BS ISO 15638-2:2013

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

## Part 2: Common platform parameters using CALM

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**National foreword**

This British Standard is the UK implementation of ISO 15638-2:2013.

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

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

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INTERNATIONAL STANDARD

**ISO 15638-2**

First edition
2013-06-15

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

## Part 2: Common platform parameters using CALM

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

*Partie 2: Paramètres de plate-forme commune utilisant CALM*

Reference number
ISO 15638-2:2013(E)

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# Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is 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*

— *Part 2: Common platform parameters using CALM*

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

— *Part 5:Generic vehicle information*

— *Part 6: Regulated applications* [Technical Specification]

— *Part 7: Other applications*

— *Part 8: Vehicle access monitoring (VAM)* [Technical Specification]

— *Part 9: Remote electronic tachograph monitoring (RTM)* [Technical Specification]

— *Part 10: Emergency messaging system/eCall (EMS)* [Technical Specification]

— *Part 11: Driver work records (work and rest hours compliance) (DWR)* [Technical Specification]

— *Part 12: Vehicle mass monitoring (VMM)* [Technical Specification]

— *Part 14: Vehicle access control (VAC)* [Technical Specification]

— *Part 15: Vehicle location monitoring (VLM)* [Technical Specification]

— *Part 16: Vehicle speed monitoring (VSM)* [Technical Specification]

— *Part 17: Consignment and location monitoring (CLM)* [Technical Specification]

— *Part 18: ADR (Dangerous Goods) transport monitoring (ADR)* [Technical Specification]

— *Part 19: Vehicle parking facilities (VPF)* [Technical Specification]

The following parts are under preparation:

— *Part 4: System security requirements* [Technical Specification]

— *Part 13: Mass Penalties and Levies (VMC)*

# 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, it is timely to consider an overall architecture (business and functional) that could support these functions from a single platform within a commercial freight vehicle that operate within such regulations. International Standards will allow for a speedy development and specification 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 and requirements so that the on board equipment and back office systems can be commercially designed in an open market to meet common requirements of jurisdictions.

This suite of standards addresses and defines the framework for a range of cooperative telematics applications for regulated commercial freight vehicles (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, using an on-board ITS platform. The framework is based on a (multiple) service provider oriented approach provisions for the certification and auditing of service providers.

This suite of standards deliverables will:

- provide the basis for future development of cooperative telematics applications for regulated commercial freight vehicles. Many elements to accomplish this are already available. Existing relevant standards will be referenced, and the specifications will use existing standards (such as CALM) wherever practicable.
- allow for a powerful platform for highly cost-effective delivery of a range of telematics applications for regulated commercial freight vehicles.
- a business architecture based on a (multiple) service provider oriented approach
- address legal and regulatory aspects for the certification and auditing of service providers.

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 ISO 15638 provides definition and specification of the wireless communications media and related aspects required to support *TARV* and therefore the other parts of ISO 15638 by adherence to the 'CALM' *ITS-station* wireless communication and networking International Standards. This ensures a stable and interoperable communications architecture between a vehicle and an application service provider, and is also capable of vehicle-vehicle communications, and enables the same in-vehicle system (IVS) to support other standardised cooperative ITS systems using the same communications platform(s)

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 will not impose any requirements on nations in respect of how they define a regulated 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 will not impose any requirements on nations in respect of which services for regulated vehicles countries will require, or support as an option, but will provide standardised sets of

requirements descriptions for identified services to enable consistent and cost efficient implementations where implemented.

NOTE 3 Cooperative ITS applications, in this context, is defined as the use of ITS to meet both commercial and regulatory needs from a single on-board platform.

**INTERNATIONAL STANDARD** **ISO 15638-2:2013(E)**

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

## Part 2:
## Common platform parameters using CALM

### 1 Scope

This part of ISO 15638 defines a generic cooperative *ITS service* (4.3) platform for *TARV* using CALM, including protocol of coding, timing, and performance and support interfaces (such as driver ID card/USB or similar etc.).

### 2 Conformance

This part of ISO 15638 defines requirements for wireless communications within the *TARV* context, 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 that are normatively referenced in this part of ISO 15638.

Conformance to any other International Standard or specification 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, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

| | |
|---|---|
| EN 12253 | *Road transport and traffic telematics — Dedicated short-range communication — Physical layer using microwave at 5,8 GHz* |
| EN 12795 | *Road transport and traffic telematics — Dedicated Short Range Communication (DSRC) — DSRC data link layer: medium access andlogical link control* |
| EN 12834 | *Road Transport and Traffic Telematics — Dedicated Short-Range Communication (DSRC) — DSRC application layer* |
| ISO/TR 12859 | *Intelligent transport systems — System architecture — Privacy aspects in ITS standards and systems* |
| ISO 13183 | *Intelligent transport systems — Communications access for land mobiles (CALM) — Broadcast communications* |
| ISO 15628 | *Road transport and traffic telematics — Dedicated short range communication (DSRC) — DSRC application layer* |

| | |
|---|---|
| ISO 15638 -1 | *Intelligent transport systems — Framework for cooperative telematics applications for regulated commercial freight vehicles (TARV) — Part 1: Framework and architecture* |
| ISO 15638 -3 | *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Part 3: Operating requirements, 'Approval Authority' procedures, and enforcement provisions for the providers of regulated services* |
| ISO 15638 -4 | *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Part 4: System security requirements* |
| ISO 15638 -5 | *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Part 5: Generic vehicle data* |
| ISO 15638 -6 | *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Part 6: Regulated applications* |
| ISO 15638 -7 | *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Part 7: Other applications* |
| ISO 21210 | *Intelligent transport systems — Communications access for land mobiles (CALM) — IPv6 Networking* |
| ISO 21212 | *Intelligent transport systems — Communications access for land mobiles (CALM) — 2G Cellular systems* |
| ISO 21213 | *Intelligent transport systems — Communications access for land mobiles (CALM) — 3G Cellular systems* |
| ISO 21214 | *Intelligent transport systems — Communications access for land mobiles (CALM) — Infra-red systems* |
| ISO 21215 | *Intelligent transport systems — Communications access for land mobiles (CALM) — M5* |
| ISO 21216 | *Intelligent transport systems — Wireless communications — CALM using millimetre communications — Air interface* |
| ISO 21217 | *Intelligent transport systems — Communications access for land mobiles (CALM) — Architecture* |
| ISO 21218 | *Intelligent transport systems — Communications access for land mobiles (CALM) — Access technology support* |
| ISO 24102 | *Intelligent transport systems — Communications access for land mobiles (CALM) — Management* |
| ISO 25111 | *Intelligent transport systems — Communications access for land mobiles (CALM) — General requirements for using public networks* |
| ISO 25112 | *Intelligent transport systems — Communications access for land mobiles (CALM) — Mobile wireless broadband using IEEE 802.16* |
| ISO 25113 | *Intelligent transport systems — Communications access for land mobiles (CALM) — Mobile wireless broadband using HC-SDMA* |
| ISO 26683-2 | *Intelligent transport systems — Freight land conveyance content identification and communication — Part 2: Application interface profiles* |
| ISO 29281-1 | *Intelligent transport systems -- Communication access for land mobiles (CALM) — Non-IP networking — Part 1: Fast networking & transport layer protocol (FNTP)* |
| ISO 29281-2 | *Intelligent transport systems -- Communication access for land mobiles (CALM) — Non-IP networking — Part 2: Legacy system support* |
| ISO 29282 | *Intelligent transport systems — Communications access for land mobiles (CALM) — Satellite networks* |
| ISO 29283 | *ITS CALM Mobile Wireless Broadband applications using Communications in accordance with IEEE 802.20* |
| ITU-R BS.1194-2 | *Systems for multiplexing frequency modulation (FM) sound broadcasts with a sub-carrier* |

| | |
|---|---|
| | *data channel having a relatively large transmission capacity for stationary and mobile reception* |
| ITU-R BO.1408-1 | *Transmission system for advanced multimedia services provided by integrated services digital broadcasting in a broadcasting-satellite channel* |
| ITU-R BO.1516 | *System D, Digital multiprogramme television systems for use by satellites operating in the 11/12 GHz frequency range* |
| ITU-R BT.1306-3 | *System C, Error correction, data framing modulation and emission methods for digital terrestrial television broadcasting* |
| ITU-R BT.1833 | *Multimedia System C, Broadcasting of multimedia and data applications for mobile reception by handheld receivers* |
| ITU-R BS.1114-6 | *System F, Systems for terrestrial digital sound broadcasting to vehicular, portable and fixed receivers in the frequency range 30-3 000 MHz* |
| IEEE 802.11 | *IEEE Standard for Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications* |
| IEEE 1609.4 | *Wireless Access in Vehicular Environments (WAVE) — Multi-channel operation* |
| IEEE 802.16e | *Part 16: Air interface for fixed and mobile broadband wireless access systems: Amendment for physical and medium access control layers for combined fixed and mobile operation in licensed bands* |
| IEEE 802.16g | *Part 16: Air interface for fixed and mobile broadband wireless access systems: Management plane procedures and services* |
| IEEE 802.20 | *Part 20: Air Interface for Mobile Broadband Wireless Access Systems Supporting Vehicular Mobility - Physical and Media Access Control Layer Specification* |
| IETF RFC 2461 | *Neighbor Discovery for IPv6* |
| IETF RFC 2462 | *IPv6 Stateless Address Auto-configuration* |
| IETF RFC 3963 | *NEMO Basic Support protocol* |
| IETF RFC 4294 | *IPv6 Node Requirements* |
| 3GPP/3GPP2 | *3GPP/3GPP2 Standards as they relate to 2G/2.5G and 3G* |
| TIA-95-B | *Mobile Station-Base Station Compatibility Standard for Wideband Spread Spectrum Cellular Systems (cdmaOne)* |
| ANSI/TIA-136-A | *Mobile Station-Base Station Compatibility Standard for Wideband Spread Spectrum Cellular Systems* |
| TIA/EIA/IS-54-C | *Cellular System Dual-Mode Mobile Station--Base Station Compatibility Standard* |
| ARIB PDC RCR Standard No.27 | *Personal Digital Cellular Telecommunication System Fascicle 1* |
| ARIB STD-T75 | *Dedicated Short-Range Communication (Japan);* |
| ITU-R M.1801 | *Radio interface standards for broadband wireless access systems, including mobile and nomadic applications, in the mobile service operating below 6 GHz.*<br>*ANSI ATIS HC-SDMA is described in ITU-R document in this Recommendation ("RecDoc. 8/167(Rev.1) Annex 4 III")* |
| TTAS.KO-06.0025 | *Standard of DSRC Radio Communication between Road-side Equipment and On-board Equipment in 5.8GHz band (Korea);* |

## 4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15638-1 and the following apply.

**4.1**
**continuous session**
establishes a session as soon as the vehicle is switched on, and maintains that session, so long as it is possible, for as long as the vehicle is operating

**4.2**
**heterogeneous handover**
process by which a communication link is switched from one virtual communication interface to another one of a different medium type

**4.3**
**ITS service**
communication functionality offered by an *ITS-station* to an *ITS-station* application

**4.4**
**ITS-station**
**ITS-s**

entity in a communication network, comprised of application, facilities, networking and access layer components specified in ISO 21217 that operate within a bounded secure management domain

**4.5**
**MC Mode**
multi-carrier mode

NOTE: The 625k-MC mode referred to in this document is an enhancement of ANSI ATIS-0700004.2005, High Capacity-Spatial Division Multiple Access (HC-SDMA) Radio Interface Standard September, 2005.

**4.6**
**prime mover**
heavy-duty commercial vehicle tractor unit which serves as a method of moving trailers (most often semi-trailers) by coupling to the trailer using some sort of mechanical lock system, usually a fifth wheel coupling

NOTE: Tractor units can couple to different types of trailers.

**4.7**
**time controlled session**
active communication session created when the in-vehicle equipment at a time of its choosing initialises a time controlled session in order to send a message/exchange data, or it receives an inbound call, such as receipt of a safety message from the infrastructure; and the session is ended as soon as the task is achieved

**4.8**
**user controlled session**
user of the vehicle elects, for whatever reason, to connect upon the user's instruction and disconnect immediately when instructed to do so by the user

## 5 Symbols (and abbreviated terms)

For the purposes of this document, the general symbols and abbreviations for *TARV* are given in ISO 15638-1, and in the standards specifically reference in a Clause title. For additional symbols and abbreviated terms specific to ISO 15638-2 the following apply:

**API**
application programme interface

**CAL**
communication adaptation sub-layer

**CI**
communication interface

**CIAC**
communications interface access class

**CIC**
communication interface class

**CoA**
care of address

**C-SAP**
communications service access point

**CVIS**
Cooperative Vehicle-Infrastructure Systems (EU Project)

**DAB**
digital audio broadcasting

**DARC**
data radio channel

**DNS**
domain name server

**DSRC**
dedicated short range communication

**EGPRS**
enhanced *GPRS* (EDGE)

**FA**
facilities – applications

**FDD**
frequency division duplex

**FSS**
fixed satellite service(s)

**GEO**
geostationary earth orbit

**GNSS**
global navigation satellite system

**GPRS**
general packet radio service

**GSM**
global system mobiles

**HC-SDMA**
high capacity spatial division multiple access

**HoA**
home address

**IETF**
internet engineering task force

**I-Mode**
mobile internet (Japan)

**IN**
interface – network

**IP**
internet protocol

**IPv4**
internet protocol version 4

**IPv6**
internet protocol version 6

**IR**
infra-red

**ISDB-TSB**
Integrated services digital broadcasting-terrestrial sound broadcasting

**ITS-s**
*ITS-station* (4.4)

**ITS-SCU**
*ITS-station* (4.4) secure communication unit

**IVS**
in-vehicle system

**LAN**
local area network

**LEO**
low earth orbit

**LLC**
link layer control

**MA**
management – applications

**MAC**
media access control

**MAE**
management adaptation entity

**MF**
management – facilities

**MI**
management - interaction

**MIH**
media independent handover

**MMAE**
medium management adaptation entity

**MN**
management - network

**MNN**
*IPv6* mobile network node (by extension an abbreviation for ‘Mobile Network [*ITS-s IPv6 LAN*] Modes)

**MNP**
mobile network prefix

**M-SAP**
management service access point

**MSS**
mobile satellite service

**MSS/ATC**
mobile satellite service and ancillary terrestrial components

**MWB**
mobile wireless broadband

**NEMO**
network mobility (*IETF*)

**NF**
network – facilities

**OSI**
open systems interconnection

**PHY**
physical link layer

**PPP**
point to point protocol

**RDS**
radio data service

**S-DMB**
satellite digital multimedia broadcasting

**SA**
security – applications

**SAE**
security adaptation entity

**SAP**
service access point

**SF**
security – facilities

**SI**
security – interaction

**SN**
security – networking

**TARV**
telecommunications applications for regulated (commercial) vehicles

**TCP**
transport control protocol

**TID**
trailer identifier

**TDD**
time division duplex

**UDP**
user datagram protocol

**UMTS**
universal mobile telecommunications system

**VCI**
virtual communication interface

**VMS**
variable message sign

**WAP**
wireless access protocol

**W-LAN**
wireless local area network

## 6 General overview and framework

ISO/TS 15638-1 provided a framework and architecture for *TARV*. It provided a general description of the roles of the actors in *TARV* and their relationships. *TARV* communications shall be compliant to that framework and architecture.

To understand clearly the *TARV* framework the reader is referred to ISO/TS 15638-1.

Figure 1 shows the role model conceptual architecture showing the key actors and their relationships.

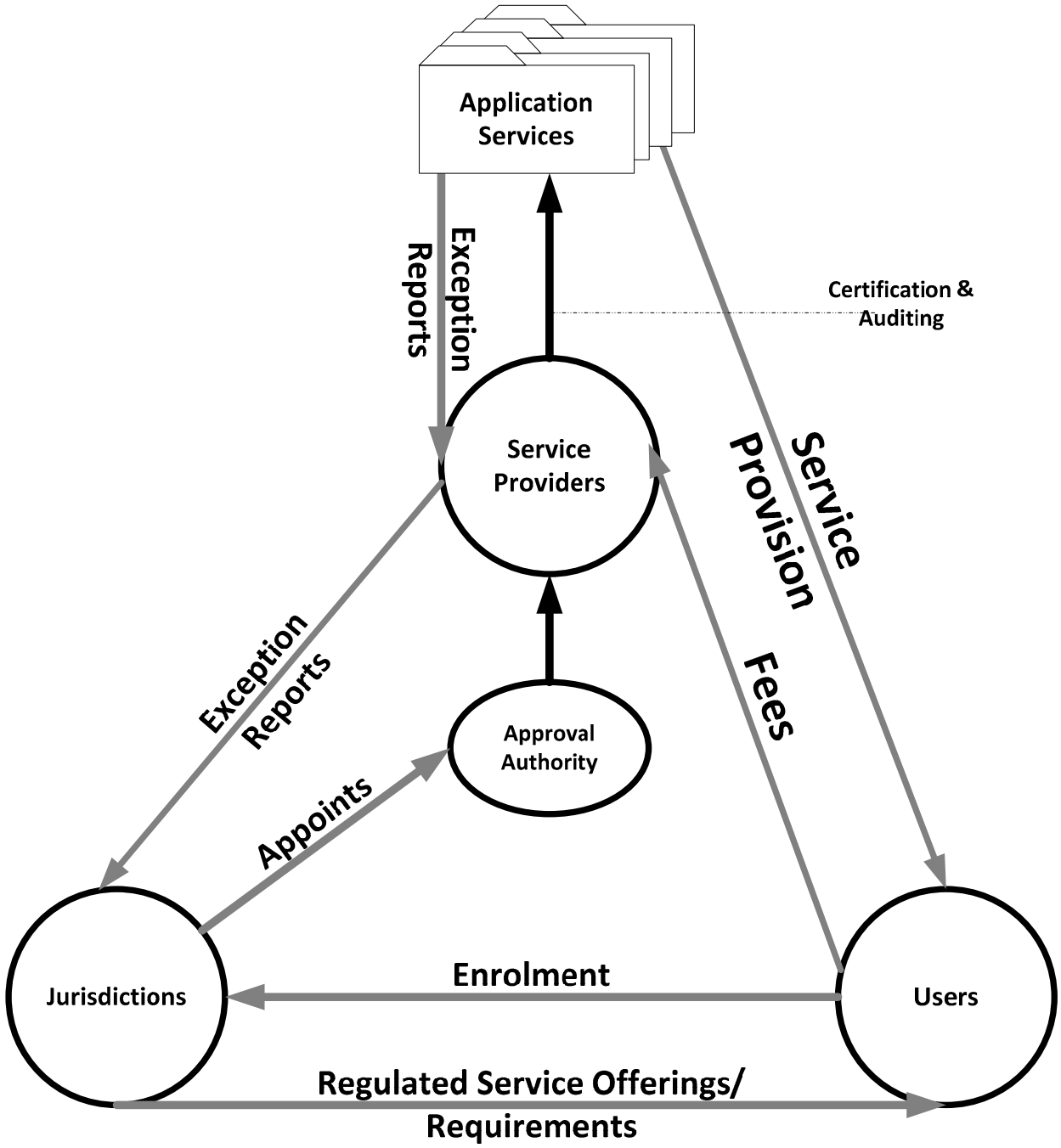


**Figure 1 — Role model conceptual architecture**
(Source: ISO 15638-1)

ISO 15638 provides a suite of standards deliverables addresses and defines the framework for a range of cooperative telematics applications for regulated commercial freight vehicles (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 *ITS service* (4.3) platform. The framework is based on a (multiple) service provider oriented approach provisions for the certification and auditing of service providers. ISO 15638 is comprised of seven framework parts and twelve application specific parts.

- Part 1 Framework and architecture
- Part 2: Common platform parameters using CALM

- Part 3: Operating requirements, 'Approval Authority' procedures, and enforcement provisions for the providers of regulated services
- Part 5:Generic vehicle information
- Part 6: Regulated applications [Technical Specification]
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- Part 8: Vehicle access monitoring (VAM) [Technical Specification]
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- Part 18: ADR (Dangerous Goods) transport monitoring (ADR) [Technical Specification]
- Part 19: Vehicle parking facilities (VPF) [Technical Specification]

The following parts are under preparation:

- Part 4: System security requirements [Technical Specification]
- Part 13: Mass Penalties and Levies (VMC)

This part specifies how different media can use the CALM suite of standards to provide wireless communications interface between the IVS and the application service provider.

# 7. Requirements

## 7.1 General

This part of ISO 15638 defines a generic cooperative *ITS service* (4.3) platform for *TARV* using CALM, including protocol of coding, timing, and performance and support interfaces (such as driver ID card/USB or similar etc.)

## 7.2 ISO 21217 CALM Architecture

### 7.2.1 ISO 21217 General requirement

The wireless network aspects of instantiations of *TARV* shall comply to the requirements of, and operate within the framework of the architecture defined in ISO 21217 Intelligent transport systems -Communications access for land mobiles (CALM) – ITS-station Architecture.

The following subClauses identify some of the aspects of ISO 21217 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 21217. However, in respect of CALM architecture, ISO 21217 is the paramount and core document and shall be consulted, and in respect of wireless communications shall be complied with in any *TARV* instantiation.

### 7.2.2 ISO 21217 Specific aspects as they relate to TARV

#### 7.2.1.1 Principles and viewpoint

Clause 5.1 of ISO 21217 states that 'CALM-related International Standards shall focus on specifying open interfaces with regard to the functionalities required for all relevant layers of the *OSI* reference model'.

#### 7.2.1.2 Wireless links

Figure 2 (of ISO 21217) illustrates the global ITS scope to be considered by the set of CALM-related International Standards. It shows several types of access technologies for wireless communication links between individual *ITS-station*s and between *ITS-station*s and legacy stations which can be expected to be present in ITS environments.

NOTE The CALM concept is not limited to the access technologies presented in Figure 2.

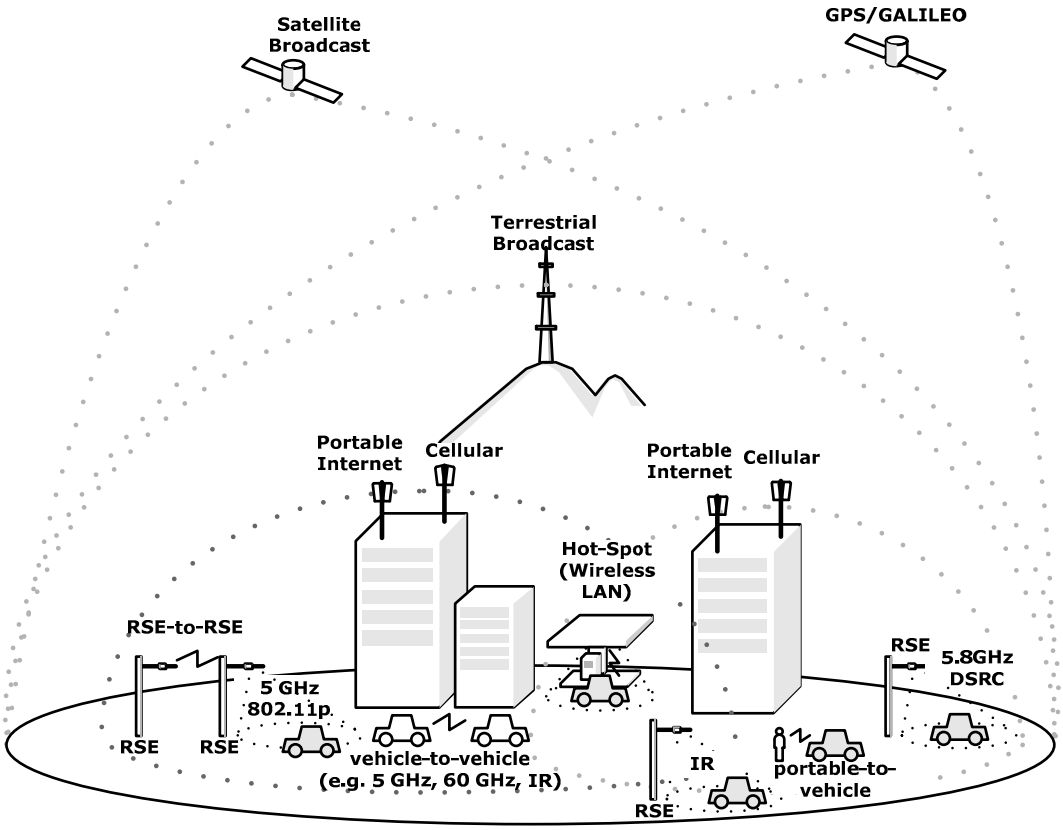


**Figure 2 — Examples of wireless links employing various access technologies**
(Source ISO 21217)

### 7.2.3 ISO 21217 Communication interface and channel types

ISO 21217 defines an implementation of an access technology as a communication interface (*CI*). The concept of a communication interface (*CI*) and its virtual communication interfaces (*VCI*s) are specified in ISO 21218. (See 7.10 below).

All CALM communication access points are regarded as peers and are called '*ITS-station*s' (*ITS-s*). In the context of *TARV* an *ITS-s* may be a roadside communication point, a *GSM*/*UMTS* access point, a wide area local network or WiFi point, or any of the CALM supported wireless access points determined below; a truck; or a trailer (connected to the *prime mover* (4.6) via CALM [other trailer-tractor communications may be hard wired or use other communications]).

Logical communication channels are determined as a key element of CALM's abstraction of *ITS-station* applications from the physical communication channels used to transport the information. *ITS-station* applications communicate through logical channels which are mapped by the *ITS-s* management to physical channels in communication interfaces. Automatic mapping of *ITS-s* applications on specific communication interfaces, referred to as "*CI* selection management", is specified in ISO 24102.(See 7.11 below)

Definitions of logical channel types are provided in ISO 21218. (See 7.10 below).

### 7.2.4 ISO 21217 Handover

It is envisaged that most *TARV* communications sessions will be short, therefore involving only one wireless medium. The IVS shall detect the media possibilities and, through CALM management (ISO 24102 See 7.11 below), select the most appropriate; or the IVS will be contacted by the landside system using an available wireless medium.
The *TARV* communication session will be transacted over that medium.

However, an essential feature of the CALM concept that distinguishes it from traditional communication systems is that applications are abstracted from the access technologies that provide the wireless connectivity and the networks that transport the information from the source to the destination(s). *ITS-station*s are not limited to a single access technology and networking protocol and can implement any of those supported, and the *ITS-s* management can make optimal use of all these resources. To exploit this flexibility, CALM-compliant systems provide the ability to support handover of different types including

- those involving a change of communication interface (which may or may not involve a change of access technology, since *ITS-station*s may have multiple communication interfaces using the same access technology),
- those involving reconfiguration or change of the network employed to provide connectivity, and
- those involving both a change in communication interface and network reconfiguration.

The following examples illustrate the various types of handover that are possible.

— *Homogeneous handover*:
Maintaining a session between an *ITS-station* application in a vehicular ITS subsystem and an *ITS-station* application in a central ITS subsystem using subsequent roadside *ITS-s*'s along the road of the same roadside subsystem, using the same access technology in the various *ITS-s*.

— *Heterogeneous handover*:
Maintaining a session between an *ITS-s* application in a vehicular ITS subsystem and an *ITS-s* application in a central ITS subsystem by switching from a dedicated CALM access technology, e.g. M5 or *IR*, to a public cellular network.

So where it is appropriate (as for example, may be the case monitoring the progress of nuclear waste in transit, or other highly controlled freight), it is possible for *TARV*, using CALM, to maintain a quasi-continuous communication session between the vehicle and central landside system.

### 7.2.5 ISO 21217 IVS - ITS subsystem

The IVS subsystem, known in ISO 21217 as the vehicular ITS subsystem presented in Figure 3, contains a vehicle *ITS-station* (*ITS-s*). The vehicle *ITS-s* may be physically split into *ITS-station* hosts, *ITS-station* routers and the CALM-compliant part of the vehicle *ITS-station* gateway.

The vehicle *ITS-s* gateway supports functionality in order to connect to the *ITS-s* host and the *ITS-s* router via the *ITS-station* (4.4)-internal network. The part of the vehicle *ITS-s* gateway which connects to the proprietary in-vehicle network and the electronic control units is outside the scope of ISO 21217.

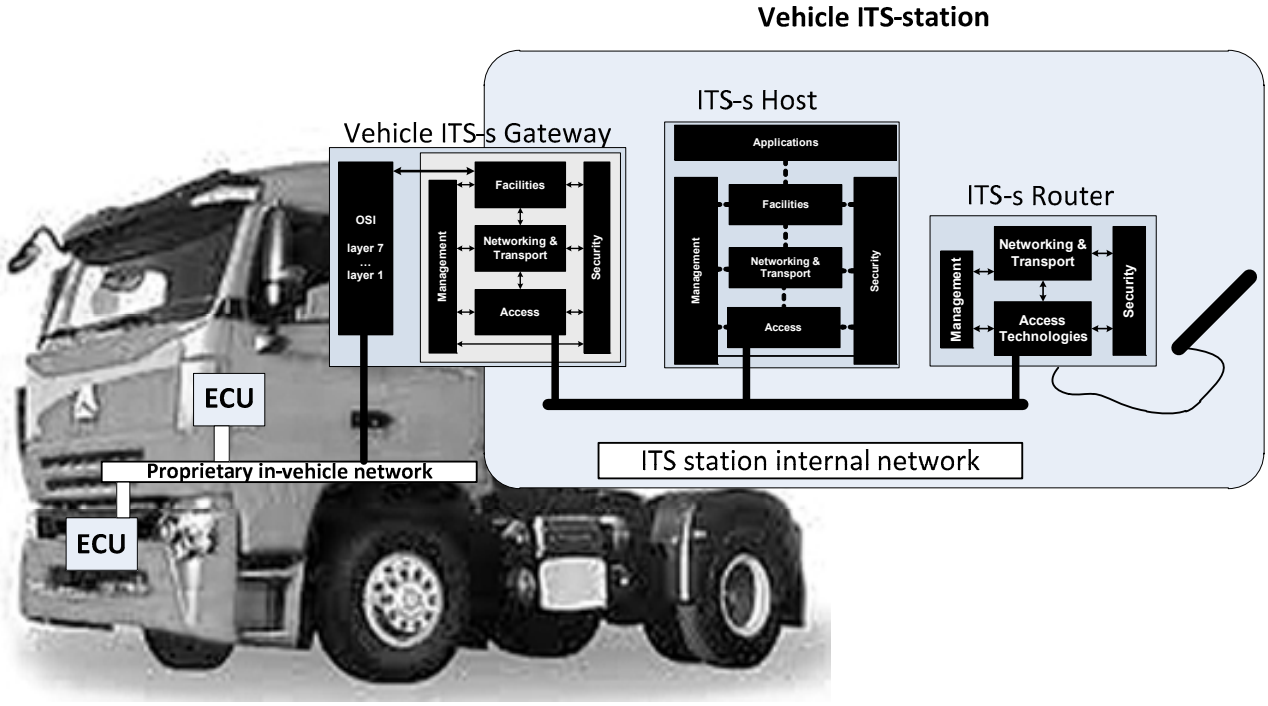


**Figure 3 — Vehicular ITS subsystem**
(detail taken from ISO 21217)

### 7.2.6 ISO 21217 Roadside ITS subsystem

The roadside ITS subsystem presented in Figure 4 contains a roadside *ITS-s*. The roadside *ITS-s* may be physically split into *ITS-s* hosts, *ITS-s* routers and the CALM-compliant parts of roadside *ITS-s* gateways and *ITS-s* border routers. In this context, the *ITS-s* router is also called an 'access router'.

The roadside *ITS-s* gateway supports functionality in order to connect to the *ITS-s* hosts, the *ITS-s* routers and the *ITS-s* border routers via the *ITS-station* (4.4)-internal network presented in Figure 4. The part of the roadside *ITS-station* gateway which connects to the proprietary roadside network and the roadside components such as variable message signs, inductive loops, etc., is outside the scope of ISO 21217.

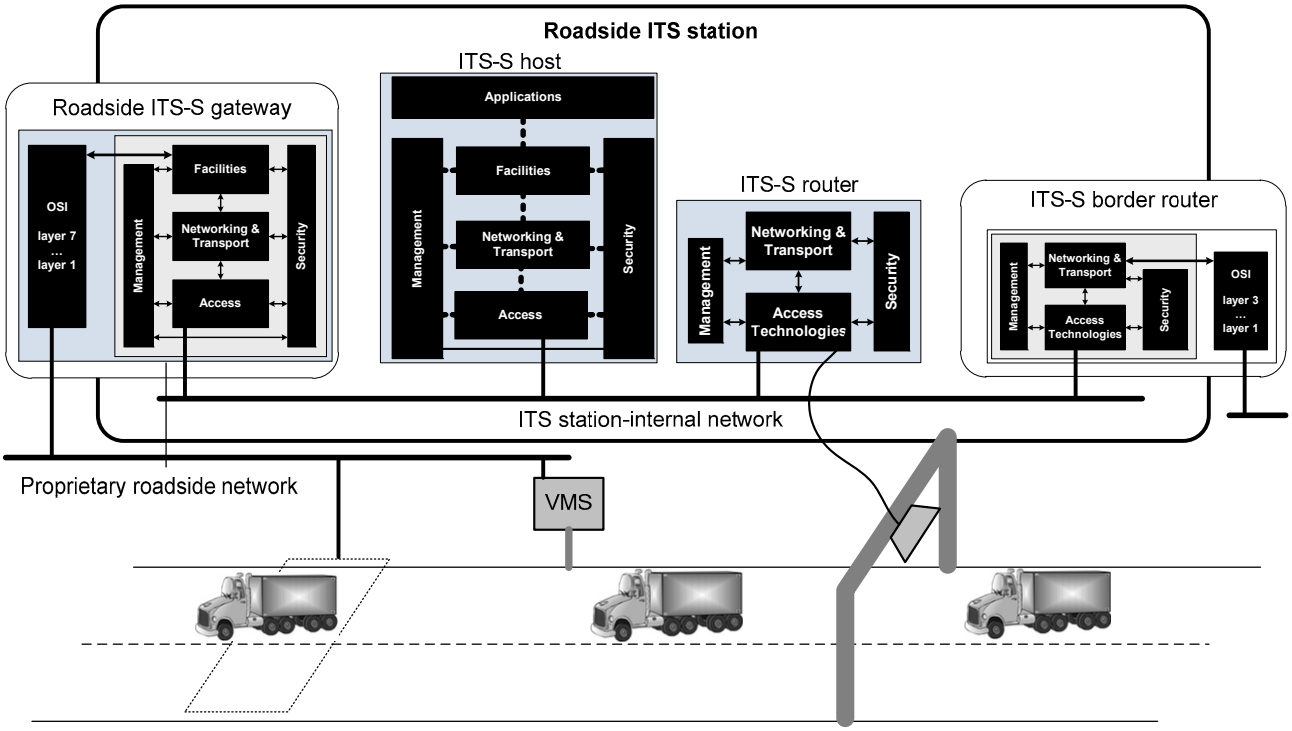


**Figure 4 — Roadside ITS subsystem**
(source ISO 21217)

### 7.2.7 ISO 21217 Communication scenarios and classes

#### 7.2.7.1 Communication scenarios

ISO 21217 specifies four basic communication scenarios. The distinction between these scenarios is based on two criteria:

a) whether the CALM-compliant *ITS-station* is connected to the final peer station
   1) with a single-hop link, or
   2) via a network;

b) whether the final peer station is
   1) also a CALM-compliant *ITS-station*, or
   2) a legacy station.

NOTE 1 This classification of scenarios does not consider any details of the network between CALM-compliant *ITS-station* and peer station.

NOTE 2 These communication scenarios are in no way restricted to a specific communication mode, i.e. broadcast, multicast or unicast mode.

NOTE 3 The *ITS-station* connecting to the peer station may be either the original source of a data packet or may act as a forwarding station.

Single-hop communication between two CALM-compliant *ITS-station*s, in accordance with ISO 21217 is presented in Figure 5. This can represent, for example, a link between two vehicle stations, or between a vehicle station and a roadside station. But in the ISO 15638 scenario, it primarily represents the link between the vehicle and the roadside, or, if wireless communications are used, between a trailer *TID* and the *prime mover* (4.6) IVS.

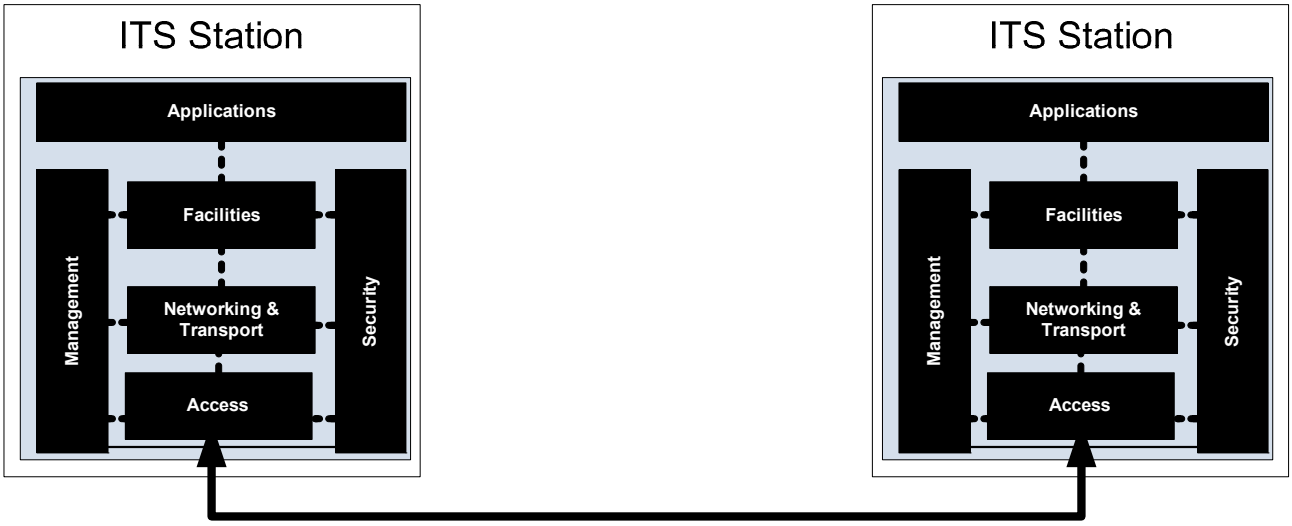


**Figure 5 — ISO 21217 Scenario I — *ITS-station* to *ITS-station* via single-hop link**
(source ISO 21217)

Communication between two CALM-compliant *ITS-station*s involving network connectivity is illustrated in Figure 6. This can represent, for example, a peer-to-peer communication involving a single-hop link from the *ITS-station* to a base station of a cellular network which is connected to the Internet which also provides the connection to the *ITS-station* of a central subsystem. Most *TARV* communications are made to an *IPv6* destination address, and so this scenario represents the most common scenario for ISO 15638 *TARV* applications.

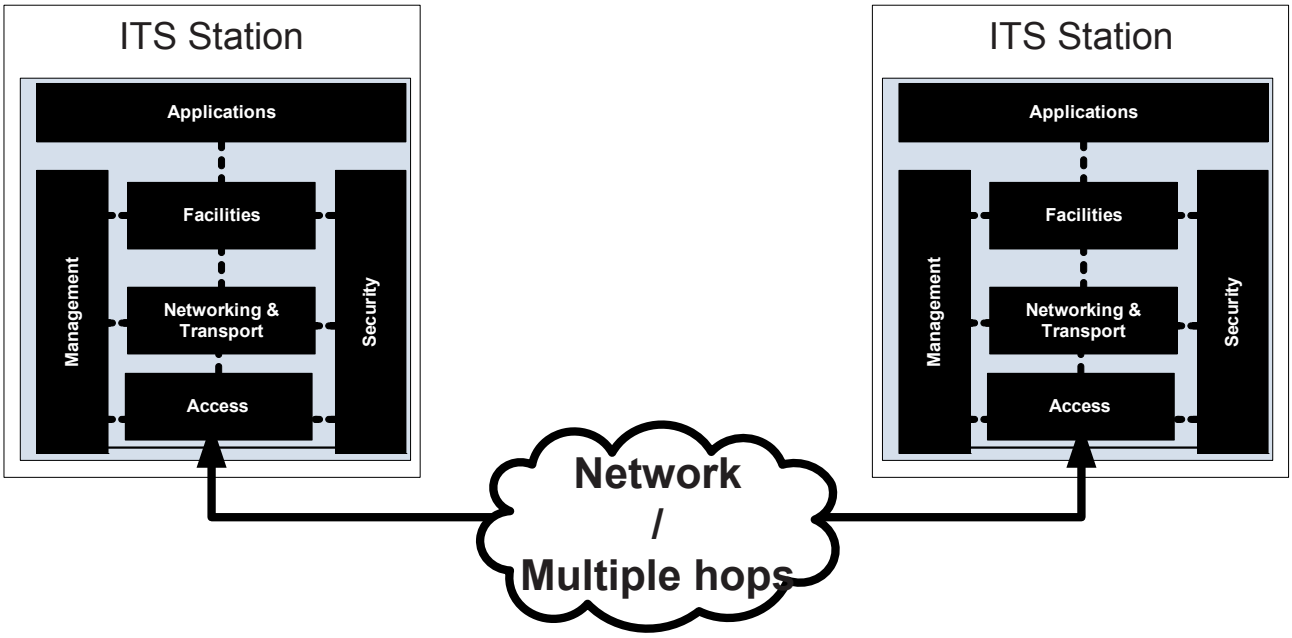


**Figure 6 – ISO 21217 Scenario II — *ITS-station* to *ITS-station* via network (multiple hops)**
(source ISO 21217)

Single-hop communication between a CALM-compliant *ITS-station* and a legacy station is illustrated in Figure 7. This can represent, for example, a link between a *DSRC* communication interface implemented in a vehicle *ITS-station*, as specified in ISO 29281 (see 7.9) , and a legacy (e.g. European standard *DSRC* roadside station).In the context of *TARV*, this is relevant if a legacy system link is used to download data from the vehicle to the central system.

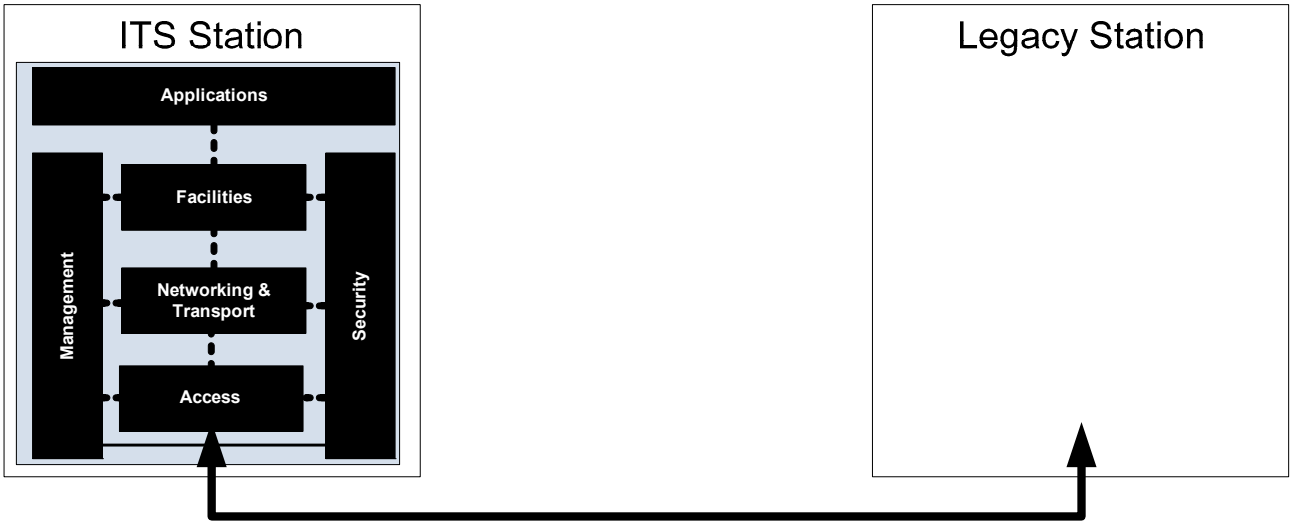


**Figure 7 — ISO 21217 Scenario III — *ITS-station* to legacy peer station via single-hop link**
(source ISO 21217)

Communication between a CALM-compliant *ITS-station* and a legacy station involving network connectivity is illustrated in Figure 8. This can represent, for example, a single-hop link from the *ITS-station* to a base station of a cellular network that connects to the Internet which also provides the connectivity to the legacy station In the context of *TARV*, this is relevant if a legacy system link is used to download data from the vehicle to the central system via an internet address.

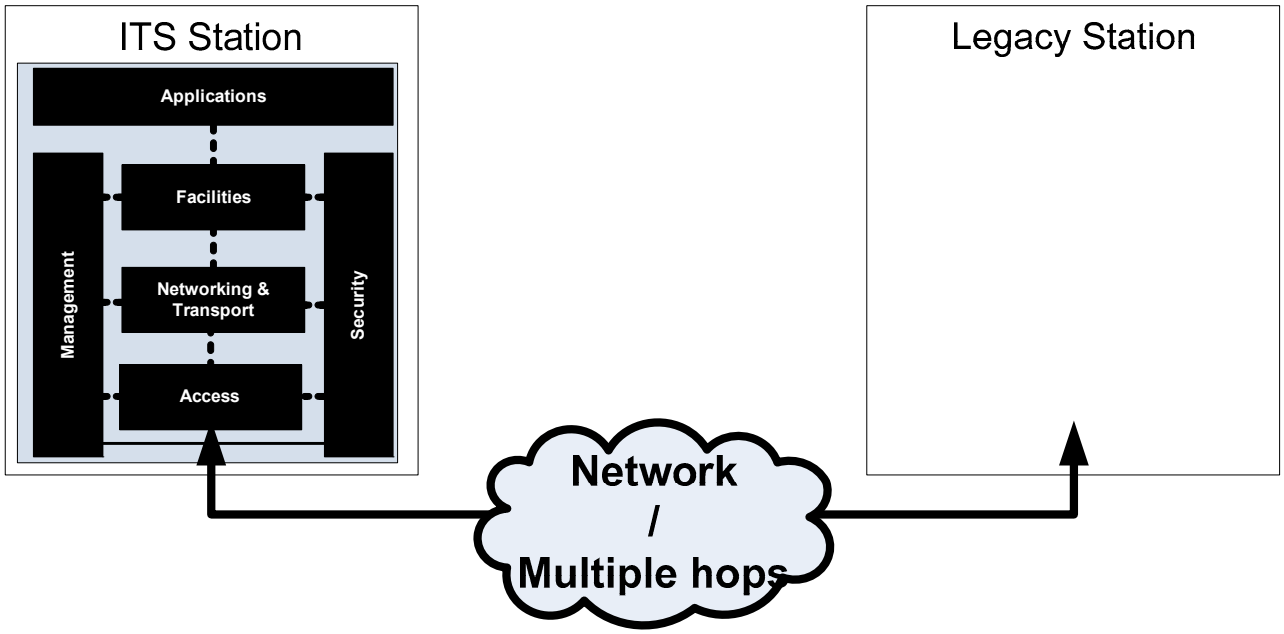


**Figure 8 – ISO 21217 Scenario IV — *ITS-station* to legacy peer station via network (multiple hops)**
(source ISO 21217)

An *ITS-station* may have multiple simultaneous active sessions involving any or all of these basic communication configurations.

### 7.3 ISO 21217 ITS-station reference architecture

#### 7.3.1 General

Figure 9 shows the general *ITS-station* (*ITS-s*) reference architecture, including interfaces between the various blocks with informative details. Such interfaces may be partly non-observable and thus non-testable service access points (*SAP*s), or observable and testable interfaces.

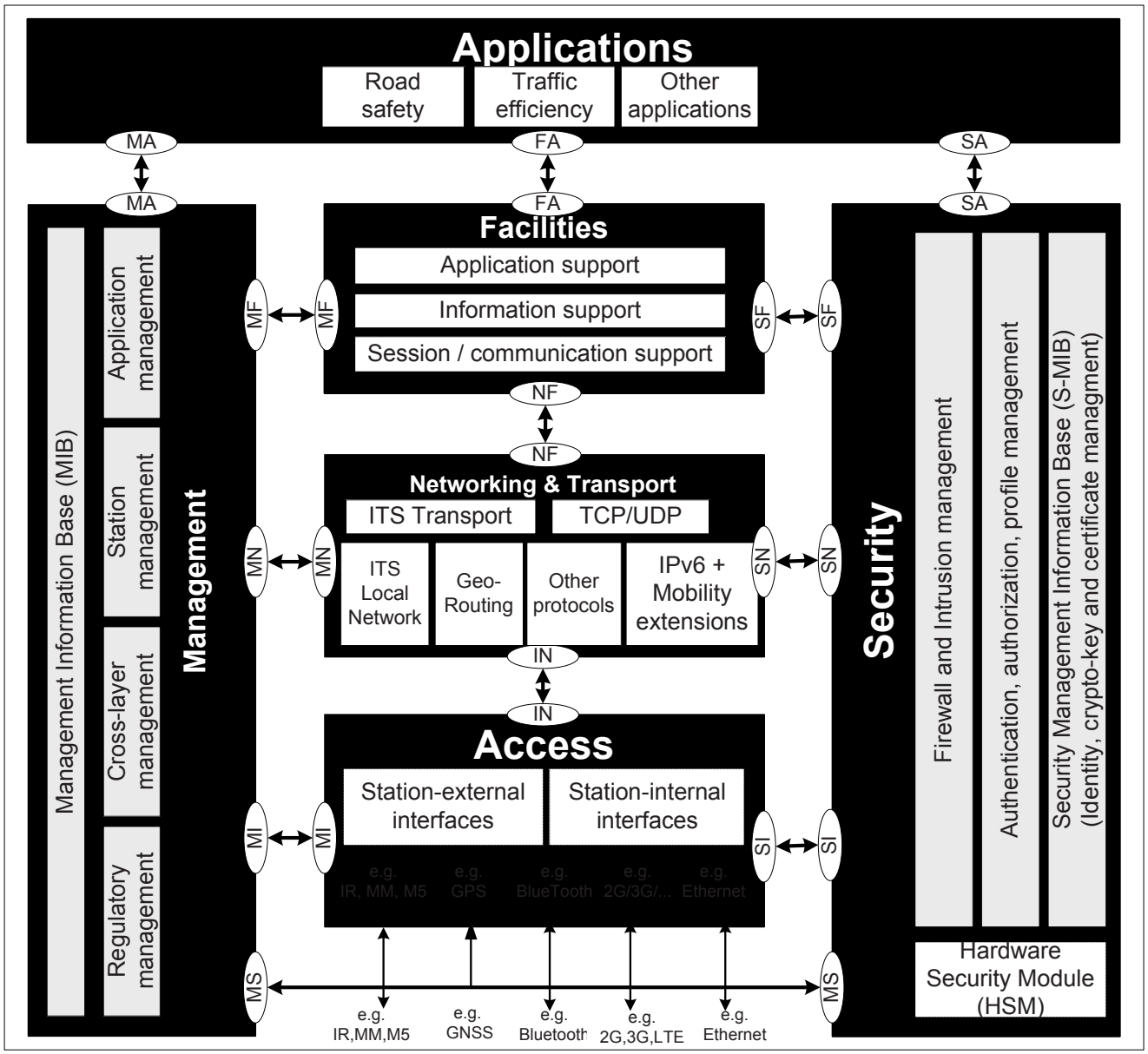


**Figure 9 — *ITS-station* reference architecture**
(source ISO 21217)

Five categories of interface are described in ISO 21217.

#### 7.3.2 Interfaces towards the management entity

- Management - Interaction (*MI*):
  - Enables the management entity to interact with the access layer (*OSI* layers 1 and 2/communication interfaces).

- Management -Network (*MN*):
  - Enables the management entity to interact with the networking and transport layer (*OSI* layers 3 and 4).
- Management -Facilities (*MF*):
  - Enables the management entity to interact with the facilities layer (*OSI* layers 5 through to 7).
- Management -Applications (*MA*):
  - Enables the management entity to interact directly with *ITS-station* applications.

#### 7.3.3 ISO 21217 Interfaces towards the security entity

ISO 15638-4 *TARV* security is the principal ISO 15638 deliverable concerning security aspects, and all *TARV* communications, in addition to compliance to the security aspects of the media standards(s) that they use, shall also comply to the requirements of ISO 15638-4. For all detail of specifications for security of *TARV* communications and applications, refer to ISO 15638-4 (*TARV* System security requirements).

However it is relevant to explain the security aspects of Figure 9.

- Security interaction (*SI*):
  - Enables the security entity to interact with the access layer (*OSI* layers 1 and 2/communication interfaces).
- Security networking (*SN*):
  - Enables the security entity to interact with the networking and transport layer (*OSI* layers 3 and 4).
- Security facilities (*SF*):
  - Enables the security entity to interact with the facilities layer (*OSI* layers 5 through 7).
- Security applications (*SA*):
  - Enables the security entity to interact directly with *ITS-station* applications.

#### 7.3.4 ISO 21217 Interface between access layer and networking and transport layer

Explanation of aspect of Figure 9.

- Interface – Network (*IN*):
  - Allows the networking and transport layer and the access layer to interact with each other. Typically implemented as a service access point (*SAP*).

#### 7.3.5 ISO 21217 Interface between networking and transport layer and facilities layer

Explanation of aspect of Figure 9.

- Network – Facilities (*NF*):
  - Allows the facilities layer and networking and transport layer to interact with each other. Typically implemented as a service access point (*SAP*).

#### 7.3.6 ISO 21217 Interface between facilities layer and *ITS-station* applications

Explanation of aspect of Figure 9.

- Facilities – Applications (*FA*):
  - Allows the facilities layer to interact with *ITS-station* applications. Typically implemented as an application program interface (*API*).

NOTE A valid implementation option is to merge the *IN*, *MI* and *SI* interfaces into a plug-and-play interface, e.g. according to a system specification.

## 7.4 ISO 21217 Host, router, and gateway architecture

Host, router, and gateway architecture shall be as specified in ISO 21217 (see 5.6.4).

## 7.5 ISO 21217 Service

### 7.5.1 ISO 21217 ITS service

Within ISO 21717 the term "*ITS service* (4.3)" in the context of CALM refers to a service provided by an ITS application to a user of an *ITS-station*. The ITS application itself consists of two or more complementary *ITS-station* applications. Pairs of *ITS-station* applications may be classified as, for example, server/client applications. Within the context of ISO 15638 *TARV*, this translates to the service provider of an *ITS service* (4.3) to a regulated commercial freight vehicle, and the *TARV* user (the operator of the *TARV*, or the driver as a subclass of the user).

Using ISO 21217, a user (client station) can identify available user services in the two following ways.

1. User service discovery.
    i. A *TARV* user actively tries to discover user services.
2. User service notification.
    ii. A *TARV* service provider is actively broadcasting service notification messages in service announcements. These service announcements are managed through various processes, including application registration and announcement requests, and construction of such announcement messages is to be transmitted over the air with an appropriately chosen access technology to passing users.

NOTE *ITS-station*s communicate in a peer-to-peer mode where, once the application association has been made, data exchanges between applications occur until such time as the session is complete or the link between the applications is broken.

*ITS-station* applications use *ITS-station* services in order to connect to one or more other *ITS-station* application. In implementations with more than one wireless communication interface, quasi-simultaneous provision of *ITS-station* services with data streams via different communications interfaces, is supported.

### 7.5.2 ISO 21217 ITS-station service

The term "*ITS-station* service" in the context of CALM refers to a communication functionality offered by an *ITS-station* to an *ITS-station* application. An *ITS-station* service provides the complete communication link through all the *OSI* layers (facilities, networking) down to a communication interface and via the medium to a peer station.

### 7.5.3 ISO 21217 Details related to the access layer

Figure 10 shows elements of the access layer. The access layer is part of the *ITS-station* reference architecture presented in Figure 9 above.

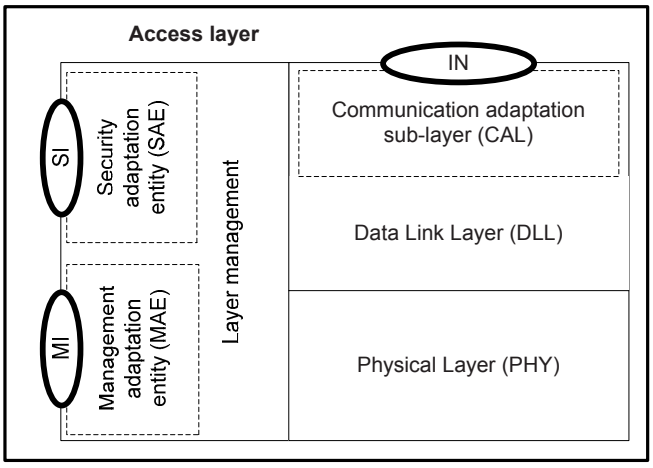


**Figure 10 — Elements of access layer**
(source ISO 21217)

For further details refer to ISO 21217, Clause 5.9.

The data link layer consists of a *MAC* sub-layer and an *LLC* sub-layer, as specified in ISO 21218. (See also 7.10 below)

There is a dedicated *MAC* sub-layer for every *PHY* layer.

The roles of the CALM communication adaptation layer (CAL) and the management adaptation entity (MAE) specified in ISO 21218 are to provide a common interface between each specific data link layer and the common functionality of the networking and transport layer. *CAL* and *MAE* are dedicated to a specific access technology. *CAL* provides the *IN* interface to the networking and transport layer following the principles determined in ISO/IEC 8802-2:1998. *CAL* can be interpreted as an *LLC* extension of existing communication technologies.

The role of the security adaptation entity (*SAE*) is to provide a common interface to the security entity.

### 7.5.4 ISO 21217 Details related to the networking and transport layer

Figure 11 shows elements of the networking and transport layer. The networking and transport layer is part of the *ITS-station* reference architecture presented in Figure 9.

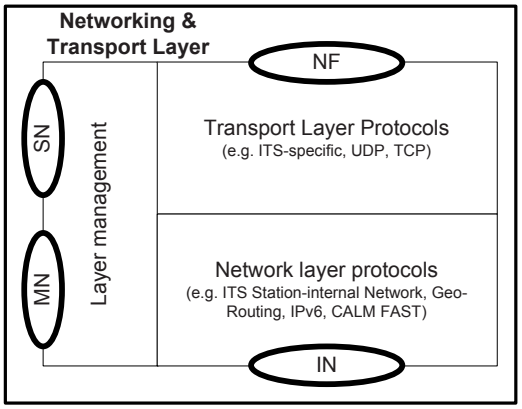


**Figure 11 – Elements of the networking and transport layer**
(source ISO 21217)

For further detail see ISO 21217.

The network layer connects the data link layer to the transport layer. Multiple optional and complementary network protocols running independent of each other may be supported.

At this time, ISO 21217 identifies two classes of network protocols:

1. Internet protocol
    i. In order to achieve Internet-based communications, version 6 of the Internet protocol (*IPv6*) shall be used.

    ii. *IPv6* protocols are required for Internet connectivity, session continuity and seamless communications.

    iii. Details shall be as specified in ISO 21210. (see also 7.8 below)

2. Non-*IP* protocols

    Protocol functionality as specified in ISO 29281. (see also 7.9).

The transport layer connects the network layer with the facilities layer and provides transparent transfer of data between the communicating entities.

In addition to *IPv6* networking, options exist for utilising user datagram protocol (*UDP*), and optionally, transmission control protocol (*TCP*), see 7.6.2, and ISO 21210.

#### 7.5.5 ISO 15638-1 details related to facilities layer

Figure 12 shows elements of the facilities layer. The facilities layer is part of the *ITS-station* reference architecture presented in Figure 9,

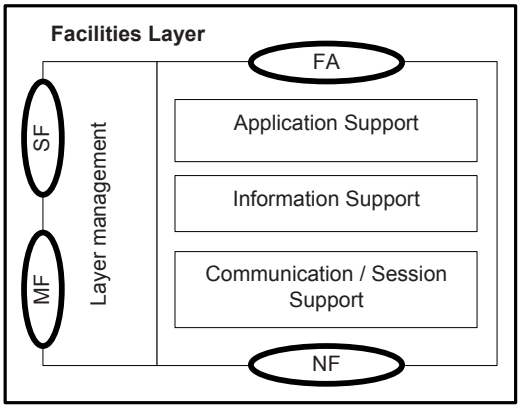


**Figure 12 – Elements of the facilities layer**
(source ISO 21217)

and shall be compliant to ISO 15638-1, ISO 21217 and 7.14 below, For further details refer to these standards and 7.14 below.

### 7.6 ISO 21217 Details related to ITS-station applications (ISO 21217)

#### 7.6.1 ISO 21217 CALM-aware applications

"CALM-aware *ITS-station* applications" are *ITS-station* applications that can interact with the *ITS-station* management by:

- responding to requests from the communication and station management entity for registration information,
- requesting registration at the communication and management entity upon initialization, and

- passing service level requirements to the communication and management entity. See also ISO 24102.

ISO 21217 identifies two types of CALM-aware *ITS-station* applications:

a) *ITS-station* applications that get real-time access to pre-selected parameters
b) Other *ITS-station* applications that, typically, use *IPv6* networking (ISO 21210)

ISO 15638 *TARV* 'CALM aware' applications shall be type b).

NOTE Although *TARV* systems use *IPv6*, CALM FAST is used in session location and establishment.

#### 7.6.2 ISO 21217 Non-CALM-aware applications

"Non-CALM-aware *ITS-station* applications" are *ITS-station* applications that cannot interact with the *ITS-station* management as CALM-aware *ITS-station* applications can do. These *ITS-station* applications operate under the assumption that a specific transport/networking protocol is used, e.g. a *UDP*/*IP* or *TCP*/*IP* connection is being established for communication. Such applications may obviate the abstraction from lower layers and may be restricted to a particular lower layer protocol and access technology.

NOTE Examples of non-CALM-aware applications are legacy *IP* applications, and those built following ISO 15628/EN 12795, as specified in ISO 29281.

ISO 15638 *TARV* 'Non-CALM aware' applications may use such provisions when communicating with legacy systems that do not support *IPv6*. However, in such circumstances, it shall be the responsibility of the application service provider to determine the protocols and ensure that the legacy *ITS-station* has appropriate software to comprehend the data, and that the IVS is equipped to send the data in the form defined by the user.

### 7.7 ISO 21217 Management elements

See ISO 21217 regarding *OSI* cross-layer management, including regulatory information management; management of communication links, and ITS application support.

*ITS-station* management shall be as specified in ISO 24102. Facilities management shall be as specified in ISO 15638-1 and ISO 15638-5.

### 7.8 ISO 21210 CALM IPv6 Networking

### 7.8.1 ISO 21210 General requirement

The wireless network aspects of instantiations of *TARV* shall comply to the networking requirements of, ISO 21210 Intelligent transport systems — Communications access for land mobiles — *IPv6* Networking

The following subClauses identify some of the aspects of ISO 21210 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 21210. However, in respect of *IPv6* networking ISO 21210 is the paramount and core document and shall be consulted and complied with in any such *TARV* instantiation, although ISO 24102 shall be consulted in respect of session initiation.

#### 7.8.2 ISO 21210 Requirements on all ITS IPv6 LAN nodes

ISO 21210 determines that any instance of an ITS sub-system capable of supporting communications as specified in ISO 21217 shall comprise an 'ITS *IPv6 LAN*'.

ISO 21210 also specifies that an 'ITS *IPv6 LAN* node' shall implement *IPv6* in compliance with *IETF* RFC 4294 '*IPv6* Node Requirements'.

NOTE Additional features are needed according to the role of the 'ITS *IPv6 LAN* node' and whether it is deployed in the vehicle ('mobile ITS *IPv6 LAN*'), in the roadside or in the central ITS sub-systems. This is illustrated in ISO 21217.

ISO 21210 specifies that implementations of *IPv6* in *ITS-stations* (4.4) shall be backward compatible with all

legacy *IPv6* implementations connected to the *ITS-station* (4.4) either in the '*ITS-station IPv6 LAN*' or anywhere in the Internet.

ISO 21210 specifies that the functions of an *ITS-station* (4.4) may be distributed among various nodes on an ITS *IPv6 LAN*. There shall be at least be one '*ITS-station IPv6* router' on the 'ITS *IPv6 LAN*'.

ISO 21210 specifies that an '*ITS-station IPv6* router' shall have at least one external *IPv6* interface and that:

- An '*ITS-station IPv6* router' may have an internal *IPv6* interface. In such a situation, the *ITS-station IPv6* router is said to be an '*ITS-station IPv6* router serving an ITS *IPv6 LAN*'
- An '*ITS-station IPv6* router serving an ITS *IPv6 LAN*' may provide means for legacy *IPv6* nodes deployed in its attached 'ITS *IPv6 LAN*' to connect to the Internet
- An '*ITS-station* host' deployed in an 'ITS *IPv6 LAN*' shall implement the modules of an '*ITS-station IPv6* host' as indicated in Clauses 6.4.2.

NOTE If desired in a particular implementation the functions of the *ITS-station* host can be performed by an '*ITS-station IPv6* router'.

An '*ITS-station* border router' deployed in an 'ITS *IPv6 LAN*' and connected to the Internet shall implement the modules of an '*ITS-station IPv6* border router' as indicated in Clauses 6.4.5 of ISO 21210.

NOTE If desired in a particular implementation the functions of the '*ITS-station IPv6* border router can be performed by an '*ITS-station IPv6* access router' and the functions of an *ITS-station* host can be performed by an '*ITS-station IPv6* router'.

An '*ITS-station* gateway' deployed in an 'ITS *IPv6 LAN*' and acting as a firewall isolating non-*IPv6* devices from other devices reachable over *IPv6* shall be implemented preferably as an '*ITS-station IPv6* host' (ISO 21210 6.4.2 ('*ITS-station IPv6* hosts' modules) or otherwise as an '*ITS-station IPv6* router' (ISO 21210 subClauses 6.4.1, ( '*ITS-station IPv6* mobile router' modules), ISO 21210 6.4.3 ('*ITS-station IPv6* access router' modules) or 6.4.5 ('*ITS-station IPv6* border router' modules)).

### 7.8.3 ISO 21210 ITS-station IPv6 nodes deployed in the Vehicle ITS sub-system

In addition to 7.8.1 which applies to all ITS sub-systems, the subClauses below shall also apply to the vehicle ITS sub-system.

ISO 21210 specifies that any instance of a vehicle ITS sub-system capable of supporting communication classes 3, 4, 7 or 8 as specified in ISO 21217 shall comprise a 'mobile ITS *IPv6 LAN*'.

ISO 21210 specifies that an '*ITS-station* router' deployed in a 'mobile ITS *IPv6 LAN*' and used to attached to foreign 'ITS *IPv6 LAN*' shall implement the modules of an '*ITS-station IPv6* mobile router' as indicated in Clauses 6.4.1 of ISO 21210.( '*ITS-station IPv6* mobile router' modules), and that a 'mobile ITS *IPv6 LAN*' shall at least contain one '*ITS-station IPv6* mobile router'.

ISO 21210 further specifies that an '*ITS-station IPv6* mobile router' may use any mutually available access technology to connect either to an '*ITS-station IPv6* access router' or a legacy '*IPv6* access router' from some public *W-LAN* or a cellular operator.

### 7.8.4 ISO 21210 ITS-station IPv6 nodes deployed in the roadside ITS sub-system

ISO 21210 specifies that in addition to Clauses 7.8.1 which apply to any all ITS sub-systems, the Clauses below shall also apply to the roadside ITS sub-system.

An '*ITS-station* router' deployed in an 'ITS *IPv6 LAN*' and used to provide access to 'mobile ITS *IPv6 LAN*' shall implement the modules of an '*ITS-station IPv6* access router' as indicated in Clauses 6.4.3 ('*ITS-station IPv6* access router' modules) of ISO 21210.

NOTE There is no limitations in the number of '*ITS-station IPv6* access router' deployed in a given Roadside ITS sub-system.

### 7.8.5 ISO 21210 ITS-station IPv6 nodes deployed in the central ITS sub-system

ISO 21210 specifies that in addition to Clauses 7.3.1 which apply to any all ITS sub-systems, the Clauses below shall also apply to the central ITS sub-system.

For communication classes 3, 4, 7 and 8 as defined in ISO 21217 a 'home ITS *IPv6 LAN*' shall be deployed to host functions necessary for 'mobile ITS *IPv6 LAN*s' to maintain their reachability at a global *IPv6* address. Functions to be provided by the 'home ITS *IPv6 LAN*' shall include *IPv6* prefix allocation and domain name registration.

NOTE With the above Clause, it is assumed that a global *IPv6* prefix is allocated to the vehicle ITS sub-system but for communication classes 3 & 4 (i.e. no internet access) nodes located in vehicles would be unable to communicate with nodes located in Internet. However, it is reasonable to assume that the central ITS sub-system may be reached via the Internet infrastructure, probably via a tunnelling mechanism. In such a situation, the ability for packets between ITS sub-systems to cross the Internet does not qualify for the ability to provide Internet access to 'mobile ITS *IPv6 LAN*'.

For communication classes 4 and 8 as defined in ISO 21217, an '*ITS-station* router' deployed in the 'home ITS *IPv6 LAN*' and used to perform the functions necessary for 'mobile ITS *IPv6 LAN*s' to maintain session continuity while performing handovers shall implement the modules of an '*ITS-station IPv6* home agent' as indicated in Clauses 6.4.4 ('*ITS-station IPv6* home agent' modules) of ISO 21210.

NOTE If desired in a particular implementation the functions of the *IPv6* home agent may be implemented as a legacy *IPv6* node.

ISO 21210 determines that:

- 'ITS *IPv6 LAN*'s deployed in vehicles, the roadside and the central network shall be part of the global public Internet.
- 'ITS *IPv6 LAN*'s shall all be *IPv6* 'islands' inter-connected over the public Internet either using native *IPv6* whenever available, or otherwise shall be tunnelled in *IPv4* networks.
- Transition mechanisms may be optionally deployed so that *IPv6* entities can also communicate with public Internet entities not able yet to communicate in *IPv6*.

NOTE Being part of the global Internet, *IPv6* nodes deployed in 'ITS *IPv6 LAN*'s deployed may communicate with *IPv6* third parties not located in 'ITS *IPv6 LAN*'s.

### 7.8.6 ISO 21210 IPv6 functional modules

#### 7.8.6.1 Module 1: IPv6 forwarding

ISO 21210 specifies that the '*IPv6* forwarding' module receives *IPv6* packets from its 'external *IPv6* interface(s)' and from its 'internal *IPv6* interface(s)' or the layer above. For details of how this is achieved see ISO 21210 Clause 6.3.1.

NOTE The default settings are particularly important so that the '*IPv6* forwarding' module is able to route flows originated from 'non CALM-Aware' applications. Rules are configurable by stakeholders, e.g. users, device vendors, service providers, OEMs, car manufacturers. These rules are competitive factors among stakeholders, so the definitions of these policies are outside the scope of ISO 21210. The default routing procedures could be pre-registered in any manner the manufacturer wishes to implement or could be performed based on the source and destination addresses indicated in the *IPv6* header and protocol and port numbers. A more advanced method could be using the 'Flow Id' field in the *IPv6* header (legacy applications would continue to work as is) and exchanging rules between the applications and the MR (this would require the modification of applications) in order to express preferences based on application requirements. The specification of this method is outside the scope of ISO 21210.

#### 7.8.6.2 Module 2: ITS *IPv6* LAN interface

ISO 21210 specifies that the 'ITS *IPv6 LAN* interface' module shall provide a mechanism for transmitting the *IPv6* packets between the '*IPv6* forwarding' module and the layer below.

For details of how this is achieved, see ISO 21210 Clause 6.3.2.

#### 7.8.6.3 Module 3: external *IPv6* interfaces

ISO 21210 specifies that the 'external *IPv6* interface' module shall provide a mechanism for transmitting the *IPv6* packets between the '*IPv6* forwarding' module and the layer below using the methods defined in ISO 21218.

For details of how this is achieved, see ISO 21210 Clause 6.3.3.

Whenever required, the 'external *IPv6* interface' module shall configure its *IPv6* addresses as indicated in Clauses defined in Section 6.5 (*IPv6* Address Configuration) of ISO 21210.

Whenever an *IPv6* address changes, the 'external *IPv6* interface' module shall notify the 'CALM Manager' through the *MN-SAP* using N-REQUEST.request instructions as specified in ISO 24102.

Whenever required, the 'external *IPv6* interface' module shall perform the methods specified in RFC 2461 'Neighbor Discovery for *IPv6*'.

NOTE When availability of an 'external *IPv6* interface' is disrupted, the associated communication interface shall be considered as unavailable and notified to the 'CALM Manager' but not immediately de-activated as the loss of coverage may be transient (e.g. the 3G interface may be down for a few seconds when driving under a tunnel). This decreases the period during which the interface is unavailable as it allows the *IPv6* node to maintain the associated global *IPv6* address and thus doesn't require to perform 'Duplicate Address Detection' as specified in RFC 2462 (DAD) or RFC 4429 (ODAD) when the communication link is re-established at layer 2.

#### 7.8.6.4 Module 4: mobility management

ISO 21210 specifies that the 'mobility management' module' shall implement mobility support functions for Internet reachability and session continuity in accordance with RFC 3963 '*NEMO* Basic Support protocol'.

To achieve this a bidirectional tunnel shall be established between the '*ITS-station IPv6* mobile router' and the '*ITS-station IPv6* home agent' for every global *IPv6* address available on any 'external *IPv6* interface'.

For details of how this is achieved, see ISO 21210 Clause 6.3.4.

NOTE The key idea of *NEMO* Basic Support is that the *IPv6 mobile network prefix* (known as *MNP*) allocated to the MR is kept irrespective of the topological location of the MR while a *binding* between the *MNP* and the newly acquired temporary 'Care-of Address' (*CoA*) configured on the external *IPv6* egress connecting the MR to the Internet is recorded at the HA. This registration is performed by the MR at each subsequent point of attachment to an AR. In order to do this, the MR is using its global address known as the 'Home Address' (*HoA*).

This allows a node in the vehicle to remain reachable at the same address as long as the address is not deprecated. The HA is now able to redirect all packets to the current location of the vehicle. *MNN*s attached to the MR do not need to configure a new address nor do they need to perform any mobility support function to benefit from the Internet connectivity provided by the MR. This mobility support mechanism provided by *NEMO* is thus very easy to deploy, at a minimum cost.

NOTE For a better understanding of *NEMO*, the terminology is specified in RFC 4885 and the design goals behind '*NEMO* Basic Support' in RFC 4886. These documents serve as the normative documents for how to apply '*NEMO* Basic Support' to the CALM architecture.

ISO 21210 specifies that whenever the *IPv6* address of tunnel end-point changes, the 'mobility management' module shall notify the 'CALM Manager' through the *MN-SAP* using N-REQUEST.request instructions as specified in ISO 24102.

NOTE As a result of the notification of the tunnel set-up from the *IP* 'mobility management' module to the 'CALM Manager', the 'CALM Manager' should notify the '*IPv6* forwarding' module with new forwarding table entries. See section '*IPv6* forwarding' module.

When there exists multiple tunnels, '*ITS-station IPv6* mobile router' and the '*ITS-station IPv6* home agent' shall be synchronised in order to take their decision based on the same criteria (user choices, network availability, media characteristics and type of flow) on both directions. See ISO 21210 for details of how this is achieved.

#### 7.8.7 ISO 21210 Module 5: IPv6 security

ISO 21210 specifies which security features and functions shall be provided by the *IPv6* security module to '*ITS-station IPv6 LAN* nodes'. ISO15638-4 (*TARV* System security requirements) shall provide the reference for security for ISO 15638, and shall take ISO 21210 measures into account as part of its core system security.

ISO 21210 provides specification for the following security aspects:

- Encryption, anti-replay and anti-forge
- Authentication
- Location privacy

#### 7.8.8 ISO 21210 Modules implemented in *ITS-station IPv6* nodes

Each type of '*ITS-station IPv6* node' ('Mobile Router', 'Access Router', 'Border Router', 'Vehicle Host', 'Roadside Host', 'Central Host', 'Home Agent', 'Vehicle Gateway', 'Central Gateway', 'Roadside Gateway' as highlighted in ISO 21217) comprises a subset of the modules specified in ISO 21210. ISO 21210 does not specify basic *IPv6* functions (such as addressing or transmission over Ethernet or network management) because these are features that all *IPv6* nodes shall conform with in order to be complaint to RFC 4294 '*IPv6* Node Requirements'.

##### 7.8.8.1 'ITS-station IPv6 mobile router' modules

###### 7.8.8.1.1 Modules required for non-continuous Internet connectivity

ISO 21210 specifies that the '*ITS-station IPv6* mobile router' supporting non-continuous Internet connectivity, as defined in ISO 21217, shall comprise at least the following modules:

- Module 1: *IPv6* forwarding
- Module 3: *IPv6* external interface(s)
- Module 5: *IPv6* security

and that there shall be an '*IPv6* external interface' module for each communication interface.

See ISO 21210 for further details.

###### 7.8.8.1.2 Modules required for continuous Internet connectivity

ISO 21210 specifies that the '*ITS-station IPv6* mobile router' supporting continuous Internet connectivity as defined in ISO 21217, shall comprise at least the following modules:

- Module 1: *IPv6* forwarding
- Module 3: *IPv6* external interface(s)
- Module 4: *IPv6* mobility management
- Module 5: *IPv6* security

and that there shall be a '*IPv6* external interface' module for each communication interface.

See ISO 21210 for further details.

###### 7.8.8.1.3 'ITS-station IPv6 hosts' modules

ISO 21210 specifies that '*ITS-station IPv6* hosts' (i.e. 'Vehicle Hosts', 'Roadside Hosts', 'Central Hosts', 'Vehicle Gateway', 'Roadside Gateway' and 'Central Gateway' as referred to in 21217) shall only implement the non-routing capabilities of an *ITS-station* (4.4) and shall comprise at least the following modules:

- Module 2: *IPv6* ITS *LAN* interface
- Module 5: *IPv6* security
- Module 6: transport protocols
- Module 8: 'CALM-aware' applications

See ISO 21210 for further details.

#### 7.8.8.1.4 'ITS-station IPv6 access router' modules

ISO 21210 specifies that the '*ITS-station IPv6* access router' shall comprise at least the following modules:

- Module 1: *IPv6* forwarding
- Module 3: *IPv6* external interface(s)
- Module 5: *IPv6* security

There shall be an '*IPv6* external interface' module for each communication interface.

Optionally, Module 2 '*IPv6* ITS *LAN* interface' shall be implemented if there is attached '*ITS-station IPv6 LAN* nodes'.

#### 7.8.8.1.5 'ITS-station IPv6 home agent' modules

ISO 21210 specifies that the '*ITS-station IPv6* home agent' shall comprise the minimum following modules:

1) Module 1: *IPv6* forwarding
2) Module 4: *IPv6* mobility management
3) Module 5: *IPv6* security

Optionally, Module 2 '"Pv6 ITS *LAN* interface" or Module 3 "*IPv6* external interface" shall be implemented.

#### 7.8.8.1.6 'ITS-station IPv6 border router' modules

ISO 21210 specifies that the '*ITS-station IPv6* border router' shall comprise at least the following modules:

1) Module 1: *IPv6* forwarding
2) Module 2: *IPv6* ITS *LAN* interface(s)
3) Module 3: *IPv6* external interface(s)
4) Module 5: *IPv6* security

There shall be an '*IPv6* external interface' module for each communication interface.

### 7.8.9 ISO 21210 IPv6 address configuration

#### 7.8.9.1 IPv6 address configuration for all 'ITS-station IPv6 LAN nodes'

ISO 21210 specifies that all 'ITS *IPv6 LAN* nodes' shall configure a 'link-local *IPv6* address' on each of their *IPv6* interfaces following the methods specified in RFC 2462 '*IPv6* Stateless Address Auto-configuration';

and that all 'ITS *IPv6 LAN* nodes' shall configure a 'global *IPv6* address' following the methods specified in RFC 2462 '*IPv6* Stateless Address Auto-configuration'.

For further details see ISO 21210 Clause 6.5.1.

#### 7.8.9.2 IPv6 address configuration for 'mobile ITS IPv6 LAN nodes'

ISO 21210 specifies that an '*ITS-station IPv6* mobile router' shall be allocated an *IPv6* prefix of a maximum length of 64 bits (64 or smaller). See ISO 21210, Clause 6.5.2 for further details.

ISO 21210 further specifies that:

- An '*ITS-station IPv6* mobile router' shall be allocated an *IPv6* prefix, known as an *MNP* from a 'home ITS *IPv6 LAN*' located in a remote central ITS sub-system. This *MNP* may be allocated dynamically using DHCPv6 'Prefix Delegation for *NEMO*' or using any other method according to the operator of the given central ITS sub-system.

- An '*ITS-station IPv6* mobile router' shall announce the *MNP* and other necessary network parameters (default router, *DNS* server, etc.) on each of its 'internal *IPv6* interface(s)' using the method specified in RFC 2461 'Neighbor Discovery for *IPv6*' in order for all 'mobile ITS *IPv6 LAN* nodes' to configure their own global *IPv6* addresses according to Clause 6.5.1 (*IPv6* address configuration for all '*ITS-station IPv6 LAN* nodes'). 'mobile ITS *IPv6 LAN* nodes' shall retain the same global address which has been configured originally from the *MNP* irrespective of their location in the IP network topology. 'mobile ITS *IPv6 LAN* nodes' shall only change their address if the '*ITS-station IPv6* mobile router' advertises a new *MNP*.

NOTE The term *MNP* is usually associated with the use of RFC 3963 ('*NEMO* Basic Support') but in this specification it is paraphrased to mean an *IPv6* prefix allocated to a 'mobile ITS *IPv6 LAN*' whether RFC 3963 is used or not for a particular communication class.

NOTE The *MNP* belongs to the Central ITS sub-system '. It is taken from the 'home ITS *IPv6 LAN*' prefix (home link) and could be changed dynamically for instance for security reasons, or if the '*ITS-station IPv6* mobile router' changes its 'home ITS *IPv6 LAN*', or if the address configuration of the 'home ITS *IPv6 LAN*' is changed.

And that for communication classes 4 & 8 as defined in ISO 21217:

- An '*ITS-station IPv6* mobile router' shall be configured a global *IPv6* address known as a 'Home Address' (*HoA*) belonging to its 'home ITS *IPv6 LAN*' following the methods specified in RFC 3963 '*NEMO* Basic Support protocol', and shall retain it even if connectivity to the 'home ITS *IPv6 LAN*' is lost.

- An '*ITS-station IPv6* mobile router' shall configure a global *IPv6* address known as a 'Care-of Address' (*CoA*) on each of its external *IPv6* interfaces and for each *IPv6* prefixes advertised by visible '*IPv6* access router' (''*ITS-station IPv6* access router' or legacy *IPv6* access router). The configuration of the *CoA* shall be achieved in accordance to RFC 2462 ('*IPv6* Stateless Address Auto-configuration'). There may be medium specific methods (e.g. *PPP* link in cellular networks). The 'Duplicate Address Detection' (DAD) mechanism as specified in RFC 2462 may be replaced by RFC 4429 'Optimistic Duplicate Address Detection' (ODAD).

For non-continuous Internet connectivity) as defined in ISO 21217, an '*ITS-station IPv6* mobile router' may be allocated its *IPv6* prefix using the same method as for communication class 8 'Continuous Internet Connectivity' (preferred method) or by any other mechanism. This prefix shall be announced on the 'mobile ITS *IPv6 LAN*' for *MNN*s to configure their own addresses.

For further details see ISO 21210 Clause 6.5.2.

#### 7.8.9.3 IPv6 address configuration for 'ITS *IPv6* LAN nodes' deployed in a roadside ITS sub-system

ISO 21210 specifies that the allocation of global addresses to the 'ITS *IPv6 LAN*' located in the roadside ITS sub-system shall be achieved by the '*ITS-station IPv6* Border Router' preferably by stateless-autoconfiguration (RFC 2462) of alternatively by static configuration.

For further detail see ISO 21210 Clause 6.5.3.

#### 7.8.9.4 IPv6 address configuration for 'ITS *IPv6* LAN nodes' deployed in a central ITS sub-system

ISO 21210 specifies that the allocation of global addresses to the 'ITS *IPv6 LAN*' located in the Central ITS sub-system shall be achieved by the '*ITS-station IPv6* border router' by stateless-autoconfiguration (RFC 2462) of by static configuration.

### 7.8.10 ISO 21210 Addressing requirement for reachability from the Internet

ISO 21210 specifies that the following Clauses shall apply:

- 'ITS *IPv6 LAN* nodes' shall be reachable at their global addresses from nodes located in another 'ITS *IPv6 LAN*' or the internet. This shall be achieved by allocating a globally-unique *IPv6* prefix (*MNP*) to each ITS *IPv6 LAN*.
- A domain name shall be associated and registered in the *DNS* to any 'ITS *IPv6 LAN* nodes' which *IPv6* global address has to be automatically retrieved by communication pairs located in another 'ITS *IPv6 LAN*' or the Internet through name resolution.
- An '*ITS-station IPv6* mobile router' shall implement mobility support functions in accordance with RFC 3963 '*NEMO* Basic Support protocol' for maintaining Internet reachability of 'ITS *IPv6 LAN* nodes' at their global addresses whereas the 'mobile ITS *IPv6 LAN*' is attached to a '*ITS-station* access router' or legacy *IPv6* access router. See 'Mobility management' module in ISO 21210.

### 7.8.11 ISO 21210 Optional features and functions

ISO 21210 also specifies the following optional features and functions that are not necessary to support any of the communication classes as specified in ISO 21217 but they could be necessary to ensure specific design choices are not prevented by the specification of *IPv6* networking as described in ISO 21210.

- *IPv6*-*IPv4* interoperability.
- *IPv6* nomadic devices.
- *IPv6* seamless horizontal handovers.
- *IPv6* seamless vertical handovers.

### 7.8.12 ISO 21210 IPv6 priority

The *ITS-station IPv6* router may implement mechanisms to ensure *IPv6* packets with higher priority (time critical, safety, etc) are sent prior to packets of lower priority. The specification of these methods is outside the scope of ISO 21210.

NOTE For example: The 'Flow Label' field in the IPv6 header may be used to differentiate flows with higher priorities and to match flows to particular interfaces based on preferences exchanged between the applications running on hosts and the router serving the IPv6 LAN.

## 7.9 ISO 29281 Intelligent transport systems CALM non-IP networking

### 7.9.1 ISO 29281 General requirement

The wireless network aspects of instantiations of *TARV* shall, where appropriate, comply to the non-*IP* networking requirements of ISO 29281 (CALM non-*IP* networking).

This Standard is now revised into 3 parts:

1) ISO 29281 -1 Non-*IP* networking
2) ISO 29281 -2 Fast networking & transport layer protocol (FNTP)
3) ISO 29281 -3 Legacy system support

#### 7.9.2 ISO 29281-1 Non-IP networking

The scope of ISO 29281-1 is to specify elements of communications for cooperative ITS which are not based on the Internet protocol.

Especially, the following architectures, procedures and protocols are specified:

- Protocol architecture based on the *ITS-station* (4.4) reference architecture
- References to protocols of the *ITS-s* networking & transport layer
- References to protocols of the *ITS-s* facilities layer

ISO 29281 operates within the framework of ISO 21217 ITS station architecture; ISO 24102-4, ITS station communication unit (ITS-SCU); ISO 24102-3, Management *SAP*s; ISO 24102-1, Local ITS station management; ISO 24102-2, Remote ITS station management.

The protocols of the *ITS-s* networking & transport layer specified in ISO 29281-1 apply to two basic communication scenarios:

1) single-hop communication between *ITS-stations* (4.4), regardless where the stations are installed
2) multi-hop communications between *ITS-stations* (4.4)

##### 7.9.2.1 ISO 29281 Single-hop communication scenario

Single-hop communications as specified in ISO 29281 involve communication between two CALM stations as specified in ISO 21217.

Examples of single-hop communication scenarios are presented in Figure 13.

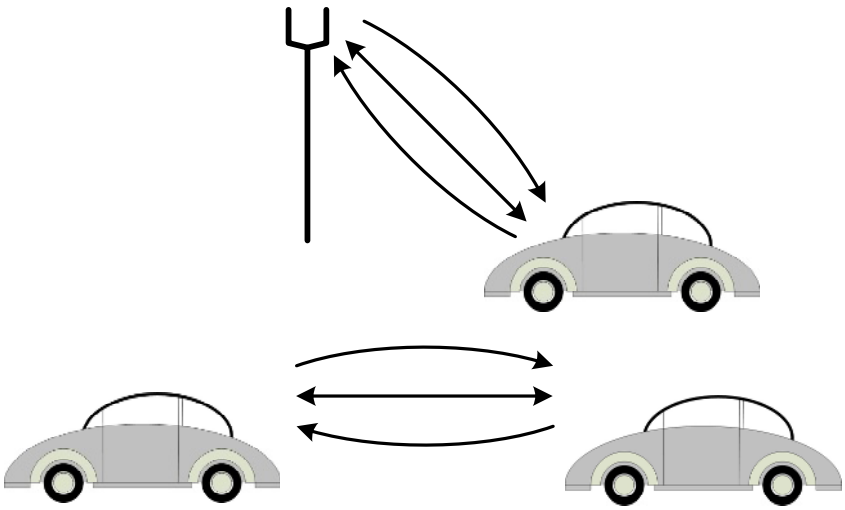

**Figure 13 — Examples of single-hop communications**
(Source: ISO 29281-1)

The first scenario is a typical scenario for advertisement of services provided by roadside service providers. More is needed for traffic efficiency and road safety services.

The second scenario is primarily for road safety services.

Roadside ITS sub-systems announce *ITS services* (4.3) using broadcast single-hop communication. Sessions using unicast single-hop communications may follow as specified in ISO 29281-1. Many road safety and traffic efficiency services rely on communications between vehicles.

#### 7.9.2.2 Multi-hop communication scenarios

Multi-hop communication as specified in ISO 29281-1 involves communication between two *ITS-stations* (4.4) using forwarding capabilities provided by one or more other *ITS-stations* (4.4).

Multi-hop (N-hop) communications is supported by the "Fast networking & transport layer protocol" (FNTP) specified in part 2 of ISO 29281.

An example of N-hop broadcast is illustrated in Figure 14. It provides data dissemination from a source node to all nodes reachable with a limited number of subsequent hops. The number of next hops shall be set by the service. In Figure 14, the maximum number of hops is two.

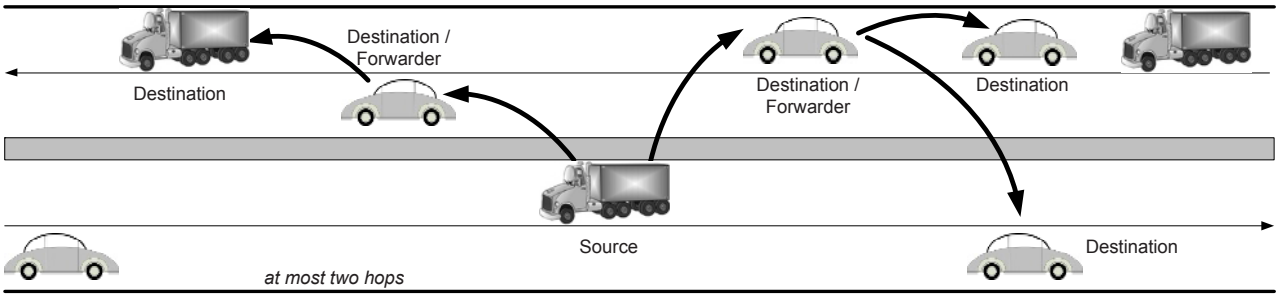


**Figure 14 — N-hop (Topologically scoped) broadcast**
(Source ISO 29281-1 amended for *TARV*)

For details and specification of how these communications are achieved see ISO 29281-1.

### 7.9.3 ISO 29281 -2 Fast networking & transport layer protocol (FNTP)

ISO 29281-2 specifies a protocol of the ITS networking & transport layer in support of efficient ad-hoc single-hop communications with optional N-hop broadcast.

This protocol supports *ITS-station* (4.4)-internal forwarding of packets, i.e. between *ITS-s* routers and *ITS-s* hosts and vice versa.

This protocol is the basis for legacy system support in *ITS-stations* (4.4), especially those related to the ISO 15628 *DSRC* application layer.

The protocol is named "Fast Networking & Transport Protocol" (FNTP).
FNTP distinguishes

- a basic port mapper protocol,
- protocol extensions for :
  - N-hop groupcast and
  - LPP,
- protocols for *ITS-station* (4.4)-internal forwarding of packets between *ITS-s* host ITS-SCUs and *ITS-s* router ITS-SCUs.

FNTP was validated in the CVIS project.

The "Fast Networking & Transport layer Protocol" (FNTP) specified in ISO 29281-2 supports any kind of ad-hoc access technology, e.g. CALM M5, CALM *IR*, ITS-G5. FNTP may be used to connect "endpoints" identified by port numbers in peer *ITS-stations* (4.4), where peer *ITS-stations* (4.4) are uniquely identified by a Link-ID (usually *MAC* address contained in it) of the access layer. Consequently, FNTP is a port mapper protocol, usually located in the transport layer of the *OSI* model.

FNTP may support the implementation architectures presented in Figures 15,16 and 17 with the peer *ITS-stations* (4.4) A and B.

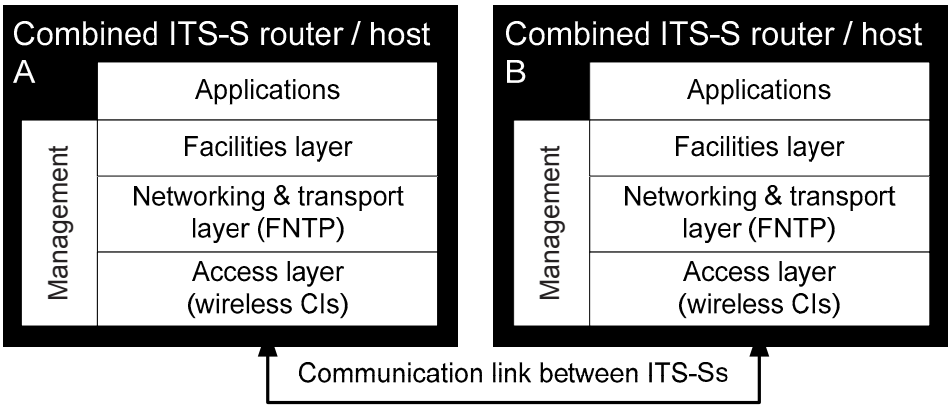


**Figure 15 — ISO 29281-2 Implementation architecture I**

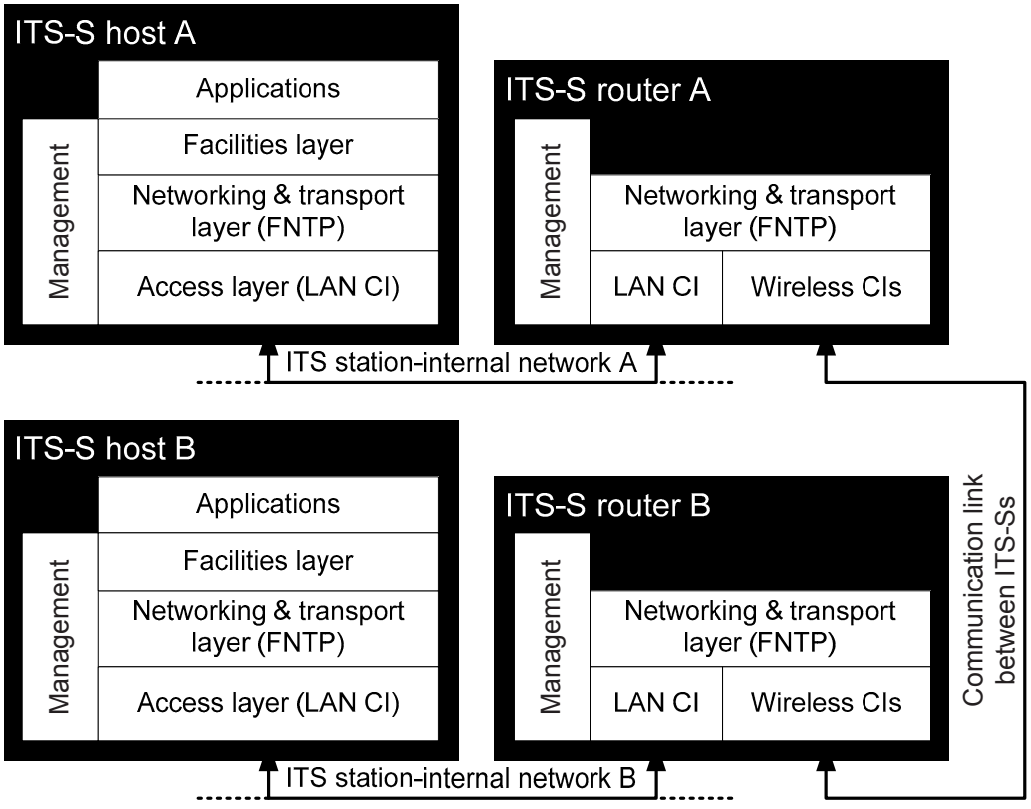


**Figure 16 — ISO 29281-2 Implementation architecture II**

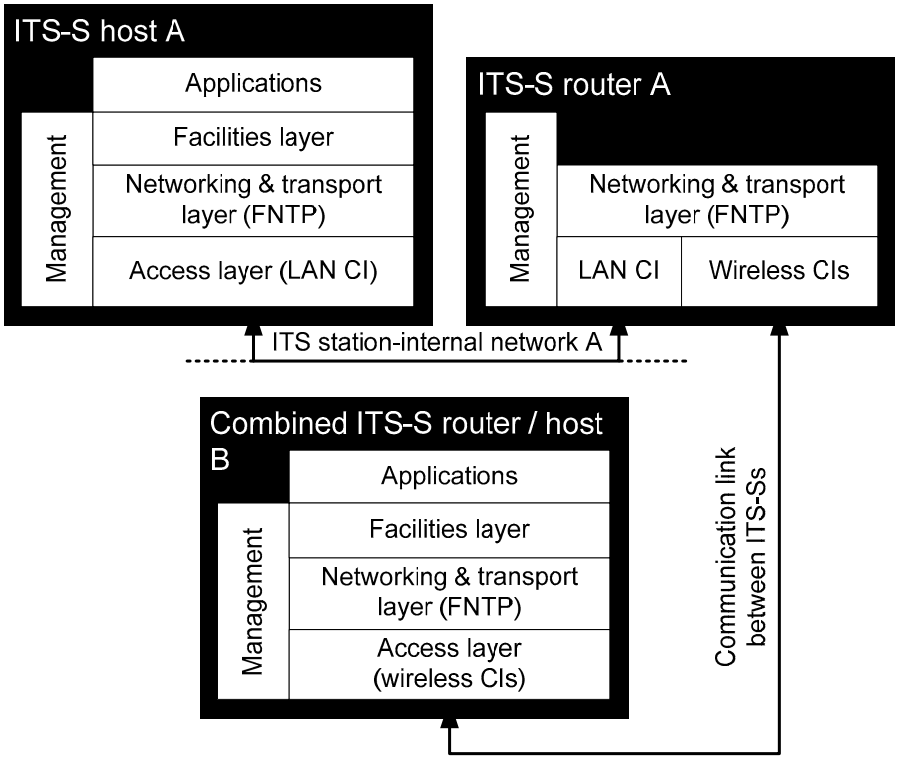


**Figure 17 — ISO 29281-2 Implementation architecture III**

Figure 18 illustrates the location of FNTP in the *ITS-station* (4.4) reference architecture specified in ISO 21217 and the communication relations with other protocol entities. Management relations are not explicitly presented.

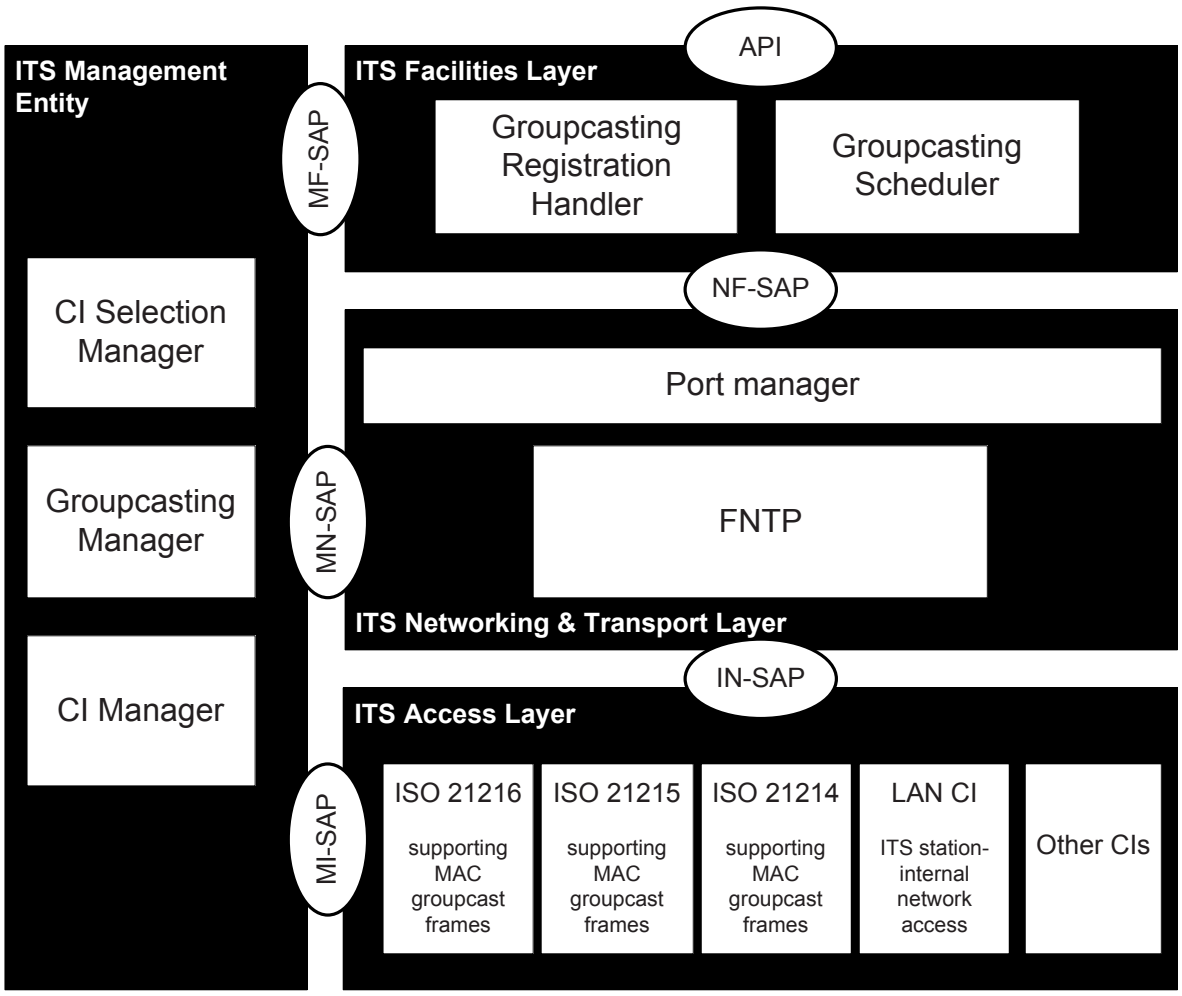


**Figure 18 — FNTP reference architecture**

For details and specification of how FAST services are advertised and supported see ISO 29281-2.

### 7.9.4 ISO 29281 -3 Legacy system support

#### 7.9.4.1 General concept

ISO 29281-3 specifies elements of communications for cooperative ITS which are not based on the Internet protocol.

Especially, the following architectures, procedures and protocols are specified:

- Support of communication interfaces (*DSRC-CI*) using ISO 15628
- Support of ISO 15628 *DSRC* applications via an ITS ad-hoc access technology

The specifications given in ISO 29281-3 comply with the *ITS-station* (4.4) architecture and with the concept of an *ITS-station* (4.4) communication unit (ITS-SCU) as specified in ISO 21217 and ISO 24102 4, and Communication scenarios are specified in ISO 24102 1 and in ISO 21217.

An existing access layer technology may be implemented in a *ITS-station* (4.4) as a “Legacy *CI*”, as presented in Figure 19, such that it can communicate with peer stations that are not necessarily aware of any *ITS-s* context, and where none of the networking protocols specified for *ITS-s* are used in the wireless link.

Types of *CI*s are specified in ISO 21218 in I parameter 22 “Medium”. The only legacy *CI* medium identified so far in ISO 21218 is "*DSRC*" with an application layer specified in ISO 15628. Further types may be added.

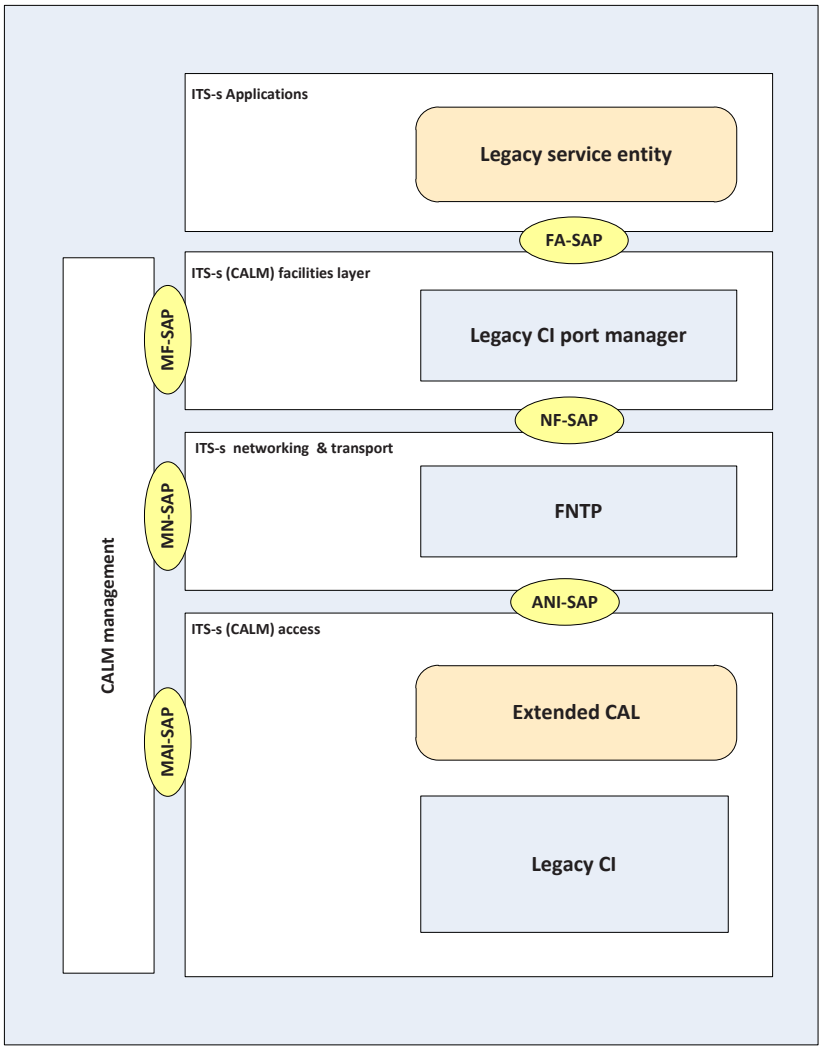


**Figure 19 — Legacy communication interfaces**
(Source: ISO 29281-3 adapted)

Inside the CALM station, the CALM FAST networking protocol is used for forwarding of packets between the CALM communications interface layer and the CALM service layer.

This requires

- to implement a CALM adaptation layer (CAL) as specified in ISO DIS 21218 extended with the additional functionality for FAST networking support as specified in ISO, which optionally may include also parts of the service processing functionality
- to make use of the "Legacy communications interface port manager" as specified in ISO 29281 and in ISO 2410

The "Legacy Service Entity" registers at the "Legacy Port Manager" indicating the communications interface class and legacy option of the required legacy communications interface. See ISO 21218 and 7.10 below.

#### 7.9.4.2 ISO 29281 supporting ISO 15628 legacy services

Legacy services (user applications) built on top of an *OSI* layer 7 as specified in ISO 15628 may be operated over a CALM communications interface of communications interface class CIC-wl1 specified in ISO 21218. The services interface with the CALM FAST networking protocol via the "15628 Kernel Emulator", see Figure 20.

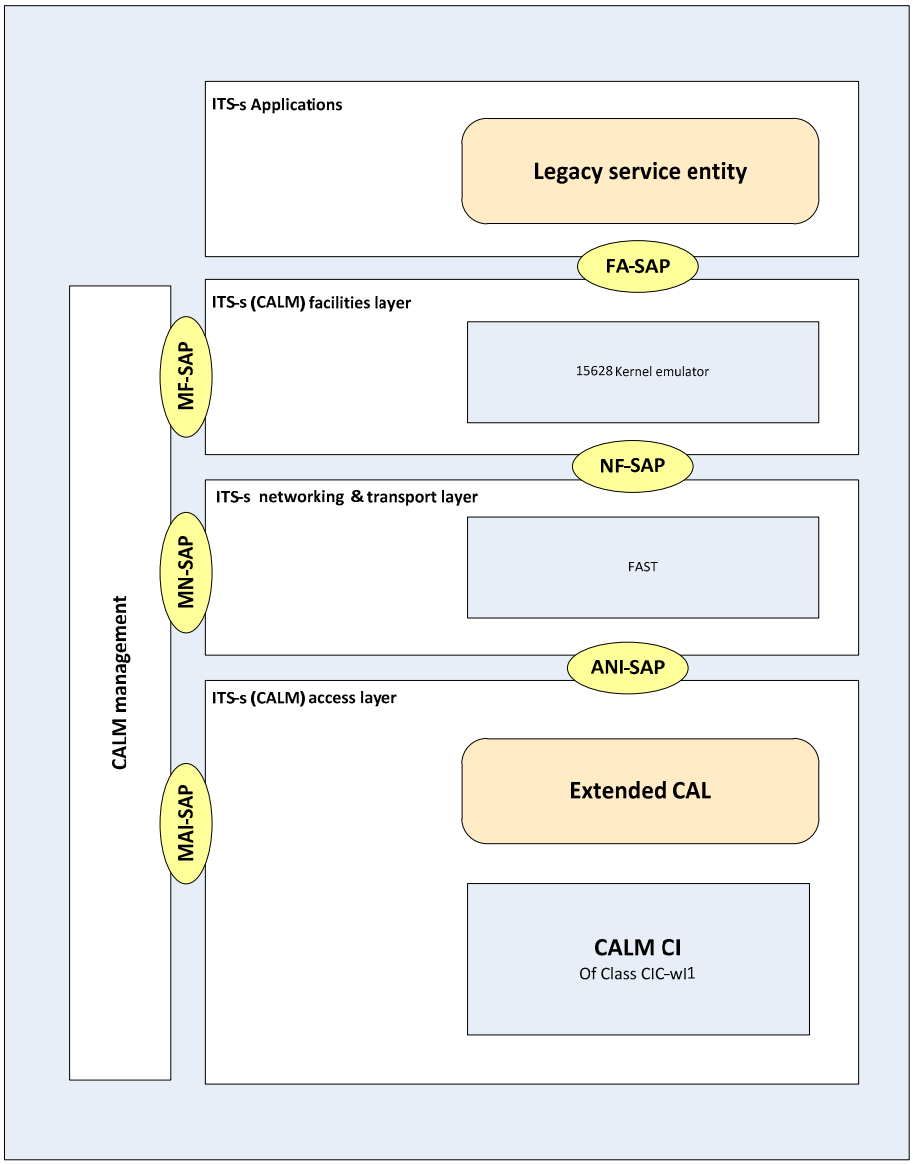


**Figure 20 — ISO 15628 Kernel emulator**
(Source: ISO 29281)

The 15628 initialization phase shall be implemented with the groupcast functionality specified in ISO 24102-1 and in ISO 24102-5.

The "15628 Kernel Emulator" performs the following tasks:

- Register at server groupcast manager for periodic transmission of BST, if applicable.
- Register at client groupcast manager for transmission of VST, if applicable.
- Emulate the 15628 T-Kernel interface for usage by applications.
- Map the 15628 "FlowControl" on BC-*VCI* and UC-*VCI*.

The purpose of 15628 LID is served by Link-ID specified in ISO 21218.

See ISO 29281-3 for detail of how this is achieved.

#### 7.9.5 ISO 29281 Communication scenarios

The networking protocols specified in ISO 29281 apply to two basic communication scenarios

- single-hop communication between CALM *ITS-station*s, regardless where the stations are installed,
- multi-hop communications between CALM *ITS-station*s.

NOTE 1: Subsequent hops may be managed either by services, or by network / transport protocol extensions. From a global architectural point of view, subsequent hops constitute the functionality of multi-hopping according to the CALM communication scenarios B1 and B2 as specified in ISO 21217.

NOTE 2: The CALM communication scenarios A3 and B3 as specified in ISO 21217, i.e. communication between roadside installations, are not within the focus of CALM FAST. It is recommended to use *IPv6* based communications in these scenarios. However CALM *ITS-stations* (4.4) are treated as peer stations. Thus from an operational point of view, there is no difference between mobile stations and roadside (fixed) stations, as a parking mobile station also can be considered as a roadside station. Consequently the FAST procedures may be applied also within CALM communication scenarios A3 and B3

### 7.10 ISO 21218 CALM Lower Layer SAP

#### 7.10.1 ISO 21218 overview

The wireless network aspects of instantiations of *TARV* shall comply to the requirements of ISO 21218 Intelligent transport systems -- Communications access for land mobiles (CALM) - Medium service access points.

The following subclauses identify some of the aspects of ISO 21218 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 21218. However, in respect of CALM lower layer *SAP*, ISO 21218 is the paramount and core document and shall be consulted and complied with in any such *TARV* instantiation.

ISO 21218 determines the service access points (*SAP*s) of a communication interface (*CI*) as provided by the communication adaptation layer (CAL) for communication, and as provided by the communication interface management adaptation entity (CIMAE) for management of the communication interface.

As CALM is open for existing communication modules, i.e. communication modules that are not aware of CALM, and CALM-specific communication modules, there is a need to adapt the interfaces of such existing communication modules to those expected by the CALM network layer and the CALM management.

ISO 21218 specifies that the communication module protocol layers shall include at a minimum a physical layer (*PHY*), a medium access control sub-layer (*MAC*), and optionally a logical link control sub-layer (*LLC*). In the communication path, the *CAL* shall offer an *LLC* service access point (*C-SAP*) towards the CALM network layer, and shall serve the underlying protocol layer.

In a specific implementation, the communication module may include higher layers of the *OSI* communication protocol stack including the related management.

The inclusion of higher protocol layers is restricted to those communication technologies already existing and not being aware of CALM, (e.g. the cellular media ISO 21212 and ISO 21213 and other public communications media).

In the management path, the 'Communications Interface - Management Adaptation Entity' (CIMAE) provides a management *SAP* (*M-SAP*) towards the interface management entity, and serves the communication module and the communication adaptation layer. See Figure 21.

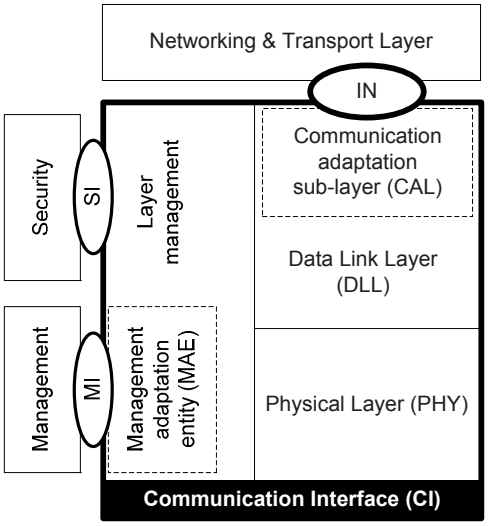


**Figure 21 — SAP architecture**
(Source: ISO21218)

ISO 21218 provides common basic functional specifications for the communication adaptation layer and for the communication interface management adaptation entity. It specifies both the communication *SAP* (*C-SAP*) and the management *SAP* (*M-SAP*). The means by which this is technically achieved is specified in ISO 21218 Clause 5. Further information may be also be found in the related standards for a specific medium, e.g. ISO 21212, ISO 21213, ISO 21214, ISO 29282, ISO 29283, etc. (see normative references), and in the Standard regularising the interface between public wireless networks and CALM, ISO 25111 .(Also see subClauses below regarding these Standards).

### 7.11 ISO 24102 CALM management

The wireless network aspects of instantiations of *TARV* shall comply to the requirements of, ISO 24102 Intelligent transport systems — Communications access for land mobiles (CALM) — CALM management.

The following text identifies some of the aspects of ISO 24102 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 24102. However, in respect of CALM management, ISO 24102 is the paramount and core document and shall be consulted and complied with in any such *TARV* instantiation.

ISO 24102 provides specifications for intelligent transport systems (ITS) station management to be compliant with the *ITS-station* reference architecture and the set of communications access for land mobiles (CALM) related standards.

Management actions are specified via:

a) service access points
b) messages and data that flow between the *ITS-station* management entity and the security entity, the application entity and the various communication protocol layers of the *ITS-station* reference architecture, and
c) protocol data units for management communications between addressable instances of functionality of an *ITS-station*

The *ITS-station* management entity specified in ISO 24102 provides functionality related to the:

- management of communication protocol layers and the security entity presented in the *ITS-station* (4.4) reference architecture specified in ISO 21217 and presented in Figure 22, and

- station-local management communications (Inter-*ITS-SCU*communications) enabling a sub-division of an *ITS-station* into several addressable entities, e.g. hosts and routers, in line with the general ITS architecture specified in ISO 21217.

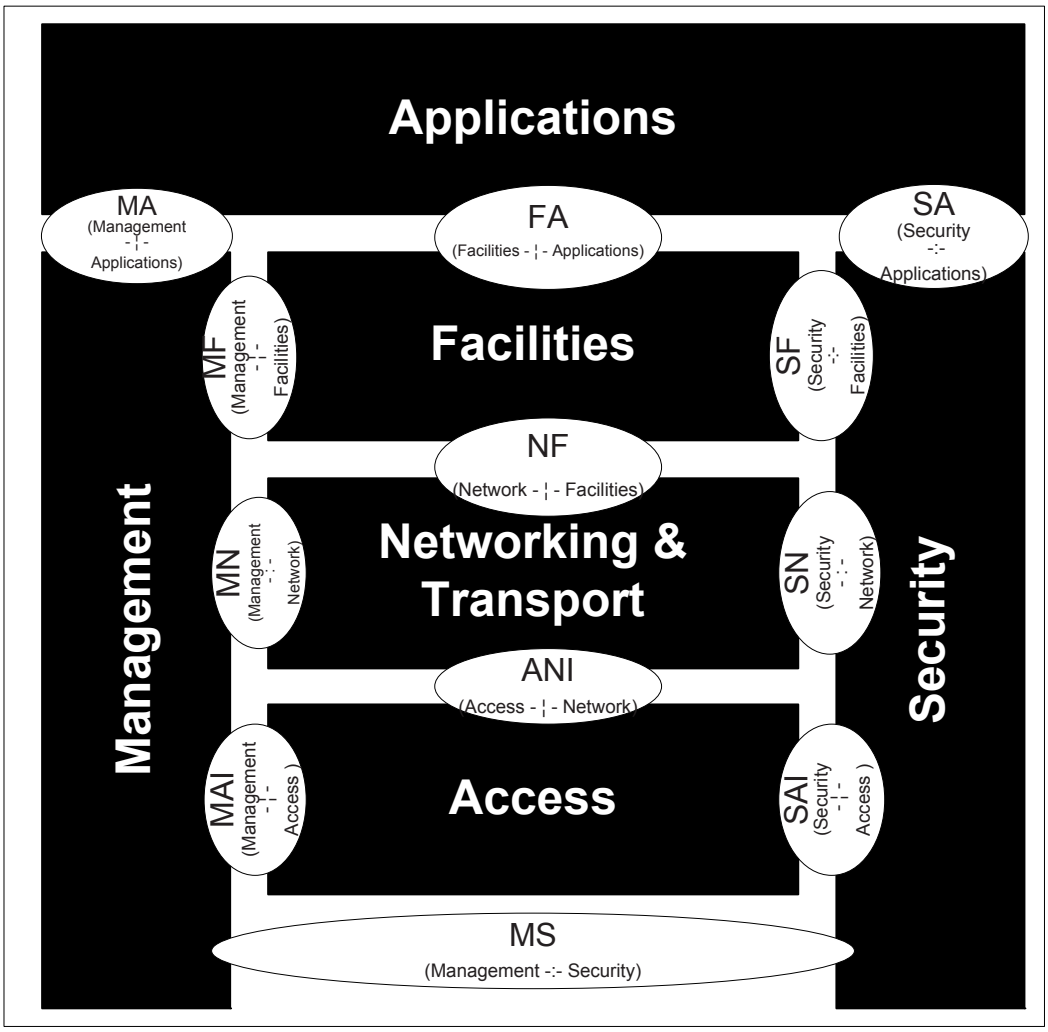


**Figure 22 — ITS-station reference architecture with named interfaces**
(Source: ISO 24102 / ISO 21217)

ISO 24012 specifies *ITS-station* (4.4) management as a distributed process, where no supervisory entity is employed. The *ITS-station* (4.4) management entity provides the service primitives of the

a) MAI-*SAP*, specified in ISO 21218 (See ISO 21218 and 7.10)
b) *MN-SAP*, specified in ISO 24102 (See ISO 24102)
c) *MF-SAP*, specified in ISO 24102 (See ISO 24102)

For further detail refer to ISO 24102 Clauses 5 – 17 and the Annexes to ISO 24102, which also define further mandatory requirements.

## 7.12 CALM Media

### 7.12.1 ISO 21215 CALM M5

The wireless network aspects of instantiations of *TARV* using 5 GHz wireless communications shall comply to the requirements of ISO 21215 Intelligent transport systems -- Communications access for land mobiles (CALM) -- M5.

The following subClauses identify some of the aspects of ISO 21215 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 21215. However, in respect of CALM M5, ISO 21215 is the paramount and core document and shall be consulted and complied with in any such 5 GHz *TARV* instantiation.

ISO 21215 provides specifications of the access layer (*OSI* layers 1 and 2 and the related management functionality) of a communication interface (*CI*) named "CALM M5", operating in the 5 GHz microwave frequency range.

CALM M5 communication interfaces include communication modules (CMs) that are based on the wireless *LAN* technology standardized at IEEE. ISO 21215 specifies the additions to and deviations from IEEE 801.11 (including amendment [16] developed by IEEE Task Group p (TGp)) required to make CALM M5 communication interfaces compatible with the *ITS-station* (4.4) reference architecture based on the CALM concept specified in ISO 21217.

Frequency allocations in regions other than North America are supported.

Figure 23 shows the architecture diagram of a CALM M5 communications interface (*CI*) embedded in the general CALM architecture.

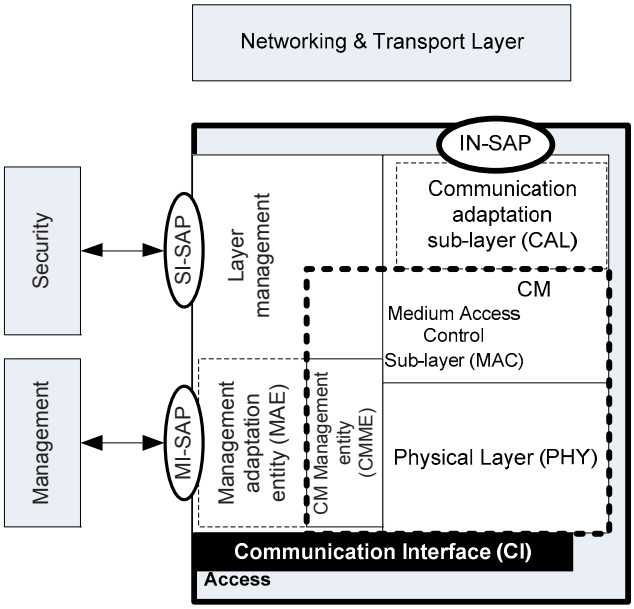


**Figure 23 — CALM M5 communication interface architecture**
(Source: ISO 21215)

The M5 communication module is indicated with a bold dotted line. The communication module along with the *CAL* "Communication Adaptation Layer" and CIMAE "Communication Interface Management Adaptation Entity" constitute a CALM communication interface as specified in ISO 21218 (see 7.10 and ISO 21218).

The communication protocol layers of the communication module specified in ISO 21215 are:

- Physical layer for microwave communications (*PHY*).
- Medium access control sub-layer (*MAC*).

ISO 21215 specifies that a CALM M5 communications interface shall comply with the CALM International Standards ISO 21218 on access layer service access points, ISO 24102 on *ITS-station* (4.4) management, ISO 21217 on global ITS architecture, ISO 29281 on non-*IP* networking and ISO 21210 on *IPv6* networking, with restrictions and amendments as specified in ISO 21215.

ISO 21215 specifies that a:

- CALM M5 communication module shall be compliant with IEEE 802.11 with restrictions and amendments as specified in ISO 21215

- CALM M5 communications interface and virtual communication interface (*VCI*) shall support *MI*-parameters specified in ISO 21218 with amendments and restrictions as specified in ISO 21215

- CALM M5 communications interface as specified is a CALM wireless communications interface that shall support communications interface class CIC-wl1 for general simultaneous bi-directional communications with multiple peer-stations, coded in *MI*-parameter 15 "CIclass" specified in ISO 21218

NOTE This includes the capability of communications interface class CIC-wl3 and CIC-wl4.

- CALM M5 communications interface shall support at least communications interface access class CIAC-1 coded in *MI*-parameter 24 "CIaccessClass" specified in ISO 21218

- CALM M5 communications interface shall provide an *IN-SAP* and an *MI-SAP* as specified in ISO 21218 with restrictions as specified in ISO 21215

- CALM M5 communications interface shall support cross-communications interface prioritization as specified in ISO 21218 with details as specified in ISO 21215

NOTE Multiple CALM M5 communications interfaces per *ITS-station* (4.4) are possible, regardless of whether the communications interfaces belong to the same *ITS-SCU* or to different i, see ISO 24102 for the specification of an *ITS-SCU*.

- CALM M5 communications interface shall support all modes of usage of the CtrlCI bits in the communication interface-ID as specified in ISO 29281 with details as specified in ISO 21215

- CALM M5 communications interface shall support packets carrying management data being transferred via the *MI-SAP* as specified in ISO 21218

- CALM M5 communications interface shall support one or more of the logical channels "control channel" (CCH), "service channel" (SCH) and "auxiliary channel" (ACH) as specified in ISO 21218

- CALM M5 communications interface shall provide QoS functionality based on user priorities as specified in ISO 21218 and based on access categories as specified in IEEE 1609.4.

For detail of how this is technically achieved refer to ISO 21215, Clauses 7 – 8, and the Normative Annexes of ISO 21215.

### 7.12.2 ISO 21214 CALM Infrared

The wireless network aspects of instantiations of *TARV* using 5 infrared wireless communications shall comply to the requirements of ISO 21214, Intelligent transport systems — Communications access for land mobiles (CALM) — Infra-red systems.

The following text identifies some of the aspects of ISO 21214 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 21214. However, in respect of CALM infrared, ISO 21214 is the paramount and core document and shall be consulted and complied with in any such infrared *TARV* instantiation.

ISO 21214 determines the CALM air interface using Infra-red systems at 820 nm to 1010 nm.

ISO 21214 provides protocols and parameters for medium range, medium to high speed wireless communications in the ITS sector using infra-red systems.

Such links are required for quasi-continuous, prolonged or short communications between

- vehicles and the roadside,
- between vehicles, and
- between mobile equipment and fixed infrastructure points,
- over medium and long ranges.

Vehicles may be moving or stationary.

Wherever practicable, ISO 21214 has been developed by reference to suitable extant International Standards, adopted by selection. Required regional variations are provided.

Due account is given to, and use made of, any relevant parts of appropriate communications systems, such as 'Global Satellite Navigation Systems' (GNSS), 'Digital Audio Broadcasting' (*DAB*), 'Digital Video Broadcasting' (DVB), 'Radio Local Area Networks' RLANs, 'Digital Data Broadcasting' (DDB), TETRA, FM subcarrier, 'Mobile Broadband Systems' (MBS, W-ATM), 'Internet Protocols', and *DSRC*.

ISO 21214:

- supports data rates of 1Mbit/s up to 128Mbit/s. It may also support higher data rates;
- supports vehicle speeds to a minimum of 200km/h (closing speeds could be double this value);
- defines or reference environmental parameters relevant to link operation;
- supports communication distances to 100 meters. It may also support longer communication distances of 300 to 1000 meters;
- supports latencies and communication delays in the order of milliseconds;
- is compliant to regional/national regulatory parameters;
- may support other regional/national parameters as applicable.

Application specific requirements are outside the scope of ISO 21214.

For details of the function and operation of this CALM wireless interface see ISO 21214.

#### 7.12.3 ISO 21216 CALM Millimetre

The wireless network aspects of instantiations of *TARV* using millimetre wave wireless communications shall comply with the requirements of ISO 21216, Intelligent transport systems — Wireless communications — CALM using millimetre communications — Air interface.

The following text identifies some of the aspects of ISO 21216 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 21216. However, in respect of CALM millimetre, ISO 21216 is the paramount and core document and shall be consulted and complied with in any such *TARV* millimetre wave instantiation.

ISO 21216-1 covers the *OSI* Layer 1 (*PHY*) air interface for a communications medium operating in the 60 GHz millimetric frequency range by providing the parameters for medium range, medium to high speed wireless communications in the ITS sector. It specifies the parameters required to interface the layer 1 of such a system to the CALM architecture.

Such communications links are required for quasi-continuous, prolonged or brief communications:

- between vehicles and the roadside communication infrastructure, and
- between vehicles.

Vehicles may be moving or stationary.

Wherever practicable, this standard has been developed by reference to suitable extant standards, adopted by selection. Required regional variations are provided for.

Application-specific requirements are not included in ISO 21216.

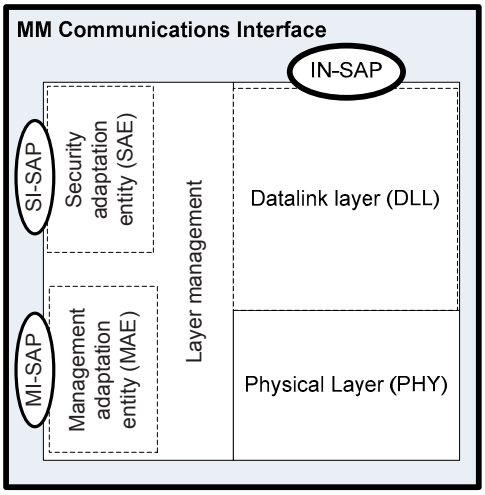


**Figure 24 — MM architecture schematic**
(Source: ISO 21216)

In Figure 24, the *PHY* is specified by ISO 21216 and the data link layer and the layer management by anticipated future standards.

For detail specifications and protocols and details of how this is achieved see ISO 21216-1.

### 7.12.4 ISO 24103 CALM media adapted interface layer

The wireless network aspects of instantiations of *TARV* shall comply with the requirements of ISO 24103 Intelligent transport systems — Communication access for land mobiles (CALM) — Media adapted interface layer (MAIL).

The following text identifies some of the aspects of ISO 24103 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 24103. However, in respect of CALM media adapted interface layer, ISO 24103 is the paramount and core document and shall be consulted and complied with in any such *TARV* instantiation.

ISO 24103 determines the "Media Adaptation Interface Layer" (MAIL) which enables legacy communication media such as *DSRC* which shall be compliant to ISO 15628 (*DSRC* application layer), to be used as CALM media for *IP* based communications, which shall be compliant to one or more of the following standards:

ARIB STD-T75; Dedicated Short-Range Communication (Japan);

TTAS.KO-06.0025; Standard of *DSRC* Radio Communication between Road-side Equipment and On-board Equipment in 5.8GHz band (Korea);

CEN EN 12253, *DSRC* Physical Layer using Microwave at 5.8GHz band,
CEN EN 12795, *DSRC* Data Link Layer,
CEN EN 12834; *DSRC* Application Layer (Europe).

Figure 25 shows the architecture of MAIL. MAIL can be considered as a specific extension of the "CALM Adaptation Layer" (CAL) specified in ISO 21218.

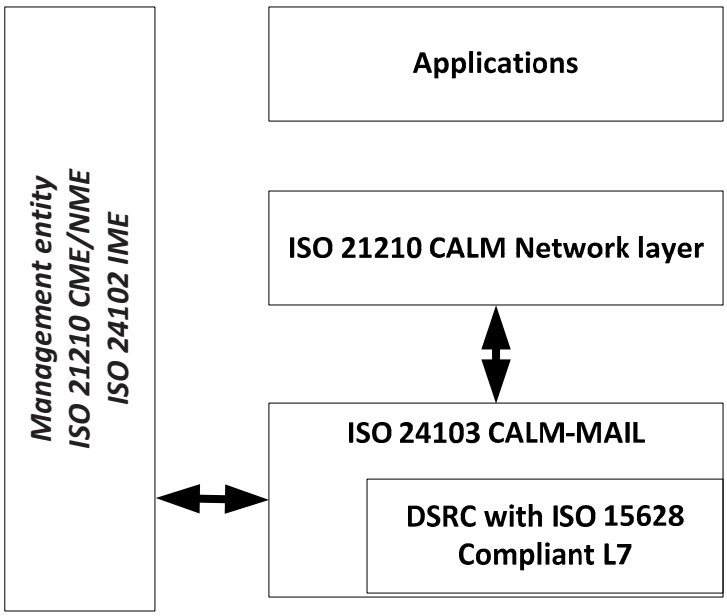


**Figure 25 — CALM-MAIL in CALM architecture**
(source ISO 24103)

NOTE To furnish related information of CALM MAIL, ARIB STD-T88 (*DSRC* Application Sub Layer) may be referred. MAIL interfaces ISO 15628 *DSRC* application layer protocol stacks and CALM network protocols to provide the *DSRC* with supplemental communications functions (Refer to Figure 26).

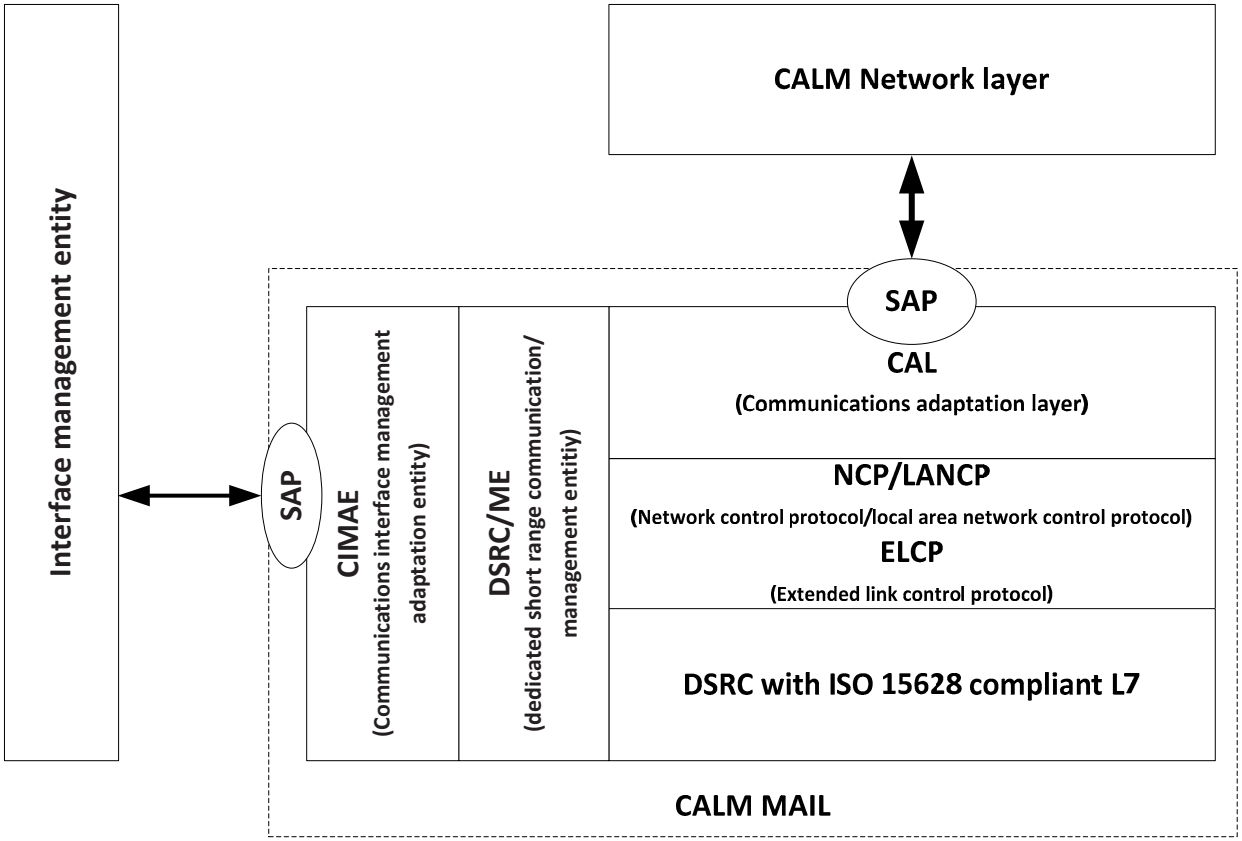


**Figure 26 — CALM MAIL Medium adaptation**
(Source: ISO 24103)

ISO 24103 specifies that CALM MAIL communication interfaces (*CI*) shall support requirements specified in ISO 21218 on lower layer service access points, ISO 24102 on interface management, ISO 21217 on global architecture and ISO 21210 on *IP* networking, with restrictions and amendments as specified in ISO 24103.

ISO 24103 specifies that CALM MAIL communication interfaces as specified are a CALM wireless communication interface that shall support communication interface class CIC-wl5 according to ISO 21218.

ISO 24103 specifies that CALM MAIL communication interfaces shall support at least communication interface access class CIAC-1 according to ISO 21218.

ISO 24103 specifies that CALM MAIL communication interfaces shall provide a *C-SAP* as specified in ISO 21218.

ISO 24103 specifies that CALM MAIL communication interfaces shall provide an *M-SAP* as specified in ISO 21218.

For detail of how this is technically achieved refer to ISO 24103, Clauses 6 – 9.

### 7.12.5 ISO 25111CALM General requirements for public networks

#### 7.12.5.1 General

The wireless network aspects of instantiations of *TARV* using public wireless communications shall comply to the requirements of ISO 25111, Intelligent transport systems — Communications access for land mobiles (CALM) — General requirements for using public networks ***and*** to the relevant CALM reference standard for that public wireless communications network; as defined below.

The following subClauses identify some of the aspects of ISO 25111 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 25111. However, in respect of CALM using public networks, ISO 25111 is the paramount and core document and shall be consulted and complied with in any such *TARV* instantiation.

ISO 25111 specifies general requirements for the provision of *ITS services* (4.3), using the CALM architecture and protocols, via the use of public wireless networks (including cellular telephony and mobile wireless broadband (*MWB*) systems).

In particular, ISO 25111 specifies protocols and parameters that public wireless networks shall include to support prolonged, communication links in ITS environments where *heterogeneous handovers* (4.2) or media independent handovers (*MIH*) are either necessary to maintain the link, or desirable as determined by media selection policies, and such handover is provided by the public wireless network.

The requirements for the use of CALM via public wireless networks where there is no provision for heterogeneous cell/cell handover (i.e. so called nomadic services) is not the central focus of ISO 25111, but general requirements to enable the use of such systems, within the limits of the range of a single cell, are also provided.

Wherever practicable, ISO 25111 has been developed by reference to suitable extant standards, adopted by selection. Required regional variations are provided.

Specifically, for ISO 25111, extant national and International Standards for public wireless networks, are adopted by reference and are not redefined.

Application specific upper layers are not included in ISO 25111.

References to known medium specific CALM International Standards that utilise the provisions of ISO 25111 as their foundation, are as follows. However, other new public media may be introduced in the future and will operate within the aegis of ISO 25111:

| | |
|---|---|
| ISO 21212 | Intelligent transport systems, CALM, using 2G cellular networks (see 7.12.6) |
| ISO 21213 | Intelligent transport systems, CALM, using 3G cellular networks (see 7.12.7) |
| ISO 25112 | Intelligent transport systems, CALM, using 802.16e mobile wireless broadband networks (see 7.12.9) |
| ISO 25113 | Intelligent transport systems, CALM, using HC-SDMA mobile wireless broadband networks (see 7.12.11) |
| ISO 29282 | Intelligent transport systems, CALM, using satellite networks (see 7.12.8) |
| ISO 29283 | Intelligent transport systems, CALM, using IEEE 802.20 mobile wireless broadband networks (see 7.12.10). |

#### 7.12.5.2 'Public Mobile Network'

ISO 25111 asserts that the CALM architecture will support two types of air-interface media

- those that are purpose designed to provide *ITS services* (4.3) (non public media)
- those that use public mobile network media

ISO 25111 explains that some *ITS service* (4.3) provision can only be supported using 'non public' purpose designed media, such as those defined in ISO 21214 (CALM using Infra-red), ISO 21215 (CALM using 5 GHz), and ISO 21216 (CALM using millimetre wave). These services are primarily, but not exclusively, those requiring time critical dialogues and transactions (measured in milliseconds). Some *ITS services* (4.3) may be provided using either type of media, and some commercial services may be only available from a particular type of' Public Land Mobile Network'.

ISO 25111 provides the general requirements for the provision of *ITS services* (4.3), via the CALM architecture, using public land mobile network media.

#### 7.12.5.3 'Continuous' and 'Time Controlled' sessions

The principal difference between continuous and *time controlled sessions* (4.7) to the communications architecture lies in the sequence of events - whether the CALM session is established before the medium session or whether the medium session is established prior to the CALM session.

To conform with ISO 25111, a 'Continuous' communication system shall attempt to establish a session as soon as the vehicle is switched on, and shall maintain that session, so long as it is possible, for as long as the vehicle is operating. If it loses the connection it shall immediately, and at regular intervals, try to establish a new session and restore a quasi *continuous session* (4.1), regardless of whether there is an immediate need to transact an exchange of data or not. This means that the communications sequence is that at engine start 'CALM Management' seeks to determine which media are available (See ISO 24102), as soon as the medium possibility is detected, a communications session is established, and that session is then quasi-instantaneously available to the CALM Manager.

Whereas, with a 'time controlled' system, at engine start the 'CALM Manager' seeks to determine which media are available (See CIC-wl2 and CIAC-2 in ISO 24102) , the communications equipment will identify itself to the medium and the medium may or may not establish a background session providing the location of the in-vehicle equipment, but does not establish an active communication session. An active communication session shall only be created when the in-vehicle (CALM) equipment chooses to initialise a *time controlled session* (4.7) in order to send a message/exchange data, or it receives an inbound call, such as receipt of a safety message from the infrastructure. There may well be situational variations as systems evolve. However the architectural consequence is as determined below.

So long as the appropriate equipment is fitted in the vehicle, the CALM concept can create and maintain sessions with many different communication media. However, there is a fundamental difference between the sequencing of session establishment procedures for sessions with media that, so long as they are present, are continuously connected, and those that are connected only when it is required to send a message.

Further, for those that are connected only when it is required to send a message, there are media types (for example 2G *GSM*) which, so long as the equipment is switched on, will establish a background link and non charged connection in order to be able to locate a user for incoming calls, and those (such as some satellite systems, or 'aircraft mode locked' equipment) which remain totally disconnected unless a session is initiated.

Finally, the user may, for whatever reason, elect only to connect upon the user's instruction and disconnect immediately when instructed to do so by the user. Clearly, in such an environment, *ITS services* (4.3), via CALM can only be available when the system is connected.

NOTE The user may also wish to control access to sessions with media. This may be for a number of reasons, including privacy and cost, but in some circumstances and countries, regulations for safety or national security, may forbid such 'User Controlled' override option for certain types of transactions.

NOTE ISO 25111, and related International Standards, neither prescribe nor proscribe any of these session types nor options within the session types, but simply enable them. Clearly, a session that is continuously connected can respond more quickly than one which has first to establish the communication session at the time of the request to send that message, and may therefore be suitable to support a greater range of services. However there are technical, commercial and political reasons for each of the described types of communication session. This Standard simply provides general procedures for all types of public wireless networks in order to function within the CALM environment.

NOTE The reasons for continuous or time controlled communications sessions are commercial, technical and political. Some media may be available more ubiquitously than others (such as Satellite, 2G *GSM*, 3G) but be based on commercial models that only use call-time controlled charging, or may have volume limitations that for technical reasons need to minimise actual connection time. Other media (such as many instantiations of *MWB*) are subscription based, and work on the principal of quasi continuous connection to the medium (for example for immediate internet access) on a non session-time controlled subscription, and in the case of use within the CALM context, to establish a connection, so long as it is possible, during the whole period that the vehicle engine is running. However, it is not possible to say that one medium will always use time controlled charging while another will always use subscription based charging. For example, there are instantiations of 2G and 3G that use 'free call' subscription based charging and there examples of *MWB* that use session-time controlled charging. These models may vary according to location, service provider, and in any event may change over time. This Standard provides technical provision to deal with all of these options, and to ensure that where permitted they function effectively. It does not get involved in the commercial or political preferences.

For detail of the overall procedures for these options see ISO 25111. However, while the overall procedure in respect of CALM can be determined in ISO 25111, the specific procedures for each medium are determined in the relevant CALM International Standard for that medium (e.g ISO 21212, 21213, 25112, 25113, 29282, 29283 etc.), and these International Standards provide an ITS-CALM operational environment that will itself operate within the standards which govern the management of the particular medium.

#### 7.12.5.4 'User Controlled' sessions

*User controlled sessions* (4.8), where they are permitted, regardless of whether the medium is 'Continuous' or 'Time Controlled', will operate according to the sequence of a 'Time Controlled' session, except that the instruction to enable CALM to commence a session (with any specific or all media) is determined by the user.

The means by which such user control is effected by the in-vehicle equipment is not determined within ISO 25111. The instruction to terminate may originate from the user, or from the CALM Management International Standard (ISO 24102). Within the concept of 'User Controlled' sessions it is envisioned that there may be vendor/equipment based options and it is not the intention of ISO 25111 to propose or standardise such options.

#### 7.12.5.5 Establishment and termination of a 'Continuous' session

In a 'Continuous' system, the session using the medium shall be connected at the earliest opportunity (i.e. when the CALM Manager seeks to identify which media options are possible at ignition turn-on). The operational sequence is determined as follows:

a) Establish session with medium in accordance with the relevant CALM International Standard for that medium (e.g. ISO 21212, 21213, 21214, 25112, 25113, 29282, 29283 etc).

b) Subsequently establish CALM session as determined by the 'CALM Management' (ISO 24102) and 'CALM Networking' (ISO 21210) International Standards.

c) A session with medium shall be terminated when ignition is switched off, i.e. the communication interface state "not-existent " (see ISO 21218) is reached.

#### 7.12.5.6 Establishment and termination of a 'Time Controlled' session

In a 'Time Controlled' system the operational sequence is:

1) 'CALM Management' (ISO 24102) identifies if the communication interface is available.

2) A CALM session is established as determined by 'CALM Management' (ISO 24102) and 'CALM Networking' (ISO 21210) International Standards (with all media possibilities).

3) The 'CALM Management' (ISO 24102) monitors the continuing availability of the communications interface

4) Each time that the 'CALM LL-*SAP*' (ISO 21218) wishes to use the specific communications interface, a session with the communications interface is established in accordance with the procedures in ISO 24102 and the standards within which the specific public wireless network operates.

5) When the transaction is completed the 'CALM Management' (ISO 24102) instructs the 'CALM Networking Manager' (ISO 21210) to terminate the session with the medium, which iis achieved by deletion of all virtual communication interfaces (ISO 21218). As a result the communications interface shall return to the state "registered"

#### 7.12.5.7 Establishment and termination of a 'User Controlled' session

The system shall establish a communication session only upon instruction by the user of the vehicle and shall disconnect a communication session immediately upon instruction from the user regardless of whether the system is of a 'Continuous' or 'Time Controlled' type. Such systems shall operate in accordance with the procedures determined in 6.1.4 above.

#### 7.12.5.8 Example

See Figure 27 below.

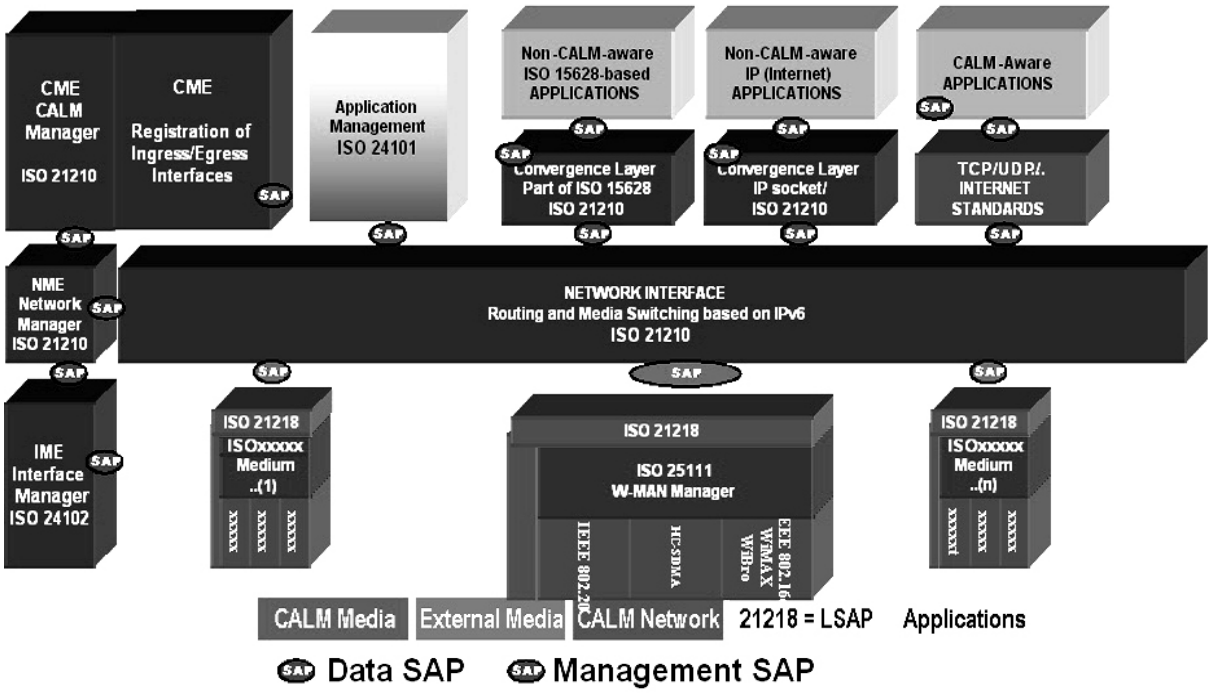


**Figure 27 — ISO 21217 CALM system architecture as it relates to public wireless networks, showing the example of MWB**

(Source: ISO 25111)

For detail of how these functionalities and protocols are effected see ISO 25111.

### 7.12.6 ISO 21212 CALM GSM

The wireless network aspects of instantiations of *TARV* using *GSM* public wireless communications shall comply to the requirements of ISO 25111, Intelligent transport systems — Communications access for land mobiles (CALM) — General requirements for using public networks AND ISO 21212, Intelligent transport systems — Communications access for land mobiles (CALM) — 2G Cellular systems.

The following text identifies some of the aspects of ISO 21212 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 21212. However, in respect of CALM using 2G wireless networks, ISO 21212 is the paramount and core document and shall be consulted and complied with in any such *TARV* instantiation.

ISO 21212 determines the air interface using 2nd generation cellular networks: 2nd generation (e.g. using *WAP* and *I-Mode* type protocols) systems to be compliant to CALM, i.e., requirements that must be met before a 2G system can be incorporated into a CALM system. In particular, ISO 21212 specifies protocols and

parameters that 2G systems shall include to support prolonged, long-range, high data rate wireless communication links in ITS environments where *heterogeneous handovers* (4.2) or media independent handovers (*MIH*) are either necessary to maintain the link, or desirable as determined by media selection policies.

ISO 21212 provides protocols and parameters for long range, medium speed wireless communications in the ITS sector using 2nd generation cellular communications.

Wherever practicable, ISO 21212 has been developed by reference to suitable extant standards, adopted by selection. Required regional variations are provided.

Specifically, for ISO 21212, extant 2G systems, as defined by various international and national standards, are adopted by reference.

Application specific upper layers are not included in ISO 21213.

#### 7.12.6.1 Adoption of other standards and internationally adopted practices

ISO 21212 requires equipment and systems complying to ISO21212 to operate in the environment of, and to the parameters defined *for 2G and 2.5G systems* in one the following sets of standards and Internationally adopted practices:

- 3GPP/(including *GSM*/*EGPRS* Active specifications
- TIA-95-B (cdmaOne)
- ANSI/TIA-136-A
- TIA/EIA/IS-54-C
- ARIB PDC RCR Standard No.27
- 3GPP2 (for CDMA2000-1x, which is considered to be 2.5G in some countries)

and operate within the limits and parameters defined in regional and national regulations.

#### 7.12.6.2 Non packet switching cellular networks

Non packet switched cellular networks shall not be used for CALM communication sessions, except to transmit non time critical emergency messages from the vehicle to predetermined numbers or assistance centres.

NOTE "non time critical" in this context does not imply that it is not important to transmit the message as quickly as possible, but implies that the time taken to establish communication with the target number is non time critical and can follow predetermined dial up protocols according to normal dialling procedures.

ISO 21212 operates within the framework of ISO 25111.For detail of how this is achieved, see ISO 25111 and ISO 21212.

### 7.12.7 ISO 21213 CALM UMTS

The wireless network aspects of instantiations of *TARV* using *UMTS* public wireless communications shall comply to the requirements of ISO 25111, Intelligent transport systems -—- Communications access for land mobiles (CALM) — General requirements for using public networks AND ISO 21213, (CALM) — 3G Cellular systems.

The following text identifies some of the aspects of ISO 21213 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 21213. However, in respect of CALM using 3G cellular wireless networks, ISO 21213 is the paramount and core document and shall be consulted and complied with in any such *TARV* instantiation.

ISO 21213 determines the air interface options applicable to CALM using 3rd generation cellular networks. In particular, ISO 21213 specifies protocols and parameters that 3G systems shall include to support prolonged, long-range, high data rate wireless communication links in ITS environments where *heterogeneous handovers*

(4.2) or media independent handovers (*MIH*) are either necessary to maintain the link, or desirable, as determined by media selection policies.

ISO 21213 provides protocols and parameters for long range, medium speed wireless communications in the ITS sector using 3rd generation cellular communications.

Wherever practicable, ISO 21213 has been developed by reference to suitable extant Standards, adopted by selection. Required regional variations are provided.

Specifically, for ISO 21213, extant 3G systems, as defined by various international and national Standards, are adopted by reference.

Application specific upper layers are not included in ISO 21213.

#### 7.12.7.1 Adoption of other standards and internationally adopted practices

Equipment and systems complying to ISO 21213 shall operate in the environment of, and to the parameters defined for 3G systems in one the following sets of Standards and Internationally adopted practices:

- 3GPP Active specifications
- 3GPP2 Active specifications
- *GSM*-MAP
- W-CDMA
- cdma2000
- ANSI/TIA-41
- ULTRA-*TDD*
- ANSI/TIA-136

and shall operate within the limits and parameters defined in regional and national regulations.

#### 7.12.7.2 Non packet switching cellular networks

Non packet switched cellular networks shall not be used for CALM communication sessions, except to transmit non time critical emergency messages from the vehicle to predetermined numbers or assistance centres.

NOTE "non time critical" in this context does not imply that it is not important to transmit the message as quickly as possible, but implies that the time taken to establish communication with the target number is non time critical and can follow predetermined dial up protocols according to normal dialling procedures.

ISO 21213 operates within the framework of ISO 25111.For detail of how this is achieved, see ISO 25111 and ISO 21213.

### 7.12.8 ISO 28282 CALM Satellite

The wireless network aspects of instantiations of *TARV* using satellite public wireless communications shall comply to the requirements of ISO 25111, Intelligent transport systems — Communications access for land mobiles (CALM) — General requirements for using public networks AND ISO 29282, Intelligent transport systems — Communications access for land mobiles (CALM) — Applications using satellite networks.

The following subClauses identify some of the aspects of ISO 29282 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 29282. However, in respect of CALM using satellite wireless networks, ISO 29282 is the paramount and core document and shall be consulted and complied with in any such *TARV* instantiation.

ISO 29282 defines the operation for the 'Medium Management Adaptation Entity' (*MMAE*) which provides the management interface between a proprietary satellite communications medium and the 'ITS Station Management'. This will allow the 'ITS Station Management' to know the status of the communications medium and to control the interface without the applications at the *ITS-station* (4.4) needing to have any knowledge of

the satellite communications interface. The procedures that the 'ITS Station Management' expects to use are explained in this part of ISO 15638.

ISO 29282 defines how to connect and disconnect a communication session using satellite communication systems, within the context of an application operated within the environment defined in the CALM architecture Standard (ISO 21217).

NOTE The Standard supports peer to peer modes of communication. Support for broadcast satellite systems is defined in another standard (ISO 13183) which defines a common approach for all broadcast media.

ISO 29282 supports satellite communications networks that are interconnected with the public network; those which connect via the internet; and with those which provide a stand-alone capability.

As there are multiple instantiations of satellite systems, most of which are not interoperable, there is the possibility of several simultaneous satellite sessions, each forming a separate CALM medium, (although the differences may only be in software within the in-vehicle system).

Wherever practicable, ISO 29282 has been developed by reference to suitable extant Standards, adopted by selection.

Application specific upper layers are not included in ISO 29282.

#### 7.12.8.1 Proprietary connectivity protocols

Satellite communications systems are implemented in a variety of ways, which deliver different characteristics. It is useful to have an overview of these implementations and their characteristics because these will affect the way that CALM applications will use these systems. This will therefore affect the design of CALM systems that use satellite communications.

- 'Geostationary Earth Orbit' (*GEO*) satellites orbit over the equator at the same rotation rate as the earth, so appear to be stationary above the equator. (35,786km above the earth's surface). A set of satellites at fixed positions ensure that all longitudes can be covered; however, coverage at higher latitudes is limited with significant obstruction possible in urban areas, and rural areas with obstructions such as trees.

- Non-*GEO* satellites may be at low (*LEO*) or medium height (MEO) above the earth, Non-*GEO* satellites have orbits offset to the equator which gives much better coverage at higher latitudes. Continuous coverage and availability are possible if there are sufficient orbits and satellites. Store and forward techniques need to be used if there are insufficient satellites to give continuous availability. MEO satellites operate with an orbit time of between 2 and 12 hours. The advantages of the lower and faster orbit is that the satellite is closer to the ground and therefore has less path loss, and potentially a smaller coverage footprint, which allows more frequency reuse and therefore higher capacity for a given spectrum allocation. However, these systems do require more satellites to give the required availability and introduce an additional overhead to manage the hand-over of sessions from one satellite to the next. Note that this complexity is handled in the receiver and is not visible to CALM systems, except that any impact on instantaneous availability would be reported to the 'ITS Station Management' using the interface and protocols defined in ISO 21218 – CALM medium service access points.

- Additionally, highly elliptical orbits offer the advantage that the satellites spend a significant proportion of their time at high altitude at a point which can be set to be above main area where coverage is required. Coverage of a large area (continent) can be achieved by several satellites spaced in the orbit such that the traffic is passed from one satellite to the next.

- Satellites may be optimised for fixed services or mobile services. Fixed systems typically have a larger antenna, with higher gain which allows a higher bandwidth.

- Some satellite system service providers also operate "ancillary terrestrial components" otherwise known as "complimentary ground component" where the satellite transceiver will switch automatically to use a terrestrial wireless service typically provided by a third party operator (e.g. *GSM* / PCS). This has some similarity to the *heterogeneous handover* (4.2) that is provided by CALM, but is implemented as a

proprietary solution that typically provides a single alternative medium, via a commercial arrangement that is provided by the satellite service operator.

Commercial satellite services all rely upon proprietary protocols to handle data communications within their system. Interworking between systems is not supported. Only the interface between the satellite transceiver and the CALM station is standardised.

Examples of satellite telecommunications systems that are the subject of this standard include the following:

- *MSS* (Mobile Satellite Services) (*GEO*)
  - Aces
  - Inmarsat
  - Thuraya
  - Solaris S-Band
  - Inmarsat S-Band
- *MSS* (Mobile Satellite Services) (non-*GEO*)
  - (Galileo – Search And Rescue - SAR)
  - Globalstar
  - Iridium IS
- Store & Forward (non-*GEO*)
  - Argos
  - ORBCOM
- *MSS/ATC* (Mobile Satellite Services with Ancillary Terrestrial Components)
  - ICO GLOBAL
  - MSV (Mobile Satellite Ventures)
  - Terrestar Networks
- *FSS* (Fixed Satellite Services)
  - Eutelsat
  - HYLAS
  - *IP* STAR
  - SES Astra
  - Telesat / Wildblue

NOTE There are many satellites that provide broadcast services:

Typically these are primarily for entertainment and carry either video or audio; additionally Global Satellite Navigation System (*GNSS*). The interface to these systems is the subject of the CALM Broadcast standard (ISO 13183).

#### 7.12.8.2 Internet connectivity

Satellite systems are becoming available that support *IPv4* and *IPv6*.

NOTE *IPv6* communications can be supported by either transmitting Ipv6 packets encapsulated into *IPv4* packets (when *IPv4* support is provided) or natively. The satellite link will be seen as an "*IPv6* egress interface" from the point of view of the *IPv6* networking layer as specified in ISO 21210 "CALM *IPv6* networking".

Satellite systems implementing *IPv6* broadcast mode will be able to support geo-networking protocols that are being defined within ETSI as an extension to the *IPv6* networking defined in ISO 21210.

In respect of satellite telecommunications systems that support internet connectivity, conformance shall be as determined in system specifications. At some point in the future a conformance standard for the generic aspects may be developed, but this is beyond the scope of ISO 29282.

#### 7.12.8.3 Requirements for satellite systems compliant to CALM

The efficient connection of a satellite communications system into a CALM station requires compliance with a number of related standards. The overall CALM Architecture is defined in ISO 21217 which defines how the individual standards operate together to deliver the total functionality. An abstraction of the total architecture is shown in Figure 28 below. This only shows the modules that the satellite communications system has direct interaction with, and identifies the relevant standards. The requirements from each of these standards will be

considered in the following sections, together with consideration of the need to interface to a diverse range of proprietary satellite systems.

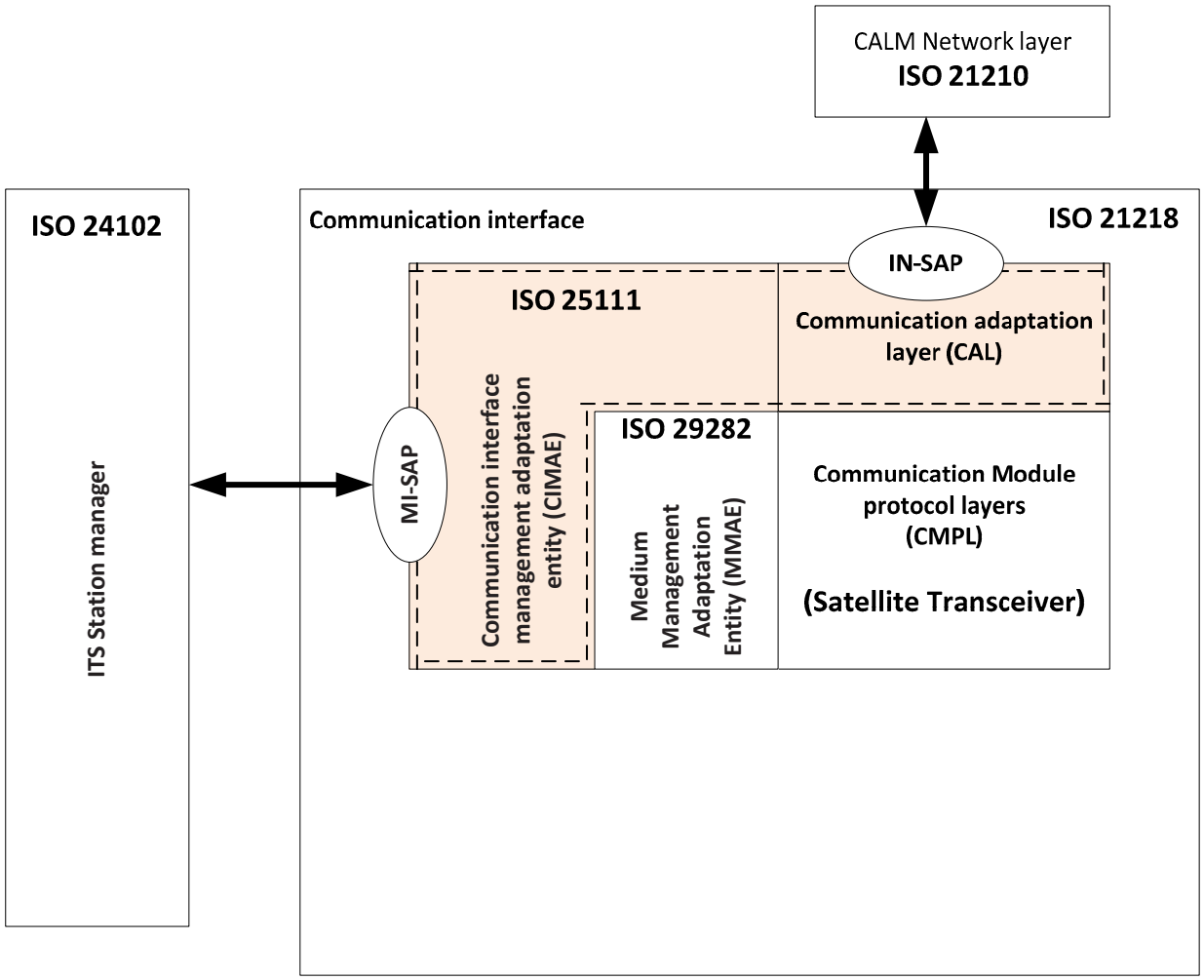


**Figure 28 — Interdependency in CALM Standards (satellite systems)**
(Source: ISO 29282)

#### 7.12.8.4 Adoption of satellite standards and internationally adopted practices

Equipment and systems complying with ISO 29282 shall operate in the environment, regulations and parameters defined for satellite systems in internationally adopted practices and within the limits and parameters defined in regional and national regulations.

The frequency spectrum allocation for radio communications including satellite communications is given in ITU Radio Regulation.

For further detail regarding how satellite systems achieve compliance within the CALM architecture see ISO 29282.

### 7.12.9 ISO 25112 CALM MWB using IEEE 802.16

The wireless network aspects of instantiations of *TARV* using IEEE 802.16 public wireless communications shall comply to the requirements of ISO 25111, Intelligent transport systems — Communications access for land mobiles (CALM) — General requirements for using public networks AND ISO 25112, Intelligent transport systems — Communications access for land mobiles (CALM) — Mobile wireless broadband using IEEE 802.16.

The following text identifies some of the aspects of ISO 25112 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 25112. However, in respect of CALM using IEEE 802.16, ISO 25112 is the paramount and core document and shall be consulted and complied with in any such *TARV* instantiation.

ISO 25112 shall be used to select the options appropriate for CALM using mobile wireless broadband (*MWB*) techniques complying to IEEE 802.16e/802.16g, and specifies the management interface requirements.

CALM links are required for quasi-continuous, prolonged and short duration communications between vehicles and the roadside, between vehicles, and between mobile equipment and fixed infrastructure points, over medium and long ranges.

Wherever practicable, ISO 25112 has been developed by reference to suitable extant Standards, adopted by selection. Required regional variations are provided.

Application specific upper layers are not included in ISO 25112.

Equipment and systems complying to ISO 25112 shall operate in the environment of, and to the parameters defined in one the following sets of International Standards and Internationally adopted practices:

- IEEE 802.16e - Part 16: "Air Interface for Fixed and Mobile Broadband Wireless Access Systems : Amendment for Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands"
- IEEE802.16g - Part 16: " Air Interface for Fixed and Mobile Broadband Wireless Access Systems - Management Plane Procedures and Services"

and shall operate within the limits and parameters defined in regional and national regulations.

For further detail regarding how IEEE 802.16 systems achieve compliance within the CALM architecture see ISO 25112.

#### 7.12.10 ISO 29283 CALM MWB using IEEE 802.20

The wireless network aspects of instantiations of *TARV* using IEEE 802.20 public wireless communications shall comply to the requirements of ISO 25111 Intelligent transport systems -- Communications access for land mobiles (CALM) -- General requirements for using public networks AND ISO 29283 ITS CALM Mobile Wireless Broadband applications using Communications in accordance with IEEE 802.20.

The following text identifies some of the aspects of ISO 29283 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 29283. However, in respect of CALM using IEEE 802.20, ISO 29283 is the paramount and core document and shall be consulted and complied with in any such *TARV* instantiation.

ISO 29283 shall select the options appropriate for CALM using mobile wireless broadband (*MWB*) techniques conforming to IEEE802.20 air interface and protocol specification recommended by ITU-R M.1801 and specifies the management interface requirements.

CALM links are required for quasi-continuous, prolonged and short duration communications between vehicles and the roadside, between vehicles, and between mobile equipment and fixed infrastructure points, over medium and long ranges.

Wherever practicable, ISO 29283 has been developed by reference to suitable extant Standards, adopted by selection. Required regional variations are provided.

Application specific upper layers are not included in ISO 29283.

ISO 29283 specifies two modes of operation, The Wideband mode is designed with wide bandwidth to operate for all Frequency Division Duplex (*FDD*) and Time Division Duplex (*TDD*); and The 625k-*MC Mode*

[4.5] is designed with 625 kHz carrier bandwidth supporting aggregation of multiple carriers for *TDD* operation only.;

and shall operate within the limits and parameters defined in regional and national regulations.

For further detail regarding how IEEE 802.20 systems achieve compliance within the CALM architecture see ISO 29283.

#### 7.12.11 ISO 25113 CALM MWB using HC-SDMA

The wireless network aspects of instantiations of *TARV* using *HC-SDMA* public wireless communications shall comply to the requirements of ISO 25111, Intelligent transport systems — Communications access for land mobiles (CALM) — General requirements for using public networks AND ISO 25113, ITS (CALM) — Mobile wireless broadband using *HC-SDMA*.

The following text identifies some of the aspects of ISO 25113 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 25113. However, in respect of CALM using *HC-SDMA*, ISO 25113 is the paramount and core document and shall be consulted and complied with in any such *TARV* instantiation.

ISO 25113 selects the options appropriate for CALM using mobile wireless broadband (*MWB*) techniques complying to ANSI ATIS *HC-SDMA* air interface and protocol specification recommended by ITU-R M.1801 and specifies the management interface requirements.

CALM links are required for quasi-continuous, prolonged and short duration communications between vehicles and the roadside, between vehicles, and between mobile equipment and fixed infrastructure points, over medium and long ranges.

Wherever practicable, ISO 25113 has been developed by reference to suitable extant Standards, adopted by selection. Required regional variations are provided.

Application specific upper layers are included in ISO 25113.

For further detail regarding how *HC-SDMA* systems achieve compliance within the CALM architecture see ISO 29283.

#### 7.12.12 ISO 13183 CALM Broadcast

The wireless network aspects of instantiations of *TARV* using broadcast public wireless communications shall comply to the requirements of ISO 25111, Intelligent transport systems — Communications access for land mobiles (CALM) — General requirements for using public networks AND ISO 13183, Intelligent transport systems — Communications access for land mobiles (CALM) — Broadcast communications.

The following text identifies some of the aspects of ISO 13183 that relate specifically to instantiation of ISO 15638 *TARV* and where appropriate its compliance to ISO 13183. However, in respect of CALM using broadcast communications, ISO 13183 is the paramount and core document and shall be consulted and complied with in any such *TARV* instantiation.

ISO 13183 specifies the architectural communications framework of "Intelligent Transport Systems" (ITS) for the family of CALM-related International Standards. The architecture is described in an abstract way with several graphical views and examples. The graphical representations follow partly the ISO *OSI* principles. In addition to the requirements specified within ISO 13183 a number of notes and examples are provided to illustrate the CALM concept.

Wherever practicable, ISO 13183 has been developed by reference to suitable extant International Standards, adopted by selection. The architecture provides for regional variations where regulations differ in different countries and regions.

#### 7.12.12.1 Proprietary and standardised connectivity protocols

There are many terrestrial broadcast transmitters and satellites that provide broadcast services.

Typically these are primarily for entertainment and carry either video or audio but may also provide digital information broadcast services. Additionally, global navigation satellite systems (*GNSS*) broadcast their location and time in order that the receiver can determine its location and the time. The interface to these systems is the subject of this CALM Broadcast standard.

Terrestrial services include:

- Sub carrier services carried on FM broadcast entertainment systems
  - *RDS* (Radio Data Service)
  - *DARC* (Data Radio Channel) ITU-R BS 1194-2.
- Digital coded audio
  - *DAB* – 'Digital Audio Broadcasting' in Europe
  - *ISDB-TSB* (ITU-R BS.1114-6 System F) / (ITU-R BT.1833.multimedia system F)
- 'Digital Multimedia Broadcasting' (DMB)
- Digital terrestrial TV
  - DVB as defined by ETSI
  - ISDB-T (ITU-R BT.1306-3 System C)/(ITU-R BT.1833 multimedia system C)
  - ISDB-Tmm(ITU-R BS.1114-6 System F)/(ITU-R BT.1306-3 System C)/ (ITU-R BT.1833 multimedia system F)
  - FLO (ITU-R BT. 1833 multimedia system M)

Satellite services include:

- S-*DAB* (Digital Audio Broadcast)
  - ONDAS
  - SIRIUS
  - Worldspace
  - XM Radio
- Satellite Television
  - DVB-H
  - DVB-SH
- *S-DMB* (Satellite Digital Multimedia Broadcast)
  - Solaris (Eutelsat / SES Astra)
  - Mobile Broadcasting Corporation
  - ISDB-S (ITU-R BO.1408-1) / (ITU-R BO.1516 System D)
- *GNSS*
  - COMPASS
  - GALILEO
  - 'Global Positioning System' (GPS)
  - GLONASS
  - Correction information from reference stations – including networked real time kinematics

NOTE The satellite systems identified above are illustrative. These are proprietary systems and not normative.

New systems are in development and ISO 13183 has been developed to be able to make full use of those new services.

#### 7.12.12.2 Requirements of the MMAE

The efficient connection of a CALM broadcast receiver requires compliance with a number of related standards. The overall CALM architecture is defined in ISO 21217, which defines how the individual standards operate together to deliver the total functionality. An abstraction of the total architecture is shown in Figure 29 below. The satellite 'Medium Management Adaptation Entity' is an adaptation layer between the broadcast communication system and the 'ITS station management', it uses the generic protocol defined in ISO 25111 and ISO 21218 and in this standard. Figure 29 shows only the modules that the broadcast communications

system has direct interaction with, and identifies the relevant standards. The requirements from each of these standards will be considered in the following sections, together with consideration of the need to interface to a diverse range of proprietary broadcast technologies.

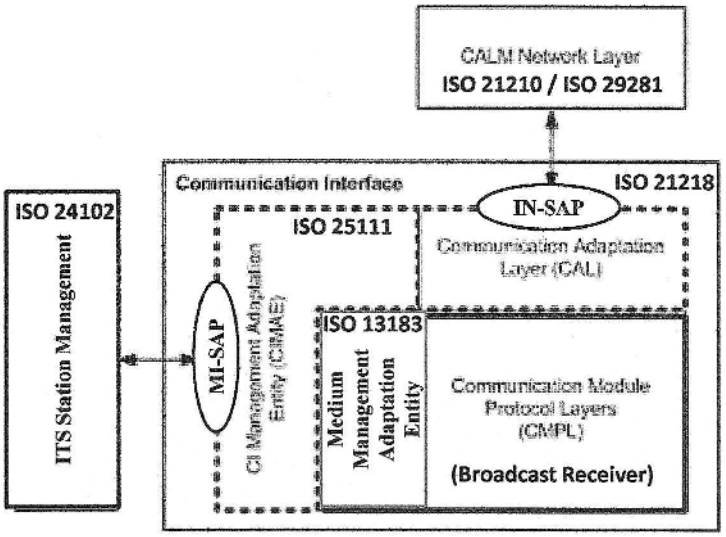


**Figure 29 — Interdependency of CALM standards**

#### 7.12.12.3 Adoption of broadcast standards and internationally adopted practices

Equipment and systems complying with ISO 13183 shall operate in the environment, regulations and parameters defined for broadcast systems in internationally adopted practices and within the limits and parameters defined in regional and national regulations.

#### 7.12.12.4 Broadcast types

Broadcast communications may be used by CALM-aware and non-CALM-aware applications.

Applications may be grouped according to common communications requirements:

1) Broadcast applications (e.g. map updates, road use charging fee tables, and traffic information) where it is acceptable that there is no guarantee that the information will be received correctly by all users.

    a. Includes communication classes 1 and 9 as defined in ISO 21217.

2) Broadcast with a return link (e.g. for message acknowledgement / retransmission request) – the return link may use a return path using another medium.

    a. Includes communications classes 1 to 4 and 9 to 12 as defined in ISO 21217.

    b. Broadcast mode is not applicable to internet browsing.

3) Broadcast communications of management information (e.g. paging of the vehicle).

    a. Supports the establishment of all communication classes 1 to 16, as defined in ISO 21217.

For further detail regarding how broadcast systems achieve compliance within the CALM architecture see ISO 13183.

### 7.14 Facilities layer for CALM communications

Shall comply to facilities management provisions of ISO 21217.

### 7.15 Application management for CALM communications

#### 7.15.1 ISO TR 12859 Privacy

*TARV* applications shall take into account the geographically relevant privacy requirements described in ISO 12859, Intelligent transport systems — System architecture — Privacy aspects in ITS standards and systems

#### 7.15.2 ISO 26683-2 Freight land conveyance content identification

*TARV* applications shall take into account the relevant provisions of the following International Standards when identifying freight land conveyance content:

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

ISO 15638 -4 *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Part 4: System security requirements*

ISO 15638 -5 *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Part 5: Generic vehicle data*

ISO 15638 -6 *Intelligent transport systems — Framework for collaborative Telematics Applications for Regulated commercial freight Vehicles (TARV) — Part 6: Regulated applications*

ISO 26683-2 *Intelligent transport systems — Freight land conveyance content identification and communication — Part 2: Application interface profiles*

### 7.16 Support interfaces

#### 7.16.1 Driver identification

While the communications means of obtaining driver identification are not standardised within the ISO 15638 suite of standards deliverables, the communications means to obtain that information shall, wherever practicable, utilise an existing means of communication specified in an extant ISO International Standard.

#### 7.16.2 Physical interfaces to ancillary devices and data

While the communications means for connecting to and obtaining data from ancillary equipment (tachograph, sensors, *TID*s, etc.) is not defined within this part of ISO 15638, the communications means to obtain that information shall, wherever practicable, utilise an existing means of communication specified in an extant ISO International Standard.

## 8 Quality of service requirements

This part of ISO 15638 contains no specific requirements concerning quality of service. Such aspects are expected to be determined by a jurisdiction as part of its specification for any particular regulated application service.

## 9 Test requirements

Test requirements for wireless communications using CALM are defined in the relevant CALM standards referenced in this part of ISO 15638 or in the case of wireless communications using public media, in the standards defining those media communications, and are not defined within this part of ISO 15638.

## 10 Marking, labelling and packaging

This part of ISO 15638 has no specific requirements for marking labelling or packaging.

However, where the privacy of an individual may potentially or actually compromised by any instantiation based on the ISO 15638 family of Standards, the contracting parties shall make such risk explicitly known to the implementing jurisdiction and shall abide by the privacy laws and regulations of the implementing jurisdiction and shall mark up or label any contracts specifically and explicitly drawing attention to any loss of privacy and precautions taken to protect privacy. Attention is drawn to ISO/TR 12859 in this respect.

## 11 Declaration of patents and intellectual property

This part of ISO 15638 contains no known patents or intellectual property other than that which is implicit in the media standards referenced herein. While the CALM standards themselves are free of patents and intellectual property, CALM in many cases relies on the use of public networks and IPR exists in many of the public network media standards. The reader is referred to those standards for the implication of any patents and intellectual property.

Application services specified within ISO 15638-6 and ISO 15638-7 contain no direct patents nor intellectual property other than the copyright of ISO. However, national, regional or local instantiations of any the applications services defined in ISO 15638-6 and ISO 15638-7, or of the generic vehicle information defined in ISO 15638-5, the security requirements contained in ISO 15638-4, or the requirements of ISO 15638-3, may have additional requirements which may have patent or intellectual property implications. The reader is referred to the regulation regime of the jurisdiction and its regulations for instantiation in this respect.

# Annex A
(normative)

# Guidance regarding the initiation of an application service communication session

## A.1 General scenario

There are four classes of application service supporting *TARV*.

a) Basic generic commands `GET CAD` and `GET STORED DATA` and the `Basic vehicle data` and `core application data` that support these commands

b) Regulated required application services for regulated commercial freight vehicles

c) Non-regulated but supported application services for regulated commercial freight vehicles

d) Commercial services

The basic generic commands required are determined in ISO 15638-3.The definition of `Basic vehicle data` and `core application data` is defined in this part, ISO 15638-5.

The core of services that are suitable to be regulated application services shall be as defined in ISO 15638-6. However, while the standard provides common definitions that are suitable to be used around the world, instantiations will vary around the world. In some jurisdictions some of these services will be mandated (regulated application service) in others the same service will be optional but supported(supported application services). These services are defined in ISO 15638-6.

Jurisdictions are free to add additional required domestic applications using the ISO 15638 framework and equipment, but shall be expected to do so only if a similar service is not defined in ISO 15638-6 or ISO 15638-7. Wherever practicable, the internationally standardized specification should be used.

Commercial application services are unlikely to be defined (although some examples may be provided), but as they have to share the use of the IVS with the required and supported services, the conditions under which they have to operate, have to be strictly controlled, and the requirements for this co-existence shall be as defined in ISO 15638-7.

All *TARV* application services, be they mandated regulatory services, supported optional regulated services, or commercial services, are based on wireless communications. This Normative Annex describes the sequence for initiating, conducting and terminating the principal options for wireless communications sessions between the IVS and the application service provider (ASP).

## A.2 Communications scenario

*TARV* application services are enacted using a wireless communication link. This link will vary according to the user and how his vehicle is equipped, and what infrastructure is available within the jurisdiction.

By using CALM, the maximum flexibility is supported. The application service design is largely independent of the wireless communication media used. (That said, some media, for example European *DSRC*, provide very time limited opportunity windows which will strictly limit the nature of the service supported.)

In communications terms, the *TARV* services are not time critical services (unlike, for example, collision avoidance systems).

There are two generic scenarios for service provision:

a) Where the vehicle contacts the application service

b) Where the application service provider (ASP) contacts the vehicle IVS

The generic process steps for scenario a) described in PROCESS A.

### A.2.1 PROCESS A: IVS INITIATES

i. The IVS decides to instigate a communication to the application service provider
ii. The IVS then selects the most appropriate media from the options available to it at that point in time
iii. The communication session is initiated
iv. The IVS provides the *IPv6* address of the application service
v. An 'internet' connection is established between the IVS and the application service
vi. The data exchanges take place according to the requirements of the application service
vii. The communication is terminated
viii. The application service processes data and sends the results to the involved parties

### A.2.2 PROCESS B: Application service provider (ASP) INITIATES

In scenario b) where the service provider contacts the vehicle the process is a little more complicated.

There are in fact a number of possible sequences.

#### A.2.2.1 PROCESS B1: ASP BROADCAST INITIATES

The first possibility here is a broadcast instigated scenario.

Here the process is:

i. the application service provider makes a broadcast over a defined area of coverage *That coverage could be very limited, as for example using a European or Japanese DSRC wireless link, or could be much more wide area, for example using UMTS/SMS*
ii. Any equipped vehicle in the area of coverage receives the message. The receipt of the broadcast provides an instruction to the IVS to connect to the application service provider
iii. The IVS then selects the most appropriate media from the options available to it at that point in time
iv. The communication session is initiated
v. The IVS provides the *IPv6* address of the application service
vi. An 'internet' connection is established between the IVS and the application service
vii. The data exchanges take place according to the requirements of the application service
viii. The communication is terminated
ix. The application service processes data and sends the results to the involved parties

#### A.2.2.2 Targeted WAKE UP

The second scenario is a targeted wake up, for example by sending an SMS or data to a target *UMTS* phone number (but could be targeted via many media). The process is similar to the broadcast example above, but is to a targeted vehicle:

Here the process is:

#### A.2.2.3 PROCESS B2: ASP TARGETS SPECIFIC RECIPIENT VIA UMTS (or similar)

i. The application service provider makes a targeted 'wake-up' call to a number that has a constant network connection without being in a constant communication session (for example to a *UMTS* phone number)
ii. The targeted IVS receives the wake-up call.
iii. The IVS then selects the most appropriate media from the options available to it at that point in time
iv. The communication session is initiated (and the *UMTS* or whatever session terminated if it is not the most appropriate link)
v. The IVS provides the *IPv6* address of the application service
vi. An 'internet' connection is established between the IVS and the application service
vii. The data exchanges take place according to the requirements of the application service
viii. The communication is terminated
ix. The application service processes data and sends the results to the involved parties

### A.2.3 PROCESS C: USER TELLS ASP WHEN VEHICLE IS IN OPERATION

Making the assumption that the vehicle is not constantly on-line, which is likely to be the case for the intermediate future, and the option to provide a *UMTS* (or similar) wake-up is not appropriate (for whatever reason), the only way for the service provider to instigate a session is if it is first advised by the IVS that the vehicle is on the road and the IVS available, and has *n* wireless media options available to it.

In this scenario the process steps are as follows:

i. When the vehicle starts up it contacts the application service provider (via PROCESS A) to let it know that it is operating
ii. It will probably make sense at this time to send the CAD (**`core application data`**)
iii. If the connection is good, it will probably make sense at this time to send **`stored data`** to the ASP
iv. Unless it receives an instruction from the ASP, the IVS puts the wireless communication into stand-by.
v. If the wireless conditions change the IVS contacts the ASP and repeats the steps above providing the new selected media information to the ASP.
vi. The IVS decides to instigate a communication to the application service provider
vii. The IVS then selects the most appropriate media from the options available to it at that point in time The communication session is initiated
viii. The IVS provides the *IPv6* address of the application service
ix. An 'internet' connection is established between the IVS and the application service
x. The data exchanges take place according to the requirements of the application service
xi. The communication is terminated
xii. The application service processes data and sends the results to the involved parties

### A.2.4 PROCESS D: SERVICE ANNOUNCEMENT from RSUs INITIATES

Commercial services, if they are of a vehicle or driver centric approach, can of course use any of the PROCESSES A-C, and when these application services are very specific to *TARV*, will use the direct *IPv6* routing to a predetermined application service provider. But these International Standards consider only their use in regulated commercial freight vehicles, and how these services co-exist simultaneously with *TARV* application services.

'Commercial' services used by *TARV* may also, and will often, be offered to many classes of vehicle, only one class of which is the regulated commercial freight vehicle. Therefore many other standards need to be considered.

The CALM standards ISO21218, ISO e.g. CALM FAST service advertisement (ISO 24102 and ISO 29281), and the IEEE Standards in the IEEE1609 series address these issues through ‘service advertisement’. In this scenario, it is the *ITS-station* that is in contact with the vehicle which ‘advertises’ to the vehicle the range of services that it can support. Alternatively, in another scenario, the vehicle IVS (which in the CALM architecture/IEEE ‘WAVE’ Architecture provides simply another *ITS-station*), asks the *ITS-station* that it is in communication with, whether it supports a particular application.

# Bibliography

[1] ISO/IEC Directives, Part 2, *Rules for the structure and drafting of International Standards*

[2] ISO/IEC TR 10000-1, *Information technology — Framework and taxonomy of International Standardized Profiles — Part 1: General principles and documentation framework*

[3] ISO 10241, *Terminological entries in standards — Preparation and layout*

[4] IETF RFC 4886, *NEMO Basic Support*

[5] ITU-R BS.1194-2, *Systems for Multiplexing Frequency Modulation (FM) Sound Broadcasting with a Sub-Carrier Data Channel Having a Relatively Large Transmission Capacity for Stationary and Mobile Reception*

[6] ITU-R BO.1408-1, *Transmission system for advanced multimedia services provided by integrated services digital broadcasting in a broadcasting-satellite channel*

[7] ITU-R BO.1516, *System D, Digital Multiprogramme Television Systems for use by Satellites operating in the 11/12 GHz Frequency Range*

[8] ITU-R BT.1306-3, *System C, Error correction, data framing modulation and emission methods for digital terrestrial television broadcasting*

[9] ITU-R BT.1833, *Multimedia System C, Broadcasting of multimedia and data applications for mobile reception by handheld receivers*

[10] ITU-R BS.1114-6 *System F, Systems for terrestrial digital sound broadcasting to vehicular, portable and fixed receivers in the frequency range 30-3,000MHz*

[11] *Cooperative Vehicle-Infrastructure Systems - An EU funded project* (www.cvisproject.org)

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