INTERNATIONAL STANDARD

ISO
15765-2

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

Part 2:
Transport protocol and network layer services

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

Partie 2: Protocole de transport et services de la couche réseau

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Contents

Page

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15765-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

This second edition cancels and replaces the first edition (ISO 15765-2:2004), which has been technically revised.

ISO 15765 consists of the following parts, under the general title *Road vehicles — Diagnostic communication over Controller Area Network (DoCAN)*:

— *Part 1: General information and use case definition*

— *Part 2: Transport protocol and network layer services*

— *Part 3: Implementation of unified diagnostic services (UDS on CAN)*

— *Part 4: Requirements for emissions-related systems*

Introduction

This part of ISO 15765 has been established in order to define common requirements for vehicle diagnostic systems implemented on a controller area network (CAN) communication link, as specified in ISO 11898. Although primarily intended for diagnostic systems, it also meets requirements from other CAN-based systems needing a network layer protocol.

To achieve this, it is based on 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 as shown in Table 1.

Table 1 — Enhanced and legislated on-board diagnostics specifications applicable to the OSI layers

Applicability	OSI 7 layers	Vehicle-manufacturer-enhanced diagnostics	Legislated OBD (on-board diagnostics)	Legislated WWH-OBD (on-board diagnostics)
Seven layers according to ISO/IEC 7498-1 and ISO/IEC 10731	Application (layer 7)	ISO 14229-1, ISO 14229-3	ISO 15031-5	ISO 27145-3, ISO 14229-1
	Presentation (layer 6)	Vehicle manufacturer specific	ISO 15031-2, ISO 15031-5, ISO 15031-6, SAE J1930-DA, SAE J1979-DA, SAE J2012-DA	ISO 27145-2, SAE 1930-DA, SAE J1979-DA, SAE J2012-DA, SAE J1939:2011, Appendix C (SPN), SAE J1939-73:2010, Appendix A (FMI)
	Session (layer 5)	ISO 14229-2		
	Transport protocol (layer 4)	ISO 15765-2	ISO 15765-2	ISO 15765-4, ISO 15765-2
	Network (layer 3)			
	Data link (layer 2)	ISO 11898-1 ISO 11898-2 ISO 11898-3 ISO 11898-5 or user defined	ISO 15765-4	ISO 15765-4, ISO 11898-1, ISO 11898-2
	Physical (layer 1)		ISO 11898-1, ISO 11898-2	ISO 27145-4

The application layer services covered by ISO 14229-3 have been defined in compliance with diagnostic services established in ISO 14229-1 and ISO 15031-5, but are not limited to use only with them. ISO 14229-3 is also compatible with most diagnostic services defined in national standards or vehicle manufacturer's specifications.

The transport protocol and network layer services covered by this part of ISO 15765 have been defined to be independent of the physical layer implemented, and a physical layer is only specified for legislated OBD.

For other application areas, ISO 15765 can be used with any CAN physical layer.

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

Part 2:
Transport protocol and network layer services

1 Scope

This part of ISO 15765 specifies a transport protocol and network layer services tailored to meet the requirements of CAN-based vehicle network systems on controller area networks as specified in ISO 11898. It has been defined in accordance with the diagnostic services established in ISO 14229-1 and ISO 15031-5, but is not limited to use with them and is also compatible with most other communication needs for in-vehicle networks. The protocol specifies an unconfirmed communication.

The diagnostic communication over controller area network (DoCAN) protocol supports the standardized service primitive interface as specified in ISO 14229-2.

This part of ISO 15765 provides the transport protocol and network layer services to support different application-layer implementations such as

— enhanced vehicle diagnostics (emissions-related system diagnostics beyond legislated functionality, non-emissions-related system diagnostics),

— emissions-related on-board diagnostics (OBD) as specified in ISO 15031, and

— world-wide harmonized on-board diagnostics (WWH-OBD) as specified in ISO 27145.

2 Normative references

The following referenced documents are indispensable for the application 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 7498-1, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model*

ISO 11898-1, *Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical signalling*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 7498-1 apply.

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

BS	BlockSize
CAN	controller area network
CF	ConsecutiveFrame

confirm	confirmation service primitive
CTS	continue to send
DL	DataLength
DoCAN	diagnostic communication over CAN
ECU	electronic control unit
FC	FlowControl
FF	FirstFrame
FF_DL	FirstFrame data length
FMI	failure mode indicator
FS	FlowStatus
indication	indication service primitive
Mtype	message type
N_AE	network address extension
N_AI	network address information
N_Ar	network layer timing parameter Ar
N_As	network layer timing parameter As
N_Br	network layer timing parameter Br
N_Bs	network layer timing parameter Bs
N_ChangeParameter	network layer service name
N_Cr	network layer timing parameter Cr
N_Cs	network layer timing parameter Cs
N_Data	network data
N_PCI	network protocol control information
N_PCItype	network protocol control information type
N_PDU	network protocol data unit
N_SA	network source address
N_SDU	network service data unit
N_TA	network target address
N_TAtype	network target address type
N_USData	network layer unacknowledged segmented data transfer service name
NW	network
NWL	network layer
OBD	on-board diagnostics

OSI	Open Systems Interconnection
SF	SingleFrame
SN	SequenceNumber
SPN	suspect parameter number
STmin	SeparationTime minimum
UDS	unified diagnostic services
WWH-OBD	world-wide harmonized OBD

4 Conventions

ISO 15765 is based on the conventions discussed in the OSI service conventions (ISO/IEC 10731) as they apply for diagnostic services.

5 Document overview

Figure 1 illustrates the most applicable application implementations utilizing the DoCAN protocol.

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OSI	Open Systems Interconnection
PCI	protocol control information
SF	SingleFrame
SN	SequenceNumber
SPN	suspect parameter number
STmin	SeparationTime minimum
UDS	unified diagnostic services
WWH-OBD	world-wide harmonized OBD

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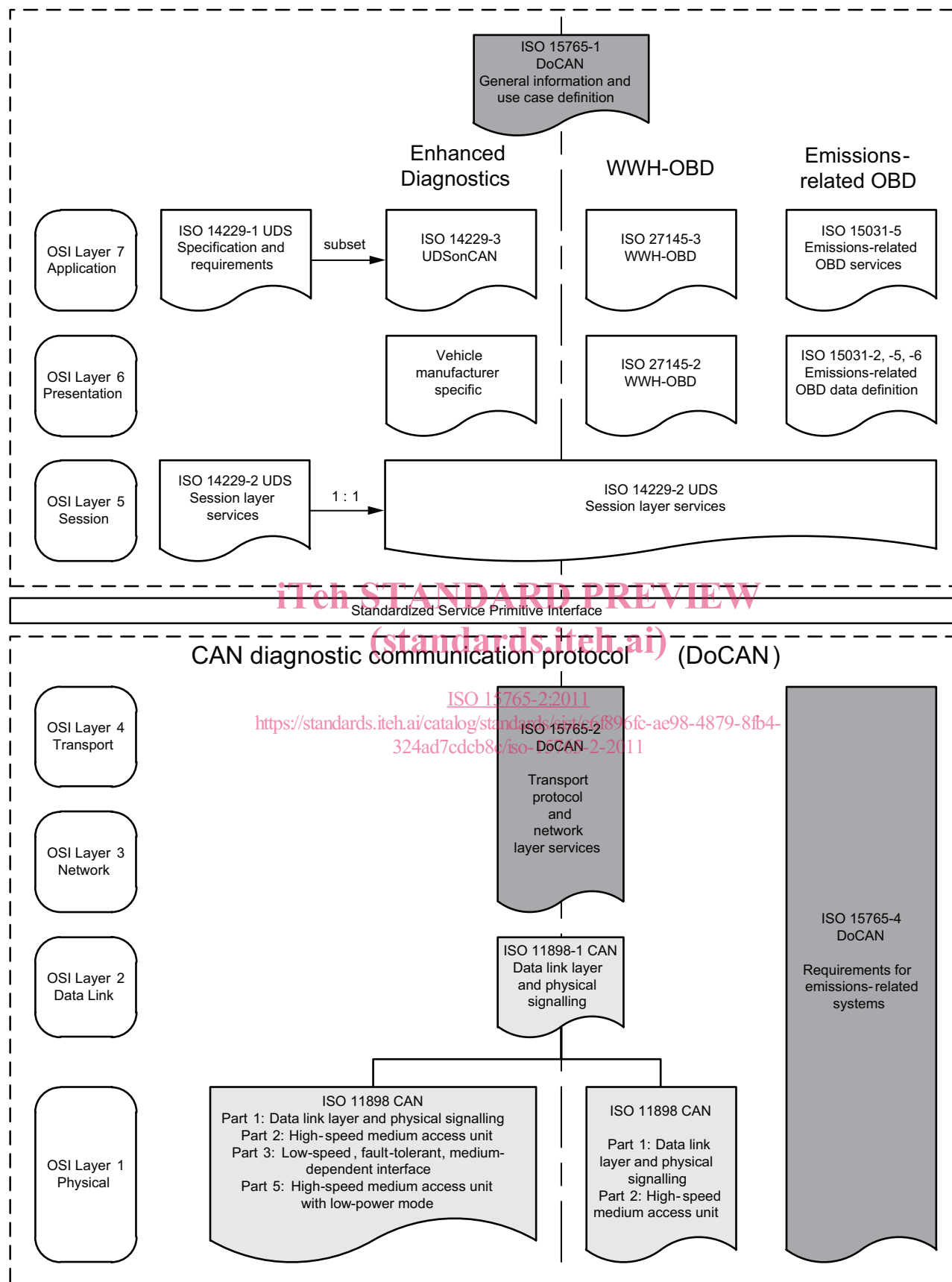324ad7cdcb8c/iso-15765-2-2011

Figure 1 — DoCAN document reference according to the OSI model

6 Network layer overview

6.1 General

This part of ISO 15765 specifies an unconfirmed network layer communication protocol for the exchange of data between network nodes, e.g. from ECU to ECU, or between external test equipment and an ECU. If the data to be transferred do not fit into a single CAN frame, a segmentation method is provided.

In order to describe the functioning of the network layer, it is necessary to consider services provided to higher layers and the internal operation of the network layer.

6.2 Services provided by network layer to higher layers

The service interface defines a set of services that are needed to access the functions offered by the network layer, i.e. transmission/reception of data and setting of protocol parameters.

Two types of service are defined.

a) **Communication services**

These services, of which the following are defined, enable the transfer of up to 4 095 bytes of data.

1) N_USData.request

This service is used to request the transfer of data. If necessary, the network layer segments the data.

2) N_USData_FF.indication

This service is used to signal the beginning of a segmented message reception to the upper layer.

3) N_USData.indication

This service is used to provide received data to the higher layers.

4) N_USData.confirm

This service confirms to the higher layers that the requested service has been carried out (successfully or not).

b) **Protocol parameter setting services**

These services, of which the following are defined, enable the dynamic setting of protocol parameters.

1) N_ChangeParameter.request

This service is used to request the dynamic setting of specific internal parameters.

2) N_ChangeParameter.confirm

This service confirms to the upper layer that the request to change a specific protocol has been carried out (successfully or not).

6.3 Internal operation of network layer

The internal operation of the network layer provides methods for segmentation, transmission with FlowControl, and reassembly. The main purpose of the network layer is to transfer messages that might or might not fit in a single CAN frame. Messages that do not fit into a single CAN frame are segmented into multiple parts, where each can be transmitted in a CAN frame.

Figures 2 and 3 show, respectively, an example of an unsegmented message transmission and of a segmented message transmission.
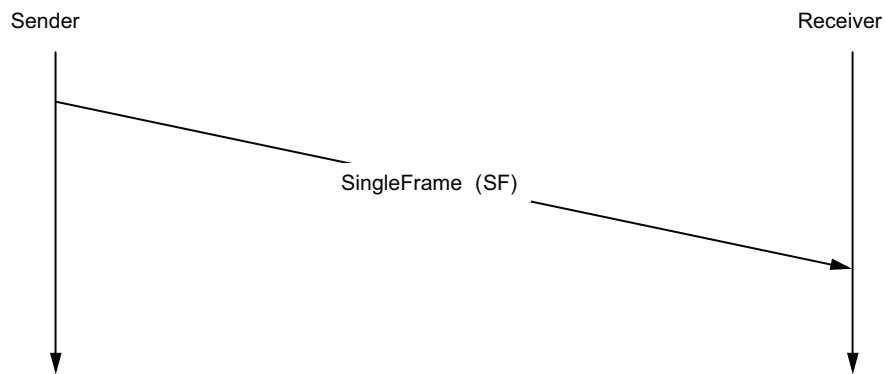
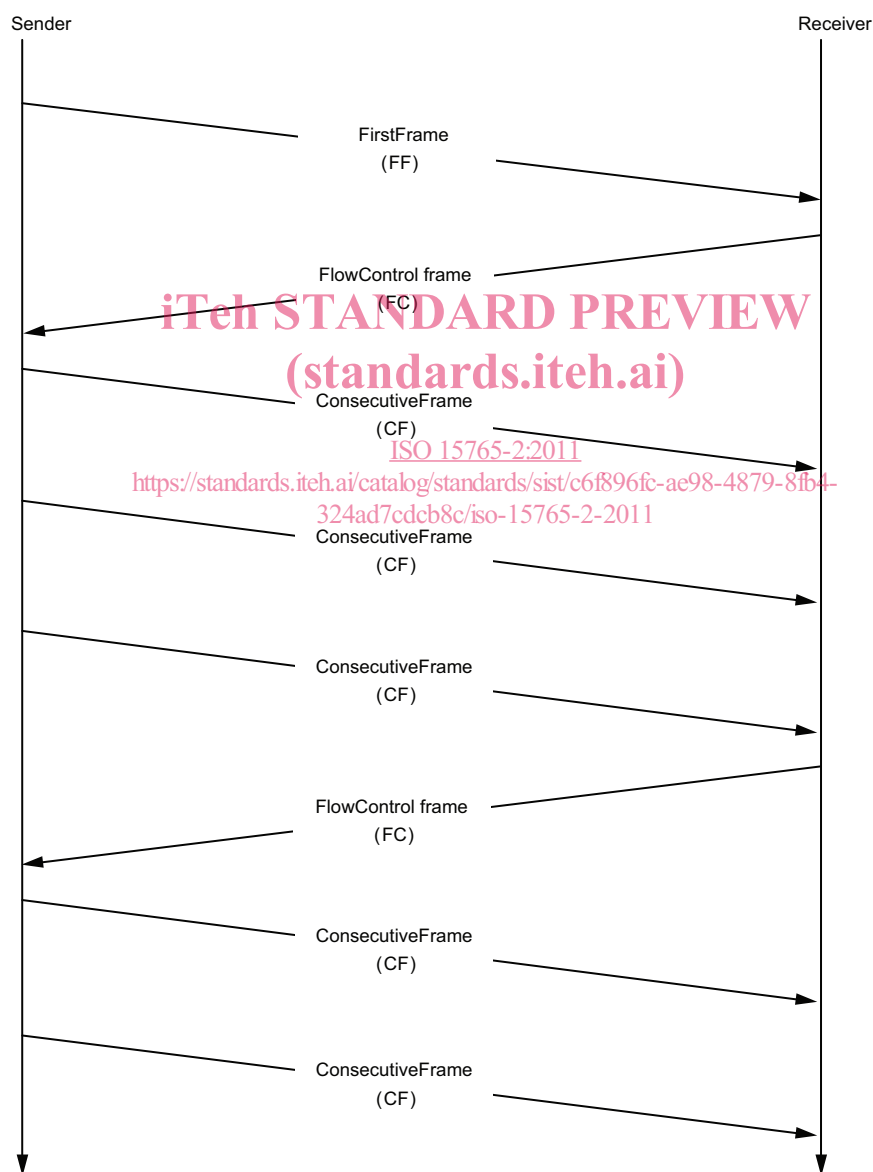**Figure 2 — Example of an unsegmented message**

Figure 3 — Example of a segmented message

FlowControl is used to adjust the sender to the network layer capabilities of the receiver. This FlowControl scheme allows the use of diagnostic gateways and sub-networks.

7 Network layer services

7.1 General

All network layer services have the same general structure. To define the services, three types of service primitive are specified:

— a *service request primitive*, used by higher communication layers or the application to pass control information and data required to be transmitted to the network layer;

— a *service indication primitive*, used by the network layer to pass status information and received data to upper communication layers or the application;

— a *service confirmation primitive*, used by the network layer to pass status information to higher communication layers or the application.

This service specification does not specify an application programming interface, but only a set of service primitives that are independent of any implementation.

All network layer services have the same general format. Service primitives are written in the form:

service_name.type   (
                parameter A,
                parameter B
                [,parameter C, ...]
)

where "service_name" is the name of the service, e.g. N_USData, "type" indicates the type of service primitive, and "parameter A, parameter B [,parameter C, ...]" are the N_SDU as a list of values passed by the service primitive. The square brackets indicate that this part of the parameter list may be empty.

The service primitives define how a service user (e.g. diagnostic application) cooperates with a service provider (e.g. network layer). The following service primitives are specified in this part of ISO 15765: request, indication and confirm.

— Using the service primitive *request* (service_name.request), a service user requests a service from the service provider.

— Using the service primitive *indication* (service_name.indication), the service provider informs a service user about an internal event of the network layer or the service request of a peer protocol layer entity service user.

— With the service primitive *confirm* (service_name.confirm), the service provider informs the service user about the result of a preceding service request of the service user.

7.2 Specification of network layer service primitives

7.2.1 N_USData.request

The service primitive requests transmission of <MessageData> with <Length> bytes from the sender to the receiver peer entities identified by the address information in N_SA, N_TA, N_TAtype [and N_AE] (see 7.3 for parameter definition).