112 eCall – Lessons Learnt and Next Steps

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Outline

- Introduction
- Lessons Learnt
  - Example: AMR-WB Performance
- Certification Framework
- eCall Evolution
- Conclusion
Introduction
Introduction

Motivation
eCall Transmission Chain

How eCall works?

Legend:
- PSAP/112: Public Safety Answering Point 112 (PSAP)
- MSD: Minimum set of data
- VMS: Variable Message Sign
- Traffic Info
- Rescue Intervention
- Data connection
- Voice connection
Lessons Learnt

Example: AMR-WB Performance
Lessons Learnt

- **Expected performance**
  - **Average** MSD success rate should be >99%
  - **Average** MSD transmission time should be <4s

- **Issue investigation**
  - Failed MSD transmissions need careful investigation to isolate the root cause, e.g.
    - Network related issue?
    - PSAP configuration/implementaiton issue?
    - IVS integration/implementation issue?
    - In-band modem related issue?

- **Failure analysis guideline**
  - What is the failure symptom?
    - How often did it happen and at what call stage?
  - What was the test environment?
    - E.g. field test or lab?
  - What is the root cause?
    - Inspect available HLAP and audio logs and identify the potential entity that is responsible
  - Who could help to solve the issue?
    - E.g. PSAP vendor/operator, IVS vendor, test equipment vendor, car manufacturer, network operator

Most observed issue are due to wrong configuration or implementation/integration
eCall Performance with AMR-WB

Failure Symptom & Analysis

1. NW-A exhibits unexpected performance issues
   - Lower MSD success rate
   - Higher MSD transmission time

2. Root issue cause investigation
   - Resampling artifacts leading to misdetections of signal sign reversals, resulting in synchronization failures

3. Solution
   - Improvement of codec inversion detection (CID) algorithm
   - 3GPP adopted the new solution from Rel. 11.1 onwards

<table>
<thead>
<tr>
<th>Codec</th>
<th>%Succ</th>
<th>%Succ gt20s</th>
<th>avg MSD time</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMR-NB (NW-B)</td>
<td>100.0</td>
<td>100.0</td>
<td>3.6</td>
</tr>
<tr>
<td>AMR-WB (NW-B)</td>
<td>100.0</td>
<td>100.0</td>
<td>3.6</td>
</tr>
<tr>
<td>AMR-NB (NW-A)</td>
<td>100.0</td>
<td>100.0</td>
<td>3.2</td>
</tr>
<tr>
<td>AMR-WB (NW-A Region 1)</td>
<td>100.0</td>
<td>100.0</td>
<td>3.5</td>
</tr>
<tr>
<td>AMR-WB (NW-A Region 2)</td>
<td>87.1</td>
<td>76.7</td>
<td>7.8</td>
</tr>
</tbody>
</table>

Increased MSD TX Time

No AMR-WB issues seen

Unsatisfactory NT MSD success rate
Validation challenges with new CID algorithm

1. Comparing legacy and new CID results with modified 3GPP simulator and post-processing of existing data showed promising results
   - See our presentation from 19th ITG/VDE Fachtagung “Mobilkommunikation”

2. Field test validation (Part 1)
   - Retested in critical regions with new IVS software builds
   - Unfortunately, NW-A had switched off AMR-WB for mobile to fixed-line calls
     • “It should have newer been switched on”

3. Field test validation (Part 2)
   - We had to employ a mobile PSAP to bypass the network configuration
   - Disadvantage: 2nd radio link with potential additional AMR-WB re-encoding
     • May lead to weaker performance compared to mobile to fixed-line connections
   - Conducted more than 6000 test calls
     • Employing all combinations of legacy and new CID on both IVS and PSAP side
     • Tested in critical areas with mobile PSAP in Nuremberg office as well as in same cell as IVS
     • Some tests had to be repeated due to network related issues in order to obtain reasonable confidence of the statistics
### eCall Performance with AMR-WB (cont’d)

#### Validation result overview

<table>
<thead>
<tr>
<th>PSAP location</th>
<th>IVS CID</th>
<th>PSAP CID</th>
<th>#Calls</th>
<th>#Succ</th>
<th>%Succ</th>
<th>avg MSD time</th>
<th>stdev MSD time</th>
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</thead>
<tbody>
<tr>
<td>same cell</td>
<td>legacy</td>
<td>legacy</td>
<td>1118</td>
<td>1017</td>
<td>91.0</td>
<td>4.32</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>legacy</td>
<td>new</td>
<td>610</td>
<td>586</td>
<td>96.1</td>
<td>3.88</td>
<td>0.54</td>
</tr>
<tr>
<td></td>
<td>new</td>
<td>legacy</td>
<td>600</td>
<td>571</td>
<td>95.2</td>
<td>4.23</td>
<td>0.70</td>
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<tr>
<td></td>
<td>new</td>
<td>new</td>
<td>1240</td>
<td>1238</td>
<td>99.8</td>
<td>3.88</td>
<td>0.53</td>
</tr>
<tr>
<td>Nbg office</td>
<td>legacy</td>
<td>legacy</td>
<td>906</td>
<td>808</td>
<td>89.2</td>
<td>4.32</td>
<td>0.59</td>
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<tr>
<td></td>
<td>legacy</td>
<td>new</td>
<td>200</td>
<td>191</td>
<td>95.5</td>
<td>4.08</td>
<td>0.43</td>
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<td></td>
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<td>legacy</td>
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<td>183</td>
<td>92.0</td>
<td>4.23</td>
<td>0.49</td>
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<tr>
<td></td>
<td>new</td>
<td>new</td>
<td>908</td>
<td>906</td>
<td>99.8</td>
<td>4.06</td>
<td>0.35</td>
</tr>
</tbody>
</table>

No significant difference between results from different PSAP locations
eCall Performance with AMR-WB (cont’d)

Failure Cases

- Legacy CID IVS + legacy CID PSAP

- New CID IVS + new CID PSAP

NW issues were regarded as non-relevant failures
Certification Framework
Certification Challenges

Why it is not so easy?

- Automotive industry is not familiar with the certification approach used in the telecommunication industry
  - Only used to follow car type-approval regulations

- Car-type approval regulations are so far self-contained and do not allow to inherit voluntary certification schemes
  - Mainly covering car safety related aspects (e.g. EMC, crash resistance)
  - So far no need to care about interoperability

- Voluntary certification schemes like GCF are hesitant to become part of a mandated car type-approval regulation
  - Claim to be in contrast with the ‘voluntary’ principle
  - However, 2G/3G NADs are already part of the eCall mandate

- Current focus of ERTICO’s certification framework initiative
  - Define boundary between regulated type-approval and voluntary certification
  - Consolidate tests from different standards and identify gaps
eCall System Elements

Embedded IVS device requires joint certification to ensure E2E functionality

- In-band Modem & HLAP
- 2G/3G Mobile Radio
- GNSS

- Antennae & Power Supply
- Crash Sensors
- HMI

- eCall-Flag Detection
- eCall Routing
- Transmission Quality

- In-band Modem & HLAP
- Application Features
- Operational Handling

? Certification TBD

✔ GCF Certification ✔ Car Type Approval ✔ Network Maintenance and Optimization
Certification Process Overview

Proposal for eCall developed within ERTICO

1. IVS manufacturer (request for certification)
   - Submit product
   - GCF certified module

2. ISO17025 accredited Test Lab (e.g. CETECOM)
   - Database of validated test cases
   - Validated test systems

3. Certification Body (e.g. ERTICO)
   - Authorization
   - List of certified terminals

4. Standards (CEN, 3GPP, etc.)
   - Submit certificate
eCall Evolution
Network Environment Evolution

- 2G/3G network separating speech and data transmission over CS and PS domains

All NW components separate speech and data over CS and PS domains
Network Environment Evolution

- 2G/3G network separating speech and data transmission over CS and PS domains

All NW components separate speech and data over CS and PS domains
Network Environment Evolution (cont’d)

- 2G/3G network separating speech and data transmission over CS and PS domains

PSTN combines speech with data through Voice-over-IP gateways (VoIP GW)
Network Environment Evolution (cont’d)

- 2G/3G network combining speech and data transmission over PS domains

MNO and PSTN combine speech with data through Voice-over-IP gateways (VoIP GW)
Network Environment Evolution (cont’d)

- 3.5G/4G networks can transport speech purely over PS domain through VoIP
- IVS devices require fallback to CS domain if networks do not support VoIP

End-to-end speech and data combination through Voice-over-IP gateways (VoIP GW)
eCall for Future Networks

- Recommended by ETSI STF 456
  - Use existing IMS Emergency Services (including multimedia)

- Requires only small enhancements to support eCall-specific functionality
- Provides end-to-end resource reservation and call prioritization
IMS eCall Prospects

- IMS eCall enables “Next Generation” eCall
  - Faster MSD transfer (during call-setup)
  - No muting of speech path necessary
  - More than 140 bytes could be exchanged
  - Allows 2 way data transmission
  - Extended data, e.g. regional/vehicle specific data, medical data, HD audio
  - Enhanced features for PSAPs, e.g. video, car instructions

- Seamless integration of warning, rescue and traffic management services

- Smartphone implementation (personal eCall)

- Interworking with other wireless networks (e.g. C-ITS, WiFi, NFC etc)

- New range of embedded and aftermarket devices employing
  - Medical equipment (e.g. defibrillators)
  - eHealth devices (e.g. patient monitoring)
  - Security devices (e.g. door/window lock/unlock, surveillance cams)
  - Monitoring devices (e.g. sensors for fires, flooding, earthquakes)
Conclusion
Conclusions

- Several field trials have proven that eCall performance is reliable enough for public safety services
- Nevertheless, the eCall transmission chain is complex and the dynamic network environments may lead to varying performance figures
- Careful investigations are needed to identify IVS, PSAP or network related performance issues
  - Example: AMR-WB performance issues required new CID algorithm
    - Improved MSD success rate
    - Reduced MSD transmission time

- A unified certification framework can ensure
  - Interoperability of devices
  - Reliable performance
  - Well defined test and validation procedures
  - Cost efficient development

- IMS eCall provides an evolution path for next generation networks
  - Additional multi-media applications allow to further improve emergency services
Thank You!

Questions?

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