KNORR-BREMSE

DAC & Digital Freight Train

Challenges of interoperable automation to increase efficiency in the freight rail sector.

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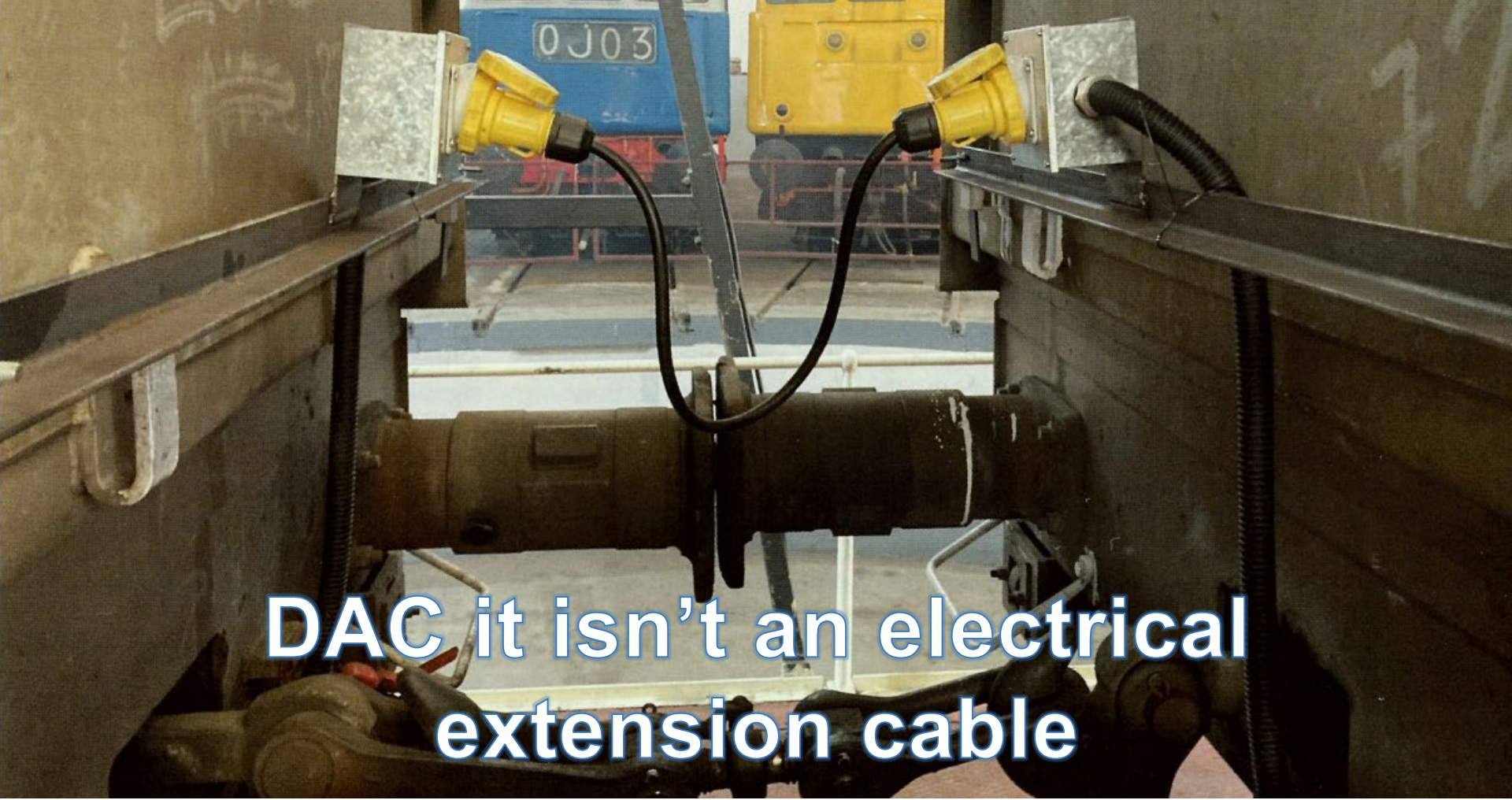
Europe's Rail

FP5TRANS4M-R
Transforming Europe's Rail Freight

DAC it isn’t a hook to pull freight cars



DAC it isn’t an electrical extension cable

or a pneumatic pipe ...


DAC it is an ENABLER

... it is the need of Innovation


… a transition in a
New Era …


Safety Increase
Higher speeds
Environmental Awareness
Higher Capacity
Efficiency

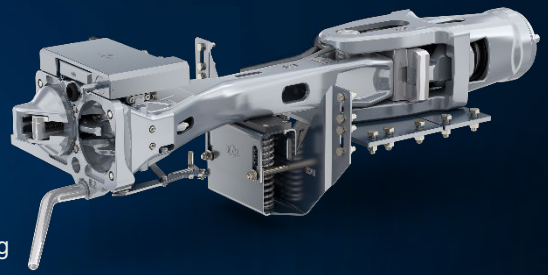
DAC makes rail freight fit for the future – it is safe for the staff, automates coupling and enables the digitalization of the freight train

Digital Automatic Coupler

Automatic coupling

- mechanical
- pneumatic
- Electrical / digital

Type 4 – automatic coupling
Type 5 – automatic coupling & decoupling



Benefits

- fast, efficient coupling
- Automatic coupling
- Safe operation
- Enabler for automation

Finally, the digital freight train enabled by the DAC will be a game changer

Intelligent Automation - Control and Monitoring

Train Preparation

faster processing

Automated
- Brake test
- Train composition detection
- Brake weight calculation

Remote controlled
- Parking brake control
- Brake settings

Automated Coupling

Train Operation

more transportation capacity
dynamic infrastructure utilization

Electro-pneumatic brake

Monitoring
- Operational brake monitoring
- Train integrity detection and monitoring

Warnings and alerts
- driver alerts or warnings for critical operation conditions

Shunting & Parking

faster processing

Remote
- Decoupling (DAC5)
- Parking brake control

Shunting Assistant etc.

Maintenance Services

Sustain, Enhance, Accelerate

Condition (data) based maintenance

Device management
- Over-the-air software update

Asset management
- Identification and usage tracking

Competitive rail freight transportation requires Digital Freight Train automation

Train Preparation

faster processing

Train Operation

more transportation capacity
dynamic infrastructure utilization

Maintenance Services

sustain, enhance, accelerate

Shunting & Parking

faster processing

Train Run Mode

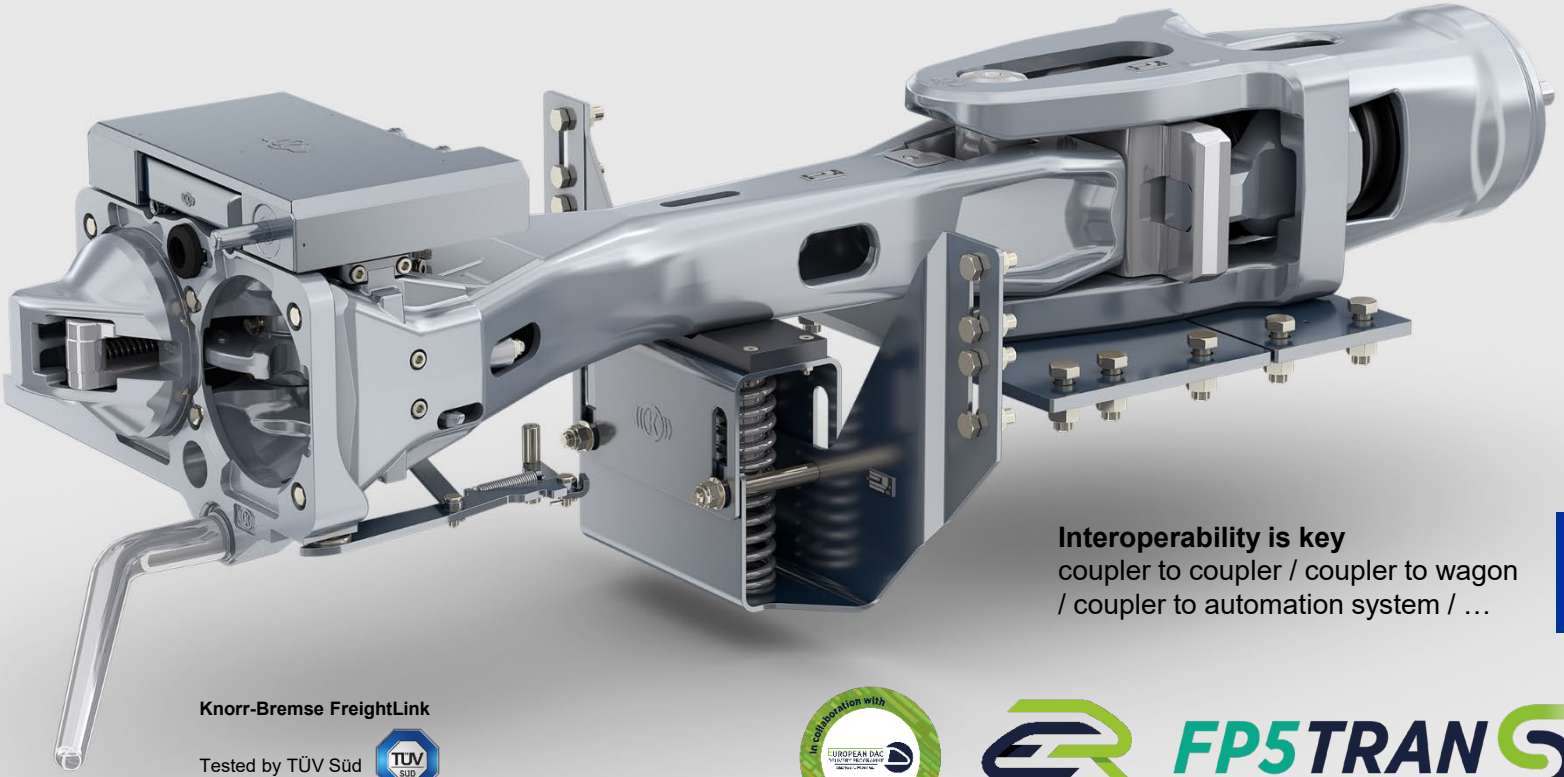
- Train integrity monitoring
- Network based electro-pneumatic brake

Shunting Mode

- Apply / release parking brake
- De-coupling
- Train composition detection
  incl. train length determination
- Automated brake test

- Change of operation mode
- (Automatic coupling)

Knorr-Bremse DAC “Freight Link”



Knorr-Bremse FreightLink

Tested by TÜV Süd

Interoperability is key
coupler to coupler / coupler to wagon / coupler to automation system / …

In collaboration with EUROPEAN DAC DELIVERY PLATFORM

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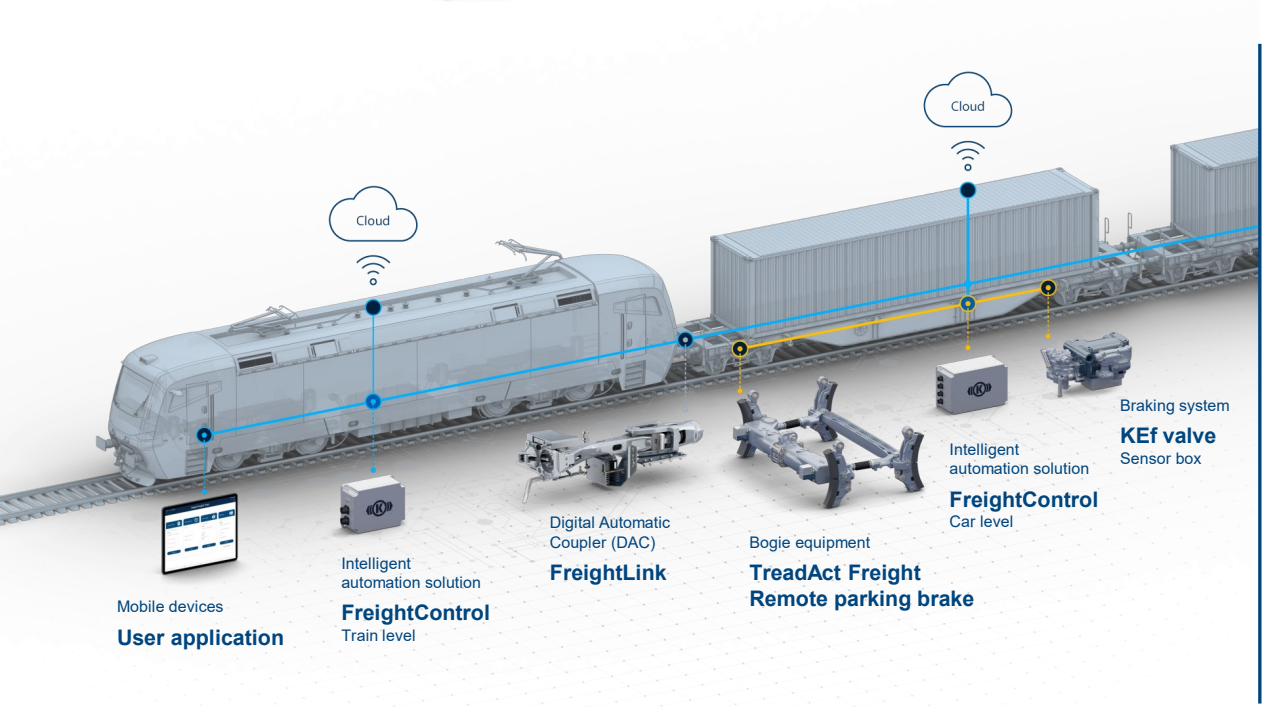
Digital Automatic Coupler (DAC) – Technology enabler of the Digital Interoperable Freight Train

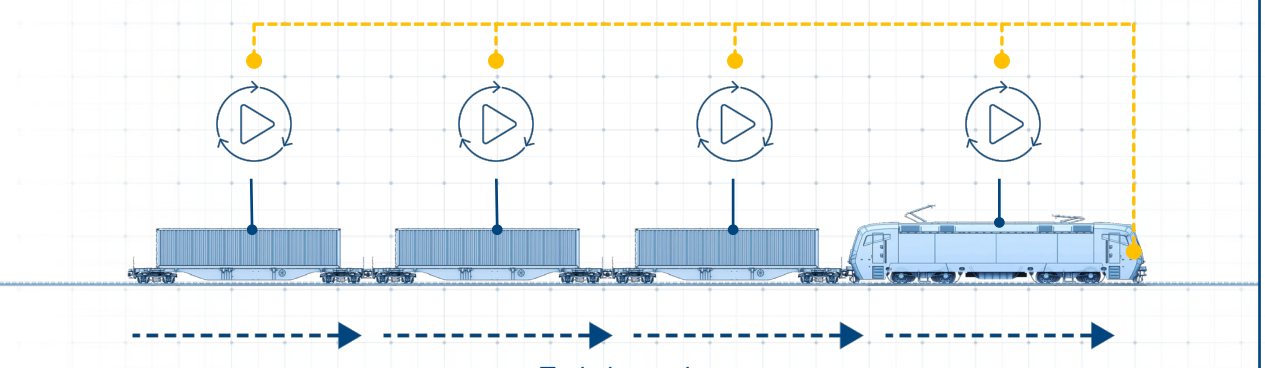


Knorr-Bremse Scope

- Pneumatic braking systems
- Digital Automatic Coupler
- FreightControl
  - Automated brake test
  - Train composition detection incl. train length determination & train integrity monitoring
  - De-coupling
  - Parking brake control
  - Network based EP-brake
  - User interface application
- Automated parking brake systems
- Wagon power supply / battery

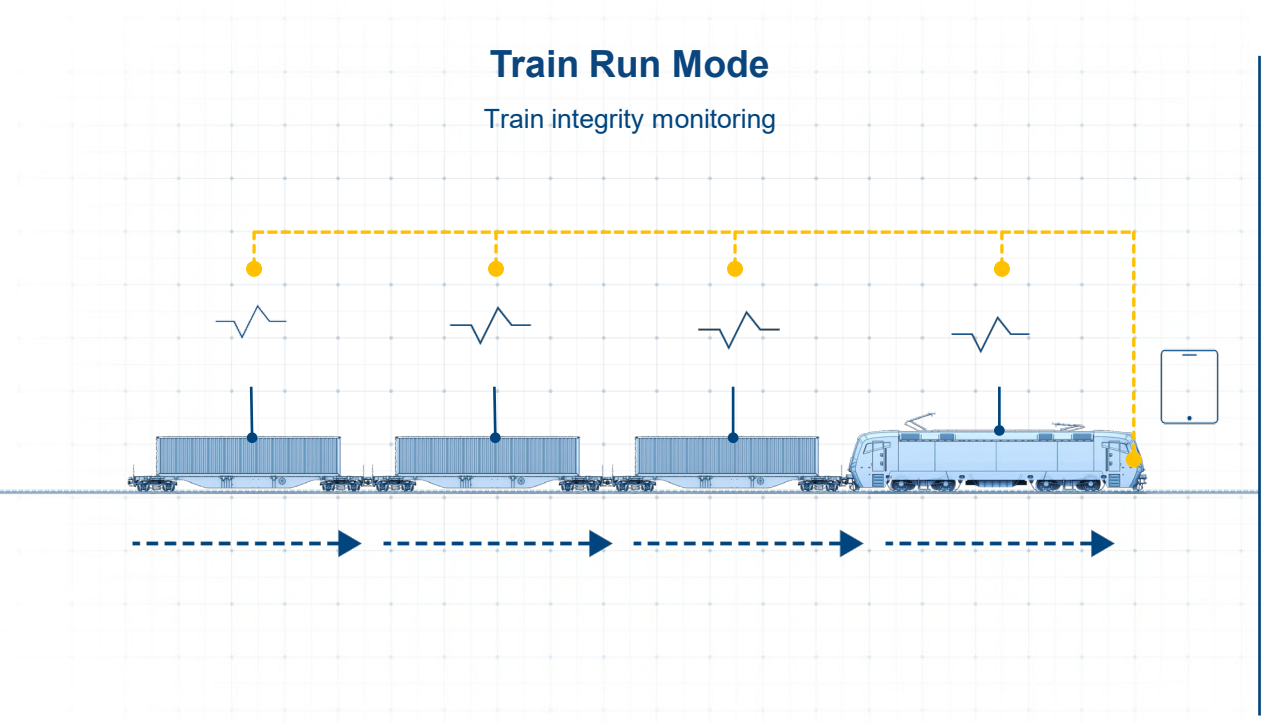
Competitive rail freight transportation requires Digital Freight Train automation

Train Run Mode



Train Run Mode

Competitive rail freight transportation requires Digital Freight Train automation



Train Run Mode

- Train integrity monitoring

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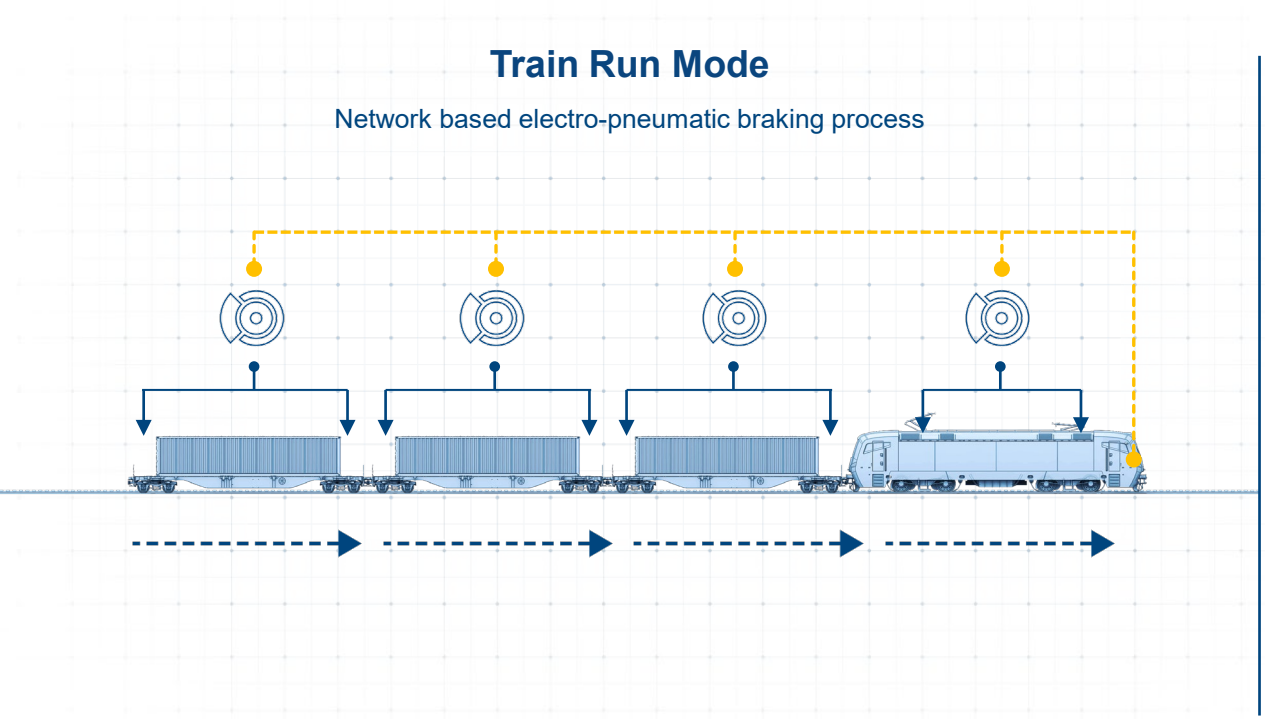
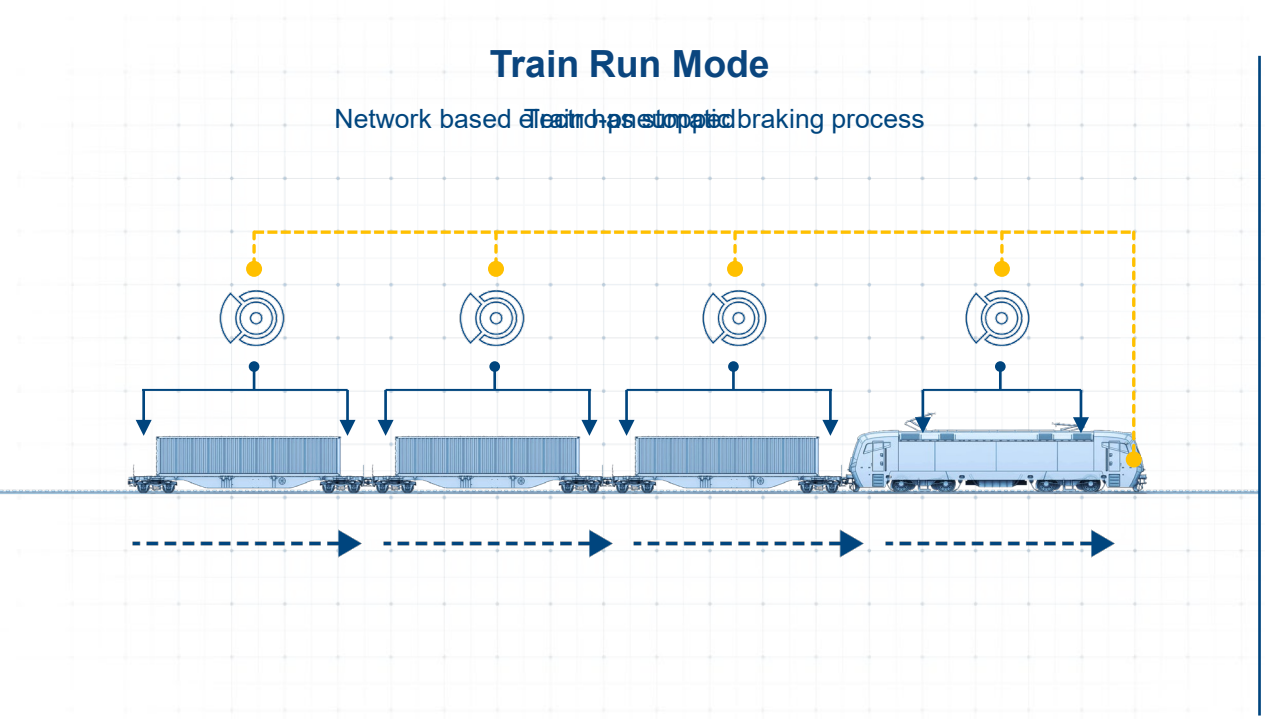


Train Run Mode

- Train integrity monitoring
- Network based electro-pneumatic brake

Competitive rail freight transportation requires Digital Freight Train automation

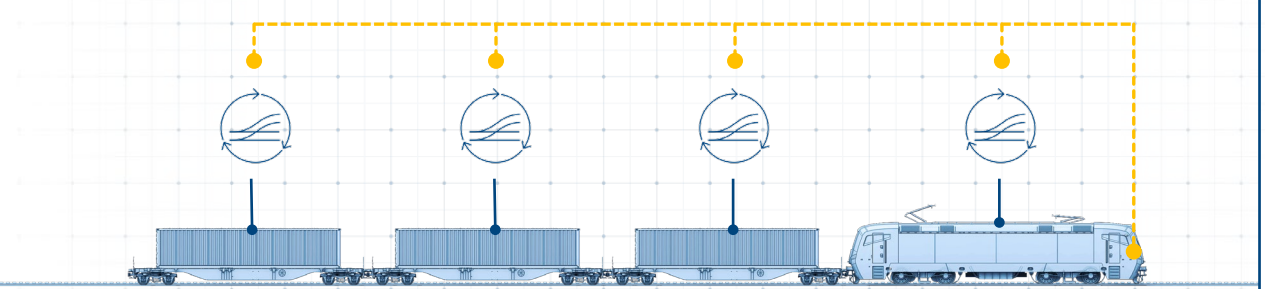


Train Run Mode

- Train integrity monitoring
- Network based electro-pneumatic brake
- Train has stopped

Competitive rail freight transportation requires Digital Freight Train automation

Shunting Mode



Train Run Mode

- Train integrity monitoring
- Network based electro-pneumatic brake
- Train has stopped

Change to Shunting Mode

Competitive rail freight transportation requires Digital Freight Train automation

Shunting Mode

Apply parking brake

Train Run Mode

- Train integrity monitoring
- Network based electro-pneumatic brake
- Train has stopped

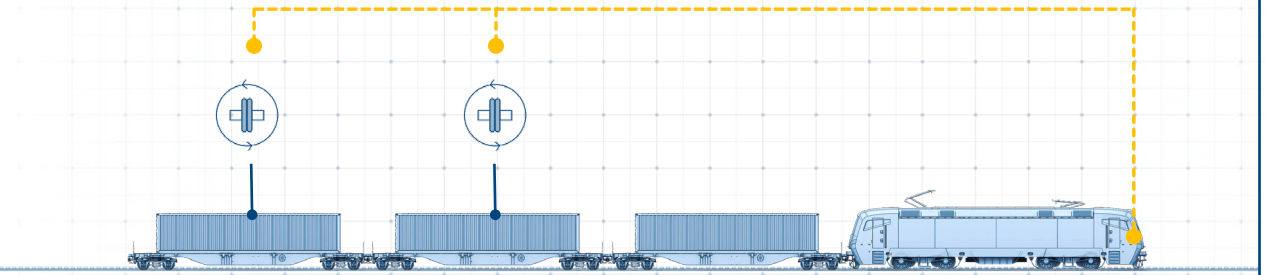
Change to Shunting Mode

- Apply parking brake

Competitive rail freight transportation requires Digital Freight Train automation

Shunting Mode

De-couple



Train Run Mode

- Train integrity monitoring
- Network based electro-pneumatic brake
- Train has stopped

Change to Shunting Mode

- Apply parking brake
- De-couple

Competitive rail freight transportation requires Digital Freight Train automation

Shunting Mode

Move forward

Train Run Mode

- Train integrity monitoring
- Network based electro-pneumatic brake
- Train has stopped

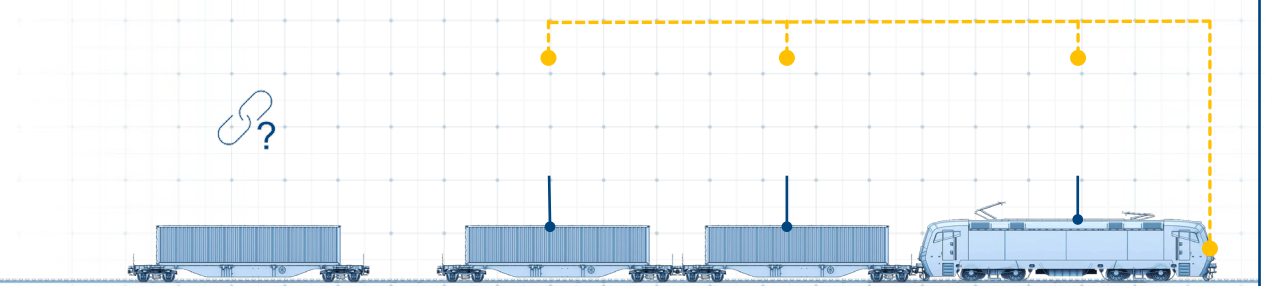
Change to Shunting Mode

- Apply parking brake
- De-couple
- Move forward

Competitive rail freight transportation requires Digital Freight Train automation

Shunting Mode

Train composition detection



Train Run Mode

- Train integrity monitoring
- Network based electro-pneumatic brake
- Train has stopped

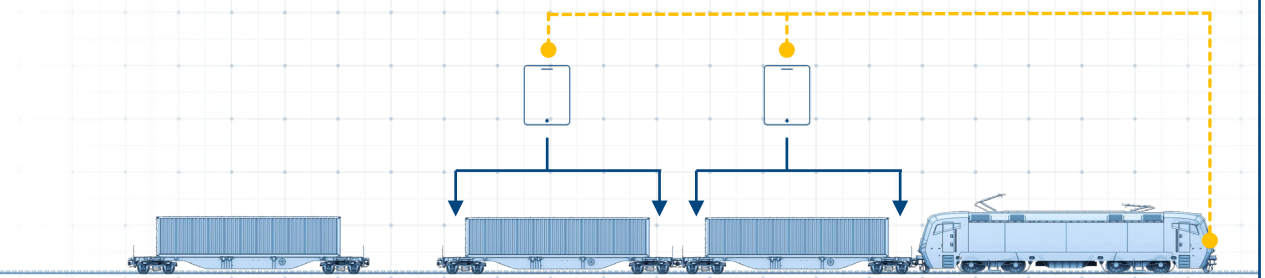
Change to Shunting Mode

- Apply parking brake
- De-couple
- Move forward
- Train composition detection

Competitive rail freight transportation requires Digital Freight Train automation

Shunting Mode

Automated brake test



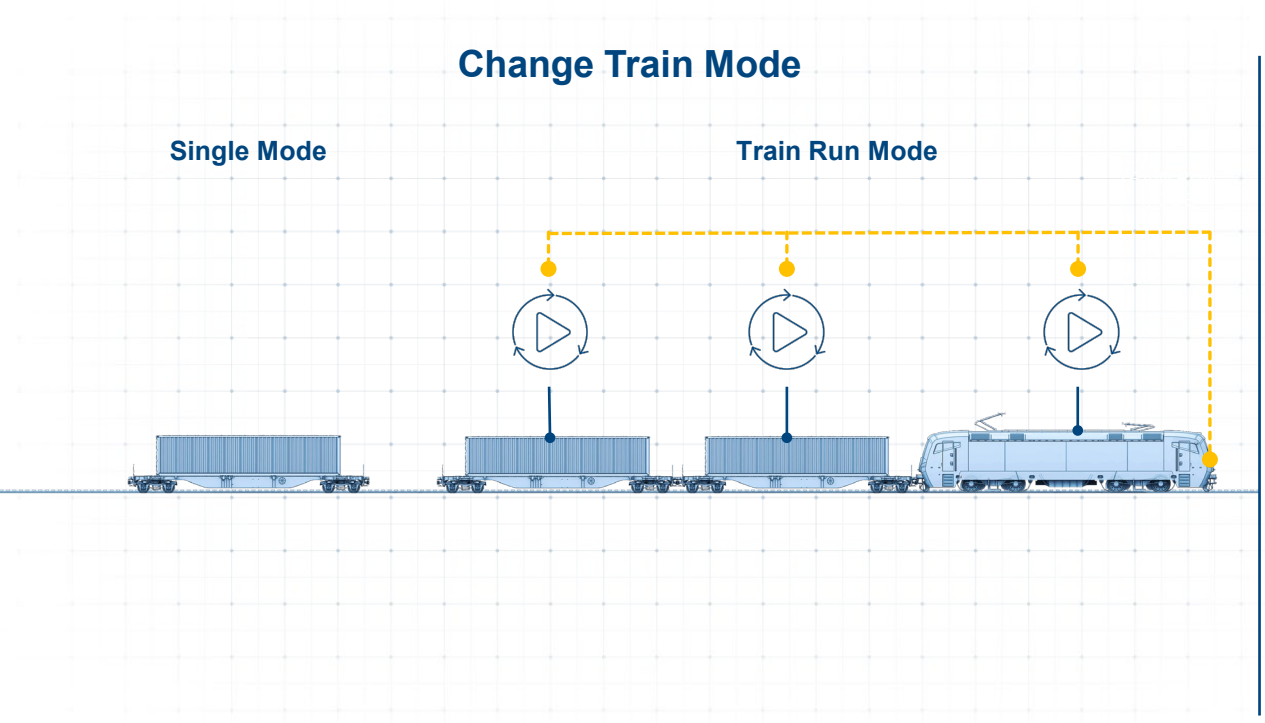
Train Run Mode

- Train integrity monitoring
- Network based electro-pneumatic brake
- Train has stopped

Change to Shunting Mode

- Apply parking brake
- De-couple
- Move forward
- Train composition detection
- Automated brake test
  - Release brakes
  - Apply brakes
  - Release brakes

Competitive rail freight transportation requires Digital Freight Train automation



Train Run Mode

- Train integrity monitoring
- Network based electro-pneumatic brake
- Train has stopped

Change to Shunting Mode

- Apply parking brake
- De-couple
- Move forward
- Train composition detection
- Automated brake test
  - Release brakes
  - Apply brakes
  - Release brakes

Change to Train Run Mode

Competitive rail freight transportation requires Digital Freight Train automation

Train Run Mode

Move away

Train Run Mode

- Train integrity monitoring
- Network based electro-pneumatic brake
- Train has stopped

Change to Shunting Mode

- Apply parking brake
- De-couple
- Move forward
- Train composition detection
- Automated brake test
  - Release brakes
  - Apply brakes
  - Release brakes

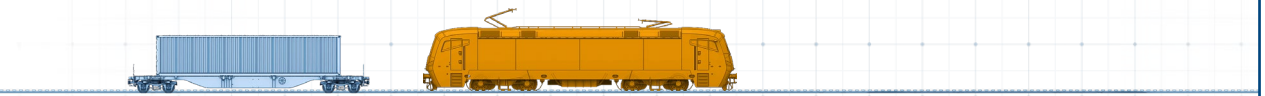
Change to Train Run Mode

- Move away

Competitive rail freight transportation requires Digital Freight Train automation

Single Mode

Shunting locomotive arrives



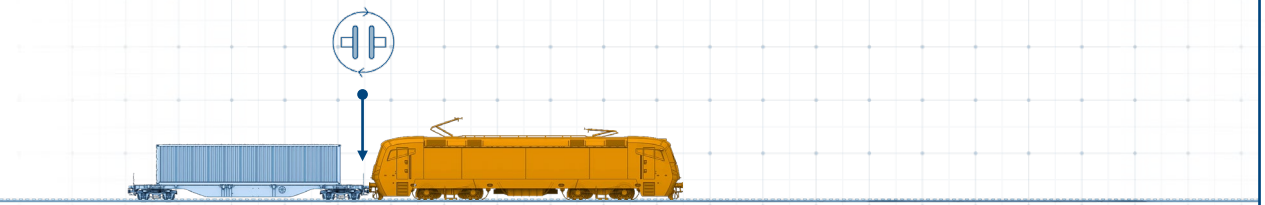
Single Mode

- Shunting locomotive arrives

Competitive rail freight transportation requires Digital Freight Train automation

Shunting Mode

Automatic coupling



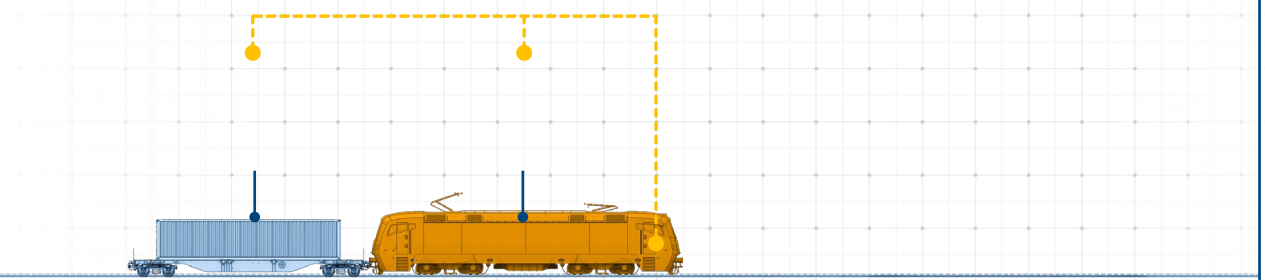
Single Mode

- Shunting locomotive arrives
- Automatic coupling

Competitive rail freight transportation requires Digital Freight Train automation

Shunting Mode

Train composition detection



Single Mode

- Shunting locomotive arrives
- Automatic coupling

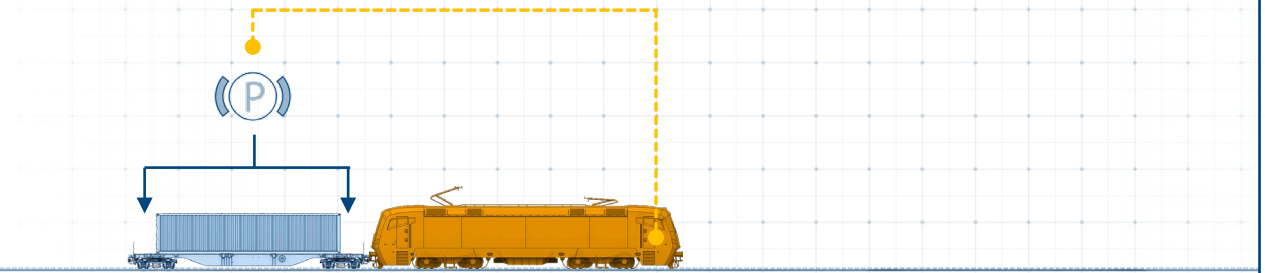
Shunting Mode

- Train composition detection

Competitive rail freight transportation requires Digital Freight Train automation

Shunting Mode

Release parking brake



Single Mode

- Shunting locomotive arrives
- Automatic coupling

Shunting Mode

- Train composition detection
- Release parking brake

Competitive rail freight transportation requires Digital Freight Train automation

Shunting Mode

Movement in shunting yard

Single Mode

- Shunting locomotive arrives
- Automatic coupling

Shunting Mode

- Train composition detection
- Release parking brake
- Movement in shunting yard

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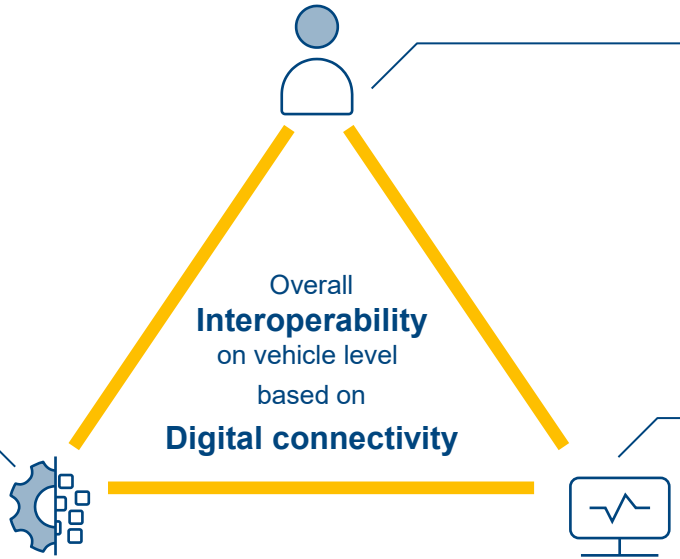
Europe's Rail Joint Undertaking – TRANS4M-R project content
Train functions – generate added value to the user



Train function user

- Train driver
- Brake test responsible
- Automated train operation (ATO) system, for example a yard automation system

Train control functions

- Change of operation mode
- Automated brake test
- De-coupling
- Parking brake control
- Network based EP-Brake
- Distributed power (multi-traction for up to 4 loco in a train)
- Power management

Train monitoring functions

- Train composition detection
- Train length determination
- Train integrity monitoring
- Parking brake / brake monitoring
- Distributed power (multi-traction for up to 4 loco in a train)
- Power management – battery load monitoring

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Train functions – pre-requisites

Step 1

Upgrade Digital Automatic Coupler

DAC 4 and DAC 5 development as interoperability component

+

Step 2

Establish energy supply system

From locomotives to wagons

- 400V AC system 2* 1 phase (redundant)
- 3 kW loco power supply
- 2 * 2 train lines
- Wagon power supply incl. board battery system 48V DC

+

Step 3

Implement train communication system

- Ethernet train backbone acc. IEC61375 with a new physical interface: SPE (single pair ethernet)
- 2 * 2 cables (redundant)
- 10 Mbit / s

Thank you for your attention!

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