



## SMART protection of the railway infrastructure

The liberalisation of the railway market in terms of separating railway operators from infrastructure managers carries both positive and negative aspects. One of the most serious negative aspects is "the loss of connection between the vehicle and the track". An operator's efforts to reduce costs might impact its buying and maintaining of vehicles, and infrastructure managers operate and maintain the infrastructure with no direct effect on the vehicles that run on it.

The objective of the proposed action is to minimise negative effects on the railways by defining and measuring the parameters that have an impact and the real length of transport. In addition, in the event that these parameters will be subject to transport tariffs, it is possible to increase revenue from the transport. (In legislative terms, in determining the fees for railway services, Regulation (EU) 2015/909 (9) allows the different levels of infrastructure wear and tear caused by one or several defined parameters to be taken into account.)



The implementation of a diagnostic and monitoring system on the railway network should create safe and smooth traffic by building checkpoints (ChP). These include one or more technical devices (diagnostic systems) for detecting irregularities and defects on railway vehicles, monitoring infrastructure and automated system processes covered by the Electronic Control System (ECS) to mitigate such impacts.

Each vehicle dynamically affects the infrastructure when being driven, and the level of this impact is closely connected to the technical parameters of the vehicle's chassis.

#### The main impacts of a vehicle on the infrastructure are as follows:

- Degradation of track geometry position and the gravel bed;
- Damage to rails;
- Damage to parts of rail switches and rail infrastructure.

The vehicle's weight is the main parameter that affects the infrastructure.

## MAIN GOALS

- Improve security, reliability of rail infrastructure and increase traffic safety;
- Reduction of operational and maintenance costs;
- Reduction of noise and air pollution;
- Fulfilment of requirements for interoperability;
- Improving the competitiveness of transport;
- Increase of traffic and overall efficiency and economy;
- Support a freer market in the field of railway transport by setting up comparable qualitative criteria for transport companies;
- Define parameters that take into account and identify the real costs of damage on railway infrastructure, which will then be used to calculate transport tariffs;
- Provision of electronic services/information identified by the system.

## OUR SOLUTION

The SkyToll solution allows high flexibility mainly associated with device variability, modularity of functions and compatibility of inputs and outputs. This feature ensures gradual establishment, reliable operation and low maintenance costs.

Ensuring the effectiveness of checking processes shall be implemented through the following **key processes**:

- **Stationary Control** – implemented through the ChPs;
- **Manual Data Processing** – performed by the ECS control staff using the Stationary Control, which will be provided by ChPs that monitor the passage of vehicles.

## KEY COMPONENTS

**A**

### Construction of ChPs in a country's railway system:

- Located directly on the corridors of the Core Network;
- Located at border crossings to neighbouring countries;
- Intended as a reference for testing measurements.

**B**

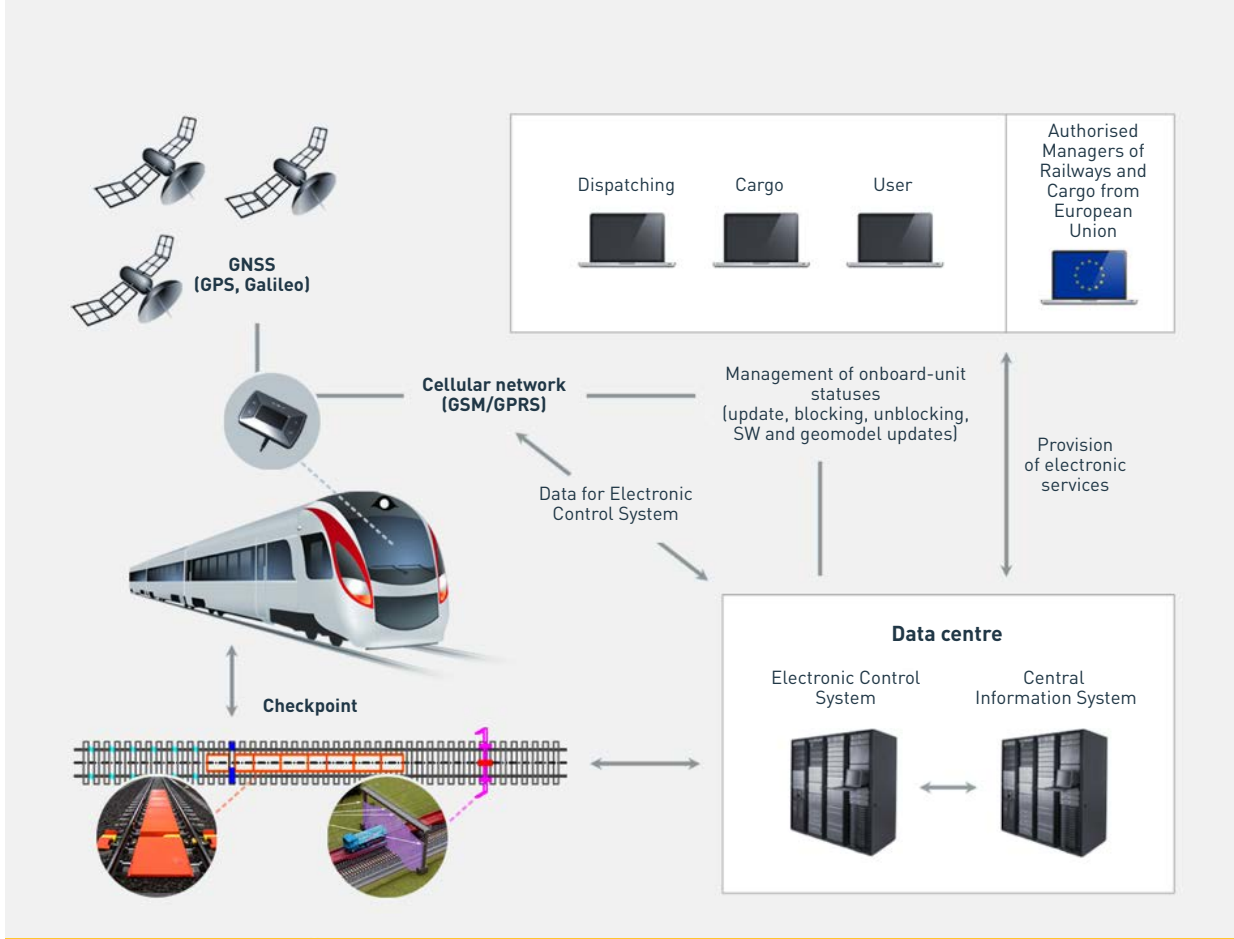
### Building an ECS

The ECS will provide up-to-date registration data on shipments, evaluate the differences between registration data and the actual parameters, and provide data for operational staff and for dispatching / Operational Centre. The system will be placed in a data centre so as to secure the highest-available parameters. The system requires a connection to a central system of country railways as well as ChPs and onboard units.

**C**

### Delivery and installation of onboard units to locomotives (up to 4,000 pcs needed in Slovakia)

The onboard unit is a key component of the ECS. Its main purpose is to create data records based on analysing the motion of a locomotive. These records are then sent by the onboard unit to the ECS for additional processing.



## THE ChPs

are designed with these diagnostic systems:

- Wheel weighing and axle weighing of railway vehicles;
- Monitoring compliance with the axle weight of a railway vehicle with the relevant category;
- Monitoring compliance with the agreed limit values of wheel-weight differences;
- Monitoring exceeding the outline shapes of the vehicle – vehicle loading gauges;
- Monitoring vehicle information – reading the registration numbers of railway vehicles;
- Monitoring condition of the pantographs of electrical-traction railway vehicles;
- Monitoring cooperation of the pantographs of electrical-traction railway vehicles;
- Monitoring the flat wheels of railway vehicles (WFD);
- Monitoring the hot axle box of railway vehicles (HABD);
- Monitoring the hot wheel circumference and hot discs (HWHDD);
- Identifying the train using RFID communication.

A modern type of ChP for the needs of the infrastructure manager will, in addition to providing fast, accurate and reliable information about wagon weight and other required parameters, enable the transfer of measured data and its connection with the ECS or technologies providing comprehensive information about a passing vehicle (train) so as to permit the automatic comparison of data of vehicles declared by the carrier with the actual measured data. Weighing and monitoring rail systems shall include diagnostic systems according to the specified requirements for a given track section, and not all the devices need to be located at one ChP.

The ChP will take photographs of the trainsets passing through it with the use of cameras and simultaneously it will measure their parameters. The ChP will send, in defined intervals, all the records of the passing trainsets to the ECS for further processing, i.e. verifying the compliance of the declared and measured data.

All monitoring parameters are compared with the registered data of each trainset. In case of non-compliance of the measured data with the declared data provided by the shipper or railways, the case will proceed (i.e., the shipper will be charged).

### The ChPs will perform the following functions automatically:

- Recognition of passing trainsets;
- Identification of the onboard unit of the train using RFID communication;
- Recognition of rail-car numbers and their evaluation through the ECS;
- Recognition of train length and the number of vehicles on the train;
- Specification of the train weight;
- Identification of the type of vehicle;
- Specification of the train speed;
- Identification of the axle load and the number of axles;
- Recording of the flat parts number on wheels or an efficient use of equipment to protect against wheel slip
- Sending data to the ECS for automated monitoring and evaluation processes;
- Generating reliable evidence and documentation about identified irregularities.

## The ECS

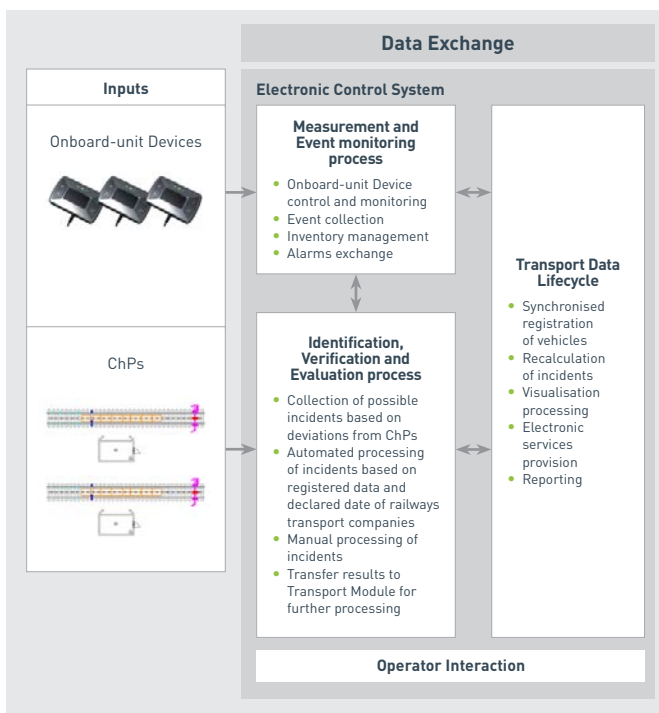
is a complex information system that supports enforcing and controlling the business activities of a company involved in the provision of train infrastructure. The main tasks of the ECS are:

- Handling transport data;
- Collecting information about infrastructure usage;
- Identifying and evaluating incidents related to the protection of infrastructure;
- Recalculating charges based on identified incidents;
- Managing onboard units;
- Providing electronic services.

The product can functionally be divided into four domains:

- Measurement and Event monitoring;
- Identification, Verification and Evaluation;
- Transport data lifecycle;
- Data Exchange;
- Operator interaction.

Each domain is internally built from modules with dedicated functionality.



### Electronic Control System processes

The ECS system can receive and process rail-infrastructure data from ChPs and onboard units. The ECS is an open, fully extendible system based on service-oriented architecture, with all subsystems internally realised as three-layer architecture. Subsystems communicate through dedicated and agreed communication channels and precisely defined homogenous interfaces.

The product offers a handful of modules that allow monitoring, management and provide a wide range of standard and user-defined reports.

## ONBOARD UNIT (OBU)

One part of the automated checking process is the unique identification of trainsets. For this purpose, the locomotives will be mandatorily equipped with an onboard unit. The onboard unit will clearly identify the locomotive and while driving it will record the location of the locomotive using a global satellite tracking system (GPS).

The onboard unit will send the recorded position via GSM/GPRS to the ECS. In addition to the ECS, the onboard unit will communicate with ChPs set up along the railway network.

### The onboard unit supports the following functions:

- Collection and check of position data gathered by GNSS;
- Railways section recognition using a stored geomodel;
- Record of borderline crossing;
- Recognition of a locomotive in a defined polygon;
- Creation of event records for the ECS.

## OTHER POSITIVE EFFECTS

- Provision of electronic services – transport information recorded by the proposed solution can be provided through electronic services not only to the control centre but also other authorised entities such as carriers or the Ministry of Transportation, or users themselves. Using the onboard unit with the recording of location and GSM/GPRS technologies, information on the movement of individual trainsets will be available almost online.
- Data provision within the European area – within the European area the recorded data can be provided to other entities authorised to access it under European legislation or following an agreement between individual infrastructure managers and/or carriers. Information about measured transport parameters can be provided.



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