BS ISO 15638-1:2012

BSI Standards Publication

Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV)

Part 1: Framework and architecture

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National foreword

This British Standard is the UK implementation of ISO 15638-1:2012.

The UK participation in its preparation was entrusted to Technical Committee EPL/278, Road transport informatics.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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INTERNATIONAL STANDARD

ISO 15638-1

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Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) —

Part 1: Framework and architecture

Systèmes intelligents de transport — Cadre pour applications télématiques collaboratives pour véhicules de fret commercial réglementé (TARV) —

Partie 1: Cadre et architecture

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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 15638-1 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

ISO 15638 consists of the following parts, under the general title *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV)*:

— *Part 1: Framework and architecture*

The following parts are to be published:

— *Part 2: Common platform parameters using CALM*

— *Part 3: Operating requirements, 'Approval Authority' procedures, and enforcement provisions for the providers of regulated services*

— *Part 4: System security requirements*

— *Part 5: Generic vehicle information*

— *Part 6: Regulated applications*

— *Part 7: Other applications*

Subsequent parts of ISO 15638 will provide definitions for specific TARV application services.

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Introduction

Many *ITS* technologies have been embraced by commercial transport operators and freight owners, in the areas of fleet management, safety and security. Telematics applications have also been developed for governmental use. Such regulatory services in use or being considered vary from country to country, but include electronic on-board recorders, vehicle charging, digital tachograph, on-board mass monitoring, vehicle access monitoring, hazardous goods tracking and e-call. Additional applications with a regulatory impact being developed include, fatigue management, speed monitoring and heavy vehicle charging based on mass, location, distance and time.

In such an emerging environment of regulatory and *commercial applications* *(4.15),* it is timely to consider an overall *architecture* *(4.7)* (business and functional) that could support these functions from a single platform within a commercial freight vehicle that operates within such regulations. International standards will allow for a speedy development and *specification* *(4.40)* of new applications that build upon the functionality of a generic *specification* platform. A suite of standards deliverables is required to describe and define the *framework* *(4.20)* and requirements so that the on-board equipment and *back office* *(4.9)* systems can be commercially designed in an open market to meet common requirements of *jurisdictions* *(4.24)*.

This suite of standards addresses and defines the *framework* *(4.20)* for a range of cooperative telematics applications for *regulated commercial freight vehicles* *(4.37)* (such as access monitoring, driver fatigue management, speed monitoring, on-board mass monitoring and charging). The overall scope includes the concept of operation, legal and regulatory issues, and the generic cooperative provision of services to *regulated commercial freight vehicles* *(4.37),* using an on-board *ITS* platform. The *framework* *(4.20)* is based on a (multiple) *service provider* *(4.39)* oriented approach provisions for the approval and auditing of *service providers* *(4.40)*.

This suite of standards deliverables:

— provides the basis for future development of cooperative telematics applications for *regulated commercial freight vehicles* *(4.37).* Many elements to accomplish this are already available. Existing relevant standards will be referenced, and the *specifications* *(4.41)* will use existing standards (such as *CALM*) wherever practicable.

— allows for a powerful platform for highly cost-effective delivery of a range of telematics applications for *regulated commercial freight vehicles* *(4.37).*

— presents a business *architecture* *(4.7)* based on a (multiple) *service provider* *(4.39)* oriented approach.

— addresses legal and regulatory aspects for the approval and auditing of *service providers* *(4.40)*.

This suite of standards deliverables is timely as many governments (Europe, North America, Asia and Australia/New Zealand) are considering the use of telematics for a range of regulatory purposes. Ensuring that a single in-vehicle platform can deliver a range of services to both government and industry through open standards and competitive markets is a strategic objective.

This part of the ISO 15638 provides the overall *framework* *(4.20)* description and *architecture* *(4.7)* for *TARV*, including the detailed *architecture* *(4.7)* *specification* *(4.40)* of the facilities layer.

NOTE 1 The definition of what comprises a ‘regulated’ vehicle is regarded as an issue for National decision, and may vary from country to country. This suite of standards deliverables does not impose any requirements on nations in respect of how they define a regulated commercial freight vehicle.

NOTE 2 The definition of what comprises a ‘regulated’ service is regarded as an issue for National decision, and may vary from country to country. This suite of standards deliverables does not impose any requirements on nations in respect

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of which services for regulated commercial freight vehicles countries will require, or support as an option, but provides standardised sets of requirements descriptions for identified services to enable consistent and cost efficient implementations where implemented.

NOTE 3 *Cooperative ITS (4.14)* applications, in this context, are defined as the use of an in-vehicle *ITS* platform to meet both commercial and regulatory needs from a (functionally) single on-board platform.

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Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) —

Part 1:
Framework and architecture

1 Scope

This part of ISO 15638 provides the following for cooperative telematics applications for *regulated commercial freight vehicles* *(4.37)*:

a) A *framework* *(4.20)* for the provision of cooperative telematics application services for regulated commercial freight vehicles;

b) A description of the concept of operation, regulatory aspects and options and the role models;

c) A conceptual *architecture* *(4.7)* using an on-board platform and wireless communications to a *regulator* *(4.25)* or his agent;

d) References for the key documents on which the *architecture* *(4.7)* is based;

e) Details of the *architecture* *(4.7)* of the facilities layer;

f) A taxonomy of the organisation of generic procedures;

g) Common terminology for the ISO 15638 family of standards.

This part of ISO 15638 is based on a (multiple) *service provider* *(4.39)* oriented approach.

ISO 15638 has been developed for use in the context of regulated commercial freight vehicles. There is nothing however to prevent a jurisdiction extending or adapting the scope to include other types of regulated vehicles, as it deems appropriate.

NOTE The specific 'approval' procedures for specific application services are a matter for the jurisdiction (4.24) and are outside the scope of this (or any) part of 15638. However approval authorities (4.6) are encouraged to use the guidance of ISO 17000 and ISO/IEC 17065:2012 when developing and implementing such procedures.

2 Conformance

This part of ISO 15638 defines a general architecture (4.7), and has no specific conformance tests defined herein. Some aspects defined within may have conformance tests defined in other parts of ISO 15638.

Conformance declarations for the various parts of a CALM-compliant system shall be based on the relevant

CALM-related international standards.

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Conformance to any other international standard or specification (4.40) referenced in this part of ISO 15638 shall be ascertained according to the requirements of the referenced deliverable.

Conformance to this part of ISO 15638 is therefore a matter of self declaration of compliance, or by submission to a test house to ascertain that the provisions of the clauses of this part of ISO 15638 have been adhered to.

3 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/TR 12859, *Intelligent transport systems — System architecture — Privacy aspects in ITS standards and systems*

ISO 15638-2 [1], *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Common platform parameters using CALM*

ISO 15638-3 [2], *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Operating requirements, 'Approval Authority' procedures, and enforcement provisions for the providers of regulated services*

ISO 15638-5 [3], *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Generic vehicle information*

ISO/TS 15638-6 [4], *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Regulated applications*

ISO 15638-7 [5], *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Other applications*

ISO 21210, *Intelligent transport systems — Communications access for land mobiles (CALM) — IPv6 Networking*

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

ISO 21218, *Intelligent transport systems — Communications access for land mobiles (CALM) — Medium service access points*

ISO 24102, *Intelligent transport systems — Communications access for land mobiles (CALM) — Management*

ETSI TS 102 665, Digital Enhanced Cordless Telecommunications (DECT); DECT access to IP networks

NOTE 1 Subsequent parts of ISO 15638 will provide definitions for specific TARV application services.

NOTE 2 See Bibliography for references to other parts of ISO 15638 which are in various stages of ballot, but not yet published at the date of publication of this International Standard.

[1] To be published.

[2] To be published.

[3] To be published.

[4] To be published. Full International Standard approval procedures are in process.

[5] To be published.

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4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE This clause contains all definitions generally used within the ISO 15638 suite of standards.

4.1
applicant
party which has applied for approval as a *service provider* *(4.39)*

4.2
application service
service provided by a *service provider* *(4.39)* accessing data from the *IVS* *(4.23)* of a *regulated commercial freight vehicle* *(4.37)* via a wireless communications network

4.3
appoint/appointment/appointed
assign officially to take responsibility for a role

4.4
approval
formal affirmation that an *applicant* *(4.1)* has satisfied all the requirements for *appointment* *(4.3)* as a *service provider* *(4.39)*

4.5
approval agreement
written agreement made between an *approval authority (regulatory)* (4.6) and a *service provider* (4.39)

NOTE An *approval agreement* *(4.5)* recognises the fact that a '*service provider*' *(4.39)* having satisfied the '*approval authority (regulatory)* *(4.6)* requirements for *appointment* *(4.3)* as a '*service provider*', is *appointed* *(4.3)* in that capacity, and sets out the legal obligations of the parties with respect to the on-going role of the 'service provider'.

4.6
approval authority (regulatory)
organisation (usually independent) which conducts *approval* *(4.4)* and ongoing *audit* *(4.8)* for *service providers* *(4.39)*

4.7
architecture
formalised description of the design of the structure of *TARV* and its *framework* *(4.20)*

4.8
audit
review of a party's capacity to meet, or continue to meet, the initial and ongoing *approval agreements* *(4.5)* as a *service provider* *(4.39)*

4.9
back office
generic term for the computing and communication facilities of a *service provider* (4.39) or an *approval authority (regulatory)* (4.6) or *jurisdiction regulator* (4.25)

4.10
basic vehicle data
data that shall be maintained/provided by all *IVS* *(4.23)*, regardless of *jurisdiction* (4.24)

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4.11
Controller Area Networking bus
CAN bus
network designed for use in automotives; it uses a single terminated twisted pair cable; is multi master; maximum signal frequency used is 1 Mbit/sec; length is typically 40M at 1Mbit/sec up to 10KM at 5Kbits/sec; it has high reliability with extensive error checking; typical maximum data rate achievable is 40KBytes/sec; maximum latency of high priority message <120 µsec at 1Mbit/sec

NOTE CAN is unusual in that the entities on the network, called nodes, are not given specific addresses. Instead, it is the messages themselves that have an identifier which also determines the messages' priority. For this reason there is no theoretical limit to the number of nodes although in practice it is ~64.

4.12
certification authority (digital)
organization which issues digital certificates for use by other parties (specifically in the context of communications security)

4.13
cmpn
OSGi® (open services gateway initiative) service platform specifications

[OSGi®]

4.14
cooperative ITS
C-ITS
ITS applications in *regulated commercial freight vehicles* *(4.37)* for both regulatory and commercial purposes that require the exchange of data between uncontracted parties using *ITS* stations

4.15
commercial applications
ITS applications in *regulated commercial freight vehicles* *(4.37)* for commercial (non-regulated) purposes

Example Asset tracking, vehicle and engine monitoring, cargo security, driver management etc.

4.16
condition
set of rules determined by the *jurisdiction* *(4.24)* to trigger the generation of reports

EXAMPLE Compliance or non-compliance reports, *exception reports* *(4.19),* condition reports, events, alarms and passage reports.

4.17
core application data
basic vehicle data (4.10) plus any additional data required to provide an implemented *regulated application service* (4.36)

4.18
enrolment
official registration to participate

4.19
exception report
report that is generated according to the *condition(s)* *(4.16)* in an application, and forwarded to a *jurisdiction* *(4.24)* by a *service provider* *(4.39)*

4.20
framework
particular set of beliefs or ideas referred to in order to describe a scenario or solve a problem

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4.21
global navigation satellite system
GNSS
comprises several networks of satellites that transmit radio signals containing time and distance data that can be picked up by a receiver, allowing the user to identify the location of its receiver anywhere around the globe

4.22
global positioning system
GPS
instantiation of *GNSS (4.21)* controlled by the US Department of Defence

4.23
in-vehicle system (*IVS*)
ITS-station and connected equipment on board a vehicle

4.24
jurisdiction
government, road or traffic authority which owns the *regulatory applications (4.35)*

Example Country, state, city council, road authority, government department (customs, treasury, transport), etc.

4.25
jurisdiction regulator
regulator
agent of the *jurisdiction (4.24)* *appointed (4.3)* to regulate and manage TARV within the domain of the jurisdiction

NOTE May or may not be the *approval authority (regulatory) (4.6)*.

4.26
map
spatial dataset that defines the road system

4.27
on-board unit
OBU
integrated telematics unit installed on board which provides the specified telematics functionality required for the *IVS (4.23)*

4.28
OSGi® Bundles
OSGi® components made by the developers

4.29
OSGi® Execution environment
defines what methods and classes are available in a specific platform

4.30
OSGi® Life-cycle
application programming interface (API) to install, start, stop, update, and uninstall bundles

4.31
OSGi® Modules
layer that defines how a bundle can import and export code

4.32
OSGi® Security
layer that handles the security aspects

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4.33
OSGi® Services
connect bundles in a dynamic way by offering a publish-find-bind model for plain old JAVA® objects

4.34
prime service provider
service provider (4.39) who is the first contractor to provide *regulated application services (4.36)* to the *regulated commercial freight vehicle (4.37),* or a nominated successor on termination of that initial contract

NOTE The *prime service provider* is also responsible for maintaining the installed *IVS (4.23)*; if the *IVS* was not installed during the manufacture of the vehicle, the *prime service provider* is also responsible for installing and commissioning the *IVS.*

4.35
regulated/regulatory application
approval arrangement utilised by *jurisdictions (4.24)* for granting certain categories of commercial vehicle rights to operate in regulated circumstances subject to certain *conditions (4.16*

NOTE Each *jurisdiction* may use their own terminology including, but not limited to, permit, application, scheme, concession, exemption, gazettal and notice.

4.36
regulated application service
TARV application service (4.2) that is mandated by a regulation imposed by a *jurisdiction (4.24)*, or an option supported by a *jurisdiction*

4.37
regulated commercial freight vehicle
vehicle (often but not always designed to haul commercial freight) that is subject to regulations determined by the *jurisdiction (4.24)* as to its use on the road system of the jurisdiction in regulated circumstances, subject to certain *conditions (4.16),* and in compliance with specific regulations for that class of vehicle

NOTE At the option of jurisdictions this may require the provision of information via *TARV* or provide the option to do so.

4.38
regime for open application management
ROAM
facilities and open application execution and its management for *TARV* systems

4.39
service provider
party which is certified by an *approval authority (regulatory) (4.6)* as suitable to provide regulated or commercial *ITS application services (4.2)*

4.40
specification
explicit and detailed description of the nature and functional requirements and minimum performance of equipment, service or a combination of both

4.41
tamper
conduct towards *IVS (4.23)* or a *service provider's (4.39)* system which is intended to prevent the *IVS* or the *service provider's* system from functioning correctly

4.42
Unified Modeling Language
UML
graphical language for visualizing, specifying, constructing, and documenting the artifacts of a software-intensive system

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NOTE *UML* offers a standard way to write a system's blueprints, including conceptual things such as business processes and system functions as well as concrete things such as programming language statements, database schemas, and reusable software components, and is standardised as ISO/IEC 19501.

4.43
uniform resource identifier
URI
string of characters used to identify a name or a resource on the Internet

NOTE Such identification enables interaction with representations of the resource over a network (typically the World Wide Web) using specific protocols; schemes specifying a concrete syntax and associated protocols define each URI.

4.44
uniform resource locator
URL
uniform resource identifier [*URI* *(4.43)]* that specifies where an identified resource is available and the mechanism for retrieving it

NOTE In popular usage and in many technical documents and verbal discussions it is often incorrectly used as a synonym for *URI* *(4.43)* (The best-known example of the use of *URL*s is for the addresses of web pages on the World Wide Web, such as http://www.example.com/).

4.45
user
individual or party that enrols in and operates within a regulated or commercial *application service (4.2)*

Example Driver, transport operator, freight owner, etc.

5 Abbreviated terms

For the purposes of this part of ISO 15638 and the ISO 15638 suite of standards deliverables, the following abbreviated terms apply.

API
application programming interface

app
application programme

CALM
communications access for land mobiles

CAD
core application data *(4.17)*

CAN
controller area network *(4.11)*

C-ITS
cooperative intelligent transport systems

CDS
charging data services

DDS
distributed directory service

DMT
device management tree

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DSRC
dedicated short range communication

FA
interface between the facilities layer and the ITS-S applications entity

[ISO 21217]

FOAM
framework for open applications

[project CVIS]

G
gravitational force

GNSS
global navigation satellite system *(4.21)*

GPS
global positioning system *(4.22)*

HMC
host management centre

HMI
human/machine interface

I2I
infrastructure to infrastructure

ID
identity

IETF
internet engineering task force

IN
interface between the access layer and the networking and transport layer

[ISO 21217]

ITS
intelligent transport system

IVS
in-vehicle system *(4.23)*

JAR
JAVA® archive retrieval (file format)

LDT
local data tree

LDM
local dynamic map

LTE
long term evolution (mobile phone generation after 3G)

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MA
interface between the communication and station management entity and the ITS-S applications entity

[ISO 21217]

MF
interface between the communication and station management entity and the facilities layer

[ISO 21217]

MI
interface between the communication and station management entity and the access layer

[ISO 21217]
MN
interface between the communication and station management entity and the networking and transport layer

[ISO 21217]

MS
interface between the communication and station management entity and the security entity

[ISO 21217]

NF
interface between the networking and transport layer and the facilities layer

[ISO 21217]

OMA
open mobile alliance

OBU
on-board unit *(4.27)*

OEM
original equipment manufacturer

OSGi®
open services gateway initiative

RAM
random access memory

ROAM
regime for open application management (4.38)

RSE
roadside equipment

RSI
roadside Infrastructure

SAP
service access point

SF
interface between the security entity and the facilities layer

[ISO 21217]

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SI
interface between the security entity and the access layer

[ISO 21217]

SN
interface between the security entity and the networking and transport layer

[ISO 21217]

SOA
service oriented architecture

SSO
single sign-on

TARV
telematics applications for regulated commercial freight vehicles

UML
Unified Modeling Language *(4.42)*

(ISO 19501)

URI
uniform resource identifier *(4.43)*

URL
uniform resource locator *(4.44)*

UTC
universal time coordinated

V2I
vehicle to infrastructure (communication)

V2V
vehicle to vehicle communication

6 General overview and framework

6.1 Objective

This Clause describes a generic *framework* *(4.20)* for the provision of cooperative telematics *application services* *(4.2)* for *regulated commercial freight vehicles* *(4.37)*. Clause 7 provides the general concept of operations for which this *architecture* *(4.7)* is designed. Clauses 8 and 9 provide a *framework*, role definition and elaboration of the *architecture* at a conceptual level. Clause 10 provides the taxonomy of the *architecture* *(4.7)* and Clause 11 defines the communications *architecture*. Clause 12 defines the facilities layer and its interoperability.

Annex A provides some informative examples from telematics systems for regulated commercial freight vehicles, cited from Jurisdictions around the world.

6.2 National variations

6.2.1 As stated in the scope, the definition of what comprises a ‘regulated’ vehicle is regarded as an issue for National decision, and may vary from country to country.

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6.2.2 The instantiation of interoperable on-board platforms for regulated commercial freight vehicles with common features is expected to vary from country to country, as will the provision of regulated, or supported, services.

6.2.3 It is possible that some countries will mandate the use of such a platform, others will offer it as an option to meet the requirements of the regulation with minimum administration and paperwork (providing a good business case for operators to fit and use the equipment).

6.2.4 Some countries may implement a single, government operated, controlled, or contracted *service provider* *(4.39)* which is the single communication manager between the vehicle and the service. Other countries may provide a market based solution with multiple *service providers* competing for the business of vehicle operators.

6.3 Mandatory, optional and cooperative issues

6.3.1 As stated in 6.2.1, the definition of what comprises a 'regulated' service is regarded as an issue for National decision, and may vary from country to country. Further, services may be 'required' by a *regulator* *(4.25)*, or may be supported by a regulator, but not required. (There may for example be a choice between using electronic means to plan, approve and monitor the movement of a hazardous cargo journey, or to use traditional paper request, approval and monitoring).

6.3.2 The *IVS* *(4.23)* may also support the provision of other commercial *application services* *(4.2)* that are not required by the *regulator* *(4.25)*.

6.3.3 This suite of standards deliverables does not impose any requirements on Nations in respect of which services for regulated commercial freight vehicles countries will require, or which they will support as an option, but this suite of standards deliverables will provide a generic common *architecture* *(4.7)* within which countries can achieve their own objectives in respect of *application services* *(4.2)* for *regulated commercial freight vehicles* *(4.37)*, and provide standardised sets of requirements descriptions for identified services to enable consistent and cost efficient implementations where instantiated.

6.3.4 Cooperative *ITS* *(4.14)* applications, in this context, is the use of a common on-board platform to meet both regulated and commercial service provision.

6.4 Specification of service provision

Cooperative *ITS* *(4.14)* applications for regulated commercial freight vehicles (both regulated services and commercial services) are specified in terms of the service provision, and not in terms of the hardware and software.

6.5 Architecture options

Architecturally, it needs to be possible for a vehicle operator to use the services of different *service providers* *(4.40)* in different geographical areas, or for the provision of different services within the same geographical area. In these circumstances, where there is a market of competing service providers, the most likely solution may be expected to be that the *user* *(4.45)* will choose a single service provider who will install and maintain the *in-vehicle system* *(4.23)* into the regulated commercial freight vehicle and deliver all services that the user to which the user chooses to subscribe. In future years however, the in-vehicle system may be a vehicle original equipment *specification* *(4.40)* option, inbuilt at the time of manufacture of the vehicle, with service provider selection being a subsequent user choice (much as we select an internet service provider today). Other options are possible and should be able to be supported within the conceptual *architecture* *(4.7)*.

6.6 Approval of service providers

As determined by the regulatory *jurisdiction* *(4.24)*, the *service provider* *(4.39)* may need to be certified by the *regulator* *(4.25)*, and so some form of '*Approval authority (regulatory)* *(4.6)*' role forms an essential part of the *architecture* *(4.7),* but the role may and will be instantiated differently by different *jurisdictions*.

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7 Concept of operations

7.1 General

This Clause describes the characteristics of a proposed system from the viewpoint of an individual who will use that system. Its objective is to communicate the quantitative and qualitative system characteristics to all stakeholders.

This part of ISO 15638 describes the roles and responsibilities of the classes and actors involved in the provision of regulated services for regulated commercial freight vehicles using telematics.

This part of ISO 15638 recognises that there will be variations between *jurisdictions (4.24)*. It does not attempt, nor recommend, homogeneity between *jurisdictions*, simply it is designed to provide common standard features to enable equipment of common *specification (4.40)* to be used, and the common features of service provision to be able to be referenced by a jurisdiction in its regulatory and/or legislative regime simply by reference to an International Standards deliverable (requiring it to specify in detail only the particular additional requirements of a jurisdiction).

A 'concept of operations' (CONOPS) generally evolves from a concept and is a description of how a set of capabilities may be employed to achieve desired objectives.

7.2 Statement of the goals and objectives of the system

The overall objective of *TARV* is the assessment, monitoring etc. of regulated commercial freight vehicles to meet the requirements of the jurisdiction within it is operating, using telematics.

This is achieved by the provision of *application services (4.2)* for specific aspects of the control and management of *regulated commercial freight vehicles (4.37).* These services are provided by agreement with the *user (4.45),* and using an approved *service provider (4.39)* to meet the requirements of the jurisdiction using *in-vehicle system (4.23)* with communications capability between the vehicle and the *service provider,* and access to relevant data from the regulated commercial freight vehicle.

7.3 Strategies, tactics, policies, and constraints affecting the system

Strategies, tactics, policies and constraints, and indeed, the services that are regulated as mandatory or optionally supported, may vary from *jurisdiction 4.24)* to *jurisdiction. (*Clause 6 provides detail of the options of such aspects.

7.4 Organisations, activities, and interactions among participants and stakeholders

The classes, attributes and key relationships are described in Clause 8, and are some high level conceptual architectural detail is elaborated in Clause 9. Clause 10 provides the taxonomy of the *architecture (4.7)* and Clause 11 defines the communications *architecture*. Clause 12 defines the facilities layer and its interoperability.

7.5 Clear statement of responsibilities and authorities delegated

Clause 6 describes the high level options and issues. The actors, their responsibilities and authorities are described in Clause 8 below, and the roles are described in Clause 8 and in this Clause (Clause 7).

7.6 Operational processes for the system

The following description of operational processes is at a high abstracted level (above that of any particular application service). Specific services may have additional requirements not described herein, but guidance and *specification (4.40)* for some aspects may be obtained from ISO 15638-6 and ISO 15638-7.

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7.6.1 Service requirements definition

A jurisdiction passes legislation/regulation to require or support the provision of a particular *application service (4.2).* The legislation/regulation needs to provide clear and unambiguous definition of what is required.

7.7 Appointment of an approval authority (regulatory)

The jurisdiction creates or *appoints (4.3)* an authority to approve and *audit (4.8)* the process. The structure of that authority is a matter for the jurisdiction and it may be a separate appointed organisation, or a department of the *jurisdiction. (4.24).* Within the context of this part of ISO 15638, it is the actor 'role' of 'approval authority' that is important, not its structure, ownership or business model.

An *approval authority (regulatory) (4.6)* may only preside over the instantiation and operation of one particular *application service (4.2)*, or may preside over the instantiation and operation of some or all *application services* for regulated commercial freight vehicles (at the discretion of the jurisdiction).

The *approval authority (regulatory) (4.6)* will approve *service providers (4.40), IVS (4.23)*, and will provide *audit (4.8)* as described in Clause 6 above, in accordance with the requirements of the *jurisdiction (4.24)*.

NOTE: The *TARV* approval authority is described throughout as the '*approval authority (regulatory) (4.6)* to clearly distinguish it from a certification authority which issues digital certificates (especially in the context of communications security).

7.8 Role of service provider

The *service provider (4.39)* shall offer to users to provide the application service needed to meet the requirements of the legislation/regulation of the *jurisdiction (4.24).* The *service provider (4.39)* may also provide additional commercial services so long as they do not impair, impede or interfere with, the provision of the enrolled regulated application service(s).

7.9 User

The *user (4.45)* is most usually the operator of the regulated commercial freight vehicle, but in some cases may be the driver. He/she will enrol with the jurisdiction to have his service provided automatically by wireless communications. He/she will appoint an approved *service provider (4.39)* to provide the *regulated application service (4.36)* for the regulated commercial freight vehicle (or driver where appropriate).

It is the responsibility of the operator of the vehicle to enrol, and to have its vehicle equipped to enable it to provide the service (regardless of whether the *user (4.45)* of the service is the vehicle operator or the driver of the vehicle). So long as operator uses certified *service providers (4.40),* installers and maintainers, the operator may then assume that the application service will be provided in accordance with the legislation/regulations.

The *user (4.45)* will be responsible to pay any fees for the provision of the service agreed with the *service provider (4.39),* to the *service provider.* The means by which this is achieved is a subject for the commercial marketplace and is outside the scope of this part of ISO 15638.

7.10 Application service

The *service provider (4.39)* will provide the *regulated application service (4.36)* (and may also provide other commercial services so long as they do not impair, impede or interfere with, the provision of the enrolled regulated application service(s)).

In some *jurisdictions (4.24)* the *service provider (4.39)* application service, with authorisation from the *user (4.45),* may also collect permit fees, licence fees and other fees required to be paid to the *jurisdiction,* and forward these to the *jurisdiction.* The commercial provisions for such transactions are a matter between the jurisdiction and the *service provider* and are outside the scope of this part of ISO 15638.

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8 Conceptual architecture framework

8.1 General

Clause 7 above provided the generic concept of operations which these actors and classes enact in order to provide the application service(s). In order to specify a generic *framework* (4.20) standard of the ITS service platform, this framework standardisation deliverable identifies core actors and classes as described in 8.2 to 8.4 below, which are described as elements which are independent of any specific application.

8.2 Actors

This part of ISO 15638 defines a role model where the roles and responsibilities of four key actor classes are defined to provide an entity known as an 'application service':

a) the '*Jurisdiction(s)*' *(4.24);*

b) the '*Users*' *(4.76);*

c) the '*Service Provider(s)*' *(4.40);*

d) the '*Approval authority (regulatory)*' *(4.6)*.

The 'role model' provides the general attributes and the responsibilities of the parties. These aspects are described within this part of ISO 15638. Figure 1 illustrates a conceptual role model *architecture* *(4.7)* for *TARV*.

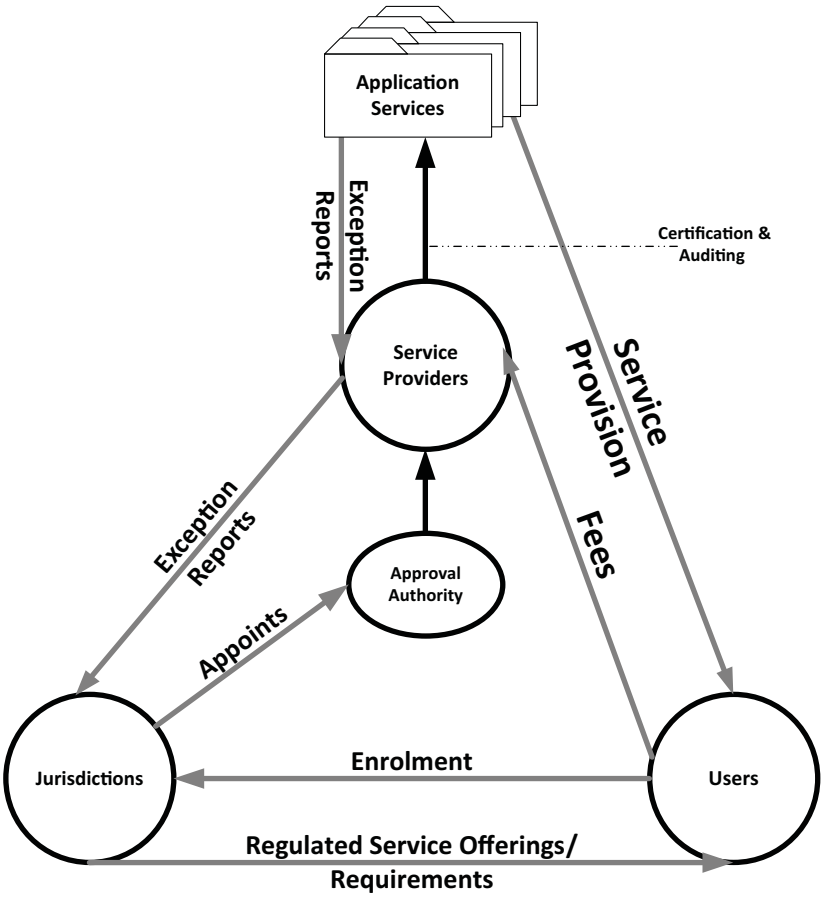

Figure 1 — Role model conceptual architecture

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However the basic rules of procedure are also required and shall be as defined in ISO 15638-3 (TARV – Operating requirements, 'Approval authority' approval procedures, and enforcement provisions for the providers of regulated services) which provides common generic *specifications* *(4.41)* for these issues in respect of *regulated application services* *(4.36)*. Individual service provision aspects shall be as provided in ISO 15638-5 (TARV – Essential and core application data', ISO 15638-6 (TARV regulated applications) and ISO 15638-7 (TARV- Other applications).

Using a *UML* *(4.42)* approach, the relationships between the classes can be represented as shown in Figure 2.

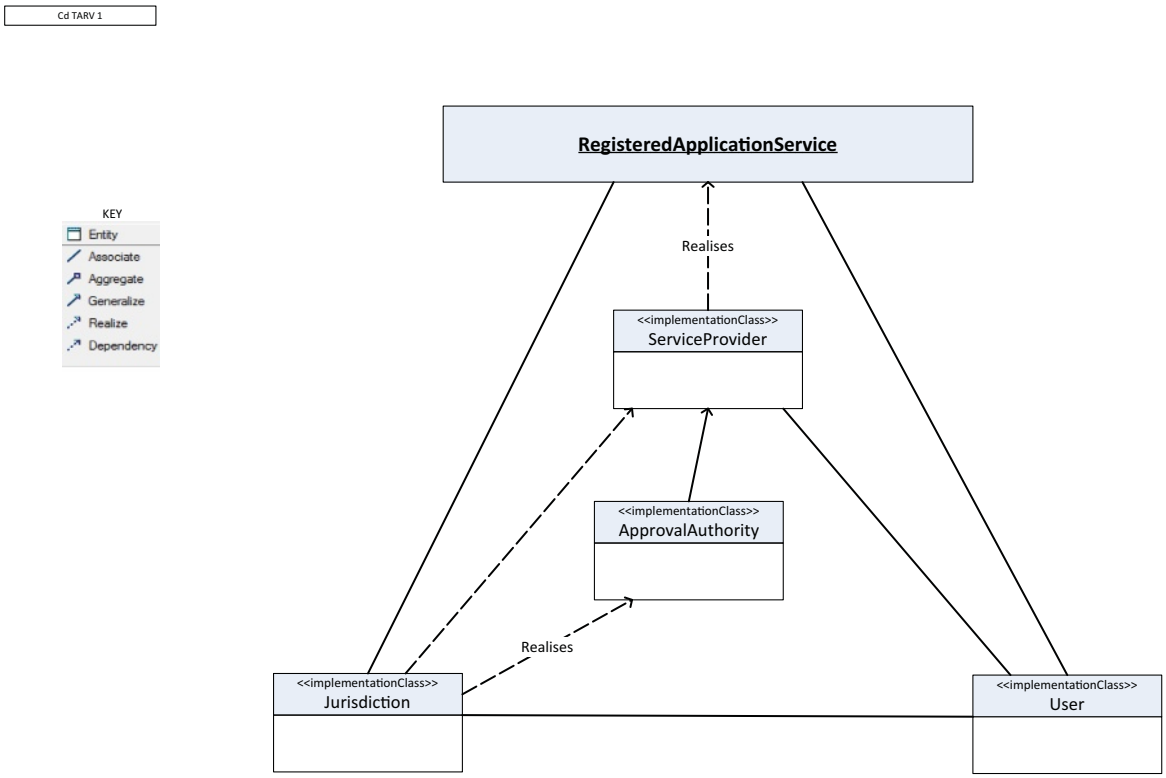

Figure 2 — UML model overview of the classes

The ISO 15638 family of standards deliverables comprises:

15638-1 TARV-Framework and architecture (this part)
15638-2 TARV-Common platform parameters using *CALM*
15638-3 TARV-Operating requirements, 'Approval Authority' procedures, and enforcement provisions for the providers of regulated services
15638-4 TARV-System security requirements *(expected completion TS 2012, IS 2013)*
15638-5 TARV-Essential and core application data
15638-6 TARV-Regulated applications *(expected completion TS 2012, IS 2013)*
15638-7 TARV-Other applications.

Clause 9 provides more detailed architectural elaboration of the role models.

The communications aspects of the concept can also be graphically represented as in Figure 3 below.

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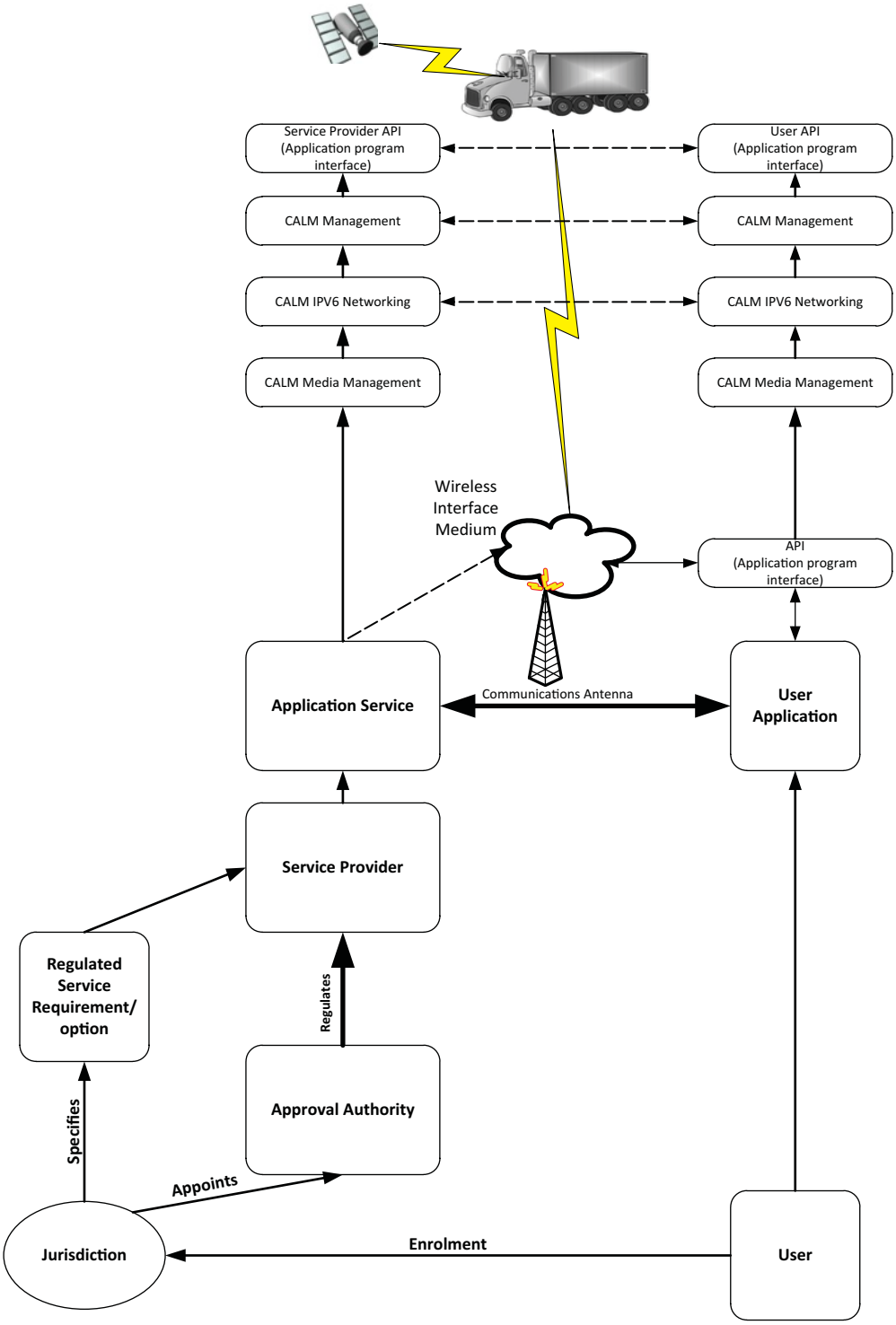

Figure 3 — Service provision and its communications

The communications *architecture* *(4.7)* is defined in greater detail in ISO 15638-2.

8.3 Service definition

For any specific service, regulated or commercial, mandatory or optional, the definition of the service that a *Service Provider'* *(4.40)* has to support shall be specified and provided, including a given service level. Specific application service examples can be found in ISO 15638-6 and ISO 15638-7.

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The service definition for each application service comprises:

a) a clear description of the service provided and its inputs, outputs and results;

b) basic vehicle data content and quality that an *IVS* *(4.23)* has to deliver;

c) *core application data* *(4.17)* content to meet the requirements of the jurisdiction;

d) any additional application specific data content for the provision of that particular service;

e) service elements (such as “retrieve data from *OBU*”, “map data to a map with access conditions”, “report non-compliance”, etc.);

f) rules for the *approval* *(4.4)* of *IVSs* *(4.23)*, ‘application *service providers* *(4.40)* ’ and ‘*application services* *(4.2)*’.

Unlike commercial services, regulated services, be they required or optional, are a special case, because the jurisdiction has to trust a *service provider* *(4.39)* to ensure that the *regulated application service* *(4.36)* is properly provided in accordance with the regulation. ‘*Rules for approval* *(4.4)*’ of *service providers* and *IVSs* *(4.23)* are therefore required, and there will in most instantiations be a ‘*Approval authority (regulatory)* *(4.6)*’ to regulate the service provision. ISO 15638-3 (TARV–Operating requirements, 'Approval Authority' procedures, and enforcement provisions for the providers of regulated services) provides both ‘*generic approval* *(4.4)* *procedures*‘ and ‘*Basic service requirements for Service Providers*’ that are generic and independent of a specific application.

(for example, shall have secure processing, shall have *map* *(4.26)*-matching capability, shall keep records in a transparent and auditable way, shall read *IVS* *(4.23)* data at defined intervals etc.). ISO 15638-3 provides *specifications* *(4.41)* for these issues.

ISO 15638-2 shall provide *specifications* *(4.41)* for communications aspects and the communications *architecture* *(4.7)* is defined in greater detail in ISO 15638-2.

ISO 15638-4 shall provide *specifications* *(4.41)* for security issues.

Application service provision shall in part provided by ‘*core application data* *(4.17)* ’, as defined in ISO 15638-5, and in part by requirements specific only to a particular regulated service application. *Basic vehicle data* *(4.10)* is calculated and stored by all *IVSs* *(4.23)*, regardless of *jurisdiction* *(4.24).* Additional specific data requirements of the *jurisdiction,* together with the *basic vehicle data* are known as the *core application data* *(4.17)*.

Examples of *Basic vehicle data* *(4.10)* include aspects such as: a unique vehicle identifier, a unique *IVS* *(4.23)* identifier, time and location data. ISO 15638-5 shall define the common data concepts for vehicle information known within the suite of ISO 15638 standards deliverables as *basic vehicle data* *(4.10)*. Some of this data is permanent for the lifetime, or a contract span, other information is dynamic and journey specific (such as location, freight and driver information). ISO 15638-3 shall define aspects such as identifying tasks, and who has responsibilities for them, such as: shall have secure data processing and storage, shall be physically and environmentally robust, shall be able to communicate with the *service provider* *(4.39)* etc.

Most services will also require data that is specific to the application**.** These are specific data concepts to enable the provision of a particular *application service* *(4.2).* For example, data from a tacograph for remote tacograph monitoring. ISO 15638-6 shall provide high level *specifications* *(4.41)* for these issues, in respect of commonly agreed generic requirements for *regulated applications* *(4.35)*, but is designed to operate in an environment where the jurisdiction determines its exact requirements and the application *service provider* *(4.39)* determines and designs the system that provides the application service to the *user* *(4.45).*

ISO 15638-7 shall provide generic *specifications* *(4.41)* for the standardised *specification* of future regulatory and commercial *application services* *(4.2)* which can share access to the on-board platform.

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8.4 Role model architecture

8.4.1 General

This Clause considers the roles of the actors defined in 8.2 and their interrelationship in greater detail, and their relationship to the provision of the applications service(s).

8.4.2 Jurisdictions

The *jurisdiction (4.24)* is the body that has official power to make legal decisions and impose regulations. How this operates will vary from country to country according to their constitution or legal structure. Countries may have a single *jurisdiction,* or may delegate such authorities to their constituent states, or, as in the case of Europe, independent states may concede part of their independent National jurisdiction to a common jurisdiction union (e.g. European Union) to achieve common goals and interoperability within common *conditions (4.16),* while retaining independent jurisdiction in other matters.

Regardless of the differences between *jurisdictions (4.24)*, what is common for the purposes of this part of ISO 15638, is the concept that at any specific location, and time, there is a single jurisdiction that has official power to make legal decisions and impose regulations in respect of the regulation of commercial freight transport.

While the specific *regulated application services (4.36)* that are offered or imposed on *regulated commercial freight vehicles (4.37)* will vary from *jurisdiction (4.24)* to *jurisdiction,* the generic requirements to offer or impose such *regulated application services* are largely similar.

The *jurisdictions (4.24)* are the owners of the *regulated applications (4.35)*. These may be required by regulation, or may be offered by a *jurisdiction* as an option to demonstrate compliance to a regulation, according to the choice of the *jurisdiction* and the regulations that it enforces.

Within the context of this part of ISO 15638, the role of the *jurisdiction (4.24)* is to:

— define the regulated application services (4.36);

— define if they are mandatory or optional;

— pass legislation to determine and regulate;

— manage and regulate the provision of the regulated application services.

Without prescribing the domestic arrangements within any *jurisdiction (4.24),* the management and regulation of the provision of the *regulated application services (4.36)* can be architecturally described as:

— laws and regulations;

— adopted standards;

— adjudication and mediation;

— auditing;

— *approval (4.4)* of equipment;

— *approval* of *service providers (4.40);*

— *approval* of *application services (4.2);*

— trusted third party;

involving five further classes/subclasses of actors in addition to the jurisdiction:

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— The jurisdiction;

— The service provider;

— The *IVS* *(4.23)* equipment installer (subclass);

— The *IVS* equipment maintainer (subclass);

— The *approval authority (regulatory)* *(4.6);*

— The user.

Single entities may perform the roles of multiple classes of actor (a *service provider* *(4.39)* for example may also install and maintain the *IVS* *(4.23)*). Other actors will also be embraced within these key roles (such as a communications provider), but these may be regarded as additional subclasses that support one of the key actor roles.

At the specific *jurisdiction* *(4,24)* level this *architecture* *(4.7)* can be elaborated in greater detail, and specifically to the instantiation of *TARV* within that *jurisdiction.* For the purposes of this part of ISO 15638, however, abstracting to the level of Figure 1 and Figure 2, provides a generic common *framework* *(4.20)* that can be instantiated with variations from jurisdiction to *jurisdiction,* yet remain a generic common *framework* *(4.20)* to which equipment can be built and *application services* *(4.2)* specified.

8.4.3 Service provider(s)

A *service provider* *(4.39),* within the context of this part of ISO 15638, can be described as a party which is certified by the *approval authority (regulatory)* *(4.6)* as suitable to provide regulated or commercial *ITS* services.

The *service providers* *(4.40)* may be provided or subcontracted by the *jurisdiction* *(4.24),* but are more likely to be by the use of third party commercial companies which provide *ITS* services. It is expected that in many cases, and particularly in the early years, the *service providers* will also install the *IVS* *(4.23)* into the users' vehicles, although in the future the *IVS* *(4.23)* platforms may be an option for installed equipment at manufacture, or may be mandated equipment at manufacture, according to the *jurisdiction,* and separation of the provision and maintenance of equipment and service provision may also be possible if allowed by the *jurisdiction.*

The *service provider* *(4.39)* will provide the application service, interacting wirelessly with the vehicle to collect relevant data from the *IVS* *(4.23)*, process the data and provide the *jurisdictions* *(4.24)* with *exception reports* *(4.19)* and any other relevant and required data, according to the requirements of the application(s), and provide relevant data to the *user* *(4.45).*

As stated in 6.2, some countries may implement a single, government operated, controlled, or contracted *service provider* *(4.39)* which is the single communication manager between the vehicle and the service. Other countries may provide a market based solution with multiple *service providers* competing for the business of vehicle operators. In instantiation, the role of the *service provider* is more complex where there may be multiple *service providers*, and even more complex where a *user* *(4.45)* may use multiple *service providers* for different services. The *architecture* *(4.7)* defined in this part of ISO 15638 has at least to encompass these three possibilities. Fortunately, the *architecture* for the most complex situation is also appropriate with its simpler alternatives.

This, the most complex of the options to instantiate, is sometimes called the *CDS* - Charging Data Services model. The model is simple, even if the instantiation options may make instantiation more complex. In this model *service providers* *(4.40)* compete in an open market to provide data based services for which they charge the *user* *(4.45)* a fee for the service provision. See Figure 4. The functionality of the model to provide *application services* *(4.2)* still operates where there the *service provider* is mandated by the *jurisdiction* *(4.24)* (and there is no open market), and operates regardless of whether the application service is an offered option or is a requirement mandated by regulation.

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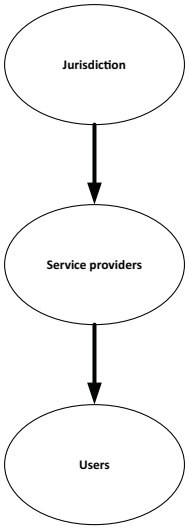

Figure 4 — CDS model

What is important to understand is that in this model, which fits clearly within the models shown in Figure 1 and Figure 2, responsibility for collection of data rests with *service providers* *(4.40)*.

The *service providers* *(4.40)* will most frequently charge the users for the service provided. It is also possible in this model that the *service provider* also collects fees required by the regulation from the *user* *(4.45)* (such as fees for permits, road use payment, additional policing, possibly even fees for violations) on behalf of the *jurisdiction* *(4.24)* and forward these payments to the *jurisdiction,* thus minimising the costs of the *jurisdiction* to maintain its regime. It is also possible that in some *jurisdictions* for some *regulated applications* *(4.35)* the *jurisdiction* may bear the cost of providing the service.

The responsibility for determination of such fees (or the scope within which the *service provider* *(4.39)* can set its fees) has to rest with the jurisdiction and will depend on the legislation and regulation imposed by the *jurisdiction* *(4.24).*

Multiple *service providers* *(4.40)* can also transmit raw or collated data to the back-office of the *jurisdiction* *(4.24),* or to transport departments of the *jurisdiction,* for which they may expect to receive fees from the authority, or it may be a *condition* *(4.16)* of their licence. In these cases privacy aspects need to be carefully considered by both the *jurisdiction* and *service provider* *(4.39).*

Approval *(4.4)* and auditing of *service providers* *(4.40),* to meet the requirements of the *jurisdiction* *(4.24)* is needed to guarantee required (and clearly defined) levels and quality of service.

In the open market context, *service providers* *(4.40)* are third party commercial companies who provide *ITS* services based on the applications. Where a *user* *(4.45)* employs a single *service provider* *(4.39)* to provide all of the regulated services (and possibly some additional commercial services) it may be expected that the *service providers* may also install and maintain *IVSs* *(4.23)* in the user's vehicles. However, in a situation where the *IVS* is provided as part of the original equipment *specification* *(4.40)* of the vehicle, or in a situation where a *user* elects to employ multiple *service providers* either to provide different services, or in different geographic areas, or a combination of both, we also need to introduce the concept of the 'equipment installer' and the 'equipment maintainer' as essential actor roles in the *architecture* *(4.7),* even if they are technically sub-classes of the *service provider.*

NOTE The choices may not necessarily be only those of the *user* *(4.45).* In some *jurisdictions* *(4.24)*, in order to maintain control and assure quality of service to its *regulated application services* *(4.36)*, and because of issues of liability, a *jurisdiction* may limit the option of the *user* to that of a single or limited number of *service providers* *(4.40)*.

Whatever the combination used, once contracted, the *service provider* *(4.39)* will be responsible to collect relevant data from the *IVS* *(4.23)*, process the data and provide the *jurisdiction(s)* *(4.24)* with reports according

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to the requirements of the *application service* *(4.2)* provided (as specified by the jurisdiction in respect of *regulated application services* *(4.36)*).

In most cases, although collecting data from the vehicle constitutes a crucial part of the service provision, the end results are sorted and evaluated by and at the *service provider* *(4.39)* and communicated to the *jurisdiction* *(4.24)* (as demanded by the regulation) and to the *user* *(4.45)* (as agreed in the contract between the *service provider* and the user).

While it is desirable that *service providers* *(4.40)* are also permitted to provide commercial services to users using the same *IVS* *(4.23)*, it will be necessary for the *service provider* to gain approval of the *regulator* *(4.25)* or its *approval authority (regulatory)* *(4.6)* to assure that the provision of a non-regulated service does not affect the quality of the service provision of any regulated services.

The technical requirements for a *service provider* should be performance based. That is, the *jurisdiction regulator* *(4.25)* defines required outputs and it is up to each potential service provider to establish, to the satisfaction of the *jurisdiction regulator*, or its *approval authority (regulatory)* *(4.6)*, that its equipment and related back-office systems deliver the required outputs. The *jurisdiction regulator* *(4.25)*, and its *approval authority (regulatory)*, should not normally specify the particular equipment and systems required. Thus, competing companies whose equipment and systems differ significantly may be certified, as long as they deliver the required outputs.

This enables *service providers* *(4.40)* to have the flexibility to take full advantage of innovative, cutting edge *ITS* technologies when designing and developing their equipment and systems, and to evolve those systems over time as technology advances. Coupled with market competition between *service providers* (where permitted by the *jurisdiction* *(4.24)*), this flexibility will ensure that the technology keeps pace with world-wide advances in broader *ITS* technologies.

8.4.4 Application services

Application services *(4.2)*, whether regulated or commercial, therefore need clear definition in terms of the requirements on the *service provider* *(4.39).* Guidelines and example *specifications* *(4.41)* are provided in 15638-6 and 15638-7.

It is important to understand the difference between *approval* *(4.4)* of the *application service* *(4.2)* provider and *approval* of the application service. Where there is only one *service provider* providing the service across the *jurisdiction* *(4.24),* or where a *user* *(4.45)* is tied to a single *service provider* for the provision of all of its services, the difference may at times seem somewhat academic, however there is a functional difference of significance.

The jurisdiction will want the provision of a *regulated application service* *(4.36)* to be identical for all users, regardless of *service provider* *(4.39).* It has only two ways to achieve this. It can appoint only one *service provider* to provide an application service, compelling all users to use the one *service provider* (in which case a *user* *(4.45)* may have to contract with multiple *service providers* *(4.40)* to provide different *application services* *(4.2)* unless the jurisdiction opts to offer a monopoly service provider). Alternately, there may be multiple *service providers* *(4.40)*. If there are multiple *service providers* it is crucial that the both the requirements of its *application service* *(4.2)* and the net result are identical, regardless of *service provider,* even if harvested in slightly different ways. Another way to achieve this would be for the jurisdiction to develop the application service, and provide the same software to multiple *service providers* to use. In this circumstance, responsibilities for any defects in the software, and all upgrades or modifications, will have to lie with the jurisdiction

ISO 15638-3 provides *specification* *(4.40)* for three simple generic *application services* *(4.2)*:

— basic vehicle data (4.10);

— core application data (4.17);

— stored data.

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ISO 15638-3 shall provide common requirements for operating requirements, *appointment (4.3)*, election and *approval (4.4)* and these operating service commands. ISO 15638-5 shall provide common core *specification (4.40)* for *regulated application services (4.36)* that *jurisdictions (4.24)* may elect to implement. The *specification* in ISO 15638-5 therefore provide *jurisdictions* with a way to ensure that the service provided and received for these *application services (4.2)* is homogenous across its regime. However, *jurisdictions* or their *appointed (4.3) regulator (4.25)* or approval authority *(4.6)* retain responsibility to ensure that the quality of service provision meets their requirements and is consistent from service provider *(4.39)* to *service provider.* Standards assist by providing common requirements specification, but that alone does not ensure consistent instantiation, and it is the responsibility of the jurisdiction and its agents- the *approval authority (regulatory)* function and *jurisdiction regulator (4.25)* function - to ensure quality and consistency, however it is organisationally arranged within the *jurisdiction.*

For regulated services, both the inputs and outputs, together with the process requirements to provide the service, need to be specified in a way that is independent of any *service provider (4.39)* or *IVS (4.23)* technology. Process requirements refer to the IT system used in, for example, the collection, processing, data storage, data reporting, security and quality management procedures. The *application service (4.2)* provider system shall have sufficient transfer capability in its specified communication coverage area, and sufficient storage and processing capacity to support the number of *IVSs* for which it has been certified, so the minimum *specifications (4.41)* for these requirements need also to be defined for each application service.

It shall not be allowed to provide the destination IPv6 address of a *jurisdiction (4.24), prime service provider (4.34)* or *application service (4.2)* provider, intended to be used for the receipt of data, to the party requesting data. Data issued from the ITS-station of the *IVS (4.23)* shall only be provided to a predetermined IPv6 address, and shall in no circumstances whatsoever be provided directly to an address specified by the party requesting the data.

NOTE By responding to a command by sending the response (data) only to a predetermined IPv6 address, the possible phishing and other unauthorised third party access to the data is significantly reduced.

8.4.5 The IVS equipment installer

This is the actor who installs the *IVS (4.23)*, into the vehicle and connects it to additional equipment that is required, so that it is able to perform the application service.

If this is part of the original equipment *specification (4.40)* for the vehicle, the *IVS (4.23)* equipment installer will be the vehicle manufacturer or his agent.

Where the *IVS (4.23)* is not part of the original equipment, the equipment installer is likely to be a *service provider (4.39)* or his agent, particularly in a situation where the market model is where a *user (4.45)* selects a single *service provider* (or is required to do so). In this environment each *service provider* offers and installs their own type of *IVS (4.23)* and has the freedom to offer different market models to recoup the cost of the equipment and its installation (similar to those *conditions (4.16)* which operate in the mobile telecommunications and satellite television markets).

In a situation where the *user (4.45)* is able to, and elects to, use multiple *service providers (4.40)*, the *IVS (4.23)* equipment installer is likely to be a third party commercial company. In these circumstances, it will be up to the jurisdiction to establish a regime that ensures effective quality control, and multi-equipment and system functionality, as such a regime will depend on the nature of the particular regulations for that *jurisdiction. (4.24)*

In all circumstances where the *IVS (4.23)* is not part of the original equipment it is expected that these equipment installers will in most *jurisdictions (4.24)* have to be registered with, and approved by, the *approval authority (regulatory) (4.6)*.

The *IVS (4.23)* equipment installer has the role not only to install the *IVS* communications equipment but to connect it to other equipment required in order to deliver the application service. For example, in the case of remotely monitoring an electronic tacograph, to connect the tacograph into the *IVS*; in the case of on-board weigh in motion monitoring, connecting that equipment to the *IVS*; etc., and to test the functionality of the installed equipment, and that where multiple equipment is connected, that all regulated services can be provided without detriment of one because of another.

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In order to maintain control of the regime, it would seem that it has to be the *IVS (4.23)* equipment installer who is held accountable by the *approval authority (regulatory) (4.6)* for providing the data to application service(s) to the required quality, and the only way that this can be practically achieved is through the service provider(s). Therefore, the installers of any other equipment have to be responsible to the *IVS* equipment installer that their equipment functions properly (and architecturally are therefore a sub-class of the *IVS* equipment installer) and, architecturally, the *IVS* equipment installer has to be responsible to (and is therefore architecturally a sub-class of) the *service provider (4.39).*

While the requirements of the *application service (4.2)* are determined by the *jurisdiction (4.24),* the *jurisdiction* also certifies, approves and *appoints (4.3)* service provider(s) and holds them accountable for the provision of the application service. The *jurisdiction* may decide that it also has to approve *IVS (4.23)* equipment providers, or it may leave this function to the *service provider (4.39)* which it will hold to account, and give the *service provider* freedom (possibly within some limits) as to how he controls his subcontractors.

8.4.6 The IVS equipment maintainer

Once installed, the *IVS (4.23)* equipment has to be maintained. Functionality and capabilities have to be checked from time to time, and the equipment may have to be recalibrated and recertified from time to time in accordance with the regime imposed by the *jurisdictions (4.24)*.

A number of business models for this can be envisaged. Maintenance may be a service provided by the service provider; it may be provided by the equipment installer; it may be provided by the vehicle maintainer; it may be provided by the vehicle inspector used for vehicle safety test *approval (4.4)*; etc.

The regime allowed will depend on how the jurisdiction best believes that its regime can be implemented and maintained, and will vary from *jurisdiction (4.24)* to *jurisdiction.*

Regardless of the business model operating within a particular *jurisdiction (4.24),* as with *IVS (4.23)* equipment installers, the *IVS* equipment maintainer can also architecturally be considered as a sub-class of the *service provider (4.39).*

8.4.7 Approval authority (regulatory)

Clause 6.5 expounded that if third party *service providers (4.40)* are to provide a service determined by the jurisdiction to users, the *jurisdiction (4.24),* and for that matter the *users (4.76),* need to be assured that this service is being properly provided to the regime and requirements of the jurisdiction's regulation. The *service provider* will therefore need to be certified by the regulator, and so some form of '*Approval authority (regulatory) (4.6)*' forms an essential component of the *architecture (4.7)* (even where this function is in practice carried out by the staff of the jurisdiction).

A '*Approval authority (regulatory) (4.6)*' would most commonly be expected to be an independent organisation which certifies the '*Service providers (4.40)*', and ensures that the level of service provided by the *service providers* is maintained, although *jurisdictions (4.24)* of course have the right to make other arrangements for approval and *audit (4.8)*. The concept of the (usually independent) '*Approval authority (regulatory) (4.6)*' *appointed (4.3)* by the jurisdiction is used throughout this *framework (4.20)* and *architecture (4.7)*.

Approval (4.4) refers to the confirmation of certain characteristics of an object, person or organisation. In this context, *approval (4.4)* applies to both the *service providers* and the *IVS (4.23)* for which requirements need to be formulated. These requirements need be described as tests to be passed. Each requirement leads to a verdict (passed or failed) on which the *approval* is based. While the ISO 15638 series of standards prescribe the generic requirements for appointing an *approval authority (regulatory) (4.6)*, the ISO 15638 series of standards do NOT prescribe the specific requirements to achieve *approval*, nor its procedures nor pass criteria, nor evaluation methods, which are deemed to be within the provenance of each *jurisdiction*, and not a matter for these International Standards.

8.4.8 Certification authority (digital)

Organization which shall issue digital certificates for use by other parties, particularly in the context of communications and online security.

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8.4.9 Service provider approval

This is the process where an organisation is certified as being able to competently complete the tasks to be fulfilled in the *regulated application(s)* *(4.35)*.

The prime role of the *approval authority (regulatory)* *(4.6)* is therefore, on behalf of the *jurisdiction* *(4.24),* and to its regime to:

— consider candidates to be service providers (4.40);

— test and approve that the service provider can meet the requirements necessary to provide the application service;

— approve their business model in relation to charging users (where required by the jurisdiction);

— approve and approve the service provider;

— determine the duration of the approval (4.4) and renewal options and requirements.

Approval *(4.4)* has a significant business impact. Based on the *approval* *(4.4)*, it will be decided which companies will be *appointed* *(4.3)* as *service providers* *(4.40)*. Such procedures therefore need to be clearly and unambivalently defined by the *jurisdiction* *(4.24).*

While *approval* *(4.4)* provides assurance that a service provider meets *approval* requirements at a point in time, a process of on-going *audits* *(4.8)* is also required to ensure that the *service provider* *(4.39)* continues to maintain the minimum level of service in accordance with the *approval* agreement.
The *audit* *(4.8)* requirements comprise a variety of aspects which include operational, technical and financial capabilities. The process of *audit* *(4.8)* is specific to the *regulated application* *(4.35)*. But the generic common objectives of the *audit* *(4.8)* function form the second set of requirements for the *approval authority (regulatory)* *(4.6)*, which are to:

— support the policy objectives to the various legislation and requirements;

— monitor compliance by *service providers* *(4.40)* with the standard and the *approval agreement* *(4.5);*

— ensure that information provided by the *service provider* is reliable, compete and accurate;

— assist in determining the integrity of information provided by the *service provider;*

— enhance transparency, integrity and public credibility of the *regulated applications* *(4.35)*.

8.4.10 Application service approval

In addition to the *approval* *(4.4)* of the *application service* *(4.2)* provider, each application service, whether regulated, or unregulated, shall need to be tested and certified by the *approval authority (regulatory)* *(4.6)* to assure that:

a) The system provides the *application service* *(4.2)* and its data consistent with its *specification* *(4.40)* and documentation;

b) The documentation is adequate;

c) The provision of the *application service* does not adversely impact the provision of other *regulated application services* *(4.36)*.

8.4.11 in-vehicle system (*IVS*) approval

Having assured that the *service provider* *(4.39)* is capable to provide and is certified to provide the *application services* *(4.2)*, the *approval authority (regulatory)* *(4.6)* has also to:

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— type approve' the *IVS* *(4.23)*, or if performance-based requirements are in place, perform tests to assure compliance with those standards.

— provide a regime to test and provide assurance that *IVS* *(4.23)* equipment is capable and properly installed in order to provide the *application services* *(4.2)*.

These should be seen as two functionally separate tasks.

Where an *IVS* *(4.23)* takes the form of a discrete *OBU* *(4.27)*, it can be 'type approved' using an independent test house. This is more complex in the case of *OEM* installed equipment, which will have to be certified as part of the vehicle type approval tests.

In respect of approving that approved equipment has been installed correctly, the *jurisdiction* *(4.24)*/*approval authority (regulatory)* *(4.6)* has a number of ways that it can do this, either by designing specific installation tests directly or assigning that role as a responsibility of a *service provider* *(4.39)*. That decision is to be made by the *jurisdiction* *(4.24)* and is not defined in this part of ISO 15638.

8.4.11.1 IVS type approval

In terms of in-vehicle platform (*IVS* *(4.23)*) *approval* *(4.4)*, this refers to processes intended to determine if the *IVS* meets minimum standards to assure the required quality.

8.4.11.1.1 VS instantiated as an OBU

In the case where the *IVS* *(4.23)* is an independent functioning *on-board unit* *(4.27)* (*OBU*) it may be viewed as a single product, independent of the vehicle into which it is fitted. It shall be tested in a testable environment where its' functionality can be tested separately from the functionality and performance of any equipment connected to it in order to provide data for the performance of an application service.

8.4.11.1.2 IVS instantiated not as an OBU

If the *IVS* *(4.23)* is part of the original equipment of the vehicle it is likely that there will not be a single *OBU* *(4.27)*, but that the functionality will be provided, at least in part via the *CAN bus* *(4.11)* and/or from similar equipment disbursed around the vehicle. For example, the *GNSS* *(4.21)* data and compass function will most probably be obtained from the vehicles satellite navigation system; accelerometer data and multi-axis gyroscope from the electronic drive/stability control, etc.

In this event, the *IVS* *(4.23)* *approval* *(4.4)* will have to be integrated into the overall vehicle *approval* *(4.4)*.

8.4.11.1.3 IVS attributes

The functionality of the *IVS* *(4.23)* is a computing device with six key attributes:

— central processing unit;

— data storage means;

— data input means;

— connectivity means to/from auxiliary equipment;

— communications means;

— power supply.

Each function needs specific tests as to fitness of purpose.

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8.4.11.1.3.1 Central processing unit

The *IVS* *(4.23)* shall be able to prove that it is able to perform the program of operations required in order to fulfil regulated service provision. This normally implies the combination of

— a processor;

— volatile memory (*RAM*/D*RAM*/S*RAM* etc.);

— recognised operating system (e.g. LINUX®).

Functionality tests for such systems are widely available and easily devised. The speed of the processor shall be adequate enough to perform the *regulated application service* *(4.36)*. By today's typical computer performance standards, these demands are not high and can be easily demonstrated to be satisfied.

NOTE Providers of in-vehicle platforms that may perform multiple functions in the vehicle in addition to regulated services may be advised to use high performance processors, but this should not be a requirement for the provision of currently envisaged regulated services.

Volatile memory shall be adequate to handle data processing of multiple *regulated applications* *(4.35)*. Since non-volatile memory will also be present, by standards of typical computer performance at the time of the development of this part of ISO 15638, these demands are not high and can be easily demonstrated to be satisfied.

The testing of the central processing unit shall be completely independent of any envisaged application service.

8.4.11.1.3.2 Data storage means

The *IVS* *(4.23)* shall have a means of non-volatile bistable data storage that can retain the stored information even when not powered (such as hard disc, flash memory etc.).

8.4.11.1.3.3 Data input means

The *IVS* *(4.23)* shall have a means to receive inputs both from auxiliary equipment, and from its communications capability (in order to receive and process instructions from the service provider)

8.4.11.1.3.4 Connectivity means to/from auxiliary equipment

The *IVS* *(4.23)* shall have multiple interfaces to connect with auxiliary equipment using standard physical interfaces (USB2, RS232, RS422 etc.) (or in the case of *OEM* installation, access to the *CAN bus* *(4.11)*).

In the case of a stand-alone *OBU* *(4.27)*, the equipment required to provide the '*basic vehicle data* *(4.10)*' as specified in ISO 15638-5 shall be provided within the *IVS* *(4.23)*. (*GNSS* *(4.21)*, accelerometer, multi-axis gyroscope, altimeter, clock, compass, etc., and probably a megapixel camera/video)

In the case of *OEM* installation the *IVS* *(4.23)* shall be provided with access to the vehicle generic data as specified in ISO 15638-5. *(*from *GNSS* *(4.21)*, accelerometer, multi-axis gyroscope, altimeter, clock, compass, etc., and probably a megapixel camera/video) or shall provide such functionalities as defined in ISO 15638-5 that are not available to it elsewhere.

8.4.11.1.3.5 Communications means

The *IVS* *(4.23)* shall have, or have access to, one or more wireless means to communicate with the *service provider* *(4.39)*. ISO 15638 architecturally envisages the communications link using the *CALM* protocols. The *CALM* protocols shall be as defined in ISO 21217 Intelligent transport systems — Communications access for land mobiles (*CALM*) — Architecture; ISO 21210 Intelligent transport systems — Communications access for land mobiles — IPv6 Networking; ISO 21218 Intelligent transport systems — Communications access for land

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