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Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) —

Part 5:
Specification for an in-vehicle network connected to the diagnostic link connector

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Véhicules routiers — Communication de diagnostic sur gest ionnaire de réseau de communication (DoCAN) —

ISO/FDIS 15765-5
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Partie 5: spécification pour un réseau véhicule connecté sur la prise de diagnostic

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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

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A list of all parts in the ISO 15765 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.

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Introduction

The ISO 15765 series defines common requirements for vehicle diagnostic systems using the controller area network (CAN), as specified in the ISO 11898 series.

The ISO 15765 series presumes the use of external test equipment for inspection, diagnostics, repair and other possible use cases connected to the vehicle.

This document does not specify any requirements related to the in-vehicle CAN network architecture. It defines the requirements to enable the in-vehicle CAN network to successfully establish, maintain and terminate communication with the devices externally connected to the diagnostic link connector.

This document has been structured according to the open systems interconnection (OSI) basic reference model, in accordance with ISO/IEC 7498-1 and ISO/IEC 10731, which structures communication systems into seven layers. When mapped on this model, the OSI layer 4 to OSI layer 1 framework requirements specified or referenced in the ISO 15765 series are structured according to Figure 1, which shows the related documents of OSI layer 4 to OSI layer 1.

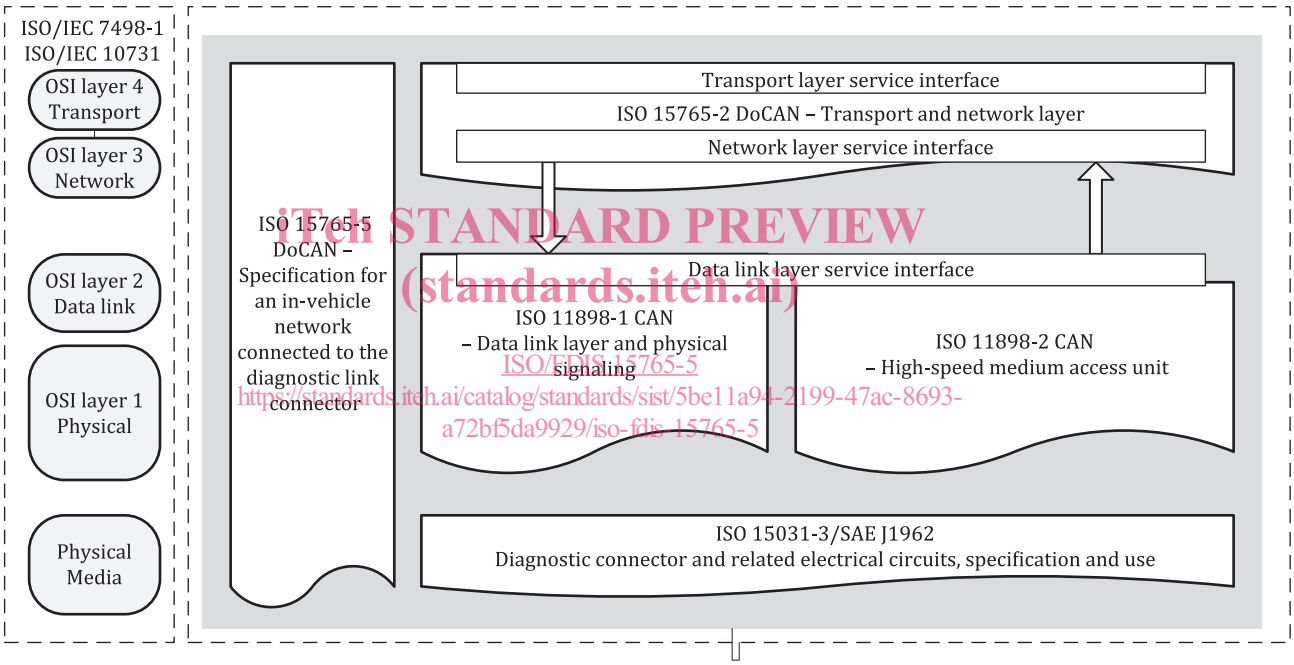

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Figure 1 — CAN documents reference according to OSI model

The documents include the following content:

— transport layer (TL) -related requirements with reference to ISO 15765-2;

— network layer (NL) -related requirements with reference to ISO 15765-2;

— data link layer (DLL) -related requirements with reference to ISO 11898-1, which are composed of:

  — DLL protocol entity requirements;

  — DLL device interface requirements;

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  - DLL network system requirements;
- physical layer (PHY) -related requirements with reference to ISO 11898-2, which are composed of:
  - physical signalling (PS) requirements, which are composed of:
    - PS entity requirements;
    - PS device interface requirements;
    - PS network system requirements;
  - physical medium attachment (PMA) requirements, which are composed of:
    - PMA protocol entity requirements;
    - PMA device interface requirements;
  - physical medium dependent (PMD) requirements, which are composed of:
    - PMD entity requirements;
    - PMD device interface requirements;
    - PMD network system requirements.

The PS sub-layer is implemented in the CAN protocol controller. The PMA sub-layer is implemented normally in the CAN transceiver or the system base chip (SBC). Optionally it may comprise also additional protection circuitry. The media-dependent sub-layer comprises the connectors and the cabling.

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Figure 2 shows an implementation example of the data link and physical layers block diagram.

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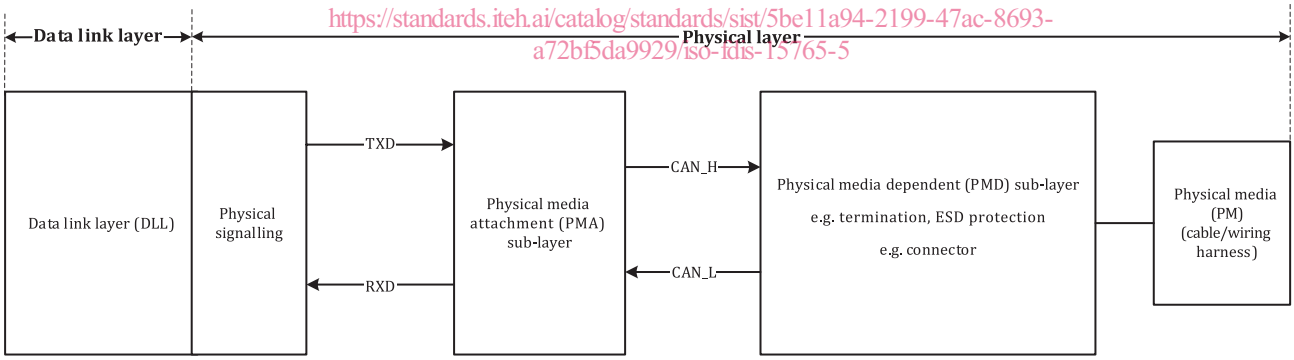

Figure 2 — Implementation example of lower OSI layers block diagram

The above structure is chosen to provide the following implementers with relevant requirements:

- transceiver developers;
- device (e.g. electronic control unit) developers;
- system network developers.

All requirements are numbered and headlined uniquely, so that each implementer can reference them.

Annex A provides a description of the compatibility between test equipment and in-vehicle network connected to the diagnostic link connector.

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Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) —

Part 5: Specification for an in-vehicle network connected to the diagnostic link connector

1 Scope

This document specifies the requirements related to the connection between the external test equipment externally connected to the diagnostic link connector and the in-vehicle CAN network to successfully establish, maintain and terminate communication.

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.

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ISO 11898 (all parts), *Road vehicles — Controller area network (CAN)*

ISO 15031-3, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 3: Diagnostic connector and related electrical circuits: Specification and use*

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ISO 15765-2, *Road vehicles — Diagnostic communication over Controller Area Network (DoCAN) — Part 2: Transport protocol and network layer services*

ISO 15765-4, *Road vehicles — Diagnostic communication over Controller Area Networks (DoCAN) — Part 4: Requirements for emissions-related systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in the ISO 11898 series, ISO 15765-2 and ISO 15765-4 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/

4 Symbols and abbreviated terms

4.1 Symbols

–	empty table cell or feature undefined
Δf	oscillator tolerance
f_{Ba}	nominal data bit rate

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f_{Bd}	data bit rate
L_{CABLE}	cable length between in-vehicle CAN node and diagnostic link connector
t_{Ba}	arbitration bit time
t_{Bd}	data bit time
t_{BIT}	bit time
t_{BIT_RX}	receive bit time
t_{BIT_TX}	transmit bit time
t_{Qa}	nominal arbitration bit time quantum length
t_{Qd}	nominal data bit time quantum length
t_{SJWa}	arbitration bit synchronisation jump width
t_{SJWd}	data bit synchronisation jump width
t_{Q}	time quantum
t_{SPa}	nominal arbitration bit sample point position
t_{SPd}	nominal data bit sample point position
X	table cell selected or feature defined

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4.2 Abbreviated terms

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AE	address extension
AL	application layer
CAN	controller area network
CAN FD	controller area network flexible data-rate
CBFF	classical base frame format
CEFF	classical extended frame format
DCC	diagnostic communication channel
DLL	data link layer
DoCAN	diagnostic communication over controller area network
Ftype	frame type
FBFF	FD base frame format
FEFF	FD extended frame format
L_	data link
MSb	most significant bit
Mtype	message type

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N_	network
NL	network layer
N_PDU	network protocol data unit
PDU	protocol data unit
PHY	physical layer
Ptype	packet type
SA	source address
SJW	synchronisation jump width
SP	sample point
T_	transport
TA	target address
TAtype	target address type
TL	transport layer
T_PDU	transport protocol data unit
DiagNormAddr	diagnostic message with normal addressing
DiagNormFixAddr	diagnostic message with normal fixed addressing
DiagExtAddr	diagnostic message with extended addressing
RDiagMixAddr	remote diagnostic message with mixed addressing

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5 Conventions

This document is based on OSI service conventions as specified in ISO/IEC 10731.

6 In-vehicle network to external test equipment connection

6.1 Connectivity scenarios between external test equipment and vehicle

This document specifies the requirements for the diagnostic link connector providing access to CAN FD network. A backward compatibility to classical CAN is described in Annex A.

6.2 Technical requirements overview

Table 1 provides an overview of the technical requirements and associated requirement numbers.

Table 1 — Technical requirements overview

REQ #	Technical requirement title
4	Transport layer (TL)
4.1	TL – ISO 15765-2 T_Data interface primitive parameter mapping
4.2	TL – ISO 15765-2 TX_DL = 8

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Table 1 *(continued)*

REQ #	Technical requirement title
4.3	TL – ISO 15765-2 TX_DL > 8
3	Network layer (NL)
3.1	NL – ISO 15765-2 N_Data interface primitive parameter mapping
3.2	NL – ISO 15765-2 network layer services
3.3	NL – ISO 15765-2 network layer timing parameters
3.4	NL – ISO 15765-2 uniqueness of node diagnostic address
3.5	NL – ISO 15765-2 supported addressing formats
3.6	NL – ISO 15765-2 functional addressing
3.7	NL – ISO 15765-2 reception of N_PDU
2	Data link layer (DLL)
2.1	DLL – Data interface primitive parameter mapping – Mapping of upper OSI layer service interface parameters
2.2	DLL – Data interface primitive parameter mapping – ISO 11898-1
2.3	DLL – Mapping of N_AI into the 11-bit CAN identifier
2.4	DLL – Mapping of N_AI into the 29-bit CAN identifier
2.5	DLL – Device acceptance of CAN identifier
1	Physical layer (PHY)
1.1	PHY – PS entity requirements – ISO 11898-1 conformance
1.2	PHY – PS device interface requirements – Classical CAN bit timing parameters
1.3	PHY – PS device interface requirements – CAN FD sampling method
1.4	PHY – PS device interface requirements – CAN FD bit timing parameters
1.5	PHY – PS device interface requirements – CAN FD transmitter delay compensation
1.6	PHY – PS device interface requirements – Termination resistance
1.7	PHY – PMA entity requirements – ISO 11898-2 conformance
1.8	PHY – PMA entity requirements – Qualification
1.9	PHY – PMD entity requirements – Diagnostic link connector
1.10	PHY – PMD entity requirements – DoCAN pin assignment on diagnostic link connector
1.11	PHY – PMD entity requirements – Cable characteristics between vehicle network connected to the diagnostic link connector for data bit rates > 500 kbit/s
1.12	PHY – PMD network system requirements
1.13	PHY – PMD network system requirements – Cable length between single CAN node and diagnostic link connector

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6.3 SI — Data.req, Data.ind and Data.conf service interface

The service interface defines the service and parameter mapping from the application layer to the session layer.

Figure 3 shows the Data.req (request), Data.ind (indication) and Data.conf (confirmation) service interface.

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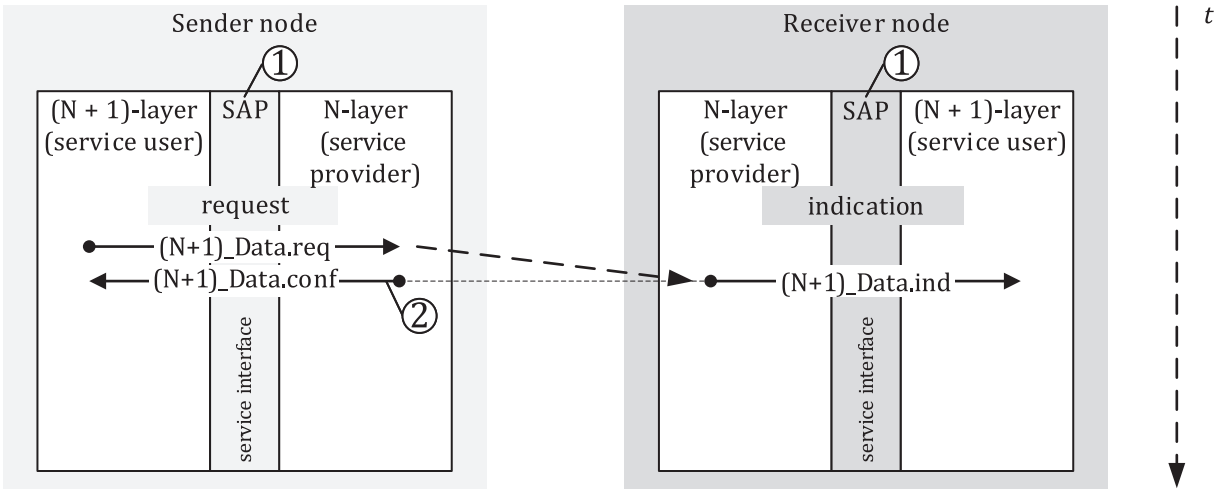

Key

1 service access point

2 read back from N-layer service provider

Figure 3 — Data.req, Data.ind and Data.conf service interface

6.4 SI — Parameter mapping and configuration of OSI-layers

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Each OSI layer contains layer-specific information to manipulate or edit the PDU depending on whether the PDU is provided as a Data.req (sender), Data.ind (receiver) or Data.conf (receiver).

A PDU, which is sent by an application (service user), is assembled by each applicable OSI-layer based on PDU identification information. A PDU, which is received by the OSI-layers (service provider), has PDU identification information used by each applicable OSI layer to disassemble the PDU before it is transferred to the application (service user).

A specific implementation of the service primitive interface parameter management for each OSI-layer is not specified in this document.

6.5 Transport layer (TL)

6.5.1 TL – Data interface primitive parameter mapping

This requirement specifies the A_Data to T_Data interface primitive parameter mapping between the application layer and the TL.

REQ	4.1 TL – ISO 15765-2 T_Data interface primitive parameter mapping
The T_Data service primitive shall use the service primitive parameters as specified in Table 2.	

Table 2 — T_Data service primitive parameter mapping

TL	.req	.ind	.conf	Description
T_TAtype	X	X	X	target address type: the configurable TX_DL value is an upper bound for the valid CAN frame data length (CAN_DL) for the transmitting node. AddrType: (DiagNormAddr, DiagNormFixAddr, DiagExtAddr, RDiagMixAddr)
T_Length	X	X	X	length of PDU
X Supported. – Not supported.				

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