Rail – SATCOM requirements
Context and SATCOM Key requirements

- The predicted obsolescence of GSM-R by 2030, combined with the long term life expectancy of ETCS (2050) and the Railway business needs, have led to the European Railway community initiating work to identify a successor for GSM-R. With the aim of assessing the feasibility of the satellite communications (SATCOM) in the Future Railway Mobile Communication System (FRMCS), the following key requirements are envisaged:

  - **Link Type**: the type of communication for voice or data
    - Bi-directional voice: like a user-to-user communication
    - Uni-directional voice: like a “broadcast” communication
    - Bi-directional data: like an application sending and receiving data
    - Uni-directional data: like an application sending or receiving data

  - **Availability**: a qualitative indication of the availability required of the communications system when the application is in use exceeding a certain quality of service.
    - High
    - Normal

  - **Latency**: The delay between action and reaction
    - Normal: there is no explicit requirement from the user, there is no need for immediate and the delay does not harm the use of the application by the user.
    - Low: immediate.

  - **Bandwidth**: a qualitative indication of the anticipated rate of data transfer when using the application.
    - High
    - Medium
    - Low

  - **Coverage**: an indication of geographical area which can be reached by the service.
    - Europe

  - **Symmetry Up/Down**: The ratio between the uplink traffic and the downlink traffic. For example:
    - 50/50 for bi-directional voice
    - 100/0 for uni-directional voice
    - 80/20 for internet use

  - **Distribution**: User-to-User: between two users, where a user can be a human or a system.
    - Multi-User: between a group of users, where a user can be a human or a system
    - N/A: an application which does not use the air interface

  - **Setup**: a qualitative indication of the time to establish a voice or data communication session with the application that would be acceptable to a user, and is sufficient to perform the railway operation.
    - Normal: there is no explicit requirement from the user, there is no need for immediate and the delay does not harm the use of the application by the user.
    - Immediate

  - **Speed**: the speed that a user is travelling in, maximum value:
    - Low ≤40 Km/h, including stationary users
    - Normal >40 Km/h
    - High ≥250 Km/h, ≤500 Km/h
### Main applications

<table>
<thead>
<tr>
<th>Critical Communication Applications (CA)</th>
<th>Performance Communication Applications (PA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-train voice communication from driver to controller(s) and vice-versa</td>
<td>On-train voice communication from train staff towards ground user(s) and vice-versa</td>
</tr>
<tr>
<td>Multi-train voice communication for drivers including ground users</td>
<td>Multi-train voice communication for drivers excluding ground users</td>
</tr>
<tr>
<td>Trackside maintenance voice communication</td>
<td>On-train voice communication</td>
</tr>
<tr>
<td>Shunting voice/data communication</td>
<td>Communication at stations and depots</td>
</tr>
<tr>
<td>Public emergency call</td>
<td>Wireless on-train data communication for train staff</td>
</tr>
<tr>
<td>Railway emergency communication</td>
<td>M&amp;C of non-critical infrastructure</td>
</tr>
<tr>
<td>Automatic train control/operations communication</td>
<td>Real time video</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Business Communication Applications (BA)</th>
<th>Critical Support Applications (CSA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inviting-a-user messaging</td>
<td>Secured voice/data communication</td>
</tr>
<tr>
<td>Emergency help point for public</td>
<td>Location services</td>
</tr>
<tr>
<td>Wireless internet on-train for passengers</td>
<td>Authorisation of voice/data communication</td>
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<tr>
<td>Wireless internet for passengers on platforms</td>
<td>Authorisation of applications</td>
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<tr>
<td></td>
<td>Prioritisation</td>
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<tr>
<td></td>
<td>Multi-user talker control</td>
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<thead>
<tr>
<th>Performance Support Applications (PSA)</th>
<th>Business Support Applications (BSA)</th>
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<tbody>
<tr>
<td>Information help point for public</td>
<td>(No BSA defined at URS v2.0)</td>
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Ref: Future Railway Mobile Communication System User Requirements Specification, 2019, FRMCS working group
EU Rail X2R3 - Requirements

Critical Voice – Mainline, regional, Freight

- **Latency**
  - < 150 ms and <= 100 ms
  - <=100 ms
- **Jitter**
  - 20-30 ms
  - Depends on implementation of jitter buffer (therefore of acceptable latency) and used speech codec.
- **Packet Loss**
  - Packet loss < 0.5%. Ideally < 0.1%

Key management

TCP download is expected to be up to 5000 bytes.

Tele-maintenance

The uplink data payload is higher and expected to be in the range of 100kbps to 500kbps.

Smart object controller

A bit-rate of between 10 kbps-100 kbps is expected.

**Safely critical applications**

- Data bandwidth > 5kb/s
- Data throughput > 1 kb/s
- Latency < 100 / 400 ms, depending on application

**Non-demanding, especially non-safety applications**

- Data bandwidth > 1kb/s
- Data throughput > 40 b/s
- Latency < 20s, depending on application

Passenger information

The data payload is expected be up to 100 kbps, mostly on the downlink.