International Standard

ISO 13400-2

Third edition
2025-06

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

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Reference number
ISO 13400-2:2025(en)

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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).

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For an explanation of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 13400-2:2019), which has been technically revised. It also incorporates ISO 13400-2:2019/Amd 1:2023.

The main changes are as follows:

— modified Figure 1 to show ISO 13400-2 DoIP payload type detection;

— specified the DoIP protocol version = 4 for this edition;

— updated subclause 7.7 APP - Timing and communication parameters, Table 12;

— added new requirement 7.DoIP-190 AL – DoIP entity diagnostic message NACK code set to 09_{16};

— added new requirement 7.DoIP-191 AL – DoIP transport protocol payload type status and message structure;

— added new requirement 7.DoIP-192 AL – DoIP entity checks for supported payload types over UDP Ports;

— modified Figure 16 to include 7.DoIP-192 new requirement;

— modified Figure 23 to include 7.DoIP-105, DoIP-193 and DoIP-194 new requirements;

— added new requirement 7.DoIP-195 AL – DoIP server supports one DoIP protocol version.

A list of all parts in the ISO 13400 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

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 servers and the client DoIP entity 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 servers, 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. Various 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 client DoIP entity.

All parts of the ISO 13400 series are applicable to vehicle diagnostic systems implemented on an IP communication network.

The ISO 13400 series 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, the ISO 13400 series has been developed to also meet requirements from other IP-based systems needing a transport protocol and network layer services.

The intent of the ISO 13400 series is to describe a standardized vehicle interface which

— separates in-vehicle network technology from the client DoIP entity 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,

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

— allows connections of vehicle-internal and vehicle-external DoIP entities.

To achieve this, it is 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.

Figure 1 illustrates an overview of communication frameworks beyond the scope of this document including related standards:

— vehicle diagnostic communication framework, which is composed of ISO 14229-1, ISO 13400-2 (DoIP payload type detection), ISO 14229-2, and ISO 14229-5;

— presentation layer standards, for example, vehicle manufacturer- (VM-) specific or ISO 22901 ODX;

— OSI lower layers framework, which is composed of ISO 13400-3 and ISO 13400-4.

The ISO 13400 series and ISO 14229-5 are based on the conventions specified in the OSI service conventions (ISO/IEC 10731) as they apply for all layers and the diagnostic services.

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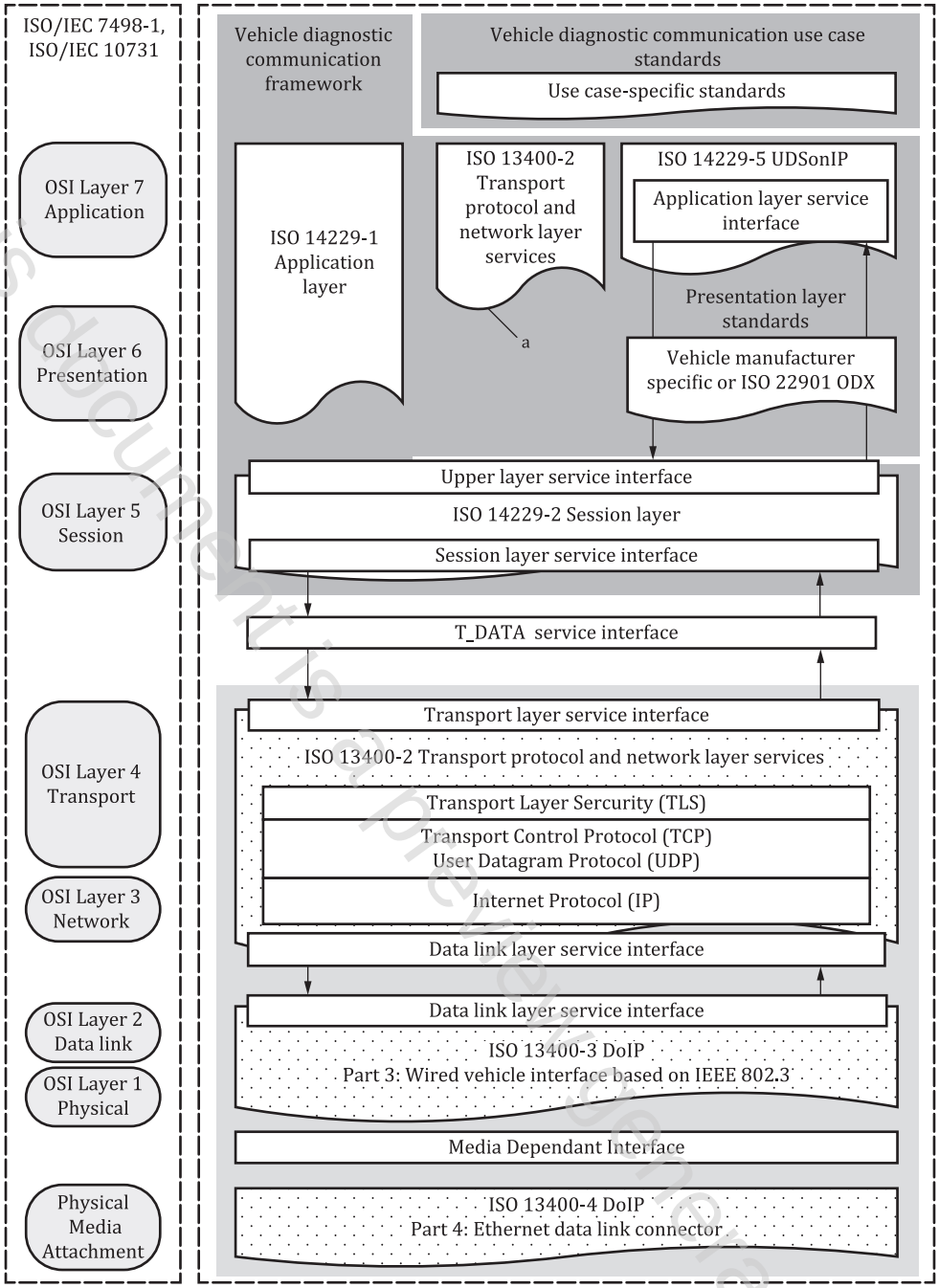

[a] Definition of application layer payload types.

Figure 1 — DoIP document reference according to OSI model

Figure 2 illustrates vehicle network architecture schematics from a functional viewpoint.

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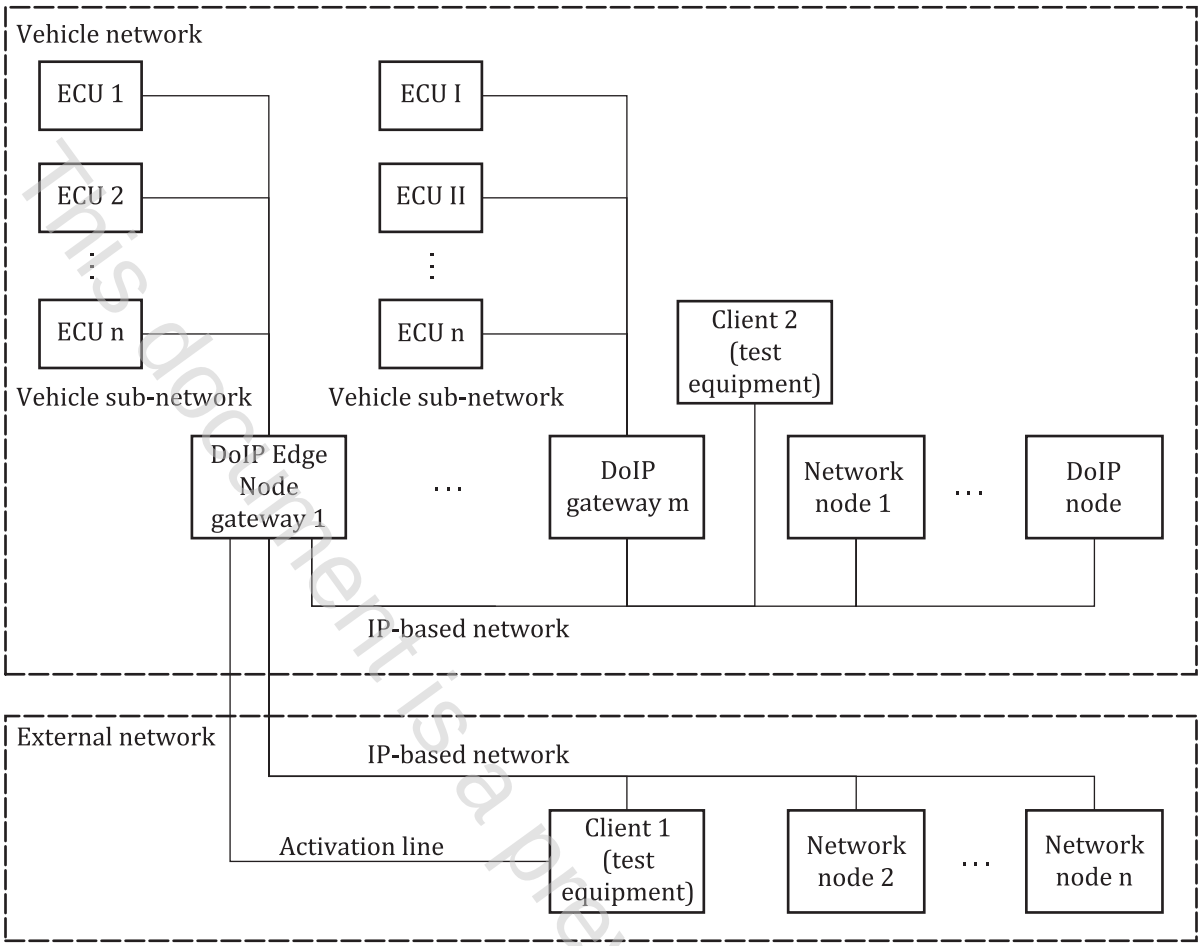

Figure 2 — Vehicle network architecture schematics (functional view)

This protocol standard is implemented by one or more DoIP entities, depending on the vehicle's network architecture. Figure 2 illustrates a client 1 (external client), which is connected to the DoIP edge node and a client 2 (internal client) in the vehicle's internal network. If not stated otherwise, the DoIP client entities are assumed to behave the same regardless to which network they are connected.

If necessary, this document distinguishes between an "internal client" and "external client" to apply a requirement or statement.

In this document, the requirements are assigned a unique number of the form "**X.DoIP-yyy**", allowing for easier requirement tracking and reference.

— X = OSI layer number; and

— DoIP-yyy = requirement number; and

— xL = x = OSI layer abbreviation [8 = APP, 7 = AL, 6 = PL, 5 = SL, 4 = TL, 3 = NL, 2 = DLL, 1 = PHY, 0 = ASP].

NOTE Requirements in this document are not numbered sequentially because the order of individual requirements changed during document development.

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

Part 2: Transport protocol and network layer services

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1 Scope

This document specifies the requirements for secured and unsecured diagnostic communication between a client DoIP entity and server(s) installed in the vehicle 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 (client DoIP entity) requirements (e.g. to detect and establish communication with a vehicle).

This document specifies features that are used to detect a vehicle in a network and enable communication with the vehicle gateway as well as with its subcomponents during the various vehicle states. These features are separated into two types: mandatory and optional.

This document 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 disconnects).

This document specifies the following optional features:

— DoIP entity status monitoring;

— transport layer security (TLS);

— DoIP entity firewall capabilities.

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.

ISO/IEC 7498-1, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model*

ISO/IEC/IEEE 8802-3, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 3: Standard for Ethernet*

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

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IETF RFC 768, *User Datagram Protocol*

IETF RFC 791:1981, *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 2375, *IPv6 Multicast Address Assignments*

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

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 4492, *Elliptic Curve Cryptography (ECC) Cipher Suites for Transport Layer Security (TLS)*

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*

IETF RFC 5246, *The Transport Layer Security (TLS) Protocol Version 1.2*

IETF RFC 5289, *TLS Elliptic Curve Cipher Suites with SHA-256/384 and AES Galois Counter Mode (GCM)*

IETF RFC 7905, *ChaCha20-Poly1305 Cipher Suites for Transport Layer Security (TLS)*

IETF RFC 7251, *AES-CCM Elliptic Curve Cryptography (ECC) Cipher Suites for TLS*

IETF RFC 8446:2018, *The Transport Layer Security (TLS) Protocol Version 1.3*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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