Technical Solutions on Interferences to GSM-R

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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 / UMTS coexistence chart ( =2.6MHz)

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

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 lightening 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 tranceiver range
- Available with REL4 and REL97 stacks
- Beside ETSI standard functionality several improved functions available, e.g. network preference, 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

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
Thank you