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BSI Standards Publication

Intelligent transport systems — eSafety — eCall High level application protocols (HLAP) using IP Multimedia Subsystem (IMS) over packet switched networks

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National foreword

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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Systèmes de transport intelligents - ESafety - Exigences de protocole d'application de haut niveau (HLAP) relatives à l'eCall via des systèmes IMS basés sur la commutation de paquets

Intelligente Verkehrssysteme - eSicherheit - Allgemeines eCall Anwendungsprotokoll (HLAP) unter Verwendung von IMS paketvermittelnden Netzwerken

This Technical Specification (CEN/TS) was approved by CEN on 30 October 2022 for provisional application.

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European foreword

This document (CEN/TS 17184:2022) has been prepared by Technical Committee CEN/TC 278 “Intelligent transport systems”, the secretariat of which is held by NEN.

This document supersedes CEN/TS 17184:2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

Part of this revision of the document is aimed at making it purely packet switched and removing references to eCall over circuit switched networks, this in order to make the document future proof.

In comparison with the previous edition, the following technical modifications have been made:

— reordering and combining of some clauses to better reflect coherence and provide consistency (numbering below refers to the current numbering; where this differs from the numbering in the previous published version of this document, the original number is cited stroke through and between brackets)

— provide a mechanism to transfer the MSD via in-band modem via IMS as an option (Clause 7.8 (~~7.3.6 and 7.4.3~~))

— added expected IVS behaviour after reception of 6xx or 4xx response including positive MSD ACK (updated Clauses 7.4.1, 7.6.2 and 7.13.3 (~~7.3.6 and 7.14.4~~))

— removed section about PSAP application (~~7.8~~) which was moved to EN 16072

— updated expected IVS behaviour when the PSAP operator does not respond (updated Clauses 7.13.3.2 and 7.13.3.3 (~~7.14.3 and 7.14.4~~))

— updated definition of test eCall activation (updated Clauses 7.3.2 and 7.4.5 (~~7.2.2 and 7.3.6~~))

— updated Clauses 7.5, 7.13.1, 7.13.4.1 (~~7.4.2, 7.4.3, 7.5.2, 7.13.3, 7.13.4.2~~) and Annex B

— updated terms, definitions, symbols and abbreviations

— removed requirement to fall-back to CS eCall

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

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Introduction

An *eCall* is an emergency call generated either automatically via activation of in-vehicle sensors or manually by the vehicle occupants; when activated, to provide notification and relevant location information to the most appropriate Public Safety Answering Point (PSAP), by means of mobile wireless communications networks and carries a defined standardized minimum set of data, notifying that there has been an incident that requires response from the emergency services and establishes an audio channel between the occupants of the vehicle and the most appropriate PSAP.

EN 15722 specifies a standardized MSD for *eCall*, and EN 16072 specifies pan-European *eCall* operating requirements (for third party systems, EN 16102 specifies third party services supporting *eCall* operating requirements; see EC Communication on *eCall* Implementation 2009 [COM(2009) 434 final] and Official Journal *eCall* Recommendation C_2011_6269, for more information) and EN 16062 specifies High Level Application Protocols for eCall using GSM/UMTS.

The operating requirements for pan-European *eCall* are made using Public Land Mobile Networks (PLMN) (such as GSM and UMTS, and latterly LTE, NR and their successors), as specified in a number of ETSI standards and technical specifications.

In order to provide the *eCall* service across a wireless network, high level application protocols are required as an important essential element to affect this service provision.

NOTE The term PSAP, which is most widely used in the *eCall* documentation, European Commission documents, etc., is used throughout this document and equates to the term emergency call response centre used in the ITS Implementation Directive.

Subsequent to the publication of the suite of eCall standards (EN 16072, EN 16062 and EN 16454) which support the eCall Regulations, new communications technologies have become available. Over the course of time, these networks (such as LTE, NR and their successors) are expected to complement and eventually replace the circuit switched GSM/UMTS networks. These technologies use so called 'packet switched' technologies using Internet protocols (IP). Particularly, 3GPP have evolved a communication management system called IMS (IP Multimedia Subsystem) which is suitable to operate over a number of bearer technologies, including LTE, NR and their successors.

In circuit switched networks the eCall is identified as an emergency call and specifically an eCall in the telecircuit switching (TS) process. No number is dialled as the TS identifiers inform the MNO that the call is an emergency call/eCall and the MNO has procedures to direct these calls to "the most appropriate" PSAP. Having established a voice channel, the microphones and speakers are muted and a modem is used to transfer the Minimum Set of Data (MSD) to the PSAP before opening up the line to enable conversation between the PSAP operator and the occupants of the vehicle.

In a 'packet switched' network, packets of data (including voice) are sent using an internet protocol (IP) communication system. 3GPP have created the IP Multimedia Subsystem (IMS) which makes use of SIP (Session Initiation Protocol) for its call management.

This document provides High Level Application Protocols (HLAP) for eCall using IMS. It therefore provides the IMS packet switched equivalent of EN 16062 for circuit switched networks and should be suitable for all/any packet switched networks that support IMS and wireless access such as LTE, NR and their successors.

This document specifies the protocols to put into effect the pan-European *eCall* operating requirements, over packet switched networks networks (such as LTE, NR and their successors).

The European Committee for Standardization (CEN) draws attention to the fact that, while no direct patents are known in express regard to the content of these specifications, the underlying ETSI communications Standards may involve patents and the reader is directed to the referenced ETSI standards in these respects.

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1 Scope

In respect of pan European eCall (operating requirements defined in EN 16072), this document defines the high level application protocols, procedures and processes required to provide the *eCall service* via a packet switched wireless communications network using IMS (IP Multimedia Subsystem) and wireless access (such as LTE, NR and their successors).

This document assumes support of eCall using IMS over packet switched networks by an IVS and a PSAP and further assumes that all PLMNs available to an IVS at the time an eCall or test eCall is initiated are packet switched networks. Support of eCall where eCall using IMS over packet switched networks is not supported by an IVS or PSAP is out of the scope of this document.

At some moment in time packet switched networks will be the only Public Land Mobile Networks (PLMN) available. However as long as GSM/UMTS PLMNs are available (Teleservice 12/TS12) ETSI TS 122 003 will remain operational. Both the use of such PLMNs and the logic behind choosing the appropriate network in a hybrid situation (where both packet-switched and circuit-switched networks are available) are out of scope of this document.

NOTE 1 The objective of implementing the pan-European in-vehicle emergency call system (eCall) is to automate the notification of a traffic accident, wherever in Europe, with the same technical standards and the same quality of services objectives by using a PLMN (such as ETSI prime medium) which supports the European harmonized 112/E112 emergency number (TS12 ETSI TS 122 003 or IMS packet switched network) and to provide a means of manually triggering the notification of an emergency incident.

NOTE 2 HLAP requirements for third party services supporting eCall can be found in EN 16102,. This document makes reference to those provisions but does not duplicate them.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 15722, *Intelligent transport systems - ESafety - ECall minimum set of data*

EN 16072:2022, *Intelligent transport systems - ESafety - Pan-European eCall operating requirements*

EN 16454, *Intelligent transport systems - ESafety - ECall end to end conformance testing*

CEN/TS 17240, *Intelligent transport systems - ESafety - ECall end to end conformance testing for IMS packet switched based systems*

ETSI TS 122 003, *Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Circuit Teleservices supported by a Public Land Mobile Network (PLMN) (3GPP TS 22.003) [Release 14 or later]*

ETSI TS 122 011, *Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Service accessibility (3GPP TS 22.011) [Release 14 or later]*

ETSI TS 122 071, *Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Location Services (LCS); Service description; Stage 1 (3GPP TS 22.071 [Release 14 or later]*

ETSI TS 122 101, *Universal Mobile Telecommunications System (UMTS); LTE; Service aspects; Service principles (3GPP TS 22.101) [Release 14 or later]*

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ETSI TS 123 122, *Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode (3GPP TS 23.122) [Release 14 or later]*

ETSI TS 123 167, *Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS) emergency sessions (3GPP TS 23.167) [Release 14 or later]*

ETSI TS 123 216, *Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; Single Radio Voice Call Continuity (SRVCC); Stage 2 (3GPP TS 23.216) [Release 14 or later]*

ETSI TS 123 401, *LTE; General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (3GPP TS 23.401) [Release 14 or later]*

ETSI TS 123 501, *5G; System architecture for the 5G System (5GS) (3GPP TS 23.501) [Release 14 or later]*

ETSI TS 124 229, *Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; IP multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3 (3GPP TS 24.229) [Release 14 or later]*

ETSI TS 124 301, *Universal Mobile Telecommunications System (UMTS); LTE; Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3 (3GPP TS 24.301) [Release 14 or later]*

ETSI TS 124 501, *5G; Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3 (3GPP TS 24.501) [Release 14 or later]*

ETSI TS 131 102, *Universal Mobile Telecommunications System (UMTS); LTE; Characteristics of the Universal Subscriber Identity Module (USIM) application (3GPP TS 31.102) [Release 14 or later]*

ETSI TS 133 203, *Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; 3G security; Access security for IP-based services (3GPP TS 33.203) [Release 14 or later]*

ETSI TS 136 331, *LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification (3GPP TS 36.331) [Release 14 or later]*

ETSI TS 138 331, *5G; NR; Radio Resource Control (RRC); Protocol specification (3GPP TS 38.331) [Release 15 or later]*

IETF RFC 8147, *Next-Generation Pan-European eCall*

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3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
112
single European emergency call number supporting Teleservice 12

Note 1 to entry: See ETSI TS 122 003.

3.2
call clear-down
termination of call and freeing up of line (usually achieved by hanging up the receiver or pressing 'end call' or similar on screen)

3.3
cellular network
wireless communications network consisting of multiple adjacent access points (cells) with the capability of homogeneous transfer of a communications session instance to an adjacent cell without significant interruption to the session

3.4
data
representations of static or dynamic objects in a formalized manner suitable for communication, interpretation, or processing by humans or by machines; in packet switched networks, voice is carried in packets of data

3.5
data concept
any of a group of *data* structures (i.e. object class, property, value domain, *data elements,* message, interface dialogue, *association*) referring to abstractions or things in the natural world that can be identified with explicit boundaries and meaning and whose properties and behaviour all follow the same rules

3.6
data element
single unit of information of interest (such as a fact, proposition, observation, etc.) about some (entity) class of interest (e.g. a person, place, process, property, concept, state, event) considered to be indivisible in a particular context

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3.7
eCall
emergency call generated either automatically via activation of in-vehicle sensors or manually by the *vehicle occupants*

Note 1 to entry: When activated it provides notification and relevant location information to the most appropriate *Public Safety Answering Point*, by means of *mobile wireless communications networks*, carries a defined standardized *minimum set of data* (MSD) notifying that there has been an incident that requires response from the emergency services, and establishes an audio channel between the occupants of the vehicle and the most appropriate *Public Safety Answering Point*.

3.8
eCall generator
occupant of a vehicle or equipment within a vehicle that has cause to trigger an *eCall session* by automatic or manual means

3.9
eCall service
end-to-end emergency service to connect occupants of an affected vehicle to the most appropriate PSAP via an audio link across a PLMN together with the transfer of a minimum set of data to the PSAP

3.10
eCall session
establishment of a mobile wireless communications session across a public wireless communications network and the transmission of a minimum set of data from a vehicle to a public safety answering point and the establishment of an audio channel between the vehicle and the PSAP

3.11
Emergency Call Server
ECS
functional entity that consists of a Location Retrieval Function (LRF) and either a routing proxy or a redirect server, e.g. an ECS contains a VPC and a Routing Proxy or Redirect Server in NENA I2 architecture

3.12
emergency control centre
unit which deals with emergency calls and which has the capacity to consider professionally the need for response, and which has the provision to mobilise the needed resources to deal with the emergency in question

3.13
emergency call response centre
term used in ITS Implementation Directive to mean Public Safety Answering Point (PSAP)

3.14
identifier
label, symbol or token that names or identifies an entity or a collection of data or the means of designating or referring to a specific instance of a data concept

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3.15
in-vehicle equipment
equipment within the vehicle that provides or has access to in-vehicle data required for the minimum set of data and any other data that is to be sent as part of or complementary to the minimum set of data to effect the *eCall session* via a public mobile wireless communications network providing a link between the vehicle and a means of enacting the *eCall* service via a public mobile wireless communications network

3.16
in-vehicle equipment provider
provider of *eCall* in-vehicle equipment

Note 1 to entry: The in-vehicle equipment provider can be the vehicle manufacturer or the provider of aftermarket equipment.

3.17
in-vehicle system
IVS
in-vehicle equipment together with the means to trigger, manage and effect the *eCall session*

3.18
location area
LA
area in which a mobile station may move freely without updating the VLR

Note 1 to entry: A location area includes one or several GERAN/UTRAN cells.

3.19
minimum set of data
MSD
standardized data concept comprising data elements of relevant vehicle generated data essential for the performance of the *eCall* service

Note 1 to entry: See EN 15722.

3.20
mobile wireless communications network
wireless communications network with homogeneous handover between *network access points*

3.21
most appropriate PSAP
destination for eCall defined beforehand by responsible authorities to cover emergency calls from a certain area or for emergency calls of a certain type

Note 1 to entry: See also PSAP.

Note 2 to entry: A number of different instantiations of PSAP service are supported within this document. A PSAP can be a Public Authority or a private *service provider* operating on behalf of the responsible authorities.

3.22
network access device
NAD
device providing communications to a *mobile wireless communications network* with homogeneous handover between *network access points*, also known as mobile wireless communications network device

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3.23
network access point
beacon, antenna or similar source of signal propagation and receipt together with equipment to manage communication sessions with users operating within the operating reach of the *network access point* and provide connectivity for the users within the operating reach of the single *access point* to a wider communications network

Note 1 to entry: A network access point may but does not need to provide homogeneous or heterogeneous handover to another network access point.

3.24
public mobile wireless communications network
mobile wireless communications network with access to a public telecommunications network

3.25
Public Safety Answering Point
PSAP
physical location working on behalf of the national authorities where emergency calls are first received under the responsibility of a public authority or a private organization recognized by the national government

Note 1 to entry: See also most appropriate PSAP.

Note 2 to entry: A number of different instantiations of PSAP service are supported within this document.

3.26
Radio Network Controller area
RNC area
area of radio coverage consisting of one or more cells controlled by one RNC

Note 1 to entry: The boundaries of an RNC area and a location area are independent; a location area may span the boundary between RNC area and an RNC area may span the boundary between location areas.

3.27
routing area
RA
area in which a mobile station, in certain operation modes, may move freely without updating the SGSN

Note 1 to entry: A routing area includes one or several GERAN/UTRAN cells and is always contained within a location area.

3.28
vehicle manufacturer
entity which first assembles the vehicle and provides *eCall* equipment as part of its specification and subsequently sells the vehicle directly or via an agent

3.29
vehicle occupant
person inside the vehicle

3.30
wireless communications network
network operating using an air-interface capable of bi-directional transfer of *data* and or voice

Note 1 to entry: There are different types of wireless communications such as PAN, LAN, *cellular network*, etc.

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4 Symbols and abbreviations

3G	3rd Generation
3GPP	Third Generation Partnership Project
5G	5th Generation
ACK	ACKnowledgement
AL-ACK	Application Layer ACKnowledgement
AMF	Access and mobility Management Function
CAN	Controller-Area Network
CS	Circuit Switched
CSCF	Call Session Control Function
E-CSCF	Emergency Call Session Control Function
EC	European Commission
ECL	eCall using IMS over packet switched networks support indicator
ESQK	Emergency Service Query Key
ETSI	European Telecommunications Standards Institute
GSM	Global System for Mobile communications
HPLMN	Home Public Land Mobile Network
HSS	Home Subscriber Server
IBCF	Interconnection Border Control Functions
IETF	Internet Engineering Task Force
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identity
IP-CAN	IP- Connectivity Access Network
IVS	In-Vehicle System
LAN	Local Area Network
LL-ACK	Lower Layer ACKnowledgement
LRF	Location Retrieval Function
LTE	Long Term Evolution
MME	Mobility Management Entity
MNO	Mobile Network Operator
MSD	Minimum Set of Data
NAD	Network Access Device
NENA	National Emergency Numbering Association
NG-RAN	Next Generation Radio Access Network
NR	New Radio
P-CSCF	Proxy Call Session Control Function

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PAN	Personal Area Network
PCRF	Policy and Charging Rules Function
PLMN	Public Land Mobile Network
PS	Packet Switched
PSAP	Public Safety Answering Point
RDF	Routing Determination Function
REQ	REQuest
RNC	Radio Network Controller
TEL-URI	Telephone Uniform Resource Identifier
S-CSCF	Serving Call State Control Function
SDP	Session Description Protocol
SIP	Session Initiation Protocol
TPS	Third Party Service
TPSP	Third Party Service Provider
TS (i)	Technical Specification
TS (ii)	Teleservice
TS12	Teleservice 12
UE	User Equipment NOTE: ETSI/3GPP term which general refers to the IVS in the context of eCall
UMTS	Universal Mobile Telecommunication System
USIM	Universal Subscriber Identity Module
VoIP	Voice over IP
VLR	Visited Location Register
VPC	VoIP Positioning Centre
WGS-84	World Geodetic System 1984

5 Conformance

Conformance to the requirements of this document for eCall using IMS over packet switched networks are to be found in CEN/TS 17240.

This document makes no conformance specifications or requirements in respect of TPS *eCall* operating requirements, and conformance requirements in respect of TPS *eCall* can be found in EN 16102.

6 General overview of pan European eCall session via Packet Switched networks

6.1 General principle

In the introduction to the document, EN 16072, *eCall* was described as an emergency call generated either automatically via activation of in-vehicle sensors or manually by the *vehicle occupants* (the *eCall generator*); when activated, it provides notification and relevant location information to the most appropriate *Public Safety Answering Point*, by means of *mobile wireless communications networks* and

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carries a defined standardized *minimum set of data*, notifying that there has been an incident that requires response from the emergency services and establishes an audio channel between the occupants of the vehicle and the most appropriate *Public Safety Answering Point*.

Figure 1 shows an illustrative view of the pan-European *eCall service*, as defined in EN 16072.

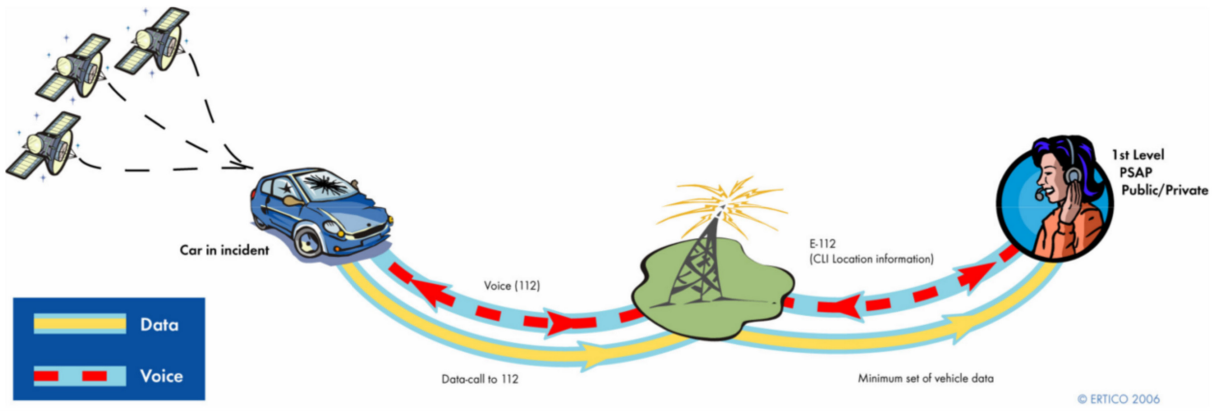

Figure 1 — General overview: pan European eCall service using GSM/UMTS

In circuit switched networks the eCall is identified as an emergency call and specifically an eCall in the telecircuit switching (TS) process. The emergency number (112) is not dialled as the TS identifiers inform the MNO that the call is an emergency call/eCall and the MNO has procedures to direct these calls to "the most appropriate" PSAP. Having established a voice channel, the microphones and speakers are muted and a modem is used to transfer the Minimum Set of Data (MSD) to the PSAP before opening up the line to enable conversation between the PSAP operator and the occupants of the vehicle.

6.2 eCall over Packet Switched networks

Technology advances and subsequently to the development of the eCall application suite EN 16072, EN 16062 and EN 16454 standards, packet switched networks have become available. Over the course of time, these packet switched networks (such as LTE, NR and their successors) are expected to provide new PLMNs to complement and eventually replace the circuit switched GSM/UMTS networks.

The high level paradigm for eCall remains unchanged, but there are fundamental differences in packet switched networks: the TS mechanism is not available and the switching paradigm is different, allowing for a more robust way of data transfer. 3GPP has developed IMS (IP Multimedia Subsystem) which is an all-IP (Internet Protocol) system designed to assist mobile operators deliver next generation interactive and interoperable services, cost-effectively, over an architecture providing the flexibility of the Internet. IMS is designed for packet switched networks and supports IP multimedia applications via IP multimedia sessions over a multitude of IP Connectivity Access Networks, such as NG-RAN, E-UTRAN, UTRAN, GERAN, LAN, DOCSIS®, WiMAX™, cdma2000® and DVB-RCS2 access. It is likely that all subsequent IP based packet switched networks will therefore be able to support IMS, making migration to future, as yet undeveloped technologies, a simpler and easier to achieve process.

It is therefore appropriate to require the availability of IMS on a packet switched network for eCall to function, rather than any of the specific wireless technologies, as it provides greater flexibility and migration potential.

6.3 eCall using IMS over Packet Switched networks

In a packet switched environment where IMS is available, the eCall is established as an internet protocol based session with the exchange of packets of data (which in this case, are largely packets of voice data), and the MSD is provided as part of the session establishment. This is completely different from the mode

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of operation in circuit switched networks. It is therefore necessary to provide a separate specification for "High Level Application Protocols" to manage eCall via packet switched networks.

Figure 2 shows the IMS equivalent of Figure 1 and compares it to eCall via circuit switched networks.

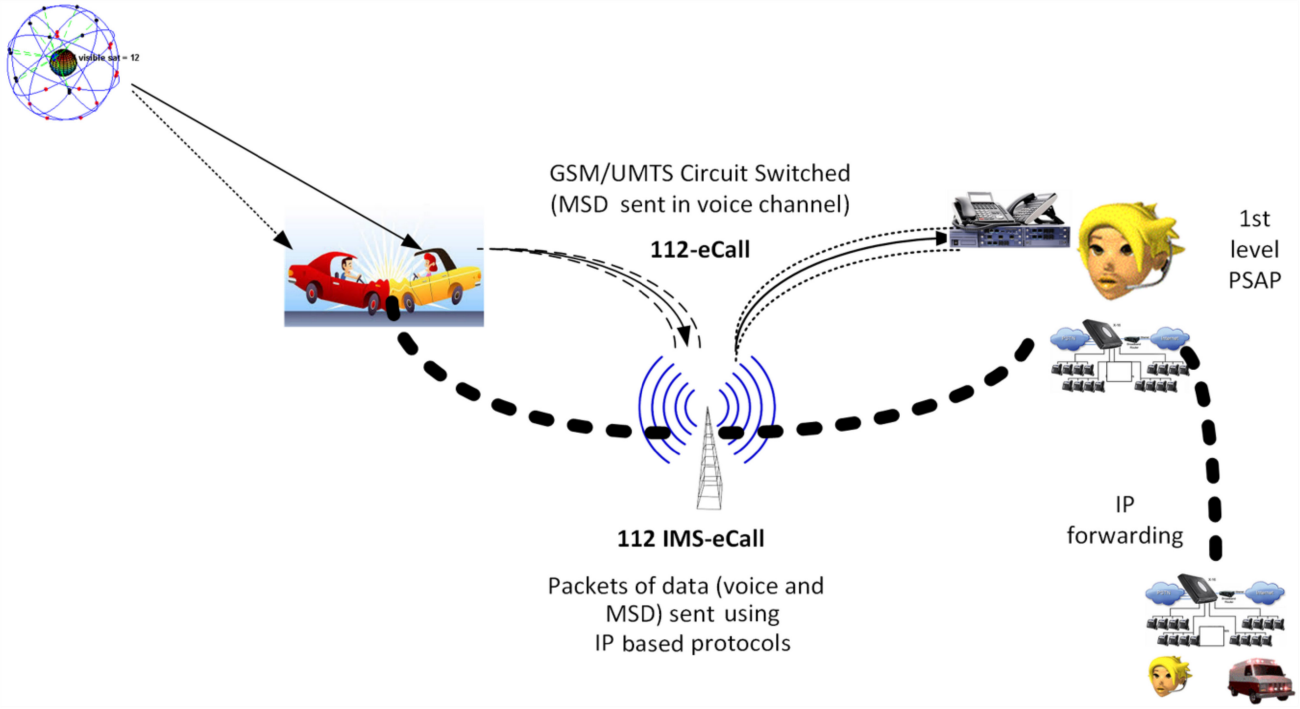

Figure 2 — Overview: eCall using IMS over packet switched networks compared to eCall over CS networks

NOTE 1 Albeit out of scope for this document, IMS has a further advantage in that it can also be used over fixed lines. This makes the forwarding of eCalls from 1st level PSAP responder to 2nd level PSAP responders and responding emergency services via fixed lines, an easier and more simple process; and even enabling the call to then be subsequently diverted to a handset of a responding ambulance, fire truck or police responder.

Session Initiation Protocol (SIP) was selected as the signalling mechanism for IMS (see Annex B), thereby allowing voice, text and multimedia services to traverse all connected networks. And is aligned with IETF internet protocols to ensure maximum re-usability of internet standards, preventing fragmentation of IMS standards.

Further information on this system is specified in ETSI:

— ETSI TS 122 228,

— ETSI TS 123 228,

— ETSI TS 123 167,

— ETSI TS 124 229.

(Or their 3GPP equivalent specifications)

IMS carries special and specific provision for emergency communications and these are further provided in ETSI TS 122 101: "Service principles", which incorporates the MSD into the SIP INVITE, and provides priority on the network for emergency communications and IETF RFC 8147, ETSI TS 123 167 and ETSI TS 124 229 (see also B.2 for a summary of key relevant provisions).

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