



IMPULSE

**SYSTEMS AND SOLUTIONS
FOR RAILWAYS**



- **1956 – 1991.** Development and supply of redundant fault-tolerant control computer systems based on M-6000, M-7000, SM-1M, SM-2M minicomputers. More than 20,000 systems were supplied to various industrial facilities and research centres.

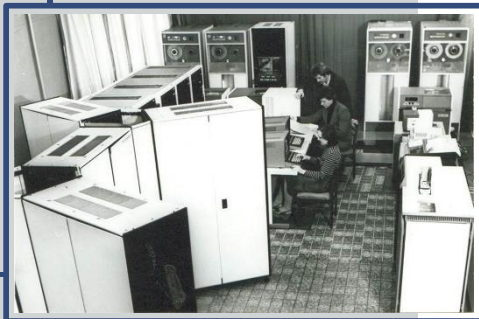
- **From 1982** - the main organization in the USSR for the production of instrumentation and control systems for nuclear power plants.

- **Until 1991** instrumentation and control systems based on the SM-2M minicomputer were implemented at 22 NPP units.



- **1992 – 2000.** Creation of a family of triplex fault-tolerant microprocessor-based industrial controllers of the MSKU series and other components for building fault-tolerant control systems.

- **2001 – 2010.** The entire range of digital monitoring and control systems for VVER-1000 and VVER-440 reactors was developed. About 200 I&C systems were manufactured and delivered to NPPs in Ukraine, Armenia, and Bulgaria. Power supply panels for electrical centralization systems on railways were developed. Beginning of development of railway automation systems (RAS).



- **2011 – 2021.** Modification of the in-core monitoring system to control mixed fuel loads of TBCA and Westinghouse. Development and testing of the proprietary calculation code "ImCore". The first RAS implementations – computer-based interlockings, automatic blocking signalling, semi-automatic blocking signalling, locomotive safety systems.

- **2022 – 2026.** Expanding the RAS portfolio (train car automation systems) and development of products complying with the ERTMS/ETCS European standards. Development and implementation of relay protection automatics products.



The certified systems are operating in compliance with the requirements of:

- quality management ISO 9001:2015;
- environmental management ISO 14001:2015;
- operational health and safety management ISO 45001:2018.

The company has successfully passed the audit examination for compliance with the supplier requirements (External Sustainability Audit).

The Siemens Mobility and Alstom Transportation official supplier status has been obtained.







The main system is ImProTRACK CBI. All traffic control and management functions, route and individual control of trackside equipment are implemented in this system.

Based on the ImProTRACK CBI platform the following systems are implemented: automatic block signalling ImProTRACK AB, semi-automatic block signalling ImProTRACK SAB, track circuits ImProTRACK TDS-TC, axle counting system ImProTRACK TDS-AC, other functions of train traffic management and railway automation trackside equipment control. They can be used both as stand-alone systems and as functions integrated into ImProTRACK CBI.

Safety and reliability of systems based on ImProTRACK CBI are confirmed by the international conformity certificate of the highest safety integrity level SIL-4 and a decade of operation at mainline railways in Ukraine and Europe.



The optimal solution for modernizing the automation of railway stations with adjacent open tracks is the application of ImProTRACK CBI with train separation functions (ImProTRACK AB or ImProTRACK SAB).

Since the first implementation in 2012 and up to date, dozens of projects have been developed and implemented on the ImProTRACK CBI platform

Main functions

- Monitoring and control of the processes of receiving, departing, passing, overtaking trains, shunting operation at the station
- Ensuring the safe movement of trains along the routes
- Display of reliable information on train position and status of Signalling, Centralization, and Blocking (SCB) devices to the station duty officer's workstation and technician's workstation
- Power supply systems monitoring
- Reporting the actions of operating and maintenance personnel, archiving all received information and generating the necessary protocols and reports
- Verifying the awareness of the operator's actions when setting responsible control commands





A range of computer-based railway automation systems is implemented based on the ImProTRACK CBI platform:

- Automatic block signalling ImProTRACK AB
- Semi-automatic block signalling ImProTRACK SAB
- Track circuits ImProTRACK TDS-TC
- Axle counting system ImProTRACK TDS-AC, etc.



These systems have the same features, reliability and functional safety (SIL4 level) as the microprocessor interlocking system ImProTRACK CBI.

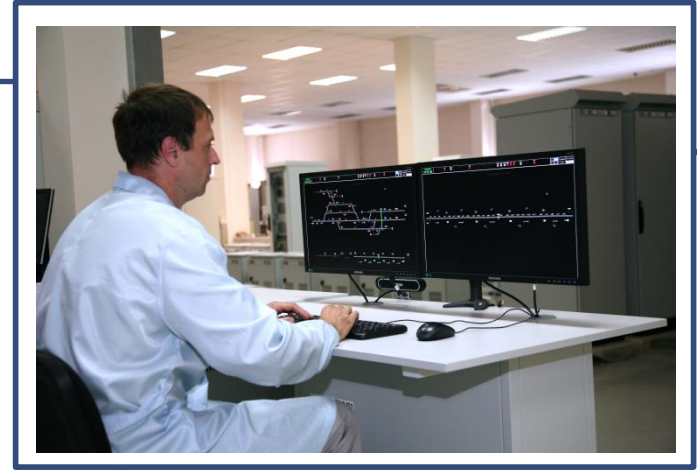


They can be used both as stand-alone systems and as functions integrated into ImProTRACK CBI.



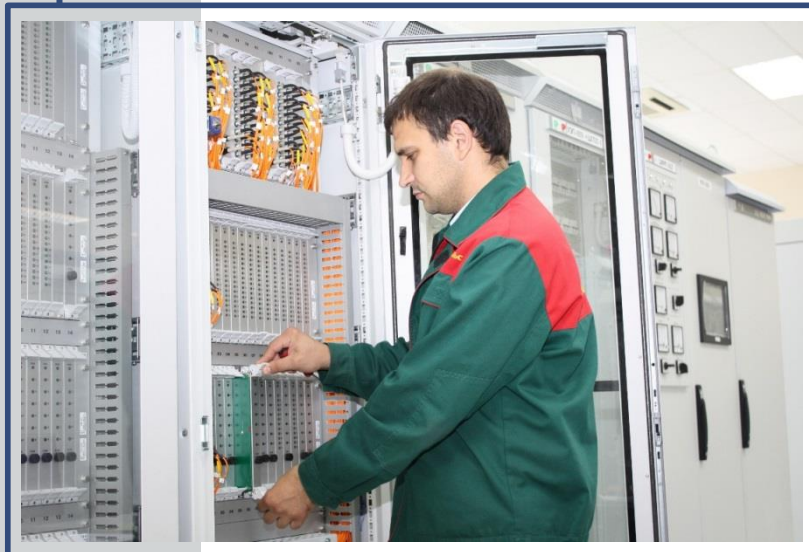
Main functions

- ☑ Monitoring of rail integrity and vacancy of block sections of the open track.
- ☑ Monitoring of the sequence of occupation and vacancy of block sections with automatic blocking in case of violations.
- ☑ Control of passing signal aspects.
- ☑ Control of level crossing and tunnel signaling.
- ☑ Coding of track circuits of block sections by ALS signals.
- ☑ Implementation of three-aspect or four-aspect signalling algorithm (depending on customer's requirements).
- ☑ Real-time display of information about train position and status of SCB devices at the open track on station operator's and technician workstations.



Main functions

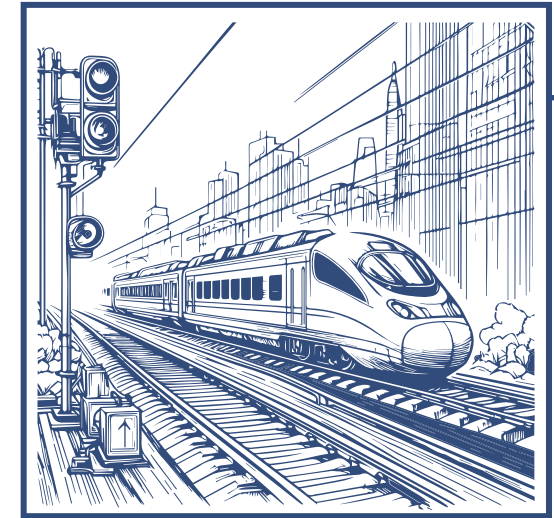
- ☑ Monitoring of occupancy/vacancy of each track at the open track.
- ☑ Automatic monitoring of complete rolling stock arrival.
- ☑ Sharing information between adjacent stations for implementation of semiautomatic block signaling algorithm
- ☑ Coding of track circuits of approach sections at the station by ALS signals.





ImProTRACK TDS-TC are intended for:

- monitoring of track sections occupancy and integrity of rail lines;
- generation of ALSN code signals.



Main functions

- Generation of track circuits power supply (audio frequency signals), measurement of current and voltage levels.
- Generation of ALSN codes.
- Diagnostics and transmission of information on the state of track circuits equipment to the upper level.
- Protection against external electromagnetic influences (caused by atmospheric phenomena, traction currents of 50 Hz frequency, etc.).
- Self-diagnostics, transition to the protective state when failures are detected.

ImProTRACK TDS-TC can be used on mainline and industrial railway transport, in subways

Main functions of ImProTRACK TDS-AC (in connection with computer-based interlocking):

- Determination of track section status:
 - determination of vacancy;
 - resetting of false occupancy of the track section using the responsible command by the station operator;
 - determination of partial passage error (in case of prolonged presence of a wheel in the detector coverage area).
- Control of open track vacancy with semi-automatic block signaling:
 - determination of the vacancy of the open track;
 - automatic detection of complete rolling stock arrival;
 - coding of approach / departure sections of the adjacent to the station open tracks with semi-automatic block signaling;
 - display of information about the traffic state, status of technological objects and ImProTRACK TDS-AC devices for the station operator and technician.
- Interfacing with relay station systems of electric centralization.
- Diagnostics of ImProTRACK TDS-AC devices.





Koziatyn railway hub

ImProTRACK CBI



Modernization of one of the busiest railway hubs in Ukraine (2019-2021).

A complex turnkey project carried out in several phases.

General contractor: SRPA "Impulse".

Control of a railway hub part, including:
85 switches (EC-3)
44 switches (EC-1).

Vacancy monitoring and ALSN coding is provided by **computer-based track circuits** integrated into ImProTRACK CBI

Completely contactless control with no relay components.

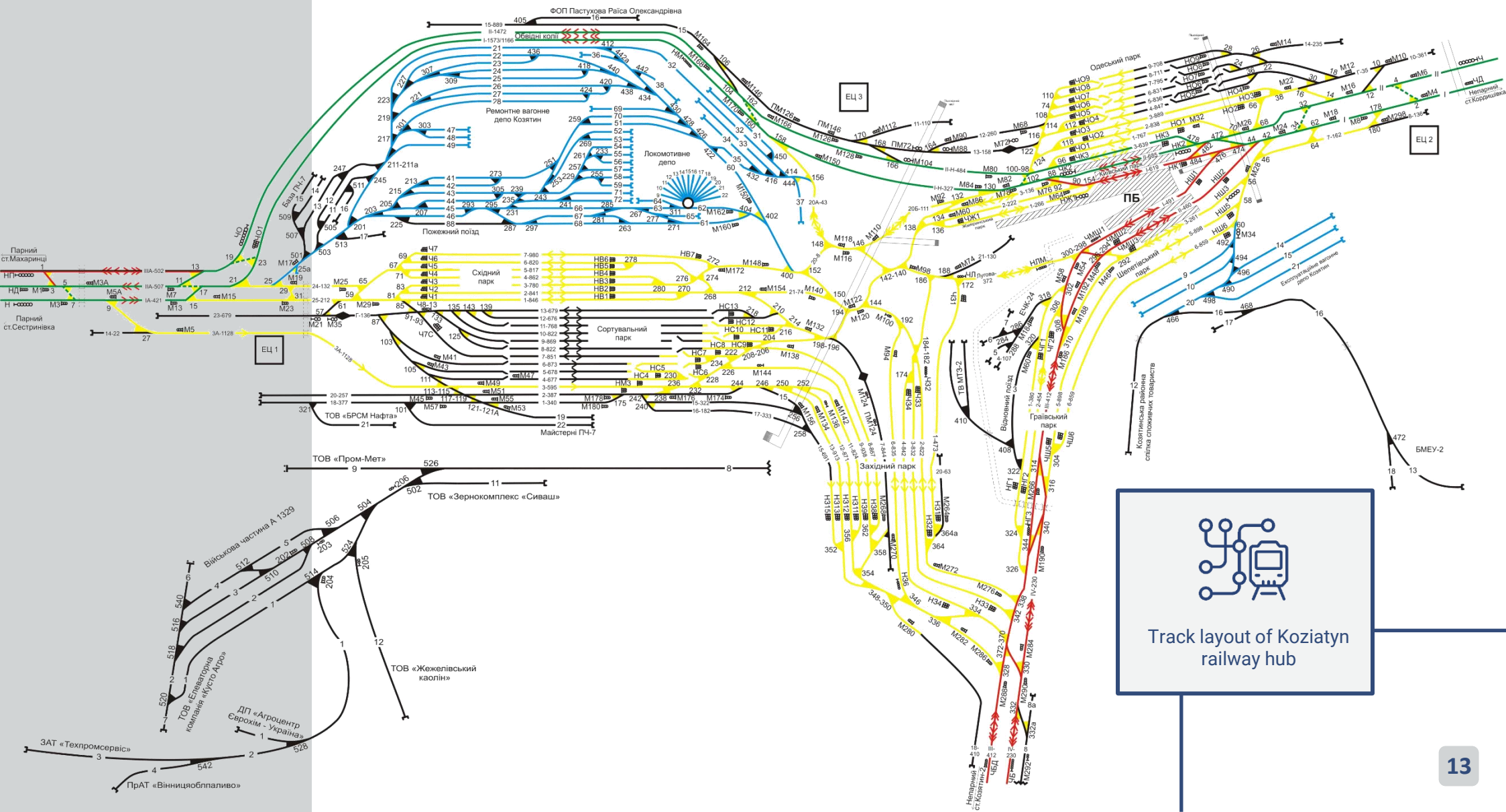
The system of complex automation of the process of the train splitting of two low-capacity humps in different shunting areas of the railway hub, integrated into the ImProTRACK CBI, has been implemented.

Communication with the main elements of the railway infrastructure is provided: level crossing automatics, automatic blocks on the adjacent open tracks, etc.



Koziatyn railway hub

ImProTRACK CBI



Track layout of Koziatyn railway hub



Computer-based interlocking system of Sindel station, Bulgaria



Sindel is a hub station, **37 switches**.



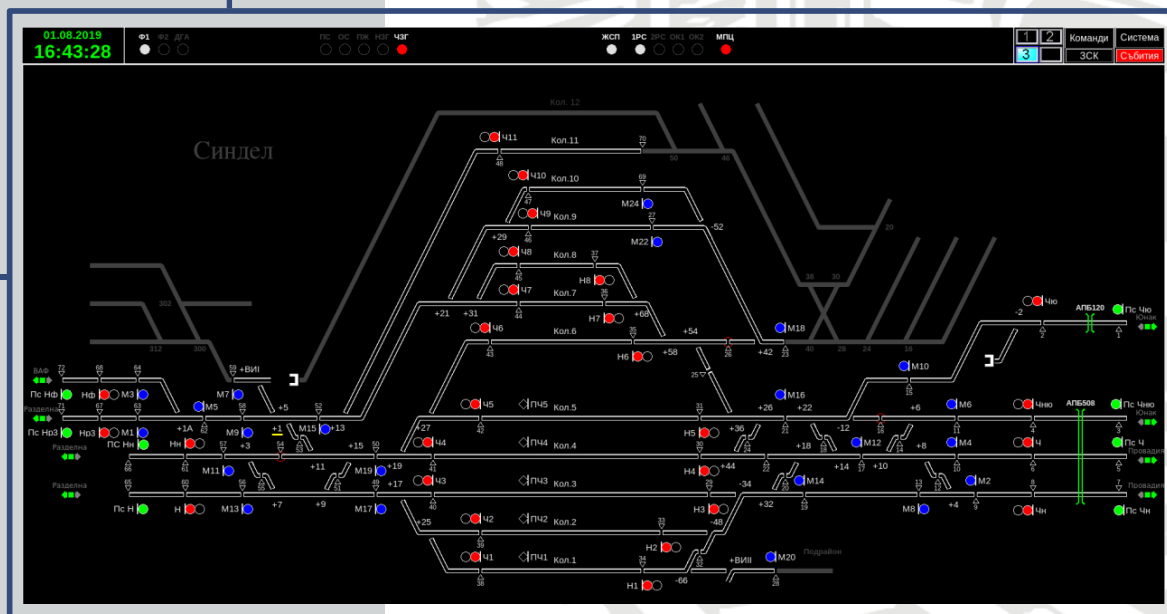
Integration with the **Frauscher axle counting subsystem** is implemented.



Digital interfaces are provided for **linkage with CTC and ETCS systems**.



The project was **successfully completed in 2021**.





Electrification of the Uzhhorod-Chop (Ukraine) railway section

The project is generally implemented under the European Union support within the framework of the project Connecting Europe Facility (CEF) and includes:



equipping the track with the semi-automatic block signalling in both directions of movement and providing the centralized traffic control



construction of 22 km European standard railway line



reconstruction of engineering facilities, objects and utilities



This project enabled to implement direct passenger routes from Uzhhorod to European countries via 1435 standard European gauge and perform transfers from trains from all the regions of Ukraine for further travelling in European countries

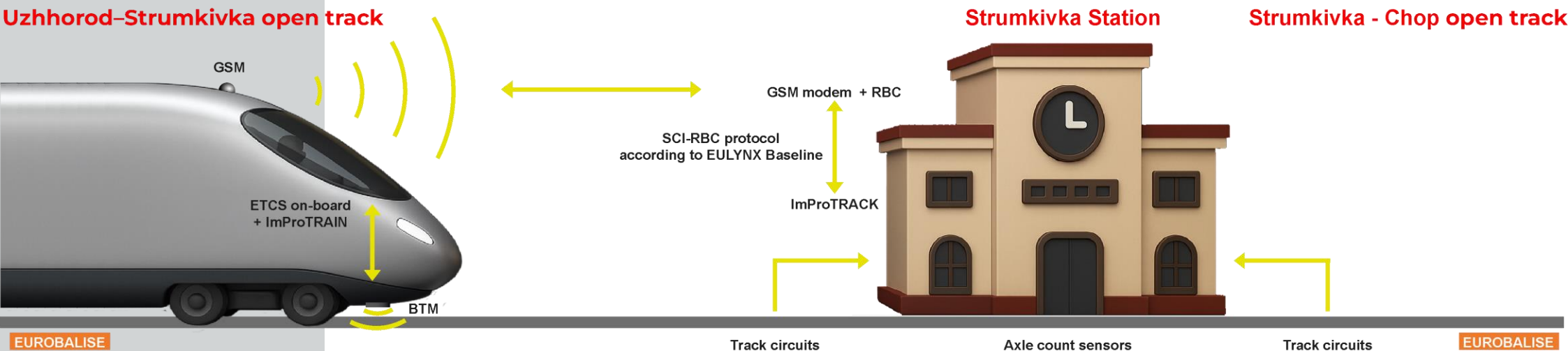


ETCS

Target architecture (at site)



- European Rail Traffic Management System (ERTMS) at Chop – Uzhhorod section of the regional branch “Lviv railway” of JSC “Ukrainian Railways”. One station and one open track, totally 22 km.
- Mutual project with European company “Mermec”.
- Project started in 2026
- The Figure depicts main elements of the ETCS Level 2 system at Strumkivka Station and the neighboring open tracks.





Modernization of track circuits of AS Eesti Raudtee (the project is implemented under a contract with Siemens Mobility)

Vacancy control and ALSN are realized by means of digital track circuits manufactured by SRPA "Impulse".

Contactless control of trackside equipment with complete elimination of relay components.

SIEMENS MOBILITY
OFFICIAL SUPPLIER
STATUS OBTAINED

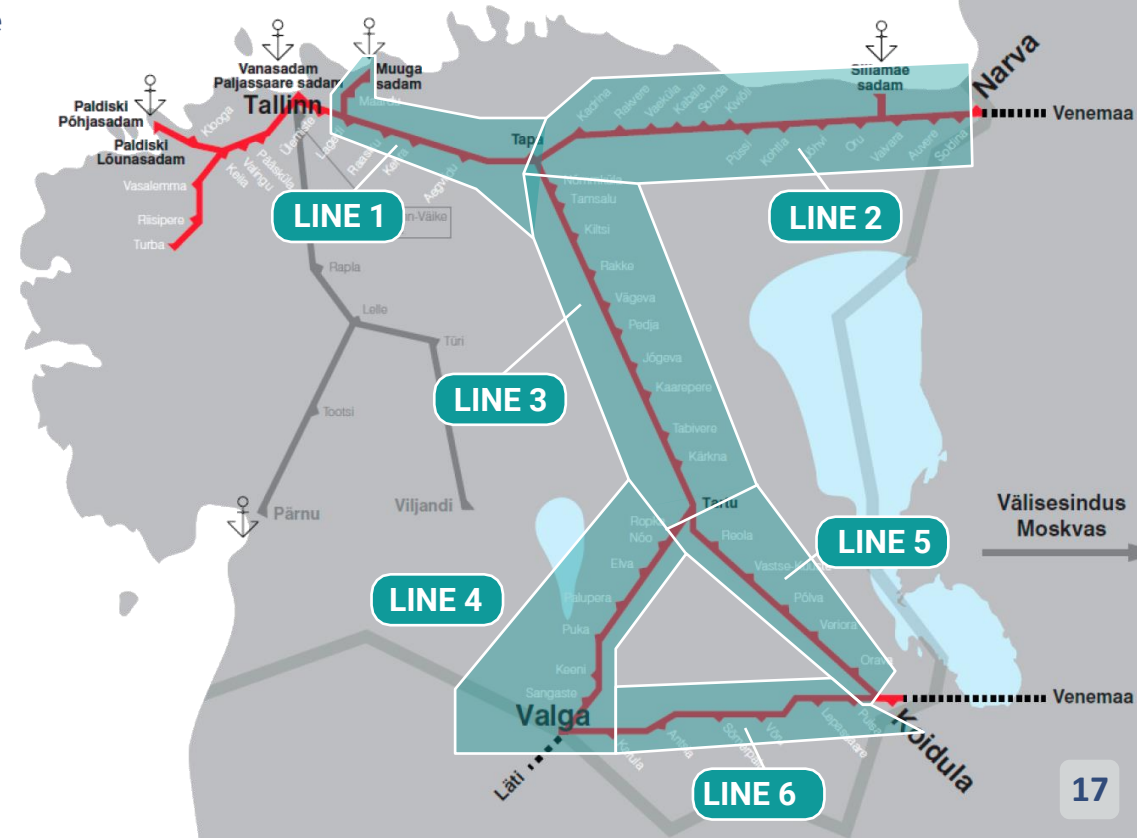
SIEMENS
Ingenuity for life

The project covers

90% of Estonian railway infrastructure

56
stations

6 railway lines with automatic block signaling and ALSN





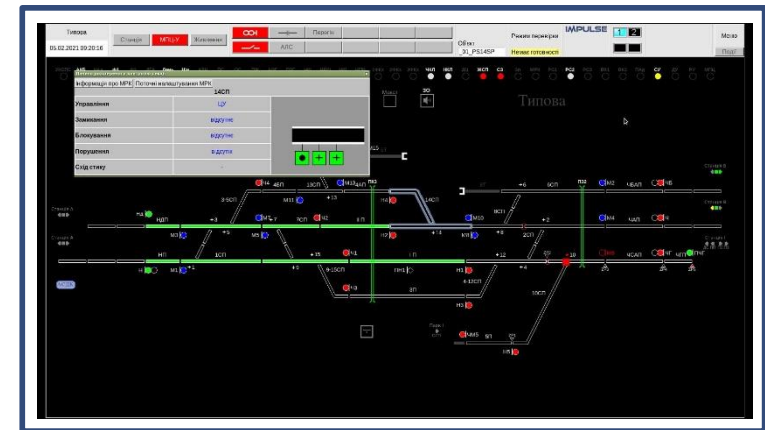
Dobele station (Latvia)

(the project is implemented in partnership with Fima SIA)

Fima

Project works:

Supply of track circuits ImProTRACK TDS-TC station equipment complex including software, calculation of technical means.



The interface between ImProTRACK TDS-TC and microprocessor interlocking manufactured by První Signální company including integration tests





Riga Central Station (Latvia)

(the project is implemented in partnership with SIA «Belam-Rīga»)



Computer-based interlocking ImProTRACK CBI at Riga Central Station with microprocessor track circuits ImProTRACK TDS-TC with the ALSN function (46 track circuits for DC electric traction)



- **ImProROUTE CTC** is a complex of hardware and software tools intended for creation of dispatch centralization systems providing monitoring and control of train traffic.



In 2024, the contract for the supply of ImProROUTE to 7 priority railway lines of the Trans-European Transport Network (**TEN-T**) in Ukraine with a total length of more than **1,100 km** was fulfilled



Implementation ImProROUTE CTC will allow to



Control from a single location - the Transportation Control Center (TCC) – train traffic at stations, level crossings and long-distance sections



Automate the traffic schedule maintenance and management process based on the predictive traffic schedule



Provide the TCC personnel with information on the situation in the dispatching section and on the status of SCB and DC devices

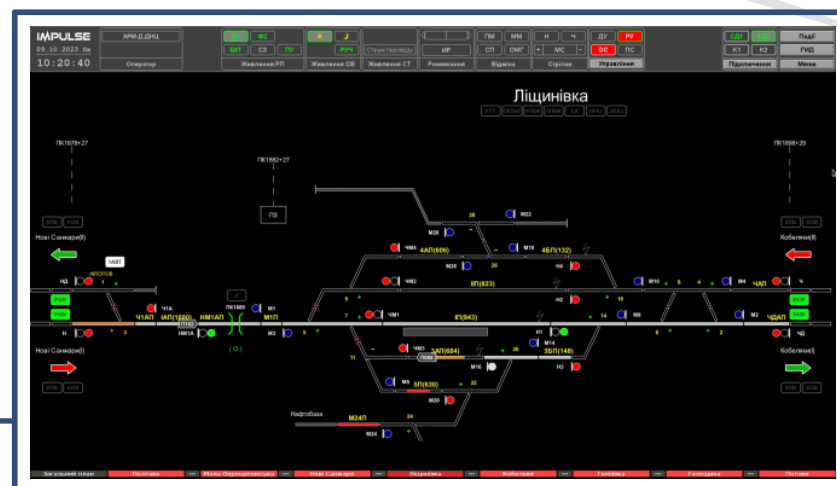
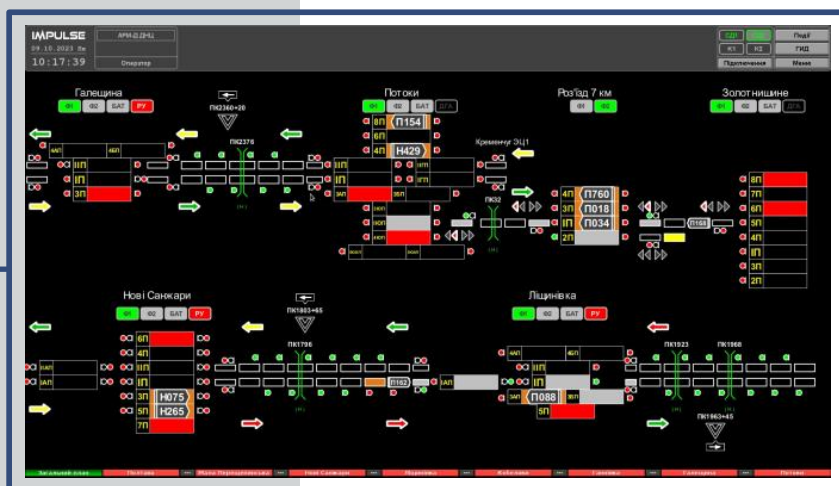


Store archived information for a long period of time with the option to view it in animation mode with adjustable playback speed



Main functions

- Monitoring and control of the train traffic process at the dispatching section by commands of the train dispatcher
- Display of information on the train situation at the dispatcher's section, status of SCB and DC devices on the operating personnel's workstation
- Maintaining of a schedule of implemented traffic
- Automation of the control process based on the predictive train schedule (function "auto dispatcher")
- Dispatch or station (local) control of linear points
- Power supply systems monitoring
- Reporting the actions of operating and maintenance personnel, archiving all received information and generating the necessary protocols and reports





In 2024, a large-scale project was completed for the manufacturing and commissioning of dispatch centralizations for JSC «Ukrainian Railways», including:



1,148 km of railway lines



117 stations



265 open tracks/level crossings



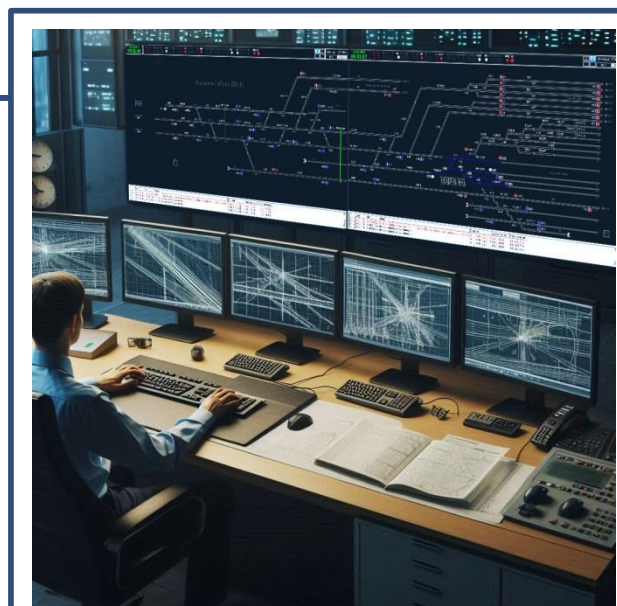
3386 points



4632 signals

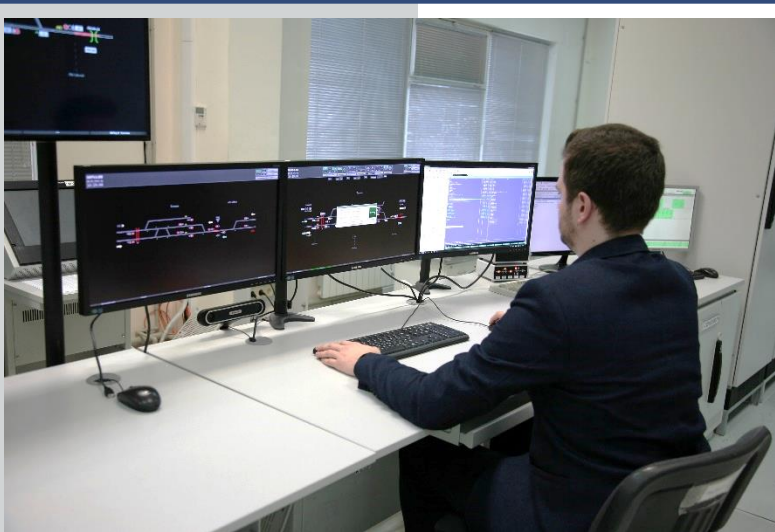
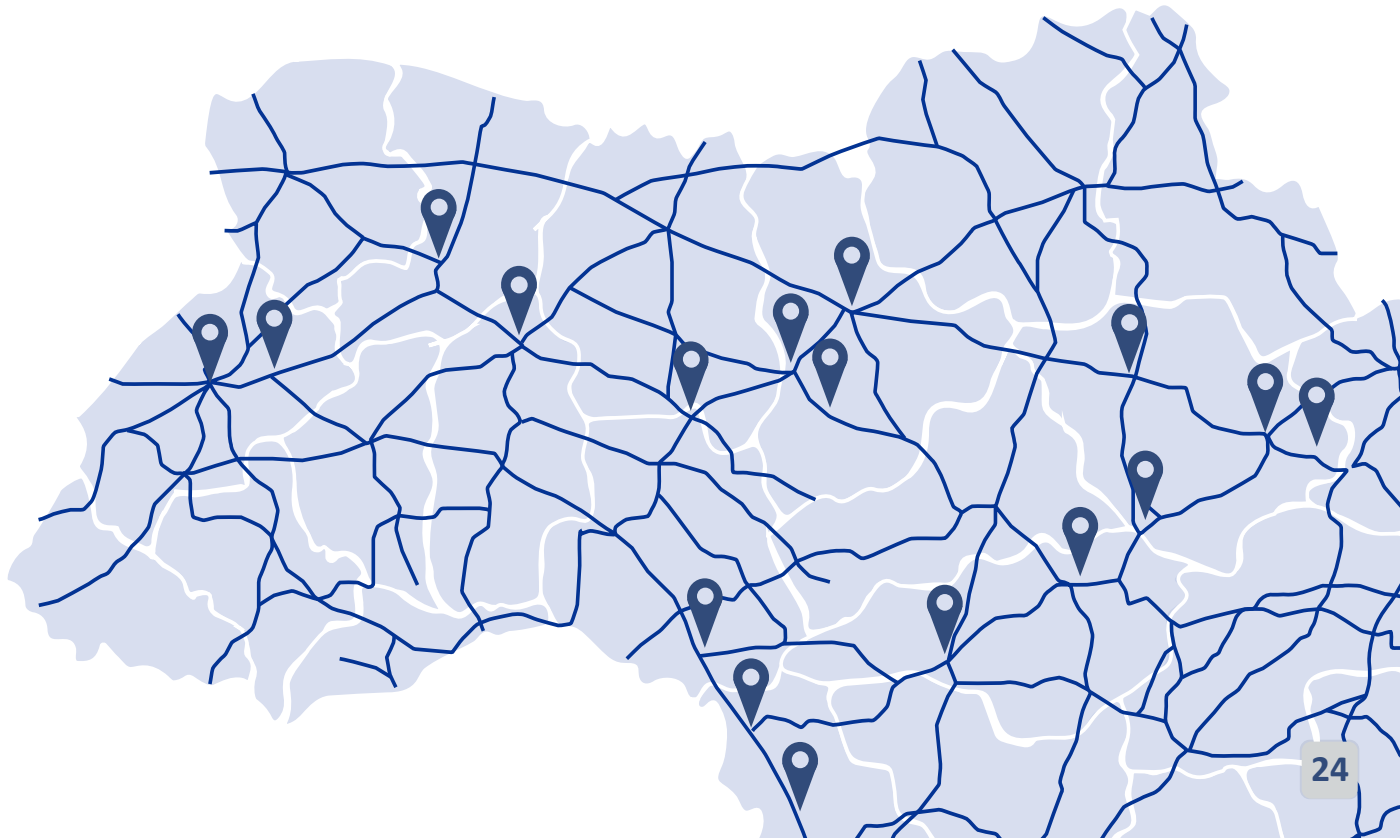


4203 track circuits



Computer-based centralized traffic control system ImProROUTE:

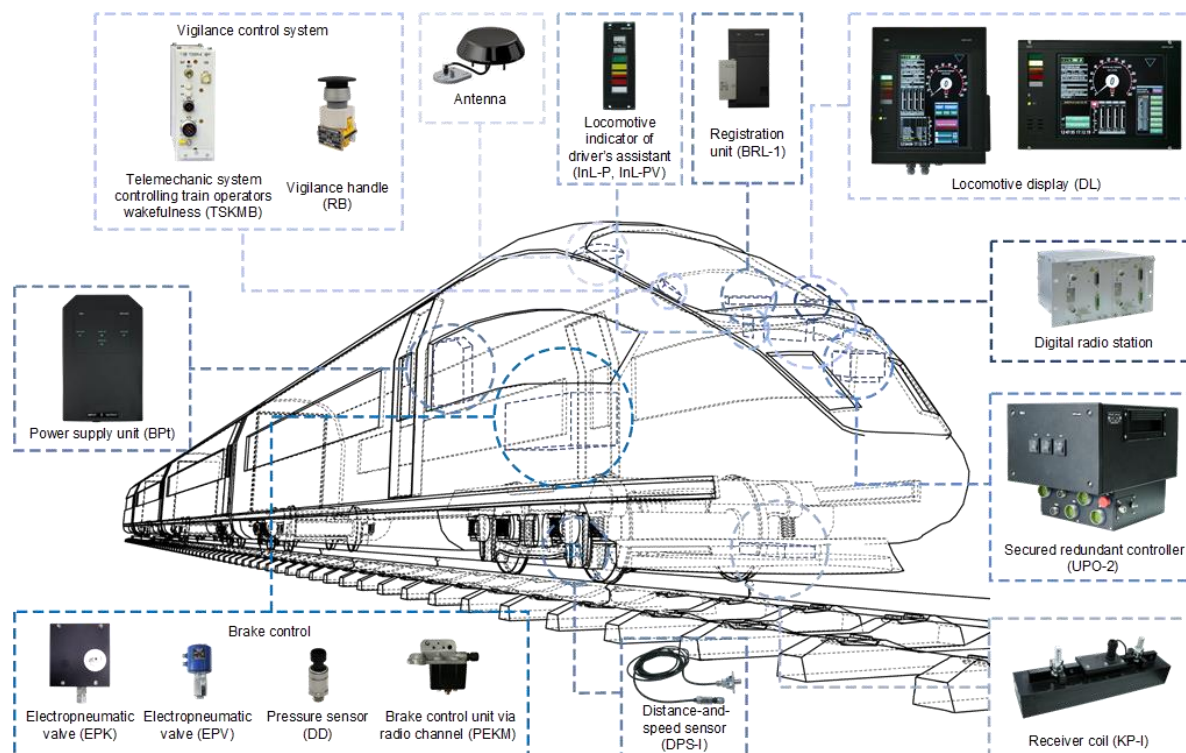
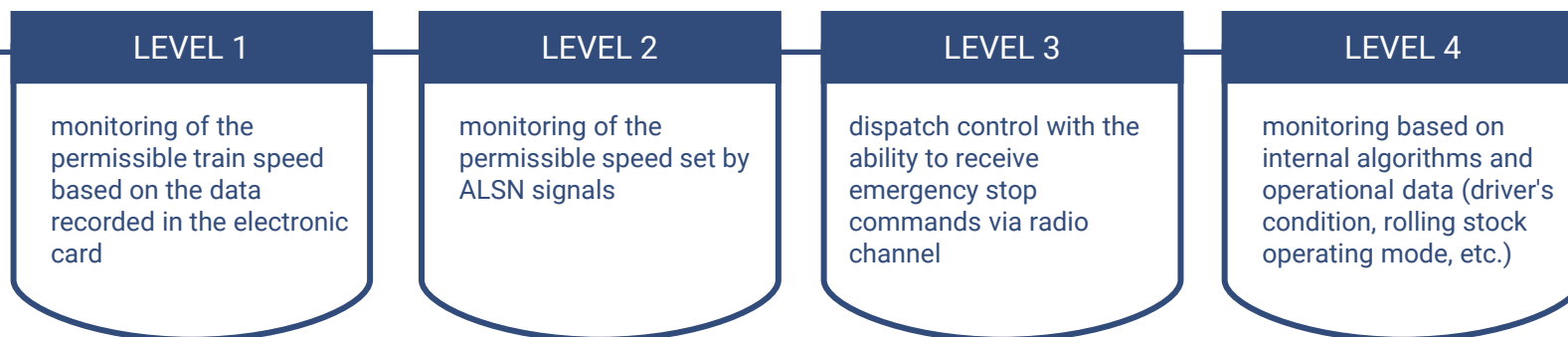
- Obkhidna – Perelioty section
- Pomichna – Chornoliska section
- Poltava-Southern – Kremenchuk – Burty section
- Lviv – Krasne – Zdolbuniv section
- Zdolbuniv – Shepetivka – Koziatyn section
- Koziatyn – Fastiv – Kyiv section
- Hrebinka – Myrhorod section
- Podilsk – Pomichna section





ImProTRAIN provides level 4 traffic safety in accordance with the requirements of industry national standards, 1520 area and EU standards.

The system implements the principle of multi-level security:





Key Features:



Flexibility - applicable to any type of rolling stock, both new and for modernizing outdated fleets



Functional safety level corresponds to SIL 4 (frequency of occurrence of dangerous failures does not exceed one in 70 thousand years)



Communication with upper-level systems via radio channel (through a secure exchange protocol "EuroRadio" (UNISIG Subset-037) without safety risk



Compliance with standards: EN 50121-3-1, EN 50121-4, EN 61373, EN 50155, DSTU 4178, SOU 45.020 00034045 002



Cybersecurity



Technical Support (in format 24/7) and maintenance provided by the manufacturer during warranty and post-warranty period

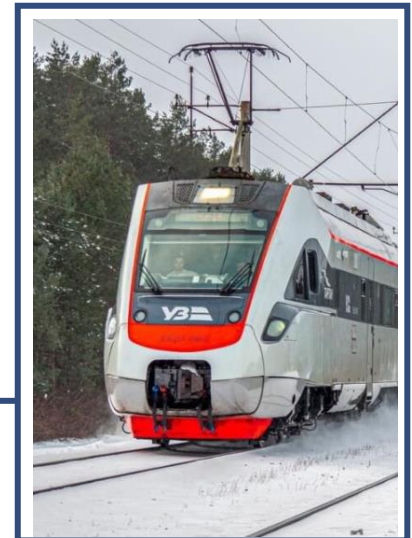
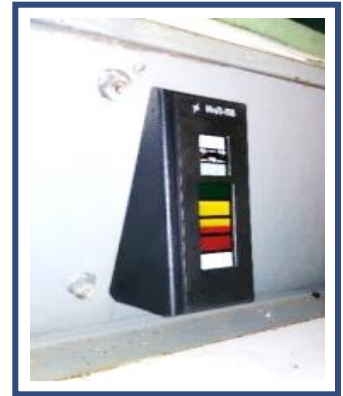
Main functions of the system:

- Constantly monitoring driving speed and triggering emergency brake application if the admissible maximum speed is exceeded
- Preventing passing of signals with prohibitive aspects with minimal losses ("targeted braking")
- Preventing unauthorized locomotive movement (rolling down)
- Generating a value of admissible maximum speed of a train using ALSN signals, radio channel data, and electronic maps
- Indication of distance to an actual obstacle with the speed required to pass it (speed target)
- Service brake application through a driver's brake valve attachment on a command transmitted through a digital radio channel (remote control of rolling stock)
- Determination of speed and coordinates of a locomotive based on information from satellite navigation devices and distance and speed sensors
- Interaction with other on-board systems of the locomotive via digital interfaces
- Adaptive driver vigilance control



ImProTRAIN are operated in Ukraine on new and modernized rolling stock:

- diesel trains DPKr-3 and DPKr-2;
- electric locomotives VL80S, VL80T, ChS8 and ChS4;
- electric multiple units EKr-1;
- diesel locomotives 2TE116;
- implementation is in progress on electric locomotives VL11, DE1, Alstom UA8AC.





ImProTRAIN are operated in Lithuania:

- on diesel locomotives 2 M 62 and ER 20 (manufactured by Siemens) in LTG Cargo;
- on a track-testing car (a joint project with TESMEC RAIL S.R.L., Italy) at LTG INFRA;
- on diesel locomotives TEM 2 UM 1000 manufactured by LTG TECH;
- on self propelled rolling stock APV 520 (manufactured by SVI S.P.A., Italy).

Contracts have been concluded for the modernization of the entire rolling stock fleet of JSC “Lithuanian Railways” including the supply of 186 systems.





Modernization of rolling stock at Lietuvos geležinkeliai AB (LTG AB)

15 locomotive safety systems ImProTRAIN have been already implemented on rolling stock of the following types:



- KTD – multipurpose rolling stock intended for construction, maintenance and major repairs of electrified railway lines;
- MPT-6 – diesel switcher;
- Plaser EM140 – motor track measurements car (Plasser & Theurer);
- WM-15S – draisine (ZNTK Stargard);
- ADM-1s – diesel railcar for mounting and construction;
- ADM – diesel railcar for mounting;
- AGRC-1200 – self-propelled railway draisine intended for construction and maintenance of railway lines.

The personnel who will operate this system have already undergone training on actual equipment, and certificates have been issued confirming their competence to operate the specific system or equipment.





Modernization of rolling stock at Lietuvos geležinkeliai AB (LTG AB)

Currently, within the framework of agreement with LTG Cargo 111 system are being implemented on rolling stock of the following types:



- ER20CF – mainline diesel locomotive (Siemens AG);
- TEM-LTH – shunting diesel locomotive (CZ Loco, a.s.);
- ČME3M – shunting diesel locomotive (ČKD Praha);
- TEM-TMH – shunting diesel locomotive .



Within the framework of agreement with LTG Link replacement of 35 systems in following rolling stock is planned:

- 620M – rail bus (rail car) (PESA Bydgoszcz SA);
- 630MiL – diesel multiple unit (PESA Bydgoszcz SA);
- 730ML – three-car diesel multiple unit with hydraulic transmission (PESA Bydgoszcz SA);
- EJ575 – double-decker AC electric multiple unit (Škoda Transportation).

ImARIS is a comprehensive solution for an intelligent rolling stock diagnostics and monitoring system.

- Modular wayside diagnostic equipment (checkpoint and station equipment).
- Flexible and multi-level centralization for monitoring.



HBD – Hot Box Detection

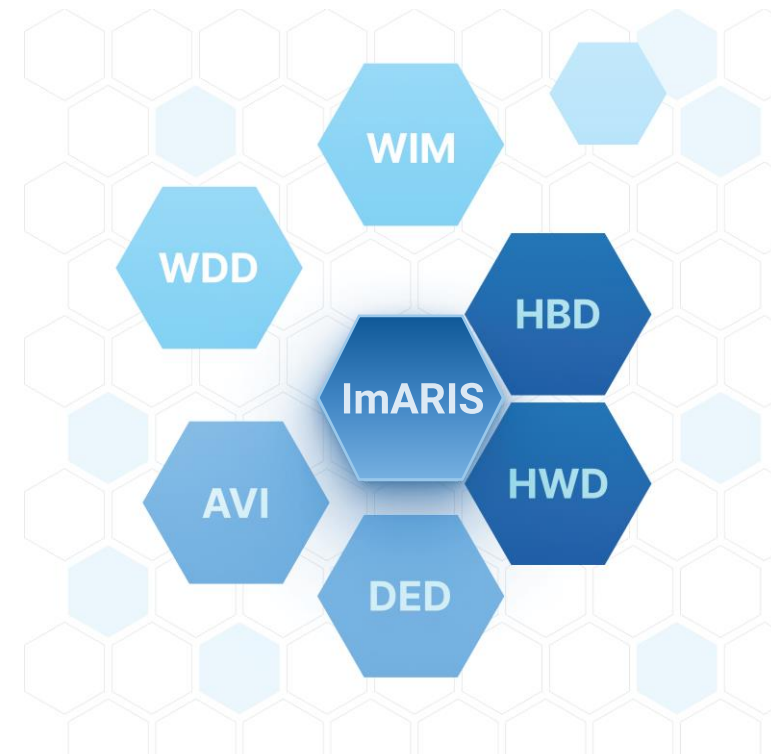
HWD – Hot Wheel Detection

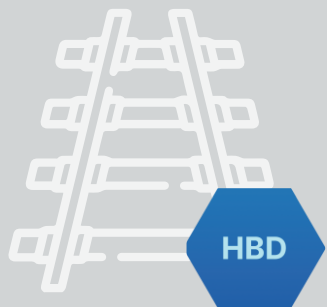
DED – Dragging Equipment Detection

AVI – Automatic Vehicle Identification

WDD – Wheel Defect Detection

WIM – Weighing In Motion

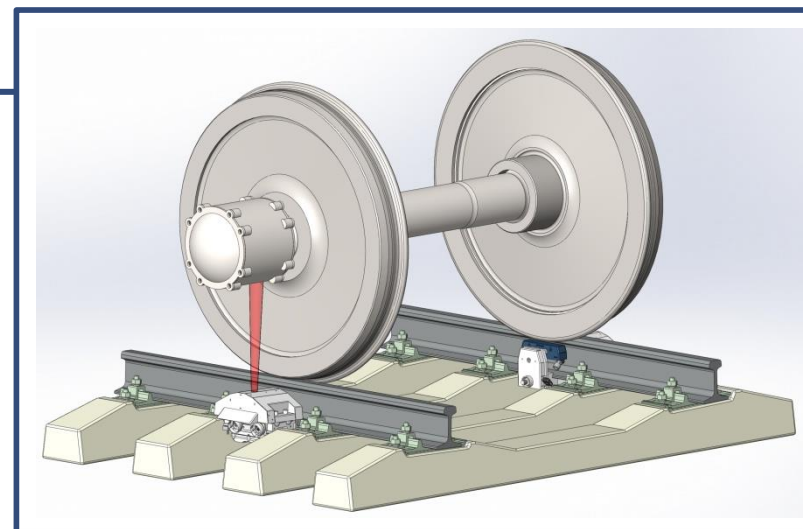




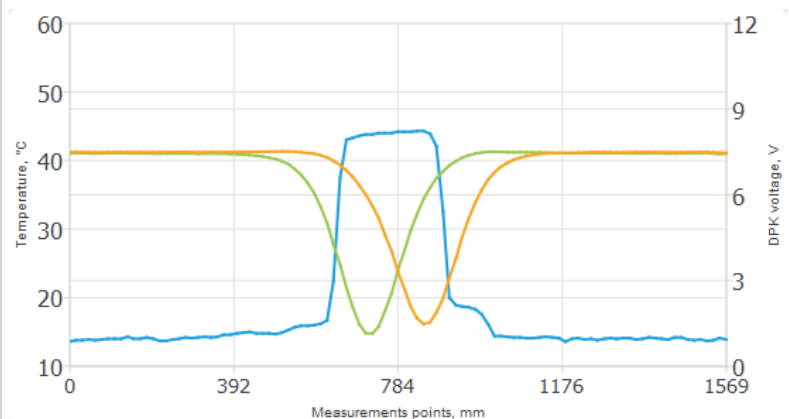
Hot Box Detection (HBD)

Bearing defects and brake system failures are the most common rolling stock failures.

Bearing defects are indeed dangerous as they cause rapid heating of a wheelset axle journal which may lead to its brake and derailment of the train. Economic losses from such incidents can reach millions of euros.

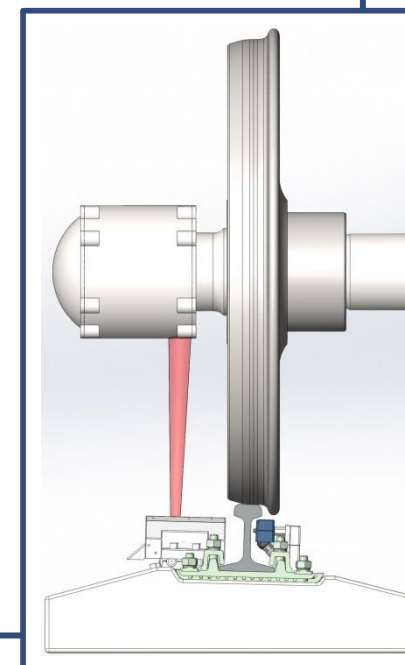


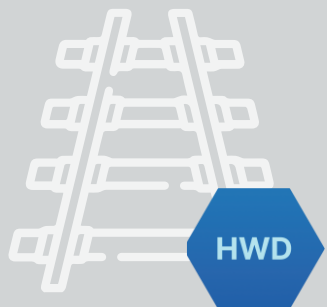
HBD function is used for checking the axle box heating due to bearing fail



ImARIS allows the operator to view the temperature profiles of each axle box*. This feature helps to minimize the waste of resources on false positive alarms/warnings.

**only temperature profiles where alarm or warning were recorded are stored on a long-term basis.*

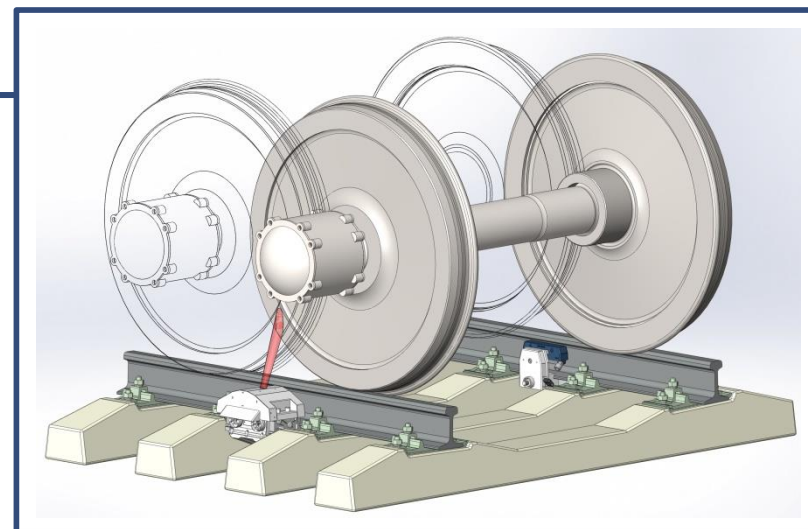




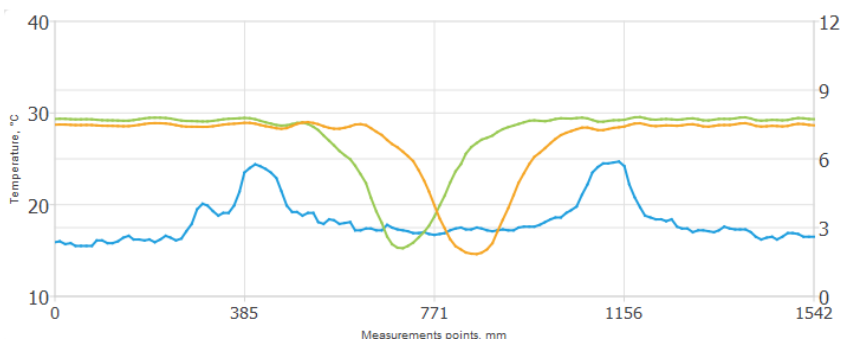
Hot Wheel Detection (HWD)

Another rolling stock issue is a brake system failure (jamming or wearing out of the pads). If the brake pads are jammed, they wear out quickly and increase fuel/energy consumption for traction. In some cases, significant heating of the wheel rim can be a fire hazard.

ImARIS allows you to measure the temperature in the rim area, the area that heats up the most when the brakes are stuck.

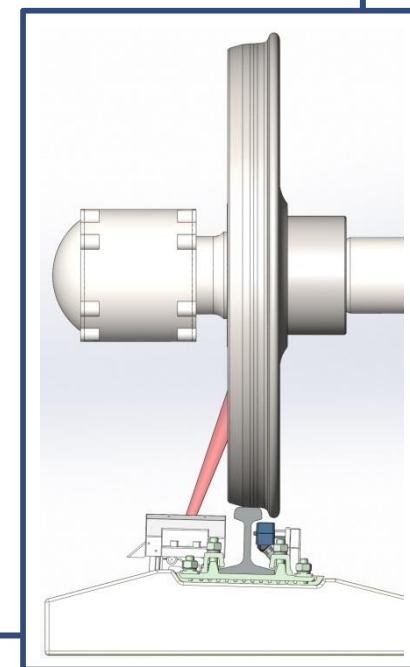


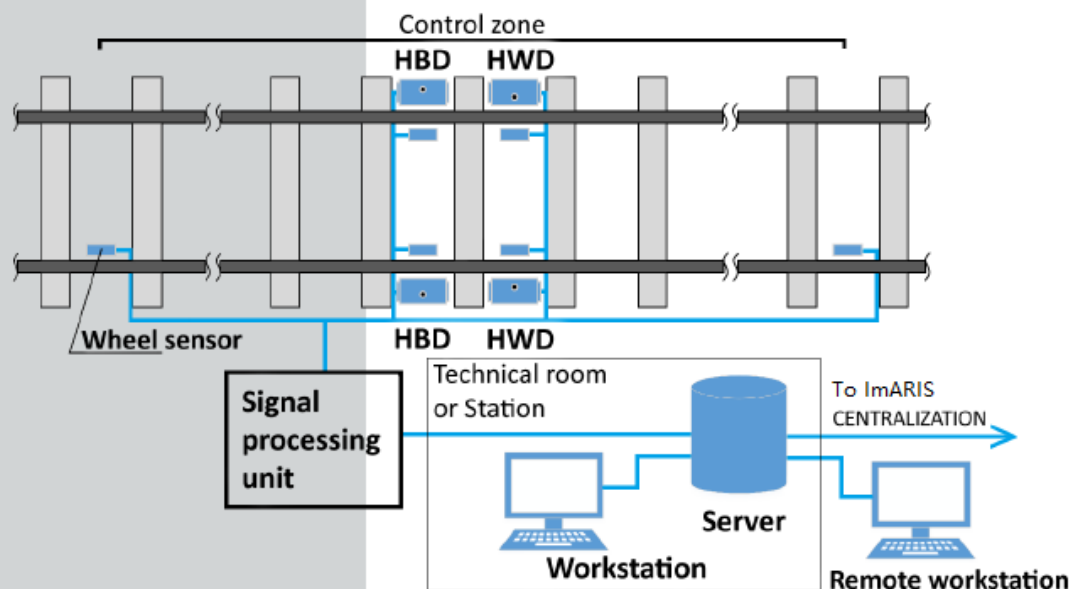
HWD function is used for checking Wheel Disk heating due to jammed brake pads.



ImARIS allows the operator to view the temperature profiles of each wheel disk*. This feature helps to minimize the waste of resources on false positive alarms/warnings

**only temperature profiles where alarm or warning were recorded are stored on a long-term basis.*





Checkpoint equipment

- **HBD** measures the temperature of the axle boxes
- **HWD** measures the temperature of the wheel disks
- **Signal Processing Unit** collects and processes the measured data and stores the data until transferring it to the server

*The **Signal Processing Unit** has a built-in uninterruptible power supply function (8 h. minimum).*



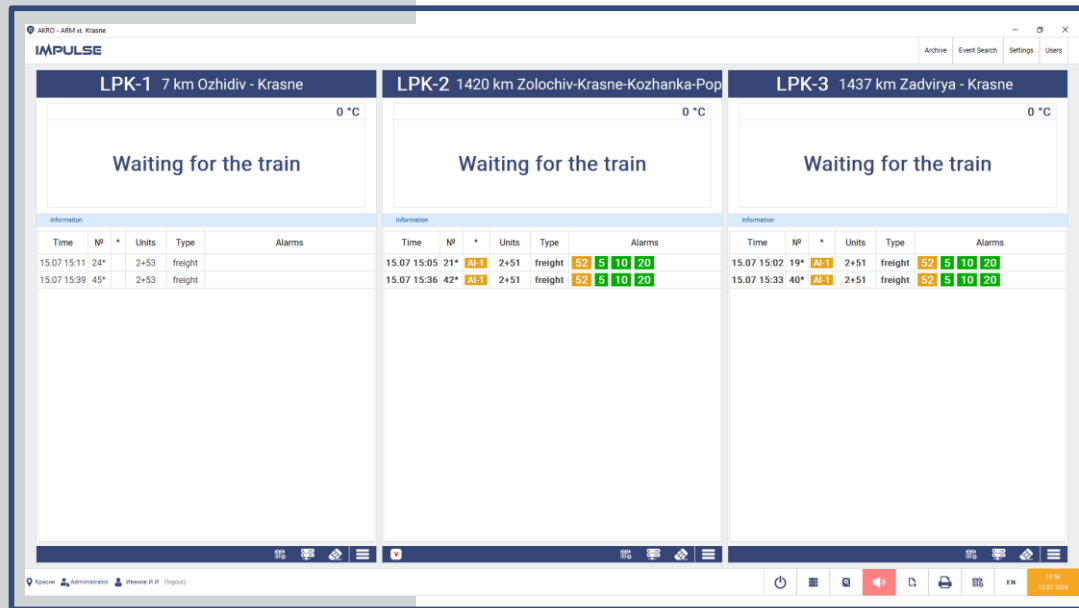
Station equipment

- **Server***
- **Workstation** is one or some industrial workstations*

*The **Workstation** can be connected to the Server via a local network or remotely.*

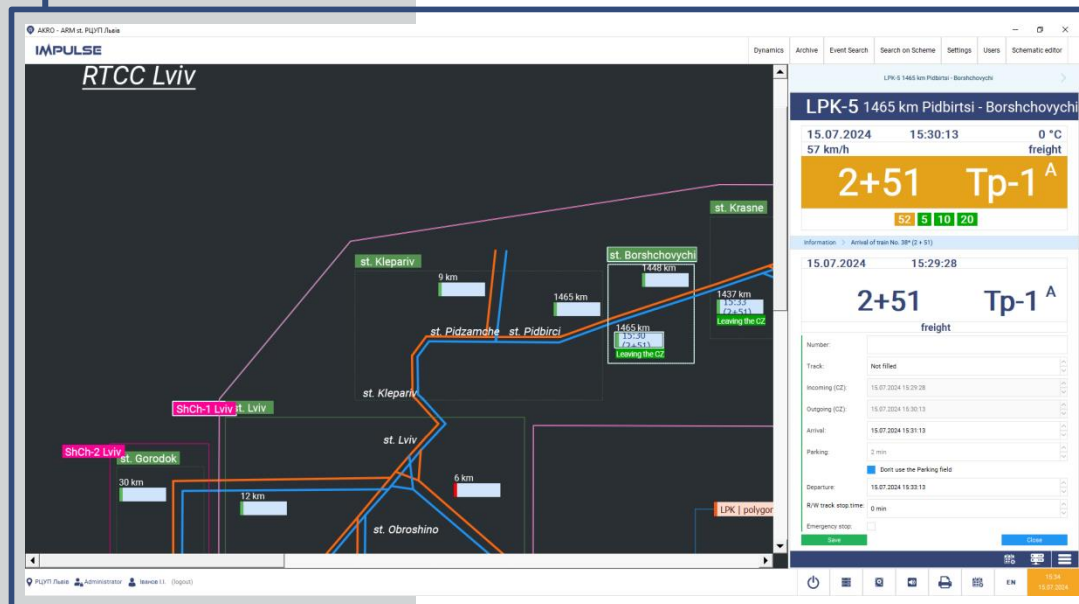
** **Server and industrial workstation** are supplied as standard with passive cooling.*





ImARIS software –
an intelligent diagnostic tool

ImARIS allows the station dispatcher to operate up to 4 sets of ImARIS checkpoint equipment at one workstation



ImARIS-C software –
an intelligent monitoring (centralization) tool

ImARIS-C allows you to implement a centralization system for servicing a railway section, regional or national railway



Automated rolling-stock inspection system ImARIS:

- The contract with JSC “Ukrainian Railways”: 40 checkpoints (2023)
- The contract with “Ukrainian Railways”/EBRD: 217 checkpoints (2023-2026)





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