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Road vehicles — Modular vehicle communication interface (MVCI) —

Part 2: Diagnostic protocol data unit (D-PDU API)

Véhicules routiers — Interface de communication modulaire du véhicule (MVCI) —

Partie 2: Interface de programmation d'application d'unité de données du protocole de diagnostic (D-PDU API)

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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 22900-2:2017), which has been technically revised.

The main changes are as follows:

— introduction of reference to ISO 15765-5 for CAN-FD;

— introduction of secured communication for the DoIP protocol based on TLS (as defined in ISO 13400-2:2019);

— introduction of automatic DoIP reconnect handling;

— introduction of ISOBUS protocol.

A list of all parts in the ISO 22900 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.

Introduction

The ISO 22900 series is applicable to vehicle electronic control module diagnostics and programming.

This document was established in order to more easily exchange software and hardware of vehicle communication interfaces (VCIs) among diagnostic applications. It defines a generic and protocol independent software interface towards the modular vehicle communication interface (MVCI) protocol module, such that a diagnostic application based on this software interface can exchange the MVCI protocol module or add a new MVCI protocol module with minimal effort. Today, the automotive aftermarket requires flexible usage of different protocol modules for vehicles of different brands. Many of today's protocol modules are incompatible with regard to their hardware and software interface, such that, depending on the brand, a different protocol module is required.

The objective of this document is to specify the diagnostic protocol data unit application programming interface (D-PDU API) as a generic software interface and to provide a "plug and play" concept for access onto different MVCI protocol modules from different tool manufacturers. The D-PDU API will address the generic software interface, the protocol abstraction, its exchangeability, as well as the compatibility towards existing standards such as SAE J2534-1 and RP1210a.

The implementation of the modular VCI concept facilitates co-existence and re-use of MVCI protocol modules, especially in the aftermarket. As a result, diagnostic or programming applications can be adapted for different vehicle communication interfaces and different vehicles with minimal effort, thus helping to reduce overall costs for the tool manufacturer and end user.

Vehicle communication interfaces compliant with ISO 22900 series support a protocol-independent D-PDU API as specified in this document.

Road vehicles — Modular vehicle communication interface (MVCI) —

Part 2:
Diagnostic protocol data unit (D-PDU API)

1 Scope

This document specifies the diagnostic protocol data unit application programming interface (D-PDU API) as a modular vehicle communication interface (MVCI) protocol module software interface and common basis for diagnostic and reprogramming software applications.

This document covers the descriptions of the application programming interface (API) functions and the abstraction of diagnostic protocols, as well as the handling and description of MVCI protocol module features. Sample MVCI module description files accompany this document.

The purpose of this document is to ensure that diagnostic and reprogramming applications from any vehicle or tool manufacturer can operate on a common software interface and can easily exchange MVCI protocol module implementations.

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.

SAE J2411, *Single Wire CAN Network for Vehicle Applications*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions 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/

3.1 Terms and definitions

3.1.1
application
way of accessing the diagnostic protocol data unit application programming interface (D-PDU API)

Note 1 to entry: From the perspective of the D-PDU API, it does not make any difference whether an application accesses the software interface directly or through an MVCI D-Server. Consequently, in this document, the term "application" represents both ways of accessing the D-PDU API.

3.1.2
ComLogicalLink
logical communication channel towards a single electronic control unit (ECU) or towards multiple electronic control units

3.1.3
COMPARAM-SPEC
protocol-specific set of predefined communication parameters (ComParams), the value of which can be changed in the context of a layer or specific diagnostic service

Note 1 to entry: This part of the model can also contain OEM-specific ComParams.

3.1.4
ComPrimitive
smallest aggregation of a communication service or function

EXAMPLE A request message to be sent to an ECU.

3.1.5
Ethernet
physical network media type

3.1.6
local network
part of the network connected directly to the tester

Note 1 to entry: Also called "primary network" in some subclauses.

3.1.7
remote network
part of the network located behind a gateway connected to the tester

Note 1 to entry: Also called "secondary network" in some subclauses.

3.1.8
DoIP MVCI module
diagnostic communication over Internet Protocol modular vehicle communication interface module
MVCI module able to handle connections to one or multiple *DoIP entities* (3.1.11)

3.1.9
DoIP gateway
diagnostic communication over Internet Protocol gateway
gateway connected to the tester via DoIP protocol

3.1.10
DoIP node
diagnostic communication over Internet Protocol node
ECU connected to the tester directly via DoIP protocol

Note 1 to entry: ECU has no gateway capabilities.

3.1.11
DoIP entity
diagnostic communication over Internet Protocol entity
general term for either a *DoIP gateway* (3.1.9) or a *DoIP node* (3.1.10)

3.1.12
DoIP entity certificate
certificate issued by an *intermediate CA* (3.1.13) to *DoIP entity* (3.1.11)

Note 1 to entry: It is presented during the TLS handshake to the external test equipment to verify the authenticity of this DoIP entity.

3.1.13
intermediate CA
certificate authority which issues subordinal certificates

Note 1 to entry: A reason to issue subordinal certificates can be, for example to further to another intermediate CA or *DoIP entities* (3.1.11).

3.1.14
intermediate certificate
certificate used by an *intermediate CA* (3.1.13)

Note 1 to entry: The intermediate certificate(s) is/are either stored in the external test equipment or are presented during authentication together with the end node certificate to complete the chain of trust.

3.1.15
root CA
certificate authority (CA) acting as the root of trust

Note 1 to entry: Root CA typically issues *intermediate certificates* (3.1.14) to allow an *intermediate CA* (3.1.13) to further submit certificates.

3.1.16
root certificate
certificate of the r*oot CA* (3.1.15) used as the trust anchor

Note 1 to entry: It is securely stored and used by all entities that wants to validate end node certificates [e.g. from the *DoIP entity* (3.1.11)] together with all necessary *intermediate certificates* (3.1.14) in the chain of trust.

3.2 Abbreviated terms

API	application programming interface
ASCII	American Standard for Character Information Interchange
CA	certificate authority

CAN	controller area network
CAN IDs	controller area network identifiers
CDF	cable description file
CLL	ComLogicalLink
ComLogicalLinks	communication logical links
ComParam	communication parameter
ComParamSpec	communication parameter specification
ComPrimitive	communication primitive
CRC	cyclic redundancy check
DLC	data link connector
DLL	dynamic link library
DoIP	diagnostic communication over Internet Protocol
D-PDU	diagnostic protocol data unit
D-Server	diagnostic server
ECU	electronic control unit
HDD	hard disk drive
HI	differential line — high
HW	Hardware
IEEE 1394	firewire serial bus
IFR	in-frame response
IGN	Ignition
IOCTL	input/output control
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
K	UART K-Line
KWP	keyword protocol
L	UART L-Line
LL	Logical Link

LOW	differential line — low
MDF	module description file
MOST	media oriented systems transport
MVCI	modular vehicle communication interface
ODX	open diagnostic data exchange
OEM	original equipment manufacturer
OSI	open systems interconnection
PC	personal computer
PCI	protocol control information
PGN	parameter group number
PROGV	programmable voltage
PWM	pulse width modulation
RDF	root description file
RX	UART uni-directional receive
SCI	serial communications interface
SCP	standard corporate protocol
TCP	transmission control protocol
TLS	transport layer security
TX	UART uni-directional transmit
UDS	unified diagnostic services
UDSonCAN	unified diagnostic services on CAN
UDSonIP	unified diagnostic services on IP
USB	universal serial bus
USDT	unacknowledged segmented data transfer
UUDT	unacknowledged un-segmented data transfer
VCI	vehicle communication interface
VPW	variable pulse width
XML	extensible markup language

4 Specification release version information

4.1 Specification release version location

Specification release version information is contained in each modular VCI release document specification under the same clause title “Specification release version information”. It is important to check for feature support between modular VCI release specifications if the most recent API features shall be implemented. The D-PDU API supports the reading of version information by the API function call PDUGetVersion.

Release version information is also contained in the following files:

— root description file (RDF);

— module description file (MDF);

— cable description file (CDF);

— D-PDU API library file.

4.2 Specification release version

The specification release version of this document is 2.2.2.

5 Modular VCI use cases

5.1 OEM merger

In the past, several OEMs in the automotive industry have merged into one company.

All companies try to leverage existing (legacy) components and jointly develop new products, which are common across different vehicle types and badges.

If OEMs already had modular VCI compliant test equipment, it would be simple to connect MVCI protocol modules from merged OEMs into one chassis or device. All protocols would be supported by a single MVCI protocol module configuration without any replacement of MVCI protocol module hardware at the dealer site. The same applies for engineering and some of this concept might also work for production plants (end of line).

5.2 OEM cross vehicle platform ECU(s)

OEMs specify requirements and design electronic systems to be implemented in multiple vehicle platforms in order to avoid re-inventing a system for different vehicles. The majority of design, normal operation and diagnostic data of an electronic system are re-used if installed in various vehicles. The engineering development centres are located worldwide. A great amount of re-authoring of diagnostic data is performed to support different engineering test tools.

Providing diagnostic data in an industry standard format like ODX and XML will avoid re-authoring into various test tool specific formats at different system engineering locations. The D-PDU API supports this re-use concept by fully abstracting vehicle protocols into the industry supported ComParam descriptions.

5.3 Central source diagnostic data and exchange during ECU development

Single source origin of diagnostic data (as depicted in Figure 1), combined with a verification and feedback mechanism and distribution to the end users, is highly desirable in order to lower engineering expenses. Engineering, manufacturing and service specify which protocol and data shall be implemented in the ECU. This information will be documented in a structured format like XML. Furthermore, the same structured data files can be used to setup the diagnostic engineering tools to verify proper communication with the ECU and to perform functional verification and compliance testing of the ECU. Once all quality goals are met, these structured data files shall be released to the OEM database. An Open Diagnostic data eXchange (ODX) schema has been developed for the purpose of supporting these structured formatted files used for ECU diagnosis and validation.

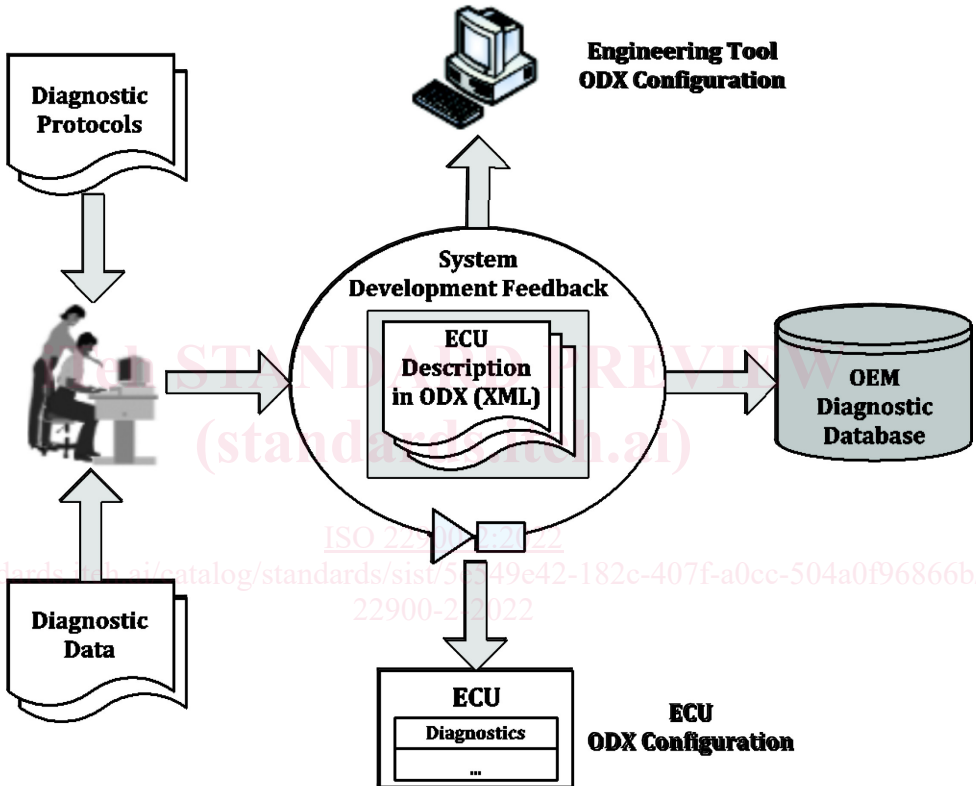

Figure 1 — Example of central source engineering diagnostic data process

5.4 OEM franchised dealer and aftermarket service outlet diagnostic tool support

The service shop uses the modular VCI hardware and software for vehicle diagnosis and enhanced procedural testing. By using the same engineering, manufacturing and service functions as those used for individual ECU testing, the reliability of the data is maintained. A modular VCI protocol module can be used with any PC (handheld or stationary) and can be utilized as an embedded device.

6 Modular VCI software architecture

6.1 Overview

The modular VCI concept is mainly based on three software components (see Figure 2):

— MVCI D-Server software;