Final Review of draft UNI DSRC Specifications

Prepared by Expert Group 8
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on the work in Directive 2004/52/EC

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Table of contents

1. Introduction

1.1. Purpose and scope

European Directive 2004/52/EC deals with the interoperability of electronic road toll systems in the Community. The Directive sets a target date of July 2006 for international agreement on the definition of the European Electronic Toll Service (EETS).

It is expected that on-board units (OBUs) will be provided to users wanting the EETS service by any authorised Issuer for use with all eligible charging schemes across Europe.

Expert Group 8 (EG8) was established by the European Commission to make a final review of the revised Draft UNI DSRC standards, in connection with the Regulatory Committee on Electronic Fee Collection (EFC) created by the Directive 2004/52/EC.

The overall aim of the review is to appreciate whether the Draft UNI DSRC standards support an open vendor market for UNI DSRC compliant OBUs from a technical point of view, i.e. whether they provide the same type and depth of information as the European 5.8 GHz-related standards do.

Following the work of EG1, Italy delivered a revised set of Draft UNI DSRC standards, aimed at resolving the issues raised as a result of EG1's work.

Specifically, the task of EG8 is to assess to what extent the issues identified in EG1's final report on "Recommendations on microwave DSRC technologies at 5.8 GHz to be used for the European electronic toll service" [EG1 Final Report] related to the Draft UNI DSRC standards have been resolved in the revised Draft UNI DSRC standards.

The aim of this study is also to provide guidelines on additional information and further technical work essential to manufacturers that wish to include a "UNI DSRC compliant interface" in their OBUs, and hence contribute to the opening up of public procurement of "Telepass system compatible OBU" to competition.

EG8 comprises three experts (see Annex A) selected by the European Commission.

1.2. Reviewed documents

The scope of EG8 of the detailed analysis on the Draft UNI DSRC standards was the same set of documents as studied by EG1 but on the most recent versions, provided by Autostrade per l'Italia at EG8's kick-off meeting on 2005-08-03. Table 1 below provides an overview of the reviewed Draft UNI DSRC standards. The European standards that were used as baseline are shown in the left column in Table 1, as the Draft UNI DSRC standards largely mirror the communication architecture of the European standards for DSRC and EFC.

European baseline standards	Reviewed Draft UNI DSRC standards
EN 12253: 2004 RTTT – DSRC – Physical layer using microwave at 5.8 GHz	UNI 10607-2 Part1 Road traffic and transport telematic. Automatic dynamic debiting systems and automatic access control systems using dedicated short-range communication at 5.8 GHz - Part 1: Physical layer (2005-01-18)

European baseline standards	Reviewed Draft UNI DSRC standards
EN 12795: 2002 RTTT – DSRC – Medium access and logical link control	UNI 10607-2 Part2 Road traffic and transport telematics. Automatic dynamic debiting systems and automatic access control systems using dedicated short-range communication at 5.8 GHz - Part 2: Data link layer (2005-01-17)
EN 12834: 2002 RTTT – DSRC – Application Layer	UNI 10607-2 Part3 Road traffic and transport telematics. Automatic dynamic debiting systems and automatic access control systems using dedicated short-range communication at 5.8 GHz - Part 3: Application layer common application service elements (2005-01-14)
EN 13372: 2004 RTTT – DSRC – DSRC profiles for RTTT applications	Not applicable.
EN ISO 14906: 2004 RTTT – EFC – Application interface definition for DSRC	UNI 10607-2 Part4 Road traffic and transport telematics. Automatic dynamic debiting systems and automatic access control systems using dedicated short-range communication at 5.8 GHz - Part 4: The Electronic Fee Collection Service Object (2005-01-18)

Table 1: European baseline standards and the reviewed revised Draft UNI DSRC standards

1.3. Review principles and methodology

The review of the Draft UNI DSRC standards (see Table 1) has been carried out according to the following principles and methodology:

- Compare the type and depth of information in the Draft UNI DSRC standards with that of the corresponding European baseline standards for DSRC and EFC (see Table 1). The comparison has been established layer by layer. The result is reported in section 2.
- Review of Draft UNI DSRC standards in terms of completeness and coherence, from an OBU technical point of view. Annex G accounts for the detailed review comments. For the detailed review comments, any identified weakness has been assigned a perceived severity class as follows:
    - Class 1 denotes an editorial comment, intended to improve the reader's understanding and readability of the specification;
    - Class 2 denotes a lack of precision or inappropriate wording that could mislead the reader and lead to equipment non-compatibility or non-compliance;
    - Class 3 is used for contradictions or lack of information that is blocking from the OBU designer's point of view, i.e. is absolutely needed in order to design compatible OBU.
- The scope of the detailed analysis is restricted to the total scope covered by the Draft UNI DSRC standards (see Table 1).
- No assessment has been made whether the specifications correctly reflect the deployed OBUs deployed in the Telepass system, i.e. no judgement has been made on the suitability of Draft UNI DSRC standards for the Telepass system.
- Intellectual property and patent rights have not been investigated. However, it is noted that the Italian EG1 and EG8 members declared that Draft UNI DSRC standards and Telepass technology are not subject to any intellectual property rights.

1.4. Limitations - the DSRC and EFC standards outside the scope

The scope of EG8 of the detailed analysis on the UNI DSRC standard was the same set of documents as studied by EG1 (see Table 1) It should be noted that other relevant DSRC and EFC standards exist.

Table 2 below provides an overview of those relevant standards that are outside EG8's scope, and consequently are not considered in this analysis.

European DSRC EFC standards outside the scope	**European DSRC EFC standard related to UNI DSRC EFC standards but outside the scope of EG8**
EN 300 674-1: 2003-12 Electromagnetic compatibility and Radio spectrum Matters (ERM) - RTTT - DSRC transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band - Part 1: General characteristics and test methods for RSU and OBU (V1.2.1)	ES 200 674-1 : 1999-02 Electromagnetic compatibility and Radio spectrum Matters (ERM) – RTTT - Part 1: Technical characteristics and test methods for High Data Rate (HDR) data transmission equipment operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band (V1.1.1)
EN 300 674-2-1: 2003-12 ERM - RTTT – DSRC transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band - Part 2-1: Harmonised EN for the RSU under article 3.2 of the R&TTE Directive (V1.2.1)	
EN 300 674-2-2: 2003-12 ERM - RTTT – DSRC transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band - Part 2-2: Harmonised EN for the OBU under article 3.2 of the R&TTE Directive (V1.2.1)	
ERM – RTTT - Test specifications for DSRC transmission equipment; Part 1: DSRC data link layer: medium access and logical link control; • Sub-Part 1: Protocol Implementation Conformance Statement (PICS) proforma specification (DTS/ERM-TG37-001-1) • Sub-Part 2: Test Suite Structure and Test Purposes (TSS&TP) (DTS/ERM-TG37-001-2) • Sub-Part 3: Abstract Test Suite (ATS) and partial PIXIT proforma (DTS/ERM-TG37-001-3)	
ERM – RTTT - Test specifications for DSRC transmission equipment; Part 2: DSRC application layer; • Sub-Part 1: Protocol Implementation Conformance Statement (PICS) proforma specification (DTS/ERM-TG37-002-1) • Sub-Part 2: Test Suite Structure and Test Purposes (TSS&TP) (DTS/ERM-TG37-002-2) • Sub-Part 3: Abstract Test Suite (ATS) and partial PIXIT proforma (DTS/ERM-TG37-002-3)	
CEN ISO/TS 14907-2: 2005 RTTT – EFC – OBU conformance test procedures	
CEN/TC278 N1701: 2004-12-22 Resolution by correspondence TC 278/C11/2004: New work item: Road transport and traffic telematics – Electronic fee collection (EFC) - Minimum Interoperable Specification for DSRC-EFC transactions (www.nen.nl/cen278/n1701.pdf)	
CEN/TC278 N1702: 2004-12-22 Resolution by correspondence TC 278/C12/2004: New work item: Road transport and traffic telematics – Electronic fee collection (EFC) - Conformity evaluation of onboard unit and roadside equipment to "DSRC-MIS EFC application transaction requirements" (www.nen.nl/cen278/n1702.pdf)	

Table 2: Overview of the European and UNI DSRC standards outside the scope of EG8

From Table 2 above, it can be seen that provision has been made to evaluate conformity of the CEN DSRC EFC "requirements" standards whereas such provision is currently largely lacking for the Draft UNI standards. It is highly recommended that the Draft UNI DSRC standards suite is complemented with associated conformance test standards (as also reported in Section 3.2 in [EG1 Final Report]).

2. Comparative assessment

2.1. Layer 1

Parameter	**CEN – EN 12253**	**UNI DSRC – Part 1**	**Remarks**
D1 Carrier Frequencies	Channel 1: 5,7975 GHz Channel 2: 5,8025 GHz Other 10 MHz band within the same ISM band allocated for RTTT on a national basis: Channel 3: 5,8075 GHz Channel 4: 5,8125 GHz These channels are defined in accordance with ECC/DEC(02)01.	5,8 GHz	
D1a Tolerance of Carrier Frequencies	within ± 5 ppm	± 200 ppm	

Parameter	**CEN – EN 12253**	**UNI DSRC – Part 1**	**Remarks**
D2 RSU Transmitter Spectrum Mask	1) Out band power: see ETSI EN 300674-1 2) In band power:≤+33 dBm 3) Unwanted emission for unmodulated carrier wave shall be less than: • Co-channel uplink at 1,5 MHz: ≤-27 dBm in 500 kHz. • Co-channel uplink at 2,0 MHz: ≤-27 dBm in 500 kHz. • Adjacent channel uplinks: ≤ -47 dBm in 500 kHz. 4) For in-band unwanted emission with modulated carrier wave, different requirement classes are defined: **Class B**: • Co-channel uplink at 1,5 MHz: ≤-17 dBm in 500 kHz. • Co-channel uplink at 2,0 MHz: ≤-27 dBm in 500 kHz. • Adjacent channel uplinks: ≤ -37 dBm in 500 kHz. **Class C:** • Co-channel uplink at 1,5 MHz: ≤-27 dBm in 500 kHz. • Co-channel uplink at 2,0 MHz: ≤-27 dBm in 500 kHz. • Adjacent channel uplinks: ≤ -47 dBm in 500 kHz.	(1) Out of band power: see ETSI ES 200 674:1999 (2) In band power: +39 dBm (3) Unwanted emissions for unmodulated carrier in the frequency range from 3 MHz up to 14 MHz around the carrier frequency: -94 dBm/Hz. This limit equals –49 dBm measured in 30 kHz bandwidth. (4) Unwanted emissions for modulated carrier in the frequency range from 2 MHz up to 3 MHz around the carrier frequency, and from 8 MHz up to 14 MHz around the carrier frequency: -77 dBm/Hz. This limit equals –32 dBm measured in 30 kHz bandwidth. (5) Unwanted emissions for modulated carrier in the frequency range from 3 MHz up to 8 MHz around the carrier frequency: -74 dBm/Hz. This limit equals –29 dBm measured in 30 kHz bandwidth.	The maximum allowed radiated power is basically limited to +33 dBm (EIRP) for RTTT applications in Europe according to ERC Recommendation 70-03 relating to the use of Short Range Devices (Feb 2004, Annex 5).
D3 OBU Minimum Receive Frequency Range	5,795 GHz – 5,815 GHz	5.725 – 5.875 GHz	Frequency band allocation is specific to Italy. It does not bring any problem for consistency, but might be a concern for implementation cost, see section 3.3

Parameter	**CEN – EN 12253**	**UNI DSRC – Part 1**	**Remarks**
D4a Maximum E.I.R.P	+33 dBm	See D2 (i.e. +39 dBm)	The maximum allowed radiated power is basically limited to +33 dBm (EIRP) for RTTT applications in Europe according to ERC Recommendation 70-03 relating to the use of Short Range Devices (Feb 2004, Annex 5).
D4b Angular E.I.R.P. mask	Θ ≤70°: ≤+33 dBm Θ> 70°: ≤+18 dBm	0° ≤ Q ≤ 30°: ≤_+39 dBm 30° < Q ≤ 50°: ≤_+33 dBm 50° < Q ≤ 70°: ≤_+23 dBm Q >70°: ≤_+15 dBm	Has a direct impact on equipment behaviour and performance in tolling applications
D5 Polarisation	Left hand circular	Vertical linear	6 dB is lost in case a circular polarised antenna is used to receive and backscatter a linear polarised wave (and vice-versa) resulting in a reduction of the footprint.
D5 Cross Polarisation	In bore sight: RSUt ≥15 dB OBUr ≥10 dB At -3 dB area: RSUt ≥10 dB OBUr ≥6 dB	In boresight: RSUt: >20 dB OBUr: ≥10 dB In –3dB area: RSUt: >10 dB OBUr: ≥6 dB	
D6 Modulation	Two level amplitude modulation.	ASK-OOK	
D6a Modulation Index	0,5 ... 0,9	0,5 … 0,9	
D7 Data Coding	FM0	Manchester	
D8 Bit Rate	500 kbits/s	921 kbits/s	
D8a Tolerance of Bit Clock	better than ±100 ppm	± 0,2%	
D9 BER within dynamic range of OBU receiver	10^{-6} when incident power at OBU is in the range given by [D11a to D11b].	≤ 10^{-6}	
D10 Wake-up trigger for OBU	OBU shall wake up on receiving any frame with 11 or more octets (including preamble)	Square-wave tone at 4.600 Hz consisting of 8 cycles, starting with the maximum power state of the carrier modulation. Duty cycle: 50% ± 5%. Period of a single cycle: 217µs ± 30 µs	

Parameter	**CEN – EN 12253**	**UNI DSRC – Part 1**	**Remarks**
D10a Maximum Start Time	≤ 5 ms	1,8 ms	
D10(c) Wake-up sensitivity	Not defined	Upper limit at least equal to D11a. Lower limit not standardized (but part of dedicated system specification available).	Has a direct impact on equipment behaviour and performance in tolling applications
D10(d) Start of Preamble	Not defined	≥ 270 µs	
D11 Communication zone – Power limit for communication (upper)	Incident power: D11a-0: -24 dBm D11a-1: -17 dBm	Dynamic Range of OBU receiver – Upper Communication Power Limit: -17 dBm	Measured at a receiving antenna with the same polarization as the transmitting antenna. See parameter D5a.
D11b Communication zone – Power limit for communication (lower)	Incident power: 43 dBm	Dynamic Range of OBU receiver – Sensitivity level ≤ -43 dBm	Measured at a receiving antenna with the same polarization as the transmitting antenna. See parameter D5a.
D12	Cut-off power level of OBU: -60 dBm	Not used	
D13 Preamble	Preamble is mandatory.	A sequence of four properly coded HDLC flags (An HDLC flag is the binary sequence '01111110')	
D13a Preamble Length	16 ± 1 bit	See above	
D13b Preamble Wave form	An alternating sequence of low and high level with pulse duration of 2 µs. The tolerance is given by D8a.		
D13c Trailing Bits	The RSU is permitted to transmit a maximum of 8 bits after the end flag. An OBU is not required to take these additional bits into account.	Not defined	

Table 3: L1 downlink parameters comparison

Parameter	**CEN – EN 12253**	**UNI DSRC – Part 1**	**Remarks**
U1 Sub-Carrier Frequencies	An OBU shall support 1,5 MHz and 2,0 MHz An RSU shall support 1,5 MHz or 2,0 MHz or both. U1-0: 1,5 MHz U1-1: 2,0 MHz EN 12834 and EN 13372 define the procedures for selection of (profile and) sub-carrier frequency.	(1): 10,7 MHz (2): 9,21 MHz (3): 4,6 MHz	As for the UNI DSRC-requirement, the U1 value is requested by the RSU in each frame dependent on data rate needed. See parameter "Responding Mode" in UNI DSRC L7. Parameter values are bound one-to-one to the corresponding values of parameters [U6a] and [U8a].
U1a Tolerance of Sub-Carrier Frequencies	within ±0,1%	0,1 %	
U1b Use of Side Bands	Same data on both sides	Equal data simultaneous in both sidebands	
U2 OBU Transmitter Spectrum Mask	1) Out band power: see ETSI EN 300674-1 2) In band power: ≤ [U4a] dBm in 500 kHz 3) Emission in any other uplink channel: U2(3)-0 = -39 dBm in 500 kHz U2(3)-1 = -35 dBm in 500 kHz	(1) Out of band power: see ETSI ES 200 674:1999 (2) Maximum E.I.R.P.: ≤ [U4] in 500kHz (3) Spurious emission in any other uplink channel: ≤ -35 dBm in 500 kHz	
U4a Maximum Single Side Band E.I.R.P. (bore sight)	U4a-0: -14 dBm U4a-1: -21 dBm	-21 dBm	Measured at a receiving antenna with the same polarization as the transmitting antenna. Part of OBU Transmitter Spectrum Mask.
U4b Maximum Single Side Band E.I.R.P. (35°)	-17 dBm	Not defined	
U5 Polarisation	Left hand circular transmitted when left hand circular received	(1) Vertical linear (2) Left hand circular	Circular polarized antennas are allowed both in Rx and Tx modes. See parameters D11a, U12a and U12b.
U5a Cross Polarisation	In bore sight: RSUr ≥15 dB OBUt ≥10 dB At -3 dB: RSUr ≥10 dB OBUt ≥6 dB	At boresight: RSUr: >20 dB OBUt: ≥10 dB At –3dB area: RSUr: >10 dB OBUt: ≥6 dB	

Parameter	**CEN – EN 12253**	**UNI DSRC – Part 1**	**Remarks**
U6 Sub-Carrier Modulation	2-PSK	(1): Binary FSK (2): BPSK (3): BPSK	As for the UNI DSRC-requirement, the U6 value is requested by the RSU in each frame dependent on data rate needed. See parameter "Responding Mode" in UNI DSRC L7. Parameter values are bound one-to-one to the corresponding values of parameters [U1a] and [U8a].
U6(a) Frequency Deviation for FSK	Not applicable	"high" level: +0,7 MHz "low" level: -0,7 MHz	
U6b Duty Cycle	50% ± α, α ≤ 5%	± 2%Tolerance of Frequency Deviation for FSK	
U6c Modulation on Carrier	Multiplication of modulated subcarrier with carrier.	AM	
U7 Data Coding	NRZI	Manchester	
U8a Bit Rate	250 kbits/s	(1): 144 kbits/s (2): 921 kbits/s (3): 460 kbits/s	As for the UNI DSRC-requirement, the U8a is requested by RSU in each frame dependent on data rate needed. See parameter "Responding Mode" in UNI DSRC L7. Parameter values are bound one-to-one to the corresponding values of parameters [U1a] and [U6a].
U8b Tolerance of Bit Rate	Within ± 1000 ppm	± 0,2%	
U9BER within dynamic range of RSU receiver	$\leq 10^{-6}$	$\leq 10^{-6}$	
U11Communication Zone	The spatial region within which the OBU is situated such that its transmissions are received by the RSU with a bit error ratio of less than that given by U9.	The spatial region within which the OBU is situated such that its transmissions characteristics are defined by U11a and U11b.	
U11a Dynamic Range of RSU receiver – Sensitivity level	N/A	-92dBm	Measured at a receiving antenna with the same polarization as the transmitting antenna.
U11b Dynamic Range of RSU receiver – Upper Communication Power Limit	N/A	-40 dB	Measured at a receiving antenna with the same polarization as the transmitting antenna.

Parameter	CEN – EN 12253	UNI DSRC – Part 1	Remarks
U12a Conversion Gain (lower limit)	Lower level: 1 dB for each side band Range of angle: Circularly symmetric between bore sight and ± 35°	1 dB	Greater than or equal to the specified value for each side band within a circular cone around bore sight of ±35° opening angle.
U12b Conversion Gain (upper limit)	10 dB for each side band	10 dB	Less than the specified value for each side band within a circular cone around bore sight of ±35° opening angle.
U13a Preamble Length and Pattern	32 µs to 36 µs modulated with subcarrier only, then 8 bits of NRZI coded "0" bits.	A sequence of four properly coded HDLC flags. An HDLC flag is the binary sequence '01111110'.	
U13b Trailing Bits	The OBU is permitted to transmit a maximum of 8 bits after the end flag. A RSU is not required to take these additional bits into account.	Not explicitly defined. See U13a	

Table 4: L1 uplink parameters comparison

Preliminary Conclusion 1 : The issues identified by EG1 related to previous version of UNI DSRC layer 1 standard have largely been resolved in the revised Draft UNI DSRC layer 1 standard [UNI L1], notably the specification of the following parameters:

- ***OBU minimum receive frequency range***
- ***Maximum single side band EIRP at bore sight (but not within a 35 degrees cone around the bore sight)***
- ***OBU conversion gain – upper limit***

The definition of layer 1 [UNI L1] is deemed complete once the U4b (the maximum signle side band EIRP within 35 degrees around the bore sight) has been specified. UNINFO experts have expressed their willingness to resolve the minor issues reported in annex G.1 in the future published version of UNI standards.

2.2. Layer 2

Parameter	CEN – EN12795	UNI DSRC – Part 2	Remarks
Frame structure	HDLC frame structure	HDLC frame structure	Same core HDLC structure
Start / End flag	HDLC flag	HDLC flag	Same
FCS	CRC-16	CRC-16	Same CRC-16
Bit order	LSB	LSB	Same, LSB
Transparency	zero bit insertion	zero bit insertion	Same, zero bit insertion

Address establishment procedures	Defined, including link id (LID)	N/A	Different. UNI DSRC lets the User (Application Layer) specify LaID and calculates Link Id as part of the internal Layer 7 address establishment procedure.
MAC	Defined	Not defined	The Draft UNI DSRC standards allocate more services to the Application layer. The LLC layer is rather thin, and there is no need for a MAC layer.
LLC	Acknowledged and unacknowledged service	Unacknowledged services	
DL max frame size	128 octets	64 octets	
UL max frame size	128 octets	64 octets	

Table 5: L2 comparison

The UNI DSRC layer 2 specification [UNI L2] is quite different from to its CEN equivalent, reflecting a different system topology concept, and a different allocation of communication services between the OSI layers.

Preliminary Conclusion 2 : The issues identified by EG1 related to previous version of UNI DSRC layer 2 standard have been resolved in the revised Draft UNI DSRC layer 2 standard [UNI L2], notably the clarification of the following parameters:

- ***Link address establishment procedures***
- ***Data collision and error recovery procedures***
- ***Communication link timing requirement, e.g. for OBU response in "responding mode***"

The definition of layer 2 [UNI L2] is complete in terms of content. UNINFO experts have expressed their willingness to resolve the minor inconsistencies reported in annex G.2 in the future published version of UNI DSRC L2 standard.

2.3. Layer 7

Parameter	**CEN – EN 12834**	**UNI DSRC – Part 3**	**Remarks**
Multiplexing	Described, optional	N/A	
Fragmentation	Described, optional	N/A	
Concatenation	Described, optional	Yes	
Chaining	Described, optional	Described, optional	
Communication initialisation and release procedures	Described, mandatory	Described, mandatory	
Broadcast service support	Described, mandatory	Described	

Parameter	CEN – EN 12834	UNI DSRC – Part 3	Remarks
DSRC profile handling	Described, mandatory	N/A	CEN provides for different profiles, UNI DSRC has no selectable options at connection establishment phase.
Generic application services	Described, mandatory	Described, mandatory	
Addressing	Described, mandatory	Described, mandatory	Different.

Table 6: L7 comparison

The UNI DSRC layer 7 specification [UNI L7] is quite different from to its CEN equivalent, reflecting different concepts.

Preliminary Conclusion 3 : The revised Draft UNI DSRC layer 7 specification [UNI L7] has been improved mainly in the following issues:

- ***The addressing mechanism has been explained and detailed.***
- ***The layer 1 communication profile handling (selection of bit rate, sub-carrier frequency, sub-carrier modulation) has been detailed.***
- ***The applications selection mechanism (different applications and different versions of an application) has been detailed***

UNINIFO experts have expressed their willingness to resolve the inconsistencies reported in annex G.3 in the future published version of UNI standards, including:

- Clarification on the "Responding Mode" parameter and the selection of the corresponding transmission bit rate, including consistency of associated ASN.1 definition;
- Clarification of the semantics of 'opc-failure' in 'Result and Diagnostics' parameters in 9.1.4 and Annex A
- Definition of A-Association Parameters:
  - Clarification of semantics (i.e. the functional meaning) of the parameters
  - Clarification of Called AP Invocation Identifier (in section 9.1.2)
  - Clarification on "Number of Directives" service parameter functionality and semantics
- Clarification on Encoding rules

2.4. DSRC profile management

Parameter	CEN – EN 13372	UNI DSRC	Remarks
Profile definitions	Described, based on INIT_Kernel services	No profiles provided by this set of standards	The equivalent of DSRC L1 profile is correctly described in the set of UNI standards, and the equivalent of EN 13372 is not needed for completeness / consistency

Table 7: DSRC profile comparison

The UNI DSRC standards do not use a "profile concept" to select layer 1 options. An UNI DSRC compliant RSE uses the so-called "Responding Mode" parameters to dynamically select transmission bit rate, sub-carrier modulation and sub-carrier frequency on a frame by frame basis (i.e. "command" sent in the downlink frame to select the uplink settings).

2.5. EFC application interface definition

Parameter	CEN – EN ISO 14906	UNI DSRC – Part 4	Remarks
Addressing of application data and peripherals	Yes	Yes	
EFC functions	Yes	Yes	
Provision of protected access to user data – access credentials	Yes	Yes	
Provision of protection of the integrity of charging data and protection against false foreign operator claims Data signatures	Yes	Yes	
EFC application data, including semantics, format and encoding	Yes	Yes	
CARDME transaction - Bit-level transaction sequence example (L1, L2, L7 and application data)	Yes	Yes	
Examples of transaction types	Yes	Yes, limited to CARDME transaction	

Table 8: EFC application comparison

The UNI DSRC EFC application interface definition [UNI AID] is quite different from to its CEN equivalent.

Preliminary Conclusion 4 : The revised Draft UNI DSRC EFC application standard [UNI AID] has been improved mainly in the following issues:

- Clarification of the functional description of the service primitives.
- More detailed semantics of the protocol message elements for the EFC use.
- Description of the common memory structures and their usage in the context of EFC.
- Description of addressing mechanisms, by referencing to memory structures.
- Description of dynamic (challenge – response) data integrity service primitives and mechanism, in order to provide for multi-operator data integrity.
- Introduction of a bit-level informative annex detailing a complete transaction based on the CARDME specification, which includes all aspects in a top-down description (i.e. from A-Associate invocation down to addressing the data attribute in memory).

The specification of the EFC application interface is complete. UNINIFO experts have expressed their willingness to resolve the inconsistencies and the following main issue (see G.4 for details): Correct the CARDME transaction example.

3. Summary of findings and recommended further steps

The revised Draft UNI DSRC standards (see Table 1) have been analysed regarding their completeness, consistency and accuracy compared with the CEN DSRC standards.

This section summarises the main results of this analysis and the recommended further steps.

3.1. Improvements of the UNI specifications

Conclusion 1 : The review comments raised by EG1 have been addressed by UNINFO experts and the results incorporated in the reviewed revised Draft UNI DSRC standards. The overall architecture and functional allocation of communication services across communication layers and EFC API are consistent.

An overview of the improvements brought by the draft UNI standards suite, compared with the versions reviewed by EG1, is presented here below:

- **Layer 1**:
  - Almost all parameters that were not defined or inadequately defined in previous version have been defined and clarified.
  - The mechanism for profile handling has been clarified. There is no profiling, rather a possibility to dynamically select the values of a few parameters (transmission bit rate, sub-carrier frequency and sub-carrier modulation). The selection mechanism (which involves interaction between Layer 1, Layer 7 and a management Entity) has been described.

- **Layer 2**:
  - Link addressing procedures description has been improved.
  - Retransmission and error recovery description has been improved

- **Layer 7**:
  - Addressing mechanism description has been improved.
  - Application data addressing (memory structures) has been introduced.
  - Support for multi-application handling has been described.

- **EFC ASO**:
  - The description of application data structures and associated addressing mechanisms has been added.
  - Data integrity and data access protection service primitives and related mechanisms have been described as optional features.
  - An informative annex describing a transaction sequence at bit-level, such as the ones presented in the CEN documents has been introduced. Following the CEN documents, the CARDME transaction example has been chosen.

3.2. Recommendations related to the draft UNI DSRC standards suite

Conclusion 2 : It is recommended that the issues identified in Annex G are resolved in the updating process of the UNI DSRC standards. The main issues to be resolved are listed below (for minor and editorial issues see Annex G):

- **Layer 1**: U4b parameter (maximum single side band EIRP within 35° from bore sight) needs to be defined, since it is required from an antenna designer's point of view and essential when exploring the possibility of a common layer 1 modem serving both CEN and UNI layers.
- **Layer 2**: no major issue remaining
- **Layer 7**:
  - clear definition of responding mode parameter in relation to L1 should be given
  - semantics of A-association parameters should be specified.
  - length limitation of protocol messages should be defined exactly detailing all message fields
  - encoding rules usage should be clarified in view of practical implementation
  - ASN.1 module registration should be taken into consideration
- **EFC ASO**:
  - ASN.1 module registration should be taken into consideration
  - a bit level description of Telepass would be useful in view of future implementations and subsequent conformity evaluation (for recommendations related to the European electronic toll service see also 3.3).

3.3. Recommended further steps to enable industrial implementation

This section gives an overview of the required actions needed in view of creating an open market situation, enabling several manufacturers to source UNI and Telepass compliant equipment.

This is obviously a fairly large topic. However it can be structured in clear successive steps:

1. **Finalisation of the UNI DSRC requirements suite**. Some additions and corrections to the draft UNI standards are required, as can be seen from 3.2, in addition to those that have already been made since EG1's review. Since the structure of the drafts, as well as their consistency is now positively assessed, and due to the relatively limited number of remaining points, there is no doubt that these corrections can be implemented without threatening the documents consistency. **As a consequence, EG8's opinion is that these corrections may be brought in the final published version of the UNI standards, and that the final check may be part of the required test suite specification work (i.e. checking for input completeness and consistency). This would speed up the whole process and avoid a new EG group to be launched.** Such a process would also cover any minor issue left undiscovered by EG8 since its appraisal was comprehensive but not exhaustive and was not to the same depth as further test suite analysis work would require.

2. **Preparation of the UNI DSRC test suite.** In order to enable an industrial implementation, test suite of specifications are required, as is always the case with

standards and public specifications. This work has been carried out at layer 1 level for CEN and UNI, but the corresponding UNI document [ETSI UNI] definitely needs revision due to the new definitions added in the revised UNI DSRC L1 [UNI L1] but also to better reflect the R&TTE Directive [RTTE]. The test specification work has been completed for OBU conformance to CEN EFC application interface definition [EFC AID Tests] and is now ongoing for the CEN upper layers. **It is recommended that UNINFO takes immediate action in order to launch similar tasks, e.g. in ETSI in order to maximise harmonisation between both test suites and ease the task of implementers**.

3. **Miscellaneous actions** outside the scope of standardisation, assuming that the Telepass service will be part of the EETS, should take the following into account:
   - **'Opening up' the Telepass specification** : it is understood that Telepass equipment will be fully compliant to published UNI standards ; in order to develop and deploy interoperable OBUs, **manufacturers will need additional information regarding the Telepass specifications, for what is not covered by the UNI documents including equipment personalisation, selection of functions, use of security, etc.**
   - **Defining the dual mode OBU architecture** from a software and hardware points of view: as seen from EG8, the architecture could be the one presented by Annex E. This needs to be studied in depth, from a physical implementation point of view (i.e. optimisation of the OBU ASIC architecture). This study should also include the EETS user signalling concept and possibly MMI resources.
   - **Assessing the feasibility of a single radio modem**: from comparing CEN and UNI L1 specifications, one might think that the use of a single radio modem in the OBU is possible: this has a fairly large influence on equipment cost and should therefore be carefully assessed[1]. This assessment should include verification of compliance with both CEN and (the next release of) the UNI related ETSI L1 test specifications.
   - **Creating a workplace for the Telepass implementation work** for the purpose of fostering development, product prototyping and interoperability testing, including development and operation of an interoperability testbed. This might be achieved through a funded research project e.g. by the EC, or left to market initiatives. The former is highly preferred, since it will enable the largest number of manufacturers to get involved at the same time and consequently ensure the best possible coverage of all technical issues and reduce the threshold for manufacturers to develop Telepass compliant OBUs.
   - **Ownership and governance of specifications**: **it is also highly recommended to make provision to manage and solve questions that are likely to arise when various manufacturers implement dual mode OBU** (i.e. Telepass and CEN), both from a technical and operational point of view. This includes implementation of evolutions of the specifications, technical issues that may rise from distribution of dual mode equipment by several operators, possible enhancement of security features, etc. The provisions should include “change request and control management, release and publication procedures”.

[1] Especially regarding antenna bandwidth requirement and U4 parameter

Conclusion 3 :

1. Final corrections may be brought in the final published version of the UNI standards, and final check may be part of the required test suite specification work (i.e. checking for input completeness and consistency). This would speed up the whole process and avoid a new EG group to be launched

2. It is recommended that UNINFO takes immediate action in order to define a complete test suite of specifications.

3. manufacturers will need additional information regarding the Telepass specifications, for what is not covered by the UNI documents including equipment personalisation, selection of functions, use of security, etc.

4. It is advised to create a workplace for the Telepass implementation work for the purpose of fostering development, product prototyping and interoperability testing, including development and operation of an interoperability testbed.

5. it is also highly recommended to make provision to manage and solve questions that are likely to arise when various manufacturers implement dual mode OBU

ANNEX A– MEMBERS OF EXPERT GROUP 8

The members of Expert Group 8 were appointed by the European Commission.

Name	**Company / Organisation**
Fausto Caneschi	Lecit Consulting (Italy)
Jesper Engdahl (Lead)	Rapp Trans (Switzerland)
Bernard Lamy	THALES e-transactions CGA (France)

ANNEX B – GLOSSARY OF TERMS

ASIC	Application Specific Integrated Circuit
CARDME	Concerted Action for Research on Demand Management in Europe
CEN	European Committee for Standardization (Comité Européen de Normalisation, www.cenorm.be)
DSRC	Dedicated Short-Range Communication
EETS	European Electronic Toll Service
EIRP	Emitted Isotropically Radiated Power
EFC	Electronic Fee Collection
EG1	Expert Group 1 (on microwave technologies at 5.8 GHz)
ETSI	European Telecommunications Standards Institute (www.etsi.org)
GSS	Global Specification for Short Range Communication
ISO	International Standards Organisation (www.iso.ch)
L1	Layer 1 of DSRC (Physical Layer)
L2	Layer 2 of DSRC (Data Link Layer)
L7	Layer 7 of DSRC (Application Layer)
MMI	Man-Machine Interface
OBU	On-Board Unit
RSE	Road-Side Equipment

ANNEX C – REFERENCED DOCUMENTS

Reference	Document no	Date	Document title
			CEN
[CEN DSRC]	EN 12253	2004	Road Transport and Traffic Telematics (RTTT) – Dedicated Short-Range Communication (DSRC) – Physical layer using microwave at 5.8 GHz
	EN 12795	2002	Road Transport and Traffic Telematics (RTTT) – Dedicated Short-Range Communication (DSRC) – Medium access and logical link control
	EN 12834	2002	Road Transport and Traffic Telematics (RTTT) – Dedicated Short-Range Communication (DSRC) – Application Layer
	EN 13372	2004	Road Transport and Traffic Telematics (RTTT) – Dedicated Short-Range Communication (DSRC) – DSRC profiles for RTTT applications
[EFC AID]	EN ISO 14906	2004	Road Traffic and Transport Telematics (RTTT) – Electronic Fee Collection – Application interface definition for dedicated short range communication
[EFC AID Tests]	CEN ISO/TS 14907-2	2005	Road Traffic and Transport Telematics (RTTT) – Electronic Fee Collection – OBU conformance test procedures
[ETSI DSRC]	EN 300 674-1	2003-12	Electromagnetic compatibility and Radio spectrum Matters (ERM) - Road Transport and Traffic Telematics (RTTT) - Dedicated Short Range Communication (DSRC) transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band - Part 1: General characteristics and test methods for RSU and OBU (V1.2.1)
	EN 300 674-2-1	2003-12	Electromagnetic compatibility and Radio spectrum Matters (ERM) - Road Transport and Traffic Telematics (RTTT) - Dedicated Short Range Communication (DSRC) transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band - Part 2-1: Harmonised EN for the RSU under article 3.2 of the R&TTE Directive (V1.2.1)
	EN 300 674-2-2	2003-12	Electromagnetic compatibility and Radio spectrum Matters (ERM) - Road Transport and Traffic Telematics (RTTT) - Dedicated Short Range Communication (DSRC) transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band - Part 2-2: Harmonised EN for the OBU under article 3.2 of the R&TTE Directive (V1.2.1)
	prEN / managed by ETSI ERM TG37		ERM – RTTT - Test specifications for DSRC transmission equipment; Part 1: DSRC data link layer: medium access and logical link control; • Sub-Part 1: Protocol Implementation Conformance Statement (PICS) proforma specification (DTS/ERM-TG37-001-1) • Sub-Part 2: Test Suite Structure and Test Purposes (TSS&TP) (DTS/ERM-TG37-001-2) • Sub-Part 3: Abstract Test Suite (ATS) and partial PIXIT proforma (DTS/ERM-TG37-001-3)
	prEN / managed by ETSI ERM TG37		ERM – RTTT - Test specifications for DSRC transmission equipment; Part 2: DSRC application layer; • Sub-Part 1: Protocol Implementation Conformance Statement (PICS) proforma specification (DTS/ERM-TG37-002-1) • Sub-Part 2: Test Suite Structure and Test Purposes (TSS&TP) (DTS/ERM-TG37-002-2) • Sub-Part 3: Abstract Test Suite (ATS) and partial PIXIT proforma (DTS/ERM-TG37-002-3)
[R&TTE]	Directive 1999/5/EC	1999-03-09	Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity
[CEN EFC]	CEN/TC278 N1701	2004-12-22	Resolution by correspondence TC 278/C11/2004: New work item: Road transport and traffic telematics – Electronic fee collection (EFC) - Minimum Interoperable Specification for DSRC-EFC transactions (www.nen.nl/cen278/n1701.pdf)
	CEN/TC278 N1702	2004-12-22	Resolution by correspondence TC 278/C12/2004: New work item: Road transport and traffic telematics – Electronic fee collection (EFC) - Conformity evaluation of onboard unit and roadside equipment to "DSRC-MIS EFC application transaction requirements" (**www.nen.nl/cen278/n1702.pdf**)
[ERC]	ERC Rec 70-03	Feb 2004	ERC recommendation 70-03 relating to the use of Short Range Devices (Annex 5)

Reference	Document no	Date	Document title
UNI			
[UNI L1]	Draft UNI10607-1	2005-01-18	Road traffic and transport telematics. Automatic dynamic debiting systems and automatic access control systems using dedicated short-range communication at 5.8 GHz Part 1: Physical Layer
[UNI L2]	Draft UNI10607-2	2005-01-17	Road traffic and transport telematics. Automatic dynamic debiting systems and automatic access control systems using dedicated short-range communication at 5.8 GHz Part 2: Data link layer
[UNI L7]	Draft UNI10607-2	2005-01-14	Road traffic and transport telematics. Automatic dynamic debiting systems and automatic access control systems using dedicated short-range communication at 5.8 GHz- Part 3: Application layer common service elements
[UNI AID]	Draft UNI10607-2	2005-01-18	Road traffic and transport telematics. Automatic dynamic debiting systems and automatic access control systems using dedicated short-range communication at 5.8 GHz - Part 4: Application layer EFC application service objects
[ETSI UNI]	ETS 200 674		Electromagnetic compatibility and Radio spectrum Matters (ERM) - Road Transport and Traffic Telematics (RTTT) - Dedicated Short Range Communication (DSRC) transmission equipment.
[Eval UNI]		2005-01-17	Expert Group 1 – Task 2 – Assessment of the Italian standards proposal specifications in view of inclusion into the European EFC service
Other documents			
[GSS]		2003	Global Specification for Short Range Communication (Kapsch TrafficCom AB, Kapsch Telecom GmbH, Thales e-Transactions CGA SA, version 3.2, 2003-08, www.etc-interop.com/pdf /gss_32.pdf)
[EFC Directive]	Directive 2004/52/EC	2004-04-29	Directive 2004/52/EC of the European Parliament and the Council on the Interoperability of Electronic Road Toll Systems in the Community
[EG1 Final Report]		2005-03-14	Recommendations on microwave DSRC technologies at 5.8 GHz to be used for the European electronic toll service (prepared and approved by EG1)
[EG RTT]		Dec 1997	Report regarding designation of further frequency bands for Road Transport and Traffic Telematics, Expert Group on RTT for the European Commission DG XIII
[CARDME]	IST-1999-29053 Deliverable 4.1	2002	CARDME-4 – The CARDME concept (Final, 1 June 2002)
[UNI Encoding]		2005	UNI 10607 Encoding/Decoding (White paper, Lecit Consulting)

ANNEX D – REVISION OF THE ITALIAN DSRC STANDARD 10607

This annex contains a copy below of the public letter sent by UNINFO to EC DG TREN regarding the revision of the Italian DSRC standard 10607.

Tecnologie informatiche e loro applicazioni

UNINFO

Ente di normazione federato all'UNI

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Turin, 2005-09-27

Mr. Philippe Hamet
Commission Européenne
Direction Générale pour les Transports et l'Energie
Rue De Mot 28
1040 BRUXELLES
BELGIQUE

Subject: Revised edition of Italian DSRC standard 10607:1996

Dear Sir,

It is with pleasure that UNINFO announces the upcoming revised edition of UNI 10607 :1996 standard "Road traffic and transport telematic – Automatic Dynamic Debiting Systems and automatic access control systems using dedicated short-range communication at 5,8 GHz". This new edition, although compatible with the previous one, shows a new style (same as the ISO/CEN style), a division in Parts for an easier understanding, and new features.

We would then like to share with you the reasons behind this revision and the events around it (especially in Europe).

Background: reasons and history

The revision process of the UNI 10607 started one year and a half ago, after the International Community recognized that:

- the current edition was not easily acceptable due to its format, that made it difficult to compare with similar DSRC standards (e.g., the CEN/TC278 series).
- the specification itself was out to date technically, as some services were obsolete, while others were not included.

In parallel, the 2004/52/EC Directive of the European Parliament and of the Council on the interoperability of Electronic Road Toll Systems in the Community was promulgated. The Directive recognizes all DSRC EFC systems operating in Europe as systems of interest for the sake of interoperability, i.e., including the Italian system based on the UNI 10607 standard. This event led to a series of initiatives, notably the Comité Telepéage that, as a regulatory committee of the EU, set up the rules for interoperability of road toll systems. In essence, the adopted technical solution was the same experimented in a pan-european project, the MEDIA project, i.e., the adoption of a multi-standard OBU. This OBU will be able to interact with the DSRC systems in Europe (CEN-based and UNI 10607-based systems).

Immediate consequences

The ultimate purpose for the revision action is then to bring the systems conforming to the UNI standards under the RTTE Directive."
Confining the EFC issue in the DSRC realm, the production of bi-standard OBUs for European interoperability can only be reached if standard specifications are available and understandable to an open vendors market. This is the reason why UNI decided to re-write the UNI 10607 standard in a way that manufacturers are used to, namely, the ISO/CEN style.

In addition to that, defining compliance to multiple standards needs the definition of clear test specifications, that should not be issued by a single manufacturer, rather by an International Institution. It is for this reason that Italian members of ETSI ERM TG37 are proposing ETSI to start activities in this direction, in the same manner as currently pursued by the ETSI STF 282 for the CEN related standards.

New naming

The new edition of the UNI 10607 standard consists of four separate Parts, that have been named UNI 10607-1, 10607-2, 10607-3, and 10607-4.

Sincerely,

Massimo Actis Dato

Massimo Actis Dato
UNINFO General Secretary

ANNEX E - DUAL-MODE OBU ARCHITECTURE

The dual-mode OBU architecture needs to be studied in depth from a physical implementation point of view (i.e. optimisation of the OBU ASIC architecture). Such a study should also include the EETS user signalling concept and possibly MMI resources.

This annex outlines two potential dual-mode OBU architectures, as input for further studies.

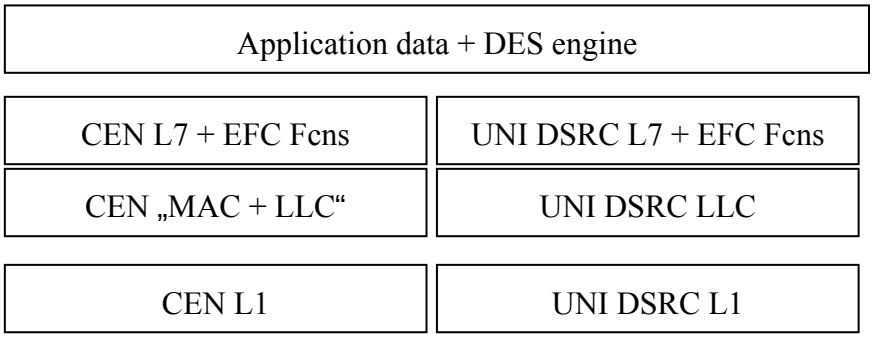

Figure 1: OBU architecture - Dual DSRC cores

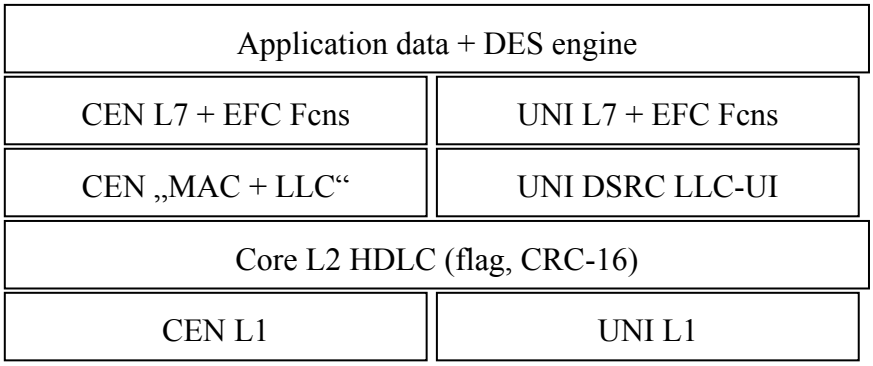

Figure 2: OBU architecture – "optimised" DSRC cores

ANNEX F – DISPOSITION OF THE DETAILED COMMENTS OF EG1

This annex accounts for the answers by Autostrade per l'Italia to the detailed comments accounted for in EG1's report (section 6) including clarification how they have been addressed and resolved in the revised Draft UNI DSRC standards (see Table 1).

Important note: in the following tables:

1. the "Disposition" column indicates how the comment has been resolved by UNINFO experts.
2. The particular value 'not accepted' in the "Disposition" field means that comment has been rejected by UNINFO. In this case, a rationale has been provided, and it does not mean that this leads to a conflictual issue between experts, as most 'non accepted' comments have been agreed as resulting from initial misunderstanding or solved elsewhere in the reference documents.

All remaining pending issues are clearly listed in Annex G.

F.1 Layer 1

Page	Class	Comment	Disposition
P 4	1	ref to CALM : See general comments	**Not accepted.** It has been agreed that a reference to CALM is necessary, as CALM provides for multimedia operation that include different types of DSRC equipments.
P 5	1	ref to LDR : LDR is not a national spec, opposite to HDR	**Accepted.** Text amended accordingly.
P 5	3	no reference to the ISM band : It must be clearly indicate for which allowed 5.8 GHz ISM band this standard has been intended	**Accepted.** Text amended accordingly.
P 6	1	Remove 'for EFC' in 'RTTT systems for EFC'	**Accepted.** Text amended accordingly.
P 6	2	Replace "architecture and services offered by physical layer' by 'physical layer parameters'	**Accepted.** Text amended accordingly.

Page	Class	Comment	Disposition
P 8	3	'enables integration of HDR and MDR on a single OBU device': this is not the case indeed. What this standard enables is the implementation of L1 HDR, but the coexistence problems, such as those parameters that are tied to physical characteristics and need to be switched between LDR and HDR are untouched, and this is normal, see 7.1.	**Accepted.** Text amended accordingly.
P 8	1	Rename 'Conformance' that is misleading with 'Verification of the layer 1 requirements'	**Not accepted.** The title "Conformance" is a standard clause title, and should be in the document according to the official Guidelines for producing Standards.
P 9	2	Ref 1 is unused, should be deleted Ref 5, 6, 7 are upper layer and should not be referenced here, this is against ref 2 and 3 8 and 9 do not exist yet, they should not be referenced, it might though be the case if ETSI and CEN work go in parallel	Ref1 is now used, see new text after previous comment. Ref3 has been deleted. Ref5, Ref6 and Ref7 are used in the introduction, which is common to all layers, so they must be kept. Ref8 and Ref9 have been deleted
P 10	2	Parameter D2: add 'emitted by the RSU transmitter *as a function of frequency*, either…"	**Accepted.** Text amended accordingly.
P 11	3	Parameter D4a, add definition similar to EN12253	**Accepted.** Text amended accordingly.

Page	Class	Comment	Disposition
P 12	2	Parameter D10a: what is the meaning of the word 'optional ?' This is important from a manufacturer's point of view	**Accepted**. Text amended accordingly. The meaning of "optional" is that the wakeup process is not mandatory (an OBU could be always active, or be waken up by other means, but remaining compliant to the standard). The specification of a wakeup process and related signals is an add-on with respect to basic functionalities. As far as incompatibility of wakeup processes is concerned, it has to be noted that there is no defined standard strategy for the wakeup process for CEN apparatus (see definition of parameter D10 of the CEN L1 where it states that "No special wakeup pattern is necessary"). The UNI DSRC system, however, does specify a wakeup strategy in the Italian version by using a specific wakeup signal sent by the UNI DSRC RSE, which could be considered as an additional (not strictly needed) feature of the system. This does not imply that a different wakeup strategy could be devised and implemented for UNI DSRC or multi-protocol OBUs. Examples could be based on data bursts, like for the CEN equipment. As an example, multi mode wakeup process in an OBU without a specific wakeup signal could be implemented by using a narrow band wakeup amplifier that detects signals in a narrow band between 500 and 900 Kbit/sec (the interval between the UNI DSRC and CEN bit rates). This would perfectly be compatible with both UNI DSRC and CEN standards.
P 12	1	Parameter D10b: replace "first slope" by "beginning of the wake-up pattern as defined by D10a	**Accepted.** Text amended accordingly.
P 12	3	D11a et D11b parameters: the phrase 'but subject to' is unclear and creates a circular reference between these parameters: to be deleted	**Accepted**. Text amended accordingly.
P 13	3	U1a: the subcarrier is referenced to the centre of the uplink band, not sideband (there are two sidebands)	**Accepted.** The word "side" has been removed.
P 13	1	U1b should be the "maximum *allowed* deviation…"	**Accepted.** Text amended accordingly.
P 13	3	Parameter U2 should be "maximum allowed power *at a given frequency* emitted …"	**Accepted.** Text amended accordingly.

Page	Class	Comment	Disposition
P 13	3	Parameter U6b: correct definition to be "The subcarrier is frequency modulated. U6b defines the difference between the central subcarrier value as defined by U1a and the its instantaneous modulation frequency corresponding to a binary symbol'.	**Accepted.** Text amended accordingly.
P 14	3	U11a et U11b parameters: the phrase 'but subject to' is unclear and creates a circular reference between these parameters: to be deleted	**Accepted.** Text amended accordingly.
P 14	2	U12a and U12b: a mention of the power at which this parameter is considered should be included, similar to what is done is prEN12253. Alternately, a reference could be made to the ETSI texts.	**Accepted**. Text amended accordingly.
P 16	2	The note from EN12253 indicating that all values are defined for free spaced propagation should be kept, it is true for all DSRC equipment.	**Not accepted.** It has been considered that a note is not part of a standard, so the same message has been conveyed in the main body text. As a matter of fact, the second paragraph of 6.1 reads: “All these parameters are valid for free space propagation”. In addition, future ETSI test suite will cover in details measurement conditions for all these parameters.
P 16	3	Parameter D2: 'out of channel' to be replaced by 'out of band' 'maximum EIRP' is somewhat ambiguous since it does not indicate modulated or unmodulated. Should be replaced by 'in band power', and thus, this figure would cover the zone between 0 and 2MHz around the carrier	**Accepted.** Text amended accordingly.
P 16	3	Parameter D3: this parameter MUST be standardised, this is a necessary design requirement for any manufacturer. The comment should be deleted	**Accepted.** Text amended accordingly.
P 16	3	According to above comment D4a maximum EIRP should be specified at +39dBm.	**Accepted.** No modification to the current text is needed.
P 16	3	Parameter D4b: this parameter MUST be specified, the angular pattern of the RSU depends on it, and known value is a design requirement for any manufacturer	**Accepted.** Text amended accordingly.
P 16	3	Parameter D5b: the '-3dB area' mention must be clarified (understood as 3dB point of the RSU antenna diagram, is it correct ?) and it only makes sense if D4b is specified.	**Accepted.** Parameter values updated to new specifications. Parameter values for U5b updated as well.

Page	Class	Comment	Disposition
P 17	2	Parameter D10a: 'starting with high level' is ambiguous, because it may refer to the bit code or to the carrier modulation, and polarity between both is not described; replace by 'starting with the maximum power state of the carrier modulation'	**Accepted.** Text amended accordingly.
P 17	2	Parameter D10d: should be renamed 'start of preamble' for better clarity, since the real 'data' are after the 4 bytes preamble	**Accepted.** Text amended accordingly.
P 17	3	Parameter D11b: should preferably be named 'upper power limit for communication', because this limit may be reached for uplink spectral mask reasons well before saturation is reached. MUST be standardised since it must be known by manufacturers to design units	**Accepted.** Text amended accordingly. Parameter value defined.
P 18	3	Parameter U1a: from reading standard part 3, the understanding is that the three possible values of U1a and the three possible values of U8a are linked one-to-one. This must be made clear in U1a.	**Accepted.** Text amended accordingly.
P 18	3	Parameter U2: replace 'out of channel' by 'out of band' In band power must be specified (see EN12253) Spurious emissions around any other uplink subcarrier must be specified, because this dictates the receiver filtering and must be known by manufacturers	**Accepted.** Text amended accordingly.
P 18	3	Parameter U3: this parameter MUST be standardised, this is a necessary design requirement for any manufacturer. The comment should be deleted	**Not accepted.** The parameter has been totally deleted. It is not used, and is not used, nor defined, in the CEN standard.
P 18	3	Parameter U4: a value must be specified for this parameter, it is a design requirement for manufacturers	a) **Accepted.** Text amended accordingly. The value of U4a (Maximum Single Side Band E.I.R.P.(bore sight)) parameter has been specified.
P 19	3	Parameter U6a: from reading standard part 3, the understanding is that the three possible values of U6a and the three possible values of U8a are linked one-to-one. This must be made clear in U6a.	**Accepted.** Text amended accordingly. Same amendment implemented for parameter U8a as well.
P 20	3	Parameters U11a and U11b: the comment 'not relevant for compatibility' is valid only if one considers a dual mode OBU design, which is a somewhat restrictive approach	Parameter values have been modified. The comment does not apply any longer.

Page	Class	Comment	Disposition
P 20	1	Parameters U12a and U12b: the fact that these values are for one side band only should be added to the comment, even though they are part of the definition. Since the polarisation is linear, the 35° are supposed not to be valid for a circular cone, as is the case for EN12253, a clarification should be added in the definition and / or the comment	Parameter values have been modified. The comment does not apply any longer.
P 20	3	Figure A1: replace the last sentence, in which 'protocols' is not precise enough, with 'both HDR and MDR layer 1 parameters may coexist within a single OBU'	**Accepted.** Text amended with slight modifications.

Table 9: Detailed layer 1 comments

F.2 Layer 2

Page	Class	Comment	Disposition
P 10	3	The scope mentions explicitly data flow control but this is not explicitly entirely afterwards. See comments below	**Accepted.** Section 7.4.3 renamed “Information Transfer and data flow control”.
P 12 and 13	1	The terms "session" and "header" are mentioned but never used. However, the definition of a session would be useful.	**Accepted.** References to the definitions of “session” and “header” have been removed.

Page	Class	Comment	Disposition
P 16	3	The MAC layer is defined as empty. However, it should contain the error detection and correction scheme. It is probably logical to consider that the frame validity check and the retransmission process described in 7.4 are part of the MAC. A second point is the mention of communication with several OBUs: since the LinkID is created by the RSU, it is possible that two OBUs that entered the communication zone at the same time try to communicate with the same LinkId: in that case, how can the RSU distinguish between those OBUs ?	It is recognised that most Data Link standards feature a MAC sublayer. However, due to: 1. the very limited functions of MAC, as explained in "6 Medium access control sub-layer" 2. the fact that a MAC sublayer is not mandatory according to the OSI reference model, 3. the unneeded complication of the description (a tentative description featuring a MAC sublayer resulted in a more complicated text) it has been decided not to introduce a MAC sublayer description. As far as the second issue is concerned, there are two reasons: 1. the geometry of the communication area (including the antenna footprint) ensures that only one OBU at a time can talk with a given RSE 2. at application level, the calling/responding application title bear unique Ids
P 16	3	It could be a good idea to create a section entitled "window management and address establishment" as part of the MAC layer; the principle is fairly simple, since the basic cycle is one downlink window followed by one private uplink window, with no contention resolution, but it would clarify the structure and follow more closely the traditional OSI layering	**Not accepted.** See disposition of previous comment.
P 18	2	A new SAP is created by the OBU when receiving a new LLC address: it is supposed that the limit for a given OBU is 1 SAP per session, but it should be made clear.	**Accepted.** The limit was clear as the text reads: "… shall contain one broadcast SAP and, …, one private SAP". When the term "one" is used, the current English meaning is "one and only one". However, for the sake of clarity, the text has been modified to read "one and only one".

Page	Class	Comment	Disposition
P 19	2	1) LPDU format: the max length the LPDU should be mentioned in this section rather than in annex A 2) The LinkId should be named '2 octets MAC address' if comment above is agreed 3) section 7.3.4 describes an invalid LPDU *address* and not invalid LPDU according to the text.	1. **Not accepted:** max length is defined in 7.4.1 (Validity of frame) immediately below. It has been parameterised to allow flexibility, as a current way of writing standards. 2. **Not accepted**, as the MAC sublayer is not introduced. 3. **Not accepted:** from a Layer 2 point of view, the only validity conditions for a PDU are related to its address. Thus, a valid LPDU is one that has a valid address, and vice versa.
P 20	3	Section 7.4.1: if the LPDU is not valid, it is supposed that the OBU just discards it and takes no further action for retransmission. Is it correct ? Section 7.4.2.1: 'communication to a new OBU' to be replaced by 'a new communication session with an OBU' to cover the case in which the OBU went to sleep within the communication zone.	**Issue #1:** The penultimate paragraph of 7.4.1 reads "If the frame received is not valid it shall be discarded". A condition for frame validity is LPDU validity. The answer is YES, no action in the text is needed. **Issue #2:** The LinkID remains the same even when an OBU goes to sleep, so the comment is inaccurate. No action in the text is needed.
P 21	2	Section 7.4.3.3: replace 'shall be transmitted immediately' with 'there is no minimum time before starting transmission of the response PDU. The maximum time for this transmission is Tu'.	**Accepted.** Text amended accordingly.
P 21	1	Section 7.4.3.4: replace 'shall be derived' with 'shall be extracted'	**Accepted.** Text amended with slight modifications.
P 21	2	Section 7.4.3.5: this is indeed an OBU requirement (the OBU shall transmit LPDUs on its own) and as such should be transferred to the OBU section.	**Accepted.** Text has been improved to specify the RSU behaviour.
P 21	3	Section 7.4.3.6: the text seems in contradiction with the notion of 'immediate response' as described in 7.4.3.2. Does this mean that if the application is not ready to reply, one command-response cycle is lost and the OBU will transmit the LPDU at the next downlink request ? In a similar manner, 'duplicate' message has no real meaning for the OBU, since the LLC does not feature flow control and sequencing of downlink frames. It might be link to the above comment.	**Accepted.** The answer to the question in the last sentence is YES if the next downlink request is the same command as the previous one. As stated in the text, the RSE keeps sending commands until it gets answers, so duplicate messages do. The OBU responds to duplicate commands with the same last response. The text has been improved to make this concept clearer.

Page	Class	Comment	Disposition
general	2	It could be wise to add to the layer 2 text an informative annex showing the sequence of layer 2 usage in a chronogram zone, from the entry in the communication zone up to the end of communication, showing an example of application-not-ready response and an example of retransmission on OBU side. It is assumed that 3 data rates exist at layer 1. The timing of the command / response cycle is unique in the document, it must be made clear that this applies to all bit rates.	**Accepted.** An informative annex has been added.

Table 10: Detailed layer 2 comments

F.3 Layer 7

Page	Class	Comment	Disposition
P 10	1	The text says that this part covers the intermediate level of OSI layers, but due to the structure and services of the communication stack, it seems that these layers are indeed absent. To be clarified.	**Accepted.** OSI intermediate layers (Presentation, Session, Transport, and Network) are absent from DSRC specifications. This does not mean that functions of those layers are absent. Needed functions that, in a strict OSI view, would pertain to other layers, are implemented as Application Layer functions. An example is session control. The text has been, however, amended to clarify this point.
P 12	1	Section 3.1.1 and 3.1.2 should be rephrased 'that supports the OBU ***EFC*** Application Process', because ASOs for other applications might be different.	**Accepted.** Text amended accordingly.
P 13	1	Abbreviations: some abbreviations are defined but never used (G2, G3, M5, etc.)	**Accepted.** Text amended accordingly.
P 16	1	Last sentence should be rephrased as 'The general behaviour is that the RSU EFC-ASO is the only entity allowed to generate requests, and the OBU EFC-ASO is able to respond to these requests.	**Accepted.** Text amended accordingly with a slight modification.

Page	Class	Comment	Disposition
P 17	2	Section 7.1: 'A number of RSU EFC-ASOs can open associations with the same OBU-EFC ASO': due to the restriction concerning point –o multipoint communication as described in layer 2, this possibility is only theoretical. Correct ? Section 7.2: replace 'interaction' with 'layer 2 command-response cycle.	The answer to the question in paragraph #1 is: **Incorrect**. Layer2 communication restrictions do not have anything to do with the number of communicating ASOs. It is possible that two distinct RSEs try to open associations with the same OBU. What is written in the standard means that this Application layer does not solve the problem, which is solved by the EFC ASO. The comment in paragraph #2 is **Not accepted**. Interaction is an Application layer term, which is more suited in this context.
P 19	3	Last sentence: this supposes that the OBU may used the desired responding mode as required by the RSU: what is the behaviour in case the application data retrieval cannot comply with the response mode (e.g. Urgent with smart card data). Is it assumed that the RSE has a pre-existing knowledge of OBU capacities ?	**Accepted.** The chosen naming is a little misleading, but is has nothing to do with the actual response time in the OBU. The parameter is simply used to allow three different choices of bit rate for the response, which is anyway issued at OBU's convenience. Text has been added to clarify this concept.
P 20	3	Section 8.1.1.2: a default password in mentioned, but its value is not described.	**Accepted.** The text does not specify the value of the default password, which is implementation dependent. Text has been added to clarify this.
P 21	2	Section 8.1.3.2: the first sentence of service procedures description is a bit obscure; needs editorial clarification	**Accepted.** Text has been amended accordingly.
P 24	2	Section 8.2.4.2: in case the Deferred mode is chosen for the A-SET_ASO_Context, by 'formal control', should one understand command coherency and syntax check ?	Answer is Yes. No modifications to the text of the standard.
P 26	2	Section 8.3.2.1: the A-SET procedures should describe the difference in behaviour between Current or Next event storage	**Accepted.** Same behaviour, different "record" position, as in an index sequential file system. Text has been added to clarify this.
P 27	2	Section 8.3.3.2: same comment as 8.2.4.2	Same answer. No modifications to the text of the standard.
P 36	3	Section 9.2: the behaviour of the OBU for the concatenated responses in case there is a failure for one of the commands should be specified (go on with the rest of the responses or abort the remaining responses). This issue is partly mentioned at the end of section 9.5, but the text is still a bit ambiguous for the OBU behaviour	**Accepted.** Text in 9.2 has been added and merged with text taken from 9.5.

Page	Class	Comment	Disposition
3P6	3	Section 9.3: the responding mode management is described at the OBU side, but it is likely that a similar interlayer management takes place at the RSU to change the bit rate of the receiver. Please clarify.	**Accepted.** Text has been modified accordingly.

Table 11: Detailed layer 7 comments

F.4 EFC ASO specification

Page	Class	Comment	Disposition
P15	1	According to their description in the document, the System Control elements should be better named OBE control elements, OBE being OBU + external devices	**Accepted.** Text and Figure 5 have been modified accordingly.
P15	1	The two last paragraphs are in contradiction, to avoid this the first one should be 'The EFC ASO is the set of Kernel, Context, Execution, Security and System elements that support Electronic Fee Collection applications	Not Accepted. The last two paragraphs indicate what the EFC ASO does and who is the EFC ASO user, so there is no contradiction. However, the order of the two paragraphs has been inverted, so to make the text clearer.
P19	2	Section 8.1.3.2: the depth of the password stack should be specified; the reader's understanding is that it is set to 1.	**Accepted.** Text has been modified accordingly.
P20	2	Section 8.2.1.1: is there any extension for further / private resource management ? If yes, it should be mentioned	There is no extension of the external parameters.

Table 12: Detailed EFC ASO comments

ANNEX G– DETAILED REVIEW COMMENTS OF EG8

This annex accounts for the detailed review comments of EG8 on the Draft UNI DSRC standards (see Table 1), including the perceived severity class:

- Class 1 denotes an editorial comment, intended to improve the reader's understanding and readability of the specification;
- Class 2 denotes a lack of precision or inappropriate wording that could mislead the reader and lead to equipment non-compatibility or non-compliance;
- Class 3 is used for contradictions or lack of information that is blocking from the OBU designer's point of view, i.e. is absolutely needed in order to design compatible OBU.

This annex also accounts for UNINFO experts' intended disposition reflecting their view of how to resolve EG8's comments.

G.1 Detailed layer 1 comments

Ref	Class	Comment	UNINFO's intended disposition
Foreword	1	Correct the foreword.	To be done when documents will be put in UNI templates.
Introduction	1	Correct text after figure, i.e. remove references to MDR, add reference to CEPT and correct references on pg 6	agreed – will be included in published version of documents
Scope / Normative references	2	Correct references to UNI Standards / Specifications (i.e. replace references to CEN prEN xxxx)	agreed – will be included in published version of documents
Scope	1	Correct last sentence, i.e. correct reference to MDR, remove single and replace language (e.g. with terminology or formalism)	agreed – will be included in published version of documents
Normative references	2	Remove references to the last two references (as they do not exist)	agreed – will be included in published version of documents
Terms and definitions	1	Technical Report: clarify and use retained term consistently	agreed – will be included in published version of documents
Table 1, D2	1	Correct EN yyyyyy-1	agreed – will be included in published version of documents
Table 1, D10a	1	Correct ‘starting starting’	agreed – will be included in published version of documents
Annex A	1	Replace MDR with correct term	agreed – will be included in published version of documents. Terms such as HDR, MDR and LDR have been defined for the scope of the figure only.
Bibliography	1	Update	agreed – will be included in published version of documents

G.2 Detailed layer 2 comments

Ref	Class	Comment	UNINFO's intended disposition
Foreword	1	Correct the foreword.	To be done when documents will be put in UNI templates.
Introduction	1	Correct text after figure, i.e. remove references to MDR, add reference to CEPT and correct references on pg 6	agreed – will be included in published version of documents
Scope / Normative references	2	Correct references to UNI Standards / Specifications (i.e. replace references to CEN prEN xxxx)	agreed – will be included in published version of documents
Annex A	N/A	T1 polling interval time poses unnecessary implementation restriction, that are not justified from equipment compatibility and service interoperability point of view	
Bibliography	1	Update	agreed – will be included in published version of documents

G.3 Detailed layer 7 comments

Ref	Class	Comment	UNINFO's intended disposition
Foreword	1	Correct the foreword.	To be done when documents will be put in UNI templates.
Introduction	1	Correct text after figure, i.e. remove references to MDR	agreed – will be included in published version of documents
Scope / Normative references	2	Correct references to UNI Standards / Specifications (i.e. replace references to CEN prEN xxxx)	agreed – will be included in published version of documents
8.1.1	3	The relation between the "Responding Mode" parameter (in section 8.1.1.1) with U8a (in Part 1) needs to be defined - 4 values defined (no response, urgent, normal and late; to select the corresponding transmission bit rate (U8a)).	agreed – will be included in published version of documents
8.1.1.1	3	Consistency of "Responding Mode" definition in 8.1.1.1 and the corresponding ASN.1 definition in Annex A (and 9.1.2)	agreed – will be included in published version of documents
9.1.4	3	Semantics of 'opc-failure' in 'Result and Diagnostics' parameters in 9.1.4 and Annex A	agreed – will be included in published version of documents
A-Association Parameters	3	a) the semantics (i.e. the meaning) of the parameters should be added (in e.g. section 8.1.1.1) b) Called AP Invocation Identifier (in section 9.1.2) = sequence of "LaID and LinkID" (with reference to appropriate section in Part 2)? c) Consistency would be ensured and readability improved e.g. if Calling AP Title in Annex A was defined directly	a) agreed – will be included in published version of documents b) Answer is No. The Called AP Invocation Identifier is set to LaID. LinkID is generated by Layer 2 (see Part 2) c) See above. The Calling AP Title is part of Layer 2 addressing, hence cannot be

Ref	Class	Comment	UNINFO's intended disposition
		under "Request-Msg-Header :: = Seq { calling-AP-title Data-String(SIZE(4))…. (Note that the tables in Annex B in Part 4 need to be updated accordingly) d) "Number of Directives" seems to be missing in the main part of the document (i.e. 8.1.1.1 and 9.1.2)	part of the Request-Msg-Header. d) The Number of Directives is calculated after a group is closed (see 9.2)
Offset (in 8.2.1.1)	2	It seems as if the definition of an Application Service Object includes definition of the Offset? If so then this should be clarified (and why not define the various types of Offsets in 8.2.1.1 and reference the corresponding ones as part of the definitions of the ASOs in part 4?	Offset is indeed defined by each ASO. In the particular case of the EFC ASO, specified in Part4, the (virtual) memory structure has been added and the Offset concept is directly derivable. Also, examples of primitives for the CARDME transactions, added as Annex B, explain the usage of Offset.
9.2	3	The overall length of a protocol message after encoding shall not exceed 64 octets, excluding the A-Association parameters and the Result and Diagnostics fields? The encoded LPDU (excluding the zero-bit insertions) including A-Association parameters and the Result and Diagnostics fields shall not exceed 64 octets? (i.e. Flag (1) + LaID (2) + LinkID(2) + Request/Response-Msg-Header (calling-AP-title (4) + response-requirements (1) + number-of-directives (1, only for Req messages)) + Request/Response-Msg-Body (variable) + FCS/CRC-16 (2) + Flag (1) ≤ 64 octets?)	The example at the end of the comment is correct (as far as Requests are concerned). The 64 octets limit applies to the frame length, i.e. everything included between (and not including) starting flag and FCS. The text in 9.2 is incorrect and has been amended.
11	3	Encoding rules: How can an encoder know how to decode, e.g. a Choice type value (section 11.2.3 and Annex A) according to the rules lay down by Part 3? (through look-up table and knowledge of the personalisation of the corresponding application?)	The way an encoder can work has been provided offline, see also [UNI Encoding]
Annex A	3	The ASN.1 module needs to be given a proper identifier	Registration and consequent identification of the ASN.1 modules is part of the on going standardization process.
Text above table 13	1	protocol request => protocol response	agreed – will be included in published version of documents
Bibliography	1	Update	agreed – will be included in published version of documents

G.4 Detailed EFC application layer interface definition comments

Ref	Class	Comment	UNINFO's intended disposition
Foreword	1	Correct the foreword.	agreed – will be included in published version of documents
Introduction	1	Correct text after figure, i.e. remove references to MDR	agreed – will be included in published version of documents
Scope, Normative references, section 6.1 etc	2	Correct references to UNI Standards / Specifications (i.e. replace references to CEN prEN xxxx)	agreed – will be included in published version of documents
Section 7, pg 18	2	Precise 2nd sentence, e.g. "The first two octets identify the related application.	agreed – will be included in published version of documents
Table 23 and 31	2	The CARDME data that are OBU programmed as "Core data" need to be corrected in Tables 23 and 31: PaymentMeans (14 octets), VehicleLicencePlateNumber (9 octets), VehicleClass (1 octet) and VehicleWeightLimits (6 octets). The correction of table 31 also results in additional DL-UL frames in order to transmit the data.	Correct. There was an error in Table 23. Table 30 and 31 have been corrected accordingly, as well as Table 25.
Annex A	3	ASN.1 module (in Annex A) needs to be given a proper identifier, and the import statement needs to be corrected	Registration and consequent identification of the ASN.1 modules is part of the on going standardization process.
Table 30, octet 34	2	Bit value should read '0000 0001'	The offset should be zero (read from beginning). Both the current text and the comment are wrong. Correct value is '0000 0000'. Other offsets and related comments revised and corrected
Pg 44	2	'VehicleLicencePlateNumber' should read 'LPN	Both VehicleLicencePlateNumber and LPN are ASN.1 defined (and exportable) types. No modifications have been done.
Tables on pg 50-56	2	FCS / CRC-16 field uses 2 octets (correct tables on pgs 50-56)	Correct. Will be included in published version of documents
Pgs 52, 54-55	2	Response-Requirements seems to be wrong; 'Response not required' whereas it probably should carry 'Urgent', 'Normal' or 'Late'	Correct. Set to "Normal". Will be included in published version of documents
Table 54	2	Number-Of-Directives 54 should probably be 3 and not 5 (bit value and description to be revisited)	Correct. Text amended accordingly in published version of documents
General	N/A	It is noted that the defined MMI DSRC functions (i.e. Set-User-Interface-Rq e.g. on pg 54) seem to constitute constraints for the EETS OBU in terms of HW features to be supported	The CARDME specification is just an example, based on the UNI DSRC standard. The same example, based on the CEN standard, puts analogous constraints.

Annex B	1	It would be useful to point out that EquipmentStatus is not used in the CARDME transaction example (i.e. offset = 3 when reading the record 1 and record 2)	The example is just that, an example. EquipmentStatus (as well as the second ReceiptData) was not used, as not being considered fundamental for the overall CARDME mechanism to work. Will be included in published version of documents
Bibliography	1	Update	agreed – will be included in published version of documents