



# FRMCS as the European Radio system for Rail in Europe

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UIC

GSM-R

2G+  
+  
NATION-WIDE  
CONNECTIVITY  
INTEROPERABLE  
IMPROVE SAFETY  
ENABLE:  
RAILWAY EMERGENCY  
CALL  
ETCS  
-  
OBSOLESCENCE  
APPROACHING

# TODAY IS GSM-R...

The railways currently use the GSM-R system for operational communication, a key component of the European Railway Traffic Management System ERTMS.

Designed 20+ years ago by UIC and completely border-crossing interoperable, GSM-R is deployed on more than 130,000 kilometers of track in Europe and 210,000 kilometers worldwide.

GSM-R is supporting the "Train Radio" train driver to signaller voice applications including the Railways Emergency Call (considered to be the best method to avoid a train accident when all the other system has failed) and ETCS (European Train Control System).

Based on the limited data capability, GSM-R is also supporting some other railway applications, e.g. track side phones, passenger information screens on platform, etc.



# ...TOMORROW WILL BE FRMCS

The Future Railway Mobile Communication System (FRMCS) is the UIC's response for two elements of strategic importance for the future of the railways.

Firstly, GSM-R is a 2G system, where manufacturers have announced that GSM-R equipment is due to reach the end of its life (around 2030) and will be supported until around 2035.

Secondly, whilst replacing GSM-R is a complex issue - due the specific railways requirements in term of Functionality (Railway Emergency Call), Quality of Service, Life Cycle, Cross-Border Interoperability and European Migration Timeline, it is also a significant opportunity - to enable and support the Railways Digitalization, and therefore the need to transmit, receive and use increasing volumes of data, which is at the very heart of sustainable transport.

Improving the telecom service quality, the potential offered by the Internet of Things, smart maintenance, wireless connectivity (instead of copper or fiber cables), driverless trains... railways need a suitable radio system to enable these ever-increasing communication flows in an efficient way.



- 5G
- ENHANCE SAFETY EVEN MORE
- IMPROVED RAILWAY EMERGENCY CALL
- ETCS
- AUTONOMOUS GOA 2 TRAINS
- ENHANCE RAIL TRAFFIC & PERFORMANCE
- DIGITALISATION

Three main work directions, to provide the baseline platform for the system definition and delivery:

- User Requirements
- System architecture, interfacing with track side and on-board equipment
- Frequency Spectrum

Provide an appropriate replacement to EIRENE FRS:

- Based on the User Requirements
- Investigate future needs and add new functionalities
- Technology independent
- Future Proof

Provide an appropriate replacement for EIRENE SRS:

- Based on the FRS, and also on the 3GPP and ETSI specifications
- Boundary interfaces
- E-to-E Functional Interface
- Provide communication service to the application layer
- Ensure interoperability

The FRMCS project focuses on the system specification including E-2-E and boundary interfaces and related studies activities.

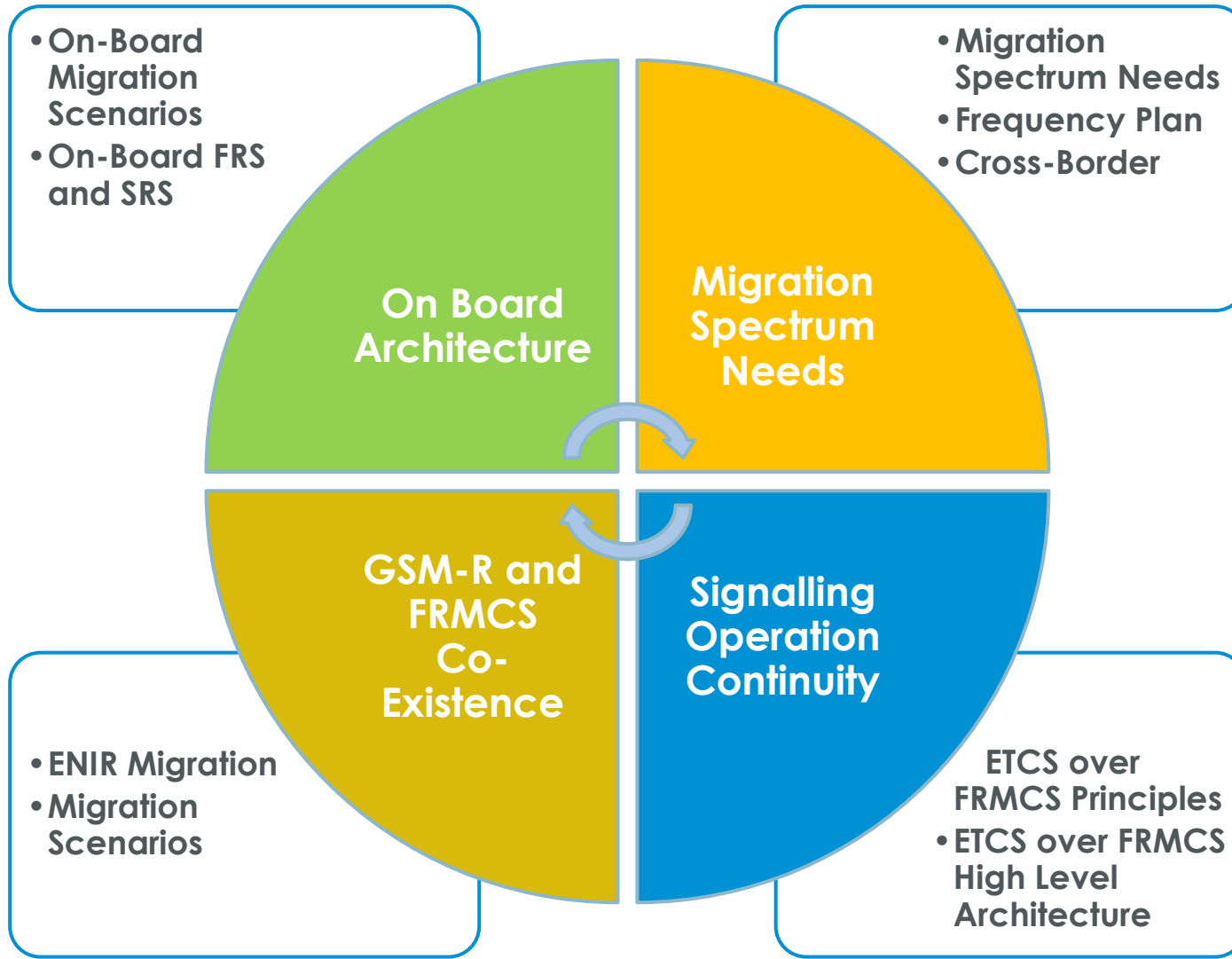
Strongly connected to ETSI and representing the members in 3GPP.

This activity is done in full transparency to ERA, and cooperating with S2R, UNISIG, UNITEL, CER & EIM.

## Project Scope:

Provide overall technical conditions for the successor of GSM-R

# FRMCS Migration Scenarios (FMS) Project



- Migration to FRMCS will Start in 2025 in Europe with the National Pilots and it is expected to last maybe until 2035
- Migrations will be Complex, Progressive and Diverse
- During migration FRMCS will co-exist with GSM-R
- During the Migration Period, the ERTMS Operations must be Ensured

**Prepare the Migration Scenarios**

## Steering Committee (reporting to UIC HQ and ERIG)

Functionalities WG (FWG)

- Functionalities:**
- User Requirements
  - Use Cases for 3GPP
  - Use Cases Specification (3GPP)
  - FRS

Architecture & Technology WG (ATWG)

- Architecture and Technology:**
- System Architecture
  - Traffic Analysis
  - System Use Cases for 3GPP
  - Liaison with ETSI
  - SRS, Interfaces (FIS, FFFIS)
  - Security

UIC Group for Frequencies Affairs (UGFA)

- Spectrum:**
- Spectrum analysis, needs, strategy
  - Traffic Analysis
  - Co-existence conditions
  - Interface ECC / WG FM; FM56; PT1; SE7;
  - RMR Report A, B;
  - ECC RMR Decision

Telecom On-Board Architecture WG (TOBA)

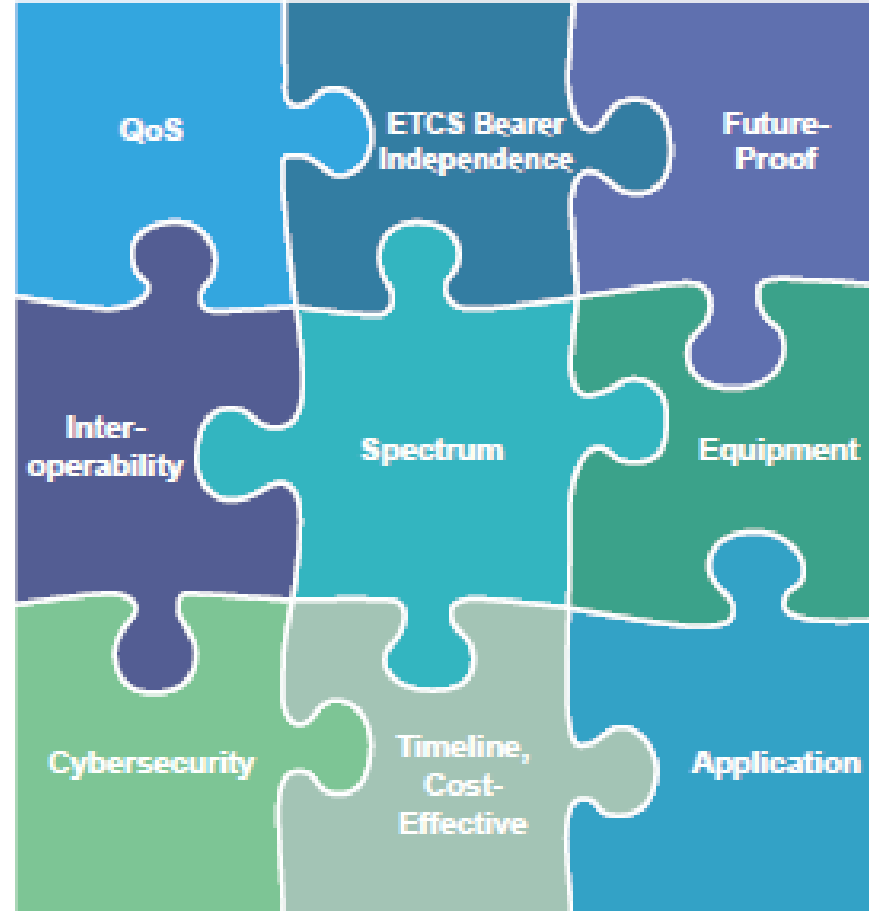
- On-Board Architecture:**
- On-Board ETCS and Cab Radio Migration Scenarios
  - On Board User Requirements
  - On Board FRS
  - On Board SRS
  - TOBA Box
  - Interfaces (OBapp)
  - Security

3GPP Task Force

- 3GPP:**
- Representing the members in 3GPP WGs
  - Submitting the Use Cases to 3GPP; working on making sure that the considered Use Cases and solutions are followed
  - developing solutions in 3GPP

Interfaced with the ETSI Technical Committee – Railways Telecom, ERA and Stakeholders

# THE FRMCS CHALLENGES



# User Requirements – the foundation of FRMCS

The User Requirements Specification (URS) is the foundation of the FRMCS. The embedded image explains the scope of the URS.

All FRMCS specifications are compliant with the URS.

The URS is open for any contributor and can be downloaded from the UIC Web Site.

<https://uic.org/rail-system/frmcs/>

It is important to mention that in addition to the critical communications e.g. voice train radio applications or signaling systems, these use cases also cover a large scale of train performance applications.

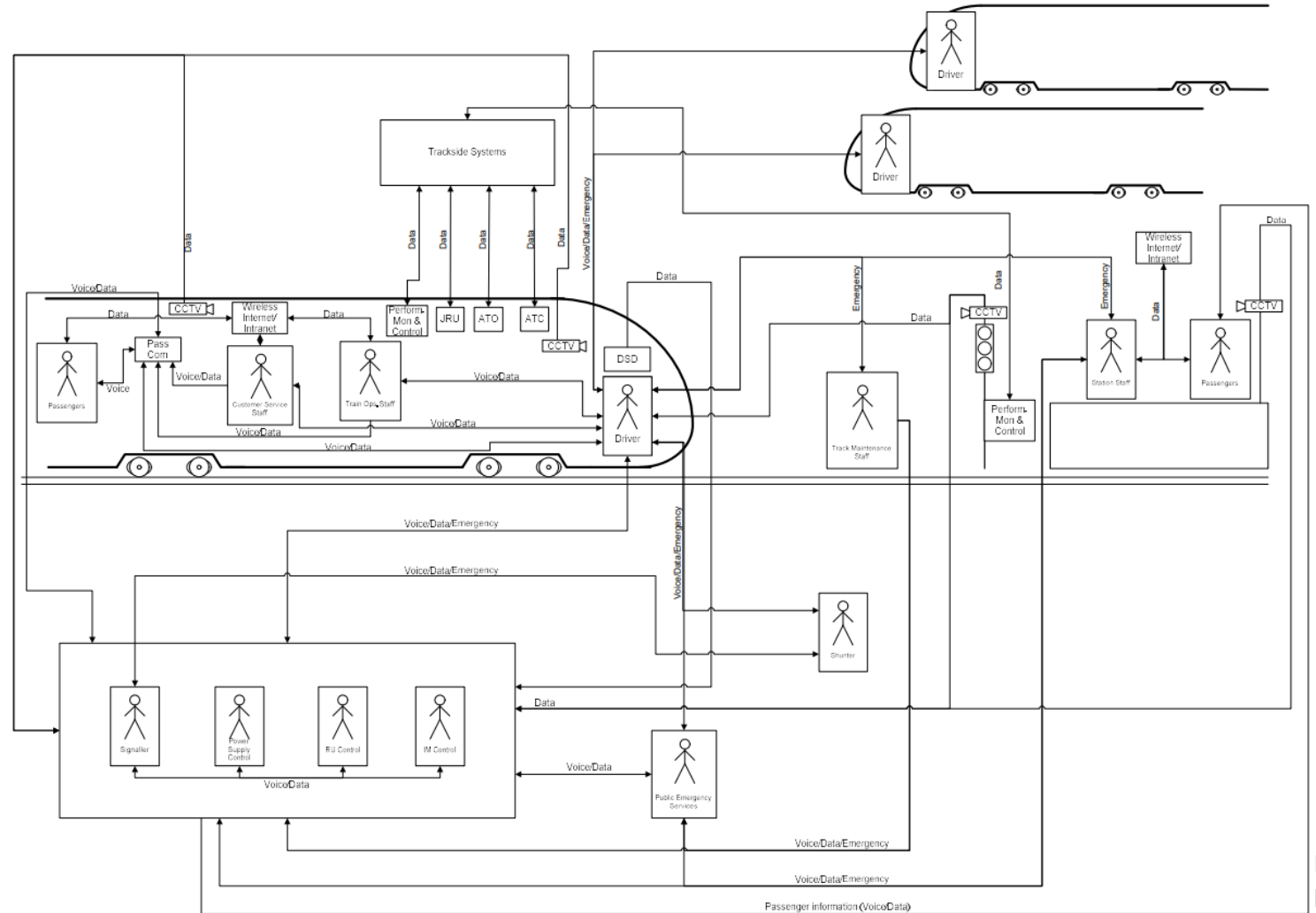


Figure 1: Application Layer Relationship Diagram

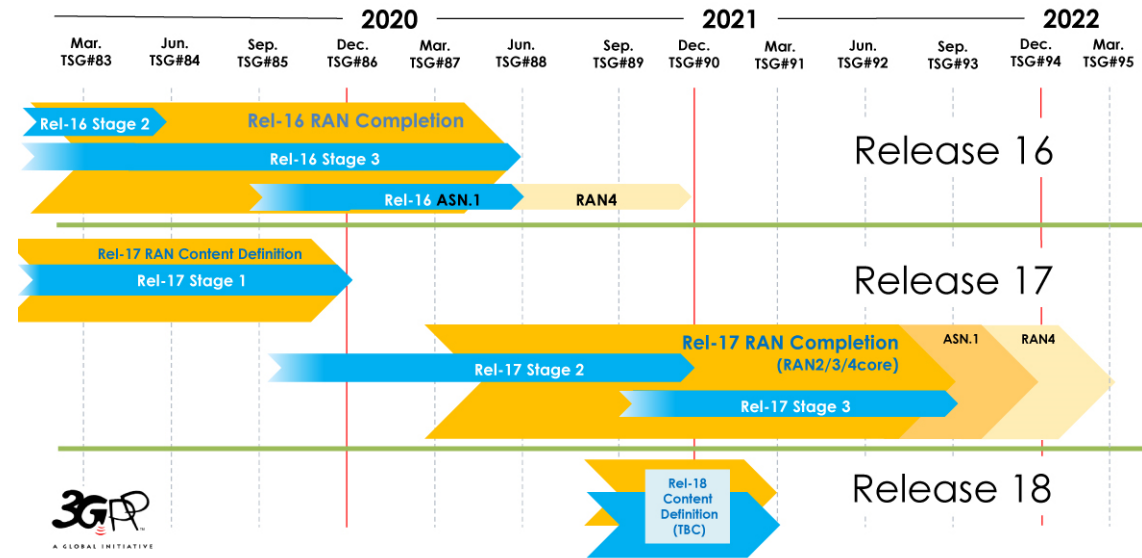


# FRMCS will be based on ETSI/3GPP standards

The FRMCS 1st Edition, planned to be available for implementors second half of 2025, will be a 5G system based on 3GPP R17.

UIC is currently working to ensure that the necessary 3GPP MCX (Mission Critical) services that are needed to meet the operational expectation are included in the R17.

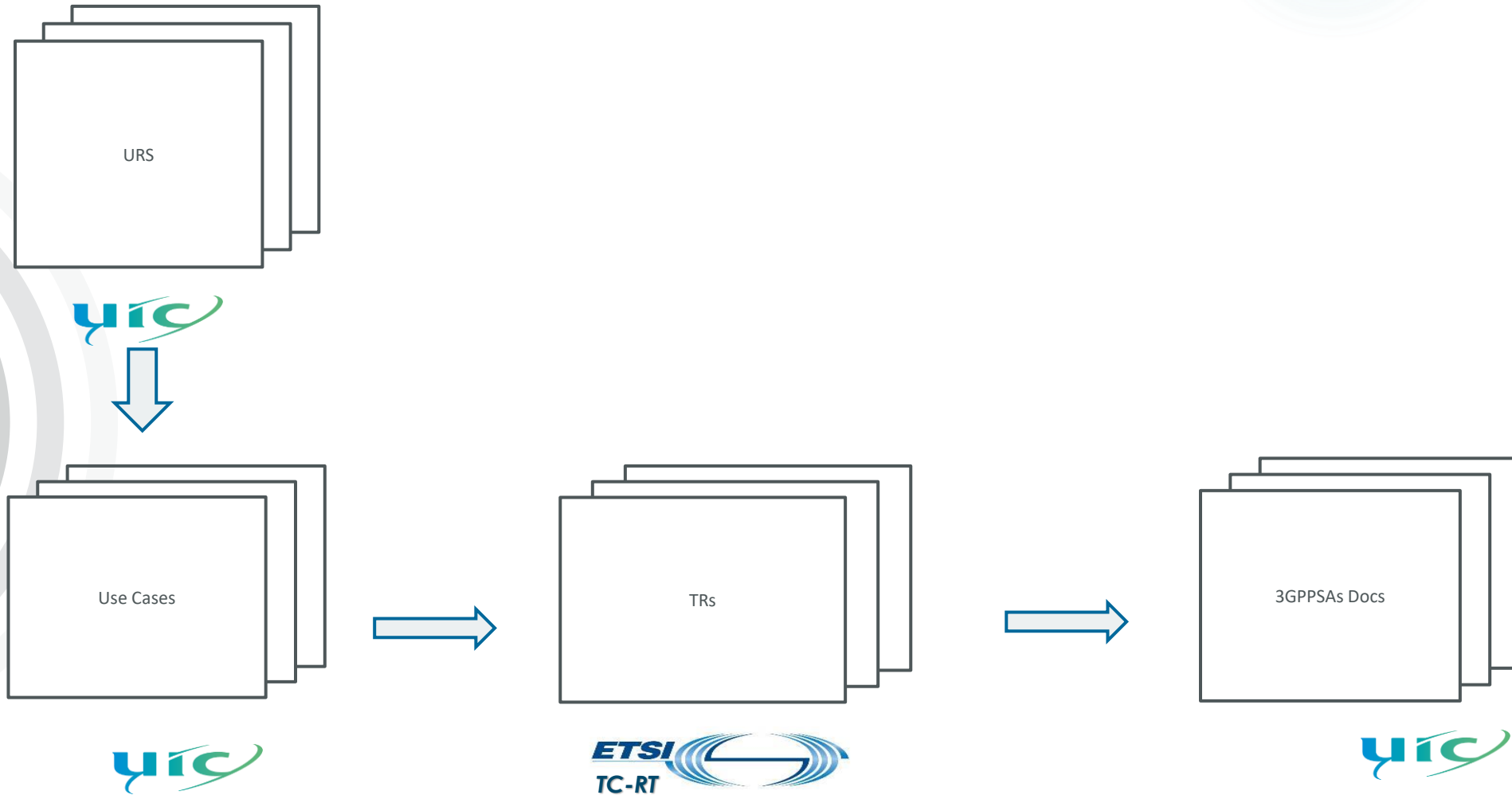
The FRMCS system will continue to evolve with more services in R18 and beyond. However, we aim for the current expected improvements to be software solutions not requiring hardware changes.



Source: 3GPP TSG SA#87e, 17-20 March 2020, e-meeting document SP-200222

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# From Railway Use Cases to Telecom standards



*Standardization work ongoing in ETSI and 3GPP*

# Introducing FRMCS planning

2Q'2019	4Q'2021	3Q'2023	2Q'2025
<b>FRMCS V1 Specification</b>	<b>FRMCS Demonstrator ⇒ V2 Spec</b>	<b>FRMCS European Trial ⇒ Readiness</b>	
<b>STARTING POINT</b>	<b>STARTING POINT</b>	<b>STARTING POINT</b>	
<ul style="list-style-type: none"> <li>• URS 4.0</li> <li>• Use Cases V1 to 3GPP R16 (60%)</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Stabilized</u> FRMCS Specification</li> <li>• R16 Products : MCX 4G/5G (→ <b>Industry</b>)</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Operational</u> FRMCS Specification</li> <li>• R17 Products : FRMCS 5G (→ <b>Industry</b>)</li> </ul>	
<b>PLAN</b>	<b>PLAN</b>	<b>PLAN</b>	
<ul style="list-style-type: none"> <li>• FRS, SRS 1.0</li> <li>• On-Board FRS, SRS 1.0</li> <li>• Principle Architecture, FIS, FFFIS 1.0</li> <li>• ETCS over FRMCS Principles</li> <li>• Interim specifications for TSI inclusion (→ <b>ERA</b>)</li> <li>• Validation of Uses Cases V1 in 3GPP R16</li> <li>• Use Cases V2 to 3GPP R17 (95%)</li> <li>• Use Cases Gaps vs. 3GPP =&gt; ETSI TS</li> <li>• CEPT Reports with Railway Frequencies &amp; Coexistence Criteria, ECC Decision</li> <li>• Migration Scenarios</li> </ul>	<ul style="list-style-type: none"> <li>• FRMCS demonstrator based on FRMCS V1 (→ <b>H2020 - 5GRail, S2R</b>)</li> <li>• FRS, SRS 2.0</li> <li>• On Board FRS 2.0</li> <li>• Validation of Use Cases V1 in 3GPP R17</li> <li>• Use Cases V3 in 3GPP R18</li> <li>• TSI inclusion 1 (→ <b>ERA</b>)</li> <li>• Additional elements for TSI</li> <li>• Frequency Plans for Migrations</li> <li>• Deployment &amp; ENIR Migration assessments</li> <li>• Signalling Continuity assessments</li> </ul>	<ul style="list-style-type: none"> <li>• FRMCS European Trials based on FRMCS V2 (→ <b>CEF 2, S2R</b>)</li> <li>• FRS &amp; SRS 3.0</li> <li>• On-board FRS 3.0</li> <li>• FIS &amp; FFFIS 3.0</li> <li>• Validation of Use Cases V3 in 3GPP R18</li> <li>• Use Cases V4 in 3GPP R19</li> <li>• TSI inclusion 2 (→ <b>ERA</b>)</li> <li>• Cross-borders procedures</li> <li>• Interconnection hubs development (ENIR) (→ <b>Industry, → S2R</b>)</li> <li>• Guidelines for Operational Migrations</li> </ul>	

UIC's goal is to make available together with partner Industry and Authorities a FRMCS 1<sup>st</sup> Edition to Railways , to start the national trials.

This will be based on 5G, 3GPP R17 MCX products.

To reach that the embedded plan is followed.

A crucial step of this plan is building and testing the FRMCS Demonstrator, especially On-Board.

This will be performed through the EU co-funded H2020 ICT-053 5GRAIL project.

- Final **CEPT Report 76** and **ECC Decision (20)02** on RMR **have been approved** by the 54<sup>th</sup> ECC plenary meeting in November 2020.

**CEPT Report 76** = “Assess the best option for long term development of FRMCS and develop EU-harmonized technical conditions” and the

**ECC Decision (20)02 on RMR** = “Harmonized use of the paired frequency bands 874.4-880.0 MHz and 919.4-925.0 MHz and of the unpaired frequency band 1900-1910 MHz for Railway Mobile Radio (RMR)”

- ECC Decision (20)02 addresses the harmonized designation of the paired frequency bands 874.4-880.0 MHz and 919.4- 925.0 MHz and of the unpaired frequency band 1900-1910 MHz to be used for Railway Mobile Radio (RMR) on a CEPT wide basis. ECC Decision will take over the existing GSM-R ECC Decision (hence the RMR acronym)
- Next step: EU Decision to be prepared by the European Radio Spectrum Committee (RSC) expected in 2021

### Dedicated frequencies: allocated RMR (FRMCS) Spectrum in Europe (post-migration)



Stay in touch with UIC!

[www.uic.org](http://www.uic.org)



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[UIC FRMCS Project](#) on YouTube

Thank you for your kind attention