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Minimum set of data transfer protocol for automotive emergency response system

Recommendation ITU-T Y.4468

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ITU-T Y-SERIES RECOMMENDATIONS

GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

GLOBAL INFORMATION INFRASTRUCTURE	
General	Y.100–Y.199
Services, applications and middleware	Y.200–Y.299
Network aspects	Y.300–Y.399
Interfaces and protocols	Y.400–Y.499
Numbering, addressing and naming	Y.500–Y.599
Operation, administration and maintenance	Y.600–Y.699
Security	Y.700–Y.799
Performances	Y.800–Y.899
INTERNET PROTOCOL ASPECTS	
General	Y.1000–Y.1099
Services and applications	Y.1100–Y.1199
Architecture, access, network capabilities and resource management	Y.1200–Y.1299
Transport	Y.1300–Y.1399
Interworking	Y.1400–Y.1499
Quality of service and network performance	Y.1500–Y.1599
Signalling	Y.1600–Y.1699
Operation, administration and maintenance	Y.1700–Y.1799
Charging	Y.1800–Y.1899
IPTV over NGN	Y.1900–Y.1999
NEXT GENERATION NETWORKS	
Frameworks and functional architecture models	Y.2000–Y.2099
Quality of Service and performance	Y.2100–Y.2199
Service aspects: Service capabilities and service architecture	Y.2200–Y.2249
Service aspects: Interoperability of services and networks in NGN	Y.2250–Y.2299
Enhancements to NGN	Y.2300–Y.2399
Network management	Y.2400–Y.2499
Network control architectures and protocols	Y.2500–Y.2599
Packet-based Networks	Y.2600–Y.2699
Security	Y.2700–Y.2799
Generalized mobility	Y.2800–Y.2899
Carrier grade open environment	Y.2900–Y.2999
FUTURE NETWORKS	Y.3000–Y.3499
CLOUD COMPUTING	Y.3500–Y.3999
INTERNET OF THINGS AND SMART CITIES AND COMMUNITIES	
General	Y.4000–Y.4049
Definitions and terminologies	Y.4050–Y.4099
Requirements and use cases	Y.4100–Y.4249
Infrastructure, connectivity and networks	Y.4250–Y.4399
Frameworks, architectures and protocols	**Y.4400–Y.4549**
Services, applications, computation and data processing	Y.4550–Y.4699
Management, control and performance	Y.4700–Y.4799
Identification and security	Y.4800–Y.4899
Evaluation and assessment	Y.4900–Y.4999

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T Y.4468

Minimum set of data transfer protocol for automotive emergency response system

Summary

An automotive emergency response system (AERS) for aftermarket devices defined in Recommendation ITU-T Y.4119 is designed to bring rapid assistance to driver and passengers involved in accidents.

For a normal operation purpose of the AERS, an accident related data (so-called minimum set of data, MSD) needs to be sent from an automotive emergency detection device (AEDD) to an automotive emergency response centre (AERC).

Recommendation ITU-T Y.4468 specifies an MSD transfer protocol to provide the rules of MSD transfer operations between an AEDD and an AERC in an AERS.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T Y.4468	2020-01-13	20	11.1002/1000/14171

Keywords

AERS, MSD, protocol.

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* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

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Table of Contents

Recommendation ITU-T Y.4468

Minimum set of data transfer protocol for automotive emergency response system

1 Scope

This Recommendation specifies a minimum set of data (MSD) transfer protocol for automotive emergency response system (AERS).

In particular, the scope of this Recommendation includes:

– MSD transfer protocol parameters

– Message types of MSD transfer protocol

– Sequence of MSD transfer protocol operation

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T Y.4119] Recommendation ITU-T Y.4119 (2018), *Requirements and capability framework for IoT-based automotive emergency response system*.

[ITU-T Y.4467] Recommendation ITU-T Y.4467 (2020), *Minimum set of data structure for automotive emergency response system*.

[IETF RFC 7252] IETF RFC 7252 (2014), *The Constrained Application Protocol (CoAP).*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 automotive emergency detection device (AEDD) [ITU-T Y.4119]: A unit (or a set of units) expected to perform at least the following functions:

– receiving sensing data, from internal sensors and/or vehicle sensors, for determining whether or not the accident occurred needs emergency recovery or receiving manual triggering signals,

– determining whether or not the accident occurred needs emergency recovery,

– receiving information about, or determining, the vehicle location,

– sending minimum set of data (MSD) which is related to the accident, and

– providing bidirectional voice communication.

3.1.2 automotive emergency response centre (AERC) [ITU-T Y.4119]: A centre managed by a public authority or a private organization, responsible for:

– answering each automotive emergency response request,

– confirming whether or not the accident occurred, and

– notifying the emergency authority (EA) if EA dispatch is necessary.

NOTE – Considering the features of aftermarket devices, AERC is equipped with false alarms filtering functions.

3.1.3 minimum set of data (MSD) [ITU-T Y.4119]: Data related to the accident sent from an automotive emergency detection device (AEDD) to an automotive emergency response centre (AERC).

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ACK Acknowledgement

AEDD Automotive Emergency Detection Device

AERC Automotive Emergency Response Centre

AERS Automotive Emergency Response System

CoAP Constrained Application Protocol

CON Confirmable

EA Emergency Authority

GNSS Global Navigation Satellite System

MSD Minimum Set of Data

5 Conventions

None

6 Overview of MSD transfer protocol

6.1 Overview of automotive emergency response system

An automotive emergency response system (AERS) reports automobile accidents to an automotive emergency response centre (AERC) by an automotive emergency detection device (AEDD) using vehicle sensors of the automobile and/or internal sensors installed on aftermarket devices such as the navigation system, dash cam, smartphone, etc. In the event of a serious road accident, the AEDD in the vehicle automatically connects to the AERC and transmits a minimum set of data (MSD), which is a set of information relating to the accident, to the emergency authority (EA) [ITU-T Y.4119].

MSD transfer protocol defines the operations for sending an MSD from an AEDD to an AERC in order to request or cancel EA dispatch. Figure 1 shows the scope of MSD transfer protocol.

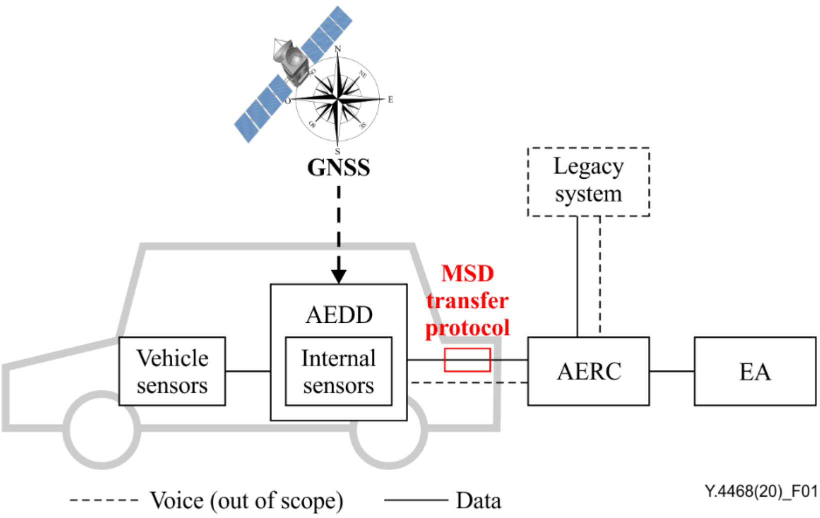

Figure 1 – Scope of MSD transfer protocol

6.2 Overview of message structure

MSD transfer operates over the constrained application layer protocol (CoAP) [IETF RFC 7252]. CoAP provides a request-response interaction between an AEDD and an AERC in order to report or cancel automobile accidents. Since CoAP is designed to support constrained devices with relatively small amounts of header size and low power consumption, it is suitable for AEDD operations such as the navigation system, dash cam, etc.

Figure 2 represents a message structure for an MSD in CoAP message.

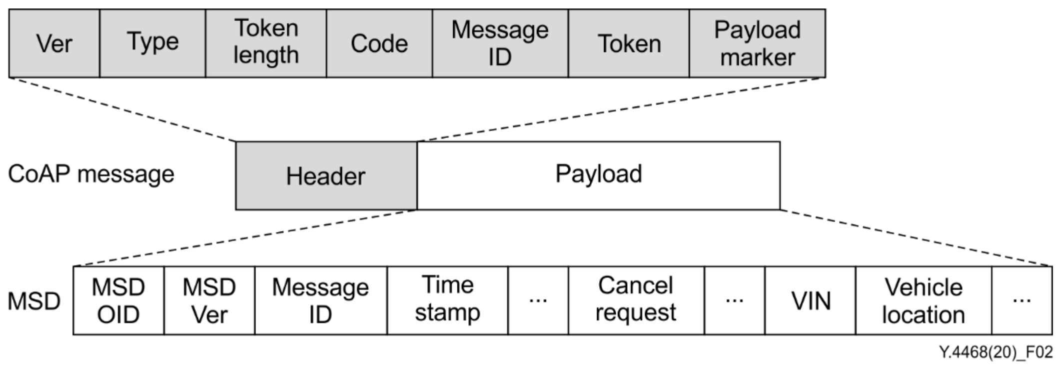

Figure 2 – MSD over CoAP message structure

7 MSD transfer message types

7.1 Request messages

7.1.1 MSD notification message

Figure 3 shows the *MSD notification message*. The message starts with a fixed-size 9-byte CoAP header including a 2-bit confirmable (CON) message type for transmission reliability, a 1-byte POST code, a 2-byte message ID for detecting message duplication, and an arbitrary 4-byte token used to match with response messages returned by AERC. The header is followed by an MSD as a message payload.

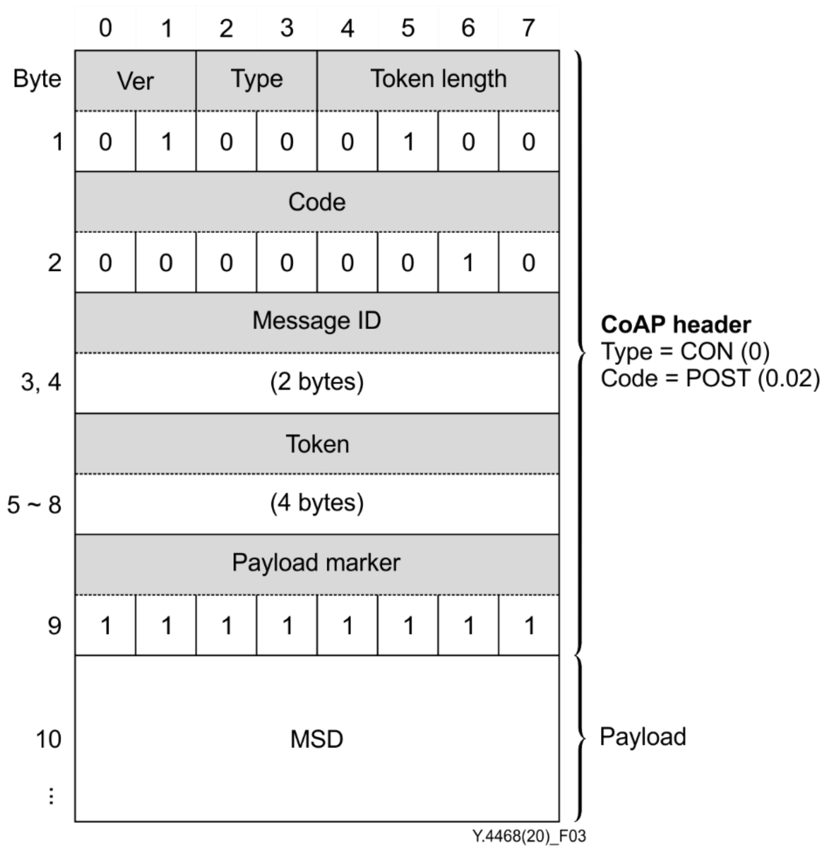

Figure 3 – MSD notification message

7.1.2 MSD cancellation message

Figure 4 shows the *MSD cancellation message*. The message starts with a fixed-size 9-byte CoAP header including a 2-bit CON message type for transmission reliability, a 1-byte POST code, a 2-byte message ID for detecting message duplication, and an arbitrary 4-byte token used to match with response messages returned by AERC. The header is followed by an MSD with *Cancel Request* [ITU-T Y.4467] changed to *True* as a message payload.

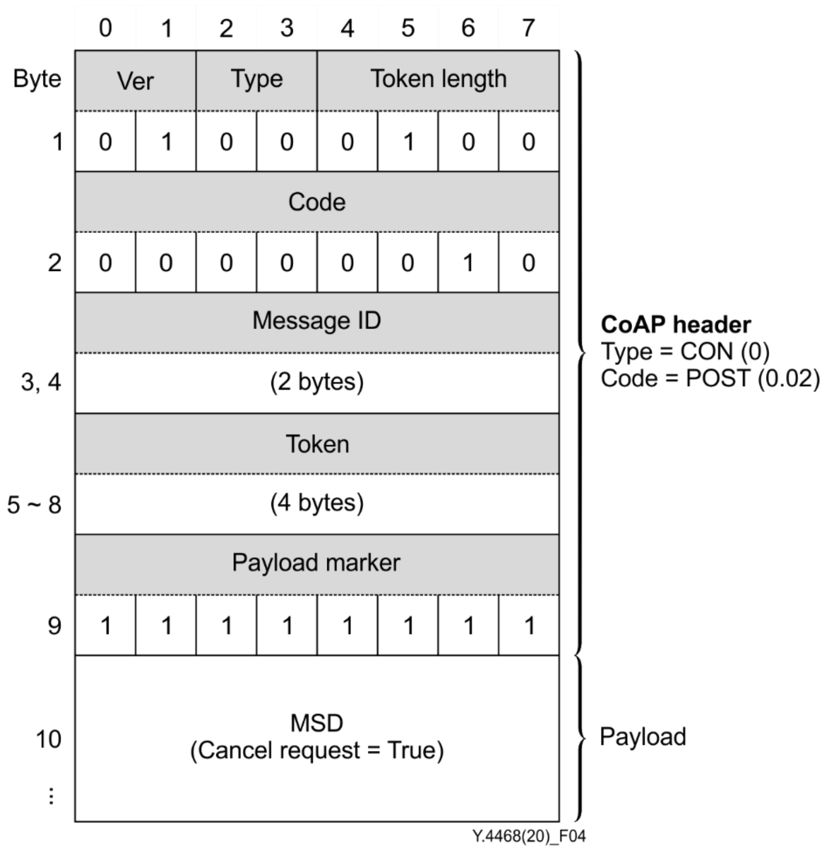

Figure 4 – MSD cancellation message

7.2 Response messages

7.2.1 Acknowledgement (ACK) response message

Figure 5 shows the *ACK response message*. The message has a fixed-size 8-byte CoAP header including a 2-bit ACK type for notifying the successful reception of the message, a 1-byte response code for indicating success or failure of MSD processing result, and a 4-byte token used to match with request messages from AEDD.

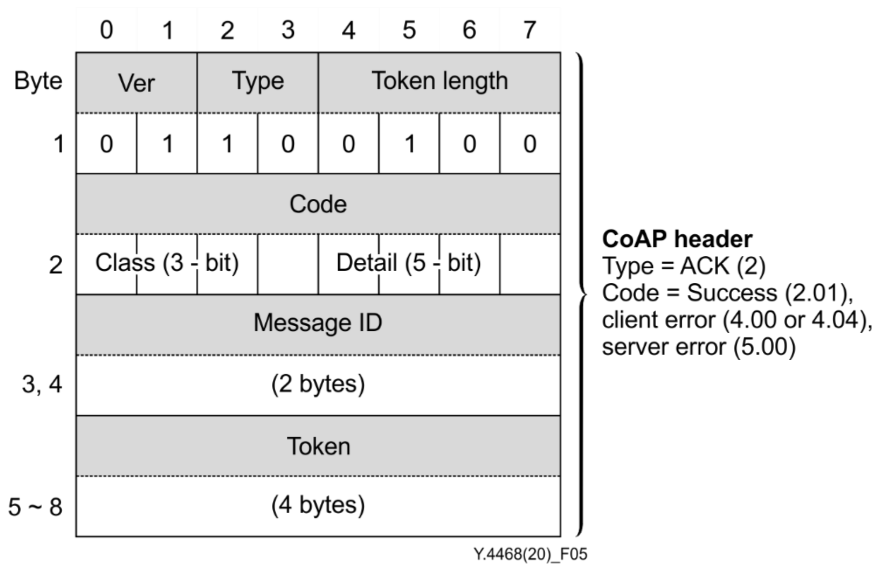

Figure 5 – ACK response message

7.2.2 Empty ACK message

Figure 6 shows the *Empty ACK message*. The message has a fixed-size 4-byte CoAP header including a 2-bit ACK type for notifying the successful reception of the message, and an empty message code without any token.

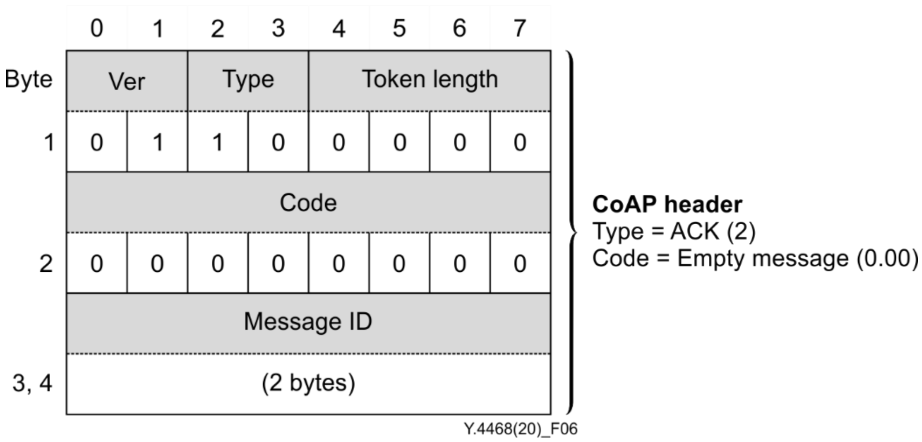

Figure 6 – Empty ACK message

7.2.3 Confirmable response message

Figure 7 shows the *Confirmable response message*. The message has a fixed-size 8-byte CoAP header including a 2-bit confirmable message type for transmission reliability, a 1-byte response code for indicating success or failure of MSD processing result, and a 4-byte token used to match with request messages from AEDD.

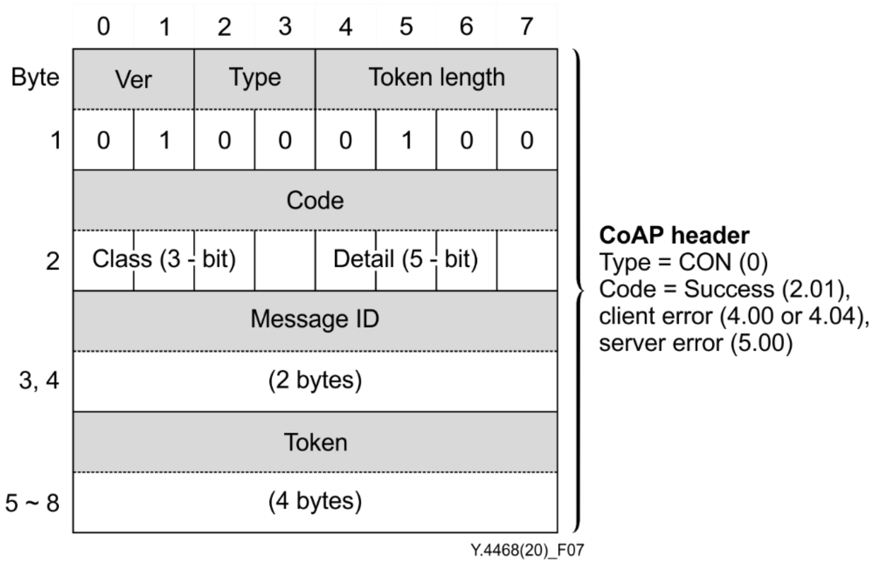

Figure 7 – Confirmable response message

7.2.4 AERC response code

Table 1 describes the AERC response codes used when a message is received.

Table 1 – AERC response code in CoAP

Code		Description
Class	**Detail**	
2	01	Created Successfully received *MSD send message* or *cancellation request message*
4	00	Bad request An unrecognized message type, an error in the message structure or exceeding the maximum message length of receiving messages
	04	Not found Non-existence of *MSD send message* corresponding to receiving *cancellation request message*
5	00	Internal server error Unable to process receiving message due to unexpected AERC internal problems

8 MSD transfer protocol operation

8.1 Request-response operation

Figure 8 describes the sequence of *MSD notification message* and *MSD cancellation message* transfer.

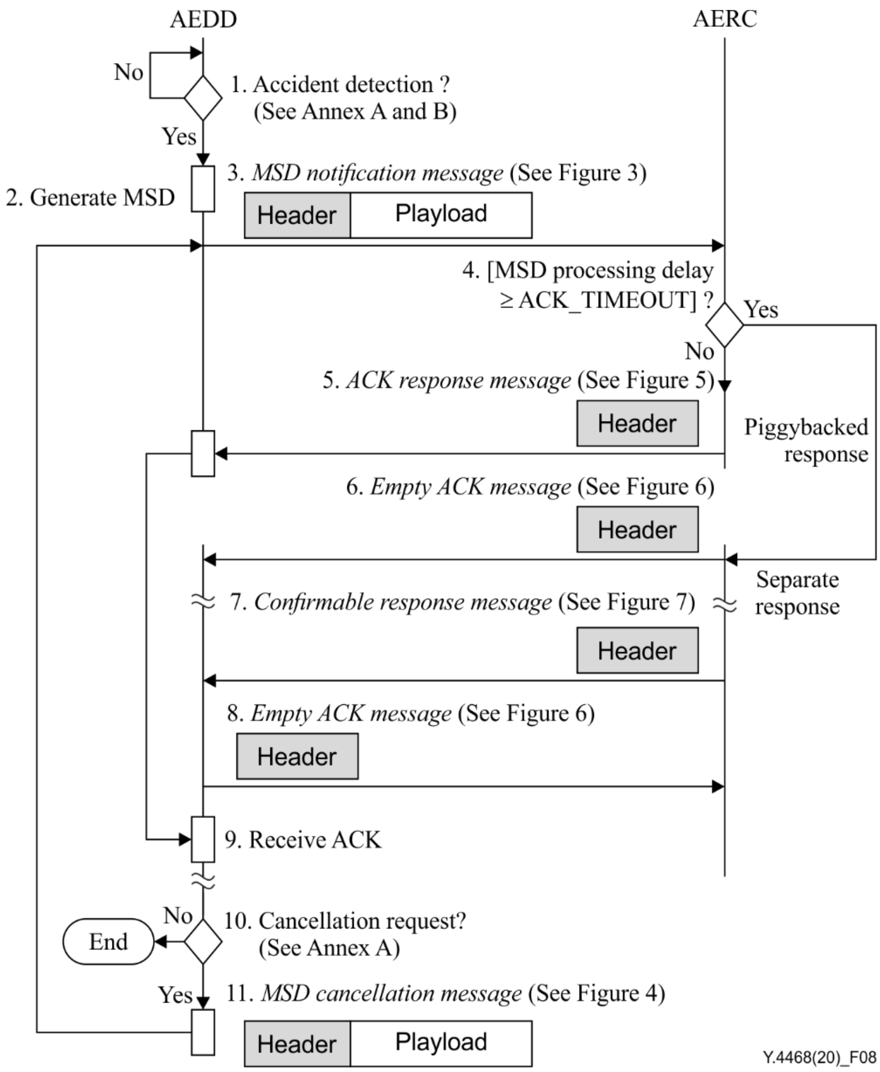

Figure 8 – Sequence of request-response operation between AEDD and AERC

(Steps 1 – 3) In case of accident detection, an AEDD generates an MSD and repeatedly transmits an *MSD notification message* including an arbitrary token to an AERC until an *ACK response message* or an *Empty ACK message* is received.

(Step 4) The AERC decides the piggybacked response when it does not need longer time to obtain the response code of the AEDD request than ACK_TIMEOUT predefined by the AERC (Step 5). Otherwise, the AERC chooses the separate response (Step 6 – 8).

(Steps 5 – 9) The AERC sends back an *ACK response message* with both the response code issued by the AERC and the received token to the AEDD.

(Steps 6 – 9) Once the AERC immediately sends back an *Empty ACK message*. When the AERC finally has issued the response code, it transmits a *Confirmable response message* with received token to the AEDD. And then, the AEDD sends back an *Empty ACK message* to the AERC.

(Steps 10 – 11) In case of cancellation request is triggered, the AEDD transmits an *MSD cancellation message* to the AERC repeatedly until an *ACK response message* or an *Empty ACK message* is received (Go to Step 4). Otherwise, the AEDD terminates this operation.

NOTE – The AEDD could consider that transmits the MSD to another AERC if there is no response from the AERC.

8.2 Retransmission

Every ACK_TIMEOUT [IETF RFC 7252] seconds, the AEDD is required to repeatedly retransmit the *MSD notification message* or the *MSD cancellation message* to the AERC until the *ACK response message* or the *Empty ACK message* is received.

Table 2 shows the parameters for retransmitting messages.

Table 2 – Retransmission parameters in CoAP

Name	Value	Description
ACK_TIMEOUT	1	MSD retransmission time interval
ACK_RANDOM_FACTOR	1.0	MSD retransmission random counter increment factor
MAX_RETRANSMIT	Infinity	Maximum number of retransmitted MSDs

9 Security considerations

As the MSD transfer protocol realizes a subset of the features in CoAP [IETF RFC 7252], the security mechanism should support the security considerations in clause 11 of [IETF RFC 7252].

Annex A

AEDD operation procedure

(This annex forms an integral part of this Recommendation.)

A.1 AEDD operation procedure

Figure A.1 shows the flow of the AEDD operation procedure. In case of accident detection, an AEDD sends an *MSD notification message* to an AERC. If the accident detection event frequency, which means the number of accident detection events during *T* (s), is equal to or smaller than *F* (Hz), then the AEDD goes to the automatic cancellation determination procedure described in Figure A.2.

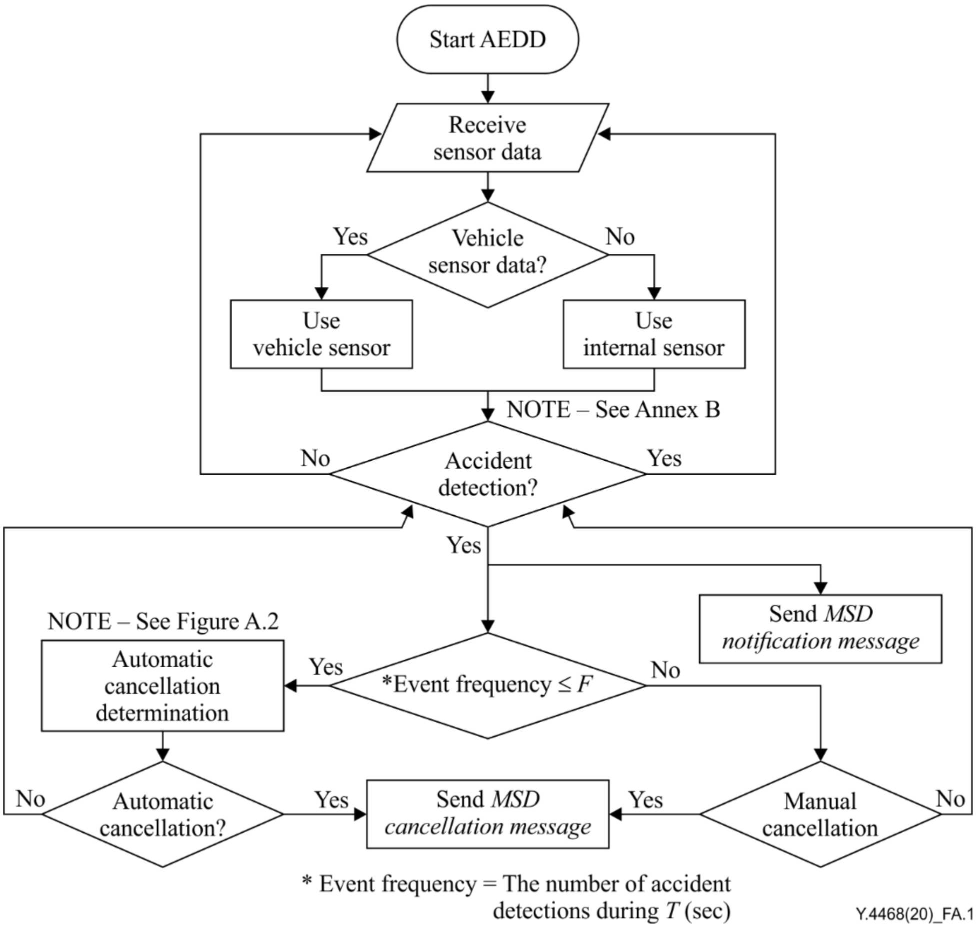

Figure A.1 – Flow of AEDD operation procedure

A.2 Automatic cancellation determination procedure

Figure A.2 shows the flow of an automatic cancellation determination procedure. In the process, an AEDD measures automotive velocity during *T* (sec) based on the global navigation satellite system (GNSS) or vehicle sensors in an automobile. If the minimum velocity during *T* (s) is larger than the predetermined *V* (km/h), the AEDD automatically transmits an *MSD cancellation message* to the AERC.

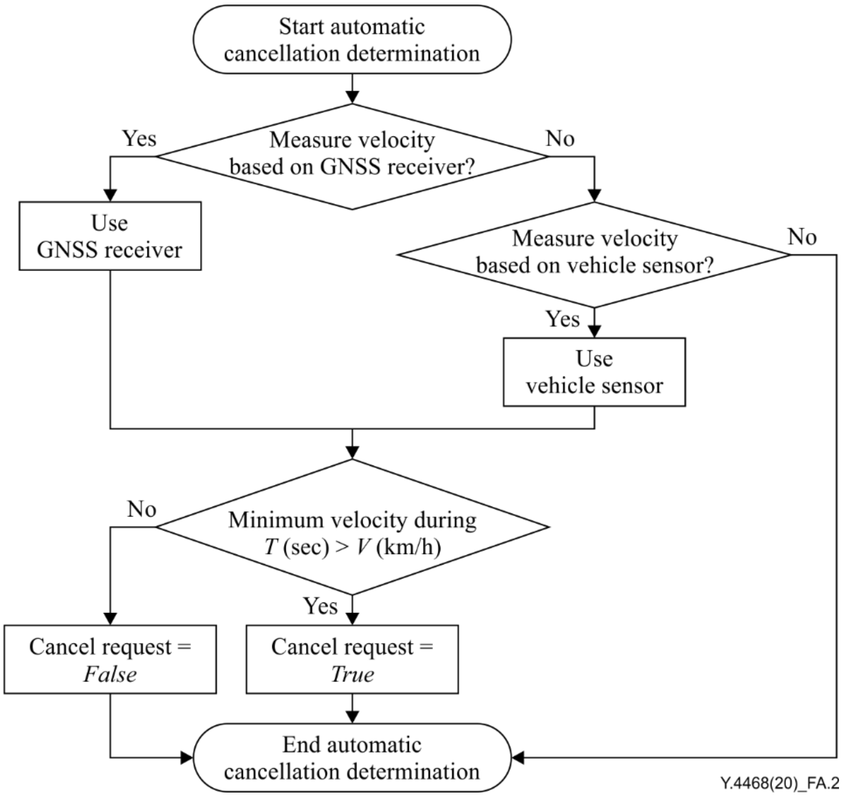

Figure A.2 – Flow of automatic cancellation determination procedure

Annex B

Accident detection procedures

(This annex forms an integral part of this Recommendation.)

B.1 Collision detection

Figure B.1 shows the flow of a collision detection procedure. An AEDD determines collision detection according to the received acceleration data as well as a collision detection threshold predefined by itself. If a cancellation request is triggered on condition of collision detection, then the AEDD sets the threshold as the detected acceleration data.

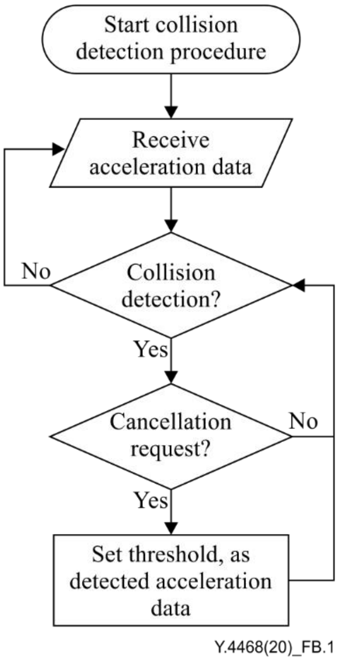

Figure B.1 – Flow of collision detection procedure

B.2 Spin off detection

Figure B.2 shows the flow of a spin off detection procedure. An AEDD determines spin off detection according to the received Yaw rate as well as a spin off detection threshold predefined by itself. If a cancellation request is triggered on condition of spin off detection, then the AEDD set the threshold as the detected Yaw rate.

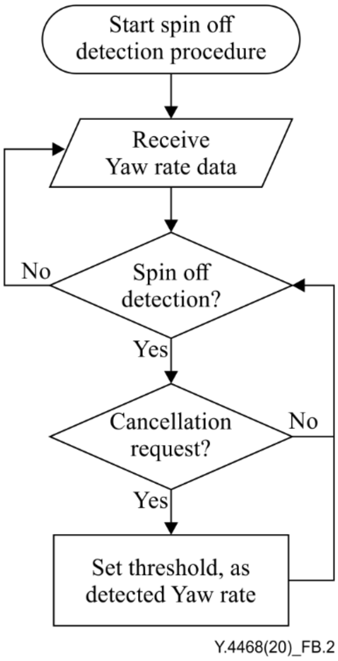

Figure B.2 – Flow of spin off detection procedure

B.3 Rollover or capsizing detection

Figure B.3 shows the flow of a rollover or capsizing detection procedure. An AEDD determines rollover or capsizing detection according to the received roll and pitch angles as well as a rollover or capsizing detection threshold predefined by itself. If a cancellation request is triggered on condition of rollover or capsizing detection, then the AEDD sets the threshold as the detected roll and pitch angles.

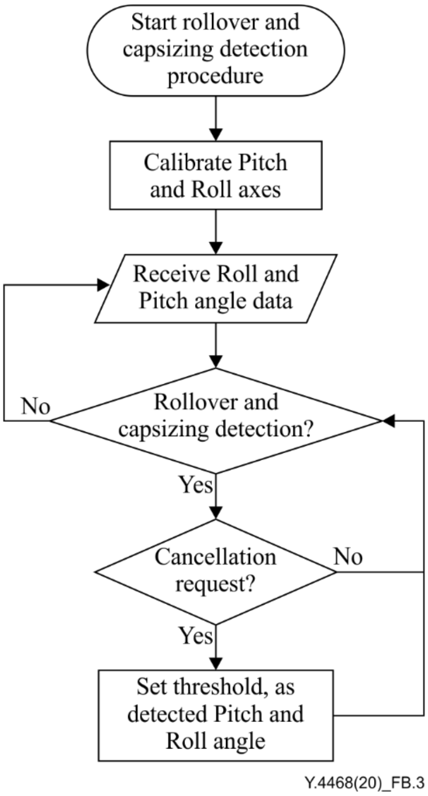

Figure B.3 – Flow of rollover or capsizing detection procedure

B.4 Abnormal wheel speed detection

Figure B.4 shows the flow of an abnormal wheel speed detection procedure. An abnormal wheel speed is found by comparing a target wheel's speed with an average wheel speed of other wheels. An AEDD determines abnormal wheel speed detection according to the received abnormal rate of wheel speed as well as an abnormal wheel speed detection threshold predefined by itself. If a cancellation request is triggered on condition of abnormal wheel speed detection, then the AEDD set the threshold as the detected abnormal rate of wheel speed.

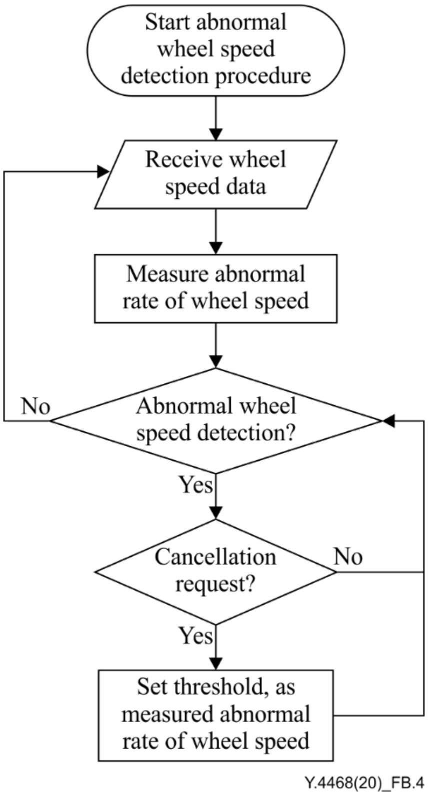

Figure B.4 – Flow of abnormal wheel speed detection procedure

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