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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Mobile Standards Group (MSG).

Introduction

Current eCall is based on CS emergency call in GSM and UMTS networks.

LTE spectrum auctions are taking place in the EU and there will be extensive LTE coverage before the implementation of eCall becomes mandatory in 2015. The longevity of GSM networks in the EU over the lifetime of vehicles is uncertain and GSM spectrum is likely to be re-allocated for UMTS and/or LTE. There is no CS emergency call in LTE.

The applicability of the existing technical solution for eCall (in-band modem) should be assessed for VoIP/VoLTE, as well as new technical solutions to be developed that are suitable for packet switched (UMTS and LTE) and offer better performance for eCall for VoIP.

Longer term strategies need to be considered and guidance (probably for further work) provided in respect of the long term migration of eCall to support over packet switched networks, and the co-existence and possible integration of eCall and other ITS communication equipment installed in vehicles.

1 Scope

The present document contains the findings of STF456. The following areas are addressed:

- Assessment of in-band modem solution in case of no use of CS bearers.

- Study the adaptation of IMS emergency call and IMS Multimedia Emergency Service for supporting current and future service required by eCall.

- Hybrid CS/IMS solution.

- Migration options and recommendations.

2 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 reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

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2.1 Normative references

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

Not applicable.

2.2 Informative references

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] Next-Generation Pan-European eCall, draft-gellens-ecrit-ecall-01.

NOTE: Available at http://tools.ietf.org/html/draft-gellens-ecrit-ecall-01.

[i.2] ETSI TS 122 101: "Universal Mobile Telecommunications System (UMTS); Service aspects; Service principles (3GPP TS 22.101 Release 8)", eCall requirements for data transmission.

[i.3] ETSI TS 124 008: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Mobile radio interface Layer 3 specification; Core network protocols; Stage 3 (3GPP TS 24.008)", eCall Discriminator Table 10.5.135d.

[i.4] ETSI TS 126 268: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); eCall data transfer; In-band modem solution; ANSI-C reference code (3GPP TS 26.268)", eCall Data Transfer - ANSI-C Reference Code.

[i.5] ETSI TR 126 969: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); eCall data transfer; In-band modem solution; Characterization report (3GPP TR 26.969)", eCall Data Transfer - Technical Report - Characterisation Report.

[i.6] eCall minimum set of data CEN EN 15722 Road transport and traffic telematics - eSafety - eCall minimum set of data.

[i.7]   CEN EN 16062: "High Level Application Protocols".

[i.8]   ETSI TS 124 229: "Digital cellular telecommunications system (Phase 2+); 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)", clause 5.1.6 Emergency Service".

[i.9]   ETSI TS 136 331: "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification (3GPP TS 36.331)", clause 6.2.2 Message definitions, SIB for IMS Emergency Support.

[i.10]   IETF RFC 3051: "A Uniform Resource Name (URN) for Emergency and Other Well-Known Services".

[i.11]   IETF RFC 4975: "Message Session Relay Protocol".

[i.12]   Internet Protocol-based In-Vehicle Emergency Calls; draft-gellens-ecrit-car-crash-01.

[i.13]   ETSI TS 123 167: "Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS) emergency sessions (3GPP TS 23.167)".

[i.14]   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)".

[i.15]   ETSI TS 131 102: "Universal Mobile Telecommunications System (UMTS); LTE; Characteristics of the Universal Subscriber Identity Module (USIM) application (3GPP TS 31.102)".

[i.16]   IETF RFC 6086: "Session Initiation Protocol (SIP) INFO Method and Package Framework".

[i.17]   IETF RFC 2326: "Real Time Streaming Protocol (RTSP)".

[i.18]   IETF RFC 6881: "Best Current Practice for Communications Services in Support of Emergency Calling".

[i.19]   IETF RFC 5547: "A Session Description Protocol (SDP) Offer/Answer Mechanism to Enable File Transfer".

[i.20]   IETF RFC 4103: "RTP Payload for Text Conversation".

[i.21]   IETF RFC 3265: "Session Initiation Protocol (SIP)-Specific Event Notification".

[i.22]   ETSI TS 122 173: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Core Network Subsystem (IMS) Multimedia Telephony Service and supplementary services; Stage 1 (3GPP TS 22.173)".

[i.23]   Additional Data related to an Emergency Call draft-ietf-ecrit-additional-data-20.

NOTE: Available at http://datatracker.ietf.org/doc/draft-ietf-ecrit-additional-data/.

[i.24]   ETSI TS 127 007: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; AT command set for User Equipment (UE) (3GPP TS 27.007)".

[i.25]   ETSI TS 125 331: "Universal Mobile Telecommunications System (UMTS); Radio Resource Control (RRC); Protocol specification (3GPP TS 25.331)".

[i.26]   ETSI TS 123 272: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Circuit Switched (CS) fallback in Evolved Packet System (EPS); Stage 2 (3GPP TS 23.272)".

[i.27]   ETSI TS 126 114: "Universal Mobile Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS); Multimedia telephony; Media handling and interaction (3GPP TS 26.114)".

[i.28]   ETSI TS 123 401: "Universal Mobile Telecommunications System (UMTS); General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (3GPP TS 23.401)".

[i.29]   ETSI TS 123 060: "Digital cellular telecommunications system (Phase 2+); Universal Mobile
            Telecommunications System (UMTS); General Packet Radio Service (GPRS); Service
            description; Stage 2 (3GPP TS 23.060)".

[i.30]   ETSI TS 123 228: "Digital cellular telecommunications system (Phase 2+); Universal Mobile
            Telecommunications System (UMTS); LTE; IP Multimedia Subsystem (IMS); Stage 2
            (3GPP TS 23.228)".

[i.31]   ETSI TS 102 936-1: "eCall Network Access Device (NAD) conformance specification;
            Part 1: Protocol test specification".

[i.32]   ISO 21217:2014: "Intelligent transport systems -- Communications access for land mobiles
            (CALM) -- Architecture".

[i.33]   ETSI TS 126 073: "Digital cellular telecommunications system (Phase 2+); Universal Mobile
            Telecommunications System (UMTS); LTE; ANSI C code for the Adaptive Multi Rate (AMR)
            speech codec (3GPP TS 26.073)".

[i.34]   EN 16102: "Intelligent transport systems - eCall - Operating requirements for third party support".

[i.35]   CEN TS 16405: "Intelligent transport systems - eCall - Additional data concept specification for
            heavy goods vehicles".

[i.36]   Draft-jesske-ecrit-ecall-urn-extension-00: "Uniform Resource Name (URN) extension for
            automatic and manual Emergency Services".

    NOTE: Available at http://tools.ietf.org/html/draft-jesske-ecrit-ecall-urn-extension-00.

3   Definitions and abbreviations

3.1   Definitions

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

circuit switched emergency call: CS voice call type TS12 teleservice, that is applicable in CS (2G and 3G) networks

    NOTE: This type is not applicable for PS based networks.

eCall: Pan European in-vehicle Emergency Call defined under the eSafety initiative of the European Commission

IMS eCall: eCall over IMS

    NOTE: That there can be other packet based solutions.

IMS emergency call: IP based emergency call that is applicable for PS based 3G and 4G networks

In-band eCall: CS voice call where the MSD is sent in the same voice channel, using in-band modem

ITS-station: entity in a communication network capable of communicating with other similar entities

    NOTE: This definition is based on ISO standards 21217.

The following definitions are copied from TS 124 008 [i.3]:

eCall-only: eCall-only mode, as described in TS 122 101

removal of eCall-only restriction: limitations as described in TS 122 101 for the eCall-only mode do not apply any
more

3.2 Abbreviations

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

ACEM Motorcycle Industry European Association
ACN Automatic Crash Notification
ADR Agreement on Dangerous goods by Road
AMR Adaptive Multi Rate
ANSI American National Standards Institute
ANSI-C American National Standard Programming Language C
APN Access Point Name
ASN Abstract Syntax Notation
AT Attention (command)
BSMD Bounded Secured Managed Domain
CALM Communications Access for Land Mobiles
CAN Controller Area Network (vehicle bus)
CB Call Barring
CDU Command Definition Utility
CLI Calling Line Identification
CM Connection Management
CR Change Request
CS Circuit Switched
CSCF Call Session Control Function
CSFB Circuit Switched Fall Back
DJB De-Jitter Buffer
ECRIT Emergency Context Resolution with Internet Technologies
EPS Evolved Packet Switch
ESM EPS Session Management
ETSI TC MSG ETSI Technical Committee MSG
FFS For Further Study
FG First Generation
GPRS General Packet Radio Service
GPS Global Positional System
HLAP High Level Application Protocol
IANA Internet Assigned Numbers Authority
ICB Incoming Call Barring
IETF Internet Engineering Task Force
IMS IP Multimedia Subsystem
IP Internet Protocol
ISIM IP Multimedia Services Identity Module
ITS Intelligent Transport System(s)
ITS-S ITS Station
IVS In-Vehicle System
LTE Long Term Evolution
MGW Media Gateway
MNO Mobile Network Operator
MSD Minimum Set of Data
MSRP Message Session Relay Protocol
MT Mobile Terminated
NAS Non-Access Stratum
NG Next Generation
OCB Outgoing Call Barring
OMA Open Mobile Alliance
OTT Over The Top
PCM Pulse Code Modulation
PDN Packet Data Network
PE Pan European
PLMN Public Land Mobile Network
PS Packet Switching
PSAP Public Safety Answering Point
QoS Quality of Service

RFC	Request for Comment
RTP	Real Time Protocol
RTSP	Real Time Streaming Protocol
SAP	Service Access Point
SDP	Session Description Protocol
SIB	System Broadcast Information
SIP	Session Initiation Protocol
SMS	Short Message Service
SS	System Simulator
STF	Special Task Force
TCP	Transmission Control Protocol
TPS eCall	Third Party Supported eCall (CEN)
TPS	Third Party Supported
UDP	User Datagram Protocol
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
URI	Uniform Resource Identifier
URN	Uniform Resource Name
USIM	Universal Subscriber Identity Module
UTRAN	Universal Terrestrial Radio Access Network
VoIP	Voice over IP
VoLTE	Voice over LTE
WAVE	Wireless Access in the Vehicular Environment
XML	Extended Markup Language

4   Introduction and General requirement

4.1   Context

Pan European eCall is an emergency call generated either automatically via activation of in-vehicle sensors or manually by the *vehicle occupants*; when activated, it provides notification and relevant location information to the most appropriate *Public Safety Answering Points* (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.*

This European Commission initiative of eCall was conceived in the late 1990s, and has evolved to a European Parliament decision requiring the implementation of In-vehicle system in new vehicles and the deployment of eCall in the European Member States in 2015.

Automotive manufacturers, and to a lesser extent aftermarket system providers have, in conjunction with PSAPs and MNOs, been working towards the Standardization and introduction of eCall for a decade. Although legally implementation will not be required until 2015, it takes several years of work in advance to build changes into automotive type acceptance tests and to introduce in-vehicle system into new models. Further, several automotive manufacturers already have private third party 'emergency call' support which they have had to amend to be consistent with and compliant with eCall. There is therefore already significant commitment and investment already made into the introduction of the system.

The Standardization aspects, both at the telecommunications level and at the application level were defined and standardized in the period 2002 - 2012 and the communications aspects are based on CS emergency call in GSM and UMTS networks.

The telecommunications sector, which always evolves rapidly, has made particular advances in the past decade. While the period 2000 - 2012 saw the widespread deployment of UMTS networks, which continue to expand to cover most of the continent, the next generation of cellular mobile communications, LTE/4G has been standardized and is beginning to roll out across Europe. This has a particularly significant impact on eCall because, while GSM and UMTS are partly 'circuit switched' networks, LTE are 'packet switched' only networks, therefore there is no circuit switched emergency call in LTE.

The existing standardized solution for eCall identification procedures and protocols are determined using the circuit switching technologies considering the circuit switched 'Teleservice 12' for voice. Further, eCall, as currently defined, establishes a voice channel and sends data within the voice channel, whereas the normal modus operandi for a packet switched network is the obverse - transmitting packets of data.

The existing standards relevant to IMS eCall are the "IMS Emergency Service" and the "IMS Emergency Multimedia Service". Only comparatively small additions are necessary to specify IMS eCall based on existing (and already implemented and deployed) standards [i.8],[i.9]. The existing IMS Emergency Call standards provide a very good basis for routing eCalls to the most appropriate PSAP if new URN classes can be defined in IETF [i.10], [i.1] for sos.eCall-Automatic, sos.eCall-Manual and eCall-Test. The IETF ECRIT is currently working on drafts for eCall [i.1] and ACN [i.12], the latter which contains information about activities outside Europe.

4.2 General considerations for IMS eCall

IMS is a platform for emergency voice calls in LTE. General requirements for eCall over IMS are based on requirements for eCall over CS defined in TS 122 101 [i.2] and additional considerations for the support of IMS that are mainly:

> NOTE: Some of these additional considerations are dependent on future CEN requirement changes.

- The voice component is based on VoIP and not TS12.

- The data to be carried over IP need not have limitations of max size of 140 bytes.

- Even though not required for eCall, it would be possible to have other media besides voice within eCall, between the IVS and the PSAP, as long as the required capabilities are supported by all involved parties (IVS, PSAP, MNO).

- eCall voice component and the Minimum Set of Data (MSD) are transported transparently and are subject to privacy considerations.

- The MSD and voice are sent to (or accessible by) the same PSAP-entity.

- An end-to-end receipt acknowledgement from the PSAP to the IVS is needed.

- In IMS eCall, there should be a network support indication for "IMS eCall" without first registering on a PLMN.

- In the future, IVSs need to support eCall for both CS and IMS to guarantee its connectivity across different networks and PSAP-implementations.

- There is no specific requirement to encrypt the MSD.

5 Non IMS solutions

5.1 In-band modem over VoIP

The eCall in-band modem is based on a pulse-position modulation scheme which requires proper time synchronization between the IVS and PSAP. Functions or systems that distort the timeline of the eCall signal by inserting or removing samples (e.g. sample slips, adaptive de-jitter buffering, and time-warping) can cause the sender and receiver to lose synchronization.

The eCall in-band modem employs a synchronization-tracker feature designed to compensate for occasional and small sample slips that occur in circuit-switched networks. This synchronization-tracker has also been shown to compensate for the occasional loss or insertion of voice frames caused by adaptive de-jitter buffering. The simulation results in Annex C illustrate how the performance of the in-band modem degrades when operating over a VoIP network with jitter. The results also demonstrate that, despite the degradation, the performance is still generally acceptable in conditions with modest amounts of jitter and when employing an adaptive de-jitter buffer that does not perform time-warping.

In commercial deployments, network equipment and devices can use more advanced de-jitter buffering techniques such as time-warping. This technique adapts to delayed or early-arriving packets by inserting or deleting sub-frame intervals into speech frames, spreading out the adaptation over multiple frames. This generally results in more frequent modifications to the timeline of the eCall signal which the synchronization tracker in an eCall modem cannot properly compensate for. Given the sensitivity of the in-band modem to time-warping that may be employed in commercial VoIP networks, the use of the eCall in-band modem is not recommended for operation over IMS. Besides dejitter problems, the other limitations of CS eCall would remain with this option such as only 140 octets MSD, loss of voice channel, and delay in establishing a voice path.

5.2   eCall over LTE with CS Fallback

CS Fallback enables fallback from LTE access to UTRAN/GERAN CS domain access. It is described in TS 123 272 [i.26] and available from Release 8. CS Fallback is only applicable for UEs that support also other services than eCall. Hence, while the UE is registered on LTE and eCall is triggered then CS Fallback may be performed.

> NOTE: eCall-only UEs are expected to only use IMS eCall if the network is broadcasting an IMS eCall support indicator (see clause 6).

An eCall IVS connected to LTE may perform the CS Fallback (CSFB) procedures defined in LTE and UTRAN/GERAN. In this case eCall IVS will use in-band modem over the CS domain and connect to a PSAP that supports the in-band modem capability.

The only requirement here is that the IVS and the MNO support CS fallback capabilities. No IMS/IP based eCall is involved in this solution.

5.3   eCall over LTE using Over The Top services (OTT)

Over The Top services run over internet based networks. In this case IMS is not required, the in-band modem is not available, and no standardized mechanism exists to transmit the MSD. However, in general, OTT currently does not provide and guarantee emergency services that are compatible to legal and regulatory requirements.

There is no standardized solution available for emergency services over mobile networks using OTT. Also, OTT may not fulfil some of the existing eCall requirements, e.g. routing to the eCall PSAP. Further, the MNO has little control over OTT. Therefore OTT is not discussed further in the present document.

5.4   ITS-Stations

ITS is an emerging technology which may potentially be applicable for eCall and related services. This is an area for further study.

In the past, it was proposed that the eCall platform could be the basis of hosting many telematics services into vehicles, indeed it could provide the 'Trojan horse' to get telematics technology into vehicles. This is unlikely to be the case and it is far more probable, and practicable, that future generation eCall can be carried over modern, secure, high capacity ITS-station platforms evolving to support a wide range of services.

Such telematics platforms will be digital, and most probably internet linked, and so will be 'packet switched' systems where, instead of the current solution of data being carried in the voice channel, the reverse will apply and voice will be carried in the data packets.

Concurrently, at the same time that the eCall project has been developed using existing GSM/UMTS technologies, the ITS sector has been developing systems based on a common telematics platform enabling bidirectional communication between vehicles, and between vehicles and the infrastructure.

The overall concept is to separate applications from the communications medium/media being used to carry the data.

In some cases, these systems may rely simply on architectural system design combined with security provisions for the public media to transfer data to safe 'addresses', by design removing much of the communications risk involved, with the main application services being conducted and provided 'landside' between a service provider and another landside client.

In other cases, and indeed the bulk of so called 'Co-operative - ITS' (C-ITS) applications, these will occur within a 'bounded secure managed domain'. Please see Annex B for more information.

6   IMS solution for eCall

The rationale for deciding to use IMS Emergency Call and IMS Multimedia Emergency Service is that citizen to authority "112" Emergency Services are already standardized for 3G/4G packet based cellular networks.

NOTE 1: The UE is included in the IVS.

NOTE 2: The descriptions in clause 6 sometimes describe the applicability to EPS. Similar principles and solutions are applicable to IMS eCall over UMTS-PS.

6.1   Aspects of IMS eCall

6.1.1   General

Based on the existing requirements of eCall and the potential additional requirements (see clause 4.2), analysis of the required changes for 3GPP specification (Stage 2 and Stage 3) are discussed in this clause.

6.1.2   eCall Architectural principles

6.1.2.1   General

The following architectural principles are applicable for both eCall over UMTS-PS and eCall over LTE/EPS.

UMTS supports both CS and PS domains, thus eCall can be supported on both domains. Configuration of the UE to prioritize CS or IMS eCall aligns with normal IMS emergency call procedures. Also the failure of receiving eCall service on one domain does not prohibit the UE from triggering the service on the other domain.

6.1.2.2   eCall Flag

eCall is differentiated from other emergency calls by an eCall Flag. The eCall Flag also indicates Automatic or Manual eCall mode.

The eCall flag is used by the MNO for identifying the emergency call as eCall and for routing it to the appropriate PSAP. The eCall flag also helps the receiving PSAP to differentiate the emergency session as an eCall. The appropriate PSAP needs to be capable to receive and interpret the MSD data, i.e. to support eCall.

The eCall Flag for "Automatic eCall" or "Manual eCall" has to be included in the IMS signalling by the IVS (see clause 6.1.3.1). The CSCF should differentiate and route the eCall based on this indication. Routing of an eCall to a PSAP in the PS/IMS domain should be performed using "SOS.eCall" URNs instead of the service category in the CS emergency call setup message.

6.1.2.3   Voice and any additional media sessions

The support of voice, and possibly other media (such as video, real-text communication,), should be negotiated between the IVS, MNO and PSAP over IMS/IP using the Session Description Protocol (SDP), and the actual media stream will then be sent in RTP packets. This should follow the same procedures as for Voice and Multimedia IMS emergency services.

For the time being, there is no requirement for eCall (as EU mandate, ETSI or CEN requirements) to support other media than voice services and to facilitate the transport of MSD. In regards to the MSD transport (see clause 6.1.2.4), depending on the solution, there may or may not be a requirement for an additional media session.

6.1.2.4 Transfer of MSD data

eCall consists of, in additional to the voice service, a minimum set of data (MSD) that is sent from the IVS to the PSAP. The IVS expects a confirmation from the PSAP indicating that the MSD is received and interpreted. The MSD is defined to be 140 bytes for eCall. The limitation of 140 bytes takes into consideration the capability of data transfer over the CS domain, however larger eCall data sets could be supported over the PS domain and IMS. Additional Data may also be supported in the future.

The PSAP should send an acknowledgement, during or after the eCall connection, towards the IVS confirming a successful reception of the MSD on the application layer. The PSAP operator may request further information from the IVS, by requesting an updated MSD.

MSD requirements are defined by CEN (CEN 15722 [i.6]). The MSD needs to be transported transparently over the MNO network, and not to be stored for longer than that required for a successful transport of the MSD. The MSD is not used for routing in the MNO network.

A new eCall High Level Application Protocol for IMS eCall will be required (under responsibility CEN), regardless of the underlying transport protocol.

6.1.2.5 Location information of the vehicle

In eCall, the PSAP should always receive the location information as part of the MSD. In addition, the location information of the vehicle can also be provided by the MNO (e.g. in the SIP INVITE messages) that is based on the network/UE location information supported features, similar to the basic IMS emergency service solution. The two sources of location information improve confidence (e.g. by comparing information in the MSD, inserted by the IVS with information received from the MNO).

During an eCall, the PSAP may request the MNO for additional location information (e.g. in case the vehicle is changing location after triggering eCall).

> NOTE: Location information provided by the MNO in the SIP INVITE messages is not to be extracted from the MSD, where the latter is transported transparently.

6.1.2.6 Caller identity

Calling Line Identification (CLI) is required for allowing the PSAP to callback the eCall UE. The MNO should provide the CLI to the PSAP in a similar way to the IMS Emergency Service. CLI should be presented in the same way.

6.1.2.7 Identifying network support for eCall over IMS

To ensure the success of the IMS eCall, it is seen necessary to indicate the network support for IMS eCall in the system broadcast information. The introduction of the broadcast indicator for IMS eCall support should be specified (see clause 6.1.3.9).

If the eCall-only UE would request an IMS eCall emergency service from a network not supporting IMS eCall, but supporting only IMS emergency services, then the IMS eCall cannot be differentiated by the network and the PSAP. In this case, IMS eCall is either treated as any other IMS emergency session or the IMS eCall request is rejected by network forcing the UE to search for another network and try again. This would be time consuming. The proposed indication in the System Information Broadcast would speed up this procedure substantially.

> NOTE 1: The MNO sets the IMS eCall support indicator (i.e. the System Information Broadcast Flag) once it configures its routing tables to support routing of IMS eCalls to the PSAP supporting IMS eCall after these PSAPs have been upgraded. See also clause 7 for the definition of this "SIB Flag NG".

> NOTE 2: In case of searching for another network, some conditions might be required to allow the UE to receive emergency services (based on CS or PS), for example after x failed tries to find a network supporting IMS eCall, the UE registers to any network that supports IMS emergency services, or CS emergency services in case the UE supports the CS based/in-band modem eCall. For the IMS emergency services, once the request fails the UE may try again a CS emergency call, or try IMS emergency call on another network, or in case of shared networks then the UE tries on another network of the shared-networks. Conditions are to be followed as described in TS 124 229 [i.8] and TS 124 301 [i.14].

6.1.2.8   Mobility management and session management for IMS eCall

Based on TS 122 101 [i.2], eCall requirements for mobility management and session management have only an impact on the UE.

IMS eCall should follow the related IMS emergency bearer services procedures for mobility management and session management, with the additional requirements for eCall-only mode that is described below.

6.1.2.8.1   Mobility management

The eCall-only UE should be able to read the broadcasted cell information, and initiates its registration to the network once IMS eCall is triggered. The eCall-only UE in inactivity mode should not perform mobility management procedures unless an eCall is triggered, that leads to performing the attach procedure. The eCall-only mode is described in TS 122 101 [i.2].

> NOTE: More details on the attach type for eCall-only UE is described in the key implementation principles (see clause 6.1.3).

Only the PSAP has authority to terminate the eCall. After an IMS eCall is terminated between the eCall-only UE and the PSAP, the eCall-only UE should continue its mobility management procedures, to allow receiving call-back, for a predefined period of time (Timer xy). Following the expiration of this limited time, the eCall-only UE should perform "eCall inactivity procedure" and detaches from the network. A PS inactivity procedure for eCall needs to be described in stage-3 NAS specifications TS 124 301 [i.14] and TS 124 008 [i.3].

For an eCall-only UE in PMM-DETACHED mode for UMTS and EMM-DEREGISTERED for EPS, upon triggering an IMS eCall and attaching to the network, the UE should move to PMM-CONNECTED mode for UMTS and ECM-CONNECTED mode for EPS. The UE then returns to PMM-IDLE Mode for UMTS or ECM-IDLE Mode for EPS once the IMS eCall is terminated, and keeps these states for a predefined period of time (Timer xy) and then returns to the inactivity state. More details regarding UE states description for IMS eCall needs to be provided in stage-3 NAS specifications TS 124 301 [i.14] and TS 124 008 [i.3].

Similar requirements and procedures apply for an eCall-only UE that requests a test or reconfiguration session. Further, for the test or reconfiguration of an eCall-only UE, the UE should perform a normal attach procedure (requesting a PDN connection to a preconfigured destination). When the test or reconfiguration call is terminated, the eCall-only UE should continue to be in Idle Mode for a predefined period of time (Timer xx) and then return to the inactivity state, if applicable.

After removal of the eCall-only restrictions, normal mobility management procedures apply.

6.1.2.8.2   Session management

An eCall-only UE should be configured to perform an emergency call and to transfer the MSD, hence there are no additional requirements on the NAS session management level in setting up the required bearers. This leaves the eCall-only UE to perform a voice session requiring an IMS signalling bearer and a data bearer to carry the voice.

The Emergency Access Point Name is used for IMS eCall.

The IMS eCall test session is considered as an eCall to a preconfigured PSAP to receive test eCalls, or a non emergency session to an appropriate test point. The IVS needs to have knowledge of the URN to reach the test point. The serving MNO should be able to route the test eCall appropriately.

The user may request to contact the home operator for the purpose of reconfiguring his/her UE and thus the accessibility to provisioned services. It is possible that a specific APN is configured by the home operator in the eCall-only UE to allow the user to contact his/her service provider for reconfiguration sessions. In this case, the eCall-only UE would use the preconfigured contact information to request a PDN connection towards the home operator. Reconfiguration of the UE may lead to removal of eCall-only restrictions.

On removal of the eCall-only restriction, the restriction on session management bearers that is configured in the UE should also be removed, and that is achieved by configuring the UE to support also other services than eCall. The service provider may reconfigure a UE supporting eCall to an eCall-only UE.

6.1.2.9 Call-back for eCall

Call-back for eCall is required for the PSAP and first responders to be able to talk again to the vehicle occupants. Call-back also allows the PSAP to request a new MSD after the initial eCall has terminated. For an eCall-only UE that is capable to receive call-back, a time of Timer xy should be started after eCall termination allowing the UE to receive call-back.

In the present IMS specifications, the UE does not recognize a PSAP call-back (including Release 12) so any MSD transfer may need to occur during the initial call or if the UE initiates another eCall.

> NOTE 1: Instead of call-back, it may be possible to meet the eCall requirements by leaving the session open for example one hour.

The main requirements that need to be considered are (see TS 122 101 [i.2]):

   a)   clause 10.7 - Transfer of data during emergency calls:

UEs designed to be able to perform transfer data during emergency calls and configured to only perform emergency calls with transfer of data (eCall only mode) shall comply with the following additional requirements:

   […]

   - *For UEs that have the ability to be called back by the PSAP, the UE shall be capable to continue mobility management procedures for a limited duration following the termination of the eCall.*

[…]

   b)   clause 10.1.3 - Call-Back Requirements:

Subject to local/regional regulations the network shall support a call-back from a PSAP.

[…]

A call-back may be attempted for a period of time defined by local regulations after the emergency call release. In case of a UE in limited service state, call-back is not required.

> NOTE 2: It seems that call-back in IMS emergency services solution in Release 12 does not support UEs attached for emergency bearer services and/or has IMS emergency registration only where call-back is considered as a normal call. Despite this, the requirements differentiate call-back from a normal call as indicated in TS 123 167 [i.13] (clause 4.1- bulletin 12). It seems that call-back still has issues to be solved on IMS level that will eventually impact eCall solution. *[also see discussion on CT1 email reflector http://list.etsi.org/scripts/wa.exe?A2=ind1309B&L=3GPP_TSG_CT_WG1&F=&S=&X=2F7B7673C7A 6709D0B&Y=ban.albakri%40gmail.com&P=5334].*

6.1.2.10 USIM configuration

The eCall-only UE configuration should be performed by the home operator to limit the mobility management procedures and the services offered to the subscriber. This is achieved by configuring the USIM.

> NOTE: Throughout the document the term "USIM" is used that reflects both the USIM and ISIM.

The eCall-only USIM should be configured such that the UE performs inactivity mode to limit the mobility management procedures (the inactivity mode is to be described in TS 124 008 [i.3] and TS 124 301 [i.14]).

In eCall-only mode, the USIM should be configured by the home operator to perform IMS emergency voice call, send MSD data, perform test eCall, connect to the service provider to get reconfigured, and possibly to receive call-back.

On removal of eCall-only restriction from the USIM, in addition to eCall the UE can perform any service it has subscribed to (see TS 122 101 [i.2], clause 10.7 - Transfer of data during emergency calls):

   - *In the case where the user subscribes to other services provided by the PLMN, it shall be possible for the network operator to reconfigure the UE so that it can access the subscribed services.*

The IMS eCall feature on the USIM should, if possible, make use of the information configured for CS eCall (see TS 131 102 [i.15], clause 5.3.40).

6.1.2.11   AT Command

A new AT command for IMS eCall, between the IVS and its UE, where the UE does not use the eCall in-band modem and only requires an emergency PDN connection, is assumably not required. The existing AT command for eCall is specified in TS 127 007 [i.24]. It does of course not differentiate between CS and IMS, but probably can be reused, unless a use case is identified needing a new specific AT command to invoke IMS eCall. Adding new AT commands is considered as an easy task, local to the IVS, not affecting networks or PSAPs.

6.1.3   IMS eCall key implementation principles

6.1.3.0   General

This clause describes the key issues and principles that need to be taken into consideration when standardizing IMS eCall.

For simplicity the solutions in this clause may only refer to EPS, however the applicability of the key issues and the solutions are similar to GPRS.

Analysis of several options, evaluations and conclusions are provided based on STF456 findings and offline discussions with stakeholder's experts expressing their opinions as well as the review by ETSI TC MSG.

6.1.3.1   Key Issue #1: indicating the eCall Flag

The eCall Flag (manual, automatic) is used by the MNO to identify, filter and route eCall to the appropriate PSAP. It also helps the PSAP to differentiate eCall from other emergency services. The UE includes the eCall Flag in the signalling messages sent to the PSAP.

To ensure conveying the eCall flag from the UE towards the MNO and the PSAP feasible solutions are considered, where the eCall flag is to be sent in the SIP INVITE message.

   NOTE: PSAP communication with third party to obtain further data related to the accident and its occupants is out of scope of the present document.

6.1.3.1.1   Solution #1

6.1.3.1.1.1   Description and Analysis

   -      Introducing URNs that identify the emergency call as IMS eCall and also specify if it is manual or automatic.

Because eCall itself, as well as its automatic and manual modes, is considered a specific service distinguished from general emergency services, and because of the specific response and treatment implications of eCall itself as well as its sub-modes, it is appropriate that eCall itself be a sub-service of the general "SOS" service, and that the eCall modes be sub-services of the eCall service.

IANA registration for the following is required:

   -      URN 'urn:service:sos.ecall' - under the sub-services 'sos' registry.

   -      Two sub-services are registered as well, namely:

      -      urn:service:sos.ecall.manual

      -      urn:service:sos.ecall.automatic

IMS Emergency Call provides a very good basis for identifying and routing IMS eCalls to the appropriate PSAP. The URN (urn:service:sos) is used to identify and route an emergency call, and the URNs (urn:service:sos.ecall.automatic and urn:service:sos.ecall.manual) are used to identify and route an IMS eCall.

   NOTE: The solution of using IETF draft draft-jesske-ecrit-ecall-urn-extension-00 [i.36], proposing to expand the URNs to cover different combinations of categories, did not gain consensus in IETF-ECRIT#87. Therefore this IETF draft is not considered in the STF456 solutions. Also see clause 6.1.7.

6.1.3.1.1.2   Evaluation

This method is recommended since it is simple and it achieves transferring the eCall flag (via eCall URN) and utilizing it to identify eCall, filter the type of eCall and route it to the appropriate PSAP based on the URNs. This solution is also in line with the IETF draft [i.1].

6.1.3.1.2   Solution #2

6.1.3.1.2.1   Description and Analysis

-    Using URNs that identify the call as emergency call and possibly as eCall.

-    Specify eCall as manual or automatic in the INVITE message in a new parameter.

6.1.3.1.2.2   Evaluation

This method is not recommended since it causes unnecessary modification of the SIP protocol.

6.1.3.1.3   Solution #3

6.1.3.1.3.1   Description and Analysis

-    Using a parameter in the Request-URI to identify the call as an IMS eCall.

-    Specify IMS eCall as manual or automatic, using a new parameter in the Request-URI header field of the INVITE message, or in a new header field.

6.1.3.1.3.2   Evaluation

This method is not recommended as it is more complex and requires new standardization work.

6.1.3.2   Key Issue #2: Transfer of MSD data

Several options exist on how to transport the MSD over IMS. This clause provides description and analysis for each possible solution.

The IVS expects to receive either a confirmation from the PSAP indicating it has successfully received the MSD and that the MSD was decoded correctly by the eCall application, or a new MSD transmission is required by the PSAP (see key issue#10).

6.1.3.2.1   Solution #1

6.1.3.2.1.1   Description and Analysis

-    The IVS supports IMS eCall and the PSAP supports only eCall modem based (CS based) configuration.

-    MSD is sent by the IVS multiplexed in the same RTP as the voice to the IMS media gateway and then in-band to the PSAP.

Mapping and conversion of PS to CS (eCall modem based) is to be performed in the IMS Media-Gateway. Furthermore, the transmission of the MSD sent within a packet-switched voice session can be delayed or degraded by VoIP processing functions, such as time-warping in the VoIP de-jitter buffers.

6.1.3.2.1.2   Evaluation

This solution is not recommended, because it adds delays, degradation of voice quality and unreliable reception of MSD data, and design complexity especially to the IMS MGWs.

6.1.3.2.2   Solution #2

6.1.3.2.2.1   Description and Analysis

-    The IVS supports IMS eCall and the IP based PSAP supports IMS eCall.

-    MSD is sent by the IVS multiplexed in the same RTP stream as the voice to the appropriate PSAP.

Voice and data (MSD) have different QoS requirements hence should not be multiplexed on the same session/stream. Also, multiplexing of MSD with voice on the same RTP stream requires filtering at the PSAP. Furthermore, the performance of MSD delivery multiplexed within the packet-switched voice session can be degraded by time-warping operations performed in the VoIP de-jitter buffers at the end points.

6.1.3.2.2.2   Evaluation

This solution is not recommended because it adds delays, degradation of voice quality and unreliable reception of MSD data, as described in clause 6.1.3.2.2.1.

6.1.3.2.3   Solution #3

6.1.3.2.3.1   Description and Analysis

-    The IVS supports IMS eCall and IP based PSAP supports IMS eCall.

-    MSD is sent by the IVS and carried in the IMS SIP signalling to transmit the data from the IVS to the appropriate PSAP by signalling means, but not by the in-band modem and not on an User Plane bearer.

-    The PSAP responds to the IVS indicating the reception and successful decoding of the MSD, or indicating a requests for a new MSD transmission. This is performed by using the SIP-INFO method / RFC 6086 [i.16] (see also Key issue#10 -Solution#1).

The MSD is carried by the IMS signalling ensuring its reception during eCall session set-up; example is, sending the MSD in the SIP INVITE message.

This method guarantees that the destination PSAP receiving the SIP INVITE message receives the MSD (within the signalling message) at the same time.

6.1.3.2.3.2   Evaluation

This method is found compelling for the current MSD and credible especially in relation to efficiency in timing and solution simplicity.

This method may be adopted by using the IETF draft [i.1] or might be implemented directly in the ETSI IMS specifications. The IETF draft [i.23] describes how to carry data structures and a mechanism to convey such data from an emergency device to the PSAP.

The MSD can be delivered to the PSAP as part of the voice session setup.

A disadvantage may be that the SIP INVITE carries non-signalling data and the IMS Network should handle this.

The SIP INVITE is able to carry more data than is currently specified in the MSD. However it is not unlimited as it will depend on implementation in the network.

6.1.3.2.4   Solution #4

6.1.3.2.4.1   Description and Analysis

-    The IVS supports IMS eCall and the PSAP supports IMS eCall.

-    The IVS indicates in the SIP INVITE message towards the PSAP its capability of sending MSD (eCall flag should be sufficient here).

-    The MSD is sent by the IVS using Real Time Streaming Protocol (RTSP)- RFC 2326 [i.17].

6.1.3.2.4.2 Evaluation

Some advantages are that RTSP messages can be exchanged in both directions quite flexibly at any time, also during the call and are not limited in size. A disadvantage is that they take the path via the control plane nodes and this is questionable.

NOTE: The MSD transfer cannot be started until the session is established. The IVS and the PSAP have to support an additional transport protocol.

Implementing both SIP/IMS and RTSP would add cost due to the duplication of network components, separate maintenance functions, and scaling inefficiency.

Therefore this option is not recommended.

6.1.3.2.5 Solution #5

6.1.3.2.5.1 Description and Analysis

- The IVS supports IMS eCall and the PSAP supports IMS eCall.

- The MSD is sent out of band between the IVS and the PSAP, via a separate media session on the user plane. Examples include using Message Session Relay Protocol (MSRP) - RFC 4975 [i.11] to carry the files/data between the endpoints as described in RFC 5547 [i.19], or the Real Time Protocol (RTP) as "RTP Payload for Text Conversation" - RFC 4103 [i.20] that is already used in IMS.

Reliable transport is required, hence the selection of a TCP connection or using a UDP connection (that requires a reliable higher layer/application protocol) and the significance of the additional delays should be taken into consideration.

This solution requires additional UE configurations to allow additional media than voice, also adds additional requirements to the PSAPs to support other media sessions than voice. This leads to additional complexity.

It is not clear if all operators implement the MSRP protocol in their networks.

6.1.3.2.5.2 Evaluation

The main advantage is that this is based on the existing standard for text-session in IMS emergency call, extendable to larger data sets and any kind of bidirectional communication.

The main disadvantage is that IVS and PSAP need to implement the support for this additional media session (e.g. RTP Payload for Text Conversation or MSRP to carry the files/data blocks between the endpoints).

NOTE 1: The MSD transfer cannot be started until the session is established.

NOTE 2: The transmission delay for the MSD is assumed to be negligible compared to the human reaction in reading the MSD and anyhow is not affecting the speech path.

6.1.3.2.6 Solution #6

6.1.3.2.6.1 Description and Analysis

- The IVS supports IMS eCall and the PSAP supports IMS eCall.

- The MSD is carried from the IVS to the PSAP over SMS over IMS.

This option is not found advantageous or favourable since the arrival of the SMS in time to the same PSAP where the voice service is already connected to cannot be guaranteed. Also emergency SMS, with high priority, may not be supported in all operator's networks.

6.1.3.2.6.2 Evaluation

System complexity would be added by guaranteeing that voice and MSD arrive to the same PSAP and without delay. Cost to the MNOs is involved. It is also considered as not a future proof solution.

Therefore this option is not recommended.

6.1.3.2.7 Solution #7

6.1.3.2.7.1 Description and Analysis

- The IVS supports IMS eCall and in-band modem. The PSAP supports only eCall modem based (CS based) configuration.

- MSD is sent by the IVS by in-band modem (within in the voice channel) to the IMS media gateway and then in-band to the PSAP similar as in CS eCall.

For CS eCall transcoding is performed in the CS-MGW from e.g. AMR to PCM. Here the transcoding is performed in the IMS Media-Gateway. The transmission of the MSD via in-band modem within a packet-switched voice session on LTE can be delayed or degraded by VoIP processing functions in the IMS-MGW, such as time-warping in the VoIP de-jitter buffers. See Annex C for an assessment of its performances.

NOTE: This solution relates to the migration scenarios 11b described in clause 7.

6.1.3.2.7.2 Evaluation

This solution adds delays, degradation of voice quality and unreliable reception of MSD data. It is not recommended as a solution.

6.1.3.3 Key Issue #3: Security and Privacy of the MSD

6.1.3.3.1 Solution #1

6.1.3.3.1.1 Description and Analysis

Generally eCall inherits the security of the cellular network. The MNO has to respect the privacy of the MSD information carried over its network between the IVS and the PSAP (not to be shared with a third party).

Since the MSD is transported transparently, the MNO need not look into the MSD. For the time being, there are no requirements for ciphering the information of the MSD.

6.1.3.3.1.2 Evaluation

No additional privacy considerations are required for the MSD as known today. Any possible future requirements may need to take into account the capabilities of the solution chosen to send the MSD.

6.1.3.4 Key Issue #4: PSAP request for updated MSD

During an active emergency call, a further request/communication of data between the PSAP and the eCall-only UE can be achieved in several ways. Security, data protection and privacy need to be considered when sending the MSD (as described in key issue-3).

Some options are listed below.

6.1.3.4.1 Solution #1

6.1.3.4.1.1 Description and Analysis

- Subscription to SIP-event notification, using SUBSCRIBE - NOTIFY / RFC 3265 [i.21].

In this case a new event package needs to be introduced.

Note that in the existing 3GPP IMS specifications, the event notification is not allowed for emergency services (UE - PSAP).

6.1.3.4.1.2   Evaluation

The 3GPP specifications do not allow this option and additional standardization work on IMS level would be required.

6.1.3.4.2   Solution #2

6.1.3.4.2.1   Description and Analysis

-       Using SIP-INFO method / RFC 6086 [i.16].

In this case INFO packages need to be introduced. The INFO package mechanism provides the tools for secure, end-to-end transport of application data. The INFO packages are exchanged bidirectionally between the IVS and the PSAP and are transparent to the IMS core network.

6.1.3.4.2.2   Evaluation

This seems to be an acceptable way forward.

6.1.3.4.3   Solution #3

6.1.3.4.3.1   Description and Analysis

-       Using a new media flow (example media to transport data) within the emergency session.
        See clause 6.1.3.2.5 Solution #5 (Transfer of MSD data) via e.g. MSRP.

6.1.3.4.3.2   Evaluation

This seems to be an acceptable way forward.

6.1.3.5   Key Issue #5: Mobility Management - eCall inactive mode

The eCall-only mode UE (as determined by information configured in USIM) in inactive mode camping on a cell that provides the IMS eCall service, should not perform mobility management procedures. Once an eCall is triggered, the eCall-only UE should register to the network by performing the attach procedure.

6.1.3.5.1   Solution #1

6.1.3.5.1.1   Description and Analysis

The eCall inactive state, similar to eCall for CS, is to ensure that the UE is powered on, but stays deregistered and ready to perform its registration once an eCall is triggered. The eCall inactivity procedure ensures that the eCall-only UE falls back to the inactive state required by CEN 16062 [i.7].

During eCALL-INACTIVE state, the UE should:

-       not perform periodic Tracking area updating;

-       not perform detach;

-       reject any requests from CM entities for ESM connections except for emergency bearer services and to a non-emergency service for test and terminal reconfiguration services;

-       not perform normal tracking area updating; and

-       not respond to paging.

6.1.3.5.1.2   Evaluation

This solution is similar to eCall for CS. It has the benefit of allowing the UE to be powered on without the need for registering to the network. This is required to eliminate the unnecessary mobility management procedures that cause load on the network as well as fulfilling the privacy requirement not to trace the vehicle unless it activates eCall.

Despite some complexity in its implementation, it has been tested and it proven that it works.

6.1.3.6   Key Issue #6: Session Management - Limiting the sessions

Based on eCall-only UE requirements, outgoing calls from the UE are limited to eCall, eCall test, reconfiguration call, and the incoming calls should ideally be limited to call-back from a PSAP and communication from the operator (when the UE is in connected mode).

Possible solutions to achieve this are described below.

6.1.3.6.1   Solution #1

6.1.3.6.1.1   Description and Analysis

The service provider configures the USIM to limit the outgoing calls by providing the identities URNs that the UE can use for initiating the services defined within eCall. This is similar as in TS 131 102 [i.15], clause 5.3.40.

6.1.3.6.1.2   Evaluation

This is a possible solution, in that it is also provided for eCall for CS.

6.1.3.6.2   Solution #2

6.1.3.6.2.1   Description and Analysis

The service provider configures the USIM and the subscription of the user to limit the communications to eCall, test, reconfiguration, and call-back from PSAP by the use of the IMS supplementary services -Communication Barring (CB) services (see requirements in TS 122 173 [i.22], clause 8.2.10):

- Outgoing Communications Barring (OCB); to bar all outgoing communications apart from eCall test and reconfiguration sessions. Setting up eCall sessions are not impacted by this barring configuration.

- Incoming Communications Barring (ICB); to bar the UE from receiving incoming calls apart from call-back or operator session.

   NOTE: It is not clear how this specific ICB would work since a PSAP or an operator call-back may not always be recognized as such (i.e. not differentiated from a normal call, which is barred).

6.1.3.6.2.2   Evaluation

This solution is applicable once the UE is registered to the network. The call-back problem needs more study.

This solution is valid and it achieves the requirements assuming valid incoming calls can be recognized.

6.1.3.7   Key Issue #7: Mobility Management and Session Management - attaching and requesting eCall session

An eCall UE should always have a USIM with valid credentials, and is configured to support eCall.

An IMS eCall UE should register to the network by performing the attach procedure and then receives eCall by requesting an emergency session. An IMS eCall UE will perform network registration and authentication procedures in the same manner as a normal IMS emergency call.

For the proposed NAS procedures description, please refer to the CRs in Annex A for TS 124 008 [i.3] and TS 124 301 [i.14].

6.1.3.7.1   Solution #1

6.1.3.7.1.1   Description and Analysis

- The eCall is triggered on the eCall-only UE, that is in its inactive mode.

- The eCall-only UE performs the emergency attach procedure, and the network selects the emergency APN for the default bearer, allowing the UE to perform IMS emergency registration and receive emergency services.

6.1.3.7.1.2   Evaluation

This solution is optimum in respect to time to set up the call, the resources provided to the session and the service to be offered to the UE. However, based on the current specification (3GPP Release 12) the UE is not able to receive call-back.

To receive call-back, the UE needs also to be registered on IMS (normal registration) as described in current specifications (3GPP Release-12).

If call-back is not required for eCall then this is the optimum solution.

> NOTE: Depending on the requirements and stage 3 specifications of call-back change (see clause 6.1.2.9), there may be a possible solution for not requiring normal registration to IMS.

6.1.3.7.2   Solution #2

6.1.3.7.2.1   Description and Analysis

- An eCall is triggered on the eCall-only UE, that is in its inactive mode.

- The eCall-only UE performs normal attach procedure with a default bearer's APN set to IMS (that is included in the protocol configuration option), allowing the UE to register to IMS.

- The UE requests an emergency PDN connection, and the network selects the emergency APN for this session, allowing the UE to perform IMS emergency registration and receive emergency services.

This solution allows the UE to receive call-back based on the current solution (3GPP Release 12). However the first attach request with the default PDN connection does not indicate any emergency session request, hence the network may reject the attach request in case of congestion and may lead to back-off the UE. The UE may follow this procedure by an emergency attach that is described in solution#1.

This solution also leads to some delay in setting up the first PDN connection and then requesting the second PDN connection for emergency services.

6.1.3.7.2.2   Evaluation

This is a possible procedure, especially if call-back is required based on current specifications (3GPP Release 12). The main drawback is that the network may not recognize the requested attach as an emergency attach and may reject the attach request in case of congestion, and subsequently delay occurs in providing the emergency service.

> NOTE: If call-back requirements and solution change in future releases of the 3GPP specifications (see clause 6.1.2.9) and if a PSAP callback can always be reliably recognized by a home network, then this solution is not seen as the best solution.

6.1.3.7.3   Solution #3

6.1.3.7.3.1   Description and Analysis

Similar to solution#2 with the following differences:

It is possible not to request the APN in the attach procedure and a default APN should be set up (providing ex. internet browsing service), and afterwards the registration to IMS requires the default bearer to be reconfigured to provide the parameters appropriate for the session, example the QoS. As long as the default bearer is set up to the default APN, it may give the user the possibility to use services (e.g. internet browsing), especially if the UE is not configured correctly. The reconfiguration of the default bearer leads to more delays.

6.1.3.7.3.2   Evaluation

This option has the disadvantage of leading to delays and may allow the UE to receive services not meant to be provided for the user while UE is configured to eCall-only mode.

For all the reasons above this option should be excluded.

6.1.3.7.4   Solution #4

6.1.3.7.4.1   Description and Analysis

- An eCall is triggered on the eCall-only UE, that is in its inactive mode.

- The eCall-only UE performs normal attach procedure including a PDN Connectivity Request without APN, but with request type = "emergency call".

- The network selects the emergency APN for this session, allowing the UE to perform IMS emergency registration and receive emergency services.

This option is possible but requires further investigating and agreement of stakeholders. There are 2 considerations here:

1) with the normal registration, the network would accept to provide the UE a PDN connection for call-back (as a normal call);

2) the current specifications (3GPP Release 12) indicate that if the UE has only an emergency PDN connection then it is considered as emergency attached. This leads to solution#1.

6.1.3.7.4.2   Evaluation

This solution should be further investigated, it does not seem to behave differently than solution#1.

6.1.3.7.5   Solution #5

6.1.3.7.5.1   Description and Analysis

- the UE attaches and performs eCall similar to solution#1.

- after eCall is terminated, the UE detaches from the network.

- the eCall- only UE performs a normal attach towards the network, including a PDN Connectivity Request with a default bearer's APN set to IMS (that is included in the protocol configuration option), allowing the UE to register to IMS and to receive call-back.

This solution is also considered as a possible option, where the second attach is performed only if the UE is capable to receive call-back. The drawback is that the time required for the UE to perform attach procedure and also to register to IMS can lead to missed call-back requests from the PSAP. The PSAP needs to try several times to reach the eCall-only UE.

6.1.3.7.5.2   Evaluation

The solution is similar to solution#1 with an alternative solution to make it possible to receive call-back.

6.1.3.8   Key Issue #8: Where to specify changes to SIP messages

6.1.3.8.1   Solution #1

6.1.3.8.1.1   Description and Analysis

The required changes to the SIP INVITE message are provided in an IETF draft draft-gellens-ecrit-ecall-01.txt [i.1] that is to be adopted for the IMS specifications. This mainly includes the new URNs as eCall flag, transporting the MSD transparently (see key issue#2), PSAP acknowledging the reception of the MSD (see key issue#10), and PSAP requesting an updated MSD (see key issue#4).

6.1.3.8.1.2   Evaluation

This solution helps providing a general IP based solution for eCall independent of being implemented for IMS.

6.1.3.8.2   Solution #2

6.1.3.8.2.1   Description and Analysis

The required changes to the IMS SIP INVITE message are provided directly in IMS specifications. This mainly includes the new URNs as eCall flag, transporting the MSD transparently (see key issue#2), PSAP acknowledging the reception of the MSD (see key issue#10), PSAP requesting for an updated MSD (see key issue#4).

6.1.3.8.2.2   Evaluation

This is an option that provides IMS specific solution. It requires less maintenance in referencing to an external specification (i.e. the IETF recommendations).

6.1.3.9   Key Issue #9: Identifying network support for IMS eCall

When the IVS receives early information of the various visible access networks providing IMS eCall support, it needs not to "try-and-error" and can register on the optimal access immediately, without losing time. This early information should be provided by the System Information Broadcast Blocks in the access network.

6.1.3.9.1   Solution #1

6.1.3.9.1.1   Description and Analysis

Indicate in the System Information Broadcast (SIB flag) that the network supports IMS eCall, see clauses 7 and 8.1.2.7.

In respect to IMS eCall set-up time, it is considered too late in the procedure to send the network support (IMS eCall indicator) in the NAS signalling messages, where the IMS eCall UE needs to register to the appropriate network.

The required changes to introduce a new SIB flag solely for this specific eCall application need to be discussed in 3GPP RAN2 (FFS).

6.1.3.9.1.2   Evaluation

Inclusion of an IMS eCall indicator in the System Information Broadcast is seen essential.

6.1.3.10   Key Issue #10: PSAP acknowledgment to the IVS (receiving the MSD)

The PSAP should acknowledge to the IVS its error free reception and successful decoding of the MSD. Otherwise, in case of transmission failure, the PSAP may request a new MSD transmission (repetition). The acknowledgment of a successful decoding of the MSD is sent by the eCall application layer.

This acknowledgment and the potential request for retransmission can be sent from the PSAP to the IVS in different methods including the solutions listed below.

   NOTE: Since the IVS expects a confirmation from the PSAP indicating that the MSD is received and interpreted, failure in receiving this confirmation leads to voice only session.

6.1.3.10.1   Solution #1

6.1.3.10.1.1   Description and Analysis

The acknowledgement from the PSAP to the IVS indicating the reception and decoding of the MSD during an ongoing session can be performed by using SIP-INFO method / RFC 6086 [i.16]. Also the PSAP may request a new MSD using SIP-INFO method as long as the session is still active. See key issue 2/solution #3 (clause 6.1.3.2.3.1) and key issue 4/solution#2 (clause 6.1.3.4.2.1).

In this solution a new INFO packages need to be defined. The INFO package mechanism provides the tools for secure, end-to-end transport of application data. See IETF draft [i.1].

6.1.3.10.1.2   Evaluation

Since the reception of the MSD is in the SIP INVITE message, the PSAP can take instantaneous action based on analysing the received MSD data.

This solution is feasible as long as there is an active session between the UE and the PSAP. It requires defining a new SIP-INFO package.

6.1.3.10.2   Solution #2

6.1.3.10.2.1   Description and Analysis

The acknowledgement from the PSAP to the IVS indicating the reception and successful decoding of the MSD during an ongoing session can be send over a media session. In case the MSD is sent over a media session (see key issue 2/solutions#1,#2, #4,#5) then the acknowledgment from the PSAP may be sent over the same media session.

Also the PSAP may request a new MSD using a new media session as long as the session is active. See key issue 4/solution #3 (clause 6.1.3.4.3.1).

6.1.3.10.2.2   Evaluation

This is a feasible solution, however similar issues as in the referenced key issues/solutions (key issue 2/solutions#1,#2, #4,#5) may arise leading to additional resources, complexity, delay, etc.

6.1.3.11   Key Issue #11: defining identification for IMS eCall reconfiguration and test service

Based on eCall requirements;

-       The eCall-only UE may contact its service provider to request reconfiguration of the USIM that removes the eCall restrictions as described in key issue 7.

-       The IMS eCall UE may perform an IMS eCall test session to an appropriate test point.

An IMS eCall test session is a special eCall type of IMS test call that should be routed to a special test point. The SIP test call facility allows for end-to-end testing of both signalling and media and in the case of eCall, the MSD transmission. The IVS needs to have the knowledge of the URN marking a test eCall.

The proposed identifications are provided below.

6.1.3.11.1   Solution #1

6.1.3.11.1.1   Description and Analysis

The eCall-only UE may contact its service provider to request reconfiguration of the USIM to remove the eCall restrictions. This requires the operator to preconfigure the contact information in the USIM that the eCall-only UE uses to request this reconfiguration. The contact information could be used/derived from the URI and other information that is configured on the USIM for the same purposes for CS eCall.

The eCall-only UE may perform an IMS eCall test session to an appropriate test point. An IMS eCall test URN needs to be registered with IANA that is in alignment with RFC 6881 [i.18] and may take the form of URN "urn:service:test.sos.ecall" (also see [i.1]). The IVS needs to have the knowledge of this URN to perform the IMS eCall test session.

6.1.3.11.1.2   Evaluation

These identifiers are required and are in line with used IMS identifiers.

6.1.4   Recommended solution

The recommended solution is based on the analysis of the key issues in clause 6.1.3.

The eCall-only UE in inactive state should camp on a cell where it reads the System Information Broadcast indicating the network support for IMS eCall. The eCall-only UE always contains a USIM with valid credentials. The USIM is configured to support IMS eCall services.

In case call-back is required and the Release 12 solution is not changed, meaning call-back is treated as a normal IMS call, then eCall-only UE initiates the attach procedure to register to the network and receive session connectivity. The attach procedure in EPS should be accompanied with a PDN connection request requesting APN=IMS that sets up the default bearer for that PDN and enables the UE to perform IMS registration. The UE requests another PDN for emergency services, with request type "emergency service" and no APN. The network includes the emergency APN to this PDN. The UE can use the emergency PDN connection to perform IMS emergency registration and receive emergency services.

This is the only solution that allows call-back based on the specifications of Release 12 available to date. The drawback is that if the UE ends up with only emergency PDN, then it is considered as emergency attached and no call-back can be offered to the UE. Also the network may reject the normal attach procedure where it is not clear that this is requested for emergency services and therefore the UE needs to follow the rejection with an emergency attach (with no call-back capability).

In case call-back is not required or call-back is treated as an emergency call, based on call-back indicator (see clause 6.1.2.9), then the eCall-only UE performs emergency attach procedure to register to the network and receive session connectivity by requesting PDN connection with request type "emergency service" in the attach procedure. The UE then performs IMS emergency registration and receives emergency services.

eCall inactive state is described in the stage 3 pseudo CRs in Annex A.

The voice session follows the normal IMS emergency services procedures. The SIP INVITE message carries the IMS eCall flag in the URN "urn:service:sos.ecall.automatic/or urn:service:sos.ecall.manual", see IETF draft [i.1].

MSD transfer from the IVS to the PSAP is best evaluated to be sent within the SIP signalling (as in key issue 2 /solution 3 - clause 6.1.3.2.3). Privacy and data protection of the voice component and the MSD follows the same requirement on MNO for other telecommunications services. It is considered beneficial if additional data protection can be provided on SIP signalling. During an ongoing emergency session, the PSAP acknowledges to the IVS its reception and successful decoding of the MSD and can also request a new MSD from the IVS using SIP-INFO method / RFC 6086 [i.16].

Whether the changes on SIP level are provided by IETF recommendation or directly by making the changes on IMS is FFS.

Crafting a new SIP specific message is not considered a realistic option due to the work this would involve.

eCall test is routed using the pre-defined specific URI (see key issue 11/solution#2) to the assigned PSAP, example an appropriate test point.

The eCall reconfiguration session requires the eCall-only UE to perform an attach procedure with a PDN connection request towards the home operator to reconfigure the USIM to allow it to receive other subscribed services than eCall, i.e. removal of eCall-only restriction.

6.1.5   Alternative Solution

An alternative solution could be the same as described in clause 6.1.4 except that the initial MSD and all further MSDs and/or eCall Commands would be sent in the user plane (e.g. via MSRP).

6.1.6 Open issues

The following open issues are identified:

- TS 122 101 [i.2] allows combinations of emergency call types for an emergency call. Whatever the emergency call type(s) is (are), in case of eCall the operator will route the eCall to a PSAP that supports eCall. It can be possible to have for example an eCall-PSAP at the police emergency centre and another eCall-PSAP at the Ambulance Emergency centre, however it is unlikely that the PSAPs will have requirements to further categorize eCalls.
  The IETF draft draft-jesske-ecrit-ecall-urn-extension-00 [i.36] refers to TS 122 101 [i.2] and it is recommended to revise the requirement below to remove such combination that causes confusion in the implementation: (*It shall be possible to tie any emergency call number to any single emergency call type or to any combination of emergency call types*.).

6.2 Work required in 3GPP

6.2.1 SA1

The following work is identified:

- TS 122 101 [i.2]:

  - Make eCall requirements generic. Remove explicit mention of TS12. Consider any additional requirement for IMS eCall.

  - Requirements for interworking with legacy PSAPs.

6.2.2 SA2

The following work is identified:

- TS 123 401 [i.28]: introducing IMS eCall for EPS and defining its impact on the procedures.

- TS 123 060 [i.29]: introducing IMS eCall for UMTS and defining its impact on the procedures.

- TS 123 167 [i.13]: clarifying architectural requirements and PSAP requirements.

- TS 123 228 [i.30]: no changes are required, where emergency services are mainly described in TS 123 167 [i.13].

6.2.3 CT1

The following work is identified:

- TS 124 008 [i.3]: introducing IMS eCall for UMTS and specifying its impact on the UE parameters and procedures.

- TS 124 301 [i.14]: introducing IMS eCall for EPS and specifying its impact on the UE parameters and procedures.

- TS 124 229 [i.8]: make IMS eCall supported by IMS emergency call and IMS Multimedia Emergency services, by introducing the IMS eCall Flag (automatic and manual), new URN types (supported by IETF protocols) that is carried over the INVITE message, indicating that the MSD to be transported via the INVITE message, as well as support for MSD acknowledgment and MSD request from a PSAP.

- TS 127 007 [i.24]: no changes are foreseen.

6.2.4 CT6

- TS 131 102 [i.15]: in case any additional changes are found required.

6.2.5   RAN2

- TS 125 331 [i.25]: for UTRAN, a new SIB flag indicating the support of IMS eCall.

- TS 136 331 [i.9]: for E-UTRAN, a new SIB flag indicating the support of IMS eCall.

6.2.6   RAN5

The following work is identified:

- TS 102 936-1 [i.31]: Extend STF399 IMS eCall test cases to LTE and UMTS.

- Modify IMS emergency call test cases to correspond to any changes made in core specifications.

6.3   Work required in IETF

The following work is identified, and not limited to:

- eCall internet draft - ongoing. draft-gellens-ecrit-ecall-01.txt [i.1]. A related IETF draft is draft-ietf-ecrit-additional-data-15 [i.23].

- Register service URNs/eCall Flag (manual and automatic), and test URN with IANA.

- Define the SIP-INFO package.

- MIME Content-type Registration for 'application/ emergencyCall.eCall.MSD+xml'.

NOTE: Registering the service URN and the MIME content- type are part of the draft-ietf-ecrit-additional-data-15 [i.24].

7   Co-existence of CS and IMS eCall

Definitions:

FG-eCall: First-Generation eCall, using the CS-radio access, the TS12 emergency call setup and the Inband Modem. FG-eCall applies between FG-IVS and FG-PSAP.

NG-eCall: Next-Generation eCall, using PS-radio-access, IMS Emergency Session and the NG-eCall Protocol (whatever that is, SIP Invite, SIP Info, RTP, etc.).
It does not use the Inband Modem.

FG-IVS: First-Generation-eCall IVS, capable of the Inband-Modem and CS-radio accesses (2G and 3G).

NG-IVS: Next-Generation eCall IVS, capable of PS-radio access (mainly LTE) and capable of IMS Emergency Call of the NG-eCall protocol.
IVS with NG-IVS capability should (for long time to come) include FG-IVS capability.

IMS-IVS: Next-Generation eCall IVS, capable of PS-radio access (mainly LTE) and capable of IMS Emergency Call of the NG-eCall protocol and no support of FG-IVS capability.

Legacy PSAP: PSAP without eCall functionality.

    NOTE: Also Legacy PSAPs may have IP-Connectivity.

IMS-PSAP   NG-PSAP with no FG capability.

FG-PSAP: First-Generation-eCall PSAP, capable of the Inband-Modem.

NG-PSAP: Next-Generation eCall PSAP, capable of the NG-eCall protocol (whatever it is).
PSAP with NG-PSAP capability should (for long time to come) have also FG-PSAP capability.

SIB Flag NG: This is a binary flag, broadcasted by the LTE network:

                       - if No: No NG-eCall routing in IMS or No NG-PSAP;

                       - if yes: NG-eCall routing in IMS and NG-PSAP.

7.1   Considerations

7.1.1   IVS assumptions

An NG-IVS also includes FG-IVS functionality, for a long time to come. Initially the IVS will use only circuit switched radio access and the in-band modem within the circuit switched emergency call to perform eCalls. It will be in accordance with CEN EN 16062 [i.7]. This is called an FG-IVS.

    NOTE: The IMS capability of the NG-IVS may also be used for non eCall services, but these are not subject of the present document. The aspect is, however, of some importance as it may substantially accelerate the migration from FG-IVS to NG-IVS.

7.1.2   Mobile Network Operator considerations

IMS emergency call will become increasingly available with the roll out of LTE and IMS. Every network offering IMS voice service is expected to also eventually support IMS emergency call.

CS emergency call is expected to be available for many more years, e.g. to support legacy devices. CS emergency call will be available as long as CS radio access is available.

From 3GPP Release-13 or Release-14 onwards, as recommended in the present document, there should be a broadcast system information (SIB) indicator in the PS radio access of network support for IMS eCall. The indicator would not explicitly indicate NG-PSAP capability, but the operator may only use the broadcast indicator if it is known that there is at least one NG-PSAP available.

    NOTE: If an existing FG-PSAP organization is upgraded to NG-eCall capability by an Protocol Converter (e.g. somewhere inside the PSAP organization), then the resulting PSAP appears like an NG-PSAP, maybe with limited functionality. NG-eCall should have minimum impact on IMS network deployments, and this is also to ensure minimum cost for the MNOs when supporting NG-eCall. This should help to promote the migration to NG-eCall.

7.1.3   PSAP assumptions

All eCall PSAPs will use the in band modem initially (FG-PSAPs). All PSAPs will increasingly have IP-connectivity, although the situation will vary between countries. Upgrading FG-PSAPs which have IP-connectivity already, to NG-PSAPS is not considered a major upgrade.

Rather than upgrading all PSAPs to NG-PSAP capability, the PSAP organization of a country may use some Protocol Converter. This function would receive incoming NG-eCalls and convert them to FG-eCalls to the FG-PSAPs using still the inband modem for MSD transmission. In the long term, it is thinkable that reduced NG-PSAP will be deployed, without the FG-PSAP capability. Hence another Protocol Converter might be required within the PSAP organization to serve the remaining FG-IVSs. This Protocol Converter would receive incoming CS eCalls and convert them to NG-eCalls. Also this second Protocol Converter is judged as PSAP internal.

NG-eCall may gradually be more available/deployed in EU countries. NG-PSAPs that have upgraded to NG-eCall capability need not to retain a FG-eCall capability indefinitely. At some point then, all eCalls may use NG-eCall capability in both the IVS and PSAP. This is latest then the case, when the last CS radio network has been shut down.

    NOTE 1: Such a Protocol Converter is more likely to be in the PSAP organization rather than in the MNO network.

It is not expected that the PSAP capabilities will be made known explicitly to the NG-IVS, before the NG-IVS reads the System Information Broadcast or before the NG-IVS connects to the PSAP.

    NOTE 2: PSAP capabilities are known to the MNO on an agreement basis, not by SIP, i.e. there is no explicit signalling indication given.

7.2   Migration scenarios

7.2.1   General

There will be a considerable time span, where FG-IVS will flood the market and FG-PSAPs will be fully engaged to serve these, before IMS bases NG-IVSs will appear, with the potential of taking advantage of NG-PSAP support. PSAP migration strategies will vary between countries. Some may upgrade their FG-PSAPs rather quickly to serve NG-eCall due to its substantial potential. Other countries may hesitate and keep FG- PSAPs for quite a while, as long as CS-radio access is area-covering.

It seems obvious that the IVS industry cannot rely (for a long time to come) on either CS-access or PS-access only, all future IVS will - reasonably - include both CS and IMS capabilities for some time, i.e. each NG-IVS will automatically include FG-IVS capability, for some time.

Some countries will upgrade their PSAPs quickly to NG -eCall, but keep FG-eCall functionality for a long time (directly or via a Protocol Converter).

Figure 1 is a generic potential representation of migration scenarios, depending on individual country strategies.
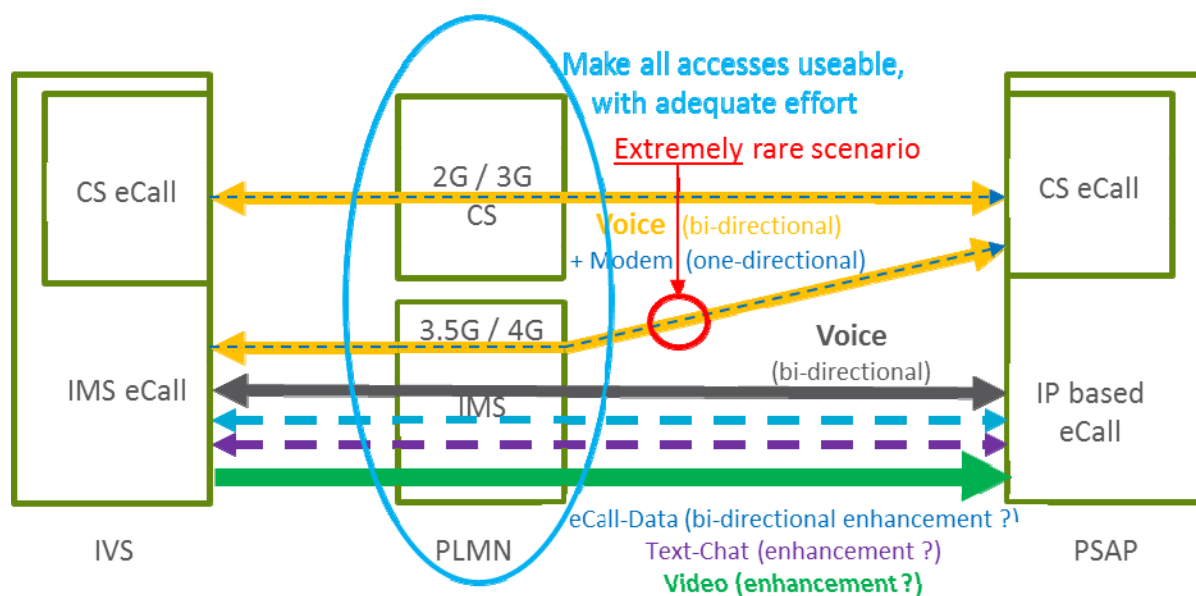
Figure 1: Generic Migration Scenarios

All scenarios based on this generic diagram are described in clause 7.2.2.

7.2.2   Description of scenarios

The following scenarios relate to Figure 1. Some scenarios may be enabled by a protocol converter on the PSAP side, rather than a PSAP upgrade.

Table 1: Summary of scenarios

Scenario	IVS Cap.	PLMN Cap. in the loc.	SIB-Flag NG?	PSAP Cap.	Applied eCall	Comment
1	FG-IVS (CS)	2G/3G (CS)	na	FG-PSAP (CS)	FG-eCall (CS+ Inband)	Initial scenario, based on CEN High Level Application Protocol (HLAP) EN 16062 [i.7].
2	FG-IVS (CS)	2G/3G (CS)	Na	NG-PSAP (CS+PS)	FG-eCall (CS+ Inband)	Some PSAPs are upgraded, but no PS access and IVS is FG.
3	FG-IVS (CS)	2G/3G/4G CS + PS	No	FG-PSAP (CS)	FG-eCall (CS+ Inband)	For many FG-IVS for long time to come.
4	FG-IVS (CS)	2G/3G/4G CS + PS	Yes	NG-PSAP (CS+PS)	FG-eCall (CS+ Inband)	For many FG-IVS for long time to come.
5	FG-IVS (CS)	4G (PS-only)	No	FG-PSAP (CS)	No eCall possible	In some rare regions, where LTE has (already) better coverage than CS, or in very far future, where CS-access is shut down.
6	FG-IVS (CS)	4G (PS-only)	Yes	NG-PSAP (CS+PS)	No eCall possible	In some rare regions, where LTE has (already) better coverage than CS, or in very far future, where CS-access is shut down.
7	NG-IVS (CS + PS)	2G/3G (CS)	na	FG-PSAP (CS)	FG-eCall (CS+ Inband)	Although the IVS is NG capable, it should use the CS-access.
8	NG-IVS (CS + PS)	2G/3G (CS)	na	NG-PSAP (CS+PS)	FG-eCall (CS+ Inband)	IVS and PSAPs are modern, but the PLMN is not upgraded.
9	NG-IVS (CS + PS)	2G/3G/4G (CS + PS)	No	FG-PSAP (CS)	FG-eCall (CS + Inband)	The PSAP is still not upgraded, as the SIB flag indicates ➜ the IVS prefers CS-access, i.e. FG-eCall.
10	NG-IVS (CS+PS)	2G/3G/4G CS + PS	Yes	NG-PSAP (CS+PS)	NG-eCall (PS +NG-eCall)	All partners are updated, SIB is set; full freedom for the IVS; The NG-IVS uses PS and NG-eCall.
11a	NG-IVS (CS+PS)	4G (PS-only)	No	FG-PSAP (CS)	No eCall possible	The NG-eCall routing is not supported. So eCall is impossible, but normal emergency call is possible. Scenario today in IMS networks This scenario should not happen because it is expected that PSAPs would be upgraded.
11b	NG-IVS (CS+PS)	4G (PS-only) IMS eCall support	No	FG-PSAP (CS)	FG-eCall (PS + Inband)	The NG-eCall routing is supported in IMS, but the PSAP is not upgraded. FG-eCall is possible. SIP Response will tell (via an negative ack of the MSD) to use Inband via VoLTE This scenario should not happen because it is expected that PSAPs would be upgraded. Furthermore any FG-IVS eCall is not supported.
12	NG-IVS (CS+PS)	4G (PS-only)	Yes	NG-PSAP (CS+PS)	NG-eCall	After CS-Networks have shut down in some regions, or in regions where CS-never reaches coverage, but PS-access does now.
13	IMS-IVS (PS-only)	4G (PS-only)	Yes	IMS-PSAP (PS-only)	NG-eCall	Long term future, CS has died out, but then maybe a third Generation eCall will come in addition.
Note for table entries: (i) na = not applicable (ii) In scenarios with a FG-IVS, the SIB flag indicates the network capability, but has no influence over the type of eCall.						

The scenarios refer only to the very location, where the IVS has the emergency case.

It does not necessarily refer to the whole network. It could well be that the networks support in principle everything, but e.g. in this very location only 4G access is possible.

All possible scenarios based on IVS, MNO and PSAP capabilities, starting from scenario 1, via migration from FG-eCall to NG-eCall and ending in scenario 13, are summarized in Table 1. The same scenarios are described further in clauses 7.2.2.1 to 7.2.2.4.

Some cases (2) do not allow eCall at all, although IVS and PSAP are FG-eCall capable, if there is no CS-radio network in some regions and the FG-IVS cannot use PS-access. This is like today in regions, where no radio coverage is given.

One scenario, i.e. 11a and 11b, is especially outstanding, because IVS and PLMN are NG capable, but the PSAP is still not upgraded. This scenario should be avoided by upgrading the PSAPs before NG-IVS occurs in such a network. If it happens anyway, in the very beginning of NG-IVS market entrance, then the NG-IVS has a good chance to use IMS Emergency Call with eCall-routing (scenario 11b), but then it should use the Inband Modem via a VoLTE voice channel.

In most cases, where scenario 11 applies, the Inband Modem performance is assumed to be good, as we can assume that these PS-accesses are still not highly loaded and therefore packet jitter is small and the speech path delay constant. The speech frame error rate in such LTE networks is typically low, so the Inband Modem is assumed to work well. Please see Annex C.

7.2.2.1   Initial scenarios with FG-eCall

Scenario 1 in Table 1 is FG-eCall based on in-band modem in the FG-IVS and FG-PSAP, and CS emergency call with eCall-Flag-supported routing in the CS-network.

Scenarios 2, 3, 4 also apply FG-eCall, because the FG-IVS has no better capabilities. This will be for many IVS for long time the case, independently of PLMN- or PSAP status.

7.2.2.2   Scenarios where even FG-eCall is not possible

In scenarios 5 and 6 the FG-IVS is in a region, where no CS coverage is given (still not - or not anymore), but the LTE coverage is (already) built up. This is unlucky for the FG-IVS, but no other way than upgrading to NG-IVS is possible.

7.2.2.3   Scenarios where NG-eCall is possible

Scenarios 10, 12, 13 in Table 1 are fully IMS capable and for this reason preferred. At least one routable NG-PSAP exists and the MNO broadcasts NG-eCall support.

7.2.2.4   Scenarios 11 with NG-IVS, IMS eCall coverage, but with FG-PSAP

The LTE network indicates NG-eCall support by the System Information Broadcast (SIB), when the IMS routing is in place based on upgraded PSAPs. The NG-IVS selects PS-access as it is the only available radio access. The NG-IVS knows that the eCall routing is supported.

For this reason the need of supporting scenarios 11 corresponds to the "extremely rare" scenario of Figure 1, where the NG-IVS should communicate via IMS with a FG-PSAP.

7.3   TPS eCall

IMS eCall will have to co-exist with TPS eCall in the same way as CS eCall does. The detail is outside the scope of the present document.

8   Conclusions and recommendations

8.1   Conclusions

1)   The existing standards for "IMS Emergency Service" and "IMS Multimedia Emergency Service" are suitable, with relatively minor modifications, to support eCall.

2)   The eCall in-band modem performance may be impaired in packet networks (de-jitter buffering) and therefore in-band modem over VoIP is not recommended as the only solution. It might be considered as last resort for some migration cases.

3)   The solution which has been developed in the present document uses the initial SIP-INVITE message for initial MSD transport. The 3GPP pseudo change requests are based on this method. An alternative solution, where a bi-directional data exchange between PSAP and IVS is achieved by a separate media bearer is worthy of consideration.

4)   Some existing eCall functionality (eCall flag for routing, inactive substate) is currently only specified for CS and needs to be added to IMS eCall solution.

5)   New URN sub-classes need to be defined for IMS eCall for routing purposes (equivalent to the Service Category in CS).

6)   An indication in the System Information Broadcast over the air interface (UMTS-PS and LTE), that the network supports IMS eCall, is required.

7)   For eCall-only UEs a short term solution is to use CS eCall on 2G/3G instead of LTE, even if the UE is IMS capable (i.e. auto default to 2G/3G).

8)   From a certain date, all IVSs should support both CS and IMS eCall. If PSAPs are upgraded to support IMS eCall then they should continue to support CS eCall.

9)   IMS eCall opens the possibility of additional eCall functionality.

10) An application layer protocol needs to be specified in CEN for IMS eCall to meet current higher layer requirements and potential future requirements.

11) XML encoding needs to be retained as an option in EN 15722 [i.6], see clause D.2.

12) PSAP should be upgraded before NG-IVS occurs in the network.

13) FG-PSAP capability should be retained as long as not all CS network are shut down.

8.2   Potential advantages of IMS eCall vs. CS eCall

1)   Faster and more reliable MSD transfer, no loss of speech path, > 140 bytes, 2 way data.

2)   Additional media (e.g. text and video).

3)   Enhanced functionality such as PSAP ability to view video streams from on-board cameras, send instructions to vehicle, e.g. sound horn, flash lights, lock/unlock doors, disable ignition.

8.3   Recommendations for next steps

It is recommended that an EC funded project, under either ETSI or CEN lead, but comprising experts from both CEN and ETSI, and the related user communities should be created as a matter of urgency, with the remit to:

•   Study and develop any additional specifications for integration of eCall into ITS-Stations.

•   Consider strategies and provide proposals and possibly high level protocols for routing to the 'most appropriate PSAP' in the ITS-s paradigm.

- Consider the potential future requirements and the viability of including other media, particularly video in IMS eCall.

- Produce a new version of the CEN High Level Application Protocol for IMS eCall (the current EN 16062 [i.7] is for in band modem).

It is recommended that this study is used by stakeholders as the basis for change requests in 3GPP for specification of packet based eCall.

Annex A:
Change requests

The CRs can be found on the STF456 web page. http://portal.etsi.org/stfs/STF_HomePages/STF456/STF456.asp.

Annex B:
eCall and ITS

Figures B.1 to B.6 taken from ISO / DIS 21217 Intelligent Transport Systems - Communications Access for Land Mobiles (CALM) - Architecture fusion are reproduced with the permission of the International Standards Organisation ISO. This standard can be obtained from any ISO member and from the website of the ISO Central Secretariat at the following address www.iso.org. Copyright remains with ISO.

B.1   Evolution of 'Intelligent Transport Systems'

While the requirements for and political acceptance for the introduction of eCall has evolved in the period 1997 - 2012, communications with vehicles, and between vehicles have evolved over the 1991 - 2013 timeframe, and continue to evolve.

CEN TC278 (originally road Transport and traffic Telematics, now renamed Intelligent Transport systems) was created in 1991, ISO TC204 (Intelligent Transport Systems) was created in 1993, and more latterly ETSI TC-ITS was created in 1997, and have been involved in developing Standards deliverables across a wide range wireless communication based intelligent transport systems, using a number of wireless networks, including 5G (802.11p (WAVE), 60G (Millimetre), infra-red, but also including GSM, UMTS, IEEE 802.16, IEEE 802.20, Wi-Fi (802.11 a-g), LTE/4G.

Particularly, ISO TC204 have developed a family of standards which separate the communications medium from management and applications, and can support multiple wireless media, indeed almost any standardized wireless media, given the provision of a standardized 'Service Access Point'. See Figure B.3 for the original approach taken.
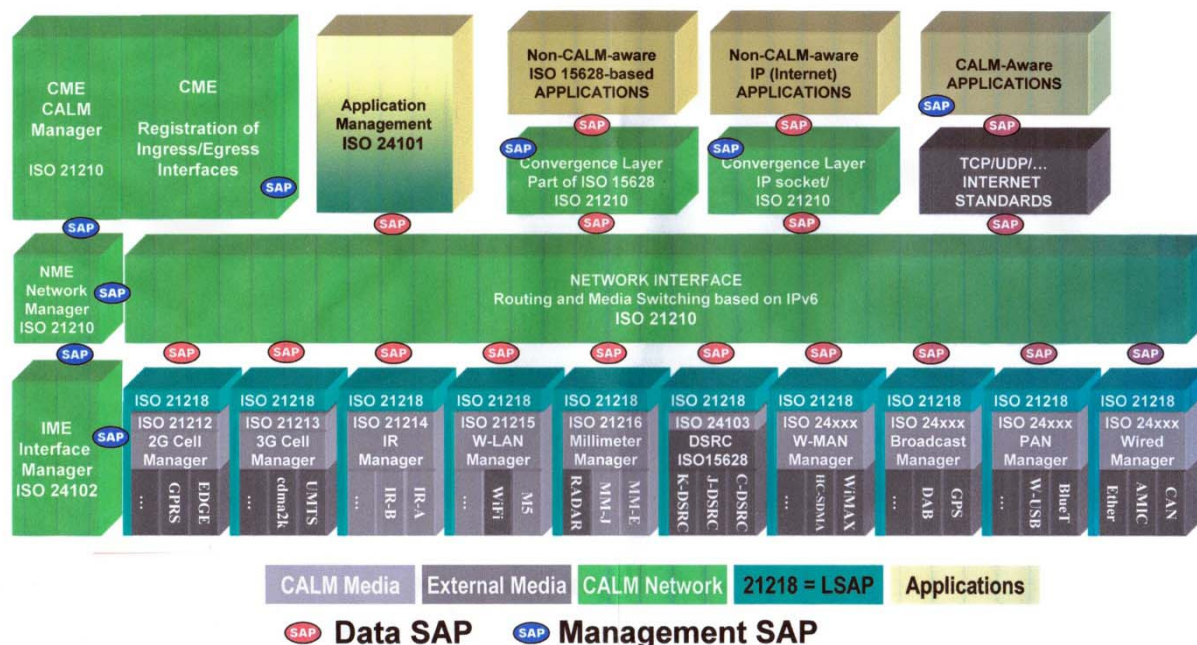
Figure B.1: Multi-media supporting ISO ITS architecture

This fits within the context of multiple communications means to effect the provision of ITS services.
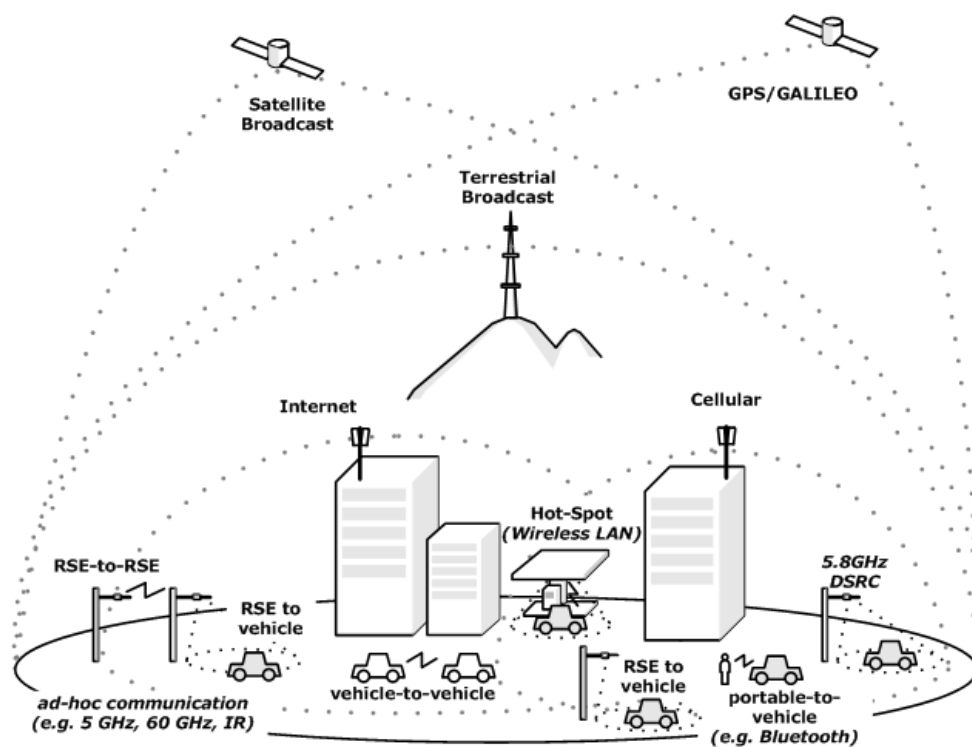
NOTE: Source ISO 21217:2013 [i.32].

Figure B.2: Examples of ITS communications

In the modern context of internet and mobile communications this fits within the framework shown in Figure B.3.
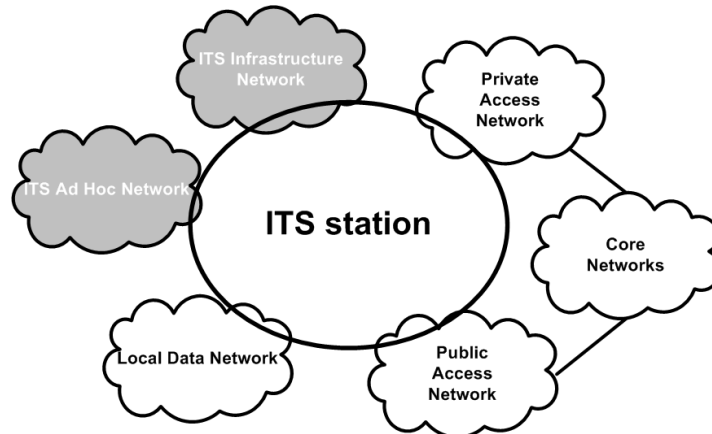
NOTE: Source ISO 21217:2013 [i.32].

Figure B.3: Networking view of ITS communications

The architecture envisioned is where the communications platform in a vehicle, or a communication point in the infrastructure, communicate together as peer 'stations' (ITS-stations), as in Figures B.6 or B.7.

NOTE: Source ISO 21217:2013 [i.32].

Figure B.4: ITS-S to ITS-S communication without an external network (single-hop)
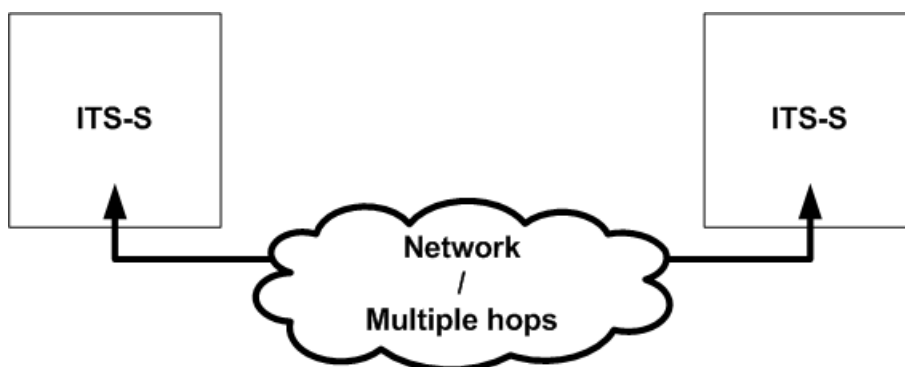
NOTE: Source ISO 21217:2013 [i.32].

Figure B.5: ITS-S to ITS-S communication over an external network (multiple hops)

The ITS station concept is based on the abstraction of ITS application processes from communication protocols serving these ITS application processes along with the ability to securely manage those application processes and communications. It is embodied in the abstract definition of an ITS station (ITS-S) as a "Bounded Secured Managed Domain" (BSMD) described in ISO 21217:2013 [i.32].

The salient feature of the ITS-S concept that distinguishes it from the concept behind traditional communication systems is that application processes are abstracted from both the access technologies that provide the wireless connectivity and the networks that transport the information from the source to the destination(s). ITS-Ss are not limited to either a single access technology, or to a specific networking and transport protocol. ITS-Ss can implement any of those technologies that are supported through appropriate adaptation specifications.

While this abstraction is generally useful for most application processes, this abstraction does not prevent application processes from requesting a specific communication profile to be considered in the communication profile selection process, or specifying communication parameters on a packet-per-packet basis.

The flexibility that ITS-S management has to make optimal use of all available ITS-S resources (communication media and higher-layer protocols) is one of the key enabling features of ITS communications and applications. The means for (dynamically) assigning ITS-S application processes to communication media and networking and transport layer protocols is specified in ISO 21217 [i.32].

In order to be able to meet the stringent security requirements of ITS application processes related to safety of life and property, the ITS-S concept provides for secure peer-to-peer communications between entities that are themselves capable of being secured and remotely managed.

Over time this ITS-S architecture has therefore evolved to the ITS-station architecture shown in Figure B.6.
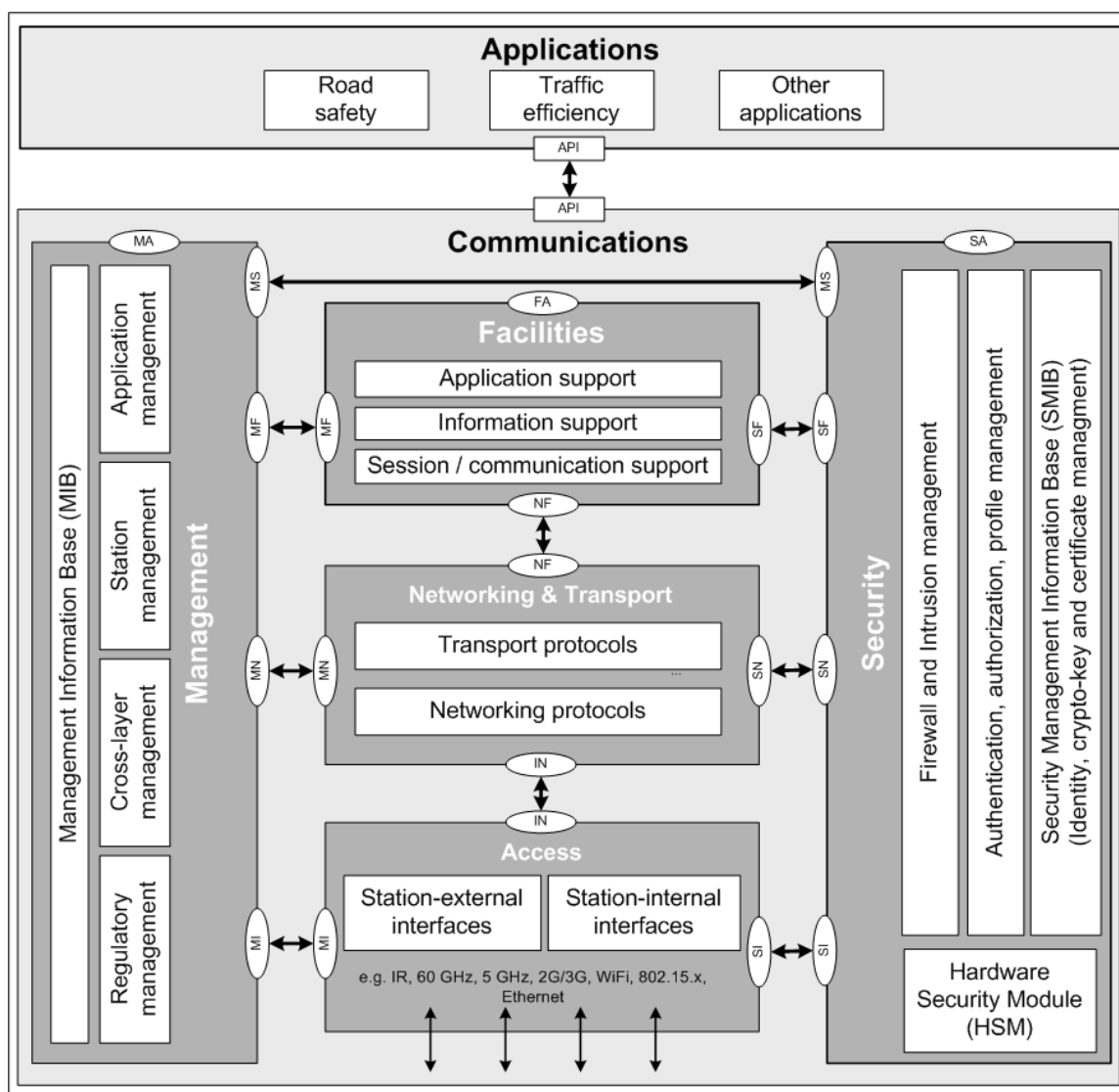
NOTE: Source: ISO 21217:2013 [i.32].

Figure B.6: ITS-S reference architecture

Convergence and equipment re-use and sharing are paramount in any consideration of future technologies. So called 'ITS-stations are being created to provide one communications capability within a vehicle that may support multiple media, (including GSM/UMTS/ Mobile wireless broadband/ LTE in addition to ITS specific media such as IEEE 802.11p (5,9 GHz), millimetre wave and infra-red ITS communications).

While some commercial applications, such as fleet management, route guidance, congestion avoidance and some advanced 'adaptive' cruise controls systems, and specialized systems for traffic management, and in the area of public transport, most of the more advanced ITS services have yet to be deployed beyond R&D implementations (for example collision avoidance, intelligent ramp entry, road/rail crossings, ice and road condition alerts, etc.) It is worthy to understand and consider that all of these services are data based (or data based + VoIP) systems and are therefore:

- packet switched;

- most operate compatibly using IPv6 compatible protocols (though there are some exceptions for very fast transactions such as collision avoidance, which revert to special protocols).

In the meantime, eCall, based on MSG emergency protocols has been politically accepted and mandated for use in new model light vehicles from October 2015.

The bulk of the work of STF456 is to enable the investment in the infrastructure and equipment mandated to be installed in vehicles and at the emergency services handling the eCalls is protected and migrates to LTE/4G. However in doing so it should be noted that it is in part handling a migration from circuit switched call management to packet switched call management.

However, the consequence is that while ITS systems evolve and are introduced to vehicles via the use of ITS-stations, the same vehicles will also have an eCall modem and communications. While transitionally this enables the safety and service benefits of both eCall and ITS (particularly active safety services) to be supported within the vehicle at the earliest opportunity, it carries the dis-functionality, complexity and additional cost of multiple communications systems in the vehicle.

Clearly, longer term strategies need to be considered and guidance (probably for further work) provided in respect of the long term migration of eCall to support over packet switched networks, and the co-existence and possible integration of eCall and other ITS communication equipment installed in vehicles.

The specification of these provisions is well beyond the scope of STF456, but STF456 is charged to identify the aspects which need to be considered in this next migrational step of evolution.

STF456 has therefore made considerable effort in its outreach activities to communicate with both 3GPP and ITS standardization communities to gain their assistance into understanding the issues that require further study and specification. Later in the present document, as a result of these considerations, STF456 will propose further studies that need to be undertaken by the MSG and ITS communities to enable this further migration (possibly via STF or Project teams or a combination of their work and developments within Standardization Committees.

B.2 "Communications Access for Land Mobiles" (CALM)

"Communications Access for Land Mobiles" (CALM) is the acronym used to refer to such ISO TC204 (Intelligent Transport Systems) work items. These International Standards focus on specifying open interfaces with regard to the functionalities required for all relevant layers and entities of the ITS station reference architecture. The set of CALM International Standards is designed to allow interoperable instantiations of ITS stations which are based on the concept of abstracting applications and services from the underlying communication layers of the ITS station. This abstraction and the functionalities and services that can be easily implemented make this ITS station architecture also well-suited to the development and deployment of ITS applications and services that share information amongst each other to improve the safety, sustainability and efficiency of transport systems. These standards include specifications for:

- ITS station management;

- ITS communications security;

- ITS station facilities layer protocols;

- ITS station networking & transport layer protocols;

- communication interfaces (CIs) designed specifically for ITS applications and services such as those designed specifically for safety of life and property;

- interfacing existing access technologies into ITS stations, distributed implementations of ITS stations; and

- interfacing ITS stations to existing communication networks and communicating with nodes thereon.

See ISO 21217 [i.32] which describes the common architectural framework around which ITS stations are instantiated and provides references to relevant standards, including access technology support standards, various networking and transport protocol standards, facilities standards, and ITS station management and security standards. It also describes the general architecture of peer-to-peer communications over various communication networks between ITS communication nodes.

Annex C:
Characterization of the eCall in-band modem Performance over 3GPP VoIP

C.1   Introduction

As part of the investigation of eCall over LTE, the present document presents simulation results characterizing the performance when operating the eCall In-band modem over an AMR Voice-Over-IP (VoLTE) bearer.

C.2   eCall simulation framework/test setup

The eCall simulation framework from TS 126 268 [i.4] was modified to integrate a VoIP bearer by inserting packet delays and errors using the delay-error profiles specified in TS 126 114 [i.27] and then feeding the output to an adaptive de-jitter buffer (DJB). The configuration is illustrated in Figures C.1a and C.1b. The AMR codec process and its related error insertion functionality that originally came along with the eCall simulation framework were completely bypassed and instead they were replaced by the VoIP + dynamic jitter buffer functionality. The encoder and decoder used the reference source code in TS 126 073 [i.33] (ANSI-C code for the Adaptive Multi Rate (AMR) speech code). The in-band modem version used is the latest (version 8.6.0 in the Release 8 series).
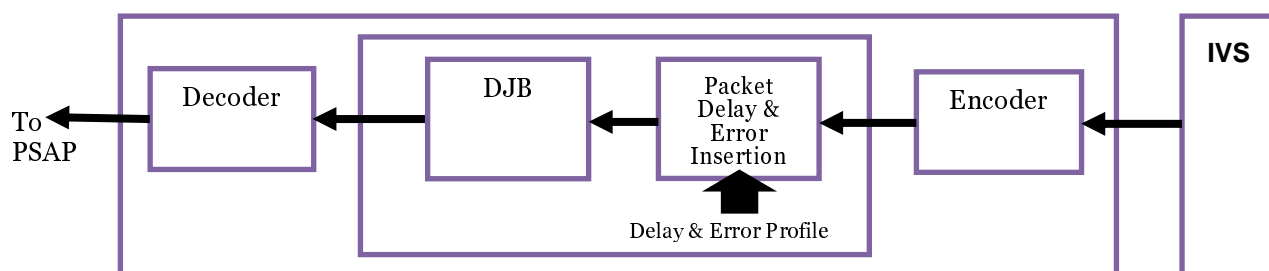
Figure C.1a: eCall test setup configuration (Uplink)

The DJB in uplink is located in an IMS-MGW.
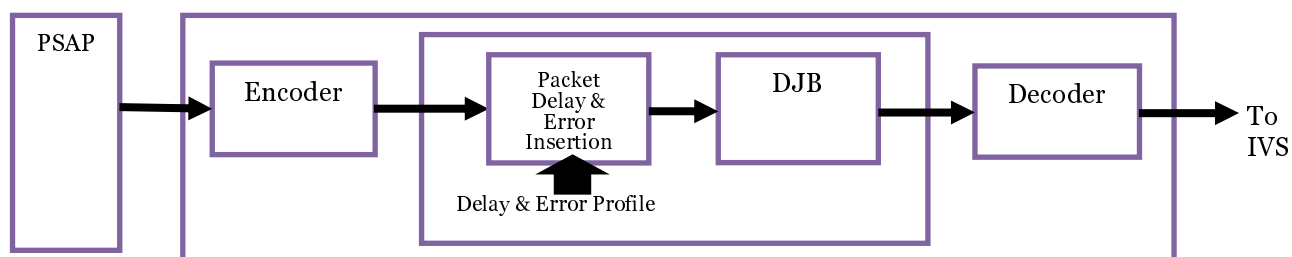
Figure C.1b: eCall test setup configuration (Downlink)

The DJB is located in the IVS-NAD.

C.3   The Dynamic Adaptive de-jitter buffer

The de-jitter buffer described in clause 5.1 of TR 126 969 [i.5] was used for the simulations. It is a speech frame-based de-jitter buffer where any delay adaptation is performed by extending or decreasing the delay by one complete speech frame duration. The de-jitter buffer does not employ frequent or sample-based time warping.

NOTE: The purpose of an adaptive de-jitter buffer is to minimize the speech path delay for every given jitter-situation: small jitter ==> low delay, high jitter ==>large delay. The speech path delay in VoLTE in non-loaded LTE-network situations is smaller than in today's 2G/3G networks.

Figures C.2 and C.3 show comparable performance between the adaptive de-jitter buffer used in the simulations and the exemplary de-jitter buffer described in TS 126 114 [i.27].
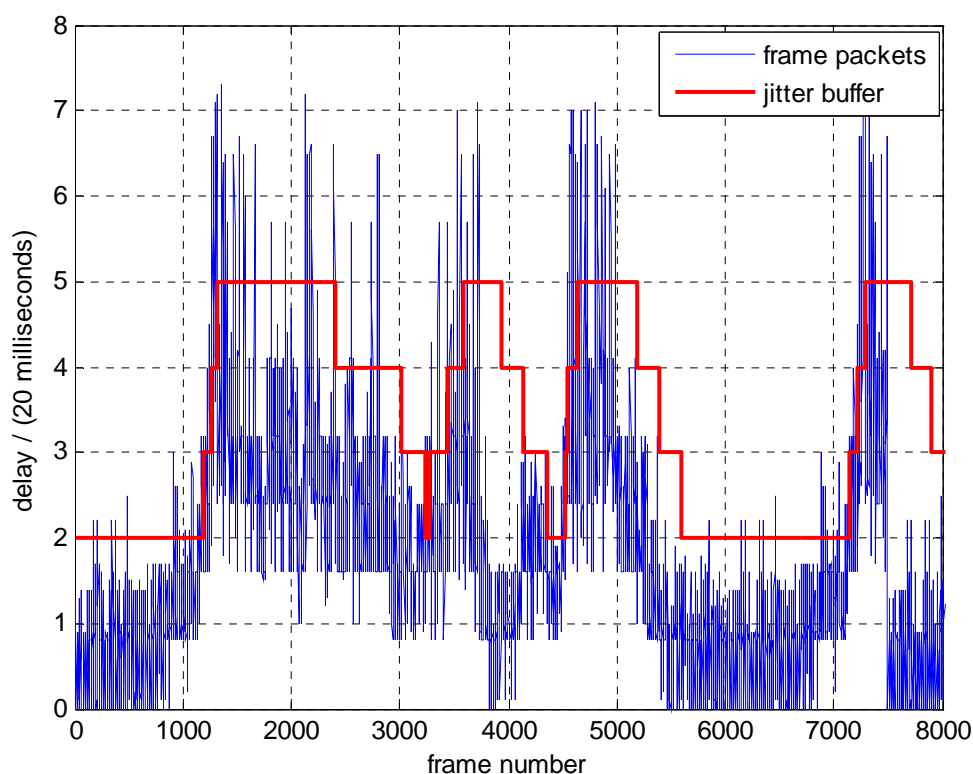
**Figure C.2: Packet delays (blue) and time varying delay of the adaptive jitter buffer (red)
with the jitter buffer as described in the present document**
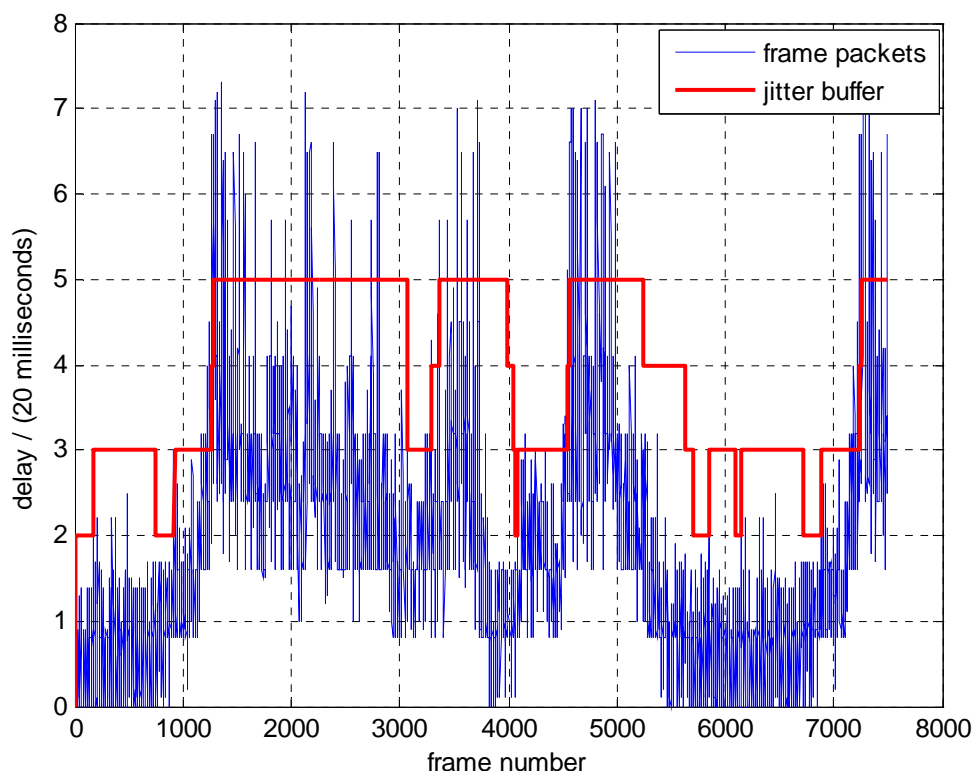
**Figure C.3: Packet delays (blue) and time varying delay of the adaptive jitter buffer (red)
from the exemplary description in TS 126 114 [i.27] (Reference delay computation)**

C.4   Simulation Test Runs & Results

To assess the effect of the VoIP bearer and dynamic jitter buffer on the performance of the eCall In-band Modem,
different test scenarios were conducted using various AMR codec modes and the six different delay-loss profiles
specified in TS 126 114 [i.27] assuming jitter buffer sizes of 2 to 5 speech frames. 10 000 runs with random starting
points were conducted for each scenario.

The simulation results shown in Table C.1a - C.1f, highlight the performance of the eCall in-band modem over the
VoIP bearer. The Figures of Merit (FOMs) when using the in-band modem over AMR VoIP are both:

- higher than the circuit-switched-only FOMs listed in clause 4.1.2 of TR 126 969 [i.5], illustrating the
  degradation in performance with respect to circuit-switched operation;

- slightly lower than the FOMs listed in Annex C of TR 126 969 [i.5] where the in-band modem operates over a
  circuit-switched voice bearer with errors and then passes through a G.711 VoIP network.

Table C.1a: Simulation Results/FoM with Delay & Error Profile 1

AMR Codec	Delay & Error Profile	MSD Transmission Time (Sec)		
		Average	95th Percentile	Maximum
12,2	1	2,0632	3,38	19,22
10,2	1	2,1724	3,78	20,44
7,95	1	2,4062	4,22	19,24
7,4	1	2,3902	4,2	20,04
6,7	1	2,8407	4,68	20,44
5,9	1	3,1241	4,68	18,52
5,15	1	4,0343	5,54	20
4,75	1	4,6438	6,4	22,14

Table C.1b: Simulation Results/FoM with Delay & Error Profile 2

AMR Codec	Delay & Error Profile	MSD Transmission Time (Sec)		
		Average	95th Percentile	Maximum
12,2	2	2,0143	3,6	23,8
10,2	2	2,0938	3,66	19,92
7,95	2	2,3147	3,8	19,8
7,4	2	2,3229	3,8	18,86
6,7	2	2,8122	4,7	22,52
5,9	2	3,0484	4,94	19,26
5,15	2	3,8559	5,84	20,58
4,75	2	4,4666	6,44	25,08

Table C.1c: Simulation Results/FoM with Delay & Error Profile 3

AMR Codec	Delay & Error Profile	MSD Transmission Time (Sec)		
		Average	95th Percentile	Maximum
12,2	3	2,3471	4,2	36,64
10,2	3	2,4611	4,22	22,92
7,95	3	2,7033	4,22	20,26
7,4	3	2,6787	4,22	25,36
6,7	3	3,1916	4,68	21,98
5,9	3	3,4601	5,1	23,32
5,15	3	4,2939	6	23,78
4,75	3	4,8661	6,84	25,46

Table C.1d: Simulation Results/FoM with Delay & Error Profile 4

AMR Codec	Delay & Error Profile	MSD Transmission Time (Sec)		
		Average	95th Percentile	Maximum
12,2	4	3,0135	6,78	24,62
10,2	4	3,1585	6,94	29,72
7,95	4	3,427	7,36	29,02
7,4	4	3,4585	7,38	27,12
6,7	4	4,0495	8,24	26,34
5,9	4	4,3425	8,7	26,6
5,15	4	5,2788	10,22	31,74
4,75	4	6,0021	11,38	30,7

Table C.1e: Simulation Results/FoM with Delay & Error Profile 5

AMR Codec	Delay & Error Profile	MSD Transmission Time (Sec)		
		Average	95th Percentile	Maximum
12,2	5	4,8047	7,76	30,64
10,2	5	4,9602	7,64	98,88
7,95	5	5,1621	8,14	27,04
7,4	5	5,179	7,78	23,84
6,7	5	5,8621	8,92	23,44
5,9	5	6,1094	9,1	27,02
5,15	5	7,3263	10,38	34,98
4,75	5	7,9524	11,22	29,38

Table C.1f: Simulation Results/FoM with Delay & Error Profile 6

AMR Codec	Delay & Error Profile	MSD Transmission Time (Sec)		
		Average	95th Percentile	Maximum
12,2	6	1,65	2,02	19,76
10,2	6	1,6864	2,02	14,98
7,95	6	1,9389	2,08	21
7,4	6	1,9291	2,08	18,94
6,7	6	2,2953	2,48	23,38
5,9	6	2,5439	2,88	15,34
5,15	6	3,1017	3,76	16,56
4,75	6	3,6898	4,68	16,54

C.5   Static dejitter buffer

An option to use a Static Jitter Buffer of sufficient size in "IMS eCall Sessions", where an All-IP end-to-end eCall data exchange is not possible, e.g. due to a legacy first-generation eCall-PSAP, is worthy of consideration.

For the Inband Modem a large delay is no problem, but for human communication is nicer (not essential) to have a small delay. Instead of an adaptive de-jitter buffer a de-jitter buffer with a "high", constant delay could be used. The speech path delay would not be larger than in the worst case of the adaptive de-jitter buffer, but the speech frame loss rate is assumed to be substantially lower (positive for human communication) and the modem performance substantially better (good for eCall data).

The speech path delay in VoLTE in non-loaded LTE-network situations is smaller than in today's 2G/3G networks. Adding a constant delay of e.g. 140 ms (7×20 ms) would not influence the human communication between IVS-occupants and PSAP-operator, but would catch most jitter-spikes in the used simulations (see clause C.3).

In such a case the IMS network is able to identify the eCall-type (2G-IVS <=IMS=>1G-PSAP) and provide the necessary transcoding between AMR and PCM in the IMS-MGW, together with the necessary Echo Canceller and the mentioned Static Jitter Buffer (one example). Note that the static DJB would only be ordered for such a rare call scenario, but not for the All-IP eCall solution (NG-IVS<=IMS>=NG-PSAP).

It seems not necessary to simulate this In-band Modem with a static jitter buffer, as the theoretical analysis is simple. The MGW would be setup with such a constant high buffer delay, independent of the Modem usage or the voice communication.

The speech path delay from IVS to PSAP would be in some cases higher than with the Adaptive Jitter Buffer, in some cases it would be identical, in all cases it could be sufficiently low for an excellent human communication (this would need to be confirmed in field trials). This is especially true for the MSD transmission in the uplink as the next generation IVS is able to differentiate between "Modem-State" and "Voice-State" and can adapt its Jitter Buffer in the downlink accordingly (Static-high or Adaptive). So the "communication-delay", which is the sum of uplink and downlink delay (round-trip) will be satisfying for the human communication. The In-band Modem is not sensitive to the round trip delay, but to the adaptive de-jittering.

This method would add a potential complication that, for PSAP callback, the IMS network would not know that it is the PSAP calling and would therefore not know to use the static jitter buffer in the uplink direction. The IVS would quickly detect the Inband Modem (Send MSD) and could insert the static delay before the downlink Modem performance is affected in any way.

The case of PSAP calling back needs further consideration because the PSTN-IMS gateway would be in "voice state". A mechanism for the IMS network to know that the incoming call is callback from a PSAP would be needed.

The issues discussed in this clause would require further discussion in 3GPP.

Annex D:
Potential future enhancements of eCall

D.1 General

The potential future enhancements beyond the existing solution of CS in-band eCall are in six broad categories:

a) More comprehensive data set(s).

b) Wider range of support services.

c) Wider range of users (additional user categories).

d) Evolution to LTE/4G (E-UTRAN).

e) Inclusion in a general on-board telematics platform.

f) eCall feature enhancements, e.g. support of additional media such as text and video.

These proposed enhancements would be developed in standards bodies including CEN TC278 and ETSI MSG. There arises the question of who is going to pay if eCall enhanced features are invoked. Charging schemes, to remunerate based on the service given, may need to be supported.

D.2 More comprehensive data set(s)

The data sent with an eCall is the 'minimum set of data' (MSD) that the 'developers of eCall' felt to be required information, and reliably achievable most of the time.

At the time of the original eCall project, it was considered to send much more data, indeed the concept of a 'full set of data', was conceived as a potential future step, although never formally defined in respect of its scope and content, largely because the developers could not agree exactly what additional data was useful, and how to manage the associated data privacy issues.

Article 29 Working Party considered the eCall MSD and privacy aspects and issued an exemption in respect of the data in the MSD, so long as the data could not be used against the interests of the driver or occupants of the vehicle, especially in respect of aspects such as speed limit enforcement.

NOTE 1: Privacy has an exception but elsewhere in the present document privacy is described as a requirement.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32013R0305:EN:NOT

140 bytes was determined as the requirement for the eCall MSD because of assumptions made by ETSI standards developers of eCall communications aspects, based on the data that was transferred during early trials. The subsequent design of the eCall modem to process the amount of data at that time defined as the MSD produced a solution that transfers 140 bytes of data.

However, at the application level there had been two developments. Firstly, the content of the MSD had been extended, (which if represented as previously encoded would have exceeded the 140 bytes available), but secondly, and most importantly, by coding the data in ASN.1 packed encoding rules, the transmitted data now only used less a little more than half of the 140 bytes transmitted. This opened up the possibility for one or more 'optional additional data sets', so long as the overall message size does not exceed 140 bytes. This provided far more 'user associated' flexibility than the concept of a one-size-fits-all 'full set of data'. In addition to partitioned, optional sets of data, EEiP and CEN may at some later date determine additional data that would be usefully included in all eCalls.

Is it expected that the MSD will have to be coded with XML in the future to align with the widely used IP based coding. The problem with using ASN.1 in IMS eCall would that it is a binary format, and so cannot be carried as-is in SIP but instead should have an additional encoding into printable characters. That adds complexity and makes the data much larger. There would not be any benefit, since a legacy PSAP cannot accept the SIP anyway, and an IP PSAP can more easily accept the XML.

In order for PSAPs to be able to understand such additional data, it has to be defined in a Standards deliverable, or recorded in an on-line data registry available to the PSAPs (and in many cases both defined in a standards deliverable then registered in such a data registry).

To date an optional additional data set has been developed for commercial vehicles, providing data concerning the type, quantity, and condition of its cargo at the time of the incident.

The Russian Confederation is introducing an eCall system of its own, which is largely compatible with Pan European eCall but requires additional data, so have registered an ERA/GLONASS 'optional additional dataset'.

Other 'optional additional datasets', such as those providing medical information, and other vehicle related data are being considered, but there are no concrete proposals as yet.

Two of the advantages of the 'optional additional data' approach are that:

a) Additional data can be tailored to that most appropriate for the affected vehicle (for example, in the case of one private vehicle it may be some additional data relating to that specific model, while for another vehicle with an occupant with a specific health condition it may be (at the occupants request) some medical data, and in the case of a commercial vehicle it may be to notify the cargo of the affected vehicle which may have significant importance to the nature of the response to the request for assistance.

b) So long as the data is recorded in the data registry in an appropriate manner, the optional additional data need not be the result of a standardization consensus. For example there could be one dataset registered by one car manufacturer providing additional relevant data for a 2015 car model, and another by another car manufacturer for a 2016 car model.

NOTE 2: The limitation of 140 bytes remains an intrinsic limitation of the eCall modem. If technology were to remain static, and demand for additional data to increase, it is technically possibly to develop the system to send multiple 140 byte datasets, although this would increase the period between the establishment of an eCall and when the occupants of the vehicle may expect to talk with the PSAP operator, which is generally considered undesirable (sending data in a voice channel is a comparatively slow process). However, there is little sign of such demand at present, and technology does evolve, as evidenced by the subject and scope of this STF.

With this flexibility, discussion concerning a 'full set of data' has disappeared from the agenda of the relevant Standardization committees.

D.3   Wider range of support services

eCall is a type of 'emergency call' (Teleservice 12) to provide specific assistance once notification of an incident that requires the support of the emergency services has been triggered (automatically or manually). It has been proposed, and is proposed from time to time, that the range of services that could be supported using this technology could be increased.

Indeed, proponents, including some deliverables from the European Commission and Parliament, propose that the eCall platform could be the basis of hosting many telematics services into vehicles, indeed could provide the 'Trojan horse' to get telematics technology into vehicles.

This optimism suffers from three significant impediments.

a) As a TS12 emergency service, the eCall mechanism can only be used in an emergency situation and not for general operational communications.

b) As data transferred in a voice channel, the data rate is slow.

c) Other faster, more secure (see note) data transfer and exchange mechanisms are being developed to provide on-board ITS-station communications platforms.

eCall equipment does however provide a GSM/UMTS link into the vehicle, and it is recognized that there are existing service offerings that use communication with a vehicle to provide 'bundled' commercial services, such as breakdown support, roadside assistance, crisis assist, turn-by-turn navigation, vehicle diagnostics, stolen vehicle assistance, etc., and ample commercial opportunity to extend the take up of such service provision. Such services also offer 'emergency'/post-crash assistance, and it was determined to be better to bring such emergency/post-crash assistance services closer in line with the objectives of Pan European eCall and transferring the semantic content of the MSD to the most appropriate PSAP by developing a Standard for 'Third Party Supported eCall'. This was achieved with the development of EN 16102 [i.34].

But it is far more probable, and practicable, that future generation eCall can be carried over modern, secure, high capacity ITS-station platforms evolving for a wide range of services (such as weather alerts, obstacle alerts, ramp control, platooning, railway crossing warning, and even, in time, collision avoidance, as well as access to the internet and infotainment), rather than using the existing eCall platform to also host such services. (See clause 5.3).

NOTE: As an eCall is made very infrequently, and in the case of PE eCall, the UE is only registered on the network in the rare case of an incident occurring, and the duration of the eCall is limited, the 'threat' risk to eCall is considered very low and therefore the normal GSM/UMTS security levels are considered more than adequate. However other ITS services have to deal with greater levels of threat.

D.4   Wider range of users

The current regulations for eCall relate only to passenger cars and light commercial vehicles (categories M1 and N1).

Consideration has been given/is being given to extend the benefits of eCall to other categories of vehicles, such as:

a)   Commercial vehicles.

b)   Powered two wheel vehicles.

c)   Unpowered vehicles (bicycles, etc.).

d)   Vulnerable road users (visually, physically, mentally challenged).

e)   Personal eCall.

D.4.1   Commercial vehicles

The MSD (specified in EN 15722 [i.6]) contains static information regarding the vehicle, dynamic information regarding its location, direction of travel, etc., at the time of the incident, If sensors are in place it may also indicate the number of occupants. As discussed above, EN 15722 [i.6] also makes provision for additional data to be provided.

However, for commercial vehicles, a matter of significant importance to the emergency service responders is the cargo that the vehicle was carrying, which will potentially affect the nature of the response required from the emergency responders.

CEN TS 16405 [i.35] has been designed to provide a specification for an optional additional data concept for commercial vehicles to provide dynamic data about the load that it is carrying at the time of the incident that triggered the eCall, with specific emphasis on identification of dangerous goods. Two variants are provided, one (schema A) for use where information about the goods (ADR classified or not) is known in the eCall device; the second variant (schema B) is for use where information about the load is fetched from other sources.

D.4.2   Powered two wheel vehicles

The population at highest risk of death and serious injury on our roadways are those riding 2 wheeled powered vehicles (motor cycles, mopeds). The European Commission would therefore like to see the benefits of eCall extended to this category of road users.

The trend for motorcycle user fatalities differs clearly from the trend for other modes of transport. Motorcycle is the only mode of transport for which number of fatalities has increased over the last eight years (Source: European Road Safety Observatory). Fatality and injury rates for mopeds has fallen slowly, but at a much slower rate than that for cars and light vehicles.

Also the behaviour required from eCall for P2WV in the event of an accident is fundamentally different to that for four wheeled vehicles. In a serious P2WV accident the driver and passenger are highly likely to be separated from the motorcycle, and are very unlikely to be trapped by it. It is therefore not the location of the motorcycle that is of importance, but the location of the (potentially injured) driver and passenger. Solutions under consideration for P2WV under consideration include automatically generating the eCall based from the helmet of the driver, or the cell-phone of the driver. However, application level requirements are still at an early stage of discussion between the European Commission, EEiP, CEN, the European P2WV vehicle manufacturers association and PSAPs.

Several technical solutions have been offered, some involving a Bluetooth link between the bike and riders helmet, others just tracking the rider. The Industry association ACEM has attended CEN meetings to discuss, and held internal meetings on the subject, but the industry is very sceptical in respect of the additional cost (particularly for mopeds) and it has proven difficult to get participation in standardization. Our colleagues in CEN TC278 WG15 continue to liaise with ACEM about possible solutions. The possibility of a 'smart phone' 'app' linking solely with the driver and not involving the motorcycle itself is also considered (See also clause D.4.5).

D.4.3   Unpowered vehicles (bicycles, etc.)

Nearly a thousand cyclists die and 20 000 are seriously injured on Europe's roads each year. It is particularly disturbing that a high proportion of these are children and youths. The European Commission would like to extend the benefits of eCall to cyclists. However it is recognized that this could only be pursued as a variant of 'personal' eCall. (See clause D.4.5.)

Students in Sweden have developed an app that, via sensors, detects that you are riding a bike and if you fall over (most common accident) the phone sends an SMS or sets up a call according to a list in the phone. This demonstrates that the market can give cheap and viable solutions that, thanks to the current deployment of smart phones, can be used by almost everyone.

D.4.4   Vulnerable road users (visually, physically, mentally challenged)

This is seen as a special class of 'personal' eCall. (See clause D.4.5.)

D.4.5   Personal eCall

Opinions differ as to the benefit and complications of extending eCall to all persons. In practice, as almost all now have a mobile phone, and there is no technical data required (unlike a vehicle crash), a 112 call is already effectively a personal eCall. However it usually does not provide accurate location other than the CLI (which is not always available to the PSAP).

It is recognized that for many a 112 call is all that is required. However there are some special cases where a 'personal eCall' either as an 'app' on a smart phone, or based existing 3GPP or OMA protocols might be advantageous. Such scenarios include:

  a)   Vulnerable road users (visually, physically, mentally challenged).

  b)   Cyclists.

  c)   Motor-cyclists (especially moped users where the cost of equipment is a major factor).

  d)   Those with medical conditions. This could also be useful to report crime (e.g. mugging, assault, theft) in circumstances where a user cannot engage in a voice emergency call.

  e)   Mobile phone users who have been the subject of unusual movement characteristics (e.g. impact from vehicle causing unnatural movement sequence, vertical fall and fall velocity, etc.).

It seems apparent that, with most smart phones equipped with satnav, and devices such as accelerometers and gyroscopes, 'apps' for 'smart phones' could be relatively easily be specified, developed and made available. Examples of apps which send GPS coordinates from the phone to the PSAP during an emergency call already can be seen in Denmark and the UK. Potentially the GPS coordinates could also be given to the ambulance.

CEN TC278 WG15 continues to monitor these opportunities. However, there appears to be no market place interest in providing standards for such 'apps' and their related eCall systems.. An EU funded Project will be required if 'personal' eCall is to progress.

Recommendation: As these are areas of vital interest to the safety of EU citizens, EC should sponsor a Project Team or Strategic Task Force, comprising experts from **both** CEN and ETSI and groups representing users to determine the practicable and technically feasible options for providing 'smart phone' 'apps' to provide eCall capabilities for 'Personal eCall' for vulnerable road users, cyclists, motor-cyclists, and those with medical conditions.

D.4.6   Evolution to LTE/4G (E-UTRAN)

Is the subject of STF456. See the principal clauses and conclusions of the present document.

D.4.7   Inclusion in a general on-board telematics platform

See clause D.3 and Annex B.

D.4.8   eCall features enhancement

While the provision of more comprehensive data will be dealt with via 'optional additional data'(as described above), the evolution to packet switched IP based communication, and the potential inclusion in a general on-board telematics platform, presents new opportunities for eCall:

   a)   Removal of muting requirements.

   b)   Removal of 140 byte limit and provision of bidirectionality.

   c)   Option to provide video link between PSAP and occupants of the vehicle.

   d)   Option to enable PSAP to access onboard cameras to gain a first hand visual assessment of the crash site situation. A PSAP could also obtain further sensor readings - e.g. from non-standard as well as standard sensors.

   e)   Ability of the PSAP to send instructions to the vehicle (e.g. to sound the horn, flash the lights, lock/unlock doors, disable ignition, etc.).

D.4.8.1   Removal of muting requirements

Current eCall requires that the IVS disconnects audio equipment from the line while the MSD is transmitted. This is to stop the associated noise of the transmission of data in the voice channel from assailing the occupants of the vehicle, and to eliminate noises from the vehicle distorting the MSD transmission. However it has the consequence that it is several seconds before the PSAP and the occupants of the vehicle have voice contact. Using a packet switched solution means that this delay is no longer required, the PSAP can be in almost immediate contact with the occupants of the vehicle, and the IVS installation does not have to conduct the associated muting and unmuting, thus simplifying the IVS.

D.4.8.2   Removal of 140 byte limit and provision of bidirectionality unidirectionality

Similarly, the use of packet switching removes the limitation imposed by the eCall modem of 140 bytes maximum data. Multiple 'optional additional data' becomes a more capable option. Data may also be transferred from the PSAP to the vehicle. This is important also for the possibilities described in clauses D.4.8.3 and D.4.8.4.

D.4.8.3   Option to provide video link between PSAP and occupants of the vehicle

Using IP/IMS it is relatively simple, by mutual negotiation (as is standard with IMS Multimedia) or on request of the PSAP, to connect to a camera within the vehicle (probably but not necessarily mounted on the bottom of the rear view mirror) so that the PSAP can see first hand the state of the vehicle and its occupants.

This would of course require the car to be equipped with a suitable camera, and so, unless legislation were to be changed, would be an optional provision.

If the vehicle has a screen, the face of the PSAP or emergency responder could also be presented.

D.4.8.4   Option to enable PSAP to access onboard cameras to gain a first hand visual assessment of the crash site situation

Cars are increasingly equipped with cameras. A new generation model seen recently by one of the STF team had a reversing camera at the rear, cameras mounted under the wing mirrors to provide blind spot vision on both sides of the vehicle, a blindspot camera at the front to see obstacles below bonnet level, and side pointing cameras at the very front of the vehicle to enable the driver to see round blind junctions in advance of the driver obtaining direct visual sighting.

All of these cameras are controlled normally within the CAN bus, and are controlled by software. For example the reversing camera feeds to the dashboard screen or a reversing mirror display, only when the vehicle has engaged reverse gear. The three front blindspot cameras feed images to the dashboard screen only when 'drive' is engaged and the vehicle is travelling below 15 kph, and the side blindspot cameras feed images to the dashboard screen only when the car is in forward or reverse gear and the steering wheel is turned significantly. For example, the IVS could include in the initial SDP offer (in the INVITE) one-way media streams for each such camera; the PSAP is then able to accept such media streams, and the camera feeds then sent as usual for IMS media. This further leverages the standard capabilities of multimedia IMS emergency services. This capability might be especially helpful in a variety of situations, enabling the PSAP to get a first hand sight of the crash scene, in order to better assess the required response and perhaps subsequently to monitor (this may be important, for example in a complex motorway pile-up, when there is a fire, when the occupants have been thrown from the vehicle, etc.).

> NOTE: The SDP option would require the development of further application level standards for the IVS and PSAP in addition to modifying the SDP offer.

Annex E:
Potential conformance test cases for IMS eCall

E.1   Introduction

The present annex contains a list of potential signalling conformance test cases for IMS eCall, based on the Recommended Solution in clause 6.1.4. The main purpose of this analysis is to have an early assessment of the conformance testability of the Recommended Solution.

The test cases list only covers the conformance testing of what is considered to be the main IMS eCall core requirements and the most likely use case scenarios. The test cases are equivalent to those specified in TS 102 936-1 [i.31] for CS eCall.

The test requirements focus solely on the eCall specific additions to the generic IMS emergency call functionalities. IMS emergency call features are already conformance tested in the 3GPP test specifications from Release 9.

E.2   Test environment

Scenario 12 in clause 7.2.2 Table 1 is considered for the test cases thereafter, i.e.:

-    LTE is used.

-    The UE under test is a NG-IVS or an IMS-IVS.

UMTS is not considered in this analysis, however it is expected that equivalent test cases will be needed for IMS eCall over UMTS PS domain.

A positioning simulator is considered to be part of the test environment, to enable to UE under test to acquire its position and generate positioning information. However the validity and accuracy of positioning information in the MSD information is considered out of scope of the signalling conformance test cases.

E.3   Test cases

In the test cases specified thereafter, when the test case number contains an upper-case letter, it means that it is one alternative to several possible alternatives considered as feasible in the Recommended Solution.

E.3.1   Test Case 1A: Manually initiated IMS eCall using eCall-only UE, call-back required and performed

Initial Conditions:

-    SS: 1 LTE cell, suitable, indicating network support for IMS eCall in its System Information Broadcast.

-    UE: equipped with a USIM with valid credentials and configured for IMS eCall-only services, camped on the LTE cell in eCall-inactivity state.

Test Procedure:

1)   Test Operator triggers the UE to perform a manual IMS eCall (AT command +CECALL(2)).

2)   UE performs an LTE Attach procedure with the SS and establishes a PDN connection to the IMS PDN by setting up one Default EPS Bearer.

3)   UE performs an IMS registration on the IMS PDN.

4) UE triggers an additional PDN connectivity request to the emergency PDN. The emergency PDN connection is established by setting up a Default EPS Bearer for the second/emergency PDN connection.

5) UE performs an IMS emergency registration on the emergency PDN.

6) UE performs an IMS emergency session establishment for eCall. A Dedicated EPS Bearer (linked to the emergency PDN Default EPS Bearer) is established to carry the VoIP packets between the UE and the SS.

7) The SS sends an INFO SIP message to the UE to acknowledge successful reception of the MSD message.

8) The SS terminates the eCall. The Dedicated EPS Bearer is released.

9) While inactivity timer T34XX is still running, the SS performs an MT IMS voice call establishment on the IMS PDN to call-back the UE. A Dedicated EPS Bearer (linked to the IMS PDN Default EPS Bearer) is established to carry the VoIP packets between the UE and the SS.

10) The SS releases the call-back IMS voice call. The Dedicated EPS Bearer is released.

eCall Test Requirements:

- Step 2: The UE sends an ATTACH REQUEST of type 'EPS attach'.

- Step 6 - The INVITE SIP message contains the following information:

  - Request-URI: urn:service:sos.ecall.manual

  - To: urn:service:sos.ecall.manual

  - Content-Type: application/emergencyCallData.eCall.MSD+xml

  - Message-Body: Presence of MSD data is checked; however its validity is not checked.

- Step 7: The UE sends a 200 (OK) SIP message response.

E.3.2   Test Case 1B: Manually initiated IMS eCall using eCall-only UE, call-back not required

Initial Conditions:

- Same as for Test Case 1A.

Test Procedure:

1) Test Operator triggers the UE to perform a manual IMS eCall (AT command +CECALL(2)).

2) UE performs an LTE Emergency Attach procedure with the SS and establishes a PDN connection to the emergency PDN by setting up one Default EPS Bearer.

3) UE performs an IMS emergency registration on the emergency PDN.

4) UE performs an IMS emergency session establishment for eCall. A Dedicated EPS Bearer (linked to the emergency PDN Default EPS Bearer) is established to carry the VoIP packets between the UE and the SS.

5) The SS sends an INFO SIP message to the UE to acknowledge successful reception of the MSD message.

6) The SS terminates the eCall. The Dedicated EPS Bearer is released.

eCall Test Requirements:

- Step 2: The UE sends an ATTACH REQUEST of type 'EPS emergency attach'.

- Step 4 - The INVITE SIP message contains the following information:

  - Request-URI: urn:service:sos.ecall.manual

  - To: urn:service:sos.ecall.manual

- Content-Type: application/emergencyCallData.eCall.MSD+xml

  - Message-Body: Presence of MSD data is checked; however its validity is not checked.

- Step 5: The UE sends a 200 (OK) SIP message response.

E.3.3 Test Case 2A: Automatically initiated eCall, call-back required and performed

Initial Conditions:

- Same as for Test Case 1A.

Test Procedure:

1) Test Operator triggers the UE to perform an automatic IMS eCall (AT command +CECALL(3)).

2) - 10) Same steps as Steps 2) to 10) of Test Case 1A.

eCall Test Requirements:

- Step 2: The UE sends an ATTACH REQUEST of type 'EPS attach'.

- Step 6: The INVITE SIP message contains the following information:

  - Request-URI: urn:service:sos.ecall.automatic

  - To: urn:service:sos.ecall.automatic

  - Content-Type: application/emergencyCallData.eCall.MSD+xml

  - Message-Body: Presence of MSD data is checked; however its validity is not checked.

- Step 7: The UE sends a 200 (OK) SIP message response.

E.3.4 Test Case 2B: Automatically initiated eCall, call-back not required

Initial Conditions:

- Same as for Test Case 1A.

Test Procedure:

1) Test Operator triggers the UE to perform an automatic IMS eCall (AT command +CECALL(3)).

2) - 6) Same steps as Steps 2) to 6) of Test Case 1B.

eCall Test Requirements:

- Step 2: The UE sends an ATTACH REQUEST of type 'EPS emergency attach'.

- Step 4: The INVITE SIP message contains the following information:

  - Request-URI: urn:service:sos.ecall.automatic

  - To: urn:service:sos.ecall.automatic

  - Content-Type: application/emergencyCallData.eCall.MSD+xml

  - Message-Body: Presence of MSD data is checked; however its validity is not checked.

- Step 5: The UE sends a 200 (OK) SIP message response.

E.3.5 Test Case 3: Test eCall using eCall-only UE to a test point PSAP

Initial Conditions:

- Same as for Test Case 1A with the following addition: The UE has been configured with the URN to be used to reach the test point PSAP.

Test Procedure:

1) Test Operator triggers the UE to perform a test IMS eCall (AT command +CECALL(0)).

2) - 8) Same steps as Steps 2) to 8) of Test Case 1A.

eCall Test Requirements:

- Step 2: The UE sends an ATTACH REQUEST of type 'EPS attach'.

- Step 6: The INVITE SIP message contains the following information:

    - Request-URI: urn:service:test.sos.ecall.automatic

    - To: urn:service:test.sos.ecall.automatic

    - Content-Type: application/emergencyCallData.eCall.MSD+xml

    - Message-Body: Presence of MSD data is checked; however its validity is not checked.

- Step 7: The UE sends a 200 (OK) SIP message response.

E.3.6 Test Case 4: Reconfiguration call of eCall-only UE

NOTE: This is used for example to request removal of eCall-only restriction.

Initial Conditions:

- Same as for Test Case 1a with the following addition: The USIM has been configured with the contact information (URI) used to contact the service provider for reconfiguration services.

Test Procedure:

1) Test Operator triggers the UE to perform a reconfiguration IMS eCall (AT command +CECALL(1)).

2) UE performs an LTE Attach procedure with the SS and establishes a PDN connection to the IMS PDN by setting up one Default EPS Bearer.

3) UE performs an IMS registration on the IMS PDN.

4) UE performs an IMS session establishment to the service provider URI. A Dedicated EPS Bearer (linked to the IMS PDN Default EPS Bearer) is established to carry the VoIP packets between the UE and the SS.

5) The SS terminates the eCall. The Dedicated EPS Bearer is released.

6) Wait for duration 10 % longer (test system tolerance) than the periodic tracking area update timer (timer T3412).

eCall Test Requirements:

- Step 2: The UE sends an ATTACH REQUEST of type 'EPS attach'.

- Step 4: The INVITE SIP message contains the following information:

    - Request-URI: service provider's URI

    - To: service provider's URI

-       Step 6: The UE sends a TRACKING AREA UPDATE REQUEST message.

E.3.7   Test Case 5: eCall state before and after inactivity timer T34XX expiry

NOTE: Timer T34XX is the IMS eCall equivalent to CS eCall timer T3242.

Initial Conditions:

-       SS: 2 LTE cells, Cell1 suitable, Cell2 non-suitable, both indicating network support for IMS eCall in its System Information Broadcast. Cell1 and Cell2 belong to different Tracking Areas.

-       UE under test: equipped with a USIM with valid credentials and configured for IMS eCall-only services, camped on the LTE Cell1 in eCall-inactivity state.

Test Procedure:

1)   - 8) Same steps as Steps 1) to 8) of Test Case 1A.

9)   Wait for T34XX. Whenever a TRACKING AREA UPDATE REQUEST is sent by the UE, the SS completes the tracking area updating procedure.

10)   UE performs an LTE Detach procedure with the SS and the IMS PDN Default EPS Bearer is released.

11)   Wait for duration 10 % longer (test system tolerance) than the periodic tracking area update timer (timer T3412).

12)   The SS pages the UE for an incoming PS MT call.

13)   Test Operator triggers the UE to perform a normal IMS call to a specified URI (AT command +CDU).

14)   Change the power levels of Cell1 and Cell2 such that Cell1 becomes unsuitable and Cell2 becomes suitable. Wait for 1 min.

eCall Test Requirements:

-       Step 9: The UE sends a TRACKING AREA UPDATE REQUEST message at every expiry of timer T3412.

-       Step 10: At expiry of timer T34XX, the UE sends a DETACH REQUEST message.

-       Steps 11, 12, 13 and 14: The UE does not send an *RRCConnectionRequest* message.

E.3.8   Test Case 6: eCall state before and after inactivity timer T34XY expiry

NOTE: Timer T34XX is the IMS eCall equivalent to CS eCall timer T3243.

Initial Conditions:

-       SS: 2 LTE cells, Cell1 suitable, Cell2 non-suitable, both indicating network support for IMS eCall in its System Information Broadcast. Cell1 and Cell2 belong to different Tracking Areas.

-       UE under test: equipped with a USIM with valid credentials and configured for IMS eCall-only services and configured with the URN to be used to reach the preconfigured PSAP, camped on the LTE Cell1 in eCall-inactivity state.

Test Procedure:

1)   - 8) Same steps as Steps 1) to 8) of Test Case 3.

9)   Wait for T34XY. Whenever a TRACKING AREA UPDATE REQUEST is sent by the UE, the SS completes the tracking area updating procedure.

10) UE performs a local Detach. The IMS PDN Default EPS Bearer is also released locally.

11) - 13) Same steps as Steps 1) to 8) of Test Case 5.

eCall Test Requirements:

- Step 9: The UE sends a TRACKING AREA UPDATE REQUEST message at every expiry of timer T3412.

- Step 10: At expiry of timer T34XY, the UE does not send a DETACH REQUEST message.

- Steps 11, 12 and 13: The UE does not send an *RRCConnectionRequest* message.

E.3.9 Other test cases

The following IMS eCall test requirements are not covered by the test cases above and could be the subject of additional signalling conformance test cases to be specified:

- eCall-inactivity state at UE power-on.

- eCall-only UE does not Attach to the network before an IMS eCall is triggered.

- PSAP requests further information to UE, by requesting an updated MSD.

- Activation of eCall-only restrictions.

- eCall state before and after inactivity timer T34XY expiry for reconfiguration call.

Annex F:
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History

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