GSM-R – Managing the Challenges

Performance Monitoring
Our GSM-R network is (partly/fully) established!

Our GSM-R network is in operational use!

Complaints are rising…!

Something wrong with our network?
• Starting with E2E-tests on ETCS L2 lines → Failure probability is very high!

Trainside: „Our system is working properly!“

Interlocking: „Our system is working properly!“
Solution: Performance Monitoring - Passive

Passive Probes:

- Data is permanently collected using Probes on different interfaces within the GSM-R network.
- Data from different Probes are correlated to get a full end-to-end view of each call in your network (\( \rightarrow \) CDR „Call Detail Record“).
- Data is collected „high-impedance“ \( \rightarrow \) non-interacting with GSM-R network.
- Use optical and/or electrical taps.

Active Probes:

- Data is collected from different terminal devices like cab radios, handhelds, modems and scanners.
  - Attended Drive Test Systems (temporarily in engine or wagon).
  - Unattended Drive Test Systems (fixed in engine or wagon).
  - Black Box Systems (basically for statistical analysis).
Passive Probes

Optical ethernet probes

E1 euroradio/SCP probe

E1 TDM Abis/Gb probes
Example for Active Probes / Attended Test System

1) Huber+Suhner SencityRail
2) Huber+Suhner SencityRail + GPS

MSC
ISDN PRI

Responder Unit (Vienna)

1)

K1
K2

Triorail
TTS-S75
Triorail
TTS-S75

1)

K3 K4 K5 K6 K7

USB

USB

1)\n
Portable 14" Rack

USB

IEEE1394

230VAC

Connected in engine

Rohde & Schwarz
TSML-GW / TSML-CW

Scanner

Notebook with Measurement SW
### Comparison Active/Passive Probes

<table>
<thead>
<tr>
<th>Pro’s</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active Probes / Test system</strong>&lt;br&gt;Based on the generation of artificial traffic&lt;br&gt;&lt;br&gt;Allows to perform the type of test of interest, when and where it is required/necessary</td>
<td><strong>Limitations</strong>&lt;br&gt;- It’s just a snapshot picture of the network&lt;br&gt;- Not statistically relevant</td>
</tr>
<tr>
<td><strong>Passive Probes</strong>&lt;br&gt;Based on data extraction from network elements&lt;br&gt;&lt;br&gt;Allows to monitor all the transactions&lt;br&gt;Massive quantity of data ensures statistical relevancy</td>
<td><strong>Limitations</strong>&lt;br&gt;- Data available only if there are transactions: no calls no data….&lt;br&gt;- Not possible to perform the test required when and where needed.</td>
</tr>
</tbody>
</table>
## Traffic model vs. Monitoring recommendations

<table>
<thead>
<tr>
<th>Traffic Model</th>
<th>Monitoring recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historic lines with GSM-R train radio. No ETCS Level 2.</td>
<td></td>
</tr>
</tbody>
</table>
- Human generated traffic  
- Voice calls  
- Low traffic volume  
- OBU traffic  
- Long continuous data connections  
- High availability requirements |  
- Active Probes are a must-have  
- Passive Probes suggested  
- OMC-R counters for monitoring  
- Passive Probes are a must have  
- Active Probes needed for periodic data testing QoS according to UIC standard O-2475 |

| High speed lines with ETCS Level 2 in operation. |  
- OBU traffic  
- Long continuous data connections  
- High availability requirements |  
- Active Probes are a must-have  
- Passive Probes suggested  
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- Passive Probes are a must have  
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Features Passive Probes

- Collecting data for each transaction in your network end-to-end incl. Abis (RxLev, RxQual,…)
- Fault analysis / Troubleshooting for a specific call/transaction
- Real-Time analysis possible
- Huge amount of data → calculate high-level KPI's based on the CDR's
  - Call Drop Rate
  - Call Setup Time
  - Handover Failure Rate
  - Black Sheep Report and so on…
- Reporting feature → Generate reports for engineers and/or management board
  - Manual reporting / Automatic reporting (e.g. every week)
- GUI with progressive drill-down from KPI's to call traces
- Create your own reports according to your requirements
Features Active Probes / Test System

- Perform different tests in GSM-R cells which are suspicious
- Voice calls / Data calls / GPRS (EDGE) / Network Scan (GSM-R <-> Public)
- GPS correlation / Correlation with your track chainage
- End-to-End QoS to verify Subset 093 according to UIC O-2475
- Possibility to get a statement about the fulfilment of EIRENE-criterion
- Test the behaviour of different terminal devices at different interference positions
- Interference analysis / Spectrum analysis
- Replay functionality
- Post processing analysis (maps, graphs, tables, event logs, Layer 3)
- Reporting feature
- Export functionality (*.csv)
Passive Probes – Part of Trace View of one ETCS L2 Call
Passive Probes – Report Generation

Performance on cell group Network

MOC

Quality since 2013-04-12
### List of 10 worst cells for the last 31 days

<table>
<thead>
<tr>
<th>Cell ID</th>
<th>CI</th>
<th>Name</th>
<th>Count</th>
<th>Failures</th>
<th>Failure Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>11003</td>
<td>Wien Westbahnhof-BF-1 (Network)</td>
<td>16322</td>
<td>595</td>
<td>3.64</td>
</tr>
<tr>
<td>40</td>
<td>18600</td>
<td>Gmünd Hof-1 (Network)</td>
<td>13220</td>
<td>477</td>
<td>3.61</td>
</tr>
<tr>
<td>100</td>
<td>15002</td>
<td>Salzburg-BAHA-1 (Network)</td>
<td>16069</td>
<td>412</td>
<td>2.56</td>
</tr>
<tr>
<td>30</td>
<td>11301</td>
<td>Wien Zähr. Laxenburger-1 (Network)</td>
<td>13346</td>
<td>410</td>
<td>3.03</td>
</tr>
<tr>
<td>50</td>
<td>13309</td>
<td>Wt Hirschstr.Atz-1 (Network)</td>
<td>11844</td>
<td>302</td>
<td>2.55</td>
</tr>
<tr>
<td>40</td>
<td>18010</td>
<td>Villach-Höf Zara-1 (Network)</td>
<td>14866</td>
<td>292</td>
<td>2.02</td>
</tr>
<tr>
<td>100</td>
<td>14079</td>
<td>Lust Hof Zara-1 (Network)</td>
<td>13673</td>
<td>282</td>
<td>2.06</td>
</tr>
<tr>
<td>200</td>
<td>16003</td>
<td>Wörgl-1 (Network)</td>
<td>11029</td>
<td>230</td>
<td>2.09</td>
</tr>
<tr>
<td>200</td>
<td>16012</td>
<td>Burggasthof-1 (Network)</td>
<td>12327</td>
<td>212</td>
<td>1.74</td>
</tr>
<tr>
<td>200</td>
<td>16027</td>
<td>Brixen/2 (Network)</td>
<td>3337</td>
<td>209</td>
<td>3.92</td>
</tr>
</tbody>
</table>

### List of 10 most frequent end causes for the last 31 days

<table>
<thead>
<tr>
<th>Call type</th>
<th>End</th>
<th>Cause</th>
<th>May be caused by</th>
<th>Failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOC</td>
<td>DISC_NSS</td>
<td>User busy</td>
<td>User</td>
<td>3367</td>
</tr>
<tr>
<td>MOC</td>
<td>CLR_REQ</td>
<td>Radio interface failure</td>
<td>Radio</td>
<td>2154</td>
</tr>
<tr>
<td>MOC</td>
<td>ASG_FAIL</td>
<td>Radio interface failure, reversion to old channel</td>
<td>Radio</td>
<td>877</td>
</tr>
<tr>
<td>MOC</td>
<td>DISC_NSS</td>
<td>Unassigned/unallocated number</td>
<td>User</td>
<td>813</td>
</tr>
<tr>
<td>MOC</td>
<td>CLR_REQ</td>
<td>Radio interface message failure</td>
<td>Radio</td>
<td>553</td>
</tr>
<tr>
<td>MOC</td>
<td>DISC_NSS</td>
<td>User aborting, no answer</td>
<td>User</td>
<td>590</td>
</tr>
<tr>
<td>MOC</td>
<td>CMS_EJ</td>
<td>Service option temporarily out of order</td>
<td>NSS</td>
<td>92</td>
</tr>
<tr>
<td>MOC</td>
<td>DISC_NSS</td>
<td>No route to destination</td>
<td>User</td>
<td>91</td>
</tr>
<tr>
<td>MOC</td>
<td>ASG_FAIL</td>
<td>Radio interface message failure</td>
<td>Radio</td>
<td>59</td>
</tr>
<tr>
<td>MOC</td>
<td>DISC_NSS</td>
<td>Facility rejected</td>
<td>NSS</td>
<td>57</td>
</tr>
</tbody>
</table>

### Failures distribution per mobile power capability for the last 31 days

<table>
<thead>
<tr>
<th>Call type</th>
<th>End</th>
<th>Cause</th>
<th>May be caused by</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSM 1.8W</td>
<td>DCS 0.25W</td>
<td>291086</td>
<td>4820</td>
</tr>
<tr>
<td>GSM 2W</td>
<td>86880</td>
<td>3696</td>
<td>4.26</td>
</tr>
<tr>
<td>DCS 1W</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Active Probes – Replay / Post Processing Analysis
Active Probes – Replay / Post Processing Analysis
Performance Monitoring

Questions?