REPORT
Risk analysis – The impact of changes in the technical conditions for mobile operators on GSM-R
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Introduction

This risk analysis has been conducted together with representatives from the trade association Tågoperatörerna (the Association of Swedish Train Operating Companies) and Trafikverket (the Swedish Transport Administration).

Version 1.0 of the risk analysis is ratified with the remark that it has yet to be reviewed by an independent assessment body.

Background

GSM-R is the harmonised communication system of the European railways. The system uses frequencies in the 900 MHz band, and GSM-R (MobiSIR) has been in operation as a communication system for railways in Sweden since the year 2000. The system is currently in operation on the entire railway network in Sweden for which Trafikverket is the infrastructure manager, including Inlandsbanan (the Inland Line).

During 2009, EU changed the use of spectrum in the 900 MHz band, which also contains GSM-R, in order to allow for the introduction of broad band mobile technologies. In 2011, the administrative court established technical conditions for the mobile network operators, resulting in the protection against interference from strong broadband signals of GSM-R terminals on vehicles until the 30th of June 2015. From 1st of July 2015, the technical license conditions allow the public mobile operators to increase their signal level, which will have an impact on the railways since the signals may be up to 200 times stronger than before, also in the vicinity of railways. At such strong levels, the GSM-R terminals onboard the vehicles will stop working unless they are protected by filters or have a replacement radio module with improved performance.

The introduction of protection onboard vehicles has for legal and economic reasons not yet been carried out. This risk analysis has been performed in order to shed light on risks associated with traffic safety and quality.

Purpose and scope

The purpose of the analysis is to identify risks related to safety and quality of rail services imposed by changes in the mobile operators’ licence conditions. The analysis is based on the assumption that the public mobile operators will turn on their base stations in accordance with stipulated licence conditions applying from 1st of July 2015, and that the GSM-R voice cab radios and the EDORs are not protected.

The analysis was conducted with the following two scenarios:

- GSM-R voice communication between train driver/TSM and traffic control (also including voice communication between drivers) not working after 1 July 2015 (Scenario 1)

- GSM-R data communication for ETCS not working after 1 July 2015 (Scenario 2)
Method

Trafikverket’s risk management method has been applied, which is based on ISO 31000 for risk management and also includes CSM-RA. Trafikverket’s criteria for risk evaluation have been applied as a basis for the risk assessment (TDOK 2010:163 Trafikverket’s Internal Management and Control document). The risks have been qualitatively assessed based on the expertise of the analysis group and factual input.

The analysis is carried out as a comparative risk analysis with the system prior to changes of the licence conditions as a baseline. Hazards have been identified and assessed weather to have an increased impact on safety and punctuality/availability of rail services. When assessing the impact of the hazards, a probable worst case scenario has been applied.

The following sub-stages have been implemented:

- Identification of hazards for the two scenarios
- Description of hazard
- Probability assessment
- Description of consequence (probable top incident)
- Risk evaluation
- Proposed mitigations

Implementation

Responsible for ordering the risk analysis

The joint GSM-R working group composed of representatives from the trade association Tågoperatörerna and Trafikverket.

Responsible for the risk analysis

Johan Hansen and Jonas Lindh, Trafikverket

Analysis group

Johan Hansen TRV  Analysis Manager, Risk Manager
Jonas Lindh TRV  Expert, Operative Telephony and Radio Systems
Pelle Thorén TRV  Expert, Traffic Safety, Traffic Control
Nils Eriksson TRV  Expert, Traffic Safety, Maintenance
Kent-Erik Hytter TRV  Expert, Traffic Safety, International
Lars-Åke Kjellson GC  Expert, Traffic Safety
Peter Brickner SJ  Expert, Traffic Safety
Mathias Rosholm Veolia  Expert, Traffic Safety
Lasse Eriksson STÅG  Expert, Traffic Safety
Identified risks
A total number of 13 hazards were identified for Scenario 1, GSM-R voice communication between train driver and traffic control not working, 6 of them have some form of impact on safety of which 4 were deemed not be acceptable. The other 7 risks belonged to the category “availability, punctuality and quality” and 2 are found not acceptable in terms of quality of service.

For Scenario 2, GSM-R data communication for ETCS not working, 4 hazards have been identified, one of which was related to safety and deemed not acceptable. The other 3 hazards are of the category “availability, flexibility and quality”. One of these is not acceptable in terms of quality of service.

CSM RA
Justification and analysis
In this risk analysis, we have applied CSM-RA in applicable parts. The root cause of the change lies outside the actual railway system (Mobile operators’ introduction of new mobile technology according to Directive 2009/114/EG of 16 September 2009 on changing of the Council’s Directive 87/372/EEG ”the GSM Directive” on the frequency bands to be reserved for the coordinated introduction of public pan-European cellular digital land-based mobile communications in the Community) but the impact on the control-command signalling subsystem is significant.

We have made an assessment whether the change is significant with respect to safety of railway service based on the criteria in CSM-RA.

Failure consequence: Credible worst-case scenario in the event of failure of the system under assessment, taking into account the existence of safety barriers outside the system.

Answer: The change leads to disrupted and/or loss of communications in the railway communication system, which will have a major impact on the possibilities to send alarms in case of accidents and dangerous situations, the impact will be increased risk of accidents and contribute to more severe consequences of an accident.

Conclusion: A significant change with respect to safety of railway traffic.

Novelty used in implementing the change: This concerns both what is innovative in the railway sector, and what is new for the organisation implementing the change.

Answer: No innovation, irrelevant.

Complexity of the change
Answer: The change is complex in the sense that measures for solving the problem are not allowed according to the current specifications for CAB-radio in the CCS TSI. The updated CCS TSI entries into force on the 1st of July 2015, it allows for protection of GSM-R onboard
vehicles, but the requirement is voluntary and in no way mandatory. This means that the interoperability of GSM-R has not been handled to the full extent since authorised vehicles will not work properly in the radio environment that will exist in Sweden after 1st of July 2015.

**Conclusion:** A significant change with respect to safety of railway traffic.

**Monitoring:** The inability to monitor the implemented change throughout the system life-cycle and intervene appropriately.

**Answer:** The possibility to monitor the radio environment from an interference point of view along the railway exists, communications in the GSM-R infrastructure are monitored and analysed continuously. On the other hand, it is difficult to determine the actual reason for the interference. Trafikverket also measures the public mobile operators’ signals several times a year in conjunction with periodic measurement with IMV200 (a measuring train). The introduction of protection would also mean that the vehicle owners would have to have updated manuals and procedures the check the functionality of GSM-R equipment on the vehicles.

When the GSM-R terminals are not connected, it is impossible to monitor the interference in any other way than by the driver noting that the GSM-R terminal has no coverage. (The symptom of interference is the same as absence of GSM-R coverage)

**Reversibility:** The inability to revert to the system before the change.

**Answer:** Technically possible, but from a commercial point of view extremely doubtful. When the mobile operators have put their networks into operation, it is judged impossible, from the commercial point of view, to reverse the decision.

**Conclusion:** A significant change with respect to safety of railway traffic.

**Additionality:** Assessment of the significance of the change taking into account all recent safety-related changes to the system under assessment and which were not judged to be significant.

**Answer:** For voice communication, the assessment is that it is not a problem. For ERTMS equipment it is not quite as easy in since on-board systems currently only have temporary authorisations and this is yet another thing that influences the ERTMS on-board installations.

**CSM-RA overall assessment**

The overall assessment is that the change is a significant change with respect to safety of railway traffic.
Conclusion
The analysis group has identified a number of risks that are unacceptable when it comes to both traffic safety and quality (punctuality/availability) in the railway system.

The conclusion of the analysis group is that it is not possible to operate railway services while maintaining safety and reliability without mitigation of the identified risks.
References

http://www.trafikverket.se/PageFiles/117321/coexistence.pdf

A factual document produced by Trafikverket, Transportstyrelsen (the Swedish Transport Agency), Post- och Telestyrelsen (the Swedish Post and Telecom Authority), the trade association Tågoperatörerna and the mobile network operators. (March 2013)

http://www.trafikverket.se/PageFiles/19223/ertms_broschyr_a6_web.pdf

A popular version of the information brochure on ERTMS from 2013. The presentations on pages 6 and 7 describe how GSM-R is used in ERTMS.

Appendix

Hazard record.

Appendix to Risk Analysis – The impact of changes in the technical conditions for mobile operators on GSM-R dated 10 February 2015. Version 1.0