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Road vehicles — Open diagnostic data exchange (ODX) —

Part 2: Emissions-related diagnostic data

Véhicules routiers — Échange de données de diagnostic ouvert (ODX) —

Partie 2: Données de diagnostic relatives aux émissions

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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.

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 22901-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 22901 consists of the following parts, under the general title *Road vehicles — Open diagnostic data exchange (ODX)*:

— *Part 1: Data model specification*

— *Part 2: Emissions-related diagnostic data*

Introduction

This International Standard has been established in order to define the data format for transferring standardized emissions-related diagnostic data of the vehicle's OBD system between system supplier, vehicle manufacturer and service dealerships and diagnostic tools of different vendors.

The standardized information is contained in the following standards:

— Diagnostic protocol information:

  — ISO 9141-2:1994, *Road vehicles — Diagnostic systems — Part 2: CARB requirements for interchange of digital information,*

  — ISO 9141-2:1994/Amd.1:1996, *Road vehicles — Diagnostic systems — Part 2: CARB requirements for interchange of digital information — Amendment 1*,

  — ISO 14230-4:2000, *Road vehicles — Diagnostic systems — Keyword Protocol 2000 — Part 4: Requirements for emissions-related systems*,

  — ISO 15765-4, *Road vehicles — Diagnostic communication over Controller Area Network (CAN) — Part 4: Requirements for emissions-related systems*,

  — SAE J1850, *Class B Data Communications Network Interface*

  — ISO 15031-5, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 5: Emissions-related diagnostic services*;

— Emissions-related OBD data:

  — ISO 15031-4, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 4: External test equipment*,

  — ISO 15031-5, *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 5: Emissions-related diagnostic services*,

  — ISO 15031-6, *Road vehicles — Communication between vehicle and external test equipment for emissions-related diagnostics — Part 6: Diagnostic trouble code definitions,*

  — SAE J1979-DA, *Digital Annex of E/E Diagnostic Test Modes*,

  — SAE J2012-DA, *Digital Annex of Diagnostic Trouble Code Definition*;

— OBD Conformance test cases:

  — SAE J1699-3, *OBD II Compliance Test Cases*.

The automotive industry mostly utilizes an informal description to document diagnostic data stream information of vehicle ECUs. Each user, who desires to use the ECU diagnostic data stream documentation to setup development tools or service diagnostic test equipment, has a requirement for a manual transformation of this documentation into a format readable by these tools. This effort will no longer be required if the diagnostic data stream information is provided in ODX format and if those tools support the ODX format.

Road vehicles — Open diagnostic data exchange (ODX) —

Part 2: Emissions-related diagnostic data

1 Scope

This part of ISO 22901 is intended to ensure that diagnostic data stream information is available to diagnostic tool application manufacturers to simplify the support of the aftermarket automotive service industry. The ODX modelled diagnostic data are compatible with the software requirements of the Modular Vehicle Communication Interface (MVCI) (ISO 22900-2 and ISO 22900-3). The ODX modelled diagnostic data can enable an MVCI device to communicate with the vehicle [ECU(s)] and interpret the diagnostic data contained in the messages exchanged between the external test equipment and the ECU(s). For ODX-compliant external test equipment, no software programming is necessary to convert diagnostic data into technician-readable information for display by the external test equipment.

This part of ISO 22901 contains emissions-related OBD data examples described in ODX. The data examples derive from ISO 15031 (all parts).

EXAMPLES Diagnostic trouble codes, data parameters, identification data and communication parameters.

The emissions-related OBD ODX modelled diagnostic data describe

— the protocol specification from diagnostic communication of emissions-related ECUs;

— the communication parameters for the emissions-related OBD protocols and data link layers and for emissions-related ECU software;

— the related vehicle interface description (connectors and pin-out);

— the functional description of diagnostic capabilities of a network of ECUs.

This part of ISO 22901 is based on emissions-related diagnostic data derived and formatted according to the ISO 15765-4 DoCAN protocol. The definitions and XML representation is exemplary for all other protocols that are referenced in ISO 15031-5.

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 15031 (all parts), *Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics*

ISO 15765-4, *Road vehicles — Diagnostic communication over Controller Area Network (CAN) — Part 4: Requirements for emissions-related systems*

ISO 22901-1, *Road vehicles — Open diagnostic data exchange (ODX) — Part 1: Data model specification*

3 Terms and definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22901-1 apply.

3.2 Abbreviated terms

MVCI Modular Vehicle Communication Interface

ODX-RT Open Diagnostic data eXchange — Run-Time format

4 Conventions

This part of ISO 22901 is based on the conventions discussed in the OSI Service Conventions (ISO/IEC 10731[11]) as they apply for diagnostic services.

5 ODX data in the ECU life cycle

Figure 1 shows the usage of ODX in the ECU life cycle. Engineering, manufacturing, and service specify that communication protocol and data should be implemented in the ECU. This information is documented in a structured format utilizing the XML standard and by an appropriate ODX authoring tool. There is potential to generate ECU software from the ODX file. Furthermore, the same ODX file is used to set up the diagnostic engineering tools to verify proper communication with the ECU and to perform functional verification and compliance testing. Once all quality goals are met, the ODX file may be released to a diagnostic database. Diagnostic information is now available to manufacturing, service, OEM franchised dealers and aftermarket service outlets via Intranet and Internet.

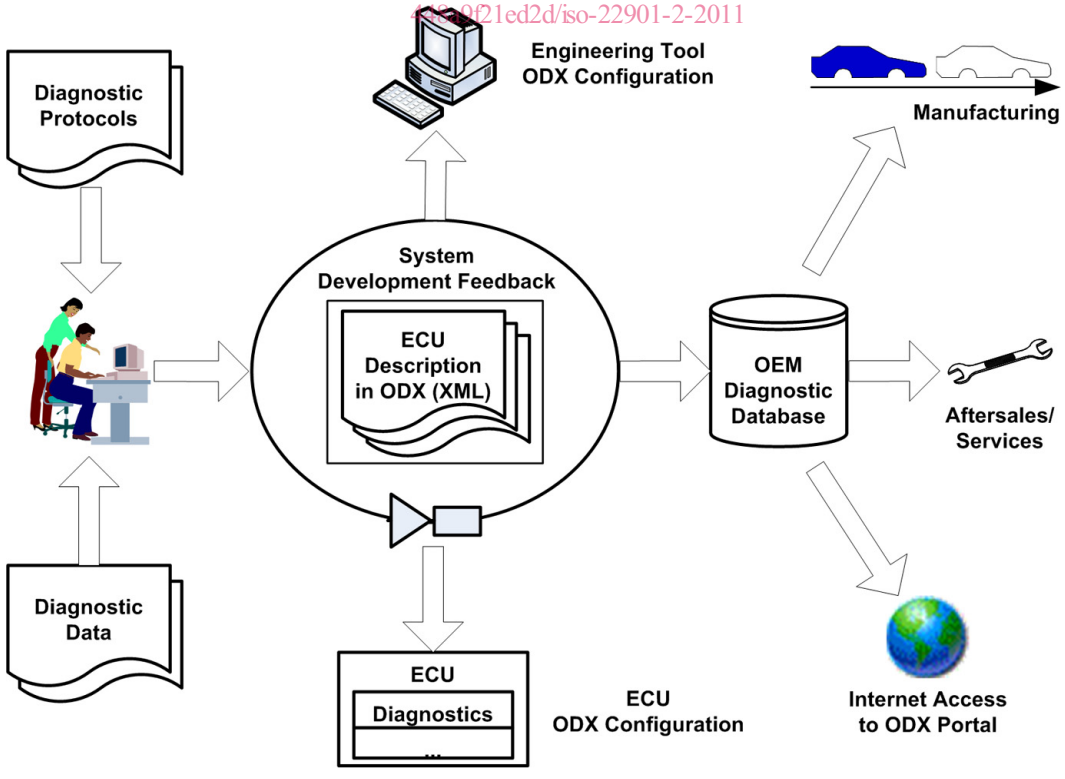


Figure 1 — Usage of ODX data in the ECU life cycle

The objective of this specification is to ensure that diagnostic data from any vehicle manufacturer is independent of the testing hardware and protocol software supplied by any test equipment manufacturer.

6 Emissions-related OBD ODX use cases

6.1 Use case 1 — OBD Scan Tool based on a Modular VCI architecture and ODX

This use case describes the usage of an OBD scan tool in accordance with ISO 15031-4 / SAE J1978 and implemented according to the Modular VCI specification (see ISO 22900, parts 1, 2 and 3) and ODX (see ISO 22901-1).

The benefits of an emissions-related OBD scan tool that is based on the Modular VCI and ODX standard are the following:

— no software programming to support the implementation of

  — new diagnostic trouble codes (see ISO 15031-6 / SAE J2012-DA),

  — new PIDs, Test IDs, Monitor IDs, Info Type IDs, and Scaling IDs (see ISO 15031-5 / SAE J1979-DA);

— OBD scan tool applications in accordance with ISO 15031-4 are developed only once and are not impacted by modifications / changes in the definition of emissions-related OBD data and formats;

— separation of application, communication logic and data items.

NOTE The Modular VCI software architecture supports the emissions-related OBD scan tool requirements as well as enhanced diagnostic protocols, data streams and applications.

Figure 2 illustrates external test equipment connected to the vehicle's diagnostic connector. The OBD scan tool's software architecture is compliant to the Modular VCI specifications. The diagnostic kernel is the key software component of the Modular VCI system. It implements the D-PDU API (see ISO 22900-2), the D-Server API (see ISO 22900-3) and the interface to the ODX derived runtime data.

The OBD scan tool application depends on standardized names or naming conventions as defined by this part of ISO 22901. These names are defined in the emissions-related ODX data and utilized by the OBD scan tool application to address logical links, services, and emission-related data. Using the standardized names and structures from this part of ISO 22901, the interface to implement the scan tool application against is clearly defined. This is indicated by the dashed line in Figure 2.

The D-PDU API is a software component of the tool supplier's Modular VCI protocol module. It connects the diagnostic kernel with any Modular VCI compatible vehicle communication interface.

The D-Server API of the diagnostic kernel provides a standardized interface to the OBD scan tool applications. These applications shall be in accordance with ISO 15031-4, which implements the standardized data and messages of ISO 15031-5 and ISO 15031-6.

The emissions-related ODX runtime data format is tool supplier specific. The runtime format is not contained in the ODX standard (see ISO 22901-1). Based on the use cases supported by the diagnostic tool, the content and structure of the ODX runtime data format and content may differ. However, for emissions-related OBD the OBD scan tool applications and ODX runtime data shall support the full scope of ISO 15031 (all parts) and the respective SAE J documents.

All emissions-related OBD data as specified in ISO 15031-5 and SAE J1979-DA, ISO 15031-6 and SAE J2012-DA shall be authored according to the requirements established in this part of ISO 22901.

This use case requires the unique and complete definition of all elements necessary for any OBD scan tool application compliant to ISO 22900.

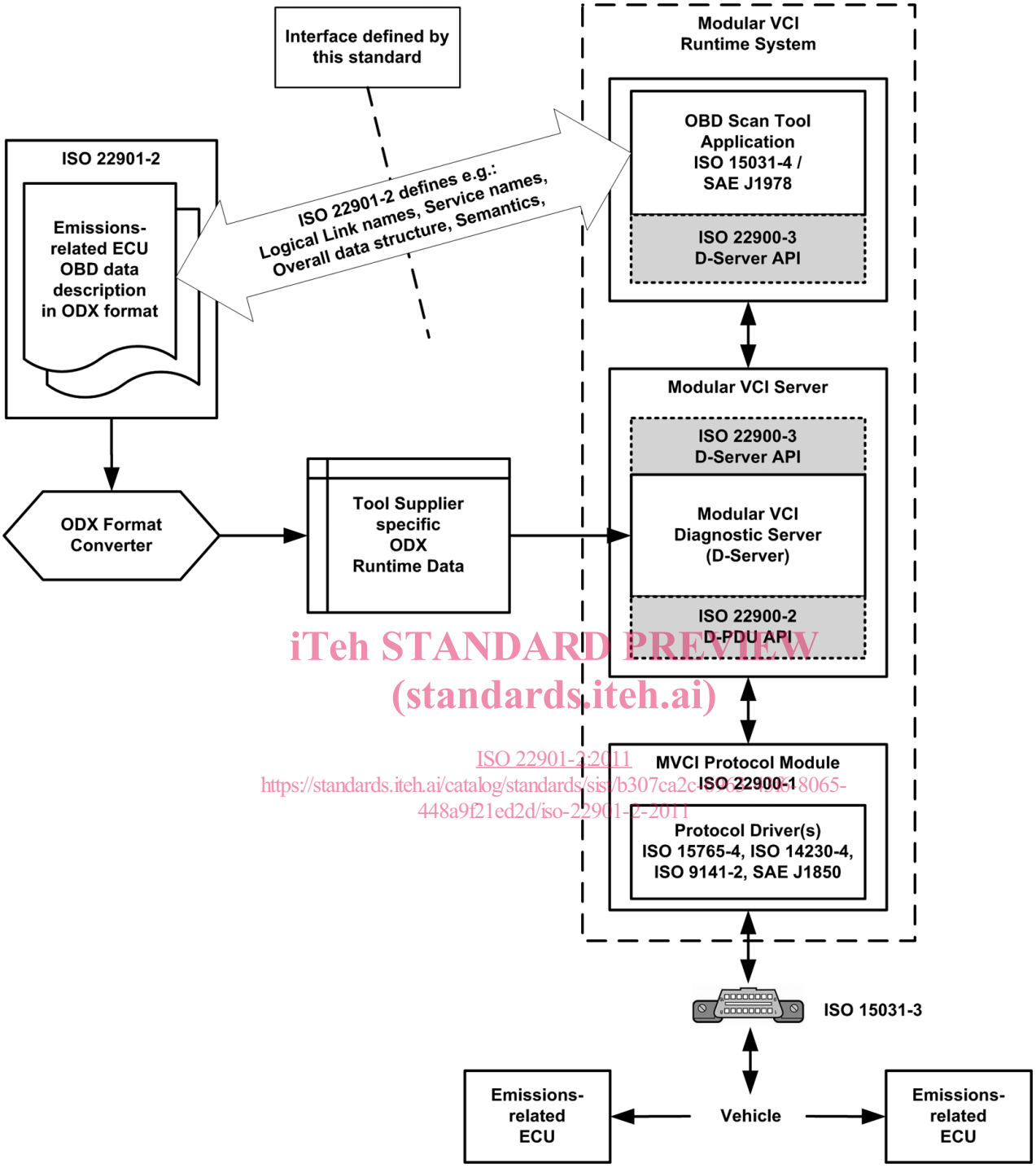


Figure 2 — OBD scan tool based on Modular VCI architecture and ODX

6.2 Use case 2 — Conversion of emissions-related OBD data to ODX format

This use case describes the conversion of emissions-related OBD data into the ODX format in order to provide various applications of external test equipment with emissions-related OBD data in an ODX-RT (runtime) format.

It is assumed that the external test equipment is based on ISO 22900.

The emissions-related OBD data files derive from the Registration Authority installation for ISO 15031.

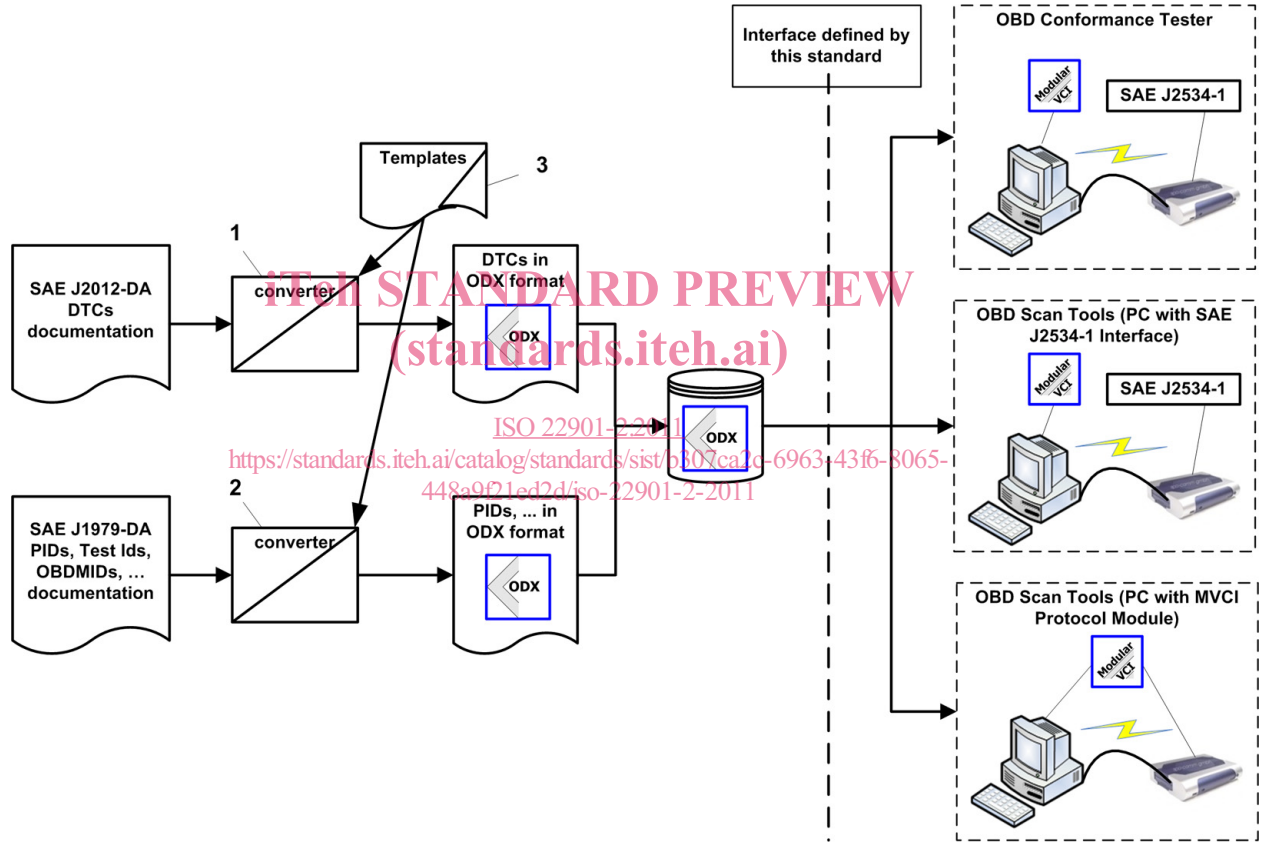
The applicable emissions-related OBD data files are

— SAE J1979-DA,

— SAE J2012-DA.

Figure 3 illustrates the process to be followed in order to convert SAE J2012-DA, and SAE J1979-DA data file information (i.e. Excel or equivalent format) into a standardized ODX format[1],[2] which enrich the emissions-related OBD data with template[3] information. The dotted line depicts the interface that this part of ISO 22901 defines. ODX data providers can deliver ODX data in the format defined here, while tester and scan tool developers can create their tools in accordance with this part of ISO 22901. Thus, both parties can work independently and their products will work together.

How far the converter processes can be automated depends solely on the concrete format of the digital annex. This part of ISO 22901 defines the target format of these processes.



Key

1 SAE J2012-DA DTC converter into ODX format

2 SAE J1979-DA PIDs, OBDMIDs, ... converter into ODX format

3 ODX converter templates to determine standardized ODX parts i.e. PROTOCOLS, COMPARAMS, ... and ODX usage as defined by this part of ISO 22901

Figure 3 — Emissions-related OBD data converter to ODX-RT format

The benefits of implementing this use case are

— the setup/update of an ISO 22900 Modular VCI based OBD test equipment utilizing a SAE J2534-1 compliant vehicle communication interface or an MVCI compliant Protocol Module with emissions-related OBD data (ODX-RT format) that derive from a conversion of the applicable SAE Digital Annexes;

— the setup/update of an ISO 22900 Modular VCI based OBD conformance tester with emissions-related OBD data (ODX-RT format) that implements the test cases as specified in SAE J1699-3.

7 Emissions-related OBD ODX application examples

7.1 OBD conformance tester according to SAE J1699-3

This application example describes the implementation of an OBD conformance tester in accordance with SAE J1699-3 and based on the Modular VCI software architecture. The base architecture as shown in use case 1 applies. The major difference between the emissions-related OBD scan tool and the OBD conformance tester is implemented in the test applications. While the emissions-related OBD scan tool is in accordance with ISO 15031-4, the OBD conformance tester is in accordance with SAE J1699-3. This specification describes very specific test cases in order to achieve vehicle emissions-related system compliance. These test cases have been introduced and referenced by legislation in order to reduce emissions-related diagnostic software implementation deviations in the ECUs from ISO 15031 (all parts) and the respective SAE J documents.

The benefits of an OBD conformance tester based on the Modular VCI and ODX standard are

— no software programming to support the implementation of

  — new diagnostic trouble codes (see ISO 15031-6 / SAE J2012-DA),

  — new PIDs, Test IDs, Monitor IDs, Info Type IDs and Scaling IDs (see ISO 15031-5 / SAE J1979-DA);

— conformance test applications implement the test logic but not the data items (derive from emissions-related ODX runtime);

— clear separation of application and communication logic as well as from all data items.

Figure 4 is based on the architecture as shown in use case 1.

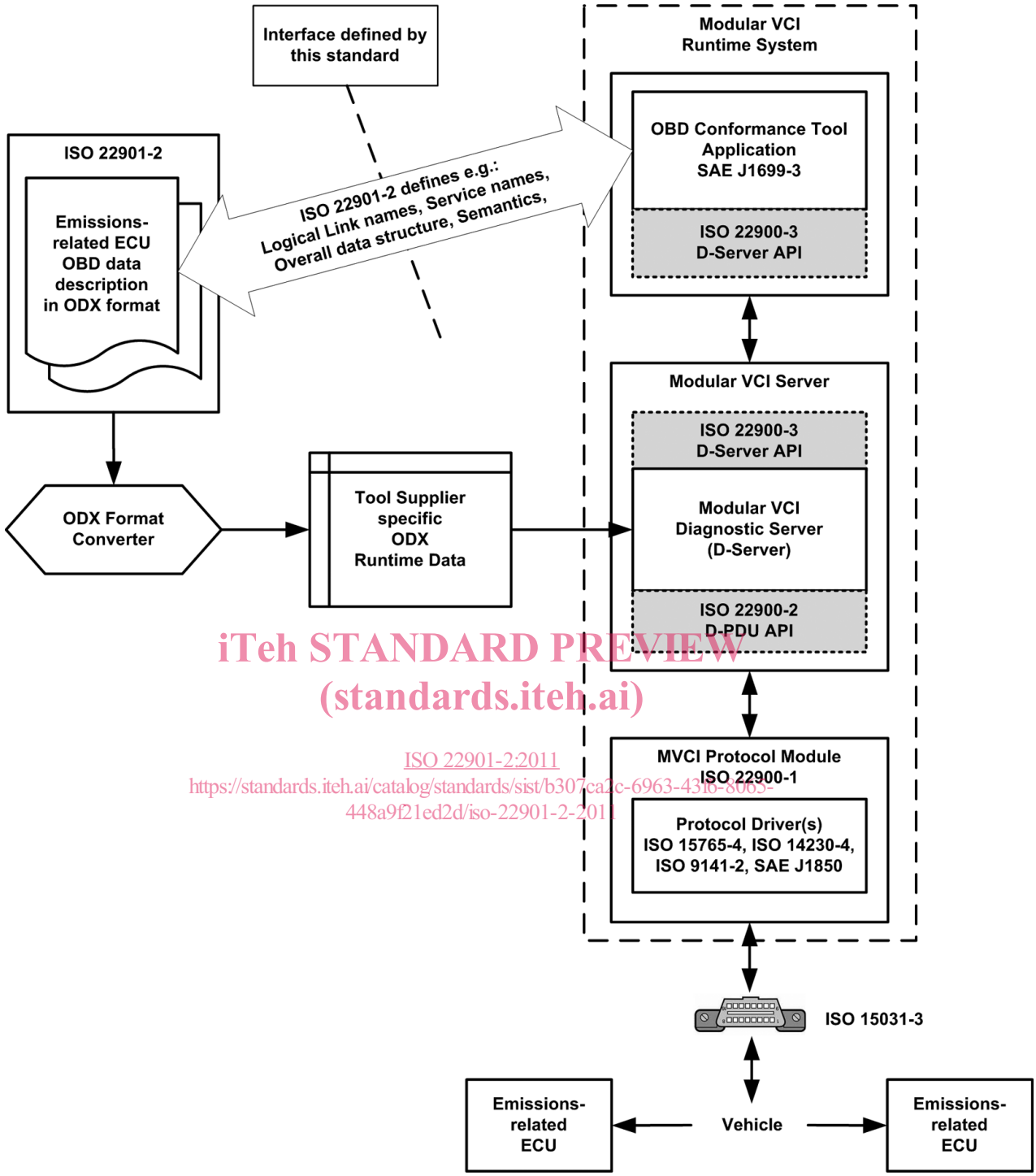


Figure 4 — ODX emissions OBD Modular VCI based OBD conformance tester

7.2 Usage of ODX as a configuration for standardized ECU software

This application example describes how to drive the implementation of the emissions-related OBD diagnostic software module of the ECU by the OBD ODX data. This may be done either by using the OBD ODX data as configuration for a generic diagnostic software module or by utilizing a software generation process, which is controlled by the OBD ODX configuration data.

Once the OBD behaviour of an ECU is defined in ODX format, this file can be used to configure a standardized software part in the ECU.

The benefits of implementing this use case are that

— it is necessary to test standardized ECU software modules only once;

— standardized ECU software modules can be reused in different projects;

— ECU behaviour fits exactly to the behaviour described in the ODX file (because the software as well as the documentation are derived from the same data source).

Figure 5 depicts an example of an ECU diagnostic software module and configuration data derived from ODX.

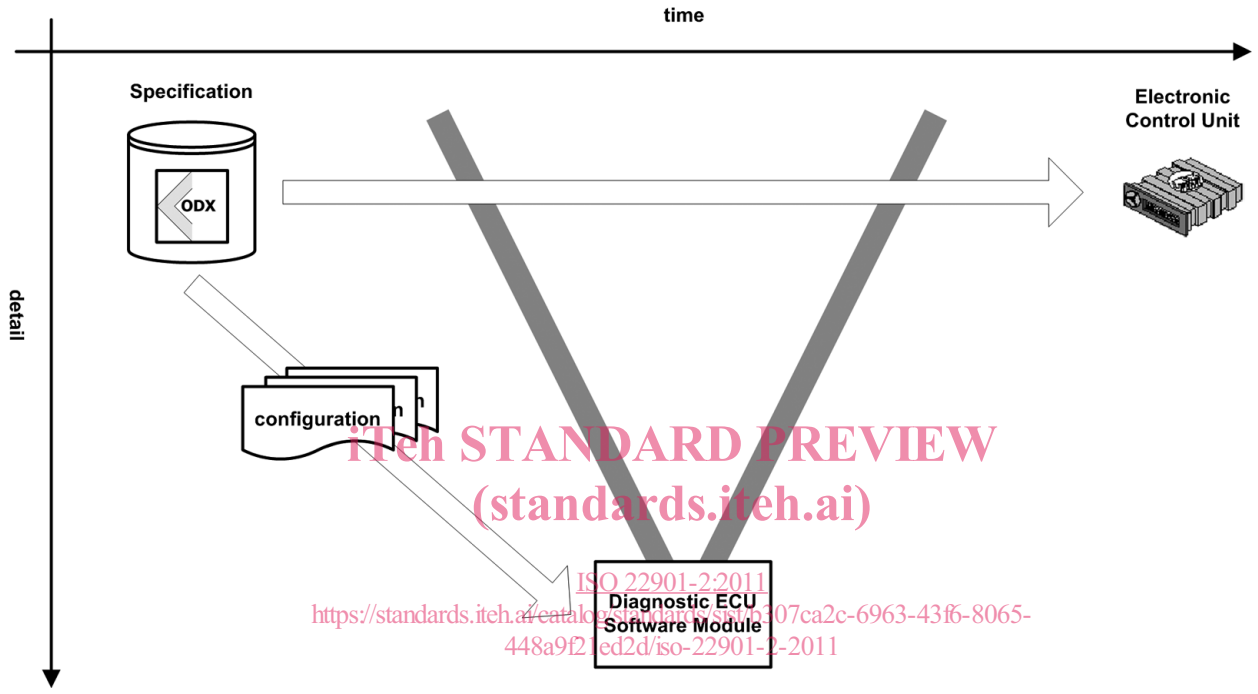


Figure 5 — Example of an ECU diagnostic software module and configuration data derived from ODX

7.3 Usage of ODX checker rules for ECU development

This application example describes the usage of ODX checker rules, which represent a subset of the SAE J1699-3 test cases.

For ODX, adaptable checkers exist. These allow to check for ODX compliance and may be extended with individual checker rules. With these, OBD compliance may be checked before the ECU is implemented, only if the emissions-related OBD ODX data follow the requirements of this part of ISO 22901.

EXAMPLE When specifying the behaviour of an individual ECU in ODX, the support of Infotype 0x0A (ECU-name) for model year 2010 and later can be checked before the ECU code is implemented.

The benefits of implementing this application example are:

— early check for errors (before ECU is implemented in the vehicle);

— checker rules may be provided by a third party and made available to interested users.

Figure 6 depicts an emissions-related OBD compliance test during ECU specification phase.

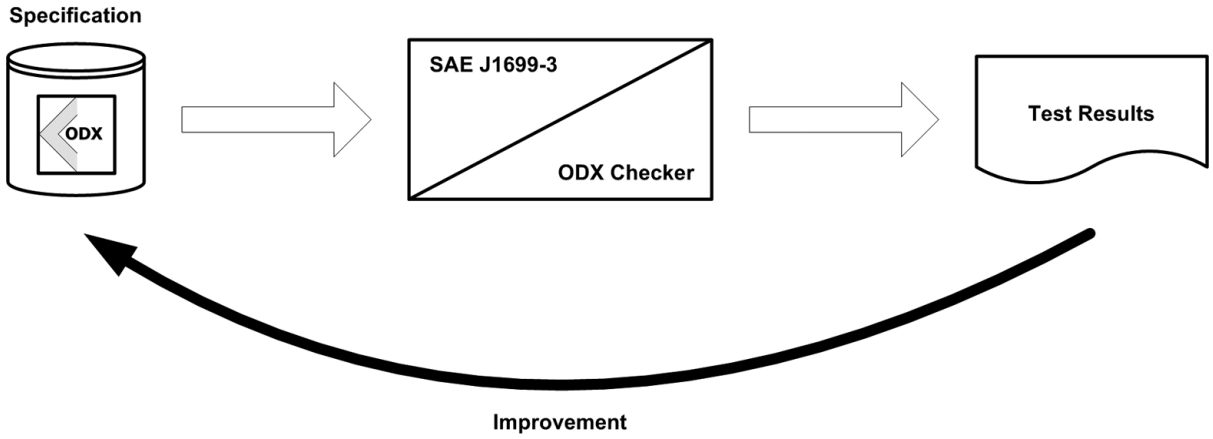


Figure 6 — Emissions-related OBD compliance test during ECU specification phase

8 Specification release version information

8.1 Specification release version location

The release version of the ODX standard can be obtained from every ODX file instance. It is contained in the MODEL-VERSION attribute.


```
<ODX MODEL-VERSION="2.2.0">
```

8.2 Specification release version

The specification release version of this document is: 2.2.0

9 OBD authoring in ODX

9.1 ODX layering

9.1.1 Relationship between ODX layers

Figure 7 illustrates the partitioning of the emissions-related OBD protocols and their associated ComParamSpec from the ECU-Shared-Data and Functional Groups 1 and 2. The Vehicle-Info specifies the Logical Links to the Protocols and Functional Groups. The light and dotted parts are user extensions that can be integrated, if protocols other than ISO 15765-4 are to be supported.

This part of ISO 22901 covers only the ISO 15765-4 DoCAN case. If other physical layers are modelled in ODX as well, the naming as defined in this part of ISO 22901 are to be used.