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Intelligent transport systems — Communications access for land mobiles (CALM) — Non-IP networking

Systèmes intelligents de transport — Accès aux communications des services mobiles terrestres (CALM) — Réseautique non-IP

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 29281 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

Introduction

This International Standard is part of a family of International Standards based on the communications access for land mobiles (CALM) concept. These International Standards specify a common architecture (see ISO 21217), network protocols and communication interface definitions for wired and wireless communications using various access technologies including cellular 2nd generation, cellular 3rd generation, satellite, infra-red, 5 GHz microwave, 60 GHz millimetre-wave and mobile wireless broadband. These and other access technologies that can be incorporated are designed to provide broadcast, unicast and multicast communications between mobile stations, between mobile and fixed stations and between fixed stations in the intelligent transport systems (ITS) sector.

A fundamental advantage of the CALM concept over traditional 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). This means that ITS stations are not limited to a single access technology and networking protocol and can implement any of those supported, and the ITS station management can make optimal use of all these resources. To exploit this flexibility, CALM-complaint systems may support handover of different types including

— those involving a change of communication interface without a change of access technology,

— those involving a change of communication interface with a change of 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.

A detailed introduction to the CALM family of International Standards is provided in ISO 21217.

There are applications and services in the ITS sector that are not well suited to IPv6 networking. Due to the rapidly changing topologies that can be encountered in ITS communications and the importance of physical location in some circumstances, networking & transport layer protocols specifically designed for efficiency (low-overhead, rapid initialization, etc.) and others based on geo-addressing and multi-hopping mechanisms are necessary to enable a much larger class of applications and services than would be possible with only IP networking. Examples of such applications include

— time-critical vehicle and road safety,

— road traffic efficiency,

— road tolling,

— access control, and

— commercial services.

This International Standard focuses on non-IP operations and contains specifications for the ITS station facilities layer and the non-IP networking & transport layer, which complements the IPv6 specifications given in ISO 21210.

Intelligent transport systems — Communications access for land mobiles (CALM) — Non-IP networking

1 Scope

This International Standards specifies FAST services, i.e.

— FAST networking & transport layer protocols for

  — single-hop communications,

  — N-hop broadcast communications,

  — ITS-MUX, and

  — ITS station-internal forwarding,

— FAST service for 15628 CI (DSRC CI) support,

— FAST service for 15628 application support,

and the related support of the MN-SAP and MF-SAP.

This International Standard references ISO 24102 for related specifications of

— FAST ITS service announcement, and

— groupcast management.

NOTE Formerly “FAST ITS service announcement” was referred to as “FAST service advertisement”. The name is being changed in order to align with terminology specified in ISO 21217.

Wherever practicable, this International Standard has been developed by reference to suitable extant standards, adopted by selection.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 8825-2, *Information technology — ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)*

ISO 15628:2007, *Road transport and traffic telematics — Dedicated short range communication (DSRC) — DSRC application layer*

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

ISO 21215, *Intelligent transport systems — Communications access for land mobiles (CALM) — M5*

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

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

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

ISO 24103, *Intelligent transport systems — Communications access for land mobiles (CALM) — Media adapted interface layer (MAIL)*

ARIB STD-T88, DSRC application sub-layer

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21217, ISO 21218, ISO 21210, ISO 24102, ISO 24103 and the following apply.

3.1
ITS station information
information on the identity, location and movement of an ITS station together with a time stamp

3.2
forwarding data
information received in a network node, optionally evaluated, modified and amended, and finally retransmitted, without involvement of an ITS-S application

3.3
ITS FAST service provider
entity using an ITS-S application (e.g. referred to as server application) in order to provide an ITS service to an ITS FAST service user, initiating and controlling communications for the transmission/exchange of packets with the FAST networking & transport layer protocol

3.4
ITS FAST service user
entity using an ITS-S applications (e.g. referred to as client application) in order to consume an ITS service offered by an ITS FAST service provider entity, where the ITS-S applications of the ITS FAST service provider and ITS FAST service user are complementary parts of the same ITS application

3.5
FAST ITS service
service offered by an ITS FAST service provider, by means of an ITS-S application (e.g. referred to as server application) residing in one ITS station, to the ITS FAST service user applying the complementary ITS-S application (e.g. referred to as client application) residing in another ITS station, which implies at least transmission of a single message or an exchange of messages between these ITS-S applications applying the FAST networking & transport layer protocol

3.6
GeoNetworking
networking functionality based on the geographic coordinates of the transmitter location and a geographic description of the destination

3.7
NWref handler
functionality to handle assignment and usage of NWref numbers

3.8
Host ITS-SCU
ITS-SCU containing the functionality of an ITS-S host

3.9
Router ITS-SCU
ITS-SCU containing the functionality of an ITS-S router

3.10
FAST basic header
header of the FAST networking & transport layer protocol supporting its basic functionality

3.11
FAST extension header
additional header of the FAST networking & transport layer protocol appended to the FAST basic header, supporting its extended functionality

3.12
FAST forwarding header
header of the FAST networking & transport layer protocol replacing the FAST basic header for ITS station-internal forwarding of packets

3.13
FAST ITS service announcement
ITS service announcement using the FAST networking & transport layer protocol as specified in ISO 24102

4 Symbols and abbreviated terms

Symbols and abbreviated terms used in this International Standard are listed below. Reference should also be made to ISO 21217, ISO 21210, ISO 21215, ISO 21218, ISO 24102 and ISO 24103.

CIP	CI Parameters
CIP0	LSB of CIP reference
CIP1	Middle bit of CIP reference
CIP2	MSB of CIP reference
ELCP	Extended Link Control Protocol
ETC	Electronic Toll Collection
ITSSI	ITS Station Information
LCP	LAN Control Protocol
LPCP	Local Port Control Protocol
LPP	Local Port Protocol
NWref	Network reference
OBE	On-board equipment
SAF	Service Advertisement Frame

SCF	Service Context Frame
SID	Service Identifier
STA	Service Table for Advertisement
HMI	Human–Machine Interface

5 Requirements

The principal requirements of this International Standard are specified in Clauses 6, 7, 8 and 9 as follows:

— Clause 6 gives an overview of the functionalities specified in this International Standard;

— Clause 7 specifies protocols of the networking & transport layer;

— Clause 8 specifies protocols of the facilities layer;

— Clause 9 specifies common elements and procedures.

Clauses 10 and 11 are related to conformance declaration and testing.

Annexes provide further normative and informative details related to the principal requirements.

6 Overview

6.1 ITS-S architecture

The specifications given in this International Standard shall comply with the ITS station architecture and with the concept of an ITS station communication unit (ITS-SCU) as specified in ISO 21217 and ISO 24102.

NOTE The terminology from the series of International Standards on CALM was modified during the process of harmonization of the standards. ITS-SCU (ITS-S communication unit) was formerly referred to as “CALM communication kernel” (CCK).

6.2 Services

6.2.1 Types of services

This International Standard specifies ITS-S FAST services:

a) protocols in the networking & transport layer for

   1) single-hop communications,

   2) N-hop broadcast communications,

   3) ITS-MUX, and

   4) ITS station-internal forwarding;

b) 15628 CI (DSRC CI) support;

c) 15628 application support;

d) ITS service announcement (specification is done by reference to ISO 24102).

ITS-S FAST services located in the facilities layer are offered to ITS-S applications designed to use the FAST protocols in the ITS-S networking & transport layer.

An example of an ITS-S FAST service is the “FAST ITS service announcement” specified in ISO 24102. It is a protocol optimized for low latency and single-hop communications. It is based on groupcasting and the FAST networking & transport protocol as specified in this International Standard. FAST ITS service announcement also includes announcement of locally available IPv6-based services.

6.2.2 Legacy CIs

An existing access layer technology may be implemented in a ITS station as a “Legacy CI”, as presented in Figure 1, 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 CIs are specified in ISO 21218 in MI-parameter 22 “Medium”. The only legacy CI medium identified so far in ISO 21218 is 128 “ISO 15628”. Further types may be added.

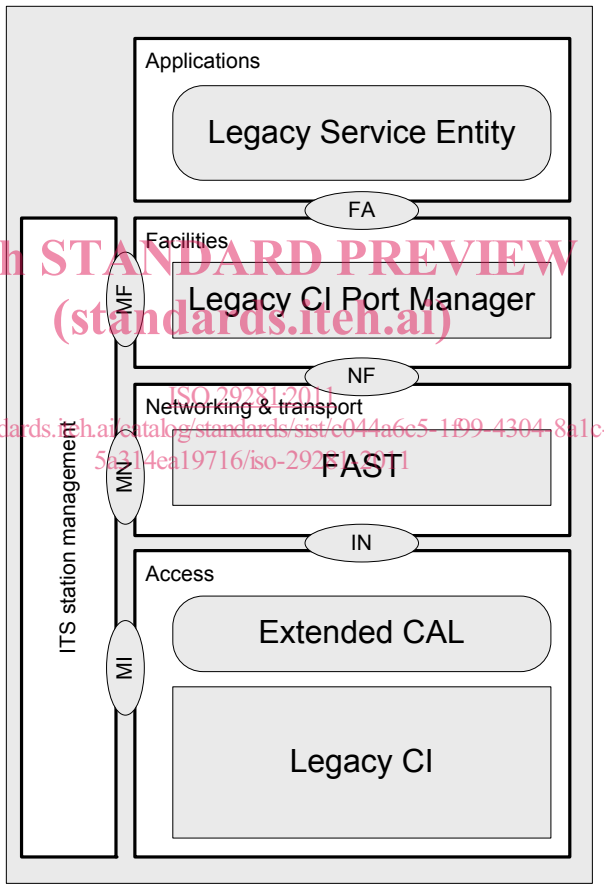

Figure 1 — Legacy CI

Inside the ITS station, the FAST networking & transport layer protocol shall be used for the forwarding of packets between the access layer and the facilities layer.

This requires

— implementing a CALM adaptation layer (CAL) as specified in ISO 21218, extended with the additional functionality for FAST networking & transport layer support as specified in this International Standard, which, optionally, may also include parts of the service processing functionality,

— making use of the “Legacy CI Port Manager” as specified in this International Standard and in ISO 24102.

Legacy CIs shall specify the medium specific parameters presented in Table 1 (see ISO 21218 for the MI parameter 254 “MediumParameter”):

Table 1 — Legacy CI parameters

MediumParam.mediumPar.no	MediumParam.detail	Description
0	LegacyOption	Optional classification of different options of the same legacy CI
1	NWrefPM	NWref of the “Legacy CI Port Manager” connecting to the applicable “Legacy Service Entity”

The “Legacy Service Entity” shall register at the “Legacy CI Port Manager” indicating the CI class and legacy option of the required legacy CI.

Further details depend on the existing communication interface technology. Normative examples for legacy systems compliant with ISO 15628:2007 are provided in Annex B.

6.2.3 15628 applications

Applications built on top of an OSI layer 7 as specified in ISO 15628:2007 may be operated over an ITS CI of CI class CIC-wl1, specified in ISO 21218. The services shall interface with the FAST networking & transport layer protocol via the “15628 Kernel Emulator” (see Figure 2).

NOTE In the given context, 15628 applications are also referred to as 15628 legacy applications.

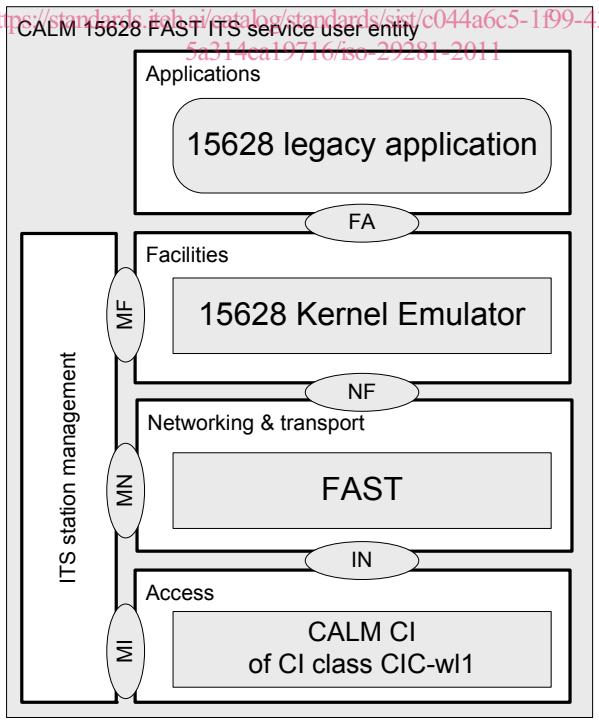

Figure 2 — 15628 legacy service

The 15628 initialization phase shall be implemented with the groupcast functionality specified in this International Standard and in ISO 24102.

The “15628 Kernel Emulator” shall perform 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 shall be served by CI-ID.

Detailed procedures are specified in Clause 8.

6.3 Communication scenarios

6.3.1 General

The protocols of the ITS-S networking & transport layer specified in this International Standard apply to two basic communication scenarios:

— single-hop communications between ITS stations, regardless of where the stations are installed;

— multi-hop communications between ITS stations.

Subsequent hops may be managed either by services or by network/transport protocol extensions.

6.3.2 Single-hop communication scenario

Single-hop communications as specified in this International Standard involves communication between two ITS stations as described in ISO 21217.

Examples of single-hop communication scenarios are illustrated in Figure 3.

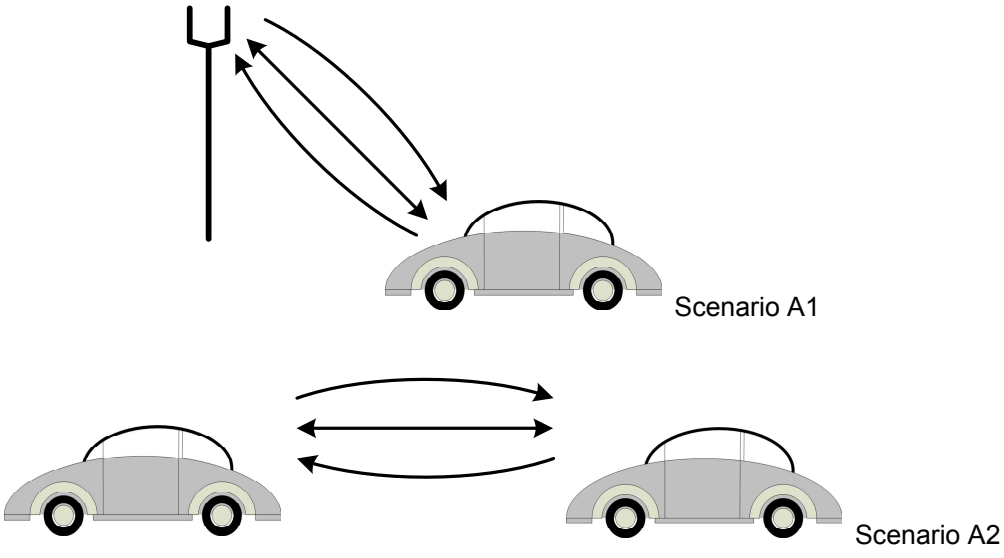

Figure 3 — Examples of single-hop communications

Scenario A1 is a typical scenario for anouncement of ITS services provided by roadside service providers. Further on, this is needed for traffic efficiency and road safety services.

Scenario A2 mainly is for road safety and traffic efficiency services.

6.3.3 Multi-hop communication scenarios

Multi-hop communications as specified in this International Standard involves communication between two ITS stations using forwarding capabilities provided by one or more other ITS stations.

Multi-hop (N-hop) communications is supported, for example, by the GeoNetworking protocol currently being developed at ETSI, which is based on the geo-address information of stations, and by the FAST networking & transport layer protocol specified in this International Standard.

NOTE A new work item at ISO/TC204/WG16 is developing an International Standard on how to apply GeoNetworking in an ITS station compliant with CALM. The development of GeoNetworking protocols at ETSI is based on the results of the GeoNet project funded by the European Commission (see Reference [7]).

N-hop broadcast was presented in Reference [1] and named “Topologically Scoped Broadcast”. An example of N-hop broadcast is illustrated in Figure 4. It provides data dissemination from a source node to all nodes reachable with a limited number of subsequent hops. The number of subsequent hops shall be set by the service. In Figure 4 the maximum number of hops is two.

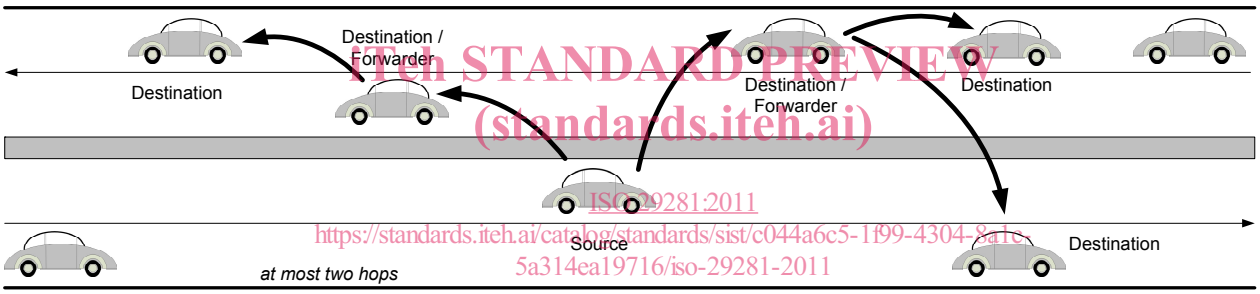

Figure 4 — N-hop broadcast (example with N=2)

6.4 Groupcasting

Groupcast communications includes broadcast communications and multicast communications. The definition and maintenance of multicast groups and the related MAC multicast addresses is outside the scope of this International Standard. Groupcasting is applicable to all kinds of networking protocols and to CIs of the CI classes CIC-wl1, CIC-wl3 and CIC-wl5 specified in ISO 21218.

Three basically different types of groupcasting are given:

a) event-driven groupcasting;

b) repetitive event-driven groupcasting;

c) registered periodic groupcasting.

Groupcast transmissions may be requested by, for example,

— a service for dissemination of

  — LDM data and other groupcast pool data,

  - ITS service announcement information,
  - “forwarding data”,
- any networking protocol for dissemination of
  - “forwarding data”,
  - “ITS Station Information” (ITSSI),
  - other network-protocol-specific groupcast data,
- an ITS-S management entity for dissemination of
  - CI management data,
  - ITS station management data,
  - ITSSI,
- the MAC-sublayer of a CI for dissemination of
  - medium-specific MAC management data.

ITS-S management groupcasting shall be as specified in ISO 24102, if applicable.

MAC-sublayer groupcasting is medium-specific and shall be specified in the media standards, if applicable.

A communication medium, e.g. CALM M5, may accept control from the ITS station management entity with respect to transmission and reception of management frames commanded via the MI-SAP. Such functionality is expected to be specified in the related medium standard rather than in this International Standard.

All periodic groupcast communications except for those carried on MAC management frames, independent of the basic networking protocol used, may be processed by the ITS-MUX virtual network service, as specified in this International Standard.

NOTE 1 The main design goal of groupcasting via ITS-MUX is to minimize the load in the wireless communication channels by mapping as many groupcast transmission requests as possible onto a single frame.

NOTE 2 In simple implementations with only one networking protocol, ITS-MUX forwards data packets between the networking protocol and the IN-SAP.

The overall groupcasting architecture is presented in Figure 5. The building blocks are:

d) “Groupcasting Registration Handler” located in the “ITS Facilities Layer”;

e) “Groupcasting Manager” located in the “ITS station management entity” and specified in ISO 24102;

f) “Groupcasting Schedulers” located in the networking & transport layer;

g) CIs supporting MAC groupcast frames.