



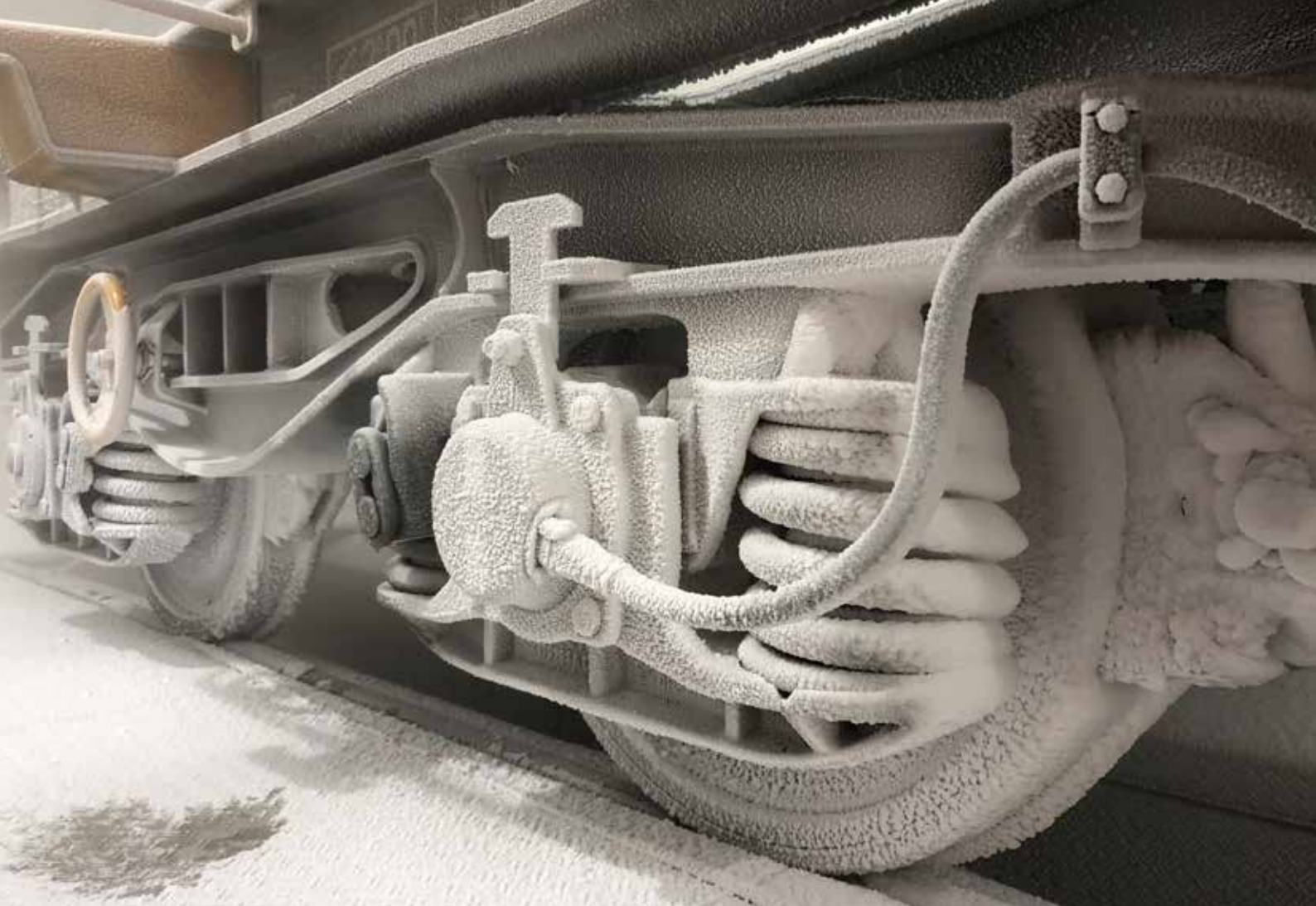
Digital freight transport on track:

Monitoring & automation with the digital overall system WaggonTracker

Unique worldwide: WaggonTracker is the first and only digital overall system for monitoring and automating freight wagons. The system is a true all-rounder, combining automated processes such as brake testing, weight monitoring, monitoring functions and radio-based in-train communication.

All-rounder: The digital wagon backbone manages the integration and connection of all wagon components such as couplings, brakes and trestles / kingpins at safety and non-safety level.

Condition Based Monitoring: Due to the extensive monitoring of the goods train, extensive data material is determined. The advantages: Effective maintenance and servicing planning saves costs and valuable time. Increased safety and automated processes shorten turnaround times and increase the efficiency of rail operations.



Reliable under all conditions: Like all PJM products, the WaggonTracker has been tested in the climate chamber, among other things. The WaggonTracker was designed for a wide temperature range from - 40° to + 60° degrees.

The backbone of smart freight trains: The digital overall system WaggonTracker

- Autonomous and powerful power supply thanks to wheel hub generator
- Scalable for further applications desired by the customer
- DAC-compatible
- Easy installation: The system is easy to integrate, both for new vehicles and for existing vehicles
- Patented technology
- Autonomous information acquisition: All data is reported directly to a web portal via mobile network. This guarantees the highest availability of data anywhere in the world. The data is transmitted via an encrypted, secure connection.
- Always available, robust and maintenance-free: The hub generator provides energy self-sufficiently. The WaggonTracker is very robust and long-lasting. It was designed to sustain hard weather conditions and was tested for temperatures ranging - 40° to + 60° degrees Celsius. The system is nearly maintenance-free. A possible replacement of the rechargeable battery can be done according to the vehicle's service interval.

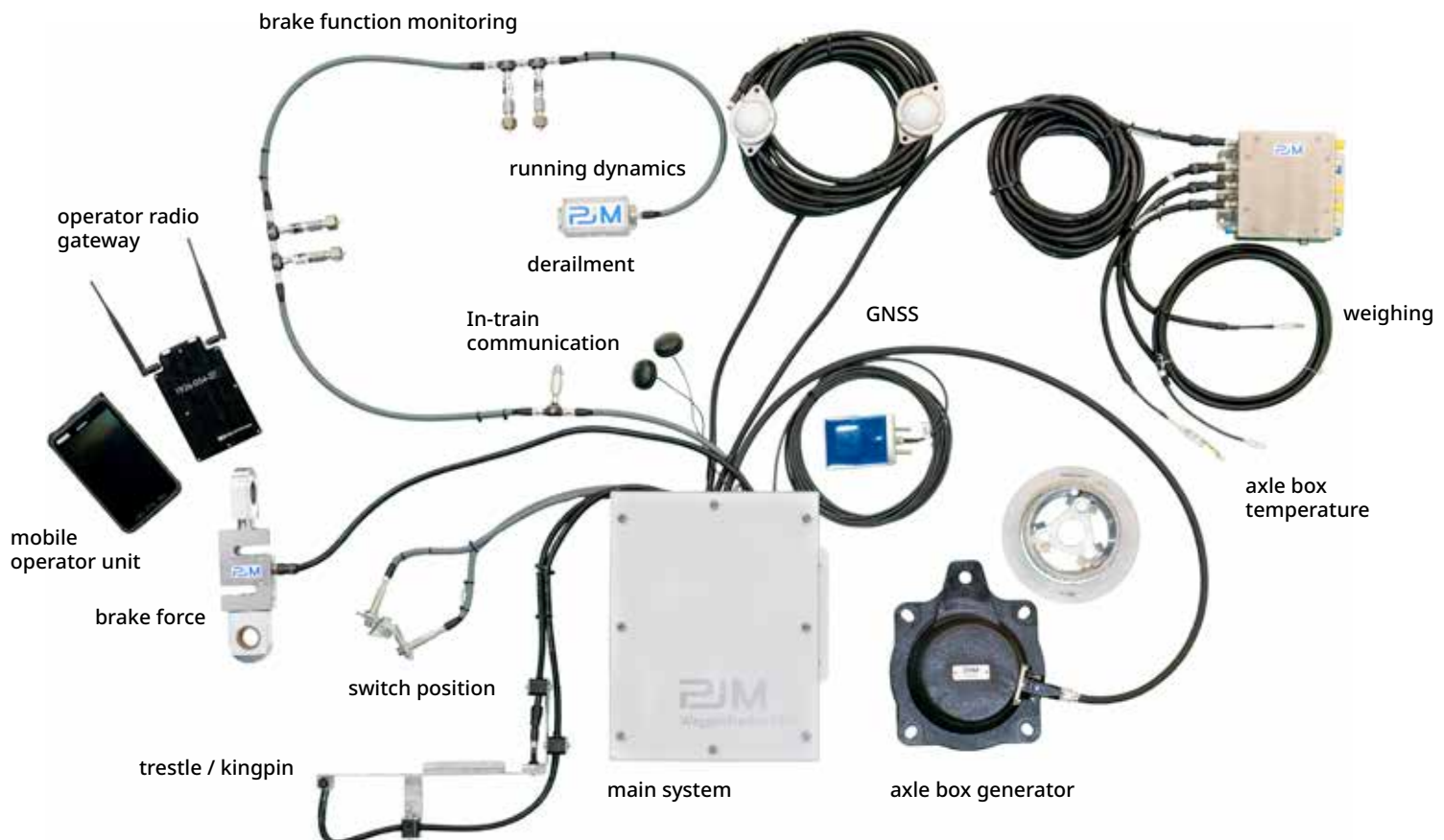
A wide range of functionalities

Train stand still

- Automated brake test (operational brake test)
- Partly automated train preparation
- Wagon order
- Load monitoring "optimal load", asymmetric / overload protection, on-vehicle visualisation
- Impact monitoring (lateral, vertical)
- Free-fall alert (waggon is lifted during loading process)
- Brake system monitoring (correct technical functioning)
- Handbrake status monitoring
- Trestle / king pin status monitoring and notification (intermodal traffic)
- Cargo goods and theft monitoring incl. door alerts

Train operation

- Brake system monitoring (correct functioning)
 - Brake release check and notification (operational)
 - Trestle / king pin status change alert (intermodal traffic)
 - Running dynamics (safety, stability)
 - IDDS: Derailment analysis
 - Flat spot diagnosis
 - Axle box temperature monitoring
- Upcoming
- Bearing monitoring
 - Coupler monitoring
 - Automated de-coupling
 - Train integrity



Intelligent freight train: Real-Time monitoring during train operation

- Brake status of last waggon
- Derailment diagnosis
- Hot axle box warning
- Automatic/remote controlled park brake
- Automatic/remote controlled de-coupling
- Diagnosis of faulty braking wagons during operation (adjust pressure)
- Safety relevant measurement of trestle/hitch
- Base for future requirements

Safety relevant development

According to EN 50155, EN 50126, EN 50129, EN 50657, EN 50159, EN 61508, EN 62061, et al.

Safety relevant system solution

- SIL2 sensors in combination with safety electronics for safe and reliable status determination
- Wireless LoRa in train communication system with safe communication protocol
- Utilization of existing standard tablets for status visualization

Homologation and approval by TÜV Süd Rail

- WaggonTracker ABT is the first and only approved automated brake test system in Europe

WaggonTracker MDS – overview (Multi Diagnosis System)

Depending on the waggon, 2-3 sensor are mounted on the waggon frame

Sensor is the basis for

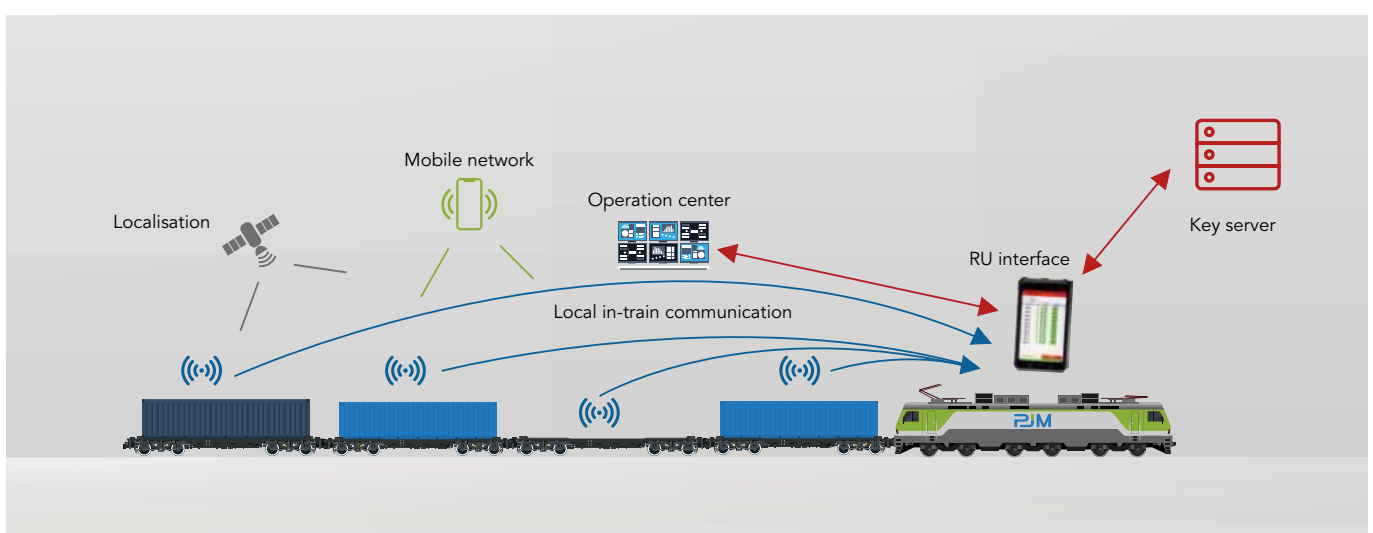
- Impact monitoring according to EN 12663
- Vertical impact monitoring
- Running safety behaviour and stability based on EN 14363
- Free fall detection during loading/unloading
- Dynamic derailment detection
- Flat spot diagnosis (in development)

WaggonTracker MDS – free fall detection

- Detection of derailments during loading/unloading process
- Calculation of free fall distance
- Calculation of free fall time
- Data transmission to the WaggonTracker web portal via mobile network

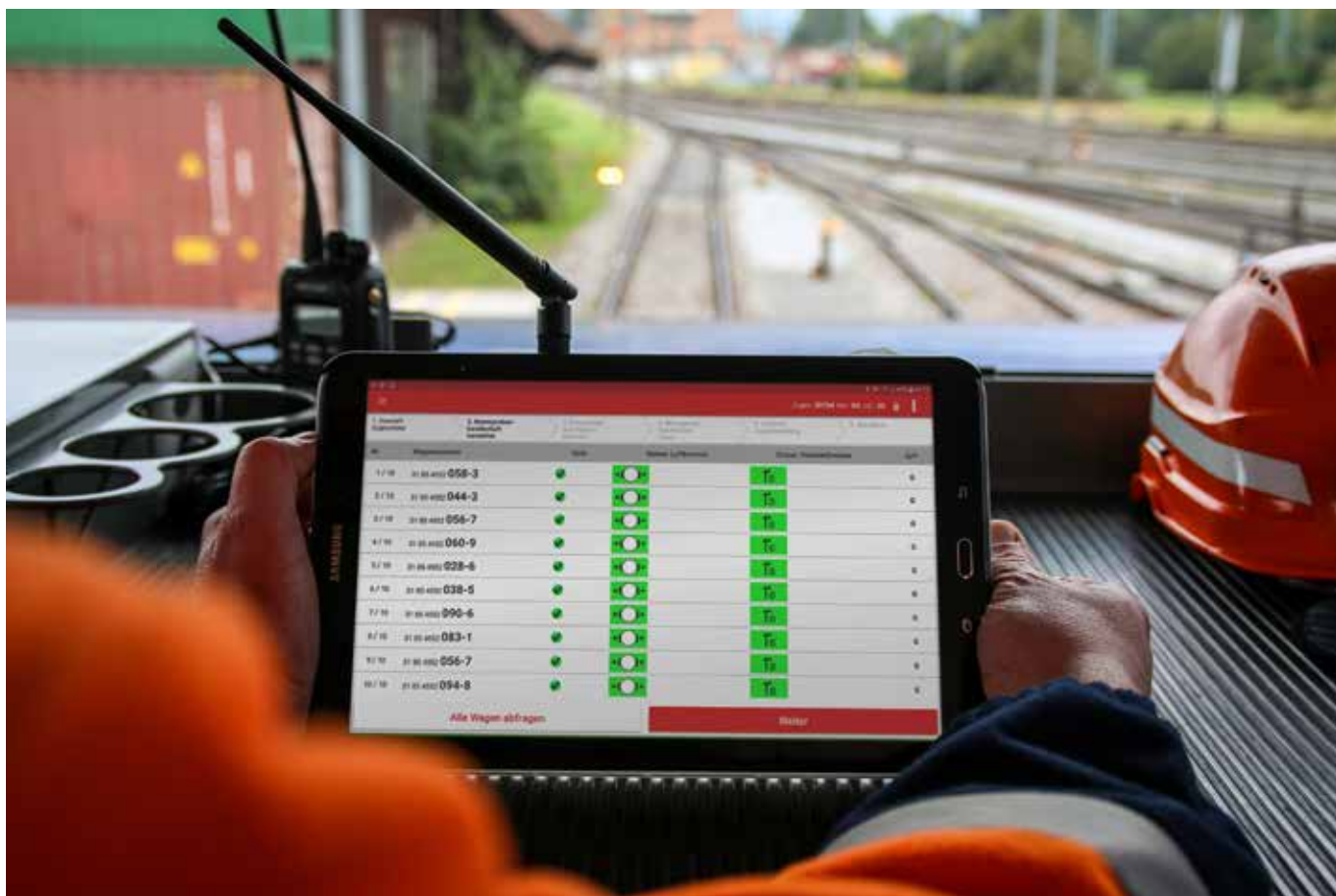
In-Train communication

- In-train long-range wireless system
- Direct communication
- Wagon in stand-by
- Relaying possible
- Designed for maximum availability
- Encrypted, secure connection
- Locally available, inter-operable, fully integrated, open interfaces



Highest availability and an encrypted, secured connection due to in-train communication.

Automated brake test and partly automated train preparation



For a 500-long freight train, the automated brake check takes less than 2 minutes. The automatic brake test fulfils all safety-relevant regulations in terms of operation and vehicle.

- Reliable and safe detection of brake state
- Increase safety, efficiency, availability
- Support Train Preparation
- G/P switch position
- Train length
- Brake calculation
- Verification of train wagon order



Video:
The automated brake test in operational mode →



Brake monitoring at stand-still and during operation

Determination of:

- Brake events (service / full / emergency braking)
- Correct functioning of the brake system: adequate pressure levels of HL/C/T
- Fill time: Determination of brake- and release times
- Realized brake energy: per time unit (thermal stress) as well as in total (wear)
- Bogie load / vehicle weight (weighing valve pressure)

Safety relevant trestle and coupler monitoring

- Automation of operational processes requires safe and reliable status determination
- Risk assessment determines required safety levels for the system (e.g. SIL2 for sensors, safety electronics, data evaluation and result interpretation)
- Safe and secure transmission of the wagon status via LoRa communication to the existing operator tablet

Advantages

- Providing safety relevant data via in-train communication whenever needed
- Increase of overall safety and reliability





On-site visualisation in real-time via signal lamps. Automatic load weight monitoring indicates in real time during loading: Overloading, asymmetric loading, wheelset and wheel disc overloading, inadmissible load distribution on the bogie, loading level and loading is ok.

Automated Load Monitoring

- Real-time visualization during loading process
- On-site and in remote via web service
- Advantages: Prevention from over-loading. Higher efficiency and safety, best possible loading capacity

Prevention and detection of derailment

Prevention of derailments

- Detect incorrect loading
- Detect vehicle damages & malfunctioning components
- Ensure maintenance and servicing
- Detect infrastructure defects and report them (vehicle monitoring and information to infrastructure department)

Behaviour in the case of derailments

- Quickest possible detection due to PJM IDDS
- Real-time alarm to train driver (due to in-train communication) and warning the infrastructure operator (information provided by WaggonTracker web service)



References

International customers appreciate the WaggenTracker systems and its wide range of advantages

SBB Cargo | Mercitalia | Transwaggon |
Mercer | Lenzing | GATX | VTG |
Rail Cargo Austria



Awarded Technology

Awarded WaggonTracker system

RailTech Innovation Award 2022 | Winner
Export Award 2022 | Winner Styrian Ex-
port Award 2022 | ERCI Innovation Award
2021 (Best SME of 17 European Railway
Cluster nations) | German Innovation
Award Winner 2020 | Austrian Mobility
Award 2020 | Finalist Houska Award 2020
| Fast Forward Award 2019

PJM at a glance

PJM is an internationally renowned system specialist for rail transport and has successfully implemented projects in 30 countries on 6 continents. As an accredited test centre according to ISO/IEC 17025, PJ Messtechnik GmbH carries out tests for the approval of rail vehicles worldwide. PJ Monitoring GmbH is a technology leader in the automation of rail freight transport with forward-looking comprehensive solutions. PJM was founded in 2006. 60 employees at the Graz site ensure „100 % Made in Austria“: R&D, hardware and software

development, production & administration come exclusively from Austria.



Get more on PJM in the video:
<https://www.youtube.com/watch?v=mde4KbH93L8>