GSM and GPS Combine for European eCall

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eCall is a European emergency call system that will combine GSM and GPS technologies to support automated vehicle emergency services throughout the European Union. Its goal is to provide rapid assistance to motorists involved in a collision anywhere in the EU. The system is officially defined as a “Pan-European automatic in-vehicle emergency call system”.

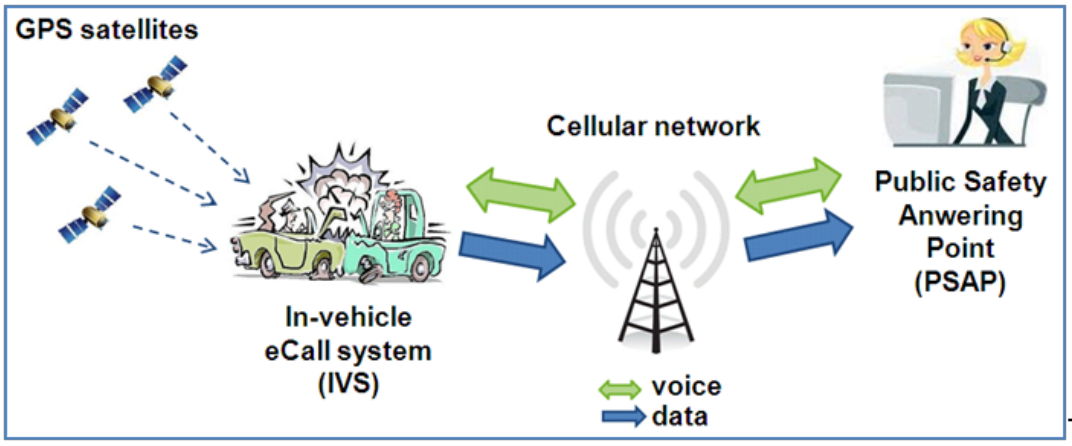
The service is planned for initial implementation in 2015 and mandates that all new models of cars and light vehicles sold in the EU should be eCall compliant. A memorandum of understanding supporting eCall has been signed by most European countries, the European Automobile Manufacturers Association and many automotive companies.

The system, which will ultimately be required for all new vehicles sold in the EU, will monitor in-vehicle sensors for such events as airbag deployment to automatically transmit location details and summon assistance via GSM emergency cellular service “112”, the universal emergency services number adopted throughout the European Union and Switzerland.

When activated, the in-vehicle eCall system (IVS) automatically initiates an emergency call carrying both voice and data (including GPS location data) directly to the nearest 112 Public Safety Answering Point (PSAP) to determine whether rescue services should be dispatched to the known position.

The motivation for eCall is the reduction of the consequences of the road accidents in Europe:

• 40,000 people killed and more than 1.2 million injured (EU statistics from 2007)
• Economic loss caused by road accidents: € 160 billion per year
• Potential to save 2,500 lives and save € 26 billion each year in the EU



The core functionality of eCall requires an embedded system in each vehicle that continuously monitors crash sensors and GPS receiver in order to initiate an automated data and full duplex voice call via a dedicated GSM modem in case of an emergency condition.

The goal is to equip all cars in the EU with this hardware either as first-mount unit in new cars, or installed in pre-existing vehicles (after market devices).

Some key technical requirements of the eCall system are:

• Both data and voice call must utilize the same physical voice channel (SMS channel is not suitable due to delay and lack of prioritization, and GPRS has low priority than voice and may not be consistently available everywhere)
• It must be fast and reliable: voice channel set-up confirmation (ring-back tone reception) must occur no more than 4 seconds after the call is initiated.
• The existing cellular network architecture must be used without modification
• A minimum set of mission-critical data (MSD) of 140 bytes (including time, location and vehicle description), plus a full-duplex voice communication channel must be supported over the same channel.

These requirements dictate that the GSM transceiver implements an “in-band modem” that allows data transmission over the voice channel, similar to the way a fax machine operates over telephone networks.

3GPP has initiated the standardisation process of the in-band modem solution for eCall data transfer (3GPP TS 26.267: "eCall Data Transfer; In-band modem solution; General Description") and the related reference software (3GPP TS 26.268: "eCall Data Transfer; In-band modem solution; ANSI-C reference code"). The solution consists of an eCall in-band modem pair, usually referred as IVS eIM (IVS eCall In-band Modem, eCall data transmitter) and PSAP eIM (PSAP eCall In-band Modem, eCall data receiver).

GPS subsystem
For the IVS device, a stand-alone GPS receiver chip in automotive quality grade

(AEC-Q100, ISO/TS 16949) is typically required. Alternatively, for after-market IVF devices, a GPS receiver module can be used. Ideally, a GPS receiver module with high integration of passives resulting in a minimum external BOM is the most attractive solution.

For interoperation with the GSM modem, as well as optimal GPS performance, a GPS receiver that also supports direct interface to the GSM modem is a convenient design feature.

GSM subsystem
The embedded GSM modem in the IVS must also conform to automotive requirements (AEC-Q100, ISO/TS 16949) as a minimum.

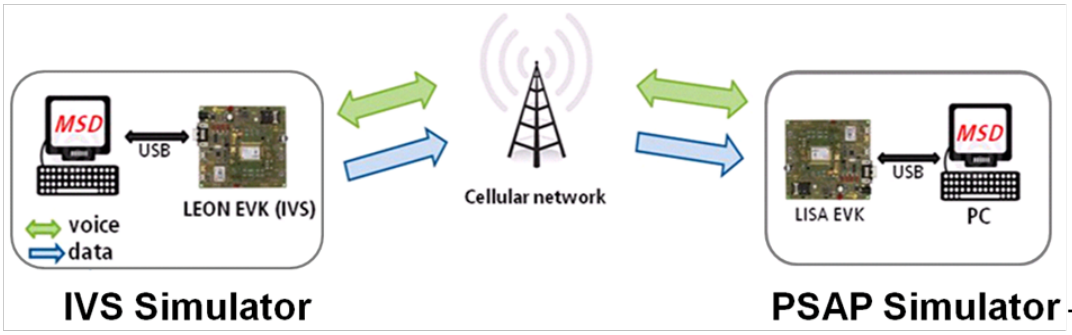
To support eCall over the existing 2G mobile phone networks in the EU, the GSM modem requires an integrated in-band modem according to the 3GPP TS 26.267 specification. eCall data transmission over the GSM voice channel is a mandatory requirement.

Another important consideration for optimal GPS performance is the presence of an Assisted GPS client embedded in the GSM modem. This allows for more reliable positioning performance, especially in areas where GPS satellite signals are blocked or attenuated: satellite ephemeris can instead be called up via wireless connection to an A-GPS server.

As precise eCall protocol specifications may still change before it is fully deployed, the GSM modem should also support firmware update over the air (FOTA). This allows for software update over the air to allow for evolving eCall specifications.

eCall test environment
To facilitate the design and evaluation of IVS designs before the eCall infrastructure is actually deployed, a comprehensive testing environment enabling the verification of the overall in-band communication and the development of customer eCall devices is an important requirement for IVS OEMs.

The test environment must allow the IVS to use its in-band modem functionality to establish a voice call over an actual GSM network



The digital audio stream containing the MSD is sent by the IVF over the In-Band modem channel and received by a PSAP simulator. The MSD is than decoded by the PSAP. A diagram of an eCall IVF/PSAP test setup based on u-blox components is outlined below:

In-band modem demo setup subsystems

IVS Simulator: EVK-G20 evaluation kit

A notebook computer communicates via standard AT commands to the EVK-G20 LEON-G100 evaluation kit which is mounted with a LEON GSM module with embedded in-band modem capability and a NEO-6Q GPS receiver module. The evaluation kit comes with all the accessories and software needed to easily connect it to the notebook computer and to the air interface.

The LEON-G100 is the core of the in-band modem demo set up and it is an ideal starting point for the development of “eCall ready” automotive boxes.

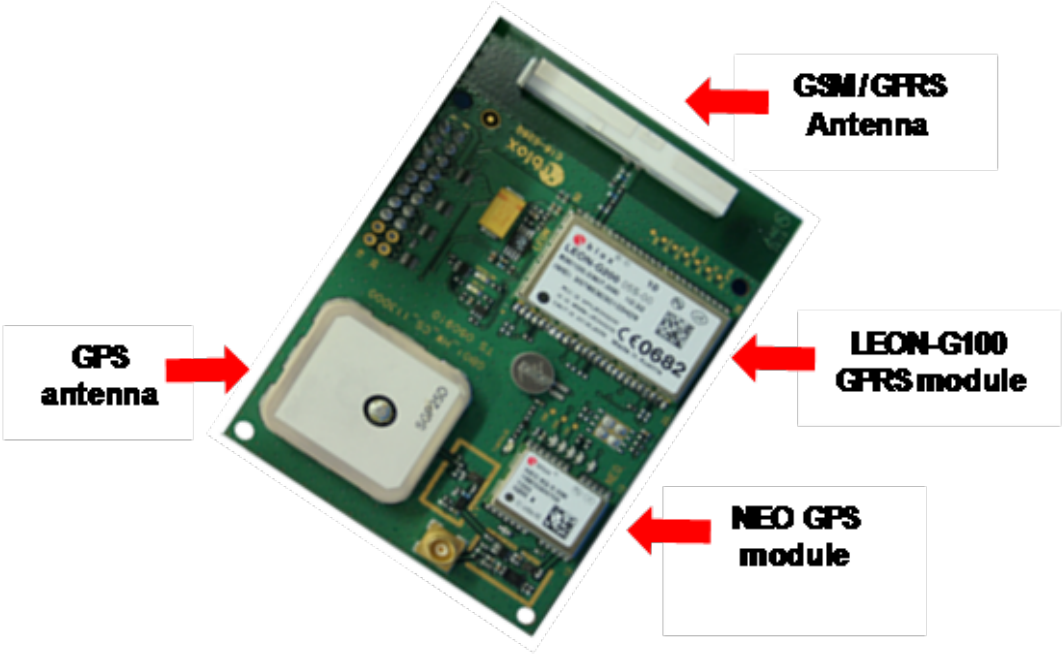
PSAP simulator

The hardware part of the PSAP simulator consists of a PC or laptop computer running u-blox’ m center wireless evaluation software. The PSAP simulator embedded in m-center takes care of the synchronization between the IVS (LEON) and the receiving device (EVK-U1x eval kit wit LISA module), the audio lines management, and of the MSD decoding.

Other considerations: Operator approval of the GSM modem

GSM modems are subject to country-specific government approvals. In addition, operator-specific certifications within each country may also be required. Without these approvals, an IVF device based on the module will not be allowed to operate over that country's or operator's mobile network.

It is for this reason that a pre-certified wireless module is the most attractive solution. With certifications already granted at the module level, certification of the end-device is vastly simplified: many steps may be skipped. The risk of failing to pass final certification is also minimized as any chance of a potential design flaw in the module has been eliminated.



eCall IVS

Reference Design

To help bring IVF terminals to market faster, a GPS and GSM reference design with integrated SMT antennas is available. The C26 is a complete and integrated solution for telematics applications such as eCall, fleet management, stolen vehicle and asset tracking, road pricing, and security/surveillance. This 100% SMD solution uses SMT passive GPS and GSM antennas.

Conclusion

With the imminent deployment of eCall, development of IVF terminals is in full swing. The correct choice of components will have a large affect on time-to-market. Important factors to consider are the supplier's know-how and ability to support design-in requirements of GPS and GSM subsystems, comprehensive software support, certification of the GSM modem, forward compatibility with future technologies, as well as the ability to deliver high-quality automotive-grade components in high-volume.

References

• 3GPP TS 26.267: "eCall Data Transfer; In-band modem solution; General Description" (www.3gpp.org [1])
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http://www.wirelessdesignmag.com/blogs/2012/03/gsm-and-gps-combine-european-ecall?qt-digital_editions=0

Links:
[1] http://www.3gpp.org