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Road vehicles — Diagnostic communication over Internet Protocol (DoIP) —

Part 3: Wired vehicle interface based on IEEE 802.3

Véhicules routiers — Communication de diagnostic au travers du protocole internet (DoIP) —

Partie 3: Interface du véhicule câblé sur la base de l'IEEE802.3

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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.

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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 31, *Data communication*.

This second edition cancels and replaces the first edition (ISO 13400-3:2011), which has been technically revised.

A list of all parts in the ISO 13400 series can be found on the ISO website.

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Introduction

Vehicle diagnostic communication has been developed starting with the introduction of the first legislated emissions-related diagnostics and has evolved over the years, now covering various use cases ranging from emission-related diagnostics to vehicle-manufacturer-specific applications like calibration or electronic component software updates.

With the introduction of new in-vehicle network communication technologies, the interface between the vehicle's electronic control units and the test equipment has been adapted several times to address the specific characteristics of each new network communication technology requiring optimized data link layer definitions and transport protocol developments in order to make the new in-vehicle networks usable for diagnostic communication.

With increasing memory size of electronic control units, the demand to update this increasing amount of software and an increasing number of functions provided by these control units, technology of the connecting network and buses has been driven to a level of complexity and speed similar to computer networks. New applications (x-by-wire, infotainment) require high band-width and real-time networks (like FlexRay, MOST), which cannot be adapted to provide the direct interface to a vehicle. This requires gateways to route and convert messages between the in-vehicle networks and the vehicle interface to test equipment.

The intent of ISO 13400 (all parts) is to describe a standardized vehicle interface which

— separates in-vehicle network technology from the external test equipment vehicle interface requirements to allow for a long-term stable external vehicle communication interface,

— utilizes existing industry standards to define a long-term stable state-of-the-art communication standard usable for legislated diagnostic communication, as well as for manufacturer-specific use cases, and

— can easily be adapted to new physical and data link layers, including wired and wireless connections, by using existing adaptation layers.

To achieve this, all parts of ISO 13400 are based on the Open Systems Interconnection (OSI) Basic Reference Model specified in ISO/IEC 7498-1 and ISO/IEC 10731, which structures communication systems into seven layers. When mapped on this model, the services specified by ISO 14229-1, ISO 14229-2 and ISO 14229-5 are divided into

a) unified diagnostic services (layer 7), specified in ISO 14229-1, ISO 14229-5, ISO 27145-3,

b) presentation (layer 6):

   1) for enhanced diagnostics, specified by the vehicle manufacturer,

   2) for WWH-OBD (World-Wide Harmonized On-Board Diagnostics), specified in ISO 27145-2, SAE J1930-DA, SAE J1939-DA (SPNs), SAE J1939-73:2010, Appendix A (FMI), SAE J1979-DA, SAE J2012-DA,

c) session layer services (layer 5), specified in ISO 14229-2,

d) transport protocol (layer 4), specified in ISO 13400-2,

e) network layer (layer 3) services, specified in ISO 13400-2, and

f) physical and data link services (layers 1 and 2), specified in this document,

in accordance with Table 1.

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

OSI 7 layers[a]	Vehicle manufacturer enhanced diagnostics	WWH-OBD document reference
Application (layer 7)	ISO 14229-1/ISO, 14229	ISO 14229-1/ISO, 27145
Presentation (layer 6)	Vehicle manufacturer specific	ISO 27145-2, SAE J1930-DA, SAE J1939-DA (SPNs), SAE J1939–73:2010, Appendix A (FMIs), SAE J1979-DA, SAE J2012-DA
Session (layer 5)	ISO 14229-2	ISO 14229-2
Transport (layer 4)	ISO 13400-2 DoIP TCP and IP	
Network (layer 3)		
Data link (layer 2)	ISO 13400-3 DoIP, IEEE 802.3	
Physical (layer 1)		
[a] Seven layers according to ISO/IEC 7498-1 and ISO/IEC 10731.		

The application layer services covered by ISO 14229-5 have been defined in compliance with diagnostic services established in ISO 14229-1, but are not limited to use only with them.

The transport and network layer services covered by ISO 13400-2 have been defined to be independent of the physical layer implemented.

For other application areas, this document can be used with any Ethernet physical layer.

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Road vehicles — Diagnostic communication over Internet Protocol (DoIP) —

Part 3:
Wired vehicle interface based on IEEE 802.3

1 Scope

This document specifies the vehicle communication interface and test equipment requirements for a physical and data link layer based on IEEE 802.3 100BASE-TX.

This interface serves as the physical basis for IP-based communication between the vehicle and test equipment. This document specifies the following aspects:

— requirements for signal and wiring schematics in order to ensure physical layer compatibility of the vehicle interface and Ethernet networks and test equipment communication interfaces;

— discovery/identification of the in-vehicle diagnostic Ethernet interface;

— activation and deactivation of the in-vehicle diagnostic Ethernet interface;

— mechanical and electrical diagnostic connector requirements;

— this edition has been modified to include the identification of two Ethernet pin assignments.

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.

IEC 60950-1, *Information technology equipment — Safety — Part 1: General requirements*

IEEE 802.3-2015, *IEEE Standard for Ethernet*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13400-1 and ISO 14229-1 and the following apply.

3.1
automatic medium-dependent interface crossover
Auto-MDI(X)
device that allows the Ethernet hardware to decide whether a cross-linked cable or a one-to-one connected (patch) cable is used for the connection between two Ethernet ports and which configures the physical layer transceiver (PHY) according to the type of cable in order to correctly connect Tx and Rx linesterm

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3.2
DoIP Edge Node
host inside the vehicle, where an Ethernet activation line in accordance with this part of ISO 13400 is terminated and where the link from the first node/host in the external network is terminated

3.3
link segment
twisted-pair link for connecting two physical layers (PHYs) for 100BASE-TX

Note 1 to entry: Adapted from IEEE 802.3:2008, 1.4.355.

4 Abbreviated terms

Cat5	category 5 cable as specified in TIA/EIA-568-B[1]
DoIP	diagnostics over Internet Protocol
DoEth	diagnostics over Internet Protocol on Ethernet
FMI	failure mode indicator
MAC	media access control
MDI	medium-dependent interface
PE	protective earth conductor
PHY	physical layer transceiver
Rx	receive
SPN	suspect parameter number
Tx	transmit

5 Conventions

ISO 13400 is based on the conventions discussed in the OSI Service Conventions (ISO/IEC 10731) as they apply to diagnostic services.

6 Document overview

ISO 13400 is applicable to vehicle diagnostic systems implemented on an IP communication network.

ISO 13400 has been established in order to define common requirements for vehicle diagnostic systems implemented on an IP communication link.

Although primarily intended for diagnostic systems, ISO 13400 has been developed to also meet requirements from other IP-based systems needing a transport protocol and network layer services.

Figure 1 illustrates the most applicable application implementations utilizing DoIP.

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