4.2 AutoPASS Requirement Specification

CPE – AutoPASS Radio Link

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Author	Hans-Joachim Fischer	19.03.2009	
Norwegian Public Roads Administration	Geir Kalheim	19.03.2009	

DOCUMENT REVISION HISTORY

The objective of the Document Revision history is to reflect the evolution of the document.

Version	Date	Author	Main changes
1	19-10-2007	Sigmund Ellingsen	After a major revision
1.1	24-06-2008	Trond Clausen	New front page New main section: “Document revision history”
1.2	03-02-2009	Rune Lende	Updated requirement [R-linkEFC 23] to reflect that no traceable information of the passage shall be written in the OBU log.
1.3	19-03-2009	Hans-Joachim Fischer	Added a new requirement [R-linkL2 15] which enables the second LLC return status. Deleted the modification on [R-linkEFC 23]. Added a new requirement [R-linkEFC 37] as a replacement for changes in revision 1.2. Font adjustment in section 9-

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1. TERMS AND DEFINITIONS

For overall terms and abbreviations please refer to [1.1] AutoPASS Specification Charging point equipment - Terms, Definitions and References".

In addition to the terms defined in [1.1] and in the standards from CEN and ETSI [1, 2, 3, 4, 5, 6,7, 8] the terms defined in this clause prevail.

In this document following the ETSI standard editor's rules within numbers we use the "," as decimal point and the "." to indicate groups of three digits.

Example: 10,500 equals 10 plus 1/2.
10.500 equals 10 thousands 500.

'xxx'B is a binary number, x ∈ {0, 1}.

'xxx'H is a hexadecimal number, x ∈ {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F}.

The following list explains terms used in this document:

Term	Description
AL	OSI Application Layer of DSRC
HDR	High Data Rate
I3	OBU time out. Minimum time, an OBU must stay awake without receiving data.
LDR	Low Data Rate
MAC	Medium Access Control OSI sub-layer of the Data Link Layer
MDR	Medium Data Rate
N16	BST Repetition Timer
N17	LID time out
nonmand	non mandatory
OBE	On Board Equipment
OBU	On Board Unit DSRC communication part of an OBE.
PrWA	Private Window Allocation MAC downlink frame used in the initialisation phase.
PrWRq	Private Window Request MAC uplink frame used in the initialisation phase.
PuWA	Public Window Allocation Only used after a BST
rq	request
rs	response
RSE	Road Side Equipment
RSU	Road Side Unit DSRC communication part of RSE.
TR	Maximum wait time for repeat of polling (late response)

Term	Description
V(PUB)	First public window transmission indicator
V(RB)	Reception state variable
V(RI)	Receive state variable
V(SI)	Transmit state variable

2. OBJECTIVES AND SCOPE

This document provides the specification of the ISO/OSI protocol stack for Dedicated Short Range Communication (DSRC) and the Electronic Fee Collection (EFC) Application for the Norwegian AutoPASS tolling system.

This document is one out of a set of documents that specify the whole AutoPASS system. A list of all documents making up the AutoPASS specification can be found in document [1.1]. This document replaces document “07 AutoPASS Specification, Radio Link Specification” of November 2004

Testing of the radio link between OBUs and RSUs is specified in [2.8.2] and [2.8.3].

This DSRC and EFC procurement standard is a public document that can be used by other toll operators and RTTT/ITS service providers, as well in other countries, considering the need for pan-European interoperability as expressed in the Directive on Interoperable EFC systems of the European Council [10].

This specification is compliant with the CEN standards EN 12253 [1], EN 12795 [2], EN 12834 [3] and EN 13372 [4] on DSRC, the CEN standard EN 14906 [8] on the EFC application interface, and it requires conformance of equipment according to the ETSI standards EN 300 674 parts 1 [5], 2-1 [6] and 2-2 [7]. The CEN standards are applied such as to ensure compatibility of equipment provided by different manufacturers, and in order to allow for interoperable and efficient road tolling in Norway and whole Europe.

The specification does not depend on any private specifications from manufacturers. Thus it is manufacturer independent and allows all major OBU and RSU vendors to supply interoperable equipment.

3. DISCLOSURE

The radio link specification described in this document is believed to be correct with respect to the current AutoPASS system implementation. However, if inconsistencies are found, the priority shall be in the order from the most important specification:

1. Implicit specification provided by implementation as is of date of this document .
2. This document.
3. Standards referenced in this document.

4. INTRODUCTION

The requirements for the DSRC / EFC protocol stack as defined in this document are grouped into

- global requirements R-linkG,
- requirements for the DSRC OSI layer 1 R-linkL1,
- requirements for the DSRC OSI layer 2 R-linkL2,
- requirements for the DSRC OSI layer 7 R-linkL7,
- requirements for the EFC application R-linkEFC.

In addition to the basic functionality, optional functionality is specified and listed as

- optional requirements R-linkO.

Clause 5 presents the global requirements.

Clause 6 presents the optional requirements.

Annex A illustrates the global philosophy of EFC based on DSRC, i.e. the possible sequences of frames transmitted.

Annex B explains EN 12795 [2] by means of state transition tables for the initialisation phase.

Annex C explains EN 12795 [2] by means of state transition tables for the OBU component and the RSU component.

Annex D provides the complete sequence of bits for all possible frames as transmitted in the DSRC link.

5. BASIC REQUIREMENTS

5.1 GENERAL

In addition to the general normative requirements for DSRC and EFC as presented in this sub-clause, the following four sub-clauses present normative requirements dedicated to the DSRC protocol stack layers 1, 2 and 7 and the EFC application on top of this protocol stack.

[R-linkG 1] The communication protocol stack implemented in OBU and RSU shall be compliant with profiles 0/1 of the CEN DSRC standard EN 13372 [4]. In case this standard describes alternative or optional elements, these will be detailed in further requirements of this specification.

[R-linkG 2] Both profiles according to [R-linkG 1] shall be available at the OBU.

[R-linkG 3] The RSU shall request one out of the profiles according to [R-linkG 1], depending on the installation needs. If there are no requirements to select a specific profile, then profile 0 shall be used as the standard profile.

[R-linkG 4] The minimum time I3, an OBU must stay awake without receiving data, shall be 100 ms.

[R-linkG 5] The sequence of bits "in the air" shall be as presented in the Annex D.

5.2 DSRC PHYSICAL LAYER

[R-linkL1 1] The physical layer of the communication protocol stack implemented in OBU and RSU shall be compliant with the CEN DSRC standard EN 12253 [1]. In case this standard describes alternative or optional elements, these will be detailed in further requirements of this specification.

[R-linkL1 2] Conformity of the physical layer of the communication protocol stack with the ETSI DSRC standards EN 300 674 [5], [6], [7] is a pre-requisite for acceptance of equipment. Environmental conditions for testing are specified in [6], [7].

[R-linkL1 3] In case a manufacturer declares conformance of equipment [R-linkL1 2] based on measurements that were not conducted by an accredited test laboratory, the manufacturer shall be responsible for all possible damages related to an erroneous conformance declaration.

[R-linkL1 4] The RSU shall comply with Class C [1].

[R-linkL1 5] With respect to the parameters OBU conversion gain, OBU wake-up sensitivity and OBU sensitivity [5] limits shall apply for an OBU installed in a vehicle, i.e. including the effects of a windscreen. Test shall be performed according to [5] under normal test conditions with nominal supply voltage. In addition, worst case test conditions shall apply only for measurements in OBU bore sight direction.

[R-linkL1 6] Preferably one OBU type shall cover all vehicle types and all windscreen types.

[R-linkL1 7] Considering [R-linkL1 5] and alternative to [R-linkL1 6], the contractor may offer up to four OBU types or may present alternative solutions to compensate for the degradations caused by windscreens, in order to cover all vehicle / windscreen types if this allows for reduced total cost.

[R-linkL1 8] The OBU shall wake-up as specified in [1] with a wake-up sensitivity power level of -54 dBm or less.

[R-linkL1 9] The OBU sensitivity [5] power level shall be at least 6 dB below the minimum incident power according to parameter D11b [1] in order to ensure a reasonable link margin.

[R-linkL1 10] The power re-transmitted by the OBU according to the definition of parameter U4a [1] shall not exceed a value of -21 dBm as long as the power incident to the OBU according to the definition of parameter D11a [1] is not exceeding -17 dBm.

[R-linkL1 11] Unwanted emissions of the OBU according to the definition of parameter U2-3 [1] shall not exceed a power value of –39 dBm.

[R-linkL1 12] In accordance with parameter U13b [1] the OBU may send the following trailing bits: Two "1" bits + further 6 random bits to switch off and decrease the power level at least by 40 dB. The decreased power level shall be achieved at any time during the duration of these 6 further bits, independent of whether any bits are transmitted or not.

[R-linkL1 13] The RSU shall tolerate Doppler shifts of at least ± 1000 Hz.

5.3 DSRC DATA LINK LAYER

[R-linkL2 1] The data link layer of the communication protocol stack implemented in OBU and RSU shall be compliant with the DSRC standard EN 12795 [2]. In case this standard describes alternative or optional elements, these will be detailed in further requirements of this specification.

[R-linkL2 2] A RSU shall be able to manage communication to more than one OBU at one time.

[R-linkL2 3] A private uplink window re-allocation shall not be performed by the RSU MAC sub-layer.

[R-linkL2 4] In addition to the mandatory downlink frames no. 1, 2 and 5 of set Int in EN 13372 [4], the following downlink frames of set Int in [4] shall be supported: no. 6, 7.

[R-linkL2 5] In addition to the mandatory uplink frames no. 1 and 2 of set Int in EN 13372 [4], the following uplink frames of set Int in [4] shall be supported: no. 4, 5, 6, 7.

[R-linkL2 6] Requesting a private uplink window by setting the R bit to 1 in uplink frame carrying an LPDU shall be easily to be implemented in the RSU. This is not required by the DSRC standards [2], [4] but an important option for future functionality enabling efficient handling of fragmented frames, and considers as well the previous AutoPASS radio link specification.

[R-linkL2 7] Procedure II of [4] for late response shall apply, i.e. the DLL acknowledge of the request shall indicate the LLC status OK_OK together with the AL ret code "processing". Then the application shall manage the late response by polling the OBU.

[R-linkL2 8] It shall be easily possible to implement procedure I of [4] for late response at the RSU.

[R-linkL2 9] The management of ACn commands shall be according to the requirements for state transition tables as presented in Annex C.

[R-linkL2 10] Reset of state variables requested by the ACn command with poll bit P=0 and LSDU = NULL (resynchronisation) shall not be supported.

[R-linkL2 11] An ACn command not supported by an OBU shall be acknowledged with status RS_OK; RRRR = RS = '0001'B.

[R-linkL2 12] The RSU parameter N11 [2] "Maximum number of retransmissions" shall be set equal one, if not required differently for a specific installation, i.e. the RSU-LLC shall not initiate re-transmissions

[R-linkL2 13] The OBU-DLL shall properly respond to re-transmissions.

[R-linkL2 14] The RSU parameter N13 [2] "Maximum Value for Acknowledgement Timer" shall be equal one if not required differently for a specific installation.

[R-linkL2 15] For uplink frame no. 4 requested in [R-linkL2 5] with the LLC return status value as required in [R-linkL2 11] according to the requirement [R-linkL2 10], the LLC return status NR_OK as specified in [4] also is allowed. An RSU shall accept both values.

5.4 DSRC APPLICATION LAYER

[R-linkL7 1] The application layer of the communication protocol stack implemented in OBU and RSU shall be compliant with the DSRC standard EN 12834 [3]. In case this standard describes alternative or optional elements, these will be detailed in further requirements of this specification.

[R-linkL7 2] Upon every reception of a BST the time reported in the BST shall be used to update the BST-time stored in the OBU. This applies as well if the time difference Δt between subsequent BSTs is negative.

[R-linkL7 3] A negative time difference Δt between subsequent BST messages, where Δt is derived from the BST time, shall be treated as follows:

- If $|\Delta t| < 255$ s, then the rules for $0 \leq \Delta t < 255$ s [3] shall apply.
- If $|\Delta t| \geq 255$ s, then the rules for $\Delta t \geq 255$ s [3] shall apply, i.e. then the OBU will generate a new LID and will respond to the BST message with a new VST message.

[R-linkL7 4] The AutoPASS EFC application shall be qualified as a mandatory application in the BST.

[R-linkL7 5] The AutoPASS RSU shall honour the most local EFC application offered in the VST.

[R-linkL7 6] The RELEASE command may be send to an OBU as soon as the RSU no longer needs communication to this OBU.

[R-linkL7 7] The service SET from [3] shall be implemented.

[R-linkL7 8] The service ACTION from [3] shall be implemented.

[R-linkL7 9] The optional service GET from [3] shall easily to be implemented at the RSU for future use.

[R-linkL7 10] The parameter Invoker Identifier IID shall not be used unless applications are multiplexed.

[R-linkL7 11] A one octet fragmentation header shall be implemented.

[R-linkL7 12] Fragmentation shall not be supported.

[R-linkL7 13] It shall be easily possible to implement the optional functionality (de-) fragmentation at the RSU for future use.

[R-linkL7 14] It shall be easily possible to implement the optional functionality (de-) multiplexing at the RSU for future use.

[R-linkL7 15] It shall be easily possible to implement the optional functionality (de-) concatenation at the RSU for future use.

[R-linkL7 16] It shall be easily possible to implement the optional functionality (de-) chaining at the RSU for future use.

[R-linkL7 17] The I-KE shall work according to the state transition tables presented in the Annex B.

[R-linkL7 18] Repetitive transmission of BST not necessarily is a periodical transmission based on a fixed period. It is up to the manufacturer to define a suitable strategy on when a BST shall be transmitted. This might depend on the installation. Repetitive transmission may be controlled by a BST repetition timer N16 as follows.

When the BST Repetition Timer N16 expires, then the BST shall be retransmitted at the earliest possible time and the BST Repetition Timer shall be reset to zero.

If there is no communication with OBUs active, then a continuous retransmission shall be done. In this case the BST shall be repeated as frequent as possible, e.g. approximately 500 times per second, which is equal to a time period of about 2,0 ms.

[R-linkL7 19] A private LID shall be invalidated if not used for a period of at least N17. It is N17 = 255 s.

5.5 EFC APPLICATION

AutoPASS EFC is a tolling system based on central account and retrieval of an identification number from the OBU. The retrieval is done in plain text with authentication. The result of the transaction is stored in a log file in the OBU without any security means. The basic philosophy of AutoPASS EFC is presented in the Annex A in terms of DSRC frames exchanged between RSU and OBU.

[R-linkEFC 1] The EFC application interface shall be compliant with the standard EN 14906 [8]. In case this standard describes alternative or optional elements, these will be detailed in further requirements of this specification.

[R-linkEFC 2] A buffer with the following organisation shall be implemented in the OBU:

Address	Purpose	Access
0 ... 99	Logfile (AutoPASSdata3)	unprotected read / write
100 ... 113	reserved for other applications, e.g. floating car data.	depends on application
114 ... 255	reserved for future use	not defined

[R-linkEFC 3] The log file shall be stored in the OBU buffer [R-linkEFC 2] at addresses in the range (0..99).

[R-linkEFC 4] The LogIndex in the OBU shall point to the most recent entry of the log file.

[R-linkEFC 5] Initially the LogIndex in the OBU shall point to the address 99.

[R-linkEFC 6] Prior to writing into the log file of the OBU, the RSU shall read the actual LogIndex as part of AutoPASSdata1 from the OBU using the GET_SECURE command.

[R-linkEFC 7] If the LogIndex read from the OBU is equal to 0, then the RSU shall set it to 99; otherwise the RSU shall decrement the LogIndex by one. The new value of LogIndex shall then be used in the SET command to update the actual log file into the OBU, see AutoPASSdata2 [R-linkEFC 20] and OBUstatusControl [R-linkEFC 21].

[R-linkEFC 8] The following data elements shall be available in the OBU:

Access	**Data Element**
Read Only	ObeConfiguration [3] .equipmentClass .manufacturerID (= CS2.ManufacturerIdentifier [9]) .efcStatus (equipment status) EFC-ContextMark [8] (optionally multiple context marks) .contractProvider .countryCode (= CS1.CountryCode [9]) .providerIndentifer (=CS1.IssuerIdentifier [9]) .typeOfContract .contextVersion AutoPASSdata1 .obuID (= CS1 [9]) .efcStatus .TC (Transaction Counter [2.10.1]) .RND-2 (Random Number 2 [2.10.1]) .MAC1 (Integrity Certificate MAC1 [2.10.1]) .MAC2 (Integrity Certificate MAC2 [2.10.1]) .LogIndex (Points to most recent entry in the log file)
Read/Write	AutoPASSdata2 .LogIndex .OBUstatusControl (Used to clear the moved flag and to update the log index pointer at the end of a session) .passingLogData (= AutoPASSdata3) Multiple instances of AutoPASSdata3 in the log file. AutoPASSdata3 .LogType (Type of log entry: 1 for AutoPASS_1) .SessionTime [8] .SessionServiceProvider [8] .StationLocation [8] .TypeOfSession [8] .SessionLocation [8] .SessionResultOperational .SessionResultFinancial .ReceiptAuthenticator
Neither Read nor Write	Security Keys [2.10.1].

[R-linkEFC 9] The data element SessionResultFinancial shall consist of one octets as follows:

MSB LSB 7 6 5 4 3 2 1 0	Description
0	reserved for future use
0	reserved for future use
i	GET_INSTANCE Error i=0: no error
s	SET Error s=0: no error
a	Authentication Error a=0: no error
g	GET_SECURE Error g=0: no error
v	VST Error v=0: no error
m	SAM Error m=0: no error

[R-linkEFC 10] The data element ReceiptAuthenticator is the CRC-16 authenticator over the preceding 14 octets.

[R-linkEFC 11] The AttributeList used in the SET command shall contain a single attribute only.

[R-linkEFC 12] The LogIndex in the OBU shall be set as requested by the SET command according to the u-bit contained in OBUstatusControl.

[R-linkEFC 13] When reading log file data from the OBU using the GET_INSTANCE [8] command, always four instances of AutoPASSdata3 shall be requested; i.e. always posOfLastInstance=posOfFirstInstance + 3 shall apply. The first instance shall be addressed by the parameter posOfFirstInstance. The following shall apply:

posOfFirstInstance	Instances retrieved from OBU	Instances to be used at RSU
< 0 or >255	None	none
n = 0 ... 96	n, n+1, n+2, n+3	n, n+1, n+2, n+3
97	97, 98, 99, dummy	97, 98, 99
98	98, 99, dummy, dummy	98, 99
99	99, dummy, dummy, dummy	99

[R-linkEFC 14] The data element efcStatus shall consist of two octets as follows:

Octet #	MSB LSB 7 6 5 4 3 2 1 0	Description
1	m	Moved m=1: OBU was moved.
	0	reserved for future use
	b	Battery Low/Problem b=0: Battery ok.
	0	reserved for future use
	0	reserved for future use
	0	reserved for future use
	0	reserved for future use
	0	reserved for future use
2	0 0 0 0 0 0 0 0	reserved for future use

[R-linkEFC 15] The m-bit in efcStatus shall be set to m=1 as soon as the OBU was removed from the windscreen.

[R-linkEFC 16] The b-bit in efcStatus shall be set to b=1 as soon as low voltage is detected.

[R-linkEFC 17] The EFC attribute AutoPASSdata1 shall have attributeId = 99.

[R-linkEFC 18] The EFC attribute AutoPASSdata1 shall be in ASN.1 presentation:

```
AutoPASSdata1::=SEQUENCE{
    obuID                       CS1 [9],
    efcStatus                   BIT STRING(SIZE(16)),
    TC                          OCTET STRING(SIZE(2)),
    RND-2                       OCTET STRING(SIZE(4)),
    MAC1                        OCTET STRING(SIZE(4)),
    MAC2                        OCTET STRING(SIZE(4))
    LogIndex                    INTEGER(0..255)
}
```

[R-linkEFC 19] The EFC attribute AutoPASSdata2 shall have attributeId = 100.

[R-linkEFC 20] The EFC attribute AutoPASSdata2 shall be in ASN.1 presentation:

```
AutoPASSdata2::=SEQUENCE{
    LogIndex                    INTEGER(0..255),
    OBUstatusControl            OCTET STRING(SIZE(2)),
    passingLogData              AutoPASSdata3
}
```

[R-linkEFC 21] The data element OBUstatusControl shall consist of two octets as follows:

Octet #	MSB LSB 7 6 5 4 3 2 1 0	Description
1	m	m=1: Clear efcStatus.Bit7 (moved flag)
	u	u=1: Update LogIndex in the OBU
	0	reserved for future use
	0	reserved for future use
	0	reserved for future use
	0	reserved for future use
	0	reserved for future use
	0	reserved for future use
2	0 0 0 0 0 0 0 0	reserved for future use

[R-linkEFC 22] The EFC attribute AutoPASSdata3 shall have attributeId = 127.

[R-linkEFC 23] The EFC attribute AutoPASSdata3 shall be in ASN.1 presentation:

```
AutoPASSdata3::= SEQUENCE{
    LogType                  INTEGER(0..255),
    SessionTime              TimeReal,
    SessionServiceProvider   Provider,
    StationLocation          INTEGER(0..1048575),
    SessionLocation          BIT STRING(SIZE(8)),
    TypeOfSession            StationType,
    SessionResultOperational ResultOp,
    SessionResultFinancial   ResultFin,
    ReceiptAuthenticator     OCTET STRING(SIZE(2))
}
```

[R-linkEFC 24] The EFC functions GET_SECURE and GET_INSTANCE [8] shall be implemented.

[R-linkEFC 25] GET_SECURE.request shall carry the EFC AccessCredentials KeyGeneration, RND-1 and TVP, and shall request the data element AutoPASSdata1.

[R-linkEFC 26] The EFC AccessCredentials shall be in ASN.1 presentation:

```
AccessCredentials::=SEQUENCE{
    KeyGeneration            INTEGER(0..127),
    RND-1                    OCTET STRING(SIZE(4))
    TVP                      OCTET STRING(SIZE(4))
}
```

[R-linkEFC 27] GET_SECURE.response shall carry the requested data element AutoPASSdata1.

[R-linkEFC 28] GET_INSTANCE.request shall carry the positions of the first and last instance to be retrieved and shall request the data element AutoPASSdata3.

[R-linkEFC 29] GET_INSTANCE.response shall carry the requested data element AutoPASSdata3.

[R-linkEFC 30] The AL-command SET.request shall be used to send the data element AutoPASSdata2 and shall store it in the log file. Further on this command optionally may reset the m-bit of the efcStatus and may request to update the LogIndex in the OBU at the end of the session.

[R-linkEFC 31] The AL-command SET.response shall be used to carry the acknowledge information with possible AL ReturnStatus values of 0 (accepted), 1 (access denied) or 5 (processing).

[R-linkEFC 32] The ECHO command shall be used only without fragmentation and with zero-length data. It shall be mandatory only at the OBU. It is allowed but not requested, that a RSU sends an ECHO command for purposes that are not specified here and that are needed to perform correct transactions. The ReturnStatus of the ECHO.response shall not be used.

[R-linkEFC 33] SET_MMI shall easily to be implemented at the RSU for future use. If implemented it may precede every RELEASE command indicating success (ok) or failure (nok) of the EFC transaction.

[R-linkEFC 34] At the OBU the SET_MMI may be implemented as an optional function that provides added value.

[R-linkEFC 35] A late response to an ACn command shall be realised by repeated polling done by the application. The maximum number of repetitions shall be defined by the manufacturer of the RSU. The maximum time to wait for the next polling command shall not exceed the value of TR.

[R-linkEFC 36] The timer TR shall be TR = 10ms.

[R-linkEFC 37] The elements `SessionTime`, `SessionServiceProvider`, `StationLocation` and `SessionLocation` shall be set to zero in `AutoPASSdata2.passingLogData`.

6. ANNEX A – EFC PHILOSOPHY

The table below provides an overview of the AutoPASS EFC transaction in terms of the sequence of data exchanged between an RSE and an OBE.

Phase	RSE	<>	OBE	Remark
Initialisation BST - VST	INITIALISATION.rq (BST)	→		Repeated Broadcast
		←	INITIALISATION.rs (VST) • EFC-ContextMark	A newly arrived OBE answers with VST, if at least one of the DSRC profiles offered in the BST matches the capabilities of the OBE. EFC-ContextMark reports all details about the EFC protocol supported.
Presentation	GET_SECURE.rq (AutoPASSdata1) • KeyGeneration • RND-1 • TVP.	→		RSE requests to get details of the subscriber in a secure way. KeyGeneration selects a specific generation of security keys to be used for this transaction. RND-1 is a random challenge used by the OBE to authenticate itself. TVP is a time dependent parameter used by the OBE to authenticate itself.
		←	GET_SECURE.rs (AutoPASSdata1)	OBE responds with the required attribute AutoPASSdata1. Beside the required EFC information, this attribute contains as well signatures for the local and for foreign operators together with a random challenge RND-2. RND-2 allows secure write access to the OBE, but is not used currently.
Receipt	SET.rq (AutoPASSdata2)	→		RSE requests to store information on the actual transaction in the logfile of the OBE. Using RND-2 this could be done in a secure way with the SET_SECURE service.
		←	SET.rs	OBE confirms the storage of the logfile information.
Optional Tracking	ECHO.rq ()	→		Track OBE in communication zone.
		←	ECHO.rs ()	
Optional Closing	EVENT_REPORT.rq (Release)	→		RSE closes transaction and requires from OBE to delete LID, i.e. to delete relation with this RSE.
Optional Control	GET_INSTANCE.rq (AutoPASSdata3)	→		The RSU requires to get a number of subsequent receipts as stored in the logfile.
		←	GET_INSTANCE.rs (AutoPASSdata3)	The OBE responds with the required logfile information.

7. ANNEX B– INITIALISATION

All actions related to the problem of duplicate LIDs are not mandatory. The procedures described for OBUs and RSUs not necessarily reflect the real timing. The timing strategy shall be to serve "old" OBUs first to allow them to finalise transaction before they leave the communication zone. At single lane installations normally OBUs can be served in the sequence they are approaching. Thus these state transition tables should be considered to be guidelines only and not to be necessarily detailed specifications.

The behaviour of the **OBU I-KE** is presented in the following state transition table. There are three states, i. e. SLEEP, INIT and READY. The state SLEEP refers to the sleep mode of battery powered OBUs. During the state INIT the OBU tries to establish communication to a RSU. During the state READY the LID of the OBU is registered at the RSU and the OBU is active. Dark shaded transitions not necessarily are implemented explicitly or are optional. Transactions #1 and #2 become important only in an OBU that serves multiple applications.

Current State	#	Event (multiple events are connected with AND)	Action(s)	Next State
INIT	1	RegisterApplicationVehicle	Activate referred application.	INIT
	2	DeregisterApplication	Deactivate referred application	INIT
	3	Reception of BST which does not cause the creation of a new private LID	Update stored BeaconID and date and time, reset N17, transmit PrWRq in randomly chosen public up link window.	INIT
	4	Reception of BST which causes the creation of a new private LID	Update stored BeaconID and date and time, reset N17, generate new private LID, transmit PrWRq in randomly chosen public up link window. NotifyApplicationBeacon. Prepare VST.	INIT
	5	Reception of PrWA	Transmit VST	INIT
	6	Reception of frame with private LID which is not a PrWA	Process the received message	READY
	7	OBU_TIME_OUT	NEXT_STATE(INIT) STAND_BY()	SLEEP
	8	DUPLICATE_LID	Print message "Failure due to duplicate address" to MMI, if optional MMI is available at OBU.	READY
READY	9	Reception of a BST which does not cause the creation of a new private LID	Update stored BeaconID and date and time.	READY
	10	Reception of a BST which causes the creation of a new private LID	Update stored BeaconID and date and time, generate new private LID, transmit PrWRq in randomly chosen public up link window.	INIT
	11	EVENT-REPORT(RELEASE)	DELETE_ LID() NEW_LID() NEXT_STATE(INIT) STAND_BY() / Optionally an OBU may switch to the sleep mode.	SLEEP
	12	OBU_TIME_OUT	NEXT_STATE(READY) STAND_BY()	SLEEP
SLEEP	13	WAKE_UP STATE=INIT	Reset OBU time out timer I3	INIT
	14	WAKE_UP STATE=READY	Reset OBU time out timer I3	READY

OBU Initialisation State Transitions

Legend:

DUPLICATE_LID:
SET_MMI.request indicating that an address conflict between at least two OBUs occurred. Activates a message at an optional generic man-machine interface at the OBU, e. g. a beeper or a display.

NEXT_STATE(next state):
Function stores next valid state.

DELETE_LID():
Function deletes currently used LID.

NEW_LID():
Function generates a new LID.

SLEEP():
Sets the OBU to the sleep mode to save battery power.

OBU_TIME_OUT:
OBU time out I3 is reached.

WAKE_UP:
Wake-up circuit detected RSU data.

STATE=next state
Retrieves next valid state from memory that was written using NEXT_STATE

The behaviour of the **RSU I-KE** to manage the initialisation phase is presented in the following state transition table. There are three states, i. e. INIT, INIT1 and OP. INIT indicates gathering and evaluation of messages in public up link windows. INIT1 is an intermediate state to check whether there are remaining public up link windows. INIT2 is an intermediate state to check remaining requests to be processed. WAIT indicates waiting for new BST request.

Current State	**#**	**Event (multiple events are connected with AND)**	**Action(s)**	**Next State**
INIT	1	RegisterApplicationBeacon	Activate referred application.	INIT
	2	DeregisterApplication	Deactivate referred application	INIT
	3	No response to BST	D_ PuWC()	INIT1
	4	PrWRq with new LID detected.	REQ(LID) D_PuWC() I_RqC().	INIT1
	5	PrWRq with known LID detected	REQ(LID) OLD(LID) D_PuWC() I_RqC().	INIT1
INIT1	6	PuWC > 0	-	INIT
	7	PuWC = 0	Start to process all requests for private up link windows.	INIT2

Current State	#	Event (multiple events are connected with AND)	Action(s)	Next State
INIT2 /1	8	RqC>0 VST_RECEIVED(LID) OLD_LID	Activate Enforcement System SET_MMI(LID,DUPLICATE_LID) EVENT-REPORT(LID,RELEASE) DELETE_LID(LID) D_RqC()	INIT2
	9	RqC>0 VST_RECEIVED(LID) NEW_LID	D_RqC() NotifyApplicationBeacon Start LID time out timer N17.	INIT2
	10	RqC>0 NON_VST_MESSAGE(LID) OLD_LID	D_RqC() Process Message Reset LID time out timer N17.	INIT2
	11	RqC>0 NON_VST_MESSAGE NEW_LID	Ignore message	INIT2
	12	RqC = 0	OLD(0)	WAIT
WAIT	13	Request for transmission of BST.	INITIALISATION(BST). Reset BST Repetition Timer N16. Set PuWC = N5.	INIT
	14	LID_TIMER_EXPIRED(LID)	DELETE_LID(LID)	WAIT
	15	ReadyApplication	Delete entry for the referred application from the stored ApplicationList from the VST.	WAIT
	16	All applications related to a specific LID finished	EVENT-REPORT(LID,RELEASE) DELETE_LID(LID)	WAIT

RSU Initialisation State Transitions

Legend:

PuWC:
Counter for public up link windows.

D_PuWC():
Decrement PuWC.

RqC:
Request Counter. Counts the number of public up link windows within which a request for private up link was decoded successfully.

I_RqC():
Increment RqC.

D_RqC():
Decrement RqC.

REQ(LID):
Store request for private up link window for OBU with address LID.

SET_MMI(lid,DUPLICATE_ LID)[2]
A message is generated indicating that a collision occurred and communication to these OBUs will be stopped. This message is first send to the OBUs using an SET-MMI frame and private address LID=lid and second to a roadside display.

[1] An already used LID was received in a VST message indicating an address conflict. This case is not considered in EN 12253 /1/. It will be managed in a way to stop communication to these OBUs. This is an optional transition that can be implemented at the RSU. Further on it can be that due to the conflict both OBUs tried to send a message. If not implemented, then transition #9 applies.

[2] This message needs to be decoded only at OBUs that provide a suitable MMI. This is not mandatory for AutoPASS-DSRC. Simple OBUs may ignore this command.

EVENT-REPORT(lid,RELEASE)
A RELEASE message is send to the OBUs with LID=lid using an EVENT-REPORT frame and private address LID=lid.

OLD(lid)
Not mandatory, just recommended
lid=LID: Store LID in list of already known LIDs.
lid=0: Delete list of already known LIDs.

VST_RECEIVED(lid):
A VST was received in a private up link window from LID=lid.

OLD_LID:
LID is in list of already known LIDs.

NEW_LID
LID is not in list of already known LIDs.

DELETE_LID(lid):
Deletes the LID=lid.

LID_TIMER_EXPIRED(lid)
The LID time out timer N17 expired for the specified LID=lid.

8. ANNEX C– COMPONENTS

8.1 GENERAL

The LLC elements of procedure as specified verbally in EN 12795 [2] are described using state machine descriptions for the following two types of components:

- *Acknowledged connectionless-mode Receiver Component (OBU Component).*
- *Acknowledged connectionless-mode Sender Component (RSU Component)*.

Dark shaded transitions not necessarily are implemented explicitly or are optional.

8.2 OBU COMPONENT (RECEIVER COMPONENT)

The following variables shall be created and deleted together with the creation and deletion of the LID (receiver component).

- V(RI): Receive Sequence State Variable (1 bit). Will be created upon first reception.
- V(RB): Reception Status State Variable (CCCC sub-field), used in case of retransmissions.

There is only one state, i. e. the READY state. Transitions #4, #6 and #9 never will occur as the received command was erroneous and therefore discarded. Transition #3 reflects reception of a command, e.g. re-synchronisation that is not supported at the OBU. Transitions #10, #11 and #12 are repetitions.

Current State	#	Event (multiple events are connected with AND)	(Sequence of) Action(s)	Next State
READY /[3]	1	REPLY_UPDATE_REQUEST	SAVE:=GIVEN_LSDU REPLY_UPDATE_STATUS_INDICATION	READY
/[4]	2	RECEIVE_ACn_CMD(n=V(RI), P='0'B, INFO<>NULL) RECEIVE_STATUS( )=OK	DATA_ACK_INDICATION V(RI):='1'B-V(RI) TRANSMIT_ACn_RSP(n=V(RI), F='0'B, C=OK, R=NR, LSDU=NULL) V(RB):=C	READY
/[5]	3	RECEIVE_ACn_CMD(n=V(RI),P,INFO) RECEIVE_STATUS( )=OK Command not implemented at OBU.	V(RI):='1'B-V(RI) TRANSMIT_ACn_RSP(n=V(RI), F, C=OK, R=RS, LSDU=NULL) V(RB):= C	READY
	4	RECEIVE_ACn_CMD(n=V(RI), P='0'B) RECEIVE_STATUS( )<>OK	V(RI):='1'B-V(RI) TRANSMIT_ACn_RSP(n=V(RI), F='0'B, C=RECEIVE_STATUS( ), R=NR, LSDU=NULL) V(RB):= C	READY

[3] This happens in case of late response. Depending on the implementation at the OBU, the message stored in the save area will be transmitted either upon next request by the same ACn command or by the OBU using an UI command.

[4] This is the normal mode to write data to the OBU.

[5] This is the case for re-synchronisation and not supported by AutoPASS. Thus the response indicates failure.

Current State	#	Event (multiple events are connected with AND)	(Sequence of) Action(s)	Next State
/6	5	RECEIVE_ACn_CMD(n=V(RI), P='1'B, INFO<> NULL) RECEIVE_STATUS( )=OK ACCESS( )=OK	DELETE_SAVE_BUFFER REPLY_INDICATION(LSDU=INFO) V(RI):='1'B-V(RI) SAVE:=GIVEN_LSDU REPLY_UPDATE_STATUS_INDICATION TRANSMIT_ACn_RSP(n=V(RI), F='1'B, C=OK, R=OK, LSDU=SAVE) V(RB):=C	READY
	6	RECEIVE_ACn_CMD(n=V(RI), P='1'B) RECEIVE_STATUS( )<>OK ACCESS( )=OK	REPLY_INDICATION(LSDU=NULL) V(RI):='1'B-V(RI) TRANSMIT_ACn_RSP(n=V(RI), F='1'B, C= RECEIVE_STATUS( ), R=OK, LSDU=SAVE) V(RB):= C	READY
/7	7	RECEIVE_ACn_CMD(n=V(RI), P='1'B, INFO<>NULL) RECEIVE_STATUS( )=OK ACCESS( )<>OK	DELETE_SAVE_BUFFER REPLY_INDICATION(LSDU=INFO) V(RI):='1'B-V(RI) TRANSMIT_ACn_RSP(n=V(RI), F='1'B, C=OK, R=NE, LSDU=NULL) V(RB)=C	READY
/8	8	RECEIVE_ACn_CMD(n=V(RI), P='1'B, INFO=NULL) RECEIVE_STATUS( )=OK	V(RI):='1'B-V(RI) TRANSMIT_ACn_RSP(n=V(RI), F='1'B, C=OK, R=RS, LSDU=NULL) V(RB)=C	READY
	9	RECEIVE_ACn_CMD(n=V(RI), P='1'B) RECEIVE_STATUS( )<>OK ACCESS( )<>OK	V(RI):='1'B-V(RI) TRANSMIT_ACn_RSP(n=V(RI), F='1'B, C=RECEIVE_STATUS( ), R=ACCESS( ), LSDU=NULL) V(RB):= C	READY
/9	10	RECEIVE_ACn_CMD(n<>V(RI), P='0'B, INFO)	TRANSMIT_ACn_RSP(n=V(RI), F='0'B, C=V(RB), R=NR, LSDU=NULL)	READY
/10	11	RECEIVE_ACn_CMD(n<>V(RI), P='1'B, INFO) ACCESS( )=OK	REPLY_INDICATION(LSDU=NULL) TRANSMIT_ACn_RSP(n=V(RI), F='1'B, C=V(RB), R=OK, LSDU=SAVE)	READY
/11	12	RECEIVE_ACn_CMD(n<>V(RI), P='1'B, INFO) ACCESS( )<>OK	TRANSMIT_ACn_RSP(n=V(RI), F='1'B, C=V(RB), R=NE, LSDU=NULL)	READY

OBU Component State Transitions

The functions, events and actions are defined as follows:

DELETE_SAVE_BUFFER:
Sets an "invalid" flag for the SAVE location.

RECEIVE_STATUS():
Returns the CCCC part of the LLC status field of the related response.

---

[6] This is the normal mode to exchange data with the OBU (INFO <> NULL). Polling data from the OBU only (INFO=NULL) is not allowed; see transition #8. The response provided by the SAVE function can indicate as well the ret code "processing" only; this is the case for late response based on repeated polling.

[7] This is the case of a late response based on UI-command. The requested data are not available.

[8] Polling of data only (INFO = NULL) is not supported by AutoPASS. The response shall indicate failure.

[9] Repetition of #2 or #3. This causes repetition of the empty DLL acknowledgement frame.

[10] Repetition of #5. This causes repetition of the response frame that carries the requested data.

[11] Repetition of #7 or #8. This causes repetition of the empty DLL acknowledgement frame.

ACCESS():
Returns the RRRR part of the LLC status field of the related response.

REPLY_UPDATE_REQUEST:
The application layer has passed a DL-REPLY-UPDATE.request service primitive to the LLC.

RECEIVE_ACn_CMD(SQC, P, INFO):
The MAC sub-layer has passed a MA-DATA.indication service primitive to the LLC that contains an ACn command PDU.
n=V(RI): Either the command sequence bit (SQC = n) received in the LLC control field is equal to V(RI) or V(RI) does not exist.
n<>V(RI): V(RI) exists and is not equal to n.
P: Poll bit of the LLC control field.
INFO=NULL: The information field in the command is null (of zero length).
INFO<>NULL: The there is a non-null information field in the command.

SAVE:=GIVEN_LSDU:
The LSDU given in the associated DL-REPLY-UPDATE.request service primitive is held in readiness for transmission in the abstract location SAVE.

V(RI):='1'B-V(RI):
V(RI) is set to the complement of the sequence bit n in the received command PDU.

TRANSMIT_ACn_RSP(SQR, F, C, R, LSDU):
Pass an MA-DATA.request primitive to the MAC sub-layer containing an ACn response PDU. The following parameter values exist for this action:
n=V(RI): The response sequence bit (SQR = n) of the LLC control field is set equal to the received command sequence bit V(RI) after V(RI) has been adjusted properly.
F=: The Final bit in the LLC control field is set to the indicated value.
C=: The CCCC part of the LLC status field is set to the indicated value.
R=: The RRRR part of the LLC status field is set to the indicated value.
LSDU=NULL: The LSDU of the response is null.
LSDU=SAVE: The LSDU of the response contains the LSDU held in readiness in the SAVE location.

DATA_ACK_INDICATION:
Pass a DL-DATA-ACK.indication primitive to the application layer that contains a LSDU equal to the information field from the associated received command PDU.

REPLY_INDICATION(LSDU):
Pass a DL-REPLY.indication service primitive to the application layer. The following parameter values exist for this action:
LSDU=INFO: The service primitive contains an LSDU equal to the information field from the associated received command PDU.
LSDU=NULL: The service primitive contains a null LSDU.

REPLY_UPDATE_STATUS_INDICATION[12]:
Pass a DL-REPLY-UPDATE-STATUS.indication service primitive to the application layer. Depending on the implementation, this might be omitted.

8.3 RSU COMPONENT (SENDER COMPONENT)

The following variable shall be created and deleted together with the creation and deletion of a private LID (receiver component).

- V(SI): Transmit Sequence State Variable (1 bit). Shall be created with an initial value of '0'B.

[12] Optional

Only one outstanding command PDU for a LID, i. e. one command that is not acknowledged yet, is managed. There shall be as many RSU components as registered OBUs are in the communication zone. A registered OBU is one of which the RSU knows the LID.

There are three states, i. e. the IDLE, WAIT_A and WAIT_R states.

In the IDLE state, the LLC is capable of executing a request from the application layer to transmit a acknowledged connectionless-mode command PDU.

In the WAIT_A state, the LLC is waiting for an acknowledgement of a previously transmitted acknowledged connectionless-mode command PDU which was invoked by a DL-DATA-ACK.request service primitive.

In the WAIT_R state, the LLC is waiting for an acknowledgement of a previously transmitted acknowledged connectionless-mode command PDU which was invoked by a DL-REPLY.request service primitive.

The parameter N11 "Maximum Number of Transmissions" has to be set. If it is set to N11 = 1, then there will be no retransmissions of a frame done by the LLC; retransmissions then may be initiated either by the AL or by the application. It is

- N11: dependent on installation.

N11 together with an acknowledgement timer is maintained separately for each acknowledged connectionless information exchange between RSU and OBU.

The acknowledgement timer, i.e. a counter, is incremented with every BST.

The value of the parameter N13 "Maximum Value for Acknowledgement Timer" is defined in EN 13372 [4].

Transitions #7 and #12 never will occur for N11 = 1 (there will be no retransmissions). Transitions #6 and #11 are duplicates (sequence error) that need to be ignored.

Current State	**#**	**Event (multiple events are connected with AND)**	**Action(s)**	**Next State**
IDLE /13	1	RECEIVE_ACn_RSP	(No action)	IDLE
/14	2	DATA_ACK_REQUEST	TRANSMIT_ACn_CMD(n=V(SI), P='0'B) START_ACK_TIMER RETRY_COUNT:=RETRY_COUNT+*1*	WAIT_A
/15	3	REPLY_REQUEST	TRANSMIT_ACn_CMD(n=V(SI), P='1'B) START_ACK_TIMER RETRY_COUNT:=RETRY_COUNT+*1*	WAIT_R
WAIT_A /16	4	RECEIVE_ACn_RSP(n<>V(SI), LSDU=NULL)	DATA_ACK_STATUS_INDICATION (STATUS=STATUS_SUBFIELD) CANCEL_ACK_TIMER RETRY_COUNT:=*0* V(SI):= '1'B-V(SI)	IDLE
/17	5	RECEIVE_ACn_RSP(n<>V(SI), LSDU<>NULL)	DATA_ACK_STATUS_INDICATION (STATUS=PE) CANCEL_ACK_TIMER RETRY_COUNT:=*0* V(SI):= '1'B-V(SI) REPORT_STATUS(ILLEGAL_LSDU)	IDLE

[13] This should never occur

[14] This is to write to the OBU without polling data.

[15] This is to exchange data with the OBU.

[16] Command #2 has been completed successfully.

[17] The acknowledgement frame carries unexpected data.

Current State	#	Event (multiple events are connected with AND)	Action(s)	Next State
/[18]	6	RECEIVE_ACn_RSP(n=V(SI))	(no action)	WAIT_A
/[19]	7	ACK_TIMER_EXPIRED RETRY_COUNT<N11[20]	RETRANSMIT_OLD_CMD START_ACK_TIMER RETRY_COUNT:=RETRY_COUNT+*1*	WAIT_A
/[21]	8	ACK_TIMER_EXPIRED RETRY_COUNT>=N11	DATA_ACK_STATUS_INDICATION (STATUS=UNSUCCESSFUL) RETRY_COUNT:=*0*	IDLE
WAIT_R /[22]	9	RECEIVE_ACn_RSP(n<>V(SI), R=OK)	REPLY_STATUS_INDICATION (STATUS=STATUS_SUBFIELD, LSDU=GIVEN_LSDU) CANCEL_ACK_TIMER RETRY_COUNT:=*0* V(SI):= '1'B-V(SI)	IDLE
/[23]	10	RECEIVE_ACn_RSP(n<>V(SI), R<>OK)	REPLY_STATUS_INDICATION (STATUS=STATUS_SUBFIELD, LSDU=NULL) CANCEL_ACK_TIMER RETRY_COUNT:=*0* V(SI):= '1'B-V(SI)	IDLE
/[24]	11	RECEIVE_ACn_RSP(n=V(SI))	(No action)	WAIT_R
/[25]	12	ACK_TIMER_EXPIRED RETRY_COUNT<N11[26]	RETRANSMIT_OLD_CMD START_ACK_TIMER RETRY_COUNT:=RETRY_COUNT+*1*	WAIT_R
/[27]	13	ACK_TIMER_EXPIRED RETRY_COUNT>=N11	DATA_ACK_STATUS_INDICATION (STATUS=UNSUCCESSFUL, LSDU=NULL) RETRY_COUNT:=*0*	IDLE

RSU Component State Transitions

The events and actions are defined as follows:

DATA_ACK_REQUEST:
The application layer has passed a DL-DATA-ACK.request service primitive to the LLC.

REPLY_REQUEST:
The application layer has passed a DL-REPLY.request service primitive to the LLC.

[18] Response with sequence error ignored.

[19] Repetition of command #2.

[20] This will never occur if N11 = 1.

[21] Number of possible repetitions exceeded. ACn command sequence stopped without response.

[22] Command #3 has been completed successfully.

[23] Command #3 has been completed without reception of requested data.

[24] Response with sequence error ignored.

[25] Repetition of command #3.

[26] This will never occur if N11 = 1.

[27] Number of possible repetitions exceeded. ACn command sequence stopped without response.

RECEIVE_ACn_RSP(SQR, R, LSDU):

The MAC sub-layer has passed a MA-DATA.indication service primitive to the LLC that contains an ACn response PDU, where the response sequence bit SQR (bit seven of the LLC control field code) is '0'B for an AC0 response or '1'B for an AC1 response. The following parameter values exist for this event:

n=V(SI): The response sequence bit (SQR = n) is equal to V(SI).

n<>V(SI): The response sequence bit n is not equal to V(SI).

R=OK: The RRRR part of the LLC status field of the received response PDU shows the OK status.

R<>OK: The RRRR part of the LLC status field of the received response PDU shows a status other than the OK status.

LSDU=NULL: The received LSDU is null.

LSDU<>NULL: The received LSDU is non-null.

ACK_TIMER_EXPIRED:

The acknowledgement timer associated with this sender component (LID) has expired.

RETRY_COUNT<N11:

The retry count for this sender component (LID) is less than the LLC parameter N11.

RETRY_COUNT>=N11:

The retry count for this sender component (LID) is greater than or equal to the LLC parameter N11.

TRANSMIT_ACn_CMD(SQC, P):

Pass an MA-DATA.request service primitive containing an ACn command PDU to the MAC sub-layer. The following parameter values exist for this action:

n=V(SI): Set the command sequence bit (SQC = n) equal to the V(SI) state variable. If V(SI) does not exist, create it with a value of zero; otherwise use the current value.

P=: The Poll bit is set to the indicated value.

The RR parameter of the F-MA-DATA.request service primitive shall be set in order to allocate a private up link window used for the expected response (DLL acknowledge frame).

RETRANSMIT_OLD_CMD:

Pass an MA-DATA.request service primitive containing the ACn command PDU most recently transmitted by this sender component to the MAC sub-layer.

The RR parameter of the MA-DATA.request service primitive shall be set in order to allocate a private up link window used for the expected response (DLL acknowledge frame).

START_ACK_TIMER:

Start the acknowledgement timer for this sender component.

CANCEL_ACK_TIMER:

Cancel the acknowledgement timer for this sender component.

DATA_ACK_STATUS_INDICATION(STATUS):

Pass a DL-DATA-ACK-STATUS.indication service primitive to the application layer if mode = 1. The following parameter values exist for this action:

STATUS=UNSUCCESSFUL: The status parameter is set to indicate failure to receive an acknowledgement.

STATUS=STATUS_SUBFIELD: The status parameter is set according to the status returned in the received response PDU.

REPLY_STATUS_INDICATION(STATUS, LSDU)

Pass a DL-REPLY-STATUS.indication service primitive to the application layer. The following parameter values exist for this action:

STATUS=UNSUCCESSFUL: The status parameter is set to indicate failure to receive an acknowledgement.

STATUS=STATUS_SUBFIELD: The status parameter is set according to the status returned in the received response PDU.

STATUS=PE: The status parameter is set to the PE status (protocol error).

LSDU=NULL: The data parameter is null.

LSDU=GIVEN_LSDU: The data parameter contains the LSDU given in the associated MA-DATA.indication service primitive.

V(SI):='1'B-V(SI):

Complement V(SI).

RETRY_COUNT:=0:

Set the retry counter to *0*.

RETRY_COUNT:=RETRY_COUNT+*1*:

Increment the retry counter.

REPORT_STATUS(ILLEGAL_LSDU):

Report to layer management that an LSDU was received in violation of the acknowledged connectionless-mode LLC protocol.

9. ANNEX D – SEQUENCES OF BITS

9.1 GENERAL

The tables presented in the following paragraphs show the data sequences (APDU [3]) as being embedded between start flag and the Frame Check Sequence [2]. These tables show precisely how the first AutoPASS installation was done. All subsequent implementations shall be compatible to the first implementation.

The complete down link frame is as follows:

Data #	Field	Contents or Bits in Octet b_7 b_0 respectively	Description
0	Preamble	Preamble waveform of duration 16 bit ± 1 bit	See EN 12253 [1].
1	Start Flag	0 1 1 1 1 1 1 0	See MAC layer specification
2	APDU	Dependent on frame	See following paragraphs
3	Frame Check Sequence	x x x x x x x x x x x x x x x x	16 bits dependent on APDU.
4	End Flag	0 1 1 1 1 1 1 0	Same as Start Flag

The complete up link frame is as follows:

Data #	Field	Contents or Bits in Octet b_7 b_0 respectively	Description
0	Preamble	Preamble waveform of duration 32 ... 36 µs plus 8 bit	See EN 12253 [1].
1	Start Flag	0 1 1 1 1 1 1 0	See MAC layer specification
2	APDU	Dependent on frame	See following paragraphs
3	Frame Check Sequence	x x x x x x x x x x x x x x x x	16 bits dependent on APDU.
4	End Flag	0 1 1 1 1 1 1 0	Same as Start Flag

9.2 BST

Octet #	Attribute / Field		b_7 b_0	Description
0	Broadcast LID		1 1 1 1 1 1 1 **1**	Link address for broadcast
1	MAC control field. L		1	The frame contains an LPDU
	MAC control field. D		0	Direction is down link
	MAC control field. A		1	Private Up Link Window is allocated
	MAC control field. C/R		0	Command LPDU
	MAC control field. S		s	Value irrelevant. Set to 0.
	MAC control field. reserved bits		0 0 0	Reserved.
2	LLC control field. M		0 0 0 0 0	UI command
	LLC control field. P/F		0	
	LLC control field. reserved bits		1 1	Not used. Always set to 1.
3	Fragmentation header		1 0 0 1 0 0 0 1	No fragmentation
4			1 0 0 0	INITIALISATION.request
	BST	SEQUENCE		
	{			
	OPTION indicator		0	Nonmand applications not present.
	BeaconId.ManufacturerId	INTEGER (0..65535),	m m m	(MSB) See list of manufacturers as formalised in ISO 14816 and as managed by NNI.
5			m m m m m m m m	
6			m m m m m	
	BeaconId.IndividualId	INTEGER(0..2^{27}-1),	i i i	(MSB) 27 bit ID available for manufacturer
7			i i i i i i i i	
8			i i i i i i i i	
9			i i i i i i i i	
10	Time	TimeReal	t t t t t t t t	(MSB) 32 bit UNIX real time.
11			t t t t t t t t	
12			t t t t t t t t	
13			t t t t t t t t	
14	Profile	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 p	No extension, Profile p p=0: 1,5 MHz subcarrier p=1: 2,0 MHz subcarrier

Octet #	Attribute / Field		b_7 b_0	Description
15	MandApplications	SEQUENCE(0..127,..) OF	**0** j j j j j j j	No extension, Number of MandApplications j
15+1 ... 15+j	**{**			*This sequence in paranthesis is repeated j-times for every of j MandApplication. The example shown below is for EFC.*
	OPTION indicator		0	EID not present
	OPTION indicator		0	Parameter not present
	AID	DSRCApplicationEntityID	**0** 0 0 0 0 1	No extension, AID = 1 (EFC)
	}			
16+j	Profile List	SEQUENCE(0..127,...) OF	**0** x x x x x x x	No extension, number of profiles in list = x. The value of x shall be **x=0**. If x=0, then the following octets are not existent.
16+j+1	**{**			
	Profile	INTEGER(0..127,...)	0 x x x x x x x	Profile 1
16+j+2	Profile	INTEGER(0..127,...)	0 x x x x x x x	Profile 2
	.....			
16+j+n	Profile	INTEGER(0..127,...)	0 x x x x x x x	Last profile (n)
	}			
	}			

9.3 PRIVATE WINDOWREQUEST

Octet #	Attribute / Field	b_7 b_0	Description
0	Private LID	x x x x x x x **0**	Link address of a specific OBU
1		x x x x x x x **0**	
2		x x x x x x x **0**	
3		x x x x x x x **1**	
4	MAC control field. L	0	The frame contains no LPDU
	MAC control field. D	1	Direction is up link
	MAC control field. R	1	Private Up Link Window is requested
	MAC control field. C/R	0	Command LPDU
	MAC control field. reserved bits	0 0 0 0	Reserved.

9.4 PRIVATE WINDOW ALLOCATION

Octet #	Attribute / Field	b_7 b_0	Description
0	Private LID	x x x x x x x **0**	Link address of a specific OBU
1		x x x x x x x **0**	
2		x x x x x x x **0**	
3		x x x x x x x **1**	
4	MAC control field. L	0	The frame contains no LPDU
	MAC control field. D	0	Direction is down link
	MAC control field. A	1	Private Up Link Window is requested
	MAC control field. C/R	0	Command LPDU
	MAC control field. S	s	Sequence bit. Set to 0 for absolute first allocation to this LID.
	MAC control field. reserved bits	0 0 0	Reserved.

9.5 VST

Example with one context mark:

Octet #	Attribute / Field		b_7 b_0	Description
0	Private LID		x x x x x x x **0**	Link address of a specific OBU
1			x x x x x x x **0**	
2			x x x x x x x **0**	
3			x x x x x x x **1**	
4	MAC control field. L		1	The frame contains a LPDU
	MAC control field. D		1	Direction is up link
	MAC control field. R		0	Private Up Link Window is not requested
	MAC control field. C/R		0	Command LPDU
	MAC control field. reserved bits		0 0 0 0	Reserved.
5	LLC control field. M		0 0 0 0 0	UI command
	LLC control field. P/F		0	
	LLC control field. reserved bits		1 1	Not used. Always set to 1.
6	Fragmentation header		1 0 0 1 0 0 0 1	No fragmentation
7	VST	SEQUENCE	1 0 0 1	INITIALISATION.response
	{			
	Fill	BIT STRING (SIZE(4))	0 0 0 0	Set to 0
8	Profile	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 p	No extension, profile p
9	Applications	SEQUENCE(0..127,...) OF	**0** 0 0 0 0 0 0 1	No extension, one application
10	**{**			
	OPTION indicator		1	EID present
	OPTION indicator		1	Parameter present
	AID	DSRCApplicationEntityID	**0** 0 0 0 0 0 1	No extension, AID = 1 (EFC)
11	EID		0 0 0 0 0 0 0 1	EID unique within the OBU and related to a context mark.
12	Parameter	Container	0 0 0 0 0 0 1 0	OCTET STRING = 2
13			**0** 0 0 0 0 1 1 0	No extension, octet string length = 6
14	EFC-ContextMark	SEQUENCE		
	{			
	ContractProvider	SEQUENCE		
	{			
	CountryCode	BIT STRING(SIZE(10))	c c c c c c c c	(MSB) 10 bit country code c according to ISO 3166 with ITA2 binary encoding based on ISO 14816
15			c c	

Octet #	Attribute / Field		b_7 b_0	Description
	IssuerIdentifier	INTEGER(0..16383)	d d d d d d	(MSB) 14 bits issuer identifier d
16			d d d d d d d d	
17	}			
	TypeOfContract	OCTET STRING (SIZE(2))	t t t t t t t t	(MSB) Type t of contract
18			t t t t t t t t	
19	ContextVersion	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 1	No extension, context version = 1
	}			
	}			
20	ObeConfiguration	SEQUENCE		
	{			
	OPTION indicator		1	efcStatus present
	equipmentClass	INTEGER(0..32767,...)	x x x x x x x x	(MSB)
21			x x x x x x x x	
22	manufacturerId	INTEGER(0..65535,...)	i i i i i i i i	(MSB). E.g. Q-Free ASA: 6
23			i i i i i i i i	
24	efcStatus	SEQUENCE		
	{			
	StatusFlags	BIT STRING(SIZE(16)		
	OBU.Moved		m	Moved bit: m=1: OBU moved, else m=0.
	-		0	not used for AutoPASS
	Battery.Low		b	Battery low bit: b=1: voltage low, else b=0.
	-		0	not used for AutoPASS
	-		0	not used for AutoPASS
	-		0	not used for AutoPASS
	-		0	not used for AutoPASS
	-		0	not used for AutoPASS
25	Reserved		0 0 0 0 0 0 0 0	not used for AutoPASS
	} } }			

9.6 ECHO.REQUEST

Octet #	Attribute / Field		b_7 b_0	Description
0	Private LID		x x x x x x x **0**	Link address of a specific OBU
1			x x x x x x x **0**	
2			x x x x x x x **0**	
3			x x x x x x x **1**	
4	MAC control field. L		1	The frame contains a LPDU
	MAC control field. D		0	Direction is down link
	MAC control field. A		1	Private Up Link Window is allocated
	MAC control field. C/R		0	Command LPDU
	MAC control field. S		s	Sequence bit. At RSU the S bit is set equal to V(A). At the OBU V(A) is set equal to S.
	MAC control field. reserved bits		0 0 0	Reserved.
5	LLC control field. n		n	ACn command frame bit
	LLC control field. M		1 1	ACn command
	LLC control field. P/F		1	Polling
	LLC control field. reserved bits		1 1	Not used. Always set to 1.
6	Fragmentation header		1 0 0 1 0 0 0 1	No fragmentation
7			0 0 0 0	ACTION.request
	ECHO.request	SEQUENCE		
	{			
	OPTION indicator		0	No AccessCredentials
	OPTION indicator		1	ActionParameter present
	OPTION indicator		0	IID not present
	Mode	BOOLEAN	1	Reply expected
8	EID	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 0	No extension, EID = 0
9	ActionType	INTEGER(0..127,...)	**0** 0 0 0 1 1 1 1	No extension, ECHO.request = 15
10	ActionParameter	CONTAINER	**0** 0 0 0 0 0 1 0	No extension, Type 2 = Octet string
11			**0** 0 0 0 0 0 0 0	No extension. String length = 0 octets
	}			

9.7 ECHO.RESPONSE

Octet #	Attribute / Field		b_7 b_0	Description
0	Private LID		x x x x x x x **0**	Link address of a specific OBU
1			x x x x x x x **0**	
2			x x x x x x x **0**	
3			x x x x x x x **1**	
4	MAC control field. L		1	The frame contains a LPDU
	MAC control field. D		1	Direction is up link
	MAC control field. R		0	Private Up Link Window is not requested
	MAC control field. C/R		1	Response LPDU
	MAC control field. reserved bits		0 0 0 0	Reserved.
5	LLC control field. n		n	ACn command frame bit
	LLC control field. M		1 1 0 1	ACn command
	LLC control field. P/F		1	Final bit set.
	LLC control field. reserved bits		1 1	Not used. Always set to 1.
6	LLC status field. RRRR		0 0 0 0	Response available
	LLC status field. CCCC		0 0 0 0	Command accepted
7	Fragmentation header		1 0 0 1 0 0 0 1	No fragmentation
8			0 0 0 1	ACTION.response
	ECHO.response	SEQUENCE		
	{			
	OPTION indicator		0	No IID
	OPTION indicator		1	ResponseParameter present
	OPTION indicator		0	ReturnStatus not present
	FILL	BIT STRING (SIZE(1))	0	Set to 0.
9	EID	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 0	No extension, EID = 0
10	ResponseParameter	CONTAINER	**0** 0 0 0 0 0 1 0	No extension, Type 2 = Octet string
11			**0** 0 0 0 0 0 0 0	No extension. String length = 0 octets
	}			

9.8 GET_SECURE.REQUEST

Octet #	Attribute / Field		b_7 b_0	Description
0	Private LID		x x x x x x x **0**	Link address of a specific OBU
1			x x x x x x x **0**	
2			x x x x x x x **0**	
3			x x x x x x x **1**	
4	MAC control field. L		1	The frame contains a LPDU
	MAC control field. D		0	Direction is down link
	MAC control field. A		1	Private Up Link Window is allocated
	MAC control field. C/R		0	Command LPDU
	MAC control field. S		s	Sequence bit. At RSU the S bit is set equal to V(A). At the OBU V(A) is set equal to S.
	MAC control field. reserved bits		0 0 0	Reserved.
5	LLC control field. n		n	ACn command frame bit
	LLC control field. M		1 1	ACn command
	LLC control field. P/F		1	Polling
	LLC control field. reserved bits		1 1	Not used. Always set to 1.
6	Fragmentation header		1 0 0 1 0 0 0 1	No fragmentation
7			0 0 0 0	ACTION.request
	GET_SECURE.request	SEQUENCE		
	{			
	OPTION indicator		1	AccessCredentials present
	OPTION indicator		1	ActionParameter present
	OPTION indicator		0	IID not present
	Mode	BOOLEAN	1	Reply expected
8	EID	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 1	No extension, EID = 1
9	ActionType	INTEGER(0..127,...)	**0** 0 0 0 0 0 1 0	No extension, GET_SECURE.request = 2
10	AccessCredentials	OCTET STRING	**0** 0 0 0 1 0 0 1	No extension, string length = 9 octets
11	**{**			
	KeyGeneration	INTEGER(0..127,...)	**0** 0 0 0 0 g g g	Key generation.
12	RND-1	OCTET STRING(SIZE(4)	r r r r r r r r	(LSB) 4 octets random number challenge from roadside
13			r r r r r r r r	
14			r r r r r r r r	
15			r r r r r r r r	

Octet #	Attribute / Field		b_7 b_0	Description
16	TVP	OCTET STRING(SIZE(4)	t t t t t t t t	(LSB) 4 octets time variable parameter used in encryption
17			t t t t t t t t	
18			t t t t t t t t	
19			t t t t t t t t	
20	**}**			
	ActionParameter	CONTAINER	**0** 0 0 0 0 0 1 0	No extension, Type 2 = Octet string
21			**0** 0 0 0 0 0 1 0	No extension, octet string length = 2
22	**{**		**0** 0 0 0 0 0 0 1	No extension, number of attributes = 1
23	First attributeId	INTEGER(0..127,...)	0 1 1 0 0 0 1 1	Attribute AutoPASSdata1; attributeId=99.
	} }			

9.9 GET_SECURE.RESPONSE

Octet #	Attribute / Field		b_7 b_0	Description
0	Private LID		x x x x x x x **0**	Link address of a specific OBU
1			x x x x x x x **0**	
2			x x x x x x x **0**	
3			x x x x x x x **1**	
4	MAC control field. L		1	The frame contains a LPDU
	MAC control field. D		1	Direction is up link
	MAC control field. R		0	Private Up Link Window is not requested
	MAC control field. C/R		1	Response LPDU
	MAC control field. reserved bits		0 0 0 0	Reserved.
5	LLC control field. n		n	ACn command frame bit
	LLC control field. M		1 1 0 1	ACn command
	LLC control field. P/F		1	Final bit set.
	LLC control field. reserved bits		1 1	Not used. Always set to 1.
6	LLC status field. RRRR		0 0 0 0	Response available
	LLC status field. CCCC		0 0 0 0	Command accepted
7	Fragmentation header		1 0 0 1 0 0 0 1	No fragmentation
8			0 0 0 1	ACTION.response
	GET_SECURE.response	SEQUENCE		
	{			
	OPTION indicator		0	IID not present
	OPTION indicator		1	ResponseParameter present
	OPTION indicator		0	ReturnStatus not present
	fill	BIT STRING (SIZE(1))	0	
9	EID	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 1	No extension, EID = 1
10	ResponseParameter	CONTAINER	**0** 0 0 0 0 0 1 0	No extension. OCTET String = 2.
11			**0** 0 0 1 1 1 0 0	No extension, octet string length = 28
12	**{**			
	Attributes	SEQUENCE	**0** 0 0 0 0 0 0 1	No extension. 1 attribute in list
13	**{**			
	AttributeId	INTEGER(0..127,...)	**0** 1 1 0 0 0 1 1	No extension. AttributeId = 99 (AutoPASSdata1)
14	Attribute Value	CONTAINER	0 0 0 0 0 0 1 0	OCTET STRING = 2
15			**0** 0 0 1 1 0 0 0	No extension. String length = 24 octets

Octet #	Attribute / Field		b_7 b_0	Description
16	{			
	obuID	CS1	c c c c c c c c	country code c
17			c c	
			i i i i i i	IssuerIdentifier i
18			i i i i i i i i	
19			s s s s s s s s	ServiceNumber s
20			s s s s s s s s	
21			s s s s s s s s	
22			s s s s s s s s	
23	efcStatus	BIT STRING(SIZE(16))	m	Moved bit: m=1: OBU moved, else m=0.
			0	not used for AutoPASS
			b	Battery low bit: b=1: voltage low, else b=0.
			0	not used for AutoPASS
			0	
			0	
			0	
			0	
24			0 0 0 0 0 0 0 0	
25	TC	OCTET STRING(SIZE(2))	t t t t t t t t	(LSB): Transaction counter
26			t t t t t t t t	
27	RND-2	OCTET STRING(SIZE(4))	r r r r r r r r	(LSB): Random number challenge
28			r r r r r r r r	
29			r r r r r r r r	
30			r r r r r r r r	
31	MAC1	OCTET STRING(SIZE(4))	m m m m m m m m	(LSB): Message authenticator
32			m m m m m m m m	
33			m m m m m m m m	

Octet #	Attribute / Field		b_7 b_0	Description
34			m m m m m m m m	
35	MAC2	OCTET STRING(SIZE(4))	n n n n n n n n	(LSB): Message authenticator
36			n n n n n n n n	
37			n n n n n n n n	
38			n n n n n n n n	
39	LogIndex	INTEGER(0..255)	j j j j j j j j	Points to most recent entry in log file
	} } } }			

9.10 SET.REQUEST

Octet #	Attribute / Field		b_7 b_0	Description
0	Private LID		x x x x x x x **0**	Link address of a specific OBU
1			x x x x x x x **0**	
2			x x x x x x x **0**	
3			x x x x x x x **1**	
4	MAC control field. L		1	The frame contains a LPDU
	MAC control field. D		0	Direction is down link
	MAC control field. A		1	Private Up Link Window is allocated
	MAC control field. C/R		0	Command LPDU
	MAC control field. S		s	Sequence bit. At RSU the S bit is set equal to V(A). At the OBU V(A) is set equal to S.
	MAC control field. reserved bits		0 0 0	Reserved.
5	LLC control field. n		n	ACn command frame bit
	LLC control field. M		1 1 0 1	ACn command
	LLC control field. P/F		1	Polling
	LLC control field. reserved bits		1 1	Not used. Always set to 1.
6	Fragmentation header		1 0 0 1 0 0 0 1	No fragmentation
7			0 1 0 0	SET.request
	SET.request	SEQUENCE		
	{			
	OPTION indicator		0	No AccessCredentials present
	OPTION indicator		0	IID not present
	fill	BIT STRING (SIZE(1))	0	Fill bit
	Mode	BOOLEAN	1	Reply expected
8	EID	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 1	No extension, EID = 1
9	Attributes	SEQUENCE	**0** 0 0 0 0 0 0 1	No extension. 1 attribute in list
10	**{**			
	AttributeId	INTEGER(0..127,...)	0 1 1 0 0 1 0 0	No extension. AttributeId = 100 (AutoPASSdata2)
11	Attribute Value	CONTAINER	0 0 0 0 0 0 1 0	OCTET STRING = 2
12			0 0 0 1 0 0 1 1	No extension. String length = 19 octets
13	**{**			
	LogIndex	INTEGER(0..255)	i i i i i i i i	Log index number for write process
14	OBUstatusControl	OCTET STRING(SIZE(2))	m	m=1: Clear efcStatus.Bit7 (moved flag)
			u	u=1: Update log index pointer
			0 0 0 0 0 0	

Octet #	Attribute / Field		b_7 b_0	Description
15			0 0 0 0 0 0 0 0	Reserved, set to 0.
16	passingLogData	SEQUENCE		
	{			
	LogType	INTEGER(0..255)	0 0 0 0 0 0 0 1	Type of log entry
17	SessionTime	TimeReal	t t t t t t t t	Time of session
18			t t t t t t t t	
19			t t t t t t t t	
20			t t t t t t t t	
21	SessionServiceProvider	Provider	p p p p p p p p	Organisation that provides the service of the session.
22			p p p p p p p p	
23			p p p p p p p p	
24	StationLocation	INTEGER(0..1048575)	l l l l l l l l	Service provider specific coding of the station location.
25			l l l l l l l l	
26			l l l l	
	TypeOfSession	StationType	y y y y	Type of service station
27	SessionLocation	BIT STRING(SIZE(8))	c c c c c c c c	Service provider specific coding of the session location within the station location (Lane)
28	SessionResultOperational	Result	o o o o o o o o	efcStatus (most significant octet)
29	SessionResultFinancial	Result	f f f f f f f f	Code designating whether a session has been completed successfully or not with regard to financial issues
30	ReceiptAuthenticator	OCTET STRING(SIZE(2))	a a a a a a a a	CRC-16 authenticator over the preceding 14 octets.
31			a a a a a a a a	
	}			
	} } }			

9.11 SET.RESPONSE

Octet #	Attribute / Field		b_7 b_0	Description
0	Private LID		x x x x x x x **0**	Link address of a specific OBU
1			x x x x x x x **0**	
2			x x x x x x x **0**	
3			x x x x x x x **1**	
4	MAC control field. L		1	The frame contains a LPDU
	MAC control field. D		1	Direction is up link
	MAC control field. R		0	Private Up Link Window is not requested
	MAC control field. C/R		1	Response LPDU
	MAC control field. reserved bits		0 0 0 0	Reserved.
5	LLC control field. n		n	ACn command frame bit
	LLC control field. M		1 1 0 1	ACn command
	LLC control field. P/F		1	Final bit set.
	LLC control field. reserved bits		1 1	Not used. Always set to 1.
6	LLC status field. RRRR		0 0 0 0	Response available
	LLC status field. CCCC		0 0 0 0	Command accepted
7	Fragmentation header		1 0 0 1 0 0 0 1	No fragmentation
8			0 1 0 1	SET.response
	SET.response	SEQUENCE		
	{			
	OPTION indicator		0	IID not present
	OPTION indicator		1	ReturnStatus present
	fill	BIT STRING (SIZE(2))	0 0	Fill bit. Set to 0.
9	EID	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 1	No extension, EID = 1
10	ReturnStatus	INTEGER(0..127,...)	**0** s s s s s s s	No extension. s=0: accepted s=1: access denied s=5: processing
	}			

9.12 GET_INSTANCE.REQUEST

Octet #	Attribute / Field		b_7 b_0	Description
0	Private LID		x x x x x x x **0**	Link address of a specific OBU
1			x x x x x x x **0**	
2			x x x x x x x **0**	
3			x x x x x x x **1**	
4	MAC control field. L		1	The frame contains a LPDU
	MAC control field. D		0	Direction is down link
	MAC control field. A		1	Private Up Link Window is allocated
	MAC control field. C/R		0	Command LPDU
	MAC control field. S		s	Sequence bit. At RSU the S bit is set equal to V(A). At the OBU V(A) is set equal to S.
	MAC control field. reserved bits		0 0 0	Reserved.
5	LLC control field. n		n	ACn command frame bit
	LLC control field. M		1 1 0 1	ACn command
	LLC control field. P/F		1	Polling
	LLC control field. reserved bits		1 1	Not used. Always set to 1.
6	Fragmentation header		1 0 0 1 0 0 0 1	No fragmentation
7			0 0 0 0	ACTION.request
	GET_INSTANCE.request	SEQUENCE		
	{			
	OPTION indicator		0	No AccessCredentials present
	OPTION indicator		1	ActionParameter present
	OPTION indicator		0	IID not present
	Mode	BOOLEAN	1	Reply expected
8	EID	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 1	No extension, EID = 1
9	ActionType	INTEGER(0..127,...)	**0** 0 0 0 0 1 0 0	No extension, GET_INSTANCE.request = 4
10	**{**	Container1.3	**0** 0 0 1 0 1 0 0	Type = GetInstanceRq
11	posOfFirstInstance	INTEGER(0..255)	n n n n n n n n	Points to latest record to be retrieved
12	posOfLAstInstance	INTEGER(0..255)	m m m m m m m m	m=n+3
13	**{**			
	Attributes	SEQUENCE	**0** 0 0 0 0 0 0 1	No extension, number of attributes = 1
14	AttributeId		**0** 1 1 1 1 1 1 1	No extension, attributeId=127 (AutoPASSdata3)
	} } }			

9.13 GET_INSTANCE.RESPONSE

Octet #	Attribute / Field		b_7 b_0	Description
0	Private LID		x x x x x x x **0**	Link address of a specific OBU
1			x x x x x x x **0**	
2			x x x x x x x **0**	
3			x x x x x x x **1**	
4	MAC control field. L		1	The frame contains a LPDU
	MAC control field. D		1	Direction is up link
	MAC control field. R		0	Private Up Link Window is not requested
	MAC control field. C/R		1	Response LPDU
	MAC control field. reserved bits		0 0 0 0	Reserved.
5	LLC control field. n		n	ACn command frame bit
	LLC control field. M		1 1 0 1	ACn command
	LLC control field. P/F		1	Final bit set.
	LLC control field. reserved bits		1 1	Not used. Always set to 1.
6	LLC status field. RRRR		0 0 0 0	Response available
	LLC status field. CCCC		0 0 0 0	Command accepted
7	Fragmentation header		1 0 0 1 0 0 0 1	No fragmentation
8			0 0 0 1	ACTION.response
	GET_INSTANCE.response	SEQUENCE		
	{			
	OPTION indicator		0	IID not present
	OPTION indicator		1	ResponseParameter present
	OPTION indicator		0	ReturnStatus not present
	fill	BIT STRING (SIZE(1))	0	Fill bit, set to 0.
9	EID	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 1	No extension, EID = 1
10	ResponseParameter	CONTAINER	**0** 0 0 1 0 1 0 1	No extension. GetInstanceRs = 21.
11	**{**			
	Attributes	SEQUENCE	**0** 0 0 0 0 0 0 1	No extension. 1 attribute in list
12	**{**			
	AttributeId	INTEGER(0..127,...)	**0** 1 1 1 1 1 1 1	No extension. AttributeId = 127 (AutoPASSdata3)
13	Attribute Value	CONTAINER1.4	0 0 0 0 0 0 1 0	OCTET STRING = 2
14			**0** 1 0 0 0 0 0 0	No extension. String length = 64 octets
15 - 30	**{**			
	log_entry_n_plus_0	AutoPASSdata3	16 octets	first instance
31 - 46	log_entry_n_plus_1	AutoPASSdata3	16 octets	second instance

Octet #	Attribute / Field		b_7 b_0	Description
47 - 62	log_entry_n_plus_2	AutoPASSdata3	16 octets	third instance
63 - 78	log_entry_n_plus_3	AutoPASSdata3	16 octets	fourth instance
	} } } }			

9.14 GET_INSTANCE.RESPONSE (LATE RESPONSE)

Shall be send if OBU is not ready to provide requested log information.

Octet #	Attribute / Field		b_7 ... b_0	Description
0	Private LID		x x x x x x x **0**	Link address of a specific OBU
1			x x x x x x x **0**	
2			x x x x x x x **0**	
3			x x x x x x x **1**	
4	MAC control field. L		1	The frame contains a LPDU
	MAC control field. D		1	Direction is up link
	MAC control field. R		0	Private Up Link Window is not requested
	MAC control field. C/R		1	Response LPDU
	MAC control field. reserved bits		0 0 0 0	Reserved.
5	LLC control field. n		n	ACn command frame bit
	LLC control field. M		1 1 0 1	ACn command
	LLC control field. P/F		1	Final bit set.
	LLC control field. reserved bits		1 1	Not used. Always set to 1.
6	LLC status field. RRRR		0 0 0 0	Response available
	LLC status field. CCCC		0 0 0 0	Command accepted
7	Fragmentation header		1 0 0 1 0 0 0 1	No fragmentation
8			0 0 0 1	ACTION.response
	GET_INSTANCE.response	SEQUENCE		
	{			
	OPTION indicator		0	IID not present
	OPTION indicator		0	ResponseParameter not present
	OPTION indicator		1	ReturnStatus present
	fill	BIT STRING (SIZE(1))	0	Fill bit, set to 0.
9	EID	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 1	No extension, EID = 1
10	ReturnStatus	INTEGER(0..127,...)	**0** 0 0 0 0 1 0 1	Processing = 5.
	}			

9.15 RELEASE.REQUEST

Octet #	Attribute / Field		b_7 b_0	Description
0	Private LID		x x x x x x x **0**	Link address of a specific OBU
1			x x x x x x x **0**	
2			x x x x x x x **0**	
3			x x x x x x x **1**	
4	MAC control field. L		1	The frame contains a LPDU
	MAC control field. D		0	Direction is down link
	MAC control field. A		0	Private Up Link Window is not allocated
	MAC control field. C/R		0	Command LPDU
	MAC control field. S		s	Sequence bit. At RSU the S bit is set equal to V(A). At the OBU V(A) is set equal to S. The value is irrelevant as this is the last command.
	MAC control field. reserved bits		0 0 0	Reserved.
5	LLC control field. M		0 0 0 0 0	UI command
	LLC control field. P/F		0	
	LLC control field. reserved bits		1 1	Not used. Always set to 1.
6	Fragmentation header		1 0 0 1 0 0 0 1	No fragmentation
7			0 0 1 0	EVENT-Report.request
	RELEASE.request	SEQUENCE		
	{			
	OPTION indicator		0	No AccessCredentials
	OPTION indicator		0	No EVENT Parameter
	OPTION indicator		0	IID not present
	Mode	BOOLEAN	0	No reply expected
8	EID	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 0	No extension, EID = 0
9	EVENT Type	INTEGER(0..127,...)	**0** 0 0 0 0 0 0 0	No extension, RELEASE.request = 0
	}			

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