Questionnaire

*Evaluation of the use of GSM-R for operational voice and emergency communication*

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# Purpose and scope of this questionnaire

Due to the anticipated obsolescence of GSM-R around 2030, ERA, in close cooperation with many others, is preparing the introduction of the successor system. Work on the requirements specification for this successor is ongoing.

The introduction of FRMCS could provide opportunities to optimise the railway operations (due to more technical possibilities), although the current usage of GSM-R will still be a reference. For this reason, evaluation of GSM-R and feedback on more than a decade of operational use could provide very helpful information.

In 2014 an ex-post analysis of GSM-R was performed by ERA; this analysis focused on the safety and performance contribution of GSM-R in general and did not address specific items related to operation.

This questionnaire aims to collect detailed and specific information to be used for the development of the specifications for the successor of GSM-R and, where possible, to introduce improvements in the railway operation. It focuses on operational voice communication using GSM-R in the context of the CCS TSI. As there is - in many cases - a direct relationship between operational use and system properties and limitations, the questions are not only related to strictly operational items.

In order to benefit from the experience and information which is available in the railway sector, many questions are inviting to provide more information and detailed explanation of usage, benefits and /or issues. In some cases examples are added for information. Note that some of the questions are starting with “could it be...”. This kind of questions are intended to trigger discussions on possible improvements and/or enhancements.

Note that non-voice applications, such as ETCS, are out of scope of this questionnaire.

This questionnaire covers the following subjects:

1. General
2. Driver-signaller communication
3. Emergency communication
4. Other communication
5. Migration
6. Availability
7. Future developments

The questionnaire will result in a Report *Evaluation of GSM-R for operational voice and emergency communication in Railways*.

End of 2018, ERA will issue a report to the Commission, containing conclusions on the system definition for the successor of GSM-R. This report will also cover the item Functionality, where the evaluation report may offer a decent justification for conclusions about similar/reduced/enhanced functionality for voice and emergency communication, compared to current CCS TSI.

**Responses**

Respondents are invited to add answers directly below the questions in this questionnaire. Any additional information, e.g. reference to reports, is welcomed.

Please send the completed questionnaire and/or any enquiries regarding the questionnaire by e-mail to Chiel Spaans (chiel.spaans@era.europa.eu)

*Information about the respondent*

Name:

Company/organisation:

E-mail

Date:

*Confidentiality*

Please indicate below if the information in this questionnaire has to be treated in a confidental way by the Agency:

Confidential: yes/no

# General

## Introduction

The original development of the functional requirements and the technical solutions of GSM-R were based upon experiences with analog radio and with the system properties of the 2G (GSM) technology. This has led to some enhancements (the “R” features). Some basic principles - with relevance for this questionnaire - were taken into account:

* Setting up a call by dialing a mobile number was not considered as the best option for mission critical communication. For that reason the principle of functional numbering has been introduced. In the context of this questionnaire the most relevant elements are train (running) number, engine (coach)number and function codes. The assignment of a functional number and a function code requires a so called FN registration procedure, performed by the driver prior to the communication itself.
* Some operational situations require voice communication between more than two participants; this has led to the introduction of broadcast (unidirectional) and group (bidirectional) calls.
* A mechanism was introduced to use the position of a train (based in the area of coverage of the individual base stations) in order to identify/address the corresponding Signaller or to compose the required group call area.
* In order to interrupt ongoing calls when needed (and/or to get access to resources in a loaded network), the mechanism of priority levels has been introduced. GSM-R has 5 levels, of which the highest is for emergency and the two lowest are for voice communication.
* Many communication options for users of GSM-R can be configured, e.g. allowing initiating or receiving calls from outside GSM-R networks. These so called call restrictions can vary from very restrictive to very open.
* GSM-R mobile devices (e.g. cabradio) can be used in all GSM-R networks, under the condition that the GSM-R networks allow this (the so called roaming). It is needed for any radio device to be registered in the network in the network it wants to use. Network registration is done automatically at powering up of the radio; usually this will be the network it was using before. In border crossing situations, a registration to the new network has to be performed. This procedure can take long and all communication services may be interrupted during around 20 seconds.

## Questions

*Functional number registration*

### Have there been issues with registration of train running number, engine/coach number, function code and when yes, what were the causes and consequences; what mitigation measures were taken and/or what procedures do apply? (e.g. functional number already occupied)

### Could it be beneficial when automatic assignment and registration of train running number is available, and what could be the conditions for success?

*Group/broadcast calls*

### Are broadcast and/or groupcalls used in driver-signaller communication (except REC) and when yes, which one is used in what operational situations?

### Have there been issues with groupcalls, e.g. related to the use of the PTT button, call setup/response times, etc.?

### Could it be beneficial when groupcalls will get the character of “conference calls”, where all members of the call can speak at any time without PTT, and what could be the conditions for success?

### Have there been issues with the use of predefined, radio network dependent, geographic areas for groupcalls and broadcast calls? (e.g. not matching with signaller areas, losing communucation when leaving the area)

### Could it be beneficial when radio network independent geographical areas or free configurable groups (such as conference call) are available, and what could be the conditions for success?

*Priority levels*

### Have there been issues with the number of priority levels, with the handling of calls by the cab radio or with the availability of radio channels when trying to establish a call; was there any impact on safety and/or performance?

### Could it be beneficial when more priority levels are available for non-emergency voice communication?

### Call restrictions

### Are there specific call restrictions for drivers and when yes, what are these restrictions? (e.g. initiate or receive calls from public networks, only allowed to initiate a call at standstill)

### Have there been issues with distraction of drivers caused by voice communication via GSM-R?

*Roaming*

### Have there been issues with network registration due to lack of roaming facilities? (e.g. impossibility to register in the next GSM-R network on a border line)

### Have there been issues with support of communication functions/services when roaming in another GSM-R network? (e.g. call restrictions, no support of cell dependent addressing)

*Network change*

### Have there been issues due to unavailability of communication during the “silent period” of approx 20 seconds when changing from one GSM-R network to another, e.g. when border crossing? (e.g. not possible to inform the driver about an obstacle)

### Could it be beneficial when the “silent period” is reduced (even to almost zero) and when yes, please indicate the impact on safety and/or performance.

# Driver <-> Signaller communication

## Introduction

Communication between driver and signaller is an essential part of railway operation and hence the OPE TSI refers to this communication in many cases. Usually the terminology “ the driver shall inform the signaller” and vice versa is used. The Annex A of this TSI describes a couple of rules related to this communication.

In GSM-R, Driver to Signaller communication is facilitated by the following features:

* A driver initiates a “normal” (point-to-point) call to the Signaller by dialing the corresponding phone number manually, as indicated in his route-book, or select the correct signaller/number from the phonebook
* A driver initiates a call to the Signaller by using a single, specific key; the GSM-R trackside system will identify and connect to the corresponding responsible Signaller, taking into account the position of the train and/or the Driver’s train running number.
* In some networks there is also an option to use another key, which does the same but with a higher priority, resulting in the interruption of a call (to the same signaller) which was set up by one of the previous methods.
* A driver initiates an Railway Emergency Call by using a single, specific key; the GSM-R trackside system will identify and connect to the corresponding responsible Signaller, taking into account the position of the train.

Signaller to Driver communication is facilitated by the following features:

* A signaller initiates a “normal” (point-to-point) call to a driver by dialing his mobile number
* A Signaller initiates a “normal” (point-to-point) call to a Driver by dialing his train (running) number
* A Signaller initiates a “normal” (point-to-point) call to a driver by dialing his engine number
* A Signaller initiates a broadcast call to all drivers in a certain area
* A Signaller initiates a group call to all drivers in a certain area
* A Signaller initiates a group call to all drivers in a certain area with a higher priority, resulting in the interruption of ongoing calls between driver(s) and Signaller(s)
* A Signaller initiates a Railway Emergency Call to all drivers in a certain area

## Questions

### Driver-> Signaller voice communication

### What operational situations require driver -> signaller communication; what information is exchanged, how often is this used (e.g. per train running hour)?

### For a “normal” call to a signaller, which number is used by the driver: single button (with automatic addressing the corresponding signaller), and/or dialing a phone number (whether or not via phonebook)?

### What operational situations require the use of a higher priority call (when available) and has this led to issues with interrupting other calls?

### Have there been issues with addressing the corresponding signaller; was there any impact on safety and/or performance? (e.g. the “signaller button” for location dependent routing was not connecting to the correct signaller, or phonebook was not up to date)

### Have there been issues in contacting the signaller due to the fact that a signaller was in another call; was there any impact on safety and/or performance?

### Have REC been used in non-emergency situations and when yes, what was the reason?

### Are there differences between train preparer and driver, related to the questions above?

### Signaller -> driver voice communication

### What operational situations require signaller -> driver communication; what information is exchanged, how often is this used (e.g. per hour per signaller)?

### For a “normal” call, which number is used by the Signaller: mobile number, train running number, engine number) and, when this is the case, why not always the train running number?

### What operational situations require the use of a broadcast call to all drivers? (e.g. in case of a driver who has not registerd his trainnumber)

### What operational situations require the use of a group call to all drivers?

### What operational situations require the use of a high priority group call to all drivers and has this led to issues with interrupting other calls?

### Have there been issues in contacting a driver due to the fact that the was in another call (e.g. with another signaller or in a driver - driver group call); was there any impact on safety and/or performance?

### Are there differences between train preparer and driver, related to the questions above?

# Railway Emercency Call (REC)

## Introduction

REC is an emergency warning and communication functionality, intended to be used in operational situations with direct danger. According to the OPE TSI, the receiving driver has to reduce speed and drive on sight until further instructions are given by the signaller.

In GSM-R, the current implementation of the REC is based upon a group call in a pre-defined area. The “area” is the zone covered by one or more GSM-R radio cells. This means that in case of detecting a dangerous situation, a REC will be initiated by a driver or a signaller and all trains in this area as well as the (predefined) signallers for this area will receive the emergency warning tone, automatically followed by a voice message from the initiator (driver or signaller) and the subsequent conversation between signaller and initiator. As with any group call, a driver or signaller has to use the so called push-to-talk button in order to be heard. As long as the call is active, other drivers entering in the area will receive the warning tone (‘late entry”), but may miss the information exchanged so far. Drivers who leave the area will leave the radio call. As the REC has the highest priority, no other calls can be initiated or received by the drivers.

GSM-R defines two kinds of REC: train emergency calls and shunting emergency calls. The same functionality is available, but the configuration of radio cells can be different. Depending on the selected mode of the cabradio (normal or shunting mode) the related kind of REC will be activated.

Given the use of *radio* cells to define the area, it is not easy to discriminate between different *railway* areas, such as crossing railway lines, independent lines that run in the same area of coverage, station and connected lines, shunting yards. Hence, a REC may be received by more drivers than strictly necessary. In order to improve this situation, eREC has been developed, allowing to discriminate between lines/areas. eREC is only effective when initiating and receiving trains as well as the trackside supports eREC.

The introduction of REC on border lines has proven to be complicated, both operationally (e.g. which signaller is in the lead) and technically. The relatively long interruption of radio communication during the process of changing networks has to be taken into account when configuring REC on border lines or when communicating during REC.

## Questions

### The use of an REC in general

### In what kind of operational circumstances a REC is used (describe type of emergency)?

### How often is a REC used (per year and per million train-km), and on what type of lines (station/yard, dense/urban, highspeed, regional, low density, single track/multitrack). What is the distribution between train REC and shunting REC?

### Initiating: who was initiating (signaller/driver/automatic, in percentage) and how was the initiator triggered (e.g. observation by driver, information to signaller, automatic); is there a difference in daylight/darkness conditions?

### In how many cases REC has proved to prevent further risks of a dangerous situation or even fatalities (number, percentage of total RECs)?

### How many trains were involved in a REC (average, min, max number), how many trains were unnecessarily[[1]](#footnote-1) involved (average percentage)?

### Considering that ETCS L2 has an emergency stop function: do you still see an added value of REC on these lines; please explain.

### Is shunting REC used? When yes, can information be provided on the questions 4.2.1 - 4.2.6 for this shunting REC?

### Configuration of REC areas

### What configuration rules for REC area are in place ? (e.g. to define the size of an area for driver initiated REC and for signaller initiated REC)

### Did the final REC area configuration cause issues? (e.g. unwanted coverage from adjacent radio cells. or when the REC area covers more than one signaller area)

### Does the configuration of shunting REC area as configured in the network differ from the train REC?

### Is eREC in use or is this planned? What effect on the figures of 4.2.5 is experienced or expected?

### Could it be beneficial when a REC could be addressed to one or more specific trains only, e.g. the nearest train on an adjacent track or the first approaching train on every track in the opposite direction, assuming that the signaling system takes care of subsequent trains.

### Specific experience with REC

### Have there been issues with the initiating of a REC (e.g. related to HMI and accessibility of REC button); what were the consequences?

### Have there been issues with the call setup delay or with the duration of the warning tone? (e.g. loss of information from the initiator)

### Have there been issues with the use of the PTT button? (e.g. loss of information from the initiating driver). Could a solution without PTT be preferred (maybe with the consequence that more vocal discipline is required from the involved drivers)?

### Have there been issues related to the possibility for non-initiating drivers to speak? (e.g. causing confusion on who is speaking)

### Have there been issues related to “late entry”? (e.g. due to the lack of information which usually is exchanged in the early phase of a REC)

### Could it be beneficial when a REC is clearly split into two phases: an Alert Phase (with a warning tone and a clear indication of the danger location, which also works for late entry) and a (manual or automatic) subsequent driver to signaller (or vice versa) communication?

### REC related procedures

### What driver response is required upon reception of a REC warning tone? (e.g. in addition to the harmonised rules)

### What procedure is in place to retain speed (e.g. by direct signaller-to-driver communication or by group/broadcast call); are there issues related to this? (e.g. due to lack of information about involved drivers in the REC or with drivers who left the area already)

### REC on border crossing lines

### Have there been safety issues due to unavailability of REC during the “silent period” of approx 20 seconds; what mitigation measures have been put in place and are these sufficient?

### Are border crossing REC areas implemented (covering both sides of a border) and when yes provide information on the questions 4.2.1 - 4.2.6 for this border crossing REC?

### Are there specific issues with these border crossing REC? (e.g. related to different operational rules on both sides of the border)

### When border crossing REC is not implemented, what operational procedures are in place to manage emergencies? (e.g. are signallers on both sides of the border informed)

# Other communication

## Introduction

GSM-R provides services to facilitate other voice communication needs, such as driver to driver, driver to shunter, signaller to trackside workers, etc. Within the context of this questionnaire it could be relevant to understand possible interworking between these communication and the driver to signaller or the REC communication.

## Questions

*Driver to driver communication*

### Is direct driver to driver voice communication via GSM-R used and when yes in what kind of operational situations?

### Is it possible for the Signaller to join (listen/speak) this call?

### Have there been issues with driver to driver communication related to interrupting or preventing driver to signaller (or vice versa) communication?

### Shunting voice communication

### Is driver to shunter voice communication via GSM-R used? When yes, is the driver using the cabradio or a handheld device? (Please answer the questions below also for non- GSM-R solutions)?

### Is shunting communication using group communication or point-to-point communication?

### How many drivers and shunters are involved in a single shunting groupcall (usual, maximum)?

### How is communication between driver and signaller performed during an ongoing shunting group call, e.g. by leaving the groupcall and setting up a normal call. Who is initiating this communication?

### Have there been issues with the performance of shunting communication? (e.g. time needed to switch from listening to speak mode, interruptions, etc.)

### Is the link assurance signal in use and when yes has it proven to contribute to the safety?

### When GSM-R is not used for shunting voice communication, what are the reasons for this; what other communication means are used?

### Signaller - trackside worker voice communication

### Is signaller to trackside worker voice communication via GSM-R used?

### When not, what other means of communication is used?

### When yes, is this based upon group communication, point-to-point communication or both?

### When used, how many trackside workers are involved in a single groupcall (usual, maximum)?

### Can trackside workers receive/initiate REC and when yes, what are the experiences (see also question 4.2.4)?

# Availability of GSM-R communication

## Introduction

Given the importance of GSM-R radio communication for railway operation, non-availability could have impact on performance and/or safety of railway operation. Although there are several solutions for increasing the availability, such as adding redundancy and removing single points of failure, GSM-R can be unavailable due to technical failures or planned maintenance.

In some cases, coverage of GSM-R is not available at all, and other communication solutions are used for operational communication. One of the options, which can also be used as fallback, is that cabradios are roaming in public networks, another option is to use other radio systems such as TETRA, etc.

In case of planned or unplanned unavailability of GSM-R, trackside or onboard, users (i.e. drivers, signallers) have to be made aware of this situation. Hence, processes to switch to other communication means for driver <-> signaller communication and for emergency communication - when available - have to be in place.

## Questions

### Information about unavailability of GSM-R trackside services

### What processes are in place to inform signallers and drivers about unavailability of GSM-R trackside services? (e.g. information from GSM-R network operator about planned outages, impacted ares, duration of the outage, etc)

### What processes are in place to inform signallers and drivers about the end of unavailability of GSM-R trackside services?

### Do these processes also contain instructions for the use of fallback solutions and when yes, how is this communicated between signaller and driver?

### Are there specific processes for border lines and, when relevant, for trains using roaming, both for roaming “foreign“ trains and for trains roaming abroad?

### Use of cabradios roaming in public networks

### Is this option available and when yes, is this used as fallback for or replacement of GSM-R?

### When used: have there been issues due to the lack of support of (some) cabradios for public roaming? When yes, was this due to the lack of roaming facilities for “foreign” simcards and/or due to the incapability of the cabradio? (e.g. protective filters which block public network frequencies)

### Have there been issues in driver <-> signaller communication due to the lack of some GSM-R features in public networks and how were these solved or mitigated? (e.g. addressing: calling the right driver or signaller, lack of REC, lack of broadcast/group communication)

### What processes, as mentioned in 6.2.1, 6.2.2 and 6.2.3, are in place in case of unavailability of public networks?

# Future developments

## Introduction

As per today, the use of GSM-R is well harmonised and stable. Expected developments, such as expansion of ETCS and introduction of L3, could have some impact on operational voice communucation between driver and signaller or on emergency communication.

Also developments in other domains of the digitalisation of Railways could lead to reduction of the need for voice communication, by increasing visual and/or audible information exchange, such as updates of the route book, operational instructions, etc. Also the expected increase of availability of suitable information about position of trains could lead to new applications which can be beneficial for railway operation.

## Questions

### Could the further expansion of ETCS and/or the introduction of ATO lead to a decrease of driver <-> signaller voice communication; please explain.

### Could messaging (e.g. operational instructions, written orders, etc) replace operational voice communication? What operational cases could still require voice communication?

### Could integration of a DMI for voice communication with a DMI for messaging (e.g. operational instructions) be beneficial for railway operation? What could be the conditions for success?

### In the case of a split between alert and communication of REC (see question 4.2.19): could the alerting be integrated in the DMI as descibed above? And could emergency communication be replaced by messaging? When yes, what could be the conditions for success?

The European Union Agency for Railways would like to thank the respondents for taking the time to answer the questionnaire.

1. In the meaning of: not receiving the REC has no impact on safety [↑](#footnote-ref-1)