

## Understanding the railway system



# ERTMS

European Rail Traffic Management System

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# 1 What ERTMS is

The European Rail Traffic Management System will be a new standard for safety, signaling and communication. Not only in the European railway system, but also in other parts of the world.

ERTMS is a development to contribute to the interoperability of the railway transportation system in Europe, as each member state has its own safety and signaling system up until now. None of these systems are compatible with each other, causing significant inefficiency in international rail traffic. In the traditional environment either locomotive changes at the state borders are needed or locomotives should be equipped with the on board safety systems of the countries to cross. For example Thalys, the Amsterdam – Paris high speed train, has 7 different safety systems on board! This also is a very cost-ineffective situation.

The basic target of ERTMS therefore is to swiftly cross borders in international (European) railway traffic.



*Substantial growth over the years demands interoperable and sustainable safety and signaling systems.*

Throughout Europe, ERTMS will be implemented on all high speed lines, specific transit corridors and eventually on all railways. ERTMS as a definition consists of all aspects considering management, safety and communication in the whole railway system.

Subsets of ERTMS are ETCS, which stands for European Train Control System and GSM-R, a radio communication system. ETCS includes all systems necessary for both drivers' cab and track signaling.

In some publications ETML (European Track Management Layer) and INESS (Interlocking Safety System) are also counted to belong to ERTMS.

## 2 ERTMS principles

ERTMS' concept is based on standardization of data exchange in traffic management. This can best be compared with the operational methods in aviation. Aircraft can always land on every international airport due to exchange of standard data and the use of standard systems and procedures for takeoff and landing. Like in aviation, trains should be able to connect stations, regardless the country they are in, crossing over having their destination.

This principle however does not implicate automatically that all trains have exactly the same systems on board. Airplanes don't have that either by the way. The only things really standardized in aviation are communication procedures and specifications of communication equipment. Communication in this perspective means both communication between the train and equipment alongside the track, as well as between train and traffic control centre. Differences between certain interfaces showing information to the driver are still possible.

### **Track – train communication**

This is where ETCS comes in. ETCS states specifications for track – train communication, consisting of several systems:

- Eurobalise<sup>1</sup>: standardized beacon, acting as an interface between track and train;
- Eurocab: standardized cab equipment for the use of ETCS, replenished with specific transmission modules (STM), facilitating existing network specific safety systems.
- Euroradio: GSM-R is gsm for railways. GSM-R is used for communication, data exchange and – on longer term – positioning;
- Euroloop: facility of loops, making rail guided data exchange possible.

Trains equipped with the Eurocab always have STM available, as this interface makes it possible to operate on non-ETCS lines as well, then using the traditional safety system.

ERTMS can be implemented on new railways as well as on existing lines. To accomplish compatibility three different levels were developed.

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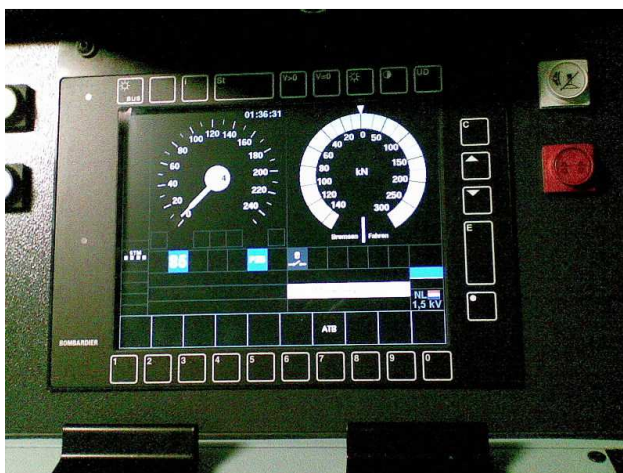
<sup>1</sup> Balise (French) = beacon



*Eurocab: driver's cab of a modern multi courant locomotive from the so called TRAXX-family*



*ETCS-beacon on a German track.*



*DMI: driver machine interface, consisting of ETCS and the German network specific PZB safety system*

### 3 ERTMS levels

ERTMS consists of three different levels, meeting different specifications:

- level 1: continuous track – train communications;
- level 2: continuous train – radio block centre communications;
- level 3: “moving block” technology.

System upgrades are possible by expanding components, meeting specifications of the next level.

#### Level 1

ERTMS level 1 is connected with traditional lines, equipped with trackside signals and detections. Communications are ensured by means of beacons (“balise”) located adjacent to signals alongside the tracks.

As soon as a movement authority is received through a beacon, the ETCS on board equipment calculates the permitted speed, taking the characteristics of the train into account. The train’s speed is under continuous monitoring by the system.

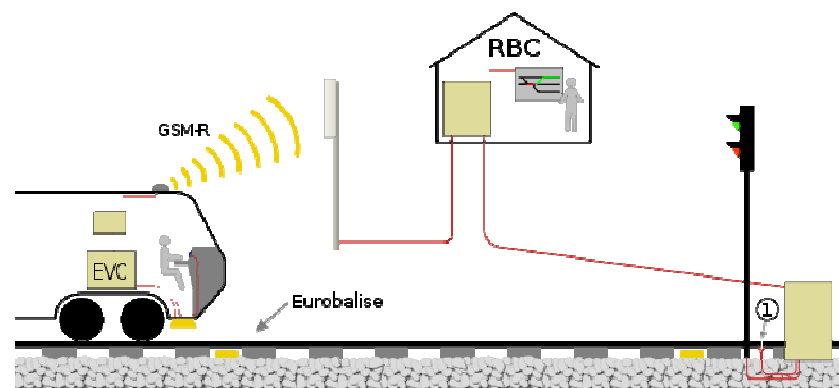
ERTMS level 1 can relatively easy be used to make traditional lines interoperable, ensuring automatic braking when maximum speed is exceeded.

#### Level 2

ERTMS level 2 does not require signals along the tracks. Movement authority is therefore not necessarily communicated by a fixed signal, but by means of a radio block centre (RBC) to the on board ETCS-unit which is equipped with GSM-R.

The inline beacons communicate data like location, limits on speed, gradients on the way etc. The information about data and signals ahead is shown to the driver on a cab display. Level 2 counts with a braking distance factor, to ensure there is an adequate braking path available.

The removal of trackside fixed signals and replacement by beacons can raise the capacity of a line significantly.

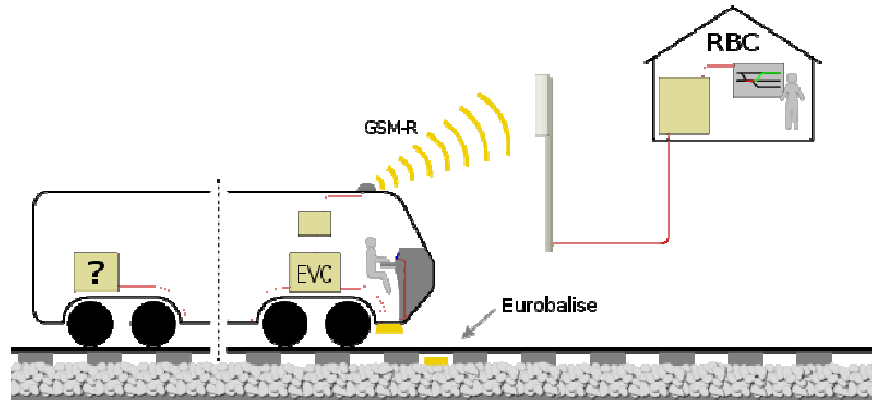


*Principle working scheme of ETCS level 2. Positioning by means of beacon, communication with RBC with GSM-R, on board equipment in Eurocab.*

### Level 3

Level 3 allows “moving block technology” to come in. Whilst level 1 and 2 still operate with fixed sections and thus limiting use of a block to one train at the time, level 3 supplies the control centre of continuous information about the train’s position.

In this level, the train itself is to be regarded as a “moving block”.



*Principle working scheme of ECTS level 3.*

# 4 ERTMS technology

With ERTMS beacons (“balise”) are used for data transfer.

### Information transfer

In level 1 there is communication from track to train only. The beacons transfer information to the trains, containing:

- the beacon’s identification;
- distance remaining to next point of speed changing;
- target speed of train (in relation to braking path etc.);
- validity of the information.

In level 2 communication is two way: from track to train and reversed. The beacon’s signals are the same as in level 1, but in level 2 the train communicates about data too. In fact it sends information to the radio block centre (RBC) by means of GSM-R.



*Modern technologies make borders vanish indefinitely.*

### Transition

When a train moves from a traditional line to ERTMS-covered tracks an entry beacon is used to register with the RBC. Specific information about the train – length, weight, braking path etc) is being sent with the registration.

## 5 ERTMS in The Netherlands

On several railway lines in The Netherlands ERTMS is already implemented.



- high speed line Amsterdam – Brussels: ERTMS level 2;
- the Betuweroute, a dedicated freight line: ERTMS level 2 between Rotterdam and the German border and level 1 between Rotterdam and Maasvlakte;
- the fully overhauled and expanded line Amsterdam – Utrecht: level 2, executed as a dual signaling version (traditional signals still in use next to ETCS);
- new line Lelystad – Zwolle: ERTMS level 2, still under construction.