How the connected car revolution is going to increase safety on our roads and fast rescue in case of car collisions
Drive Connected, Drive Safe
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Nearly 1.3 million people die in traffic accidents each year around the world, on average 3,287 deaths a day. An additional 20-50 million are injured or disabled. Road accidents are the 1st cause of death among young adults aged between 15-29.

Traffic accidents cost USD $518 billion globally, for individual countries 1-2% of their annual GDP. Road accidents cost low and middle-income countries USD $65 billion annually, exceeding the total amount received by developmental assistance. Unless actions are taken, road traffic injuries are predicted to become the fifth leading cause of death by 2030.

Collisions can be avoided by means of safer driving, safer cars and better infrastructure. One major enhancement will be the Connected Car revolution.

But what happens after a car accident?

30% of deaths occurs within minutes of accident, 70% of deaths occur within 2 hours. This presents a large opportunity to improve the chances of survival by getting the proper emergency services to the crash location as quickly as possible. But this also presents the problem in how to make this possible.

Several factors come into play in order to have the most appropriate rescue resources directed to the accident:

- Ability of passengers to contact emergency assistance
- Communicating critical information after an event
- Identification of the location in which the accident took place
- Direction of travel of the vehicle (important when travelling on highways, in tunnels, etc so Emergency Services access most appropriate on ramp)
- Number of passengers
- Type of vehicle
- Propulsion Type

These are the main factors which determine if lives could be saved in these fateful two hours.

In recent years, emergency buttons have begun to appear in an increasing number of cars that, when pressed, establish a connection with an emergency call center. Depending on the on-board equipment, it is increasingly possible for the car to automatically determine its geolocation and establish a communication link between the call operator and the passengers. If the passengers are able they can assist to determine the nature of help needed, such as an ambulance, fire brigade or car maintenance.

This is only possible if the vehicle is equipped with such a system and the passengers are capable of using it. For this reason, the European Union has decided to standardize this system with automatic activation and to make it mandatory for all vehicles produced and sold in Europe from April 2018 onwards. A similar system is operational and mandatory in Russia as ERA-GLONASS system since January 2017.
The Pan European project known as eCall is supported by ACEA (European Automobile Manufacturers Association) and ERTICO - ITS (Intelligent Transportation Systems) Europe. It consists of a Public Safety Answering Point (PSAP) in the emergency call centers (112) and In Vehicle System (IVS) capable of:

- Geo-location of the car via satellite receiver (GPS/GLONASS), assisted by the cellular network
- Detecting the event of a crash (e.g., deployment of air bags, etc.)
- Establishing an emergency call to an emergency call center using a mobile network (2G/3G) and provides:
  - Position at the time of the accident and in previous moments
  - Direction of travel
  - Number of passengers (detected by sensors in the seats and/or belts)
  - Car data (vehicle type, fuel type, etc.)
  - Data of the driver associated to the car
- Establish a two-way audio call with the passengers to request more details about the situation, if possible.

After a crash the eCall/ERA-GLONASS IVS (In Vehicle System) module, automatically establishes a call with the emergency call center (112) and transmits a Minimum Set of Data (MSD). The MSD contains relevant information (vehicle type, fuel type, number of passengers, location of the vehicle, etc.). After the successful transmission of the MSD an audio connection is enabled to communicate with the passengers. The eCall/ERA-GLONASS IVS module can also be manually triggered in order to call for help when passing by a roadside incident with a vehicle that may have no eCall feature or if the incident was not severe enough to trigger an automatic eCall. To receive and acknowledge the MSD the emergency call center is equipment with a Public Safety Answering Point (PSAP).

Before installation of the IVS module in a vehicle, it needs to be tested to ensure it operates as designed and meets the required operating standards.

- IVS must comply with eCall/CEN/ETSI standards
- Verify that the IVS modem is able to trigger an emergency call both automatically and manually, and sets the eCall Flag appropriately
- MSD is composed and transmitted correctly
- Establish a voice connection with the PSAP
- Produce logs of results/ACK/NACKS/timers for troubleshooting
- Optionally test audio quality

<table>
<thead>
<tr>
<th>Feature</th>
<th>eCall</th>
<th>ERA-GLONASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio Access Network</td>
<td>GSM (2G) / WCDMA (3G) (optional)</td>
<td>GSM (2G) / WCDMA (3G)</td>
</tr>
<tr>
<td>GNSS</td>
<td>GPS</td>
<td>GLONASS, GPS (optional)</td>
</tr>
<tr>
<td>In-Band-Modem</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Secondary (redundant) channel</td>
<td>No</td>
<td>SMS</td>
</tr>
<tr>
<td>MSD</td>
<td>MSD</td>
<td>Similar to eCall, but additional fields</td>
</tr>
<tr>
<td>Additional (packet) data channel</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
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Once installed in a vehicle, ideally these tests should then be repeated in the real world under different conditions such as traffic congestion, varying weather conditions, urban and rural geographies. Due to ever changing channel conditions it is almost impossible to develop repeatable test conditions outside the lab however it is now possible to record live signal environments that can be replayed in a lab environment including eCall performance.

In addition to the standard eCall/ERA-GLONASS/ service, some manufacturers offer additional services such as roadside assistance, fleet management with back-up capability if initial communication fails. These services are routed to private call centers or TPSP (Third Party Service Provider)

Comparison between Pan European eCall and private eCall:

<table>
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<tr>
<th></th>
<th>Pan European Call</th>
<th>TPS eCall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose/service</td>
<td>Only emergency calls</td>
<td>Combined with other value-added services (i.e. track and trace, B-call)</td>
</tr>
<tr>
<td>Mandatory</td>
<td>Yes (automatic and manual) MS has to accept</td>
<td>No, optional</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MS may require Pan European eCall only</td>
</tr>
<tr>
<td>Type of Communication</td>
<td>Voice + MSD, in band</td>
<td>Voice + MSD, service provider specific</td>
</tr>
<tr>
<td>Destination</td>
<td>PSAP, fixed in national routing schemes MN0s must implement (national law)</td>
<td>Private answering point; TPS specific</td>
</tr>
<tr>
<td>Data</td>
<td>Only MSD according to standards</td>
<td>MSD and additional data (not yet standardized); TPS specific</td>
</tr>
<tr>
<td>Priority</td>
<td>Handled as normal 112 emergency call with priority in the networks</td>
<td>Call has no priority in the networks</td>
</tr>
<tr>
<td>Traceability</td>
<td>Only when eCall-message is triggered</td>
<td>Dependent on agreement customer/TPSP</td>
</tr>
</tbody>
</table>
With the E6950A, Keysight offers an eCall / ERA-GLONASS Conformance Test Solution that enables the user to perform end-to-end functional and standard-compliant testing of eCall / ERA-GLONASS IVS modules, with optional audio performance analysis. It includes a PSAP Emulator Software to simulate a Public Safety Answering Point (PSAP), emulates a cellular network and provides GNSS geo-coordinates required by the IVS to compile the MSD. The system also verifies if the IVS is able to trigger an automatic or manual emergency call, sends the correct raw MSD and establishes a voice connection with the PSAP – independent of public mobile networks.

<table>
<thead>
<tr>
<th>Real Environment</th>
<th>GPS</th>
<th>Automobile</th>
<th>Cellular network</th>
<th>Public Safety Answering Point (PSAP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Environment</td>
<td>Signal generator</td>
<td>IVS under test</td>
<td>Call Box</td>
<td>PSAP Emulator</td>
</tr>
<tr>
<td></td>
<td>E5172B EXG Signal Generator OR N5182B MXG RF Vector Signal Generator</td>
<td></td>
<td>E7515A UXM Wireless Test Set OR E5515C Wireless Test Set</td>
<td></td>
</tr>
</tbody>
</table>
Keysight’s solution is scalable. A minimum setup consists of a GNSS emulator, a Base Station Emulator and the E6951A PSAP Emulator.

The basic setup can be enhanced to include the U8903B Audio Analyzer for automated audio quality test with algorithms like PESQ and POLQA. The E7515A UXM Wireless Test Set with up-to two, fully independent cells allow the full breadth of wireless network simulation like handovers, end-to-end data throughput, built in Fading etc. It supports all common cellular standards: GSM, WCDMA, TD-SCDMA, LTE, LTE-CA.

The solution is completed by the E6951A Public Safety Answering Point, that can be installed inside the UXM Base Station Emulator or run on a separate PC.

The SW has an intuitive GUI that allows manual operation with minimal effort due to the fact that the E7515A Base Station Emulator and GNSS Emulator are controlled by the PSAP Emulator for ease of use. In addition, depending on the IVS under-test interface, the PSAP Emulator can also initiate an eCall, answer calls, perform redials and send MSD.

The MSD is displayed in raw format, but also decoded in a human readable form to allow for easy control and debugging. Logs are taken and stored every time an emergency call is initiated and stored for later analysis or documentation.
A remote API allows for automated conformance tests using Keysight’s TAP Automation Platform or from another test software product.
Safer roads and faster rescue are the new challenges faced by the automotive industry through the implementation of new control and monitoring systems as part of the connected car revolution.

The eCall system was created and developed to help developers meet standards compliance, and on this basis, to ensure a safe driving experience and effective and fast hedging in the event of accidents.

Keysight as a passionate player in the automotive market and to support the continuing evolution offers a reliable, compact and flexible system for simulation and testing of eCall systems in order to minimize the cost of development and to speed up time to market.
Evolving Since 1939

Our unique combination of hardware, software, services, and people can help you reach your next breakthrough. We are unlocking the future of technology. From Hewlett-Packard to Agilent to Keysight.

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