BS ISO 15765-1:2011

BSI Standards Publication

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

Part 1: General information and use case definition

National foreword

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

Part 1: General information and use case definition

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

Partie 1: Informations générales et définition de cas d'usage

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Foreword

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ISO 15765-1 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 15765-1:2004), 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 document set includes the communication between the vehicle's on-board diagnostic (OBD) systems and test equipment implemented across vehicles within the scope of the legislated OBD.

It has been established in order to apply the emissions-related diagnostic services as specified in ISO 15031-5.

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 structure communication systems into seven layers as shown in Table 1.

Table 1 — Enhanced and legislated-OBD diagnostic specifications applicable to the OSI layers

<table>
<tr><th>Applicability</th><th>OSI 7 layers</th><th>Vehicle manufacturer enhanced diagnostics</th><th colspan="2">Legislated OBD (on-board diagnostics)</th><th colspan="2">Legislated WWH-OBD (on-board diagnostics)</th></tr>
<tr><td rowspan="8">Seven layer according to ISO/IEC 7498-1 and ISO/IEC 10731</td><td>Application (layer 7)</td><td>ISO 14229-1,
ISO 14229-3</td><td colspan="2">ISO 15031-5</td><td colspan="2">ISO 27145-3, ISO 14229-1</td></tr>
<tr><td>Presentation (layer 6)</td><td>Vehicle manufacturer specific</td><td colspan="2">ISO 15031-2,
ISO 15031-5,
ISO 15031-6,
SAE J1930-DA,
SAE J1979-DA,
SAE J2012-DA</td><td colspan="2">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)</td></tr>
<tr><td>Session (layer 5)</td><td colspan="5">ISO 14229-2</td></tr>
<tr><td>Transport protocol (layer 4)</td><td rowspan="2">ISO 15765-2</td><td rowspan="2">ISO 15765-2</td><td rowspan="3">ISO 15765-4</td><td rowspan="2">ISO 15765-4,
ISO 15765-2</td><td rowspan="3">ISO 27145-4</td></tr>
<tr><td>Network (layer 3)</td></tr>
<tr><td>Data link (layer 2)</td><td rowspan="2">ISO 11898-1,
ISO 11898-2,
ISO 11898-3,
ISO 11898-5,
or
user defined</td><td rowspan="2">ISO 11898-1,
ISO 11898-2</td><td rowspan="2">ISO 15765-4,
ISO 11898-1,
ISO 11898-2</td></tr>
<tr><td>Physical (layer 1)</td></tr>
</table>

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.

INTERNATIONAL STANDARD ISO 15765-1:2011(E)

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

Part 1: General information and use case definition

1 Scope

This part of ISO 15765 gives an overview of the structure and the partitioning of ISO 15765, and shows the relationships between the different parts. It also defines the diagnostic network architecture. The terminology defined in this part of ISO 15765 is common for all diagnostic networks and is used throughout all parts of ISO 15765.

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

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*

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.

DoCAN	diagnostic communication over controller area network
CAN	controller area network
ECU	electronic control unit
FMI	failure mode indicator
OBD	on-board diagnostics
SPN	suspect parameter number
WWH-OBD	world-wide harmonized on-board diagnostics

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 Overview of ISO 15765

5.1 General

ISO 15765 is applicable to vehicle diagnostic systems implemented on a CAN communication network as specified in ISO 11898.

ISO 15765 has been established in order to define common requirements for vehicle diagnostic systems implemented on a CAN communication link as specified in ISO 11898.

Although primarily intended for diagnostic systems, ISO 15765 has been developed to also meet requirements from other CAN-based systems needing a network layer protocol.

5.2 Open Systems Interconnection (OSI) model

ISO 15765 is based on the Open Systems Interconnection (OSI) Basic Reference Model as specified in ISO/IEC 7498-1 which structures communication systems into seven layers.

All parts of ISO 15765 are guided by the OSI service conventions as specified in ISO/IEC 10731 to the extent that they are applicable to diagnostic services. These conventions define the interaction between the service user and the service provider through service primitives.

The aim of this subclause is to give an overview of the OSI model and show how it has been used as a guideline for this part of ISO 15765. It also shows how the OSI service conventions have been applied to ISO 15765.

The OSI model structures data communication into seven layers called, from top down, *application layer* (layer 7), *presentation layer* (layer 6), *session layer* (layer 5), *transport protocol layer* (layer 4), *network layer* (layer 3), *data link layer* (layer 2) and *physical layer* (layer 1).

A subset of these layers is used in ISO 15765, which specifies the application, session, transport protocol, network, data link and physical layers for DoCAN.

The purpose of each layer is to provide services to the layer above. The application layer provides services to the diagnostic application. The active parts of each layer, implemented in software, hardware or any combination of software and hardware, are called *entities*. In the OSI model, communication takes place between entities of the same layer in different nodes. Such communicating entities of the same layer are called *peer entities*.

The services provided by one layer are available at the *Service Access Point* (SAP) of that layer. The layer above can use them by exchanging data parameters.

ISO 15765 distinguishes between the services provided by a layer to the layer above it and the protocol used by the layer to send a message between the peer entities of that layer. The reason for this distinction is to make the services, especially the application layer services and the transport layer services, reusable for CAN and for other network types. In this way, the protocol is hidden from the service user and it is possible to change the protocol if special system requirements demand it.

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

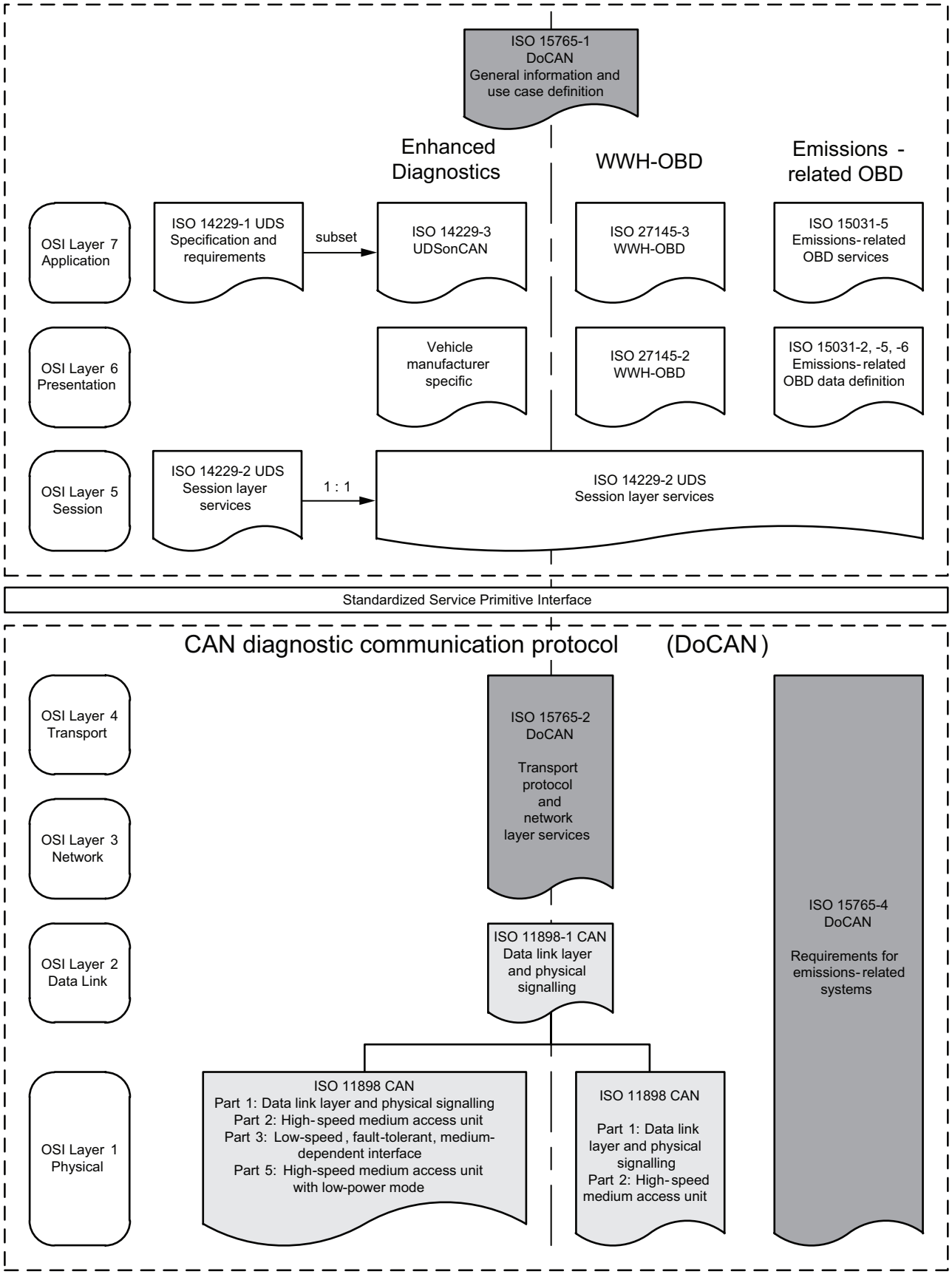

Figure 1 — DoCAN document reference according to the OSI model

6 Diagnostic network architecture

6.1 Diagnostic network

The diagnostic network, as a whole, contains all the clients and servers that can communicate with each other.

A diagnostic network can range from a simple point-to-point connection between a client and a server to a complex distributed network architecture with several physical sub-networks interconnected by diagnostic gateways.

6.2 Diagnostic sub-network

All clients and servers of a sub-network are connected to the same physical communication link.

In the scope of ISO 15765, all clients and servers of a sub-network are connected to the same physical CAN network and are able to communicate directly with each other.

6.3 Diagnostic gateway

A diagnostic gateway is a node in the network that is physically connected to two (or more) sub-networks and has the ability to transfer diagnostic messages between the sub-networks.

Connecting individual sub-networks via diagnostic gateways creates larger diagnostic network architectures.

7 DoCAN use case overview and principles

7.1 Overview

The individual use cases covered by the DoCAN protocol derive from the use of diagnostic communication in the following areas:

— vehicle/ECU engineering (development);

— vehicle/ECU manufacturing (production plant, assembly line);

— service (dealership, aftermarket repair shop);

— legislated inspections (emission-check, safety inspection).

NOTE ISO 15765 will only focus on communication protocol provisions which are necessary to support these use cases. It will not specify data contents, signal update rate, signal availability, etc.

7.2 DoCAN use case clusters

Table 2 provides an overview of the main DoCAN use case clusters which are applicable to systems which support the DoCAN protocol. A main DoCAN use case cluster may have one or more use case definitions.

Table 2 — DoCAN main use case clusters

#	Main title of use case cluster	Brief description
1	Vehicle inspection and repair	The purpose of this use case requires that all data necessary to perform an I/M (Inspection/Maintenance) test as well as a repair be made available through the CAN network from the vehicle. The vehicle data can be quickly retrieved without requiring connection establishment and/or security negotiations.
2	Vehicle/ECU software reprogramming	The purpose of this use case requires that the in-vehicle CAN network provides the capability to provide vehicle/ECU software programming in order to update software/calibrations of the ECU(s). The vehicle requires a connection establishment with security negotiations.
3	Vehicle/ECU assembly line inspection and repair	The purpose of this use case requires that all data necessary to perform a vehicle/ECU assembly line test as well as a repair be made available through the CAN network from the vehicle. The vehicle data can be quickly retrieved without requiring a connection establishment and/or security negotiations.

For security reasons, certain use cases and communication scenarios may be rejected by the vehicle depending on vehicle state conditions (e.g. while driving) or may require additional security provisions.

8 DoCAN use case definition

8.1 Use case 1 — Vehicle inspection and repair

Table 3 specifies the use case required to enable an external test system to qualify the readiness of the vehicle and to perform vehicle diagnostic fault tracing as part of a repair.

Table 3 — UC 1 Vehicle inspection and repair

Actor	Inspection and Maintenance Agency and Repairers
Goal	Data must be transferred reliably and in the order as requested by the external test equipment to qualify vehicle readiness by an external I/M test system or repair. The vehicle data set can be quickly retrieved without requiring connection establishment and/or security negotiations.
Use case input	One or multiple requests from the external test system to the vehicle CAN network.
Use case output	One or multiple response messages from the vehicle including data to qualify vehicle readiness or to perform vehicle diagnostic fault tracing.
Brief description	In this case, usually an external test equipment is connected to the vehicle which implies that the communication is not time critical (within standard timing requirements of communication). This external test equipment can request vehicle data which can be qualified to determine readiness of the vehicle or to perform vehicle diagnostic fault tracing as part of a repair.

8.2 Use case 2 — Vehicle/ECU software reprogramming

Table 4 specifies the use case required to enable an external programming system to perform vehicle ECU programming in the vehicle manufacturer assembly plant or at a repairer's site.

Table 4 — UC 2 Vehicle/ECU software reprogramming

Actor	Vehicle Engineering/Manufacturing and Repairers
Goal	Provide efficient and secure data transfer mechanism between external programming equipment and ECU(s) in the vehicle. It also implies that the communication protocol contains provisions to allow for an efficient gateway implementation (i.e. data splitting and reassembly).
Use case input	A predefined sequence of message and data exchange between the external programming equipment and the vehicle's ECU(s). The security-related data must be made available to the external programming equipment in order to unlock the secured vehicle ECU(s).
Use case output	A final status which provides information on whether the programming of the vehicle's ECU(s) was performed with success.
Brief description	This use case implies that large amounts of data will be transferred from the external test equipment to the vehicle. The vehicle requires connection establishment with security negotiations.

8.3 Use case 3 — Vehicle/ECU assembly line inspection and repair

Table 5 specifies the use case required to enable an external test system to perform vehicle readiness in the vehicle manufacturer assembly plant and to perform a repair if necessary.

Table 5 — UC 3 Vehicle/ECU assembly line inspection and repair

Actor	Vehicle Manufacturing
Goal	Data must be transferred reliably and in the order as requested by the external test equipment to qualify whether the vehicle has passed the end-of-assembly line readiness test. In addition, data must be provided by the vehicle to allow for vehicle diagnostic and repair. The vehicle data set can be quickly retrieved without requiring connection establishment and/or security negotiations.
Use case input	One or multiple requests from the external test system to the vehicle CAN network.
Use case output	One or multiple response messages from the vehicle including data to qualify vehicle readiness or to perform vehicle diagnostic fault tracing.
Brief description	This use case is similar to the use case described in 8.1 but will be limited to the production area.

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