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Part 3: Communications system for the planning and reservation of EV energy supply using wireless networks

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Contents

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

The present document is part 3 of a multi-part deliverable covering the infrastructure to Vehicle Communication as identified below:

Part 1: "Electric Vehicle Charging Spot Notification Specification";

Part 2: "Communication system specification to support application requirements for Tyre Pressure Monitoring System (TPMS)";

Part 3: "Communications system for the planning and reservation of EV energy supply using wireless networks".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**may not**", "**need**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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1 Scope

The present document specifies wireless application protocols and messages supporting the discovery of offered services (completing related discovery protocols), charging spot reservation (and possible renegotiation), pre-payment of the service reservation in the vehicle (involving pre-payment support or contract validation), and application-level logical pairing of the Electric Vehicle to a selected charging spot. Requirements regarding the underlying transport and network layer services are also defined.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] ISO/IEC 15118-2: "Road vehicles - Vehicle-to-Grid Communication Interface - Part 2: Network and application protocol requirements".

[2] DIN SPEC 91286:2011: "Electric mobility - Schemes of identifiers for E-Roaming - ContractID and Electric Vehicle Supply Equipment ID".

[3] IETF RFC 5246: "The Transport Layer Security (TLS) Protocol Version 1.2".

[4] IETF RFC 6347: "Datagram Transport Layer Security Version 1.2".

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TS 101 556-1: "Intelligent Transport Systems (ITS); Infrastructure to Vehicle Communication; Electric Vehicle Charging Spot Notification Specification".

[i.2] IEC 61851-3: "Electric vehicle conductive charging system - Part 3: Communication protocol between electric vehicle charging station and electric vehicle".

[i.3] ISO/IEC 15118-7: "Road vehicles - Vehicle-to-Grid Communication Interface - Part 7: Network and application protocol requirements for wireless communication".

[i.4] ISO/IEC 15118-3: " Road vehicles -- Vehicle to grid communication interface -- Part 3: Physical and data link layer requirements".

[i.5] ISO/IEC 15118-8: " Road vehicles -- Vehicle to grid communication interface -- Part 8: Physical layer and data link layer requirements for wireless communication".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Alternating Current (AC): AC charging through the usual grid voltage

Direct Current (DC): fast charging over high-voltage DC current provided by the recharging spot

Electric Vehicle Supply Equipment (EVSE): charging control equipment in the charging spot

inductive: inductive charging without a physical contact

quickdrop: swapping of the EV battery pack or of the trailer carrying the battery extension

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
DC	Direct Current
EIM	External Identification Means
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
HMI	Human Machine Interface
NFC	Near Field Communications
TCP	Transport Control Protocol
TLS	Transport Layer Security
UDP	Universal Datagram Protocol
UTC	Universal Time Coordinate

4 Overview of the recharging spot reservation procedure

4.1 Reservation process in the context of related electro-mobility standards

The recharging spot reservation process starts from the journey planning phase and continues during the driving phase, terminating with the approach of the reserved parking / fast recharge / quick drop area. The charging spot reservation process shall support both EVs equipped with the V2G adapter, i.e. ISO/IEC 15118-2 interface compliant vehicles [1], as well as EVs performing "mode 3" recharging based only on the IEC 61851-3 interface [i.2]. This includes support of different electrical energy provisioning modes, such as wired, quick drop or inductive recharging.

Figure 1 illustrates the scope of this protocol in the context of the EV's journey phases and in relation to other standards. This protocol is expected to be implemented either in the EV's on-board computer or on the driver's nomadic device. The reservation involves the validation of the user's payment account, in order to make sure beforehand that the user is capable of paying for the reserved services; therefore the reservation management server shall be prepared to handle such account validation.

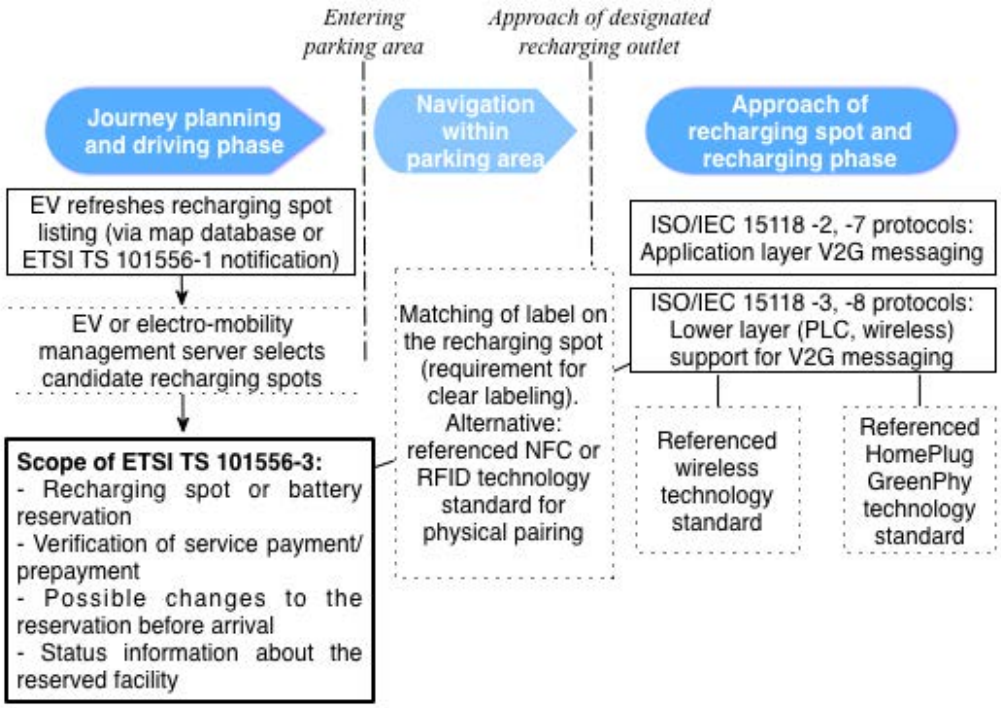

Figure 1: Overview of complementing EV recharging management standards' roles

Depending on the system architecture, the recharging spot selection is done either by the EV, a nomadic device application, or an electro-mobility server/infrastructure; such architectural difference is irrelevant from the point of view of this reservation protocol. A candidate recharging spot has been selected before initiating this procedure.

As shown in Figure 1, the matching of charging spot identifier by the EV driver is complemented by the EVSE's matching of plugged-in EV with the one belonging to the reservation. When the EV supports the V2G interface, the ISO/IEC 15118-2 procedures [1] ensure that only the EVs with a valid reservation shall be able to recharge. Furthermore, the ISO/IEC 15118-2 procedures [1] may ensure that the offered charging sessions terminate by the end of the reservation period, so that there is no point for the EV to stay longer than reserved. The implementation of this concept requires appropriate system-level integration between the presently described reservation interface and the V2G interface defined in the ISO/IEC 15118-2 documents [1]; the present document defines the identification data which shall be passed between these systems.

In order to support EVs recharging without the V2G interface, the reservation process shall allow the exchange of a Pairing ID, such as RFID or NFC based identifiers, which is then used by the EVSE during the validation of physical pairing.

The complete transaction cycle begins from information gathering at the start of journey planning, and completes with the billing and accounting of utilized charging services. Figure 2 illustrates the wider view of this transaction cycle, and shows this cycle, along with the role of relevant communication standards.

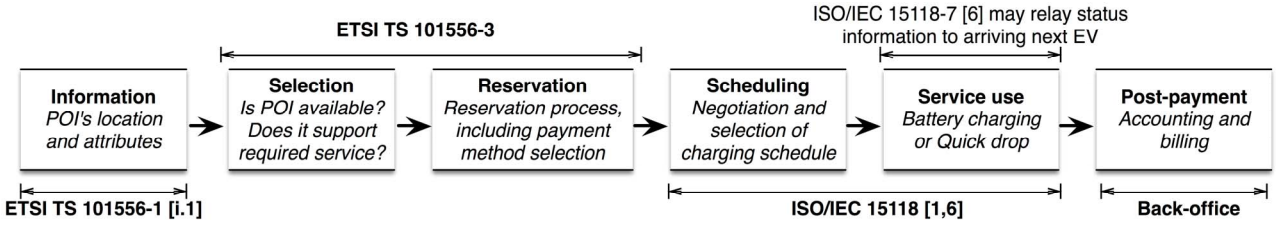

Figure 2: The EV energy management cycle

It is furthermore recognized that a trustable reservation system shall be complemented by an appropriate enforcement process to guarantee that the reserved resource shall be available. The main challenges are to ensure that the reserved recharging space is not occupied by someone else before the arrival of reserving EV and that the reserving EV departs by the end of the reserved time period. While the specification of such complementing enforcement is out of scope of the present document, the following observations are made:

- It appears that a legal enforcement is a most cost-effective solution for enforcing reservation-based EV charging spots in regions where parking itself is payment based. In that case the EVSE may detect through some sensor when a vehicle occupies a corresponding parking slot, and alert parking enforcement personnel if a valid charging session is not initiated subsequently within some timeout. Similarly, the EVSE may alert parking enforcement personnel if the recharging EV does not depart by the end of its reservation period.

- In regions where parking is for free, EV charging spots should be planned in locations of abundant parking space availability; therefore, chances for conflicting parking occupation would be minimized.

The EV charging spot reservation protocol specified in the present document is based on a request-response model based client-server architecture, where every transaction is initiated by the reserving client. There may be situations, where the EV driver should be alerted of some upcoming time limit, such as the pending expiry of reserved charging time if the EV is still plugged in. Figure 3 gives a graphical illustration of such relevant time limit alerts. The presently described protocol conveys all the needed information to the client device during the reservation process for making such alert. It is not the responsibility of the reservation management server to make such alerts towards the EV driver; therefore, no such alert procedure is being specified. Displaying alerts as needed is the responsibility of the client device implementation, and is considered to be a design issue being out of the scope of the present document.

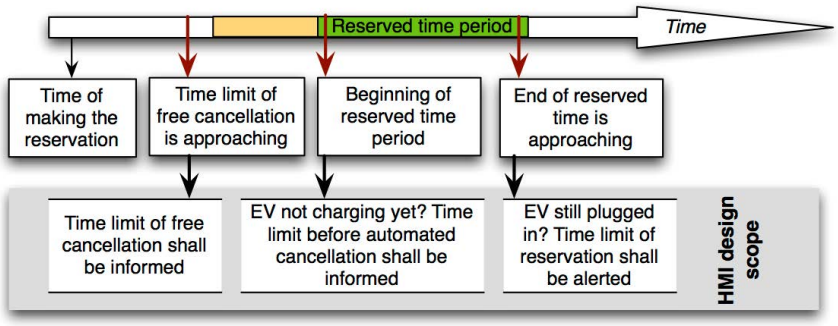

Figure 3: HMI aspects of the EV recharging management procedure

The present reservation protocol does not convey the actual pricing information of the reserved services. The reason is that the charging session is negotiated upon plugin at the start of the ISO/IEC 15118 procedure [1] and [i.3], and the final charging price may depend on the selected power and priority levels. Conveying pricing information during the reservation stage might therefore be confusing for EV users.

4.2 Identification of the reservation server

Before initiating the recharging spot reservation, the client device has the EVSE-ID which identifies the recharging spot intended to be reserved. This list of candidate EVSE-IDs is received either directly through the recharging spot notification broadcasts, or from the e-Mobility management server which plans and optimizes the recharging spot allocations. There is an IPv6 address or URL resource belonging to each EVSE-ID, which identifies the corresponding server responsible for the reservations; this information is contained in the 'Booking contact information' data element of recharging spot notification broadcasts specified in ETSI TS 101 556-1 [i.1] and shall be received by the entity making the recharging spot reservation. While the 'Booking contact information' data element is indicates as optional in ETSI TS 101 556-1 [i.1], from the perspective of the present document it is expected to be present in the recharging spot notification broadcasts.

5 Protocol procedures

5.1 Overview of the protocol operation

Figure 4 illustrates the overall flow of the EV energy supply reservation protocol procedures. The format of the involved messages and fields is described in clause 7 and clause 8.

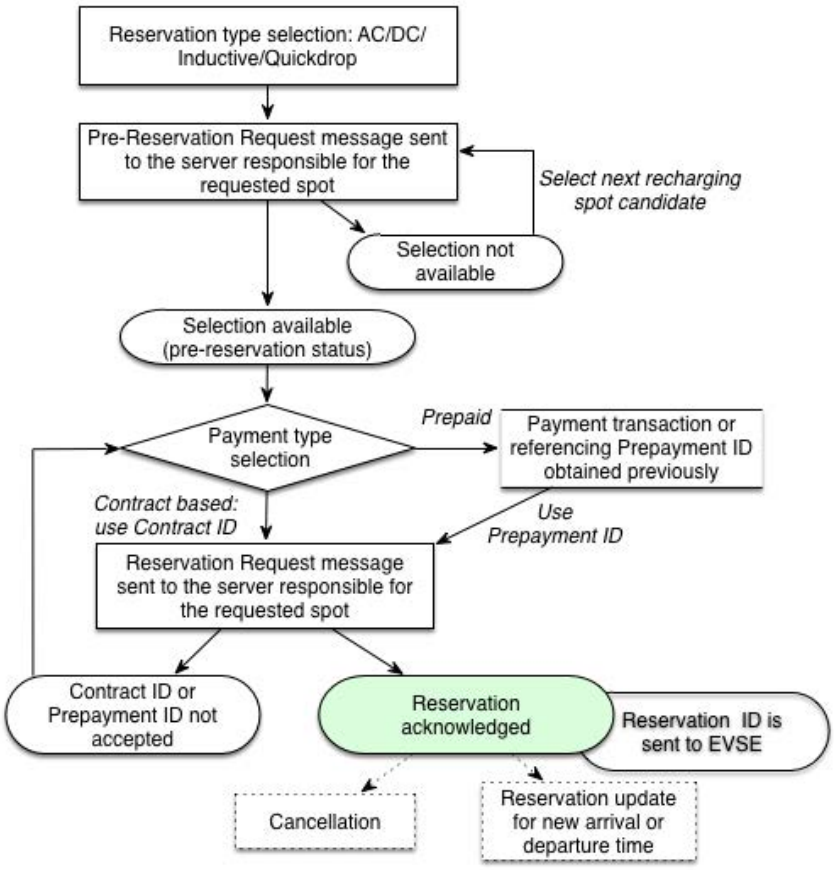

Figure 4: The EV recharging spot reservation process flowchart

Upon the completion of the reservation procedure, the charging spot reservation server shall forward to the corresponding EVSE to the assigned Reservation ID (in case of V2G based recharging) or the driver identifier (in case of recharging without V2G). The specification of such interface to the EVSE is out of the scope of the present document. It is noted that the first release of the ISO/IEC 15118-2 standard [1] does not support the transmission of Reservation ID. Therefore, such validation of the arriving EV can be based on either a future revision of ISO/IEC 15118-2 [1] or on the wireless V2G interface specified in the ISO/IEC 15118-7 [i.3] document.

The application messages described in the present document rely on IP-based network layer service, utilizing the transport protocol stack shown in Figure 5. As illustrated in Figure 5, the deployment of this service may be realized through any IP-based system, as well as through a web-based reservation interface running behind a proxy server. The access options shown in Figure 5 are examples for deployment possibilities, keeping in mind that the presently described application layer protocol is agnostic to the underlying communications technology.

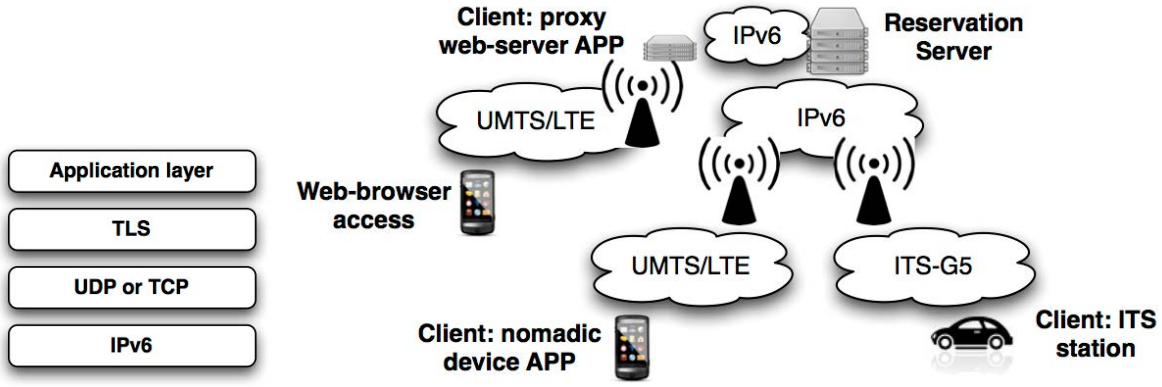

Figure 5: Deployment options for accessing the reservation service

In case of stream-based transport layer service, the messages defined in the present clause are exchanged in the same transport-layer session, which is set up by the client before sending the Pre-Reservation Request message. This transport-layer session is terminated upon the reception of the Reservation Response message, which completes the reservation procedure.

Before processing any request message, the reservation management server always authenticates the requesting client. For this security reason, the services of the underlying TLS v1.2 [3] and [4] secure transport layer shall be used. For stream-based transport services (such as TCP), the required TLS implementation is defined in IETF RFC 5246 [3], while for datagram-based transport services (such as UDP), the required TLS implementation is defined in IETF RFC 6347 [4]. Currently, TLS provides for one-way authentication of the server.

Subsequently to a completed reservation, there is a possibility to cancel a reservation or update the reservation times. The reservation update supports only later arrival time update and/or earlier departure, and not the other way around. As described in clause 6, a change of EVSE, later departure, or similar changes require making a new reservation and the cancellation of existing one. The matching Reservation ID / Reservation Password combination requirement assures the security of reservation updating process.

During the driving phase, the EV may want to poll the status of the charging spot, in order to know whether it is already available or still occupied by a preceding vehicle. Such polling procedure is not supported by the presently described service, but it may be directly provided by the wireless V2G interface of the EVSE, which is specified in the ISO/IEC 15118-7 [i.3] and document.

5.2 Pre-Reservation procedure

The client starts the reservation process by sending the Pre-Reservation Request message for reserving the preferred recharging spot. To identify the requested charging spot, the client uses the EVSE-ID in the Pre-Reservation Request message. The structure of EVSE-ID is defined in DIN 91286:2011 [2]. The server responds by informing the current status in the Pre-Reservation Response message, putting the recharging spot into pre-reservation status so that the client can trust it can safely go ahead to reserve a recharging spot which is indicated to be available. In case of a battery changing station this means the pre-reservation of the needed battery type. If the Pre-Reservation Response informs no availability at the requested recharging spot, the client can send a new Pre-Reservation Request message for the next candidate recharging spot on its list.

In case of battery replacement service, there is no indication of the needed battery type. The reason is that it may not be practical to keep track of all possible changeable EV battery types within this protocol. It is the responsibility of the recharging spot discovery procedure to keep track of possible recharging spots for a given battery type. From the point of view of this protocol, if a battery replacement station offers multiple battery types then a distinct EVSE-ID is used to indicate a recharging spot for each corresponding battery type, and the EV addresses the requested EVSE-ID.

It is needed to ensure that the requesting client is a valid one, since the recharging spot gets into a pre-reservation status upon the processing of this request. A suitable security mechanism is provided by the client authentication procedure of the underlying TLS v1.2 [3] and [4] security layer. The implementation shall take care of setting up the required client certificates for both contract-based and pre-paid procedures.

The server responds with the availability status of the recharging spot. Available recharging spots are placed into pre-reserved status by the server for the indicated time. The EV should complete the reservation procedure until the indicated time; otherwise, the pre-reservation status is removed on the server side.

The testable requirements for the Pre-Reservation procedure are listed in Table 1.

Table 1: Testable requirements for the Pre-Reservation procedure

Requirement #	Semantics
1	The encoding of Pre-Reservation Request and Response messages shall correspond to the syntax defined in the present document
2	The ArrivalTime shall be greater than current time
3	The estimated DepartureTime shall be present unless Quickdrop service is requested
4	If present, the DepartureTime shall be greater than ArrivalTime
5	The BatteryType field shall be present when Quickdrop service is requested

5.3 Reservation procedure

The client continues the reservation process by sending the Reservation Request message for reserving the preferred charging spot. The client identifies itself through the PreReservation-ID obtained in the Pre-Reservation step. This message also indicates the selected payment method (PaymentType).

A reservation request contains the estimated arrival (ArrivalTime) and departure time (DepartureTime) and the requested energy (EnergyReq). The client also sends the energy required for the completion of the current trip (EnergyMin). Requested energy and the minimal energy can therefore have different values.

The EV chooses the needed recharging service through the Recharging-type parameter. The third part of the message is the payment method selection. The payment method can be contract or pre-payment. If the EV selects the contract option, then the ContractID shall be also included. The format of the ContractID is defined in ISO/IEC 15118-2 [1]. In case of pre-payment, the External Identification Means (EIM) is also included. The procedure for obtaining and managing of the External Identification Means is out of the scope of the present document, and is specific to the local EV recharging system. For example, there could be payment cards or virtual tokens sold that include some External Identification Means identifier.

The transmission of ContractID or ExternalIdentificationMeans is also done in the ISO/IEC 15118-2 protocol [1]. No additional identification information is collected beyond these required identifiers for proper reservation handling. In addition, encryption is provided by the underlying TLS protocol.

The reservation request may contain the PairingID, which is then used by the EVSE to validate that the correct vehicle has connected to the charging spot. This field shall be present when the EV does not support the V2G interface. The encoding of Pairing-ID is implementation dependent; for example, it may correspond to a code written on an RFID card or to the NFC identifier of a smartphone device.

As with the preceding Pre-Reservation Request message, the underlying TLS v1.2 [3] and [4] security layer provides client authentication.

If the reservation is acceptable, the server sends the reservation response message with response code OK. Otherwise the response contains the actual error code, e.g. no free capacity at the selected charging spot or payment error. Positive response message contains the reservation identifier, the reserved charging spot number, optional information about the free cancellation time limit, and optionally extra information about the charging spot. The absence of free cancellation time limit indicates that the EV driver may freely make a cancellation at any time. The EV should arrive to the charging spot before the expiration time. After this time the charging centre deletes the EV's reservation.

The reservation request may be rejected for a number of reasons, such as pre-reservation identifier mismatch, payment reservation error, or insufficient power availability at the EVSE for satisfying the request. The relating cause is identified by the ReservationResponseCode field.

The testable requirements for the Reservation procedure are listed in Table 2.

Table 2: Testable requirements for the Reservation procedure

Requirement #	Semantics
6	The encoding of Reservation Request and Response messages shall correspond to the syntax defined in the present document
7	The ArrivalTime and DepartureTime shall be the same as in the corresponding Pre-Reservation request message, otherwise the reservation request is not accepted
8	The reservation request is not accepted if the PreReservation-ID is not the same as the PreReservation-ID for which the pre-reservation has been made
9	The Reservation-ID shall be present in the Reservation Response message if it contains ReservationResponseCode = OK
10	The reservation is not accepted if the EVSE cannot validate that the ContractID is valid or that sufficient pre-payment has been made under the indicated ExternalIdentificationMeans.
11	The pre-reservation status is cancelled if too long time elapses between the Pre-Reservation and Reservation procedures; the exact timeout is a system parameter.

5.4 Cancellation procedure

The EV may cancel the reservation through the Cancellation Request message. The corresponding server responds with the Cancellation Response message.

The Cancellation Request/Response message pair is exchanged in the same transport-layer session, which is set up by the client before sending the Cancellation Request message. This transport-layer session is terminated upon the reception of the Cancellation Response message.

The Cancellation Request contains the Reservation ID, Reservation Password, and a timestamp. The cancellation response contains the response code. The response code can be OK if the cancellation is successful or indicating the failure reason otherwise.

The testable requirements for the Cancellation procedure are listed in Table 3.

Table 3: Testable requirements for the Cancellation procedure

Requirement #	Semantics
12	The encoding of Cancellation Request and Response messages shall correspond to the syntax defined in the present document
13	The Reservation-ID and Reservation-Password shall correspond to an existing reservation, otherwise the cancellation request is not accepted

5.5 Update procedure

The EV may update its arrival time (to a later time) or departure time (to an earlier time) through the Update Request message. The reservation server responds with the Update Response message. This is relevant to keep the reservation in case of later arrival, as a consequence of e.g. some traffic jam.

The Update Request/Response message pair is exchanged in the same transport-layer session, which is set up by the client before sending the Update Request message. This transport-layer session is terminated upon the reception of the Update Response message.

The Update Request contains the Reservation ID, Reservation Password, and the updated arrival and departure times. The Update Response contains the response code. The response code can be OK if the update is successful or indicating the failure reason otherwise.

The testable requirements for the Update procedure are listed in Table 4.

Table 4: Testable requirements for the Update procedure

Requirement #	Semantics
14	The encoding of Update Request and Response messages shall correspond to the syntax defined in the present document
15	The Reservation-ID and Reservation-Password shall correspond to an existing reservation, otherwise the update request is not accepted
16	The UpdatedArrivalTime shall be same as or greater than the ArrivalTime of the existing reservation
17	The UpdatedDepartureTime shall be same as or less than the DepartureTime of the existing reservation

6 Reservation modification issues

The reservation of a recharging spot may need to be modified for example because of a re-assignment by the e-Mobility server due to some optimization of recharging spot allocations. From the perspective of this protocol, such change is performed through the reservation of a new recharging spot and the cancellation of the previous reservation. Therefore, the corresponding reservation server shall allow an existing reservation to co-exist with a new a pre-reservation at least temporarily (e.g. within one minute). However, duplicate reservations are not allowed.

Another possible issue is a change in the forecasted energy availability at the recharging spot. This issue is not addressed in the recharging spot reservation protocol.

7 Tabular description of protocol messages

7.1 Pre-Reservation Request and Response message formats

The tabular format of the Pre-Reservation Request message is defined in Table 5.

Table 5: Pre-Reservation Request message

Data element name:	Type:	Semantics:
EVSE-ID	Octet String (max length:32 octets)	Unique ID of the charging station according to DIN 91286:2011 [2].
ArrivalTime	UTC timestamp	The EV's estimated arrival time to charging spot in UTC
DepartureTime	UTC timestamp	(Optional) The EV's estimated departure time from charging spot in UTC. This field is not present for example in case of Quickdrop service.
RechargingType / RechargingMode	Integer (length: 4 bits)	The semantics of this field is in correspondence with ETSI TS 101 556-1 [i.1]: 0: Mode 1 standard charging, 1: Mode 2 standard charging, 2: Mode 3 standard or fast charging (3,7 kW to 43 kW), 3: Mode 4 fast charging using external charger (DC charging beyond 43 kW), 4: Reserved for new charging type, 5: Reserved for new charging type, 6: Reserved for new charging type, 7: Reserved for new charging type, 8: Quickdrop (battery replacement), 9: Reserved for new quickdrop, 10: Reserved for new quickdrop, 11: Reserved for new quickdrop, 12: Inductive charge while stationary, 13: Reserved for new inductive charge while stationary, 14: Inductive charge while driving, 15: reserved for new inductive charge while driving.

Data element name:	Type:	Semantics:
RechargingType / PowerSource	Integer (length: 3 bits)	The semantics of this field is as follows: 0: notApplicable 1: AC1Phase 2: AC2Phase 3: AC3Phase 4: DC 5: ChaDeMo
BatteryType	String	(Optional) The indication of EV's replaceable battery type. This field is only sent in case of Quickdrop recharging type. The listing of possible battery types is not included in the present document.

The tabular format of the Pre-Reservation Request message is defined in Table 6.

Table 6: Pre-Reservation Response message

Element name:	Type:	Semantics:
PreReservation-ID	Integer	A unique identifier for the given Pre-Reservation.
AvailabilityStatus	Enumeration	The response code to the reservation request: Available (Pre-reserved), No-free-capacity (No free capacity at the selected charging station), Invalid-EVSE-ID (Invalid EVSE ID, recharging spot does not exist), Authentication-error (Invalid or expired certificate).
PreReservationExpirationTime	UTC timestamp	The pre-reservation expires after this time in UTC. If the EVSE is not available, this timestamp just shows the current time.
SupportedPaymentTypes	BitString	Indication of supported payment methods: Contract, ExternalIdentification.

7.2 Reservation Request and Response message formats

The tabular format of the Reservation Request message is defined in Table 7.

Table 7: Reservation Request message

Data element name:	Type:	Semantics:
CurrentTime	UTC timestamp	Timestamp in UTC.
PreReservation-ID	Integer	A unique identifier received during Pre-Reservation.
ArrivalTime	UTC timestamp	The EV's estimated arrive time to charging spot in UTC.
DepartureTime	UTC timestamp	(Optional) The EV's estimated departure time from charging spot in UTC. This field is not present for example in case of Quickdrop service.
EAmount	Integer	The amount of requested energy in Wh (estimated at arrival time).
EAmountMin	Integer	The needed energy in Wh for the completion of the trip.
PaymentType	Enumeration	Payment method enumeration: Contract, ExternalIdentification.
ContractID or ExternalIdentificationMeans	String	ContractID if the chosen payment type is Contract. ExternalIdentificationMeans if the chosen payment type is ExternalIdentification.
SecondExternalIdentificationMeans	String	(Optional) The client may need to use a second ExternalIdentificationMeans if the credit on the one from previous session(s) is about to expire.
Pairing-ID	String	(Optional) The client may need to use a Pairing ID if the EV does not support the V2G interface.

The tabular format of the Reservation Response message is defined in Table 8.

Table 8: Reservation Response message

Element name:	Type:	Semantics:
ReservationResponseCode	Enumeration	The response code to the reservation request: OK (Reservation process complete), Invalid-EVSE-ID (Invalid EVSE ID, recharging spot does not exist), Payment-type-not-supported (selected payment method is not supported, for example no prepaid reservation accepted at this recharging spot), Payment-error (Invalid External Identification Means, invalid ContractID or expired ContractID), Authentication-error (Invalid or expired certificate), Insufficient-power-availability (EVSE has insufficient power availability for delivering EAmountMin).
Reservation-ID	String	(Conditional, only present if response code is OK) This field is the Reservation ID.
Reservation-Password	String	(Conditional, only present if response code is OK) This field is the Reservation Password.
StationDetails	String	(Optional) Additional information about the charging station (for example other offered services: Internet access point, restaurants, hotels, etc.).
ChargingSpotLabel	String	(Optional) The charging spot label, which is visually or electronically verified when arriving at the recharging spot site. This field helps the EV driver to ensure plugging in to the correct outlet. String type is used for more flexibility, even though numerical value is expected.
ExpirationTime	UTC timestamp	The reservation expires after this time in UTC. (For example the EV's estimated arrival time + tolerance time, e.g. 15 min.). If the reservation procedure has not been successful, this timestamp just shows the current time.
FreeCancelTimeLimit	UTC timestamp	(Optional) Any cancellation incurs a cost after this time limit expressed in UTC. The message does not show information about the cost of cancellation after this time limit; this is contract specific information, not communicated.

7.3 Cancellation Request and Response message formats

The tabular format of the Cancellation Request message is defined in Table 9.

Table 9: Cancellation Request message

Element name:	Type:	Semantics:
Reservation-ID	Integer	The reservation identifier
Reservation-Password	Integer	The reservation password
CurrentTime	UTC timestamp	Timestamp in UTC

The tabular format of the Cancellation Response message is defined in Table 10.

Table 10: Cancellation Response message

Element name:	Type:	Semantics:
Reservation-ID	Integer	The reservation identifier for which the cancellation has been initiated
CancellationResponseCode	Enumeration	The response to the cancellation request: OK (Reservation cancelled), Unknown-Reservation-ID, Mismatching-Reservation-Password

7.4 Update Request and Response message formats

The tabular format of the Update Request message is defined in Table 11.

Table 11: Update Request message

Element name:	Type:	Semantics:
Reservation-ID	Integer	The reservation identifier
Reservation-Password	Integer	The reservation password
UpdatedArrivalTime	UTC timestamp	Timestamp in UTC; same or greater than in the existing reservation
UpdatedDepartureTime	UTC timestamp	Timestamp in UTC; same or less than in the existing reservation

The tabular format of the Update Response message is defined in Table 12.

Table 12: Update Response message

Element name:	Type:	Semantics:
Reservation-ID	Integer	The reservation identifier for which the update has been initiated
UpdateResponseCode	Enumeration	The response to the update request: OK (Reservation updated), Unknown-Reservation-ID, Mismatching-Reservation-Password, Invalid-Arrival-Time, Invalid-Departure-Time
ChargingSpotLabel	String	(Optional) The plug-in outlet may be reassigned for optimization

8 Protocol encoding

This protocol is encoded by using ASN.1 PER Unaligned encoding rules. The ASN.1 syntax is defined in Annex A.

Annex A (normative): ASN.1 syntax

```
EV-RechargingSpotReservation-PDU-Descriptions {
 itu-t (0) identified-organization (4) etsi (0) itsDomain (5) wg1 (1) ts (101556) ev-rsr (4) version
(1)
}

DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
   ItsPduHeader FROM ITS-Container {
 itu-t (0) identified-organization (4) etsi (0) itsDomain (5) wg1 (1) ts (102894) cdd (2) version
(1)
};

EV-RSR ::= SEQUENCE {
    header      ItsPduHeader,
    messageBody EV-RSR-MessageBody
}

EV-RSR-MessageBody ::= CHOICE {
 preReservationRequestMessage       PreReservationRequestMessage,
 preReservationResponseMessage      PreReservationResponseMessage,
 reservationRequestMessage              ReservationRequestMessage,
 reservationResponseMessage         ReservationResponseMessage,
 cancellationRequestMessage         CancellationRequestMessage,
 cancellationResponseMessage            CancellationResponseMessage,
 updateRequestMessage                       UpdateRequestMessage,
 updateResponseMessage                  UpdateResponseMessage,
...
}

PreReservationRequestMessage ::= SEQUENCE {
 evse-ID            EVSE-ID,
 arrivalTime        TimestampUTC,
 departureTime  TimestampUTC OPTIONAL,
 rechargingType RechargingType,
 batteryType        BatteryType OPTIONAL,
 ...
}

PreReservationResponseMessage ::= SEQUENCE {
 preReservation-ID                      PreReservation-ID,
 availabilityStatus                 AvailabilityStatus,
 preReservationExpirationTime   TimestampUTC,
 supportedPaymentTypes              SupportedPaymentTypes,
 ...
}

ReservationRequestMessage ::= SEQUENCE {
 currentTime            TimestampUTC,
 preReservation-ID  PreReservation-ID,
 arrivalTime            TimestampUTC,
 departureTime      TimestampUTC OPTIONAL,
 eAmount                EAmount,
 eAmountMin         EAmount,
 paymentType            PaymentType,
 payment-ID             Payment-ID,
 secondPayment-ID   Payment-ID OPTIONAL,
 pairing-ID         Pairing-ID OPTIONAL,
 ...
}

ReservationResponseMessage ::= SEQUENCE {
 reservationResponseCode            ReservationResponseCode,
 reservation-ID                         Reservation-ID OPTIONAL,
 reservation-Password                   Reservation-Password OPTIONAL,
 stationDetails                         StationDetails OPTIONAL,
 chargingSpotLabel                      ChargingSpotLabel OPTIONAL,
 expirationTime                         TimestampUTC,
```

```
 freeCancelTimeLimit                   TimestampUTC OPTIONAL,
 ...
}

CancellationRequestMessage ::= SEQUENCE {
 reservation-ID             Reservation-ID,
 reservation-Password       Reservation-Password,
 currentTime                    TimestampUTC,
 ...
}

CancellationResponseMessage ::= SEQUENCE {
 reservation-ID                 Reservation-ID,
 cancellationResponseCode   CancellationResponseCode,
 ...
}

UpdateRequestMessage ::= SEQUENCE {
 reservation-ID             Reservation-ID,
 reservation-Password       Reservation-Password,
 updatedArrivalTime     TimestampUTC,
 updatedDepartureTime       TimestampUTC,
 ...
}

UpdateResponseMessage ::= SEQUENCE {
 reservation-ID         Reservation-ID,
 updateResponseCode UpdateResponseCode,
 chargingSpotLabel      ChargingSpotLabel OPTIONAL,
 ...
}



AvailabilityStatus ::= ENUMERATED { available, no-free-capacity }

BatteryType ::= UTF8String (SIZE(1..16))

CancellationResponseCode ::= ENUMERATED { ok, unknown-Reservation-ID, mismatching-Reservation-
Password }

ChargingSpotLabel ::= UTF8String (SIZE(1..4))

ContractID ::= UTF8String (SIZE(1..24))

EAmount ::= INTEGER { oneWh(1) } (1..500000)

ChargingPower ::= INTEGER { oneW(1) } (1..200000)

EVSE-ID ::= OCTET STRING (SIZE(1..32))

ExternalIdentificationMeans ::= UTF8String (SIZE(1..24))

Pairing-ID ::= VisibleString (SIZE(1..64))

PaymentType ::= ENUMERATED {contract, externalIdentification}

Payment-ID ::= CHOICE {
 contractID ContractID,
 externalIdentificationMeans    ExternalIdentificationMeans
}

RechargingType ::= SEQUENCE {
 rechargingMode RechargingMode,
 powerSource PowerSource
}

RechargingMode ::=  INTEGER { mode1(0), mode2(1), mode3(2), mode4(3), quickDrop(8),
inductiveChargingWhileStationary(12), inductiveChargingWhileDriving(14) } (0..15)

PowerSource::=  INTEGER { notApplicable(0), ac1Phase(1), ac2Phase(2), ac3Phase(3), dcc(4),
chaDeMo(5) } (0..7)
ReservationResponseCode ::= ENUMERATED {ok, invalid-EVSE-ID, payment-type-not-supported, payment-
error, authentication-error, insufficient-power-availability }

Reservation-ID ::= VisibleString (SIZE(8))

PreReservation-ID ::= Reservation-ID
```

```
Reservation-Password ::= VisibleString (SIZE(8))


StationDetails ::= UTF8String (SIZE(1..32))

SupportedPaymentTypes ::= BIT STRING { contract(0), externalIdentification (1) } (SIZE(2))

TimestampUTC ::= INTEGER { utcStartOf2013(0), oneSecondAfterUTCStartOf2013(1) }

UpdateResponseCode ::= ENUMERATED { ok, unknown-Reservation-ID, mismatching-Reservation-Password,
invalid-Arrival-Time, invalid-Departure-Time }

StatusResponseCode ::= ENUMERATED { charging-Spot-Occupied, charging-Spot-Unoccupied, charging-
Ongoing, reservation-Limit-Exceeded, reservation-Cancelled, unknown-Reservation-ID, expired-
Reservation-ID }

END
```

History

Document history		
V1.1.1	October 2014	Publication