

GSM-R – Managing the Challenges

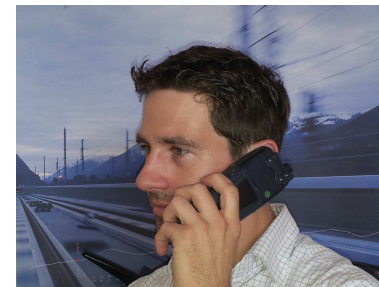
Performance Monitoring

Initial situation

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



- Our GSM-R network is in operational use!



- Complaints are rising...!

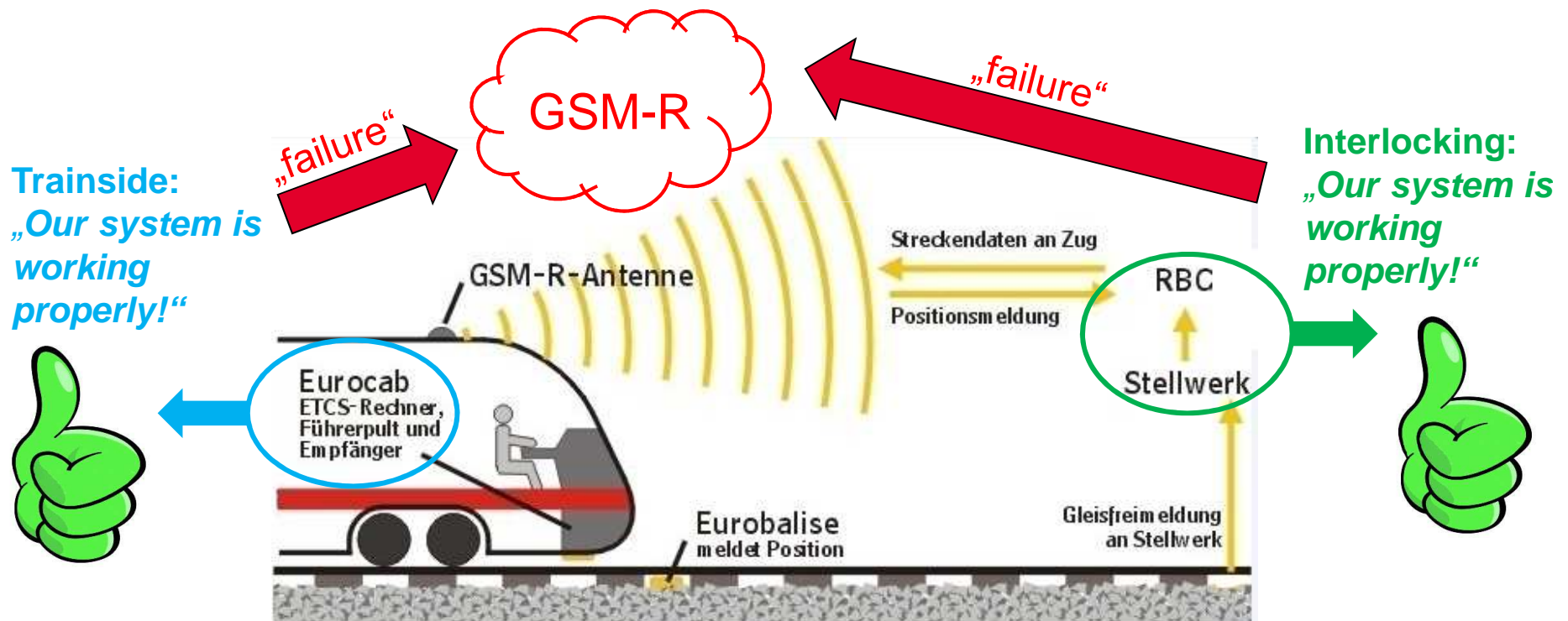


- Something wrong with our network?



Example ETCS L2

- Starting with E2E-tests on ETCS L2 lines → Failure probability is very high!



Solution: Performance Monitoring - Passive

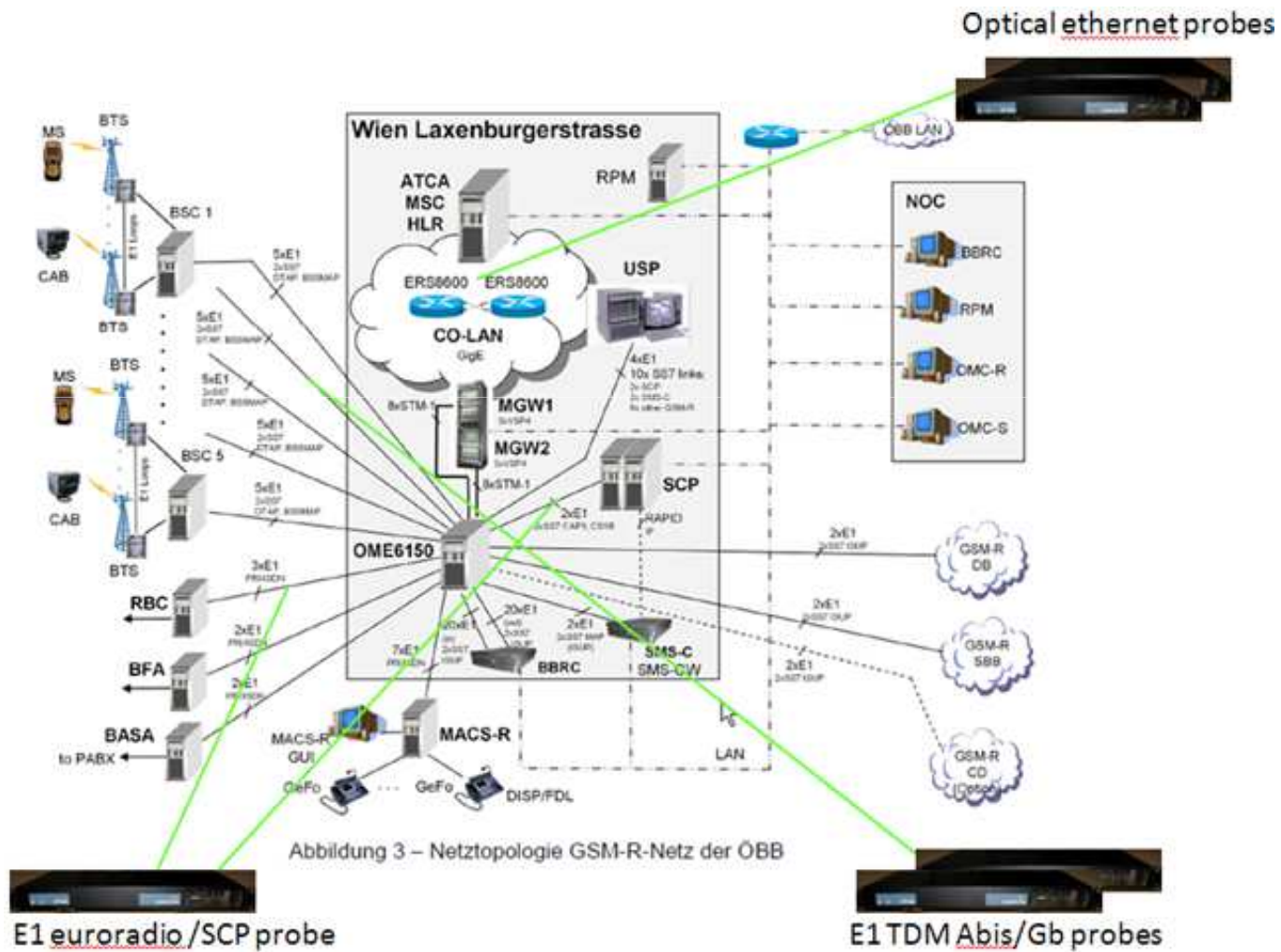
Passive Probes:

- Data is permanent 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 (→ CDR „Call Detail Record“)
- Data is collected „high-impedance“ → non-interacting with GSM-R network
- Use optical and/or electrical taps

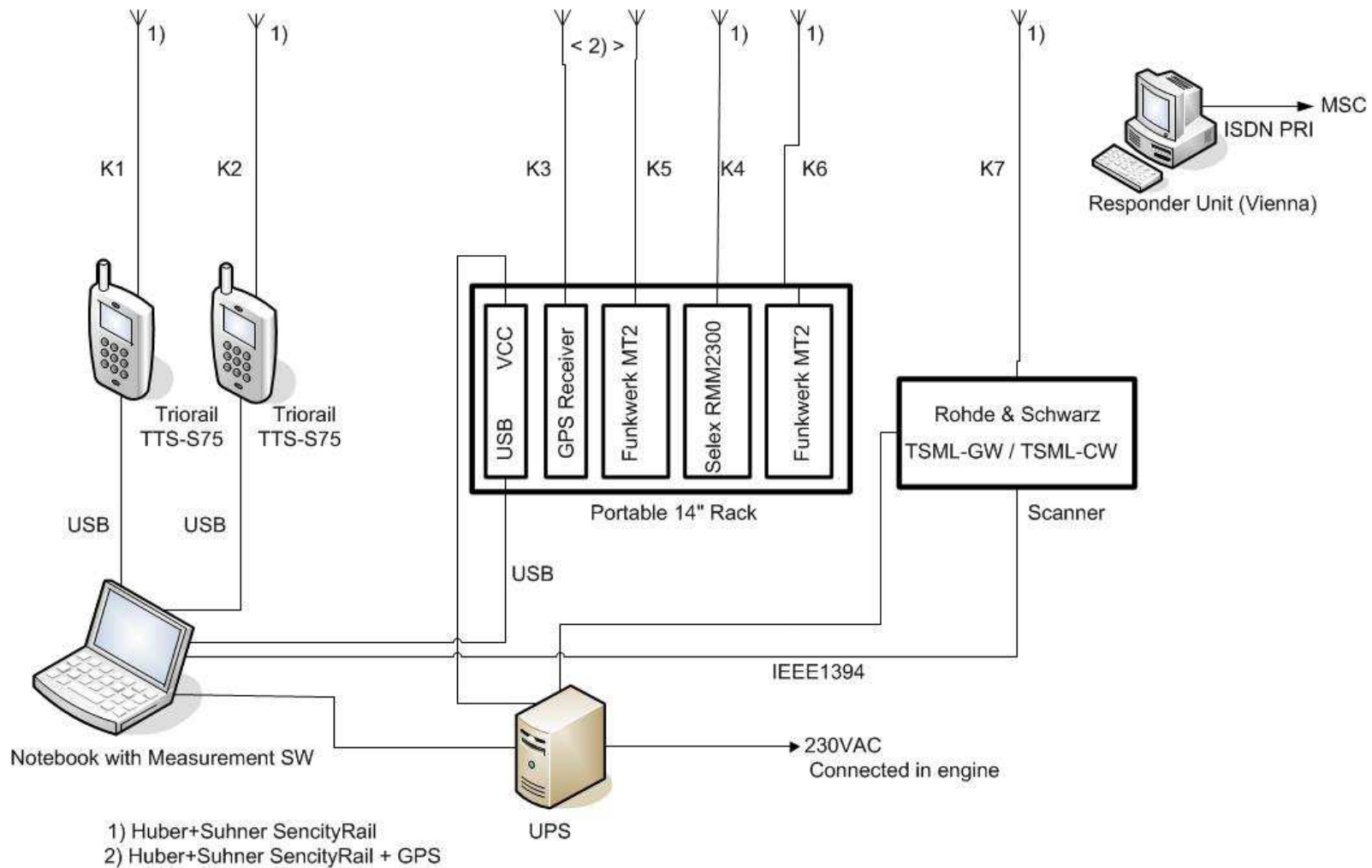
Active Probes:

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

Passive Probes



Example for Active Probes / Attended Test System



Comparison Active/Passive Probes

	<u>Active Probes / Test system</u> Based on the generation of artificial traffic	<u>Passive Probes</u> Based on data extraction from network elements
Pro's	Allows to perform the type of test of interest, when and where it is required/necessary	Allows to monitor all the transactions Massive quantity of data ensures statistical relevancy
Limitations	<ul style="list-style-type: none">• It's just a snapshot picture of the network• Not statistically relevant	<ul style="list-style-type: none">• Data available only if there are transactions: no calls no data....• Not possible to perform the test required when and where needed.

Traffic model vs. Monitoring recommendations

	<u>Traffic Model</u>	<u>Monitoring recommendations</u>
<p>Historic lines with GSM-R train radio. No ETCS Level 2.</p>	<ul style="list-style-type: none"> • Human generated traffic • Voice calls • Low traffic volume 	<ul style="list-style-type: none"> • Active Probes are a must-have • Passive Probes suggested • OMC-R counters for monitoring
<p>High speed lines with ETCS Level 2 in operation.</p>	<ul style="list-style-type: none"> • OBU traffic • Long continuous data connections • High availability requirements 	<ul style="list-style-type: none"> • Passive Probes are a must have • Active Probes needed for periodic data testing QoS according to UIC standard O-2475

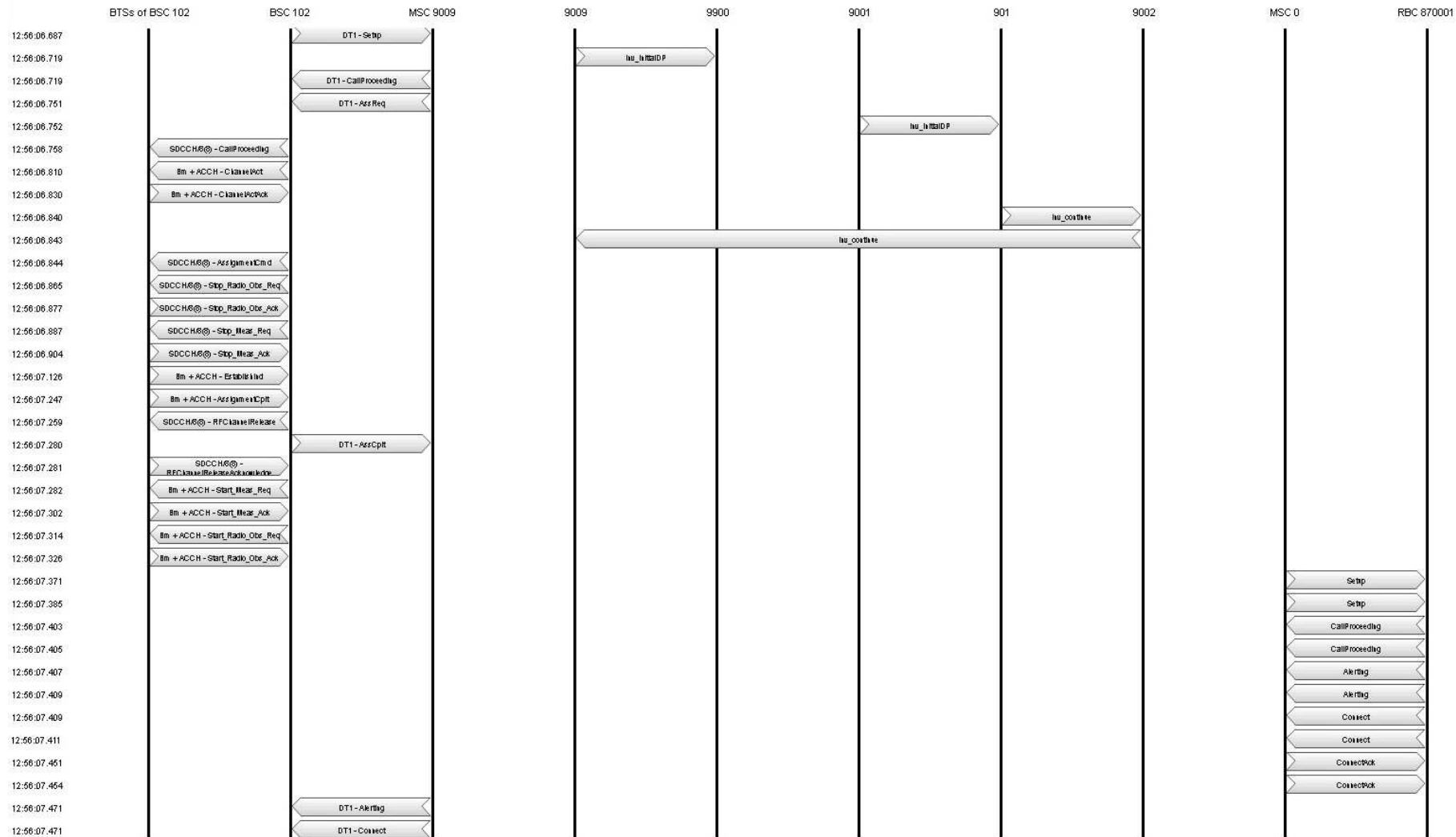
Features Passive Probes

- 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

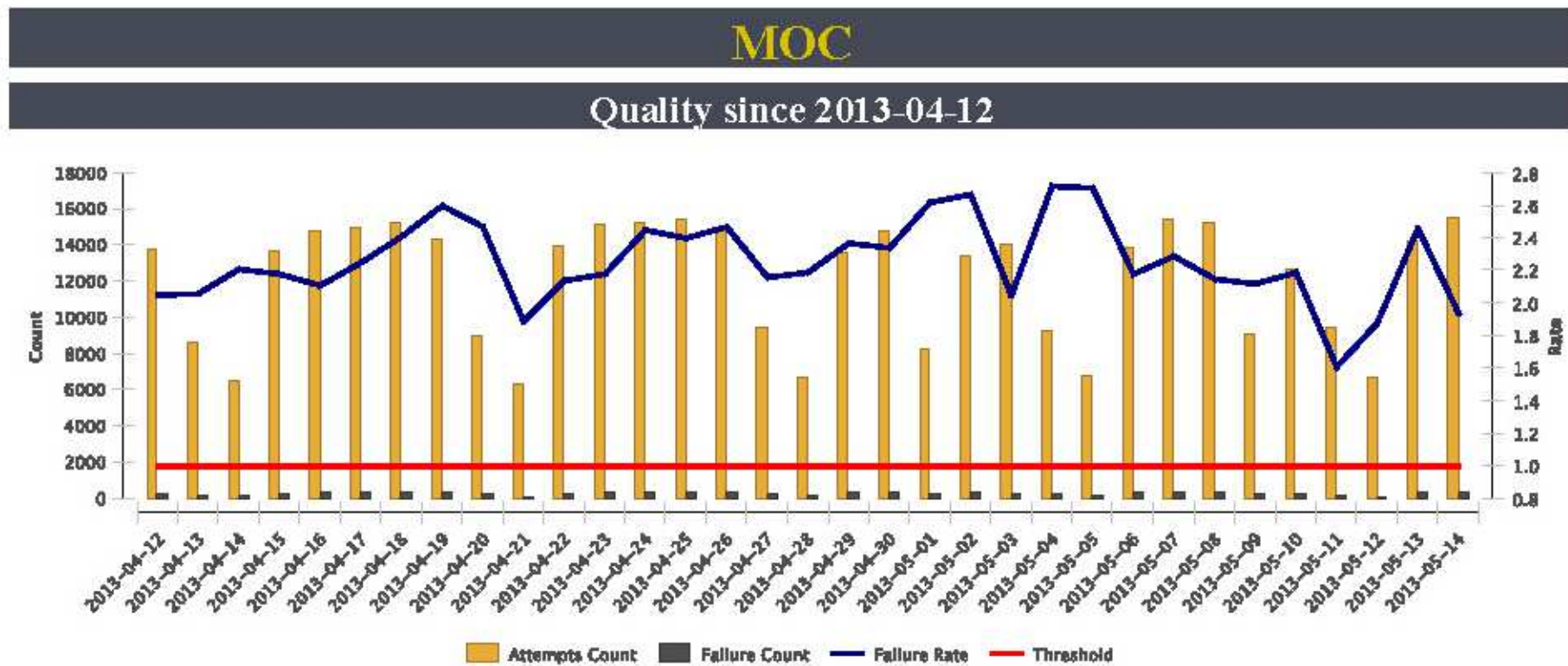
- Perform different tests in GSM-R cells which are suspicious
- Voice calls / Data calls / GPRS (EDGE) / Network Scan (GSM-R <-> Public)
- GPS correlation / Correlation with your track chainage
- End-to-End QoS to verify Subset 093 according to UIC O-2475
- Possibility to get a statement about the fulfilment 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



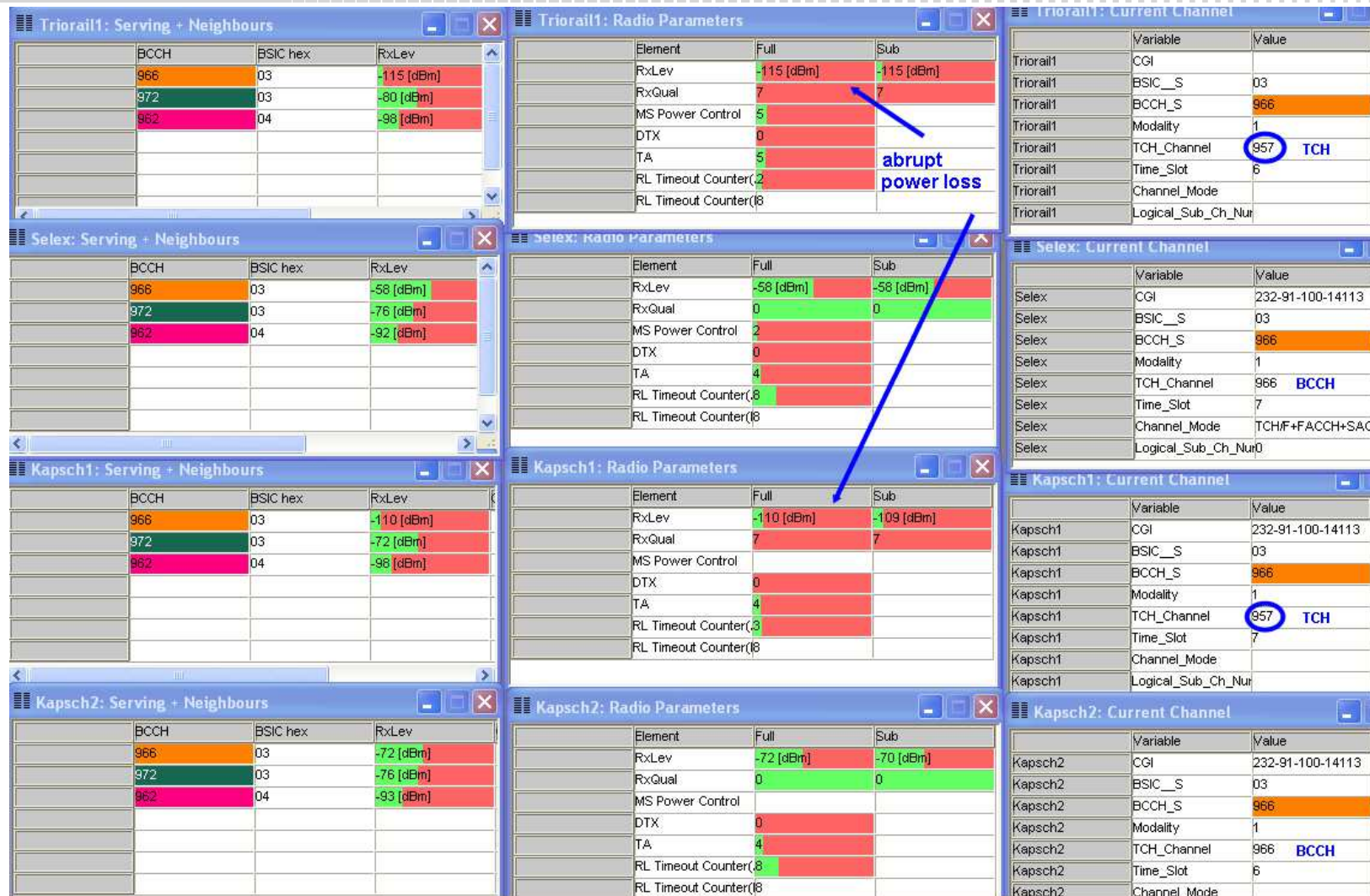
Passive Probes – Report Generation

List of 10 worst cells for the last 31 days					
Lac	Ci	Name	Count	Failures	Failure Rate
30	11003	Wien Westbahnhof FBf_1 (Network)	16332	595	3.64
40	18600	Graz Hbf_1 (Network)	13220	477	3.61
100	15002	Salzburg BASA_1 (Network)	16069	412	2.56
30	11301	Wien Zstw Laz enburger_1 (Network)	13546	410	3.03
30	13309	Wr Neustadt Abf_1 (Network)	11844	302	2.55
40	19010	VillachHbfZstw_1 (Network)	14486	292	2.02
100	14179	Linz Hbf Zstw_1 (Network)	13673	282	2.06
200	16003	Woergl_1 (Network)	11029	230	2.09
200	16012	BergiselNP_1 (Network)	12207	212	1.74
200	16027	Brennersee_1 (Network)	5337	209	3.92

List of 10 most frequent end causes for the last 31 days				
Call type	End	Cause	May be caused by	Failures
MOC	DISC_NSS	User busy	User	3367
MOC	CLR_REQ	Radio interface failure	Radio	2154
MOC	ASG_FAIL	Radio interface failure, reversion to old channel	Radio	877
MOC	DISC_NSS	Unassigned (unallocated) number	User	818
MOC	CLR_REQ	Radio interface message failure	Radio	553
MOC	DISC_NSS	User alerting, no answer	User	390
MOC	CMS_REJ	Service option temporarily out of order	NSS	92
MOC	DISC_NSS	No route to destination	User	91
MOC	ASG_FAIL	Radio interface message failure	Radio	58
MOC	DISC_NSS	Facility rejected	NSS	57

Failures distribution per mobile power capability for the last 31 days			
Call type	End	Cause	May be caused by
GSM 8W / DCS 0.25W	291086	4920	1.69
GSM 2W	86820	3696	4.26
	4	0	0
DCS 1W	1	0	0

Active Probes – Replay / Post Processing Analysis



The screenshot displays a multi-pane interface for GSM-R analysis. It shows data for four mobile stations: Triorail1, Selex, Kapsch1, and Kapsch2. Each station's data is presented in three main sections: 'Serving + Neighbours', 'Radio Parameters', and 'Current Channel'.

Triorail1: Radio Parameters

Element	Full	Sub
RxLev	-115 [dBm]	-115 [dBm]
RxQual	7	7
MS Power Control	5	5
DTX	0	0
TA	5	5
RL Timeout Counter(2)	0	0
RL Timeout Counter(8)	0	0

Triorail1: Current Channel

Variable	Value
CGI	
BSIC_S	03
BCCH_S	966
Modality	1
TCH_Channel	957 TCH
Time_Slot	6
Channel_Mode	
Logical_Sub_Ch_Nur	

Selex: Radio Parameters

Element	Full	Sub
RxLev	-58 [dBm]	-58 [dBm]
RxQual	0	0
MS Power Control	2	2
DTX	0	0
TA	4	4
RL Timeout Counter(8)	0	0
RL Timeout Counter(8)	0	0

Selex: Current Channel

Variable	Value
CGI	232-91-100-14113
BSIC_S	03
BCCH_S	966
Modality	1
TCH_Channel	966 BCCH
Time_Slot	7
Channel_Mode	TCHF+FACCH+SAC
Logical_Sub_Ch_Nur0	

Kapsch1: Radio Parameters

Element	Full	Sub
RxLev	-110 [dBm]	-109 [dBm]
RxQual	7	7
MS Power Control	0	0
DTX	0	0
TA	4	4
RL Timeout Counter(3)	0	0
RL Timeout Counter(8)	0	0

Kapsch1: Current Channel

Variable	Value
CGI	232-91-100-14113
BSIC_S	03
BCCH_S	966
Modality	1
TCH_Channel	957 TCH
Time_Slot	7
Channel_Mode	
Logical_Sub_Ch_Nur	

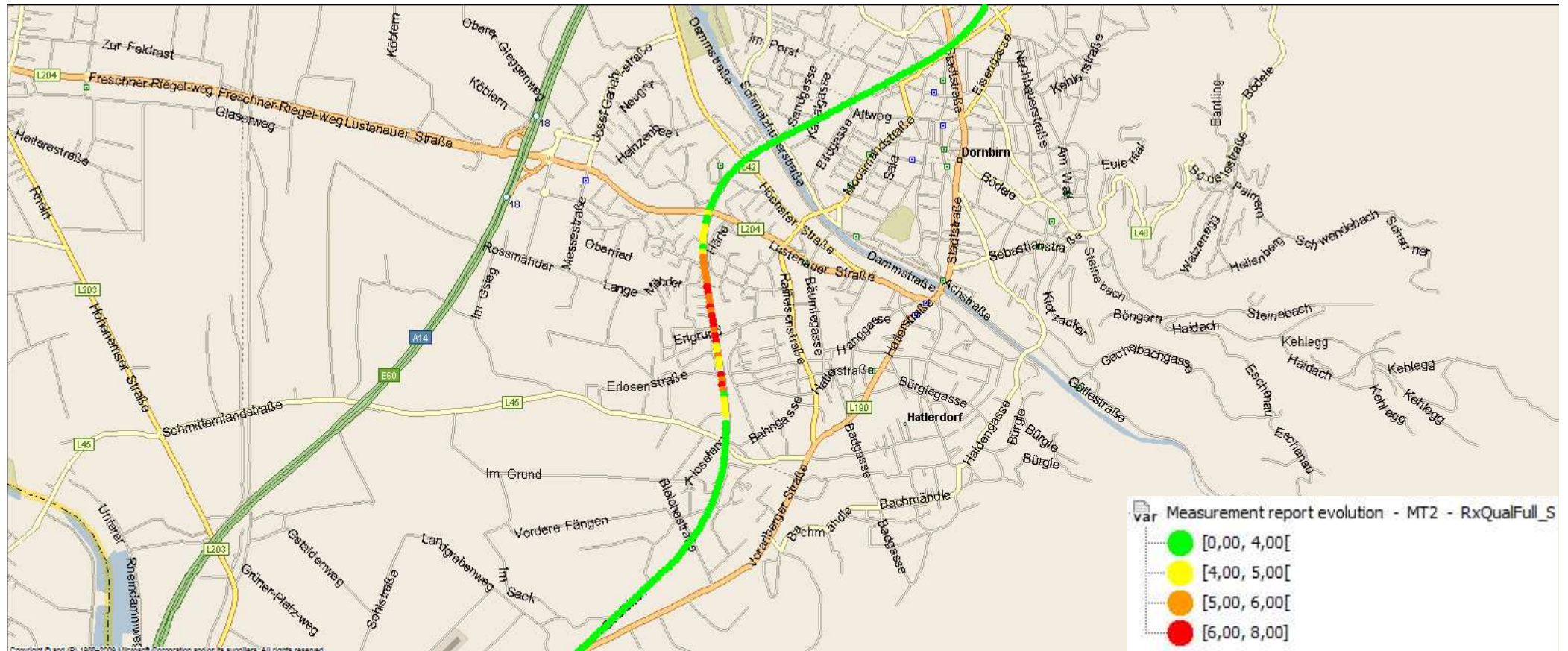
Kapsch2: Radio Parameters

Element	Full	Sub
RxLev	-72 [dBm]	-70 [dBm]
RxQual	0	0
MS Power Control	0	0
DTX	0	0
TA	4	4
RL Timeout Counter(8)	0	0
RL Timeout Counter(8)	0	0

Kapsch2: Current Channel

Variable	Value
CGI	232-91-100-14113
BSIC_S	03
BCCH_S	966
Modality	1
TCH_Channel	966 BCCH
Time_Slot	6
Channel_Mode	

Active Probes – Replay / Post Processing Analysis



Performance Monitoring

