Training on Interoperability and Safety ERTMS
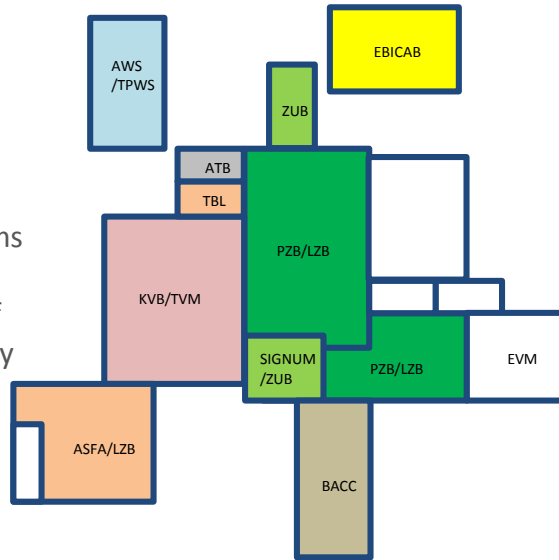
European Railway Traffic Management System
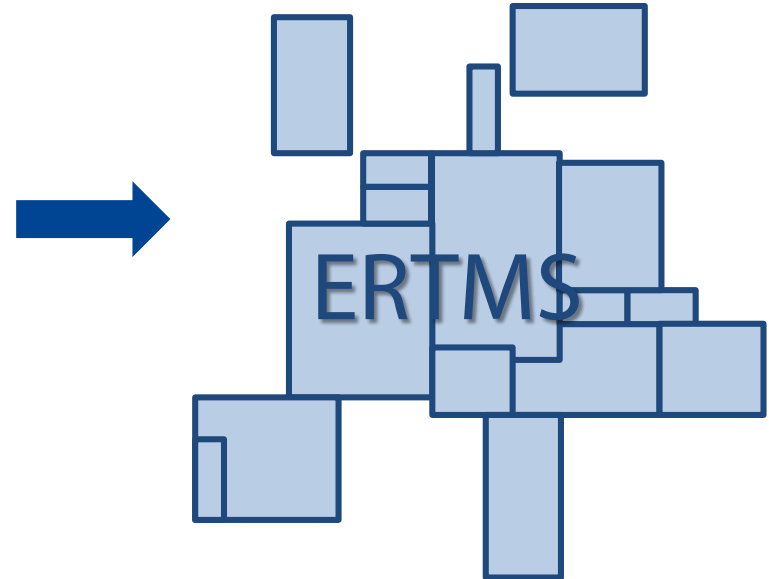
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EUROPEAN UNION AGENCY FOR RAILWAYS

Fragmented national railway systems

- National supplier oligopolies (captive)
  - obsolescence
- Cross-border:
  - change of locomotive
  - multiple systems fitted
- Limitations in terms of functionality and safety

Single European Railway Area

AWS /TPWS

EBICAB

ZUB

ATB

TBL

PZB/LZB

KVB/TVM

SIGNUM /ZUB
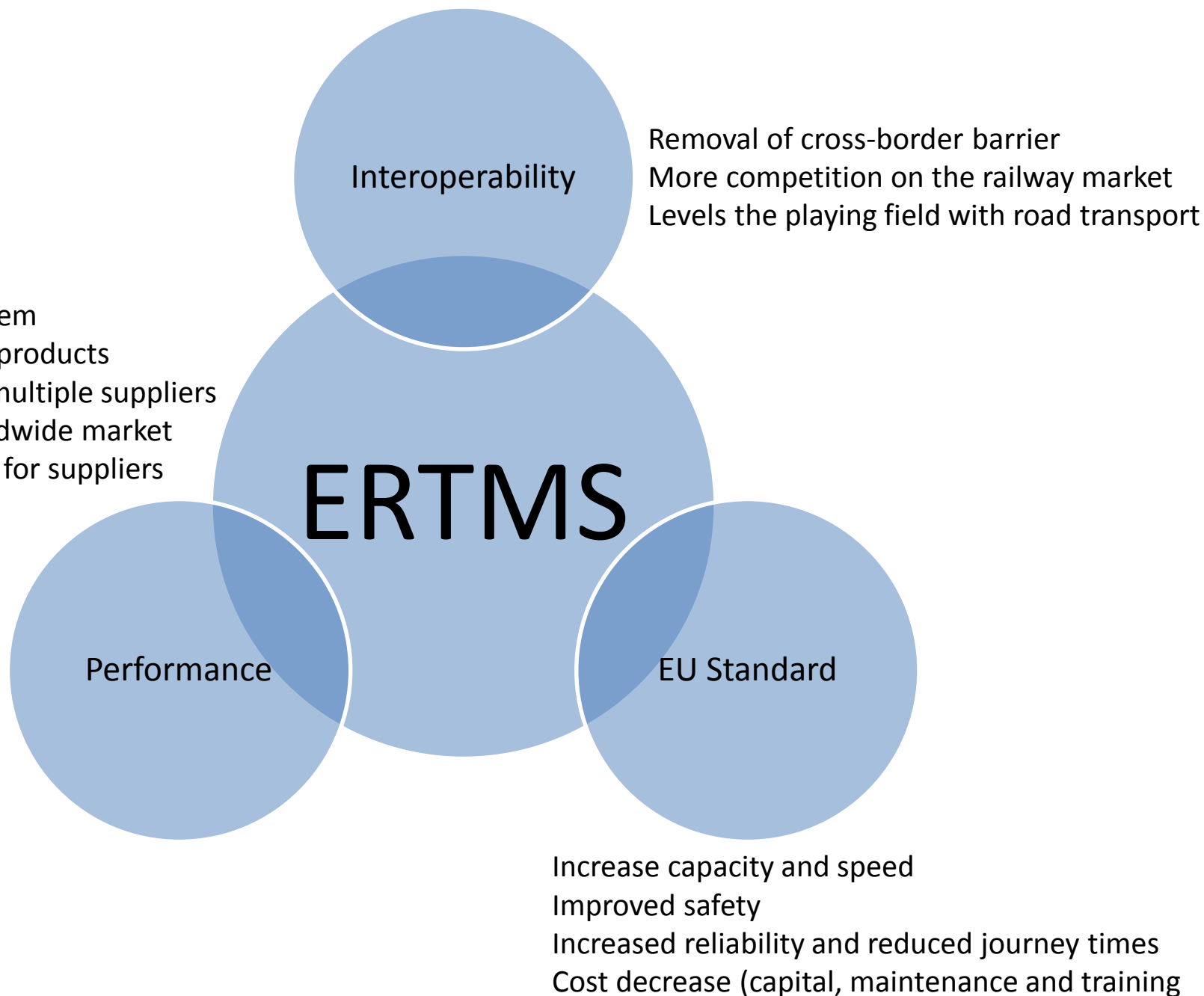
PZB/LZB

EVM

ASFA/LZB

BACC

ERTMS

Clarity on goals is needed

"Seamless train operation without borders (caused by signalling) at best economic conditions"
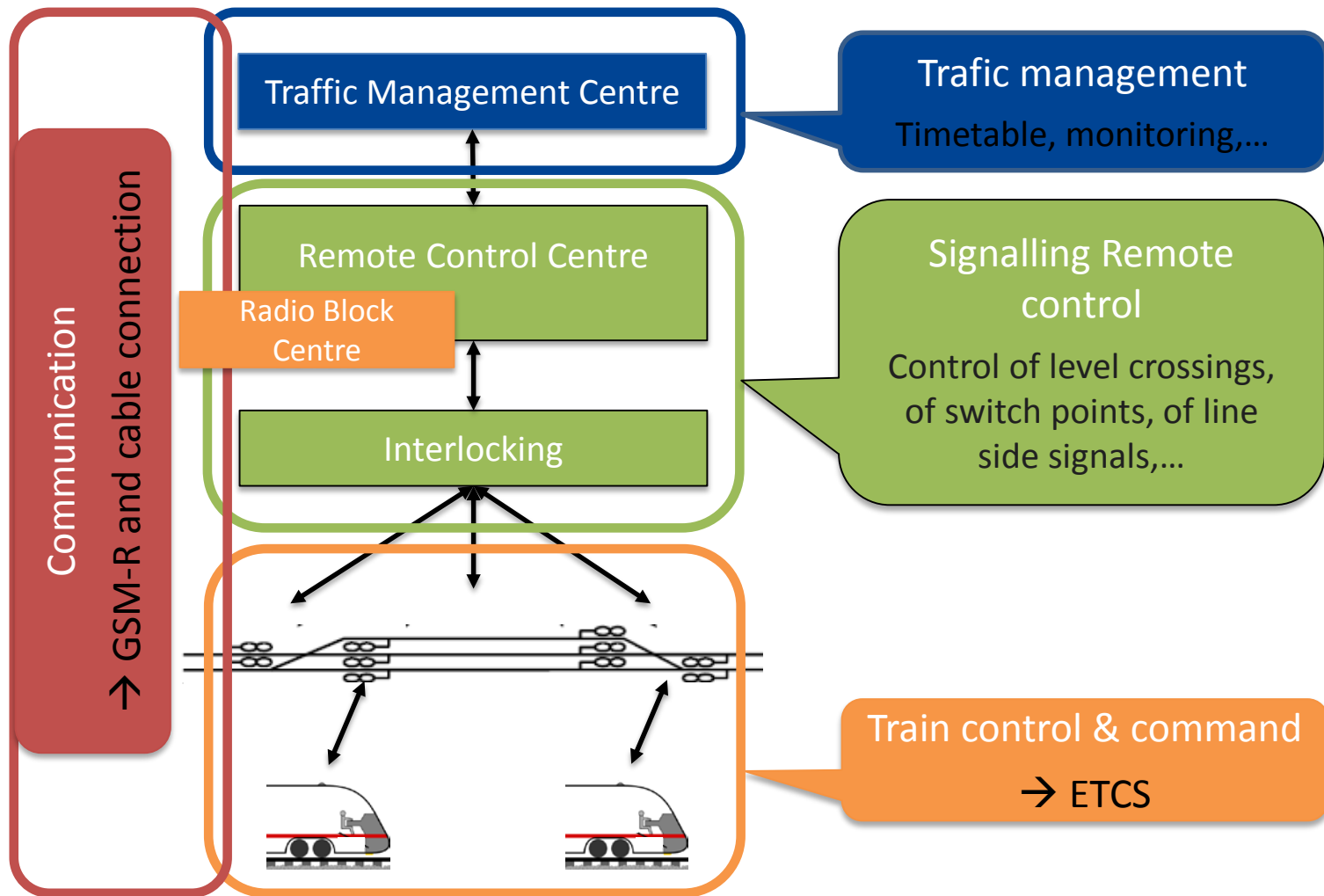
Need to define the **target state** and intermediate states

- **European Railway Traffic Management System**
  - Major industrial project being implemented by Europe
  - Project making rail transport safer and more competitive

- **Fundamental objective of ERTMS**
  - To develop and to deploy a single harmonised Control/Command, Signalling and Communication system, fully interoperable across borders sourced from a broad supply base, enabling compatible evolutions through open standards

- **Benefits**
  - Interoperability, increase of capacity, safety, reliability and punctuality

- **Why**
  - Mobility contributes to growth
  - Rail is an essential transport mode
  - European leadership in transport needs to be maintained

- **Infrastructure Managers**

  – Increase safety, higher speeds, higher capacity on lines, potential maintenance costs reduction, high reliability rates

- **Railway Undertakings**

  – Ability to run everywhere in ERTMS network with only one signaling system onboard, decrease time losses at borders due to formalities, easier and quicker certification and approval process for onboard equipment

- **Member States and Society**

  – Higher level of safety, reduction of investment in signalling systems equipment with standard ERTMS products, improving competitiveness of railway market

- **Railway Sector**

 – Strengthen European supplier industry

Why is the Agency interested in Wireless Communications?

Traffic Management Centre

Trafic management
Timetable, monitoring,…

Communication → GSM-R and cable connection

Remote Control Centre

Radio Block Centre

Interlocking

Signalling Remote control
Control of level crossings, of switch points, of line side signals,…

**Train control & command**
→ ETCS

ERTMS functions: ETCS + GSM-R

- **Automatic train protection system (ATP)**
  - continuously ensures that the train does not exceed the safe speed and distance
  - provides the relevant information to support the task of the train driver

- **A safe and continuous speed control**
  - information sent from track to train
  - driver's response monitored continuously
  - speed limits are transmitted to driver
  - on board computer stops train if speed limit exceeded

- **A cab signalling unified in all Europe**
  - allowing to any train to be operated on any line (= target)
  - in-cab display of "target speed / target distance"
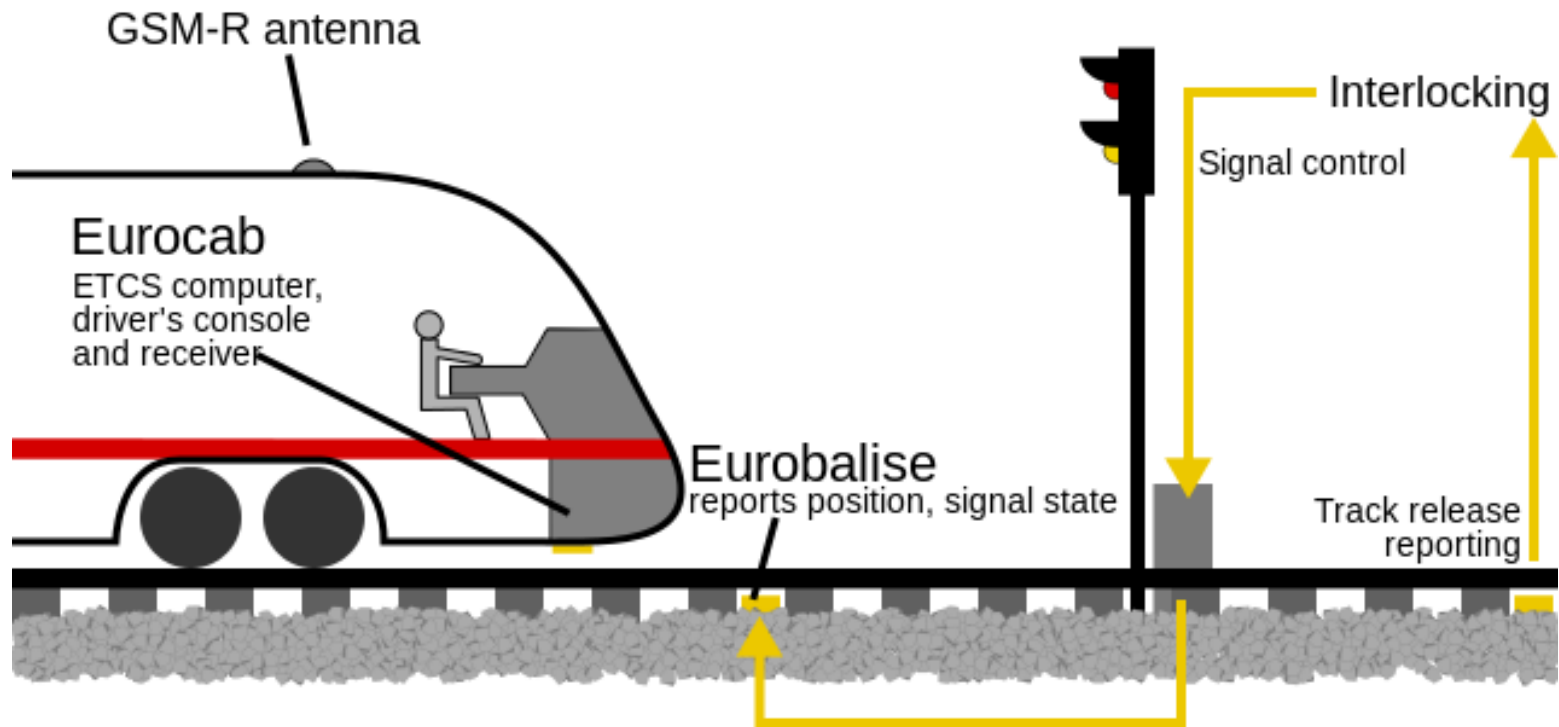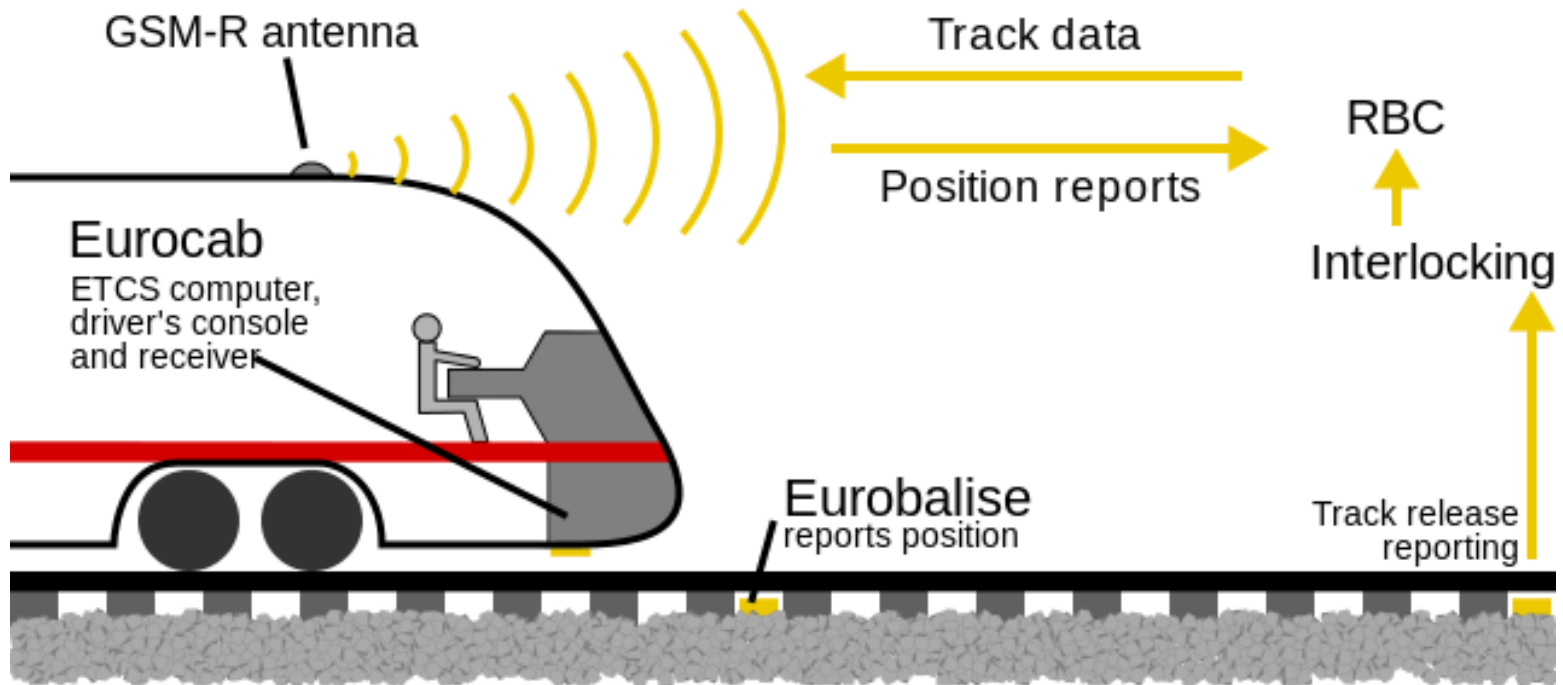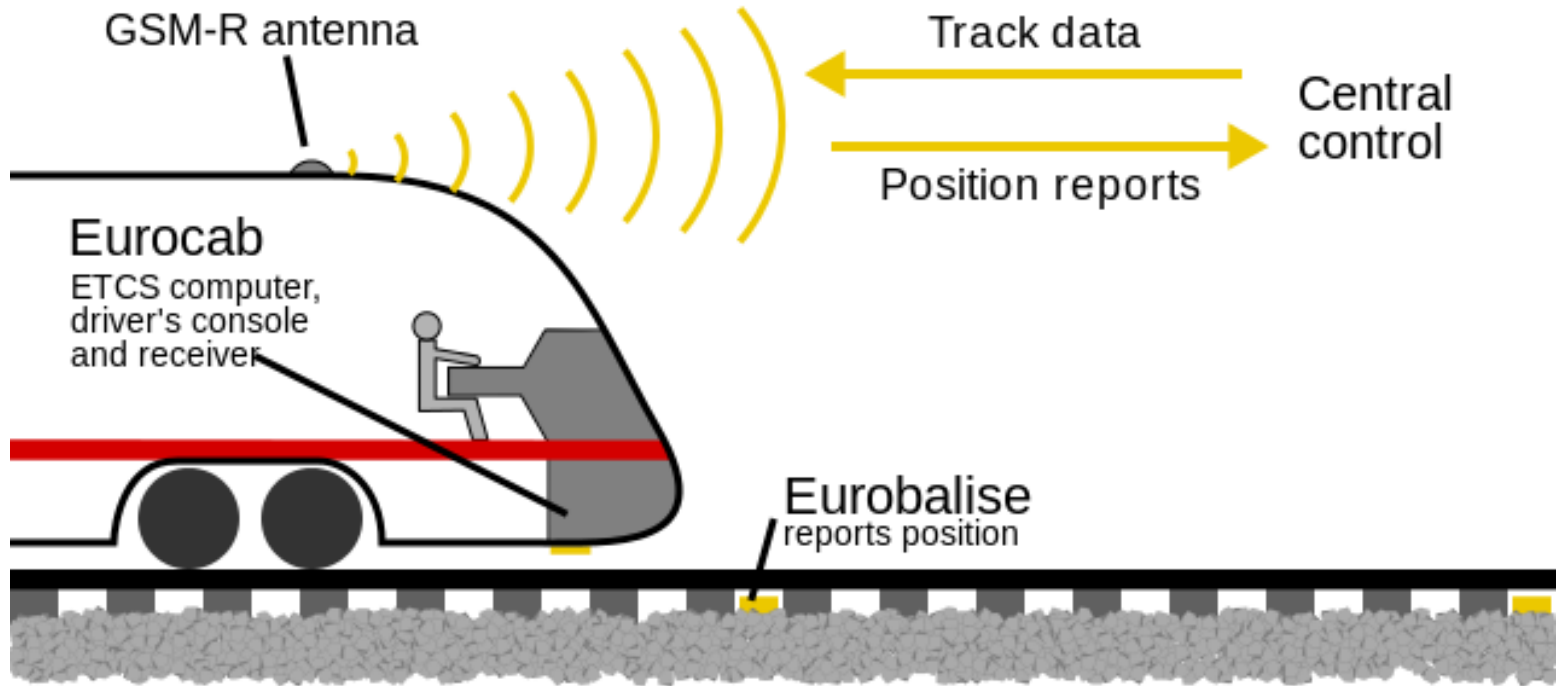
- **Baseline** = a stable kernel in terms of system functionality, performance and other non-functional characteristics
  → any system needs to evolve, to add new functions and corrections

- Baseline 1: trials and proof of concept

- Baseline 2: legally enforced in 2008
  → the first complete set of requirements, considered as interoperable, and to be adopted at European level

- Baseline 3: June 2016
  → symmetric compatibility with Baseline 2
  → mature and functionally complete set of specifications
  → will remain stable for a long period, protecting investment in on-board and trackside implementations, enabling widespread deployment

- Harmonised braking curves
  → better prevision on timetable

- Online Key Management System
  → ease of distribution of cryptographic keys

- Limited Supervision
  → simplified deployment for faster implementatior

- Packet Switch radio link (GPRS)
  → first step towards all-IP communication networks

- Harmonised Driver Machine Interface
  → enhanced user experience when operating different equipment

- Dedicated radio communication system for voice and data services supporting railway operations

    – Harmonised spectrum in EU: R-GSM band

    – Voice services: point-to-point and group calls, Railway Emergency Call

    – Data services supports ETCS level 2 and 3

    – Location dependent and functional addressing

    – Priority control and preemption

- GSM-R equipment

    – On-board: handhelds, cabradios and ETCS Data Only Radios (EDOR)

    – Trackside: Radio access (Base Stations) and core network

    – Dispatchers (controllers)

- GSM-R continuously integrated new functionalities since 90's, and evolving towards all-IP interfaces

GSM-R is today the only possibility as per EU regulation

- **GSM-R will be in operation up to 2030 and beyond**
  - Successful system: packet switching for ETCS, interferences can be managed
  - Does this situation create long term stability or does this block innovation and/or cost reduction?

> The Agency investigates current and future needs

- **Definition of GSM-R successor, introduction and migration has to be planned**
  - Functionality, performance, technology, radio spectrum
  - Balance between sustainability and flexibility while maintaining interoperability
  - Potential migration scenarios and the economic impact

> The Agency leads the coordination with users

The Agency program Evolution of Railway Radio

- **High level planning for the development activities:**
  - 2015 – 2018: studies to identify the main requirements and strategy
  - 2016 – 2020: identification and preparation of changes for the CCS TSI (basic parameters, authorization, implementation and Annex documents)
  - 2019 – 2022: further development and Proof of Concept

- **Inputs:**
  - CCS TSI release planning (e.g. ETCS related baselines/releases)
  - MS/IM and RU investment (replacement/LCM) plans
  - External activities, e.g. evolution of standards (e.g. 3GPP)
  - MS decision on availability of spectrum

- **Involved organisations**
  - System definition: ETSI, UIC, UNISIG, Shift²Rail, railway stakeholders
  - Implementation strategy: transport administrations, spectrum regulator

http://www.era.europa.eu/Core-Activities/ERTMS/Pages/The-Project-Evolution-of-Railway-Radio.aspx

Today	Future situation
Single radio access technology	Multiple radio access technologies
Dedicated networks	Dedicated/shared/public networks
Dedicated radio spectrum for railways	Dedicated/shared radio spectrum
Simple/static on-board devices and interfaces	More complex and flexible on-board architecture
Clear implementation objective	Challenging transition phase: continuous evolution

Main challenge: provisions in the legal framework in order to

- Keep *interoperability* during the transition: GSM-R will be operational until at least 2030

- Offer sufficient *flexibility* for future developments : minimize the impact of technical evolution in the overall system

- Find a *balance* between natural updates and/or changes of Subsystems/IC's, and the planned introduction of GSM-R successor (RU's vs IM's)

- **General: possible cost reduction**
- **Conditions/challenges for introduction in CCS TSI**
  - Based upon standards (no proprietary solutions)
  - Sustainable (long term support)
- **Satellite based localisation: some examples**
  - Virtual balise for ETCS
  - Level crossing
- **Satellite based communication?**
  - Integration with terrestrial systems, IP based?
  - Suitable for operational voice and (ETCS) data?
  - Current technology/systems or wait for 5G?
  - Implementation/migration issues?

- **Agency study in cooperation with ESA**
  - Performed by INDRA
  - Conclusions available on the Agency's website
    http://www.era.europa.eu/Document-Register/Pages/Study%2c-performed-by-INDRAALG.aspx
- **Findings**
  - For Railway requirements, most feasible solution would be medium orbit (MEO) and "medium" frequency (the C-band, 4-8 GHz)
  - Neither current nor planned SATCOM services and products can support simultaneously both voice and data railway applications as a full replacement for terrestrial solutions
    - For ETCS data and limited voice capabilities, SATCOM may provide an acceptable solution, with the potential to reduce the overall costs (on-board + trackside) for radio communication
- **Agency's conclusion**
  - SATCOM solutions are not to be considered in the next CCS TSI as mandatory
  - Proposed architecture should allow use of satellite as an option

Making the railway system work better for society.

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