Implementation Guide Eichrecht Working Document

SAFE AG Roaming

Calibration law (Eichrecht) sets high demands on both the accuracy of measurement and the verifiability of measured values used for billing. In the perspective of charging processes for electric cars, this means that during the charging process, the end user of a calibrated measuring device must be able to review the charging progress, and at the end of the charging process the customer must be able to check the measured value of charging consumption. As users get a bill/receipt of their charging session geographically and timewise separated from the charging session itself it is not possible for them to do this verification directly onsite. Therefore it must be ensured that the measured values have not been falsified. The implementation of this requirement is not easy due to the multitude of roles (CPO, roaming, MSP, manufacturer,...) and actors. In the first step, the SAFE initiative developed a proposal for the signing of measured values within the measuring capsule of the charging pole, as well as the Transparenzsoftware for the subsequent verification of these same measured values. This has now been established as a standard in Germany.

This document provides guidance on billing based on metered data that is billed between a Charge Point Operator (CPO) and a Mobility Service Provider (MSP) and/or Payment Service Provider (PSP). It covers various areas of application, including customer front-ends, roaming interfaces, and data storage.

The current version of this document focuses on the latest versions of existing roaming protocols, including OCPP 1.6 and OCPP 2.0.1, OCPI 2.1.1 and OCPI 2.2.1, OCHP 1.4 and 1.4.1, and OICP 2.3. However, IEC protocols are out of scope for this version.

It is important to note that charging hardware with local validation modules is also out of scope for this version. The document solely focuses on the customer/user perspective, and B2B-relations are not in scope.

Overall, this document aims to provide a comprehensive guide to billing based on metered data for CPOs, MSPs, and PSPs. By following the guidelines outlined in this document, stakeholders can ensure accurate and reliable billing for electric vehicle charging, helping to support the growth of the electric vehicle industry.

The target audience for this document are product manager for CPOs and MSPs.

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1.1 Related Documents:

- Reference customer journey for Eichrecht in EV Roaming
- Best practices on smart meter handling and roaming
- General definition of CDR data structures
- General definition of POI and tariff data structures

1.2 Terms and definitions

- **Dynamic pricing:** the practice of varying the price for a product or service to reflect changing market conditions, in particular the charging of a higher price at a time of greater demand. With EV Charging the pricing will be dynamic during the day. When charging will be started, the price will be fixed on the prices at the start time of the charging session (more information: Dynamic Pricing for Electric Vehicle Charging—A Literature Review; https://www.mdpi.com/1996-1073/12/18/3574/htm)
- **Charge Detail Record (CDR):** Data records with information on individual charging processes. This includes, for example, the name and address of the charging point, the MSP, the relevant electricity meter number, user identification, start and end timestamp of charging.
- **Backend-only reservation:** reservation is handled in the backend system only and not communicated to a charging infrastructure.
- **Local validation module**: A component of the charging hardware which is able to store and display calibration law relevant charging session data in the charger in a secure way.
- **Payment app:** Payment of a charging transaction via a general payment app (e.g. Apple Pay, Google Pay).
- **Mobile network operator (MNO)**: Offering payment of charging sessions via the mobile phone invoice.
- **Invoiced party:** Referred to as “Customer”.
- **Invoicing party:** The legal entity which is holding a contractual agreement with a customer and issuing the invoice for the charging services.
- **Customer**: The entity receiving the invoice that is the result of a contractual agreement. I.e. the customer can be a person or company that receives an invoice from an MSP, or it can be the MSP receiving an invoice from the CPO. The Eichrecht compliant invoicing is only applicable to the customer, since the customer is the one being invoiced for the energy consumption.
- **User/Driver**: The person performing the charging session on-site, i.e. plugging the car into the charger. If the customer is not the same (legal) person as the user user but wants to be able to review invoices according to Eichrecht he/she might rely on the user/driver.
- **Mobility Service Provider (MSP):** Gives EV drivers access to charging services. MSP is the Invoicing party in a roaming charging session.
- **Charging Point Operator (CPO):** Charging Point Operator. Operates a network of Charge Points.
- **Eichrecht:** (German word for ‘calibration law’) A term used for the calibration law requirements in EV charging beyond the metering itself, as this has been established as a common term even in english (within the industry).

2 Goals of this document

This document has several goals, including identifying what is currently possible with existing protocols, identifying gaps, and providing proposals on how to close them. It also aims to provide guidance for Charge Point Operators (CPOs) and Mobility Service Provider (MSPs) on how to use the protocols when applying calibration law, with a focus on the customer perspective.

1. Identify what is currently possible with the existing protocols:

One of the primary goals of this document is to identify what is currently possible with the existing protocols used in electric vehicle charging. By understanding what is possible with the current protocols, stakeholders can make informed decisions about how to implement them effectively. This includes understanding the capabilities of protocols such as OCPP, OCPI, OCHP, and OICP, and how they can be leveraged to provide reliable and accurate electric vehicle charging services.

2. Identify gaps and give proposals on how to close them:

Another goal of this document is to identify gaps in the existing protocols and provide proposals on how to close them. These gaps may relate to the accuracy and reliability of metered data, the communication of data to drivers, or the interoperability of different charging stations and networks. By identifying these gaps and providing proposals on how to close them, stakeholders can work towards a more efficient and effective electric vehicle charging system.

3. Provide guidance for CPOs and MSPs on how to use the protocols:

Finally, this document aims to provide guidance for CPOs and MSPs on how to use the protocols when applying calibration law. This includes guidance on how to ensure compliance with calibration laws, how to communicate data to drivers, and what drivers should do with the data. By providing this guidance, stakeholders can ensure that they are providing reliable and accurate electric vehicle charging services that meet the needs of drivers and support the growth of the electric vehicle industry.

3 Eichrecht Requirements

The requirements of the calibration law have to be interpreted and applied for the electric vehicle charging domain. The following table lists the five main protection goals of the calibration law together with a description of the consequences for the charging system. In the later chapters of this document, we will describe how these requirements can be fulfilled by the different market roles in an end-to-end scenario.

PROTECTION GOAL	DESCRIPTION
TRUTHFULNESS	The value of the measurand must be correctly assigned by a measuring device according to the physical conventions of the measurand. ➢ A calibrated meter is needed.
INTEGRITY	The contents of a remotely transmitted message with measured values cannot be falsified undetected. ➢ Transmission has to be secured end-to-end.
AUTHENTICITY	A message with measured values can be assigned to a specific data source without doubt after the remote transmission. ➢ The message has to contain identity of the charge point or meter.
IMPUTABILITY	A message with measured values after remote transmission can be assigned without doubt to the person which has caused an invoice debt in connection with the measurement. ➢ The message has to contain customer identification.
AVAILABILITY	A message with measured values must be available to the contractors of the transaction until the process, including the mutual settlement of the invoice debt, is finally completed. ➢ The customer must be able to access the data at any time until the end of the objection period.

4 Fulfillment of the requirements

The requirements from the chapter before have to be fulfilled for every charging session over the progress of the customer journey. The following user stories help to fulfill the requirements over the distributed roaming system of multiple market roles.

4.1 User stories in scope of this document

1. As a customer I want to be invoiced for charging sessions based on metering values which conform to the five Eichrecht objectives only so that I know that I only pay for what I really consumed.
2. As a customer I want to be able to validate any of my charging sessions in order to find errors in case of doubt, so that I can trust the whole ecosystem.
3. As a customer I want to be able to get invoices corrected if I identify non-compliant charging sessions so that I have the possibility to get my money back when errors happen.
4. As a customer I want to speak directly to my contract party (MSP) so that I will be able to claim incorrect charging sessions directly instead of being forwarded to the CPO.
5. As a customer I want to get all necessary tools to validate the charging session (e.g. Transparenz-software) in order to be able to do the validation in an easy and understandable way.

4.2 Requirements derived from the user stories

The five user stories can be used to derive the specific system requirements along the customer journey.

4.2.1 1. Be invoiced for charging sessions based on trusted metering values

Requirements for *“As a customer I want to be invoiced for charging sessions based on metering values which are conform to the five Eichrecht objectives,so that I know that I only pay for what I really consumed.”*

1. The customer receives confirmative metering values for all charging sessions where energy consumption is invoiced.
2. The customer is invoiced only for charging sessions based on metering values which conform to the five Eichrecht objectives
3. Any customer is able to validate the metering data from the charging station to fulfill the five protection goals
4. The invoicing party only invoices the energy consumption of charging sessions, if the CDR’s for these charging sessions contain all the Eichrecht relevant data
5. The invoicing party stores all the Eichrecht relevant data
    a. complete and validated set of signed meter values
    b. public key
    c. charging station identification (POS)
6. (the invoice including ad-hoc invoicing must contain the start and stop meter values of the applicable charging session)
7. the invoiced values must be calculated from the provided meter values

4.2.2 2. Validate any of my charging sessions

Requirements for *“As a customer I want to be able to validate any of my charging sessions in order to find errors in case of doubt, so that I can trust the system.”*

1. The customer is able to validate the following data of each individual charging session:
    a. date, time, session duration and location match to own charging experience
    b. consumed energy
2. The validation result proves if metered values and invoiced meter values are equal.
3. The customer is able to do all validations based on the instructions given on the invoice. (Might contain information or identifiers which allow to receive the full 'data' needed for the validation; compare step 5.)
4. The customer is able to retrace the selection of the tariff components that were used to calculate the price of the charging session. (e.g. power level, day/night tariff, etc.)
5. All needed data is available to the customer.
    a. Eichrecht does not require to provide all data in the invoice. (MessEG §33)
    b. If the data is not in the invoice, the invoice shows how and where to get the needed data.

4.2.3 3. Get invoices corrected

Requirements for *“As a customer I want to be able to get invoices corrected if I identify non-compliant charging sessions so that I have the possibility to get my money back when errors happen.”*

1. The customer is able to prove to the invoicing party that a correction is needed.
2. The invoice correction happens as legally required and within standard processes of MSP/CPO contract.

4.2.4 4. Speak directly to my contract party

Requirements for: “*As a customer I want to speak directly to my contract party (MSP) so that I will be able to claim incorrect charging sessions directly instead of being forwarded to the CPO.”*

1. The customer is able to hold his invoicing MSP accountable for receiving the Eichrecht data correctly.
2. All validations are handled directly between the invoicing party and the customer.

The MSP could outsource these activities to another company.

4.2.5 5. Get all necessary tools

Requirements for *“As a customer I want to get all necessary tools to validate the charging session (e.g. Transparenz-software) in order to be able to do the validation in an easy and understandable way.”*

1. The customer receives the transaction data in a data format the transparency software can read from the invoicing party.
2. The customer receives a link to the correct version of the transparency software from the invoicing party.

4.3 Derived requirements for the Roaming system (CPO and MSP)

Based on these customer requirements before, the following requirements towards the roaming ecosystem were identified. They are to be applied in the systems of the CPOs and the MSPs in a roaming scenario. The appliance of the requirements is described in the following chapter. The available interface protocols are investigated in the last chapter..

I. CPO needs to reflect to the MSP if and how a charging station is compliant to Eichrecht:
   A. The CPO must ensure that Eichrecht parameters according to chapter 5 of the SAFE *General definition of POI and tariff data structures*[1] are provided to the MSP.

II. CPO and MSP must differentiate between compliant and non-compliant chargers when applying the tariff or price model.
   A. CPO is obliged by Eichrecht to invoice energy based tariffs only on calibrated meter values to the MSP.
   B. The MSP is obliged by Eichrecht to offer the customer only energy-based tariffs, when the charger is compliant to Eichrecht.
   C. For compliant chargers and Eichrecht-based tariffs, the MSP must make sure that invoices are based on conforming CDRs and all necessary meter values have been provided.
   D. For non-compliant chargers, the CPOs tariff must not be based on metered values.

III. CPO needs to send compliant CDR data to the MSP
   A. CPO needs to send it in a format that allows for automated validation (including format tag, versioning, data containers, etc)
   B. The MSP needs to receive and store compliant CDR data.

IV. CPO needs to do B2B invoicing based on signed meter values for all compliant charging stations.

V. The MSP needs to persist all signed meter values of the CDR to forward and prove the Eichrecht compliance of a charge event to its customers.

VI. CPO needs to persist the signed meter values in the CDR to prove the B2B invoices.

[1] https://www.safe-ev.de/global/downloads/general_definition_POI_and_tariff_data_structures.pdf

5 Appliance of requirements for CPOs and MSPs

The requirements for Roaming systems between Charge Point Operators (CPOs) and Mobility Service Providers (MSPs) are essential for the accurate and transparent billing of electric vehicle charging services. This chapter focuses on the appliance of derived requirements for the roaming system, with a specific focus on CPOs and MSPs. The chapter will provide guidance on how CPOs and MSPs can comply with these requirements, including the accurate and verifiable measurement of charging consumption and the communication of this data to customers. It will also offer proposals on how to close any identified gaps in the existing protocols used in electric vehicle charging, such as OCPP, OCPI, OCHP, and OICP. By following the guidelines outlined in this chapter, CPOs and MSPs can ensure accurate and transparent billing for electric vehicle charging services, contributing to the growth of the electric vehicle industry and providing a seamless charging experience for customers.

5.1 CPO

This section identifies the key requirements that CPOs must meet when operating Eichrecht compliant charging units, including the use of different tariffs for compliant and non-compliant charging units, validation and storage of signed meter values, and invoicing based on energy consumption. By meeting these requirements, CPOs can ensure that they are providing reliable and compliant charging services that meet the needs of drivers and support the MSPs charging tariffs.

Req	Implementation
I.	A. The CPO provides Eichrecht information of the charge point according to roaming protocol specification to the MSP.
II.	A. In the B2B relation, the CPO uses at least two different tariffs for the charging infrastructure: A energy-based tariff for compliant charging units and a non-energy-based tariff for all other charging units. B. The CPO makes sure, that compliant charging units are only assigned to the energy-based tariff and that non-compliant charging units are only assigned to the non-energy-based tariff C. The CPO only invoices energy consumption from the MSP if a charger is Eichrecht compliant and signed meter values are provided. D. The CPO doesn't invoice based on energy consumption from the MSP if a charger is not Eichrecht compliant or signed meter values can't be provided.
III.	A. The CPO receives all signed meter values from the charging units connected to the CPMS via OCPP, validates it according to the charging unit and format specifications and stores them with the CDR data. B. The CPO forwards the CDR including signed meter values according to roaming protocol specifications to the MSP.
IV.	The CPO only invoices energy consumption from the MSP if a charger has been Eichrecht compliant at the time of the charge event and signed meter values have been provided with the CDR. The CPO doesn't invoice based on energy consumption from the MSP if

	a charger is not Eichrecht compliant or signed meter values can't be provided.
V.	Not applicable. (MSP requirement)
VI.	The CPO implements long-term storage for metering data. The CPO is able to export specific signed metering data for a B2B invoice.

5.2 MSP

This section identifies the key requirements that MSPs must meet when applying tariffs in a roaming network of compliant and non-compliant charging units with inhomogeneous metering and verification capabilities. The MSP must ensure that non-compliant chargers are not invoiced based on energy consumption values and validate received session data for conformance. Also the MSP must implement long-term data storage for signed meter values to prove the compliance of a session to a customer.

Req	Implementation
1.	A. The MSP stores Eichrecht relevant data of charging stations according to roaming protocol specifications.
2.	A. MSP can be sure that non-Eichrecht compliant chargers are not invoiced based on energy consumption values. B. The MSP makes sure, that compliant charging units are only assigned to the energy-based tariff and that non-compliant charging units are only assigned to the non-energy-based tariff C. The MSP is only invoicing its customers based on energy consumption when the charger is Eichrecht compliant and signed meter data is available. D. The MSP doesn't invoice based on energy consumption from its customers if the charger is not Eichrecht compliant or signed meter data aren't available.
3.	A. The MSP enables its own IT systems to process received conforming meter values in a roaming protocol compliant way. The invoicing party should store the public key to ease their own processes, e.g. for user story 4. B. The MSP validates the received session data to prove the conformance.
4.	Not directly applicable. (CPO requirement) CPO-invoices containing CDRs of compliant chargers. CDRs without conforming meter values can be rejected by the MSP.
5.	The MSP implements a long-term data storage for signed meter values to be able to prove the compliance of a session to a customer. The MSP implements a frontend or a process to provide signed meter values of a charging session to the customer.
6.	Not applicable. (CPO requirement)

6 Consistency of protocols

This chapter provides a detailed overview of how the derived requirements for the roaming system can be fulfilled per protocol. The chapter covers several protocols, including OCPP, OCHP, OICP and OCPI. The tables provided in this chapter aim to ensure consistency and compatibility across different protocols, making it easier for stakeholders to understand how the requirements can be met using their preferred protocol stack.

6.1 OCPP 1.6

Req	Implementation
1.	n/a. The requirement can be fulfilled on roaming-level. Relevant information can be transferred via the OCPP interface and might be the basis for the communication to the MSP. The CPO can map the charger model of the Boot Notification via a mapping table or read proprietary configuration (via configuration items or data transfer) from the charging unit (vendor specific) in order to obtain the compliance state of a charging unit or charge point. The CPO needs to maintain an own database of compatible charging units, firmware versions and configuration to derive compatibility state communicated to the MSP.
2.	n/a (Prerequisites covered by 1.; Roaming tariffs not in scope of OCPP)
3.	CPO collects compliant session data from MeterValues message and StopTransaction message. The data is contained in the “SignedData” format in the 7.33. MeterValue field. The CPO should validate the session data to make sure it is compliant, consistent and complete. The CPO stores the signed meter values unchanged and complete as received from the CU per session. In case of dynamic tariffs, the CPO should sample a meter value at the moment the tariff changes.
4.	n/a
5.	n/a
6.	The CPO persists the metering values independent of the chargers future usage and for the legally binding containment period.

6.2 OCPP 2.0.1

Req	Implementation
1.	n/a. The requirement can be fulfilled on roaming-level. Relevant information can be transferred via the OCPP interface and might be the basis for the communication to the MSP. The CPO can map the charger model of the Boot Notification via a mapping table or read proprietary configuration (via configuration items or data transfer) from the charging unit (vendor specific) in order to obtain the compliance state of a charging unit or charge point. The CPO needs to maintain an own database of compatible charging units, firmware versions and configuration to derive compatibility state communicated to the MSP.
2.	Can be fulfilled. The CPO needs to configure the charging unit according to the requirements of the MSP and its tariff in order to fulfill this requirement. E.g. the parameter SampledDataTxUpdatedInterval amongst other has to be set accordingly.
3.	CPO collects compliant transaction data from TransactionEvent messages. The data is contained in the “MeterValueType”. The CPO should validate the signedMeterValue of SampledValueType against all other properties in order to ensure consistency. The CPO should validate the meter data as well as the whole transaction data to make sure it is compliant, consistent and complete. The CPO stores the signed meter values unchanged and complete as received from the CU per session. In case of dynamic tariffs, the CPO should sample a meter value at the moment the tariff changes by configuring the charging units AlignedDataInterval accordingly.
4.	n/a
5.	n/a
6.	The CPO persists the metering values independent of the charger's future usage and for the legally binding containment period.

6.3 OCHP 1.4.1

Req	Implementation
1.	Fulfilled. The CPO must include the ‘meteringInfo’ field in both Charge Point and CDR Data if the Eichrechts Data is available. enums for ‘local’ ‘software’ and ‘other’ solutions are available.
2.	Fulfilled, albeit the protocol does not specify how the MSP informs their customers. However, both the information on Eichrecht compliance as well as the meter values inside the CDRs. The field length in the CDR data (string255) might be insufficient for real-world use-cases however.
3.	Fulfilled. The meteringInfo class contains information on the kind of Eichrecht compliance, the vendor (producer of the charging station) as well as the version number of the used firmware. The public key of the charging station is also part of the package.
4.	Not enforced by the protocol, since invoicing processes are not a part of it.
5.	Not enforced by the protocol, since data storage is not part of it
6.	Not enforced by the protocol, since data storage is not part of it

6.4 OICP 2.3

Req	Implementation
1.	Fulfilled. CPOs must inform MSPs if 'calibration law data' is available on an EVSE. The CPO can choose if the calibration law data is available locally at the charging station (refers to the SAM module that is out of scope in this document) or externally available. Additionally CPOs can inform MSPs that individual EVSEs don't have any calibration law data available.
2.	Fulfilled. The MSPs are informed by CPOs if calibration law data is available on certain EVSEs and can derive from this information between Eichrecht compliant and non compliant charging stations.
3.	Partly fulfilled. The CPO can optionally inform the MSP about SignedMeteringValues & CalibrationLawVerificatioInfo. For locally available calibration law data the CPO has to trust the type examination certification of the device because automatic validation based on values sent by the charging station is not possible. For externally available the CPO can do automatic validation.
4.	Not fulfilled. OCPI 2.3 enforces that SignedMerteringValues are provided in the CDR for charge events on EVSEs that have the value "External" in the CalibrationLawDtaAvailability field. There is no enforced validation that the SignedMeteringValues match the consumption value of the CDR.
5.	Not enforced by the protocol, since data storage is not part of it
6.	Not enforced by the protocol, since data storage is not part of it

6.5 OCPI 2.1.1

no possibilities, except for a backported 2.2.1 implementation at Gireve

6.6 OCPI 2.2.1

Req	Implementation
1.	Not fulfilled. OCPI has no possibilities of supplying any calibration law relevant data of the chargepoint, in the locations interface
2.	Not fulfilled. OCPI has no possibilities of supplying any calibration law relevant data of the chargepoint, in the locations interface
3.	Fulfilled. CDR can contain encoding_method, encoding_method_version, public_key, signed_values and url: https://github.com/ocpi/ocpi/blob/develop-2.2.1/mod_cdrs.asciidoc#mod_cdrs_signed_data_class
4.	Not enforced by the protocol, since invoicing processes are not a part of it.
5.	Not enforced by the protocol, since data storage is not part of it.
6.	Not enforced by the protocol, since data storage is not part of it

6.7 IEC 63110-1

Not analyzed due to low market coverage.

6.8 IEC 63119-1

Not analyzed due to low market coverage