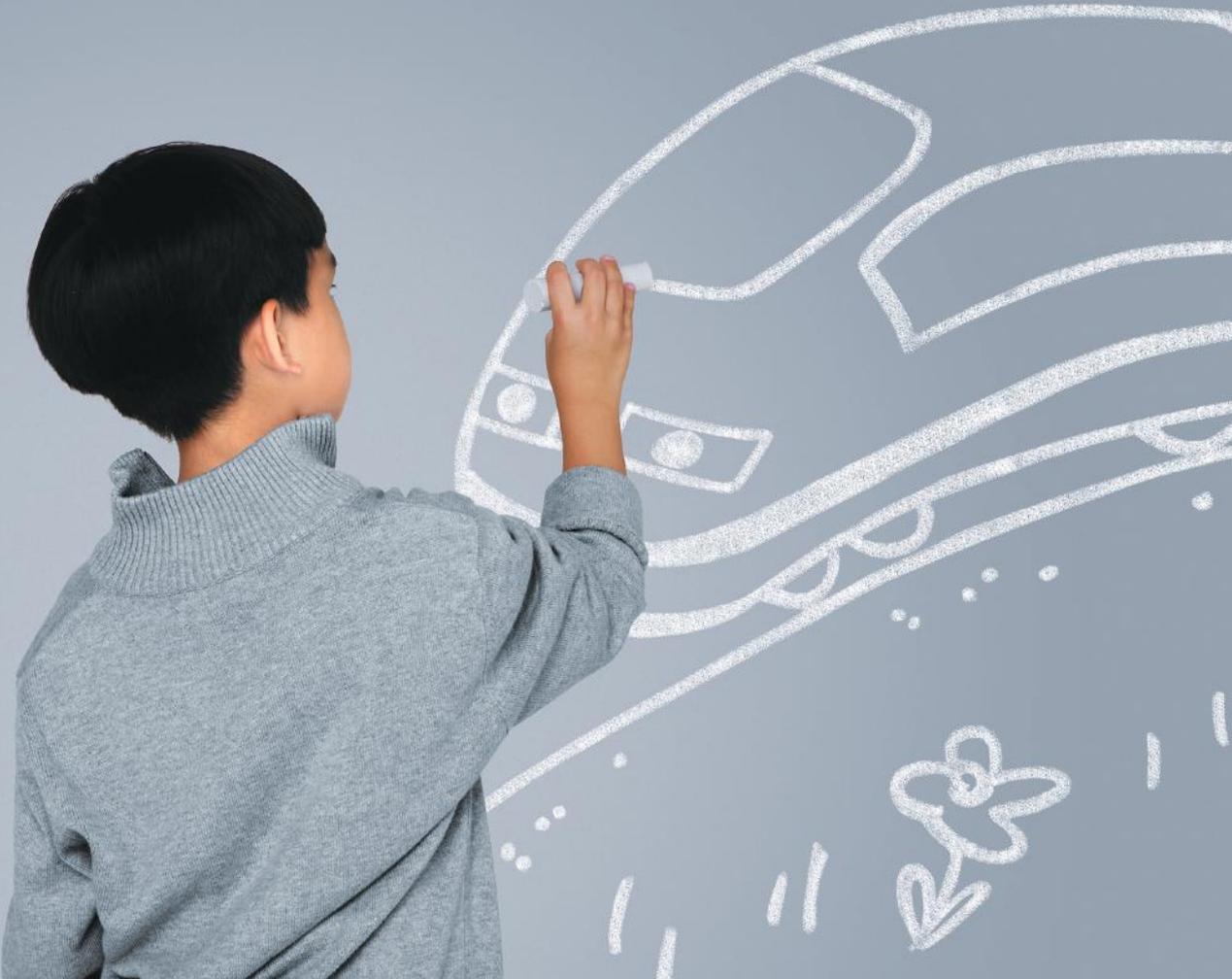


Railway connectivity

Edition 2014



Intelligent solutions for tomorrow





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Your partner for railway solutions

HUBER+SUHNER is a global manufacturer and supplier of components and system solutions for electrical and optical connectivity. With cables, connectors and systems – developed from the three core technologies of radio frequency, fiber optics and low frequency – the company serves customers in the communication, transportation and industrial sectors.

The company has been developing and manufacturing high-quality products specifically for the railway sector for decades. Safety, comfort and operating efficiency are the most important requirements that train operators need to fulfil now and in the future. HUBER+SUHNER provides reliable and intelligent connections for the most advanced train applications in order to meet these demands.

Connectivity solutions based on three technologies

Today's rail transport must be fast, efficient and safe. At the same time, it should also provide exceptional comfort and service to its passengers. Modern and complex systems are entering the market that enable train operators to fulfil these requirements. OEMs and systems integrators must now construct trains and systems that also fulfil future requirements and avoid subsequent, costly modifications.

HUBER+SUHNER is the right partner in this endeavour. Whatever the application, the company has been developing intelligent and innovative products for years that fulfil the individual requirements of a range of railway applications.

The company supplies components and systems for power supply, signal and data transmission in all types of rail vehicles and along the track. With HUBER+SUHNER, trains are fully equipped for today's and future needs.

Range of products

Low frequency

- Databus cables
- Signal cables
- Control and power cables
- Cable assemblies and systems

Radio frequency

- Antennas
- Radio frequency cables, connectors and cable assemblies
- Power splitters
- Lightning protection
- DC blocks

Fiber optics

- Fiber optic cables, connectors and cable assemblies
- Fiber management systems
- Cable systems





Durable – even in adverse environmental conditions

The products are characterised by their exceptional performance, robustness, reliability and durability. They have been specially developed for the railway market and fulfil the railway industry's most important environmental and fire-safety requirements.

HUBER+SUHNER's globally renowned RADOX® brand stands for particularly high-quality and resistant cables that are devel-

oped and manufactured in-house. They are based on specially designed compounds that provide high-performance insulation and sheath materials. The materials are made extremely robust through an electron-beam crosslinking process.

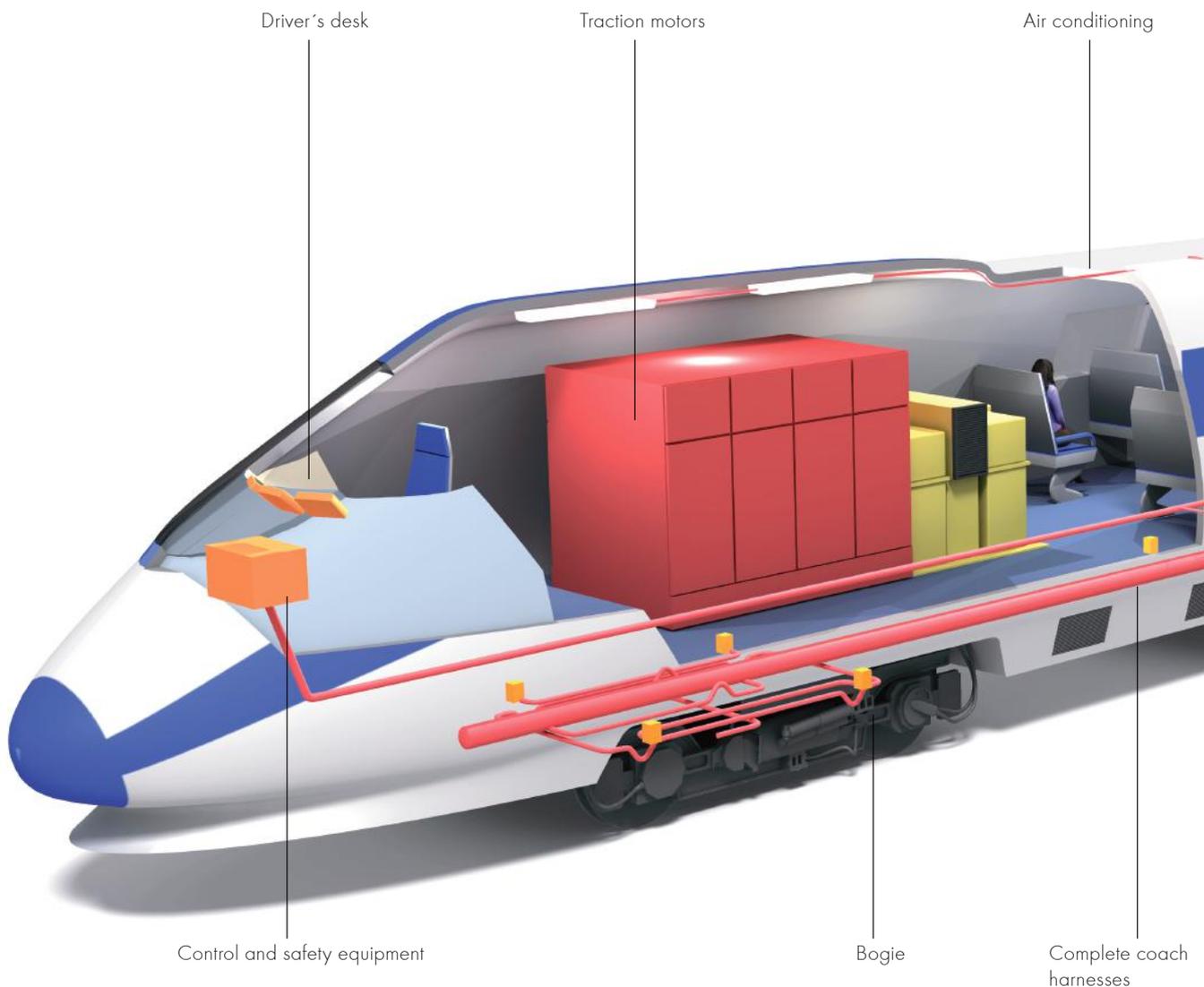
Through the use of engineered materials, HUBER+SUHNER products can be put to use in sophisticated applications under adverse conditions.

Signal and power transmission

Increased complexity in train systems has increased car body wiring. This in turn impacts on the space required for extra wiring and increases weight, which has an adverse affect on performance and cost of ownership. This means that wiring the individual components is becoming increasingly challenging.

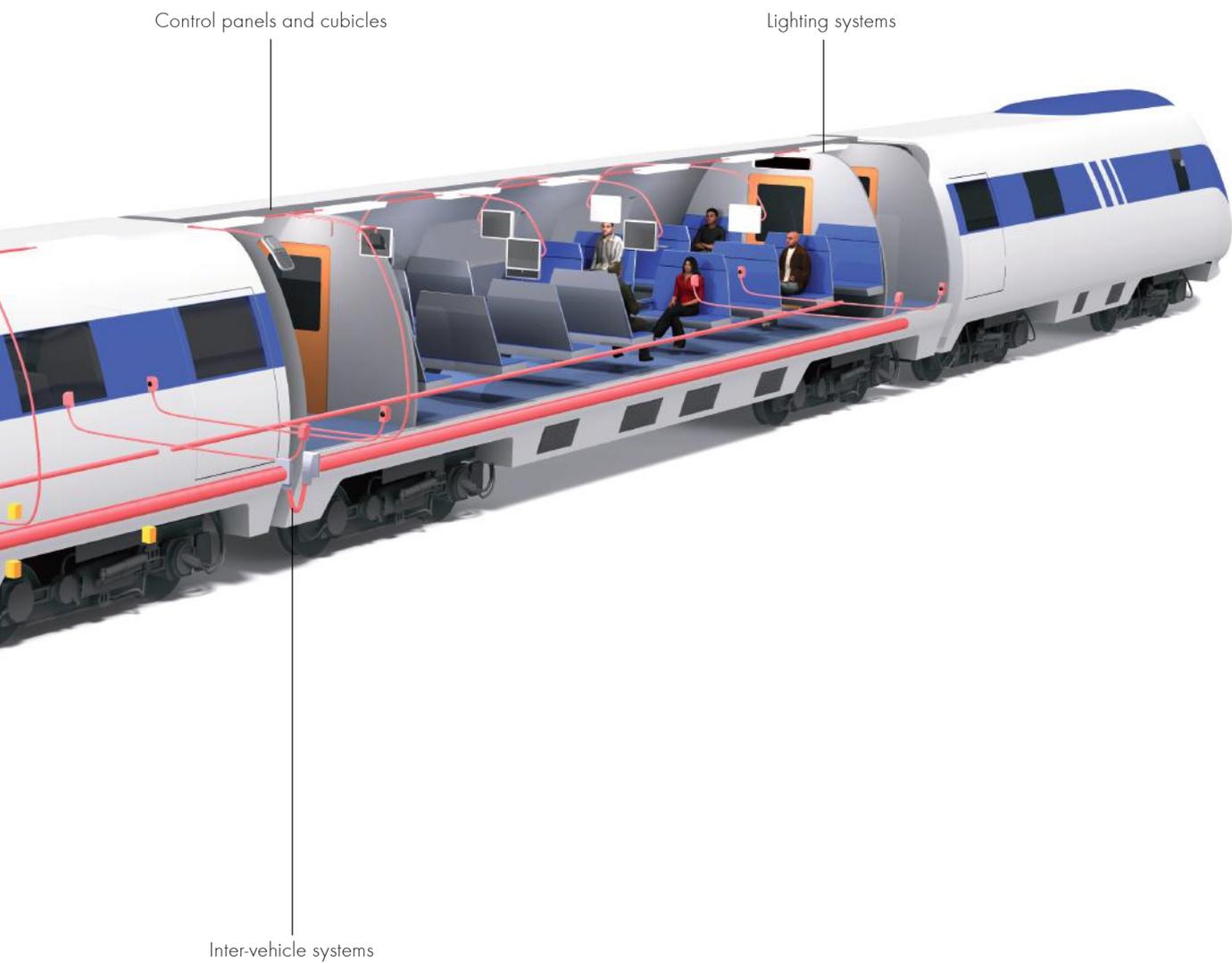
Under these conditions, the use of thinwall and lightweight cables is essential to meet the technical challenges of the market while simultaneously reducing the amount of combustible material and thus potential fire hazard.

To transmit signals and power within the train, HUBER+SUHNER has been developing, constructing and manufacturing an extensive range of single cores, multicore cables and inter-vehicle jumper systems for many years. Bulk cables are just as much a part of the offering as pre-assembled cables or customer-specific cable systems. All products are completely halogen free, non-toxic, low-smoke, and resistant to abrasion and fire. Therefore, they provide a very high degree of safety for all passengers throughout the entire life cycle of the rail vehicle.



Range of products

- Single cores
- Multicore cables
- Customer-specific cables
- Inter-vehicle jumper cables and systems
- Cable assemblies



Cable portfolio for signal and power transmission



RADOX® 4 GKW-AX family

- Compact, flexible energy cables
- Electron-beam crosslinked RADOX® insulation does not melt or run at high temperatures
- Flexible
- Space and weight-saving
- Resistant to mineral oil and detergents
- Easy to strip
- Halogen free, low smoke, flame-retardant
- Resistant to wear, ozone and oil



RADOX® TENUIS-TW family

- Control and signal cables for transport systems
- Smaller, more lightweight and more flexible than conventional products
- Electron-beam crosslinked RADOX® insulation does not melt or run at high temperatures
- High abrasion resistance
- Very flexible
- Space and weight-saving
- Easy to strip and install



RADOX® GKW-LW family

- For system wiring in modern rolling stock
- Halogen free, compact and lightweight core
- High abrasion resistance
- Lightweight and thin
- Excellent in damp environments



RADOX® 9 GKW-AX family

- Compact, flexible energy cables
- Space and weight-saving
- Electron-beam crosslinked RADOX® insulation does not melt or run at high temperatures
- Resistant to mineral oil and detergents
- Flexible
- Easy to strip



RADOX® 3 GKW family

- Single-core power and control cable
- Halogen free
- Electron-beam crosslinked RADOX® insulation does not melt or run at high temperatures
- Long service life
- Compact and optimal weight
- Narrow bending radii



RADOX® EN 50306 and EN 50264 family

- Electron-beam crosslinked insulation
- Halogen free, flame-retardant
- Excellent electrical properties
- Highly resistant to heat and cold
- Oil, ozone and weather-resistant
- Flexible
- Easy to strip

Cable systems for signal and power transmission

In collaboration with its customers, HUBER+SUHNER develops pre-assembled cables and customised cable systems which meet railway-specific requirements and which are safe, reliable and low-maintenance to use.

Drawing upon many years of experience in the railway market, HUBER+SUHNER offers a full array of services in the provision of ready-to-use and tested cable systems.

HUBER+SUHNER provides

- Complete inter-vehicle jumper systems
 - Cables or system cables made from optical cables, databus, signal and power cables
 - Pre-assembled units
 - EMC-optimised solutions
 - Systems for high dynamic loads
- Coach harnesses
 - Pre-assembled cables
 - Complex cable harnesses made from optical cables, databus, signal and power cables
- Cable systems for bogies
- Railcar and locomotive cabling
- Cabling of control and safety systems
- Switchgear and distribution cabinets

Scope of activities

- Built to print
- Solutions developed with the customer
- Concept
- Sourcing
- Product and system design
- Prototyping
- Integration of subsystems
- Project management



Connected Mobility

Communication and mobility have become basic human needs in our modern times. It is almost taken for granted that both people and trains can exchange information at any time anywhere.

With Connected Mobility, HUBER+SUHNER brings together the two worlds of communications and railway. Robust and reliable data communication is instrumental for key railway applications:

Train control systems

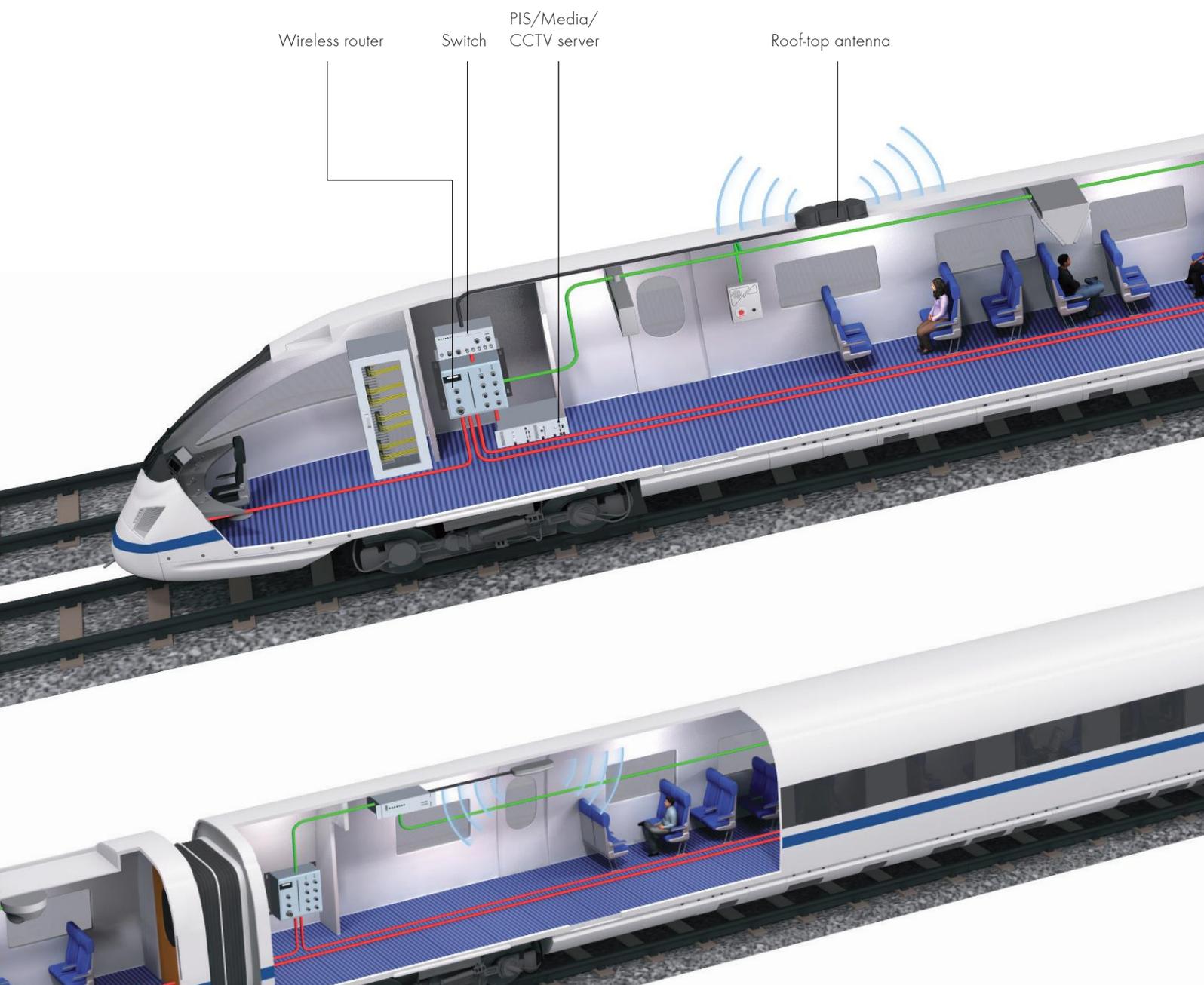
- CBTC
- ETCS/PTC

Train operations

- On-train monitoring and recording (OTMR)
- CCTV
- Automatic passenger counting
- On-board ticketing
- Staff information systems
- SCADA

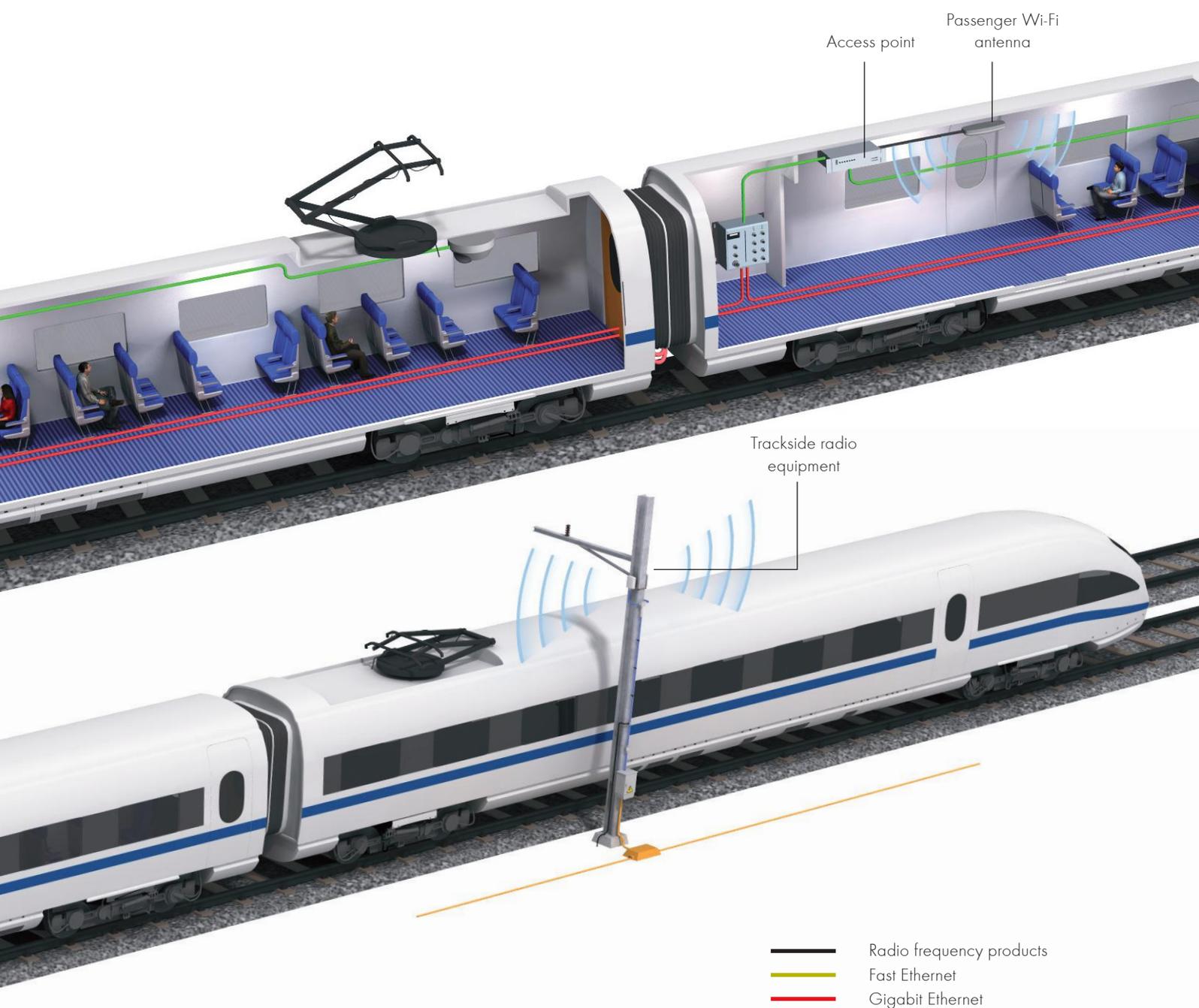
Passenger information and entertainment systems

- Travel routes and schedules
- News and advertisements
- Internet on board
- Video on demand
- Gaming



For these applications, increasing amounts of data must be transmitted within the train, between the train and the ground and along the track. The implemented systems use state-of-the-art communication technologies to fulfil demanding market needs:

- Robust and reliable connections
- Enough bandwidth to cope with today's demands (Fast Ethernet, Gigabit Ethernet, 3G)
- Easy scalable and upgradable network architecture (to 10 Gigabit Ethernet, 4G)
- Innovative broadband technologies (MIMO)
- Components that meet railway specific environmental standards



Gigabit data transmission on rolling stock

A modern train requires a high-performance communication infrastructure that provides a broadband connection to the outside world and a backbone network throughout the entire train. In the long term, this enables multiple new applications to be implemented to the existing network and offers increased flexibility to add or exchange active components later on.

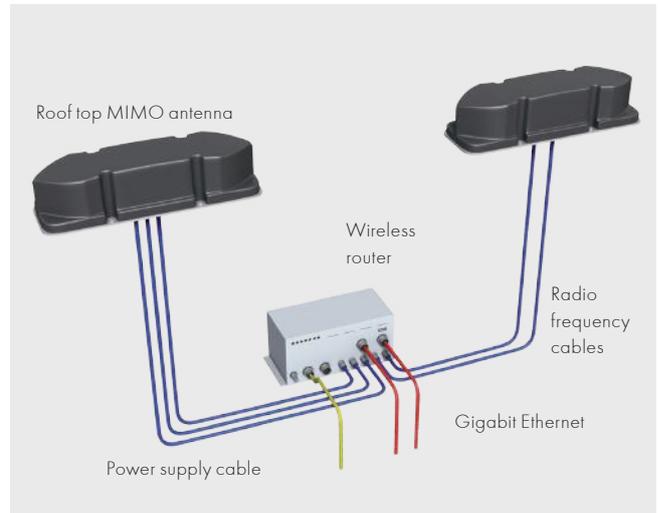
Three factors are crucial for successful Gigabit data transmission on board rolling stock. HUBER+SUHNER offers the appropriate connectivity solutions with its range of products.



1. Train-to-ground broadband wireless data transmission

HUBER+SUHNER solution:

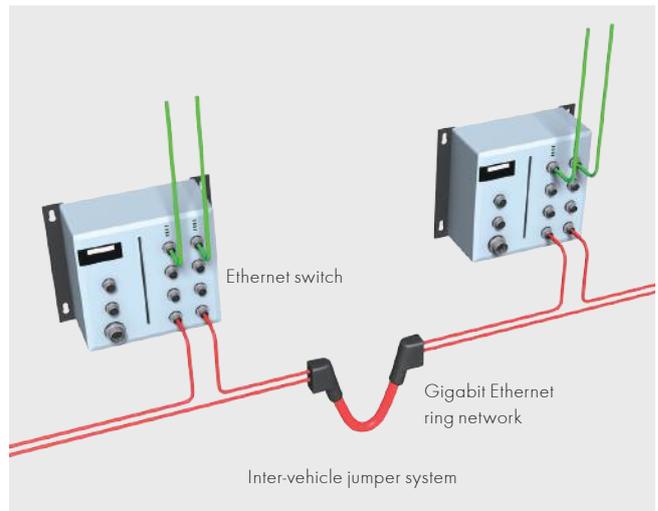
- One or more antennas on the roof of the train in communication with the trackside infrastructure, a combination of:
 - Cellular networks: GSM, GSM-R, UMTS, LTE
 - Wi-Fi or proprietary Wi-Fi based
 - MIMO-capable solutions are available
- Antennas and a railway-specific wireless router:
 - Aggregate bandwidth from the available networks
 - Enable a fast handover
 - Increase the available bandwidth to the Gigabit network on board



2. On-board Gigabit backbone

HUBER+SUHNER solution:

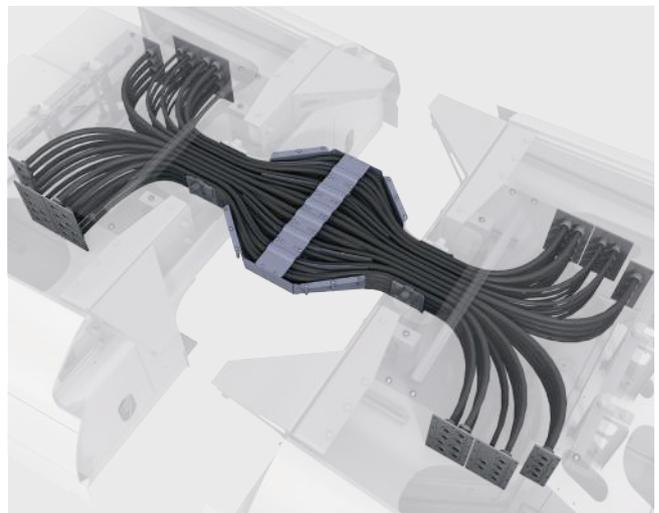
- Fiber optic or copper-based CAT7 connections permanently provide consistent, stable bandwidth throughout the train
- Benefits of fiber optic connections:
 - Free from electromagnetic interference (EMI)
 - Di-electric fiber optic technology provides full electrical isolation



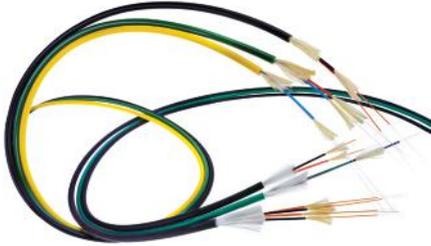
3. Data transmission from carriage to carriage

HUBER+SUHNER solution:

- 100% tested and optimised system cables which can withstand particularly challenging environmental conditions:
 - In trains at very high speed
 - Permanent movement, exposure to vibrations and shock
 - Can withstand particularly high and low temperatures, moisture, detergents, dirt and UV light
- Combination of optical cables, databus, signal and power cables in one system cable
- Maintenance-free use



Components for the trainborne Ethernet backbone



Fiber optic cables and assemblies

- Metal-free connection solution
- Electron-beam crosslinked RADOX® cables
- Flame-retardant, halogen free, low smoke
- Cable systems for vehicle interiors and inter-vehicle jumper systems
- Customised design
- 100 % optically and mechanically tested and ready for installation



Databus cables and assemblies

- Wide range of RADOX® databus cables
- Including CAT5 and CAT7 databus connections
- Electron-beam crosslinked RADOX materials do not melt or flow at high temperatures
- Halogen free and flame-retardant
- Particularly resistant to heat and cold, as well as ozone and weather-proof
- Easy to strip
- Exceptional data transmission properties
- Excellent screening effect



Fiber optic inter-vehicle jumper systems

- Project-specific designs
- Supply of complete systems, ready to install
- Fully tested systems with in-house movement test rig (mechanically and optically tested)
- Over 20 years of return on experience in rail environment
- Over 10 years extended system lifetime
- Lightweight, di-electric, EMI-free
- Ideal for Electrical Multiple Unit- (EMU) consists

Components for the train-to-ground and on-board wireless network

Railway roof-top antennas



SENCITY® Rail MIMO roof-top antenna

- Rugged, omnidirectional roof-top antenna for trains
- Supports 2x2 MIMO from 698 MHz to 6 GHz
- Low profile and compact design for use on all types of trains
- Multi-band antenna - supports all modern wireless standards worldwide
- Flexible mounting options
- Minimum installation effort when replacing existing antennas thanks to the same mounting scheme (footprint)
- Embedded GPS/Galileo/Glonass antenna
- Low-profile version available



SENCITY® Rail roof-top antennas

- Omni-directional roof-top antenna with an extremely rugged mechanical design
- Multi-band support 380 MHz to 6 GHz
- Embedded GPS/Galileo/Glonass antenna
- Low-profile version available

In-carriage antennas



SPOT-S and SPOT-M antennas

- Directional antennas
- Compact design
- Excellent size/performance ratio
- Supports Wi-Fi 2.4 and 5 GHz
- Various designs, e.g. vertical polarisation, dual slant or MIMO



Indoor antennas

- Robust, omni-directional MIMO indoor antennas
- Support Wi-Fi 2.4/5GHz as per IEEE 802.11 b/g
- Simple cable connection by using QUICK-LOCK connectors
- Various assembly options

In- and outdoor coaxial cables

High-frequency cables, connectors and assemblies

- Low-loss feeder cables
- Highly flexible jumper cables
- Tested, customised, pre-assembled cables with high return loss
- Flame-retardant, low smoke, halogen free
- Wide temperature range
- Available with all common RF connectors



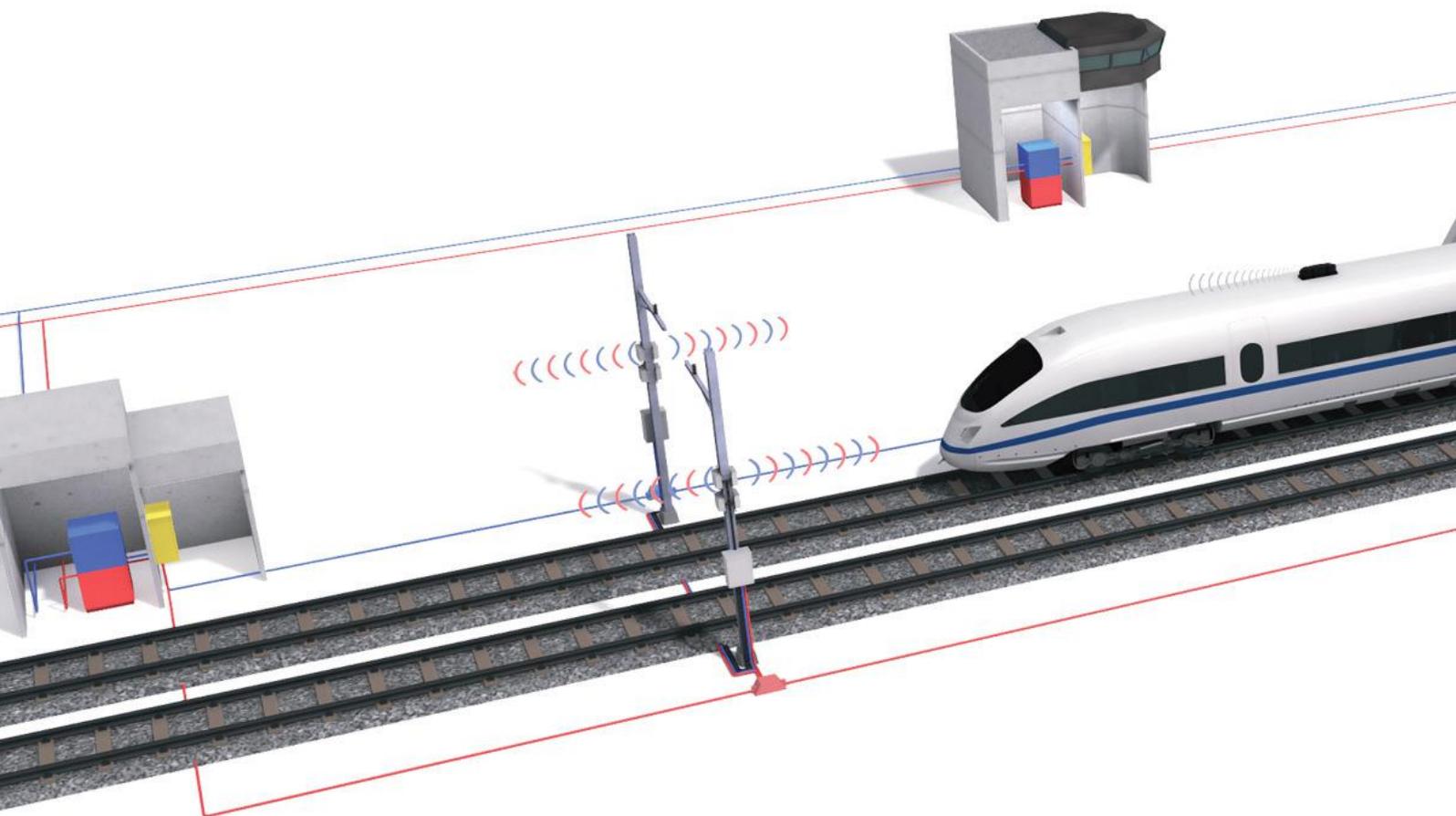
Trackside data transmission

A fiber optic network interconnects the full range of trackside equipment and provides a connection to the control centre. Additionally, trackside radio equipment enables continuous two-way communication between the trains and the ground. This enables both the trackside and train data to be monitored and controlled centrally. The redundant design of the network infrastructure ensures a high degree of system availability, which is key for optimal and safe traffic operation.

Complete connectivity solutions

HUBER+SUHNER offers reliable and future-proof passive components which are compatible with all system vendor products and future generations of active equipment. As the dedicated components are critical to train operations and extremely exposed to the environment, HUBER+SUHNER connections have the following specific features:

- Easy and quick to install
- High maintainability
- Withstand harsh environmental conditions over a long lifetime



Trackside data transmission is required in different applications:

Trackside wireless communication networks

Dedicated equipment for wireless networks is fitted along the track to provide high-speed wireless connectivity between the train and the ground. These systems are primarily based on 2.4 or 5 GHz Wi-Fi or proprietary Wi-Fi technology. Today, such networks are preferably used in urban areas, e.g. metro applications. They enable the data transmission for CBTC, or bandwidth-intensive applications such as CCTV and on-board Internet.

Cellular communication networks

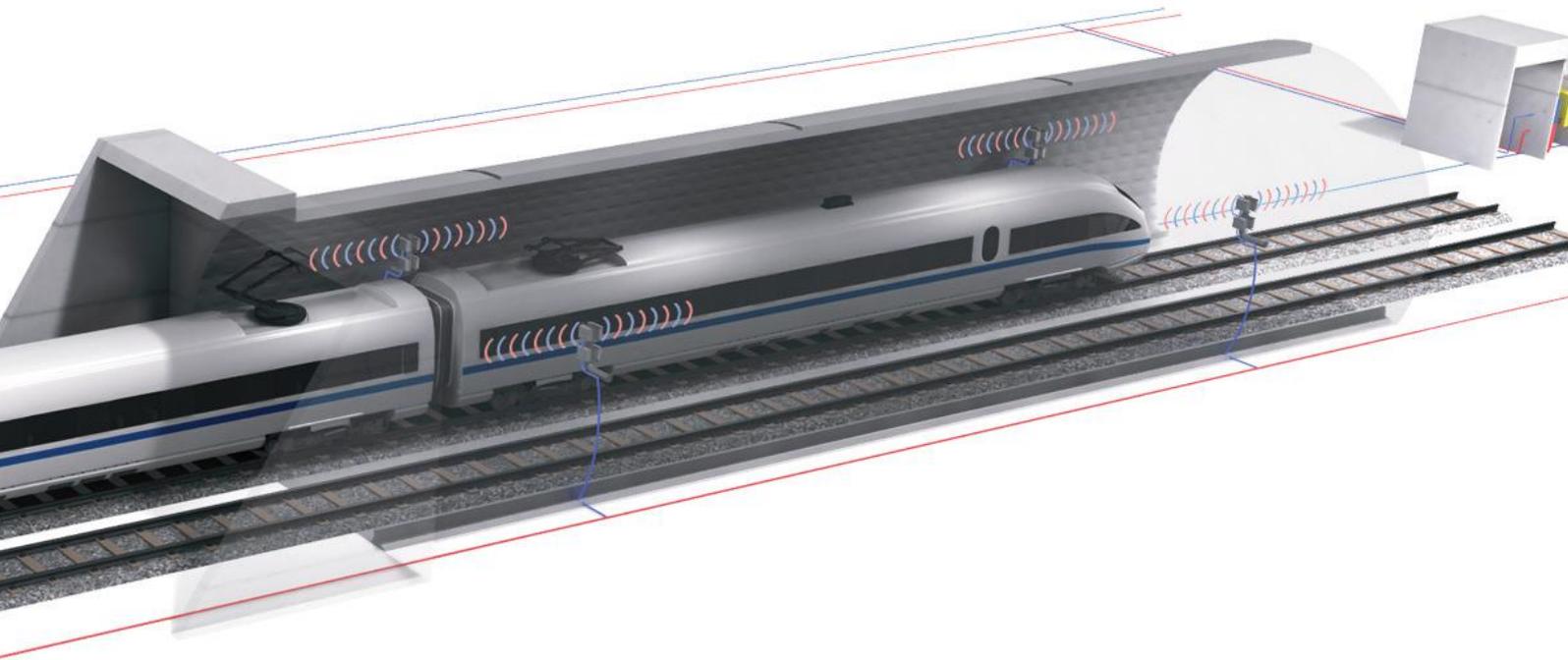
The existing cellular network (public or GSM-R) is used to wirelessly communicate with the train. The LTE standard allows more bandwidth than GSM networks and is used for data communication. GSM-R is typically used for mainline signalling.

Trackside backbone networks

Typically, a fiber optic network deployed along the tracks connects control centres to stations and trackside equipment used either for communication, signalling or other vital operational functions (e.g. SCADA).

Communication in railway stations

Inside a railway station, a wide range of equipment such as displays, ticketing machines, CCTV cameras and further equipment requires data connections.



Radio frequency trackside components



Yagi antennas

- Linear-polarised, directional antennas
- Support Wi-Fi as per IEEE 802.11 b/g
- Extremely robust and compact design
- The enclosed bracket facilitates installation on walls and masts



SPOT-S and SPOT-M antennas

- Directional antennas
- Compact design
- Excellent size/performance ratio
- Supports Wi-Fi 2.4 and 5 GHz
- Various designs, e.g. vertical polarisation, dual slant or MIMO



DC and DC/DC blocks

- DC blocks (inner conductor DC blocking) and DC-DC blocks (inner and outer conductor DC blocking)
- For galvanic isolation up to 15 kV
- Sufficient safety even in worst case scenario if overhead high voltage lines fall to the ground



Radio-frequency power splitter

- Symmetrical RF power dividers
- For diversity transmission and bidirectional track illumination
- Low insertion loss
- Very good adaptability



High-frequency cables, connectors and assemblies

- Low loss feeder cables
- Highly flexible jumper cables
- Tested, customised, pre-assembled cables with high return loss
- Flame-retardant, low smoke, halogen free
- Wide temperature range
- Available with all common RF connectors



Lightning protection components

- Protection of sensitive trackside radio equipment from damage caused by over voltages (caused by lightning or currents induced by train traction currents)

Fiber optic backbone components



MASTERLINE

pre-assembled fiber optic cable systems

- «Plug&play» installation
- No more field terminations of connectors needed
- All lengths can be implemented
- Large selection of cable types
- All standard connectors available
- High mechanical stability



Fiber optic management system

- Customised frames, boxes, enclosures
- Low to high fiber capacity
- Suitable for indoor and outdoor applications



Fiber optic cable

- High fire safety performance
- Anti-termite jacket material
- Rodent protection (corrugated steel, fiber glass)
- Jelly-free
- Approved for use in tunnels (such as on the London Underground)
- Various designs available



Fiber optic splice closures

- Easy fiber management for looping through/uncut fibers
- Sealing of fiber optic connections
- Re-opening and sealing without special tools
- Fittings to mast, walls, cable ducts or directly buried
- Splicing of up to 96 fibers
- IP67

Services

Design

- **Feasibility studies**
Assess if the required project-specific system can be manufactured and will deliver performance according to the desired specifications
- **Antenna positioning recommendation**
Define the best antenna mounting locations to achieve optimal radio system performance, taking into consideration the available real-estate on the roof of the train
- **Antenna radiation pattern simulation**
Characterise the impact of the antenna surroundings on its original radiation pattern
- **Customer-specific accessory designs**
(e.g. mounting brackets)
Design of specific accessories that enable the mounting of standard components (e.g. antennas) on existing equipment or trains
- **Subsystem integration**
Design and manufacturing of a basic electrical or electronic subsystem on customer's request



Testing

- **Tests according to customer and project-specific criteria**
Movement test rigs, environmental test facilities, electrical or optical test stations
- **Site surveys / RF propagation studies**
Simulation and measuring of actual electromagnetic field propagation in complex environments (e.g. tunnels) for optimal network planning



Implementation

- **Management of national and international projects**
- **Installation management**
Managing the physical installation of a system on a train or trackside by HUBER+SUHNER or by subcontracted installation teams. Planning of availability of manpower on time on site.
- **Kitting**
Supply product bundles (including third party items), manage related stock, procure and deliver a functional set rather than stand-alone products on site



Aftersales

- **Performance verification studies**
Testing and consulting for used connectivity systems (e.g. inter-vehicle jumper systems)



Customer benefits

There are many reasons to work with HUBER+SUHNER. As a technology leader, the company provides excellent connectivity solutions from which clients all over the world will benefit:

Excellent products

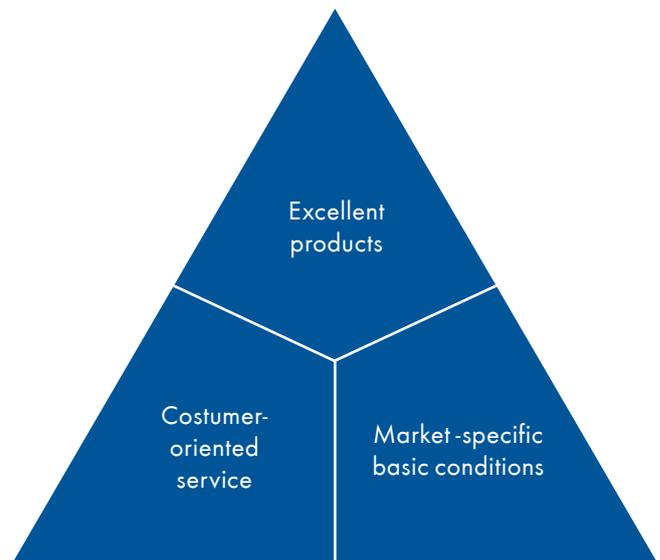
- Connectivity solutions based on different technologies: fiber optics, radio frequency or low frequency
- Low weight, space-saving connections
- Robust and reliable components
- Long service life and therefore low maintenance costs
- Tested connections
- Powerful broadband radio connections (MIMO technology)
- Quick installation in brown field thanks to ready-to-use «plug&play» solutions
- Individual inter-vehicle jumper systems

Customer-oriented service

- Customer-specific systems according to individual project and customer requirements
- Engineering and cross-border project management for integrated solutions
- Consulting and technical support for all products and services
- Global distribution network

Market-specific basic conditions

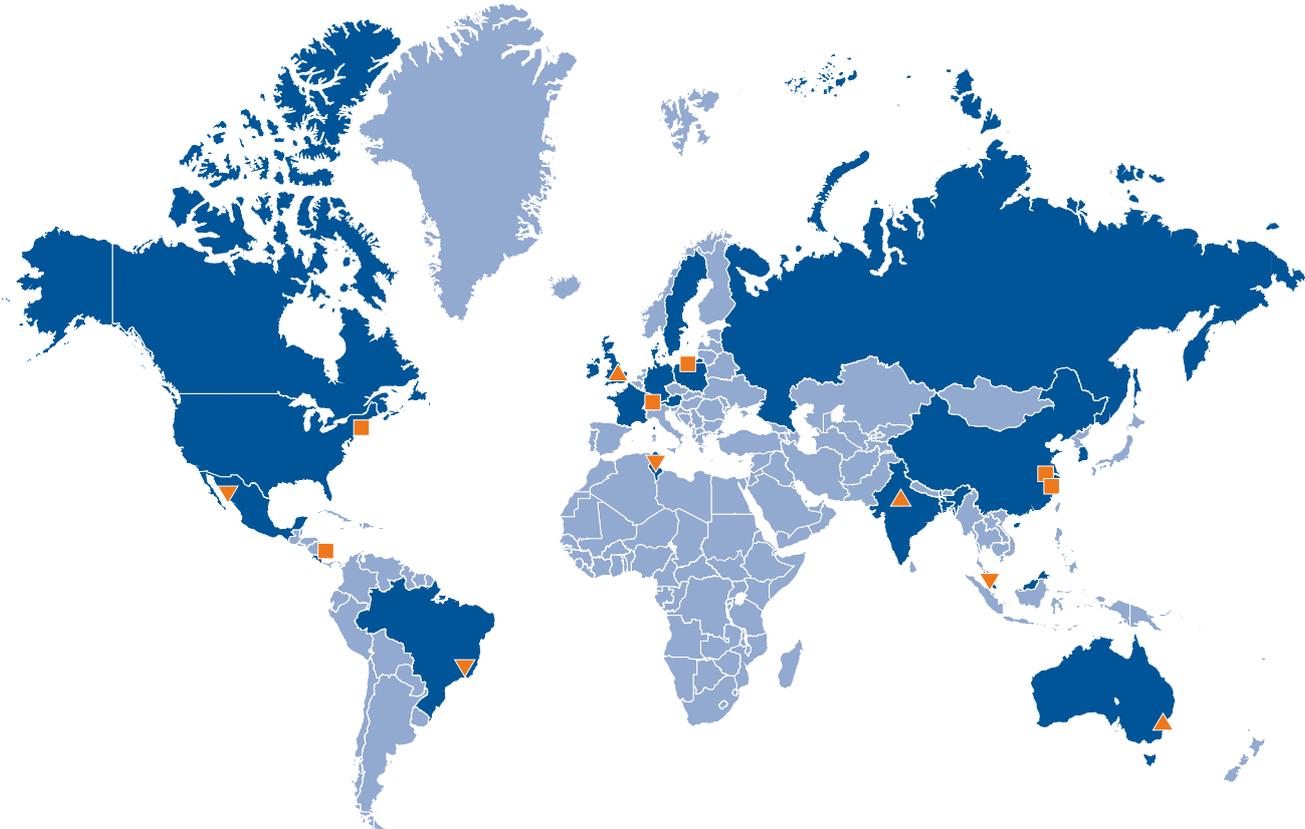
- Years of experience in development and production of components in the railway market
- IRIS-certified supplier
- Compliance with environmental requirements for the railway industry as set out in EN 50155
- Compliance with fire protection requirements, e.g. DIN 5510-2, BS 6853, NF F 16-101/102, EN 45545-2



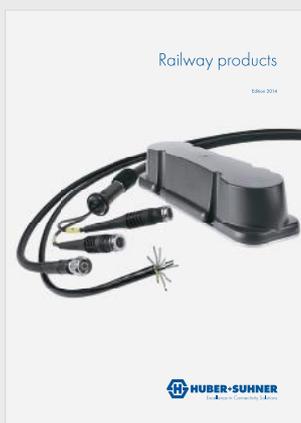
Globally successful

Decades of product development for the railway sector, the company's own compounding facility and superior technological manufacturing facilities form the basis for precise and durable products. A global production network, combined with group companies and agencies in over 60 countries, puts

HUBER+SUHNER close to its customers. This global presence and in-depth product and market knowledge allow HUBER+SUHNER to successfully implement projects and manufacture excellent products worldwide.



Further catalogues



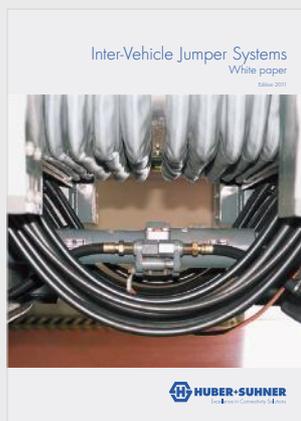
Railway products
Item no. 84110507



Train-to-ground
communication
Item no. 84112422



On-train fiber optic
connectivity (white paper)
Item no. 2326/JS/11.2011



Inter-Vehicle Jumper Systems
(white paper)
Item no. 84071428



CBTC Connectivity
Solutions (white paper)
Item no. 2326/JS/11.2011

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HUBER+SUHNER is certified according to EN(AS) 9100, ISO 9001, ISO 14001, ISO/TS 16949 and IRIS.

Waiver

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