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Intelligent transport systems — Communications access for land mobiles (CALM) — Communication protocol messages for global usage

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National foreword

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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.

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 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

Introduction

This document is a member of the set of International Standards for communications access for land mobiles (CALM). An introduction to this set of International Standards is provided in ISO 21217.[2]

Localized communications, i.e. communications without networking through a cloud, and service advertisement are essential protocol functionalities in Cooperative Intelligent Transport Systems (C-ITS). ISO and IEEE developed protocols with similar functionality, i.e. the

— ISO Fast Networking & Transport Protocol (FNTP) standardized in ISO 29281-1,[6]

— IEEE WAVE Short Message Protocol (WSMP) standardized in IEEE 1609.3,[13]

— ISO Fast Service Advertisement Protocol (FSAP) standardized in ISO 24102-5,[5] and

— IEEE WAVE Service Advertisement (WSA) standardized in IEEE 1609.3,[13]

where ISO considered the architectural context of an ITS station specified in ISO 21217[2] and IEEE considered the architectural context of a WAVE device specified in IEEE 1609.0™.[11]

Although initial versions of these protocols from ISO and IEEE are very similar, there are differences in details of the message formats and the functionality. These differences were identified by the EU/US task force HTG 3, from which a recommendation resulted to harmonize the protocols.[16]

The result of harmonization of FNTP with WSMP, and of FSAP with WSA is presented in this document, distinguishing interoperability modes and enhanced features only specified in this document. The next revisions of ISO 24102-5, ISO 29281-1 and IEEE 1609.3, and the new standards from other SDOs can align their message specifications with the protocol message elements specified in this document in order to achieve global interoperability of equipment designed for different architectures.

Intelligent transport systems — Communications access for land mobiles (CALM) — Communication protocol messages for global usage

1 Scope

This document specifies the following:

— the Localized Message (LM) format: an NPDU of a networking and transport layer protocol that does not support routing of a packet through a network;

— the Service Advertisement Message (SAM): an APDU to be transported in for example, an LM;

— the Service Response Message (SRM): an APDU acknowledging a SAM that offered a service based on an ITS application class[8] to be transported in for example, an LM;

— the related basic requirements for procedures.

Specifications are partly done by normative references to IEEE 1609.3™-2016.

NOTE These message format specifications and basic procedures need to be complemented by complete procedures and SAP specifications according to the context of usage, i.e. an ITS station specified in ISO 21217,[2] or a WAVE device specified in IEEE 1609.0™[11] or any other context.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 8824-1, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation*

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

IEEE 1609.3™-2016, *Standard for Wireless Access in Vehicular Environments (WAVE) — Networking Services*

3 Terms and definitions

No terms and definitions are defined in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

4 Abbreviated terms

CIP	communication interface parameter
C-ITS	cooperative ITS
FNTP	fast networking & transport protocol
FSAP	fast service advertisement protocol
HTG	harmonization task group
IPv6	internet protocol version 6
ITS	intelligent transport systems
ITS-AID	its application identifier
LM	localized message
MAC	medium access control
NPDU	network protocol data unit
OSI	open system interconnection
PSID	provider service identifier
RX CIP	receiver CIP
SAM	service advertisement message
SAP	service access point
SRM	service response message
TPID	transport protocol identifier
TX CIP	transmitter CIP
VANET	vehicular ad hoc network
WAVE	wireless access in vehicular environment
WSA	WAVE service advertisement
WSMP	WAVE short message protocol

5 Localized communications messages

5.1 Purpose

Localized communications is used to communicate with nearby peer stations, e.g. ITS station units or WAVE devices. These stations are uniquely identified with an OSI data link layer address, typically by the Medium Access Control (MAC) address. Networking in the sense of IP networking, where stations route packets to other nodes through a network (cloud), is not supported. Nevertheless multi-hopping can be performed in different ways, e.g.

— N-hop broadcast or N-hop multicast, which requires careful means to avoid flooding of the communication channel;

— dedicated forwarding performed at higher layers, e.g. at the ITS-S facilities layer of an ITS station[2]; this is a feature useful for geo-dissemination of information;

which creates so-called “Vehicular Ad hoc NETworks” (VANETs). Routing of packets through a network in ITS will use the Internet protocol version 6 (IPv6).

5.2 Localized message protocol

As this document does not specify a specific localized communications protocol but just the structure of messages of such protocols and related basic requirements, a hypothetical localized communications protocol with the name “Localized Message Protocol” is used to simplify reading of the document.

5.3 Message formats

Figure 1 illustrates the basic format of the Localized Message (LM). Unaligned packet encoding rules (UPER) applied to the ASN.1 type `LMnpdu` defined in A.2.1 results in the intended binary presentation of this LM format.

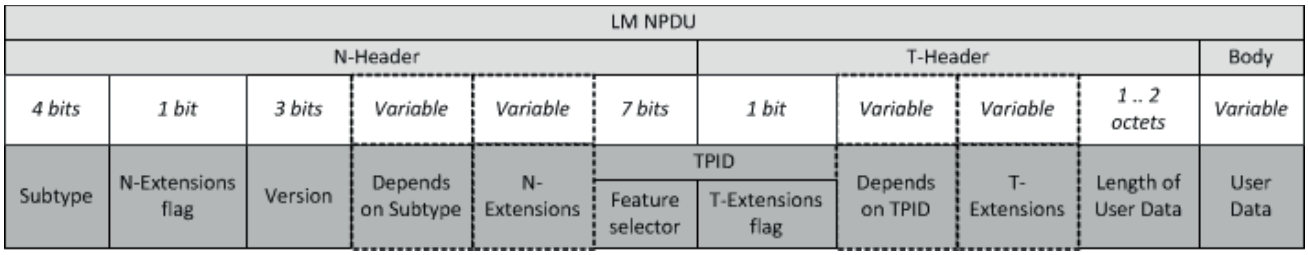

Figure 1 — General format of the LM NPDU

NOTE 1 In Figure 1, the “TPID” field (specified in IEEE 1609.3™-2016 as a one-octet unsigned integer field completely allocated in the WSMP-N-Header) is split into a “Feature selector” field of the “N-Header” and a “T-Extensions flag” field of the “T-Header” (according to the general rules of the OSI model). However, the two presentations result in identical binary presentations.

The LM consists of three parts:

— “N-Header”

  — a 4-bit unsigned integer “Subtype” number in the range of 0 to 15 indicating a networking related feature;

  — a 1-bit “N-Extensions flag”;

  — a 3-bit unsigned integer “Version” number in the range of 0 to 7 indicating the version of the localized message protocol. In case a receiver does not support the version, the received packet cannot be processed. The first version number used is three as specified in IEEE 1609.3™-2016;

  NOTE 2 The format presented in Figure 1 is such that WAVE devices implementing version 2 of WSMP[13] can identify LMs as WSMP messages with version number 3 or higher.

  — a networking related feature specified in 5.4 and selected by the value contained in the field “Subtype”;

  — “N-Extensions” being present if the “N-Extensions flag” is set to ‘1’b;

  — a 7-bit unsigned integer in the range of 0 to 127, the “Transport Protocol Identifier (TPID) feature selector”, indicating content in the “T-Header”.

— “T-Header”

  — a 1-bit “TPID - T-Extensions flag”;

  - a transport related feature specified in 5.5 and selected by the TPID feature selector value contained in the “N-Header”;
  - “T-Extensions” being present if the “T-Extension flag” is set to ‘1’b;
  - a one or two octet field indicating the number of octets contained in “User data”.
- Body
  - the “User data”.

The distinction of “N-Header” (networking related features) and “T-Header” (transport related features) is in support of the ITS-S networking and transport layer that combines OSI layers 3 and 4 as illustrated in ISO 21217.[2]

The field “Length of User data” has a length of one or two octets dependent on the value contained in it:

- one octet size: Values from 0 to 127. The most significant bit is always set to zero. Presented as 0x00 (=0) to 0xEF (=127); i.e. the remaining 7 bits contain an unsigned integer number.
- two octet size: Values from 128 to 16383. The most significant bit of the first octet is always set to one and the second most significant bit of the first octet is always set to zero. Presented as 0x8080 (=128) to 0xBFFF (=16383); i.e. the remaining 14 bits contain an unsigned integer number.

NOTE 3 This presentation results from the unaligned packed encoding rules applied to ASN.1 types of unconstraint variable length.

5.4 Networking features

5.4.1 Subtype values

Networking features are identified by a subtype value. Subtype values are presented in Table 1.

Table 1 — Subtype values

Subtype	N-Extensions flag	N-Extensions	Networking related features	Remark
0	‘0’b	Not present	Null-Networking	Mandatory feature specified in IEEE 1609.3™-2016. Format described in 5.4.2.
	‘1’b	Present		
1	‘0’b	Not present	ITS station-internal forwarding	Format specified in 5.4.3.
	‘1’b	Present		
2	‘0’b	Not present	N-hop forwarding	Format specified in 5.4.4.
	‘1’b	Present		
3	‘0’b	Not present	Geo-forwarding	Reserved. Not specified in this document.
	‘1’b	Present		
4–7	‘0’b	Not present	Reserved for ISO	Allows for further four networking features.
	‘1’b	Present		
8–15	‘0’b	Not present	Reserved for IEEE	Allows for further eight networking features.
	‘1’b	Present		

N-Extensions and related basic procedures shall be as specified in 5.4.5.

New networking features can be specified and linked to so far reserved subtype values at a later stage without breaking backward compatibility.

NOTE Updates of N-Extensions will be published in the ISO/TS 16460 folder of the ISO standards maintenance portal at http://standards.iso.org/iso/ts/16460.

5.4.2 Networking feature 0

Subtype 0 selects the "Null-Networking" feature introduced in 5.4.1.

NOTE Procedures on how to use this feature in the context of an ITS station unit, or a WAVE device or any other context are outside the scope of this document.

The "Null-Networking" feature with Subtype 0 is the uppermost simple feature, as it requires only processing of the TPID feature selector field specified in 5.6. Figure 2 presents the N-Header format for Subtype 0 with N-Extensions being absent.

N-Header			
4 bits	*1 bit*	*3 bits*	*1 octet*
Subtype = 0	N-Extensions flag = '0'b	Version	TPID - Feature Selector

Figure 2 — N-Header for Subtype 0 without N-Extensions

Figure 3 presents the N-Header format for Subtype 0 with N-Extensions being present.

N-Header				
4 bits	*1 bit*	*3 bits*	*Variable*	*7 bits*
Subtype = 0	N-Extensions flag = '1'b	Version	N-Extensions	TPID - Feature Selector

Figure 3 — N-Header for Subtype 0 with N-Extensions

N-Extensions and related basic procedures shall be as specified in 5.4.5.

5.4.3 Networking feature 1

Subtype 1 selects the "ITS Station-Internal Forwarding" feature introduced in 5.4.1.

NOTE Procedures on how to use this feature in the context of an ITS station unit, or a WAVE device, or any other context are outside the scope of this document.

ITS station-internal forwarding is a feature applicable in ITS stations compliant with ISO 21218[3] (Link-ID) and ISO 24102-1[4] (ITS-SCU-ID). It is used to forward packets between router units and host units that are part of the same station/device. The field "Direction" contains an unsigned integer number with the two possible values "0" ("from host to router") and "255" ("from router to host"). The field "Counter" contains a one octet unsigned integer cyclic packet counter being unique in the unit that forwards a packet. Figure 4 presents the N-Header format for Subtype 1 with N-Extensions being absent.

N-Header							
4 bits	*1 bit*	*3 bits*	*1 octet*	*2 octets*	*8 octets*	*1 octet*	*variable*
Subtype = 1	N-Extensions flag = '0'b	Version	Direction	ITS-SCU-ID ITS-S host	Link-ID VCI in ITS-S router	Counter	Original N-Header

Figure 4 — N-Header for Subtype 1 without N-Extensions

Figure 5 presents the N-Header format for Subtype 1 with N-Extensions being present.

N-Header								
4 bits	*1 bit*	*3 bits*	*1 octet*	*2 octets*	*8 octets*	*1 octet*	*Variable*	*variable*
Subtype = 1	N-Extensions flag = '1'b	Version	Direction	ITS-SCU-ID ITS-S host	Link-ID VCI in ITS-S router	Counter	N-Extensions	Original N-Header

Figure 5 — N-Header for Subtype 1 with N-Extensions

N-Extensions and related basic procedures shall be as specified in 5.4.5.

5.4.4 Networking feature 2

Subtype 2 select the "N-hop Forwarding" feature introduced in 5.4.1.

NOTE Procedures on how to use this feature in the context of an ITS station unit, or a WAVE device, or any other context are outside the scope of this document.

N-hop forwarding is a feature that allows extending the communication range for information dissemination (MAC broadcast or multicast mode) beyond the next directly reachable neighbour stations. It uses parameters that allow avoiding flooding of the communication channel. Figure 6 presents the N-Header format for Subtype 2 with N-Extensions being absent.

N-Header					
4 bits	*1 bit*	*3 bits*	*22 bit*	*2 bit*	*7 bits*
Subtype = 2	N-Extensions flag = '0'b	Version	Message ID	Hop Count	TPID - Feature Selector

Figure 6 — N-Header for Subtype 2 without N-Extensions

The 22-bit Message ID is generated from a random number generator and is unique within the N-hop communication range with a "high" likelihood. In case of duplicate Message ID values, forwarding might not be performed correctly in a station.

The 2-bit unsigned integer Hop Count indicates to a receiver whether a forwarding shall be performed or not. If Hop Count equals zero, forwarding is prohibited. Prior to forwarding of a packet, the Hop Count shall be decremented by one. Consequently, a maximum of four hops is possible.

Forwarding shall be performed also if the TPID value contained in the received message is not supported or reserved.

Figure 7 presents the N-Header format for Subtype 2 with N-Extensions being present.

N-Header						
4 bits	*1 bit*	*3 bits*	*22 bit*	*2 bit*	*Variable*	*7 bits*
Subtype = 2	N-Extensions flag = '1'b	Version	Message ID	Hop Count	N-Extensions	TPID - Feature Selector

Figure 7 — N-Header for Subtype 2 with N-Extensions

N-Extensions and related procedures shall be as specified in 5.4.5.

5.4.5 N-Extensions

The structure of the N-Extensions is specified in Clause 7. Extension elements presented in Table 2 may be used in the "N-Extensions" field.

Table 2 — N-Extensions elements

Element ID	Element type (ASN.1)	Element name
c-TxPowerUsed80211 = 4	TXpower80211	Transmit Power Used (specified in IEEE 1609.3™-2016)
c-ChannelNumber80211 = 15	ChannelNumber80211	802.11 Channel Number used (specified in IEEE 1609.3™-2016)
c-DataRate80211 = 16	DataRate80211	802.11 Data Rate used (specified in IEEE 1609.3™-2016)
c-LMtxCip = 80	TXcip	Communication Interface transmit parameters
c-LMrxCip = 81	RXcip	Communication Interface receive parameters (RX-CIP)
c-LMchannelBusyRatio = 82	LMchannelBusyRatio	Channel Busy Ratio

The "Transmit Power Used" element is optionally included in the LM N-Header for use by the LM recipient; see also IEEE 802.11™.[10]

The "Channel Number" element is optionally included in the LM N-Header for use by the LM recipient; see also IEEE 802.11™.[10]

The "Data Rate" element is optionally included in the LM N-Header for use by the LM recipient; see also IEEE 802.11™.[10]

The "TX CIP" element is optionally included in the LM N-Header indicating Communication Interface Parameter (CIP) settings used by the transmitter of the LM.

The "RX CIP" element is optionally included in the LM N-Header used with Subtype 1 indicating Communication Interface Parameter (CIP) settings of the ITS-SCU that received the LM from a peer station.

The "Channel Busy Ratio" element is a one octet unsigned integer optionally included in the LM N-Header reporting the observed channel busy ratio in percent (0 % up to 100 % in steps of 0,5 %). The integer values 201 to 255 indicate "unknown ratio".

5.4.6 TPID values

Table 3 — TPID values

TPID		T-Extensions	Transport related feature	Remark
Feature selector	T-Extensions flag			
0	'0'b	Not present	Information dissemination	Mandatory feature specified in IEEE 1609.3™-2016. Format described in 5.5.1
	'1'b	Present		
1	'0'b	Not present	General session mode	Format specified in 5.5.2
	'1'b	Present		
2	'0'b	Not present	LPP mode	Format specified in 5.5.3
	'1'b	Present		

Table 3 *(continued)*

TPID		T-Extensions	Transport related feature	Remark
Feature selector	**T-Extensions flag**			
3–10	‘0’b	Not present	Reserved for ISO	Allows for further 8 transport features.
	‘1’b	Present		
11–127	‘0’b	Not present	Reserved for IEEE	Allows for further 117 transport features
	‘1’b	Present		

New transport features can be specified and linked to so far reserved TPID feature selector values at a later stage without breaking backward compatibility.

5.5 Transport features

5.5.1 Transport feature 0

The TPID feature selector 0 selects the “Information Dissemination” feature specified in 5.4.6.

Figure 8 presents the T-Header for TPID = 1, i.e. with T-Extensions being present.

T-Header (TPID = 1)			
1 bit	*Variable*	*Variable*	*Variable*
TPID T-Extensions flag = '1'b	Destination Address *ITS-AID*	T-Extensions	Length of User data

Figure 8 — TPID 1 — Information dissemination with T-Extensions

The T-header consists of four parts:

— a 1-bit “T-Extensions flag” (LSB of TPID) set to ‘1’b;

— a variable length “Destination Address” field containing an ITS Application Identifier (ITS-AID) specified in ISO/TS 17419,[8] identifying the upper layer entity (referred to as ITS-S application process in ISO 21217[2]) in the receiver for which the message is intended;

— a variable length “T-Extensions” field with the structure specified in Clause 7 and content details specified in 5.5.4;

— a variable length field indicating the length of the User data.

NOTE PSID specified in IEEE 1609.3™-2016 and ITS-AID share a common number space; see 6.2.1.

If no T-Extensions are needed, the T-Extensions flag is set to ‘0’b. The corresponding T-Header is presented in Figure 9.

T-Header (TPID = 0)		
1 bit	*Variable*	*Variable*
TPID T-Extensions flag = '0'b	Destination Address *ITS-AID*	Length of User data

Figure 9 — TPID 0 — Information dissemination without T-Extensions

Feature 0 is designed for information dissemination (typically combined with MAC broadcast or MAC multicast).

A receiver shall first check the T-Extensions and shall perform related procedures, if supported. Then the receiver shall forward the data contained in the message (optionally together with information contained in T-Extensions) to the recipient(s) identified by the Destination Address.

NOTE 1 If the Destination Address is not identifying a known upper layer entity, the receiver cannot further process the message.

NOTE 2 Procedures on how to use this feature in the context of an ITS station unit, or a WAVE device, or any other context are outside the scope of this document.

5.5.2 Transport feature 1

The TPID feature selector 1 selects the "General Session Mode" feature specified in 5.4.6.

Figure 10 presents the T-Header for TPID = 3, i.e. with T-Extensions being present.

T-Header (TPID = 3)				
1 bit	*2 octets*	*2 octets*	*Variable*	*Variable*
TPID T-Extensions flag = '1'b	Source Address *ITS port number*	Destination Address *ITS port number*	T-Extensions	Length of User data

Figure 10 — TPID 3 — General purpose session support transport feature with T-Extensions

The T-Header consists of five parts:

— a 1-bit "T-Extensions flag" (LSB of TPID) set to '1'b;

— a two octet ITS port number in the "Source Address" field identifying the address of the upper layer entity in the transmitter;

— a two octet ITS port number in the "Destination Address" field identifying the address of the upper layer entity in the receiver;

— a variable length "T-Extensions" field with the structure specified in Clause 7 and content details specified in 5.5.4;

— a variable length field indicating the length of the User data.

If no T-Extensions are needed, the T-Extensions flag is set to '0'b. The corresponding T-Header is presented in Figure 11.

T-Header (TPID = 2)			
1 bit	*2 octets*	*2 octets*	*Variable*
TPID T-Extensions flag = '0'b	Source Address *ITS port number*	Destination Address *ITS port number*	Length of User data

Figure 11 — TPID 2 — General purpose session support transport feature without T-Extensions

Feature 1 is designed for sessions, e.g. when a reply is expected. Note that also groupcast transmissions with no expected reply can use this TPID.

A receiver shall first check the T-Extensions and shall perform related procedures, if supported. Then the receiver shall forward the data contained in the message (optionally together with information

contained in T-Extensions) to the recipient(s) identified by the ITS port number contained in the Destination Address field.

NOTE 1 If the Destination Address ITS port number is not identifying a known upper layer entity, the receiver cannot further process the message.

The ITS port number contained in the Source Address field typically is used in the Destination Address field of replies to the transmitter.

NOTE 2 Procedures on how to use this feature in the context of an ITS station unit, or a WAVE device, or any other context are outside the scope of this document.

5.5.3 Transport feature 2

The TPID feature selector 2 selects the "LPP" feature specified in 5.4.6. LPP is the "Local Port Protocol" standardized in ARIB STD-T88.[15]

Figure 12 presents the T-Header for TPID = 5, i.e. with T-Extensions being present.

T-Header (TPID = 5)					
1 bit	*2 octets*	*2 octets*	*variable*	*Variable*	*Variable*
TPID T-Extensions flag = '1'b	Source Address *ITS port number*	Destination Address *ITS port number*	LPP Header ARIB STD-T88:2004, *DSRC application sub-layer*	T-Extensions	Length of User data

Figure 12 — TPID 5 — LPP feature with T-Extensions

The T-Header consists of six parts:

— a 1-bit "T-Extensions flag" (LSB of TPID) set to '1'b;

— a two octet ITS port number in the "Source Address" field identifying the address of the upper layer entity in the transmitter;

— a two octet ITS port number in the "Destination Address" field identifying the address of the upper layer entity in the receiver;

— the "LPP Header" specified in ARIB STD-T88;[15]

— a variable length "T-Extensions" field with the structure specified in Clause 7 and content details specified in 5.5.4;

— a variable length field indicating the length of the User data.

If no T-Extensions are needed, the T-Extensions flag is set to '0'b. The corresponding T-Header is presented in Figure 13.

T-Header (TPID = 4)				
1 bit	*2 octets*	*2 octets*	*variable*	*Variable*
TPID T-Extensions flag = '0'b	Source Address *ITS port number*	Destination Address *ITS port number*	LPP Header ARIB STD-T88:2004, *DSRC application sub-layer*	Length of User data

Figure 13 — TPID 4 - LPP feature without T-Extensions

NOTE 1 If the Destination Address ITS port number is not identifying a known upper layer entity, the receiver cannot further process the message.

NOTE 2 Procedures on how to use this feature in the context of an ITS station unit, or a WAVE device, or any other context are outside the scope of this document.

5.5.4 T-Extensions

The structure of the T-Extensions is specified in Clause 7. Extension elements presented in Table 4 may be used in the "T-Extensions" field.

Table 4 — T-Extensions elements

Element ID	Element type	Element name
`c-LMpacketID = 83`	`LMpacketID`	Packet Identifier

The "Packet Identifier" element is optionally included in the LM T-Header to identify uniquely a specific packet in a sequence of packets from a specific transmitter.

NOTE Updates of T-Extensions will be published in the ISO/TS 16460 folder of the ISO standards maintenance portal at http://standards.iso.org/iso/ts/16460.

5.5.5 ITS port numbers

ITS port numbers are unsigned integer numbers of ASN.1 type `PortNumber` in the range 0 to 65535, i.e. contained in two octets. Details of ITS port numbers usage and management are presented in ISO/TS 17419.[8]

5.6 Procedures

A receiver shall first inspect the Version field specified in 5.2. If the presented version is supported by the implementation, then the receiver shall inspect the subtype field specified in 5.2 and in 5.4.1.

NOTE 1 If the presented version is not supported in a given implementation, the message cannot be processed.

If the presented subtype is supported by the implementation, then the related procedure shall be performed as specified in 5.4.2 to 5.4.4.

NOTE 2 If a received subtype value is pointing to `NoSubtypeProcessing`, i.e. not supported in a given implementation, the message cannot be processed.

Upon successful processing of the subtype procedure, the receiver shall inspect the TPID feature selector field specified in 5.2 and in 5.4.6.

If the transport feature identified by the number contained in the TPID feature selector field is implemented in the receiver, the respective procedure shall be executed as specified in 5.5.1 to 5.5.3.

NOTE 3 If a received TPID value is pointing to `NoTpidProcessing`, i.e. not supported in a given implementation, the T-Header part of the message cannot be processed.

Optional features, or features defined by implementation, may become normative mandatory features in other standards using the specifications of this document as a basis.

NOTE 4 Further procedures can be specified in standards that use this message format.

6 Service advertisement messages

6.1 Purpose

Service advertisement is used to inform peer stations, e.g. ITS station units or WAVE devices, about accessible ITS services ("push service advertisement"). ITS services are provided by means of ITS

applications; see ISO 21217.[2] ITS applications are identified by globally unique ITS Applications Identifiers (ITS-AID) specified in ISO/TS 17419.[8]

NOTE 1 In the context of an ITS station specified in ISO 21217,[2] service advertisement is performed according to the Fast Service Advertisement Protocol (FSAP) specified in ISO 24102-5.[5] In the context of a WAVE device specified in IEEE 1609.0™,[11] service advertisement is performed according to the WAVE Service Advertisement (WSA) protocol specified in IEEE 1609.3.[13]

NOTE 2 IEEE WAVE uses globally unique Provider Service Identifiers (PSID) specified in IEEE 1609.3[13] and IEEE 1609.12™[14] to identify ITS applications. ITS-AID and PSID share a common number space.

ITS services typically are provided in sessions. However, an ITS service can also be an information dissemination service.

The service advertisement distinguishes at least the following roles:

a) Service Advertisement Manager:

   — Server management,

     Transmission of SAMs and reception of SRMs

   — Client management,

     Reception of SAMs, transmission of SRMs;

b) Service Provider:

   Provision of ITS services,

c) Service User:

   Consumption of ITS services.

6.2 Unique identifiers

6.2.1 ITS-AID/PSID

ITS-AID is specified in ISO 17419[8] as an unsigned integer. ITS-AID shares a common number space with IEEE PSID; see IEEE 1609.3.[13] ITS-AID and PSID are synonyms. The purposes of ITS-AID is specified in ISO/TS 17419;[8] ITS-AID may be used at the OSI transport layer to identify a destination as, for example, specified in 5.5.1.

ITS-AID values are assigned to:

— WAVE Service Advertisement (WSA) specified in IEEE 1609.3;[13]

— Fast Service Advertisement Protocol (FSAP) specified in ISO 24102-5.[5]

NOTE The assigned numbers are presented at the ISO Standards Maintenance Portal.[17]

6.2.2 ITS-PN

ITS port numbers (ITS-PNs) are two octet unsigned integer numbers specified in ISO/TS 17419.[8] ITS-PN may be used at the OSI transport layer to identify source and destination of a message as e.g., specified in 5.5.2. For some ITS-PNs, acronyms are introduced in ISO/TS 17419,[8] e.g. the acronym PORT_SAM for the well-known ITS-PN = 1 identifying the service advertisement protocol (i.e. used by FSAP in ISO 24102-5[5]).

The well-known ITS-PN PORT_SAM is used to identify the service advertisement protocol that is receiving broadcast service advertisement messages (SAM).

A dynamically assigned ITS-PN PORT_DYN_SAM is used to identify the service advertisement protocol that is receiving unicast service advertisement messages (SAM). The dynamic assignment is done in the service user station that is transmitting SRMs.

A dynamically assigned ITS-PN (PORT_DYN_SRM) is used to identify the service advertisement protocol that is receiving SRMs. The dynamic assignment is done in the service advertiser station that is transmitting SAMs.

6.3 Service advertisement protocol

As this document does not specify a specific service advertisement protocol but just the structure of service advertisement messages and related basic requirements, a hypothetical service advertisement protocol with the name "Service Advertisement Protocol" is used to simplify reading of the document.

6.4 Service advertisement message

6.4.1 Messages

This document specifies two messages, i.e.

— Service Advertisement Message (SAM) of ASN.1 type `Sam` specified in A.2.2;

— Service Response Message (SRM) of ASN.1 type `Srm` specified in A.2.2.

SAM is used to advertise services provided by ITS applications or by ITS application classes specified in ISO/TS 17419.[8] ITS application classes are unique only with a defined context. The SRM provides the context to an ITS application class advertised in a SAM, i.e. it acknowledges a SAM. Such an acknowledgement is not applicable for advertised ITS applications. The SRM is also used to indicate interest in an offered service that requires usage of a privately allocated communication channel.

NOTE SRM is not supported in IEEE 1609.3™-2016.

6.4.2 Message structure

Figure 14 illustrates the basic format of the Service Advertisement Message (SAM). Unaligned packet encoding rules (UPER) applied to the ASN.1 type `Sam` defined in A.2.2 results in the intended binary presentation of this SAM format.

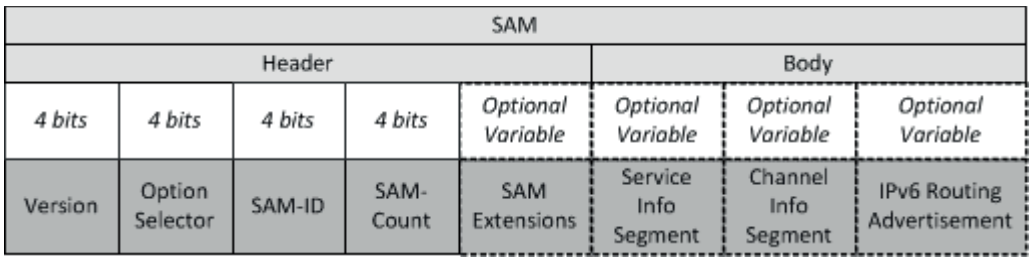

Figure 14 — General format of the SAM

The SAM consists of two parts:

a) SAM header specified in 6.4.3:

   1) "Version": a 4-bit unsigned integer number indicating the version of the service advertisement protocol specified in 6.4.3.1. The smallest allowed number is 3; this is the initial version number specified in IEEE 1609.3™-2016;

2) "Option Selector": a 4-bit field indicating presence or absence of optional fields:

   — Bit 3 = '1'b: "SAM Extensions" field is present;

   — Bit 2 = '1'b: "Service Info Segment" field is present;

   — Bit 1 = '1'b: "Channel Info Segment" field is present;

   — Bit 0 = '1'b: "IPv6 Routing Advertisement" field is present;

3) SAM identification specified in 6.4.3.2:

   — "SAM-ID": a 4-bit unsigned integer number field allowing to distinguish up to 16 different SAMs announced by the same station (same advertiser);

   — "SAM-Count": a 4-bit unsigned integer number field indicating the actual content status of the SAM indicated by the previous field.

4) An optionally present "SAM Extensions" field specified in 6.4.3.3; see also Bit 3 above.

b) SAM body specified in 6.4.4:

1) an optionally present "Service Info Segment" field specified in 6.4.4.2; see also Bit 2 above;

2) an optionally present "Channel Info Segment" field specified in 6.4.4.3; see also Bit 1 above;

3) an optionally present "IPv6 Routing Advertisement" field specified in 6.4.4.4; see also Bit 0 above.

6.4.3 Message header

6.4.3.1 Protocol version

The protocol version is presented as a 4-bit unsigned integer number of ASN.1 type `RsvAdvPrtVersion` specified in A.2.2.

6.4.3.2 SAM-ID and SAM-Count

SAM-ID and SAM-Count are used to

— distinguish different service advertisements (SAM-ID) presented by the same Service Advertiser, and

— identify a change of content of the indicated SAM (SAM-Count).

See ASN.1 type `SrvAdvChangeCount` specified in A.2.2.

Up to 16 different SAMs (SAM-ID = 0 up to SAM-ID = 15) presented by the same Service Advertiser can be distinguished. The Service Advertiser shall select values in a unique way. SAM-ID is of ASN.1 type `SrvAdvID`.

SAM-Count is a cyclic counter of ASN.1 type `SrvAdvContentCount`. For every value of SAM-ID, a separate SAM-Count shall be maintained. Upon first transmission of a new SAM, SAM-Count shall be set to zero. Upon every change of content of a SAM, this number shall be incremented by one. SAM-Count shall wrap around from 15 to zero. A change of content of a SAM may be either

— changing details of already advertised services,

— adding new services, or

— discontinuing provision and advertisement of services.

Discontinuing provision and advertisement of services may finally result in an empty SAM, i.e. a SAM that consists only of a header. Transmission of such empty SAMs is optional. How often such an empty SAM is transmitted before transmission is stopped and the related SAM-ID is deprecated and defined

by the implementation. The amount of time such a deprecated SAM-ID is blocked before it can be used for a new SAM is defined by the implementation.

This mechanism allows a receiver of a SAM not to parse a previously received SAM with same SAM-ID and SAM-Count. It further allows indicating that a previously announced service is no more available.

6.4.3.3 SAM extensions

The structure of extensions is specified in Clause 7. Extension elements presented in Table 5 may be used in the SAM Extensions field. The presence of the SAM Extensions field shall be indicated by the Options bit B3 specified in 6.4.1.

Table 5 — SAM extensions elements

Element ID	Element type (ASN.1)	Element name
c-2Dlocation = 5	TwoDLocation	2D Location (specified in IEEE 1609.3™-2016)
c-3Dlocation = 6	ThreeDLocation	3D Location (specified in IEEE 1609.3™-2016)
c-advertiserID = 7	AdvertiserIdentifier	Advertiser Identifier (specified in IEEE 1609.3™-2016)
c-RepeatRate = 17	RepeatRate	Repeat Rate (specified in IEEE 1609.3™-2016)
c-ExtendedChannelInfos = 84	ExtendedChannelInfos	Extended Channel Info Segment

ASN.1 details are specified in A.2.3.

The “2D Location” element provides the location of the SAM transmit antenna. Latitude has a least significant bit representing 1/10 micro degree, representing a range from –90° to +90°, with value 900000001 indicating unavailable. The bits presenting the latitude value are preceded with a bit set to ‘0’b in order to achieve octet alignment. Longitude has a least significant bit representing 1/10 micro degree, representing a range from –180° to +180°, with value 1800000001 indicating unavailable.

The “3D Location” element provides the location of the SAM transmit antenna. Latitude and longitude are as in “2D Location”. Elevation represents the geographic position above or below the reference ellipsoid (typically WGS-84). The 16-bit number has a resolution of 1/10 m and represents an asymmetric range of positive and negative values. The encoding is as follows: the range 0x0000 to 0xEFFF (0 to 61,439 decimal) are positive numbers representing elevations from 0 to +6143,9 m (i.e. above the reference ellipsoid). The range 0xF001 to 0xFFFF includes negative numbers representing elevations from –409,5 m to –0,1 m (i.e. below the reference ellipsoid). An elevation higher than +6143,9 m is represented by 0xEFFF. An elevation lower than –409,5 m is represented by 0xF001. If the sending device does not know its elevation, it shall encode the 25 elevation data element with 0xF000.

EXAMPLE The elevation 0 m is encoded as 0x0000, the elevation –0,1 m is encoded as 0xFFFF and the elevation +100,0 m is encoded as 0x03E8.

The “Advertiser Identifier” element provides an identifier associated with the Service Advertiser device. It has a length from 1 to 32 octets.

The “Repeat Rate” element is an unsigned integer number with a range of 0 to 255. This element indicates the number of times the SAM is transmitted per 5 s. It may be used by recipients in evaluating link quality. Repeat Rate should not be used with unicast announcements.

The “Extended Channel Info Segment” element is an extended version of the “Channel Info Segment” that can be used as a replacement of “Channel Info Segment” or in addition to “Channel Info Segment”. The purpose is to support different access technologies (not only 802,11 at 5,9 GHz), i.e. to allow a channel change being performed together with a change of access technology.

The counting of channel info sets in "Channel Info Segment" and "Extended Channel Info Segment" used in Service Info sets ("Channel Index") specified in 6.4.4.2 is as follows.

— "Channel Info Segment": 1 to N_{ci}, $0 \leq N_{ci} \leq 31$;

— "Extended Channel Info Segment": N_{ci} +1 to N_{cimax}, $N_{cimax} = 31$.

NOTE When "Channel Info Segment" is not used, N_{ci} equals zero.

The "Extended Channel Info Segment" element is used to allocate private communication channels as specified in 6.7.2.

6.4.4 Message body

6.4.4.1 General

The SAM body consists of optional fields only. Table 6 presents all possible configurations of the SAM body.

Table 6 — SAM body configurations

Service Info Segment	Channel Info Segment[a]	Routing Advertisement	Informative explanations
absent	absent	absent	Empty SAM
present	absent	absent	Service advertisement.
			Service accessible on the same radio channel as used for SAM
absent	present	absent	Invitation to switch a receiver to the indicated channel.
present	present	absent	Service advertisement
			One or several services accessible on a different radio channel as used for SAM
absent	absent	present	Advertisement of access to an IPv6 network (e.g. Internet) on the same radio channel as used for SAM.
present	absent	present	Service advertisement.
			Service accessible on the same radio channel as used for SAM.
			Usage of IPv6 communications.
absent	present	present	Advertisement of access to an IPv6 network (e.g. Internet) on a different radio channel as used for SAM.
present	present	present	Service advertisement
			One or several services accessible on a different radio channel as used for SAM.
			Usage of IPv6 communications.

[a] In addition to or instead of the Channel Info Segment, an Extended Channel Info Segment of ASN.1 type, `ExtendedChannelInfos` extension element also applies.

6.4.4.2 Service info segment

The optional Service Info Segment of ASN.1 type `ServiceInfos` specified in A.2.2 and presented in Figure 15 provides information pertaining to services being advertised in SAMs. It consists of a "Count *N*" field with variable length specified in 6.6, indicating the number *N* of subsequent service information sets.

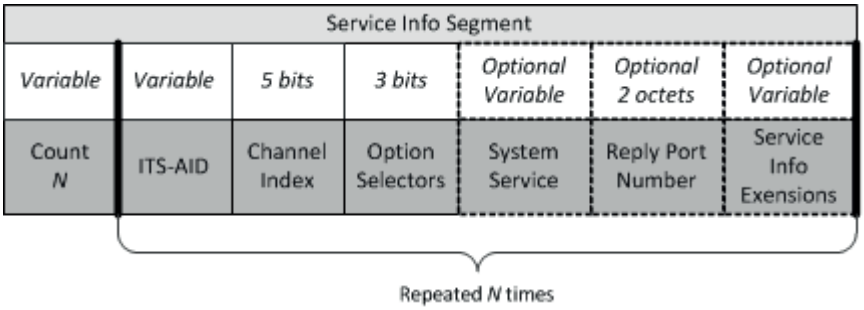

Figure 15 — General format of the Service info segment

Service information sets are of ASN.1 type `ServiceInfo` specified in A.2.2 and consist of:

— a field with variable length containing the "ITS-AID" indicating the advertised service;

— a field containing a 5-bit unsigned integer "Channel Index" used as a pointer to an entry in the Channel Info Segment;

— "Option Selectors": a 3-bit field indicating presence or absence of optional fields:

  — Bit 2 = '1'b: The "System Service" field is present,

  — Bit 1 = '1'b: The "Reply Port Number" field is present,

  — Bit 0 = '1'b: The "Service Info Extensions" field is present;

— the optional "System Service" field;

— the optional "Reply Port Number" field;

— the optional "Service Info Extensions" field.

NOTE "System Service" and "Reply Port Number" are not supported in IEEE 1609.3™-2016.

There maybe 0 to 31 Service Info sets in a Service Info Segment.

"Channel Index" of ASN.1 type `ChannelIndex` specified in A.2.2 provides a pointer to the *n*-th set of channel parameters within the Channel Info Segment specified in 6.4.4.3 and the Extended Channel Info Segment extension element specified in 6.4.3.3, and indicates the service channel where the advertised service is being offered. A channel index of 1 indicates the first set of parameters, a channel index of 2 indicates the second set of parameters, and so on, through channel index of 31. Channel index 0 is used in cases no change to a service channel is needed.

"System Service" of ASN.1 type `SystemService` specified in A.2.2 is an optional field not supported in IEEE 1609.3™-2016. Presence of the "System Service" field shall be indicated by the Options bit B2 specified in this subclause. "System Service" shall be present when ITS-AID = 0 is supported.

NOTE ITS-AID = 0 selects the ITS application class "system" specified in ISO 15628.[1]

Further details of "System Service" will be specified in a later version of this document or in other International Standards.

"Reply Port Number" is the `serviceProviderPort` component of the ASN.1 type `ChannelOptions` specified in A.2.2 containing a two octet ITS Port Number (ITS-PN) used in transport headers such as specified in 5.5.2. Presence of the "Reply Port Number" field shall be indicated by the Options bit B1 specified in this subclause. If present, this ITS port number shall be used by a Service User as a destination port number in messages sent to the Service Provider.

The structure of Extensions is specified in Clause 7. Extension elements presented in Table 5 may be used in the "Service Info Extensions" field. Presence of the "Service Info Extensions" field shall be indicated by the Options bit B0 specified in this subclause.

Table 7 — Service Info Extensions elements

Element ID	Element type (ASN.1)	Element name
c-ProviderServContext = 8	ProviderServiceContext	Provider Service Context (PSC) (specified in IEEE 1609.3™-2016)
c-IPv6Address = 9	IPv6Address	IPv6 Address (specified in IEEE 1609.3™-2016)
c-servicePort = 10	ServicePort	Service Port (specified in IEEE 1609.3™-2016)
c-ProviderMACaddress = 11	ProviderMacAddress	Provider MAC address (specified in IEEE 1609.3™-2016)
c-RCPIthreshold = 19	RcpiThreshold	RCPI Threshold (specified in IEEE 1609.3™-2016)
c-WSAcountThreshold = 20	WsaCountThreshold	SAM Count Threshold (specified in IEEE 1609.3™-2016)
c-WSAcountThresInt = 22	WsaCountThresholdInterval	SAM Count Threshold Interval (specified in IEEE 1609.3™-2016)
c-SAMapplicationData = 85	SAMapplicationData	SAM Application Data

ASN.1 details are specified in A.2.3.

The "PSC" element provides supplementary information related to the advertised application with which it is associated. If present, the PSC has a length from 1 to 31 octets.

The "IPv6 Address" element provides the 128-bit IPv6 address of the device hosting the advertised application and is formatted per IETF RFC 4291. This element may be present when the application employs IP addressing.

The "Service Port" element provides the 16-bit port number (e.g. UDP port number or TCP port number) of the higher layer entity providing the service. This element may be present when the application employs IP addressing.

NOTE This port number has a different purpose than the one provided in the optional "Reply Port Number" field.

The "Provider MAC Address" element is a 48-bit MAC address used to address the device providing the application. The "Provider MAC Address" element is present if different from the MAC address of the device transmitting the SAM.

If present, the "RCPI Threshold" element indicates the recommended minimum received SAM signal value in dBm, 0 to –110, below which the application opportunity should be ignored by a recipient. It is encoded as RCPI in IEEE 802.11™.

If present, the "SAM Count Threshold" element indicates the recommended minimum number of received SAMs, below which an advertised application should be ignored by a recipient. It has a length of 1 octet and is an unsigned integer with range 0 to 255.

The "SAM Count Threshold Interval" element may be optionally used with the "SAM Count Threshold" element. It indicates the time interval over which received SAMs are counted. It has a length of 1 octet, and is an unsigned integer with range 1 to 255, in units of 100 ms. The default value used if no "WSA Count Threshold Interval" element is included in the SAM is 1 s.

If present, the "SAM Application Data" element contains application data. This allows using FSAP to broadcast short messages without the need to start a session. It might also be useful to provide initial data for a subsequent session.

6.4.4.3 Channel info segment

The optional Channel Info Segment of ASN.1 type `ChannelInfos` specified in A.2.2 and presented in Figure 16 provides information pertaining to channels utilized by services being advertised in SAMs.

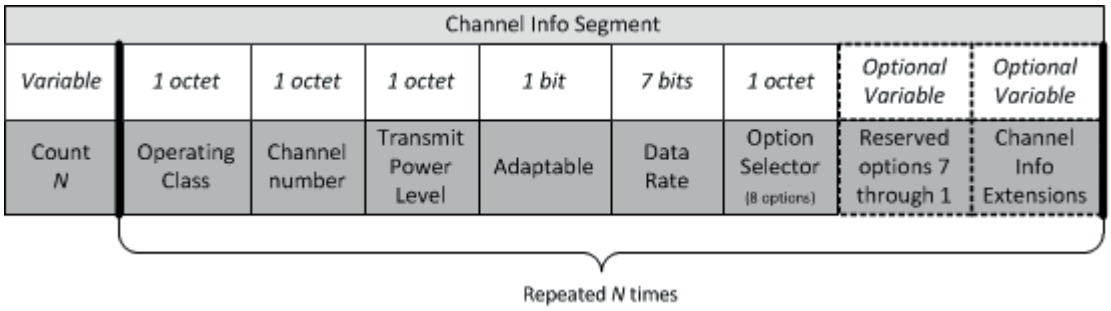

Figure 16 — General format of the Channel info segment

It consists of a "Count *N*" field with variable length specified in 6.6, indicating the number *N* of subsequent channel information sets. Each channel information set indicates the characteristics of one channel associated with zero or more Service Info Sets. Channel information sets are of ASN.1 type `ChannelInfo` specified in A.2.2 and consist of:

— a field containing the IEEE 802.11™[10] "Operating Class";

— a field containing the IEEE 802.11™[10] "Channel number";

— a field containing the "Transmit Power Level" to be used for transmissions on the associated channel;

— a field containing the "Adaptable" bit indicating whether "Data Rate" contains a boundary value or fixed value;

— an "Option Selector" field containing eight option selector bits:

  — Bit 7 to Bit 1: Reserved for future use. Set to '0'b,

  — Bit 0 = '1'b: The "Channel Info Extensions" field is present;

— an optional "Channel Info Extensions" field.

There may be 0 to 31 Channel Info sets in the Channel Info Segment.

The "Operating Class" field specified in IEEE 802.11™ of ASN.1 type `OperatingClass80211` specified in A.2.2 provides the necessary information allowing the following "Channel number" identifying a specific channel uniquely in the context of a country.

The "Channel number" field specified in IEEE 802.11™ of ASN.1 type `ChannelNumber80211` specified in A.2.3 provides the number of the channel to which the accompanying information pertains. An identical "Operating Class"/"Channel Number" pair shall not appear in two sets of the "Channel Info Segment" in the same SAM.

The "Transmit Power Level" field of ASN.1 type `TXpower80211` specified in A.2.3 provides the Effective Isotropic Radiated Power (EIRP), in the range –128 dBm to 127 dBm, to be used for transmissions on the associated channel. Transmit Power Level should be interpreted as the maximum EIRP power level allowed.

The "Adaptable" field is a 1-bit subfield in the ASN.1 type `WsaChInfoDataRate` specified A.2.3 indicating whether "Data Rate" provides a boundary value or fixed value. A value of '1'b indicates "Data Rate" should be interpreted as the minimum rate allowed. A value of '0'b indicates "Data Rate" should be interpreted as a fixed value.

The "Data Rate" field is a 7-bit subfield in the ASN.1 type `WsaChInfoDataRate` specified A.2.3 indicating the data rate used on the channel. Per IEEE 802.11™, "Data Rate" is represented by a count from 0x02 to 0x7F, corresponding to data rates in increments of 500 kbit/s from 1 Mb/s to 63,5 Mb/s. If "Adaptable" is set to '1'b, "Data Rate" should be interpreted as the minimum rate allowed, and any higher rate should also be allowed.

The structure of extensions is specified in Clause 7. Extension elements presented in Table 5 may be used in the "Channel Info Extensions" field. Presence of the "Channel Info Extensions" field shall be indicated by the Option Selector bit B0 specified in this subclause.

Table 8 — Channel Info Extensions elements

Element ID	Element type (ASN.1)	Element name
`c-EDCAparameterSet = 12`	`EdcaParameterSet`	EDCA Parameter Set (specified in IEEE 1609.3™-2016)
`c-ChannelAccess = 21`	`ChannelAccess80211`	Channel Access (specified in IEEE 1609.3™-2016)

If present, the "EDCA Parameter Set" of ASN.1 type `EdcaParameterSet` specified in A.2.3 provides information on the MAC-layer channel access parameters which should be used by the various devices communicating on the channel. The EDCA Parameter Set contains four EDCA Parameter Records specified in IEEE 802.11™:2012, 8.4.2.31 of ASN.1 type `EdcaParameterRecord` specified in A.2.3.

6.4.4.4 IPv6 routing advertisement

The optional "IPv6 Routing Advertisement" field of ASN.1 type `RoutingAdvertisement` specified in A.2.2 and presented in Figure 16 provides information about infrastructure internetwork connectivity, allowing receiving devices to be configured to participate on the advertised IPv6 network.

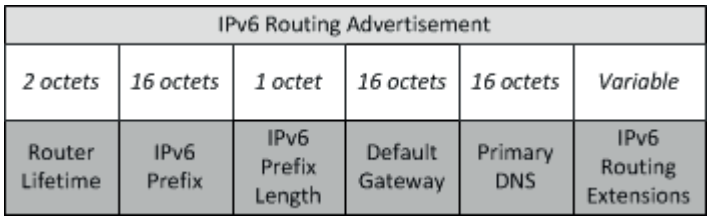

Figure 17 — General format of the IPv6 Routing Advertisement field

The IPv6 Routing Advertisement field consist of the following:

— a "Router Lifetime" field;

— an "IPv6 Prefix" field;

— an "IPv6 Prefix Length" field;

— a "Default Gateway" field;

— a "Primary Domain Name Service (DNS)" field;

— an "IPv6 Routing Extensions" field.

The "Router Lifetime" field specified in IETF RFC 4861 of ASN.1 type `RouterLifetime` specified in A.2.2 provides the duration that the Default Gateway and associated information is valid.

The "IPv6 Prefix" field of ASN.1 type `IpV6Prefix` specified in A.2.2 provides IPv6 subnet prefix of the link described in IETF RFC 4861.

The "IPv6 Prefix Length" field of ASN.1 type `IpV6PrefixLength` specified in A.2.2 provides information on how many of the higher order bits of "IPv6 Prefix" are significant, as described in IETF RFC 4861.

The "Default Gateway" field of ASN.1 type `IPv6Address` specified in A.2.3 provides the 128-bit IPv6 address of a router that provides internetwork connectivity to the subnet.

The "Primary DNS" field of ASN.1 type `IPv6Address` specified in A.2.3 provides the 128-bit IPv6 address of a device that can provide Domain Name System (DNS) lookup for the subnet devices.

The structure of extensions is specified in Clause 7. Extension elements presented in Table 5 may be used in the "IPv6 Routing Extensions" field.

Table 9 — Routing Extensions elements

Element ID	Element type (ASN.1)	Element name
`c-SecondaryDNS = 13`	`SecondaryDns`	Secondary DNS (specified in IEEE 1609.3™-2016)
`c-GatewayMACaddress = 14`	`GatewayMacAddress`	Gateway MAC address (specified in IEEE 1609.3™-2016)

ASN.1 details are specified in A.2.3.

If present, the "Secondary DNS" element provides the 128-bit IPv6 address of an alternative device that can provide DNS lookup for the subnet devices.

If present, the "Gateway MAC Address" element provides the 48-bit MAC address associated with the Default Gateway. This element shall be present if the gateway MAC address is different to the MAC address of the device transmitting the SAM.

6.5 Service response message

6.5.1 Message structure

Figure 18 illustrates the basic format of the Service Response Message (SRM). Unaligned packet encoding rules (UPER) applied to the ASN.1 type `Srm` defined in A.2.2 results in the intended binary presentation of this SRM format.

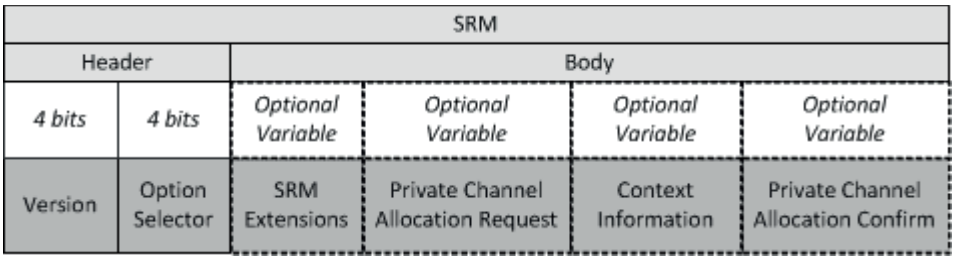

Figure 18 — General format of the SRM

The SRM consists of two parts:

a) SRM header specified in 6.5.2:

- "Version": a 4-bit unsigned integer number indicating the version of the service advertisement protocol specified in 6.5.2.1;
- "Option Selector" field: a 4-bit field indicating presence or absence of optional message fields:
  - Bit 3 = '1'b: the "SRM Extensions" field is present;

— Bit 2 = ‘1’b: the “Private Channel Allocation Request” field is present;

— Bit 1 = ‘1’b: the “Context Information” field is present;

— Bit 0 = ‘1’b: the “Private Channel Allocation Confirm” field is present;

b) SRM body specified in 6.5.2.2:

— an optionally present “SRM Extensions” field specified in 6.5.3.2;

— an optional “Private Channel Allocation Request” field specified in 6.5.3.3;

— an optional “Context Information” field specified in 6.5.3.4;

— an optional “Private Channel Allocation Confirm” field specified in 6.5.3.5.

6.5.2 Message header

6.5.2.1 Protocol version

The protocol version is presented as a 4-bit unsigned integer number of ASN.1 type `RsvAdvPrtVersion` specified in A.2.2. The smallest allowed number is 3; this is the initial version number specified in IEEE 1609.3™-2016.

6.5.2.2 Selection of options in the message body

Bits 3, 2, 1 and 0 may be set to either ‘0’b or ‘1’b dependent on the protocol needs.

6.5.3 Message body

6.5.3.1 Usage of optional fields

The SRM body consists of optional fields only. Table 6 presents all possible configurations of the SRM body based on the optional fields “Private Channel Allocation Request”, “Context Information” and “Private Channel Allocation Confirm”. The optional “SRM Extensions” may be present in any one of the configurations.

Table 10 — SRM body configurations

Private Channel Allocation Request	Context Information	Private Channel Allocation Confirm	Informative explanations
absent	absent	absent	Empty SRM. Potential usage is not specified.
present	absent	absent	Reply to an advertised ITS Application that requires assignment of a private communication channel.
absent	present	absent	Reply to an advertised ITS Application Class, providing context information.
present	present	absent	Reply to an advertised ITS Application and/or an ITS Application Class that requires assignment of a private communication channel, together with the provision of context information related to an ITS Application Class.
absent	absent	present	Acknowledgement of a privately allocated channel

Table 10 *(continued)*

Private Channel Allocation Request	Context Information	Private Channel Allocation Confirm	Informative explanations
present	absent	present	Typically not used. Combination of an acknowledgement of a privately allocated channel with a new reply to an advertised ITS Application that requires assignment of a private communication channel.
absent	present	present	Combination of an acknowledgement of a privately allocated channel with a reply to an advertised ITS Application Class, providing context information.
present	present	present	Typically not used. Combination of an acknowledgement of a privately allocated channel with a new reply to an advertised ITS Application and/or ITS Application Class that requires assignment of a private communication channel.

6.5.3.2 SRM Extensions field

The structure of extensions is specified in Clause 7. Extension elements presented in Table 11 may be used in the SRM Header Extensions field. The presence of the SRM Header Extensions field shall be indicated by the "Option Selector" bit specified in 6.5.1.

Table 11 — SRM extensions elements

Element ID	Element type (ASN.1)	Element name
n.a.	`n.a.`	No SRM Extension elements are identified so far.

SRM Extension elements are of ASN.1 type `SRMextension` specified in A.2.2.

6.5.3.3 Private channel allocation request field

The optional Private Channel Allocation Request field of ASN.1 type `SrmPrivateChannelsRq` specified in A.2.2 and presented in Figure 19 acknowledges services being advertised in SAMs for which an allocation of a private communications channel is requested.

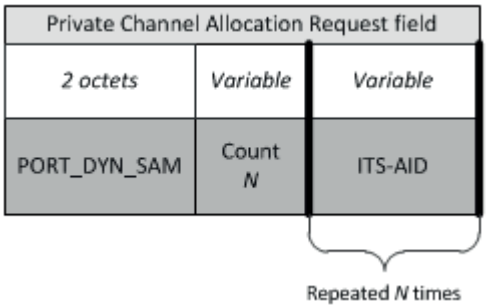

Figure 19 — Private Channel Allocation Request field

It consists of

— a "PORT_DYN_SAM" field containing a dynamically allocated two octet ITS-PN to be used by the Service Provider in subsequent privately addressed (unicast mode) SAM transmissions containing information on a privately allocated communications channel,

— a “Count *N*” field of variable length specified in 6.6 indicating the number *N* of subsequent ITS-AIDs, and

— a field of variable length containing *N* ITS-AID values.

6.5.3.4 Context information field

6.5.3.4.1 Structure

The optional Context Information field of ASN.1 type `SrmContexts` specified in A.2.2 and presented in Figure 20 provides information on ITS application class contexts related to services being advertised in SAMs.

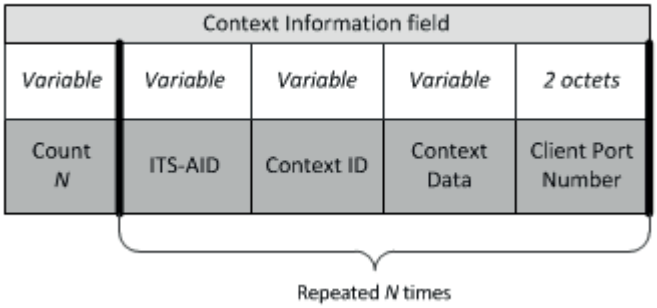

Figure 20 — Context Information field

It consists of the following:

— a “Count *N*” field of variable length specified in 6.6 indicating the number *N* of subsequent Context Information sets;

— a sequence of *N* Context Information sets of variable length specified in 6.5.3.4.2, each containing two parts:

  — Application class context information:

    — “ITS-AID” field indicating the ITS application class for which context information is provided (component `itsaid` of the ASN.1 type `ItsAidCtxRef`),

    — “Context ID” field indicating the context reference number of the associated ITS application class (component `ctx` of the ASN.1 type `ItsAidCtxRef`),

    — “Context Data” field providing context data for the given “ITS-AID” - “Context ID”,

    — “Client Port Number” providing a dynamically allocated two octet ITS port number PORT_DYN to be used by the Service Provider in transport layer destination port fields. In case of acknowledging a SAM with a requirement to a so far unknown communications channel, this field contains the dynamically assigned ITS-PN PORT_DYN_SAM to which the subsequent SAM with information on a privately allocated communications channel shall be sent.

6.5.3.4.2 Context information set

A context information set consists of context information and an ITS port number. Context information is identified by a two-dimensional identifier of ASN.1 type `ItsAidCtxRef` specified in A.2.2, consisting of an ITS-AID and a Context ID:

— The “ITS-AID” field contains the component `itsaid` of the ASN.1 type `ItsAidCtxRef` specified in ISO/TS 17419[8] indicates the ITS application class for which context information is provided.

— The “Context ID” field contains the component `ctx` of the ASN.1 type `ItsAidCtxRef` specified in A.2.2 indicates the context reference number of the associated ITS application class.

The “Context Data” field provides context data for the given “ITS-AID” - “Context ID” (see of ASN.1 type `SamContext.context`).

Table 12 specifies “Context Data”. Further “Context Data” may be specified in other standards.

Table 12 — Context Data

ITS-AID	Context ID	Context Data type (ASN.1)	Comment
0 (System)	0	`NullCtx`	This “Null-Context” may be used to indicate interest in an advertised service that requires operation in a privately allocated communication channel.[a]
0 (System)	1	`MandAppCtx`	Used to indicate the System Service “Mandatory Applications” in an SAM; see 6.4.4.2.[a] Mandatory applications are ITS applications that are required by either regulations or policies. Information on details of mandatory applications, e.g. usage, and area and time of applicability, are contained in the related ITS-S applications, regulations and policies.

[a] This feature is not supported in IEEE 1609.3™-2016.

NOTE Specified contexts will be published in the ISO/TS 16460 folder of the ISO standards maintenance portal at http://standards.iso.org/iso/ts/16460.

A service user may provide information on several contexts of the same ITS application class.

EXAMPLE The ITS application class “Electronic Fee Collection” identified with ITS-AID = 1 has a large number of contexts, e.g. for different operators in different countries. A Service User may have contracts with several operators and thus can offer the contexts for each contract he has. The Service Provider, upon reception of the SRM, will decide on the context to be used.

The “Client Port Number” field provides an ITS port number of ASN.1 type `PortNumber` specified in A.2.1 that shall be used by the Service Provider in transport layer destination port fields of messages to the Service User related to the given context.

6.5.3.5 Private channel allocation confirm field

The optional Private Channel Allocation Confirm field of ASN.1 type `SrmPrvChAllocConf` specified in A.2.2 and presented in Figure 21 acknowledges allocation of private communications channels for the services indicated by the given ITS-AIDs.

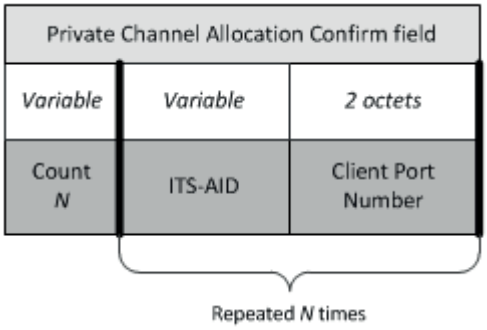

Figure 21 — Private Channel Allocation Confirm field

It consists of a "Count N" field of variable length specified in 6.6 indicating the number N of subsequent pairs of "ITS-AID" and related dynamically assigned "Client Port Number" (PORT_DYN). The "Client Port Number" shall be used by the Service Provider in transport layer destination port fields.

6.6 Count N

The "Count *N*" fields specified in 6.4.4.2 and 6.4.4.3 have a length of one or two octets dependent on the value contained in it:

— One octet size: Values from 0 to 127. The most significant bit is always set to zero. Presented as 0x00 (=0) to 0xEF (=127); i.e. the remaining 7 bits contain an unsigned integer number.

— Two octet size: Values from 128 to 16383. The most significant bit of the first octet is always set to one, and the second most significant bit of the first octet is always set to zero. Presented as 0x8080 (=128) to 0xBFFF (=16383); i.e. the remaining 14 bits contain an unsigned integer number.

NOTE This presentation results from the unaligned packed encoding rules applied to ASN.1 types of unconstraint variable length.

6.7 Procedures

6.7.1 General

General basic procedures specified in 6.4 and 6.5 shall apply.

Optional features, or features defined by implementation, may become normative mandatory features in other standards using the specifications of this document as a basis.

6.7.2 Privately allocated channels

While the Channel Info Segment field and Extended Channel Info Segment extension element basically request a change of communication channel to be performed by all service users, the following procedure allows private assignments of communication channels. A four-step approach is specified:

a) Transmission of SAM in broadcast mode with source ITS-PN = PORT_DYN_SRM and destination ITS-PN = PORT_SAM. The Extended Channel Info Segment extension element indicates the unknown channel `chInfoType-unknown` for one or several services indicated by an ITS-AID in the Service Info Segment for which a private communication channel is to be allocated.

b) The service advertisement manager in the service user station replies with a SRM for all desired services that need a privately allocated communication channel. The SRM is transmitted in unicast mode with source ITS-PN = PORT_SAM and destination ITS-PN = PORT_DYN_SRM. It contains, as a minimum, the Private Channel Allocation Request field presenting the ITS-AIDs being of interest

for the service user and the dynamically allocated port number PORT_DYN_SAM to which the service advertiser shall send the subsequent privately addressed SAM.

c) The service advertisement manager in the service advertiser station identifies the private channels and indicates them to the service user in a privately addressed SAM with source ITS-PN = PORT_DYN_SRM and destination ITS-PN = PORT_DYN_SAM.

d) The service advertisement manager in the service user station replies with a SRM for all services for which a private communication channel was allocated, and that is supported by the service user station. The SRM is transmitted in unicast mode with source ITS-PN = PORT_DYN_SAM and destination ITS-PN = PORT_DYN_SRM. It contains, as a minimum, the Private Channel Allocation Confirm field presenting the ITS-AIDs being of interest for the service user together with the dynamically allocated port numbers PORT_DYN to which the service provider shall send the subsequent privately addressed session protocol data units.

Upon reception of the SRM in step 4, the service advertisement manager in the service advertiser station shall inform the service provider to start the service session.

6.8 Secured messages

In this document, no specific security means are specified. This allows for several (regional) options to be specified in other standards or system specifications.

Unsecured messages may be encapsulated as presented in Figure 22. This may apply for SAM and SRM, but not for LM.

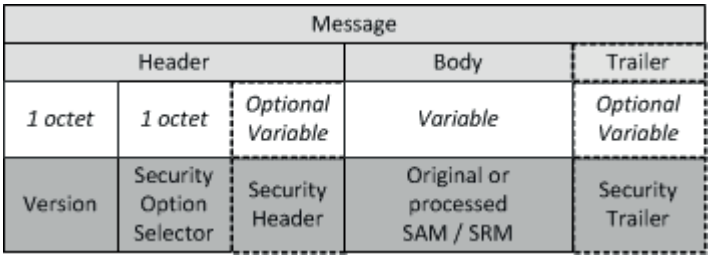

Figure 22 — General format specified in IEEE 1609.2™

The “Message” is specified in ASN.1 with OER. This ensures that all fields are octet aligned. The “Body” field is specified as an OCTET STRING that contains either the unsecured original message (with the original encoding) or a signed or encrypted version of the original message preceded with a length field indicating the number of octets contained in the octet string.

The one octet unsigned integer “Version” field contains the version number of the security protocol. The actual version number is three.

The one octet “Security Option Selector” indicates the applied type of security (none, signed, encrypted, ...), and by this whether the “Security Header” and “Security Trailer” are present.

The fields “Security Header” and “Security Trailer” contain information dependent on the security mechanism used.

An ASN.1 presentation of “Message” is given by the type `Ieee1609Dot2Data`[12] specified in the ASN.1 module

— IEEE1609dot2 {iso(1) identified-organization(3) ieee(111) standards-association-numbered-series-standards(2) wave-stds(1609) dot2(2) base (1) schema (1)}

that itself imports relevant basic types from

— IEEE1609dot2BaseTypes {iso(1) identified-organization(3) ieee(111) standards-association-numbered-series-standards(2) wave-stds(1609) dot2(2) base(1) base-types(2)}.

Applying "Octet Encoding Rules" (OER) to these ASN.1 specifications results in the intended binary message structure. OER is specified in ISO/IEC 8825-7.[9]

Further details are outside the scope of this document.

7 Structure of extension elements

The N-Extensions field (see 5.4) and T-Extensions field (see 5.5) contain information in type-length-value encoded "Extension Elements" as specified in IEEE 1609.3™-2016 and as illustrated in Figure 23. Extension elements are used to provide additional information in messages. Specification of new extension elements does not break backward compatibility with earlier specifications; thus, new extension elements may be specified in future versions of this document or in other standards, and the result of such standardization is managed by means of a registry of this document.

NOTE 1 ISO maintains such a registry in the ISO/TS 16460 folder of the ISO standards maintenance portal at http://standards.iso.org/iso/ts/16460.

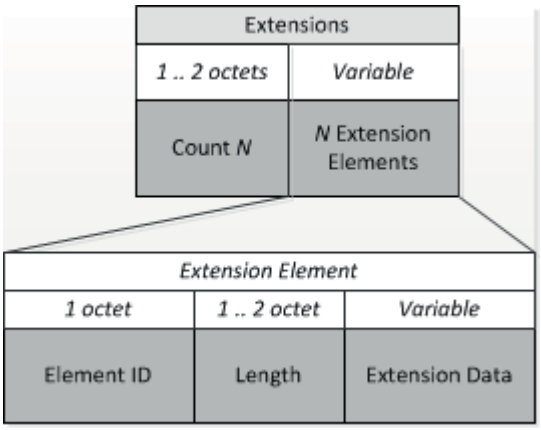

Figure 23 — Extension elements

As presented in Figure 23, the "Count *N*" field of variable length contains the number *N* of subsequent extension elements. Each extension element consists of

— an "Element ID" field containing a one octet unsigned integer identifying the type of Extension Data, and

— a "Length" field of variable length field indicating the number of octets contained in the "Extension Data" field.

The "Count *N*" and "Length" fields have a length of one or two octets dependent on the value contained in it:

— One octet size: Values from 0 to 127. The most significant bit is always set to zero. Presented as 0x00 (=0) to 0xEF (=127); i.e. the remaining 7 bits contain an unsigned integer number.

— Two octet size: Values from 128 to 16383. The most significant bit of the first octet is always set to one, and the second most significant bit of the first octet is always set to zero. Presented as 0x8080 (=128) to 0xBFFF (=16383); i.e. the remaining 14 bits contain an unsigned integer number.

NOTE 2 This presentation results from the unaligned packed encoding rules applied to ASN.1 types of unconstraint variable length.

In case a receiver does not know the meaning of an Element ID, i.e. the type of Extension Data, it may ignore this extension and continue parsing with the next element in the packet. The number in the "Length" field allows a receiver to "jump over" the octets that contain the unknown "Extension Data".

Extension elements with Element IDs in the range 4 to 17 and 19 to 23 are specified in IEEE 1609.3.[13] This document adds new extension elements. Table 13 presents the extension elements identified so far.

Table 13 — Extension elements

Name	ASN.1 type	Element ID value	Usage
		0–3	Reserved for IEEE
Transmit Power Used	`TXpower80211`	4	LM N-Extensions
2D Location	`TwoDLocation`	5	SAM Header
3D Location	`ThreeDLocation`	6	SAM Header
Advertiser Identifier	`AdvertiserIdentifier`	7	SAM Header
Provider Service Context	`ProviderServiceContext`	8	SAM Service Info
IPv6 Address	`IPv6Address`	9	SAM Service Info
Service Port	`ServicePort`	10	SAM Service Info
Provider MAC Address	`ProviderMacAddress`	11	SAM Service Info
EDCA Parameter Set	`EdcaParameterSet`	12	SAM Channel Info
Secondary DNS	`SecondaryDns`	13	SAM Routing Advertisement
Gateway MAC Address	`GatewayMacAddress`	14	SAM Routing Advertisement
Channel Number	`ChannelNumber80211`	15	LM N-Extensions
Data Rate	`DataRate80211`	16	LM N-Extensions
Repeat Rate	`RepeatRate`	17	SAM Header
		18	Reserved for IEEE
RCPI Threshold	`RcpiThreshold`	19	SAM Service Info
WSA Count Threshold	`WsaCountThreshold`	20	SAM Service Info
Channel Access	`ChannelAccess80211`	21	SAM Channel Info
WSA Count Threshold Interval	`WsaCountThresholdInterval`	22	SAM Service Info
Channel Load	not yet specified	23	LM N-Extensions
		24–79	Reserved for IEEE
LM TX CIP	`TXcip`	80	LM N-Extensions
LM RX CIP	`RXcip`	81	LM N-Extensions
Channel Busy Ratio	`LMchannelBusyRatio`	82	LM N-Extensions
Packet ID	`LMpacketID`	83	LM T-Extensions
Extended Channel Infos	`ExtendedChannelInfos`	84	SAM Header
SAM Application Data	`SAMapplicationData`	85	SAM Service Info
		86–120	Reserved for ISO
		121–255	Reserved for IEEE

Annex A
(normative)

ASN.1 modules

A.1 General

The ASN.1 basic notation is specified in ISO/IEC 8824-1. The following ASN.1 modules are specified in this annex:

— ITSlm { iso (1) standard (0) localized (16460) lm(1) version0 (0)};

— ITSsa { iso (1) standard (0) localized (16460) sa(2) version0 (0)};

— ITSee { iso (1) standard (0) localized (16460) ee(4) version0 (0)}.

These ASN.1 modules complement the IEEE modules:

— IEEE-1609-3-WEE {iso(1) identified-organization(3) ieee(111) standards-association-numbered-series-standards(2) wave-stds(1609) dot3(3) wee(1) version0(0)},

— IEEE-1609-3-WSM {iso(1) identified-organization(3) ieee(111) standards-association-numbered-series-standards(2) wave-stds(1609) dot3(3) wsm(2) version0(0)},

— IEEE-1609-3-WSA {iso(1) identified-organization(3) ieee(111) standards-association-numbered-series-standards(2) wave-stds(1609) dot3(3) wsa(3) version0(0)},

specified in IEEE 1609.3™-2016:

— ITSlm is an enhanced version of IEEE-1609-3-WSM;

— ITSsa is an enhanced version of IEEE-1609-3-WSA;

— ITSee is an enhanced version of IEEE-1609-3-WEE.

NOTE Updates of these three ASN.1 modules, if applicable, can be downloaded from the ISO/TS 16460 folder of the ISO standards maintenance portal at http://standards.iso.org/iso/ts/16460.

Applying unaligned packed encoding rules (UPER) specified in ISO/IEC 8825-2 for the encoding of the ITSlm, ITSsa and ITSee ASN.1 modules results in the intended binary presentation of the messages specified in this document.

In case there is an unintended difference between the binary presentations in Clauses 4, 5 and 6, and the UPER presentation derived from the ASN.1 modules, the presentation given by the ASN.1 modules shall prevail.

A.2 ISO modules

A.2.1 ITSlm

This module imports ASN.1 definitions from ASN.1 modules specified in ISO 21218,[3] ISO 24102-1,[4] ISO 29281-1,[6] ISO 29281-2,[7] ISO/TS 17419[8] and from other ASN.1 modules specified in this document.

```
ITSlm { iso (1) standard (0) localized (16460) lm(1) version0 (0)}

DEFINITIONS AUTOMATIC TAGS::= BEGIN
```

```
IMPORTS

RXcip, TXcip FROM CALMfntp { iso (1) standard (0) calm-nonip(29281) fntp(1) asnm-1 (1)
version1 (1)}

FNTPlpp FROM CALMlegacySupport { iso (1) standard (0) calm-nonip(29281) legacy (2) asnm-1
(1) version1 (1)}

Link-ID FROM CALMllsap {iso(1) standard(0) calm-ll-sap(21218) asnm-1 (1) version1 (1)}

ITS-scuId FROM CALMmanagement { iso (1) standard (0) calm-management (24102) local (1)
asnm-1 (1) version1 (1)}

VarLengthNumber, VarLengthNumber2 FROM CITSapplMgmtIDs {iso(1) standard(0) cits-applMgmt
(17419) ids (1) version1 (1)}

EXT-TYPE, Extension, RefExt, c-TxPowerUsed80211,c-ChannelNumber80211, c-DataRate80211,
c-Reserved, TXpower80211, ChannelNumber80211, DataRate80211, c-LMchannelBusyRatio,
c-LMrxCip, c-LMtxCip, c-LMpacketID, c-LMchannelBusyRatio, LMchannelBusyRatio  FROM ITSee {
iso (1) standard (0) localized (16460) ee(4) version0 (0)}

;
-- End of IMPORTS

-- Localized Message
LMnpdu::=SEQUENCE{
     subtype            ShortMsgSubtype,
     transport          ShortMsgTpdus,
     body               ShortMsgData
     } -- from IEEE 1609.3™-2016

-- The below is an extension of ShortMsgSubtype specified in IEEE 1609.3™-2016
ShortMsgSubtype::=CHOICE{
   nullNetworking           [0] NullNetworking, -- from IEEE 1609.3™-2016
   itssInternalForwarding   [1] LMinternalForwardingHeader,
   nHopForwarding           [2] LMmultiHopInfo,
   subTypeReserved3         [3] NoSubtypeProcessing,
   subTypeReserved4         [4] NoSubtypeProcessing,
   subTypeReserved5         [5] NoSubtypeProcessing,
   subTypeReserved6         [6] NoSubtypeProcessing,
   subTypeReserved7         [7] NoSubtypeProcessing,
   subTypeReserved8         [8] NoSubtypeProcessing,
   subTypeReserved9         [9] NoSubtypeProcessing,
   subTypeReserved19        [10] NoSubtypeProcessing,
   subTypeReserved11        [11] NoSubtypeProcessing,
   subTypeReserved12        [12] NoSubtypeProcessing,
   subTypeReserved13        [13] NoSubtypeProcessing,
   subTypeReserved14        [14] NoSubtypeProcessing,
   subTypeReserved15        [15] NoSubtypeProcessing
   }

NoSubtypeProcessing::= SEQUENCE{
    optBit              BIT STRING (SIZE(1)),  -- always set to '0'b
    version             ShortMsgVersion -- set to c-shortMsgVersion2016
    }

ShortMsgVersion::= INTEGER{
    c-shortMsgVersion2016   (3)
    }(0..7)

NullNetworking::= SEQUENCE{
    version             ShortMsgVersion,
    nExtensions         ShortMsgNextensions OPTIONAL
    }

LMinternalForwardingHeader::=SEQUENCE{
   version         ShortMsgVersion,
   direction       LMforwardDirection,
   hostITS-scuId   ITS-scuId,
   link            Link-ID,
```

```
   counter         LMpacketCounter,
   nExtensions     ShortMsgNextensions OPTIONAL,
   origHeader      ShortMsgSubtype -- Subtype 1 is invalid
   }

LMforwardDirection::= INTEGER{
   hostToRouter  (0),
   routerToHost  (255)
   } (0..255)

LMmultiHopInfo::=SEQUENCE{
   version         ShortMsgVersion,
   messageID       LMmessageID,
   hopCount        LMhopCount,
   nExtensions     ShortMsgNextensions OPTIONAL
   }

LMmessageID::=INTEGER(0..4194303)

LMhopCount::=INTEGER(0..3)

-- N-Extensions
-- Sequence of 0 to n extension elements
-- The value of n may be limited
ShortMsgNextensions::=SEQUENCE OF ShortMsgNextension

-- A single N-Extension element
ShortMsgNextension::= Extension{{ShortMsgNextTypes}}


-- all available N-Extensions
-- the below is an extension of ShortMsgNextTypes specified in IEEE 1609.3™-2016
ShortMsgNextTypes EXT-TYPE::={
     { TXpower80211        IDENTIFIED BY c-TxPowerUsed80211 } |
     { ChannelNumber80211  IDENTIFIED BY c-ChannelNumber80211 } |
     { DataRate80211       IDENTIFIED BY c-DataRate80211 } |
     { LMchannelBusyRatio  IDENTIFIED BY c-LMchannelBusyRatio } |
     { RXcip               IDENTIFIED BY c-LMrxCip } |
     { TXcip               IDENTIFIED BY c-LMtxCip },
     ...
     }

-- end of N-xtensions


-- CHOICE tag value equals TPID feature selector value
-- The following type is an extension of ShortMsgTpdus
-- specified in IEEE 1609.3™-2016
ShortMsgTpdus::=CHOICE{
     bcMode             [0] LMbcPDU, -- from IEEE 1609.3™-2016
     ucMode             [1] LMgeneralPDU,
     lpp                [2] LMlppPDU,
     tpidReserved3      [3] NoTpidProcessing,
     tpidReserved4      [4] NoTpidProcessing,
     tpidReserved5      [5] NoTpidProcessing,
     tpidReserved6      [6] NoTpidProcessing,
     tpidReserved7      [7] NoTpidProcessing,
     tpidReserved8      [8] NoTpidProcessing,
     tpidReserved9      [9] NoTpidProcessing,
     tpidReserved10     [10] NoTpidProcessing,
     tpidReserved11     [11] NoTpidProcessing,
     tpidReserved12     [12] NoTpidProcessing,
     tpidReserved13     [13] NoTpidProcessing,
     tpidReserved14     [14] NoTpidProcessing,
     tpidReserved15     [15] NoTpidProcessing,
     tpidReserved16     [16] NoTpidProcessing,
     tpidReserved17     [17] NoTpidProcessing,
     tpidReserved18     [18] NoTpidProcessing,
     tpidReserved19     [19] NoTpidProcessing,
     tpidReserved20     [20] NoTpidProcessing,
     tpidReserved21     [21] NoTpidProcessing,
```

```
tpidReserved22     [22] NoTpidProcessing,
tpidReserved23     [23] NoTpidProcessing,
tpidReserved24     [24] NoTpidProcessing,
tpidReserved25     [25] NoTpidProcessing,
tpidReserved26     [26] NoTpidProcessing,
tpidReserved27     [27] NoTpidProcessing,
tpidReserved28     [28] NoTpidProcessing,
tpidReserved29     [29] NoTpidProcessing,
tpidReserved30     [30] NoTpidProcessing,
tpidReserved31     [31] NoTpidProcessing,
tpidReserved32     [32] NoTpidProcessing,
tpidReserved33     [33] NoTpidProcessing,
tpidReserved34     [34] NoTpidProcessing,
tpidReserved35     [35] NoTpidProcessing,
tpidReserved36     [36] NoTpidProcessing,
tpidReserved37     [37] NoTpidProcessing,
tpidReserved38     [38] NoTpidProcessing,
tpidReserved39     [39] NoTpidProcessing,
tpidReserved40     [40] NoTpidProcessing,
tpidReserved41     [41] NoTpidProcessing,
tpidReserved42     [42] NoTpidProcessing,
tpidReserved43     [43] NoTpidProcessing,
tpidReserved44     [44] NoTpidProcessing,
tpidReserved45     [45] NoTpidProcessing,
tpidReserved46     [46] NoTpidProcessing,
tpidReserved47     [47] NoTpidProcessing,
tpidReserved48     [48] NoTpidProcessing,
tpidReserved49     [49] NoTpidProcessing,
tpidReserved50     [50] NoTpidProcessing,
tpidReserved51     [51] NoTpidProcessing,
tpidReserved52     [52] NoTpidProcessing,
tpidReserved53     [53] NoTpidProcessing,
tpidReserved54     [54] NoTpidProcessing,
tpidReserved55     [55] NoTpidProcessing,
tpidReserved56     [56] NoTpidProcessing,
tpidReserved57     [57] NoTpidProcessing,
tpidReserved58     [58] NoTpidProcessing,
tpidReserved59     [59] NoTpidProcessing,
tpidReserved60     [60] NoTpidProcessing,
tpidReserved61     [61] NoTpidProcessing,
tpidReserved62     [62] NoTpidProcessing,
tpidReserved63     [63] NoTpidProcessing,
tpidReserved64     [64] NoTpidProcessing,
tpidReserved65     [65] NoTpidProcessing,
tpidReserved66     [66] NoTpidProcessing,
tpidReserved67     [67] NoTpidProcessing,
tpidReserved68     [68] NoTpidProcessing,
tpidReserved69     [69] NoTpidProcessing,
tpidReserved70     [70] NoTpidProcessing,
tpidReserved71     [71] NoTpidProcessing,
tpidReserved72     [72] NoTpidProcessing,
tpidReserved73     [73] NoTpidProcessing,
tpidReserved74     [74] NoTpidProcessing,
tpidReserved75     [75] NoTpidProcessing,
tpidReserved76     [76] NoTpidProcessing,
tpidReserved77     [77] NoTpidProcessing,
tpidReserved78     [78] NoTpidProcessing,
tpidReserved79     [79] NoTpidProcessing,
tpidReserved80     [80] NoTpidProcessing,
tpidReserved81     [81] NoTpidProcessing,
tpidReserved82     [82] NoTpidProcessing,
tpidReserved83     [83] NoTpidProcessing,
tpidReserved84     [84] NoTpidProcessing,
tpidReserved85     [85] NoTpidProcessing,
tpidReserved86     [86] NoTpidProcessing,
tpidReserved87     [87] NoTpidProcessing,
tpidReserved88     [88] NoTpidProcessing,
tpidReserved89     [89] NoTpidProcessing,
tpidReserved90     [90] NoTpidProcessing,
tpidReserved91     [91] NoTpidProcessing,
tpidReserved92     [92] NoTpidProcessing,
```

```
     tpidReserved93     [93] NoTpidProcessing,
     tpidReserved94     [94] NoTpidProcessing,
     tpidReserved95     [95] NoTpidProcessing,
     tpidReserved96     [96] NoTpidProcessing,
     tpidReserved97     [97] NoTpidProcessing,
     tpidReserved98     [98] NoTpidProcessing,
     tpidReserved99     [99] NoTpidProcessing,
     tpidReserved100    [100] NoTpidProcessing,
     tpidReserved101    [101] NoTpidProcessing,
     tpidReserved102    [102] NoTpidProcessing,
     tpidReserved103    [103] NoTpidProcessing,
     tpidReserved104    [104] NoTpidProcessing,
     tpidReserved105    [105] NoTpidProcessing,
     tpidReserved106    [106] NoTpidProcessing,
     tpidReserved107    [107] NoTpidProcessing,
     tpidReserved108    [108] NoTpidProcessing,
     tpidReserved109    [109] NoTpidProcessing,
     tpidReserved110    [110] NoTpidProcessing,
     tpidReserved111    [111] NoTpidProcessing,
     tpidReserved112    [112] NoTpidProcessing,
     tpidReserved113    [113] NoTpidProcessing,
     tpidReserved114    [114] NoTpidProcessing,
     tpidReserved115    [115] NoTpidProcessing,
     tpidReserved116    [116] NoTpidProcessing,
     tpidReserved117    [117] NoTpidProcessing,
     tpidReserved118    [118] NoTpidProcessing,
     tpidReserved119    [119] NoTpidProcessing,
     tpidReserved120    [120] NoTpidProcessing,
     tpidReserved121    [121] NoTpidProcessing,
     tpidReserved122    [122] NoTpidProcessing,
     tpidReserved123    [123] NoTpidProcessing,
     tpidReserved124    [124] NoTpidProcessing,
     tpidReserved125    [125] NoTpidProcessing,
     tpidReserved126    [126] NoTpidProcessing,
     tpidReserved127    [127] NoTpidProcessing
    }

NoTpidProcessing::=BIT STRING (SIZE(1))

LMbcPDU::=SEQUENCE{
     destAddress    VarLengthNumber, -- that is PSID / ITS-AID
     tExtensions    ShortMsgTextensions OPTIONAL}
     }

LMgeneralPDU::=SEQUENCE{
    sourcePort      PortNumber,
    destPort        PortNumber,
    tExtensions     ShortMsgTextensions OPTIONAL}
    }

LMlppPDU::=SEQUENCE{
    sourcePort      PortNumber,
    destPort        PortNumber,
    lpp             FNTPlpp,
    tExtensions     ShortMsgTextensions OPTIONAL}
    }

LMpacketCounter::=INTEGER(0..255)

PortNumber::=INTEGER(0..65535)

ShortMsgData::=OCTET STRING

-- T-Extensions
-- Sequence of 0 to n T-Extension elements
ShortMsgTextensions::=SEQUENCE OF ShortMsgTextension

-- a single T-Extension element
ShortMsgTextension::= Extension{{ShortMsgTextTypes}}

-- The below is an extension of ShortMsgTextTypes specified in IEEE 1609.3™-2016
```

```
ShortMsgTextTypes EXT-TYPE::={
     { LMpacketID   IDENTIFIED BY c-LMpacketID },
     ...
     }

LMpacketID::=SEQUENCE{
    message      TPmessageID,
    fragment     TPfragmentID,
    noFragments  TPnoFragments
    }

TPmessageID::=INTEGER(0..65535)

TPfragmentID::=VarLengthNumber2

TPnoFragments::=INTEGER

-- end of T-Extensions

END
```

A.2.2 ITSsa

This module imports ASN.1 definitions from ASN.1 modules.

```
ITSsa { iso (1) standard (0) localized(16460) sa(2) version0 (0)}

DEFINITIONS AUTOMATIC TAGS::= BEGIN

IMPORTS

IPv6Address, TXpower80211, ChannelNumber80211, EXT-TYPE, Extension, c-RepeatRate,
c-2Dlocation, c-3Dlocation, c-advertiserID, RepeatRate, TwoDLocation, ThreeDLocation,
AdvertiserIdentifier, c-ProviderServContext,c-IPv6Address, c-servicePort,
c-ProviderMACaddress, c-RCPIthreshold, c-WSAcountThreshold, c-WSAcountThresInt,
c-EDCAparameterSet, c-ChannelAccess, c-SecondaryDNS, c-GatewayMACaddress,
c-LMchannelBusyRatio, c-LMrxCip, c-LMtxCip, c-LMpacketID, ProviderServiceContext,
ServicePort, ProviderMacAddress, RcpiThreshold, WsaCountThreshold,
WsaCountThresholdInterval, EdcaParameterSet, ChannelAccess80211, SecondaryDns,
GatewayMacAddress, c-ExtendedChannelInfos, ExtendedChannelInfos, SAMapplicationData,
c-SAMapplicationData FROM ITSee { iso (1) standard (0) localized(16460) ee(4) version0
(0)}

PortNumber FROM ITSlm { iso (1) standard (0) localized (16460) lm(1) version0 (0)}

ITSaid FROM CITSapplMgmtApplReg {iso(1) standard(0) cits-applMgmt (17419) applRegistry (2)
version1 (1)} -- this is the p-encoded ITS-AID

;
-- End of IMPORTS

-- Service Advertisement Protocol messages

RsvAdvPrtVersion::= INTEGER {
    c-rsvAdvPrtVersion2016    (3) -- current version number
    }(0..15) -- Protocol version

-- Service Advertisement Message
Sam::= SEQUENCE{
    version               RsvAdvPrtVersion,
    body                  SamBody
    }

SamBody::= SEQUENCE{
    changeCount          SrvAdvChangeCount,
    extensions           SrvAdvMsgHeaderExts OPTIONAL,
    serviceInfos         ServiceInfos OPTIONAL,
    channelInfos         ChannelInfos OPTIONAL,
    routingAdvertisement RoutingAdvertisement OPTIONAL
    }
```

```
SrvAdvChangeCount::= SEQUENCE{
    saID           SrvAdvID,
    contentCount   SrvAdvContentCount
    }

SrvAdvID::= INTEGER(0..15)

SrvAdvContentCount::= INTEGER(0..15)

-- SAM header extensions
SrvAdvMsgHeaderExts::= SEQUENCE OF SrvAdvMsgHeaderExt

SrvAdvMsgHeaderExt::= Extension {{SrvAdvMsgHeaderExtTypes}}

SrvAdvMsgHeaderExtTypes EXT-TYPE::= {
     { RepeatRate            IDENTIFIED BY c-RepeatRate } |
     { TwoDLocation          IDENTIFIED BY c-2Dlocation } |
     { ThreeDLocation        IDENTIFIED BY c-3Dlocation } |
     { AdvertiserIdentifier  IDENTIFIED BY c-advertiserID } |
     { ExtendedChannelInfos  IDENTIFIED BY c-ExtendedChannelInfos },
     ...
     }

-- SAM Service Info Segment
ServiceInfos::= SEQUENCE OF ServiceInfo -- '0' size allows to send only a routing
advertisement

ServiceInfo::= SEQUENCE {
    serviceID      ITSaid, -- ITS-AID
    channelIndex   ChannelIndex, -- 5 bits
    chOptions      ChannelOptions
    }

ChannelOptions::= SEQUENCE{
    systemService         SystemService OPTIONAL,
    serviceProviderPort   ReplyAddress OPTIONAL,
    extensions            ServiceInfoExts OPTIONAL
    }

ChannelIndex::= INTEGER {
    notUsed        (0), -- no change of channel
    firstEntry     (1)
    }(0..31)

ReplyAddress::= PortNumber

SystemService::= SEQUENCE OF SystemServiceAndContext

SystemServiceAndContext::= SamContext -- only ITS-AID = 0 allowed

-- Service Info Extensions
ServiceInfoExts::= SEQUENCE OF ServiceInfoExt

ServiceInfoExt::= Extension {{ServiceInfoExtTypes}}

ServiceInfoExtTypes EXT-TYPE::= {
    { ProviderServiceContext     IDENTIFIED BY c-ProviderServContext } |
    { IPv6Address                IDENTIFIED BY c-IPv6Address } |
    { ServicePort                IDENTIFIED BY c-servicePort } |
    { ProviderMacAddress         IDENTIFIED BY c-ProviderMACaddress } |
    { RcpiThreshold              IDENTIFIED BY c-RCPIthreshold } |
    { WsaCountThreshold          IDENTIFIED BY c-WSAcountThreshold } |
    { WsaCountThresholdInterval  IDENTIFIED BY c-WSAcountThresInt } |
    { SAMapplicationData         IDENTIFIED BY c-SAMapplicationData },
    ...
    }

-- Channel Info Segment
ChannelInfos::= SEQUENCE OF ChannelInfo

ChannelInfo::= SEQUENCE{
```

```
    operatingClass   OperatingClass80211,
    channelNumber    ChannelNumber80211,
    powerLevel       TXpower80211,
    dataRate         WsaChInfoDataRate,
    extensions       ChInfoOptions
    }

OperatingClass80211::= INTEGER (0..255)

WsaChInfoDataRate::= SEQUENCE{
    adaptable      BIT STRING (SIZE(1)),
    dataRate       INTEGER (0..127)
    }

ChInfoOptions::= SEQUENCE{
    option1        NULL OPTIONAL, -- not used
    option2        NULL OPTIONAL, -- not used
    option3        NULL OPTIONAL, -- not used
    option4        NULL OPTIONAL, -- not used
    option5        NULL OPTIONAL, -- not used
    option6        NULL OPTIONAL, -- not used
    option7        NULL OPTIONAL, -- not used
    extensions     ChannelInfoExts OPTIONAL
    }

ChannelInfoExts::= SEQUENCE OF ChannelInfoExt

ChannelInfoExt::= Extension {{ChannelInfoExtTypes}}

ChannelInfoExtTypes EXT-TYPE::= {
    { EdcaParameterSet     IDENTIFIED BY c-EDCAparameterSet } |
    { ChannelAccess80211   IDENTIFIED BY c-ChannelAccess },
    ...
    }

-- Routing Advertisement
RoutingAdvertisement::= SEQUENCE {
    lifetime         RouterLifetime,
    ipPrefix         IpV6Prefix,
    ipPrefixLength   IpV6PrefixLength,
    defaultGateway   IPv6Address,
    primaryDns       IPv6Address,
    extensions       RoutAdvertExts
    }

RouterLifetime::= INTEGER (0..65535)

IpV6Prefix::= OCTET STRING (SIZE (16))

IpV6PrefixLength::= INTEGER (0..255)


-- Routing Advertisement extensions
RoutAdvertExts::= SEQUENCE OF RoutAdvertExt

RoutAdvertExt::= Extension {{RoutAdvertExtTypes}}

RoutAdvertExtTypes EXT-TYPE::= {
    { SecondaryDns           IDENTIFIED BY c-SecondaryDNS } |
    { GatewayMacAddress      IDENTIFIED BY c-GatewayMACaddress },
    ...
    }

-- Service Response Message
-- not supported in IEEE 1609.3™-2016
Srm::= SEQUENCE{
    header           RsvAdvPrtVersion,
    body             SrmBody
    }

SrmBody::= SEQUENCE{
```

```
    extensions       SRMextensions OPTIONAL,
    prvChannelsRq    SrmPrivateChannelsRq OPTIONAL,
    contexts         SrmContexts OPTIONAL,
    prvChannelsCf    SrmPrvChAllocConf OPTIONAL
    }

SrmPrivateChannelsRq::= SEQUENCE{
    portDynSam     PortNumber,
    allocReqs      SrmPrvChAllocReq
    }

SrmPrvChAllocReq::= SEQUENCE OF ITSaid -- ITS-AIDs

SrmContexts::= SEQUENCE OF SrmContext

SrmContext::= SEQUENCE{
    context        SamContext,
    clientPort     PortNumber
    }

SrmPrvChAllocConf::= SEQUENCE OF ITSaid -- ITS-AIDs

-- Service Advertisement Context info CLASS
-- A context is identified by the pair of ITS-AID and Context ID (&itsaidCtxRef)
-- ITS-AID has to identify an ITS application class (e.g. EFC)
-- Context ID is a context identifier unique for a given ITS application class

SA-CONTEXT::= CLASS{
    &itsaidCtxRef    ItsAidCtxRef UNIQUE,
    &ContextInfo OPTIONAL
    }
    WITH SYNTAX {&ContextInfo IDENTIFIED BY &itsaidCtxRef}

SamContext::= SEQUENCE{
    itsaidCtxRef   SA-CONTEXT.&itsaidCtxRef({AllsamContexts}),
    context        SA-CONTEXT.&ContextInfo({AllsamContexts}{@itsaidCtxRef})
    }

ItsAidCtxRef::= SEQUENCE{
    itsaid         ITSaid,
    ctx            CtxRef
    }

CtxRef::= INTEGER(0..255)
c-ctxRefNull CtxRef::=0 -- can be used with all values of ITS-AID
c-ctxRefMandApp CtxRef::=1 -- can be used with ITS-AID = 0

-- "Null-Context information"
c-CtxTypeSystemNull ItsAidCtxRef::={itsaid content:0, ctx c-ctxRefNull}
NullCtx::= NULL -- don't care / don't know context

-- "Mandatory Application context information"
c-CtxTypeSystemMandApp ItsAidCtxRef::={itsaid content:0, ctx c-ctxRefMandApp}
MandAppCtx::= SEQUENCE OF ItsAidCtxRef -- identifiers or mandatory applications

/* Examples
c-CtxType1 ItsAidCtxRef::={itsaid content:127, ctx 255}
c-CtxType2 ItsAidCtxRef::={itsaid extension:content:256, ctx 128}
c-CtxType3 ItsAidCtxRef::={itsaid extension:extension:content:16512, ctx 254}
*/

AllsamContexts SA-CONTEXT::= {
    { NullCtx      IDENTIFIED BY c-CtxTypeSystemNull} |
    { MandAppCtx   IDENTIFIED BY c-CtxTypeSystemMandApp},
    ...
    }

-- Sequence of 0 to n SRM extension elements
SRMextensions::=SEQUENCE OF SRMextension

-- A single SRM extension element
```

```
SRMextension::= Extension{{SRMexts}}

-- all available SRM Extensions

SRMexts EXT-TYPE::={
--   {                    IDENTIFIED BY  } |
--   {                    IDENTIFIED BY  } |
--   {                    IDENTIFIED BY  },
     ...
     }

END
```

A.2.3 ITSee

```
ITSee { iso (1) standard (0) localized(16460) ee(4) version0 (0)}
DEFINITIONS AUTOMATIC TAGS::=
BEGIN

/* Quality check info:
Proper syntax and correct mapping of UPER on the intended binary presentation as specified
in the main body of this document was validated with the OSS ASN.1 Studio tool.
*/

IMPORTS

ChannelInfo FROM ITSsa { iso (1) standard (0) localized(16460) sa(2) version0 (0)}

MedType FROM CALMllsap {iso(1) standard(0) calm-ll-sap(21218) asnm-1 (1) version1 (1)}
;
-- End of IMPORTS

-- Extension Elements CLASS and reference value definitions
-- CLASS
EXT-TYPE::= CLASS {
      &extRef RefExt UNIQUE,
      &ExtValue
    }
    WITH SYNTAX {&ExtValue IDENTIFIED BY &extRef}

-- General extension (profiling)
Extension {EXT-TYPE: ExtensionTypes}::= SEQUENCE {
    extensionId   EXT-TYPE.&extRef({ExtensionTypes}),
    value         EXT-TYPE.&ExtValue({ExtensionTypes}{@.extensionId})
    }
-- ExtensionTypes are specified for SAM, SRM, and LM

-- Reference values (for all types of extensions)
RefExt::=INTEGER (0..255)

c-Reserved             RefExt::= 0
c-TxPowerUsed80211     RefExt::= 4 -- LM-N-Header, SAM Header
c-2Dlocation           RefExt::= 5 -- SAM Header
c-3Dlocation           RefExt::= 6 -- SAM Header
c-advertiserID         RefExt::= 7 -- SAM Header
c-ProviderServContext  RefExt::= 8 -- SAM Service Info
c-IPv6Address          RefExt::= 9 -- SAM Service Info
c-servicePort          RefExt::= 10 -- SAM Service Info
c-ProviderMACaddress   RefExt::= 11 -- SAM Service Info
c-EDCAparameterSet     RefExt::= 12 -- SAM Channel Info
c-SecondaryDNS         RefExt::= 13 -- SAM Routing Advertisement
c-GatewayMACaddress    RefExt::= 14 -- SAM Routing Advertisement
c-ChannelNumber80211   RefExt::= 15 -- LM-N-Header
c-DataRate80211        RefExt::= 16 -- LM-N-Header
c-RepeatRate           RefExt::= 17 -- SAM Header
c-CountryString        RefExt::= 18 -- SAM Header
c-RCPIthreshold        RefExt::= 19 -- SAM Service Info
c-WSAcountThreshold    RefExt::= 20 -- SAM Service Info
c-ChannelAccess        RefExt::= 21 -- SAM Channel Info
c-WSAcountThresInt     RefExt::= 22 -- SAM Service Info
c-ChannelLoad          RefExt::= 23 -- SAE / CAMP / 1609 are working on this
```

```
c-LMtxCip              RefExt::= 80 -- LM-N-Header
c-LMrxCip              RefExt::= 81 -- LM-N-Header
c-LMchannelBusyRatio   RefExt::= 82 -- LM-N-Header
c-LMpacketID           RefExt::= 83 -- LM-T-Header
c-ExtendedChannelInfos RefExt::= 84 -- SAM Header
c-SAMapplicationData   RefExt::= 85 -- SAM Service Info

-- all other values of RefExt are reserved

-- ChannelLoad specification is not yet available.


-- LM extension elements
DataRate80211::=INTEGER(0..255)

TXpower80211::=INTEGER(-128..127)

ChannelNumber80211::=INTEGER(0..255)

LMchannelBusyRatio::=INTEGER{
    zeroPercent    (0),
    halfPercent    (1),
    onePercent     (2),
    hundredPercent    (200),
    unknown        (201)
    }(0..255) -- values larger than 201 are prohibited


-- SAM header extension elements

RepeatRate::= INTEGER (0..255)

TwoDLocation::= SEQUENCE {
    latitude            Latitude,
    longitude           Longitude
    }

ThreeDLocation::= SEQUENCE {
    latitude            Latitude,
    longitude           Longitude,
    elevation           Elevation
    }

-- max. 32 octets are allowed in AdvertiserIdentifier!!!
-- 32 characters may produce more than 32 octets in UPER
AdvertiserIdentifier::= UTF8String (SIZE (1..32))


-- Extended Channel Info
CHINFO-TYPE::= CLASS {
    &id          MedType UNIQUE,
    &Type
    }
    WITH SYNTAX {&Type IDENTIFIED BY &id}

chInfoType-unknown   MedType::= unknown -- 0
chInfoType-any       MedType::= any -- 1
chInfoType-2G        MedType::= iso21212 -- 2
chInfoType-3G        MedType::= iso21213 -- 3
chInfoType-IR        MedType::= iso21214 -- 4
chInfoType-M5        MedType::= iso21215 -- 5
chInfoType-MM        MedType::= iso21216 -- 6
chInfoType-80216e    MedType::= iso25112 -- 7
chInfoType-HC-SDMA   MedType::= iso25113 -- 8
chInfoType-80220     MedType::= iso29283 -- 9
chInfoType-LTE       MedType::= iso17515 -- 10
chInfoType-6LowPan   MedType::= iso19079 -- 11
chInfoType-15628     MedType::= iso15628 -- 128
chInfoType-CAN       MedType::= can -- 254
chInfoType-Ethernet  MedType::= ethernet -- 255
```

```
ChInfoTypes CHINFO-TYPE::= {
    { NULL          IDENTIFIED BY chInfoType-unknown } |
    { NULL          IDENTIFIED BY chInfoType-any } |
    { ChannelInfo   IDENTIFIED BY chInfoType-M5 },
    ...
    }

ExtendedChannelInfos::= SEQUENCE OF ExtendedChannelInfo

ExtendedChannelInfo::= SEQUENCE {
    medId   CHINFO-TYPE.&id({ChInfoTypes}), -- medium identifier
    value   CHINFO-TYPE.&Type({ChInfoTypes}{@.medId})
    }

--ServiceInfo extension elements
ProviderServiceContext::= SEQUENCE{
    fillBit   BIT STRING (SIZE(3)), -- all bits set to zero!
    psc        OCTET STRING (SIZE(0..31)) -- size zero is not recommended
    }

IPv6Address::= OCTET STRING (SIZE (16))

ServicePort::= INTEGER (0..65535)

ProviderMacAddress::= MACaddress

MACaddress::= OCTET STRING (SIZE(6))

RcpiThreshold::= INTEGER (0..255) -- see IEEE Std 802.11

WsaCountThreshold::= INTEGER (0..255)

WsaCountThresholdInterval::= INTEGER (0..255) -- value 0 is not used

SAMapplicationData::= OCTET STRING

--ChannelInfo extension elements
EdcaParameterSet::= SEQUENCE{
    acbeRecord           EdcaParameterRecord,
    acbkRecord           EdcaParameterRecord,
    acviRecord           EdcaParameterRecord,
    acvoRecord           EdcaParameterRecord
    }

EdcaParameterRecord::= SEQUENCE {
    res         INTEGER (0..1),
    aci         INTEGER (0..3),
    acm         INTEGER (0..1),
    aifsn       INTEGER (0..15),
    ecwMax      INTEGER (0..15),
    ecwMin      INTEGER (0..15),
    txopLimit   INTEGER (0..65535)
    }

ChannelAccess80211::= INTEGER {
    continuous          (0),
    alternatingSCH    (1),
    alternatingCCH    (2)
    } (0..255)


-- RoutingAdvertisement extension elements
SecondaryDns::= IPv6Address
GatewayMacAddress::= MACaddress


Latitude::= SEQUENCE{
    fillBit    BIT STRING (SIZE(1)), -- set to '0' (MSB of Latitude)
    lat        INTEGER (-900000000..900000001)
    }
```

```
Longitude::= INTEGER (-1800000000..1800000001)
Elevation::= INTEGER (-4096..61439)

END
```

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