Wabtec CORPORATION

Firenze 2026

LA DIGITALIZZAZIONE DEI TRENI MERCI

Miglioramento su sicurezza e manutenzione

Relatori:

Debernardi Pierre – Frea Matteo

LE SFIDE DEL TRASPORTO MERCI FERROVIARIO

Il trasporto ferroviario delle merci in Europa deve affrontare sfide importanti legate a sicurezza, efficienza operativa e competitività.

Nel “Sustainable and Smart Mobility Strategy”, l'Unione Europea punta a raddoppiare il traffico ferroviario merci entro il 2050, ma il settore è ancora frenato da processi analogici e strumenti obsoleti.

SICUREZZA

Incidenti ferroviari causati da malfunzionamenti non identificati tempestivamente e da manutenzione non correttamente pianificata.

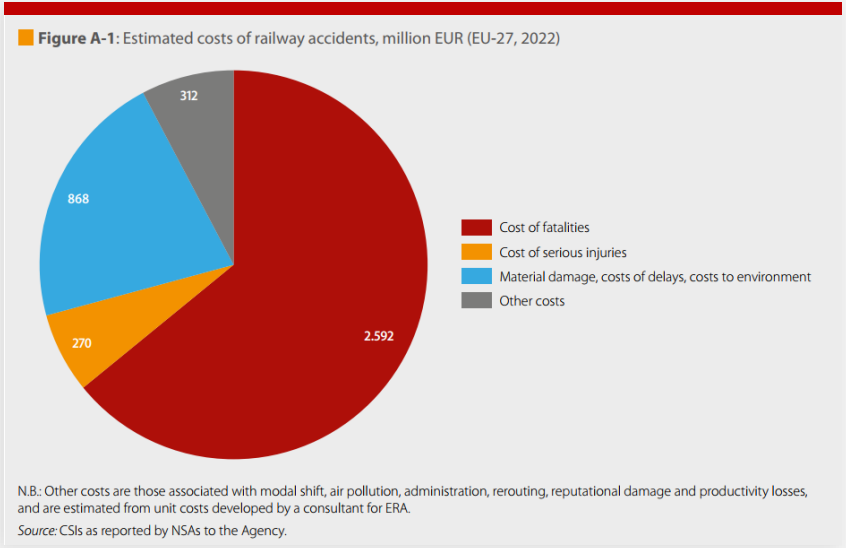
OPERATIVITA'

Soluzioni analogiche che obbligano a lunghe operazioni manuali, rallentando i processi e aumentando il rischio di errore umano.

SICUREZZA

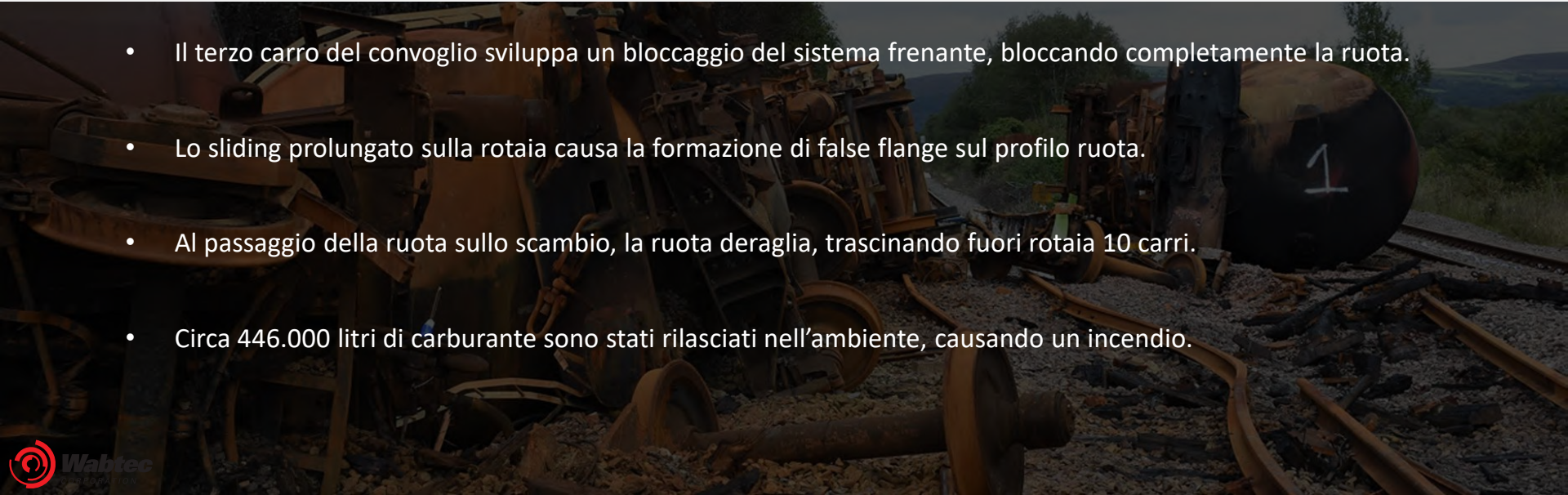
Dal Report on Railway Safety and Interoperability in the EU, i costi legati agli incidenti ferroviari sono enormi.

Oltre un quarto dei costi è relativo dai danni al materiale rotabile, infrastruttura, danni ambientali, ecc.



Derailment and fire at Llangennech (UK) (26 agosto 2020)

Deragliamento di un convoglio di 25 carri cisterna carichi di diesel/gasolio, con sversamento del carico e conseguente incendio.



- Il terzo carro del convoglio sviluppa un bloccaggio del sistema frenante, bloccando completamente la ruota.
- Lo sliding prolungato sulla rotaia causa la formazione di false flange sul profilo ruota.
- Al passaggio della ruota sullo scambio, la ruota deraglia, trascinando fuori rotaia 10 carri.
- Circa 446.000 litri di carburante sono stati rilasciati nell'ambiente, causando un incendio.


Direction of travel
Swansea District line
Central Wales line


1

01

INCIDENTI FERROVIARI

- Deragliamenti causati da freni bloccati sulle ruote, con gravi conseguenze per la sicurezza
- Malfunzionamenti di assi, cuscinetti e sistemi frenanti non rilevati in tempo utile
- Manutenzione reattiva anziche' predittiva: si interviene dopo il guasto, se identificato, quando il danno e' gia' avvenuto

02

OPERATIVITA' MANUALE

- Test di continuita' della condotta freno eseguito manualmente: un tecnico deve percorrere l'intero convoglio (fino a 800 m)
- Composizione del treno dichiarata manualmente.
- Processo di accoppiamento e disaccoppiamento dei carri eseguito manualmente.
- Tempi di preparazione del treno prolungati, con impatto su puntualita' ed efficienza della rete


SNCF

03

GAP TECNOLOGICI

- I carri non hanno alimentazione elettrica o altre fonti di energia, dispositive di diagnostica non disponibili.
- Assenza di comunicazione a bordo del convoglio. La locomotiva non conosce lo stato di salute dei carri in tempo reale.
- Assenza di comunicazione tra carri e stazioni di terra. Difficoltà nella gestione della manutenzione dei carri.

LA DIGITALIZZAZIONE DEI TRENI MERCI

Per digitalizzare i treni merci in modo strutturato, il team R&D WABTEC sta portando avanti due progetti europei.

FREIGHT MONITOR

FP5 TRANS4M-R
Transforming Europe's Rail Freight

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FREIGHT MONITOR

Measuring Online Network Integrated Train Operations in Real-time

A R&D project for train fret digitalization

- funded by the French State as part of the “France 2030” investment plan operated by the ADEME (French agency for ecological transition)

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

ADEME
AGENCE DE LA TRANSITION ÉCOLOGIQUE

FRANCE 2030

Overall objective:
double the share of goods transported by rail in France by 2030 (from 9% to 18%).

- carried out by a consortium

Hexafret

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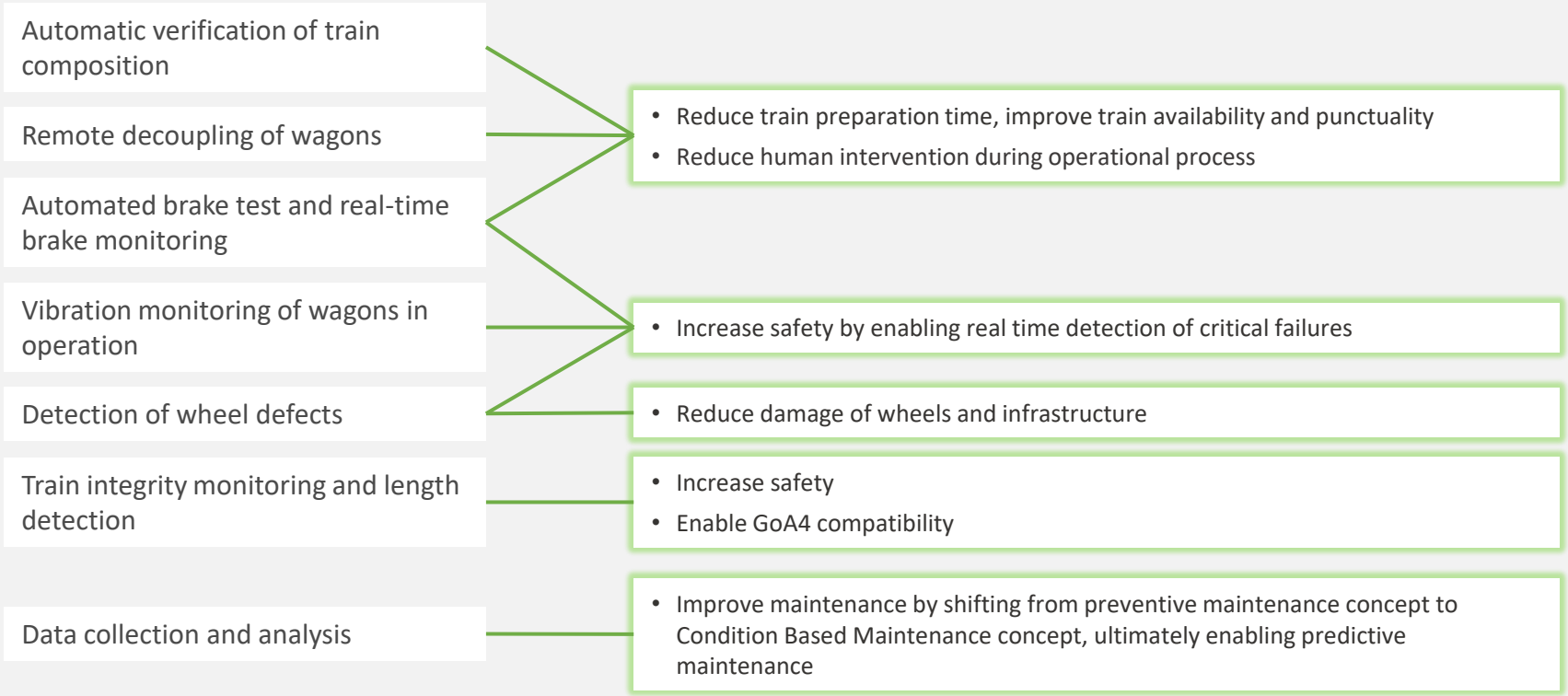
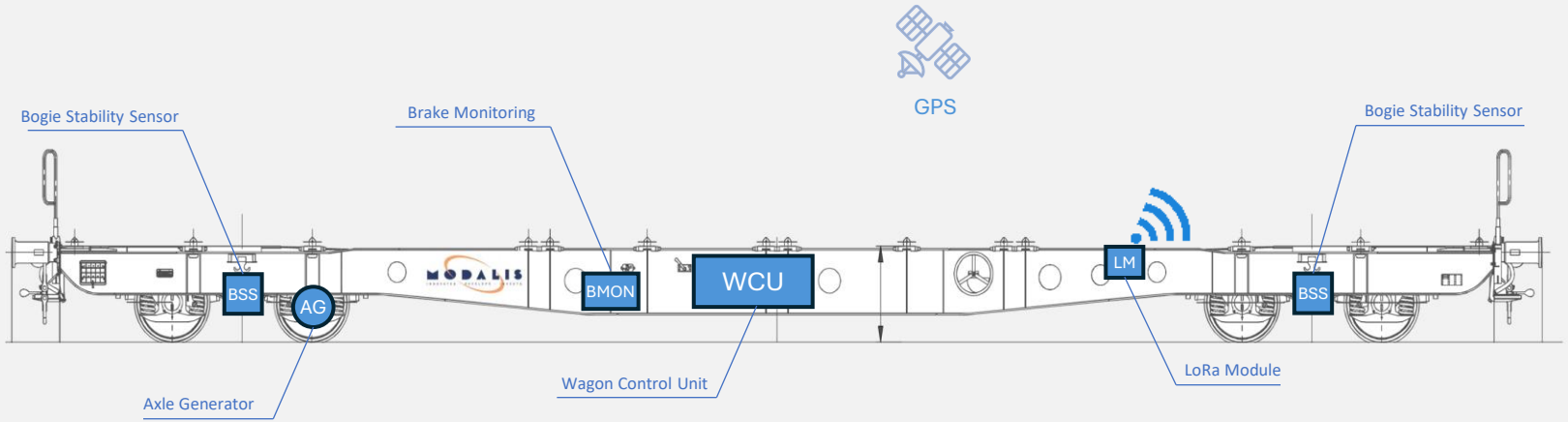
RTM

MONITOR: Functions & Benefits



MONITOR: System Architecture



- Data processing
- Pressures acquisition
- Energy harversting
- Energy storage
- Vibrations acquisition
- Wireless communication to Loco
- Wagon geolocation

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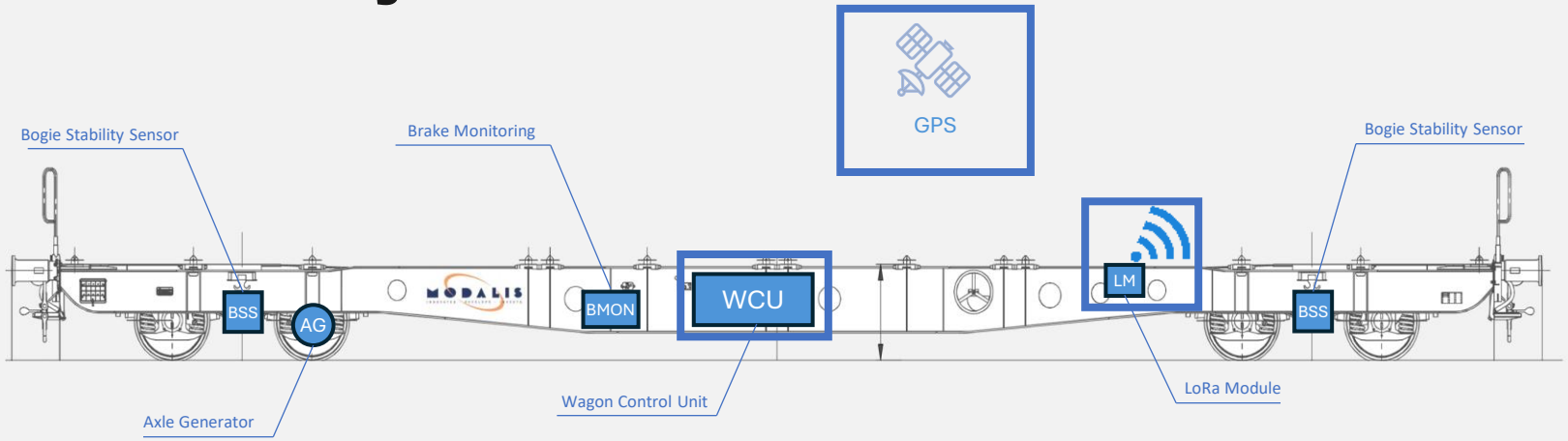
MONITOR: System Architecture



Automatic Brake Test

Data processing

Pressures acquisition

Energy harversting

Energy storage

Vibrations acquisition

Wireless communication to Loco

Wagon geolocation

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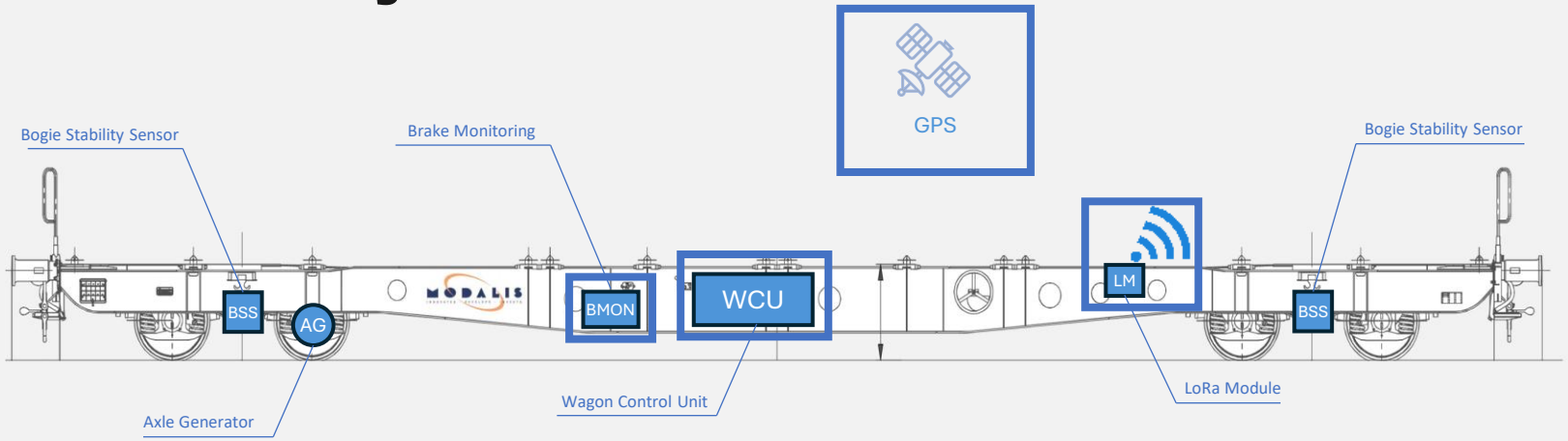
MONITOR: System Architecture



Automatic Brake Test

Automatic Composition Detection

Data processing

Pressures acquisition

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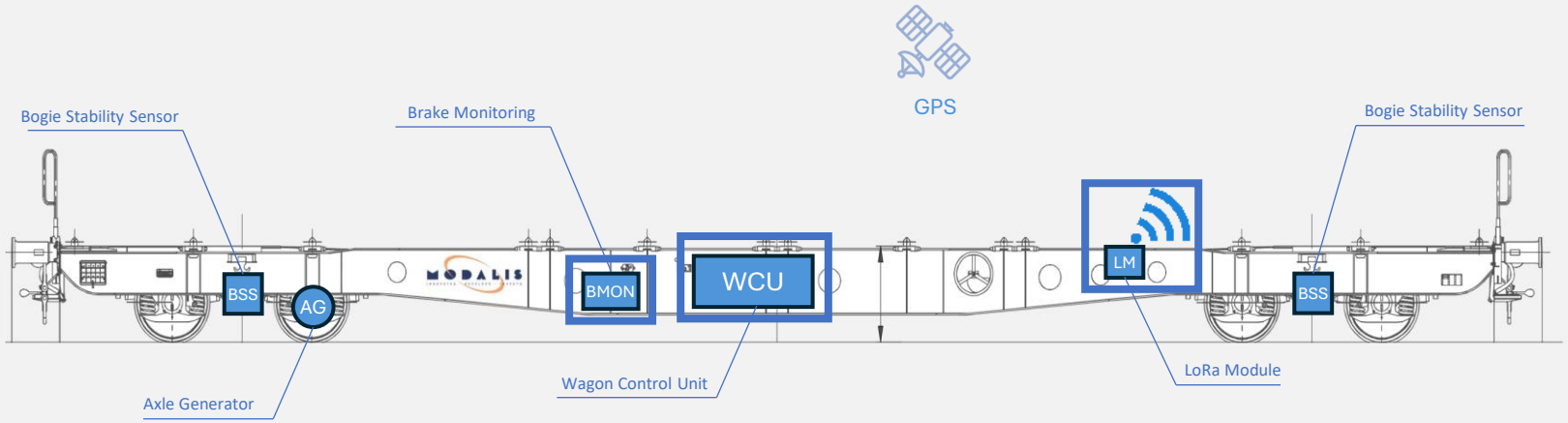

Automatic Brake Test

Automatic Composition Detection

Brakes anomalies detection

Data processing

Energy storage

Wagon geolocation

Pressures acquisition

Vibrations acquisition

Energy harversting

Wireless communication to Loco

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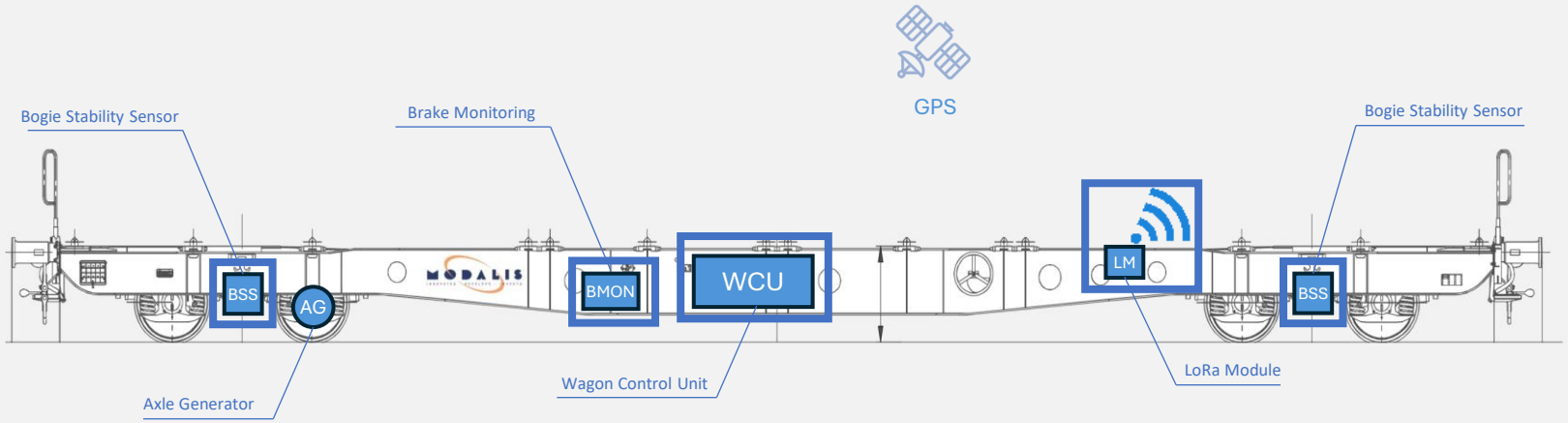
MONITOR: System Architecture



- Automatic Brake Test
- Automatic Composition Detection
- Vibrations monitoring
- Brakes anomalies detection
- Data processing
- Pressures acquisition
- Energy harversting
- Energy storage
- Vibrations acquisition
- Wireless communication to Loco
- Wagon geolocation

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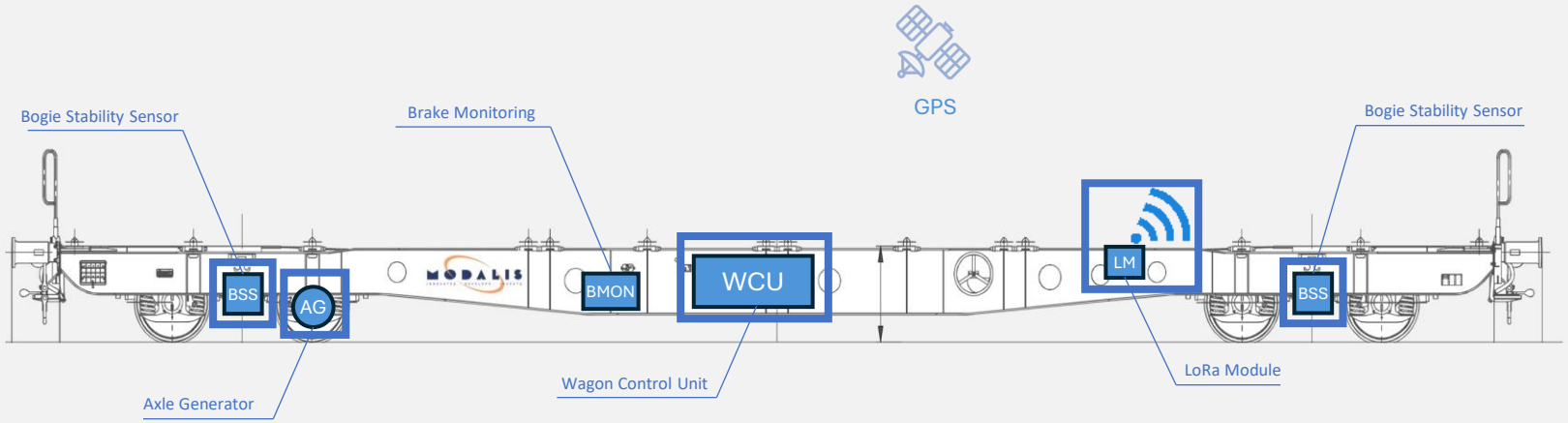
MONITOR: System Architecture



- Automatic Brake Test
- Automatic Composition Detection
- Vibrations monitoring
- Brakes anomalies detection
- Wheels defects detection
- Data processing
- Pressures acquisition
- Energy harversting
- Energy storage
- Vibrations acquisition
- Wireless communication to Loco
- Wagon geolocation

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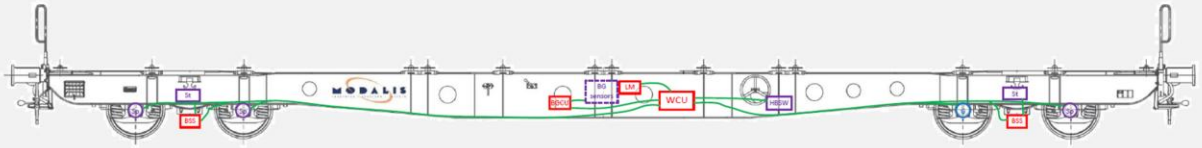
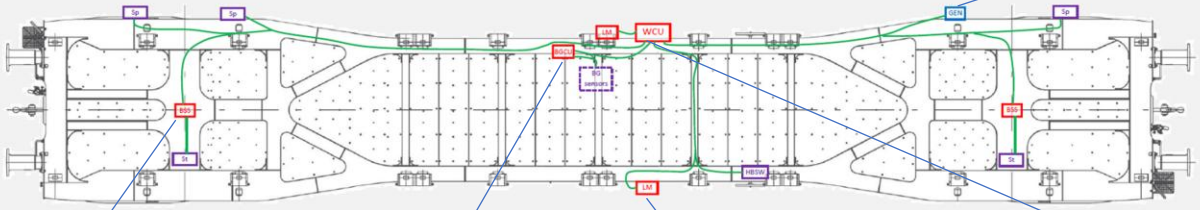
MONITOR: The Products



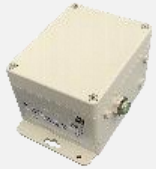


Axle Generator

Bogie Stability Sensor

Brake Monitoring

LoRa Module



Wagon Control Unit

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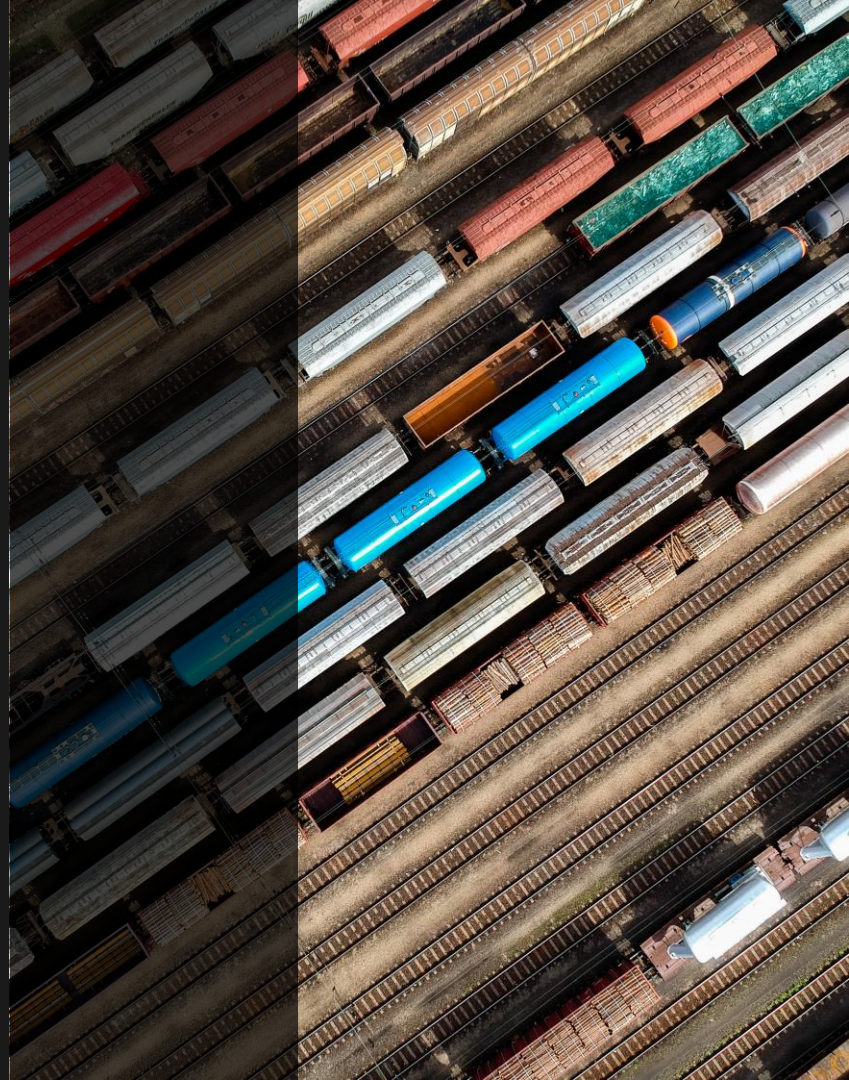
MONITOR

Specific Technical Challenges

- **Energy harvesting & storage:** power depends on train speed, battery sizing and development of energy optimization strategies to reach energetic autonomy
- **Wireless communication**: long ranges, shielding effects due to metallic containers, building train network including only the wagons belonging to the target train
- **Ordering of wagons**: determining wagons sequence using only GPS
- **High vibration levels**: category 2 acc. to EN 61373, peak levels up to 30 g



FP5 TRANS4M-R

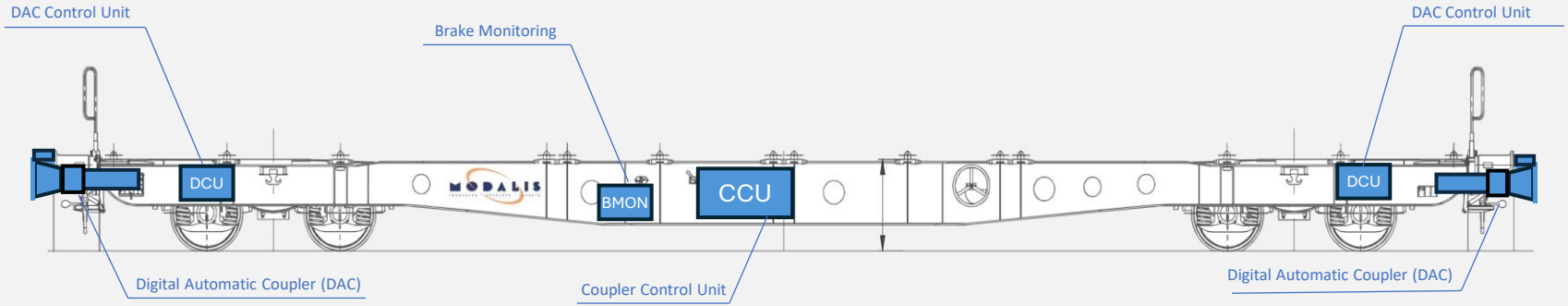
Transforming Europe's Rail Freight

FP5 is a European funded project on full digital freight trains

- carried out by a consortium

- 3 areas of activities for Wabtec: Electronics, Coupler, Yard

FP5: System Architecture



- Data processing
- Pressures acquisition
- Power supply
- Energy storage
- Coupler control and monitoring
- Data transmission

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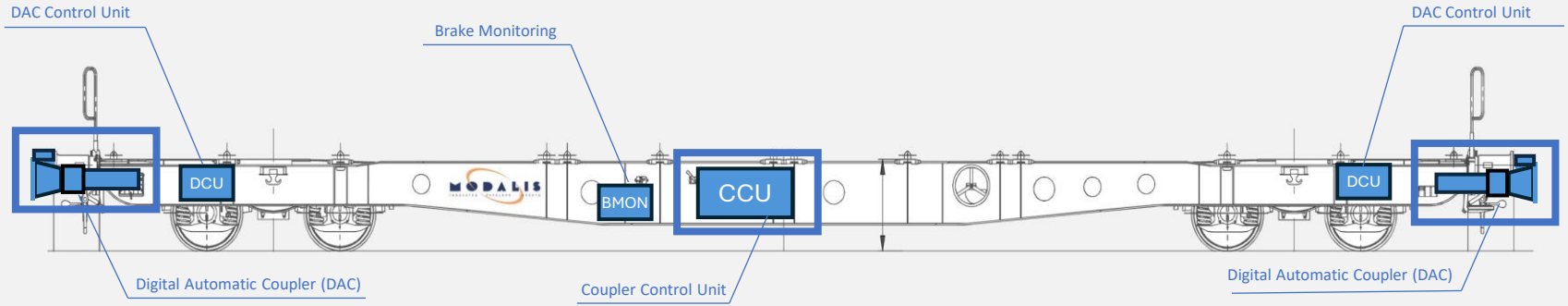
FP5: System Architecture



Automatic Composition Detection	Train length detection
Data processing	Energy storage
Pressures acquisition	Coupler control and monitoring
Power supply	Data transmission

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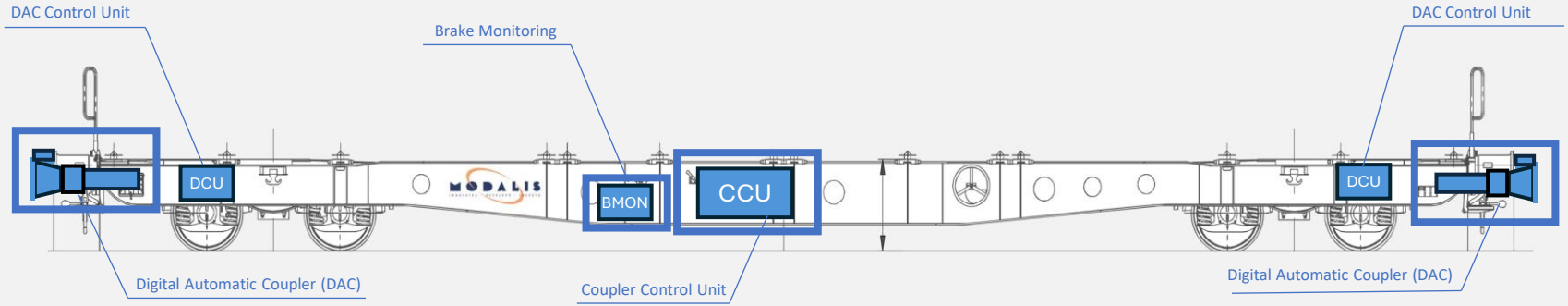
FP5: System Architecture



Automatic Brake Test

Automatic Composition Detection

Train length detection

Data processing

Energy storage

Pressures acquisition

Coupler control and monitoring

Power supply

Data transmission

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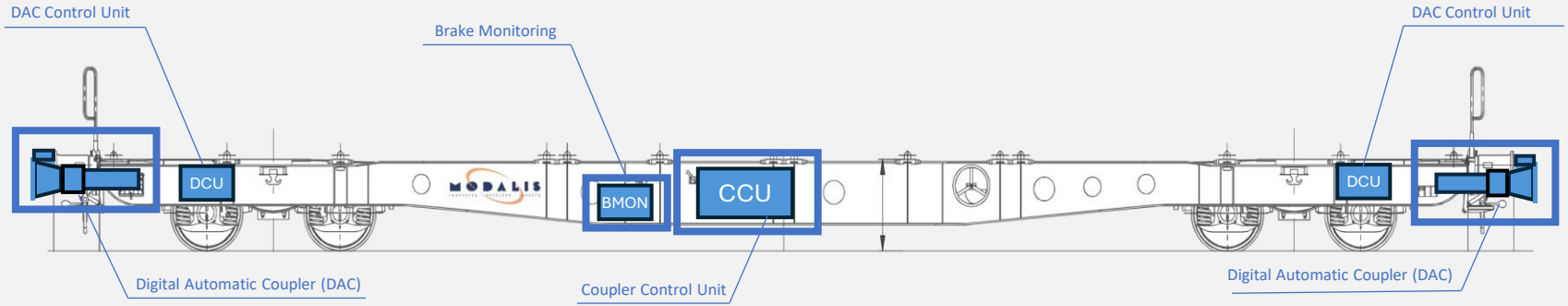
FP5: System Architecture



- Automatic Brake Test
- Train integrity monitoring
- Automatic Composition Detection
- Train length detection
- Data processing
- Energy storage
- Pressures acquisition
- Coupler control and monitoring
- Power supply
- Data transmission

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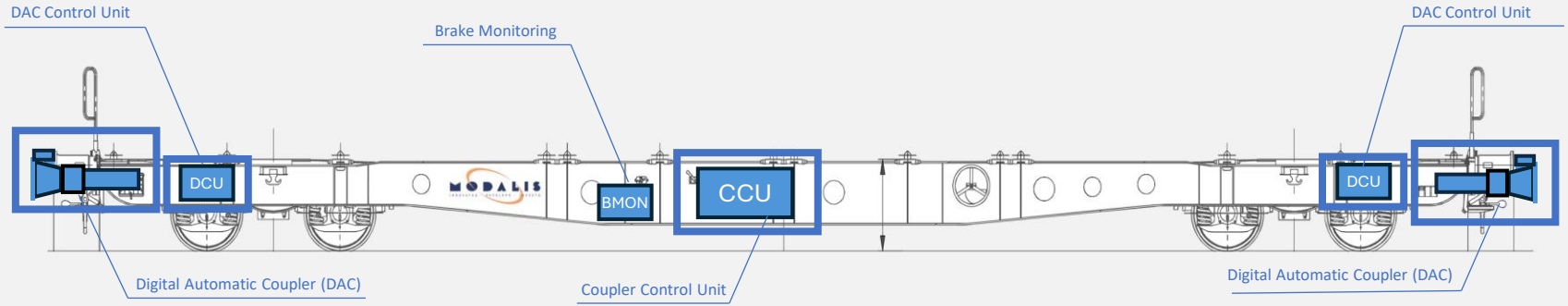
FP5: System Architecture



- Remote decoupling
- Automatic Brake Test
- Automatic Composition Detection
- Data processing
- Pressures acquisition
- Power supply
- Train integrity monitoring
- Train length detection
- Energy storage
- Coupler control and monitoring
- Data transmission

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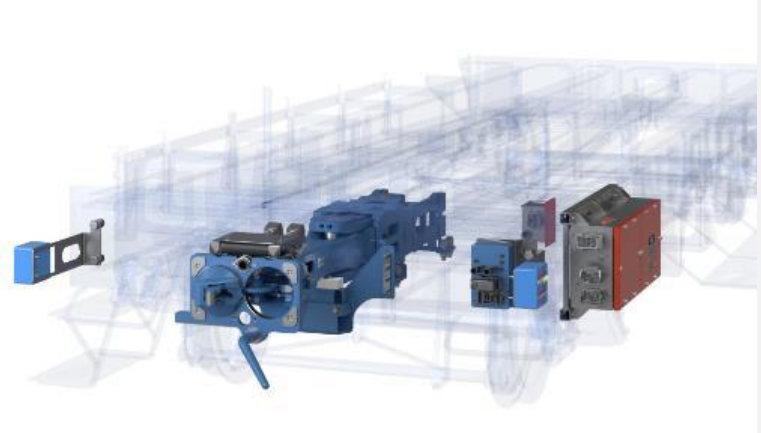
FP5: The Products

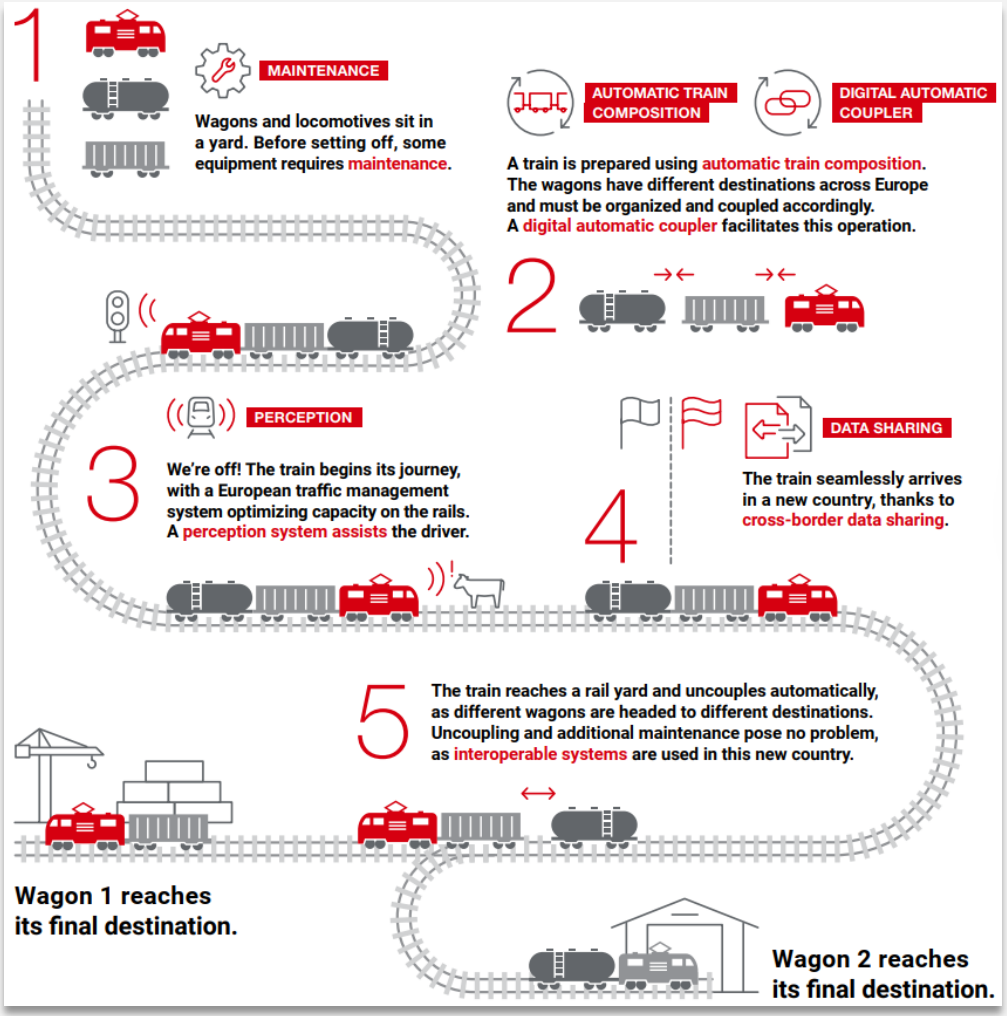


FP5

Specific Technical Challenges

- **Power supply through DAC**: long distances, resistive power losses
- **Data transmission**: adoption of Single Pair Ethernet
- **Remote decoupling**: very high safety level (SIL4), coordination between two wagons
- **Train integrity and length determination**: upgrade of SPE to detect dead / missing wagons, very high safety level (SIL4)
- **High vibration levels**: category 2 acc. to EN 61373, peak levels up to 30 g

The Wabtec Vision

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