

Road Traffic and Transport Telematics (RTTT) — Dedicated Short Range Communication (DSRC) — DSRC Data Link Layer: Medium Access and Logical Link Control

ICS 35.240.60

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National foreword

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Comments arising from the use of this Draft for Development are requested so that UK experience can be reported to the European organization responsible for its conversion into a European Standard. A review of this publication will be initiated 2 years after its publication by the European organization so that a decision can be taken on its status at the end of its three-year life. The commencement of the review period will be notified by an announcement in *Update Standards*.

According to the replies received by the end of the review period, the responsible BSI Committee will decide whether to support the conversion into a European Standard, to extend the life of the prestandard or to withdraw it. Comments should be sent in writing to the Secretary of BSI Technical Committee EPL/278, Road transport informatics, at 389 Chiswick High Road, London W4 4AL, giving the document reference and clause number and proposing, where possible, an appropriate revision of the text.

Cross-references

Attention is drawn to the fact that CEN and CENELEC Standards normally include an annex which lists normative references to international publications with their corresponding European publications.

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the ENV title page, pages 2 to 53 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

This Draft for Development, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 November 1997

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ISBN 0 580 28448 4

Amendments issued since publication

Amd. No.	Date	Comments

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ICS 35.100.20; 35.240.60

Descriptors: Teleprocessing, traffic, road transport, information interchange, data transmission, open systems interconnection, data link layer, access, inspections

English version

Road Traffic and Transport Telematics (RTTT) — Dedicated Short Range Communication (DSRC) — DSRC Data Link Layer: Medium Access and Logical Link Control

Télématique de la Circulation et du Transport
Routier — Communication dédiée, à courte
distance — Couche Liaison: Mécanisme d'accès
au média et contrôle du lien logique

Telematik für Straßenverkehr und
Transport — Nahbereichskommunikation
Bake-Fahrzeug — Datensicherungsschicht:
Kanalzugriff und Verbindungssteuerung

This European Prestandard (ENV) was approved by CEN on 1997-07-25 as a prospective standard for provisional application. The period of validity of this ENV is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the ENV can be converted into an European Standard (EN).

CEN members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

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European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

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Foreword

This European Prestandard has been prepared by Technical Committee CEN/TC 278 “Road transport and traffic telematics”, the secretariat of which is held by NNI.

This European Prestandard was prepared by CEN TC278 WG9 “Dedicated Short-Range Communication”, using its Subgroup L2 and the Project team CEN TC278 M018 PT07 to pursue its objective which is covered by TC278 Work Item WI 9.2.3.

The subject Prestandard forms a part of a series of Prestandards defining the framework of a Dedicated Short Range Communication (DSRC) link in the RTTT environment. For basic information about RTTT application requirements and the resulting concept for DSRC, please refer the Internal Technical Report TC 278 N198 “DSRC — 1st Status Report”

In addition to this Prestandard, the following parts will also be issued by CEN TC278 to build a complete set of Prestandards for the DSRC link:

prENV 12253	“DSRC Physical Layer using Microwave at 5.8 GHz”; CEN TC278 Work Item 00278 092; document N 473
prENV278/9/#63	“DSRC Physical Layer using Infrared at 850 nm”; CEN TC278 Work Item 00278 093; document N 526
prENV278/9/#64	“DSRC Data Link Layer: MAC and LLC”; CEN TC278 Work Item 00278 053; document N 474
prENV278/9/#65	“DSRC Application Layer”; CEN TC278 Work Item 00278 051, document N 505
prENV278/9/#74	“DSRC Communication Profiles”; CEN TC278 Work Item 00278 xxx, document N 6xx

WG9 consists of experts mainly from telecommunication sector and also from transport sector. Most active participating companies and organisations are:

Austria:	Alcatel, Efkon, Kapsch
France:	CGA, ISIS, Renault, Thomson
Germany:	Alcatel-SEL, Bosch-Telecom (ANT), Daimler-Benz Aerospace, RWTH, Siemens
Italy:	Alenia Marconi, Autostrade, UNINFO
Netherlands:	CMG
Norway:	Micro Design
Sweden:	SAAB Combitech Traffic, Telia Research
United Kingdom:	GEC Marconi, Peek plc, STCL

Additional contributions came from non-European experts from USA and Japan via ISO TC204 WG15, especially from Japan and USA.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this European Prestandard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Document change control record (informative)

Registration by CEN TC278	Version	Date	Change description
N 399 N 418 N 453	3.1	1995-03-18 1995-04-04 1995-07-12	First presentation(s) of prENV document to CEN TC278 (stage 32)
N 474	3.3	1995-09-25	Modification of version 3.1 acc. to received comments
N 6**	4.0	1996-12-10	1) New “Introduction” covering the TC278 Resolution 16.11 from 1996-09-26 (<i>in italics</i>); 2) Regular update of various reference numbers

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Introduction (informative)

Dedicated Short-range Communication is intended to be a communication means for Road Traffic and Transport Telematics (RTTT) applications, amongst others such as Automatic Fee Collection (AFC), Automatic Vehicle and Equipment Identification (AVI/AEI) and Traffic and Traveller Information (TTI). This European Prestandard caters for on-board units based on transponder as well as transceiver technologies, and allows for interoperability between systems based on both of these technologies. Furthermore, the Prestandard allows for mixed time, frequency and space division multiple access approaches.

Resolution 16.10 taken by CEN/TC 278 on 1996-09-26:

Subject: CEN/TC 278 — DSRC Standards for 5.8 GHz

CEN/TC 278, in view of the high priority accorded by industry, road operators and the European Commission to establish DSRC standards (DSRC layer 1, layer 2 and layer 7) taking account of the problems encountered in gaining consensus caused by the presence in some countries of large populations of already deployed pre-existing systems, resolves that:

- 1) it reaffirms the results of the work undertaken by WG 9 and reaffirms its commitment to the draft DSRC Standards (layer 1, layer 2, layer 7) for pan European use at 5.8 GHz.*
- 2) it also recognises that already established and deployed systems in large scale should be tolerated as long as they are in the public domain and can co-exist with the DSRC Standards (for layer 1, layer 2 and layer 7) and wishes to enable and encourage their migration towards full interoperability.*
- 3) it recognises that on-board equipment operating according to the DSRC Standards (layer 1, 2 and 7) does not interfere with tolling systems mentioned in 2) above working in the 5.8 GHz band.*
- 4) it requires that the path by which interoperability and migration is to be achieved remains the responsibility of those not using the preferred specification.*
- 5) it recognises that future applications may require expansion of the available bandwidth at 5.8 GHz and will do its utmost in co-operation with ETSI to persuade CEPT to expand the available bandwidth.*

Title (normative)

- a) Road Traffic and Transport Telematics (RTTT),
- b) Dedicated Short-Range Communication (DSRC),
- c) DSRC Data Link Layer: Medium Access and Logical Link Control

1 Scope (normative)

This European draft standard ...

- is positioned with respect to other related standards by the layers defined in the Reference Model for Open Systems Interconnection (ISO 7498:1984) as adopted for the dedicated short-range communication (DSRC).
- defines the Data Link Layer irrespective of the physical medium to be used.
- applies to DSRC between Fixed Equipment at the roadside and Mobile Equipment in vehicles. This standard does neither apply to vehicle to vehicle communication nor, to communication, between different instances of Fixed Equipment.
- adheres to the general DSRC architecture in which the Fixed Equipment controls the medium, allocating its use to Mobile Equipment within range of the Fixed Equipment. It supports simplex and half duplex transmission modes and caters for the use of semi-passive (transponder) as well as semi-active (transceiver) Mobile Equipment.
- supports a variety of Fixed Equipment configurations. It supports configurations where one Fixed Equipment communicates with one Mobile Equipment unit, as well as configurations where one Fixed Equipment can communicate with several Mobile Equipment units. It does neither define any specific configuration nor layout of the communication zone.
- does not define to what extent different instances of Fixed Equipment, operating in the vicinity of each other, need to be synchronised with each other.
- defines parameters to be used in negotiation procedures taking place between Fixed Equipment and Mobile Equipment.

By defining two distinct sublayers, namely the medium access control (MAC) sublayer and the logical link control (LLC) sublayer, this standard defines:

- a) medium access control procedures for the shared physical medium
- b) addressing rules and conventions
- c) data flow control procedures
- d) acknowledgement procedures
- e) error control procedures
- f) services provided to data link user(s)

The MAC sublayer is specific to the DSRC while the LLC sublayer is adopted from a subset of ISO 8802-2:1989. The services offered are unacknowledged (Type 1) and acknowledged (Type 3) connectionless services.

This standard takes into account that each Fixed Equipment covers a limited part of the road (the communication zone) and that the Mobile Equipment communicates with the Fixed Equipment while passing through the communication zone.

2 References (normative)

This standard incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references the latest of the publication referred to applies.

ISO 4335:1987, *Information processing systems, Data communications, High-level data link control elements of procedures.*

ISO 7498:1984, *Information Technology — Open Systems Interconnection — Basic Reference Model: The Basic Reference Model.*

ISO 7809:1984, *Information processing systems, Data communications, High-level data link control procedures, Consolidation of classes of procedures.*

ISO 8802-2:1989, *Local Area Networks — Part 2: Logical Link Control*; ISO 8802-2:1989, *Local Area Networks — Part 2: Logical Link Control, ADDENDUM 2: Acknowledged Connectionless-Mode Service and Protocol, Type 3 Operation.*

ISO IS 3309:1984, *Information processing systems — Data communication — High-level data link control procedures — Frame structure.*

CCITT Recom. X.25, *Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit.*

CCITT Recom. X.200, *Reference model on open systems interconnection for CCITT applications.*

3 Definitions and abbreviations (normative)

3.1 Definitions

For the purposes of this standard, the following definitions apply:

Beacon Service Table

a communication service table defining a set of parameters necessary for a Mobile Equipment to communicate with a Fixed Equipment. Parameters include transmission medium characteristics, frame length, inter frame gap length, uplink window size, timer values, counter values, etc. The Beacon Service Table is maintained by the Application Layer (which is the Data Link Layer user)

Broadcast Link Address

the predefined SAP address used as a broadcast (all parties) address. It can never be the address of a single SAP on the data link

Command

an instruction in data communications. It is represented in the control field of a PDU and transmitted by an LLC. It causes the addressed LLC(s) to execute a specific data link control function

Data Link

an assembly of two or more terminal installations and the interconnecting communications channel operating according to a particular method that permits information to be exchanged. In this standard the term terminal installation does not include the data source and the data sink

Data Link Layer

the conceptual layer of control or processing logic existing in the hierarchical structure of a station that is responsible for maintaining control of the data link. The data link layer functions provide an interface between the station higher layer logic and the data link. These functions include address/control field interpretation, channel access and command PDU/response PDU generation, transmission, and interpretation

Downlink

communication channel on which the Fixed Equipment transmits its information

Downlink Window

the period of time during which the Fixed Equipment is transmitting

Fixed Equipment

a fixed communication facility, at the roadside, with a single downlink channel and one or more uplink channels. The Fixed Equipment corresponds to the beacon's (or roadside equipment's) communication unit

Logical Link Control (LLC)

that part of communication facility that supports the logical link control functions of one or more logical links. The LLC generates command PDUs for transmission and interprets received command PDUs and response PDUs: Specific responsibilities assigned to an LLC include:

- a) Organisation of data flow
- b) Interpretation of received command PDUs and generation of appropriate response PDUs.
- c) Actions regarding error control and error recovery functions.

LLC Control Field

the first field of a PDU. The content of the control field is interpreted by the receiving destination LLC(s), designated by the link address field, as a command, from the source LLC designated by the link address field, instructing the performance of some specific function, or as a response, from the source LLC designated by the link address field

Link Address

the service access point address at the beginning of an LPDU which identifies the SAP designated to receive the PDU and the SAP transmitting the PDU

Link Turn Around Time

the link turn around time is the time between two consecutive physical layer bit streams in opposite directions (which is used for switching from transmitting to receiving mode or vice versa) comprising physical layer protocol data units, i.e. layer 2 frames (including zero bit insertion) and pre- and postambles if applicable

Logical Link Protocol Data Unit

a data unit delivered from or to the MAC sublayer

Medium Access Control (MAC)

the part of a data station that supports the medium access control functions that reside just below the LLC sublayer. The procedures of this communication entity include framing of data units, error checking, and acquiring the right to use the underlying physical medium

MAC Control Field

part of a frame holding MAC relevant control information

Multicast Address

a destination address assigned to a collection (group) of SAPs to facilitate their being addressed collectively

Mobile Equipment

a mobile communication facility capable of receiving information from the Fixed Equipment on the downlink and, possibly, also capable of transmitting information on the uplink. The Mobile Equipment corresponds to the vehicle's communication unit

Octet

a bit-oriented element that consists of eight contiguous binary bits, independently of "zero bit insertion"

Private Uplink Window

a private uplink window is the period of time which is allocated by the Fixed Equipment to a certain previously addressed Mobile Equipment for transmission

Protocol Data Unit (PDU)

the sequence of contiguous octets delivered as an unit from or to the MAC sublayer. A valid LLC PDU (LPDU) is at least 1 octet in length and contain, an LLC Control Field. An LPDU may or may not include an information field

Public Uplink Window

a public uplink window is the time period during which any Mobile Equipment is allowed to transmit, according to certain rules, in contention with other Mobile Equipment

Response

in data communications, a reply represented in the control field of a response PDU. It advises the destination LLC of the action taken by the source LLC to one or more command PDUs

Service

the capabilities and features provided by N-layer to N-user

Uplink

communication channel on which Mobile Equipment transmits its information

Uplink Window

a time period during which Mobile Equipment can transmit

Window

a period of time during which the physical medium is allocated, by the Fixed Equipment for transmission by either the Fixed Equipment (downlink window) or by the Mobile Equipment (public or private uplink window)

3.2 Abbreviations

For the purposes of this standard, the following abbreviations apply:

ACK	ACKnowledge
Acn	ACknowledged command/response
BST	Beacon Service Table
CCITT	International Telegraph and Telephone Consultative Committee
C/R	Command/Response
F	Final
FCS	Frame Check Sequence
FE	Fixed Equipment
HDLC	High-level Data Link Control
ISO	International Organisation for Standardisation
LPDU	Logical Link Control Layer Protocol Data Unit
LLC	Logic Link Control
LSDU	Link layer Service Data Unit
M	Modifier function bit
MAC	Medium Access Control
ME	Mobile Equipment
OSI	Open Systems Interconnection
P	Poll
PDU	Protocol Data Unit
P/F	Poll/Final
R	Response
RR	Response Request
SAP	Service Access Point
UA	Unnumbered Acknowledgement
UI	Unnumbered Information

Variables:

V(A)	private medium allocation state variable (MAC)
V(PUB)	first public uplink window transmission indicator (MAC)
V(RI)	receive state variable (LLC)
V(SI)	transmit state variable (LLC)
V(RB)	reception state variable (LLC)
N1	number of octets required for data link address
N2	maximum number of octets in frame in downlink window (MAC)
N3	maximum number of octets in frame in private uplink window (MAC)
N4	maximum number of octets in frame in public uplink window (MAC)
N5	number of simultaneously allocated consecutive public uplink windows (MAC)
N6	public uplink window counter
N7	random delay counter value (MAC)
N8	maximum value for random delay counter (MAC)
N9	maximum value of private uplink window allocation counter (MAC)
N10	maximum number of octets in a LPDU (LLC)
N11	maximum number of retransmissions (LLC)
T1	minimum uplink to downlink turn around time (MAC)
T2	minimum downlink to downlink window time (MAC)
T3	downlink to uplink turn around time (MAC)
T4a	maximum time before start of transmission in private uplink window (MAC)
T4b	maximum time before start of transmission in public uplink window (MAC)
T5	time duration of public uplink window (MAC)
N12	maximum private medium response time (MAC)
N13	acknowledgement time, if not indicated N13FE and N13ME is meant (LLC)
N13FE	acknowledgement time of Fixed Equipment (LLC)
N13ME	acknowledgement time of Mobile Equipment (LLC)

4 Frame format

All transmissions are in frames, and each frame conforms to the structure shown in Figure 1a and Figure 1b.

Flag	Link Address	MAC Control Field	LPDU	Frame Check Sequence	Flag
Figure 1a — Frame structure					

Frames containing only MAC control field form a special case where there is no LLC PDU (LPDU) (see Figure 1b).

Flag	Link Address	MAC Control Field	Frame Check Sequence	Flag
Figure 1b — MAC Frame structure, containing only MAC control field				

NOTE It should be noted that the physical bit stream may also comprise either a preamble and/or a postamble encapsulating a layer 2 frame (including zero bit insertion; see Figure 2). The length and pattern of the pre- and postambles, if applicable, are outside the scope of this standard. The whole length of the physical bit stream (layer 2 frame + Pre-/Postamble) shall be taken into account for the calculation of the size of windows.

Preamble	Layer 2 frame (including zero bit insertion)	Postamble
Figure 2 — Physical layer bit stream including pre- and postambles encapsulating a layer 2 frame		

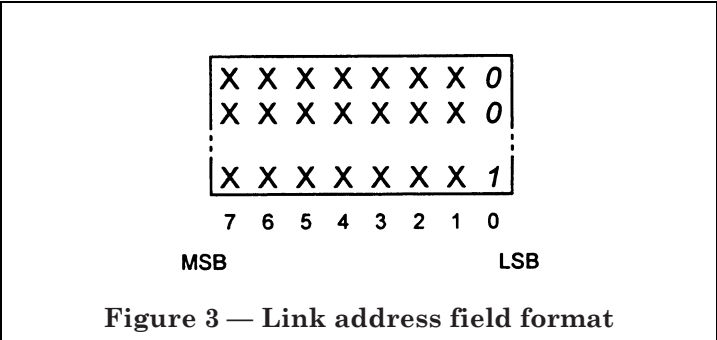
4.1 Flag sequence

All frames shall start and end with the flag sequence. This sequence is a zero bit followed by 6 one bits followed by a zero bit (0111 1110). When in receiving state, all stations shall continuously check on a bit-by-bit basis for this sequence. A transmitter shall send only complete eight bit flag sequences. The sequence which ends a frame shall not be used as the start flag sequence for the next frame. In order to achieve transparency the flag sequence is prohibited from occurring in the Data Link Address, MAC control field, LPDU and Frame Check Sequence via a zero bit insertion procedure described in subclause 4.7.

NOTE Different to the ISO IS 3309:1984 two flags should be 16 bits, i.e. two flags should be represented by 0111 1110 0111 1110. The last eight bits of the pattern sequence 0111 1110 1111 110 should be interpreted as a valid start flag.

4.2 Link address field

The address field shall contain the link address. The link address field is a sequence of up to N1 octets which comprises one address which shall be either a private link address, a multicast link address or a broadcast link address. When the first bit of an address octet is 0, the subsequent octet shall be an extension of the address field (see Figure 3). The address field shall be terminated by an octet having a 1 in bit position one. Thus the address field is recursively expandable.



The single octet address of eight 1 bits (1111 1111) shall be reserved as the broadcast address (see Figure 4). All single octet addresses other than the broadcast address shall be reserved for the multicast addresses (see Figure 5). Any address containing more than 1 octet shall be a private link address.

NOTE 1 The assignment of multicast addresses is outside the scope of this standard.

NOTE 2 The address of the SAP is equal to the content of the link address field.

NOTE 3 The length of the private link address is defined in the BST by the parameter N1

NOTE 4 Unlike ISO 8802-2:1989 there is no null address and therefore the "0000 0001" is a valid multicast address.

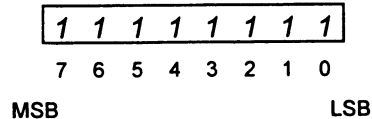


Figure 4 — Link address field format of the broadcast address

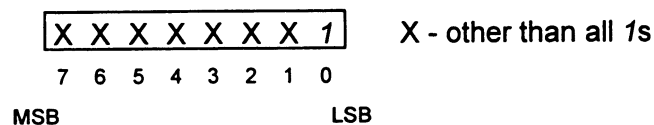


Figure 5 — Link address field format of the multicast address

4.3 MAC Control field

The MAC control field is used to:

- indicate whether an LLC unit is available (in order to allow also data-less frames)
- indicate the transmission direction: uplink or downlink (e.g. in order to detect reflected data packets or interference between FEs)
- allocate public and private windows (medium allocation code on the downlink)
- request for private windows (medium request code on the uplink).
- specify type of LLC unit

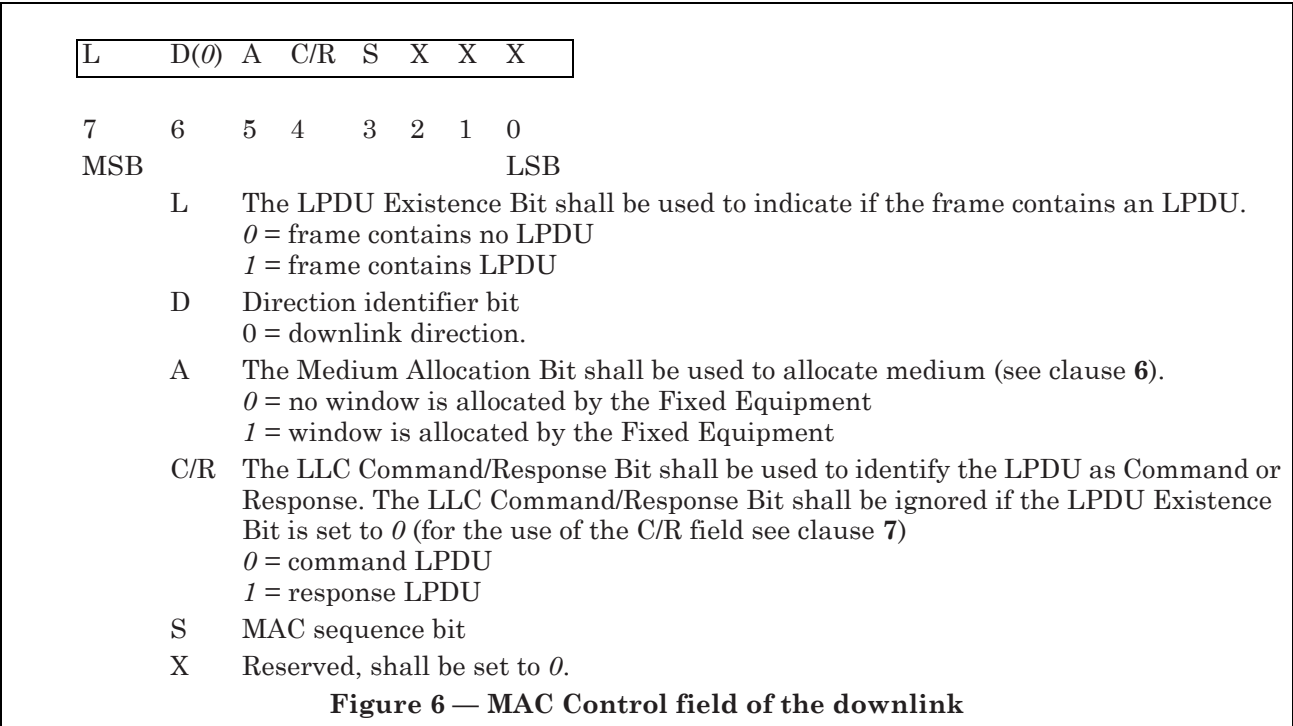
Bits which are not specified are reserved for future use, e.g. for future enhancement and optimisation of the link using window management functions (dynamic adaptation of control parameters).

The MAC control field shall contain the MAC information and the Command/Response identifier of the LPDU. The MAC control field is a sequence of one octet. It has to be distinguished between the Downlink MAC control field and the Uplink MAC control field, which have different roles in the MAC. The Fixed Equipment is the master and the Mobile Equipment is slave of the medium.

NOTE The MAC medium access parameters are defined in the BST (Application Layer)

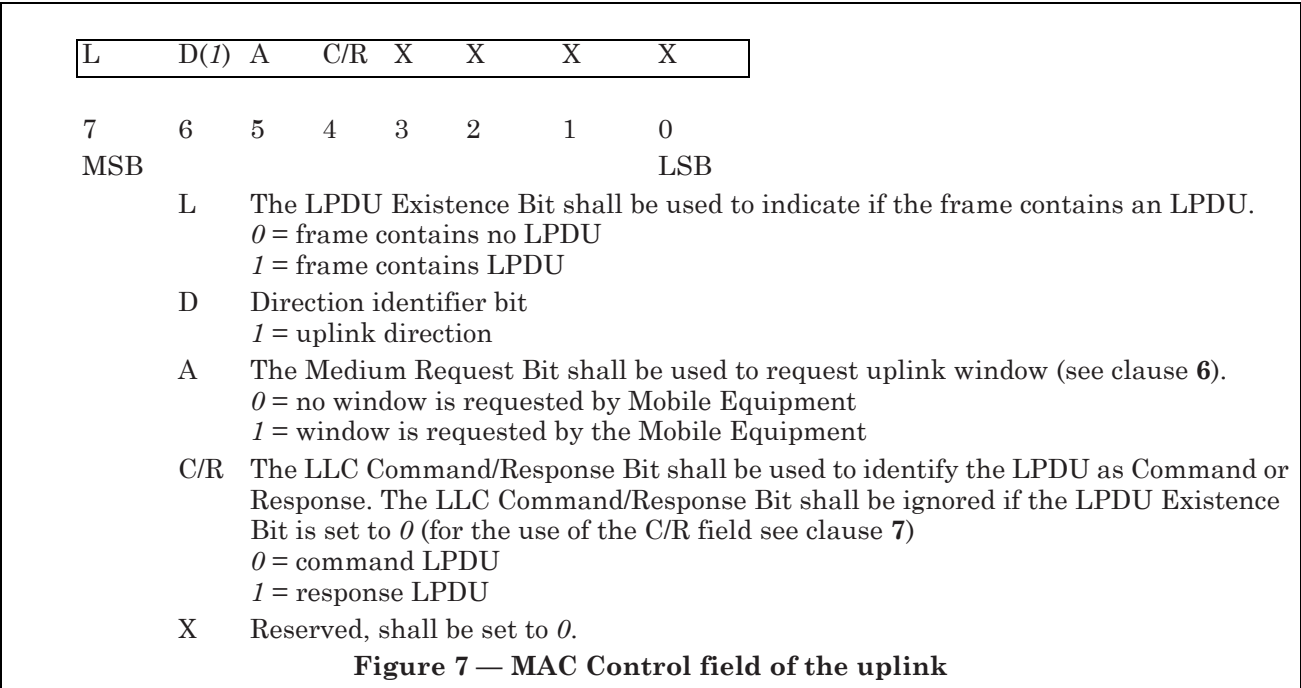
4.3.1 MAC Control field of the downlink

The MAC control field of the Downlink shall be used by frames transmitted by the Fixed Equipment. The format is described in Figure 6.



4.3.2 MAC Control field of the uplink

The MAC control field of the Uplink shall be used by frames transmitted by the Mobile Equipment. The format is described in Figure 7.



4.4 LPDU Format

The LPDU shall have the encoding described in clause 7.