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

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

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

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





COPYRIGHT PROTECTED DOCUMENT

© ISO 2012

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions, symbols and abbreviated terms	2
3.1 Terms and definitions	2
3.2 Symbols	3
3.3 Abbreviated terms	4
4 Conventions	5
5 Document overview	5
6 Basic requirements for implementation of internet protocols	7
6.1 General considerations	7
6.2 Network layer requirements	8
6.3 Transport Layer requirements	9
6.4 Application layer requirements — Dynamic host control protocol (DHCP)	14
6.5 Application layer requirements — Data transmission order	18
7 DoIP protocol — Technical description	19
7.1 IP-based vehicle communication protocol	19
7.2 Socket handling	41
7.3 Timing and communication parameters	48
7.4 Logical addressing	49
7.5 Communication environments and recommended timings	50
8 Transport layer services	50
8.1 General information	50
8.2 Specification of DoIP layer service primitives	52
8.3 Service data unit specification	53
9 DoIP protocol usage	54
9.1 General information	54
9.2 Connection establishment and vehicle discovery	54
9.3 DoIP session	56
9.4 Vehicle network integration	58
10 DoIP entity functional requirements	64
11 Communication example message sequence charts	64
Bibliography	67

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 13400-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 13400 consists of the following parts, under the general title *Road vehicles — Diagnostic communication over Internet Protocol (DoIP)*:

- *Part 1: General information and use case definition*
- *Part 2: Transport protocol and network layer services*
- *Part 3: Wired vehicle interface based on IEEE 802.3*

The following parts are under preparation:

- *Part 4: Ethernet diagnostic connector*
- *Part 5: Conformance test specification*

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 external 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 external 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 J1939:2011, Appendix C (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 this part of ISO 13400,
- e) network layer (layer 3) services, specified in this part of ISO 13400, and
- f) physical and data link services (layers 1 and 2), specified in ISO 13400-3,

in accordance with Table 1.

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

Applicability	OSI 7 layers	Vehicle manufacturer enhanced diagnostics	WWH-OBD document reference
Seven layers according to ISO/IEC 7498-1 and ISO/IEC 10731	Application (layer 7)	ISO 14229-1/ISO 14229-5	ISO 14229-1/ISO 27145-3
	Presentation (layer 6)	Vehicle manufacturer specific	ISO 27145-2, SAE J1930-DA, SAE J1939:2011, Appendix C (SPNs), SAE J1939-73:2010, Appendix A (FMIIs), SAE J1979-DA, SAE J2012-DA
	Session (layer 5)	ISO 14229-2	ISO 14229-2
	Transport (layer 4)	ISO 13400-2	ISO 13400-2
	Network (layer 3)		
	Data link (layer 2)	ISO 13400-3	ISO 13400-3
	Physical (layer 1)		

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 this part of ISO 13400 have been defined to be independent of the physical layer implemented.

For other application areas, ISO 13400-3 can be used with any Ethernet physical layer.

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

Part 2: Transport protocol and network layer services

1 Scope

1.1 This part of ISO 13400 specifies the requirements for diagnostic communication between external test equipment and vehicle electronic components using Internet Protocol (IP) as well as the transmission control protocol (TCP) and user datagram protocol (UDP). This includes the definition of vehicle gateway requirements (e.g. for integration into an existing computer network) and test equipment requirements (e.g. to detect and establish communication with a vehicle).

1.2 This part of ISO 13400 specifies features that can be used to detect a vehicle in a network and enable communication with the vehicle gateway as well as with its sub-components during the various vehicle states. These features are separated into two types: mandatory and optional.

1.3 This part of ISO 13400 specifies the following mandatory features:

- vehicle network integration (IP address assignment);
- vehicle announcement and vehicle discovery;
- vehicle basic status information retrieval (e.g. diagnostic power mode);
- connection establishment (e.g. concurrent communication attempts), connection maintenance and vehicle gateway control;
- data routing to and from the vehicle's sub-components;
- error handling (e.g. physical network disconnect).

1.4 This part of ISO 13400 specifies the following optional features:

- DoIP entity status monitoring;
- DoIP entity firewall capabilities.

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 3779, *Road vehicles — Vehicle identification number (VIN) — Content and structure*

ISO 13400-1, *Road vehicles — Diagnostic communication over Internet Protocol (DoIP) — Part 1: General information and use case definition*

ISO 13400-3, *Road vehicles — Diagnostic communication over Internet Protocol (DoIP) — Part 3: Wired vehicle interface based on IEEE 802.3*

IEEE 802.3, *IEEE Standard for Information Technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

IETF RFC 147, *The Definition of a Socket*

IETF RFC 768, *User Datagram Protocol*

IETF RFC 791 (September 1981), *Internet Protocol — DARPA Internet Program — Protocol Specification*

IETF RFC 792, *Internet Control Message Protocol — DARPA Internet Program — Protocol Specification*

IETF RFC 793, *Transmission Control Protocol — DARPA Internet Program — Protocol Specification*

IETF RFC 826, *An Ethernet Address Resolution Protocol*

IETF RFC 1122, *Requirements for Internet Hosts — Communication Layers*

IETF RFC 2131, *Dynamic Host Configuration Protocol*

IETF RFC 2132, *DHCP Options and BOOTP Vendor Extensions*

IETF RFC 2460, *Internet Protocol, Version 6 (IPv6) — Specification*

IETF RFC 2375, *IPv6 Multicast Address Assignments*

IETF RFC 3315, *Dynamic Host Configuration Protocol for IPv6 (DHCPv6)*

IETF RFC 3484, *Default Address Selection for Internet Protocol version 6 (IPv6)*

IETF RFC 3927, *Dynamic Configuration of IPv4 Link-Local Addresses*

IETF RFC 4291, *IP Version 6 Addressing Architecture*

IETF RFC 4443, *Internet Control Message Protocol (ICMP v6) for the Internet Protocol Version 6 (IPv6) Specification*

IETF RFC 4702, *The Dynamic Host Configuration Protocol (DHCP) Client Fully Qualified Domain Name (FQDN) Option*

IETF RFC 4861, *Neighbor Discovery for IP version 6 (IPv6)*

IETF RFC 4862, *IPv6 Stateless Address Autoconfiguration*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

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

3.1.1

diagnostic power mode

abstract vehicle internal power supply state which affects the diagnostic capabilities of all ECUs on the in-vehicle networks and which identifies the state of all ECUs of all gateway sub-networks that allow diagnostic communication

NOTE The intent is to provide information to the external test equipment about whether diagnostics can be performed on the connected vehicle or whether the vehicle needs to be put into a different diagnostic power mode (i.e. technician interaction required). In this part of ISO 13400, the following states are relevant: Not Ready (not all ECUs accessible via DoIP can communicate), Ready (all ECUs accessible via DoIP can communicate) and Not Supported (the Diagnostic Information Power Mode Information Request message is not supported).