The background of the advertisement shows a railway track with a red high-speed train in motion, blurred to indicate speed. To the left of the tracks is a large, modern, grey metal structure, likely a wayside train monitoring system (WTMS), with various sensors and cameras mounted on it. The scene is set outdoors with green trees and a clear blue sky. A large red diagonal shape is overlaid on the bottom left corner, containing the text.

# Wayside train monitoring systems (WTMS).

Uncompromising safety.

# We keep Switzerland moving.

Travel in comfort. Get there on time.

The Swiss are world champions in rail travel. Every day, some 10,671 trains travel on SBB's more than 3,000-kilometre-long track network, bringing 1.26 million people to their destination. SBB also transports 210,000 tonnes of freight on its railways every day. These impressive figures are unmatched anywhere in the world. Managing such vast volumes day after day is no mean feat.

To enable it to control rail traffic safely, punctually and efficiently, SBB has installed over 200 train monitoring systems throughout its rail network. The various fully automated measuring and sensor systems perform all manner of monitoring functions around the clock. They detect technical defects before they can cause an incident on the track network, such as load displacement, overloading, clearance profile breaches or the escape of dangerous goods as well as hot box or damaged axle box bearings.

SBB developed two of its train monitoring systems – the wheel load checkpoint and fire and chemical detection system – and the network train monitoring system IT application in house. We would be happy to use our expertise to help you.

## **Philippe Gauderon**

Head of SBB Infrastructure, Member of the Management Board



“Reap the benefits of  
Swiss precision”

# Train monitoring systems.

## Uncompromising safety.

THE TRAIN MONITORING SYSTEM, A SAFETY-RELEVANT AND NETWORKED MEASURING SYSTEM, DETECTS RISKS BEFORE AN INCIDENT OCCURS.

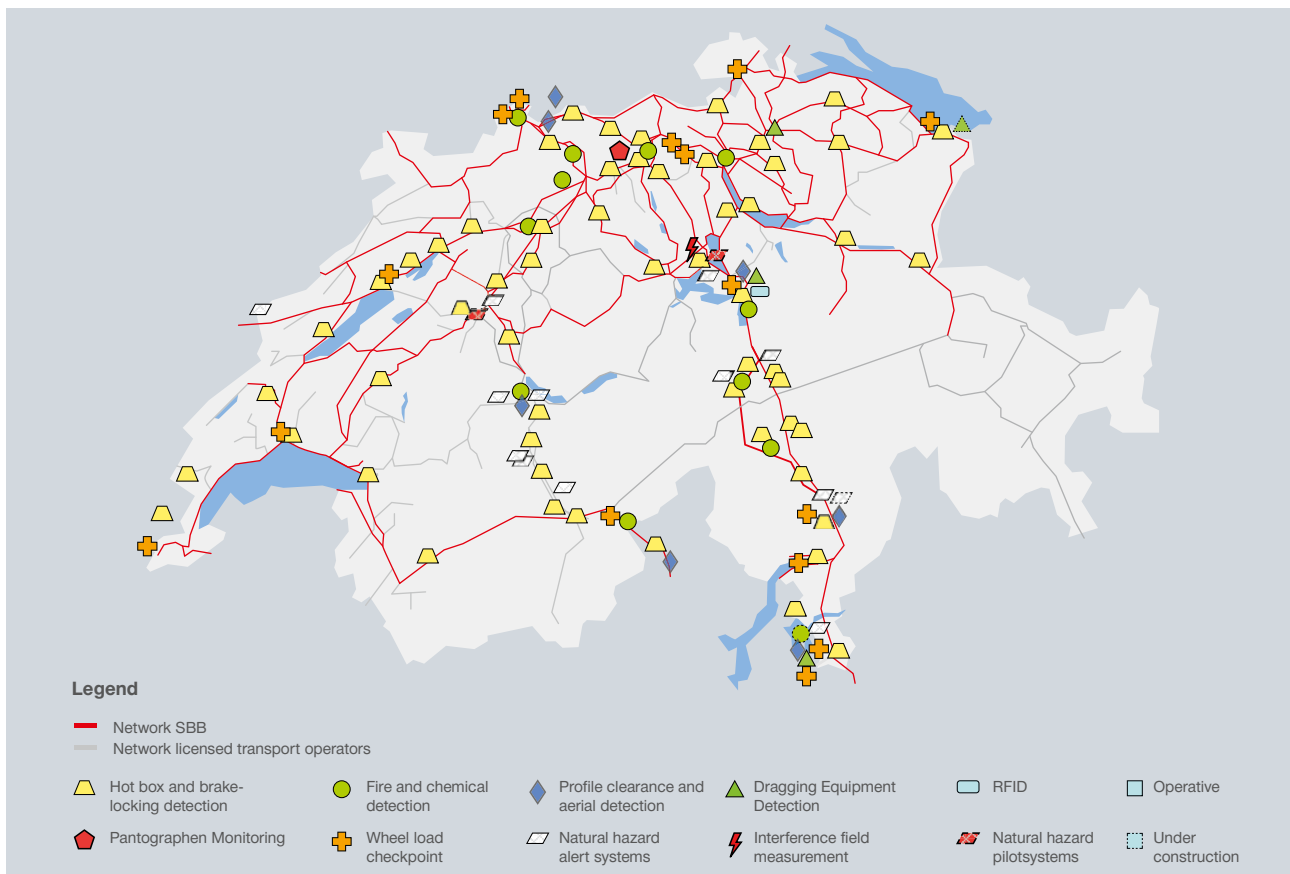
SBB Infrastructure operates and maintains Europe's most heavily used rail network. Passenger and freight trains run along the same routes at frequent intervals. Any service disruption can adversely impact operations and timetable stability within a very short time.

Such risks are minimised by monitoring trains and high-risk sections of the rail network. SBB's WTMS train monitoring systems make railway infrastructure safer and more available: an extensive and dense network of stationary

measuring systems on the track check the train's relevant physical features when it passes at normal line speed. This automatic monitoring of trains has been continuously extended, developed and networked in Switzerland.

With the network-wide placement of WTMS, SBB is making a significant contribution to the safety of rail traffic and improving the availability of the train paths in Switzerland.

### Overview of systems.



# Train monitoring systems.

## Multiple components, a single integrated system.

WTMS train monitoring systems serve to provide safety-relevant functions by detecting profile clearance and aeri-als, fire and chemicals, hot box and brake-locking, load displacement, overloading and wheel defects, as well as natural hazards. Availability-relevant checks, such as contact wire uplift measurements and dragging equipment detection (DED) are also performed. The full integration of RFID systems permits the clear-cut identification of vehicles and reliable and traceable assignment of the measured data to the individual wheelsets. All alerts and interventions are also captured in a database, with the information being forwarded to the railway undertakings concerned so as to optimise maintenance.

### Our range of services.

The networked, failsafe measuring systems reliably identify technical problems in trains before they lead to incidents. The WTMS network application acts as a real-time monitor and permits the necessary intervention based on instant location-independent data analysis (e.g. stopping trains or reducing their speed).

### Measuring systems to increase safety.

**Wheel load checkpoint:** detects load displacement, overloading and wheel defects.

**Fire and chemical detection:** prevent safety-critical situations as a result of fires or the loss of dangerous goods.

**Hot box and brake-locking detection:** provides the temperature of the axle box bearings, wheel rims and brake discs and prevents derailments due to axle and wheel failures.

**Profile clearance and aerial detection:** prevents clearance profile breaches and contact line damage due to vehicle aeri-als, cover plates or displaced loads on rolling roads.

**Natural hazard alert systems:** monitor the network to protect against rockfalls, landslides, mudslides and avalanches.

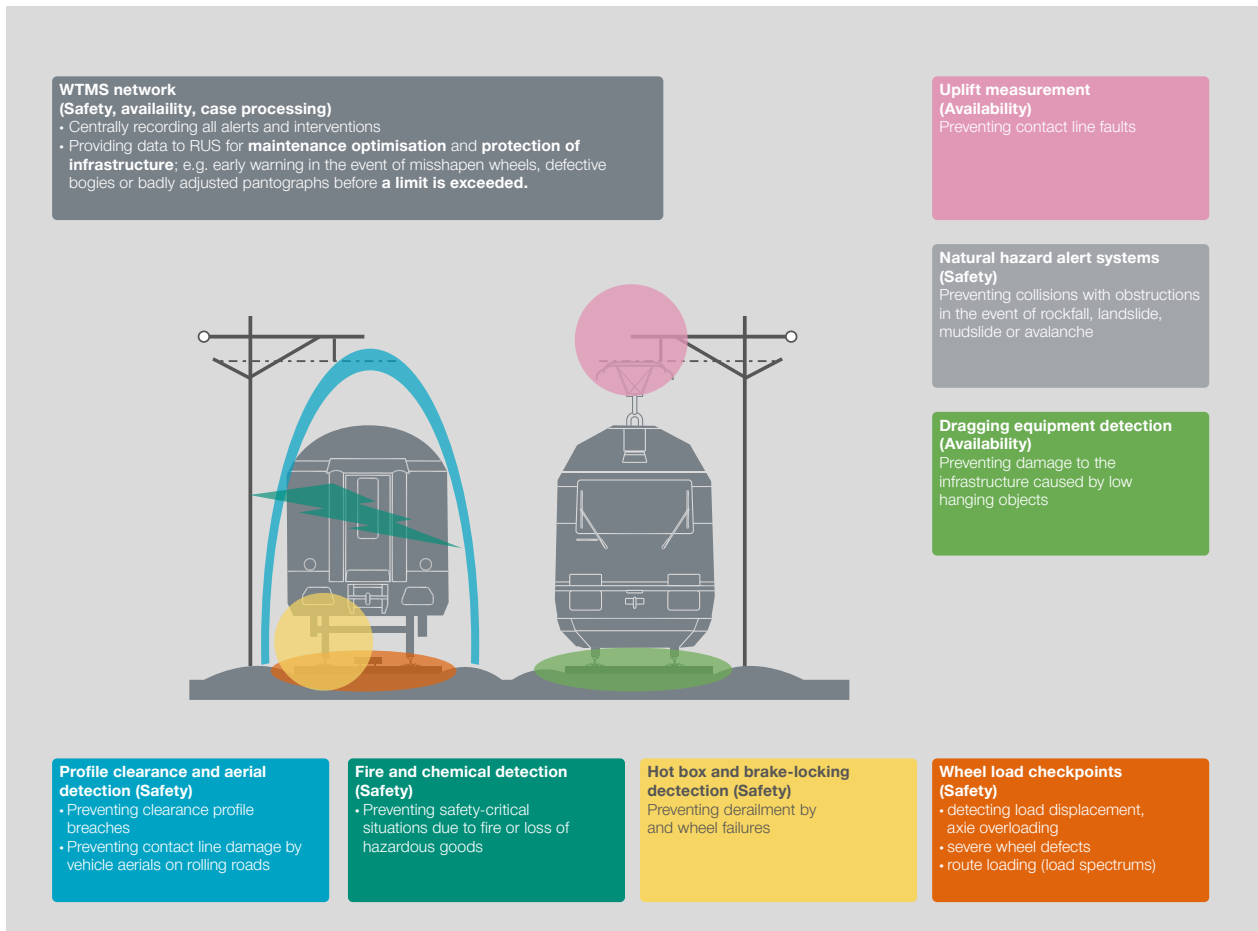
### Measuring systems to increase your availability.

**Dragging equipment detection:** detects low-hanging or dragged objects on vehicles to avoid damage to the tracks, particularly to balises.

**Uplift measurements:** monitors the wire uplift to prevent contact line faults.



# An integrated system.



All train monitoring systems comprise a range of measuring and sensor systems to ensure reliable and seamless monitoring.

# RFID technology expansion.

The majority of rail vehicles have already been fitted with two RFID (radio frequency identification) tags each. RFID readers at the edge of the track identify the vehicle number contactlessly when the train passes, enabling seamless tracing of vehicles. By 2020, SBB will have equipped all WTMS locations with RFID readers. SBB makes the measured data available to railway undertakings, allowing them to better plan their vehicle maintenance, among other benefits.

# WTMS network application.

## An integrated view of the entire system.

The WTMS IT application links up the various train monitoring systems to form a single integrated monitoring system.

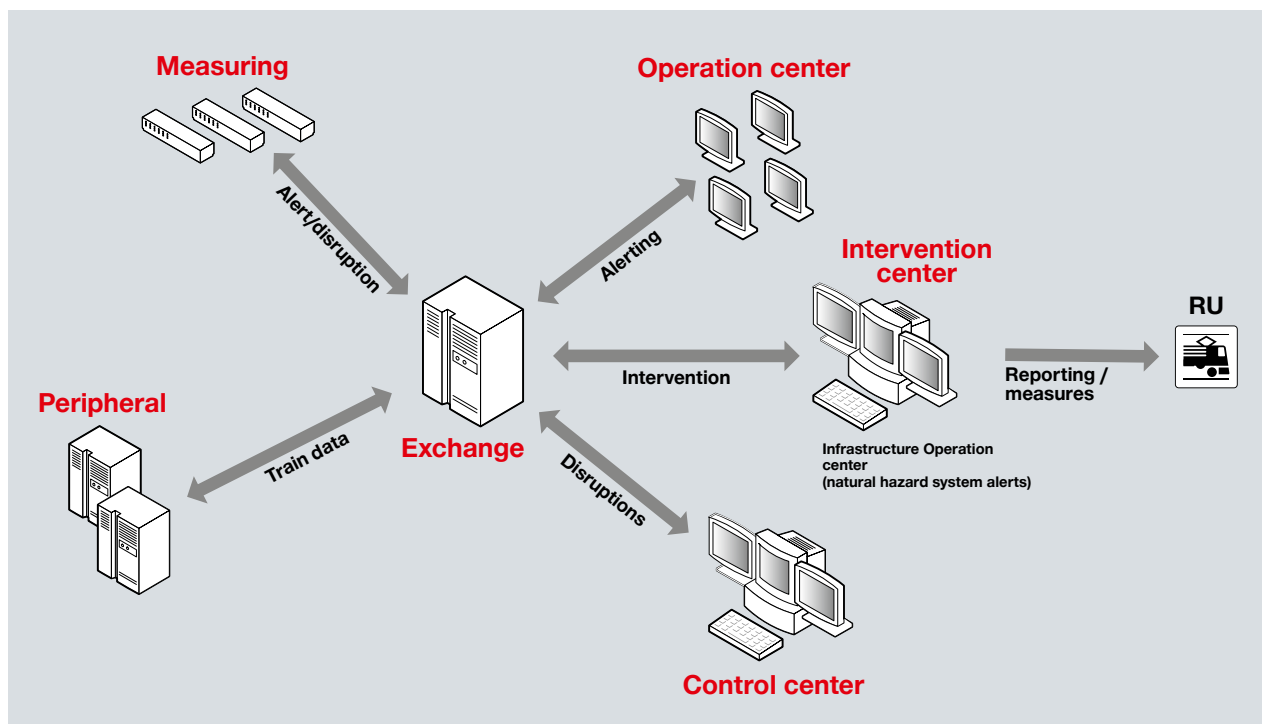
### Benefits:

- Complements the measurements with data from the peripheral systems (e.g. with train numbers, route, composition of the trains).
- Graphical representations of the measurement criteria in the event of an alert allow for immediate decisions.
- Combines data from consecutive measuring systems for trend analysis.
- Enables automatic tracking of abnormal trains and trend prediction.
- Supports case processing for reassessing analysed cases and exchanging data with the responsible RU.
- Allows immediate assessment of the measurement data and therefore normally enables an intervention decision to be made within 30 seconds.

- Allows for vehicle- or train-specific alert limit values and alerts.
- Operated via the SBB data network.
- Allows data exchange with WTMS of neighbouring railways.

### Technology:

- Rail IT application developed in accordance with EN 50128.
- Data from the measuring systems is combined with data from SBB's peripheral systems and assigned to trains.
- Highly available and disaster-proof thanks to a redundant structure with two data centres and two parallel reporting channels for alerts.



The alert is triggered redundantly over two parallel reporting channels.

# Our systems.

## Wheel load checkpoints.

The wheel load checkpoint measures the dynamic vertical wheel force when the train passes and calculates the static load figures.

### Benefits:

- Detects overloaded or unevenly loaded vehicles.
- Detects technical problems with the bogie and vehicle.
- Identifies serious wheel damage.
- Early diagnosis of wheel damage enables condition-oriented wheelset maintenance.
- Reduces damage to infrastructure and noise and vibration emissions due to improved wheel condition.
- Automatic vehicle weight measurement using certified wheel load checkpoints.



### Technology:

- Rail deformation measured using strain gauges.
- Dynamic vertical wheel force calculated from the signal.
- Dynamic wheel force measuring range = 0–50 t.
- Measurement accuracy of vehicle and train weight < 2%.

### Facts:

- Developed in-house by SBB.
- 30 systems, border crossing, marshalling yards, main traffic routes.
- 40 million axle measurements per year, 1,500 alerts per year.

# Fire and chemical detection.

The fire and chemical detection system measures tiny concentrations of typical combustion gases and dangerous substances and prevents entry into critical route sections and tunnels in the event of an incident.

## **Benefits:**

- Detects fire as soon as it starts.
- Detects tiny losses of dangerous goods.
- Ensures the safety of critical route sections and long tunnels.

## **Technology:**

- Very low concentrations of typical gases are measured with highly sensitive gas analysers based on infrared absorption spectroscopy
- Two combined measuring stations at least 300 m apart in an approach tunnel before the protected object.
- Results within 20 seconds of the train passing.
- The size of the fire and the quantity of dangerous goods can be estimated based on concentration changes, speed and tunnel cross section.

## **Facts:**

- Developed in-house by SBB.
- 30 systems in approach tunnels before critical tunnels or routes.
- 1.8 million trains measured per year.
- < 10 fire alerts per year, 1 explosive gas alert in 10 years.





# Hot box and brake-locking detection.

The hot box and brake-locking detection system monitors the temperatures of rail vehicles' axle box bearings and brakes at normal line speed.

## Benefits:

- Detects damage to axle box bearings.
- Identifies defective brake mechanisms.
- Prevents wheel and brake disc failures.
- Prevents damage to rolling stock.
- Prevents derailments and fires.

## Technology:

- The temperature of the axle box bearing, wheel rim and brake disc are measured using infrared detectors.
- The measuring range is captured using a special infrared lens.
- The measurements are assigned to the axles via contacts on the rails.

## Facts:

- 100 systems, primarily on main traffic routes.
- One system every 30 route kilometres on average.
- 100 hot box alerts per year (overheated axle box bearings).
- 2,000 brake-locking alerts per year.



# Profile clearance and aerial detection.

The profile clearance and aerial detection system checks whether rail vehicles comply with the clearance profile and detects objects close to the contact line at normal line speed.

## Facts:

- Detects overloaded or unevenly loaded vehicles.
- Prevents collisions with railway infrastructure and when trains pass each other.
- Prevents fires and material damage caused by touching the contact wire.

## Technology:

- The train's profile is measured with a laser scanner and compared with the target profile.
- The train is reconstructed in the form of a 3D model and represented visually to help with assessing alerts.
- Clearance profile breaches are recorded in images using cameras and infrared flashes.

## Fakten:

- 112 systems on freight traffic routes.
- 1,200 vehicle alerts per year due to clearance profile breaches.
- 20 vehicle alerts per year due to truck aerials.

# Natural hazard alert system.

The natural hazard alert system detects rockfalls, landslides, mudslides and avalanches near the track.

## **Benefits:**

- Prevents derailments and collisions with rock, earth or snow on the track.
- Increases the safety and availability of the SBB track network.
- Informs the SBB geologist about activities on the networks with trend alerts.

## **Technology:**

- Autonomous wireless sensors installed in the safety nets report acceleration, position changes and deformation of the nets.
- Information is transmitted via self-organising repeater networks and a base station.
- Redundant transmission via fixed-line network and GSM.

## **Facts:**

- 15 systems, primarily on the Gotthard corridor.
- Over 1,000 sensors installed.
- About 50 monitored networks with a total length of 5 km.
- Detection of serious incidents in the Gurnellen (Gotthard route) and Flamatt (Bern–Fribourg–Lausanne route) regions.



# Developed and tested by SBB.

SBB – your partner for advanced and uncompromising railway safety.

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SBB'S SUCCESS AND HIGH STANDARD OF QUALITY ARE LARGELY DUE TO ITS OWN INNOVATIONS, BASED ON MANY YEARS OF EXPERIENCE. BUT SBB ISN'T KEEPING ITS RECIPE FOR SUCCESS A SECRET: ITS SYSTEMS DEVELOPED IN-HOUSE ARE ALSO AVAILABLE FOR OTHER COMPANIES.

The innovative, forward-looking railway technology products and services have been developed together with other railway undertakings and industry partners to meet even the toughest requirements. SBB has set itself the goal of ensuring that the railway remains an attractive and reliable means of transport in future. That is why it is sharing all of its specialist knowledge with other railway companies and industry partners.

For example, SBB allows all railway undertakings to view its anonymised wayside train monitoring system (WTMS) data. Using WTMS technology and integrated control software, railway undertakings can increase the safety of their railway operations and make considerable savings on operating and maintenance costs at the same time. Furthermore, infrastructure managers who utilise the integrated SBB WTMS can effectively protect their infrastructure from damage and accidents.

SBB developed the wheel load checkpoint and fire and chemical detection train monitoring systems and the network train monitoring system IT application in-house and makes them available to external companies.

Benefit from over 100 years of experience in railway operations and technological development now.

**Contact the SBB specialists today:**

**SBB AG**

Infrastructure Sales  
Hilfikerstrasse 3  
3000 Bern 65, Switzerland  
+41 51 222 88 88  
sales@sbb.ch  
www.sbb.ch

**SBB AG**

Infrastructure Sales  
Hilfikerstrasse 3  
3000 Bern 65, Switzerland  
+41 51 222 88 88  
sales@sbb.ch

[www.sbb.ch](http://www.sbb.ch)

