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Intelligent transport systems — Evolved universal terrestrial radio access network (E-UTRAN) —

Part 2: Device to device communications (D2D)

Systèmes intelligents de transport — Réseau d'accès à la radio terrestre universelle évoluée (E-UTRAN) —

Partie 2: Communications directe entre appareils (D2D)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

A list of all parts in the ISO 17515 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Localized communications are an essential component of hybrid communications in Intelligent Transport Systems (ITS). Various access technologies are suited for localized communications. An increasing interest from ITS stakeholders in "Cooperative ITS" and "Urban ITS" is focussed on the access technology known as LTE, which refers to a packet switched cellular network technology specified by 3GPP. In addition to the "traditional" features of cellular networks, LTE also supports device-to-device communications (LTE-D2D) which can be efficiently used for ITS.

This document provides complements to LTE-D2D specifications from 3GPP needed to operate it as an ITS access technology in an ITS station unit as specified in ISO 21217. An implementation of this document is referred to as an ITS-LTE-D2D communication interface (CI).

ITS-LTE-D2D CIs are capable of:

— operating with the support of an LTE base station, and

— operating without the support of an LTE base station, e.g. outside an LTE coverage area,

as specified by 3GPP.

Intelligent transport systems — Evolved universal terrestrial radio access network (E-UTRAN) —

Part 2: Device to device communications (D2D)

1 Scope

This document provides specification on the ITS-Station (ITS-S) access layer for a communication interface (CI) named "ITS-LTE-D2D".

This specification is appropriate in the context of LTE-D2D communications that are being used for the dissemination of ITS information from an ITS-SU to other ITS-SUs, where these ITS-SUs can be either vehicle ITS-SUs, roadside ITS-SUs, or personal ITS-SUs, as specified in ISO 21217. It provides a combination of options from relevant ETSI/3GPP releases and ITS-station management standards in ISO 24102 to enable and achieve this objective.

ITS-LTE-D2D CIs are based on the evolved-universal terrestrial radio access network (E-UTRAN) device-to-device (LTE-D2D) technology standardized at 3GPP Release 13.

This document enables the use of the LTE-D2D technology as an ITS access technology in an ITS station by reference to respective specifications from 3GPP, and by specifying details of the Communication Adaptation Layer (CAL) and the Management Adaptation Entity (MAE) of CIs specified in ISO 21218.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 8825-2, *Information technology — ASN.1 encoding rules: Specification of Packed Encoding Rules (PER) — Part 2*

ISO 21218, *Intelligent transport systems — Hybrid communications — Access technology support*

ISO 24102-3, *Intelligent transport systems — ITS station management — Part 3: Service access points*

3GPP TS 23.303, *3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Proximity-based services (ProSe); Stage 2 (Release 13)*

3GPP TS 24.334 V15.1.0, *3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Proximity-services (ProSe) User Equipment (UE) to ProSe function protocol aspects (Release 13)*

3GPP TS 36.300, *3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2 (Release 13)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
SideLink
UE to UE interface for direct communication between two or more nearby UEs

Note 1 to entry: The Sidelink corresponds to the *PC5* (3.2) interface as defined in 3GPP TS 23.303.

[SOURCE: 3GPP TS 36.300]

3.2
PC5
reference point between ProSe-enabled UEs used for control and user plane for ProSe Direct Discovery and ProSe Direct Communication

Note 1 to entry: The lower protocol layers of the PC5 reference point can be based on E-UTRA *SideLink* (3.1) capabilities.

[SOURCE: 3GPP TS 36.300]

4 Symbols and abbreviated terms

CAL	communication adaptation sub-layer
CI	communication interface
D2D	device-to-device
eNB	evolved node B
E-UTRA	evolved universal terrestrial radio access
E-UTRAN	evolved universal terrestrial radio access network
HSS	home subscriber subsystem
ITS	intelligent transport systems
ITS-SU	ITS station unit
LCID	logical channel identifier
MAE	management adaptation entity
PPPP	ProSe per packet priority
ProSe	Proximity based service
RNTI	radio network temporary identifier
SL	SideLink
SL-RNTI	SideLink RNTI
SL-SCH	SideLink shared channel

UE user equipment (mobile LTE device)

UM unacknowledged mode

VCI virtual CI

5 Usage of LTE in ITS

5.1 LTE features used in ITS

The LTE network is a packet-switched cellular network specified by 3GPP. It provides features that may be used in ITS station units (ITS-SUs), namely device-to-device communications (D2D) as described in 5.2.

5.2 Device-to-device communications (D2D)

D2D communications in LTE (LTE-D2D) are possible via LTE interface, i.e. the LTE PC5 (UE-UE) communications interface.

The initial primary purpose of LTE-D2D communications identified so far by 3GPP provides proximity services by using direct communications between UEs, see 3GPP TS 36.300, for example. LTE-D2D communications can be used for the dissemination of ITS information from an ITS-SU to other ITS-SUs: see 3GPP TR 23 303, for example, where these ITS-SUs can be either vehicle ITS-SUs, roadside ITS-SUs, or personal ITS-SUs as specified in ISO 21217.

PC5 is an interface between UE to UE used for direct communications in an LTE-D2D network. In PC5 communications, information dissemination goes directly from a UE to other UEs.

PC5 communications are also referred to as SideLink communications. Two operational modes of SideLink communications exist:

— operator managed;

  1) with dynamic scheduling of resources;

  2) without dynamic scheduling of resources;

— non-operator managed.

Table 1 shows the operational modes of E-UTRAN D2D.

Table 1 — Operational modes of E-UTRAN D2D

	Served by E-UTRAN	**Not served by E-UTRAN Out-of-coverage**
Scheduled mode (Mode 1)	eNB indicates the physical radio resource to be used on a UE-specific basis	N/A
Autonomous mode (Mode 2)	A UE on its own selects radio resource from resource pools allocated on a non-UE specific basis	A UE on its own selects radio resource from resource pools allocated on a non-UE specific basis
	eNB indicates the physical resource pool configuration (via SIB or RRC signalling)	eNB indicates the physical resource pool configuration (via SIB or RRC signalling)

In the operator-managed mode, the UE may either use communication resources scheduled by the LTE network or select resources autonomously among resources which are pre-configured by the LTE network; these resources are reserved for data communications of the LTE-D2D CI.

In accordance with ETSI/3GPP, the non-operator managed mode, the UE may on its own select resources among pre-configured resources which are stored in UEs.

In D2D communications, there exist 4 types of scenarios.

a) Scenario A (see Figure 1) can be used for non-operator managed D2D communication where UEs are located out of LTE network coverage.

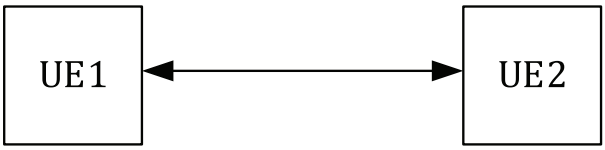

Figure 1 — D2D scenario A

b) Scenario B (see Figure 2) can be used for non-operator managed D2D communication where one of UE is located out of LTE network coverage. Also, it can be used for ProSe UE-to-Network Relay communication which supports LTE network connectivity to UEs located out of LTE network coverage.

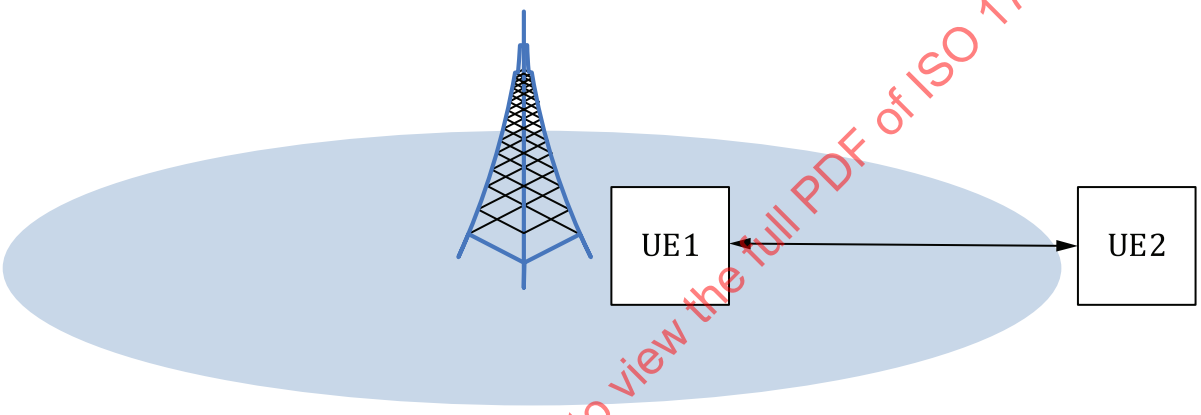

Figure 2 — D2D scenario B

c) Scenario C (see Figure 3) is for operator managed D2D communication in one LTE base station.

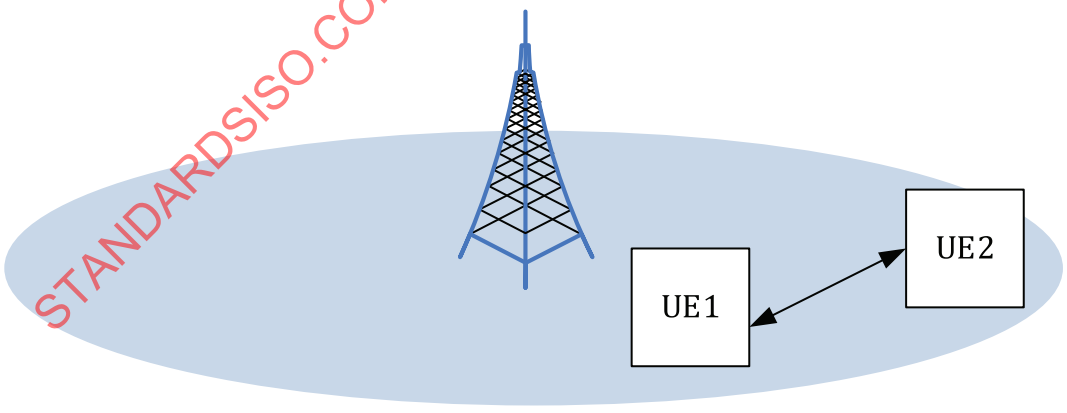

Figure 3 — D2D scenario C

d) Scenario D (see Figure 4) is for operator managed D2D communication in different LTE base stations.

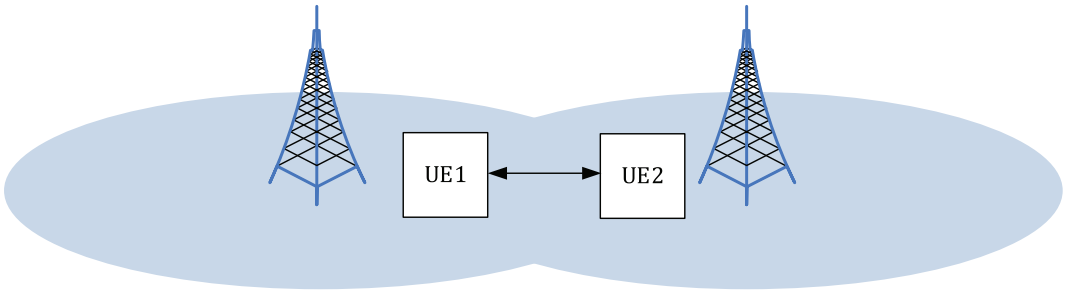

Figure 4 — D2D scenario D (3GPP 36.843)

In this document, D2D scenarios A, B, and C are considered and specifications for use in the C-ITS context are provided.

5.3 D2D communication basics

5.3.1 General

In D2D communications, in accordance with 3GPP 36.300, the UE supporting SideLink communication can operate in two modes for resource allocation:

— Scheduled resource allocation is characterized by:

  — UE requests resources for SideLink communication to the eNB. The eNB schedules resources for transmission of SideLink control information and data;

  — UE receives the scheduled resource for SideLink communication and transmits Sidelink control information and data via the resource.

— UE autonomous resource selection is characterized by:

  — A UE on its own selecting resources among pre-configured resources. Sidelink communication is performed by managing Sidelink control information and data.

5.3.2 User plane

Figure 5 shows the protocol stack for the user plane, where PDCP, RLC, MAC, and PHY sublayers (terminated at the UE) perform the functions for the user plane.

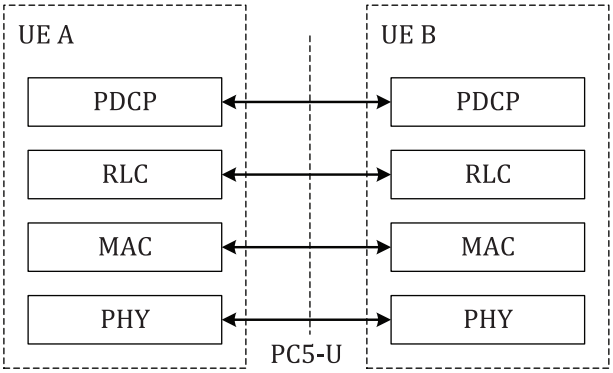

Figure 5 — User-Plane protocol stack for SideLink communication

5.3.3 Control plane

A UE does not establish and maintain a logical connection between UEs for SideLink communication except for one-to-one SideLink communication including ProSe UE-to-Network Relay operation. The control plane for one-to-one SideLink communication is shown in Figure 6.

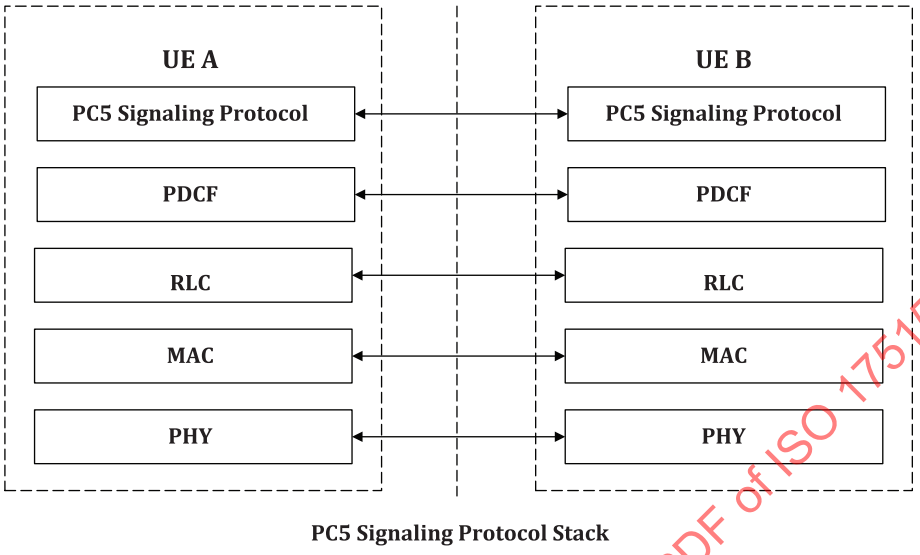

Figure 6 — Control-Plane protocol stack for one-to-one SideLink communication

5.4 Service authorization

Service authorization and revocation for LTE-D2D communication is performed for allowing UE's D2D communication as specified in 3GPP TS23.303.

In accordance with 3GPP, the LTE network pre-configures the UE with the authorization information for a list of networks where the UE is authorized to perform direct communication. If there is no associated UE context, the ProSe Function gets the subscription information for ProSe direct communication from HSS in Figure 7.

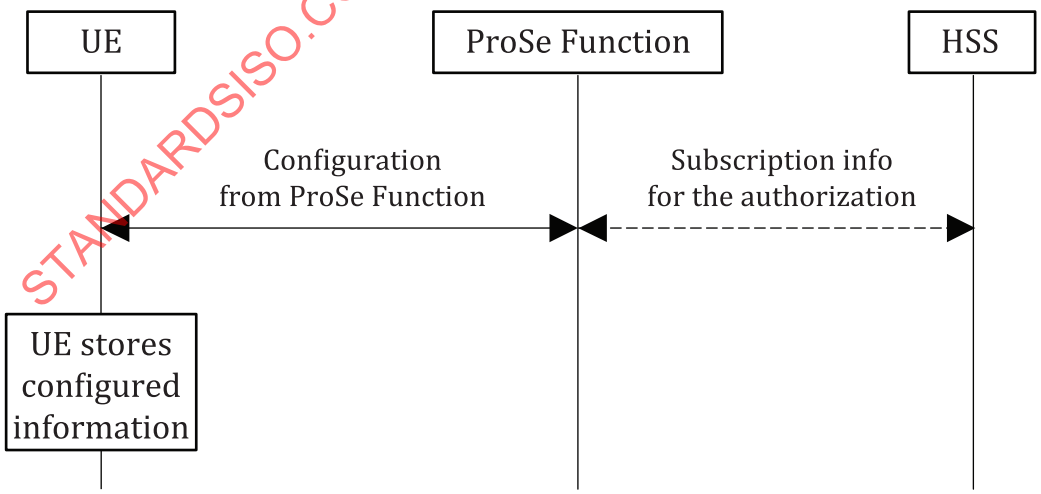

Figure 7 — Pre-configuration for ProSe direct communication

The UE gets the service authorization for ProSe direct communication with a given validity time, from the ProSe Function of the HPLMN (see Figure 8).

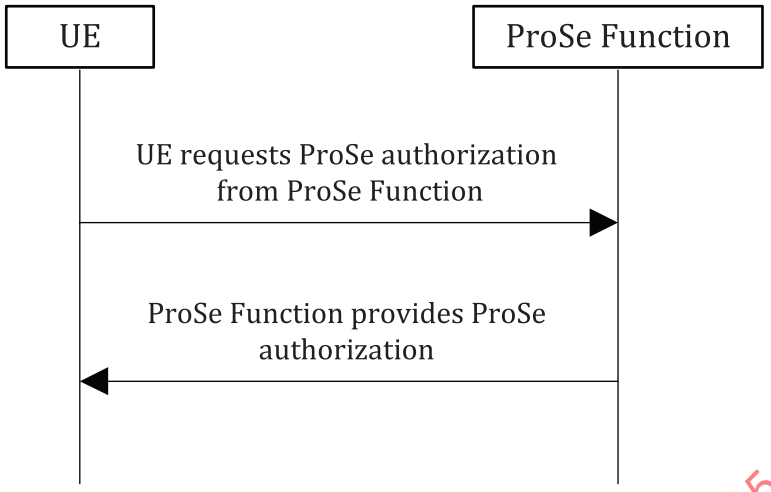

Figure 8 — Service authorization for ProSe direct communication

5.5 SideLink communication related identities

The following identities are used for SideLink communication:

— SL-RNTI (SideLink Radio Network Temporary Identifier): Unique identification used for SideLink communication scheduling;

— Source Layer-2 ID: Identifies the sender of the data in SideLink communication. The Source Layer-2 ID is 24 bits long and is used together with Destination Layer-2 ID and LCID for identification of the RLC UM entity and PDCP entity in the receiver;

— Destination Layer-2 ID: Identifies the target of the data in SideLink communication. The Destination Layer-2 ID is 24 bits long and is split in the MAC layer into two bit strings:

1) One bit string is the LSB part (8 bits) of Destination Layer-2 ID and is forwarded to the physical layer as Group Destination ID. This identifies the target of the intended data in SideLink control information and is used for filtering of packets at the physical layer.

2) The second bit string is the MSB part (16 bits) of the Destination Layer-2 ID and is carried within the MAC header. This is used for filtering of packets at the MAC layer.

No Access Stratum signalling is required for group formation and to configure Source Layer-2 ID, Destination Layer-2 ID and Group Destination ID in the UE. These identities are either provided by a higher layer or derived from identities provided by a higher layer. In case of groupcast and broadcast, the ProSe UE ID[11] provided by the higher layer is used directly as the Source Layer-2 ID and the ProSe Layer-2 Group ID[11] provided by the higher layer is used directly as the Destination Layer-2 ID in the MAC layer. In case of one-to-one communications, the higher layer provides Source Layer-2 ID and Destination Layer-2 ID.

6 General requirements

An implementation of an ITS-LTE-D2D CI is based on relevant specifications from 3GPP:

— 3GPP TS 23.303,

— 3GPP TS 24.334 V15.1.0, and

— 3GPP TS 36.300.

NOTE Further 3GPP specifications related to LTE-D2D and referenced in the basic specifications are e.g. [11] - [20].

7 ITS station

7.1 ITS station and communication architecture

The ITS station architecture specified in ISO 21217 is presented in Figure 9. The ITS-LTE-D2D CI is allocated in the ITS-S access layer of the ITS station architecture.

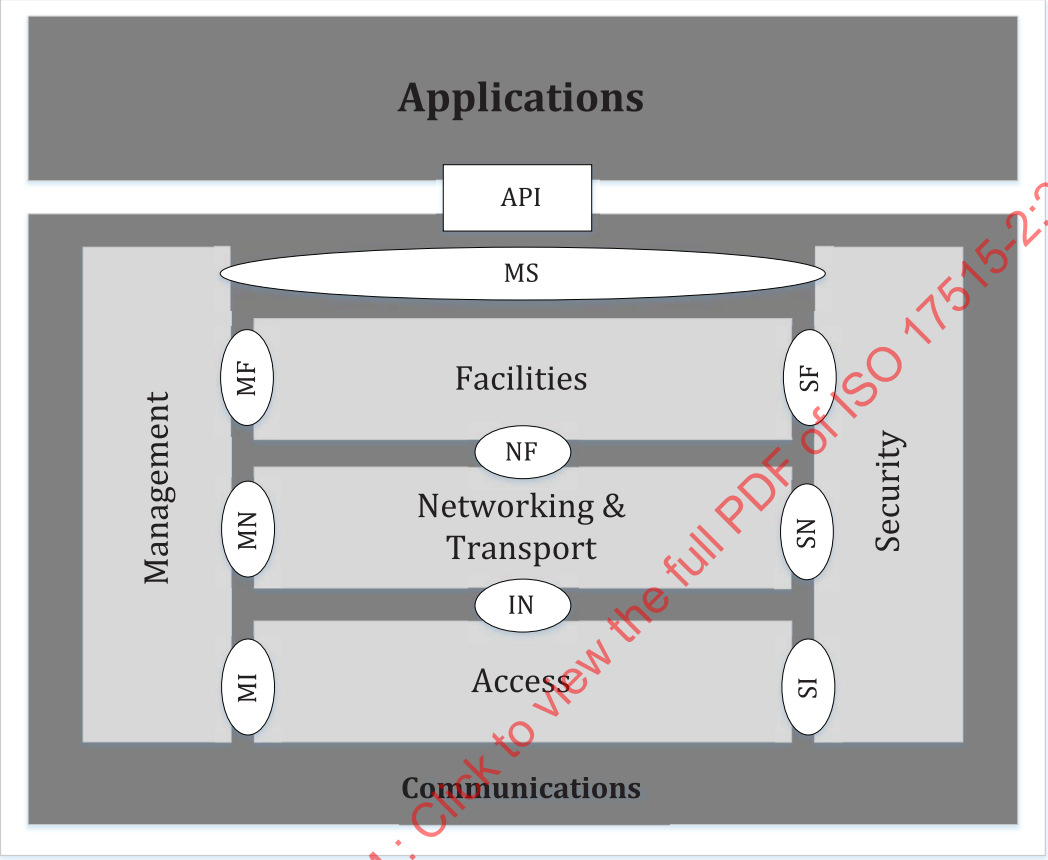

Figure 9 — ITS station architecture

Figure 10 shows the architecture diagram of an ITS-LTE-D2D CI communications interface (CI) embedded in the general ITS station architecture.

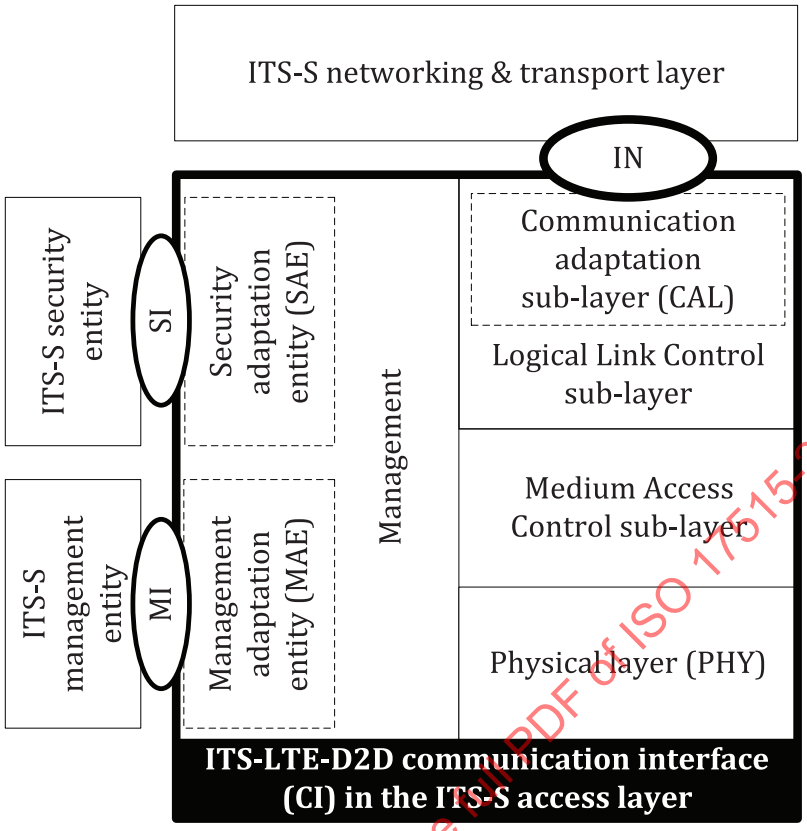

Figure 10 — LTE-D2D CI architecture

The communication protocol layers of the ITS-LTE-D2D CI specified by 3GPP are:

a) Physical layer (PHY);

b) Data link layer (DLL).

An ITS-LTE-D2D CI as specified in this document is an ITS wireless CI:

— of MedType c-ITSatt-iso17515 as specified in ISO 17419;

— of CI class CIC-l6 as specified in ISO 21218 for one-to-many communications either with support of a base station of a cellular network or without support of the base station;

— of CI access class CIAC-4, or CIAC-3, or CIAC-2 as specified in ISO 21218, dependent on the commercial agreements with an operator of the cellular network.

An ITS-LTE-D2D CI provides the functionality of the IN-SAP specified in ISO 21218, and uses the functionality of a MI-SAP, and a SI-SAP specified in ISO 24102-3.

7.2 Service access points

7.2.1 General

Requirements set up in this document to support SAPs and the related service primitives thus mean to support the functionality. This support may be implemented either in a strict meaning, i.e. using the ASN.1 definitions of the service primitives as "PDU" definitions, or in an abstract meaning, i.e. allowing for proprietary solutions.

NOTE As Service Access Points (SAPs) per definition describe functional behaviour only, SAPs can be implemented in different ways.

7.2.2 Communications service access points

An ITS-LTE-D2D CI shall support the IN-SAP functionality as specified in ISO 21218.

7.2.3 Management service access points

An ITS-LTE-D2D CI shall support the MI-SAP functionality of ISO 24102-3 with details as specified in ISO 21218.

7.2.4 Security service access points

An ITS-LTE-D2D CI shall support the SI-SAP functionality of ISO 24102-3 with details as specified in ISO 21218.

8 Communication interface (CI) protocol stack

8.1 Physical layer

The basic behaviour of the LTE-D2D CI physical layer shall be as specified in the respective LTE standards from 3GPP, see Clause 6.

8.2 Data link layer

8.2.1 Basic behaviour

The basic behaviour of the LTE-D2D CI data link layer shall be as specified in the respective LTE standards from 3GPP, see Clause 6.

8.2.2 Data link layer communication addresses

LTE-D2D SideLink communication shall not use 48 bit MAC addresses, but shall use 24 bit Layer-2 Identifiers (Layer-2 ID) for identifying source and destination, in accordance with 3GPP TS 36.300 V14.2.0 notably.

— The source Layer-2 ID shall use a self-assigned number.

— In line with the requirement in 3GPP TS 23.303 that the destination Layer-2 ID values for SideLink communication are provided by higher layers.

8.2.3 Identification of higher layer protocols

LTE-D2D shall use the concept of a "Layer-3 protocol data unit types" to identify the type of payload. This information is contained in LTE-D2D frames.

"Layer-3 protocol data unit types" and corresponding EtherType values are presented in Table 2.

Table 2 — LTE-D2D Layer-3 protocol data unit type

Value	Protocol type	EtherType
0[a]	IPv6 (ISO 21210) Ipv4 (Not supported in ITS Station)	0x86.DD 0x08.00
1	ARP	n.a.
2	Reserved	n.a.
3	Non-IP	n.a.

[a] Ipv4 is not thus far supported for SideLink communications.

Table 2 *(continued)*

Value	Protocol type	EtherType
4-7	Reserved	n.a.
[a] Ipv4 is not thus far supported for SideLink communications.		

8.3 Communication adaptation sub-layer

The communication adaptation sub-layer (CAL) is introduced in ISO 21218. The major task of CAL is to provide the IN-SAP. ASN.1 details of the IN-SAP IN-UNITDATA service primitives are specified in ISO 21218.

ITS-LTE-D2D CIs that are conformant with ISO 21218 shall use an EtherType value in the IN-UNITDATA service primitives to identify the applicable ITS-S networking & transport layer protocol. Thus, the information on type of payload presented in 8.1 shall be converted into an EtherType in support of ISO 21218.

In other implementation contexts, the EtherType value shall be used in the applicable service access point primitives that exchange service data units between ITS-LTE-D2D and the network layer entity; details are outside the scope of this document.

The IN-SAP service primitives of DL-UNITDATA shall contain the parameter "priority", which is the user priority as specified in ISO 21218. The relation between user priority and LTE ProSe Per-Packet Priority (PPPP) for LTE-D2D SideLink communication shall be as specified in Table 2.

9 Communication interface (CI) management

9.1 Basic management

The basic management of an LTE-D2D CI shall be as specified in the respective LTE standards from 3GPP. See Clause 6.

9.2 Management adaptation entity (MAE)

9.2.1 LTE-D2D parameters and I-Parameters

In implementations conformant with ISO 21218, the following rules apply:

— LTE-D2D parameters that have an equivalent I-Parameter defined in ISO 21218:2018 shall be mapped on I-Parameters as specified in Annex A.

— LTE-D2D parameters which are relevant for ITS-LTE-D2D and do not have an equivalent I-Parameter defined in ISO 21218 shall be made visible to the ITS station management by means of medium-specific I-Parameters as specified in Annex A.

I-Parameters which are relevant for ITS-LTE-D2D but cannot be mapped on LTE-D2D parameters shall be implemented in the MAE as specified in ISO 21218 with details specified in Annex A.

9.2.2 LTE-D2D management commands and MI-SAP commands and requests

In implementations conformant with ISO 21218 and ISO 24102-3, the following rules apply:

— LTE-D2D management commands that have an equivalent MI-COMMAND / MI-REQUEST defined in ISO 24102-3:2018 shall be mapped on these MI-COMMAND / MI-REQUEST as specified in Annex B and Annex C.

— LTE-D2D management commands that are relevant for an implementation of ITS-LTE-D2D and do not have an equivalent MI-COMMAND / MI-REQUEST defined in ISO 24102-3shall be made accessible in an implementation specific way.

— MI-COMMANDs / MI-REQUESTs which are relevant for ITS-LTE-D2D but cannot be mapped on LTE-D2D management commands are implemented in the MAE as specified in ISO 24102-3 with details specified in Annex B and Annex C.

10 Procedures

10.1 Communication interface (CI) procedures

10.1.1 Transmit procedure

Upon reception of a transmission request service primitive, i.e. an IN-UNITDATA.request service primitive specified in ISO 21218, CAL shall:

a) use the operational mode as indicated in the I-Parameter "Operational Mode";

b) perform settings of LTE-D2D transmit parameters as requested in the parameter "access parameters" of the IN-UNITDATA.request service primitive, and as is applicable.

10.1.2 Receive procedure

Upon reception of a frame, CAL shall present the received packet (ITS-NTPDU) to the ITS-S networking & transport layer, i.e. using the IN UNITDATA.indication service primitive as specified in ISO 21218.

10.2 Management procedures

10.2.1 Cross-CI prioritization

A basic "Cross-CI prioritization procedure" is specified in ISO 21218.

10.2.2 Operational mode

Any change of the operational mode by the LTE network shall be stored in the I-Parameter "OperationalMode". Any change of the value of the I-Parameter "OperationalMode" not requested by the ITS station management shall be notified to the ITS station management with MI-REQUEST {Event21218Notification{D21218-5} } as specified in ISO 21218.

10.2.3 LTE-D2D MAC address mapping

10.2.3.1 LTE-D2D SideLink communication

LTE-D2D SideLink communication shall use Layer-2 identifiers of size 24 bits instead of 48 bit MAC addresses; distinction is made between a source Layer-2 ID and destination Layer-2 ID, see 8.1.

1) Destination Layer-2 ID:

   Destination Layer-2 ID identifies the target of the data in Sidelink communication. The destination Layer-2 ID is 24 bits long and is split in the MAC layer into two-bit strings:

2) Source Layer-2 ID:

   An LTE-D2D SideLink source Layer-2 ID is self-assigned. An initial value may be provided by the LTE network.

NOTE The LTE-D2D SideLink source Layer-2 ID is managed as a pseudonym, i.e. values are locally assigned and replaced by new values upon request by the ITS station management. Thus far, no specific update rate or update condition is specified.

It shall be possible to change LTE-D2D SideLink source Layer-2 ID upon request by the ITS station management with MI-COMMAND {ChangePseudonymMACaddress}.

For IP based communications, the LTE-D2D CI auto-configures a link local IPv6 source address (prefix: fe80::/10) as specified in TS 23.303, subclause 4.5.3; privacy regulations may require a change of the IP source address simultaneously with the change of the source Layer-2 ID.

The mapping of LTE-D2D Layer-2 IDs onto the EUI-64 format used in Link-ID (LocalCIID and Remote CIID) as specified in ISO 21218 shall use the basic format for encapsulation of identifiers specific to ITS as specified in ISO 21218:2018, C.3:

1) LocalCIID:

   As specified in ISO 21218, i.e. the LTE-D2D SideLink source Layer-2 ID is mapped to the "VCISerialNumber" value zero in combination with "UC/GC" set to '000000'2.

2) RemoteCIID:

   As specified in ISO 21218, i.e. the LTE-D2D SideLink source Layer-2 ID is mapped to the "VCISerialNumber" value 65535 in combination with "UC/GC" set to '111111'2, i.e. indication broadcast communications.

10.2.3.2 LTE-D2D Uu communication

Either LTE-D2D Uu CIs and VCIs are identified by a 48-bit MAC address, or the LTE-D2D Uu CI and VCI identifaction shall be as follows:

1) LocalCIID: Same as for LTE-D2D SideLink communication, see 10.2.3.1.

2) RemoteCIID:

   a) The "VCISerialNumber" 65535 in combination with "UC/GC" set to '000000'2 is used to identify unicast communications to the LTE base station.

   b) The "VCISerialNumber" 65535 in combination with "UC/GC" set to '111111'2 is used to identify broadcast communications from the LTE base station.

   c) The rules for the fields "ITS-SCU-ID", and "MedID" are as specified in ISO 21218.

10.2.3.3 LTE-D2D PC5 communication

Either LTE-D2D PC5 CIs and VCIs are identified by a 48-bit MAC address, or the LTE-D2D PC5 CI and VCI identification shall be as follows:

1) LocalCIID: Same as for LTE-D2D SideLink communication, see 10.2.3.1.

2) RemoteCIID:

   a) The "VCISerialNumber" 65535 in combination with "UC/GC" set to '000000'2 is used to identify unicast communications to the LTE base station.

   b) The "VCISerialNumber" 65535 in combination with "UC/GC" set to '111111'2 is used to identify broadcast communications from the LTE base station.

   c) The rules for the fields "ITS-SCU-ID", and "MedID" are as specified in ISO 21218.

10.2.3.4 Overview

Table 3 summarizes the LTE-D2D MAC address mapping specified in 10.2.3.1 and 10.2.3.2.

Table 3 — LTE-D2D MAC address mapping

UC/GC MSB					LSB	VCISerialNumber	Comment
0	0	0	0	0	0	0	LocalCIID identifying local CI (SideLink and Uu communications)
0	0	0	0	0	0	65535	RemoteCIID identifying unicast communications to the LTE base station (Uu communications)
X	X	X	X	X	X	65535	RemoteCIID identifying multicast communications.
1	1	1	1	1	1	65535	RemoteCIID identifying broadcast communications from the LTE base station (Uu communications), and SideLink broadcast communications.

NOTE This document does not support unicast and multicast in this version.

10.2.4 CI connection procedure

When the CI state is "active" and I-Parameter Connect is set to "automatic" (0), or upon reception of the MI-COMMAND "CIstateChange" with the value "connect", the LTE D2D CI shall execute the LTE D2D connection procedure specified by 3GPP.

10.2.5 CI state management

CI state management specified in ISO 21218 (view of CI) and ISO 24102-1, (view of ITS station management) shall be supported.

The CI state-machine is needed in support of:

— hybrid communications introduced in ISO 21218 and related self-interference management specified in 10.2.1,

The mapping of LTE-D2D connection states on CI states and the transition events between CI states is presented in the informative Annex E.

11 Conformance

Conformance testing of ITS-LTE-D2D is fully specified only in combination with applicable requirements as specified in ISO 21218.

Implementation conformance statements (ICS) complementing those from ISO 21218 are not specified in this document.

Conformance tests for regional related features, e.g. interference mitigation techniques, are also applicable.

12 Test methods

The test suite structure and test purposes (TSS&TP) and an abstract test suite (ATS) for conformance tests will be specified in a future document. TSS&TP and ATS for ITS-LTE-D2D are based on TSS&TP and ATS for ISO 21218.

Conformance testing may use upper tester access in the System Under Test (SUT) applying ITS station-internal management communications specified in ISO/TS 20026, ISO 24102-4, and ISO 24102-3.

Annex A
(normative)

Communication interface (CI) parameters

A.1 General

CI parameters (I-Parameters) are generally specified in ISO 21218 for all access technologies. This annex provides details specific to ITS-LTE-D2D, and additional parameters dedicated to ITS-LTE-D2D.

A.2 I-Parameters specific to ITS-LTE-D2D

I-Parameters are specified in ISO 21218. Table A.1 specifies details of I-Parameters that are specific to ITS-LTE-D2D.

Table A.1 — I-Parameters specific to ITS-LTE-D2D

I-ParamNo	I-Parameter name / ASN.1 Type [a]	Description / range / values
8	LLaddress / LLaddress	These addresses are presented in the EUI64 format identified by the reference value c-ITSatt-iso17515 as specified in 10.2.3.
9	LLaddressTemp / LLaddressTemp	
29	LLaddressPeer / LLaddressPeer	
15	RegulatoryInformation / RegulatoryScheme	RI data structure is presented in the format identified by the reference value c-RegScheme-iso17515 with valid regulatory information, or a statement that no regulation is known or applicable. The specific format is not yet specified.[a]
17	SimPin / SimPin	Access credential for LTE-D2D such as PIN for the SIM card are presented in the format identified by the reference value c-ITSatt-iso17515. The specific format is not yet specified.[a]
32	RXsensitivity / RxSens	The receiver sensitivity is presented in the format identified by the reference value c-ITSatt-iso17515. The specific format is not yet specified.[a]
33	TXpower / TxPower	The transmit power EIRP is presented in the format identified by the reference value c-ITSatt-iso17515. The specific format is not yet specified.[a]
34	TXpowMax / TxPowerMax	
35	PeerTXpower / PeerTXpower	
36	LinkDataRate / DataRateLink	The LTE-D2D link data rate is presented in the format identified by the reference value c-ITSatt-iso17515. The specific format is not yet specified.[a]
53	PhysicalChannelIdentifier / PhysicalChannelIdentifier	The LTE-D2D identifier of a physical communication channel is presented in the format identified by the reference value c-ITSatt-iso17515. The specific format is not yet specified.[a]

[a] I-Parameters of which the ASN.1 format is not yet specified either are not used, or the format may be specified in a later version of this document.

Table A.1 *(continued)*

I-ParamNo	I-Parameter name / ASN.1 Type [a]	Description / range / values
54	OperationalMode / OperationalMode	The operational mode is presented in the format identified by the reference value c-ITSatt-iso17515 and specified in Annex D.
56	QoSrequirement / QoSrequirement	Quality of Service requirements are presented in the format identified by the reference value c-ITSatt-iso17515. The specific format is not yet specified.[a]

[a] I-Parameters of which the ASN.1 format is not yet specified either are not used, or the format may be specified in a later version of this document.

A.3 Default values of I-Parameters

Table A.2 defines default values of I-Parameters applicable for ITS-LTE-D2D.

Table A.2 — Default values of I-Parameters of LTE-D2D

I-ParamNo	I-Parameter name / ASN.1 Type	Default values / Comments
4	ITS-SCU-ID / ITS-scuId	10 (allowed is the range 5 through 65534)
6	LocalCIID / LocalCIID	As pre-configured by LTE network (source Layer-2 ID presented in format specified in 10.2.3)
7	TimeoutRegister / TimeoutRegistration	100 ms
8	LLaddress / LLAddress	LTE-D2D Source Layer-2 ID presented in format specified in 10.2.3
9	LLaddressTemp / LLAddressTemp	Same as LLaddress.
10	CIclass / CIclass	CIC-l6
11	CIaccessClass / CIaClass	CIAC-3
12	CIstatus / CIstatus	0: not-existent
13	Notify / Notify	CIstatus, LLaddressTemp
14	MedType / ITSatt	c-ITSatt-iso17515 = 10: ISO 17515
15	RegulatoryInformation / RegInfo	For intended region of operation. Not yet defined in ASN.1.
16	Connect / Connect	255: manual
19	MinimumUserPriority / MinimumUserPriority	0: smallest possible value (default in ISO 21218.)
20	QueueLevel / QueueLevelActual	{priority, 0}
21	QueueLevelThreshold / QueueLowThreshold	{priority, 85}
22	QueueAlarmThreshold / QueueAlarmThreshold	{priority, 170}
25	TimeOfLastReception / TimeOfLastReception	IAT set to 0

Table A.2 *(continued)*

I-ParamNo	I-Parameter name / ASN.1 Type	Default values / Comments
26	InactivityTimeLimit / InactTimeLimit	0: no limit
27	MediumUsage / MediumUsage	{receive:0, transmit: 0}
28	MedUseObservationTime / MedUseObsTime	1 second
31	MinPrioCrossCI / MinimumCrossCiPriority	0: smallest possible value
32	RXsensitivity / RxSens	Reference sensitivity. Not yet standardized, thus to be defined by implementation.
33	TXpower / TxPower	Reference power. Not yet standardized, thus to be defined by implementation.
34	TXpowMax / TxPowerMax	As required by regulation, otherwise 0: reference power
36	LinkDataRate / DataRateLink	Default as required by regulation, or minimum possible value
37	DataRateNW / DataRateNetwork	Equal to average of DataRatesNW.minimum and DataRatesNW.maximum
38	DataRatesNW / DataRatesNetwork	{minimum: minimum possible value if known, otherwise 0, maximum: maximum possible value if known, otherwise 0}
39	DataRateNWreq / DataRateNetworkRequired	Same as DataRateNW
40	Directivity / Directivity	{fixed, 0, 0, 0, 360, 40} - omnidirectional, or not supported
46	Cost / MediumCost	CostClass 0: "tempUnavailable"
47	Reliability / Reliability	255: unknown
48	LogicalChannels / LogicalChannels	Mappings for all supported physical channels and logical channels. Default taking into consideration regional regulation.
52	LimitChannelAccess / LimitChannelAccess	{default channel, 200, 0}: no limitation
53	PhysicalChannelIdentifier / PhysicalChannelIdentifier	Default taking into consideration regional regulation
54	OperationalMode / OperationalMode	0: unknown

Annex B
(normative)

MI-COMMANDs

B.1 General

The management service primitives MI-COMMAND.request and MI-COMMAND.confirm and some of the functions of MI-COMMAND.request are specified in ISO 24102-3. Further functions are specified e.g. in ISO 21218 and in ISO 24102-6.

B.2 Required functionality

The functionality of MI-COMMANDs shall be supported as specified in Table B.1.

Table B.1 — MI-COMMANDs

COMMAND	Description	Requirement
SimIUTcmd	See ISO/TS 20026 and ISO 24102-3.	Mandatory if ISO/TS 20026 is supported, otherwise optional.
EchoTest	See ISO 24102-3.	
CIstateChange	Change of CI status.	Mandatory if path and flow management specified in ISO 24102-6 is supported, or mandatory if ISO 21218 is supported, otherwise optional.
MonitorIparameters	Command to request monitoring of parameters.	
ChangePseudonymMACaddress	Command to request change of MAC address or other type of layer 2 address, e.g. LTE Layer-2 ID, which is visible in a link to a peer station. This may be due to privacy regulations.	Mandatory if privacy regulations require it, otherwise optional.
ManufacturerCommand	Allows for manufacturer-specific access to the CI. Used e.g. for test and maintenance purposes.	Optional.
PrioritizedRequestToSend	Information on an intended prioritized transmission of a victim CI presented to interferer CIs.	Mandatory if cross-CI prioritization specified in ISO 21218 and ISO 24102-1 is supported.
RegulatoryInformation	Provisioning of regulatory information.	If this functionality is performed by the LTE network, this command is not applicable; otherwise mandatory
VCImanagement	Command to request creation, reset or deletion of a VCI. Setting of parameters different to the default values for a newly created VCI has to be done in subsequent MI-SET commands.	Mandatory if ISO 21218 is supported, otherwise optional.

Annex C
(normative)

MI-REQUESTs

C.1 General

The management service primitives MI-REQUEST.request and MI-REQUEST.confirm and some of the functions of MI-REQUEST.request are specified in ISO 24102-3. Further functions are specified in ISO 21218 and in ISO 24102-6, for example.

C.2 Required functionality

The functionality of MI-REQUESTs shall be supported as specified in Table C.1.

Table C.1 — MI-REQUESTs

REQUEST	Description	Requirement
SimIUTreq	See ISO/TS 20026 and ISO 24102-3.	Mandatory if ISO/TS 20026 is supported, otherwise optional.
TestMIEcho	See ISO 24102-3.	
EventNotification	Notification of an event.	Mandatory if ISO 21218 is supported, otherwise optional.
PositionUpdate	Requests to receive position updates with update interval as indicated in milliseconds/cancels the request.	Optional.
PrioritizationRegistration	Registration of a victim CI for Cross-CI Prioritization.	Mandatory if Cross-CI prioritization specified in ISO 21218 and ISO 24102-1 is supported, otherwise not applicable.
PrioritizationRequest	Real-time request of a victim VCI to get prioritization.	
RegistrationCI	Request to register the CI.	Mandatory if dynamic registration specified in ISO 21218 and ISO 24102-1 is supported, otherwise not applicable.

Annex D
(normative)

ASN.1 definitions

D.1 Overview

The ASN.1 basic notation is specified in ISO/IEC 8824-1. The following ASN.1 module is specified in E.2:

— ITSlted2d {iso (1) standard (0) lte (17515) d2d (2) version0 (0)}

This document also provides ASN.1 type and value specifications in D.3 to be registered in the registry of ISO 21218.

In case the ASN.1 specifications given in this annex are not compliant with illustrations or specifications provided elsewhere in this document, the specifications given in this annex shall prevail.

Updates of these ASN.1 specifications will be published on https://standards.iso.org/iso/17515/-2/ed-1/en.

Applicable encodings of the types and values defined in this document depend on the usage. ASN.1 BASIC-PER, UNALIGNED, as specified in ISO/IEC 8825-2, shall apply if no other explicit requirement on encoding is given.

D.2 Module ITSlted2d

```
ITSlted2d {iso (1) standard (0) lte (17515) d2d (2) version0 (0)}
DEFINITIONS AUTOMATIC TAGS ::= BEGIN

IMPORTS
-- From EN ISO 17419-1
EUI64 FROM CITSdataDictionary1 {iso(1) standard(0) cits-applMgmt (17419) dataDictionary
(1) version1 (1)}
; -- End of IMPORTS

-- Medium-specific I-Parameter
LTE-D2D-InterfaceType::=INTEGER{
   unknown    (0),
   pc5        (1), /* d2d */
   uu         (2)
   } (0..255)

LTE-D2D-OperationalMode::=INTEGER{
   unknown    (0),
   scheduled  (1),
   autonomous (2)
   } (0..255)



-- Link Layer Address
LTE-D2D-Layer2Address::=EUI64 -- Layer-2 Identifier encapsulated in EUI64
/* Formats of I-Parameters to be specified later, if applicable
-- RegulatoryScheme
LTE-D2D-RegulatoryScheme::=

--SimPin
LTE-D2D-SimPin ::=
```

```
-- RXsensitivity
LTE-D2D-RXsensitivity ::=

-- TXpower
LTE-D2D-TXpower ::=

-- LinkDataRate
LTE-D2D-DataRateLink ::=

-- PhysicalChannelIdentifier
LTE-D2D-PhysicalChannelIdentifier ::=

-- QoSrequirement
LTE-D2D-QoSrequirement ::=

*/
--
END
```

D.3 Definitions to be added in ISO 21218

The following definitions are dynamic extensions of types defined in ISO 21218 with CLASS. An up-to-date version of the ASN.1 module ITSlted2d {iso (1) standard (0) lte (17515) d2d (2) version0 (0)} including all dynamic updates is published at https://standards.iso.org/iso/21218.

IMPORT statement to be added, if not yet existent:

```
-- From ISO 17515-2
LTE-D2D-InterfaceType, LTE-D2D-OperationalMode, LTE-D2D-Layer2Address FROM ITSlted2d {iso
(1) standard (0) lte (17515) d2d (2) version0 (0)}

-- From EN ISO 17419-2
c-ITSatt-iso17515 FROM CITSapplMgmtComm {iso(1) standard(0) cits-applMgmt (17419)
applRegistry (2) version2 (2)}
```

Medium specific general I-Parameter to be added:

```
InterfaceType MEDSPEC::={
   { LTE-D2D-InterfaceType IDENTIFIED BY c-ITSatt-iso17515 } ,
   ...
   }

OperationalModes MEDSPEC::={
   { LTE-D2D-OperationalMode IDENTIFIED BY c-ITSatt-iso17515 } ,
   ...
   }
LLaddress MEDSPEC::={
   { LTE-D2D-Layer2Address IDENTIFIED BY c-ITSatt-iso17515 } ,
   ...
   }
```

Once the missing basic formats identified in D.2 are defined, the following dynamic extensions of types defined in ISO 21218 with CLASS may be added.

```
IMPORT statement to be added, if not yet existent:
-- From ISO 17515-2
LTE-D2D-SimPin, LTE-D2D-RXsensitivity, LTE-D2D-TXpower,
LTE-D2D-DataRateLink, LTE-D2D-PhysicalChannelIdentifier,
LTE-D2D-QoSrequirement, LTE-D2D-RegulatoryScheme FROM ITSlted2d {iso (1) standard (0) lte
(17515) d2d (2) version0 (0)}

--SimPin
SimPins MEDSPEC::={
   { LTE-D2D-SimPin IDENTIFIED BY c-ITSatt-iso17515 } ,
   ...
   }

-- RXsensitivity
RxSenss MEDSPEC::={
   { LTE-D2D-RXsensitivity IDENTIFIED BY c-ITSatt-iso17515 } ,
   ...
```