Future Railways Mobile Communications Systems

Dan Mandoc UIC FRMCS
GSM-R – a success story

GSM-R: a fit-for-purpose railways radio system

- One single platform that serves ETCS data and Train Radio voice
- Recognized Safety improvement
- GSM-R Railway Emergency Call
- Proven to support well ETCS, also at 300 km/h
- Proven 99,95% availability
- More than 180,000 km of rail line with GSM-R coverage and 40,000 Cab Radio’s (figures for Europe)
- The European GSM-R implementers agreed to Transit Roaming Agreement where roaming in Europe is facilitated by 2 hubs – in Frankfurt and Zurich – no more point to point links!
- GSM-R is adopted also outside Europe

- GSM-R reached and exceeded the initial goals.
- **GSM-R End-of Life is expected around 2030**
Why Change?

> One of the FRMCS beginnings question is still valid: Why Change? The main motives are:

1. **GSM-R obsolescence.**
   - GSM-R Industry Group assured that GSM-R will be supported until 2028.

2. **Planned GSM-R subsystems renewals** (due to obsolescence or ETCS introduction).
   - For railways, these are significant investments. The expectation for upgrades nominal life is 5-10 years. Therefore in the solution decision stage, it is expected to consider different options, including assessment for different technologies, for business or future proof reasons.
   - ETCS radio bearer change in the middle of the ETCS expected life span will also effect the on-board EDOR change, which is very painful and expensive for the RU’s.

3. **Railways mobile communications business needs.**
   - Railways have a increased need for own wireless communications, from M2Ms to data in isolated places. Real Time information is a necessity. Many business aspects like maintenance are being automated with mobile handsets/tablets usage continuously increasing.
UIC FRMCS Project

> UIC FRMCS project was formally launched by UIC in 2014, after 5 years of active discussions and studies
FRMCS project organisation

UIC Governance structure, three Working Groups:

**WG Functionalities**
- Functionalities:
  - User Requirements
  - Traffic Analysis
  - Support ETSI SR Doc
  - Use Cases for 3GPP SA1
  - FRS

**WG Architecture & Technology**
- Architecture and Technology:
  - Technology survey
  - On board and Track Side Architecture
  - Security
  - Use Cases for 3GPP SA1
  - Support ETSI SR Doc

**WG Spectrum**
- Spectrum:
  - Spectrum analysis, needs, strategy
  - Interface ECC / WG FM,
  - Traffic Analysis
  - Support for ETSI SR Doc

Interfaced with the UIC Platforms and Forums, ERIG, ERA, ETSI TC RT / NG2R, and stakeholders and partners.
UIC FRMCS stakeholders and partners
3GPP Standardization Timelines

TCCA
(Emergency Services)
Equipment Availability

3GPP calendar as per
https://portal.3gpp.org/#55934-releases

First 5G release
Second 5G release

Rel-12
Rel-13
Rel-14
Rel-15
Rel-16

Group Communications Enablers (GCSE)
Proximity Services (ProSe)
Device-to-device communications (D2D)
Group Based Enhancements (GROUPE)
Extended Proximity Services (ProSe-Ext)
Device-to-device Communications cont...
Isolated E-UTRAN Operation (IOPS)
Mission Critical Push-To-Talk (MCPTT)

Stage 1 Freeze date for Rel-14
Stage 1 Freeze date for Rel-15

Stage 1 Freeze date for Rel-14
Stage 1 Freeze date for Rel-15

Rel-14
Rel-15
Rel-16

7 UIC FRMCS – ETSI 2-3 of November 2016
FRMCS Project Timelines (based on today knowledge)

**2016**
- **UIS v2.0.0**
- **Study Item adopted by 3GPP SA1#74**
- **Use Cases for R15 standardization. Gap Analysis**
- **SRDoc**
- **FRMCS Project becomes Global at UIC**

**2017**
- **Architecture Concept**
- **ECC WG FM/ RSPG/ITU Follow up**
- **FRS/Mobility Testing/ Apps D & T/ initial SRS/ Test plan**

**2018**
- **Standardization R15/R16**

**2019**
- **PoC Testing starts**

**2020**
- **Initial Trials Launch**

**2021-2022**
- **Spectrum Conclusions**

**FRMCS Equipment Availability**

**Conclusions**
- Study Item adopted by 3GPP SA1#74
- Use Cases for R15 standardization. Gap Analysis
- SRDoc
- FRMCS Project becomes Global at UIC
- Architecture Concept
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- Spectrum Conclusions
- FRMCS Equipment Availability

**Business Case/Migration concept/Legislative work (ERA, Commission, RISC)/ Changes in TSI**
4G or 5G?

For easiness of understanding of the complexity of choice between time constraints and future predicted opportunities, below we have included the “5G use case families and related examples” from the NGMN 5G whitepaper.
FRMCS Challenges

- Future Proof
- Bearer Independence
- Flexibility
- Operational Procedures
- FRMCS
- Equipment availability
- Security
- Network Model
- Software demarcation
Issues & Risks vs. Opportunities

FRMCS is complex, but will deliver benefits

Connectivity
FRMCS will provide seamless connectivity between trains and the Intelligent infrastructure; this will deliver operational improvements.

Interferences
FRMCS technology should be interference free.

Infrastructure Re-Usage
GSM-R infrastructure (masts, fiber, sites, power, know how) can be re-used.

Economy of Scale
FRMCS will be a COTS. Synergies are possible with Emergency Services.

Timetable
European planning diversity for ETCS Deployment, GSM-R renewals plans. GSM-R national roadmaps diversity.

Migration
Timetable, Frequencies availability for Migration, by keeping the interoperability.

Frequencies
Limited Possibilities. Political willingness is needed.
FRMCS – way forward

UIC FRMCS project continues, at Global Level. This will make possible access to enhanced innovation, and improve the system economy of scale.

UIC FRMCS shall:
- Continue the work with 3GPP and with ECC; support the FRMCS SR Doc delivery
- Start at UIC and ETSI level the specification and standardization for the system.
- Actively support the critical ETSI TC RT engagement with 3GPP.
- Start working to the Functional Requirements Specification
- Support ETCS bearer independence
- Start investigating the software layer
- Security
- Work on synergies with Emergency Services (Blue Light)
- Propose the spectrum solutions, network model, system architecture

Telecom importance within the Rail System is on a increasing trend.

GSM-R obsolescence will become critical, and the FRMCS must cover the gap that will appear end of next decade.

FRMCS is a game changer. It will improve the connectivity, and will enable the intelligent infrastructure and connected trains. It will enable a Digital Railway!
Thank You for Your Attention.

Questions?

dan.mandoc@networkrail.co.uk
Supporting Slides
FRMCS achievement: Functionalities

> After more than 12 meetings and ~780 comments processed from the initial draft, the “User Requirements Specification version 2.0.0” was delivered. It is already posted on UIC Internet site, for larger Industry consultation.

> Use Cases are currently prepared as input to 3GPP SA1 through ETSI Next Generation to Railways NG2R to allow assessment against the existing 3GPP specifications, and as input for 3GPP R15.

> February 2016, we will be able to perform the gap Analysis for R15 against FRMCS critical Needs.

> The Group will stat the first FRS assessment.
FRMCS working Group: Spectrum

- The **System Reference Document (SRDoc TR 103 333)** Work Stream on Spectrum for Railways has been accepted by ETSI as a work item, to be finalized Q3 2016.

- Liaison Statement to TCCA/CCBG to initiate work to understand better if & how sharing of spectrum and maybe more with the “blue light” community may work, was agreed by both parties.

- Given spectrum scarcity and price of the bandwidth, FRMCS is studying different options, which are not only related only to frequency but also to the network model and system architecture, with some technology choices.

- FRMCS Project currently is following a plan to engage with ETSI, ERA and ECC, to pave the way for a decision on spectrum, to be discussed in World Radio Communication Conference 2019.

- The 3 WGs have actively performed a modelling for the FRMCS frequency needs, which is a important input for the SR Doc being prepared by ETSI TC RT
This working group is in charge of:

- Proposing architecture, System, QoS and Security Requirements – based on the User Requirements Specification,
- Identifying mobile radio system evolutions, trends, feature perspectives and assessing compatibility with the Railways requirements,
- Evaluating synergies and differences with TCCA and MNOs.

The WG will decide for the possible systems:

- Consider R15 and further on R16 3GPP system as basis,
- Possible: Satellite communications e.g. for low traffic rural lines,
- Possible: WiFi to increase capacity in stations.

The WG is actively supporting the ETSI SR DOC creation.