GSM ASSOCIATION
GSM EUROPE
The European Interest Group

GSME POSITION

Options for eCall MSD signalling

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Scope

eCall is an automatically or manually initiated E112 voice call supplemented by a Minimum Set of Data (MSD) containing vehicle specific and high accuracy location information. Using this information, the emergency services can accurately locate and provide more rapid assistance to accident victims, thus saving more lives. As with the E112 call, the integrity of the MSD sent from the vehicle to the PSAP has to be ensured. It is expected that the MSD will be sent either during the E112 call set-up or immediately following the establishment of the voice call.

The eCall Minimum Set of Data (MSD) is sent from an In Vehicle System (IVS), across 2G and 3G mobile networks (MNO), to a Public Safety Answering Point (PSAP). This report will examine the technical, standardisation and cost related issues for each of the proposed MSD signalling options.

The report will also take into consideration the requirements, as listed in this document, for:

- Call set up and data transmission times
- Bearer robustness and message integrity
- Existing standardised interfaces between the IVS and MNO and PSAP
- Signalling protocols and error correction between each domains
- Acknowledgement of received MSD
- PSAP voice call-back capability
- Roaming
- Privacy
- Security

Finally, the report will draw conclusions and make recommendations as to which of the candidate solutions should be standardised to provide an efficient, reliable and cost effective MSD signalling solution for the eCall service.

Contents

1 MSD TRANSMISSION REQUIREMENTS

1.1 Introduction

The eCall system utilises existing 2G and 3G mobile networks to communicate between a vehicle and a public emergency service centre. There is no requirement for the mobile network operator (MNO) to access or modify the Minimum Set of Data (MSD) sent by the In-Vehicle System (IVS) to Public Safety Answering Point (PSAP). It is expected that the MSD will be communicated by the MNO to the PSAP using existing fixed line voice and data services. Whilst the call set-up time and the time to transfer the MSD from the IVS to the PSAP are important following a vehicle accident, it is also important to ensure that the MSD is correctly populated and that the call is established in an efficient manner. To minimise the chances of the call failing due to network congestion, especially at peak commuting times, and to avoid unacceptably high levels of network registration and location update signalling, the IVS should not register with a network until it needs to make an emergency call. It is expected that the IVS will be powered-up, aware of its location, direction of travel and available PLMNs; in this state the IVS can then quickly access to a PLMN and make the eCall (E112+MSD).

It should be noted that, as with E112 calls, the eCall is established directly between the vehicle and the most appropriate PSAP. Some national administrations may wish to redirect emergency calls, for filtering purposes, to third party service providers but this is not considered to be within the scope of the eCall service, as defined by the European Commission.

It should be possible to test the IVS system from time to time so consideration should be given to the inclusion of a test call facility e.g. using a programmable MSISDN, subject to any fraud prevention considerations

SIM/USIM and SIMless related requirements are yet to be decided, however for the purpose of this analysis it should be assumed that a SIM/USIM will be present in the IVS. A second report will consider the need or otherwise to have a SIM / USIM in the IVS.

1.2 Requirements relating to E112 call establishment and the delivery of the MSD to the PSAP

The following requirements are limited to those that apply to establishing an end-to-end emergency voice call (E112), between the vehicle IVS and the PSAP, and the transmission of the MSD to the same PSAP.

1.2.1 Mobile Network Operator Support for eCall

Whilst there is no existing legislation mandating MNOs to support eCall, all 2G and 3G mobile networks within the EU, that support 112 or E112 emergency calls, are also anticipated to support this service. Although 3GPP is specifying support for emergency calls (VoIP) in the PS (IMS) domain, it is likely that the vast majority of E112 calls will continue to be circuit switched. To ensure that the eCall service can be supported by the majority of MNOs in Europe, it should be designed to operate over existing CS bearers; this should however not preclude the possibility of an enhanced hybrid CS and PS eCall service in the future e.g. to support the Full Set of Data (FSD) that might include multimedia elements.

In a recent liaison statement from ETSI MSG to SA1, it was requested that 3GPP take the following points into account:

- eCall should be supported by IMS and UMTS Terrestrial Radio Access Network and Evolved UMTS Terrestrial Radio Access Network

- There should be minimal changes to 3GPP Technical Specifications for a satisfactory design;

- Re-use of existing standardised interfaces between the IVS and MNO and PSAP should be considered.

1.2.2 Size of MSD

Justification: The Minimum Set of Data (MSD) has been defined by the eCall Driving Group in consultation with the PSAPs and amounts to a maximum of 140 bytes.

Note: The Dutch PSAP authorities expect that, at some future date, the MSD can be increased to deliver a Full Set of Data (FSD), that could include e.g. number of persons in the vehicle, deceleration, speed on impact. The maximum size of the FSD has not been specified so cannot be used to determine the transmission time.

Requirement: The Minimum Set of Data for eCall is 140 bytes.

1.2.3 Call set up and data transmission times

Whilst the call set-up time and the time to transfer the MSD from the IVS to the PSAP are important following a vehicle accident, it is also important to ensure that the MSD is correctly populated and that the call is established in an efficient manner. To avoid unacceptably high levels of network registration and location update signalling, the IVS should not register with a network until it needs to make an emergency call. It is expected that the IVS will be powered-up, aware of its location, direction of travel and available PLMNs; in this state the IVS can then quickly access to a PLMN and make the eCall (E112+MSD).

T1: Pre-call preparation period

Justification: Elapsed time from when the IVS is activated (automatically or manually) to start of call set-up. During this period the IVS will prepare the MSD for transmission, select the best PLMN (perhaps on signal strength, location and/or preferred PLMN list), and then access to the pre-selected network

<u>Requirement:: T1 (not yet specified but is likely to be <10 seconds)</u>

T2: Call set-up period (voice part)

Justification: Elapsed time from start of call set-up to paging at the PSAP (and caller gets ring-back tone). This is based on a UK requirement for emergency voice calls and user expectation that an emergency call 'proceeding indication' will be received within this time, or else the user might hang-up and try again.

<u>Requirement:: T2 should be <4seconds</u>

T3: MSD transfer period

Justification: Elapsed time from when the data is transmitted by the IVS to when it has been delivered to the PSAP. For the candidate out-of-band signalling methods i.e. SMS, USSD and UUS, the start of T3 and T2 periods are likely to be approximately the same. For the in-band signalling methods i.e. DTMF and In-Band Modem, T2 and T3 are consecutive. It is expected that the user will be kept informed as to the progress of the eCall prior to speaking with a PSAP operator.

Requirement: T3 should be <4 seconds

1.2.4 MSD acknowledgement

Following receipt of the MSD by the PSAP an acknowledgement shall be sent to the originating IVS. This implies the need for a robust signalling system.

1.3 E112 voice call requirement

An eCall is an E112 call supplemented by the MSD. The following requirements apply:

- The E112 call shall be initiated immediately or following the transmission of the MSD;
- Should the MSD not be sent or received for any reason the E112 call shall not be affected;
- In addition to the location information contained in the MSD, the E112 call shall also make available 'best effort' location information to the PSAP
- Transmission of the MSD should not affect the E112 voice intelligibility.

If an in-band signalling solution is chosen then the MSD will be sent over the E112 voice connection immediately following call establishment. The audio channel would be blanked whilst the data is being sent. In this case there is probably a need for the IVS to provide a call progress indication to the originator of the emergency call, but this is not within the scope of this report.

1.3.1 PSAP Call-back requirement

If the IVS design does not include a SIM then complex changes to the mobile network will be needed to enable the PSAP to call back the emergency call originator.

The IVS should be configured so that it does not end an emergency call and should remain connected until the PSAP decides to terminate the call. If the eCall is dropped for other reasons, it shall be possible for the IVS to try the call again.

If, subject to existing national regulatory requirements for emergency voice calls, the PSAP needs to initiate a call-back then:

- If an eCall is dropped for any reason it shall be possible for the PSAP to call-back the originator of the emergency call; Following termination of the initial eCall the IVS must remain contactable i.e. registered on a PLMN, until the emergency has been resolved;
- It should be possible to page the IVS e.g. using an IMSI / TMSI.

2 IVS NETWORK ACCESS

It is envisaged that more than 200 million vehicles will be equipped with eCall systems. Consequently there is a significant risk that these systems could cause an unacceptable high level of network signalling if they are allowed to register on networks and perform location updates. A further consequence might be network congestion at peak traffic times and at a time when accidents are most likely to occur. To avoid this problem, the IVS should not attempt to access a network until it needs to make an emergency call. However, to minimise the delay in establishing an eCall and sending the MSD, the IVS should be powered-up but not registered on a particular PLMN. In this state it should be aware of all the available PLMNs and have pre-selected the PLMN upon which to attempt access when an eCall is activated.

As mentioned in 1.2, if an eCall is dropped for any reason and if, subject to existing national regulatory requirements for emergency voice calls, the PSAP needs to initiate a call-back, then it shall be possible for the PSAP to call-back the originator of the emergency call. This means that the IVS should register and remain attached to the network until the emergency has been resolved, even if the vehicle ignition system has been turned off.

3 ROAMING REQUIREMENT

An eCall-equipped vehicle should be capable of making an emergency call to any available PLMN that supports 112 and/or E112 emergency calls. Since some European authorities require a SIM to be present in mobile terminals when making an emergency call, it is likely that a SIM card will be included in the IVS for this purpose. The advantages and disadvantages of SIM and SIMless terminals will be discussed in a separate report.

4 PRIVACY CONSIDERATIONS

The Directive on Privacy and Electronic Communication (2002) applies equally to eCall as it does to E112 calls. Whilst for the purposes of this report privacy may be considered out of scope, it is worth mentioning that if the eCall MSD is being sent to a 3rd party, other than a PSAP, then compliance with this directive, by the network operator, should also be ensured, particularly with regard to location information. When meeting the requirement for a PASP call-back facility it should probably be ensured that the IVS alerts the vehicle occupants when auto-answering and activating the in vehicle microphone. There was a court case in the USA (ONStar verses the FBI) relating to the use, by the FBI, of the OnStar (eCall) service to monitor private conversations. The 9th Circuit Court of Appeals ruled against the FBI, not on the grounds of privacy but because whilst being 'bugged' the vehicle occupants may not be able to make an emergency call; the FBI are expected to be overcome this minor technical problem.

5 SECURITY AND FRAUD CONSIDERATIONS

Existing authentication and general security requirements apply to the transmission of data using any of the candidate solutions i.e. SMS, UUS, USSD, DTMF or in-band modem/application. Similarly it should be ensured that the chosen solution cannot be used for fraudulent purposes e.g. any programmable MSISDNS used for test purposes.

6 CANDIDATE MSD SIGNALLING SOLUTIONS

In this section we briefly describe the possible solutions and tabulate the advantages and disadvantages of each. We then compare their suitability to transport the MSD in a reliable and cost-effective way when assessed against a list of eCall design criteria. The information in this section is drawn from various sources, including previous contributions from operators and vendors.

The eCall service is intended to supplement an E112 call with up to 140 bytes of additional emergency related information, defined as the MSD. To ensure the widest availability and reliability the initial eCall service must operate in the CS domain, however, a hybrid CS and PS, or PS only, based solution can be expected in the future e.g. when IMS support and VoIP emergency calls become prevalent. SIP signalling and other IP /TCP or UDP solutions for eCall might then be possible.

For the purposes of this report the candidate MSD signalling solutions are limited to the following:

- SMS - Short Message Service
- UUS - User to User Signalling
- USSD - Unstructured Supplementary Service Data
- GSM CS Data - GSM Circuit Switched Data (Alternate speech/data)
- DTMF - Dual Tone Multi-Frequency
- In-band signalling - (voice call) modem / application

Where applicable, data rates of signalling channels are given in 3GPP TS 44.003 section 7.1.3. SACCH is about 48 byte/s. SDCCH is about 98 bytes/sec. FACCH is 1200 bytes/s (FR) or 600 bytes/s (HR); however the nature of the layer 2 signalling mechanisms specified in section 9 of 3GPP TS 44.006 mean that the actual throughput on the FR FACCH is only around 230 bytes/s.

6.1 SMS – Short Message Service

SMS is a reliable widely supported, low cost, acknowledged messaging system that could be used to transport the 140 bytes of data to the SMS-SC in the home network. Although normally subject store and forward, and mobile availability delivery delays, the SMS-SC could be configured to prioritise the delivery of the SMs containing the MSD to the same PSAP, to which the E112 voice call has been routed. Should it be necessary to increase the amount data in the future then SMs can be concatenated to overcome the 160-character limitation.

The SM is normally sent on an SDCCH. If sent during a call, after TCH allocation – TCH allocation normally happens immediately after Setup, in GSM it will be sent on a SACCH and multiplexed in between Measurement Reports.

The SDCCH data rate is 98 bytes/sec and – post multiplexing - the SACCH data rate is about 24 bytes/s.

The serving MSC routes emergency voice calls to the most appropriate PSAP based on the serving cell's ID and location; however, SMs are typically routed to the SMS-SC in the HPLMN. As a result, reliable routing of the E112 call and the MSD to the same PSAP requires a complex routing solution. Since the PSAP E164 number is not normally available in the IVS, in order to route the MSD to the PSAP, the SMS Gateway in the HPLMN would need to obtain this from the VPLMN. In addition to the routing complexity and modifications to the SMS-SC / SMS-GW, changes to operator roaming agreements might also be needed. If the SMS-SC routed the MSD to an eCall server or GMLC, the PSAP might be able to download the MSD via IP / MLP, as for the E112 location information.

Alternatively the IVS might be configured with a Global name e-Call SMS-SC address that would allow the SM to be routed to the SMS-SC in the same PLMN as the serving MSC. This would make routing of the MSD and the E112 call to the same PSAP easier, however, additional functionality would still be needed, in the SMS-SC, to obtain the address of the PSAP to which the E112 voice call component has been routed by the serving MSC in its own PLMN.

For countries with many PSAPs e.g. Germany with over 990, the PSAPs could group together to acquire a dedicated SMS-SC. To send SMSs to it, the IVS sets the SMS-SC address in the RP Data messageto "112" and existing MSC functionality is used to route thses "emergency SMSs" to the PSAP. Then there needs to be a means to have the central SMS-SC route to the right PSAP (there is no MAP extension to move Cell ID from the MSC to the SMS-SC), however, the central SMS-SC can easily look into the MSD for the IVS's location and use this to derive the correct PSAP.

A further consideration is that the SMS requires a SIM to be present in the terminal (IVS) so this might preclude the possibility of a pan-European SIM-less eCall IVS based on the VIN ID contained in the MSD; especially as the SM is not normally terminated in the VPLMN and so the VIN would not be available to verify the senders ID.

6.2 UUS – User to User Signalling

There are 3 different UUS types, namely UUS-1, UUS-2 and UUS-3 and all 3 variants permit message acknowledgement.

For UUS1, both parties may exchange UUI (User User Information) during the set-up and the clearing phases of a call by including User-user information element(s) in basic call control messages (ALERTING, CONNECT, DISCONNECT, PROGRESS, RELEASE, RELEASE COMPLETE, SETUP). UUS1 is automatically deactivated when the call is cleared. Although UUS can be carried over an ISDN D-channel many fixed-line networks limit the message size to 32-bytes (to minimise call set-up delay and to limit the opportunity for fraudulent use of this messaging system).

For UUS2, both parties may send UUI (User User Information) after the alerting indication has been sent/received and until the connect indication has been sent/received. The UUI is sent in USER INFORMATION message and is limited to two messages in each direction. UUS2 is automatically deactivated when the called subscriber is no longer being informed of the call, i.e. if the call is established or released.

For UUS3, both parties may send UUI in the active phase of a call using USER INFORMATION messages. UUS3 is activated explicitly, when a call is originated or after the connection has been established. After UUS3 has been activated, either subscriber may transfer UUI in USER INFORMATION messages to the other subscriber on the call. UUS3 is automatically deactivated when the call is released.

Routing of the MSD to the same PSAP as the E112 call should be straightforward as the UUS is contained within the ISUP/Q.931 Call Control signalling. Not many network operators have implemented or use UUS at present, this is mainly due to the fear of its misuse for messaging purposes. Were UUS to be selected for eCall then there are relatively simple solutions available to prevent this from happening.

Transit switches within any (fixed) networks in between the PLMN and the PSAP might need upgrades to support UUS.

It should also be noted that UUS is not permitted in Emergency Call Setup [TS 24.008].

Emergency Setup is sent on SDCCH and, if the standards were changed to allow UUS-1 with emergency calls, then UUS-1 would slow down the emergency call setup. In this case the MSD size would probably need to be limited to about 32 bytes. If permitted, UUS 2 with its larger message size looks better for this appliction, i.e.sent on FACCH immediately when the call has been established.

Note that over a FR-TCH, FACCH is about two times quicker than SDCCH. Over a HR-TCH FACCH is about the same speed as SDCCH. Also, FACCH use steals speech frames – but probably does not impact intelligibility.

6.3 USSD - Unstructured Supplementary Service Data

USSD is widely used by European operators and is a robust, acknowledged / bi-directional, signalling system that uses SDCCH, or FACCH if sent during a speech call. The message length for USSD is 180 bytes, which is adequate for the MSD; USSD 2 is unlimited which would cater for future needs. USSD can be sent either independently or at any time during a voice call.

The routing of a USSD message is done at VLR and, if sent to HLR, at HLR level e.g. the message from the UE (in this case the IVS) is routed to the HLR that can forward it to an USSD gateway. The USSD gateway has then to forward the message to the correct PSAP. Since the voice call follows the routing rules of the originating MSC while the USSD follows the routing rules of the home USSD gateway it is difficult to send the two parts of the eCall to the same PSAP: there may be routing table misalignments, especially for the roaming cases (where the USSD gateway and the visited MSC do not belong to the same network), and moreover the serving MSC can route the call based on local information, such as the Cell ID where the call is originated, that are not propagated to the home USSD gateway.

Most of USSD codes are currently deployed by MNOs and a harmonised USSD code would need to be agreed by all operators for eCall. As USSD is not transparent to the network it has to be processed / transcoded and forwarded to the correct PSAP via e.g. an existing IP/MLP or GTP (Global Telematics Protocol) interface.

Both USSD and UUS are Supplementary Services and are not supported by the TS12 (emergency call) teleservice. If USSD were used to send the MSD independently e.g. prior to making an E112 call, then a SIM card would be needed in the IVS. If, however, USSD is invoked after call set-up then a SIM might not be necessary, but only if the 3GPP specifications are changed to allow the TS12 teleservice to support Supplementary Services (SS).

Routeing of the USSD from the visited MSC directly to the PSAP is another possibility. However this may require extensive new MSC functionality – especially if the MSC has to perform routeing based on the Cell ID. The same is likely to apply to any USSD Gateway with MAP/SS7 to SMPP/TCT-IP routing functionality because the PSAP address (E164), to which the emergency voice call has been routed, would have to be obtained and converted into an ENUM.

6.3.1 USSD case study

Successful trials using USSD are being conducted as part of the GST RESCUE Programme that is intended to deliver a robust commercial rescue service. The RESCUE project will also optimise the communication between the PSAP and the emergency service vehicles. In the GST RESCUE project, emergency calls are routed via a 3rd party call centre who in-turn alert the PSAPs when necessary.

6.4 GSM CS Data

GSM CS data at 9.6 bits/s is widely available in European mobile networks and offers a reliable, acknowledged, data transfer solution. However, when considered for eCall it does have several significant limitations, those being the long set-up time [up to approximately 30 seconds?] and simultaneous voice and data communication not being possible. Although a CS data call can be converted to a speech call, and vice-versa, transitioning to and from an emergency voice call is likely to reduce the reliability of the eCall service. Another form of CS data is the fax protocol but this too has similar limitations. The CS data call would need to be routed to the same PSAP as the E112 call or extracted by the MNO and forwarded to the same PSAP. Currently Emergency Call Setup in GSM does not support CS data and alternate speech-data is not supported in UMTS.

Were this option to be chosen a SIM card would also be needed.

6.5 DTMF – Dual Tone Multi-Frequency

DTMF is currently used in Finland to provide early eCall type services. Uplink DTMF is sent out of band by 24.008 messages. Downlink DTMF is sent through the voice codecs and hence is subject to distortion: this gives problems for acknowledgements.

DTMF signalling is not error corrected and, depending on the voice codec and mode (data rate) being used, some dual tones may become distorted (twist, frequency and level) and thus unreadable. Although there is also no automatic acknowledgement, DTMF can be used bi-directionally to send a receipt. A significant limitation is that the data rate is too slow. One tone per 130ms, or worse, on GSM; thus it would take 36 seconds or more for 140 bytes, or not less than 8.3 seconds for 32 bytes of data [23.014 for UMTS / 03.14 for GSM]. Whilst offering a very simple, network transparent, low-cost solution, it is unlikely that DTMF could be used to deliver the higher volumes of data needed in the future. For example, the PSAPs have an expectation that a Full Set of Data (FSD), which might include details on the number of occupants, deceleration and other accident parameters, will be needed at some later date.

DTMF routing to the PSAP is automatic and it can be used with or without a SIM card being present.

Some of the advantages of the DTMF in-band signalling method e.g. easy automatic routing, network transparency, are also applicable to the in-band modem / signalling application solution, described next.

6.6 In-band Modem / Signalling application

The in-band modem solution can best be described as an error correcting, bandwidth efficient, in-band signalling application. Should the MSD not be sent, or if the data is lost en route, or delivered to a PSAP that is not equipped to process eCalls, then the E112 voice component of the eCall must continue as normal.

The MSD is transmitted to the PSAP in the audio band as soon as the emergency voice call is established, this transmission time should be kept as short as possible. The time to send the MSD to the PSAP should be commensurate with the need to deliver reliable error free data, that will enable the emergency services to locate and assist the accident victims more quickly. It is expected that the vehicle occupants will be provided with an eCall progress tone/indication and that once the MSD has been sent, and acknowledged, the in-band modem will open the audio path to the PSAP operator.

As with most applications there will be many different versions to choose from and, if it is decided to specify an in-band solution for eCall, then it can be expected that competitive testing e.g. a 'bake-off' and the normal commercial tendering will follow.

Some major benefits of the in-band modem solution are:

- Routing of calls is automatic to the PSAP, greater reliability;
- No transcoding needed in the network, less risk to data integrity;
- No changes are needed to the network, transparent operation;
- Least cost option for network operators;

Some in band modem solutions as the one detailed below offer additional advantages such as:

- Works with or without a SIM being present in the IVS;
- It can operate over all voice call codecs e.g. GSM-EFR, GSM-FR, GSM-HR, AMR-NB, AMR-WB, EVRC;
- No changes needed to the existing PSAP emergency voice call interfaces
- Note the UE's modem tones need to be disabled if no "answer tone" is received from the PSAP, otherwise the PSAP operator might be disturbed by loud tones.

6.6.1 In band modem case study

The following data relates to the OnStar system, deployed commercially in the USA, and is <u>only</u> included as an example of the typical half-rate and full-rate performance that can be expected from an in-band modem / application.

The delivery time (in seconds, round-trip with acknowledgement) for 140-byte eCall MSD is shown below. Since eCall's targeted rollout timeframe is 2009 the improved performance offered by version 5.0 would appear to meet the eCall criteria. The release 3.0 version, currently deployed in North America in more than 3 million vehicles, is included for reference.

Vocoder	In-band Modem Version 5.0 (eCall) (Available in Q406)	In-band Modem Version 3.0 (Deployed today in North America)
AMR 4.75kbps Half Rate	6.23	18.29
AMR 5.15kbps Half Rate	5.65	17.75
AMR 5.90kbps Half Rate	4.56	16.21
AMR 6.70kbps Half Rate	3.48	14.58
AMR 7.40kbps Half Rate	3.39	14.58
AMR 7.95kbps Half Rate	3.44	14.58
AMR 4.75kbps Full Rate	5.41	17.95
AMR 5.15kbps Full Rate	4.97	17.62
AMR 5.90kbps Full Rate	3.89	16.29
AMR 6.70kbps Full Rate	3.65	14.59
AMR 7.40kbps Full Rate	3.56	14.62
AMR 7.95kbps Full Rate	3.56	14.58
AMR 10.20kbps Full Rate	3.56	14.58
AMR 12.20kbps Full Rate	3.56	14.58

Notes:

- The round-trip delivery time includes positive acknowledgement from the remote peer indicating that the 140-byte message is received

- In-Band Modem release 5.0 is the modem suggested for eCall. The round-trip message delivery time for a 140 byte MSD seems to meet the 4 seconds requirement.

- Release 5.0 will be commercially available in North America by the 4th quarter of 2006. This is an 800 bps modem with significant improvement at the physical layer (less overhead and two modulating tone pairs instead of one) and data link layer transmission mechanism.

- The modem link establishment time (synchronisation and carrier detection) for both versions of in-band modem is about one second.

- Delivery time for 5.0 is not yet optimised for GSM AMR Vocoder. It is a more generic version targeted for CDMA EVRC and GSM AMR Vocoders. As such, there're still rooms for improvement in terms of data rate or delivery time.

Some standardisation e.g. specification of the eCall MSD transport application and competitive testing (bake-off) of the candidate applications could be expected. This might to be done in 3GPP SA4, OMA, the ITU or by some other standards organisation.

Any capital costs associated with this solution i.e. the in-band transmission of the MSD from the IVS across the PLMN to the PSAP, are unlikely to affect the mobile network and are limited to the IVS and PSAP installations.

The in-band modem example performance data provided shows that the existing solution for OnStar takes about 15 seconds (average) to transfer 140 bytes and receive an acknowledgement. Whilst this appears slow, compared to a normal emergency voice call dialled from a mobile phone, where the user can expect to receive a ringing tone or answer within 4 seconds, it is important to keep the eCall in context. When an accident occurs and the eCall is activated, in manual initiation mode, there is likely to be a short delay (perhaps 5 seconds) to allow the driver to cancel the call if necessary. If the call is not cancelled then the IVS will attempt to access a network, establish the call and send the MSD to the PSAP. Whilst the MSD is being transmitted (about 4 seconds) the vehicle occupants cannot speak to the PSAP operator, however, following transmission the audio path to the caller is restored (un-blanked). The elapsed time from when the accident occurs to when the PSAP operator speaks to the occupants of the vehicle is likely to be less than 25 seconds, which is not unreasonable in these circumstances. Improvements to the in-band signalling application are expected to reduce the current 15-second average to below 4 seconds.

7 SUMMARY AND COMPARISION OF OPTIONS

MSD Signalling Options and eCall Criteria	**SMS**	**CS Data**	**UUS**	**USSD**	**DTMF**	**In-Band Modem**
GSM and UMTS supported	Yes	No	Yes	Yes	Yes	Yes
Circuit Switched supported	Yes	Yes	Yes	Yes	Yes	Yes
Standardised call set-up	Yes	Yes	Yes	Yes	Yes	Yes
Capacity MSD size 140 bytes	Yes	Yes	Yes	Yes	Yes	Yes
Predictable low transfer delay (assumes no delay over MNO-PSAP interface for transcoded SMS, UUS and USSD originated messages)	Yes	Yes	Yes	Yes	No	Yes
Extensible for FSD	Yes	Yes	Yes	Yes	No	Yes
Error free	Yes	Yes	Yes	Yes	No	Yes
Acknowledgement possible	Yes	Yes	Yes	Yes	Yes	Yes
Co-ordinated E112 & MSD routing	No	Yes	Yes	No	Yes	Yes
Low impact on PLMN architecture	Yes	Yes	No	No	Yes	Yes
Works even if PLMN – PSAP interface does not support ISUP/Q.931	Yes	Yes	No	Yes	Yes	Yes
Easy Pan-European roaming	Yes	Yes	Yes	No	Yes	Yes
Secure & low risk of fraud	Yes	Yes	Yes	Yes	Yes	Yes

8 STANDARDISATION

Depending upon the chosen option for eCall MSD signalling some changes will be needed to the 3GPP standards. Apart from the DTMF, UUS and in-band modem solutions, new mechanisms would be needed to route SMS and USSD messages to ensure that the E112 call and the MSD are routed to the same PSAP. If an in-band signalling application is chosen then competitive solutions could be evaluated and standardised in 3GPP (SA4), OMA or by some other SDO.

It has yet to be decided if the IVS will be SIM or SIMless, however, as previously discussed, it is very likely that a SIM will be needed if SMS, or the UUS, USSD supplementary services are to used in conjunction with a TS12 emergency call. Alternatively the 3GPP SS specifications and MSC implementations would need to change to allow the TS12 teleservice to use these particular supplementary services.

Further standardisation work may also be needed to speed-up network access, eCall set-up and subscription handing.

9 CONCLUSIONS

This report has examined several techniques that allow the fulfilment of the eCall requirements.

Many motor manufacturers already offer their own proprietary (call centre based) breakdown and emergency rescue services. These use a variety of mobile network signalling methods, including SMS, DTMF and CS Data. In the United States the OnStar system uses an in-band modem to send data to an emergency call centre / PSAP.

Whilst most of these proprietary services provide road side assistance, lost key unlocking, stolen car location and other commercial services, in addition to automated accident emergency calls, the EU Commission eCall requirements are more fundamental. Firstly, as previously mentioned, eCall is not a commercial service but is simply intended to supplement an E112 emergency call (TS12) with up to 140 bytes of accident related data. The E112 call, together with the MSD, is to be routed directly to the responsible PSAP in the normal way.

As MNO support for eCall is not a mandatory requirement, there is no guarantee that all MNOs will invest in changes to their networks, that brings them little or no revenue, just for eCall. Hence, to ensure the fullest pan-European availability of the eCall service, it is highly desirable to employ a signalling system that has little or, preferably, no impact on existing networks. As there is no requirement for the network operator to process the content of the MSD in anyway it can be transported transparently from end-to-end. **This implies that the preferred solution for eCall should be based on an in-band modem/application.**

9.1 Decision:

<u>21 March 2006: GSMA 3GPPOPs (eCall discussion group) conference call:</u>

It was agreed unanimously that, based on the conclusions of this report, the preferred eCall MSD signalling system should be based on an in-band modem/signalling application. It was also agreed that this report should be communicated to GSME with a recommendation that it be adopted as a GSME report / position paper.

APPENDIX A

A.1 Appendix A – Level 1

[Body Text]

Report Glossary

Term 1	Definition

Report Abbreviations

2G/3G	2nd / 3rd Generation
3GPP	3rd Generation Partnership Project
ASN.1	Abstract Syntax Notation number One
AMR	Adaptive Multi-rate
AMR-NB	Adaptive Multi Rate-Narrow Band
AMR-WB	Adaptive Multi Rate-Wide Band
AUC	Authentication Centre
CDMA	Code Division Multiple Access
CLI	Caller Line Identification
DG	Driving Group
DTMF	Dual Tone Multi-Frequency
E164	The ITU standard format for international telephone numbers
EFR	Enhanced Full Rate
EMTEL	EMergency TELephony
ETSI	European Telecommunication Standards Institute
EVRC	Enhanced Variable Rate CODEC
FACCH	Fast Associated Control Channel
FR	Full Rate
FR-TCH	Full Rate Traffic Channel Traffic Channel
FSD	Full Set of Data
GMLC	Gateway Mobile Location Centre
GSM CS Data	GSM Circuit Switched Data (Alternate speech/data)
GTP	Global Telematics Protocol
HLR	Home Location Register
HMI	Human-Machine Interface
HPLMN	Home PLMN
HR	Half Rate
HR-TCH	Half Rate Traffic Channel
HTTP	Hypertext Transport Protocol
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ITU-T	International Telecommunication Union Telecommunication Sector
IVS	In-Vehicle System
MAP	Mobile Application Part (SS7)
MSG	ETSI Technical Committee Mobile Standards Group (TC MSG)
MLP	Mobile Location Protocol
MNO	Mobile Network Operator
MSC	Mobile Switching Center
MSD	Minimum Set of Data

MSISDN	Mobile Station ISDN
OMA	Open Mobile Alliance
PSAP	Public Safety Answering Points (Ambulance, Police or Fire Fighters)
PLMN	Public Land Mobile Network
SA1	3GPP SA1 standardizing services
SA4	3GPP SA4 standardizing speech, audio, video, and multimedia codecs
SACCH	Slow Associated Control Channel
SDCCH	Stand-alone Dedicated Control Channel
SDO	Standards Developing Organization
SIM	Subscriber Identity Module
SMS	Short Message Service
SMS-SC	SMS Centre
SMSG	SMS Gateway
SS	Supplementary Services
TCH	Traffic Channel
TCP	Transmission Control Protocol
Tel-URI	Telephone number expressed as an URI
TS12	Emergency call teleservice
TSG	Technical Specification Group
ToR	Terms of Reference
UDP	User Datagram Protocol
UE	User Equipment
UMTS	Universal Mobile Telecommunications System
UUI	User-to-User Information
UUS	User-to-User Signalling
USSD	Unstructured Supplementary Service Data
USIM	UMTS SIM
VAS	Value Added Services
VIN	Vehicle Identification Number
VoIP	Voice over IP
VLR	Visitor Location Register
VPLMN	Visited PLMN
XML	eXtensible Markup Language

Report References

[1] First Reference