

ALSTOM

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**SIERRA
WIRELESS™**



Technical Solutions on Interferences to GSM-R

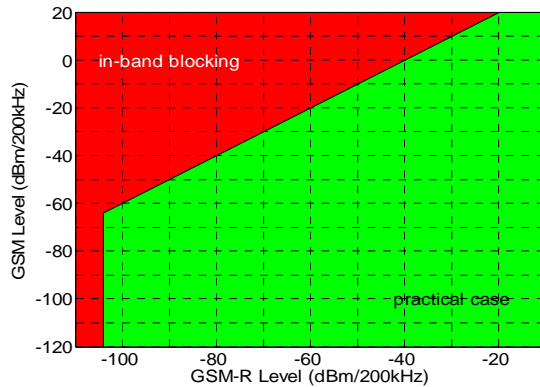
Philippe BRANLY
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Agenda

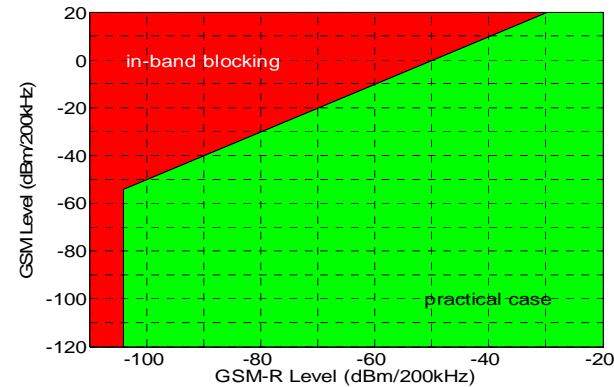


- Blocking due to « In Band » Noise
- Network solutions
- Train additional filter solution
- Global improved CAB Radio solution
- Improved radio solution

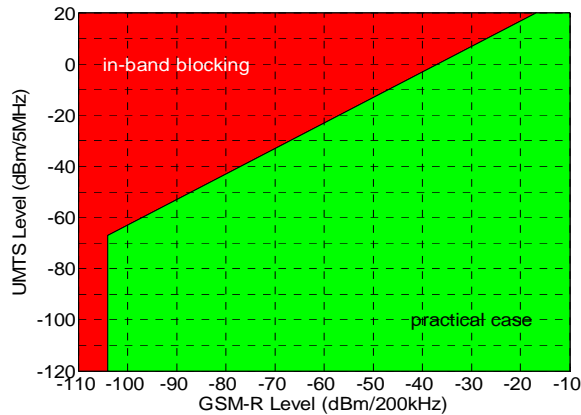
Blocking due to « In Band » Noise



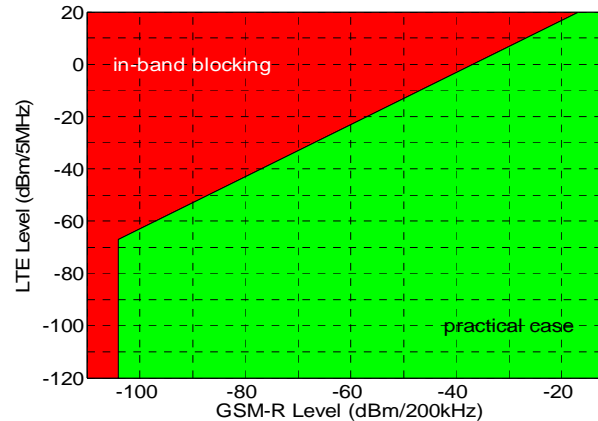
GSM-R / GSM coexistence chart (=400kHz)



GSM-R / GSM coexistence chart (=1MHz)



GSM-R / UMTS coexistence chart (=2.6MHz)



GSM-R / 5MHz LTE coexistence chart (=MHz)

- White Paper - Practical 3GPP-compliant Setup for GSM-R Co-Existence Evaluation (v1.0)

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Network solutions



- Filters in public operators' BTS
 - UMTS, LTE and GSM MCBTS can cause more emissions in the GSM-R Downlink band than single carrier GSM
 - External filters installed on public sites can minimize those emissions
 - A rejection of around 20 dB can be expected (however upper frequencies of R-GSM band might not be protected)
 - Cost of the filters to be considered
 - Negotiation with public operators so that such filters can be installed
- Improved GSM-R coverage
 - Interferences mitigated by improved radio coverage / improvement of the C/I
 - New radio sites to be inserted in addition to existing ones
 - Improved antenna (e.g. narrower beam / higher gain)
 - Redesign of existing radio coverage

Network solutions



- Fine tuning on engineering parameters
 - For geographically located interferences, possibility to advance/delay the HO
 - Modification of some radio parameters at the network side is achievable by all network suppliers
 - Simple solution after thorough study of the interference case

- Frequency band management
 - Re-allocation of carriers onto other frequencies
 - Simple software-based action, remotely controlled, applicable to railway or public networks
 - Coordination of the frequency planning is recommended in ECC Report 162 (spectrum related measures)
 - Available R-GSM frequencies are limited (19 frequencies)
 - Re-allocation of broadband systems (UMTS/LTE) frequency is more complex (5MHz carrier)

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A Possible way Forward for On-Train Filtering



- Produce a small economical filter that can be retrofitted on trains
- Fit either adjacent to the radio equipment or insert in the antenna cable
- Optimized performance within the allocated space
- Accept that the very worst cases may still require some negotiation with network operators (e.g. channel change)
- For voice applications Include ability to disable filter for when coverage of public bands is required
- Can be retrofitted to existing GSM-R installations

SIEMENS UMTS Interference Filter



- Available non-switched for ETCS or with integral by-pass switch for voice applications
- Dimensions of non-switched unit
 - 250 x 90 x 65mm
- Pass-band 873-924.9 MHz
- Insertion loss
 - 873-880 MHz <1dB
 - 880-924 MHz <2dB
 - 924-924.5 MHz <2.5dB
 - 924.5-924.9 MHz <3dB
- Stop-band
 - 926-927 MHz >10dB
 - 927-960 MHz >30dB
- R-band
 - Uplink 876-880 MHz
 - Downlink 921-925 MHz



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Alstom solution for interference fighting



- Alstom, ERTMS L2 on-board market leader (more than 1500 ERTMS L2 application over 70 different types of train) has developed a 3rd generation EDOR with specific focus on: **Interference fighting**, ETCS over GPRS and ER GSM-R band support



ARBE-C-3 : 3rd generation EDOR

- ER and UIC GSM-R band [873-880 Mhz., 918-925 Mhz.]
- ETCS over GPRS/EDGE support
- **ETSI Professional radio module (improved RF stage)**
- **Integrated H-MFA Filter/Duplexer**



H-MFA: High performance Filter/Duplexer for ETCS data application

- **Filter** → protection from Public GSM and UMTS interference
 - **RX band-pass [918-925Mhz.]**;
 - **RX out of band rejection > -30dB [927, 960Mhz.] ; > -25dB [873, 915Mhz.]**
 - **TX pass-band 873-880Mhz. ; TX out-of band rejection >-40dB [918,960 Mhz.]**
- **Duplexer** → It allows antenna co-location 1m. ;
- Impedance matching > -20dB return loss and Integrated lightning protection
- Form-fit with installed base Alstom ARBE-C and ARBE-C-2 [**smooth retrofit option**]

On board L2 ERTMS & voice Siemens solution



- SVR-400 4th generation with enhanced radio module and external filter connectivity switchable from the cab radio.



- SDR-200 2nd generation with enhanced radio module and external filter connectivity, non-switchable
- ETCS over GPRS/EDGE support

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FWK MT 5 state of the art 8W ER- GSM module



general

- 900MHz version of Funkwerk's 8W transceiver range
- Available with REL4 and REL97 stacks
- Beside ETSI standard functionality several improved functions available, e.g. network preferation, scan modes, eRec ...
- compliant to TS 102-933 „GSM-R improved receiver parameters“
- Further improved resistance against external disturbers
- Operating Temperature : -25°C .. +85°C
- Contained in latest versions of Funkwerk cab radio range

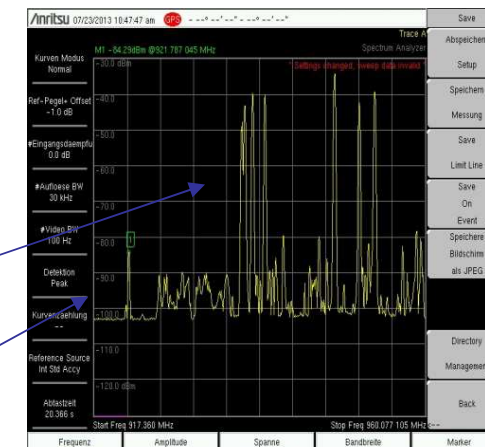


Public base station

Test car

Field proven robustness

- tested under worst case field conditions
- No call loss or other problems !
- Stable and robust behaviour



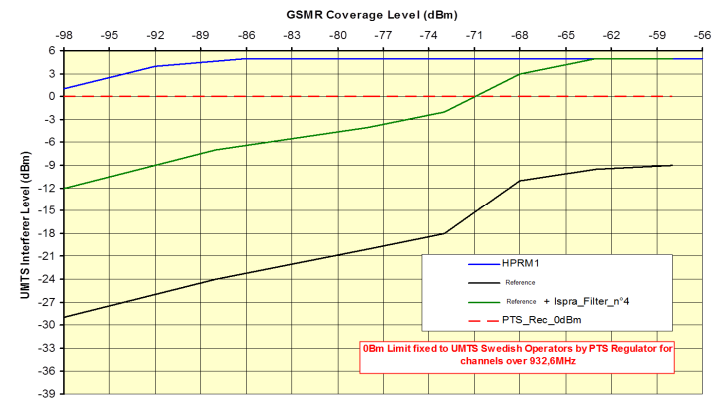
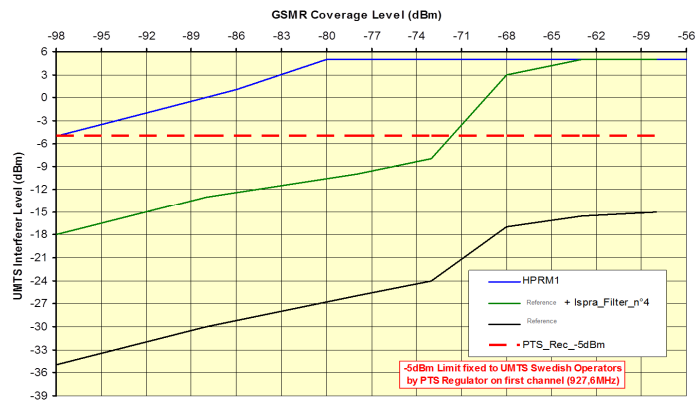
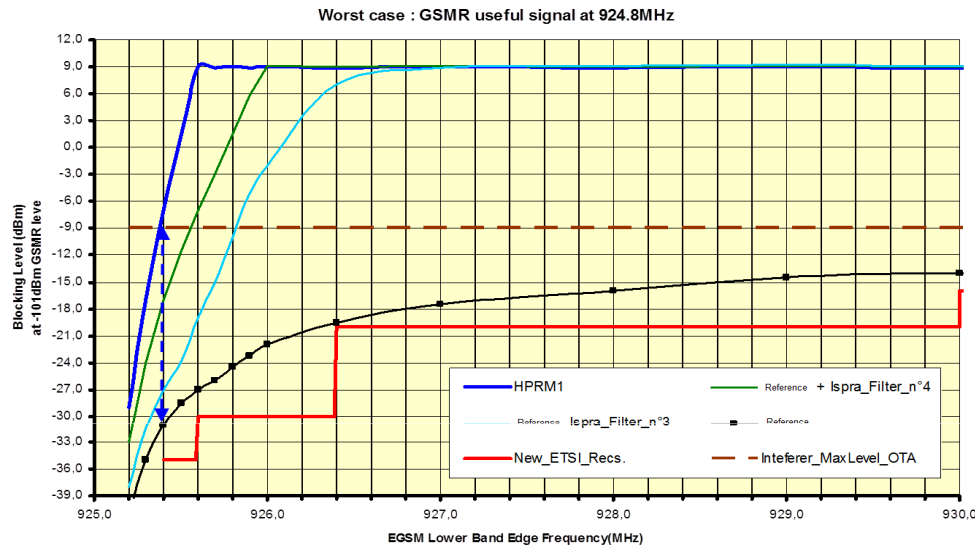
SIERRA WIRELESS 8W Module HPRM1



- Keep the whole frequency range compliant to ETSI including the new ER band
- Upward compatible with existing R2, G1TS and GPRM1 versions
- Equivalent or better than external filter
- No extra-cost requested by filter installation between the rooftop antenna and the GSM-R MS
- No extra cost due to network re-engineering due to significant additional losses



Sierra Wireless HPRM1 Blocking resistance



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.

WE ARE READY FOR SOLVING EXISTING ISSUES RIGHT NOW

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Thank you