
Intelligent transport systems — Vehicle interface for provisioning and support of ITS services —

Part 1: General information and use case definition

*Systèmes intelligents de transport — Interface véhicule pour la
fourniture et le support de services ITS —*

Partie 1: Informations générales et définition des cas d'utilisation



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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.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

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/TR 13185-1 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

ISO 13185 consists of the following parts, under the general title *Intelligent transport systems — Vehicle interface for provisioning and support of ITS services*:

- Part 1: *General information and use case definition* [Technical Report]
- Part 2: *Protocol requirements and specification for vehicle ITS station gateway (V-ITS-SG) interface*¹⁾
- Part 3: *Configuration process requirements and specification for vehicle ITS station gateway (V-ITS-SG)*²⁾

The following document is under development:

- Part 4: *Protocol conformance test cases for vehicle ITS station gateway (V-ITS-SG) interface*

1) To be published.

2) To be published.

Introduction

This part of ISO 13185 specifies the requirements for a common software interface to a vehicle gateway to easily exchange vehicle information data among nomadic and/or mobile device, vehicle gateway and the vehicle's ECUs.

Applications supporting ITS service provision and multimedia use via nomadic and mobile device need a common access method to vehicle data through an in-vehicle interface as well as the harmonization of existing standards to support a single vehicle data access solution.

This document defines a vehicle data transfer protocol between vehicle gateway also called V-ITS-SG and the nomadic and/or mobile device (ND).

This part of ISO 13185 may be used by vehicle manufacturers for future vehicle design to support the design of ITS/Telematics and as a retrofit equipment for aftersales vehicles.

Applications supporting ITS service provision and multimedia use via ND may be implemented using vehicle information, driver advisory, warning systems and entertainment systems. The following standards are subject to analysis in regard to their applicability to supporting ITS service provision and multimedia use via nomadic and mobile device.

- ISO 15031 defines emissions-related diagnostic data supported by vehicles in all countries requiring OBD compliance.
- ISO 27145 WWH-OBD defines diagnostic data (emissions-related systems, future safety related systems, etc.) to be supported by vehicles in all countries implementing the GTR (Global Technical Regulation) into their local legislation.
- ISO 22900-2 defines the Modular Vehicle Communication Interface (MVCI) D-PDU API to separate the protocol data unit (PDU) from the vehicle specific protocols.
- ISO 22901 defines the Open Diagnostic data eXchange (ODX) format which is a standard for describing diagnostic related ECU data. This International Standard is becoming the vehicle manufacturer's choice to document vehicle system diagnostic data and protocol information.
- ISO 22902 is a multimedia and telematics standard based on the AMI-C specification and reference documents for automotive industry. The important logical element of the architecture is a vehicle interface.
- ISO 22837 defines the reference architecture for probe vehicle systems and a basic data framework for probe data.
- ISO/TS 29284 defines the standardization of information, communication and control systems in the field of urban and rural surface transportation, including intermodal and multimodal aspects thereof, traveller information, traffic management, public transport, commercial transport, emergency services and commercial services in the ITS field.
- SAE J2534 defines a standardized system for programming of ECUs in a vehicle.
- SAE J2735 defines the support of interoperability among DSRC applications through the use of standardized message sets, data frames and data elements.

This part of ISO 13185 supports ITS applications which are based on ND in vehicles to operate on a common software interface to a V-ITS-SG integrated within the CALM architecture and easily exchange vehicle information data among ND, V-ITS-SG and ECUs.

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Intelligent transport systems — Vehicle interface for provisioning and support of ITS services —

Part 1: General information and use case definition

1 Scope

This part of ISO 13185 specifies the communications architecture and generic protocol to provide and maintain ITS services to travellers (including drivers, passengers and pedestrians), using nomadic and portable devices for:

- The mobile device as a mobile router,
- Augmentation of the capabilities of a nomadic device using information from in-vehicle systems,
- Nomadic device acting as a key to personalise the vehicle configuration,
- Using capabilities of a nomadic or mobile device to augment functionality within the vehicle,
- The use of portable nomadic devices within commercial vehicles and public transport,
- Optimising the use of the capabilities in nomadic and mobile devices in the provision of ITS services,
- Harmonization of existing standards to support a single solution access method,
- Applications supporting ITS service provision and multimedia use a common access method to retrieve vehicle data through a vehicle communication interface.

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/IEC 10731:1994, *Information technology — Open Systems Interconnection — Basic Reference Model — Conventions for the definition of OSI services*

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

ISO/IEC 15118-1³⁾, *Road vehicles — Vehicle to grid communication interface — Part 1: General information and use-case definition*

ISO 21217, *Intelligent transport systems — Communications access for land mobiles (CALM) — Architecture*

ISO 22837, *Vehicle probe data for wide area communications*

ISO 22900-2, *Road vehicles — Modular vehicle communication interface (MVCI) — Part 2: Diagnostic protocol data unit application programming interface (D-PDU API)*

ISO 22901 (all parts), *Road vehicles — Open diagnostic data exchange (ODX)*

ISO 22902-5, *Road vehicles — Automotive multimedia interface — Part 5: Common message set*

3) To be published.

ISO 22902-6, *Road vehicles — Automotive multimedia interface — Part 6: Vehicle interface requirements*

ISO/TS 29284, *Intelligent transport systems — Event-based probe vehicle data*⁴⁾

ISO 27145 (all parts), *Road vehicles — Implementation of WWH-OBD communication requirements*

ETSI EN 302 665, *Intelligent Transport System (ITS) — Communications Architecture*

SAE J2735, *Dedicated Short Range Communications (DSRC) — Message Set Dictionary*

SAE J2534, *Recommended Practice for Pass-Thru Vehicle Programming*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15031-2 and the following apply.

Bluetooth

BT

communication protocol for exchanging data over short distances

Communications Access for Land Mobiles

CALM

specification of a common architecture, network protocols and communications interface definitions to enable continuous or quasi-continuous communications between vehicles and the infrastructure, or between vehicles, using wireless telecommunications media that are available in any particular location, and have the ability to migrate to a different available media where required

eco lamp

lamp that is implemented on the dashboard or nomadic device to guide the driver to drive the vehicle in the most economical way

EXAMPLE A green lamp/symbol will indicate high fuel efficiency driving or travelling at a constant speed while a red lamp/symbol will indicate low fuel efficiency, i.e. strong acceleration, sudden braking.

event log file

data record with multiple event data stored with time stamp

nomadic device

ND

device that provides communications connectivity via equipment such as cellular telephones, mobile wireless broadband (WIMAX, HC-SDMA, etc.), WiFi, etc. and includes short range links, such as Bluetooth, Zigbee, etc. to connect nomadic devices to the motor vehicle communications system network

Vehicle-Intelligent Transport Systems-Station Gateway

V-ITS-SG

interface device in the vehicle that acts as the vehicle's mobile gateway between the vehicle's ECU(s) and the external nomadic device

V-ITS-SG long term memory

storage of all data in internal memory which are required to be available after key On/Off cycles

V-ITS-SG short term memory

storage of all data in internal memory which shall only be available during this key On/Off cycle

4) To be published.

Vehicle State Of Capabilities Log File**VSOCLogFile**

data record with multiple data snapshots including a pre-selected data set providing a vehicle capabilities status of the vehicle's electronic system(s)

3.2 Abbreviated terms

BT	Bluetooth
CALM	Communications Access for Land Mobiles
DLL	Dynamic Link Library
DSRC	Dedicated Short Range Communications
DTC	Diagnostic Trouble Code
ECU	Electronic Control Unit
GUI	Graphical User Interface
ITS-S	Intelligent Transport System-Station
LL	Logical Link
N2V	Nomadic and mobile devices to Vehicle
ND	nomadic device
OBE	On-Board Equipment
PDU	protocol data unit
RMI	Repair and Maintenance Information
RSE	Road Side Equipment
V2N	Vehicle to Nomadic and mobile devices
VIN	Vehicle Identification Number
V-ITS-SG	Vehicle-Intelligent Transport System-Station Gateway
VSOC	Vehicle State Of Capabilities

4 Conventions

This part of ISO 13185 is based on the conventions discussed in the OSI Service Conventions (ISO/IEC 10731:1994) as they apply to communication services. The vehicle data transfer protocol is applicable to OSI layers 4, 5, 6 and 7.

5 General information**5.1 Document overview and structure**

The ISO 13185 series provides an implementer with all documents and references required to support the implementation of the requirements related to standardized access to automotive Repair and Maintenance Information (RMI) in accordance with the requirements set forth in the EC mandate M/421.

- Part 1: This Technical Report provides an overview of the document set and structure along with the use case definitions and a common set of resources (definitions, references) for use by all subsequent parts.

- Part 2: This part of ISO 13185 specifies all technical requirements related to the protocol to be used between the V-ITS-SG and the ND to retrieve data from the vehicle's electronic systems connected to the V-ITS-SG. The requirements will reflect the deriving needs from the use cases as specified in Part 1.
- Part 3: This part of ISO 13185 specifies the requirements related to the configuration of the V-ITS-SG. The configuration data derive from an ISO 22901-1 ODX data source converted to a V-ITS-SG specific format which is V-ITS-SG system supplier specific.
- Part 4: This part of ISO 13185 specifies conformance test cases for self-certification purposes of a provider of the ND and V-ITS-SG system. The conformance test cases will follow the use-case definition of Part 1 as well as the requirements stated in Part 2. The purpose of this part of ISO 13185 is to provide information to the ND and V-ITS-SG system provider to build and test the ND and V-ITS-SG system against the conformance test cases. This final step in the development process of the ND and V-ITS-SG system is an enabler for all providers to ensure that their ND and/or V-ITS-SG system meets a high degree of functional requirements expected by the end user.

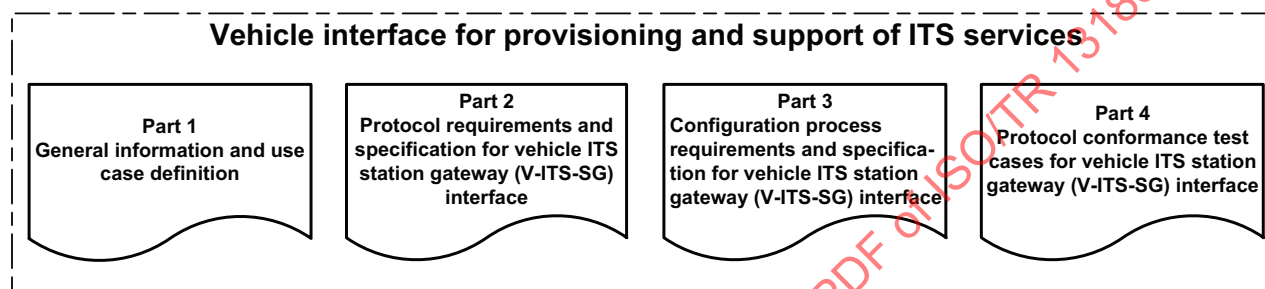


Figure 1 — Document structure

5.2 Purpose of this Technical Report

The main purpose of this Technical Report is to:

- a) Identify the requirements of bidirectional vehicle data transfer,
- b) Identify the usability of the existing International Standards for nomadic and mobile devices and existing vehicle communication network access standards,
- c) Identify additional work required to develop the common software interface to a vehicle gateway integrated within the CALM architecture by the amendment of the existing interface to D-PDU API in the provision and support of ITS services via nomadic and mobile devices.

5.3 ITS communication architecture components

The ITS communication architecture is a communication system designed for ITS and made of four physically separated subsystem components:

- the vehicle subsystem component: Vehicle ITS Station (Vehicle ITS-S),
- the nomadic and mobile subsystem component: Personal ITS Station (Personal ITS-S),
- the roadside subsystem component: Roadside ITS Station (Roadside ITS-S),
- the central subsystem component: Central ITS Station (Central ITS-S).

Figure 2 illustrates the connection between the Personal and Vehicle ITS Station. The V-ITS-S consists of:

- the V-ITS-S Router supporting the CALM architecture, and
- the V-ITS-S Host and Gateway to the in-vehicle networks.

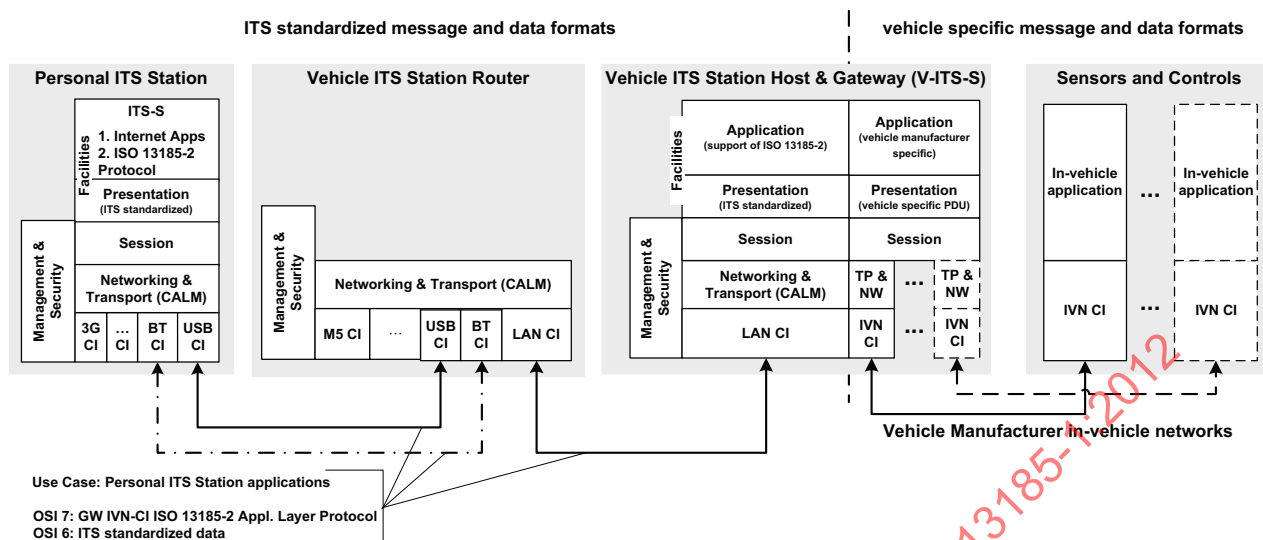
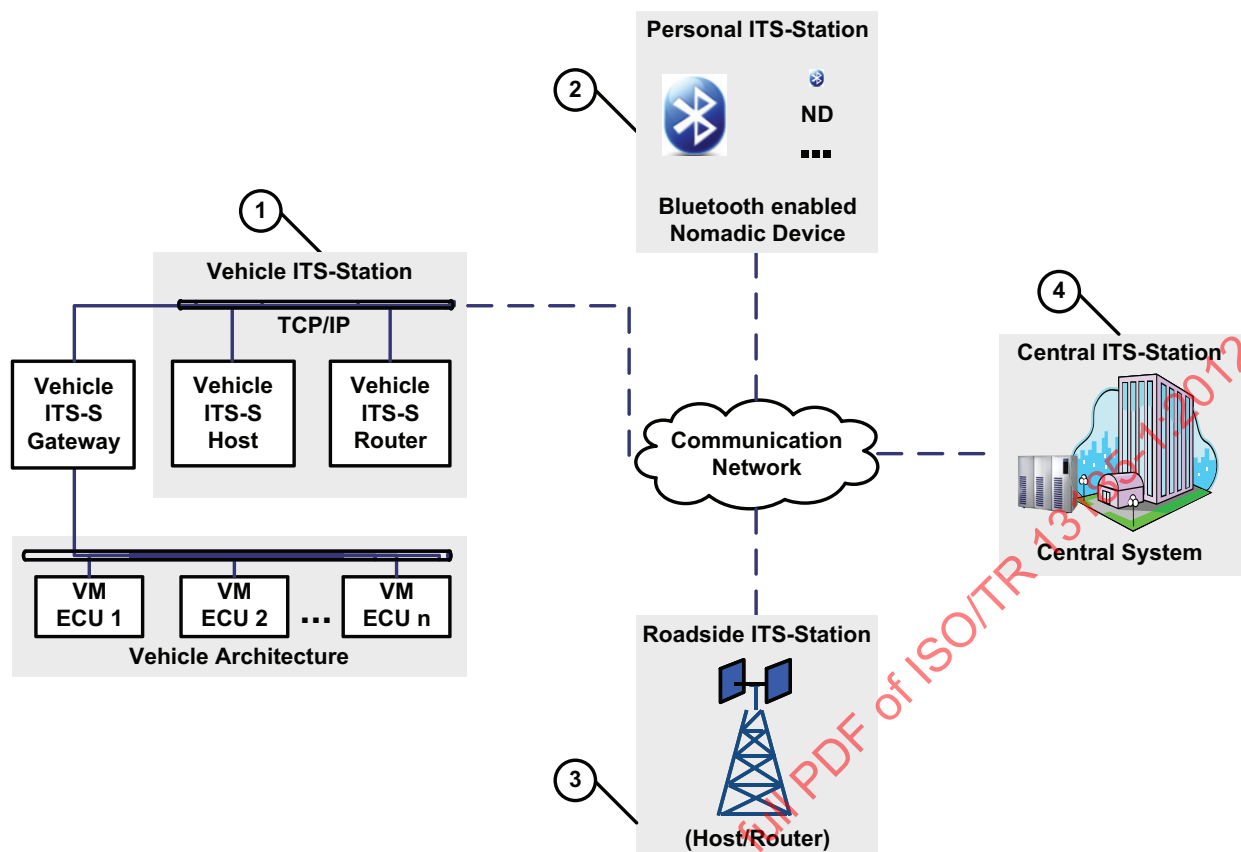


Figure 2 — Vehicle ITS Station Gateway implementation based on CALM architecture

Each of the four components described in 5.3 and in Figure 3 contains the ITS subsystem components and usually a vehicle gateway connecting the ITS Station to a legacy system. The vehicle requires a vehicle gateway connected to the Vehicle Station and to the vehicle manufacturer's proprietary vehicle network. These components are inter-linked by a communication network. The communication between the vehicle subsystem component and the mobile subsystem component are performed over a short range wireless or wired communication media.

Figure 3 illustrates the communication system designed for ITS.



Key

- 1 Vehicle ITS Station: Vehicle subsystem component connected to vehicle domain architecture designed by vehicle manufacturer via the V-ITS-SG
- 2 Personal ITS Station: Nomadic and mobile subsystem component
- 3 Roadside ITS Station: Roadside subsystem component
- 4 Central ITS Station: Central subsystem component

Figure 3 — ITS communication architecture

NOTE The V-ITS-SG is not a part of the Vehicle ITS Station.

The scope of this Technical Report is V2N (or N2V). V2N is the abbreviation used to cover all types of communication between vehicle and nomadic and mobile devices.

There are many existing International Standards for the communication between Vehicle ITS Station and Personal ITS Station for bidirectional vehicle data transfer.

There is a need to identify the usability of the existing International Standards for nomadic devices and existing vehicle communication network access standards.

6 Vehicle interface standardization

6.1 Overview of relevant standards

Various standards exist which are applicable to either the vehicle network or ITS infrastructure. The following is a summary of applicable standards:

- ISO 15031 (all parts) defines emissions-related diagnostic data supported by vehicles in all countries requiring legislative OBD compliance. This International Standard defines a diagnostic connector and facilities which should be provided by an external test tool. ISO 15031 (all parts) also specifies the diagnostic

messages and DTCs (Diagnostic Trouble Codes) which are reported by the vehicle to the external test tool. It specifies additional details of the diagnostic message format and communication for the ISO 9141-2, ISO 14230-4 and SAE J1850 protocols. ISO 15031-5 supersedes those protocol standards.

- ISO 27145 (all parts) defines diagnostic data (emission-related systems, future safety related systems) to be supported by vehicles in all countries implementing the GTR (Global Technical Regulation) into their local legislation. The ISO 27145 series includes the definitions for a common data dictionary, provides data definitions for emissions-related legislated diagnostics (reference to SAE J1930-DA, SAE J1979-DA, SAE J2012-DA) and common message dictionary, provides the message implementation details from ISO 14229-1 and ISO 14229-2, Unified Diagnostic Services (UDS) to support the required legislated WWH-OBD. It also defines the details necessary to implement the communication between the vehicle's WWH-OBD systems and external test equipment including the definition/reference of physical layers, data link layers, network layer, transport layer and session layer.
- ISO 22837 defines the reference architecture for probe vehicle systems and a basic data framework for probe data. The basic data framework provides an initial set of probe data elements which are commonly used in typical probe data enabled application domains, such as traffic, weather, and safety. The basic data framework provides example probe messages, which define how probe data elements are combined to convey information to a probe processing centre.
- ISO 22900-2 defines the Modular Vehicle Communication Interface (MVCI) D-PDU API to separate the protocol data unit (PDU) from the vehicle specific protocols. This part of ISO 22900 is becoming the diagnostic tool supplier's choice to separate diagnostic data conversion and application test logic from the vehicle communication.
- ISO 22901 (all parts) defines the Open Diagnostic data eXchange (ODX) format, which is a standard for describing diagnostic related ECU data. This series of International Standards is becoming the vehicle manufacturer's choice to document vehicle system diagnostic data and protocol information.
- ISO 22902-5 and ISO 22902-6 define a multimedia and telematics standard based on the AMI-C specification and reference documents for the automotive industry. The important logical element of the architecture is a vehicle interface. The vehicle interface is defined as a component that provides access to vehicle services from an AMI-compliant network. It may act as a gateway to the in-vehicle manufacturer defined network or it may implement some or all of the vehicle services directly.
- ISO/TS 29284 defines the probe data format that is sent from vehicles depending on particular events. The proposed Technical Specification defines events for, e.g. fog, snowfall, and accidents.
- SAE J2534 defines a standardized system for programming that includes a standard personal computer (PC), standard interface to a software device driver, and an interface that connects between the PC and a programmable ECU in a vehicle.
- SAE J2735 defines the interoperability among DSRC applications through the use of standardized message sets, data frames and data elements. This International Standard provides the messages sets, data frames and data elements to produce interoperable DSRC applications between Road Side Equipment (RSE) and On-Board Equipment (OBE).

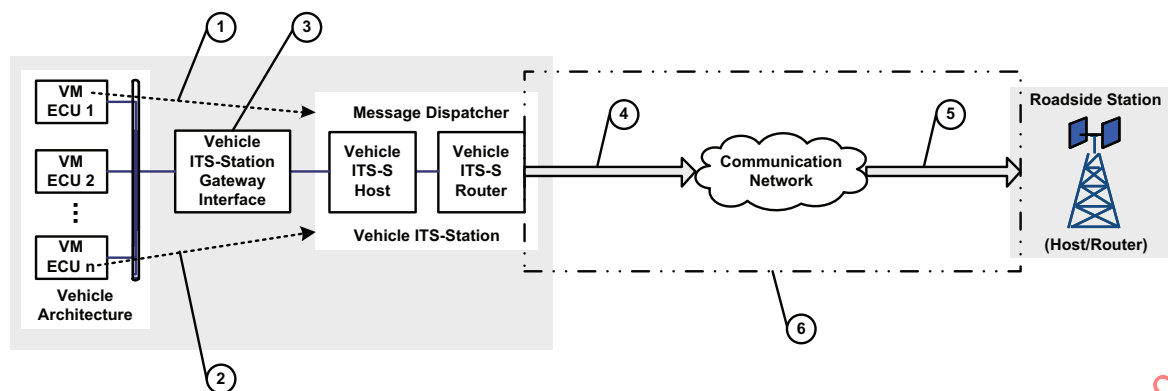
6.2 Standardized vehicle interface

6.2.1 Vehicle interface for ITS applications

Each International Standard (ISO 22837, ISO/TS 29284 and SAE J2735) defines messages sets, data frames and data elements to produce interoperable ITS applications between Vehicle Station and Roadside Station.

Figure 4 illustrates that these International Standards do not include the access method to '1' and '2' from the vehicle manufacturer's in-vehicle network (vehicle domain architecture).

IMPORTANT — The vehicle interface does not include a standardized access method to data elements from the in-vehicle network.



Key

- 1 Access method to data elements Vehicle Speed, Vehicle Acceleration from ECU 1
- 2 Access method to data element Brake Status from ECU n
- 3 Vehicle interface with non-standardized access methods to data elements of vehicle network
- 4 Standardized message including data elements Vehicle Speed, Vehicle Acceleration, Brake Status
- 5 Standardized message including data elements Vehicle Speed, Vehicle Acceleration, Brake Status
- 6 Short length packet message

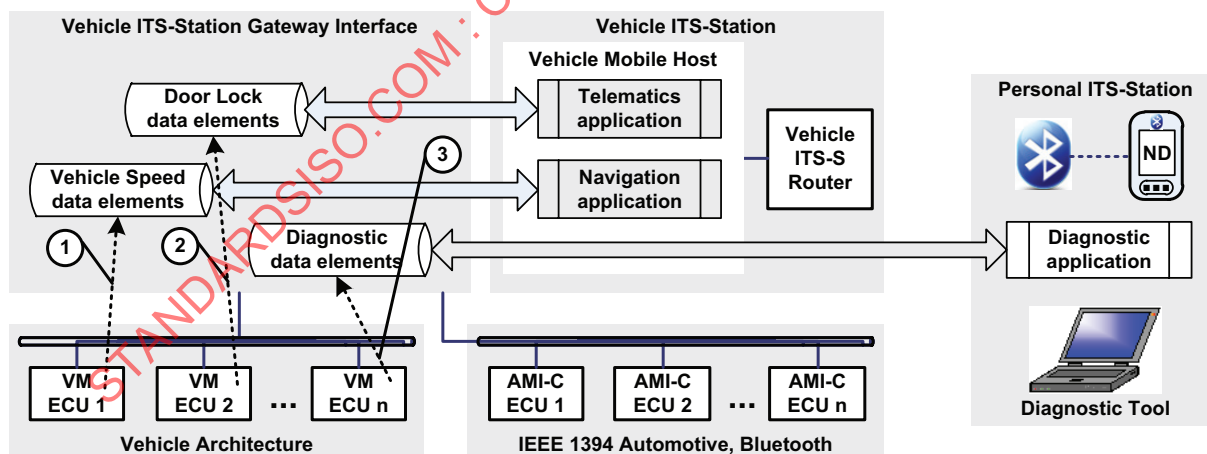
Figure 4 — ISO 22837, ISO/TS 29284 and SAE J2735 based vehicle interface for ITS applications

6.2.2 Vehicle interface for multimedia and telematics

The ISO 22902 series provides network protocol requirements for vehicle interface access and a Common Message Set (CMS). The network protocol requirements are focused on supporting access to vehicle services.

This series of International Standards does not include an access method to '1', '2' and '3' from the vehicle manufacturer's in-vehicle network (vehicle domain architecture).

Figure 5 depicts the vehicle interface for multimedia and telematics.



Key

- 1 Vehicle Speed data elements from ECU 1
- 2 Door Lock data elements from ECU 2
- 3 Diagnostic data elements from ECU n

Figure 5 — Vehicle interface for multimedia and telematics

IMPORTANT — The vehicle interface does not include a standardized access method to data elements from the in-vehicle network.

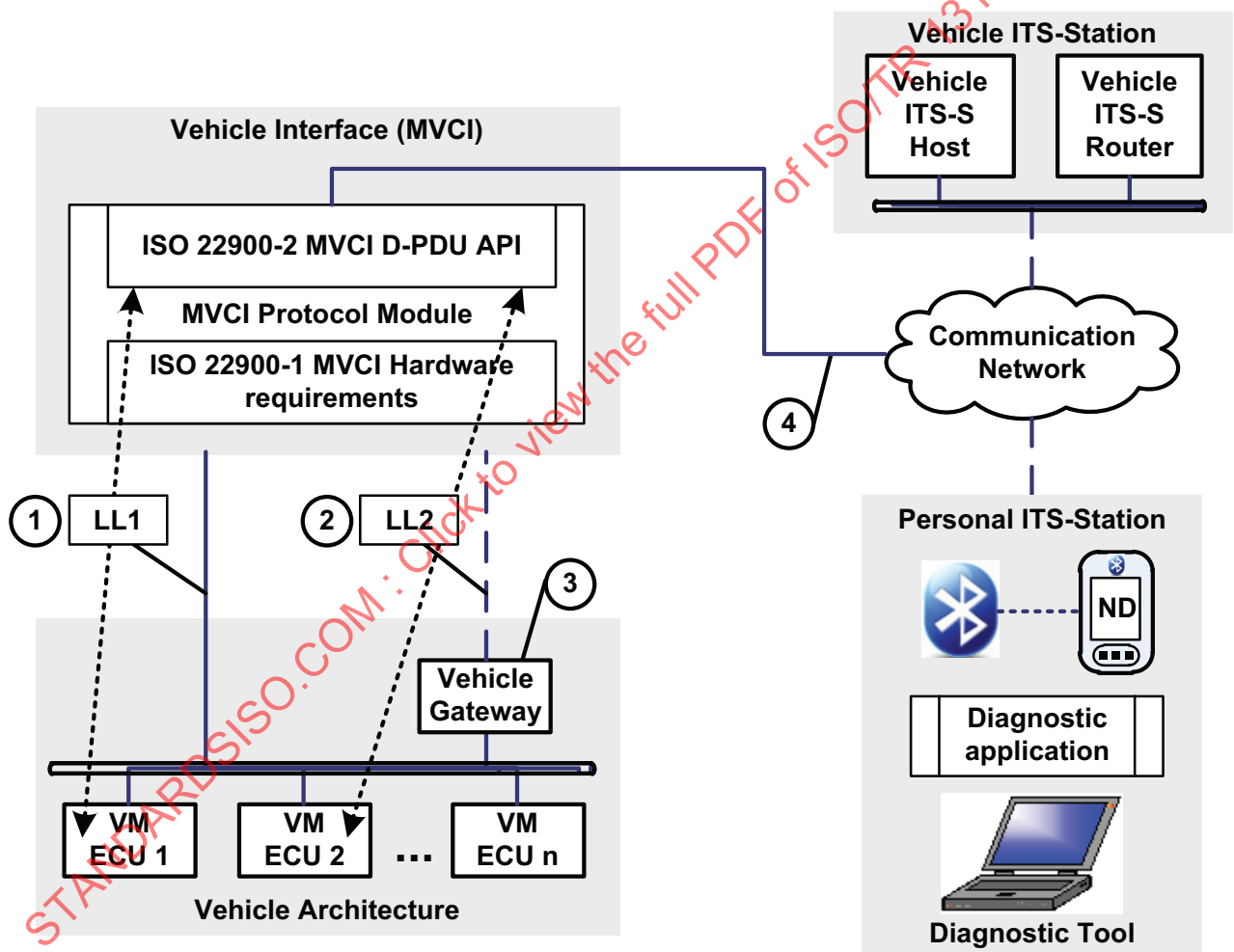
6.2.3 Vehicle interface for diagnostics

ISO 15031 (all parts), ISO 27145 (all parts), and ISO 22901(all parts) do not include any definition of a vehicle interface to support a standardized access method to the vehicle manufacturer's in-vehicle network.

ISO 22900-2 and SAE J2534 define a standardized access method to the vehicle manufacturer's in-vehicle network.

SAE J2534 requires a Windows™ 32 bit DLL while ISO 22900-2 is independent.

Figure 6 illustrates ISO 22900-2 Modular VCI – D_PDU API used as the vehicle interface supporting standardized access methods (PDU) to vehicle manufacturer's in-vehicle network through Logical Link 1 (LL1) between ECU 1 and the Modular VCI D-PDU API or Logical Link 2 (LL 2) between ECU 2 through the Vehicle Gateway (optional) and the Modular VCI D-PDU API.



Key

- 1 LL1 between MVCI D-PDU API and ECU 1
- 2 LL2 between MVCI D-PDU API and ECU 2 (only if Vehicle Gateway installed)
- 3 Optional Vehicle Gateway
- 4 TCP/IP on, e.g. IEEE 802.3 Ethernet

Figure 6 — Vehicle interface for diagnostics

IMPORTANT — The vehicle interface includes a standardized access method to data elements from the in-vehicle network.

6.3 Vehicle interface diagnostic data configuration

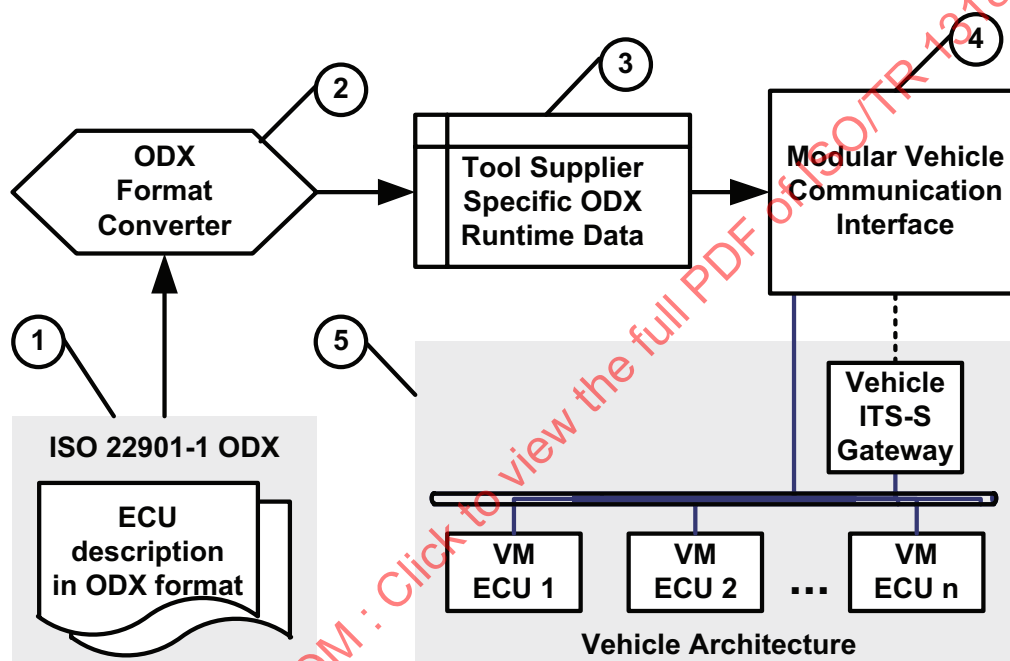
ISO 22901 (all parts) defines the Open Diagnostic data eXchange (ODX) format.

One of the use cases defined in ISO 22901-1 is to optimize the ODX data describing the ECU diagnostic data stream (diagnostic data elements) into a runtime format to setup the ISO 22900 Modular VCI. The ODX configuration file enables the Modular VCI to communicate to the vehicle's electronic systems and to interpret the message PDUs being exchanged between the Modular VCI-compliant diagnostic system and the vehicle's ECUs.

In the Modular VCI reference architecture, the tool supplier specific D-Server Kernel interprets the non-standardized ODX optimized runtime format.

IMPORTANT — The D-Server Kernel is a very complex and powerful software and requires medium to high end PC resources to operate properly and therefore does not fit the resource category of a V-ITS-SG.

Figure 7 depicts the ODX configuration of vehicle interface.



Key

- 1 ODX-ECU diagnostic data stream description (ISO 22901-1)
- 2 Software program to convert the ODX format into a target system optimized runtime format
- 3 Modular VCI tool supplier specific ODX optimized runtime format
- 4 Modular Vehicle Communication Interface (ISO 22900-2)
- 5 Represents the in-vehicle electronic system architecture designed by the vehicle manufacturer (VM)

Figure 7 — ODX configuration of vehicle interface

7 Single solution standardized access method

7.1 Functionality consolidation of vehicle interfaces into V-ITS-SG

Clauses 6.1 to 6.3 provide a brief overview of the content and basic principles of each International Standard. All of the International Standards, except for ISO 22900-2, do not specify a standardized access method to data elements from the in-vehicle network. This leads to vehicle interface supplier product specific implementations which cannot be shared across the automotive and ITS industry.

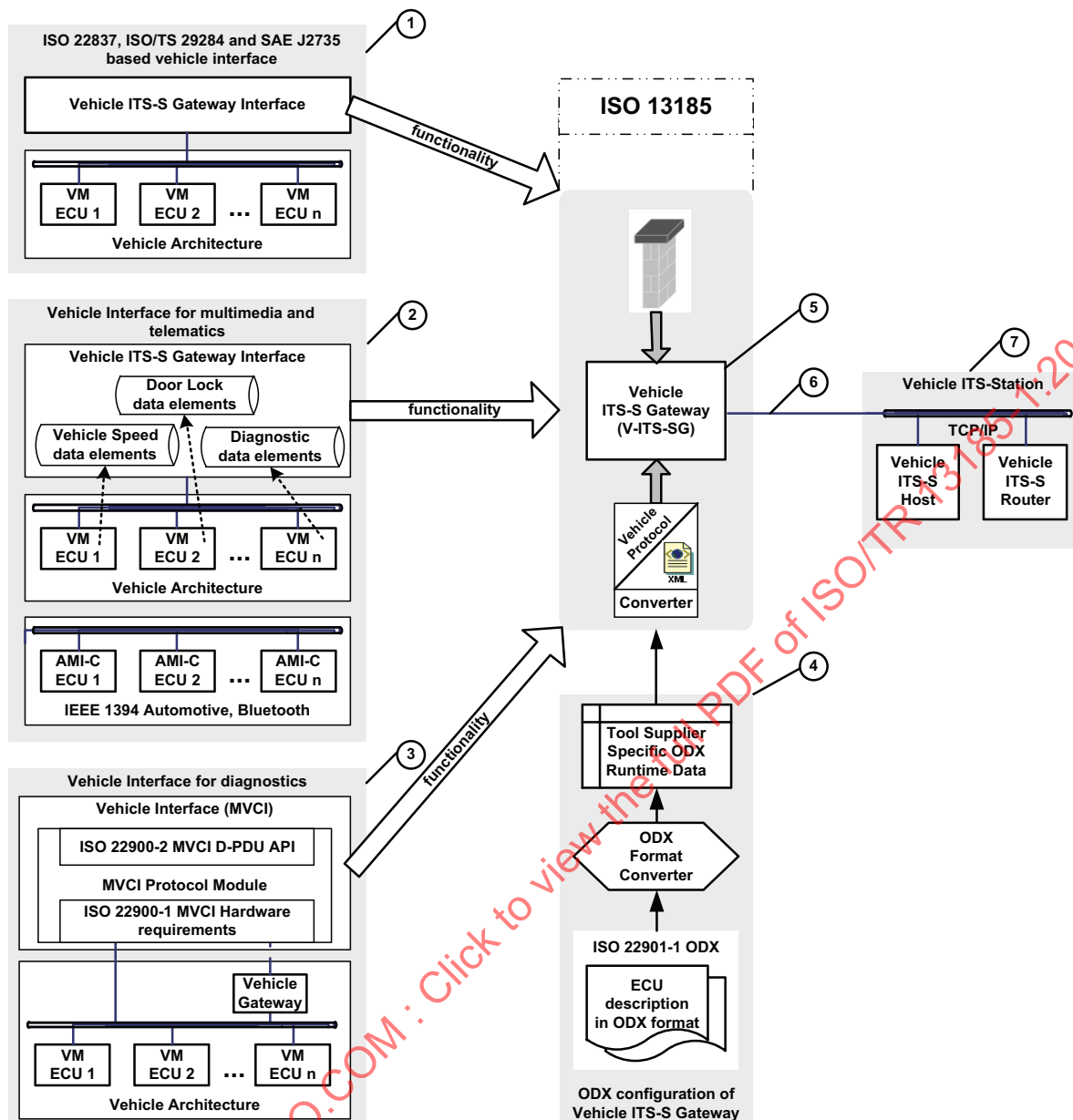
This Technical Report specifies the functionality consolidation of the various vehicle interfaces into a “single solution” concept for a “V-ITS-SG” which shall be connected to the CALM-compliant Vehicle Station (which consists of a Vehicle Mobile Host and a Vehicle Mobile Router).

The V-ITS-SG requires a runtime optimized ODX configuration data file which meets the available resources specified by the V-ITS-SG tool supplier.

The process and requirements on the use of ODX to support V-ITS-SG are specified in ISO 13185-3.

Figure 8 depicts the functionality consolidation of vehicle interfaces into V-ITS-SG.

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Key

- 1 ISO 22837, ISO/TS 29284 and SAE J2735 based vehicle interface
- 2 Vehicle Interface for multimedia and telematics
- 3 Vehicle Interface for diagnostics
- 4 ODX configuration of V-ITS-SG
- 5 Vehicle ITS Station Gateway (V-ITS-SG)
- 6 vehicle data transfer protocol
- 7 Vehicle ITS Station: Vehicle ITS Station Host and Vehicle ITS Station Router

Figure 8 — Functionality consolidation of vehicle interfaces into V-ITS-SG

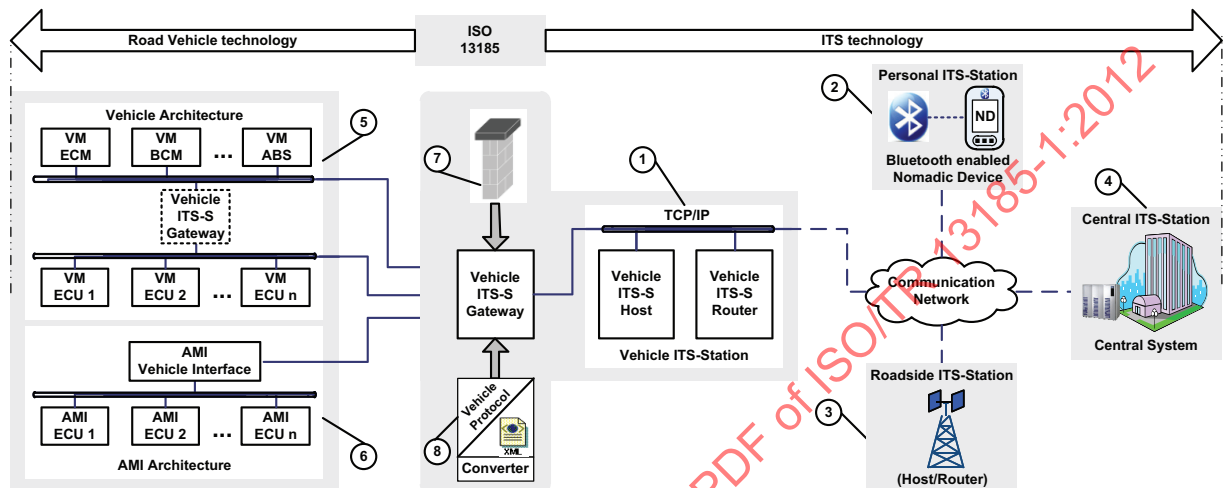
IMPORTANT — The single solution standardized access method specifies a vehicle data transfer protocol which shall be implemented in any vehicle interface product from any supplier. It takes over the role of the vehicle interface, hereinafter “V-ITS-SG”, of the existing standards and connects to the CALM reference architecture-compliant Vehicle Station.

7.2 Single solution vehicle interface for ITS applications

The concept specified in this Technical Report is backward compatible to the existing standards but specifies a “single solution” for standardized access method to data elements from the in-vehicle network. The standardized access method is specified in ISO 13185-2.

The V-ITS-SG technical requirements are specified in ISO 13185-2.

Figure 9 illustrates the V-ITS-SG as the “connector” between the “Road Vehicle technology” and the “ITS technology”.



Key

- 1 Vehicle ITS Station: Vehicle ITS Station Host and Vehicle ITS Station Router
- 2 Personal ITS Station
- 3 Roadside ITS Station
- 4 Central ITS Station
- 5 Vehicle Architecture with optional VM gateway
- 6 Automotive Multimedia Interface Architecture
- 7 Firewall implemented in V-ITS-SG
- 8 Vehicle Protocol Converter to standardized vehicle data transfer protocol

Figure 9 — Single solution V-ITS-SG for ITS applications

IMPORTANT — The standardized access method and formatting of data elements from the in-vehicle network takes place in the V-ITS-SG.

7.3 Vehicle Station and V-ITS-SG conceptual aspects and guidelines

Figure 10 illustrates six different areas of competence in the technology chain.

- a) Road vehicle technology: this competence is occupied by the vehicle manufacturers and their electronic system suppliers.
- b) Vehicle interface technology: this competence is occupied by the diagnostic tool suppliers.
- c) ITS Host Applications and Mobile Routing technology (Vehicle ITS Station): this competence is occupied by the IT application and communication companies.
- d) Short and Wide Range Communication technology: this competence is occupied by the IT communication companies.
- e) ITS Host Applications and Mobile Routing technology (Roadside ITS Station): this competence is occupied by the IT application and communication companies.

f) ITS Back Office technology: this competence is occupied by the ITS service provider companies.

The vehicle interface technology connects the road vehicle technology with the ITS technology.

IMPORTANT — The V-ITS-SG provides vehicle manufacturer/V-ITS-SG supplier controlled access to vehicle data and functions. The ND software applications have a similar functionality compared to an Internet browser.

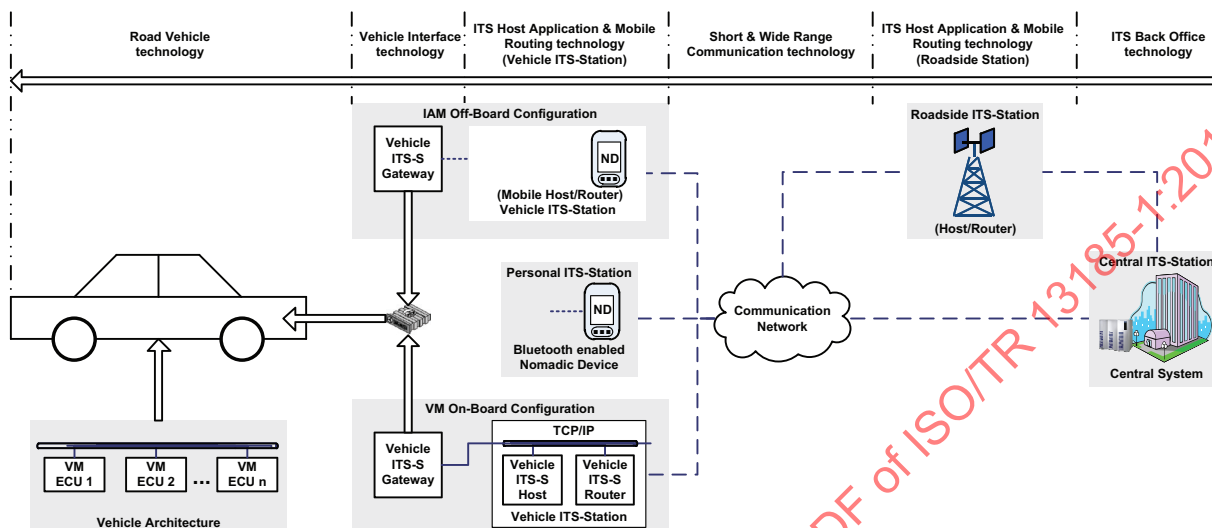


Figure 10 — Road vehicle to ITS technology chain

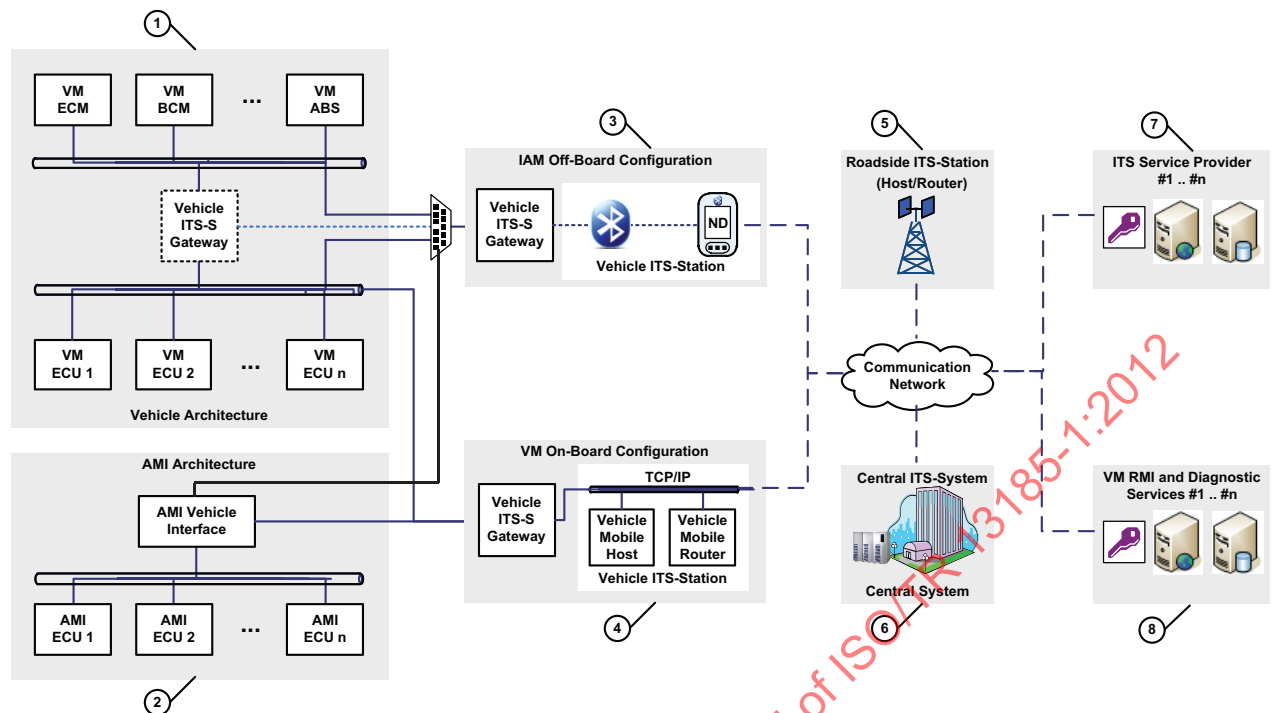
8 V-ITS-SG configuration

8.1 Overview of vehicle, Vehicle Stations, network and ITS services

This Technical Report specifies use cases and requirements to be supported by the vehicle interface (Vehicle ITS Station Gateway) for provisioning and support of ITS services.

Figure 11 illustrates two configurations for a “Vehicle-ITS- Station” connected to a “V-ITS-SG”:

- The Independent Aftermarket (IAM) “Off-Board” configuration consists of a V-ITS-SG and a Vehicle Station (Bluetooth connected CALM-compliant ND), which connects to the communication network to ITS services.
- The vehicle manufacturer (VM) “On-Board” configuration consists of a V-ITS-SG and a CALM-compliant Vehicle ITS Station (Vehicle ITS Station Host and Vehicle ITS Station Router), which connects to the communication network to ITS services.



Key

- 1 represents the in-vehicle electronic system architecture designed by the VM
- 2 represents the Automotive Multimedia Interface (AMI) designed for aftermarket add-on components/systems
- 3 IAM "Off-Board" configuration
- 4 VM "On-Board" configuration
- 5 Roadside ITS Station
- 6 Central ITS Station System
- 7 ITS service provider back-office system
- 8 VM Repair and Maintenance Information (RMI) and diagnostic back-office system

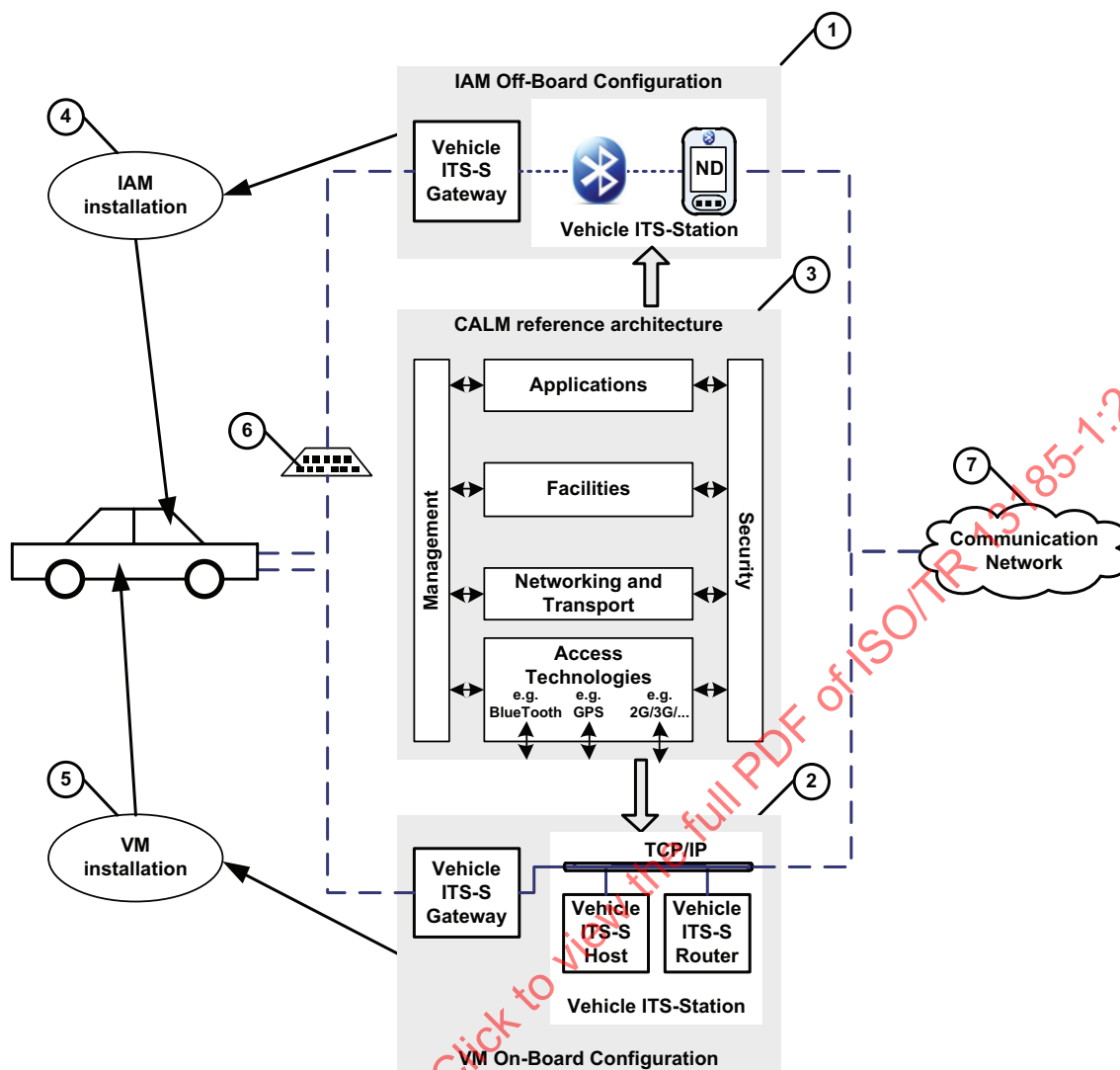
Figure 11 — Configuration for a Vehicle ITS Station connected to a V-ITS-SG

8.2 CALM reference architecture-compliant configurations

8.2.1 CALM-compliant Vehicle ITS Stations

Figure 12 illustrates two different types of supported Vehicle ITS Stations:

- a) the concept recommended to be applied by a consumer if the vehicle does not have any communication network capabilities to utilize ITS services. In such case, it is recommended that the vehicle be equipped with an IAM Off-Board configuration, which consists of a "V-ITS-SG and a CALM architecture-compliant ND (Vehicle ITS Station)" (see arrow from box 3 to box 1).
- b) the concept recommended to be applied by a VM if the vehicle is equipped with a V-ITS-SG and an "On-Board CALM architecture-compliant Vehicle ITS Station" (see arrow from box 3 to box 2).



Key

- 1 IAM "Off-Board" configuration
- 2 VM "On-Board" configuration
- 3 CALM reference architecture
- 4 IAM "Off-Board" after sales installation of configuration referenced by 1
- 5 VM "On-Board" production installation of configuration referenced by 2
- 6 Vehicle diagnostic connector
- 7 Communication network to ITS services

Figure 12 — CALM-compliant configurations

IMPORTANT — This concept considers legacy and future manufactured vehicles. Such strategy is an enabler to implement the vehicle interface for provisioning and support of ITS services by VMs, IAMs tool suppliers and consumers.

8.2.2 Applicability of existing standards to reference architecture

The V-ITS-SG concept is designed to fit two major use cases. One is the vehicle manufacturer engineered product designed into the vehicle at the time of the development of the vehicle. The second is the aftersales product designed by independent aftermarket tool suppliers. This product is an add-on for most vehicles which do not have built-in V-ITS-SG functionality.

Figure 13 illustrates where the International Standards apply in the overall architecture framework. The following is a brief description:

- The ISO 15031 series, the ISO 27145 series and ISO 22902 are vehicle protocol and data standards and are therefore applicable to vehicle and V-ITS-SG design.
- The ISO 22901 series is the applicable standard as the diagnostic data source for the configuration data of the ISO 22900-2 partial-compliant V-ITS-SG.
- This Technical Report shall be supported by the V-ITS-SG and the CALM-reference architecture-compliant Vehicle ITS Stations, which shall be implemented in two different configurations:
 - IAM Off-Board configuration: the CALM-reference architecture-compliant Vehicle ITS Station is realized in the Nomadic or Mobile Device.
 - VM On-Board configuration: the CALM-reference architecture-compliant Vehicle ITS Station is realized in the Vehicle Mobile Host and Vehicle Mobile Router.
- ISO 22837, ISO/TS 29284 and SAE 2735 are (event) vehicle probe data and message set dictionary standards and shall be supported by the Vehicle ITS Stations.

NOTE Existing standards are represented in grey shaded rectangular boxes.

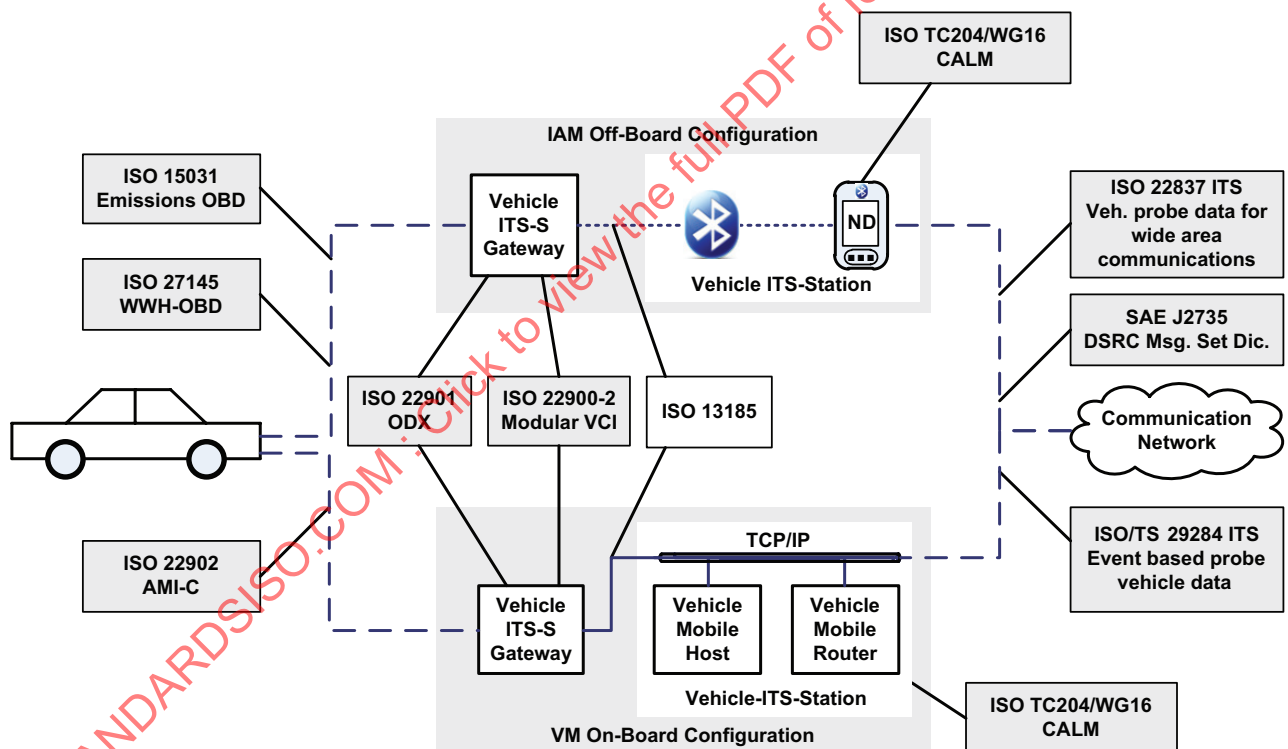


Figure 13 — Applicability of existing International Standards

8.3 Examples of benefits

8.3.1 Support for an open access method for legacy and future emerging ITS services

Applications supporting ITS need to receive vehicle information data through an in-vehicle interface access. Until now, vehicle information has been offered by vehicle manufacturers for proprietary services to a single service provider for delivery of these services in a specific market. This inflexibility made it difficult for ITS/telematics service providers to provide advanced services based on vehicle information.

A more open and standardized approach to deliver ITS/telematics services has clear benefits for the marketplace, but previous standardization efforts focused on replacing existing protocols or adding new protocols for newly emerging services rather than integrating them to overcome the barriers for adoption.

The support for an open access method needs to move from proprietary systems to a flexible, standardized system. The vehicle data transfer protocol's open access method accommodates ISO International Standards depending on various applications, e.g. eCall, Multimedia Control, Probe Data Collection, Diagnostics.

8.3.2 Support to commercial vehicle management using NDs

In commercial vehicle management, vehicles provide tracking logs, vehicle use data, etc. The vehicle data is delivered to the service facility based on an event and information generated from within the vehicle. This data is then delivered from the vehicle to the service facility via a nomadic device.

The following benefits are applicable to commercial vehicle management companies using an ND which implemented a vehicle data transfer protocol which connects to a V-ITS-SG.

- A commercial vehicle management company can save costs on different types of ND software depending on the type of vehicle (cars, vans, and trucks) and the model of vehicle.
- A company can save costs in automotive maintenance by providing an appropriate level of vehicle diagnostics and alerts for the key components, including safety systems (i.e. tire pressure alerts).

8.3.3 Manage in-car information devices

The average lifespan of a car (10 to 15 years) is much longer than that of an ND (typically less than two years) and this requires greater flexibility on in-vehicle interface between vehicle and ND. Also, the user demand of in-car information devices continues to grow (e.g. PDA, multimedia entertainment, mobile phone, navigation), but the devices become outdated quickly.

V-ITS-SG and the vehicle data transfer protocol can support legacy systems for data transfer to the vehicle throughout the service life of a vehicle and also enable adoption of new services as they become available online.

8.3.4 Calculate CO₂ emission using ND

Green ITS will assist drivers to become more conscious of their vehicle's fuel-efficiency performance by providing them with the fuel-consumption data through an in-vehicle interface access and their day-to-day driving habits.

To improve fuel efficiency and reduce CO₂ emission, the collection of traffic information, environmental data (weather information) and floating car data should be available to the driver. For example, any inefficient driving (low fuel efficiency, high CO₂ emission, etc.) would cause an eco lamp to be turned on. An eco lamp would be installed in the dashboard or shown in the ND by the use of different symbols.

The V-ITS-SG and the standardized vehicle data transfer protocol is a key factor to access vehicle data needed to inform the driver of their vehicle's fuel-efficiency and value of calculating CO₂ emission using the ND.

9 Use case overview and principles

9.1 Basic principles for use case definition

Basic principles have been established as a guideline to define the use cases:

- a) The vehicle interface (V-ITS-SG) for provisioning and support of ITS services use cases describes the interaction between an ND and a V-ITS-SG installed in a vehicle with access/connection to the electronic systems.
- b) The use cases in this Technical Report define a common way for any ND to retrieve vehicle electronic system data required to support ITS services.

- c) The content and functionality/feature set in the ND and the quality of the implementation is the responsibility of the Vehicle ITS Station product supplier.
- d) The content and functionality/feature set in the V-ITS-SG and the quality of the implementation is the responsibility of the V-ITS-SG product supplier.
- e) Actors in the use cases are any customer (e.g. vehicle owner) who wants to connect an ND (e.g. Smart Phone) to the V-ITS-SG (vehicle manufacturer installed or aftermarket installation) to retrieve data from the vehicle's electronic system(s).
- f) Country specific legislation requires each vehicle manufacturer to provide the vehicle's electronic system specific diagnostic data stream information, e.g. ISO 22901, ODX format in a non-discriminatory manner to its authorized and independent aftermarket diagnostic tool suppliers. This information is required to develop the diagnostic tools as well as the V-ITS-SG software configuration.
- g) The vehicle manufacturer is only expected to provide the V-ITS-SG software configuration data and information in the languages as provided to its authorized diagnostic tool supplier(s).

9.2 Use case clusters

Table 1 provides an overview of the different use case categories. The use cases are grouped into use case clusters.

Table 1 — Use case clusters

No.	Title of use case cluster	Brief description
1	Requesting V-ITS-SG and vehicle identification related information	The use cases belonging to this cluster describe how to request generic information about the V-ITS-SG itself and the vehicle's electronic systems. It also describes how information about the available ECUs and the available data is requested from the V-ITS-SG.
2	Requesting vehicle and ECU data values	The use cases belonging to this cluster describe the procedures necessary to request vehicle data from the V-ITS-SG. It also describes how information about the data representation can be requested.
3	Requesting and clearing DTCs and related data	The use cases belonging to this cluster describe how information about currently active DTCs in the vehicle, their status and additional DTC data, can be requested from the V-ITS-SG. The procedure to clear DTCs and DTC related data in the vehicle is also described.
4	Unsolicited V-ITS-SG messages	The use cases belonging to this cluster describe the different types of unsolicited messages (messages which have not been explicitly requested by the ND) being sent by the V-ITS-SG. Unsolicited messages are: — SendOnEvent (emergency, critical driving situation, safety, etc.); — SendOnChange (warnings triggered by sensor signals above/below a threshold, etc.).
5	Realtime data transmission	The use cases belonging to this cluster describe the realtime data transmission between the V-ITS-SG and the ND. Use cases are: — Realtime data measurements with ND requested refresh rate and optimised small size response message format; — Realtime DTC reporting with ND requested refresh rate and optimised small size response message format.

Table 1 (continued)

No.	Title of use case cluster	Brief description
6	Controlling/adjusting various equipment of the vehicle	The use cases belonging to this cluster describe any type of control and adjustment of a vehicle system capable of bidirectional vehicle protocol communication and control. Use cases are: — setup V-ITS-SG to learn settings of personal customer profile e.g. store learned settings of electrically controlled seat, sun roof, window position, pre-set radio stations, etc., — control convenience system on/off e.g. air conditioning, vehicle speed sensitive door locking and unlocking; — control EV to start or stop for charging remotely via ND
7	Writing short and long term data to V-ITS-SG	The use cases belonging to this cluster describe how the ND writes data to the V-ITS-SG. Use cases are: — ND writes long term vehicle's licence plate number, VIN, etc. to V-ITS-SG memory; — ND writes long term vehicle profile (vehicle manufacturer published vehicle data) to V-ITS-SG memory e.g. average fuel consumption, CO₂ / km, etc.; — ND enables/disables long term functional system (e.g. navigation system) related data IDs to be sent periodically for transmission to ITS infrastructure; — ND writes short/long term specific data ID thresholds to V-ITS-SG memory to trigger SendOnChange messages; — ND erases short/long term data ID thresholds in V-ITS-SG memory.
8	V-ITS-SG accessibility restrictions and firewall protection cluster	The use cases belonging to this cluster define policies about restrictions related to accessibility to vehicle data in the V-ITS-SG. Different restriction levels are available, e.g. vehicle manufacturer level, user level, etc. Use cases are: — SecurityAccess: provide a means to access data and services, which have restricted access for security or safety reasons; — RequestFirewallStatus: provide the status of the firewall (active/inactive); — ConfigFirewall: configuration of firewall to enable/disable specific services/features.
9	V-ITS-SG special features	The use cases belonging to this cluster describe special feature functionality of the V-ITS-SG. Use cases are: — Exchange: used for all data exchange services between ND and V-ITS-SG; — ActivationMode: used to activate/deactivate V-ITS-SG without ND connected; — UploadEventLogFile: used to upload the EventLogFile from the V-ITS-SG.
10	Vehicle diagnostics	The use cases belonging to this cluster describe vehicle diagnostics performed through the V-ITS-SG. Use cases are: — FG-OBD: enables the diagnostics of a functional group, e.g. emissions-related systems, safety-related systems, multimedia-related systems, etc; — Enh-OBD: enables the enhanced diagnostics which allows the ND to diagnose each individual ECU in the vehicle (if supported by V-ITS-SG); — UploadVSOCLogFile: used to upload the VSOCLogFile from the V-ITS-SG.

Table 1 (continued)

No.	Title of use case cluster	Brief description
11	Electric vehicle system status	The use cases belonging to this cluster describe electric vehicle (EV) battery system monitor and notification through the V-ITS-SG. Use cases are: — Monitor battery state of charge; — Monitor connection between charging station and EV; — Battery charge started notification; — Battery charge stopped notification.
12	V-ITS-SG maintenance	The use cases belonging to this cluster describe maintenance functionality of the V-ITS-SG. Use cases are: — UpdateCoreSoftware: enables the ND or any other connected external programming system to perform a software update/download to the V-ITS-SG; — KeyOffOnReset: condition similar to the driver turning the ignition key off and back on; — Reset: condition simulates the reset condition typically performed when the V-ITS-SG is disconnected from the power supply (i.e. battery); — UploadV-ITS-SG ConfigFile: ND reads (uploads) all V-ITS-SG configuration data for backup purpose or in case of a replacement or newer version of the V-ITS-SG (backward compatible) to customize the V-ITS-SG to the vehicle; — DownloadV-ITS-SG ConfigFile: ND writes (downloads) all V-ITS-SG configuration data into the V-ITS-SG using a backup file stored in the ND.

A detailed definition of each use case is defined in Clause 10.

Figure 14 illustrates all use case clusters and associated use cases.

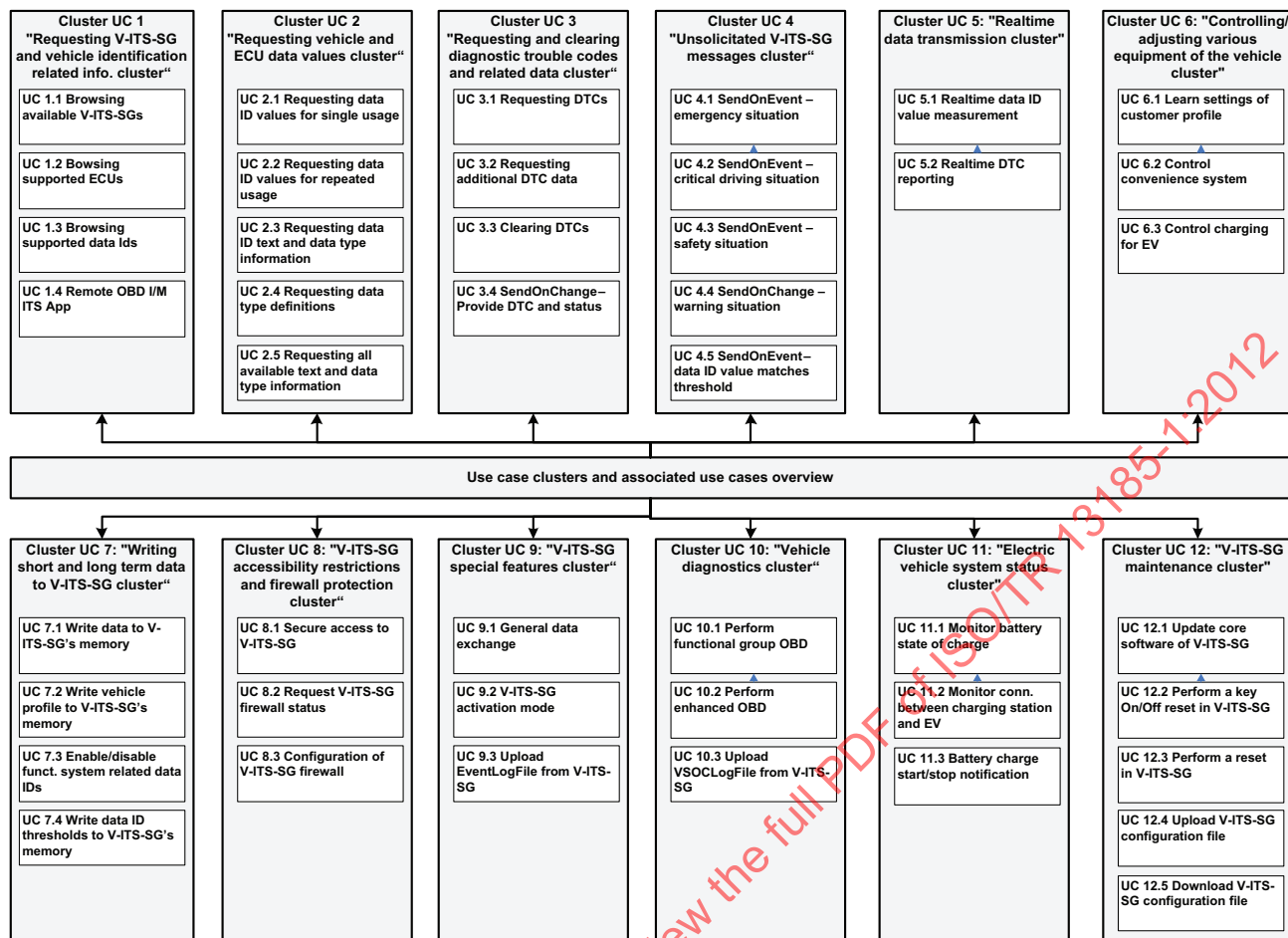


Figure 14 — Use case clusters and associated use cases

10 Use case definition

10.1 UC 1 Requesting V-ITS-SG and vehicle identification related information cluster

10.1.1 UC 1.1 Browsing available V-ITS-SGs

Table 2 specifies the procedure for the ND to gather information about an available V-ITS-SG for unique identification.

Table 2 — Browsing available V-ITS-SGs

Use case name	Browsing available V-ITS-SGs
Actor	Nomadic device (initiated by user interaction or automatically)
Goal	Gather information about a connected V-ITS-SG.
Use case input	Request for information about a connected V-ITS-SG.

Table 2 (continued)

Use case output	Information about the connected V-ITS-SG.
Brief description	After an ND has connected to a V-ITS-SG, it will request identification about the V-ITS-SG and the vehicle's electronic systems where the V-ITS-SG is built in. This information may include: — V-ITS-SG version — Vehicle type — Vehicle model The information is included in the V-ITS-SG, so no diagnostic vehicle communication is needed inside the vehicle for the reply. The gathered information may be used to present a list of available V-ITS-SG to the user to select a V-ITS-SG for further communication if more than one is available. Additionally, the information can be used to store data specific to this V-ITS-SG in the ND for later use. A vehicle shall always have only one (1) V-ITS-SG connected to the diagnostic connector or equivalent.

10.1.2 UC 1.2 Browsing supported ECUs

Table 3 specifies the procedure for obtaining a list of available ECUs from a V-ITS-SG for ECU browsing.

Table 3 — Browsing supported ECUs

Use case name	Browsing supported ECUs
Actor	Nomadic device (initiated by user interaction or automatically)
Goal	Obtain a list of all available ECUs in a vehicle registered in the V-ITS-SG.
Use case input	Request for a list of ECUs.
Use case output	— A list of ECUs available to the V-ITS-SG — Additional information about the ECUs (optional)
Brief description	After an ND has identified the V-ITS-SG it wants to communicate with, it can request a list of available ECUs from the vehicle's V-ITS-SG. The answer returned from the V-ITS-SG may be used to create a list of available ECUs on the ND and to present this list to the user for either ECU selection or functional data ID requests. This selection may be used by the ND to filter further replies from the V-ITS-SG or to restrict further requests to a specific ECU by specifying its ID. The V-ITS-SG may optionally return additional information about the available ECUs, e.g. part number.

10.1.3 UC 1.3 Browsing supported data IDs

Table 4 specifies the procedure to obtain a list of available data IDs that can be requested from an ECU.

Table 4 — Browsing supported data IDs

Use case name	Browsing supported data IDs
Actor	Nomadic device (initiated by user interaction or automatically)
Goal	Obtain a list of all available data IDs for a specified ECU.
Use case input	ECU identifier
Use case output	A list of data IDs available to the V-ITS-SG for the requested ECU.
Brief description	For each ECU that is available to the V-ITS-SG, the ND may request the available data IDs from the V-ITS-SG. The ND may request only the data IDs of the ECU that was selected during ECU browsing, or repeat the request for each available ECU to have a complete list of available data IDs. The user may select one or more data ID from this list, for which the current values must be requested.

10.2 UC 2 Requesting vehicle and ECU data values cluster

10.2.1 UC 2.1 Requesting data ID values for single usage

Table 5 specifies the scenario for requesting data IDs in a way in which they can be directly displayed on the ND.

Table 5 — Requesting data ID values for single usage

Use case name	Requesting data ID values for single usage
Actor	Nomadic device (initiated by user interaction)
Goal	Obtain the value of a specified data ID to present it to the user.
Use case input	— ECU identifier — Data identifier
Use case output	— The display texts for the ECU identifier and the data identifier — The current value of the requested data identifier, formatted in a way in which it can be directly presented to the user
Brief description	If a specific data identifier is not expected to be requested very often, the response to the request shall include all necessary information. All reply data is transmitted as strings (including a possible unit) and can be presented directly to the user. The ND does not need to look up any information from previous requests, such as the ECU or data identifier display names. The ND may also be configured for a V-ITS-SG to which it is mainly connected, for example in the user's own vehicle. Because the same data types and texts for this V-ITS-SG will be transmitted frequently, they may be stored in the ND. If the ND is connected to the V-ITS-SG of another vehicle ("guest" ND), all information necessary to display a value shall be transmitted in the reply. More data will be transmitted, but the memory on the ND is reserved for storing data from the "home" V-ITS-SG (vehicle owner V-ITS-SG). The type of V-ITS-SG response (short or long) is indicated with an attribute in the request message from the ND.

10.2.2 UC 2.2 Requesting data ID values for repeated usage

Table 6 specifies the scenario for requesting data IDs in a way in which the response message is optimized for repeated usage (smaller size, faster transmission).

Table 6 — Requesting data ID values for repeated usage

Use case name	Requesting data ID values for repeated usage
Actor	Nomadic device (initiated by user interaction)
Goal	Get the value of a specified data ID to present it to the user.
Use case input	— ECU identifier — Data identifier

Table 6 (continued)

Use case output	The current raw value of the requested data identifier, without any further information such as display texts or data types.
Brief description	If a data identifier is requested frequently, the transmission must be optimized for smaller size and faster speed. A good example is the repeated request of a measurement value from the V-ITS-SG to display it in live-mode on the ND. The ND will request the appropriate data ID, and only the data ID label and the measurement value is returned from the V-ITS-SG. If the text and data type information for this ID label has not been requested before, the ND will realize that this information is missing and request it from the V-ITS-SG. In order to display the first requested value, one additional request is necessary, which means that more data must be transmitted rather than requesting all necessary information directly. But for all following requests, the text and data type information is already present on the ND, so a lot of transmission time can be saved by just transmitting the raw values. The type of the V-ITS-SG response (short or long) is indicated with an attribute in the request message from the ND.

10.2.3 UC 2.3 Requesting data ID text and data type information

Table 7 specifies the procedure to gather text and data type information after a data ID for repeated usage has been requested.

Table 7 — Requesting data ID text and data type information

Use case name	Requesting data ID text and data type information
Actor	Nomadic device (automatically, if needed)
Goal	Gather information about the presentation of a specific text or data ID label.
Use case input	Data identifier or text label.
Use case output	Display text and data type information of the requested label.
Brief description	If the ND receives a label without additional text information when requesting a data ID value, it needs more information about the display text and the format and unit of values belonging to this label. If this information is not already known to the ND, it can be requested from the V-ITS-SG. Depending on the label, the V-ITS-SG will return more or less information. In case of text labels, only the display text is returned. For data ID labels, the display text of the data ID is returned, together with the data type of the value belonging to this label.

10.2.4 UC 2.4 Requesting data type definitions

Table 8 specifies the procedure to gather the definition of a specific data type, which is used for the correct presentation of a requested data ID value.

Table 8 — Requesting data type definitions

Use case name	Requesting data type definitions
Actor	Nomadic device (automatically, if needed)
Goal	Gather information about a data type defined for a label.
Use case input	Data type identifier

Table 8 (continued)

Use case output	Basic data type and additional data type information of the requested data type.
Brief description	If the ND receives label type information for a data ID label, the used data type for this label is included in the V-ITS-SG's response. The data type refers to a description of how the raw values must be interpreted and can be requested from the V-ITS-SG. Each data type is based upon some basic data types, e.g. numeric, string or string table. Additionally, data may be included, to define certain ranges, a unit or other useful information to display the raw value. A single data type can be used for several labels. For example, a "YES/NO" data type must only be defined once and can be referred to by all labels that have the possible values "yes" or "no". This minimizes the amount of transferred data once the definition of the data type is known.

10.2.5 UC 2.5 Requesting all available text and data type information

Table 9 specifies the procedure to gather all available text and data type information and definitions.

Table 9 — Requesting all available text and data type information

Use case name	Requesting all available text and data type information
Actor	Nomadic device (initiated by user interaction or automatically)
Goal	Gather information about all available labels and data types from the V-ITS-SG.
Use case input	Request for all available label and data type information
Use case output	— Display text and data type information of all available labels — Basic data type and additional data type information of all available data types
Brief description	If the ND decides to use the so-called "short-mode" for all further requests to the V-ITS-SG (only labels and raw values are returned), it can request all available label and data type information before this information is really needed to display the texts or values. The stored information can then be looked up, if data is received that refers to the prior received labels and data types. This implies that a larger amount of data must be transmitted only once (e.g. when the ND is paired with the V-ITS-SG in the users own vehicle), but will reduce all further data transfers when the responses are more time critical.

10.3 UC 3 Requesting and clearing DTCs and related data cluster

10.3.1 UC 3.1 Requesting DTCs

Table 10 specifies the procedure to obtain information about DTCs and associated status information in the vehicle's ECU(s).

Table 10 — Requesting DTCs

Use case name	Requesting DTCs
Actor	Nomadic device (initiated by user interaction or automatically)
Goal	Obtain information about current active DTCs from the vehicle's V-ITS-SG.
Use case input	ECU identifier (optional)

Table 10 (continued)

Use case output	— Current active DTCs for each ECU — Additional status information for each DTC (if available)
Brief description	The ND may request a list of current active DTCs from the vehicle's V-ITS-SG. The request may be directed to a specific ECU or to all available ECUs in the vehicle which can be reached by the V-ITS-SG. The V-ITS-SG will return a separate list of DTCs for each ECU. If available, status information about the DTC may also be included. All DTCs and status information follow the same principles as the data IDs, the ND may choose if only labels and raw values are transmitted (short mode) or all display texts and status information data types are already included in the reply. There is no need for the ND to know anything about possible status information or the error texts belonging to a specific DTC value. All of this information can be requested from the V-ITS-SG.

10.3.2 UC 3.2 Requesting additional DTC data

Table 11 specifies the procedure to request additional data stored in the vehicle's ECUs about a specific DTC.

Table 11 — Requesting additional DTC data

Use case name	Requesting additional DTC data
Actor	Nomadic device (initiated by user interaction)
Goal	Request information about additional stored data for a specific DTC.
Use case input	— ECU identifier — DTC identifier
Use case output	Additional stored data records for the requested DTC (if available)
Brief description	For each reported DTC, the ND may request additional information from the V-ITS-SG. Depending on the diagnostic protocol(s) used in the vehicle, there may be more or less additional information, e.g. freeze frame, snapshot or extended DTC data. The ND does not need any knowledge about how this data is acquired internally. It just requests the available information for a specific ECU and a specific DTC. All available data is returned by the V-ITS-SG in a generic way. The description of this data can be requested from the V-ITS-SG or it may already be included in the response message (depending on the reply mode used).

10.3.3 UC 3.3 Clearing DTCs

Table 12 specifies the procedure to clear DTCs and additional data about them from the vehicle's ECUs.

Table 12 — Clearing DTCs

Use case name	Clearing DTCs
Actor	Nomadic device (initiated by user interaction)
Goal	Clear DTCs and appropriate data from the vehicle's ECUs.
Use case input	ECU identifier (optional)
Use case output	Response that DTCs and data have been cleared
Brief description	The ND may instruct the V-ITS-SG to clear all DTCs and the appropriate data currently stored in the vehicle's ECUs. The ND may specify an ECU where the DTCs shall be cleared, or just instruct the V-ITS-SG to clear all DTCs in the vehicle. If DTCs cannot be cleared in an ECU, the ND will be informed by the V-ITS-SG when requesting DTCs again.

10.3.4 UC 3.3 SendOnChange – Provide DTC and status

Table 13 specifies the procedure to provide changing DTC and status information on event.

Table 13 — SendOnChange — Provide DTC and status

Use case name	SendOnChange – Provide DTC and status
Actor	ND, V-ITS-SG
Goal	The V-ITS-SG shall be capable of being configurable by the ND in a way that the ND sends a request to enable a “SendOnChange” for DTCs and their status information (if supported by the vehicle system) of all vehicle systems being monitored. The V-ITS-SG observes the DTCs and their status data of each vehicle system. Whether a vehicle system is monitored or not is based on the V-ITS-SG configuration data. The V-ITS-SG shall send a scheduled message to the ND including a list of DTCs and status data (at least one) immediately after identifying: — a new DTC occurrence of any vehicle system being monitored by the V-ITS-SG, — a change in the status of a DTC previously identified from the vehicle system(s).
Use case input	ND sends a command to the V-ITS-SG with the following configuration data: — Vehicle system address, — SendOnChange = enabled/disabled, — refresh rate = # in ms starting at 100 ms with increments of 100 ms.
Use case output	V-ITS-SG sends a response to the ND with the following information: — Vehicle system address, — List of: — DTC number, — DTC status data, — ...; — End of list.
Brief description	The ND instructs the V-ITS-SG with the information for which vehicle system, the “SendOnChange” for DTCs and their status information shall be enabled. This command shall cause the V-ITS-SG to monitor the DTCs and status information of the vehicle system advised by the ND. Upon the detection of a new DTC or changed DTC status information, the V-ITS-SG shall send a message in refresh rate configured by the ND. If multiple DTCs change their status, those shall be reported in a single message by the V-ITS-SG to the ND. If a vehicle system no longer detects the identified problem and stops reporting the DTC, the V-ITS-SG shall no longer include this DTC in the response message to the ND.

10.4 UC 4 Unsolicited V-ITS-SG messages cluster

10.4.1 UC 4.1 SendOnEvent — Emergency situation

Table 14 specifies the use case of an emergency trigger event which causes the V-ITS-SG to send an unsolicited message with pre-defined data to the ND.

Table 14 — SendOnEvent — Emergency situation

Use case name	SendOnEvent — Emergency situation
Actor	V-ITS-SG
Goal	The V-ITS-SG shall send an unsolicited message to the ND with pre-configured emergency related data items (GPS) immediately after receiving the emergency trigger from the vehicle system(s).
Use case input	— emergency trigger from the vehicle system — ND configuration data to enable emergency related data items in the V-ITS-SG

Table 14 (continued)

Use case output	— V-ITS-SG sends an unsolicited message (or unsolicited messages) with pre-configured emergency related data items with at least GPS position to ND — ND displays an emergency message on the display to user — ND initiates an eCall message including the GPS position — eCall will request emergency assistance to come to the accident
Brief description	When a vehicle is involved in an accident and the airbag system is activated, the V-ITS-SG will recognize the activation of the airbag system via the vehicle's network messages. The V-ITS-SG has previously received a configuration for an emergency data set from the ND. The emergency data set shall be sent by the V-ITS-SG to the ND immediately after the airbag activation has been recognized. The ND shall send an eCall message with at least the GPS position. Emergency assistance is requested to come to the accident.

10.4.2 UC 4.2 SendOnEvent — Critical driving situation

Table 15 specifies the use case of a critical driving situation trigger event which causes the V-ITS-SG to send an unsolicited message with pre-defined data to the ND.

Table 15 — SendOnEvent — Critical driving situation

Use case name	SendOnEvent — Critical driving situation
Actor	V-ITS-SG
Goal	The V-ITS-SG shall send an unsolicited message to the ND with pre-configured critical driving situation related data items immediately after receiving the critical driving situation trigger from the vehicle system(s).
Use case input	— critical driving situation trigger from the vehicle system — ND configuration data to enable critical driving situation related data items in the V-ITS-SG
Use case output	— V-ITS-SG sends an unsolicited message (or unsolicited messages) with pre-configured critical driving situation related data items to ND — ND displays critical driving situation warning on the display to user — ND may initiate a short text message with a critical driving situation notification including the GPS position to an ITS service system
Brief description	When a vehicle is in a critical driving situation, the V-ITS-SG will recognize the activation of any system related to vehicle dynamics control, e.g. traction control system, ABS activation via the vehicle's network messages. The V-ITS-SG has previously received a configuration for a critical driving situation data set from the ND. The critical driving situation data set shall be sent by the V-ITS-SG to the ND immediately after, e.g. the vehicle dynamics control system has initiated an indication via the vehicle network message data. The ND shall send a short text message with a critical driving situation notification with at least the GPS position to an ITS service system.

10.4.3 UC 4.3 SendOnEvent — Safety situation

Table 16 specifies the use case of a safety critical trigger event which causes the V-ITS-SG to send an unsolicited message with pre-defined data to the ND.

Table 16 — SendOnEvent — Safety situation

Use case name	SendOnEvent — Safety situation
Actor	V-ITS-SG
Goal	The V-ITS-SG shall send an unsolicited message to the ND with pre-configured safety related data items immediately after receiving the safety trigger from the vehicle system(s).
Use case input	— safety trigger from the vehicle system, e.g. anti-theft system — ND configuration data to enable safety situation related data items in the V-ITS-SG

Table 16 (continued)

Use case output	— V-ITS-SG sends an unsolicited message (or unsolicited messages) with pre-configured safety related data items to ND — ND displays safety warning on the display to user — ND may initiate a short text message with a safety notification including. the GPS position to an ITS service system
Brief description	When a vehicle is in a safety situation, the V-ITS-SG will recognize the activation of, e.g. the anti-theft system via the vehicle's network messages. The V-ITS-SG has previously received a configuration for a safety data set from the ND. The safety data set shall be sent by the V-ITS-SG to the ND if connected immediately after, e.g. the anti-theft system has initiated an indication via the vehicle network message data. If the ND is not connected to the V-ITS-SG, the V-ITS-SG shall store the event in the EventLogFile for upload and analysis later by the ND. At a later time, a notification message with at least the GPS position may be sent to an ITS service system.

10.4.4 UC 4.4 SendOnEvent — Warning situation

Table 17 specifies the use case of a warning trigger which causes the V-ITS-SG to send an unsolicited message with pre-defined data to the ND.

Table 17 — SendOnEvent — Warning situation

Use case name	SendOnEvent – warning situation
Actor	V-ITS-SG
Goal	The V-ITS-SG shall send to the ND an unsolicited message with pre-configured warning related data items immediately after receiving the warning trigger identified by the V-ITS-SG warning related data analysis.
Use case input	Configuration data including min/max value thresholds and a warning text for the selected data ID(s).
Use case output	— Enabled data ID(s) with associated current data value(s) — Data ID(s) related warning text
Brief description	With the ND the user can download configuration data for V-ITS-SG enabled data IDs. The configuration data include min/max value thresholds and a warning text for the selected data IDs. In case one or multiple thresholds of enabled data IDs are met during operation of the vehicle the V-ITS-SG shall immediately send an unsolicited message to the ND include the enabled data IDs with associated current data values as well as the warning text.

10.4.5 UC 4.5 SendOnEvent — Data ID value matches threshold

Table 18 specifies the use case to retrieve vehicle data which match a configurable threshold.

Table 18 — SendOnEvent — Data ID value matches threshold

Use case name	SendOnEvent — Data ID value matches threshold
Actor	Nomadic Device, V-ITS-SG
Goal	The ND and the V-ITS-SG shall be capable of providing data items based on a "SendOnEvent" trigger for ND selected data ID values (if supported by the vehicle system and reported to be supported by the V-ITS-SG). The purpose of this feature is — to reduce overhead traffic between the ND and V-ITS-SG (elimination of requests for each response message), and — to specify data item individual V-ITS-SG reporting schedules with condition based triggers.

Table 18 (continued)

Use case input	ND sends a command to the V-ITS-SG with the following configuration data: — Vehicle system address, — SendOnEvent = enabled/disabled, — List of: — data ID, — refresh rate = # in ms starting at 100 ms with increments of 100 ms, — minimum value, operator = “less than” / “equal” / “greater than”, — maximum value, operator = “less than” / “equal” / “greater than”, — ..., End of list.
Use case output	V-ITS-SG sends a response to the ND with the following information: — Vehicle system address, — List of: — data ID, — data ID value, — ..., End of list.
Brief description	The ND shall send a configuration message to the V-ITS-SG including the following information: The V-ITS-SG shall be capable of being configurable by the ND in a way that the ND sends a request “SendOnEvent” for ND selected data ID values (if supported by the vehicle system and reported to be supported by the V-ITS-SG). The configuration message shall include min/max values as well as “less than”, “equal” and “greater than” indicators for minimum and maximum values. The V-ITS-SG shall support more than one data ID value configuration in a single configuration request message. The V-ITS-SG shall send a scheduled message to the ND including a list of data ID values which match the configuration criteria.

10.5 UC 5 Realtime data transmission cluster

10.5.1 UC 5.1 Realtime data ID value measurement

Table 19 specifies the use case of realtime data ID value measurements.

Table 19 — Realtime data ID value measurement

Use case name	Realtime data ID value measurement
Actor	V-ITS-SG
Goal	The V-ITS-SG shall be capable of sending realtime optimized data ID value measurements to the ND. The data item value refresh rate shall be configurable by the ND to avoid burst message situations between the V-ITS-SG and ND.

Table 19 (continued)

Use case input	ND sends a command to the V-ITS-SG with the following configuration data: — Vehicle system address, — Realtime = enabled/disabled, — List of: — data ID, — refresh rate = # in ms starting at 10 ms with increments of 10 ms, — ...; End of list.
Use case output	V-ITS-SG sends a response to the ND with the following information: — Vehicle system address, — List of: — data ID, — data ID value, — ...; End of list.
Brief description	The V-ITS-SG shall send realtime optimized data ID value measurements to the ND. The V-ITS-SG response message format shall be reduced to a minimum message header and trailer size and reformat the data ID and corresponding data value into a small size format. In order to avoid burst message situations, the ND shall include a refresh timing parameter (schedule) in the request message to the V-ITS-SG. The ND shall include a refresh configuration parameter which can stop the schedule of the selected data ID value.

10.5.2 UC 5.2 Realtime DTC reporting

Table 20 specifies the use case of realtime DTC reporting.

Table 20 — Realtime DTC reporting

Use case name	Realtime DTC reporting
Actor	V-ITS-SG
Goal	The V-ITS-SG shall be capable of reporting realtime optimized DTC values to the ND. The DTC reporting refresh rate shall be configurable by the ND to avoid burst message situations between the V-ITS-SG and ND.
Use case input	ND sends a command to the V-ITS-SG with the following configuration data: — Vehicle system address, — SendOnChange = enabled/disabled, refresh rate = # in ms starting at 100 ms with increments of 100 ms.

Table 20 (continued)

Use case output	V-ITS-SG sends a response to the ND with the following information: — Vehicle system address, — List of: — DTC number, — DTC status data, — ... End of list;
Brief description	The V-ITS-SG shall send realtime optimized DTC(s) number and associated status information to the ND. The V-ITS-SG response message format shall be reduced to a minimum message header and trailer size and reformat the data ID and corresponding data value into a small size format. In order to avoid burst message situations the ND shall include a refresh timing parameter (schedule) in the request message to the V-ITS-SG. The ND shall include a refresh configuration parameter which can stop the schedule of the selected data ID value.

10.6 UC 6 Controlling/adjusting various equipment of the vehicle cluster

10.6.1 UC 6.1 Learn settings of customer profile

Table 21 specifies the use case of customizing the V-ITS-SG according to the profile of the customer.

Table 21 — Learn settings of customer profile

Use case name	Learn settings of customer profile
Actor	Nomadic Device, V-ITS-SG
Goal	Setup the V-ITS-SG with the use of the ND to learn the vehicle system settings of a customer profile, e.g. store learned settings of electrically controlled seat, sun roof, window position, pre-set radio stations.
Use case input	Customer profile name Vehicle system sensor values
Use case output	Vehicle system actuator control
Brief description	With the installation of a V-ITS-SG, ND and appropriate software applications, the customer shall be in a position to enable a learn mode in the V-ITS-SG which would capture and store the learned positions of various vehicle systems, e.g. electrically controlled seats, sun roof, window position, mirror position, pre-set radio stations. While the ND has put the V-ITS-SG in the learn mode, the customer moves the electronically controlled systems in the desired position. When done the customer confirms with the ND to the V-ITS-SG that he has finished the positioning of the systems. This shall trigger in the V-ITS-SG to read and store the current positions of the sensors of each system. Finally, the customer needs to provide a name under which he wants to reference the learned system settings. The name references his specific profile of vehicle system settings. The next time the same customer with the ND enters the vehicle, the ND and V-ITS-SG establish a connection and the V-ITS-SG will recognize the customer's profile name. This shall cause the V-ITS-SG to automatically control all registered systems to be moved into the customer adjusted positions.

10.6.2 UC 6.2 Control convenience system

Table 22 specifies the use case of remotely adjusting the vehicle's convenience systems via the ND.

Table 22 — Control convenience system

Use case name	Control convenience system
Actor	Nomadic Device, V-ITS-SG
Goal	Control the convenience systems in the vehicle, e.g. HVAC heating, ventilation and air conditioning, vehicle speed sensitive door locking and unlocking.
Use case input	Convenience systems settings, e.g. HVAC temperature of driver side
Use case output	Selected vehicle system adjusts to the settings provided by the V-ITS-SG /ND/customer
Brief description	With the installation of a V-ITS-SG, ND and appropriate software applications, the customer shall be in a position to remotely control/adjust the settings of the convenience systems installed in the vehicle.

10.6.3 UC 6.3 Control charging for EV

Table 23 specifies the use case of remotely controlling EV to start or stop for charging via ND.

Table 23 — Control charging for EV

Use case name	Control charging for EV
Actor	Nomadic Device, V-ITS-SG
Goal	Control EV to start/stop for charging procedure (based on ISO 15118)
Use case input	Command message (i.e. start or stop for charging) for EV
Use case output	Start or stop for charging procedure (based on ISO 15118)
Brief description	With the installation of a V-ITS-SG, ND and appropriate software applications, the customer shall be in a position to remotely control to start/stop for charging procedure (based on ISO 15118).

10.7 UC 7 Writing short and long term data to V-ITS-SG cluster

10.7.1 UC 7.1 Write data to V-ITS-SG's memory

Table 24 specifies the use case of customizing the V-ITS-SG to the vehicle and owner information for later identification use.

Table 24 — Write data to V-ITS-SG's memory

Use case name	Write data to V-ITS-SG's memory
Actor	Nomadic Device, V-ITS-SG
Goal	ND writes vehicle's licence plate number, VIN, etc. to V-ITS-SG's long term memory
Use case input	— Vehicle's licence plate number — VIN — Vehicle type — Vehicle model
Use case output	See Table 2
Brief description	With the installation of a V-ITS-SG, ND and appropriate software applications, the customer shall be in a position to write V-ITS-SG supported data items via the ND into the V-ITS-SG's memory for identification use. Examples of data items are a vehicle's licence plate number, VIN, etc.

10.7.2 UC 7.2 Write vehicle profile to V-ITS-SG's memory

Table 25 specifies the use case of storing the vehicle profile data into the V-ITS-SG's memory. This information is required for specific ITS services, e.g. to calculate a navigation route with minimum CO₂/km exhaust vs. minimum gas ltr/km.