AŽD PRAHA — SAFELY TO YOUR DESTINATION

REPORTER

SPECIAL EDITION | 2018

AŽD PRAHA

EDITORIAL

Dear Colleagues,
Dear business partners,

let me take the liberty of thanking you, within this special edition of our internal magazine Reporter-Special Edition, for the cooperation and loyalty which you have devoted to our company. We have been on the market of signalling systems and technologies for more than 60 years, and this itself is very binding for all of us. Our primary task is to increase transport safety and to protect human lives in railway traffic, and this means keeping up with development trends, which have rapidly changed during more than half a century. All the more I highly appreciate your support and enthusiasm which is the motive power of our company and creates also an important competitive advantage.

Since 2002, we have been actively operating in 15 countries all over the world and the development of foreign activities is currently one of the most successful attributes of the company. The proportion of foreign trade balance varies currently from 20 to 30% of the total turnover, and projects in Belarus, Serbia, Montenegro, Lithuania, Bosnia and Herzegovina, Poland, Bulgaria and Turkey play an important role in the company development. In addition, such terms as "SPEED, SAFETY and RELIABILITY" remain the main objective in the execution of our projects. However, AŽD Praha pays attention not only to the railway industry. The other field where we remain very active is the field of road and metro technology.

In recent years, we have together proved that reliability and teamwork always finds its use and evaluation on the market. I believe that the strategy set by the company will bring us further important successes in the future and will also show to new customers that cooperation with AŽD Praha will be rewarding.

Zdeněk Chrdle
General Director and CEO

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international references

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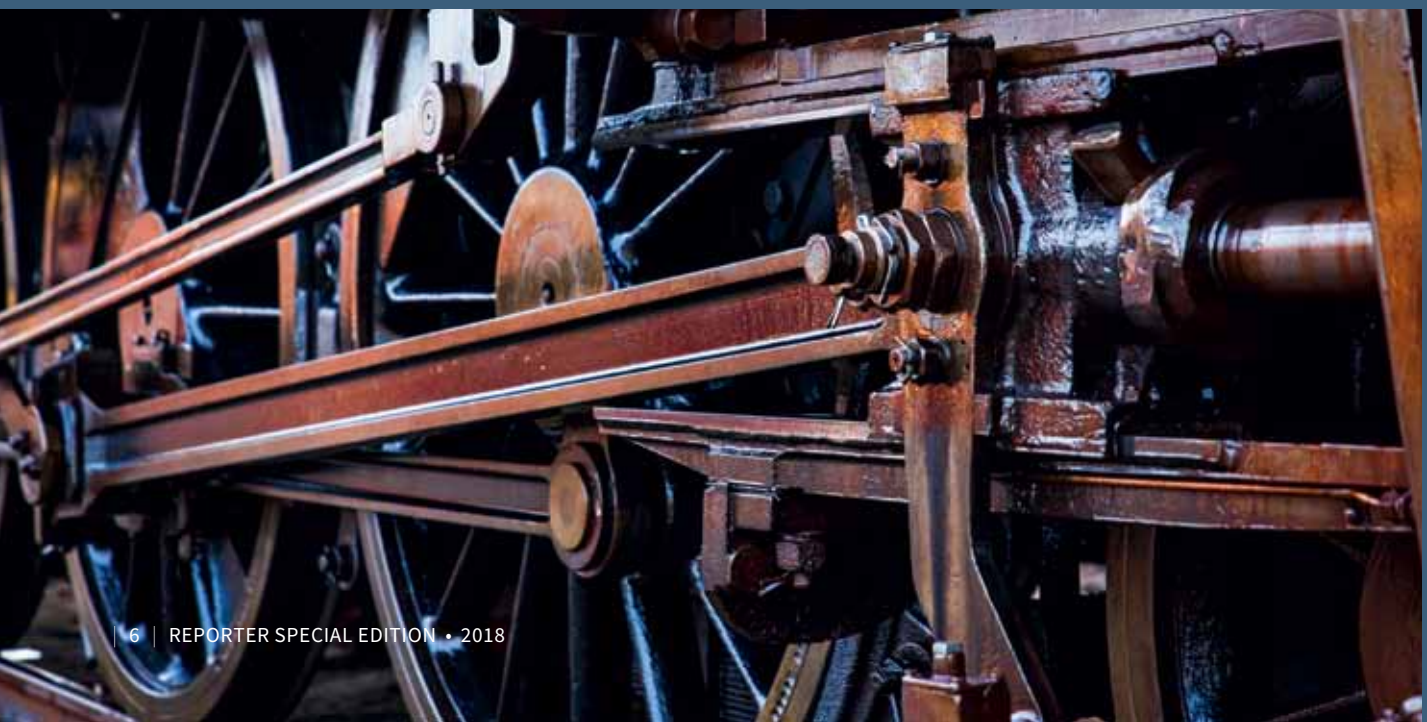
Safely to your destination

Through the Lens of Photographer Petr Dobiášovský

The Plum Line Engulfed in Steam

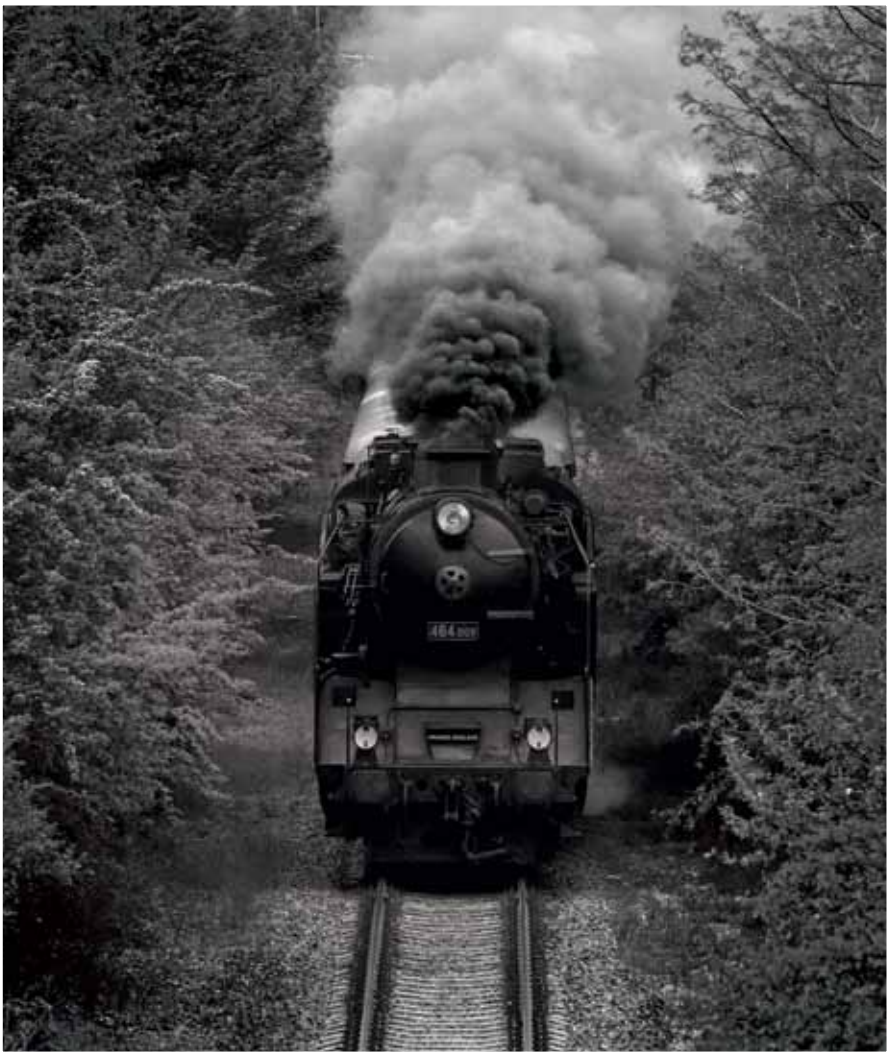
After 17 years, steam rides have returned to the so-called Plum Line, specifically the line no. 113 Čížkovice – Obrnice. Two steam rides took place – on Good Friday in March, when the Všudybylka 354.195 steam locomotive was deployed, and on Labour Day in May, when the Bulík 464.008 steam locomotive was used. It is no surprise that both events attracted hundreds of people. People were not only on the train but there were also dozens of fans with cameras recording the extraordinary ride along the line, which the state sold as an obsolete property to AŽD Praha in 2016.

Since then, massive repairs have taken place and the once-almost-cancelled local line has become a showcase regional railway.



The proof of this is that the repaired railway station in Třebívlice won second place in the competition «The Most Beautiful Railway Station» in 2017. This is a nice present for its 120th anniversary celebrated this year – regular operation on this line started on December 19, 1898.

"We are gradually fulfilling everything we promised when we bought the line. We are repairing the line to be in 100% shape and installing the necessary interlocking and communications technologies to test the technologies developed and manufactured by our company. By installing technologies that can only be found on the main or corridor lines, the Plum Line will become a state-of-the-art regional railway in Europe. At the same time, we undertook to restore rail traffic on the line no. 113. Today, we operate weekend tourist trains. However, we would like to restore regular rail traffic in cooperation with the Ústí region. We are doing our best to make it happen. By repairing and installing modern technologies, we will reduce the travel times to be under the required one hour and at the same time we are working on the acquisition of modern motor units," says Zdeněk Chrdle, CEO of AŽD Praha.



Who is ...

Petr Dobiášovský

He's a 39-year-old graphic designer by education and profession who started photographing about thirteen years ago with the arrival of accessible and quality digital photography. Originally, in addition to free work he was devoted mainly to advertising and product photography. He started with railways when he arrived at AŽD Praha. With his photographs he contributes especially to the magazine Reporter, internal newspaper, you could see several of his photos in AŽD Praha calendars with singer Kristína. In addition to photography and graphic design, he has been collaborating on preparing Pozor Vlak (The Train), a video magazine and is, for example, also the author of Reporter magazine covers.

Depot in Ankara, Turkey

is Controlled by AŽD Praha Systems

TEXT: **JAROSLAV SPOUSTA, ING. JIŘÍ ŠIMEČEK** | PHOTO: **ING. JIŘÍ ŠIMEČEK**

In the next photo report of the REPORTER magazine covering AŽD Praha foreign projects, we visit Ankara, the capital of Turkey, where our company successfully completed a contract at the Ankara railway depot under the official name of Ankara High Speed Train Station SIGNALIZATION SYSTEM WORKS.

↑ *View of the railyard of the Ankara railway depot*

↓ *One of the maintenance halls for high-speed train sets close to completion*

The subject of this project was the supply of an ESA 44-TR station interlocking system, UNZ power supply system, KOA-1 track circuits, signals with LLA-2 LED lamps, EP 600 series point machines and other AŽD Praha devices and equipment such as impedance bonds including complete cabling. During the implementation of this project, AŽD Praha fulfilled all the specific requirements of the end-user TCDD (Turkish State Railways). One of many of these requirements is the development, delivery and installation of a three aspect indicator, which will inform the train driver on the number of the destination track when entering the depot.

← *ESA 44-TR Station Interlocking System*

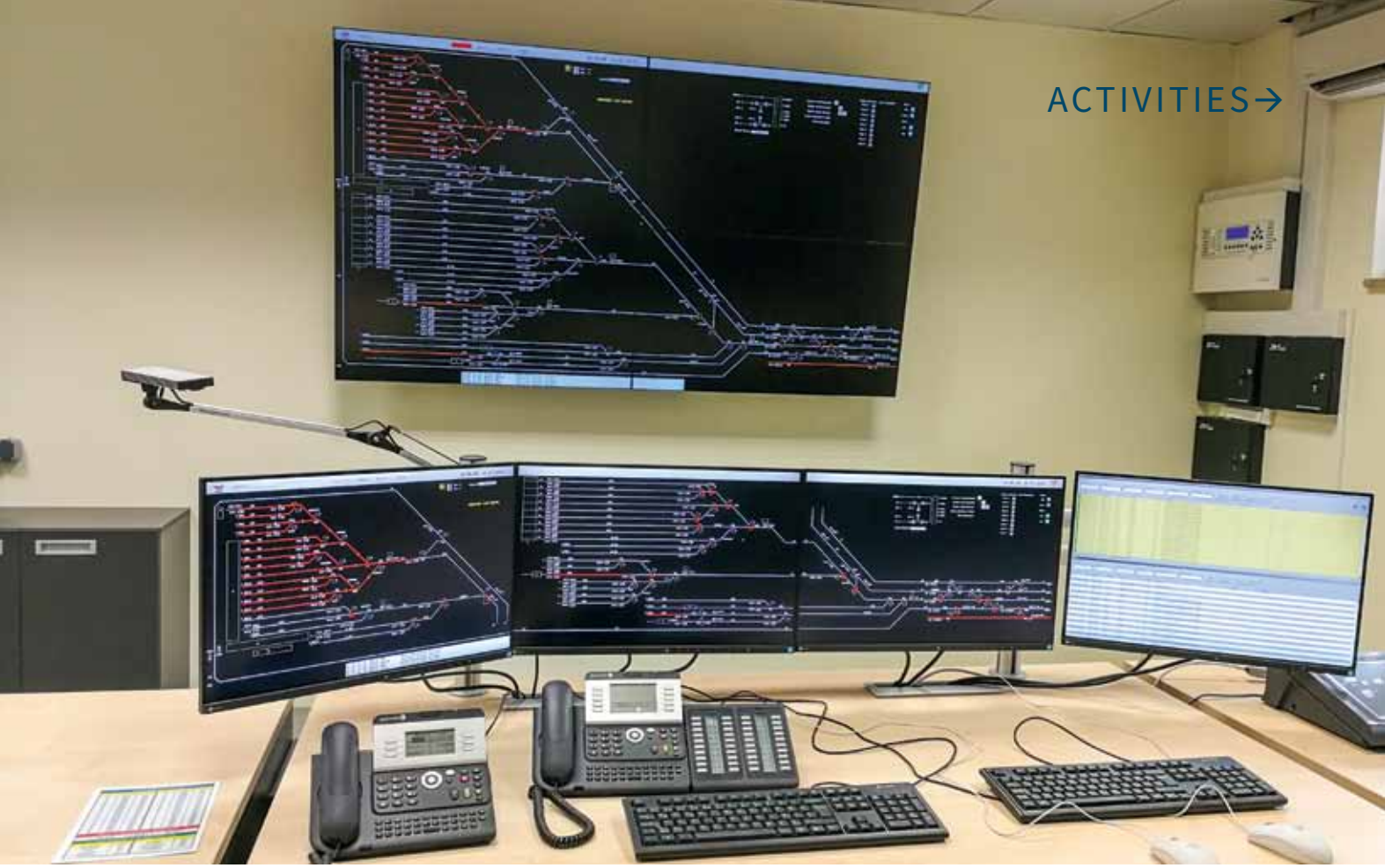
→ *Comprehensive testing of the ESA 44-TR*

→ *TCDD administrative building – depot management and traffic control centre*

← *Battery installation*

→ *Real operation of the depot in Ankara, Turkey*

← *Installed LLA-2 dwarf signals with LED lamps*



The whole complex of the Ankara depot was built on the site of a former sugar factory. The photo report describes the construction process including the technological part. The TCDD end-user representatives have repeatedly appreciated the will and compliance of AŽD Praha to adapt the delivered equipment to their specific requirements and operations.

Banja Luka–Doboj

TEXT: **ING. IVAN TUHÁČEK PH.D., JAROSLAV SPOUSTA** | PHOTO: **AUTHORS OF THE TEXT**

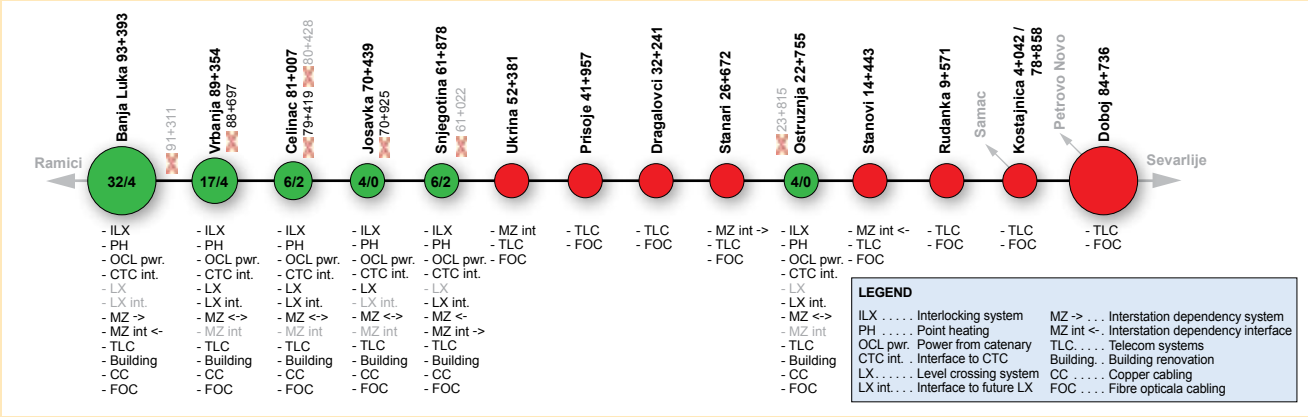
An important foreign project of AŽD Praha is the interlocking of an approximately 100 km-long line in Bosnia and Herzegovina. The project has been called SIGNALLING-TELECOMMUNICATION SYSTEM along Railway line Banja Luka – Doboj. This line was built in 1951 by Yugoslavian youth work brigades, who helped with the renovation of infrastructure during and after World War II.

↑ *Reconstruction of the station building at Vrbanja station*

↓ *Earthworks and cabling at Ostružnja station*

The contract includes the following main works:

1. Delivery and assembly of the ESA 44 – BH interlocking system in Ostružnja, Snjegotina, Jošavka, Čelinac, Vrbanja, and Banja Luka stations. Works include also renovation of railway station buildings (often in a state of disrepair), installation of switch-point heating and the connection of power supply both from the public mains and from the catenary system.
2. Delivery and installation of three level crossing systems.
3. Delivery and installation of telecommunications equipment in Doboj, Kostajnica, Rudanka, Stanovi, Ostružnja, Stanari, Dragalovci, Prisoje, Ukrina, Snjegotina, Josavka, Celinac, Vrbanja, and Banja Luka stations.



↑ *Line diagram*

4. Laying of fibre optic cables along the whole line (approx. 100 km) between Doboj and Banja Luka stations.

The scope of works is illustrated by this graphic. In the green stations, a new interlocking system from AŽD Praha has been installed; red stations are those where no works on the interlocking systems were carried out. Numbers in ringlets indicate the number of points / derailers in the station

Tests of installed equipment are currently underway. For AŽD Praha, the most important is the intent of the client – Železnica Republike Srpske – to establish a system of remote control of the installed interlockings.

Works on the Banja Luka – Doboj line interlocking began in July 2015 and the estimated completion date is 30th August 2018. The photo report shows not only changes to the individual buildings but also the progress of the installation of the technological parts. Through this contract AŽD Praha has strengthened its position in the Balkans and is committed to intensively strive for further contracts related to the renewal of railway infrastructure in this part of the European continent.

↓ *Installation of the ESA 44 – BH station interlocking system in Banja Luka station*

↑ *Pilot installation of the hydraulic point machine on a solid fixing set*

→ *Installed sensor of axle counter and INDUSI magnet in Ostružnja station*

Belarus:

The Country of Massively Modernizing and Expanding Railway Infrastructure

TEXT: **JAROSLAV SPOUSTA** | PHOTO: **ING. JIŘÍ MACOUN**

The Belarusian Railway celebrated its 155th anniversary this year. Just for the sake of interest, the first opened railway line was the Porečje – Grodno section as a part of the Saint Petersburg – Warsaw line. Today, the Belarusian railway infrastructure has roughly 12,000 km of tracks with an unusually wide gauge of 1520 mm, with 12,400 points, 1,903 bridges and overpasses as well as 1,750 level crossings. Every year approximately 190 kilometres of railway infrastructure are being modernized; also with the help of the Czech company AŽD Praha.

Belarus, officially the Republic of Belarus (Belarusian: Рэспубліка Беларусь; Russian: Республика Беларусь), is a landlocked country in Eastern Europe bordered by Russia (900 km) to the northeast, Ukraine (975 km) to the south, Poland (407 km) to the west, and Lithuania (660 km) and Latvia (167 km) to the northwest. Its capital is Minsk.

Source: Wikipedia

↑ *Railway office in Stěpjanka station*

↓ *Railway office in Obol station*

In this photo report, we show a brief overview of interesting projects of AŽD Praha in the last ten years. These include, for example, interlocking of Polock, Stěpjanka, Novopolock railway station, interlocking of Vitebsk – Polock, Minsk severnyj – Ždanoviči, Osipoviči – Žlobin, Žlobin – Gomel railway lines and interlocking of the Žlobin railway hub.

The subject of AŽD Praha deliveries was mainly the installation of the ESA 44-BC station interlocking system, UNZ power supply system, and the ABE 1-BC line block system and recently the Czech company has also been successful with the PZZ-J level crossing system on the Belarusian market.

Thanks to its features, this new type of level crossing system enables interlocking up to

8 level crossings through one control core up to a distance of 25 km from the core. PZZ-J consists of a control core and intelligent peripherals. The intelligence of the peripherals consists in the fact that each of them is actually a separate small interlocking device that is itself responsible for its activity and only receives command signals from the control core which determine its behaviour.

↑ *Railway office in Novopolock station*

←← *TPC and DOZ cabinets in Novopolock station*

← *TPC and DOZ cabinets in Uza station*

This means whether the warning board has to indicate a train approaching the level crossing or has to blink white, and also whether the barriers are to be lowered to close the level crossing or vice versa.

The successful campaign of AŽD Praha in Belarus can be underlined by the current preparations for large deliveries and installation of technologies in the modernization of Kalinkoviči and Gomel railway hubs. In the photos above, you can see for yourselves the work that our company performed in Belarus in the last few years.

The Belarusian market has huge potential in terms of railway infrastructure modernization and our company will continue to strive to acquire further significant contracts in this country.

Installation of New Split

Hollow Sleepers with Flange Point Machines in Malaysia

TEXT: **PETR ŠTĚPÁN, ING. JOSEF ADAMEC** | PHOTO: **PETR ŠTĚPÁN**

The fact that the foreign activities of AŽD Praha have been gaining in volume in recent years is evidenced by a number of articles not only in the magazine REPORTER, but also in other commercial economic titles. It is especially interesting wherever the Czech company competes for new markets. One of the last pilot installations took place in Malaysia. It was the installation of new split hollow sleepers and flange point machines on a two-lock point No. 115, which connects the depot of the KLIA Ekspres high-speed railway.

In the introduction, it should be noted that the installation itself is the result of long-term cooperation with the high-speed railway operator. Thanks to this collaboration, we have already implemented two test installations of our new products. As a first step, we installed a point machine with an internal lock function in the depot. The system has been working for two years without any problems. The second step is the currently completed installation of hollow sleepers and point machines on the point No. 115, type UIC54-1:14-760.

New narrow split hollow sleepers are the main part of the whole solution. These were designed and engineered at VP07 Kolín. The hollow sleeper replaces one concrete sleeper and it does not require changing or modifying the distance between sleepers. Two variants are designed, the first as a single piece and the second variant (the one installed) as a split sleeper. The split sleeper has been designed for installation in confined spaces, such as bridges or tunnels. Another benefit is the weight distribution as the whole sleeper weighs approximately 320 kg. This also facilitates handling and installation.

The installation itself was carried out by a team of VP07 employees, mainly in the role of expert supervision and the customer team of E-MAS (a service organization in charge of the high-speed railway operation). On the first day, we checked the material sent from the Czech Republic to our local warehouse and we met on the night shift that night.

During this time, the existing point machines were disconnected from the interlocking system, the original sleepers were removed including the point machines and external locks. Immediately after dismantling, both our sleepers, including all covers, were assembled and installed. The sleepers were then fixed by the track staff.

By that time, we had exhausted the time provided by the night traffic closure from 23:00 to 05:00 and so the point was locked by point locks. On the same day, we continued from 11:00 to 16:00 with the installation of control rods and external locks. The next day, the point gauge was checked and adjustment was performed according to the customer's requirements. During the day, we also installed the point machines, cable heads and connected the interlocking system. After some issues with clearing out the connection of position control, the device was ready for the next day for testing. The tests carried out in accordance with the prepared schedule were successful. The last day, the respective report was checked and

approved. A meeting was also held with a local manufacturer of hollow sleepers who would produce the sleepers locally for future deliveries, saving a large portion of the costs, mostly for transport.

In conclusion, it was a problem-free installation, thanks to the perfect detailed surveying of the point, the availability of all available materials and drawings, as well as good preparation and communication with the customer. An equally important factor was the flawless production of all parts.

From the immediate reaction of the customer's representatives, it can be said that the chances of installing the same technical solution on the whole section of the high-speed railway are growing.

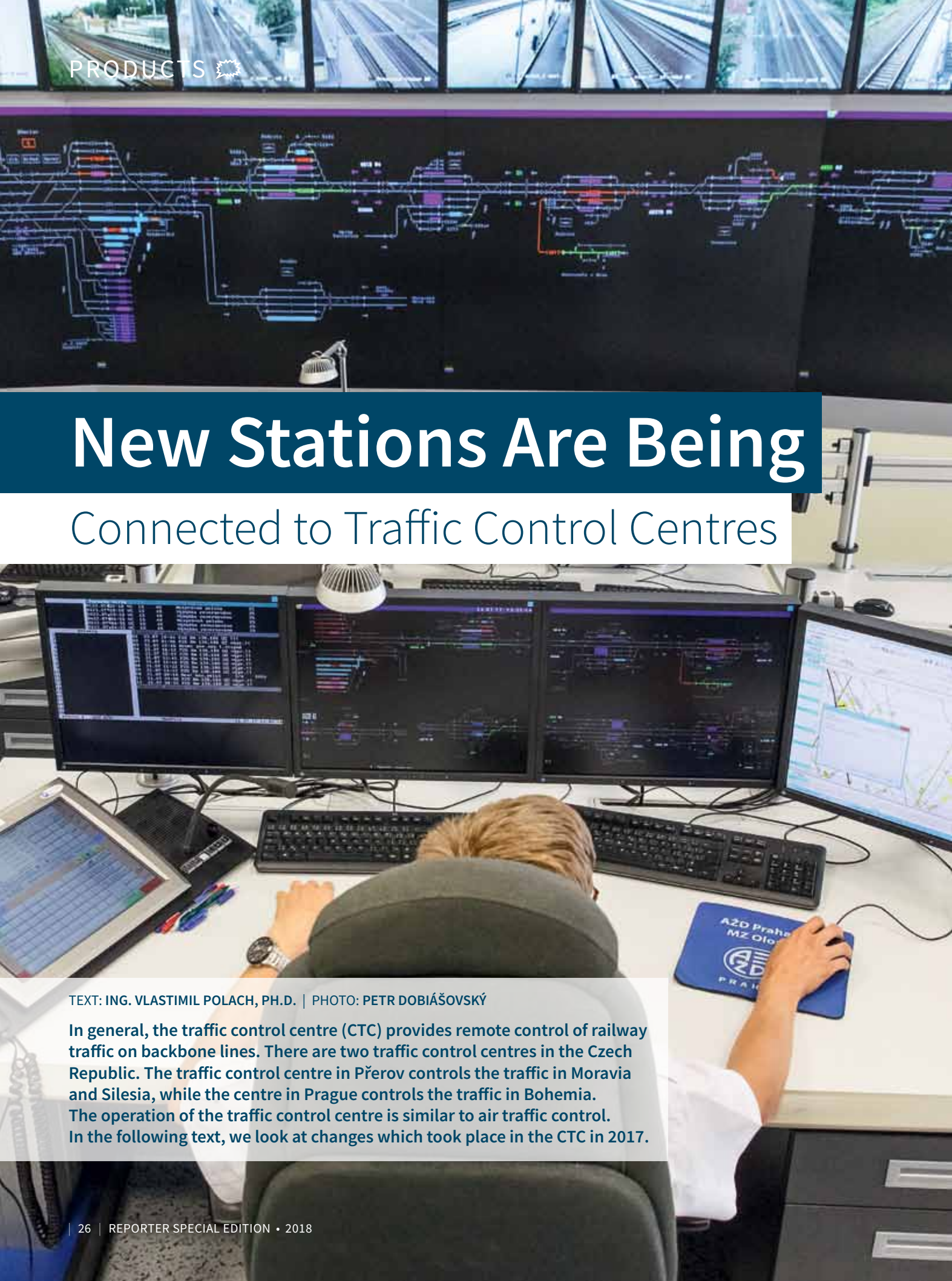
In all stations, there are about 100 point machines. Replacement of all sleepers and point machines should be carried out in several stages according to the customer's request. This installation increases AŽD Praha's chances of succeeding with this product on other lines in Malaysia run by the state-owned company KTMB.

The KLIA Ekspres is a non-stop high-speed railway for safe and fast transport of passengers between KL International Airport (KLIA) and Kuala Lumpur city centre. The line is 57 km long, the extension to KLIA 2 for domestic flights adds another 14 kilometres. The line was opened on 14th April 2002. The extension to KLIA 2 was completed in 2013 and opened on 1st May 2014. It takes 28 minutes for the KLIA Ekspres trains to travel between the city and the airport. KLIA Transit trains with three stops travel a little longer. The line has a standard 1,435 mm gauge and the whole system, including the delivery of interlocking systems, was built in cooperation with Siemens. Desiro ET 425 M Electric Multiple Units are used to transport passengers. The trains reach a speed of up to 160 kph.

Fig.: KLIA Ekspres

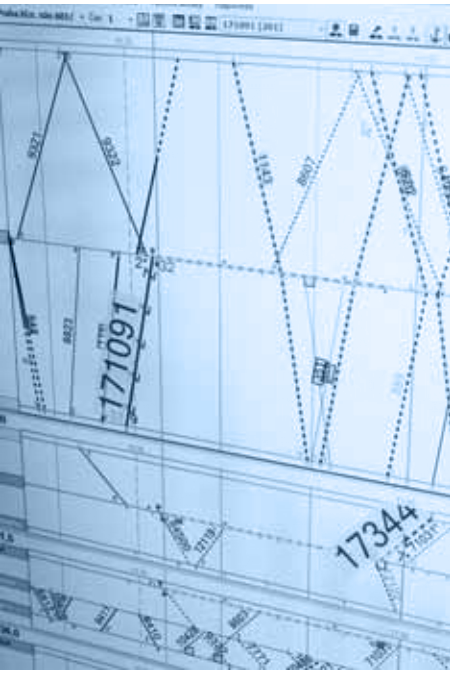
New Stations Are Being

Connected to Traffic Control Centres



TEXT: **ING. VLASTIMIL POLACH, PH.D.** | PHOTO: **PETR DOBIÁŠOVSKÝ**

In general, the traffic control centre (CTC) provides remote control of railway traffic on backbone lines. There are two traffic control centres in the Czech Republic. The traffic control centre in Přerov controls the traffic in Moravia and Silesia, while the centre in Prague controls the traffic in Bohemia. The operation of the traffic control centre is similar to air traffic control. In the following text, we look at changes which took place in the CTC in 2017.



CTC Prague

The DOZ CTC4 Prague traffic control room is designed for controlling the line from Kolín (excluding) to Kralupy nad Vltavou (excluding). Since 2016, the traffic control room has been remotely controlling the traffic in the following railway stations: Velim, Pečky, Poříčany, Český Brod, Úvaly and also Odb. Rokytka, Praha-Holešovice, Odb. Stromovka, Výh. Praha-Bubeneč, Roztoky u Prahy and Libčice nad Vltavou. In 2017, Praha-Běchovice, Praha-Libeň and Praha-Masarykovo nádraží (Prague Masaryk railway station) were connected to the DOZ and the operation has been controlled by CTC Prague dispatchers. The control stations in these three most important stations have been preserved as emergency traffic control stations. Other emergency traffic control stations were already established also in Kolín for the Velim – Úvaly section and in Kralupy nad Vltavou for the Odb. Rokytka – Libčice nad Vltavou section.

Traffic operation in Prague's northern pass is thus already centrally managed, with the possibility to respond operatively to emergencies by directly controlling the railway traffic several tens of kilometres before the Prague node. This is reflected in higher timetable stability, ability to absorb train delays, and increased capacity of the controlled tracks and the whole hub. Especially at the Praha-Libeň intersection station, it is easier to optimize concurrent train paths, thus limiting the stopping and starting of transiting trains. In brief, therefore, it is a contribution to better traffic flows and the efficiency of rail operations.

The controlled area includes 15 transport-critical traffic points. It is a corridor connecting the capital with the whole east of the Czech Republic, which is partly triple-track, and a corridor towards Germany. Because of the capital city, there is strong suburban traffic with 15-minute intervals in peaks, as well as long-distance traffic. There is also slowly growing freight transport. The high-density traffic in the whole section Velim – Praha-Libeň – Praha-Masarykovo n./Odb. Rokytka – Libčice nad Vltavou, including large nodes, is controlled by eight track dispatchers and three traffic operators. There is also an operational dispatcher and a backup dispatcher in the traffic control room.

The Praha-Bubny station will be connected to the DOZ after reconstruction of the railyard and the installation of an electronic interlocking system.

CTC Přerov

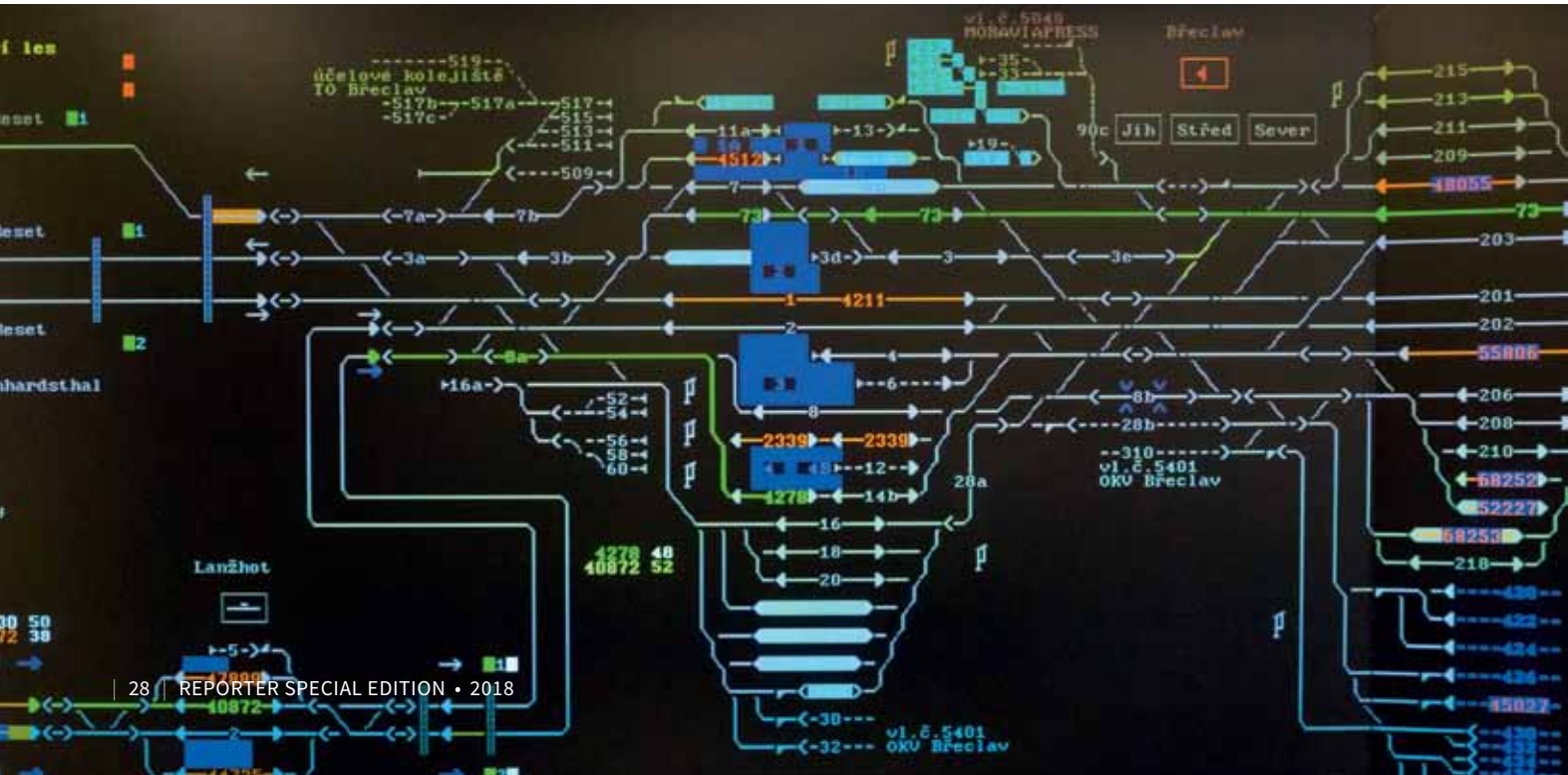
In 2017, the Břeclav hub incl. Výh. Hrušky was connected to the DOZ CTC4 Přerov traffic control room. Thus, traffic between the state border with Slovakia and Austria up to Brno can be controlled from CTC Přerov. This section includes Lanžhot, Břeclav, Hrušky, Podivín, Zaječí, Hustopeče u Brna, Šakvice, Vranovice, Hrušovany u Brna and Modřice stations. Even though the connection of such a big hub as Břeclav, incl. Výh. Hrušky, to the DOZ is a routine operation, the work had to be coordinated with the ETCS construction and it was necessary to apply a few more innovations.

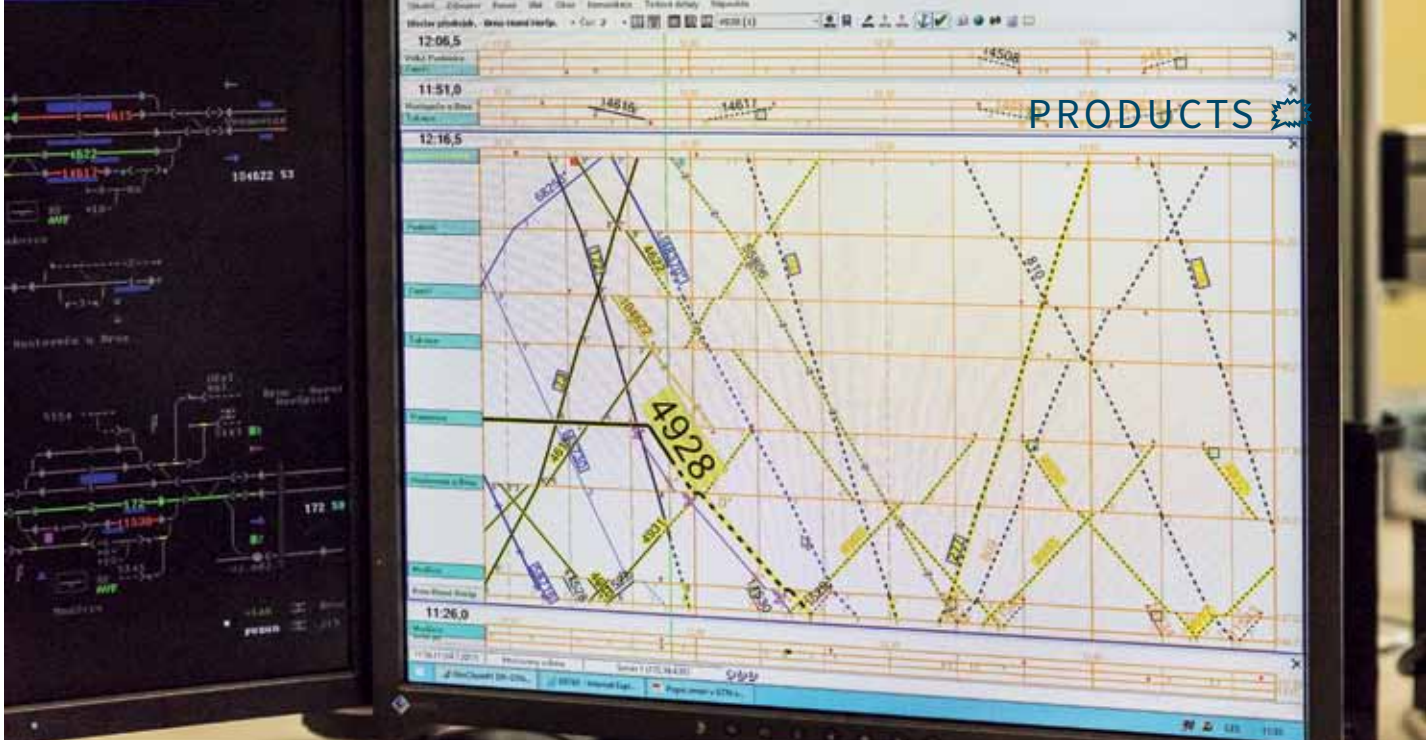
The most significant changes from the viewpoint of functional characteristics

of the control technology were due to the fact that the Břeclav station remained to be controlled from Břeclav, even after joining the DOZ, by means of local control, while maintaining all the automation functions. This solution is quite rare in the Czech Republic. Everywhere else, stations are transferred to local traffic control without automation functions. The Břeclav hub can be controlled both from CTC Přerov and Břeclav, while complete traffic control is available including data communications with neighbouring stations and information and control systems and including automatic input of incoming train numbers into the station interlocking system.

A completely new feature is the transfer of train numbers and actual departures between GTN and Austrian ARAMIS via SŽDC UIC Broker and ÖBB UIC Broker. Thanks to this, it is possible to precisely control not only the trains in the double-track corridor section Břeclav os.n. – Bernhardstahl, but also to determine more precisely the moment of crossing the state border for higher-level information systems.

A matter of course is the data exchange of train numbers, forecast and actual departures between GTN CTC4 Přerov (Lanžhot station) and GTN of the Slovak station Kúty, where the transport staff of cross-border trains do not even negotiate on the phone and communication takes place only by data. It is the same solution as previously applied between GTN Návsí (Mosty u Jablunkova station) and GTN Čadca, Slovakia.



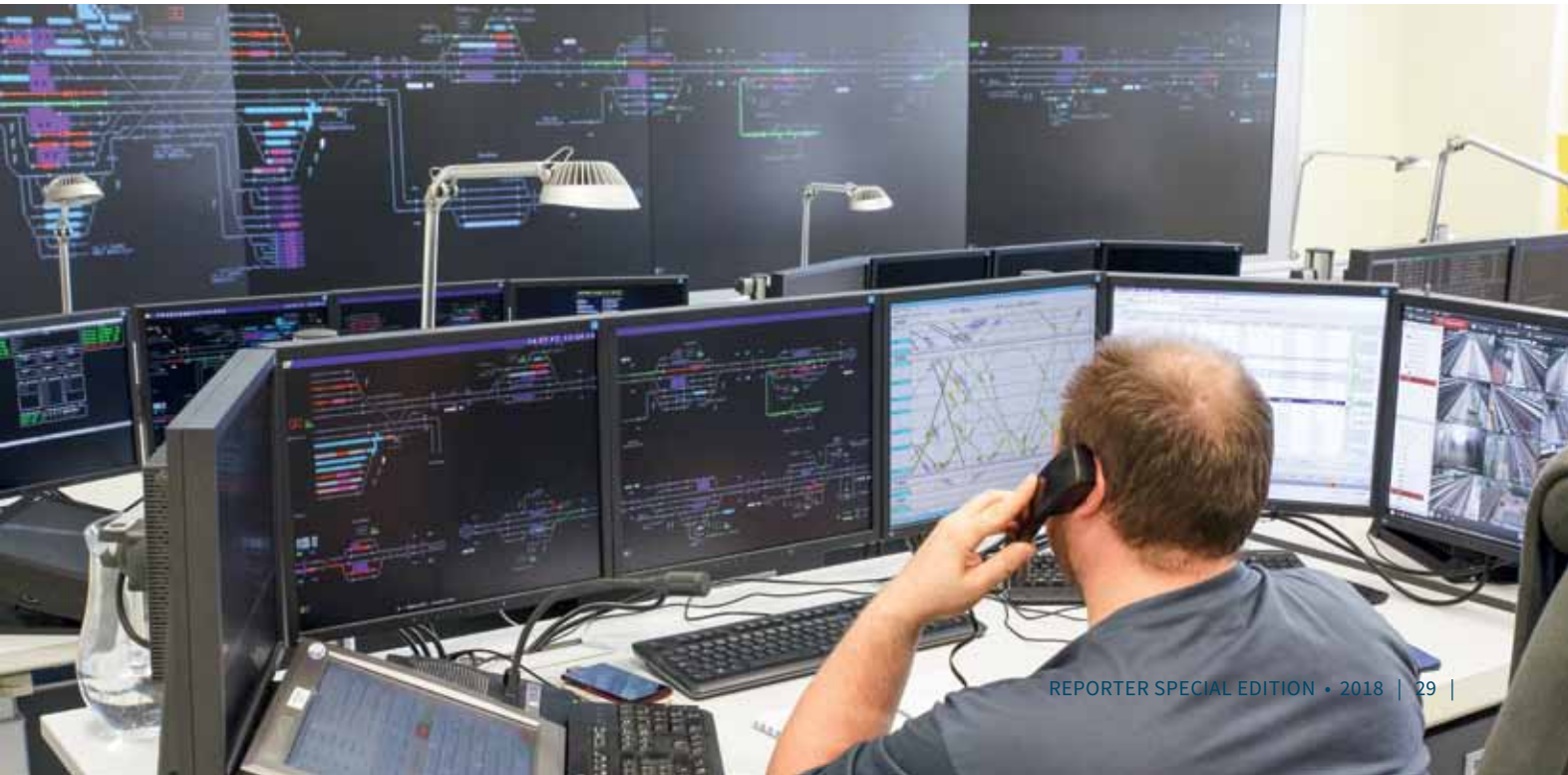


The controlled area of CTC4 Přerov includes 11 transport-critical traffic points, of which Břeclav osobní n., Břeclav přednádraží and Výh. Hrušky are controlled from Břeclav and the Lanžhot station and Podivín – Modřice section from CTC Přerov.

During peak hours, passenger trains run at 10-minute intervals from the stations near Brno. Therefore, two track dispatchers and one operator are needed in one shift at the CTC4 Přerov. Three dispatchers and one operator work in one shift in the traffic control room of the Břeclav hub. Břeclav is a border crossing station to Austria and adjoins the Slovak border crossing station Kúty via the Lanžhot station. This determines the intensity of traffic not only of long-distance passenger trains but especially of freight trains of many different, even foreign carriers.

Newly, the terminal of the ETCS Radioblock for Lanžhot – Brno – Opatov section is also located in the CTC4 Přerov. It allows line dispatchers to set infrastructure restrictions, closures, low-speed rides, and even to stop a train remotely. The ETCS terminal has been also located in the traffic control room in Břeclav.

The CTC4 Přerov (Kúty – Česká Třebová) traffic control room is dimensioned not only for controlling the Lanžhot – Modřice section, including the Břeclav hub, but it is also fitted with the equipment and large display units (VEZO) required for the future DOZ section Adamov – Opatov (Brno – Česká Třebová line).



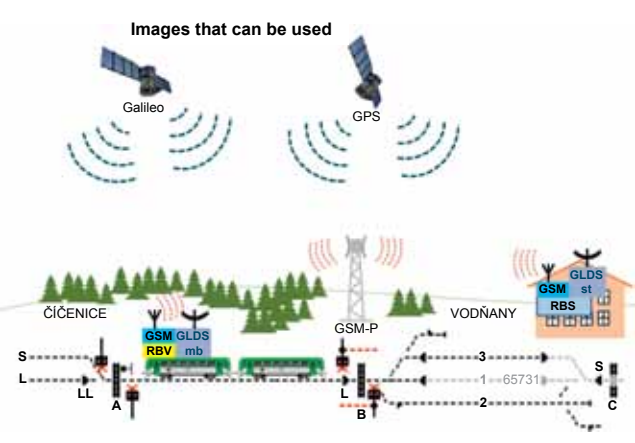
The RegioSAT Project

Enhancement of Safety of Railway Traffic on Regional Lines via Global Navigation Satellite Systems (GNSS)

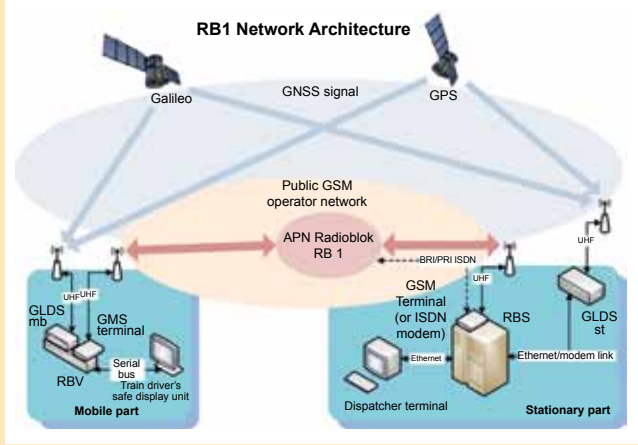
Ministerstvo dopravy

T A
Č R

TEXT: **ING. MICHAL PAVEL, ING. KAREL VESELÝ, PH.D., ING. LUBOR BAŽANT, PH.D.** | PHOTO: **AUTHORS, ING. VÁCLAV ŠAFÁŘ (VÚGTK)**



↑ *Fig. 1 – RB1 physical architecture*



↗ *Fig. 2 – RB1 network architecture*

Introduction

In recent years, the Czech Ministry of Transport, through the Technology Agency of the Czech Republic (TAČR), announced a public contract under the BETA programme – Enhancement of safety of railway traffic on regional lines via Global Navigation Satellite Systems (GNSS). According to the specification, the solution had to be based on the design of principles for GNSS-based signalling, primarily intended for regional lines without conventional signalling systems. An important part of the specification was the requirement to analyze and propose changes and adjustments to national legislation so that the new system does not violate any provisions of laws or decrees. The objective was also to provide a link to other control and information systems. Eventually, demonstration of the functionality of such a solution was to be carried out.

AŽD Praha won the public tender and became the contractor. The project was realized as a research and development project with the acronym RegioSAT. In order to solve the project, the company invited two subcontractors: the University of West Bohemia (UWB) and the Research Institute of Geodesy, Topography and Cartography (VÚGTK).

In the following text, we focus on the technical aspects of the project, not on the legislative, financial or other aspects of the project.

Basic approach to the RegioSAT solution

The solution to the public contract, i.e. the comprehensive design of a signalling system for regional lines, could have been implemented in two ways:

1. To develop a completely new concept of a signalling system for regional lines.
2. To appropriately evolve the existing signalling system for regional lines using the Radioblok version RB0+, thus upgrading the RB0 + version to RB1.

Because of the time and financial limitations of the RegioSAT project, and also because of the belief that the signalling on regional lines via the Radioblok system is an effective way to increase traffic safety on regional lines, the second solution was chosen, i.e. the innovation of the existing Radioblok system, version RB0+ (for a description of RB0+, see e.g. [1]), which AŽD Praha manufactures and sells under the RBA-10 label, to version RB1. This innovation was carried out in two parallel steps in the framework of the RegioSAT project:

- Designing a new GNSS Location Determination Subsystem (GLDS) that extends the original RB0+ Radioblok functional architecture and provides a safe estimate of the position and speed of the rail vehicle on the track,
- Designing new functionalities implemented mainly in the vehicle part of Radioblok RB1, using the GLDS output, i.e. a safe estimate of the position and speed of the rail vehicle.

In connection with the integration of the GLDS subsystem into the Radioblok interlocking system, it is necessary to note, for the sake of completeness, that even the existing version of Radioblok RB0+ uses location information from the GNSS receiver. However, this information is not safe (see below) and is used only as a backup to check the driver's activity (to check whether the scope of permissions was not exceeded, to check the entered position, ...).

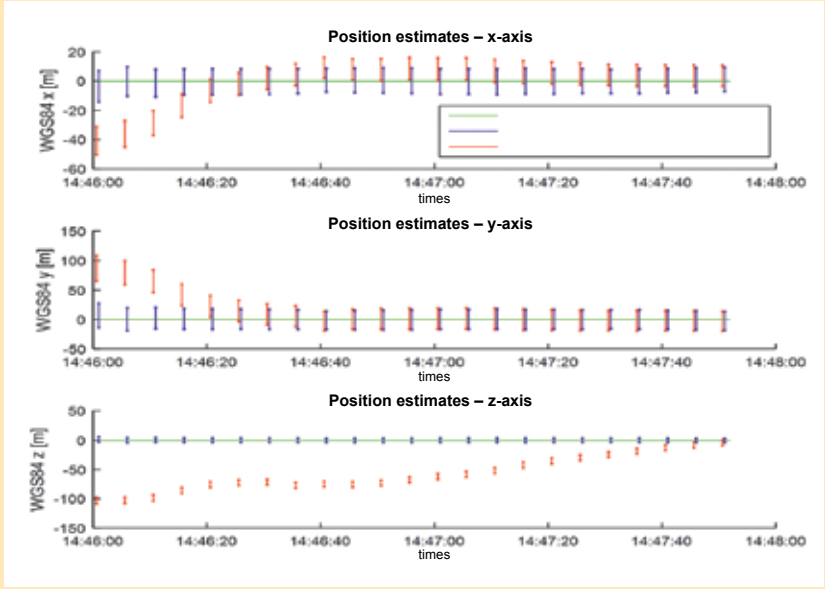
The advantage of the solution, as well as certain confirmation of the well-chosen Radioblok RB0/1 concept, was the fact that for the given functions it was not necessary to innovate the stationary part of the system – the RBS centre. However, for the upcoming functions, such as augmentation data transfer, transmission and display of information

on the possible failure status of a vehicle or temporary speed limitations on the track, an update of the RBS software is required. The proposed physical architecture of the system is shown in Fig. 1. The network architecture is then shown in Fig. 2.

GLDS Subsystem

As mentioned above, the RB1 system assumes knowledge of a safe estimate of vehicle position and speed. A safe estimate is the area (1D/2D/3D as required) for which it is true in all circumstances that the actual value is in this area with a predefined or higher probability. This is why we only refer to this value as an estimate, whether of position or speed. It is also in line with the probability nature of the levels of safety integrity based on the rate of dangerous faults according to ČSN EN 50129.

Most GNSS receiver users have the experience (e.g. thanks to car navigation) that GNSS receivers, usually receiving a GPS signal, provide a relatively accurate and mostly valid position and speed data. The question is why it is necessary to develop a stand-alone GLDS subsystem in order to obtain safe vehicle position and speed estimates, and why it is not possible to use the estimates provided directly by the receiver. Apart from the reasoning that these receivers were not developed according to railway standards, practical measurements can also be used as an argument. During the RegioSAT project, cases where the location of the vehicle provided by the commercial receiver deviated from the real position of the vehicle up to several hundred metres, were often recorded, and the receiver did not inform about it and contended that the estimates provided were accurate to a maximum of dozens of metres (see Fig. 3). It is clear that the use of such mistaken



↑ *Fig. 3 – Comparison of results of AZD algorithm and classical COTS receiver*[7]

↓ *Fig. 4 – RBV RegioSAT testing device*

↑ *Fig. 5 – Geodetic track location*

estimates in rail traffic control could lead to hazardous situations. These are the reasons why it is necessary to develop custom algorithms to safely calculate position and speed estimates when designing a safe GLDS.

The research and development of the GLDS subsystem and safe algorithms at AŽD Praha did not start with the RegioSAT project itself, but has been running continuously since 2006, in cooperation with the University of West Bohemia in Pilsen. The development has been mainly covered by AŽD Praha's own resources. However, in the past years, cooperation with the Czech Technical University in Prague in the SafeLOC project has also taken place, supported by the ALFA programme of the Technology Agency of the Czech Republic (TA01030124).

The development was carried out systematically with respect to the safety requirements of the European rail standards. One of the first steps was to develop a risk analysis of the use of GNSS in the railway environment when using safe position and speed estimates from a locator suitable for railway interlocking. During this risk analysis, approximately 60 events with the potential to cause a misleading estimation of the receiver's position/speed (which would mean that the estimate obtained using GNSS is not safe) have been identified. For each event, several measures were subsequently proposed and incorporated in the appropriate algorithms. The result of risk analysis is also the division of GLDS into mobile (GLDSmb) and stationary (GLDSst) parts of a GLDS subsystem with a known position (see Fig. 1). In real conditions, some of the events identified in the risk analysis can be detected more easily using knowledge of the exact location of the receiver on the stationary part and the GLDSmb mobile part can then be informed about their existence (so-called local augmentation). Notwithstanding the fact that GLDSst will have a good location with good satellite connection, guaranteed EGNOS signal reception and verified other influences, especially multipath levels (see Fig. 8 for an example of the multipath propagation of the GPS signal).

The algorithms developed have been tested continuously to verify the accuracy of the design and its programme implementation. These tests use both realistic and artificially generated simulation GNSS data. While real data is collected in real-time traffic, the GPS model "Ivan", which was developed for this purpose by AŽD Praha, is used to generate simulation data. This model allows (based on the ephemeris given) generation of satellite constellations for different days and different positions of the GPS receiver. It also allows, based on its own algorithms, taking into account the effects of the troposphere, ionosphere and noise, which affect the signals from satellites in the real environment. Last but not least, it is also possible to take into account the possible movement of the GPS receiver and the changes in the view of the sky (or shading of the sky) during the movement of the receiver. Moreover, the program implementation of the developed algorithms is verified by the fact that the algorithms are independently programmed in two workplaces (ZTE-VAV VP03 and UWB) and the program outputs are then compared. Algorithms are also being prepared for the European Galileo system so that, at the time of its full operational capability, it is possible to receive and process its signals in particular to increase the availability of GLDS.

For interest and comparison, Fig. 3 shows the waveform (for 115 seconds) of a safe estimate of the position of a vehicle standing in Strunkovice (on the Číčenice – Volary line where Radioblok RB0+ or RBA-10 is deployed). The waveform computed by the GLDS subsystem (blue line segments), the position estimate calculated by the commercial GPS receiver (red line segments) and the actual value of the estimated variable (green line segment) are displayed. It can be seen from the graph that while the safe estimate calculated by the GLDS subsystem always contains the actual value, the estimation provided by the receiver does not (the receiver behaved as if the vehicle was yet to reach the actual position). The estimation period was 5 seconds for chart readability.

It is important to emphasize that this know-how has long been developed in AŽD Praha and the University of West Bohemia and remains the intellectual property of both partners. Unlike the RB0+ Radioblok control and safety principles, which are defined by the Czech Railway Administration SŽDC regulation D4 and is therefore publicly available.

Design and use of new functions

The second step of the RB0+ Radioblok innovation was the design of new functionalities and their integration in RB0+. However, while identifying the new functionalities, the emphasis was placed on the new version – RB1 – to further eliminate the impact of the human factor on traffic safety and to make the new version of Radioblok even more useful and comfortable for the train driver. Taking these two requirements into account and taking into account the fact that GLDS offers a safe estimate of the train position and speed in RB1,

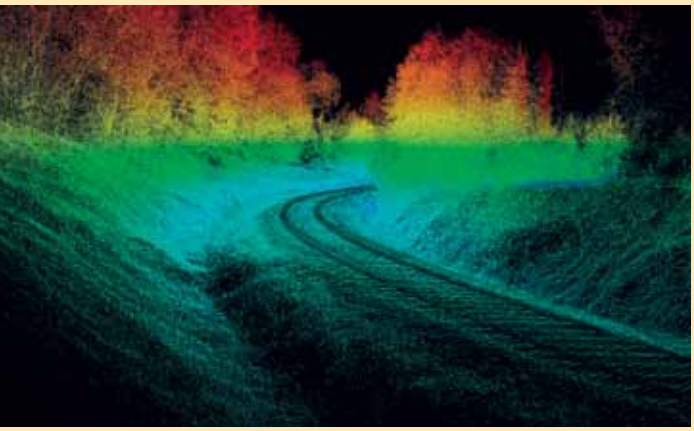
9 functionalities have been identified. The most important of these include:

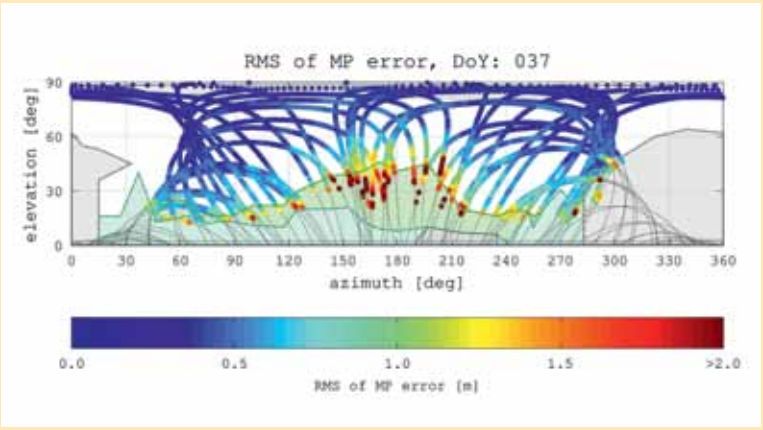
- Automatic advice of train (RB1 issues an advice after the train end passes the boundary mark without driver intervention)[3];
- Checking of destination overshoot[4] (if the train passes a permitted target, an emergency brake is triggered);
- Displaying the maximum speed and advance signal speed (in line with the static track profile) at a given train location on the track,
- Checking the current speed (if the speed is exceeded for longer than the predefined time, the emergency brake is triggered),
- Train compactness management (we differentiate between compact and coupled train sets) allowing also to check the integrity of the train if the train set or system can detect it.

Following the identification and detailed design of new functionalities, it was necessary to determine how these functionalities are to be incorporated into the new RB1 interlocking system. Since all are based on the safe estimate of position and speed, which is currently determined only from the information provided by the GNSS, it is not possible to assume that the functionality will be available at any time of the train run. In the railway environment, of course, it is not possible to ensure continuous reception of GNSS signals (presence of tunnels, dense forests, etc.). Another reason for the inability to expect permanent availability of the functionalities is that, in some situations, even if GNSS signals are available, GNSS failure protections incorporated in the GLDS subsystem evaluate that these signals cannot be used to calculate safe estimates. To ensure the safe function of the developed RB1 interlocking in situations where a safe estimate of position or speed is not available and, therefore, the new

↑ *Fig. 6 – Laser track scanning by device installed on the top of a measuring vehicle*

↙ *Fig. 7 – Output of laser scanning*





↑ *Fig. 9 – Verification of the system on the road*

← *Fig. 8 – Test results of impact of multi-directional propagation of the GNSS signal*

functions are not available, the following mode of operation of RB1 interlocking was adopted:

- If safe position and speed estimates are available in the RBV (Vehicle part of the Radioblok), the RB1 has all the functions taken from the RB0+ and all the newly designed RB1 functions.
- Otherwise, the RB1 works in the so-called degraded mode, which means that the RBV works the same as the RB0+ version.
- The driver is informed about the current Radioblok mode by the BEZOJi Safe Display Unit using the information about the currently permitted maximum speed and advance signal speed. If the RB1 is working in non-degraded mode, this information is displayed. In degraded mode, this information is not displayed and the PJ[5] mode is displayed (this is also displayed in the original RB0+ version).

This specification of the new functionalities will be a public specification and should become the basis for the specification of both the new product and the innovation of SŽDC D4 Instructions.

Safe track map

It is clear from the names of the individual functionalities that in their execution the mutual position of the vehicle, expressed by the safety estimate, and the position of some key points of the railway line must be evaluated. These key points include, for example, the position of the station boundaries and boundary marks, the position of the speed signals along the line (speed warning board, “slow ride start” and “slow ride end” signals, etc.), the position of the speed restriction warning signal, etc. In order to determine the location of these key points, a methodology for creating a safe track map was developed within the framework of the RegioSAT project in cooperation with VÚGTK, which defines the method for their determination with the required accuracy and safety/integrity. Due to the fact that the methodology addresses not only the accuracy but also the safety integrity, its risk analysis was also developed within the RegioSAT project.

The set of positions of all required key points, along with the information on permitted and advance signal speeds in individual track points, form the basis of the route map. In addition to the two above-mentioned sources of information, the GLDS track map is further extended by the track axis map, which is used to calculate the safe position and speed estimates.

During the development and design of the tracking methodology, attention was also paid to the effects of multipath (MP) propagation of the satellite signal to the

receiver. Multipath signal propagation is another dangerous phenomenon affecting the location calculations with false information. Procedures have been proposed and a series of measurements have been made to detect and quantify the phenomenon. Some outputs from these analyses are illustrated in Fig. 8. Based on these results, procedures are developed to eliminate these effects on the track.

Using the proposed methodology of creating a safe track map, the railway line No. 197 Číčenice – Volary was surveyed and its track map was created, which was subsequently placed in a functional sample of RB1. The track mapping and reconnaissance procedure in cooperation with VÚGTK staff is illustrated in Figures 5 to 7.

Tests and official demonstrations of the developed RZ1 interlocking system

After completion of the works related to the development of the GLDS subsystem, the design of new functionalities and the proposal of the methodology for the creation of a safe track map, practical implementation of the research and development results took place. The result of this implementation was the creation of a functional prototype (FP) of the RBV as a part of the Radioblok version RB1 (see Fig. 4), which includes the original functionality of the Radioblok version RB0+, the functionality of the mobile part of the GLDS subsystem, and the newly designed RB1 functionality.

After the creation of the FV RB1 and the track map of the line No. 197, the FP RB1 was tested, both in the road environment and on the surveyed Číčenice – Volary line – see Fig. 9 and 10. The purpose of this test was to verify not only the correct GLDS functionality but also to verify that RB1 control and behaviour is intuitive to the driver. As all the tests were successful, the final demonstration (presentation) of FV RB1 was prepared by AŽD for representatives of the Ministry of Transport, i.e. for the contracting authority. This demonstration took place on the Číčenice – Volary line using the AŽD measuring vehicle. The FP RB1 demonstration included two runs named “Responsible Driver Ride” and “Irresponsible Driver Ride”, which demonstrated the function of all new functionalities. As demonstrated by the name of the rides, the operation of new functionalities, both in compliance with railway regulations and in violation of them, was demonstrated. As with the FV RB1 testing, the demonstration rides were successful. Thus, for example, one of the first public demonstrations of emergency braking with a safety device developed by AŽD Praha occurred there. In this case, the emergency brake is actuated when the driver exceeds the maximum permitted speed in the given section. The course of the demonstration rides is illustrated in Figs. 11 to 13.

Conclusion

Based on the evaluation of the results achieved and the reactions of the drivers involved in the FV testing and demonstration rides, it can be stated that the results confirmed the meaningfulness of the proposed concept of the new RB1 interlocking system and its suitability for prototyping required for approval and for subsequent production.
It is currently planned that the developed RB1 interlocking system will be tested on one of the newly acquired tracks of AŽD Praha (Dolní Bousov - Kopidlno). The results of these tests will be used in the further development of the RB1 system.

↑ Fig. 10 – Track verification of the system using a rail car

[1]) Estimates are plotted separately for each axis of the WGS84 coordinate system. The estimate itself is represented at each time point for each axis by an interval – the graph is the interval for each time point expressed as a line segment indicating the values that lie within the estimate / interval.
[2]) This is because the commercial receiver uses an inappropriate motion model for the train to calculate the position estimate.
[3]) In stations where the current ride permission expires, the advice is issued with driver support (but more easily than in the RB0+). However, a detailed explanation is beyond the scope of this article.
[4]) This functionality is also implemented in the RB0+. In the RB1, it is newly implemented using a safe position estimate.
[5]) This is an operating mode called "Ride permitted".
[6]) Safety integrity is needed because the track map has a direct impact on the safety of the whole developed interlocking system (it is used in new functionalities).
[7]) In order to gain a better understanding of the accuracy of the estimates, the actual position of the receiver was subtracted from all displayed values (actual value, GLDS safe estimate, and Unsafe estimate of COTS receiver). The result of this correction, for example, is that the "actual value" displayed (green line segment) is in position 0.

↑ *Fig. 11 – Preparation of the demonstration in the AŽD Praha measuring vehicle in Číčenice station*

It is worth noting that Radioblok RB1, despite the addition of the GLDS module, still remains a relatively inexpensive solution for increasing safety on regional lines. It is a major step towards increased safety, which in some ways exceeds the level of protection offered by the conventional LS automatic train control system for main lines. It still provides the basic advantages of the Radioblok RB0+, such as easy and fast installation on vehicles or quick installation of the RBS centre for traffic control without the need for external cabling. Even the connection to the communication system of a public GSM operator does not require a cable connection, let alone the purchase, installation and operation of a special communication system.

The RB1 offers an additional level of automation to the driver, relieves the driver of some tasks, and at the same time provides secure control over the passage of a permitted target and overspeed. This fulfils the condition for a further increase in line speeds on regional lines and is another step towards higher automation of traffic on these lines.

Reference documents

[1] Racionalizace železničních tratí v ČR – Radioblok; Frýbort, F.; Železnice 2005; p. 185 – 189; 2005.

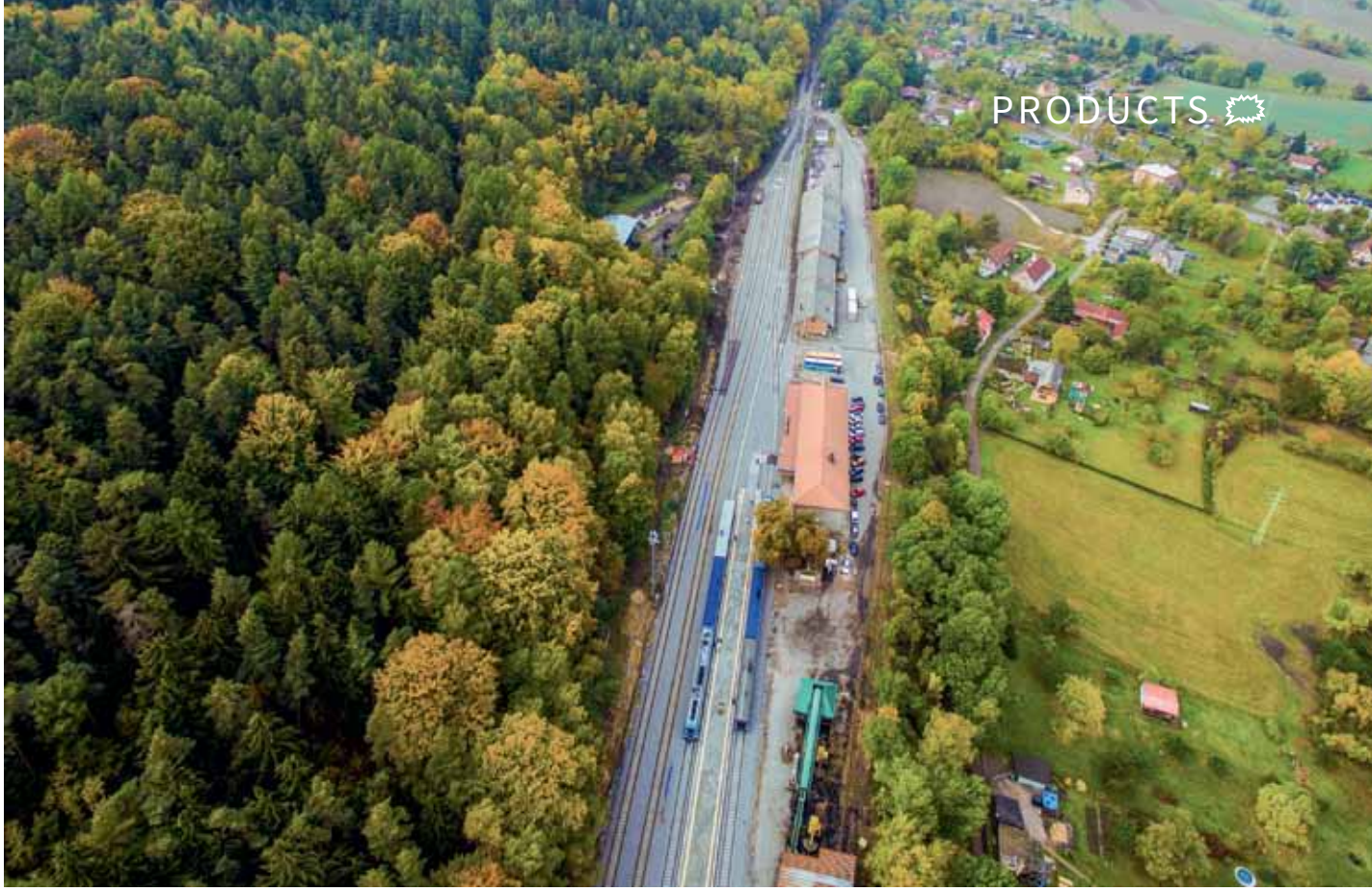
↓ *Fig. 12 – Radioblock centre and display of ride status on board the measuring vehicle*

CTC

Jaroměř – Stará Paka Project

TEXT: **ING. PAVEL GRUBER** | PHOTO: **JAN STROUHAL (ALTOMODO), PETR DOBIÁŠOVSKÝ**

The objective of the completed project DOZ Jaroměř – Stará Paka is mainly to improve rail traffic safety by limiting the influence of the human factor and centralizing the control of interlocking equipment, thus achieving the traffic control quality level of modern EU railways and ensuring conformity to EU standards.



Interlocking equipment

As for interlocking equipment manufactured by AŽD Praha, the DOZ Jaroměř – Stará Paka project is consequent to the project of Reconstruction of Stará Paka railway station for DOZ, which was realized by the Kolín assembly plant, where the first fully electronic interlocking system ESA 44 was built. The original ESA 44 station interlocking system has been extended by remote EIP panels (Electronic Interface Panel), which not only provide the function of a station interlocking system in the railway stations Horka u Staré Paky, Mostek, Bílá Třemešná and Dvůr Králové nad Labem, but also ensure functionality of the ITZZ line interlocking system in inter-station sections. In the section between the railway stations Dvůr Králové nad Labem and Jaroměř, new AHP-03D interlocking equipment was built. At the main signals, functionality of unauthorized signal passing warning (VNPN) is set up. The newly built level crossing systems of PZZ-AC type in the stations and of PZZ-RE at open line sections is equipped with lockable PZM-2 barriers. Within this project, six level crossings were equipped with a completely new PZZ-J type level crossing system.

The above-mentioned technical solution enables control of the whole section from Stará Paka to Jaroměř (excluding) from the Unified control place in Stará Paka. Centralized train route setting allows for shorter intervals for train crossings in the station as well as shorter travelling times.

Cost savings are also being made in maintenance thanks to a diagnostic system which transfers diagnostic data to the maintenance centre and which facilitates not only fault identification, but also enables identifying the risk of failures and eliminating such failures by early maintenance intervention.

Telecommunication equipment

The telecommunication system uses a transmission system based on data switches which serve as a central IP access point. The connection of stops to the neighbouring railway station is solved via an optical cable using SFP modules (Small Form-factor Pluggable). The transmission network uses the SDH transmission system.

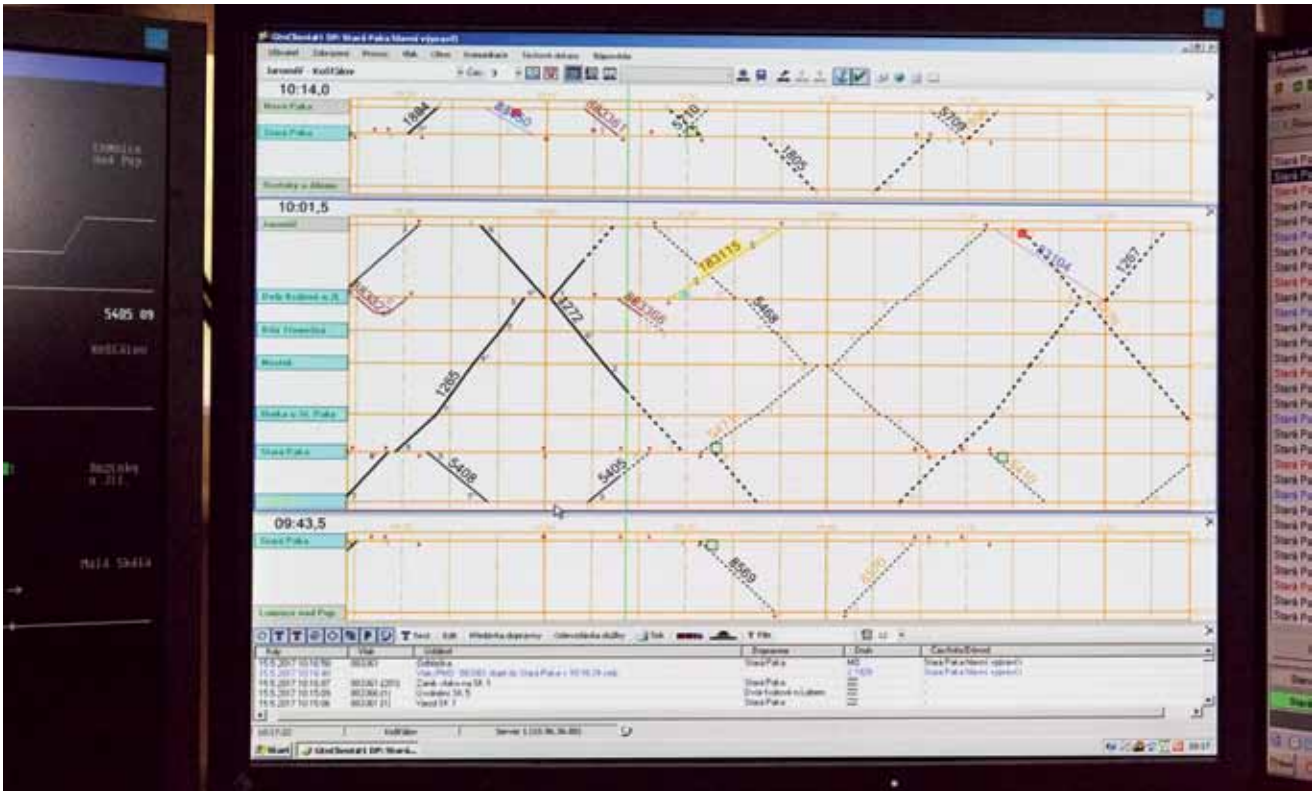
The new transmission system provides:
– LAN data networks for technological devices.
– Remote control of the passenger information

Project Overview

Number of stations newly connected to DOZ	4 railway stations
Number of dispatchers	1 employee
Savings	31 employees

system, including control of information boards in the railway stations Mostek and Dvůr Králové nad Labem
– Equipping the track with a camera system
– Equipping the track with a radio system for local operations at railway stations.
– EOV control including lighting of stops and stations
– VoIP based telecommunications equipment;
– Remote diagnostics of technological systems (DDTS ŽDC).

In addition, new clock, telephone and data lines (structured cabling), multiline subscriber sets, clocks, and passenger information and public address systems for passengers in railway stations and stops were built. The Local Radio



System and Line Radio System were also modified.

Construction

As far as construction is concerned, new platforms have been built at railway stations and stops, allowing for comfortable, barrier-free and safe passenger access to trains. In addition, track modifications were made. Within the project, selected existing points were replaced with new 2nd generation points on concrete sleepers, which allow for even more reliable operation and increased comfort of travel. Compared to the original points, reliable and fast

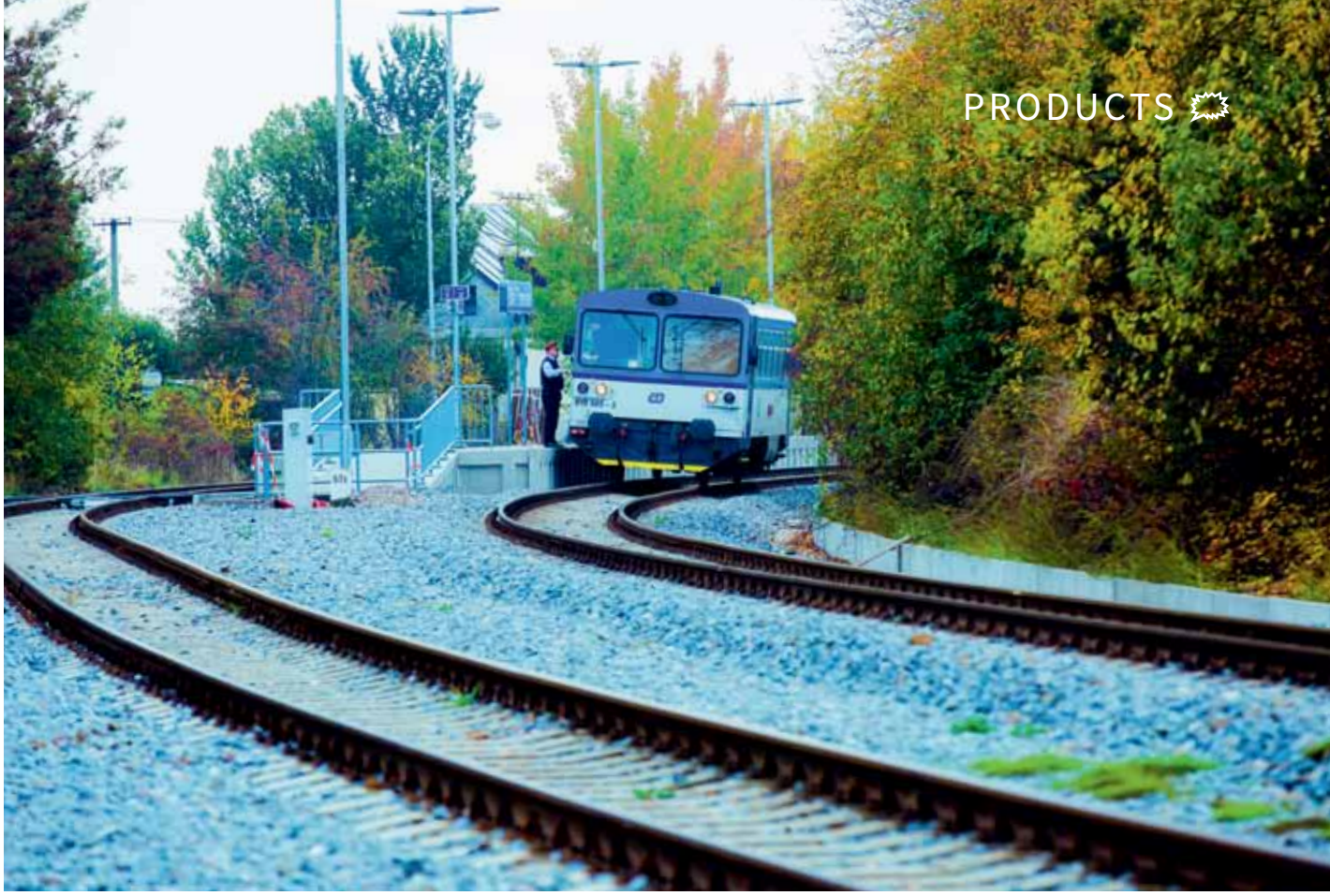
The Project Included the Following

New 49E1 track on B03 concrete sleepers, division "c"	718 m
New 49E1 track on B03 concrete sleepers, division "u"	682.1 m
New 49E1 2nd generation points on concrete sleepers	6 pcs
Restored S49 1st generation points on wooden sleepers	3 pcs
Restored S49 track on SB6 concrete sleepers	800.2 m
Restored S49 track on SB4 concrete sleepers	410.8 m
Restored S49 track on wooden sleepers	116 m
Used S49 track on SB6 concrete sleepers	116.9 m
Used S49 track on SB5 concrete sleepers	128.1 m
Directional and height alignment of the track	2,107 m
Structural layer of crushed-run rock	2,107.1 m^3
Mechanically improved soil	1,631.3 m^3
Trench channel J (large)	260 m
Trench channel J (small)	140 m
Drains	1,750 m
Excavations	15,249.5 m^3
Excavations in rocks	212.7 m^3
Culvert repair	1 pc
Construction modifications of level crossings	5 pcs
Line equipment	38 km
New platform edge, type H 130 in	1,000 m length
New platform edge, type SUDOP in	320 m length
Platform roofs	3 pcs
Ramp repair	1 pc (edge length 90 m)
Total length of disassembled railyard	738 m
Points reduction	5 pcs
Scope of demolitions	204 m^3

adjustment of the points by point machines with electromotors is also ensured.

The route directional parameters and station head configuration have been designed to maximize the possibilities given by current standards for current and future speed upgrades on existing plots. The route is dimensionally and horizontally designed so that the track position on passages and bridges and new fixed-edge platforms is unchanged, and so that currently built sections will not generate a velocity drop after a speed upgrade of currently intact sections. The level crossings, as well as station and line interlocking systems, have been designed in the same manner.

In Dvůr Králové nad Labem, five new 2nd generation points on concrete sleepers have been designed. Through their modified



arrangement, the possibility of entry/exit to the platform at the 2nd station track from/to Jaroměř at the speed of V = 80 kph instead of the originally proposed V = 50 kph was achieved.

Traction and power equipment

As for energy-related equipment, a renovation of LV connections for technological equipment and lighting ensuring safety of passengers at night took place. Electrical heating of points has also been installed within the project, which improves the operational reliability of the points in winter months.

The whole project has increased comfort of travelling, not only by reducing travel times but also by informing passengers about the current traffic situation. Because of the introduction of remote control of interlocking equipment, it was also possible to reduce the number of employees ensuring railway transport in the Jaroměř-Stará Paka section.

Control JOP for DOZ from the Stará Paka Railway Station

3 pcs	of new PZZ-RE level crossings in OPD shed
6 pcs	of new PZZ-JAZZ in OPD shed
2 pcs	of new PZZ-AC
4 pcs	of new PZM-2
28 pcs	of AŽD 97 warning boards
15 pcs	of LED warning boards
8 pcs	of AŽD 99 barrier drives
2 pcs	of PZA-200 barrier drives
34 pcs	of post signals
8 pcs	of dwarf signals
16 pcs	of point machines with electromotors
4 pcs	of electromotor derailer switches
76 pcs	of FRAUSCHER axle counters
153.5 km	of signalling cables

The Plum

Line Lives!

TEXT: **JIŘÍ DLABAJA** | PHOTO: **PETR DOBIÁŠOVSKÝ, JIŘÍ ŘECHKA**

In 2016, the Czech state did not know what to do with the unwanted railway line No. 113 Čížkovice – Obrnice. Thus, through the Railway Infrastructure Administration, the state decided to offer the local railway running through the picturesque landscape of the Central Bohemian Highlands to an entity meeting the conditions given by the state. The main condition was that rail operation had to be preserved. The almost 36-kilometre-long line was finally bought by AŽD Praha, which met the requirements. Beyond the scope of its obligations, AŽD Praha put the Plum Line in such a state that one of the stations even succeeded in the national competition Most Beautiful Railway Station.

The most modern Czech regional line

In August 2016, AŽD Praha took over the very neglected railway line No. 113 Čížkovice – Obrnice.

The first works started right away. The entire line was stripped of trees and grass, the culverts were cleared, the entire line superstructure was repaired, the geometric position of the line was aligned, the cable routes along the line were prepared and so on.

As for the stations, the highly worn manually operated points were mostly replaced by points with electromotive point machines of a new design, signals with LED lights were added, and modern infopanels and station public address systems were installed to inform the passengers.

Let's also look at the heart of the entire line, the interlocking system. In Třebívlice, the executive and control part of the fully electronic ESA 44 interlocking with a technology computer is installed.

In Třebenice and Libčeves, only the executive part of the interlocking is installed. At the moment, the entire line is remotely controlled from the unified control place in Čížkovice station by employees of the Railway Infrastructure Administration.

Currently, level crossing systems are being installed on the line to eliminate major drops in train speeds. 22 level crossings out of a total of 33 will be equipped; the vast majority will be of the PZZ-J type. Interestingly, level crossing systems modified for test purposes will be installed at kilometre 17.225 (PZZ-J type) and kilometre 31.107 (PZZ-RE type). These will be energy-efficient crossings equipped with solar panels and fuel cells...

As AŽD Praha plans to use the Čížkovice – Obrnice line as a test circuit for its new technologies, GSM-R, ETCS L1 and ETCS L2 technologies, new types of switches and indicators, innovative information systems, Smart technologies, signposts and many other solutions will be gradually installed on this line.

Charming railway stations

The buildings look much better now as well. Many of them have been completely repaired and some repairs are still underway. The goal is to bring all the buildings along the line owned by AŽD Praha into a perfect state. The fact that the repaired Třebívlice station building placed second in the Most Beautiful Railway Station of 2017 competition proves that the initiatives are paying off.

The first season of the T4 line

Following negotiations with the Ústí nad Labem Region, the weekend tourist line T4 was launched on the Lovosice – Most line, which includes the Čížkovice – Obrnice line of AŽD Praha. The operation began on April 1, 2017. Regular weekend rides were provided by an 831 series historic motor coach accompanied by an 810 series motor coach in the colours of the new carrier.

For the entire season, which lasted until 29th October 2017, AŽD Praha, in cooperation

↓ *The Plum Railway runs from Čížkovice railway station*

with the Ústí nad Labem Region, carried almost 4,500 passengers – mainly railway fans and tourists, who came not only to visit the charming Plum Line but also to visit local tourist attractions.
The first year on the railway line No. 113 was also spiced up by a number of cultural events. Let's mention, for example, the unique project of the Kredenc theatre, which was hopelessly sold out after just a few days of ticket sales. As the name of the project suggests, the event took place in the 831 series motor coach, called Kredenc. The play was based on Czech and German stories and was held not only in the train but also around it.

The end of the season on the Plum Line was unconventional. On the weekend of 28/29 October 2017, AŽD Praha deployed a diesel locomotive 749.039, called Bardotka, with a parlour car, which was met with an enthusiastic response from railway fans. They brought cameras to record these unconventional rides. The only pity was that the event was a little disturbed by the weather, namely Cyclone Herwart.

"In 2018, we are expecting further line repairs and the expansion of modern technologies. We are also preparing changes to the timetable of the T4 tourist line, which will definitely please passengers. Not only will our connections be

Unique theatre project Kredenc

↓ *Zdeněk Chrdle, CEO of AŽD Prague, accepts 2nd prize in the Most Beautiful Train Station 2017 competition*

logically linked with Czech Railways trains in Lovosice and Most, but also the travel times will be shortened thanks to higher train speeds. On weekends and holidays, three rides at 4 hour intervals will run between Lovosice and Most. In addition, a number of level crossings will be interlocked on the line, making the line considerably safer also for residents of nearby municipalities and car drivers. As far as other activities are concerned, we are planning a summer festival with music, entertainment and refreshments in the 2018 season," Zdeněk Chrdle, CEO of AŽD Praha, describes the planned activities of AŽD Praha on line No. 113.

The launch of the new season on Good Friday, when a steam train pulled by the locomotive 354.195 nicknamed Všudybylka, rode the Plum Line for the first time after 17 years, proved that the 2018 season will be spectacular. The interest in the event was so great that, unfortunately, all the visitors did not fit inside the train. Therefore, AŽD Praha is planning another similar event in the 2018 season.

However, the biggest plan is to restore regular workdays traffic on line No. 113. Negotiations are currently taking place with the Ústí nad Labem Region. The Region will support the plan if AŽD Praha fulfils all conditions, such as shortening the time of travel, adequate facilities for passengers at individual stations, and the purchase of modern trains.

AŽD Praha

Acquired Motor Coaches to be Used without Drivers

TEXT: **JIŘÍ DLABAJA** | PHOTO: **PETR DOBIÁŠOVSKÝ, LUKÁŠ GANS, ING. JIŘÍ MARTÍNEK**

At the beginning of 2017, AŽD Praha signed a contract for the purchase of three 810 series motor coaches and two 010 series trail coaches for CZK 6.8 million. Thus, AŽD Praha fulfilled its plan to transform the lines Čížkovice – Obrnice and Dolní Bousov – Kopidlno (purchased from the state as obsolete property in 2016) into test polygons to test modern and currently developed interlocking technologies. These technologies will be tested by these motor coaches in which part of the mobile technologies will be directly installed.

↑ *Graphic design of the newly acquired motor rail cars*

"*It is, for example, a system designed for regional trains, which will ride without train drivers on open tracks. AŽD Praha wants to develop this system by 2020. It would thus become the first European producer of such technology. Currently, there are driverless trains on the metro but only for closed-circuit lines. Also interesting will be new technologies based on the highly accurate Galileo satellite system,*" explains Zdeněk Chrdle, CEO of AŽD (note: see page 30 for new REGIOSAT interlocking system).

The newly developed system of driverless regional trains has raised big discussion not only in the media but also among railway professionals and the public. *"Even though some may dislike the idea, it is a logical step on the part of AŽD Praha. We know that there are driverless metro systems in the world and even the first railway lines connecting cities and airports. Of course, these are tracks where the track is strictly separated from passenger compartments and also from the surrounding environment, so there can be no extraordinary event. But if driverless cars are being tested today, why should there be no driverless trains? Our system will be based on our developed CBTC system for driverless metro, as well as our AVV automatic train control system. So now we are working on the way how to prevent a collision with an obstruction on the track, whether it is a tree, a car that is left at a crossing, or a person falling onto a track. To detect similar events in front of an automatic train we are developing sophisticated sensors, which we cannot reveal yet. These sensors can evaluate the situation in front of the train and, in the event of danger, send a signal to the system*

↓ *AŽD Praha bought 810 series rail cars from the Desná railway*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to stop. The dispatcher, who will not be on train but will be in charge of all the trains on the track, will be able to see what the obstacle is, or check cameras inside the train to see whether everything is OK. The dispatcher will then decide whether the train can continue or not. A scenario for a situation when the train is not able to continue will be precisely defined," says Zdeněk Chrdle as he explains the details about driverless trains.

Mashinky

TEXT: **JIŘÍ DLABAJA** | PHOTO: **JIŘÍ DLABAJA, JAN ZELENÝ**

Mashinky is a new strategy game, which took the now 28-year-old Jan Zelený seven years to create at nights and during weekends. Although the name does not mean anything, Czechs simply deduce that it is a railway game. At first glance, you can notice that it takes its inspiration from the legendary strategy Transport Tycoon, which the author admits and adds that it is the spiritual successor of his favourite game, with which he spent most of his childhood.

Jan Zelený is not new to the PC games industry. He gained experience with graphics, programming, and content as a member of the team that developed Mafia II and Mafia III. In case you are not familiar with the game, Mafia is a 3D action-adventure game where the player takes the role of an American gangster in various eras of the twentieth century, and experiences everything that was part of the underworld of that time such as car chases, alcohol smuggling, bank robberies, and so on. Jan Zelený is currently working with the Bohemia Interactive team, where he is engaged in the development of new technologies and graphics effects in the position of Senior Engine Programmer.

But back to his own game Mashinky. As we have already revealed, this is a strategic game where you build your own railway world in 2D

construction mode, you make locomotives and cars, and transport people as well as various goods. For this, you do not make money but technology tokens.

In each of the seven eras, which begin in the steam era and end with modern trains, players get a new type of token, such as a coal, wood, or iron token, which allows them to acquire better tractive vehicles or build more modern railway infrastructures. The game, of course, also has a 3D mode that can be displayed in Ultra HD resolution. In this mode, you fulfil tasks to earn tokens. The author himself calls this mode "chilling mode". *"In addition to transporting people and various goods, there are plenty of scripted events that appear on the map. There are, for example, some events connected with the Second World War. In contrast to other similar games, Mashinky is highly modifiable. That means the gaming community can add new models of locomotives, cars, industrial buildings, or different landscapes,"* says Jan Zelený.

What is interesting is that Jan Zelený used his own engine to develop the game. The engine is the core of a computer game, and creating your own engine means a lot of complicated work.

Originally, Mashinky was not meant to be a full game; the author first used the application as a test laboratory for game ideas. When it later became a game, he wanted to release it as freeware. But as life went, and Jan Zelený put more and more energy into his computer idea, he decided to take it all professionally. And the first response to the most recent version of game was as positive as possible. First place at Game Developers Session (GDS), the biggest Czech game conference focusing also on independent game makers, and being placed among the top three game designs at the Russian White Nights Conference, speaks for everything.

As for the train fleet, you will find a number of real steam, diesel, and super-modern locomotives, primarily of foreign origin. Do not expect technical and historical accuracy. Jan Zelený wants the game to be fun. However, what is interesting information is that Jan Zelený wants to gradually add the most interesting Czech tractive vehicles in future updates because he loves the Czech railway. He is also considering adding road, air and water transport to Mashinky.

If you're interested in the new game, visit *www.mashinky.com*, to find everything you need, including access to the game download.

Wandering the Railway Past

TEXT: **JIŘÍ DLABAJA** | PHOTO: **PETR DOBIÁŠOVSKÝ**

Imagine that you are waiting at Prague Main Railway Station and suddenly you meet the architect Josef Fanta and his daughter Maria, who invite you to visit the public and restricted areas of this cultural monument, which was built in 1871 and reconstructed and enlarged in the years 1901 to 1909 according to Josef Fanta's design. As you can guess, you did not visit the past, but the ProDivadlo theatre event organised in cooperation with the Railway Infrastructure Administration and Czech Railways under the name "Wandering the Railway Past".

Railway and architecture enthusiasts gathered in the reconstructed Fanta Café, known to everyone who has ever travelled from or to Prague. It is most decorative part of the entire railway station located under the dome of the Art Nouveau part of the historic building, which the Swiss architect, urbanist and theorist Le Corbusier declared the most beautiful building in Prague. Just for the sake of interest, after World War II, it was the only place in our country serving real coffee.

Those interested in the tour also visited areas that are usually locked or simply unknown. Whether it is the left wing of Prague Main Railway

Station with its beautiful Rakovník mosaics created by artists Beneš and Klusáček, where a third-category restaurant was located in the past, or a monumental space of a former first and second category restaurant, where the Slav Epic, a cycle of twenty large-format paintings by Alfons Mucha, was to be located.

People were also surprised by an unknown wonderful space on the first floor of the right wing of Prague Main Railway Station, where ProDivadlo operates. The ProDivadlo theatre regularly plays a marvellous puppet tale

called The Greatest Locomotive for children and even prepares a musical from the railroad environment.

The tour ends with a visit to an Art Nouveau government lounge decorated with oil paintings by Viktor Stretti and Václav Jansa. In 1872, Světozor magazine described it as follows: "…The right wing houses court lounges consisting of an antechamber, two toilet rooms and a large, beautifully decorated lounge." The author of this article in Světozor probably wouldn't believe that anti-chemical defence courses would be held there during the communist era.

Since 14th December 1871, when the station was officially opened, a number of distinguished

persons have passed through the corridors of this important traffic hub. Thus, participants of event physically met, for example, the painter Alfons Mucha, traveller Emil Holub, opera singer Emmy Destinn, Franz Ferdinand d'Este, Empress Sisi and many others.

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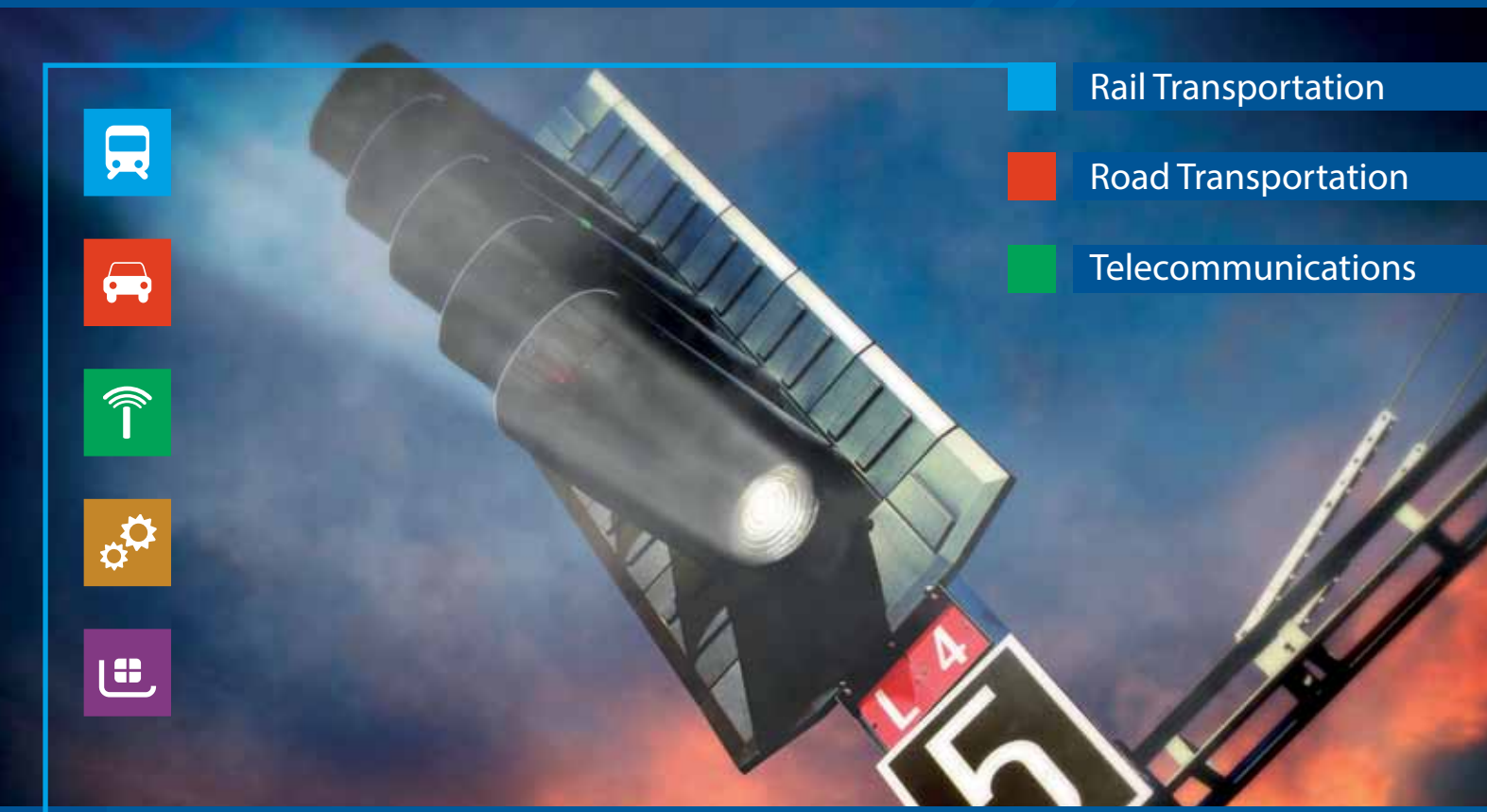

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