ETSI TS 103 152 V2.1.1 (2019-11)

TECHNICAL SPECIFICATION

**Intelligent Transport Systems (ITS);
V2X Communications;
Multimedia Content Dissemination (MCD)
Basic Service specification;
Release 2**

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This Technical Specification (TS) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

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Introduction

ITS stations (ITS–Ss) exchange information with each other to satisfy a large diversity of customers' services.

Multimedia information provides enriched information to enhance the perception of the road users as well relatively to their mobility environment as to the products and services being locally available. Multimedia information may also be used to enhance the communication between individuals and communities during their mobility.

The exchange of multimedia information needs the specification of messages supporting multimedia such as pictures, video clips, audio associated with data elements enabling their use.

1   Scope

The present document specifies the basic service of the facilities layer supporting Multimedia Content Dissemination (MCD). It also specifies the Multimedia Content Dissemination Message (MCDM) being used for the multimedia content dissemination.

2   References

2.1   Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are necessary for the application of the present document.

[1]   ETSI EN 302 637-3: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service".

[2]   ETSI EN 302 931: "Intelligent Transport Systems (ITS); Vehicular Communications; Geographical Area Definition".

[3]   ETSI TS 102 894-2: "Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary".

[4]   Recommendation ITU-T X.691/ISO/IEC 8825-2 (2015): "Information technology - ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)".

[5]   ETSI TS 103 248: "Intelligent Transport Systems (ITS); GeoNetworking; Port Numbers for the Basic Transport Protocol (BTP)".

[6]   ETSI EN 302 636-4-1: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality".

[7]   ETSI EN 302 636-5-1: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 5: Transport Protocols; Sub-part 1: Basic Transport Protocol".

[8]   IETF RFC 2046: "Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types", November 1996.

> NOTE: Available at https://tools.ietf.org/html/rfc2046.

[9]   ETSI EN 302 663 (V1.2.1): "Intelligent Transport Systems (ITS); Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band".

[10]   ETSI TS 103 613: "Intelligent Transport Systems (ITS); Access layer specification for Intelligent Transport Systems using LTE Vehicle to everything communication in the 5,9 GHz frequency band".

[11]   IETF RFC 1738: "Uniform Resource Locators (URL)", December 1994.

> NOTE: Available at https://www.ietf.org/rfc/rfc1738.txt.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ISO/TS 17419:2018: "Intelligent Transport Systems - Cooperative Systems - Classification and management of ITS applications in a global context".

[i.2] ETSI EN 302 665: "Intelligent Transport Systems (ITS); Communications Architecture".

[i.3] ETSI EN 302 636-3: " Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 3: Network Architecture".

[i.4] ETSI TS 102 723-11: "Intelligent Transport Systems (ITS); OSI cross-layer topics; Part 11: Interface between networking and transport layer and facilities layer".

[i.5] ETSI TS 102 723-5: "Intelligent Transport Systems (ITS); OSI cross-layer topics; Part 5: Interface between management entity and facilities layer".

[i.6] ETSI TS 101 539-1: "Intelligent Transport Systems (ITS); V2X Applications; Part 1: Road Hazard Signalling (RHS) application requirements specification".

[i.7] ETSI TS 101 556-1: "Intelligent Transport Systems (ITS); Infrastructure to Vehicle Communication; Electric Vehicle Charging Spot Notification Specification".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

event: object described by Multimedia Content Dissemination Message(s)

NOTE: E.g. road hazard, driving environment, traffic condition, or Point of Interest.

MCD protocol: facilities layer protocol to control the dissemination of multimedia data such as photos/pictures, video clips, audio

Multimedia Content Dissemination (MCD): facilities layer function that operates the MCD protocol

Multimedia Content Dissemination Message (MCDM): one or more facilities layer PDUs that contain multimedia content data

originator ITS-S: ITS-S that generates and transmits Multimedia Content Dissemination Messages

receiver ITS-S: ITS-S that receives and processes Multimedia Content Dissemination Messages

3.2 Symbols

For the purposes of the present document, the following symbols apply:

IF.Mng   Interface between MCD basic service and ITS management entity
IF.N&T   Interface between MCD basic service and ITS networking & transport layer
IF.SEC   Interface between MCD basic service and ITS security entity

3.3   Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACK	ACKnowledgement
API	Application Program Interface
ASN.1	Abstract Syntax Notation 1
BTP	Basic Transport Protocol
DE	Data Element
DEN	Decentralized Environmental Notification
DENM	Decentralized Environmental Notification Message
DF	Data Frame
FA-SAP	Facilities/Applications Service Access Point
GN	GeoNetworking
HMI	Human Machine Interface
IANA	Internet Assigned Numbers Authority
ISO	International Organization for Standardization
ITS	Intelligent Transportation System
ITS-S	ITS Station
LDM	Local Dynamic Map
MCD	Multimedia Content Dissemination
MCDM	Multimedia Content Dissemination Message
MF-SAP	Management/Facilities Service Access Point
MTU	Maximum Transmit Unit
MTU_AL	Maximum Transmit Unit of Access Layer
NACK	Negative ACKnowledgement
NF-SAP	Networking & Transport/Facilities Service Access Point
OSI	Open System Interconnection
PCI	Protocol Control Information
PDU	Protocol Data Unit
PER	Packet Error Rate
POI	Point Of Interest
RFC	(IETF) Request For Comments
RT	Repetition Timer
SAP	Service Access Point
SF-SAP	Security/Facilities Service Access Point
UTF	Unicode (or Universal Coded Character Set) Transformation Format
V2X	Vehicle-to-Everything

4   MCD basic service introduction

4.1   Background

Multimedia Content Dissemination Messages (MCDMs) contain multimedia content describing events for various applications. MCDMs can be broadcasted to reach all users being in the coverage of the used communication technology. They can also be broadcasted in geographical area. MCDMs can be targeted to a particular user or to a community of users using multicast. Finally, MCDMs can be addressed to a particular user through an established peer to peer session. MCDMs may incorporate several multimedia containers including pictures, video clips, audio and data. They may constitute long messages requiring segmentation to ensure their complete consistent transfer respecting the order of transmitted segments in spite of some possible losses. Received MCDMs need to be filtered according to their use context and user preferences.

Multimedia Content Dissemination (MCD) is a facilities layer function which is mainly used by ITS applications to control the dissemination of pictures, video clips, audio and data using ITS communication technologies. Applications classes to be supported by MCD can be listed as follows:

- Road safety, e.g. signalling some obstacle on the road as specified in ETSI TS 101 539-1 [i.6] or some dangerous traffic situations using pictures or video clips.

- Traffic management, e.g. providing pictures or videos of the current traffic situations.

- Mobility e.g. providing some multimedia description of POI availability, e.g. parking, electric vehicle charging spots [i.7], rest areas, etc.

- National patrimony information, e.g. monuments, local specialties, arts, etc.

- Commercial information, e.g. products/services advertisement, special sales, open days, etc.

- Personal and Communities information, e.g. hitchhiking request, community concerted mobilities, etc.

The dissemination of MCDM among ITS-Ss is operated by the MCD protocol. Example processing procedures of an ITS use case that is supported by the MCD protocol are as follows:

- Applications activate the MCD basic service either on user request or automatically when detecting a particular situation.

- The application specifies the dissemination rules of the multimedia content which is provided at the same time.

- An MCDM is generated and transmitted according to the provided dissemination rules. In case of geo-addressing, the MCDM can be relayed by one or more relevant network forwarder ITS-Ss.

- An ITS-S that receives an MCDM processes the contained information and provides it or not to the user according to contextual constraints, e.g. driving state and preference criteria.

A general inter-layer and inter-ITS-Ss dataflow for the MCDM exchange is provided in Figure 1. The solid lines illustrate the dataflow that is mandatory for all ITS applications supported by MCD basic service.

An MCDM may be forwarded by intermediate ITS-Ss in order to disseminate it from the originating ITS-S to the receiver ITS-S, if the receiver ITS-S is not located in the direct communication range of the originating ITS-S. This forwarding is realized by the ITS networking and transport layer.
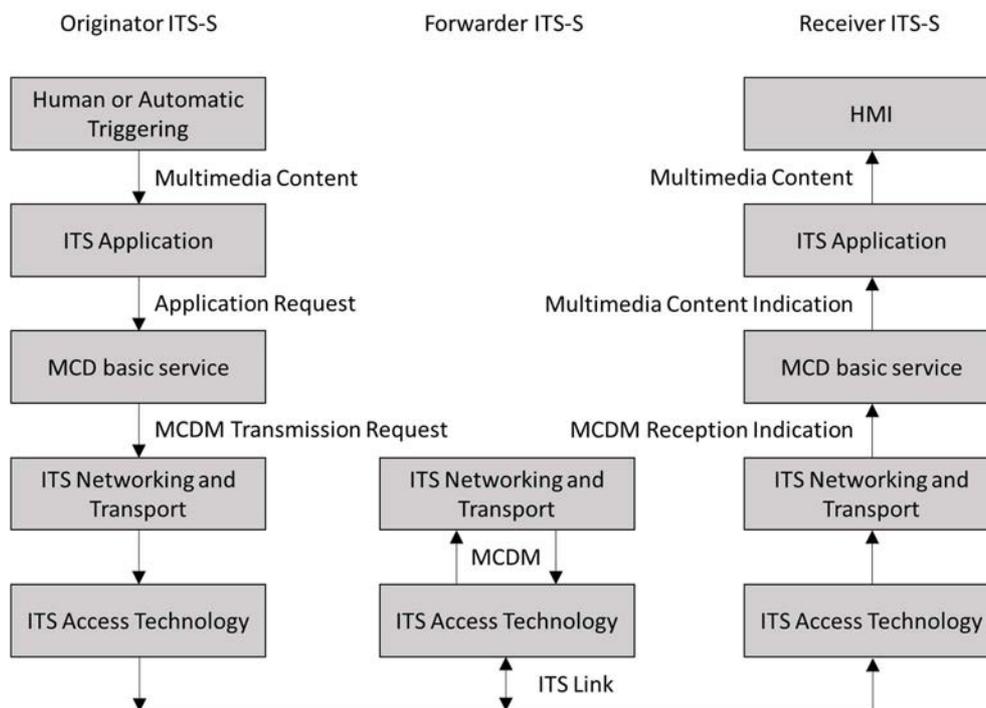

Figure 1: General data flow for ITS-S application supported by MCD basic service

4.2 Services provided by the MCD basic service

The MCD basic service is a facilities layer entity that operates the MCD protocol. It provides services to entities at the ITS applications layer. At the originator ITS-S, it triggers and maintains the transmission of MCDMs according to dissemination rules as set by the ITS-S application. At the receiver ITS-S, the MCD basic service processes the received MCDM and makes the content available for usage at ITS-S applications if relevant.

The MCD basic service uses the services provided by the protocol entities of the ITS networking and transport layer to disseminate the MCDM. Dissemination rules are provided by the requesting ITS-S application. It may be:

- Broadcast.

- Geographical broadcast.

- Multicast, using a group address, e.g. community name, or a personal logical name.

- Peer to Peer.

An MCDM contains management information, and one or several multimedia containers being characterized in the management field. Other information such as situation and/or location information may be added according to the application purpose.

An MCDM can be repeated by the originating ITS-S when using broadcast and/or multicast in order to increase the reception probability of at least one exemplary in spite of packet lost.

An MCDM can be split into several units by the MCD basic service when this service is not available at the network and/or transport layer level, e.g. BTP/GeoNetworking. In such case, the MCD basic service needs to ensure the integrity of received messages. If one unit is lost and it exists no possibility to recover it at the network and/or transport layer, the whole message may be discarded by the MCD basic service of the receiver that detected the message integrity loss.

An MCDM can be associated to a DENM, e.g. "obstacle on the road" or "hazardous location". In such case the receiver ITS-S application needs to ensure a consistent user interface.

The MCD basic service of the originator ITS-S shall construct the MCDM according to the application request.

An MCDM may contain several multimedia containers of different natures, e.g. pictures, video clips, audio, text.

5 MCD basic service functional specification

5.1 MCD basic service in the ITS architecture

The MCD basic service interfaces with ITS-S applications in order to receive the request for the MCDM dissemination and to provide the received multimedia content to the ITS-S applications. Furthermore, the MCD basic service may interact with other facilities layer entities, in particular the LDM which is a facilities layer database containing local dynamic data elements. At the receiver ITS-S, the LDM may be updated with a received MCD and ITS-S applications may retrieve information from the LDM database for further processing.

NOTE: The specification of the LDM is out of scope of the present document.

Figure 2 presents the MCD basic service in the ITS-S architecture defined in ETSI EN 302 665 [i.2] and ETSI EN 302 636-3 [i.3] as well as its logical interfaces with other entities and layers.
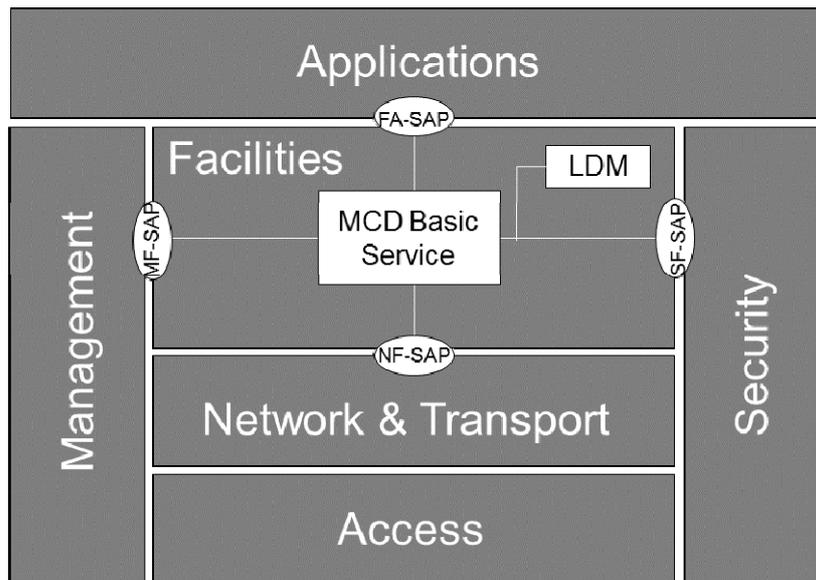
Figure 2: MCD basic service and logical interface

5.2   MCD basic service functional architecture

The MCD basic service shall provide the following sub-functions:

- Encode MCDM:

    - This sub-function constructs an MCDM according to the format specified in Annex A of the present
      document.

- Decode MCDM:

    - This sub-function decodes the received MCDM.

- MCDM transmission management:

    - This sub-function implements the MCD protocol operation of the originator ITS-S as specified in
      clause 8.2, including in particular the generation of a new MCD as requested by the ITS-S application at
      the originator ITS-S.

    - Optionally, this sub-function segments the MCDM into multiple PDUs according to rules defined by the
      selected access technology, e.g. maximum packet size at the physical layer. This function is needed when
      the segmentation is not covered by a lower communication layer or it does not intend to rely on the lower
      layer for the segmentation.

- MCDM reception management:

    - This sub-function implements the MCD protocol operation of the receiver ITS-S as specified in
      clause 8.3, in particular:

        - The optional reassembly of received MCD units if not achieved by a lower communication layer.

        - The optional verification of received message integrity after reassembly and discarding of
          incomplete messages.

        - Elimination of repeated messages after the reception of a complete message.

        - The provisioning of received messages to relevant ITS-S applications and/or to other facilities layer
          entities of the receiver ITS-S.

Figure 3 illustrates sub-functions and interfaces of the MCD basic service in a component diagram.
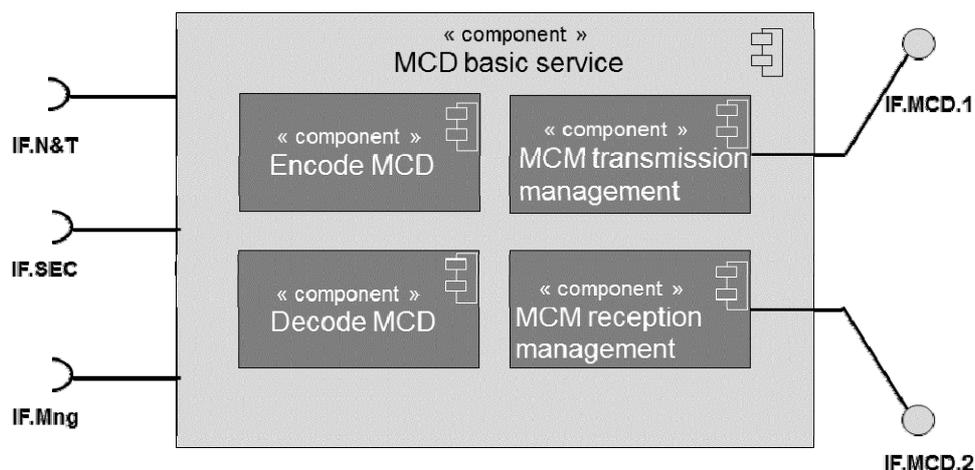
Figure 3: MCD basic service component diagram

5.3 Interfaces of the MCD basic service

5.3.1 Interface to the ITS-S application layer

An ITS-S application is a function of the ITS application layer that implements the application logic of one or more use cases. It initiates the generation of MCDMs as introduced in clause 4.2, according to some pre-defined conditions provided by the applications.

The MCD basic service provides the interfaces to the ITS-S applications for the MCD protocol operation of the originator ITS-S and receiver ITS-S. As illustrated in Figure 3, the interface IF.MCD.1 is for the MCDM transmission. At the originator ITS-S, the ITS-S application sends a request to the MCD basic service to start the MCDM transmission. This request may be acknowledged by the MCD basic service according to the dissemination mode being used. The interface IF.MCD.2 is for the MCDM reception.

The generic data passed via the IF.MCD.1 between the MCD basic service and ITS applications shall be as specified in Table 1.

Table 1: Data passed via IF.MCD.1

Category	Data	Data Requirement	Remarks
Data passed from application to the MCD basic service	Information contained in the management container	As specified in Annex A and clause B.14.	
	Information contained in the situation container	As specified in Annex A and clause B.27.	Optional
	Information contained in the location container	As specified in Annex A and clause B.13.	Optional
	Information contained in the application container	As specified in Annex A and clause B.3.	Optional
	Information contained in the multimedia container	As specified in Annex A and clause B.20.	Optional
	Repetition interval	Repetition interval between two consecutive transmissions of the same MCDM in units of milliseconds.	Optional (see note 2)
	Maximum repetition time	Duration of the MCDM repetition in units of milliseconds.	Optional (see note 2)

Category	data	Data Requirement	Remarks
	Dissemination mode	One of the following modes: • General broadcast • Geographical broadcast • Multicast • Peer to Peer	
	Destination area	Destination area for MCDM dissemination as specified in ETSI EN 302 931 [2].	Required if geographically broadcasted
	Logical address	A personal or community logical name.	Required if multicasted
	IPv6 address	The IPv6 address of the communication peer.	Required if peer-to-peer
	ACK timeout	Value of the timer being triggered for the reception of an acknowledgement from peer.	Required if peer-to-peer
	Traffic class	GN traffic class as defined in ETSI EN 302 636-4-1 [6] if GeoNetworking/BTP is used.	
Data returned from the MCD basic service to the requesting application	*actionID* or other application identifier (see note 1)	As specified in Annex A and clause B.2 The MCD basic service returns the *actionID* or other applicable identifier created by the MCD basic service to the requesting application, in case the request was successfully handled.	
	Failure notification	The MCD basic service returns a failure notification to the requesting application under the conditions as specified in clause 8.	Optional (see note 3)
NOTE 1: An applicable identifier is associated to the *actionID* as created by the MCD basic service, it may be used for the interaction between the ITS-S application and DEN basic service. NOTE 2: Applicable if the application requests the MCDM repetition. NOTE 3: Applicable as specified in clause 8. NOTE 4: Data format is up to implementation and it is possible to exchange additional information depending on the implementation.			

The generic data passed via the IF.MCD.2 from the MCD basic service are identified in Table 2.

Table 2: Data passed via IF.MCD.2

Category	Data	Data Requirement	Remarks
Data passed from MCD basic service to application	Received MCDM	In whole or in part as specified in Annex A	Optional (see note 1)
NOTE 1: Applicable if ITS-S application of the receiving ITS-S requests the content of received MCDM. NOTE 2: Data format is up to implementation.			

NOTE: The interface to the ITS application layer may be implemented as API and data are exchanged between the MCD basic service and ITS applications via this API. In another possible implementation, the interface to the application layer may be implemented as FA-SAP. Specifications of the FA-SAP and the corresponding protocols and APIs are out of scope of the present document.

5.3.2   Interface to the ITS-S network and transport layer

5.3.2.1   General requirements

The MCD basic service exchanges information with the ITS networking and transport layer via the interface IF.N&T. The interface IF.N&T may be realized as NF-SAP as defined in ETSI TS 102 723-11 [i.4].

For ITS-S applications identified in the present document, several dissemination modes are possible:

- Broadcast.

- Geographical broadcast.

- Multicast.

- Peer to Peer.

At the originator ITS-S, the MCD basic service delivers the MCDM or the segmented units to the ITS-S networking and transport layer. The MCD basic service shall provide at least the protocol control information (PCI) specified in Table 3 to the ITS-S networking and transport layer. At the receiver ITS-S, if this ITS-S is considered as one destination of the MCDM dissemination, the ITS-S networking and transport layer shall pass the received MCDM to the MCD basic service.

Table 3: Data exchanged between the MCD basic service and the ITS-S networking and transport layer

Category	Data	Data Requirement	Remarks
Data passed from the MCD basic service to the ITS-S networking and transport layer	MCDM	As specified in Annex A.	
	Destination area	Destination area for MCDM dissemination as specified in ETSI EN 302 931 [2].	Required if geographically broadcasted
	Repetition interval	Repetition interval between two consecutive transmissions of the same MCDM in units of milliseconds.	Optional (see note 1)
	Maximum repetition time	Duration of the MCDM repetition in units of milliseconds.	Optional (see note 1)
Data passed from the ITS-S networking and transport layer to the MCD basic service	Received MCDM	As specified in Annex A.	Optional (see note 2)
NOTE 1: Applicable if the ITS-S application requests the MCDM repetition by the ITS networking & transport layer. The repetition may also be performed by the MCD basic service at the facility layer.			
NOTE 2: Applicable of the receiving ITS-S is considered by the ITS networking & transport layer as inside the destination area.			
NOTE 3: Data format is up to implementation.			

The network and transport protocol that may be used depending on the dissemination mode is as defined in ETSI EN 302 636-4-1 [6] and ETSI EN 302 636-5-1 [7].

5.3.2.2   Interface to the BTP over GeoNetworking stack

The GeoNetworking/BTP protocol stack is adapted to the two dissemination modes:

- Broadcast

- Geographical Broadcast

Data being passed between the MCD basic service and the GeoNetworking/BTP stack shall be as specified in Table 3 and in Table 4.

Table 4: Data passed from the MCD basic service to the BTP stack

Category	Data	Requirement (see note 3)	Remarks
Data passed from the MCD basic service to the ITS-S networking and transport layer	BTP type	BTP header type B (ETSI EN 302 636-5-1 [7], clause 7.3).	Optional (see note 1)
	Destination port	As defined in ETSI TS 103 248 [5] (see note 2).	Optional (see note 1)
	Destination port info	As specified in ETSI EN 302 636-5-1 [7].	Optional (see note 1)
	GN Packet transport type	GeoNetworking GeoBroadcast protocol.	Optional (see note 1)
	GN Destination address	Specified as Destination are in Table 3.	

Data	Requirement (see note 3)	Remarks
GN communication profile	As defined in ETSI EN 302 636-4-1 [6].	Optional (see note 1)
GN security profile	SECURED or UNSECURED.	Optional (see note 1)
GN Traffic class	As defined in ETSI EN 302 636-4-1 [6].	
GN Maximum packet lifetime	Shall not exceed *validityDuration.*	Optional (see note 1)
GN Hoplimit	The number of hops a packet is allowed to have in the network.	Optional (see note 1)
Length	Length of the MCDM.	
NOTE 1: Applicable if the value is not provided or different from the ITS-S configuration.		
NOTE 2: When a global registration authority for ITS application ISO EN 17419 [i.1] is operational, the BTP destination port registered with this authority should be used.		
NOTE 3: Data format is up to implementation.		

5.3.2.3 Interface to the IPv6 stack and the combined IPv6/GeoNetworking stack

A MCDM may rely on the IPv6 stack or the combined IPv6/GeoNetworking stack as defined in ETSI EN 302 636-3 [i.3] for MCDM dissemination. The IPv6 stack or the combined IPv6/GeoNetworking protocol stack is adapted to the two dissemination modes:

- Multicast

- Peer to Peer

  NOTE: The specifications of the interface between the MCD basic service and the IPv6 stack is out of scope of the present document.

When the MCDM dissemination makes use of the combined IPv6/GeoNetworking stack, the interface between the MCD basic service and the combined IPv6/GeoNetworking stack may be identical to the interface between the MCD basic service and IPv6 stack.

5.3.3 Interface to the ITS-S management entity

The MCD basic service may exchange information with the ITS-S management entity via the interface IF.Mng as illustrated in Figure 3. The interface IF.Mng may be realized as the MF-SAP as defined in ETSI TS 102 723-5 [i.5].

As several communication profiles may be used to support the MCDM dissemination, the MCD basic service needs to know the available communication profiles as well as the packet size limit for each communication profile.

  NOTE: Specifications of the MF-SAP and the corresponding protocol are out of scope of the present document.

5.3.4 Interface to the ITS-S security entity

The MCD basic service may exchange information with the ITS-S security entity via the interface IF.SEC as illustrated in Figure 3.

  NOTE: Specifications of the SF-SAP and the corresponding protocol are out of scope of the present document.

6 Multimedia Content Dissemination

6.1 Multimedia content dissemination concept

6.1.1 Introduction

An MCDM may be used by various ITS-S applications for different purposes. For some applications it could be necessary to link the multimedia content delivery to some other messages, e.g. the signaling of an obstacle on the road.

The multimedia content dissemination can be targeting different categories of users from one individual user to a large group of users. An individual user as a specific group of users, e.g. a community may be identified by a logical name. For these purposes four addressing modes are used:

- The general broadcast mode enables the delivery of the multimedia content to all identified users being in the coverage of the used access technology.

- The geographical broadcast mode enables the delivery of the multimedia content to all users being in a geographical area.

- The multicast mode enables the delivery of the multimedia content to all users identified by a logical name, e.g. a community name.

- The Peer to Peer mode enables the exchange (directly or not) of multimedia contents between two identified peers.

6.1.2   Request / Event Identification

If the MCD basic service segments and reassembles the MCDM, the MCD request issued by the application shall be uniquely identified with the *actionID* generated by the MCD Basic Service in order to ensure the consistent units reassembly at the receiving ITS-S. So, in that circumstance, a unique identifier shall be used to indicate that a multimedia unit is part of the whole MCDM which is transmitted.

Moreover this *actionID* may be linked via the *linkedDenm* to an *actionID* of DENM as specified in ETSI EN 302 637-3 [1] and ETSI TS 102 894-2 [3] being used by a road safety application to signal a road hazard (event). In this case, this liaison shall be indicated in the situation container.

6.1.3   Repetition of the MCDM

An MCDM is transmitted to the destination specified in the application request. This MCDM can be repeated according to the application requirements. Such repetition could be justified to ensure that a minimum number of destinations are receiving the MCDM in spite of packet lost due to the length of the message or because some temporary radio communication difficulties. The repetition is indicated and performed by the *repetition interval* and *maximum repetition time* as described in clause 5.3.1 and ETSI EN 302 637-3 [1]. If any of the above data are not provided by the ITS-S application, the MCD basic service shall not execute the MCDM repetition.

6.1.4   Update of the MCDM

The parameter *referenceTime* is the identifier for MCDM update referring to a specific *actionID*. The *referenceTime* represents the time at which an MCDM is generated by the MCD basic service, after receiving the application request. For each MCDM update, the *referenceTime* shall be updated and the value shall be greater than the *referenceTime* value of the previous MCDM update for the same *actionID*.

The *actionID* shall remain unchanged for MCDM update, as long as the *stationID* of the originating ITS-S remains unchanged.

The *actionID* shall remain unchanged when the *validityDuration* is updated, as long as the *stationID* of the originating ITS-S remains unchanged.

6.1.5   Segmentation

Segmentation of an MCDM by the MCD basic service may be needed when the segmentation is not supported by the lower communication layers or it does not intend to rely on the lower layer for the segmentation.

When an ITS-S application requests MCDM dissemination to the MCD basic service, it may indicate an access layer technology on which the MCDM will be disseminated. The Maximum Transmit Unit (MTU), which the MCD basic service supports via the NF-SAP, i.e. the MTU_MCD depends on the MTU of the access layer technology (MTU_AL) over which the MCDM is transported.

MTU_MCD shall be less or equal to MTU_AL reduced by the header size of the facilities layer protocol (HD_MCD) and the header size of the networking and transport layer protocol (HD_NT).

$$MTU\_MCD \le MTU\_AL - HD\_MCD - HD\_NT$$

The MTU_AL per access layer technology shall be as defined in ETSI EN 302 663 (v1.2.1) [9], and ETSI TS 103 613 [10]. The header of the networking and transport layer protocol consists of the BTP header and the GoeNetworking header. The size of BTP header is defined in ETSI EN 302 636-5-1 [7], and the size of GeoNetworking protocol header per intended packet transport type is defined in ETSI EN 302 636-4-1 [6].

6.2   MCDM dissemination constraints

6.2.1   General confidence constraints

Specified data confidence constraints may apply to some data provided in the MCDM, depending on the detection capabilities of the ITS-S, such as position accuracy constraints, time accuracy constraints and event detection quality constraints when relevant.

The confidence constraints are presented in the data elements and data frame definitions as specified in Annex A of the present document.

> NOTE: According to the requirements of specific ITS applications, the data contained in MCDM may be obtained from different sources e.g. automatically from the in-vehicle network or from ITS-S user via specific HMI.

Further confidence constraints of the MCDM data elements may be specified by the ITS applications. In this case, such constraints are specified in the related application standards.

6.2.2   General security constraints

Security header is not included in MCDM.

> NOTE: The detailed specifications of the MCDM security mechanism is out of the scope of the present document.

6.2.3   General priority constraints

The MCDM priority is defined according to the class of application requesting the service. Priority information is provided in the PCI across the OSI layer.

7   MCDM format specification

7.1   General structure

7.1.1   Overview

An MCDM is segmented into a certain number of units according to packet size limits rules provided by the selected access layer. The first unit to be transmitted includes a management container enabling the linkage of transmitted successive units of the same MCDM.

The first MCDM ITS PDU includes:

- The ITS PDU header which includes the information of the protocol version, the message type and the ITS-S ID of the originating ITS-S.

- The management container contains information related to the MCDM management and the MCD protocol.

- The situation container contains information related to the triggering source of the MCDM.

- The location container contains information of the event location.

- The application payload container contains the specific application data elements.

- The multimedia container contains the multimedia data.

The other MCDM ITS PDU (when needed) includes a minimum subset of the management container and a multimedia container.

Figure 4 presents the MCDM general structure.
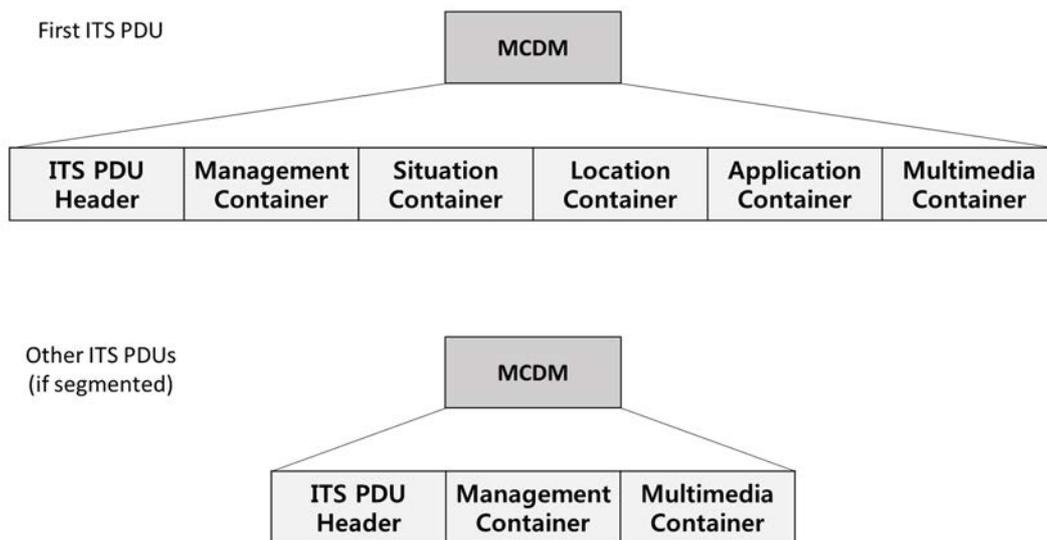
Figure 4: General structure of MCDM

7.1.2   ITS PDU header

The ITS PDU header shall be as specified in ETSI TS 102 894-2 [3]. Detailed data presentation rules of the ITS PDU header in the context of MCDM is specified in Annex A and clause B.9.

7.1.3   MCDM management container

The MCDM management container includes information required for the MCD management and the operation of the MCD protocol, the format of the multimedia, the link to an *actionID* of DENM, etc. The container shall include data as specified in Annex A and clause B.14 of the present document. The syntax and semantic specifications of DE and DFs of the container shall be as specified in Annex B of the present document.

7.1.4   MCDM situation container

The MCDM situation container includes information describing the event that the provided multimedia content refers to. The container shall include data as specified in Annex A and clause B.27 of the present document. The syntax and semantic specifications of DE and DFs of the container shall be as specified in Annex B of the present document.

7.1.5   MCDM location container

The MCDM location container describes the location of the event that the provided multimedia content refers to. The container shall include data as specified in Annex A and clause B.13 of the present document. The syntax and semantic specifications of DE and DFs of the container shall be as specified in Annex B of the present document.

7.1.6 MCDM application container

The MCDM application container contains data elements which are specific to the application. The container shall include data as specified in Annex A and clause B.3 of the present document. The syntax and semantic specifications of DE and DFs of the container shall be as specified in Annex B of the present document.

7.1.7 MCDM multimedia container

The MCDM multimedia container contains the multimedia content describing an event. This container comprises multimedia data unit(s) which size(s) and type(s) is (are) specified in the management container. The container shall include data as specified in Annex A and clause B.20 of the present document. The syntax and semantic specifications of DE and DFs of the container shall be as specified in Annex B of the present document.

7.2 MCDM format and decoding rules

7.2.1 Common data dictionary

The MCDM format makes use of the data dictionary as defined in ETSI TS 102 894-2 [3].

Where applicable, DEs and DFs that are not defined in the present document shall be imported from the common data dictionary as specified ETSI TS 102 894-2 [3].

Detailed descriptions of all DEs and DFs in the context of MCDM are presented in the normative Annex B of the present document.

7.2.2 MCDM data presentation

Unaligned packet encoding rules (PER) as defined in Recommendation ITU-T X.691/ISO/IEC 8825-2 [4] shall be used for the MCDM encoding and decoding for all MCDM containers, excepted for multimedia containers.

The ASN.1 representation of the MCDM shall be as specified in the normative Annex A of the present document.

Contents of the multimedia containers may be encoded with other encoding scheme e.g. jpeg, mpeg. The multimedia container(s) are transporting multimedia contents encoded as specified in the multimedia containers. When encoded, the multimedia containers are attached at the end of the very last application container.

8 Protocol operation of the MCD basic service

8.1 Introduction

This clause specifies the protocol operations of the MCD basic service for two main roles:

- Originating ITS-S operation (clause 8.2).

- Receiving ITS-S operation (clause 8.3).

The specification of the protocol operation is organized in three parts:

1) Protocol data setting rules specify the setting of the relevant parameters used by the protocol.

2) The general protocol operation specifies the sequence of protocol operations.

3) Exception handling specifies additional protocol operations that extend the general protocol operation. They are applied when special conditions, referred to exceptions (for example inconsistent data) occur.

This clause is informative, providing an example of MCD protocol processing.

8.2   Originator ITS-S operation

8.2.1   Protocol data setting rules

8.2.1.1   General requirements

The data setting for the originator ITS-S operation shall be as specified in Annex B.

8.2.1.2   actionID

The *actionID* shall be generated by the application. It shall be updated when the *stationID* is updated.

NOTE: An application may request the blocking of pseudo change if it considers that the *stationID* should remain
            unchanged among different segmentation.

8.2.2   General protocol operation

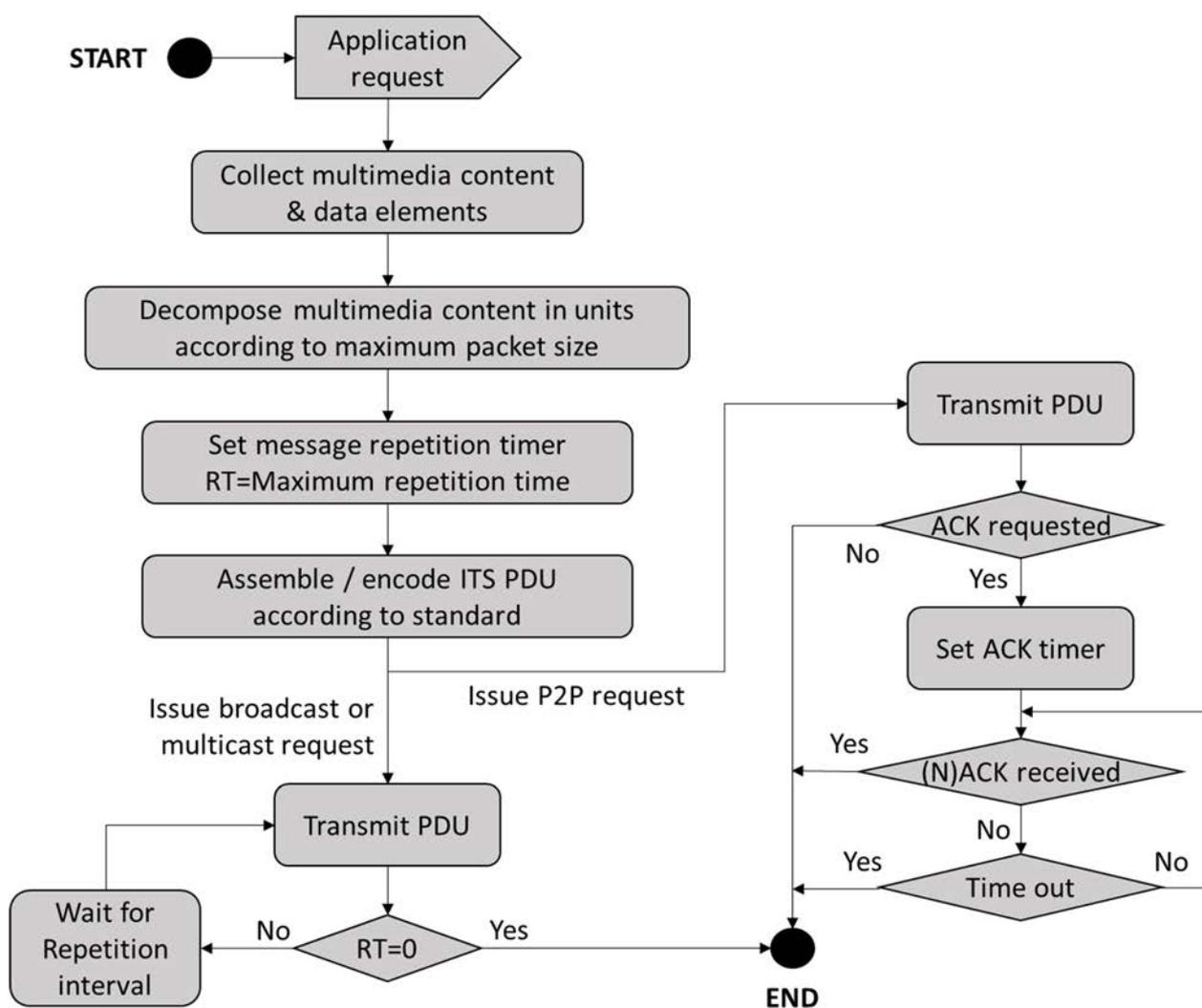The protocol operation is illustrated in Figure 5.

Figure 5: General protocol operation of the originator ITS-S

Upon reception of a request from ITS application via the interface IF.MCD.1, the MCD basic service shall execute the following operations:

1) Process the application request.

2) Collect all multimedia content and data elements associated to the application request.

3) Build a unique message ID and maintain it according to message addressing mode and selected ITS-S network and transport protocol stack.

4) Decompose multimedia content into consistent multimedia units according to the maximum access layer packet size limit. Several multimedia containers of different types per ITS-PDU can coexist.

5) Set the message repetition timer (RT) according to application request.

6) Assemble ITS-PDU according to standard in the respect of access layer packet size limit requirement.

7) Issue a transmission request to the network & transport layer specifying the dissemination mode to be used and passing the required parameters.

8) Wait for the network & transport layer response.

9) Provide an execution response to the application with an associated status.

8.3   Receiver ITS-S operation

8.3.1   Protocol data setting rules

The data setting for the receiver ITS-S operation shall be as specified in Annex B.

8.3.2   General protocol operation

Upon reception of an MCDM, the MCD basic service shall execute the following operations:

1) Verify if the received MCDM is relevant to one local application, e.g. the logical entity or the peer is locally recognized.

2) Decode the received ITS–PDU.

3) Re-assemble the received multimedia contents in a consistent way regrouping the received units of the same types if it is not real-time content. Store the MCDM in a temporary memory for application use if there is enough memory compared to the total size of multimedia content. For real-time content, re-assembly is not needed.

4) Detect the losses of multimedia units through the provided "*numberOfPDUs*" and "*pduSequenceNumber*" if it is not real-time content.

5) Delete the whole MCDM if the authorized percentage loss is reached when it is not real-time content.

6) Delete repeated MCDM having the same "*actionID*" once one complete MCDM has been properly received.

7) If it is a peer to peer message with a requested acknowledgment, return the result of the multimedia content dissemination. The result of the multimedia content dissemination shall include the mandatory data elements only, i.e. header and management container. ACK is returned when the MCDM has been completely well received while a NACK is given when the MCDM has been discarded.

8) Provides an MCD basic service indication signaling the reception of a relevant message to the relevant application.

The protocol operation is illustrated in Figure 6.
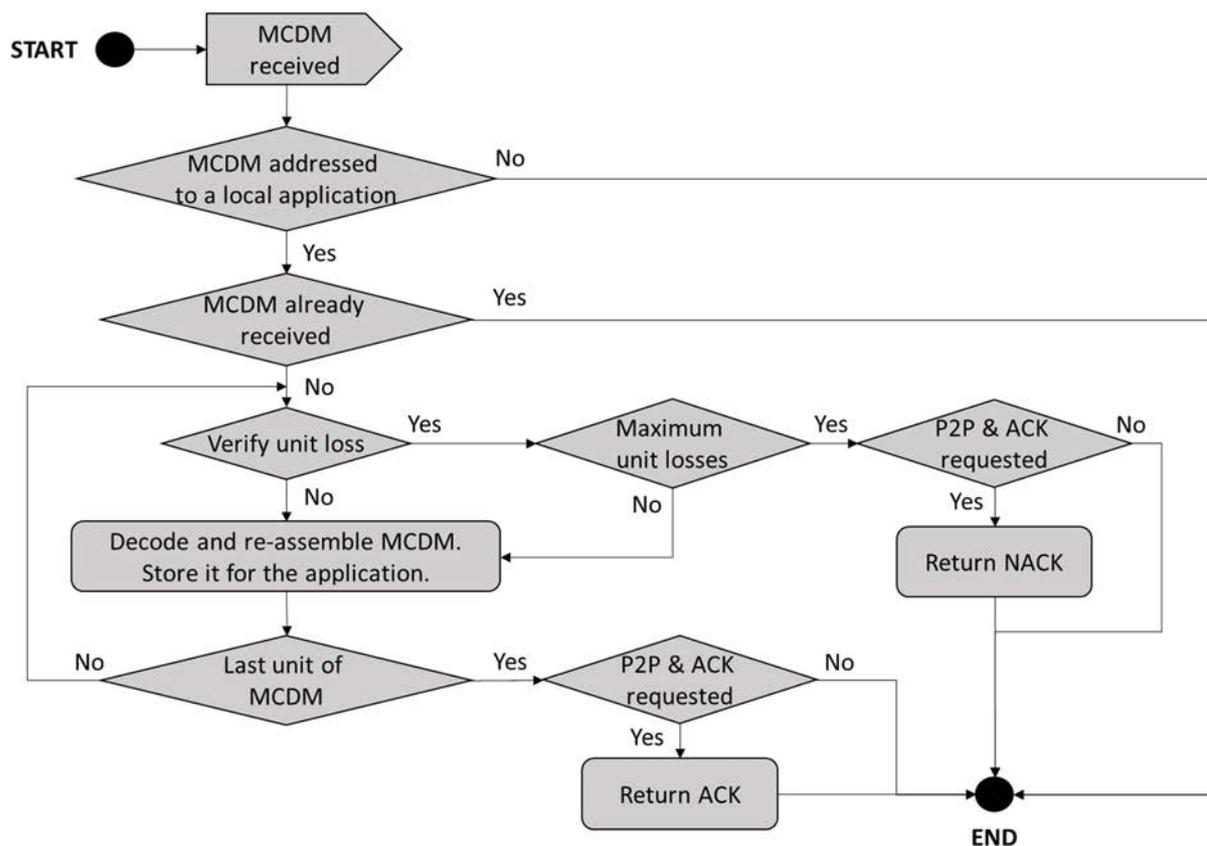
Figure 6: General protocol operation of the receiver ITS-S

8.3.3   Exception handling

8.3.3.1   General requirements

The receiver ITS-S shall apply the exception handling rules specified in clause 8.3.3.2.

8.3.3.2   MCDM decoding exception

If the received MCDM cannot be decoded by the MCD basic service or there is not enough memory to store the enough portion of the multimedia content data (when it is non-real time content), the operation shall stop, discard the MCDM and wait for a next MCDM or timer event.

Annex A (normative):
ASN.1 specification of MCDM

```
MCDM-PDU-Descriptions {itu-t (0) identified-organization (4) etsi (0) itsDomain (5) wg1 (1) ts
(103152) mcdm (1) version (1)
}


DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- Imports from the data dictionnary (TS 102 894 - 2)
IMPORTS
    ItsPduHeader,RequestResponseIndication,Traces,Speed,Heading,RoadType,TimestampIts,
InformationQuality,CauseCode,StationID,StationType,ReferencePosition,ActionID,ValidityDuration,
SequenceNumber FROM ITS-Container {
itu-t (0) identified-organization (4) etsi (0) itsDomain (5) wg1 (1) ts (102894) cdd (2) version (2)
};


-- Description of the information of the MCDM

McdmPdu ::= SEQUENCE {
    header          ItsPduHeader,
    mcdmInfo        McdmInfo
}

McdmInfo ::= SEQUENCE {
    management      MCDM-ManagementContainer,
    situation       MCDM-SituationContainer         OPTIONAL,
    location        MCDM-LocationContainer          OPTIONAL,
    application     MCDM-ApplicationContainer       OPTIONAL,
    multimedia      MCDM-MultimediaContainer        OPTIONAL,
}

MCDM-ManagementContainer ::= SEQUENCE {
    actionID            ActionID,
    request             RequestResponseIndication       OPTIONAL,
    ack                 AckNackIndication   OPTIONAL,
    detectionTime       TimestampIts        OPTIONAL,
    referenceTime       TimestampIts,
    linkedDenm          ActionID            OPTIONAL,
    validityDuration    ValidityDuration    OPTIONAL,
    stationType         StationType         OPTIONAL,
    numberOfMDUs        INTEGER (0..4294967296)         DEFAULT   1,
    numberOfPDUs        INTEGER (1..4294967296)         DEFAULT   1,
    pduSequenceNumber   INTEGER (1..4294967296)         DEFAULT   1,
    mediaTypes          SEQUENCE OF MediaTypeOfMDUs     OPTIONAL,
    urls                SEQUENCE OF URLOfMDUs           OPTIONAL,
    realTime            BOOLEAN             DEFAULT     FALSE,
    size                INTEGER (0..4294967295)         OPTIONAL,
    ...
}

AckNackIndication ::= ENUMERATED {
    aCK(0),
    nACK(1)
}

MediaTypeOfMDUs ::= SEQUENCE {
    startingMDU     SequenceNumber      OPTIONAL,
    endingMDU       SequenceNumber      OPTIONAL,
    mediaType       IA5String
}

URLOfMDUs ::= SEQUENCE {
    startingMDU     SequenceNumber      OPTIONAL,
    endingMDU       SequenceNumber      OPTIONAL,
    url             IA5String
}

MCDM-SituationContainer ::= SEQUENCE {
    eventType               CauseCode,
    linkedCause             CauseCode           OPTIONAL,
```

```
    authorizedPercentageLoss    INTEGER (0..100)    OPTIONAL,
    informationQuality          InformationQuality,
    ...
}

MCDM-LocationContainer ::= SEQUENCE {
    eventPosition           ReferencePosition,
    ...
}

MCDM-ApplicationContainer ::= SEQUENCE {
...
}

MCDM-MultimediaContainer ::= SEQUENCE SIZE(1..7) OF MultimediaDataUnit

MultimediaDataUnit ::= CHOICE {
    mediaContentUTF8       UTF8String,
    mediaContentOctet      OCTET STRING
}

END
```

Annex B (normative):
Description of the Data Elements (DE) / Data Frames (DF)

B.1 ack

Description	The DE indicates if this acknowledgement message is an ACK for a successful reception of a corresponding MCDM or NACK for an unsuccessful reception.
Data Setting & presentation requirements	This DE is optional. It shall be present if the *request* is set to 1, i.e. acknowledgement message. The DE shall be set to 0 for aCK, and 1 for nACK. This DE shall be presented as specified in Annex A.

B.2 actionID

Description	Unique identifier generated by the MCD basic service at the request of the ITS-S application each time an ITS-S needs to send multimedia content. The *actionID* generated differs from the *actionID*s generated by the same ITS-S requested by other applications, from the *actionID*s generated by the same ITS-S requested for different events, and from *actionID*s generated by other ITS-Ss. It is used to allow the receiver ITS-S to process information from an MCDM that are segmented and to acknowledge MCDM reception.
Data Setting & presentation requirements	The *actionID* shall be maintained by the originator ITS-S, and the data setting rules are as specified in clause 8.2.1. The DF is composed of ITS-S ID of the originator ITS-S and a sequence number. This DF shall be presented as specified in ETSI TS 102 894-2 [3] *ActionID*.

B.3 application

Description	Application container of the MCDM as described in clause 7.1.6. It contains DEs and DFs specific to the application.
Data Setting & presentation requirements	This DF is optional. It shall be present in the 1st segmented message unit, if the ITS-S application provides such information. The DF shall be presented as specified in Annex A.

B.4 authorizedPercentageLoss

Description	It optionally provide the authorized percentage of ITS-PDUs being lost for the receiving ITS-S to accept or discard the MCDM. This is of course related to the type of transmitted multimedia content.
Data Setting & presentation requirements	This optional DE shall be presented as specified in Annex A.

B.5 detectionTime

Description	Time at which the event is detected by the originating ITS-S. For the MCDM repetition, this DE shall remain unchanged. For the MCDM update, this DE shall be the time at which the event update is detected.
Data Setting & presentation requirements	This optional DE shall be presented as specified in ETSI TS 102 894-2 [3] *TimestampIts*.

B.6 endingMDU

Description	Sequence number of the last multimedia data unit of one or more multimedia data units associated with a single *MediaTypeOfMDUs* or *URLOfMDUs*.
Data Setting & presentation requirements	This DE shall be presented as specified in Annex A. It shall be set to an integer from 1 to 7 when it is present. It shall be set to a value greater than or equal to the value of *startingMDUs*, and less than or equal to the value of *numberofMDUs* when it is present. It shall not be present if the *MediaTypeOfMDUs* or *URLOfMDUs* is not associated with an *MultimediaDataUnit*, i.e. a url is provided by an MDCM without a multimedia data unit.

B.7 eventPosition

Description	Geographical position of the detected event. The position of an event is determined by the originating ITS-S.
Data Setting & presentation requirements	When the event position corresponds to the position of a vehicle ITS-S, the *eventPosition* shall be set to the position of the vehicle ITS-S at *detectionTime*. This DF shall be presented as specified in ETSI TS 102 894-2 [3] *ReferencePosition*.

B.8 eventType

Description	The type of event for which the provided multimedia content describes.
Data Setting & presentation requirements	It shall be present if the data is provided by the originating ITS-S. This DF shall be presented as specified in ETSI TS 102 894-2 [3] *CauseCode*.

B.9 header

Description	The ITS PDU header of the MCDM. This DF includes the protocol version of the MCDM (*protocolVersion*), MCDM message type identifier (*messageID*) and station identifier (*stationID*) of the originator ITS-S.
Data Setting & presentation requirements	For the present document, the value of the DE *protocolVersion* shall be set to 1, the DE *messageID* shall be set as defined in ETSI TS 102 894-2 [3]. The *stationID* shall be set to the station ID of the originator ITS-S. This DF shall be presented as specified in ETSI TS 102 894-2 [3] *ItsPduHeader*.

B.10   informationQuality

Description	Quality level of the information provided by the ITS-S application of the originating ITS-S. It indicates the probability of the detected event being truly existent at the event position.
Data Setting & presentation requirements	This DE is set according to the ITS application requirements. If the information is unknown, the DE shall be set to 0. This DE shall be presented as specified in ETSI TS 102 894-2 [3] *InformationQuality*.

B.11   linkedCause

Description	Description for a linked event of the provided *eventType*, or for an additional type of the event.
Data Setting & presentation requirements	This DF is optional. It shall be present if the data is provided by the requesting ITS-S. This DF shall be presented as specified in ETSI TS 102 894-2 [3] *CauseCode*.

B.12   linkedDenm

Description	Identification of a DENM to be associated to the transmission of the MCDM, e.g. road hazard signaling. This is used at the receiving ITS-S to correlate the multimedia content with another received DENM message.
Data Setting & presentation requirements	This DF is optional. It shall be present if the data is provided by the requesting ITS-S. This DF shall be presented as specified in ETSI EN 302 637-3 [1] and ETSI TS 102894-2 [3] *ActionID*.

B.13   location

Description	Location container of the MCDM as described in clause 7.1.5. It contains DEs and DFs related to location referencing of the multimedia content.
Data Setting & presentation requirements	This DF is optional. It shall be present in the 1st segmented message unit, if the ITS-S application provides such information. The DF shall be presented as specified in Annex A.

B.14   management

Description	Management container of the MCDM as described in clause 7.1.3. It contains DEs and DFs required for the MCDM protocol processing.
Data Setting & presentation requirements	This DF shall be presented as specified in Annex A.

B.15   mcdmInfo

Description	MCDM payload. It includes the mandatory *management* container. It may include the optional *situation, location*, *application*, and *multimedia* containers.
Data Setting & presentation requirements	This DF shall be presented as specified in Annex A.

B.16 mediaType

Description	Media type being used for each multimedia data unit. It shall have a value of the media types as defined in IETF RFC 2046 [8] and assigned by the IANA, e.g. text/plain, image/jpeg, image/png, audio/mpeg, video/mpeg, video/mp4, application/octet-stream, etc. Receiver ITS-S may use this information to determine the further processing of the message or to discard the message e.g. the receiver ITS-S is not able to decode the multimedia content format.
Data Setting & presentation requirements	This DE shall be presented as specified in Annex A.

B.17 mediaTypes

Description	Media types of zero or more multimedia data units of the MCDM as a sequence of *MediaTypeOfMDUs* which consist of *startingMDU*, *endingMDU* and *mediaType* as specified in Annex A.
Data Setting & presentation requirements	This optional DF shall be presented as specified in Annex A.

B.18 mediaContentUTF8

Description	Media content of UTF-8 characters included. It may be used when the media content is text media types.
Data Setting & presentation requirements	This DE shall be presented as specified in Annex A.

B.19 mediaContentOctet

Description	Media content of binary data included. It may be generally used for any media types.
Data Setting & presentation requirements	This DE shall be presented as specified in Annex A.

B.20 multimedia

Description	Multimedia container of the MCDM as described in clause 7.1.7. It contains multimedia content.
Data Setting & presentation requirements	This DF is optional. It may not be present if the transmitted message is an ACK or NACK message. This DF shall be presented as specified in Annex A. The multimedia container shall contain one or more than one *MultimediaDataUnit* DF. Each *MultimediaDataUnit* shall contain multimedia content file of one particular multimedia format.

B.21   numberOfMDUs

Description	The number of multimedia data units included in the MCDM multimedia container. Each multimedia data unit may carry multimedia content with a particular media type, e.g. mp3 for audio, mpeg for video, jpeg for photo, etc.
Data Setting & presentation requirements	This optional DE shall be presented as specified in Annex A.

B.22   numberOfPDUs

Description	The number of ITS PDUs necessary to transmit the whole MCDM, when a segmentation is done by the MCD basic service (see clause 6.1.5). This number is calculated from the information communicated by the application as defined in clause 5.3.1 and by the ITS-S management as defined in clause 5.3.3.
Data Setting & presentation requirements	This optional DE shall be presented as specified in Annex A. If no segmentation is used by the MCD basic service, the DE shall be set to its default value or it may not be present.

B.23   pduSequenceNumber

Description	Current ITS-PDU unit number associated to the frame being transmitted when an MCDM segmentation is done by the MCD basic service. This is used at the receiver ITS-S to reassemble received MCDMs.
Data Setting & presentation requirements	This optional DE shall be presented as specified in Annex A. If no segmentation is used by the MCD basic service, the DE shall be set to its default value or it may not be present.

B.24   realTime

Description	Indication of whether or not the multimedia data units in the ITS PDU unit are intended for real-time presentation.
Data Setting & presentation requirements	This optional DE shall be presented as specified in Annex A. The value shall be set to TRUE if all the multimedia data units in the ITS PDU unit are intended for real-time presentation. Otherwise the value shall be set to FALSE or it may not be present.

B.25   referenceTime

Description	This DE refers to the time at which the MCDM is generated. This DE is maintained by the MCD basic service of the originating ITS-S.
Data Setting & presentation requirements	This DE shall be presented as specified in ETSI TS 102 894-2 [3] *TimestampIts*.

B.26 request

Description	This DE indicates if the transmitted message is a multimedia MCDM or an acknowledgement message on a reception of an MCDM.
Data Setting & presentation requirements	This DE is optional. It shall be present, if an acknowledgement message is requested by the originator ITS-S application. Otherwise it shall not be present. The DE shall be set to 0 when the originator ITS-S requests an ACK or NACK. The DE shall be set to 1 when the receiver ITS-S responds to an ACK or NACK requests from the originator ITS-S. This DE shall be presented as specified in Annex A.

B.27 situation

Description	Situation container of the MCDM as described in clause 7.1.4. It contains DEs and DFs about a detected event for which the multimedia content is referred to.
Data Setting & presentation requirements	This DF is optional. It shall be present in the 1st segmented message unit, if the ITS-S application provides such information. The DF shall be presented as specified in Annex A.

B.28 size

Description	Total size in byte of the multimedia content data of the whole MCDM.
Data Setting & presentation requirements	This optional DE shall be presented as specified in Annex A.

B.29 startingMDU

Description	Sequence number of the first multimedia data unit of one or more multimedia data units associated with a single *MediaTypeOfMDUs* or *URLOfMDUs*.
Data Setting & presentation requirements	This optional DE shall be presented as specified in Annex A. It shall be set to an integer from 1 to 7 when it is present. It shall not be present if the *MediaTypeOfMDUs* or *URLOfMDUs* is not associated with an *MultimediaDataUnit*, i.e. a url is provided by an MDCM without a multimedia data unit.

B.30 stationType

Description	This DE provides the station type information of the originating ITS-S.
Data Setting & presentation requirements	This optional DE shall be presented as specified in ETSI TS 102 894-2 [3] *StationType*.

B.31 url

Description	A string representation for a resource, i.e. Uniform Resource Locator as defined in IETF RFC 1738 [11]. This information may be used to uniquely identify the resource (i.e. multimedia data unit(s)) and its delivery path.
Data Setting & presentation requirements	This DE shall be presented as specified in Annex A.

B.32   urls

Description	URL of zero or more multimedia data units of the MCDM as a sequence of *URLOfMDUs* which consist of *startingMDU*, *endingMDU* and *url* as specified in Annex A.
Data Setting & presentation requirements	This optional DF shall be presented as specified in Annex A.

B.33   validityDuration

Description	Validity duration of the MCDM. The *validityDuration* is set by the originating ITS-S. Therefore it represents an estimation of how long the event may persist. It implies the duration over which the MCDM should be kept at the MCD basic service of the receiving ITS-S and the MCDM dissemination be maintained in the relevance area or destination area, until the expiration of *validityDuration*. In case the expiry time of the event cannot be estimated at the originating ITS-S, a default value is used for the MCD protocol operation. This DE may be renewed by the originating ITS-S, if the pre-set expiry time has reached to its limit and the originating ITS-S detects that the event persists.
Data Setting & presentation requirements	The DE is represented as a time offset in the unit of second since *detectionTime*. This DE is optional. It shall be present if the information is required by the ITS application. If the DE is not present in the MCDM, a default value *defaultValidity* is assumed. This DE shall be presented as specified in ETSI TS 102 894-2 [3] *ValidityDuration*.

History

Document history		
V2.1.1	November 2019	Publication