OCPP 1.6 specification of Open Charge Alliance. According to OCPP 1.6 specification all of features and associated messages are grouped into Feature Profiles.

OCPP 1.6 specified following Feature profiles:

Profile name	Description	Mandatory
Core	Basic Charge Point functionality comparable with OCPP 1.5 without support for firmware updates, local authorization list management and reservations.	Yes
Firmware Management	Support for firmware update management and diagnostic log file download.	No
Local Auth List Management	Features to manage the local authorization list in Charge Points.	No
Reservation	Support for reservation of a Charge Point	No
Smart Charging	Support for basic Smart Charging	No
Remote Trigger	Support for remote triggering of Charge Point initiated messages	No

For more about Feature Profiles please see [1] “3.2 Feature Profiles”.

Please see below which ABB DC Fast Charging products supports which OCPP 1.6 Feature profiles from which software version:

Profile Model	Core	Firmware* Management	Local Auth List Management	Reservation	Smart Charing	Remote Trigger
Terra T53 and T54	4.0.0.x	4.0.0.x*	4.0.0.x	To be supported**	4.3.x	1.5.x (partially)
Terra High Power T175	Any version	Any version*	Any version	To be supported**	1.2.x	1.5.x (partially)
Terra HVC (Connector and OppCharge)	1.2.x	Not supported	N/A	N/A	1.2.x	1.5.x (partially)
DC Wallbox	Any version	Any version*	Any version	To be supported**	Any version	1.5.x (partially)
Terra 94/124/184	Any version	Any version*	Any version*	To be supported**	Any version	To be supported

*All messages and functionality of Firmware Management profile are implemented. However if operator wants to use this messages and functionality, it will disturb ABB’s remote support mechanism and will lead to SLA violation. In standard ABB software update process operator is informed about SW updates including release notes in advance, giving the possibility to influence the process and ask questions about the impact. ABB rolls out the new firmware in controlled way and ensures successful completion via separate dedicated connection. In this way SW updates can be more controlled than via OCPP and additionally are executed without effort for the operator.

** Reservation, profile is not yet implemented in current version of software for the chargers. ABB intends to provide this functionality in the future software versions. Update to these versions will be possible remotely, without service personnel visiting charger

Please see below which messages are supported per OCPP feature profile.

Message	Supported (Y/N)	Comment
Core profile		
Authorize	Y	
BootNotification	Y	
ChangeAvailability	Y	
ChangeConfiguration	Y	
ClearCache	Y	
DataTransfer	Y	General message is supported. Custom functionality based on this command shall be discussed with ABB separately
GetConfiguration	Y	
HeartBeat	Y	
MeterValues	Y	ABB supports following Measurand types: 1. Current.Import 2. Energy.Active.Import.Register 3. Power.Active.Import 4. SoC 5. Voltage 6. Current.Offered* 7. Power.Offered* 8. Temperature*

		NOTE: Please see chapter on MeterValues below for more details
RemoteStartTransaction	Y	
RemoteStopTransaction	Y	
Reset	Y	Both Soft and Hard reset are supported. Soft reset restart charger software, hard reset fully reboot charger. Both type of resets gracefully stops charging session if one is in progress before resetting.
StartTransaction	Y	
StatusNotification	Y	
StopTransaction	Y	
UnlockConnector	Y	Message is supported, but does not unlock connector on EVSE side simply because ABB DC fast charging does not normally have sockets, only cables. Upon receiving this message charger will only stop any active charging session on specified connector, as specified by OCPP. ABB would like to stress out that according to OCPP specification UnlockConnector command should not be used to remotely stop a running transaction, RemoteStopTransaction should be used instead.
Smart Charging		
SetChargingProfile	Y	
ClearChargingProfile	Y	
GetCompositeSchedule	N	
FirmwareManagement profile*		
GetDiagnostics	Y	Downloaded file is encrypted and password protected. Only ABB service personnel has ability to open file**
DiagnosticsStatusNotification	Y	
FirmwareStatusNotification	Y	
UpdateFirmware	Y	
Local Authorization List Management		
GetLocalListVersion	Y	
SendLocalList	Y	
Remote Trigger		
TriggerMessage (BootNotification)	Y	
TriggerMessage (StatusNotifciation)	Y	
TriggerMessage (DiagnosticsStatusNotification)	N	
TriggerMessage (FirmwareStatusNotification)	N	
TriggerMessage (HeartBeat)	N	
TriggerMessage (MeterValues)	N	

*Available from Software versions 1.2.x for Terra HP and HVC and from 4.3.x for Terra 53/4

** As mentioned above all messages and functionality of Firmware Management profile are implemented. However if operator wants to use this messages and functionality in operation, it will disturb ABB's remote support mechanism and will lead to SLA violation.

MeterValues

As mentioned above, following Measurands are supported:

1. Current.Import
2. **Energy.Active.Import.Register**
3. Power.Active.Import
4. **SoC**
5. Voltage
6. Current.Offered
7. Power.Offered
8. Temperature

Energy.Active.Import.Register and SoC are enabled by default. Other values could be enabled via ChangeConfiguration command for keys MeterValuesAlignedData, MeterValuesSampledData, StopTxnAlignedData and StopTxnSampledData. See Configuration Keys chapter for description of these keys.

NOTE: for AC cable or socket of T53 and T54 chargers only Energy.Active.Import.Register and SoC Measurands are supported.

Voltage

In OCPP 1.6 protocol specification [1], chapter 7.31, Voltage value of Measurand is specified as “Instantaneous AC RMS supply voltage”. For ABB’s DC Fast charging Voltage field contains instantaneous voltage measured on DC contactors of the plug during charging.

Current.Offered and Power.Offered

Current.Offered and Power.Offered measurands have dependency on power management software component. Due to this reason it is not enough to only enable this values by adding them to Measurands in MeterValuesAlignedData and MeterValuesSampledData keys.

To enable Current.Offered and Power.Offered either Smart Charging profile should be activated or (if Smart Charging is not used) power management component should be activated in configuration of the charger by ABB Service.

Power.Offered and Current.Offered values represent actual maximum power and current respectively which could be given to connected vehicle based on vehicle maximum capabilities provided during charging session setup. These Measurands do not always represent charger maximum capabilities without context of connected vehicle.

For example, on 350 kW High-Power charger, if during session setup vehicle communicates that it could charge only up to 100 kW, charger will allocate only 100kW plus 10-15% and communicate this number in Power.Offered. Power.Offered will not contain power of 350 kW

(NOTE: 10-15% additional power is related the fact that power and current management is based on AC input current from the grid. Therefore some margin is added during calculation of DC values)

Temperature

Temperature measurand is available for connectorId=0 only. To enable sending of temperature measurements value “Temperature” should be added to key MeterValuesAlignedData.

Temperature is measured inside one or several enclosures of the charging system. Therefore in case on multiple enclosure topology e.g. charge post + power cabinet(s) several temperature measurands are provided, one per enclosure.

Depending on number of enclosures 1 or more temperature values are put in comma separated list inside Measurands. Below is example of JSON structure containing 2 temperature measurements for Heavy Vehicle Charger which consists of Depot box and power cabinet. Power cabinet temperature is 33.8C and Depot box is 16.8C:

```
"MeterValues",
  [{"connectorId":0,"meterValue":[
    {"sampledValue":[
      {"unit":"Celsius",
       "context":"Sample.Clock",
       "measurand":"Temperature",
       "location":"Body",
       "value":"33.8,16.6"}
    ]},
    {"timestamp":"2019-12-19T14:20:00.155Z"}
  ]}
]
```

Sample moments

Samples are taken at different moments in time, depending on the value of the interval configuration settings, but always only during ongoing charging session as specified in section 3.16 of [1].

ClockAlignedDataInterval: (if greater than 0)

- at fixed moments in time during charging session (readingContext = Sample.Clock)

MeterValueSampleInterval: (if greater than 0)

- at the start of a transaction (readingContext = Transaction.Begin)
- periodically with specified interval during the charge session (readingContext = Sample.Periodic)
- at the end of a transaction (readingContext = Transaction.End)

Which Measurands (CSL)	When	OCPP message	ConnectorID
MeterValuesAlignedData	ClockAlignedDataInterval	MeterValues.req	0
MeterValuesSampledData	MeterValueSampleInterval	MeterValues.req	>0
StopTxnAlignedData	ClockAlignedDataInterval	StopTransaction.req	>0
StopTxnSampledData	MeterValueSampleInterval	StopTransaction.req	>0

MeterValues with different connectorId will be sent in separate MeterValues.req messages.

ABB custom extensions

ABB supports the following additional features for OCPP 1.6-J

Free Vend mode

ABB DC Fast charger could be set to so-called Free Vend mode. In this mode authorization is disabled and charging could be started without authorization. When this mode is enabled, Authorize message

will not be sent to Central System. StartTransaction message will be sent as usually at the beginning of charging session.

To enable this mode, Central System should send ChangeConfiguration message for key FreevendEnabled with value TRUE (default value for this key is FALSE)

For specification of these configuration key please see chapter ABB custom configuration keys.

When Free Vend mode enabled and charging started locally, StartTransaction message will contain idTag as configured by custom configuration key FreevendIdTag (default value is NOA).

NOTE: if RemoteStartTransaction is received when charging station is in Free Vend mode, StartTransaction would contain idTag that has come in RemoteStartTransaction message, but not FreevendIdTag.

Central system should be configured to accept StartTransaction with idTag configured for Free Vend mode. If this idTag is not known by Central System and Central System rejects StartTransaction for this idTag charging will be stopped with Reason = DeAuthorized unless configuration key StopTransactionOnInvalidId is set to false.

Smart Charging custom configuration key DiscardTxProfileWhenConnectionLoss

There are cases when it is desired to cancel Smart Charging limitation applied to ongoing charging session if connection to Central system is lost. For this cases ABB has implemented custom configuration key DiscardTxProfileWhenConnectionLoss.

The key is Boolean and when set to true and connection to Central System is lost (Websocket connection dropped), txProfile, if such profile exists for ongoing charging session, will be deleted immediately and all limitation applied by it will be not considered.

All other types of Smart Charging profiles will not be affected.

If key is set to false behavior is according to OCPP specification: txProfile will be active until the end of ongoing charging session even if connection to Central System is lost.

Reference to payment session for payment terminal authorized session in idTag of StartTransaction

For chargers that have built-in payment terminal ABB support link between charging session and payment session. This is implemented as following:

- reference to payment transaction is put into field idTag of StartTransaction.req message with prefix PT.

Example: for payment terminal authorized session idTag=PT:00001111.

The numbers that are communicated in idTag of OCPP StartTransaction per type of supported payment terminals are following:

- [CCV]: The “Authorisation Number” as shown on payment receipt
- [Nayax]The “Transaction Id” as shown on Nayax web portal

ABB implementation choices for some of OCPP 1.6 unspecified areas

As probably any specification OCPP 1.6 has some areas that are not explicitly specified either deliberately or not. This part contains description of how ABB interpret some of this areas and describes respective implementation (or lack of implementation) for these areas.

StopTransaction in case of power supply failure

OCPP does not specify how exactly Charging station should handle situation of unexpected immediate power loss during ongoing charging session when charging session cannot be gracefully stopped. There is no explicit description if StopTransaction must be sent and when and which StatusNotifications should be sent in which sequence.

ABB agrees that it make sense to at least properly finalize charging session and send at least StopTransaction message.

However in current implementation there is no graceful handling of power loss or recovery that would include sending StopTransaction.

ABB plans to implement sending StopTransaction for charging session that was interrupted by unexpected power loss in future versions of software. In this implementation ABB plans to send StopTransaction right after charging station has recovered from power loss and booted. Exact messages sequence will be specified later.

At the moment ABB suggest following check to be performed to detect charging session stop due to power loss:

- No messages are coming from charging station that is performing charging session for some period of time. The latest message should be either MeterValues or StartTransaction, depending on duration of the session and configuration of charging station
- After some period of time BootNotification message is received, but no StopTransaction for the connector where charging session was ongoing. This is indication that power loss or similar event interrupted ongoing charging session and then charging station recovered and booted

It is in general recommended for Central System implementation to cancel all ongoing charging session for a station where BootNotification is received.

Known issues

RebootRequired status in ChangeConfiguration.conf

According to chapter 5.3 "Change configuration" of [1], *"If the change was applied successfully, but a reboot is needed to make it effective, the Charge Point SHALL respond with status 'RebootRequired'."*

This type of response is not implemented in ABB DC chargers software. The only response implemented is "Accepted" or "Rejected".

However the only parameter change of which requires reboot of the charging station is WebSocketPingInterval. All other parameters do not require reboot and applied immediately.

ABB plans to fix it in future versions of software

Keys MeterValuesSampledData , MeterValuesAlignedData and other supported CSL configuration keys accepts any string

According to OCPP specification keys MeterValuesSampledData and MeterValuesAlignedData has type comma-separated list (CSL) and may contain combination of Measurands to be set fro sending in MeterValues or StopTransaction messages.

Section 3.16.4 of OCPP spec, that was added in last edition says *“If the comma separated list contains one or more measurands that are not supported by this Charge Point, the Charge Point SHALL respond with: ChangeConfiguration.conf with: status = Rejected”*

ABB based implementation on earlier version of OCPP document where this was not explicitly specified and selected way that charger will parse CSL with best effort and that those of Measurands that will be recognized are applied. This is why ultimately any string will be accepted.

Above is also true for every key of CSL type that is supported in ABB implementation.

ABB agrees that specification 3.16.4 is more clear, but more strict at the same time and OCPP has no means to provide information to Central System why exactly change configuration was rejected. ABB plans to fix this according to 3.16.4 in future versions of software.

Configuration keys

Supported configuration keys

Please see below which configuration keys are supported per OCPP feature profile.

Key Name	Required/Optional	Description	Type	Accessibility	Default Value
Core profile					
AllowOfflineTxForUnknownId	optional	When offline, a Charge Point may allow automatic authorization of any "unknown" identifiers that cannot be explicitly authorized by Local Authorization List or Authorization Cache entries. Identifiers with status other than "Accepted" (Invalid, Blocked, Expired) must be rejected.	Boolean	RW	FALSE
AuthorizationCacheEnabled	optional	A Charge Point may implement an Authorization Cache that autonomously maintains a record of previously presented identifiers that have been successfully authorized by the Central System.	Boolean	RW	TRUE
AuthorizeRemoteTxRequests	required	Whether a remote request to start a transaction in the form of a RemoteStartTransaction.req message should be authorized beforehand like a local action to start a transaction.	Boolean	R	FALSE
ClockAlignedDataInterval	required	Size (in seconds) of the clock-aligned data interval. This is the size (in seconds) of the set of evenly spaced aggregation intervals per day, starting at 00:00:00 (midnight). For example, a value of 900 (15 minutes) indicates that every day should be broken into 96 15-minute intervals.	int	RW	0

ConnectionTimeOut	required	Interval (from successful authorization) until incipient charging session is automatically canceled due to failure of EV user to (correctly) insert the charging cable connector(s) into the appropriate connector(s).	int	RW	120
ConnectorPhaseRotation	required	For individual connector phase rotation information, the Central System may query the ConnectorPhaseRotation configuration key on the Charging Point via GetConfiguration. The Charge Point shall report the phase rotation in respect to the grid connection.	CSL	RW	Unknown
GetConfigurationMaxKeys	required	The number of configuration keys requested in a single PDU may be limited by the Charge Point. This maximum can be retrieved by reading this configuration key.	int	R	200
HeartbeatInterval	required	Interval of inactivity (no OCPP exchanges) with central system after which the Charge Point should send a Heartbeat.req PDU.	int	RW	240
LocalAuthorizeOffline	required	Controls whether a Charge Point will authorize a user when offline using the Authorization Cache and/or the Local Authorization List.	Boolean	RW	TRUE
LocalPreAuthorize	required	Controls whether a Charge Point will use the Authorization Cache and/or the Local Authorization List to start a transaction without waiting for an authorization response from the Central System.	Boolean	RW	TRUE
MeterValuesAlignedData	required	Clock-aligned measurand(s) to be included in a MeterValues.req PDU, every ClockAlignedDataInterval seconds	CSL	RW	SoC, Energy.Active.Import.Register
MetetrValuesSampledData	required	Sampled measurands to be included in a MeterValues.req PDU, every MeterValueSampleInterval seconds.	CSL	RW	SoC, Energy.Active.Import.Register

MeterValuesSampleInterval	required	Interval between sampling of metering (or other) data, intended to be transmitted by "MeterValues" PDUs. For charging session data (ConnectorId>0), samples are acquired and transmitted periodically at this interval from the start of the charging transaction. A value of "0" (numeric zero), by convention, is to be interpreted to mean that no sampled data should be transmitted.	int	RW	0
MinimumStatusDuration	optional	The minimum duration that a Charge Point or Connector status is stable before a StatusNotification.req PDU is sent to the Central System.	int	RW	5
NumberOfConnectors	required	The number of physical charging connectors of this Charge Point.	int	R	Depends on charger model
ResetRetries	required	Number of times to retry an unsuccessful reset of the Charge Point.	int	RW	5
StopTransactionOnInvalidId	required	Whether the Charge Point will stop an ongoing transaction when it receives a non- Accepted authorization status in a StartTransaction.conf for this transaction.	Boolean	RW	TRUE
StopTxnAlignedData	required	Clock-aligned periodic measurand(s) to be included in the TransactionData element of StopTransaction.req MeterValues.req PDU for every ClockAlignedDataInterval of the charging session.	CSL	RW	SoC, Energy.Active.Import.Register

StopTxnSampledData	required	Sampled measurands to be included in the TransactionData element of StopTransaction.req PDU, every MeterValueSampleInterval seconds from the start of the charging session	CSL	RW	SoC, Energy.Active.Import.Register
SupportedFeatureProfiles	required	A list of supported Feature Profiles. Possible profile identifiers: Core, FirmwareManagement, LocalAuthListManagement, Reservation, SmartCharging and RemoteTrigger.	CSL	R	Core, LocalAuthListManagement, Smart Charging
TransactionMessageAttempts	required	How often the Charge Point should try to submit a transaction-related message when the Central System fails to process it.	int	RW	10
TransactionMessageRetryInterval	required	How long the Charge Point should wait before re-submitting a transactionrelated message that the Central System failed to process.	int	RW	60
WebSocketPingInterval	optional	Only relevant for websocket implementations. 0 disables client side websocket Ping/Pong. In this case there is either no ping/pong or the server initiates the ping and client responds with Pong. Positive values are interpreted as number of seconds between pings. Negative values are not allowed. ChangeConfiguration is expected to return a REJECTED result. <i>NOTE: A value of 0 disables client side websocket Ping / Pong. In this case there is either no ping / pong or the server initiates the ping and client responds with Pong. Positive values are interpreted as number of seconds between pings.</i>	int	RW	30
Local Authorization List Management					
LocalAuthListEnabled	required	Whether the Local Authorization List is enabled	Boolean	RW	TRUE
LocalAuthListMaxLength	required	Maximum number of identifications that can be stored in the Local Authorization List	int	R	10000
SendLocalListMaxLength	required	Maximum number of identifications that can be send in a single SendLocalList.req	int	R	1000

Smart charging profile					
ChargeProfileMaxStackLevel	required	Max StackLevel of a Charging. The number defined also indicates the max allowed number of installed charging schedules per Charging Purposes.	int	R	
ChargingScheduleAllowedChargingRateUnit	required	A list of supported quantities for use in a ChargingSchedule. Allowed values: 'Current' and 'Power'.	CSL	R	Current, Power
ChargingScheduleMaxPeriods	required	Maximum number of periods that may be defined per ChargingSchedule.	int	R	24
MaxChargingsProfileInstalled	required	Maximum number of Charging s installed at a time.	int	R	10

Not supported configuration keys

Following configuration keys are NOT SUPPORTED:

Key Name	Required/Optional	Description	Type
Core profile			
BlinkRepeat	optional	Number of times to blink Charge Point lighting when signalling	int
ConnectorPhaseRotationMaxLength	optional	Maximum number of items in a ConnectorPhaseRotation Configuration Key	int
LightIntensity	optional	Percentage of maximum intensity at which to illuminate Charge Point lighting	int
MaxEnergyOnInvalidId	optional	Maximum energy in Wh delivered when an identifier is invalidated by the Central System after start of a transaction.	int
StopTxnAlignedDataMaxLength	optional	Maximum number of items in a StopTxnAlignedData Configuration Key.	int
StopTransactionOnEVSideDisconnect	required	When set to true, the Charge Point shall administratively stop the transaction when the cable is unplugged from the EV. NOTE: this parameter is not being used, Transaction will always stop on EV disconnect or even before.	Boolean

UnlockConnectorOnEVSideDisconnect	required	When set to true, the Charge Point shall unlock the cable on Charge Point side when the cable is unplugged at the EV. NOTE: not applicable for ABB high-power chargers, not implemented	Boolean
SupportedFeaturesMaxLength	optional	Maximum number of items in a SupportedFeatures Configuration Key.	int
ConnectorSwitch3to1PhaseSupported	optional	If defined and true, this Charge Point support switching from 3 to 1 phase during a charging session.	Boolean
Reservation profile			
ReserveConnectorZeroSupported	optional	If this configuration key is present and set to true: Charge Point support reservations on connector 0.	Boolean

ABB custom configuration keys

Key Name	Description	Type	Default Value
FreevendEnabled	Enables or disables "FreeMode"	Boolean	FALSE
FreevendIdTag	This tag will is put in StartTransaction message in idTag field when authorization is disabled FreevendEnabled key.	String[20]	'NOA'
DiscardTxProfileWhenConnectionLoss	When set to true and Webscoket disconnected, txProfile is deleted immediately without waiting for end of charging session	Boolean	FALSE

Security

Encryption

In addition to network level security ABB OCPP 1.6 implementation supports OCPP-J over TLS security. TLS 1.2 is supported. It is up to Central System operator to decide if TLS with WebSocket (WSS) is used or not. No additional configuration changes are required to enable it. For more information on encryption with OCPP 1.6-J please see chapter “6.2.1 Encryption” of [2].

Authentication

ABB OCPP 1.6 implementation supports basic HTTP authentication. Username equals charge point ID and password/authorization keys can optionally be set during installation.

Setting authorization key over OCPP after installation is not supported.

For more information on OCPP 1.6-J authentication please see chapter “6.2.2 Authentication” of [2]

Reference documentation

[1] Open Charge Point Protocol 1.6

[2] Open Charge Point Protocol JSON 1.6, OCPP 1.6-J Specification