

Satellite positioning set to enhance train localisation

As Europe's railways expand, their safety and efficiency depend increasingly on knowing every train's position.

Traditional train detection systems use devices mounted along the rails, such as track circuits and axle counters

Trains also communicate track positions and distance travelled, thanks to Eurobalises and odometers

THE CHALLENGE

To achieve even greater accuracy and real-time localisation of trains by improving onboard positioning technology – using Global Navigation Satellite Systems (GNSS), such as the EU's Galileo.



HOW DO WE DO THIS?

Shift2Rail delivered six Technical Demonstrators, defining an interoperable solution for Satellite-Based Fail-Safe Train Positioning (FSTP) that brings together:

1. Virtual Balises (VB);
2. a Stand-Alone FSTP system.

Researchers produced a Roadmap and Migration Strategy exploring:

- ways to include fail-safe, interoperable train positioning solutions in future European Train Control System (ETCS) Technical Specifications for Interoperability (TSIs);
- the need to integrate Satellite-Based FSTP systems in current and future Control-Command and Signalling (CCS) systems.

VIRTUAL BALISE-BASED TRAIN POSITIONING SOLUTIONS

How does it work?

Positioning information is sent to a train through GNSS signals, supported by extra sensors, instead of relying only on physical balises along the track





An onboard Virtual Balise Reader processes the GNSS signals and compares the GNSS coordinates with the list of coordinates onboard





The reader reports the corresponding virtual balise to the Eurocab (a train-based computer), when the coordinates stored for it are reached



Solution	VB technology using GNSS to enhance positioning information for a train	VB solution in a real ERTMS/ETCS environment on non-urban lines, using European Geostationary Navigation Overlay Service	Ensuring interoperability between regional and main railway lines, for an FSTP solution plus VBs in a real ERTMS/ETCS environment
Technology Readiness Level	5 (technology validated in a relevant environment)	5 (technology validated in a relevant environment)	4 (technology validated in a lab)
Key findings	Incorporating track data into the onboard algorithm can be a crucial factor in enhancing safety and accuracy	Integration of satellite technology with standard positioning systems proved feasible, supporting: <ul style="list-style-type: none"> • interoperability • Reliability, Availability, Maintainability and Safety requirements 	Implemented algorithm robust enough to cope with environmental disturbances to train positioning. Further runs on different lines are still necessary
Who benefits?	 Infrastructure managers		 Railway operators

STAND-ALONE FAIL-SAFE TRAIN POSITIONING SOLUTIONS

Solution	Real-time demo (integrated GNSS, IMU, tachometer and a Digital Map) with an algorithm	Positioning algorithm (multi-sensor acquisitions with an emulator of EGNOS DFMC)	Real-time implementation (dual channel of GNSS, IMU or Inertial Measurement Unit, speed sensors and Digital Map)
Key findings	Showed feasibility of a positioning system of around 20 metres fixed error	Can result in error values below 3 metres	Challenging GNSS conditions affected precision of speed estimates
Who benefits?	 Infrastructure managers		 Railway operators

BENEFITS OF SATELLITE-BASED TRAIN POSITIONING

Calling on highly accurate real-time information from Virtual Balises on trains, supported by other sensors and technologies, these innovations can:

- improve the localisation of trains
- enhance rail safety, reliability and efficiency
- enable the removal of trackside train-detection systems, reducing maintenance and driving major cost savings for infrastructure managers

WANT TO LEARN MORE?

rail-research.europa.eu

Solutions developed by Shift2Rail, Europe's Rail's predecessor programme

