

INNOTRANS

BREAK THE LIMITS

RIDE THE **FLOW**

ECOLOGICAL FOOTPRINT

TRAVELING COMFORT

TRAFFIC FLOW

OPERATIONS & MAINTENANCE

DIGITAL SOLUTIONS

KNORR-BREMSE
HALL 1.2
BOOTH 250



KNORR-BREMSE

The world's rail industry will come together at Berlin ExpoCenter City from September 24-27. Come and visit us in Hall 1.2 at Booth 250.



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optimize your
ECOLOGICAL FOOTPRINT

ECOLOGICAL FOOTPRINT

Optimum performance in all operating conditions

Demand-driven, eco-friendly compressed air supply – using AirSupply Smart

Knorr-Bremse's **AirSupply Smart** system represents an industry-wide paradigm shift. For the first time, a multi-functional air supply platform is capable of optimizing the delivery of compressed air based on a wide variety of parameters – such as vehicle load, speed, number of braking operations, and route topography – instead of the usual rigid “on/off” model. For operators, this opens up totally new, eco-friendly options for managing the energy consumption and noise emissions of their air supply systems. Knorr-Bremse will be showcasing the system at InnoTrans, together with the smart screw-type compressor **ScrewSupply Eco** – the most environmentally friendly model to date.

As a smart air supply unit, **AirSupply Smart** delivers compressed air based on demand and circumstances. The fully integrated unit features an intelligent control system that monitors operating conditions. In “Silent

mode” – at night, for example, when trains are parked in residential areas or stations – the system restricts the compressor's operating speed so that it runs much more quietly. In “Boost mode”, the inverter reduces the time required to prepare parked rail vehicles, or enables the use of a smaller, more energy-efficient compressor. The system has another advantage – it can be powered directly from the vehicle's battery, making auxiliary compressors superfluous. This reduces the amount of installation space required.

By combining **ScrewSupply Eco** with **AirSupply Smart**, customers benefit from further reductions in noise emissions and weight, plus improved ease of maintenance. This is due to the ingenious layout of the components and subassemblies, as well as significantly lower oil consumption. An integrated condition monitoring function extends intervals between overhauls. These **ScrewSupply Eco** attributes are also reflected in the system's main benefit – a 40+ percent reduction in lifecycle costs.



RENDERING OF THE KNORR-BREMSE BOOTH AT INNOTRANS



» At Knorr-Bremse, we're committed to providing sustainable solutions for optimizing each customer's eco-footprint. We look forward to showcase our approaches toward building a greener future at this year's InnoTrans. «

Dr. Jonathan Paddison,
Member of the Board of Directors, Knorr-Bremse Asia Pacific Limited

The perfect pair

Why Knorr-Bremse's sustainable friction pairing is so attractive

An optimized braking system relies on perfect friction pairing. This is why Knorr-Bremse now offers application-specific pairing of friction materials for brake pads and discs, optimized for every type of train and all global rail standards. Knorr-Bremse supplies a full range of friction materials – and all of them are manufactured in-house!

The practical implications for rail vehicle manufacturers and operators are illustrated in detail by the Sustainable Friction Pairing exhibit, which includes a three-part brake disc made out of special alloys of aluminum, gray cast iron, and steel, combined with **UltraPad** and **ProPad** brake pads.

Spider diagrams show performance and sustainability figures for the various discs when they interact with different pads – visitors can interactively select different pairs. The same applies to many other parameters, such as environmental impact, disc material recycling, measures taken to reduce particulate emissions from brake pads and brake discs, and web geometry optimized for perfect disc cooling and minimal fan power loss.

In short, only an integrated approach to the development of braking systems and brake pads can produce the best possible braking performance, reduce lifecycle costs, and minimize environmental impact – in both original equipment and aftermarket segments.

Flexible energy management

SIFU: a single system featuring totally eco-friendly control electronics

As people become more environmentally aware, measuring and managing vehicles' energy use is becoming ever more important. The **System**

Integrated Functional Unit (SIFU) developed by Knorr-Bremse subsidiary Microelettrica Scientifica takes care of both functions. The unit's sensors precisely measure the current and voltage of DC and AC

systems, including energy consumed and recovered. The unit then makes it easy to analyze a vehicle's energy consumption so that operators can take steps to reduce it.

Another key consideration: Control electronics in modern rail vehicles are often very complex, so arranging countless individual components is extremely time-consuming for vehicle manufacturers. They must

find ingenious ways to link together components such as contactors, circuit breakers, isolators, and motor protection switches, as well as suitable places to install them in the vehicle. By opting for SIFU, customers can save themselves a lot of hard work: SIFU combines numerous control and diagnostic components for distributing power throughout the vehicle in a single compact, digitalized system. And thanks to a flexible, modular design which can be adapted to specific requirements, SIFU can reduce the amount of cabling in a vehicle by over 70 percent.

The greener way to cool

How rail operators benefit from Group brand Merak's green[air] approach

The potential for improving corporate eco-footprints by using state-of-the-art climate control systems is enormous. Because conventional climate control systems often consume a surprising amount of energy – up to 30 percent of a train's total energy – and still use refrigerants with high global warming potential (GWP), they are holding back the fundamentally eco-friendly use of rail vehicles. Merak's **green[air] concept** offers rail operators highly customizable design options, and the **custom[air] exhibit** at the Merak booth showcases their flexibility.

Based on an energy-efficient climate control system designed for drivers' cabs and passenger compartments, the system uses environmentally friendly refrigerants such as propane (R290), with a GWP of just 0.02, and CO₂, with a GWP of 1. The **green[air] technologies** support the most flexible of system architectures, making it easier to switch to an eco-friendly refrigerant. Operators can also select other technologies, such as optimized output controls, heat-exchanger design or fan aerodynamics, to suit their individual preferences.

ECOLOGICAL FOOTPRINT



TRAVELING COMFORT

Barrier-free boarding

The innovative ZeroStepBoarding entrance system for high-speed trains

Boarding a train with a wheelchair, stroller, bicycle or heavy luggage is one of the great obstacles to train travel. Increasingly, regulators are requiring operators to simplify access to public transit services for people with reduced mobility. The **ZeroStepBoarding system** developed by Group brand IFE provides all passengers, whether boarding or alighting, with barrier-free access to the train. The innovative concept reduces the doorstep height to 9 mm or less, and is designed to fit train doorways up to 1.6 meters wide.

To circumvent these restrictive design limits, two brilliant ideas were combined. The brush strip usually used to remove dirt and grime from sliding steps or ramps has been replaced by a walk-on scraper. The new sealing system is designed in such a way that it builds up sufficient pressure to seal the train even without a matching counterseal. Unlike other barrier-free solutions, **ZeroStepBoarding** works without any additional actuators or active elements such as hinged sealing flaps or platform lifts. Designed in particular for the E3D-e1 entrance system popular in intercity and high-speed applications, the solution also integrates with other systems in the IFE portfolio.

Another positive impact on traffic flow: The solution speeds up the whole process of boarding and alighting, and so reduces train waiting times. By maintaining a steady traffic flow, operators save valuable time.



RENDERING OF THE
KNORR-BREMSE BOOTH AT INNOTRANS



» To encourage the transition from road to rail, Knorr-Bremse needs to emphasize the benefits of traveling in comfort. Our portfolio features a broad range of passenger-friendly solutions that make the time spent aboard trains more pleasant and enjoyable. «

Dr. Peter Radina,
Member of the Management Board of Knorr-Bremse Systeme für Schienenfahrzeuge GmbH

Safe, clean air

Booth's interactive "real air feeling" simulation showcases clean[air] solution for trains

Long before the pandemic, passengers already had major doubts about whether or not air in trains was "clean". Since the pandemic, optimizing passenger comfort has become a top priority. Cutting-edge solutions include intelligent vertical air circulation, ventilation designs that maximize the amount of fresh air, functions for filtering out dust, aerosol particulates, and pathogens, plus air purification systems that use UV-C lamps and/or electronic nearfields.

Group brand Merak has combined all these technologies in the **clean[air] concept**, an integrated system consisting of cleverly mixed air, highly efficient air filters, and air purifiers. The latter not only separate out pathogens – they also neutralize them.

The company's interactive **custom[air]** exhibit – which includes a "real air feeling" simulation – shows visitors how the various technologies interact and the benefits they deliver. One of the **clean[air] concept's** most important features: The system can be installed in new vehicles, is easy to retrofit in existing rolling stock, and can be customized to meet specific customer needs.



TRAFFIC FLOW

Evolution of Braking I

How trains will brake in the future – using conventional compressed air, but also without any compressed air at all

The Evolution of Braking exhibit covers an impressive six-meter expanse and puts the technologies behind the **digital-pneumatic braking system** and **digital-electromechanical braking system (EMB)** in context – including their interacting subsystems and functions.

Why these two paradigms? Pneumatic and electropneumatic brakes have decades of evolutionary technical development behind them. The many incremental improvements made to their design, materials, and control systems all add up to measurably greater reliability and safety, more uptime, and increasingly capable braking performance.

But now the major development trends in the rail industry are shifting toward higher capacity, lower energy consumption, and optimized lifecycle costs. Another technological leap is required – in the form of the EMB system, which transmits braking signals and braking force electrically using brake-by-wire technology. The

improved braking dynamics reduce braking distances. Instead of compressed air, electricity is used to transfer and store energy, resulting in major energy savings. The elimination of pipework and redundant compressed-air reservoirs saves weight and gives vehicle designers more freedom.

EMB systems won't replace pneumatic braking systems in the foreseeable future. But they do represent an air-free, oil-free braking alternative for certain applications.

By stepping up from pneumatic to digital-pneumatic braking systems, Knorr-Bremse is paving the way for **Reproducible Braking Distance (RBD)** technology that significantly reduces braking distance variance, especially in adverse track conditions. In turn, RBD is laying the foundations for increased train frequency, more reliable scheduling, and greater punctuality. At the same time, high-precision braking is one of the key prerequisites for full-scale ATO (Automated Train Operation).



RENDERING OF THE KNORR-BREMSE BOOTH AT INNOTRANS



» Knorr-Bremse is leading the way in dynamizing traffic flow, enhancing the rail industry's efficiency and capacity. At InnoTrans 2024, you can find out how we support our customers by helping them revolutionize the transportation of people and freight. «

Mario Beinert,
Member of the Management Board of Knorr-Bremse Systeme für Schienenfahrzeuge GmbH

Evolution of Braking II

Hydraulic braking systems with HydroControl Smart

On local tracks and remote branch lines with priority switches, electrically powered LRV and suburban rail systems provide comfortable, eco-friendly passenger transit services. With clever planning, they also fulfill an important feeder function for metro train services.

Hydraulic braking systems are especially advantageous in low-floor vehicles, thanks to their compact design and flexible installation options. Here, Knorr-Bremse applies a modular approach (including digital solutions) that covers a wide range of customer requirements.

With **HydroControl Smart**, Knorr-Bremse is launching a new generation of electrohydraulic supply and control units. Despite their exceedingly modest dimensions – the electronic control unit can be integrated into the device – they perform a wide variety of functions with exceptional efficiency. Because they use standardized electronic and mechanical interfaces, they are much easier to install and manage in vehicles, no matter which of these functions are enabled. As well as braking functions, **HydroControl Ease** also takes care of leveling control functions.



RENDERING OF THE KNORR-BREMSE BOOTH AT INNOTRANS

EVOLUTION OF BRAKING

The future of freight transportation

Knorr-Bremse's Digital Automatic Coupler (DAC) is paving the way for tomorrow's rail freight

Shifting freight transportation to rail requires efficient, competitive rail freight services. Here, Europe faces a mammoth task – at present, more than 500,000 freight cars and 17,000 locomotives are still coupled manually. But this means that Europe's rail freight market also represents a huge opportunity for automation and digitalization.

Knorr-Bremse's "Future Rail Freight Transportation" approach is paving the way for this future market with its central enabler, the **Digital Automatic Coupler (DAC)** – dubbed **FreightLink** by the company. The new DAC supports consistently reliable, train-wide, interoperable power and data transmission while delivering all the benefits of automatic passenger-train couplers to the freight-train sector.

Automatic Train Composition Detection provides much-needed transparency concerning the number, identification, orientation, and sequence of the rail vehicles in a trainset. **Automated brake testing** aims to eliminate the laborious, time-consuming, on-foot inspection of the entire train by technical personnel prior to departure. Automatic uncoupling of all or spe-

cific railcars will also be possible, either remotely by the locomotive driver via the train control management system (TCMS), or by a local pushbutton next to the relevant coupling point.

Knorr-Bremse's DAC has reached an advanced stage of development: A Type 5 DAC (DAC 5) that already supports automatic remote uncoupling has been undergoing in-depth tests since summer 2023. The trade-fair exhibit will also showcase wireless systems as alternatives to DAC-bound automation solutions. As well as laboratory tests, prototype installations have already been fitted with digitalization and automation functions.



RENDERING OF THE KNORR-BREMSE BOOTH

Keeping things clean

Smart sanitary systems: Where reliability means availability – and both make traveling more comfortable

From a passenger's perspective, toilets are the most eye-catching systems in rail vehicles and are largely responsible for a pleasant journey – train journeys become much less enjoyable when error messages start to flash. But even for rail operators, sanitary systems are not just an afterthought. On the contrary, they are mission-critical components – because a single defective toilet can provide sufficient reason to take an entire train out of service.

Evac, the Knorr-Bremse brand specializing in fully integrated sanitary systems for passenger trains, builds solutions that are as reliable as they are innovative. Now the German specialist is showcasing the company's **latest-generation rail vehicle toilet**. The exhibit also features the prototype of Evac's new MLC 2.0 control and connection unit.

The trade-fair exhibit enables visitors to experience a real-world use case by demonstrating the real-time monitoring of key operating data such as the number of flushes, temperature, pressure and fill level. It also explains the resulting benefits in terms of Remote Condition Monitoring (RCM) and Condition-Based Maintenance (CBM).



RENDERING OF THE KNORR-BREMSE BOOTH



OPERATIONS & MAINTENANCE

Seamlessly integrated operations and maintenance

Knorr-Bremse RailServices: the independent full-service component provider

Knorr-Bremse **RailServices** keeps train fleets up and running worldwide by adhering to clear principles and offering attractive service models. The service specialist will showcase its sustainable innovations and examples of applications for streamlining vehicle operations in the "Operations & Maintenance" solutions area, including solutions for improving vehicle availability, optimizing processes, and extending vehicle lifecycles.

Making and keeping mobility services available is increasingly complex, requiring maximum transparency across all operating and maintenance processes – which is why RailServices is so focused on them. In coming years, operators will also have to respond faster and more flexibly to new requirements – after all, it is highly likely that requirements will change several times over a rail vehicle's decades-long service life.

Digital exhibits explain how **RailServices** can extend vehicle lifecycles through modernization. Options range from cleverly designed product upgrades through the integration of new functions to the modernization of complete vehicles. RailServices will also demonstrate its component maintenance expertise in the form of a refurbished electronic assembly and an overhauled brake caliper.



» **Knorr-Bremse RailServices offers customized solutions based on three key principles: Sustain, Enhance, Accelerate. Our solutions optimize processes and improve the environmental performance and availability of our customers' fleets.** «

Frank Uder,
Member of the Board of Directors
of Knorr-Bremse Asia Pacific (Holding) Ltd.



RENDERING OF THE KNORR-BREMSE BOOTH AT INNOTRANS

intensify your
DIGITAL SOLUTIONS

DIGITAL SOLUTIONS

From data to “done”

Digital solutions: How Knorr-Bremse generates customer benefits from smart subsystems

Smart products, smart functions, smart services – in recent years, Knorr-Bremse has been systematically digitalizing subsystems. Now end-to-end data collection plus intelligent data analytics are enabling a broad range of services, including automation solutions, Internet of Things (IoT) applications, and detailed recommendations for actions to be taken by system operators.

Knorr-Bremse calls this approach **Data2Action**, and a full explanation appears on the InnoTrans booth's central display. Examples include fleet management of climate control systems, successfully implemented in a joint project with Siemens Mobility for South Western Railway in the UK; the Knorr-Bremse braking systems in VTG freight cars with built-in wheel flat prevention and digital monitoring; and the monitoring of air supply systems implemented on Deutsche Bahn rail vehicles.

Also featured on the central display are solutions for **cybersecurity**, the **Rail Data Space** (part of the Europe's Rail Joint Undertaking technology and innovation program), **improved operations**, such as driver assistance and advisory systems, and the **Rail Computing & Communication (RCC)** system developed by Group brand Selectron.



» We're constantly optimizing Knorr-Bremse's portfolio by focusing on technologies that support automation, data processing, and the Internet of Things. In turn, they enable our customers to respond smoothly and flexibly to rapidly changing customer needs. «

Harald Schneider,
Member of the Management Board
of Knorr-Bremse Systeme für Schienenfahrzeuge GmbH



RENDERING OF THE KNORR-BREMSE BOOTH AT INNOTRANS

Scalable connectivity

New RCC platform supports highly customizable applications

Rail Computing & Communication (RCC) systems and their safety and cybersecurity applications play a vital role in the digitalization and automation of rail vehicles. Any compromise in safety-critical rail services would be, after all, unthinkable!

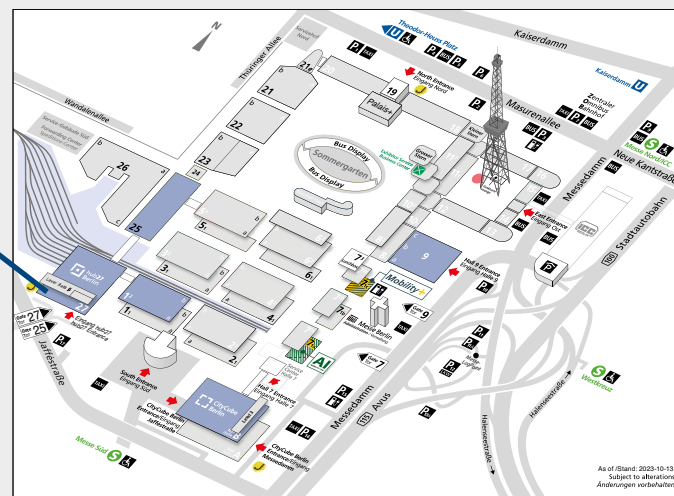
By adhering to this principle, Knorr-Bremse subsidiary Selectron has worked its way up to a world-leading position. Applications like the Train Control and Management System (TCMS) act as a control center for train systems, connecting together traction, braking, entrance, HVAC, and lighting systems, as well as wet

cells. They also ensure that vehicles in operation are protected by effective defense-in-depth concepts such as the newly developed Threat Detection Solution.

Selectron will showcase its **new RCC platform** at Booth 410 in Hall 27. For the first time, the platform makes it possible to flexibly customize individual applications such as TCMS, networking and communications, safety and cybersecurity, and the train and vehicle bus. Consisting of a computing unit, I/O systems and communication modules, the platform's project-specific adaptability offers rail vehicle manufacturers and operators unprecedented flexibility and scalability. By design, it is also open to a wide variety of programming environments.



Hall 27, Booth 410



Sending a strong signal

Knorr-Bremse Group brand Zelisko presents a new, exceptionally compact LED signal light

Thanks to their innovative LED technology and special lens systems, Zelisko's super-bright signals have become a regular trackside feature. Highly visible at any time of year, day or night, they perform well even in very poor light.

In Hall 25 at Booth 120, a digital exhibit will showcase Zelisko's new "Compact" LED signaling system. The SIL4-certified – now also IP65-certified – system is impressively svelte; the design has been slimmed down by 42 percent to a depth of just 205 millimeters, thanks to a fundamental redesign of the internal electronics. But because the new signal's functionality and electri-

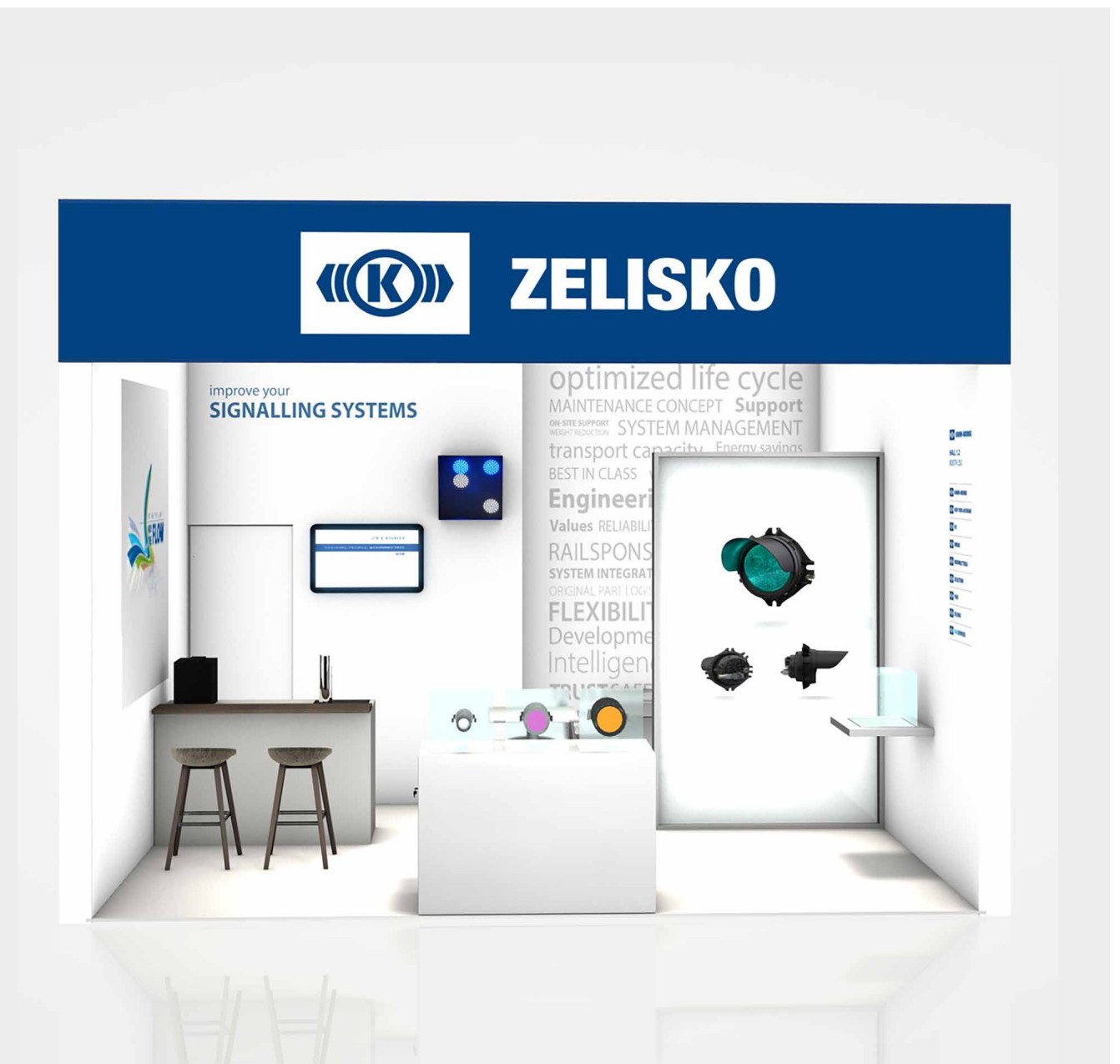
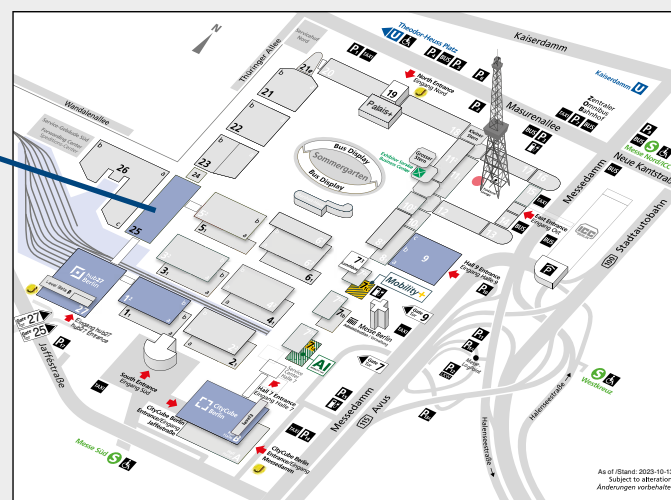
cal interfaces with the signaling infrastructure remain unchanged, it is perfectly compatible with the previous generation (see also pages 20/21).

Zelisko is also presenting a digital exhibit of its rail crossing safety system. The **computer-controlled level crossing protection system (RBÜT)** is based on fully electronic systems featuring super-safe, **SIL4-compliant** signaling technology.



In addition, the company will present the latest generation of its new compact LED signal lights as physical exhibits at InnoTrans, showcasing all models in the range.



Hall 25, Booth 120



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|  KNORR-BREMSE | Hall 1.2, Booth 250 |
|  NEW YORK AIR BRAKE | Hall 1.2, Booth 250 |
|  IFE | Hall 1.2, Booth 250 |
|  MERAK | Hall 1.2, Booth 250 |
|  MICROELETTRICA | Hall 1.2, Booth 250 |
|  SELECTRON | Hall 27, Booth 410 |
|  EVAC | Hall 1.2, Booth 250 |
|  ZELISKO | Hall 25, Booth 120 |
|  RAILSERVICES | Hall 1.2, Booth 250 |

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|  Europe's Rail | Hall 27, Booth 511 |
|  nexxiot | Hall 1.2, Booth 450 |
|  Rail Vision REGULATED BY TRAC | Hall 27, Booth 770 |