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

Internet of things and smart cities and communities – Requirements and use cases

Requirements and capability framework for IoT-based automotive emergency response system

Recommendation ITU-T Y.4119

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Recommendation ITU-T Y.4119

Requirements and capability framework for IoT-based automotive emergency response system

Summary

Recommendation ITU-T Y.4119 provides an overview of an Internet of things (IoT)-based automotive emergency response system (AERS), identifies requirements of the AERS for aftermarket devices, and provides a capability framework of the AERS.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T Y.4119	2018-03-01	20	11.1002/1000/13497

Keywords

AERS, automotive emergency response system.

* 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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Requirements and capability framework for IoT-based automotive emergency response system

1 Scope

The objective of this Recommendation is to identify requirements of an Internet of things (IoT)-based automotive emergency response system (AERS) for aftermarket devices and to provide a capability framework of the AERS.

In particular, the scope of this Recommendation includes:

– Overview of the AERS

– Requirements of the AERS

– Capability framework of the AERS

AERS for original equipment manufacturer (OEM) pre-installed devices, such as the pan-European eCall [b-CEN EN 16072], is out of scope of this Recommendation.

NOTE – AERS can be considered as a third party service provider (TPSP) system [b-CEN EN 16102] in the pan-European eCall.

Also, the operation of the emergency authority (EA) is out of scope of this Recommendation.

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.4000] Recommendation ITU-T Y.4000/Y.2060 (2012), *Overview of the Internet of things.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 Internet of things (IoT) [ITU-T Y.4000]: A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

NOTE 1 – Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled.

NOTE 2 – From a broader perspective, the IoT can be perceived as a vision with technological and societal implications.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 automotive emergency detection device (AEDD): 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 a minimum set of data (MSD) which is related to the accident and

– providing bidirectional voice communication.

3.2.2 automotive emergency response centre (AERC): 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.

3.2.3 internal sensor: Sensor installed in or physically connected to an aftermarket automotive emergency detection device (AEDD) to provide information for automotive accident detection.

3.2.4 minimum set of data (MSD): Data related to the accident sent from an automotive emergency detection device (AEDD) to an automotive emergency response centre (AERC).

3.2.5 vehicle sensor: Sensor such as collision sensor, accelerometer, airbag deployment sensor, etc., that is installed in the vehicle to be used for automotive accident detection.

3.2.6 user: Person in the vehicle using an automotive emergency detection device (AEDD).

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

EA Emergency Authority

FE Functional Entity

GNSS Global Navigation Satellite System

IoT Internet of Things

MSD Minimum Set of Data

OBD-II On-Board Diagnostic System-II

OEM Original Equipment Manufacturer

PSAP Public Safety Answering Point

TPSP Third Party Service Provider

VIN Vehicle Identification Number

5 Conventions

In this Recommendation:

– The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.

– The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

6 Overview of the IoT-based automotive emergency response system

Every year, more than 1 million people die from automobile accidents [b-WHO GSR RS]. To reduce mortalities, automobile industries have developed technologies so that accidents can be avoided or their severity reduced. However, to reduce mortalities, when a serious accident cannot be avoided, proper and efficient accident respond-rescue procedures are necessary so that victims can be transferred to hospital within the critical "golden" timeframe.

An IoT-based [ITU-T Y.4000] 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.

As shown in Figure 1, employing the AERS is expected to reduce automobile accident detection (T1) and report (T2) time using automatic accident detection-report procedures. Furthermore, since sensor assisted geographical positioning allows the emergency authority (EA) to pinpoint the exact location of an accident, the arrival time at the scene will be shortened significantly (T4).

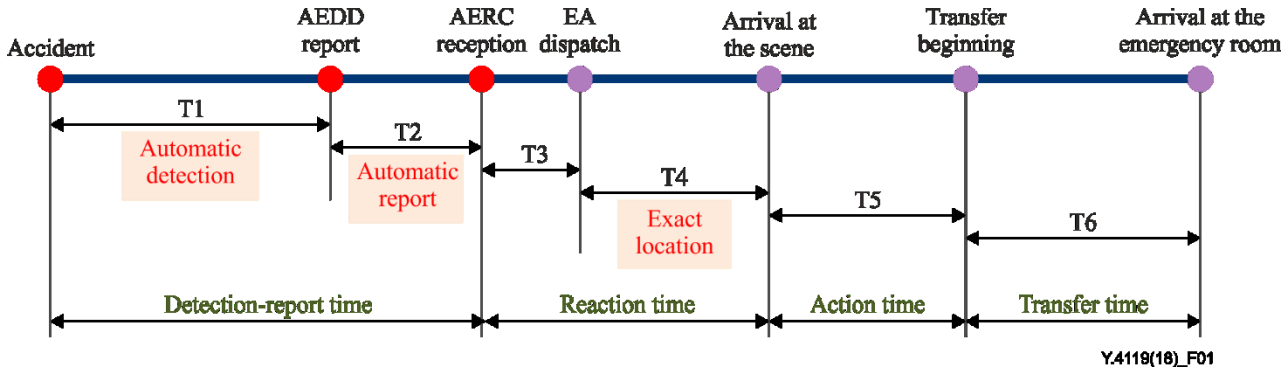

Figure 1 – Timing diagram of an IoT-based automotive emergency response system

The AERS is designed to bring rapid assistance to driver and/or passengers involved in an accident. It includes the AEDD, the AERC and the EA. In the event of a serious road accident, the AEDD in the vehicle automatically connects to the AERC and gives emergency operators information relating to the accident, including global navigation satellite system (GNSS) coordinates, the time of the accident and the vehicle identification number (VIN) [b-ISO 3779].

Figure 2 shows an overview of the AERS.

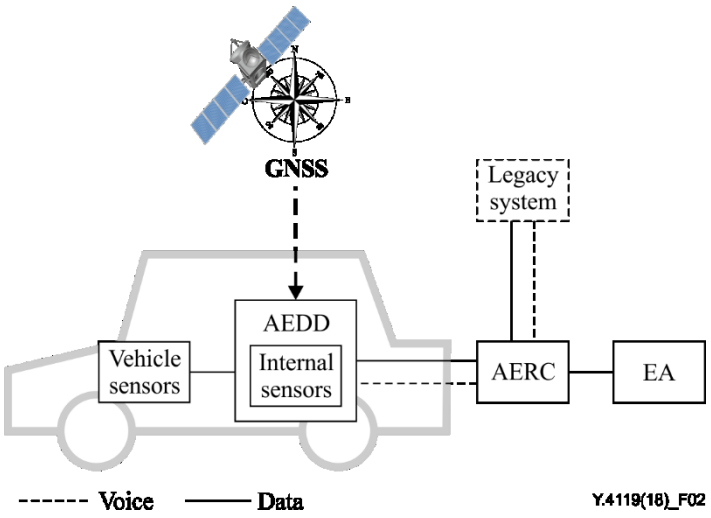

Figure 2 – Overview of the AERS

AEDD is 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.

AEDD can be any type of device equipped with sensors for shock detection and a GNSS receiver, which can be installed after the purchase of the vehicle, for example, a navigation system or dash cam. The AEDD falls into three categories in terms of data and voice communication capability with the AERC:

– device without data and voice communication capability,

– device with data communication capability only,

– device with data and voice communication capability.

For AEDD without data and voice communication capability or with data communication capability only, a cell phone is needed for providing voice communication between driver or passengers and AERC.

AERC is 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 EA if the request reports an accident.

AERC can have interfaces to legacy automotive emergency response systems such as a public safety answering point (PSAP) in the pan-European eCall.

NOTE 1 – In the case of PSAP in the pan-European eCall, the AERS can be considered as a TPSP system of the pan-European eCall.

NOTE 2 – Considering the features of aftermarket devices, the AERC is equipped with false alarms filtering functions.

7 Requirements of the IoT-based automotive emergency response system

7.1 Automotive emergency detection device requirements

The following are the AEDD requirements for the AERS:

1) Information collection requirements:

– AEDD is required to collect geographical location, geographical heading, accident-related time and acceleration information from vehicle sensors and/or internal sensors.

– AEDD is recommended to collect VIN, fuel type, the number of passengers, freight type, vehicle speed, vehicle orientation and wheel speeds from vehicle and/or internal sensors.

2) Information processing and transmission requirements:

– AEDD is required to detect automotive accidents based on the collected sensor information.

– AEDD is required to generate and transmit an MSD to AERC if an accident is detected.

– AEDD is required to detect an accident, generate an MSD and transmit an MSD even when the main power source of the vehicle has been cut off.

3) Voice call capability requirements:

– AEDD is required to have voice call capability to be connected to the AERC.

– AEDD is required to identify its phone number.

4) User interface requirements:

– AEDD is required to have a user interface to test MSD transmission.

– AEDD is required to have a user interface to manually transmit an MSD to request emergency response.

– AEDD is required to have a user interface to cancel emergency response request.

– AEDD is required to have a user interface to notify its status, i.e., power source, network connection, sensor malfunction, AERC connectivity, etc.

– AEDD is required to have a user interface to notify user the emergency response request status.

7.2 Automotive emergency response centre requirements

The following are the AERC requirements for the AERS:

1) General operation requirements:

– AERC is required to have a capability to filter out false alarms before connecting AEDD with AERC.

– AERC is required to record emergency response request related time information such as MSD recipient time, voice call initiation time, voice call connection time and voice call termination time.

– AERC is recommended to display and manage the emergency response process from the time of MSD arrival to emergency response completion.

– AERC is required to be ready to receive MSDs from AEDD at all times.

2) Information processing requirements:

– AERC is required to extract a call back phone number from the MSD and wait for a time period predefined by AERC for a cancel request message. If the cancel request message is not received, AERC shall initiate a voice call to the extracted call back phone number.

– AERC is required to present vehicle's location and heading on a map using information extracted from the MSD.

– AERC is recommended to be able to define the severity of the accident using information extracted from the MSD.
– AERC is required to distinguish different accidents from multiple MSDs sent by the same AEDD.
– AERC is recommended to be able to identify the same accident from MSDs transmitted by multiple AEDDs.

3) Information transmission requirements:

– AERC is required to transmit an acknowledgement (ACK) to AEDD when an MSD is received.
– AERC is required to transmit an ACK to AEDD when a test MSD is received.
– AERC is required to notify EA if the call is not answered for a predefined duration.
– AERC is required to forward accident related information to EA.
– AERC is recommended to be able to collect and transfer additional information obtained during a voice call to EA.

4) Requirements for personally identifiable information:

– AERC is required to delete the MSD immediately in case EA response is not needed.
– AERC is required to encrypt personally identifiable information contained in the MSD when it is needed to be stored.

8 Capability framework of the IoT-based automotive emergency response system

Figure 3 shows the capability framework of the AERS.

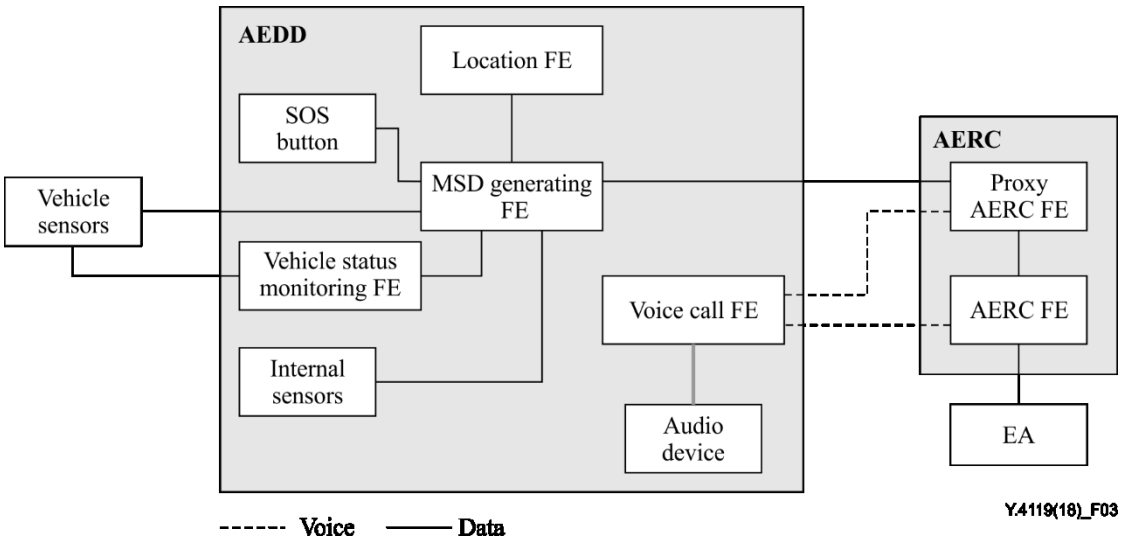

Figure 3 – Capability framework of AERS

– SOS button: enables manual EA response request.
– Vehicle sensor: sensors such as collision sensor, accelerometer, airbag deployment sensor, etc., that are installed in the vehicle to be used in automotive accident detection for providing information needed for vehicle accident detection.
– Internal sensor: sensor installed in or physically connected to AEDD to provide information for automotive accident detection.
– Vehicle status monitoring functional entity (FE): obtains information from vehicle sensors to aid AEDD. On-board diagnostic system-II (OBD-II) scanner is an example of the implementation of this FE.

– Location FE: obtains geographical location information of the vehicle using satellites or cellular network.
– MSD generating FE: generates an MSD if AEDD detects automotive accidents or SOS button is pressed.
– Voice call FE: receives a voice call from the proxy AERC FE or AERC FE.
– Proxy AERC FE: receives an MSD from AEDD, confirms, including filtering out false alarms, whether an accident occurs or not by using the automated system (voice, text, etc.), forwards the MSD to AERC FE and transfers the call to AERC FE if EA dispatch is necessary.
– AERC FE: finalizes the analysis of accident and requests EA dispatch if necessary.

9 Automotive emergency response system workflows

9.1 EA dispatch request

Figure 4 shows the AERS workflow in case of the EA dispatch request.

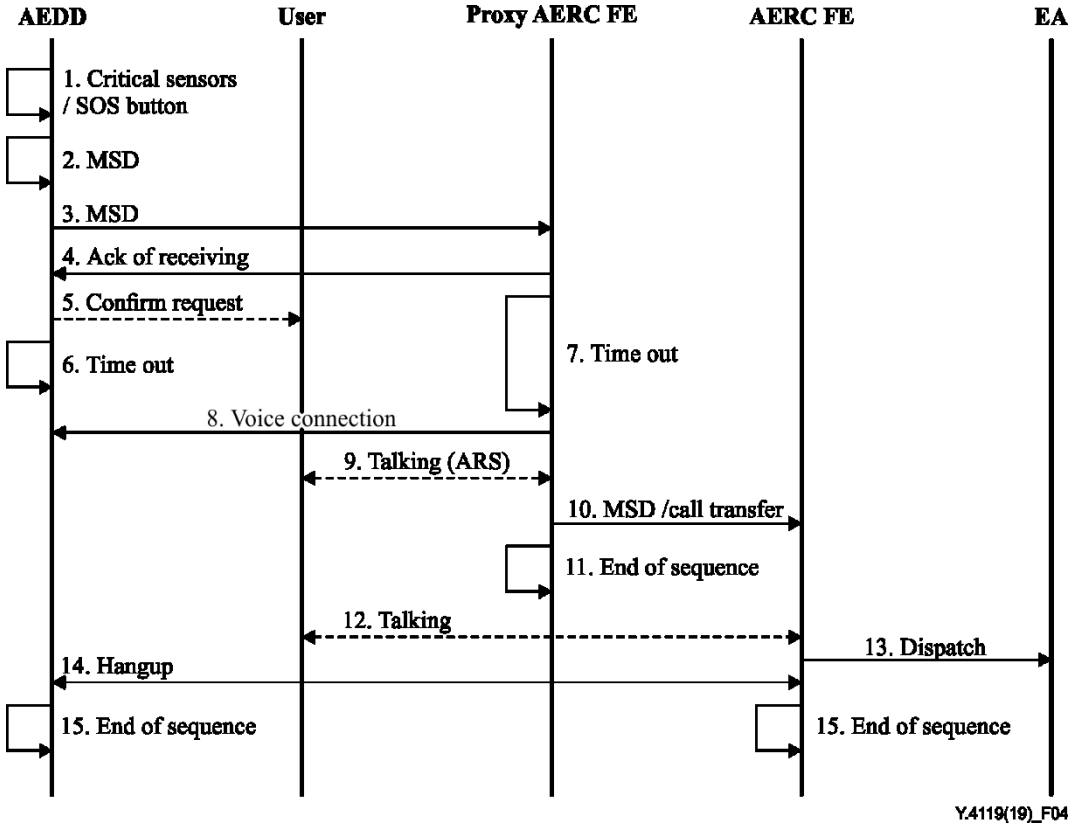

Figure 4 – AERS workflow in case of EA dispatch request

(Step 1–4) In case of accident detection or manual EA dispatch request, AEDD generates an MSD and transmits it to the proxy AERC FE repeatedly until ACK is received.

(Step 5) AEDD notifies user accident detection event and asks for confirmation.

(Step 6, 7) AEDD or proxy AERC FE automatically confirms accident if a user fails to confirm within the time out period.

(Step 8, 9) Using the information in the MSD, the proxy AERC FE initiates call back using an automated system. If the call is not answered within the time out period, it confirms the accident.

(Step 10, 11) Based on the accident confirmation, the proxy AERC FE forwards the MSD to AERC FE and transfers the call to AERC FE.

(Step 12) AERC obtains additional information from the user to confirm the accident.

(Step 13) If the accident is confirmed, AERC requests EA dispatch based on information in the MSD.

(Step 14, 15) The call is terminated once EA dispatch arrival on the site is recognized.

9.2 User cancellation using AEDD

Figure 5 shows the AERS workflow in case of user cancellation using the AEDD.

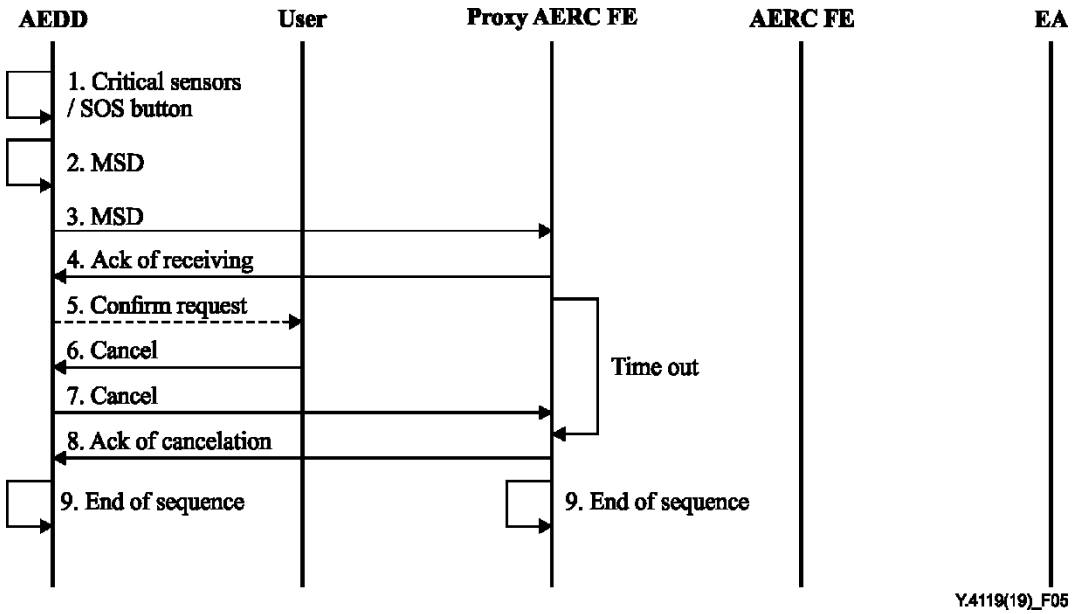

Figure 5 – AERS workflow in case of user cancellation using AEDD

(Step 1–4) In case of accident detection or manual EA dispatch request, AEDD generates an MSD and transmits it to the proxy AERC FE repeatedly until ACK is received.

(Step 5) AEDD notifies user accident detection event and asks for confirmation.

(Step 6) A cancellation request is sent by the user.

(Step 7, 8) AEDD forwards cancellation request to the proxy AERC FE repeatedly within the time out period until ACK is received.

(Step 9) EA dispatch request is cancelled.

9.3 Cancellation during proxy AERC FE confirmation

Figure 6 shows the AERS workflow in case of the EA dispatch cancellation during the proxy AERC FE confirmation stage.

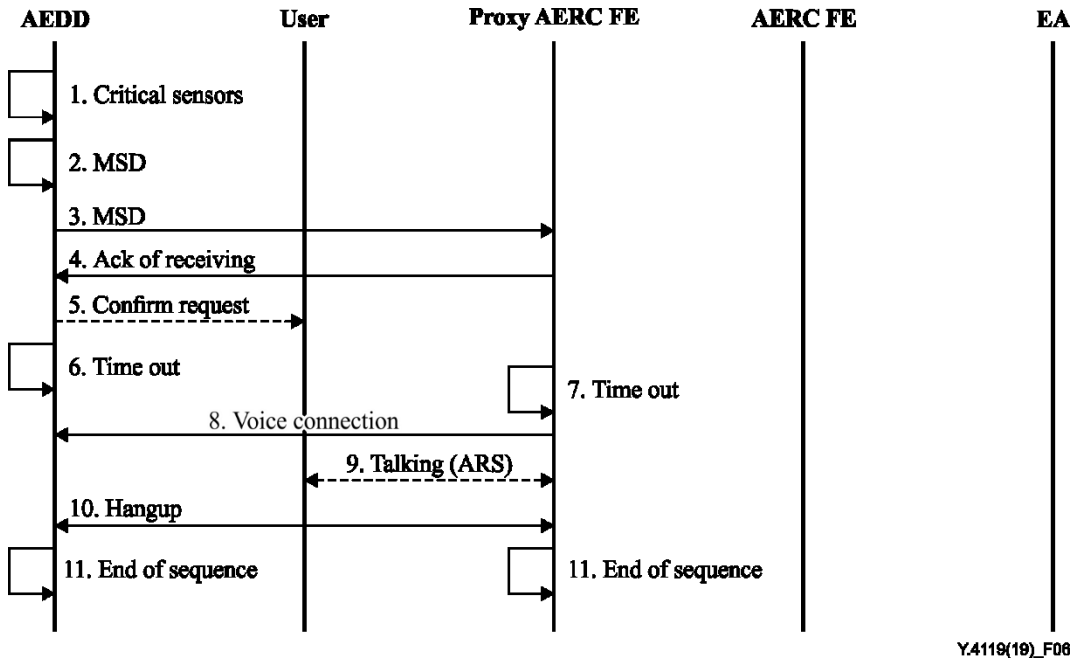

Figure 6 – AERS workflow in case of EA dispatch cancellation during proxy AERC FE confirmation stage

(Step 1–4) In case of accident detection or manual EA dispatch request, AEDD generates an MSD and transmits it to the proxy AERC FE repeatedly until ACK is received.

(Step 5) AEDD notifies user accident detection event and asks for confirmation.

(Step 6, 7) AEDD or proxy AERC FE automatically confirms accident if the user fails to confirm within the time out period.

(Step 8) Using the information in the MSD, the proxy AERC FE initiates call back using an automated system.

(Step 9) Using the automated system, the proxy AERC FE requests the user to confirm the accident.

(Step 10, 11) If cancelled in Step 9, EA dispatch request is cancelled.

9.4 MSD transmission testing

Figure 7 shows the workflow in case of MSD transmission testing.

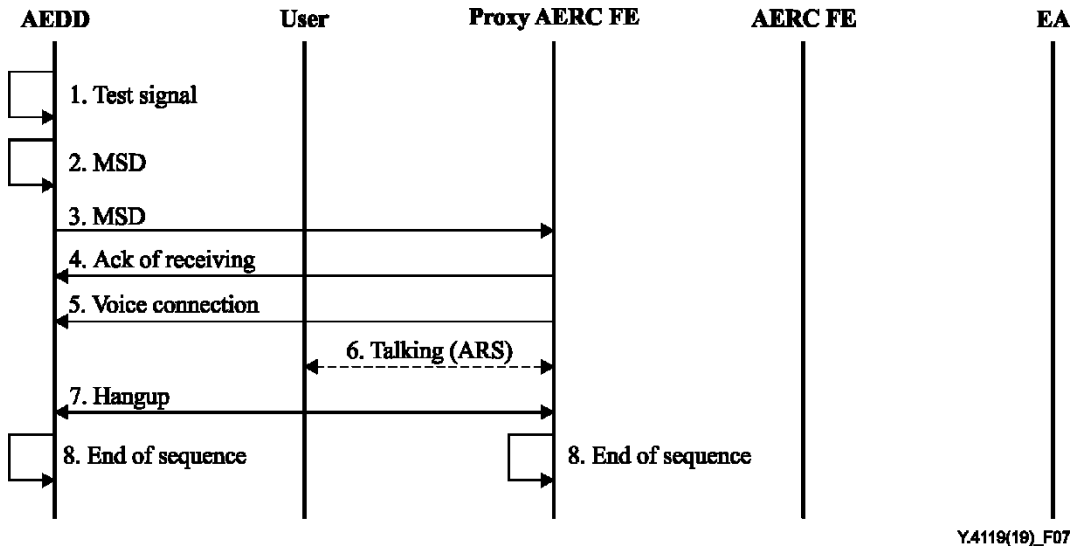

Figure 7 – AERS workflow in case of MSD transmission testing

(Step 1–4) In case of MSD transmission testing, AEDD generates a test MSD and transmits it to the proxy AERC FE repeatedly until ACK is received.

(Step 5, 6) Using the information in the MSD, the proxy AERC FE initiates call back using an automated system and notifies the user for successful MSD transmission testing.

(Step 7, 8) MSD transmission testing is terminated.

Appendix I

Implementation examples

(This appendix does not form an integral part of this Recommendation.)

I.1 AEDD without data and voice communication capabilities

Figure I.1 shows an AERS implementation example with the AEDD, which could be a navigation system or a dash cam, using data communication and voice communication capabilities of the user's phone in the case of MSD transmission. The MSD generating FE should be able to obtain the call back numbers of the user's phone in the vehicle.

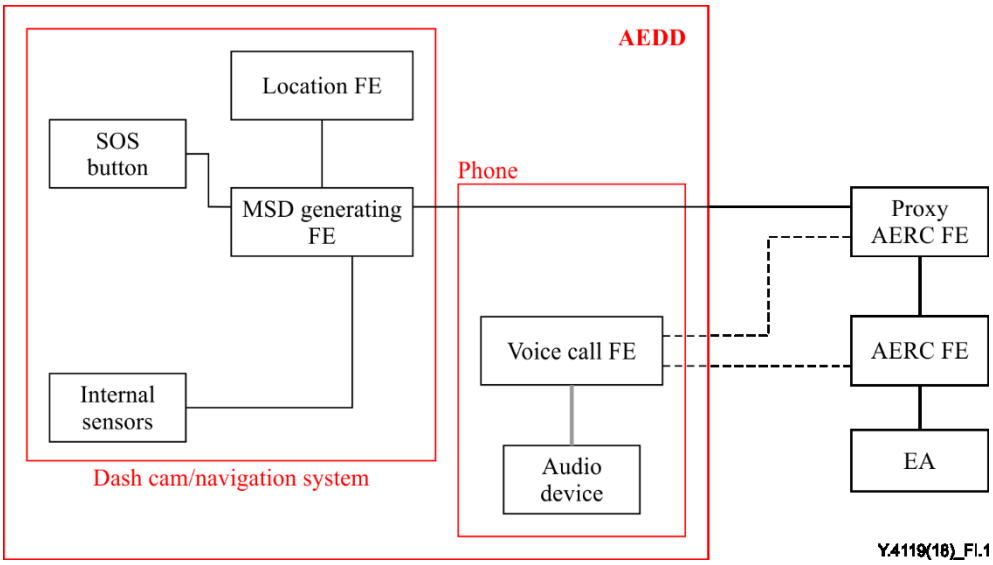

Figure I.1 – AERS implementation example for AEDD without data and voice communication capabilities

I.2 AEDD with data communication capability

Figure I.2 shows an AERS implementation example with the AEDD, which could be a navigation system or a dash cam, using its data communication modem and using the user's phone for voice communications. The MSD generating FE should be able to obtain the call back numbers of the user's phone in the vehicle.

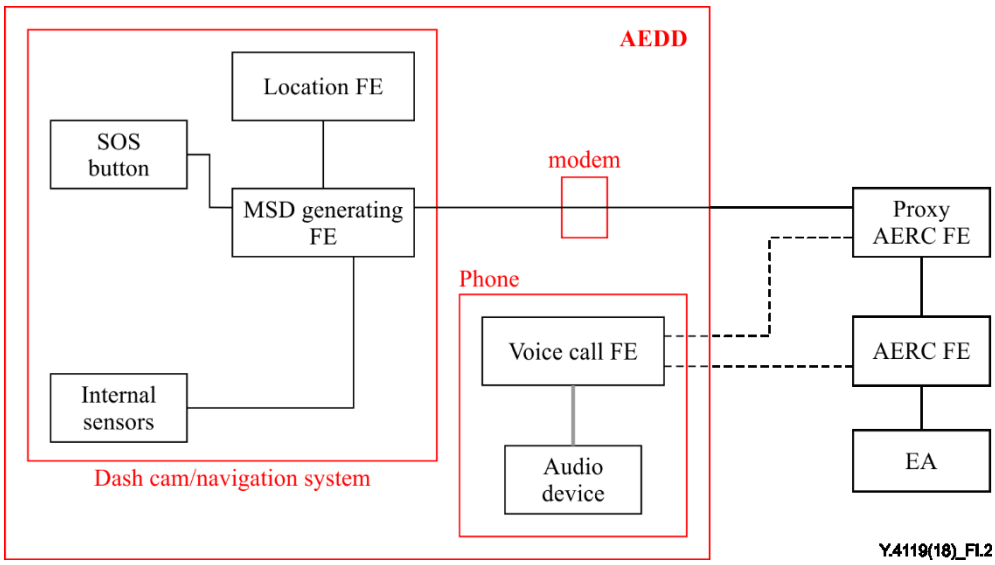

Figure I.2 – AERS implementation example for AEDD with data communication capability

I.3 AEDD with data and voice communication capabilities

Figure I.3 indicates an AERS implementation example with the AEDD, which could be a navigation system or a dash cam, using its modem having data and voice communication capabilities.

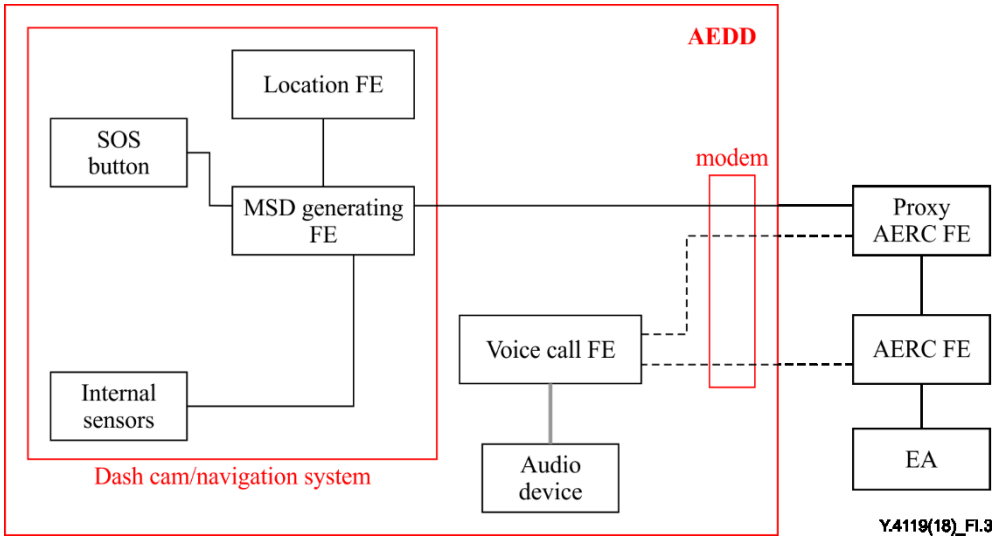

Figure I.3 – AERS implementation example for AEDD with data and voice communication capabilities

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