



Automation and Digital Condition Monitoring for Rail Transport

Conference “Modern Rolling Stock”

18 September 2023

Current Situation

- › **Cost pressure** and strong competition (road transport)
- › High proportion of **manual processes** in train preparation
- › Increasing shortage of **skilled workers**
- › High **maintenance and repair costs** due to too many non-planned repairs
- › In general **long delivery times** in rail transport (long stand-still times of cargo trains)
- › Necessary increase in safety, especially **derailment** safety (recent accident St. Gotthart tunnel 08/2023, Geseke 09/2023)
- › **Increasing pressure** to increase rail transport (achievement of climate targets)

➔ **Digital transformation is a prerequisite to increase the modal split**

Requirements For Efficient Rail Transport

Quality

- › Reliability and plannability of transport services
- › esp. for piece goods, single waggon traffic, parcels, perishable goods, etc.

Time

- › Optimized terminal times and shortened handling times
- › Optimized train preparation
- › Faster delivery times

Efficiency

- › Minimization of idle times and optimization of manual activities
- › Maintenance management and workshop processes
- › More transport volume with fewer resources

Realisation: Digital Overall System

- › WaggonTracker: specially developed for freight wagons
- › Modular system for all applications
- › Autonomous power supply with contactless wheel hub generator
- › Compatible with all freight wagons
- › Cloud service
- › Long-range train radio
- › Digital backbone for **general monitoring** and **functionally safe applications**

Monitoring

- › Wagon and load
- › Wagon components
- › Correct function
- › Correct use

Automation

- › Digitalization of operational processes
- › Support of loading/unloading
- › Control of wagon functions

Increased Safety

- › Correct loading
- › Driving and vibration behavior
- › Brake monitoring
- › Indicative derailment diagnosis

Best Practice: Europe's Smartest Freight Train

- › Automated brake test
- › Real-time brake analysis and brake monitoring system
- › Real-time trestle monitoring for intermodal transport
- › IDDS indicative derailment diagnosis system and derailment prevention
- › Monitoring of the wagon and its components & warning when limits are exceeded



Automated Brake Test



Joint development with



SBB CFF FFS Cargo

Rail Cargo Group
Member of ÖBB

ZugNr.: 50734 BNR: BS UIC.: 85

1. Auswahl Zugnummer		2. Bremsprobenbereitschaft herstellen	3. Bremsprobe durchführen: Bremsen	4. Bremsprobe durchführen: Lösen	5. Kontrolle Zugvorbereitung	6. Abschluss
Nr.	Wagennummer	Verb.	Status: Luftbremse	Status: Feststellbremse	G/P	
1 / 10	31 85 4552 058-3	✓			G	
2 / 10	31 85 4552 044-3	✓			G	
3 / 10	31 85 4552 056-7	✓			G	
4 / 10	31 85 4552 060-9	✓			G	
5 / 10	31 85 4552 028-6	✓			G	
6 / 10	31 85 4552 038-5	✓			G	
7 / 10	31 85 4552 090-6	✓			G	
8 / 10	31 85 4552 083-1	✓			G	
9 / 10	31 85 4552 056-7	✓			G	
10 / 10	31 85 4552 094-8	✓			G	
Alle Wagen abfragen			Weiter			

Brake Test: Current Situation

- › Necessary for each newly created train set
- › Invalid after 24 hours
- › Full brake test for 20 wagons (train length ~500m) takes approx. 40 mins.
- › Partial brake test for additional train parts
- › Example SBB Cargo: Brake tests at several hundred trains every day, in all weather conditions and at all times



Demographic change demands new production approaches throughout Europe

Automated Brake Test and Partly Automated Train Preparation

Main Scope

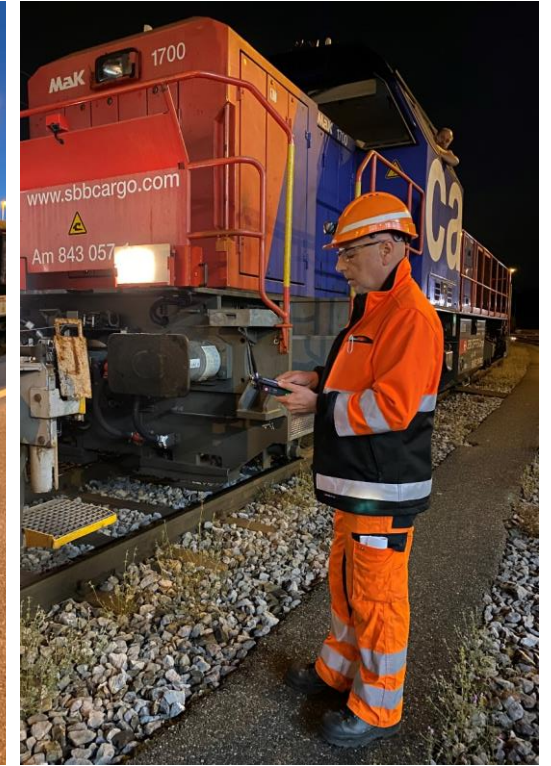
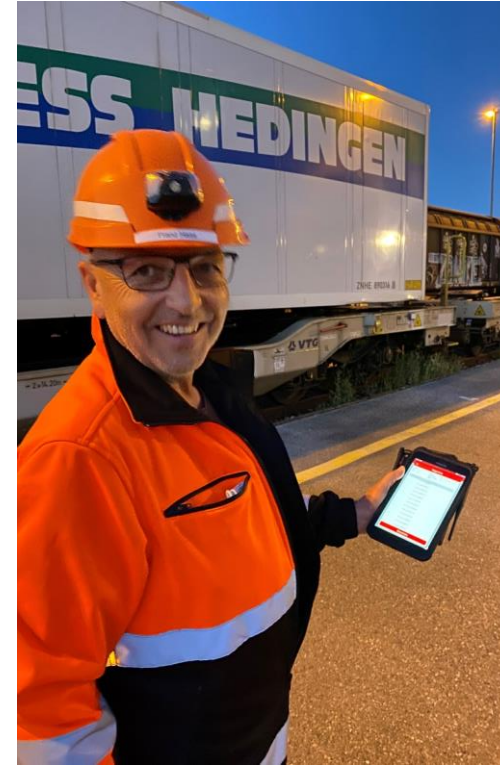
- › Reliable and safe detection of brake state
- › Increase safety, efficiency, availability

Support Train Preparation

- › G/P switch position
- › Train length
- › Brake calculation
- › Verification of train wagon order

Base For Further Applications

- › Monitoring of brake components (maintenance)
- › Brake system monitoring during train operation (faulty braking, train separation, flat spots, etc.)



Safety-Oriented Development

Safety

- › COTS Android tablet to visualize a SIL2 secured process
- › Safe Wagon Data Collection Protocol
 - › Point to point connection between tablet app and safe measurement system
 - › Protocol supports fail-safe visualization of status information
- › Secure brake status detection

Security

- › Secure radio communication
- › Authenticated software updates

Railway Environmental Conditions

System Integration Automated Brake Test

RU: Integration in SMS necessary



Technology

- › SIL 2
- › Open interfaces
- › Secure communication with all equipped wagons (also of different keepers)

Automatic Brake Test In Operation

10:26 Do., 8. Sept. Zugnr.: 50901 Abl.: HRK UIC: 85

1. Auswahl Zug
2. Bremsprobenbereitschaft herstellen

Nr.	Wagennummer	Verb.	Status: Luftbremse	Status: Feststellbremse	G/P
1/6	81 85 4565 052-0	▲	🔄	🟢 T0	P
2/6	81 85 4565 080-1	▲	🔄	🟢 T0	P
3/6	81 85 4565 016-5	▲	🔄	🟢 T0	P
4/6	81 85 4565 022-3	▲	🔄	🟢 T0	P
5/6	81 85 4565 059-5	▲	🔄	🟢 T0	P
6/6	81 85 4565 095-9	▲	🔄	🟢 T0	P

Abfragen Bestätigen

<https://www.youtube.com/watch?v=aVwpyXKGj3A>

Brake Monitoring At Standstill And During Operation

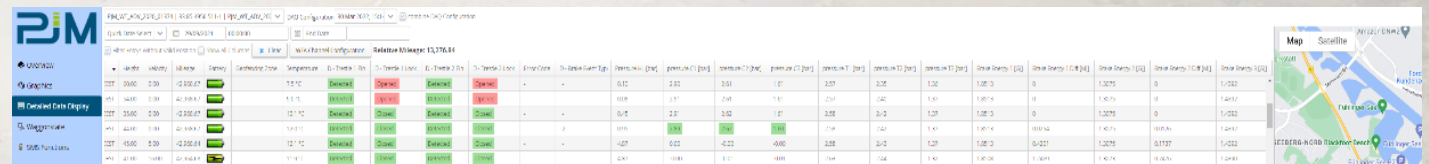
Monitoring of

- › Brake cylinder pressure
- › Weighing valve
- › Main air pipe
- › Hand brake
- › Brake mode (G/P)
- › Brake on/off

Determination of

- › Brake events (operational/full/emergency braking)
- › Correct function of the waggon's brake system
 - › Compliance with pressure ratios HLL/C/T
- › Filling times
 - › Determination of brake and release times
- › Converted braking energy
 - › Per time unit – thermal stress
 - › Total – wear
- › Bogie loads / vehicle weight (weighing valve pressure)

Real-time data in web portal

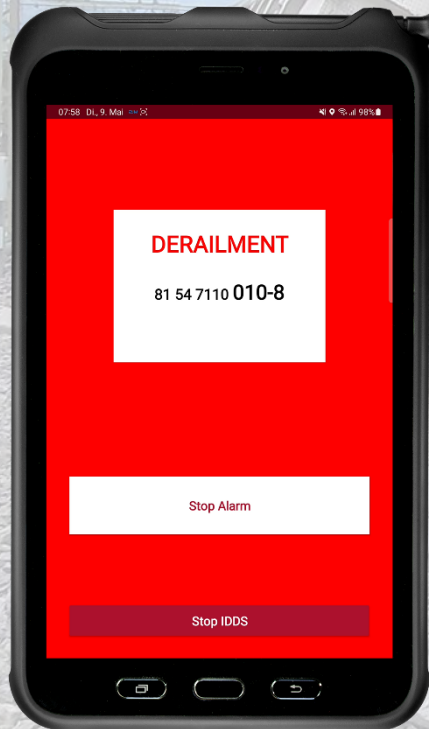


Automatic Trestle Monitoring

- › Reliable and safe detection of the correct setting
- › Detect and avoid incorrect handling
- › Avoid damage, increase availability
- › Alarm in the case of status change while driving
- › Ensure safe operation

IDDS: Informative Derailment Diagnosis System

- › Developed for rail freight transports
- › Information only, no control of brake system



Alarm message to loco

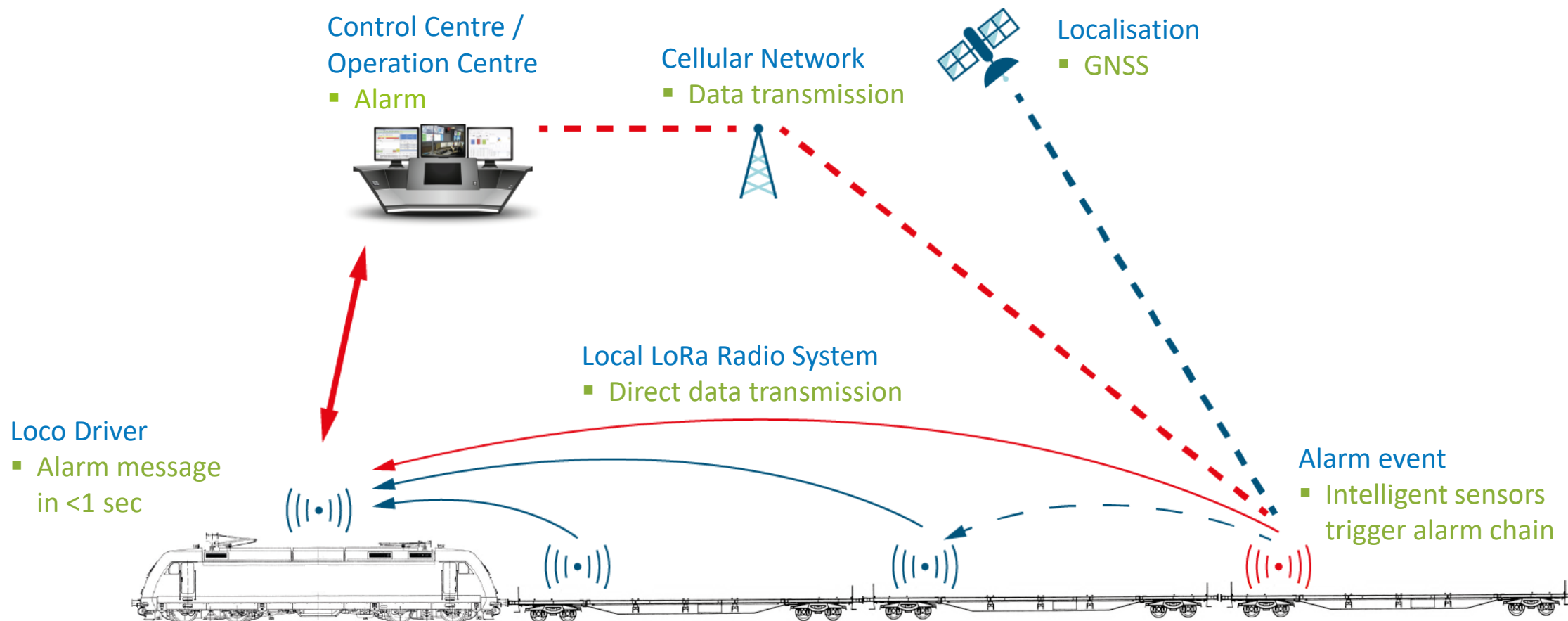
Behavior in the event of a derailment

- › Detect as quickly as possible
- › Inform train drivers and infrastructure managers in real time

Prevention of derailments through monitoring system

- › Detect faulty loading
- › Detect vehicle damage
- › Ensure maintenance and servicing
- › Detect and report infrastructure faults (on-board infrastructure monitoring)
- › Detect component failure

IDDs: Informative Derailment Diagnosis System



Automatic Load Monitoring

- › Real-time visualisation during the loading process
- › On-vehicle and remote via web service
- › **Prevention of overloading and increased efficiency and safety**

LENZING

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(120)		00,0t		

<https://www.youtube.com/watch?v=G3cfpLch4Wg>

Digital Wins

- › Automatization of manual processes
- › Plannable & condition-based maintenance
- › Optimization of transport performance
- › Integration of the locomotive driver in real-time
- › Increased safety
- › Damage and error prevention
- › **Available now** – DAC compatibility guaranteed





PJ Monitoring GmbH

www.pjm.co.at