



Session 4 TELECOM

GSM-R IG: Solutions against Interferences from Public operators

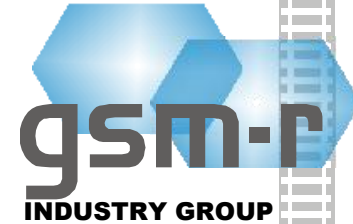


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Handling Interferences: Industry Solutions

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GSM-R IG Technical Solutions against Interferences to GSM-R



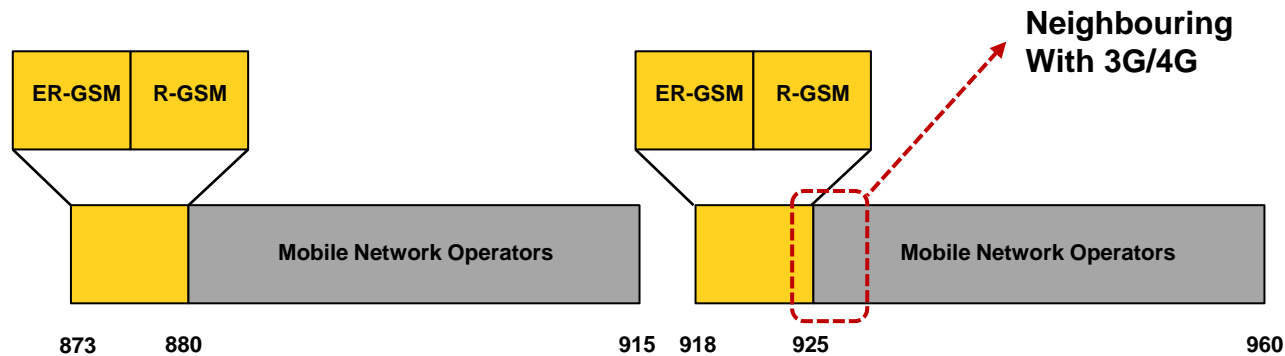
- Interferences are an increasing and recognized concern for Railway Operators
- Radio communication quality of service of all railway safety related applications between on-board and track-side is an investment → it must be protected
- Different solutions considered so far
 - Enhancements at receiver side
 - Insertion of protective filters in cab radio or between the cab radio and the roof antenna
 - Increased coverage level
 - Improved spectrum availability
 - Protection from MNO radio sites
 - Crossover frequency coordination

Short reminder on interferences

The two main mechanisms by which a Public MNO can cause interference to a GSM-R network are

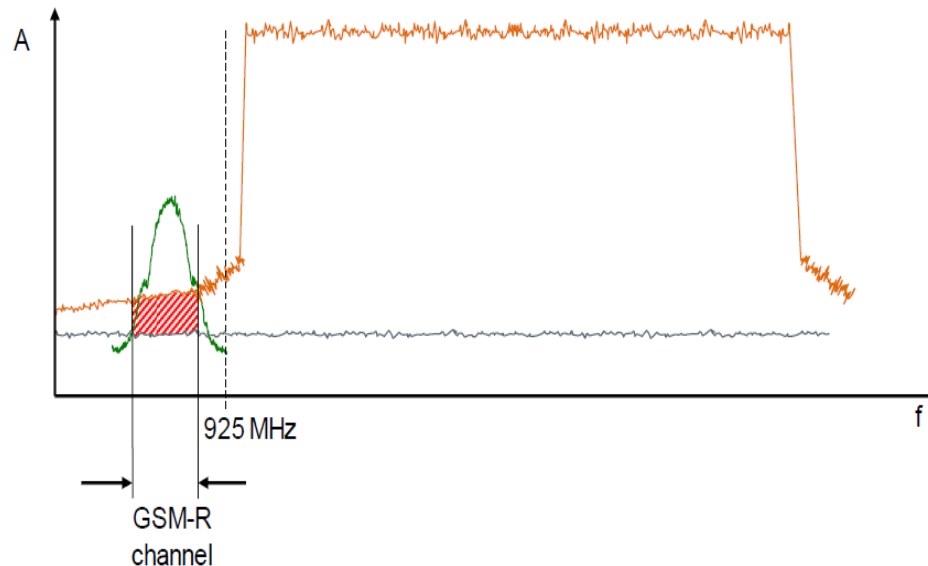
- Out Of Band (OOB) interference
- Intermodulation interference

GSM-R spectrum in Europe



Short reminder on interferences / Out of Band (OOB) interference

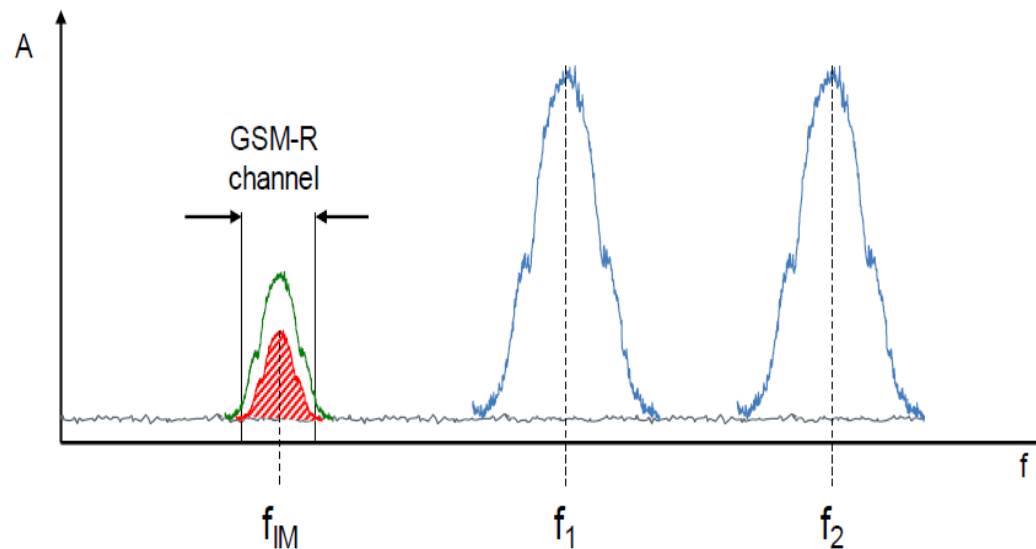
Out of band interference can be caused by strong transmissions in adjacent frequency bands



- The picture shows a standard UMTS (3G) signal. It still transmits a significant amount of energy in the adjacent GSM-R band, even though it meets the ETSI specifications,
- If the location where this occurs is covered by a weak GSM-R signal, the GSM-R mobiles will experience interferences and call establishment failures / call drops

Short reminder on interferences / Receiver intermodulation interference

Intermodulation interference can be caused by multiple transmissions in adjacent or nearby frequency bands



- The picture shows an example of two public GSM signals mixing to create an interference in the GSM-R band,
- If the location where this occurs is covered by a weak GSM-R signal, the GSM-R mobiles will experience interferences and call establishment failures / call drops

Interferences in GSM-R – Technical solutions



No "magic formula" standalone solution so far

- Mix of different solutions required
- Issue to be treated by GSM-R specialists providing end-to-end solutions and expertise

3 main categories of solutions

Increased coverage level: higher output power, radio site densification

Receiver enhancements: signal processing, received diversity, new antennas for cab radio and EDOR

Protection against interferers: Cab Radio filter, Cab Radio with IMPROVED RECEIVER, BTS filters at MNO side, coordination

Interferences in GSM-R – Increasing coverage level -



In theory

Higher received signal level at cab radio input improves C/N at signal processing level
→ efficient against blocking and in-band spurious

In practice

- To reach the required C/N necessary when mitigation measures to cope with public operators' out-of-band emissions through coordination not possible
- Radio site densification
 - Addition of more radio sites (GSM-R BTS) “in the middle” between already existing ones to increase coverage level – plus network redesign in affected area
 - High speed environments to be given special attention to ensure flawless Mobility Management
- Higher output power
 - Increase output power from GSM-R BTS to increase coverage level
→ not always possible for configuration (power already at max) and/or coordination reasons

Interferences in GSM-R – Receiver enhancements -



- Cab radio antenna improvement – rolling stock dependent
 - Typical antenna radiation pattern not adapted in interfered scenarios
- Receiver Diversity – technically difficult
 - Simple principle: two receive paths improving radio reception

Operational constraints

1. Need of two antennas on the roof top of the train
2. Signal processing has to be added in the radio module

Interferences in GSM-R – Technical solutions - Solutions at mobile side



External or internal filters in cab radios

- Effective solution against principal emissions from **Out of Band** interferers
- Side effects:
 - No roaming possible to E-GSM band if not switchable
 - Integration constraints, insertion losses, additional costs

Cab Radios with Improved mobile receivers already integrated

- Improvement against blocking caused by intermodulation according to Spec
- Next EIRENE specification will impose that solution
- Tests performed in England, which were supervised by UIC, proved that an improved receiver can support very hard LTE + 2G blocking environments without any quality degradation
- Improved receivers support the standard **ETSI TS 102 933 V2.1.1** by far
- Tested radio modules are integrated into all CAB radios and EDORs provided by GSM-R IG suppliers.
- Proven possibility to exchange existing radio modules with Improved Receiver Modules

IMPROVED RECEIVERS

- Keep the whole frequency range compliant to ETSI including the new ER band
- Uses specific filters in the GSM-R module with an intelligent software control
- Upward compatible with existing Radio Modules
- Equivalent to an external filter
- Compliant and even far better to Improved Receiver

TS 102 933-1 v2.1.1 and TS 102 933-2 v2.1.1 new standards

- Generates no extra-cost requested by external filter installation between the rooftop antenna and the GSM-R MS
- Generates no extra cost due to network re-engineering and additional losses
- Easiest, fastest and cheapest solution for upgrade of any existing CAB radios and EDORs during standard maintenance activities and for installation of new CAB/EDORs



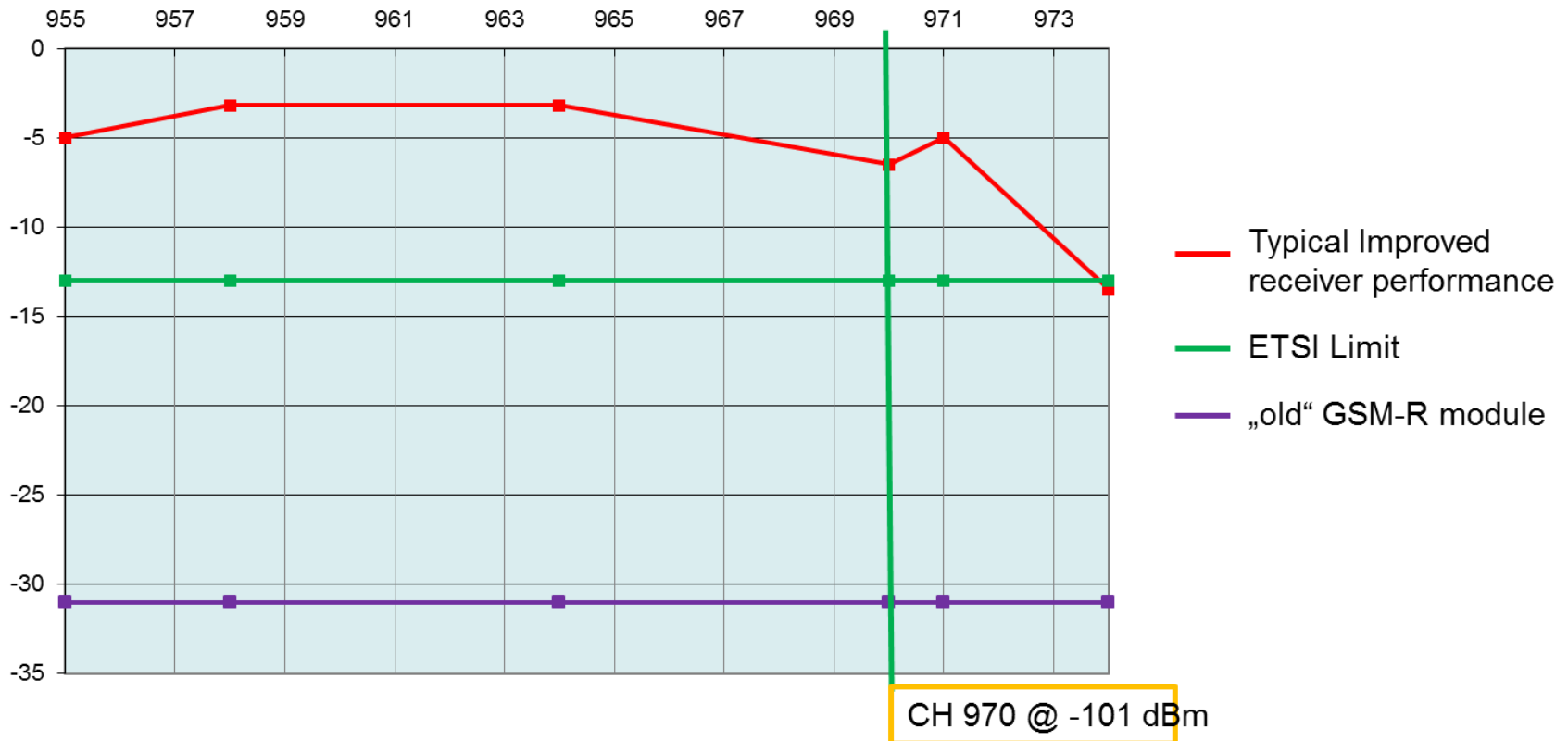
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Interferences in GSM-R – Technical solutions - Performance measurement

Measurement of blocking resistance



CAB RADIO and EDOR using improved receivers



EDOR
ARBE-C-3



Voice
Mesa26



EDOR
EDOR-5E



EDOR
RD 900



Voice and Data
RC 900



Voice
SVR400



EDOR
SDR220
And SGR220



Voice
SVR500



CONCLUSION



- INDUSTRY HAS DEVELOPPED SOLUTIONS THAT ARE AVAILABLE.
- INDUSTRY HAS DEVELOPPED SOLUTIONS THAT ARE COMPATIBLE WITH EXISTING EQUIPMENTS IN THE TRAINS.
- INDUSTRY HAS PARTICIPATED ACTIVELY TO OFFICIAL AND PRIVATE TESTS THAT PROVED THE PERFECT EFFICIENCY OF THE SOLUTIONS.
- INDUSTRY HAS ACTIVELY PARTICIPATED TO THE REDACTION OF THE LAST ETSI STANDARD
- INDUSTRY HAS CERTIFIED ITS RADIO MODULES

WE ARE READY FOR SOLVING EXISTING ISSUES RIGHT NOW

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