

# ERTMS and CCS TSI (EU) 2023/1695

## ERTMS Unit

13 December 2024 / Bonn  
TSI Open Days Germany 2024

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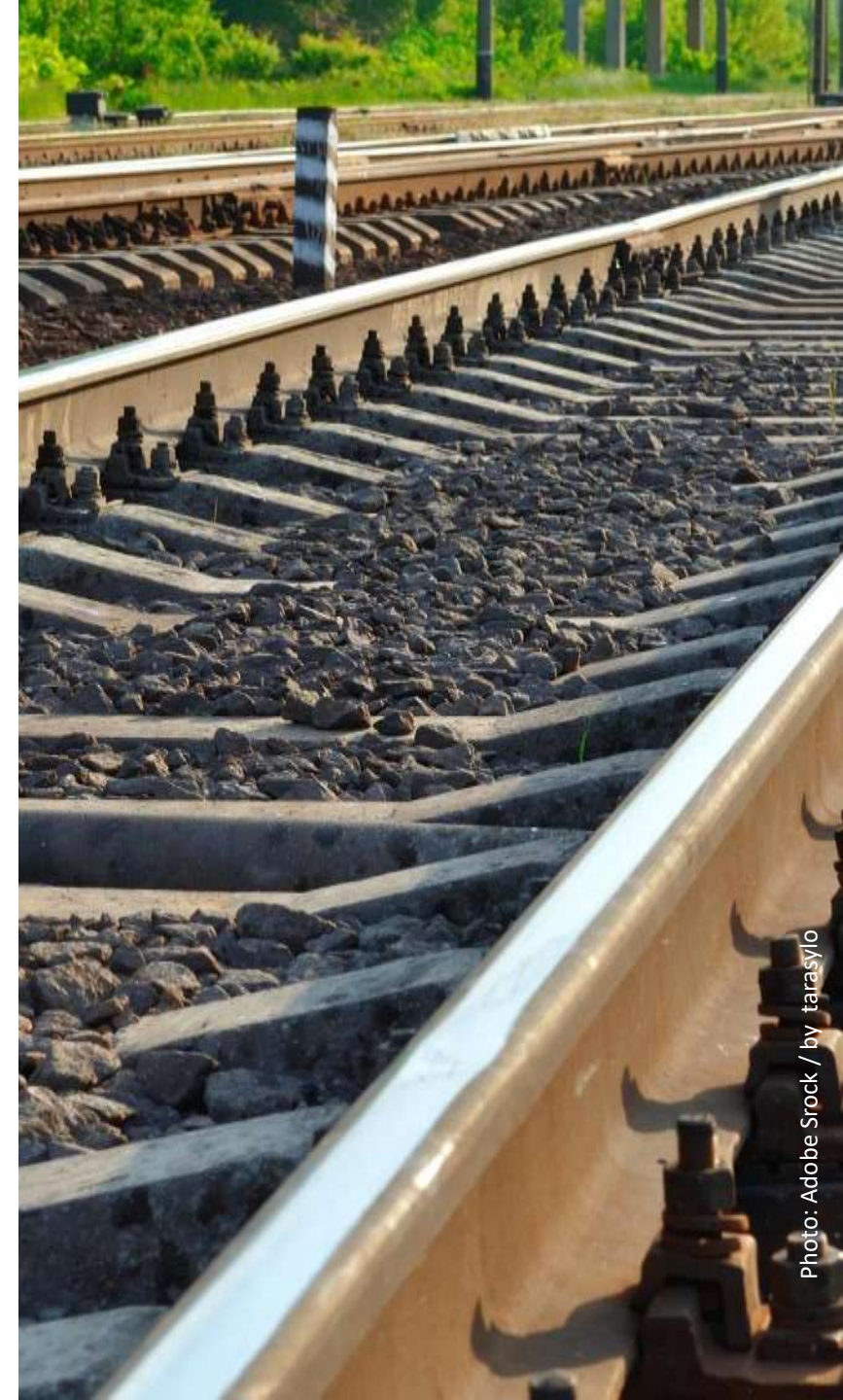


EUROPEAN  
UNION  
AGENCY  
FOR RAILWAYS



# AGENDA

1. *Signaling – principles of train protection*
2. *Migration to ERTMS in Europe – SERA*
3. *Basics on ERTMS*
4. *Legal approach to removal of technical barriers*
5. *CCS TSI Revision 2023*
6. *ERTMS Unit at ERA*





# 1. SIGNALLING – PRINCIPLES OF TRAIN PROTECTION



## Why an ATP ?

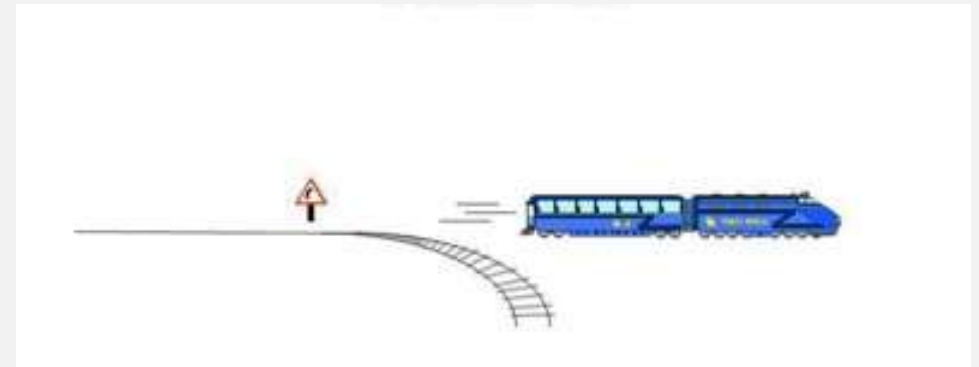
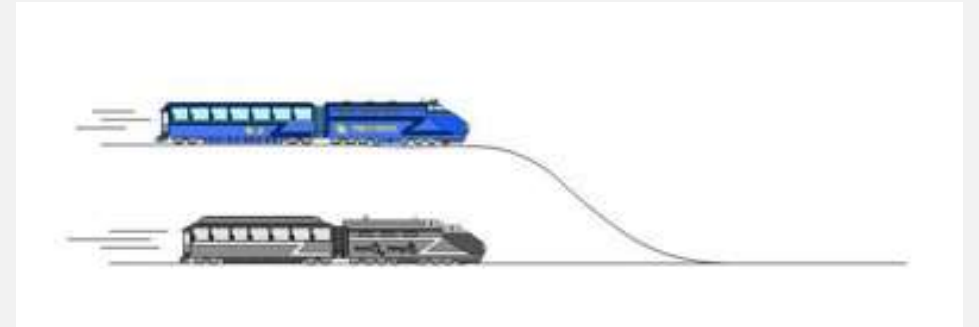
History has shown that, despite the presence of traffic lights and speed limit signs, train collisions and derailments still occur.

This is why RUs and IMs were forced by governments to find a more suitable solution and started to develop Automatic Train Protection (ATP) systems to reduce or eliminate driver errors leading to fatal accidents.

### **ATP (Automatic Train Protection) system:**

Automatic train protection system is a system that continuously checks that the speed of a train is below the permitted speed given by signalling and include also an automatic stopping at certain aspects of the signal, otherwise, ATP activates an emergency brake to stop the train.

For this purpose, a transmission of information from the track to the train is needed.





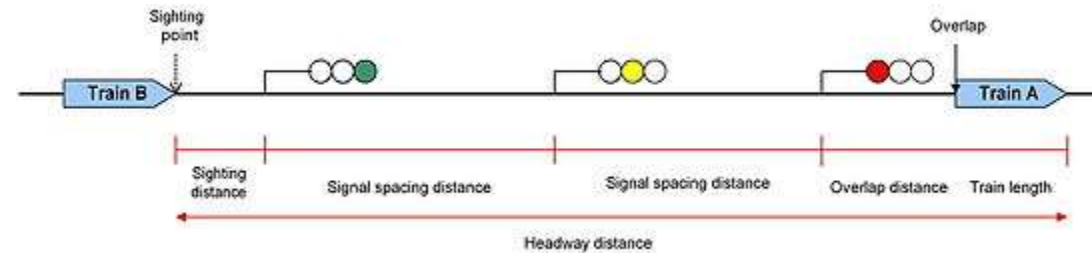
## Different types of signalling systems

- Block signalling



Token block

- Fixed block



- ATP with punctual information (ETCS L1)
- ATP with punctual supervision (ETCS L1 LS)
- ATP with continuous supervision (ETCS L1/L2)
- ATP with continuous information (ETCS L2)



- Moving block (ETCS L2+TIMS)

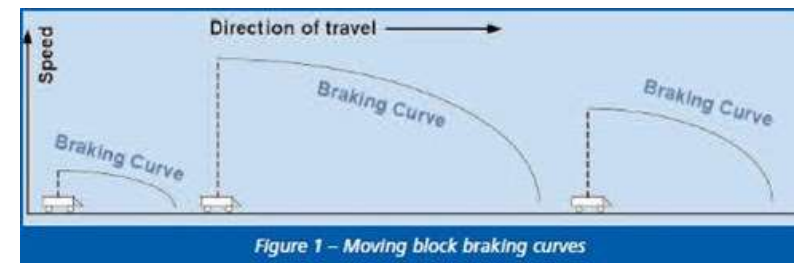
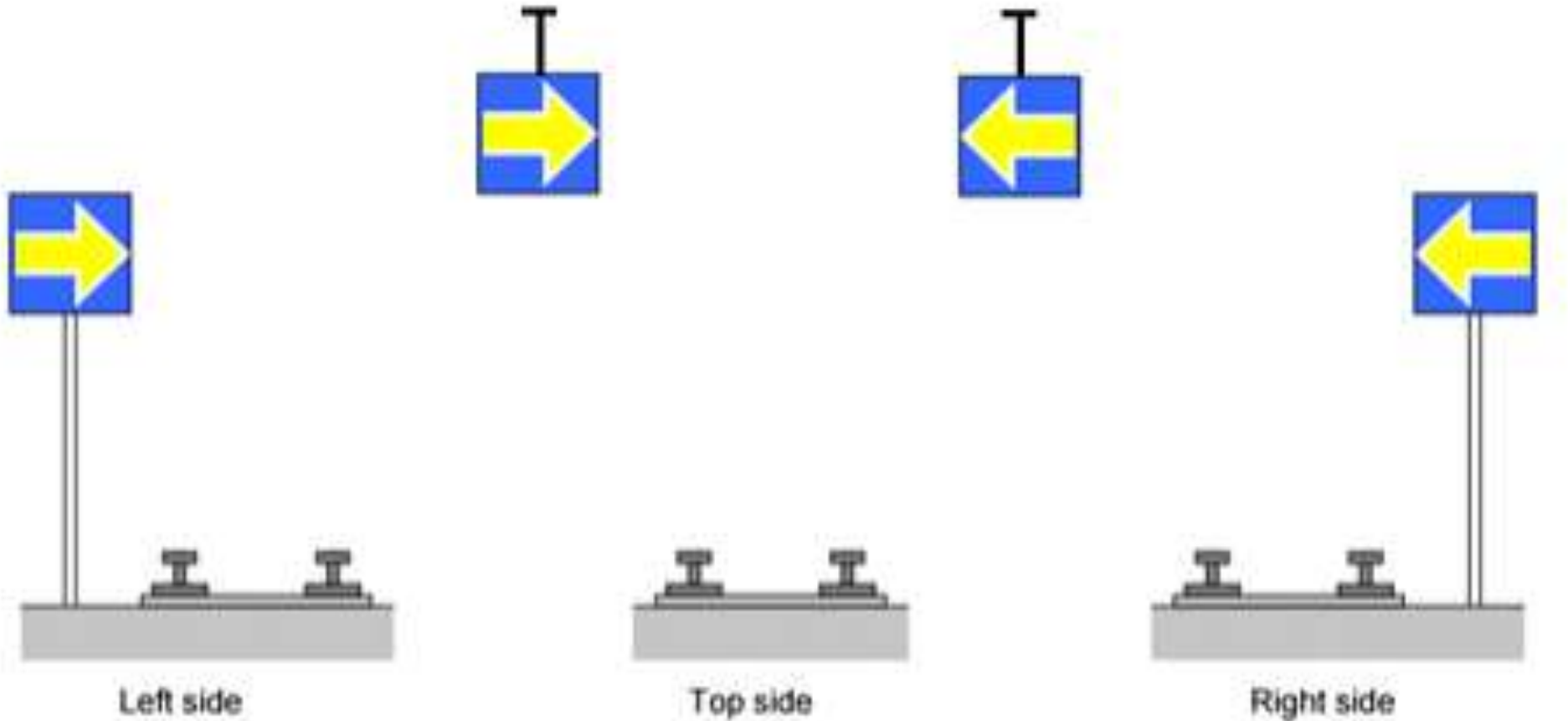


Figure 1 – Moving block braking curves

## 2.- MIGRATION TO ERTMS IN EUROPE - SERA



- simple -> complex
- warning -> stop
- Stop -> full train protection

In order to facilitate the establishment of a **“Single European Railway Area”** (SERA), there is a need for a harmonized Signalling system  
-> This is ERTMS !

## The Single European Rail Area (SERA)

Conventional approach for Driver Machine Interface:  
Simply adding legacy display systems does not work!



Standard TRAXX driver's desk

New development:  
Central ETCS display  
→ single interface for driver

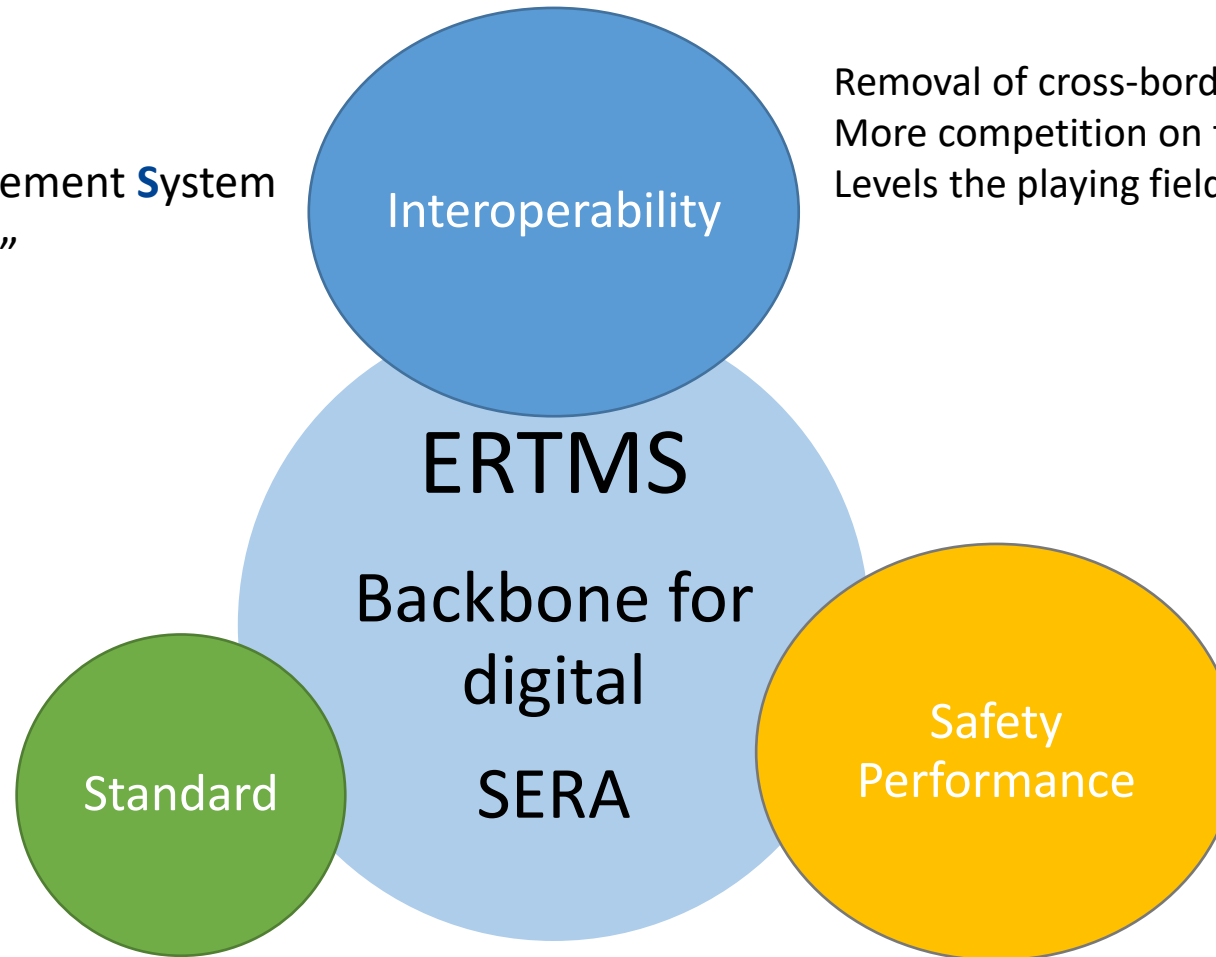




## European Rail Traffic Management System

*"One system to rule them all"*

Universal system  
Standardised products  
One system, multiple suppliers  
Opening worldwide market  
opportunities for suppliers



Removal of cross-border barrier  
More competition on the railway market  
Levels the playing field with road transport

Increase capacity and speed  
Improved safety  
Increased reliability and reduced journey times  
Cost decrease (capital, maintenance and training)

### 3. BASICS ON ERTMS





# ERTMS and CCS TSI

European **R**ailway **T**raffic **M**anagement **S**ystem

**ETCS** ( European Train Control System) = ATP  
(Automatic Train protection system)

+

**RMR** (Railway Mobile Radio) **GSM-R** (2G)/**FRMCS** (5G)  
= Radio communication for Voice and Data applications

+

**ATO** (Automatic Train Operation)



What is ERTMS ?

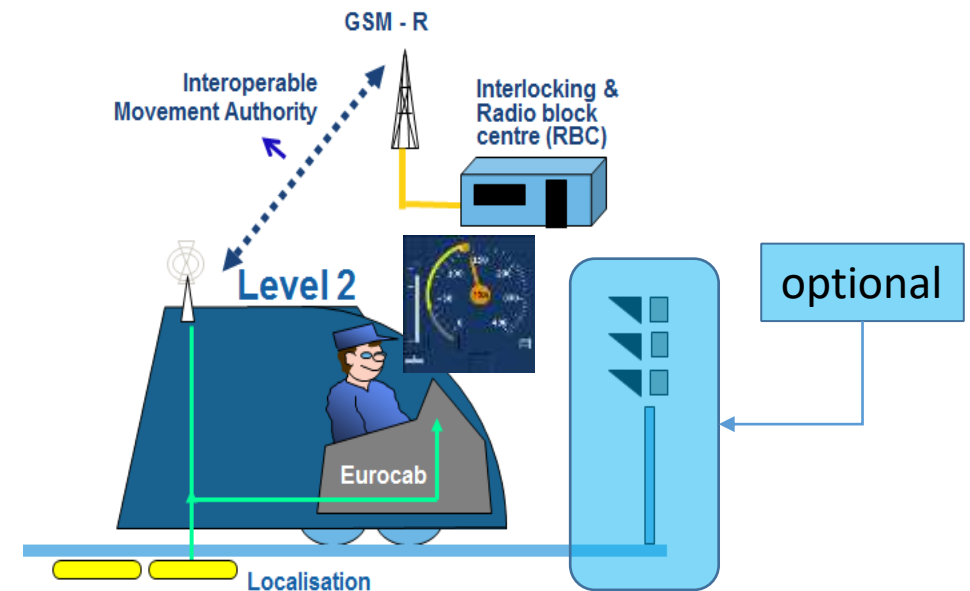
## • ETCS Level 1

- Transmission of data Track → Train via Balises
- ETCS-messages are generated “locally” @ the signals
- Line side signals are still present
- Information for the driver is visible on DMI (Driver-Machine Interface)



## • ETCS Level 2/3 (\*)

- Continuous exchange of data track → train and train → track via GSM-R
- ETCS-messages are generated centrally (in the RBC) and then send to the train
- Line side signals are optional
- All information available on DMI



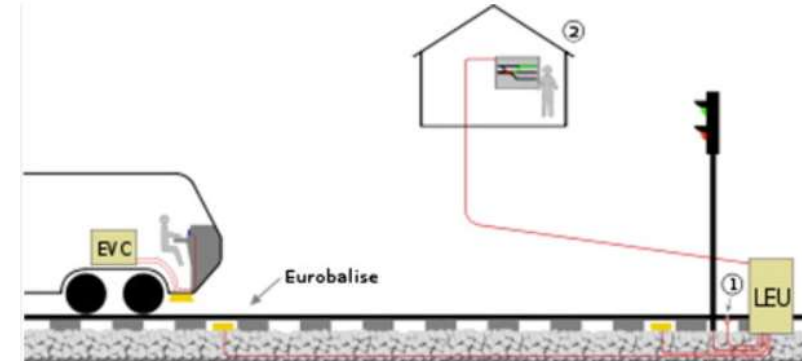
(\*) In Baseline 4 the Level 3 has been merged with the Level 2



## ERTMS trackside components L1 – Eurobalise and LEU

### Euro-balises

- Sends information from infrastructure to train
- 2 types of Balises
  - Fixed balises (fix information)
  - Switchable balises (information send depends on the signals)
- Information transfer is coded to protect data from undesired errors
- No external power supply – the balise is activated via euro antenna on the train



### LEU

- Gets information from the signal (STOP, Green, yellow, speed restriction, ...)
- Sends preconfigured information (called telegrams) to the switchable balises based on the signal aspect (STOP, Green,...).
- The telegram contains information on distances, speed, gradient, ...



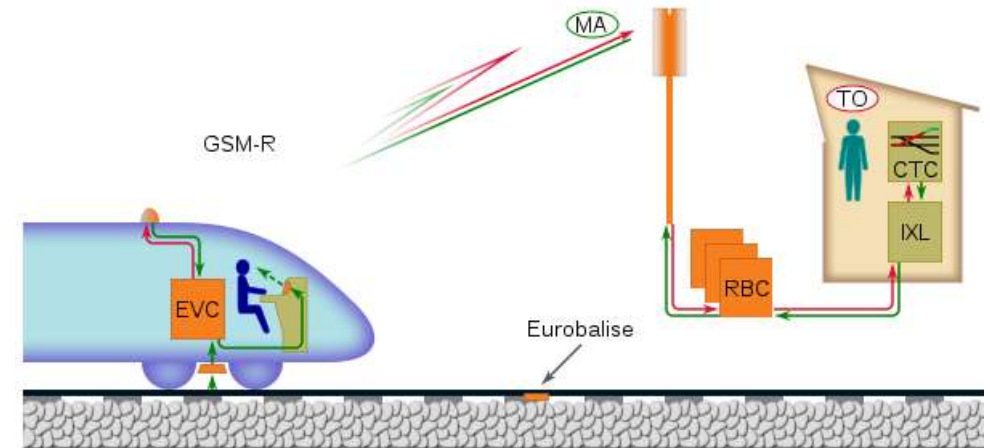
## ERTMS Trackside components L2 - RBC - GSM-R

### RBC

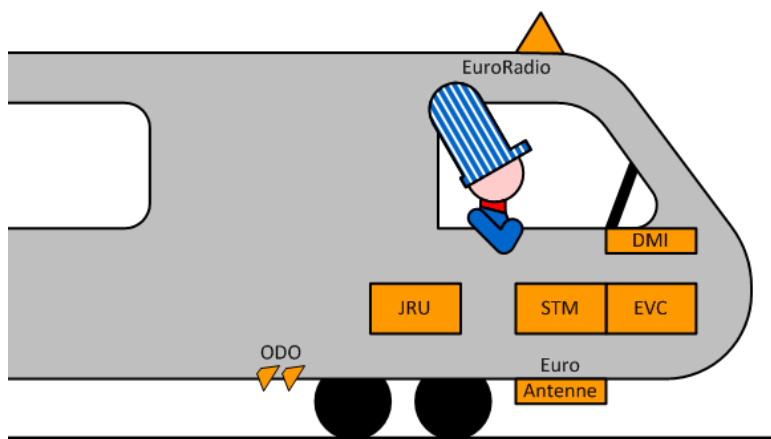
- Gets the information on the aspects of the signals from the Central Interlocking
- Exchanges dynamically information (telegrams containing information on distance, speed, ...) via GSM-R network to the train
- Fixed Balises are used as reference points

### GSM-R

- Complete network along the lines of antennas and base stations







### Euro Antenna

- Activates the balises
- Reads the telegrams from balises
- Transmits data to EVC



### ODO: odometry

- Measures distance for EVC
- Measures speed
- Use of different sensors
- (e.g. radar; GNSS; IMU)



RADAR



GNSS Receiver



IMU



Accelerometer

### JRU: Juridical Recorder

- Black box of ETCS
- Gathers all data from
  - Telegrams (received/send)
  - Interactions with train driver
  - Some EVC commands



## ETCS On-board Components

### DMI: Driver Machine Interface

- Indications on speed
- Sounds and colors changing when action is needed (slow down)
- Indication of intervention for STOP
- Planning area: gives information on distance, speed and gradient for the next kms (till end of Mouvement Authority)



### EVC: European Vital Computer

Calculation of braking curves based on

- Information from Track (distance, speed, gradient, ..)
- Train characteristics (max. speed; length, braking capacities, weight, ...)
- Odometry
- Verification of max. allowed speed
- Sending info to DMI for train driver



# Standardisation of railway radio communication in EU

- **Until mid 80's:** no standard
- **Mid 80's:** introduction of UIC 751-3 in some European countries
- **End 90's:** introduction of **GSM-R** as target system for Europe
  - *for operational voice communication and ETCS data communication*
  - GSM-R implementation started in 2000; further expansion and midlife upgrades are still ongoing (trackside, on-board)
  - 2006: EU Decision to make GSM-R mandatory all over EU
  - Expected end-of-life: not before 2030
- **FRMCS (Expected 2027-2029):** Future Railway Mobile Communication System
  - Based on 5G and Mission Critical standards
  - Opportunity to decouple railway applications from telecom transport layers in the future. (easy update for 6G,7G,8G,...)

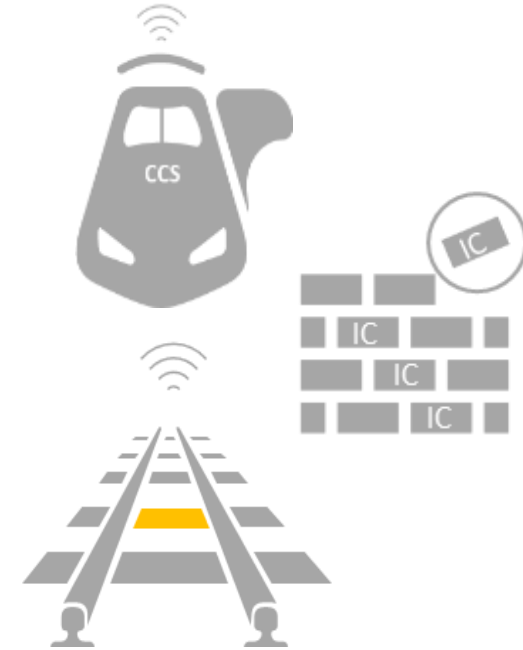


## 4. LEGAL APPROACH TO REMOVAL TECHNICAL BARRIERS





- One **TSI** covering **two Subsystems: CCS On-board** and **CCS Trackside**
- It does not cover all the subsystem, optimal level of harmonisation (overlay)
- Much more prescriptive than the other TSI (detail specs in Appendix A)
- Composed of **five parts** (CCS TSI Table 4.1)
  - Train Protection: The **Class A** system is **ETCS** whilst the
  - **Radio voice**: The **Class A radio system** is **RMR (GSM-R / FRMCS)**
  - **Radio data**: The **Class A radio system** is **RMR (GSM-R / FRMCS)**
  - **ATO**: This part is optional.
  - **Train detection**: Only for the **Trackside** Subsystem.
- **Class B**
  - The legacy systems are referred to as **Class B** (ATP, Radio) or **Non-TSI** (Train detection)
  - **Decommissioning** is required by TEN-T Regulation.



Objective: towards a Single European Railway Area (SERA)

## 5.- CCS TSI 2023 Revision



# Main changes in the CCS TSI (EU) 2023/1695



## CCS TSI Text Recast

- Framework to manage the specification changes
  - Error Corrections (Section 7.2.10)
  - B4R1 set of specs in Appendix A
  - Removal of partial fulfilment (Appendix G)
- Stronger deployment requirements
- Transition regimes (Appendix B) and notification from IM (in RINF)



## Appendix A – Technical changes

- ATO up to GoA2 (As a new optional part)
- First complete Level 2 + train integrity specifications (Former Level 3 - Merged)
- ETCS readiness for FRMCS and DAC (the interface and needed functionality as far as possible)
- System versions 2.2 and 3.0



## Train Detection Compatibility

- Target system defined. Specific Cases for non-TSI compliant systems to allow unique authorization



## Others

- Cleaning NTR & revised interface with RST (SS-034)
- OPE aligned up to SV 2.2.
- Updated parameters in ERATV and RINF
- Only **one** remaining open point: Reliability



- Published in the official journal on the **08/09/2023** ([EUR-Lex link](#))
- Entry into force 20 days after (28/09/2023)
- Appendix A documents ([link](#)).



# New Features in Appendix A

## ATO

Introduction GoA 2



Modularity



Reduced envelope

**SS-153**

(B4R1 set of specifications)\*



## FRMCS v1

ETCS/ATO readiness for  
FRMCS

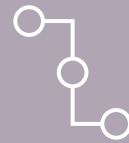


Train Detection  
Compatibility

updated to V5.0  
(closing all related  
open points)

## Level 2

with/without train  
integrity  
(merge level 2 and 3)

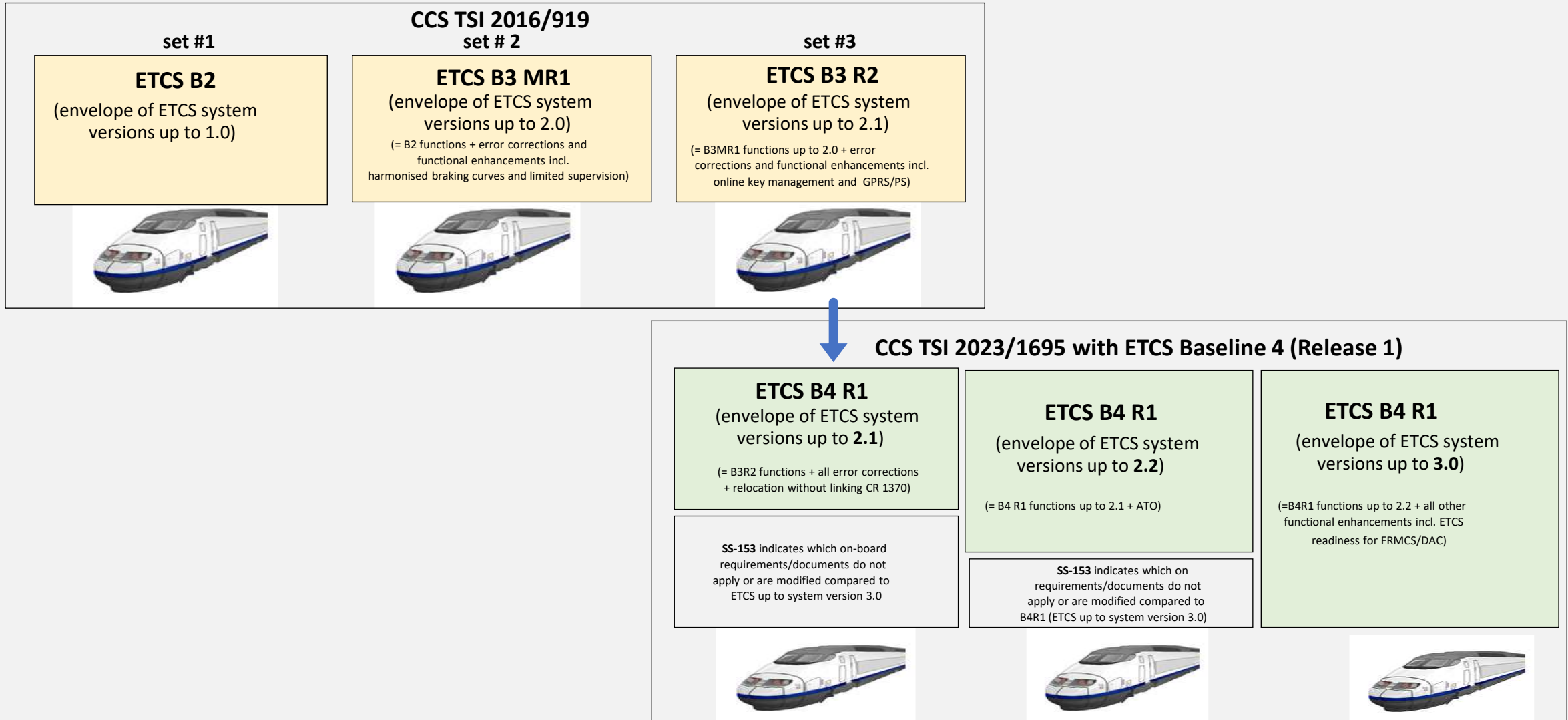


ETCS DAC readiness

\*SS-153 still Reserved

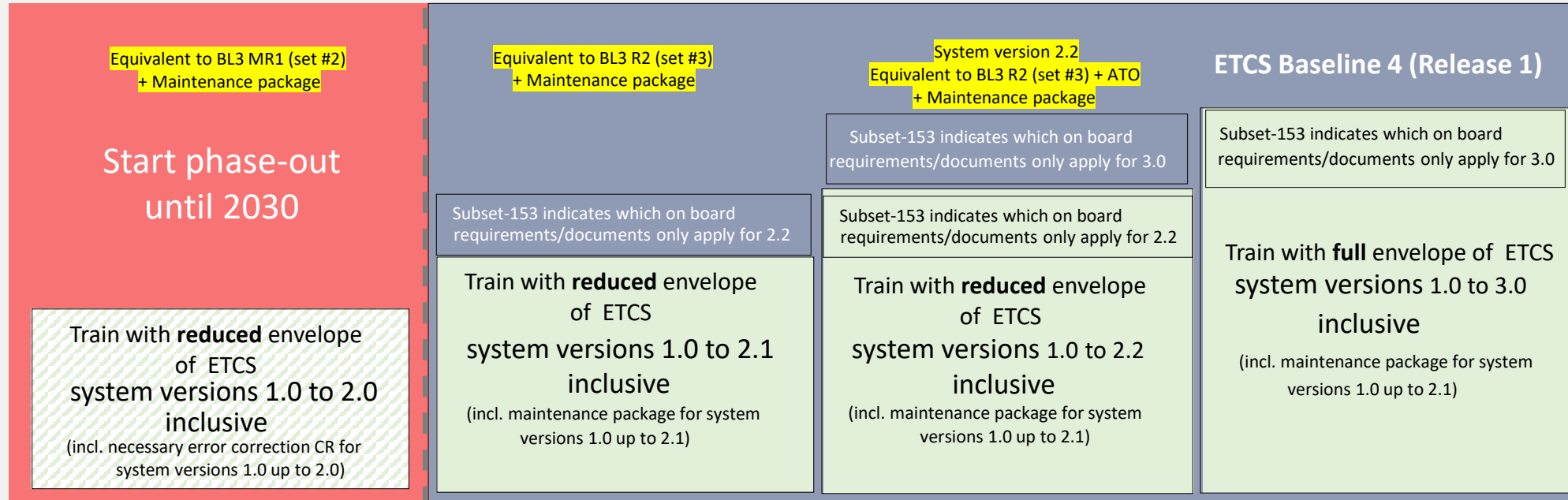


# ERTMS Specifications – Evolution of ETCS Baselines/ETCS System versions



# B4R1 set of specifications

## On-board reduced envelope and SS-153



Out of scope SS-153

Consolidated specifications (SS-153) for the reduced **on-board** defining the not applicable clauses for envelopes up to 2.1 and 2.2.



# ERTMS Specifications – Evolution of ETCS Baselines/ETCS System versions

Translation table between System Version and Baseline/SRS/Set of specs

System Version	Baseline	SRS versión	Set of specs
1.0	B2	2.3.0d	#1
2.0	B3MR1	3.4.0	#2
2.1	B3R2	3.6.0	#3
2.1	B4R1	4.0.0 + SS-153	TSI 2023/1695
2.2	B4R1	4.0.0 + SS-153	TSI 2023/1695
3.0	B4R1	4.0.0	TSI 2023/1695

The difference between SV 2.1 B3R2 and SV 2.1 B4R1 are the error corrections.

# CCS TSI 2024 amendment

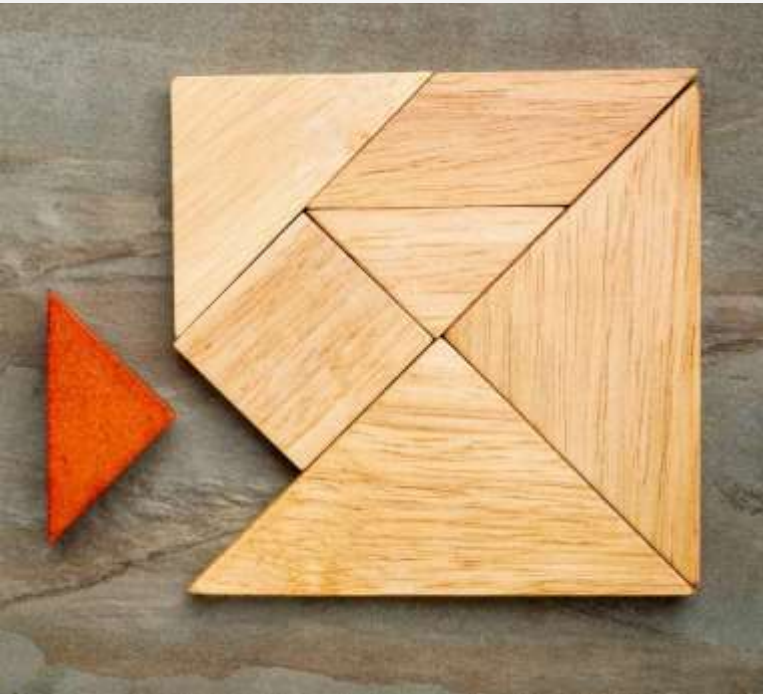
## Is CCS TSI 2023/1695 complete?



99%

- 3 groups of documents postponed
  - **SS-153** Reduced envelopes
  - **SS-076/94** ETCS OB IC test specs
  - **SS-151** ATO TS/OB test specs

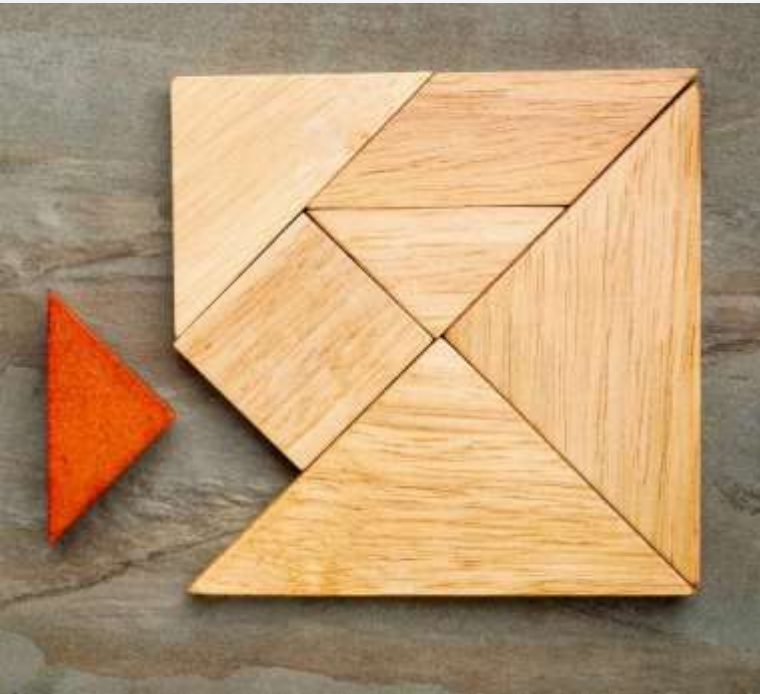
↪ Expected to be delivered **end 2024**



# CCS TSI 2024 amendment

## Return form experience on CCS TSI

- **Corrigendum:** Editorial and translation errors
- **Appendix B** transition tables
- **Error correction** dates and events
- **Editorial** amendments
- Other **adjustments** and **clarifications**





# CCS TSI Evolution



2016/  
919

**B3R2 set #3**  
OPI-2017-2 error corrections  
OPI-2020-2 error corrections

2023/  
1695

**TSI Package recast**  
Framework to manage  
specifications changes  
Appendix B transition regime  
ETCS B4R1 (one set specs)  
ATO B1 (GoA 1-2)  
RMR FRMCS B0

2027  
TSI

**EC request  
ERA REC 2026**  
Expected date for  
FRMCS/DAC  
introduction  
Cybersecurity

2012/  
88

**B2 2.3.0d set #1  
B3 MR1 set #2 (2015)**  
Introduced in several  
amendments

2019/  
776

**4<sup>th</sup> RP Alignment**  
BDC Table  
ESC/RSC  
B2 phase-out start  
**2020/387**: Extension  
area of use  
**2020/420**: German  
language correction

2025  
amend

**Expected amendment  
for completion**  
SS-153  
SS-151  
SS-076/SS-094  
Other clarification CR

2029  
TSI

**EC request  
ERA REC 2028**  
System Pillar  
deliverables

## 6.- ERMTS Unit at ERA



# ERTMS Unit at ERA



- Inside Railway System Department
- HoU + 15 Project Officers

**ERTMS** = ETCS + RMR (GSM-R, FRMCS) + ATO

- Mainly dealing with Control Command and Signalling (**CCS**) subsystems (on-board and trackside) and the interfaces with the rest of the railway system.



# Main task of ERTMS Unit

## ERTMS SYSTEM AUTHORITY

- CCS TSI Working Party
- ERTMS Control Group
- EECT (ECTS & Radio)

Support to **DG MOVE** (RISC)

Cooperation with EURJ (**System Pillar**)

## INTERFACES/STAKEHOLDERS

- Operational Harmonisation (OH) -> OPE
- Train Detection Compatibility (TDC) -> RST
- ERTMS NSA Network
- ERTMS NoBo Network
- Group with ERTMS Lab on Testing
- National rules Assessment

## 4<sup>th</sup> RAILWAY PACKAGE

- Vehicle Authorisation (VA)
- Traskside Approval (TSA)
- General support on the application of the CCS TSI



# Questions & Answers



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