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Intelligent transport systems — Communications access for land mobiles (CALM) — Mobile wireless broadband using IEEE 802.16

Systèmes intelligents de transport — Accès aux communications des services mobiles terrestres (CALM) — Mobiles à bande large sans fil utilisant IEEE 802.16

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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 25112 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

Introduction

This International Standard is part of a family of International Standards for communications access for land mobiles (CALM) which specify a common architecture, network protocols and a set of air interface definitions for wireless communications using a number of wireless media, including cellular 2nd generation, cellular 3rd generation, 5 GHz, millimetre, infra-red communications, and mobile wireless broadband (MWB), over packet-based networks. The CALM architecture is also designed to include short range, short duration, low-latency communication systems such as European dedicated short-range communications (DSRC) and North American wireless access in vehicular environments (WAVE) based on IEEE 802.11. It is anticipated that other air interfaces will be added in the future. Generally speaking, the CALM architecture is designed to include air interfaces that provide some subset of point-to-point, vehicle-to-vehicle, and vehicle-to-point communications over packet-based networks in the ITS sector. In particular, this International Standard provides additional specifications which wireless devices adhering to the mobile wireless broadband IEEE 802.16 standards must also meet to be CALM compliant.

The requirements for transmission of information over large distances using wireless technology are functionally very different from the requirements for European DSRC. Large volumes of data are required for purposes such as safety, traffic information and management, video downloads to vehicles for tourist information and entertainment and navigation-system-updates. In order to support such services, mobile units need to be able to communicate over longer ranges with access points or base stations, and the system must be able to hand over sessions from one access point or base station to another. CALM standards are explicitly designed to enable quasi-continuous data communications, as well as data communications of protracted duration between vehicles and service providers, and between vehicles. It is important to note that the CALM architecture is specifically designed to support packet-based communications; support for circuit-switched communications is not included.

The fundamental advantage of the CALM concept over traditional systems is the ability to support media independent handover (MIH), also referred to as heterogeneous handover, between the various media that can be included in a CALM system. Selection policies are supported that include user preferences and media capabilities in making decisions as to which media to use for a particular session, and when to handover between media or between service providers on the same medium. These handover mechanisms are defined within the CALM architecture International Standard (ISO 21217), the CALM IPv6 Networking International Standard (ISO 21210), the CALM medium service access points International Standard (ISO 21218) and the CALM communication and station management International Standard (ISO 24102). Handovers between access points using the same technology and service provider use mechanisms that are defined within the particular medium specific CALM Standard.

ITS applications that can be enhanced or are enabled by the CALM architecture include, among others, car-to-car and point-to-multipoint safety messaging, collision avoidance, update of roadside telemetry and messaging, probe data collection, general internet access, image and video transfer, infotainment, multimedia multicast, traffic management, monitoring and enforcement in mobile situations, and route guidance.

For a general introduction to CALM architecture, refer to ISO 21217.

This International Standard provides definitions and procedures for the establishment and maintenance of an ITS communications session within a CALM system environment using a medium communication in accordance with IEEE 802.16 (mobile WiMAX/WiBro) and RFC 5121 *Transmission of IPv6 via the IPv6 Convergence Sublayer over IEEE 802.16 Networks*.

Intelligent transport systems — Communications access for land mobiles (CALM) — Mobile wireless broadband using IEEE 802.16

1 Scope

This International Standard selects the options appropriate for CALM using mobile wireless broadband (MWB) techniques conforming to IEEE 802.16, and specifies the management interface requirements.

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

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

Application specific upper layers will not be included in this International Standard, but will be driven by application standards (which might not be technology specific).

2 Conformance

In order to claim conformance with this International Standard, mobile wireless broadband techniques standardized using IEEE 802.16 protocols shall be established in full compliance with local telecommunications procedures and protocols for IEEE 802.16 in accordance with IEEE published standards, and shall comply with the requirements of ISO 21217 (CALM System architecture), ISO 21210 (CALM IPv6 Networking), ISO 21218 (CALM medium service access points), and ISO 24102 (CALM management).

3 Normative references

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

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

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

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

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

ISO 25111:2009, *Intelligent transport systems — Communications access for land mobiles (CALM) — General requirements for using public networks*

IEEE 802.16, *IEEE Standard for Local and metropolitan area networks — Part 16: Air Interface for Broadband Wireless Access Systems*

IETF RFC 5121, *Transmission of IPv6 via the IPv6 Convergence Sublayer over IEEE 802.16 Networks*

4 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21217, ISO 25111 and IEEE 802.16 apply.

5 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO 21217 and the following apply.

CALM	communications access for land mobiles
DSRC	dedicated short-range communication
IME	interface management entity
MAC	medium access control
MMAE	medium management adaptation entity
MS	mobile station
MWB	mobile wireless broadband

6 Requirements

6.1 Adoption of other standards and internationally adopted practices

For conformance requirements, see Clause 2.

6.2 CALM Architecture

Equipment and systems complying to this International Standard shall operate in the environment of, and to the parameters defined in, ISO 21217.

6.3 CALM Networking protocols for internet connectivity

Equipment and systems conforming to this International Standard shall operate in the environment of, and to the parameters defined in, ISO 21210.

6.4 CALM Medium service access points

Equipment and systems conforming to this International Standard shall operate in the environment of, and to the parameters defined in, ISO 21218.

6.5 CALM Interface manager

Equipment and systems conforming to this International Standard shall operate in the environment of, and to the parameters defined in, ISO 24102.

6.6 CALM using public wireless networks

Equipment and systems conforming to this International Standard shall operate in the environment of, and to the parameters defined in, ISO 25111.

6.7 Establishment of a medium specific session

6.7.1 "User Controlled" sessions

6.7.1.1 General

Equipment and systems conforming to this International Standard shall utilize the procedures specified in ISO 25111:2009, 6.1.3.

6.7.1.2 Establishment and termination of a "User Controlled" session

Equipment and systems conforming to this International Standard shall utilize the procedures specified in ISO 25111:2009, 6.1.6.

6.7.2 Establishment and termination of a "Continuous" session

Equipment and systems conforming to this International Standard shall utilize the procedures specified in ISO 25111:2009, 6.1.4.

6.7.3 Establishment and termination of a "Time Controlled" session

Equipment and systems conforming to this International Standard shall utilize the procedures specified in ISO 25111:2009, 6.1.5.

6.8 Interface medium management

Shall be conducted in accordance with the specifications given in ISO 25111:2009, 6.5 to 6.7.

6.9 Medium access control (MAC)

Shall be conducted in accordance within the specifications given in ISO 25111:2009, Clause 7.

6.10 CALM IEEE 802.16 MMAE service primitives

6.10.1 General

CALM conformant 802.16 MMAE shall support the service primitives specified in 6.10.2 to 6.10.6.

6.10.2 MMAE SetParam.request

- MMAE-SetParam.request
  int interfaceId,
  uchar paramNumber, // 128
  uchar paramValue; // 1: connect, 2: disconnect

6.10.3 MMAE SetParam.confirm

- MMAE-SetParam.confirm
  int interfaceId, uchar paramNumber, uchar paramValue, uchar result;

6.10.4 MMAE GetParam.request

- MMAE-GetParam.request
  int interfaceId, uchar paramNumber;

6.10.5 MMAE GetParam.confirm

- MMAE-GetParam.confirm
  int interfaceId, uchar paramNumber, uchar ifStatus, struct ifChar, uchar result;

6.10.6 MMAE Notify.indication

- MMAE-Notify.indication
  int interfaceId
  uchar status; // 1: disconnected, 2: connected

6.11 Identification of the 802.16 MMAE

6.11.1 MMAE-GetParam.request=1

On receipt of *MMAE-GetParam.request* (int interfaceId, uchar paramNumber = 1), the 802.16 MMAE on MS side shall inquire to MAC on MS the status of the interface.

6.11.2 MMAE-GetParam.request=2

On receipt of *MMAE-GetParam.request* (int interfaceId, uchar paramNumber = 2), the 802.16 MMAE on MS side shall request to MAC on MS the interface characteristics.

- MMAE-GetParam.req
  - int interfaceId;
  - uchar paramNumber
    - 1: Request for interface status
    - 2: Request for interface characteristics

6.11.3 MMAE-GetParam.confirm

Once the parameter value is received, the 802.16 MMAE shall send to IME the *MMAE-GetParam.confirm*

- MMAE-GetParam.confirm
  - int interfaceId;
  - uchar paramNumber
  - uchar ifStatus
    - valid if ParameterNumber is 1
    - 1: Connected, 2: Disconnected
  - struct ifChar
    - valid if ParameterNumber is 2
    - int DataRate, int Cost, uchar ServiceType, uchar Security
  - uchar result

6.11.4 Result

The parameter “result” in MMAE-GetParam.confirm represents the processing result of the request service.

1: OK - successful reply
2: Error - no such media
3: Unknown error

6.11.5 Further procedures

The further procedures defined in IEEE 802.16 shall be followed.

EXAMPLE In accordance with IEEE 802.16, an example of the connection establishment procedures for the IEEE 802.16 medium is as follows:

1) C-NEM-REQ/RSP (Ranging)
2) C-NEM-REQ/RSP (SS Basic Capability)
3) C-NEM-REQ/RSP (Registration)
4) C-SFM-REQ/RSP (Create)

Once the IEEE 802.16 connection procedure is successfully completed, the medium connection is established.

6.12 CALM Session connection

6.12.1 Session connection sequence

The sequence of session initiation shall be as determined in 6.11.

In order to establish a session, the 802.16 MMAE shall perform the following procedure:

On receipt of *MMAE-SetParam.request* (int interfaceId, uchar paramNumber = 128, uchar paramValue = 1) service, the 802.16 MMAE on MS side shall attempt to connect to the IEEE 802.16 base station.

Subsequently, the 802.16 MMAE sends to IME (interface management entity) the 802.16 *MMAE-SetParam.confirm* (ok) primitive.

The parameter “result” in *MMAE-SetParam.confirm* represents the processing result of the connection request service and shall be as follows:

1: OK - 802.16 MMAE shall attempt to connect
2: Fail - try later
3: System error

6.12.2 Successful CALM session establishment

Once the IEEE 802.16 connection is established, the 802.16 MMAE notifies to IME the changed status of the medium using *MMAE-Notify.indication* service.

6.13 CALM session disconnection

On receipt of MMAE-SetParam.request (int interfaceId, uchar paramNumber = 128, uchar paramValue = 2) service, the 802.16 MMAE on MS side shall try to disconnect to 802.16 base station. 802.16 MMAE shall then send to IME the *MMAE-SetParam.confirm* primitive.

The parameter “result” in *MMAE-SetParam.confirm* represents the processing result of the connection request service:

1: OK - 802.16 MMAE has completed disconnection
2: Fail - try later
3: System error

and on receipt of *MMAE-SetParam.request* (int interfaceId, uchar paramNumber = 128, uchar paramValue = 1) service, the 802.16 MMAE on MS side shall attempt to connect to 802.16 base station.

6.14 Change of IEEE 802.16 connection state

If the 802.16 connection state changes during the session, the 802.16 MMAE in the MS shall immediately notify the IME using *MMAE-Notify.indication*.

6.15 Retrieval of the medium status

The IME checks the status of the specific medium as follows: On receipt of *MMAE-GetParam.request* (int interfaceId, uchar paramNumber), the 802.16 MMAE on MS side shall inquire to MAC on MS the status of the medium.

6.15.1 MMAE GetParam.req

- MMAE-GetParam.req
  - int interfaceId;
  - uchar paramNumber
    - 1: Request for interface status
    - 2: Request for interface characteristics

6.15.2 MMAE GetParam.confirm

- MMAE-GetParam.confirm
  - int interfaceId;
  - uchar paramNumber
  - uchar ifStatus
  - struct ifChar
  - uchar result

The parameter “result” in MMAE-GetParam.confirm represents the processing result of request service.

1: OK - successful reply
2: Error - no such media
3: Unknown error

6.16 IEEE 802.16 session disconnection

In accordance with IEEE 802.16, the 802.16 connection can be closed through one of the below M-SAP/C-SAP services, e.g. state for 802.16 data transmission can be changed through one of the following services:

- *M-MTM-REQ/RSP* (de-registration)
- *M-MTM-Notify* (Reset)
- *C-PG-REQ* (idle mode indication) ~ C-PG-Notify (Paging_Announce)

Once the appropriate procedures defined in IEEE 802.16 to close the connection are completed, the 802.16 MMAE shall be notified through the *MMAE-Notify.indication* service to IME.

7 Test and conformance requirements

As defined in ISO 25111:2009, Clause 10. See also Clause 2 of this International Standard.

8 Marking, labelling and packaging

All transmitting equipment shall be clearly and permanently marked stating with which National Regulations it complies.

All transmitting equipment shall be provided with clear instructions as to tuning and adjustment to meet the regulations of the country or countries in which it is to be used.

All transmitting equipment shall be clearly and permanently marked to indicate which CALM interfaces it supports.

All transmitting equipment shall be clearly and permanently marked to instruct that it shall only be used when adjusted to meet national radio regulations pertaining for the frequencies at which it operates.

9 Declaration of patents and intellectual property

Patents and intellectual property used in mobile wireless broadband (i.e. IEEE 802.16) communications can be obtained by reference to the standards and recommendations provided in Clause 3.

Any patents and intellectual property associated with CALM Architecture can be found in ISO 21217.

Any patents and intellectual property associated with CALM IPv6 Networking can be found in ISO 21210.

Any patents and intellectual property associated with CALM Medium service access protocols can be found in ISO 21218.

Bibliography

[1] IEEE 802.11, IEEE Standard for Local and metropolitan networks — Part 11: Wireless Lan Medium Access Control (MAC) and Physical Layer (PHY) Specifications

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