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EU SPACE WEEK 2023

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Rail – SATCOM requirements



Context and SATCOM Key requirements

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- 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

<p><i>Critical Communication Applications (CA)</i></p> <ul style="list-style-type: none"> ▪ On-train voice communication from driver to controller(s) and vice-versa ▪ Multi-train voice communication for drivers including ground users ▪ Trackside maintenance voice communication ▪ Shunting voice/data communication ▪ Public emergency call ▪ Railway emergency communication ▪ Automatic train control/operations communication 	<p><i>Performance Communication Applications (PA)</i></p> <ul style="list-style-type: none"> ▪ On-train voice communication from train staff towards ground user(s) and vice-versa ▪ Multi-train voice communication for drivers excluding ground users ▪ On-train voice communication ▪ Communication at stations and depots ▪ Wireless on-train data communication for train staff ▪ M&C of non-critical infrastructure ▪ Real time video
<p><i>Business Communication Applications (BA)</i></p> <ul style="list-style-type: none"> ▪ Inviting-a-user messaging ▪ Emergency help point for public ▪ Wireless internet on-train for passengers ▪ Wireless internet for passengers on platforms 	<p><i>Critical Support Applications (CSA)</i></p> <ul style="list-style-type: none"> ▪ Secured voice/data communication ▪ Location services ▪ Authorisation of voice/data communication ▪ Authorisation of applications ▪ Prioritisation ▪ Multi-user talker control
<p><i>Performance Support Applications (PSA)</i></p> <ul style="list-style-type: none"> ▪ Information help point for public 	<p><i>Business Support Applications (BSA)</i></p> <ul style="list-style-type: none"> ▪ (No BSA defined at URS v2.0)

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 to be up to 100 kbps, mostly on the downlink.



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