Alternative Fuels Infrastructure Regulation

AFIR for EV Charging Stations

Implementation Guide

ALFEN
POWER TO ADAPT

TABLE OF CONTENTS

EN

1.1 About this document

The purpose of this document is to provide guidelines for setting up a Charge Point Management System (CPMS) that uses Alfen's products in a way that complies with the rules of then Alternate Fuel Infrastructure Regulation (AFIR, Directive 2014/94/EU).

AFIR allows two options for ad hoc payments for charging equipment with a power output below 50 kW:

- QR code payments (Art 5 lid 1a)
- Payment terminal

This document only describes the implementation of QR code payments.

1.2 Applicable Products

This document applies to the following charging station products:

- Eve Single Pro-line (9044600xx)
- Eve Double Pro-line (904461xxx)
- Twin 5 Plus (9344527xx)

1.3 Applicable Documents

ID	Content
AFIR Regulation	https://european-union.europa.eu/institutions-law-budget/law/types-legislation_en
AFIR Publication	https://data.consilium.europa.eu/doc/document/PE-25-2023-INIT/en/pdf (PDF document)
Open Charge Point Protocol 1.6	https://openchargealliance.org/download/7b06ab293c68fb6b4f4ae0960e502579c1c5516aa2b7acf0fdcedba585b9ea7f (ZIP archive)
Open Charge Point Protocol 2.0.1	https://openchargealliance.org/download/6fa6112ab65d343b997f3b4c82cde6230dd543b4d56ff2934ba8aac5ea027c4e (ZIP archive)

2. CONFIGURING

EN

The configuration of the charging station can be changed by the CPMS by sending a message to the charging station changes OCPP keys.

The methods to do this depend on the OCPP version that is used.

2.1 Prerequisites

The prerequisites for using the ad-hoc changing function are:

- Alfen charging station with display (see list of compatible charging statons)
- For Eve Single/Double products with firmware 6.6 or higher
- For Twin 5 Plus products with firmware 2.0 or higher
- Activated Direct Payment Solutions license (one time fee)
  - All active current giro-e licenses will be upgraded to "Direct Payment Solutions" license
- Charge point management system (CPMS) with OCPP 1.6J or higher
- Implemented payment service provider in CPMS
- The OCPP configuration keys must be defined correctly
- The tariff information must be defined

Payments by means of the QR code are an addition to Alfen's existing user interface and requires a license code for direct payment solutions. This license is available from Alfen's webshop or through the sales support department.

NOTE

All the transaction must be in accordance to all the EU regulations, e.g. PSD2 et al. The CPMS and PSP must make sure their implementation complies with the applicable regulation, with special attention to regulations about invoices and taxation.

2.2 Changing Configuration (OCPP 1.6)

To change the configuration, the CSMS sends regular `ChangeConfiguration` message. For example, this can be used to change the URL that will be used to generate the QR code that is displayed.

```
ChangeConfiguration("qrCodeURL1":"www.alfen.com/QRpayment/AL1000/socket1")
ChangeConfiguration("qrCodeURL2": "www.alfen.com/QRpayment/AL1000/socket2")
```

2.3 Changing Configuration (OCPP 2.0.1)

To change the configuration, the CSMS sends regular `SetVariables` message. For example, this can be used to change the URL that will be used to generate the QR code that is displayed.

```
SetVariables("setVariableData":
{"component":{"name":"TariffCostCtrlr","evse":1},
"variable": "qrCodeURL","attributeValue":"www.alfen.com/QRpayment/AL1000/Socket1"},

SetVariables("setVariableData":[
{"component":{"name":"TariffCostCtrlr","evse":2},
"variable": "qrCodeURL","attributeValue":"www.alfen.com/QRpayment/AL1000/Socket2"}]}
```

2.4 OCPP Keys

The following backoffice configuration keys are implemented in the firmware to support the use of QR codes for payment. The correct values for these keys must be defined. Earlier versions of the software used configuration keys that have changed.

Table 1: OCPP Configuration Keys

Older OCPP Key	New OCPP Key	New values	Behaviour
DSPAvailableMethods	--	Giroe, QR, OTS, PnC15118	OTS:Always Giro-E: with compatible reader only QR: if screen available PcC15118
DSPGiroeMethodStatus	DPSConfiguredMethods	Giroe, QR, OTS. PnC15118	read/write
Authorization method		RFID, P&C	
	QRCodeURL1/2	Any value	Link for QR code 1/2
Pricing-EnergyPrice	price.kWh	decimal	Price per kWh
Pricing-StartPrice	price.session	decimal	Price to start a session
Pricing-MinutePrice	price.minute	decimal	Price per minute
Pricing-Other	price.other	decimal	Price for 'Other' tariff
Pricing-OtherSpecifier	price.otherSpecification	string[32]	Description for the 'Other' tariff. If left empty, no 'Other' tariff will be displayed
Pricing-Currency	price.currency	string [3]	ISO 4217 currency code Example: EUR
Pricing-ShowDiscalaimer	price.disclaimer		
	price.showComponentst	comma separated list of the strings disclaimer, perKwh, perMinute, perSession, perOther	Determines which pricing elements will be displayed on the screen
qrCodeURL	qrCodeURL	string[223], cardinality 1..2	The string that will be encoded as a QR code, containing the URL for starting a transaction on a at a single socket.

The authorization key **`UnlockConnectorOnEVSideDisconnect`** must be set to **`true`** in order to unlock the cable at the charging staton side when the cable is disconnected at the EV side.

NOTE

The exact behaviour of the disconnect depends on the setting of the **`DisconnectAction`** key

2.5 Display Setting

In order to optimize the readability of the code that is shown on the display, several settings are available.

When the QR code is displayed, the screen is set to full brightness.

An auto-dim function can be configured. This dimming can depend on:

- time of day (the display will dim during night). This requires accurate time synchronization.
- period of in activity (the display dims, but when a user interacts with the station the display will light up again).
- if a QR code is displayed
- a combination of the above options

2.6 Tariff Information

AFIR requires price transparency (article 5, item 4). This means that the following price components must be show (if applicable), in this order.

- price per kWh
- price per minute
- price per session
- any other price component that applies

NOTE

AFIR requires full price transparency. It does not allow a disclaimer stating that "additional costs may apply". Such a disclaimer must not be used in countries that apart of the European Union. The functionality of displaying such a disclaimer is only present for the use in non-EU countries.

These price components are shown on the display of the charging staton.

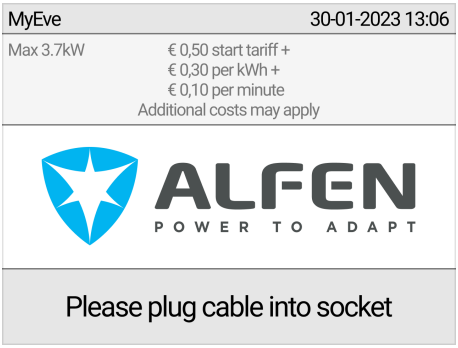

Figure 2.1: Example of tariff information displayed

The information about these price components is supplied by the CSMS to the charging station through OCPP.

Table 2: OCPP Configuration Keys

OCPP Key	Type	Cardinality	Description
price.currency	string[3]	1..1	ISO 4217 alphabetic code of the currency symbol
price.showComponents	list	1..1	List to show the various components on the display

Table 2: OCPP Configuration Keys

OCPP Key	Type	Cardinality	Description
price.kWh	decimal	0..1	Price per kWh when charging
price.minute	decimal	0..1	Price per minute
price.session	decimal	0..1	Flat (or session) fee for the charging session
price.other	decimal	0..1	Other price components
price.otherSpecification	string[32]	0..1	Specification for other price components, mandatory when price.other is specified.

To update the pricing information the CPMS can send a message to the charging station. The exact format of the message depends on the OCPP standard that is used.

2.7 Changing tariffs (OCPP 1.6)

To change the tariff information, the CPMS sends regular `ChangeConfiguration` message.

```
ChangeConfiguration("price.currency": "EUR")
ChangeConfiguration("price.kWh": "0,50")
ChangeConfiguration("price.minute": "0.02")
ChangeConfiguration("price.session": "0.50")
ChangeConfiguration("price.other": "1.0")
ChangeConfiguration("price.otherSpecificatio
n": "Idle fee per hour")
ChangeConfiguration("price.showComponents":
 "disclaimer,
 perkWh,perMinute,perSession,perOther"}")
```

Alternatively, the CSMS can send a consistent dataset in a single message:

```
ChangeConfiguration("price":"{
"currency:"EUR", "kWh":0.50,
"minute":0.02, "session":0.50,
"other":1.0, "other specification":"Idle fee
 per hour",
"showComponents":"disclaimer,
 perkWh,perMinute,perSession, perOther"}")
```

2.8 Changing tariffs (OCPP 2.0.1)

To change tariff information, the CPMS sends the information to the chaging station by means of a regular `SetVariable` messsage.

```
SetVariables("setVarableData":[
{"component":{"name":"TariffCostCtrlr"},"variable":"currency","attributeValue":"EUR"},
{"component":{"name":"TariffCostCtrlr"},"variable":"kWh","attributeValue":0,50},
{"component":{"name":"TariffCostCtrlr"},"variable":"minute","attributeValue":0.02},
{"component":{"name":"TariffCostCtrlr"},"variable":"session","attributeValue":0.50},
{"component":{"name":"TariffCostCtrlr"},"variable":"other","attributeValue":1.0},
{"component":{"name":"TariffCostCtrlr"},"variable":"otherSpecification","attributeValue":"I
dle fee per hour"},
```

OCPP 2.01 has a feature called "variable instances". This means that there is an alternative implementation where there is a variable `price` with instances `kWh`, `minute`, `session` and `other`.

NOTE

The specific implementation is up to the developers but must be consistent across all platforms.

3. TRANSACTION PROCESS WITH QR CODES

EN

3.1 Transaction with QR codes - overview

This section describes the transaction processes.

The transaction process uses a URL that is provided by the CPMS. This URL is encoded in a QR code that can be scanned by the user, using a smartphone or equivalent device.

This can be a URL that changes often, but a CPMS may have a single page for initiating all QR code payments, such as configured by:

```
ChangeConfiguration("qrCodeUR1": "www.alfen.com/QRpayment")
```

In such cases the Alfen charging station adds dynamic content to the base URL to identify the charging station/socket and add some additional code that facilitates periodical change of the QR code. This is done by adding additional parameters to the base URL in the HTTP GET request by means of a appending a question mark (**?**) and the variable parameters to the base URL.

More details about this are described ion the section on QR code generation.

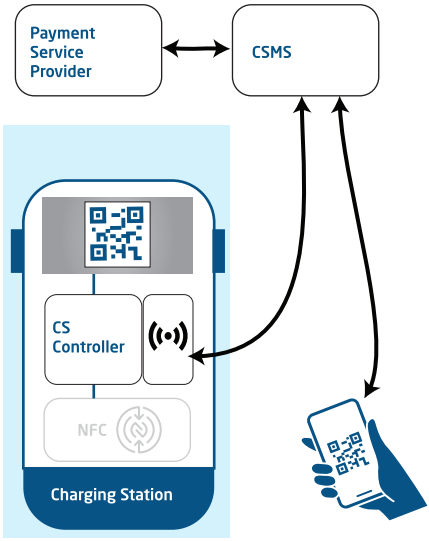

Figure 3.1: Transaction process overview. The light blue area indicates the scope of Alfen's involvement

By matching the **<object_id>** to the **chargePointSerialNumber** from the **BootNotification** message, the CPMS has all the necessary information to remotely start a transaction on the correct charging station/socket.

3.2 Transaction with QR codes - Starting

This section describes the start of the transaction processes.

The table that shows the steps of the process uses the following icons to indicate the participant in the process:

Table 3: Participant icons

Icon	Participant
	Charging station
	User's smartphone
CPMS	Charge Point Management System
	Payment Service Provider
	Electrical Vehicle

The start of the chargingprocess consists of the following steps

Table 4: Start of the charging process.

Step		
1		Charging station shows QR code
2		The user scans the QR code with a mobile device
3		The mobile device decodes the QR code and opens the landing page
4		The user provides an e-mail address (necessary for delivering an invoice)
5		The landing page shows payment providers
6		The user selects the payment provider
7		The mobile device opens the page of the payment provider.
8		The user authorizes the payment
9		The CPMS checks the payment details with the payment provider
10		The payment provider checks the payment details, and acknowledges the approved payment to the CPMS
11		The CPMS acknowledges the payment to the user

3. TRANSACTION PROCESS WITH QR CODES

Table 4: Start of the charging process.

Step		
12		The CPMS commands the charging station to start the transaction
13		The charging station display a message to the user to insert the cable
14		The user inserts the cable in the charging station and in the electrical vehicle
15		The charging session starts

3.3 Transaction with QR codes - Finishing

This section describes the finishing of the charging processes.

Table 5: Steps that finish the charging process

Step		
1		The user disconnects the cable from the EV
2		The charging station unlocks the cable
3		The charging station informs the CPMS that the charging has ended
4		The charging station shows the session details on the display
5		The user removes the cable from the charging station

Table 5: Steps that finish the charging process

Step					
6			CPMS		The CPMS settles the payment with the payment service provider
7					The payment provider bills the user The CPMS sends the invoice to the e-mail address of the user

At the end of the session, the charging station displays the session summary (energy, time). Final cost, as calculated by the CSO must be added to this summary. The CSO can send this information through a **DataTransfer** message:

```
DataTransfer.req(
"vendorId": "com.alfen.payment",
"messageId": "FinalCost",
"data": "{
"transactionId": 12345,
"cost": 4.25,
"qrCodeURL": "www.alfen.com/invoice/AL1000/12345.pdf"  }")
```

3.4 QR Code Generation

The AFIR regulation requires that transaction is started by scanning a QR code. This code must link to EBA-authorized credit / payment / e-money institution. It may not link to web-portal or smartphone application of (e)MSP / CPO.

The QR code is a code of 223 characters that starts a transaction on a single socket. This QR code contains a URL. This URL consists of the static URL provided by the CPO, to which a number of parameters are added to form the complete HTTP GET request. As is the standard for a GET request, the base URL is followed by a question mark '**?**' and a list of parameters. Each parameter consists of a parameter name followed by an equal sign ('**=**') and the parameter value. The parameters are separated by and ampersand character '**&**').

The software of the charging station randomizes the QR code every minute in order to create unique code for every transaction. The randomizing steps ensure a a new URL even when the URL provided by the CPO does not change.This code is constructed as follows:

1. The charge point received a static URL for payment, supplied by the CPMS. In the following example this is indicated as **CPOURL**. This **CPOURL** is similar to **https://mycpo.com**.
2. The ID of the charging station, the socket number and the timestamp are appended at the end of the **CPOURL** as parameters of a HTTP 'GET' request.
   a. The ID of the charging station is provided as the '**id**' parameter of the request. It is truncated to 11 characters. This example uses **ACE1234567** for this ID
   b. The socket (connector) ID is provided as the '**c**' parameter of the request. It has the value '**1**' for a single-socket charging station, or the value '**1**' or '**2**' for a double-socket charging station.
   c. The actual time is provided as the '**h**' parameter of the request. This timestamp is a hash code consisting of 8 hexadecimal characters such as '**A763FEC2**'.

The ID and the socket number remain readable, but the timestamp is not.

This results in a URL like ***CPOURL*?id=ACE1234567&c=2&h=A763FEC2**.

If the **CPOURL** already contains a question mark '**?**' and parameters, the information added by the charge point extends the list of parameters by appending an ampersand character '**&**' (instead of a question mark '**?**'), followed by the generated parameters. Example:

3. TRANSACTION PROCESS WITH QR CODES

A **CPOURL** that consists of

```
https://www.CPO.com/?authkey=4711
```

will become

```
https://www.CPO.com/?authkey=4711&id=ACE1234567&c=2&h=A763FEC2
```

instead of

```
htps://www.CPO.com/?authkey=4711?id=ACE1234567&c=2&h=A763FEC2
```

3.5 Offline behaviour

The charging station does not display a QR code if there is no active network connection.This avoids a situation where the QR codes can be scanned, but the charging cannot start because there is no connection between CPMS and the charging staton.

If the charging staton is offline, the landing page for payment (at the URL that is encoded in the QR code) must not be able to process the payment. This implementation is the responsibility of the CPO.

AFIR
Alternative Fuel Infrastructure Regulation is a policy framework or regulation focused on the development and deployment of infrastructure for alternative fuels. It aims to promote use of alternative fuels, development of infrastructure (such as charging stations), set regulatory standards and guidelines, let governments provide financial incentives to encourage adoption and supports collaboration among stakeholders. AFIR addresses price transparency and ad-hoc payments (payments without mobility service provider (MSP) subscription e.g. charging card). Specifics of AFIR can vary widely, depending on the legislative environment and the strategic goals of the region or country in question.

EBA
European Banking Authority is a regulatory agency of the European Union

CPMS
Charge Point Management System. It handles remote monitoring and management, user authentications and access control, billing and transaction management, energy management and data analytics and reporting, integration with other systems (such as payment gateways), and provides a user-friendly interface for users and providers

CPO
Charge Point Operator: the entity that operates and manages a network of EV charging stations. The CPOs are responsible for the installation of charging stations. They also handle ongoing maintenance and repair. The CPOs manage the network of charging stations, which involves monitoring their performance, managing their usage, and ensuring that they are properly integrated into the broader power grid. CPOs manage the financial transactions related to charging services. They set pricing models, process payments, and handle billing for the use of their charging stations. See also EMSP; the lines between CPOs and (e)MSPs are getting thinner, and the two company types are harder to distinguish.

CS
Charging Station

CSMS
Charging Station Management System. See CPMS (Charge Point Management System)

(e)MSP
E-Mobility Service Provider (EMSP) is a company offering an EV charging service to drivers of electric vehicles. While the CPO manages and sets up the charging infrastructure and maintains the charging stations, the EMSP offers this charging infrastructure to actual customers, helping the CPO make money with their charging stations and taking care of the billing. An (e)MSP can have more than just one CPO in their pool – this will grant more value to the end user of the (e)MSP, as their customers can now access an even larger network of charging stations. The lines between CPOs and (e)MSPs are getting thinner, and the two company types are harder to distinguish.

EVSE
Electric Vehicle Supply Equipment: a charging station or charging point for electric vehicles.

EVSE ID
Electric Vehicle Supply Equipment Identifier: a unique identifier assigned to an individual Electric Vehicle Supply Equipment (EVSE). Each EVSE has a unique ID that can be used to track the location of charging stations, in transaction processing and network mangement.

Hashing
Hashing is a process to transform any input (or 'message') into a fixed-size string of bytes. The output, known as a hash value or hash code, or just the 'hash' is typically a sequence of numbers and letters. Even a tiny change in the input should produce a significantly different hash, and It should be hard to find two different inputs that produce the same hash value. A hash function is typically one-way: given a hash value, it should be computationally infeasible to find any input that hashes to that value. The hashing process is sometimes compared to the scrambling of eggs: there is feasible way to unscramble them.

ISO 15118
ISO 15118 Road vehicles -- Vehicle to grid communication interface is an international standard defining a vehicle to grid (V2G) communication interface for bi-directional charging/discharging of electric vehicles

JSON
JavaScript Object Notation. It is a lightweight data-interchange format that is easy for humans to read and write, and easy for machines to parse and generate.

OCPP
Open Charge Point Protocol: a communication standard used in the field of electric vehicle (EV) charging infrastructure.

PCI DSS
Payment Card Industry Data Security Standard is a set of security standards designed to ensure that all companies that accept, process, store, or transmit credit card information maintain a secure environment

PNC
Plug and Charge is feature in the ISO 15118 standard. It enables an electric vehicle to automatically identify and authorize itself to a compatible charging station on behalf of the driver, to receive energy for recharging its battery. The only action required by the driver is to plug the charging cable into the EV and/or charging station, because the car and the charging station identify themselves to each other by exchanging certificates which were provided beforehand via a certificate pool to facilitate payment. The standard provides multiple use cases like secure communication, smart charging and the Plug and Charge feature used by some electric vehicle networks.

4. GLOSSARY

EN

PSP
Payment Service Provider handles the payments. This includes payment processing, secure transactions that comply with standards such as PCI DSS) and integration with CPMS or other systems used by the CPO.

QR code
Quick Response code is a type of two-dimensional barcode that can store information. They are typically scanned using smartphones or dedicated QR code scanners.

URL
Uniform Resource Locator is a reference (an address) to a resource on the Internet.

V2G
Vehicle-to-Grid

V2G-PKI
Vehicle-to-Grid Public Key Infrastructure is is a set of roles, policies, hardware, software and procedures needed to create, manage, distribute, use, store and revoke digital certificates and manage public-key encryption.

Contact

Alfen ICU B.V.
Hefbrugweg 79
1332 AM Almere
The Netherlands

P.O. box 1042
1300 BA Almere
The Netherlands

Alfen Knowledge Base:	knowledge.alfen.com
Alfen Service Portal:	aftersales.alfen.com
Tel. Service:	+31 (0)36 54 93 402
Website:	alfen.com

ALFEN
POWER TO ADAPT