Evolution of GSM-R
First workshop - 15th of October 2014 (Lille)

Study for ERA

ERA/2014/04/ERTMS/OP – October 2014

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1. Agenda for workshop 1
2. Context & objectives of the study
3. Methodology
4. Discussion on the evaluation criteria
1. Agenda for workshop 1
Agenda of workshop 1

10h00-10h30: presentation by ERA on the terms of reference

10h30-11h00: presentation by the Consortium of the methodology

- Context of the study
- Presentation of the methodology
- Steps of the study
- Sources
- Workshops

11h00-11h15: Q&A session

11h15-11h45 Presentation of the evaluation criteria (for discussion in the afternoon) & questions for stakeholders

11h45-12h30: Open discussion on the evaluation of criteria (part I)

12h30-13h30: lunch break

13h30-14h30: open discussion on the evaluation criteria (part II)

14h30-15h00: open discussion on methodology

15h00-15h30: coffee break

15h30-15h50: wrap-up

15h50-16h00 next steps (presented by ERA)
2. Context & objectives of the study
Context of the study

GSM-R has proven its reliability and usefulness in the day to day operation of railways in Europe and worldwide.

There are however indications from the industry regarding end of life of the technology and the increasing reliance on data to improve security of trains and passengers and manage traffic effectively.

This raises the question of the technological and economical evolution of GSM-R.

Objective of the assignment is studying the possible evolution of the existing railway communication system which uses the GSM-R standard.
Objectives of the study

• A previous study performed in 2013 by Analysys Mason drafted some likely options for the evolution of GSM-R

• This new study will evaluate the options defined in the previous study under different aspects:
  • methodology for their assessment
  • feasibility of the options presented
  • selection of the most suitable options
  • possible operator concepts for railways according to the options selected
  • frequency availability for railways; analysis for the different applications and possible use of a common bandwidth for different services, as presented in the different options
  • possible evolution of the terminals and network infrastructures according to the options selected
  • highlights for the economic assessment of the options studied

• This study should focus on the options defined in the previous study, analyze the feasibility of them, taking into account railway sector and potentially other sectors where similar communication needs are found (aviation, maritime traffic, blue light services)

• The possible evolution of the communication needs and different network ownership models should be evaluated, and the most suitable options should be identified.

• Particularities and differences between Member States should be considered when doing a cost-benefit analysis of the possible evolution models presented in the selected options for the system.

➤ The study will provide input for further decision on GSM-R evolution
3. Methodology
Overall methodology

• The methodology will be based on four main steps

1. Inception report: Build the evidence base
2. Step 2: Frame the problem
3. Step 3: Impact assessment of each option
4. Step 4: Recommendations

3 Workshops to take place throughout the study

Objectives
• Formulate likely evolutionary patterns of GSM-R
• Make a clear statement of the problem to be solved
• Refine the list of options
• Assess the likely effects of proceeding with no change
• For each option, perform a comparison with the baseline
• Sum up main findings, and provide recommendations

Tools
• Study performed by Analysys
• Desk research
• Interviews
• Desk research
• Interviews
• Desk research
• Interviews
Framing the problem: Use of Impact Assessment

• Among the European institutions, Impact Assessment provides a useful means of analysing costs and benefits of prospective policy interventions.

• Properly applied, *Impact Assessment serves not only to assess impacts, but also to assist in the proper formulation of policies.*

• In this case, use of standardised Impact Methodology also assists ERA in communicating results to the European Commission, and assists the Commission (if necessary) in communicating results to the European Parliament and the Council.

• Among the key steps of the Impact Assessment procedure are:
  • Clear definition of the *Problem* to be solved
  • Identification of the *Objectives*
    • *General Objectives*
    • *Specific Objectives*
    • *Operational Objectives* (this last being partly driven by the nature of the Options under analysis)
  • Identification of *Options* (and possibly *Sub-Options*) that could achieve some or all of the Objectives
  • Assessment of the likely *Impacts* (positive and negative) of each of the most promising Options and Sub-Options
What is the problem to be solved? What are the strategic objectives?

The Problem:
• Identify technical and policy measures to be undertaken to enable continued provision of critical operational communications functionality to the European rail sector as technology and markets evolve going forward.

Per the SCF (2014) study “Is Commercial Cellular Suitable for Mission Critical Broadband?”: “The ‘mission critical/non-mission critical’ dichotomy is … an oversimplification. There are many degrees of criticality.”

General Objectives:
• Support all current and anticipated future mandatory rail operational functionality (including communications to and from the dispatcher, ETCS support, and Railway Emergency Call) at reasonable cost using modern, supportable technology.
• Support additional, optional rail functionality (possibly including business-supporting communications and passenger entertainment/general communications) to the extent that the same mechanisms can do so at reasonable cost.

Per the Analysys-Mason (2014) study: “Rail-sector communications fall into three categories: critical operational communications, business-supporting communications, and passenger entertainment/general communications. GSM-R is used for the first category, and, in some cases, the second category, but does not have the bandwidth to support the third.”

So far, so good?
What Options and Sub-Options should be considered?

Options and Sub-Options:
• We intend to take the options frame in the Analysys-Mason study that was published in February 2014 as the starting point for our analysis.
• Consistent with standard Impact Assessment practice, a “business as usual” Option provides the baseline for comparison. For this study, the “business as usual” Option is equivalent to the indefinitely continued use of GSM-R.
• Every Option (or Sub-option) needs to represent a reasonably complete constellation of choices, so that its advantages and disadvantages as a whole can be evaluated.
• For this study, timing is important. Thus, the Options will need to somehow reflect not only what is to be undertaken, but also when it is to be undertaken.
• Every Option must meet at least minimum functional requirements (e.g. functionality, coverage and reliability). There is no point in analysing relative costs and benefits of Options that fall short of this minimum standard.

So far, so good?
Scenarios/Options mix

- Previous study performed by Analysys Mason (to February 2014) listed 6 options to be considered for the evolution of GSM-R.

- Depending on the policy option adopted (O1–O6), different scenarios can be implemented to replace the current use of GSM-R.

- Some of these scenarios could apply to multiple options within the tree, e.g. a new technology in a new band (O3) might be delivered using a commercial network or a private network, depending on the detail of the technology and bands adopted.

- Figure below shows the options tree with the example scenarios applicable to each option.

- Note that where an option shows multiple scenarios, it is possible for combinations of multiple scenarios to be adopted across different countries or regions.

![Options Tree Diagram]

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Options to be considered

- The previous Analysys-Mason study listed 6 options to be considered for the evolution of GSM-R.
- In the previous study, the options available relate to the policy to be recommended for adoption for Europe and the extent and nature of the regulations that are to be prescribed.

<table>
<thead>
<tr>
<th>Option 1</th>
<th>Retain GSM-R</th>
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<tbody>
<tr>
<td>For this option, GSM-R continues to be specified for use in its existing frequency band. GPRS can be deployed in the GSM-R band, but no new technology or frequency is adopted.</td>
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<table>
<thead>
<tr>
<th>Option 2</th>
<th>New technology, same band</th>
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<tbody>
<tr>
<td>For this option, a single new technology is specified, but no new frequency band is made available for rail specific use. The rail sector will have to remain on the existing spectrum, either migrating using existing spectrum, or possibly using temporary spectrum</td>
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<table>
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<tr>
<th>Option 3</th>
<th>New technology, new band</th>
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<tbody>
<tr>
<td>For this option, a single new technology is specified and a new frequency band is obtained for rail - specific use. The rail sector will migrate to the new band as the new technology is adopted</td>
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<table>
<thead>
<tr>
<th>Option 4</th>
<th>New technology, with third party</th>
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<tr>
<td>For this option, a new technology is specified and the rail sector shares the network and spectrum with another organization that has similar requirements for specialist mobile communications. This is most likely to be the public safety sector.</td>
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<tr>
<th>Option 5</th>
<th>Multiple technologies prescribed</th>
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<tbody>
<tr>
<td>For this option, a number of technologies are prescribed and any combination of the prescribed technologies can be adopted. This may include GSM-R as well as newer network technologies such as LTE and 5G technologies as they emerge.</td>
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<tr>
<th>Option 6</th>
<th>Multiple technologies, no prescription</th>
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<tbody>
<tr>
<td>For this option, there is no prescription and (in theory) any technology can be adopted to suit local priorities on a country or localized basis.</td>
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</table>
Possible scenarios

E1: Continue with GSM-R and retain frequency band
In this scenario, the rail sector continues to operate GSM-R in its existing band, with deployment of GPRS in the GSM-R band, but no new technology or frequency is adopted.

E2: New private network technology mandated in existing band
In this scenario, a new technology will be specified but no new frequency band will be available for rail specific use. The rail sector will have to remain on the existing spectrum, either migrating using existing spectrum, or possibly using temporary spectrum.

E3: New private network technology and new frequency band mandated
In this scenario, a new technology will be specified and a new frequency band will also be obtained for rail specific use.

E4: Shared network with similar organization
In this scenario, the rail sector shares spectrum and network with another organization, that has a similar view regarding resilience and availability. This is most likely to be public safety. The rail sector may assist in increasing coverage for the railway, but will share the switch elements.

E5: Commercial network service
In this scenario, the rail sector takes service from a single commercial operator, to an agreed service level.

E6: Commercial network service: MVNO
In this scenario, the rail sector establishes or takes service from a mobile virtual network operator (MVNO), to an agreed service level. The MVNO may arrange service with two (or more) commercial operators as a means of increasing coverage and resilience.

E7: Railway works with commercial operator
In this scenario, the rail sector negotiates/co-operates with a commercial operator for the deployment of a network suited to the railway application. If the rail sector has dedicated spectrum available, this may be used as part of the agreement to commercial customers.
4. Discussion on the evaluation criteria
Assessment of Impacts: Criteria to be used

• In evaluating prospective Options and Sub-Options, what criteria should be used?

• Standard practice begins with three broad categories, differentiating and adding more based on the nature of the problem to be solved.
  • **Effectiveness:** To what extent is the Option likely to achieve one or more of the Objectives? To what extent is it likely to solve (or at least mitigate) the Problem?
  • **Efficiency:** What is the expected cost of implementing the option? Cost in this sense is not only direct economic cost, but should also consider social costs and externalities. Do alternative Options achieve the Objectives at lesser cost?
  • **Coherence:** Is the Option consistent (or in conflict with) other societal goals and programmes at European level?
Assessment of Impacts: Criteria to be used

• **Among the elements of Effectiveness:**
  - Coverage
  - Reliability of the chosen technological solution
  - Punctuality
  - Safety

• Effectiveness must consider both normal operation and operation under stress (e.g. at times of bad weather, natural or man-made disasters, …).

• **Among the elements of Efficiency:**
  - The cost of deployment and operation. This would include both CAPEX and OPEX. Many costs are directly borne by the *infrastructure managers (IMs)*, but are effectively passed through to the *railway undertakings (RUs)*, i.e. train operating companies) through track access charges.
    - Network costs
    - Cab equipment costs
    - Training costs
    - Transition costs from the old environment to the new (together with possible parallel operation of both)
    - Economic costs (efficiency) of other actors

• **Among the elements of Coherence:**
  - Degree to which spectrum requirements for rail (especially sub-1 GHz) might potentially conflict with use of the same spectrum for other DAE objectives such as mobile broadband, or conceivably with use by PPDR?
Assessment of Impacts: examples of mapping the scenarios

• The scenarios interact with these evaluation Criteria.
  • For instance, the use of commercial MNO and/or MVNO services without special adaptations probably has implications for various aspects of Effectiveness, including coverage, reliability, robustness (i.e. reliability at times of stress), and so on.
  • They also interact with Efficiency. Sharing of a network with PPDR could for instance be said to increase Effectiveness by delivering more services, but those services are provided to other stakeholders, not to rail stakeholders. A clearer way to express this benefit is to assume that sharing of the rail network with other uses instead reduces effective cost for the rail network (because it need not fund the entire cost of the infrastructure). The reduced cost then represents a gain in Efficiency.

• Expected obsolescence of GSM in general affects cost and maintainability in the longer term.
  • We can express this as an impact on both Effectiveness and Efficiency.
  • We need to find a way reflect the changing Effectiveness and Efficiency over time into the analysis.

• Flexibility was treated by A-M as an evaluation criterion. We intend instead to map it into Effectiveness, Efficiency and Coherence.
  • If flexibility increases the ability of the system to meet mandatory and optional elements of the General Objectives, then it is a gain in Effectiveness.
  • If instead it reduces the risk of stranded investment if technology changes in unexpected ways, then it is reducing the statistical expectation of loss overall, which is a cost reduction and thus an Efficiency gain.

• To the extent that interoperability is a minimum requirement, it does not need to be an evaluation criterion.
### Assessment of Impacts

- Visualisation of qualitative assessment of impacts is often done in tabular format as in this simplified example.
- Only fully elaborated Options that meet at least minimum functional requirements appear.
- Ratings are 0 (same as baseline), +, ++, -, and --.
- We will consider quantitative comparisons, but they may not be feasible in this case.

#### Example

<table>
<thead>
<tr>
<th></th>
<th>Business as usual</th>
<th>New technology, same band</th>
<th>New technology, new band</th>
<th>New technology, with third party</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness overall</td>
<td>0</td>
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<tr>
<td>Coverage</td>
<td>0</td>
<td></td>
<td></td>
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<tr>
<td>Reliability</td>
<td>0</td>
<td></td>
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<tr>
<td>Punctuality</td>
<td>0</td>
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<tr>
<td>Safety …</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Efficiency overall</td>
<td>0</td>
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<tr>
<td>Cost …</td>
<td>0</td>
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<td>…</td>
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<td>Factor / requirement</td>
<td>Relevance</td>
<td>Preconditions / Constraints / Restrictions (e.g. legal, technical)</td>
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<td>---------------------------------------------------------------</td>
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<tr>
<td>Punctuality &amp; Safety</td>
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<tr>
<td>the functional requirements (e.g. REC, voice group calls, prioritisation of calls) should be fulfilled</td>
<td></td>
<td>(e.g. public provider could not support REC, so constraint could be that this function is shifted to application layer)</td>
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<tr>
<td>the availability level of the network model should match the railway service needs</td>
<td>Adap to service needs (not each line requires a very high availability level &gt; line characteristics)</td>
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<tr>
<td>the capacity of the network model should match the railway service needs</td>
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<tr>
<td>the performance (QoS) of the network model should be at least the one of the existing network</td>
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<tr>
<td>Security</td>
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<tr>
<td>Security: the solution should be secure</td>
<td>Availability of different levels of user profiles for the different security levels</td>
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<tr>
<td>Interoperability</td>
<td></td>
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<tr>
<td>Track-train Interoperability</td>
<td>Network independent behaviour of terminals</td>
<td>Seamless transitions in case of different network models;</td>
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<tr>
<td>Economic efficiency</td>
<td></td>
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<tr>
<td>of RUs: the terminal should be cost efficient</td>
<td>Market size of terminal CAPEX/OPEX of terminals Future proof: interchangeable radio bearer? Migration: co-existence with GSM-R</td>
<td>Placing into service timeframe and further updates Multisystem radio bearers within same physical restrictions (antenna + inside cabin)</td>
<td></td>
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<tr>
<td>of IM: the network model should be cost efficient</td>
<td>CAPEX/OPEX of network models cost Investment, maintenance &amp; operation Migration: Re-use of assets versus new assets to be built Future proof (SLA: dependency on 'commercial' providers as contracts may not be sufficient to guarantee a long term service)</td>
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<tr>
<td>Economic effectiveness of other actors: the spectrum should be used efficiently</td>
<td>Probability of spectrum availability according to EU agenda</td>
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</tbody>
</table>
Sources to be used: extensive desk research

- The initial desk research will be aimed at gathering publicly available information in order to complement the available data.

- Examples of potential sources for this data include:
  - IDATE and WIK data library
  - 3GPP documents
  - RSPG documents
  - EU sources
  - CEPT: FM49 and Draft Report ECC 199; FM54 and draft inputs
  - The Requirements Matrix of the Law Enforcement Working Party (LEWP)
  - WIK’s study of harmonised spectrum needs for the German BMWi, together with the 2010 PPDR requirements study by iABG for the German Ministry of the Interior
  - Various US studies (FCC, City of New York)
  - Railways sources:
    - Annual Market Monitoring Report,
    - European Railway Review,
    - The Rail Engineer – therailengineer.com
Sources to be used: Interviews

- We envision ~24 interviews with several different kinds of stakeholders:
  - From the providers point of view: Equipment manufacturers: Motorola, Nokia Siemens Networks, Alcatel Lucent…, standardization organizations
  - End users: British Rail, railway associations, PPDR, ERDF…
  - Regulators: Railway National Safety Authorities (NSAs), Spectrum Management Authorities (SMAs)

- We intend proposing a distinct, tailored interview guide for each kind of stakeholder.

- We plan the interview campaign to last from end-September 2014 until the end of November 2014.

- An introduction letter will be prepared by ERA and will be sent to the stakeholders to be interviewed.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Company/ Organisation</th>
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<tbody>
<tr>
<td>PPDR/CCBG</td>
<td>TCCA</td>
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<td>AGURRE</td>
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<td></td>
<td>ASTRID</td>
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<td></td>
<td>Fluid Mesh</td>
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<td></td>
<td>UK Broadband</td>
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<td></td>
<td>Motorola Solutions</td>
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<tr>
<td>Railways/ system users</td>
<td>UIC International Union of Railways</td>
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<td></td>
<td>Community of European Railway and Infrastructure Companies (CER)</td>
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<td></td>
<td>European Rail Infrastructure Managers (EIM)</td>
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<td></td>
<td>ERTMS Users Group (EUG)</td>
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<td></td>
<td>UNISIG (Union Industry of Signalling)</td>
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<td>Communication equipment manufacturers</td>
<td>Kapsch</td>
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<td></td>
<td>Nokia</td>
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<td>Sierra Wireless</td>
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<td>Huawei</td>
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<td>Ericsson</td>
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<td>Alcatel</td>
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<td>GSM-R Industry Group</td>
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<td>Space agency</td>
<td>ESA</td>
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<td>Spectrum agencies</td>
<td>OFCOM</td>
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<td>CEPT/ECC</td>
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<td>Mobile operators</td>
<td>Orange</td>
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<td>Vodafone</td>
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<td>SFR</td>
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<td>GSMA</td>
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<td>Deutsche Telekom</td>
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Next steps

• Following the first workshop, we will refine the list of alternative options from the previous study based on our preliminary findings and the information already present in the evidence base.

• We will assess the likely effects of proceeding with no change (business as usual). This provides a baseline for comparison.

• For each Impact Assessment Option, we will consider the likely costs and benefits in comparison with the baseline.

• We intend to organize a second workshop on the 26th of November 2014 in Valenciennes
  - This second workshop will aim at selecting the feasible options thanks to the analysis of the agreed criteria during workshop 1

• A third workshop will take place in Lille on the 11th of February 2015 and will aim at proposing the preferred option
Planning

- Study is expected to last less than 7.5 months
- Deadline is March 2015

<table>
<thead>
<tr>
<th>September</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
<th>February</th>
<th>March</th>
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<tbody>
<tr>
<td>Kick off meeting</td>
<td>Final inception report</td>
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<tr>
<td>Step 1: Workshop 1</td>
<td>Preparation of workshop</td>
<td>Workshop 1</td>
<td>Workshop report</td>
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<tr>
<td>Step 2: selection of feasible options</td>
<td>Interim report, second workshop</td>
<td>Selection of the options</td>
<td>Impact assessment</td>
<td>Workshop 2</td>
<td>Final report</td>
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<tr>
<td>Step 3: analysis of combined options</td>
<td>Third workshop, final report</td>
<td>Analysis of combined options</td>
<td>Workshop 3</td>
<td>Final draft report</td>
<td>Final report</td>
<td>Final meeting</td>
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Progression of study

<table>
<thead>
<tr>
<th>Meetings</th>
<th>Reports</th>
<th>Progression of study</th>
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ANNEXES
ANNEX 1- Methodology- Step 1 (Build the evidence base)

- We will begin with a thorough review and assessment of the previous study, which provides among other things
  - Application requirements (current and expected future)
  - Network architecture models
  - A list of scenarios
  - Quantitative/market information
  - Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis of different options

- Other desk research
  - Identify data sources
  - Benchmark with other sectors: aviation, maritime, traffic, blue light services
  - Review and summarize the data for use within the team

- Interview relevant stakeholders (interview campaign)

- Collect and reflect ERA and stakeholder input throughout the project
  - Telephone conferences and discussions with ERA/ERTMS
  - Feedback from formal Meetings with the ERA
  - Input and feedback from the three Workshops

- Formulate likely evolutionary patterns based on these inputs
  - Communication and traffic needs for both voice and data traffic
  - Migration scenarios
  - Equipment (e.g. within the cab)
  - Spectrum availability
  - Network evolution
  - Evolution in related sectors such as PPDR
ANNEX 1- Methodology- Step 2 (Frame the problem)

- Make a clear statement of the Problem to be solved

- Clearly identify and delineate the general, specific, and operational Objectives. Key indicators are functionality, QoS and availability, also covering capacity, technical feasibility and costs

- Refine the list of alternative options from the previous study based on our preliminary findings. The initial list from the Terms of Reference must include:
  - Current scenario: GSM-R;
  - Shared with PPDR (technology to be specified);
  - New private network within same band (technology to be specified);
  - New private network in new band (new band and technology to be specified);
  - Commercial network (type of commercial network to be specified (e.g. satellite network);
  - MVNO;
  - Co-operate with commercial network.

- Identify promising groupings of these options into Options (with a capital “O”) and sub-Options for purposes of Impact Assessment.
ANNEX 1- Methodology- Step 3 (Assess impacts of each Option and sub-Option)

• Assess the likely effects of proceeding with no change (business as usual). This provides a baseline for comparison.

• For each Impact Assessment Option, consider the likely costs and benefits in comparison with the baseline.

• The comparison typically begins by considering effectiveness and efficiency in achieving the Objectives. Beyond that, we will as required consider punctuality, safety, economic efficiency at IM-side, economic efficiency at RU-side, and economic efficiency of other actors.

• The Assessment of Impacts for each Option will be primarily qualitative.
  - We will consider quantitative comparisons, but they are unlikely to be feasible in this case.
ANNEX 1- Methodology- Step 4 (Formulate findings and recommendations)

- We will clearly distinguish between the Findings and the Recommendations.
  - The Findings drive the Recommendations, not the other way around.

- Each Finding will be clearly grounded either in the Evidence Base, or in the Assessment of Impacts.

- It is conceivable that a clearly preferred Option will emerge as a Recommendation.
  - More often, the Impact Assessment serves to clarify the merits of each Option for decision makers who must then make the choice.

- Feasibility of the Options (for example, political practicality) is reflected at this phase rather than earlier, so as not to prematurely exclude otherwise workable solutions.
ANNEX 2- Interview guide

• Proposed interview guide for the interview campaign

Questions to service requesting stakeholders

A.1 Would you agree on the general principle that the functional requirements of the communication system will not significantly differ from current functional requirements (e.g. security, prioritization of calls, group calls, need to identify the location of the user and its function – location dependent and functional addressing?)

A.2 Taking as a basis the functionalities currently available (voice and ETCS), can you identify the availability required by the communication service for each of them? Can you indicate if – from operational perspective – less functionality can be acceptable on certain lines and in that case what kind of lines do you consider?

Similar question for quality of service, reliability, security/privacy, resiliency, need of a redundant/fall back service, coverage needed on specific locations (inside station buildings and tunnels, inside of the train, train maintenance workshops, etc).

A.3 Considering functionalities (that may already be implemented, i.e. ticketing information to controllers, information to security personnel, trackside workers…) not mandated in the TSI, can you identify the characteristics mentioned in A.1 for them? Are any of them already in place? If so, how is the service provided (with the GSM-R network, with other networks)? Are there any constraints found when the service is not provided by the GSM-R network? Can you share specific details on the SLA?

A.4 Considering additional functionality that may be requested in the near future, can you identify their relevance for the railway operation? Can you identify the characteristics needed for the communication service (see A.1)? Do you see any need for video applications using radio?

A.5 (Migration) What are your plans for the change/upgrade of your existing assets (network elements/on board equipment)? What is the expected timeframe (expiration/renewal of contract, national requirement, improvement or development plan, etc)? Can you indicate if you have considered deploying the successor of GSM-R and for what applications?
ANNEX 2- Interview guide

• Proposed interview guide for the interview campaign

Questions to service providing stakeholders

B.1 (Network) Are you already providing “mixed” services (to railway users and not railway users)? If so, what are the main differences in their service requirements? What is in general the contract duration and what KPI’s are contracted?

B.2 (Network) In your service provisioning model, is it possible to ensure QoS requirements, network maintenance windows, levels of coverage, etc linked to different groups of users? (different profiles) Is this something linked to the technologies available? Is it possible with the technologies known today?

B.3 (Network) Are there any legal constraints for the provision of services to other users in your network or to discriminate between users (different user profiles)?

B.4 (Network) Are there any strategic items that could limit the acceptance of the shared network models presented (e.g. Dependency on commercial providers as contracts are not sufficient to guarantee a qualitative service)?

B.5 (Network) Will it be possible for a service provider to offer services into more than one Member State (e.g. using different local networks or creating a multinational network)? Has a network independent service provisioning (“one-stop-shop for all your needs”) been considered as a commercial solution?

B.6 (Terminals) For each network model associated terminal: indicate markets with similar functionality/terminal (outside railways) and its market size (outside railways). Can you also provide the market size inside railways?

B.7 (Terminals) Could you indicate which combination of network models do not impact the terminal product? (e.g. option ‘public network’ and ‘dedicated LTE-network within spectrum range …’ do not impact the terminal). Do you consider the use of software defined radios to allow the adaptation of the terminal to different networks? Can you indicate how to update these radios when needed?

B.8 (Network & terminals: Interoperability) Could you indicate the items which could negatively affect daily operation to cross borders between 2 different network models/handover between networks or services (or preconditions for interoperability)?

B.9 (Network & terminals) Could you indicate, for each network model, and evaluate the potential changes (cost drivers) to the equipment (in comparison to the other users) in order to provide railway needs (based upon voice +ETCS data applications)?

B.10 (Network) For each network model, could you indicate and evaluate the synergies (benefit drivers) to the network which makes it attractive to include other user’s needs (e.g. re-use of sites)? (i.e. for a public network, to include railways; for a railways network, to include PPDR or public users; for PPDR network, to include railways)

B.11 (Standards & equipment providers) When will compliancy to the railway needs be available/contractible for deployment (e.g. with the technologies/standards used by public operators or by PPDR)? Is there any risk of not having these deployed?
ANNEX 2- Interview guide

• Proposed interview guide for the interview campaign

Questions to regulator stakeholders

C.1 (NSAs) What are the characteristics that a communication service should have to make it feasible for the railway operational voice/data interchange? (Security/safety/availability) (Taking the current situation as a basis).

C.2 Are there any legal requirements forcing the service to be provided by a railway owned infrastructure? When yes, what infrastructure elements are subject to this legislation (sites, transmission, network elements, power supply, subscriber management)

C.3 Are there any legal requirements preventing other service providers (PPDR network or public network) to offer distinctive services for a set of users (golden service, guaranteed throughput or availability)?

C.4 Are there strategic plans/ideas to set up a network owned by the administration (national? Regional?) and to offer services to other users? (i.e. situation in Finland, network in NL)

C.5. Are there any indications on the tendency for the future with respects to spectrum allocation for different services?

C.6. What are (or can be) the conditions to share railway communication assets (sites, transmission, network elements, spectrum) with non-railway or public operators? Are railways allowed to discriminate (capacity/availability/priority) between railway usage and others? Are railways allowed to use their infrastructure for other non-railway related services (e.g. internet on board for passengers)?