

Digital Freight Train

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

Steffen Jass

Director Freight Rail Automation

Knorr-Bremse Systeme für Schienenfahrzeuge GmbH



The project is supported by the Europe's Rail Joint Undertaking and its members.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Europe's Rail Joint Undertaking. Neither the European Union nor the granting authority can be held responsible for them.



AGENDA

1. Scope of presentation & example of train functions
2. ERJU IP FP5 - Train functions
3. Architecture and interoperability
4. Challenges and Knorr-Bremse contribution

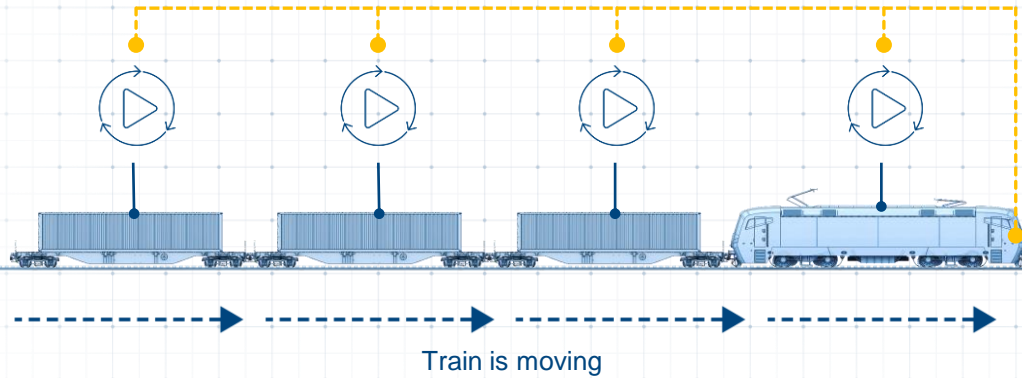


AGENDA

1. Scope of presentation & example of train functions
2. ERJU IP FP5 - Train functions
3. Architecture and interoperability
4. Challenges and Knorr-Bremse contribution

Competitive rail freight transportation requires Digital Freight Train automation

Train Run Mode

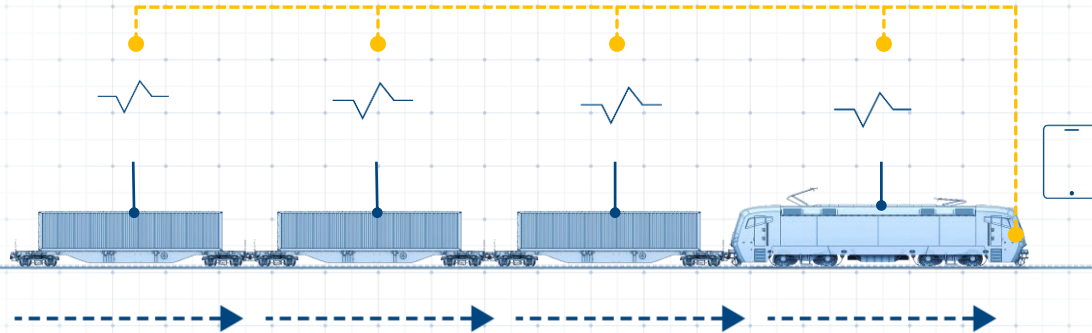


Train Run Mode

Competitive rail freight transportation requires Digital Freight Train automation

Train Run Mode

Train integrity monitoring



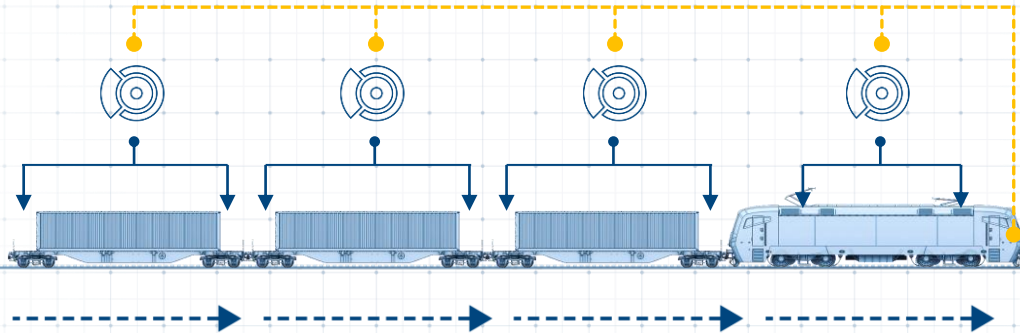
Train Run Mode

- Train integrity monitoring

Competitive rail freight transportation requires Digital Freight Train automation

Train Run Mode

Network based electro-pneumatic braking process



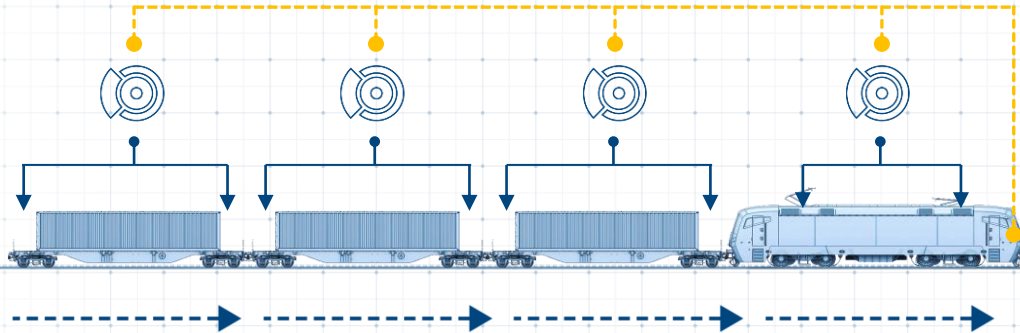
Train Run Mode

- Train integrity monitoring
- Network based electro-pneumatic brake

Competitive rail freight transportation requires Digital Freight Train automation

Train Run Mode

Train has stopped

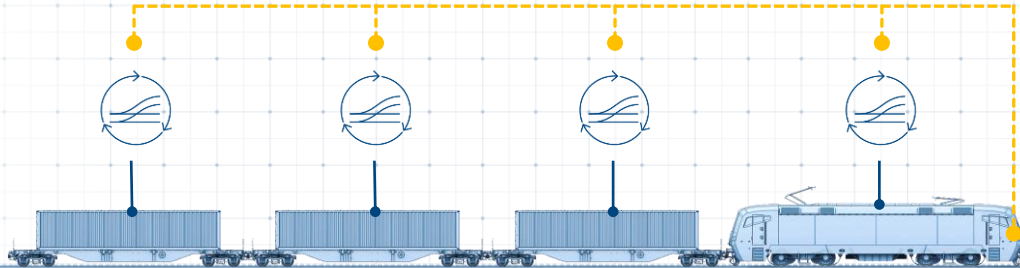


Train Run Mode

- 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

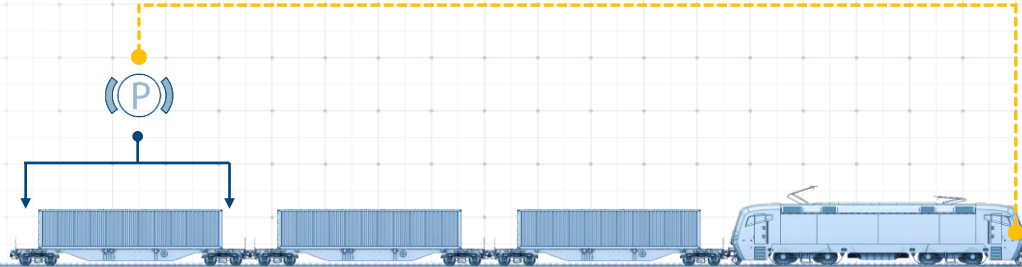
- Train integrity monitoring
- Network based electro-pneumatic brake
- Train has stopped

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

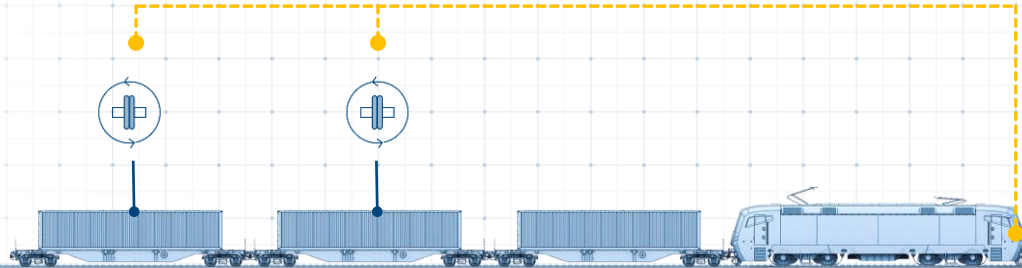
Change to Shunting Mode

- 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

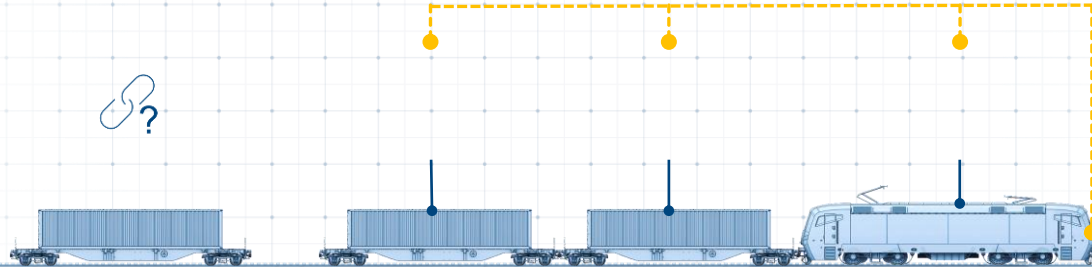
Change to Shunting Mode

- 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

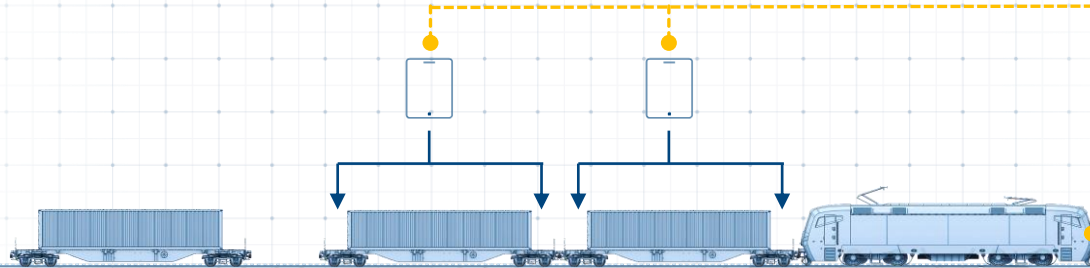
Change to Shunting Mode

- 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

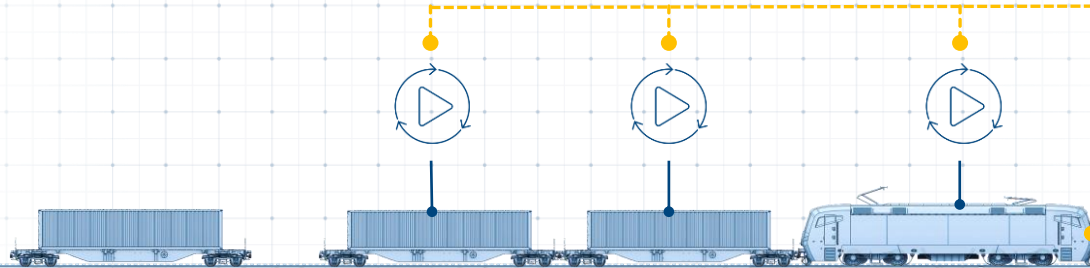
- Apply parking brake
- De-couple
- Move forward
- Train composition detection
- Automated brake test
 - Release brakes
 - Apply brakes
 - Release brakes

Competitive rail freight transportation requires Digital Freight Train automation

Change Train Mode

Single Mode

Train Run Mode



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

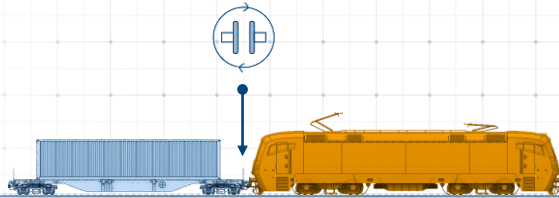
- Shunting locomotive arrives



Competitive rail freight transportation requires Digital Freight Train automation

Shunting Mode

Automatic coupling



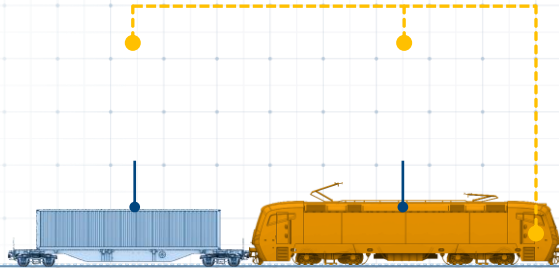
Single Mode

- 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

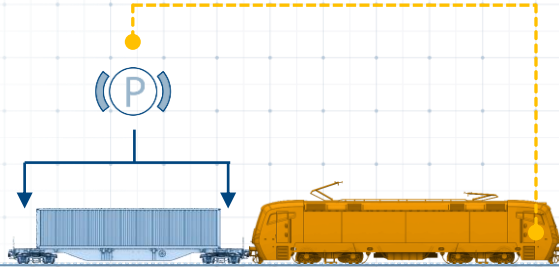
Shunting Mode

- 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



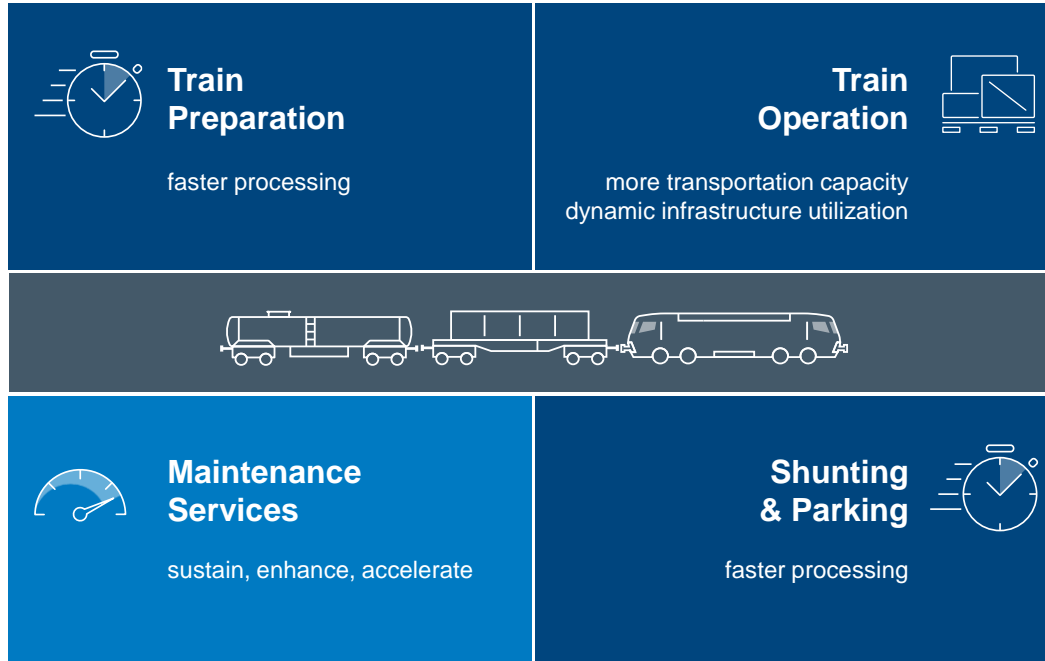
Single Mode

- Shunting locomotive arrives
- Automatic coupling

Shunting Mode

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

Competitive rail freight transportation requires Digital Freight Train automation



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)

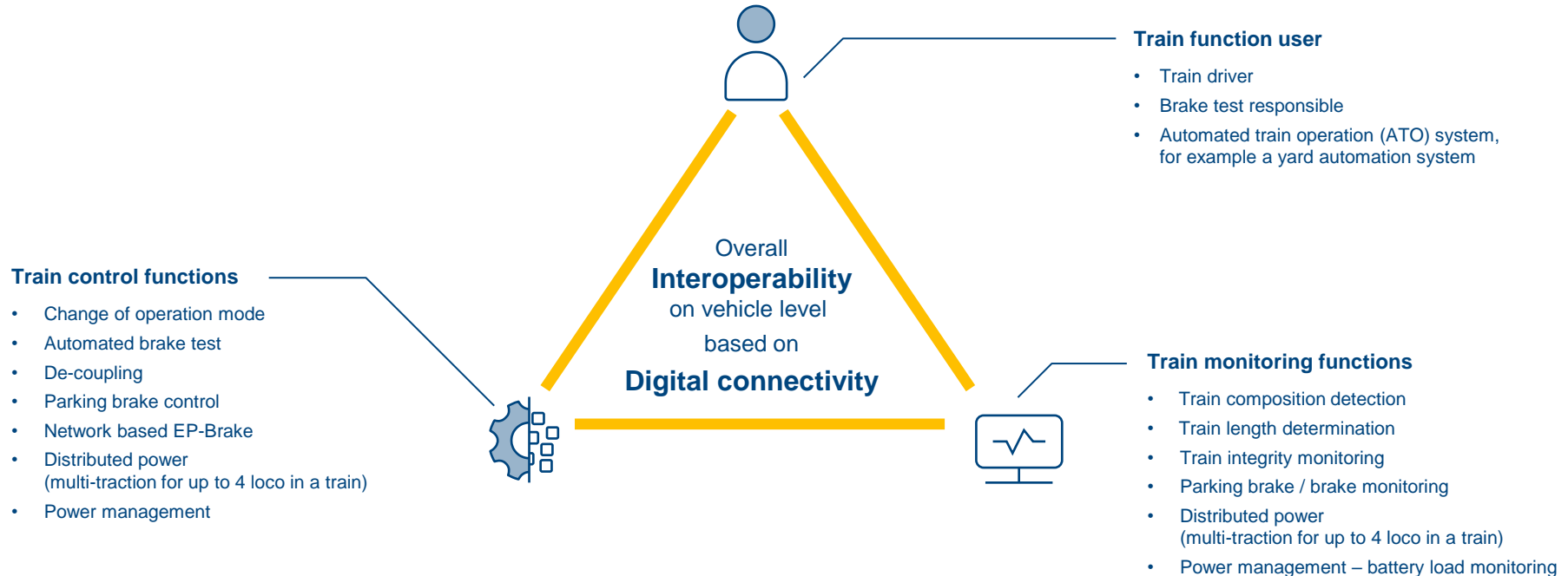


AGENDA

1. Scope of presentation & example of train functions
- 2. ERJU IP FP5 - Train functions**
3. Architecture and interoperability
4. Challenges and Knorr-Bremse contribution

Europe's Rail Joint Undertaking – TRANS4M-R project content

Train functions – generate added value to the user



Europe's Rail Joint Undertaking – TRANS4M-R project content

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



AGENDA

1. Scope of presentation & example of train functions
2. ERJU IP FP5 - Train functions
- 3. Architecture and interoperability**
4. Challenges and Knorr-Bremse contribution

Interoperability – three levels of communication

Level
3.2 cloud
Operator
Railcar owner

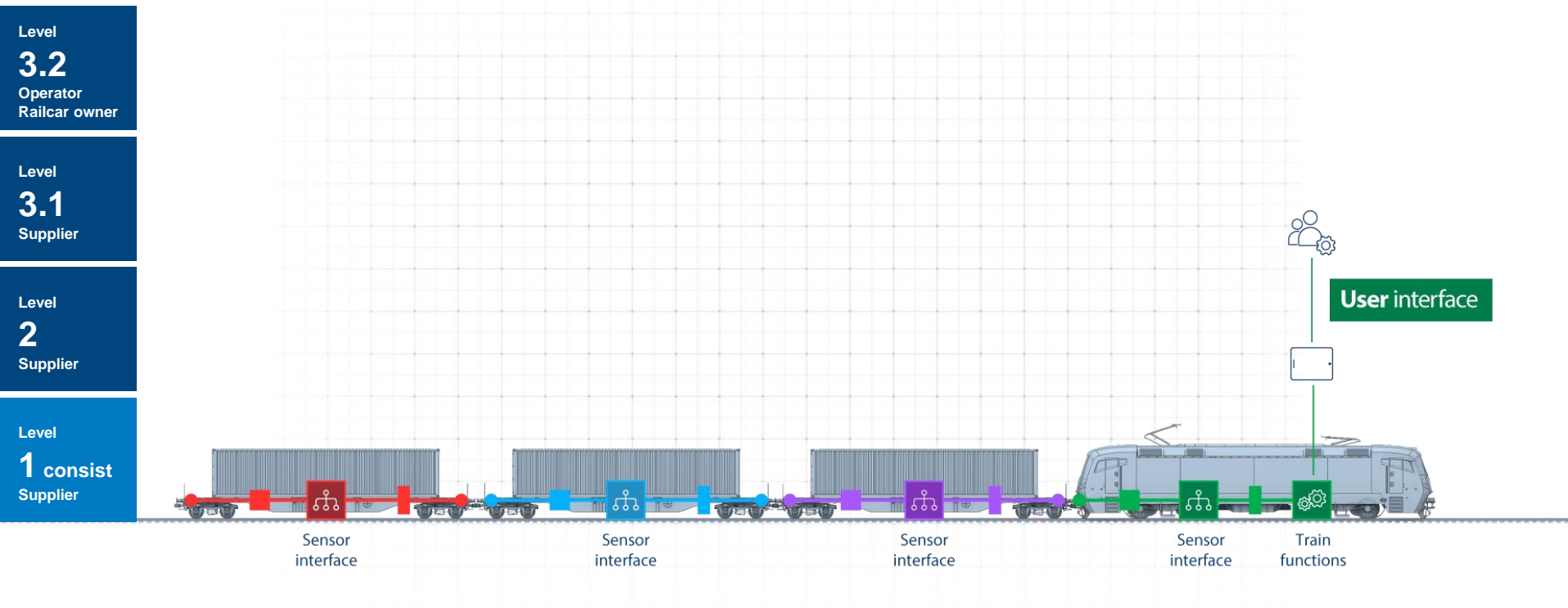
Level
3.1 cloud
Supplier

Level
2 train
Supplier

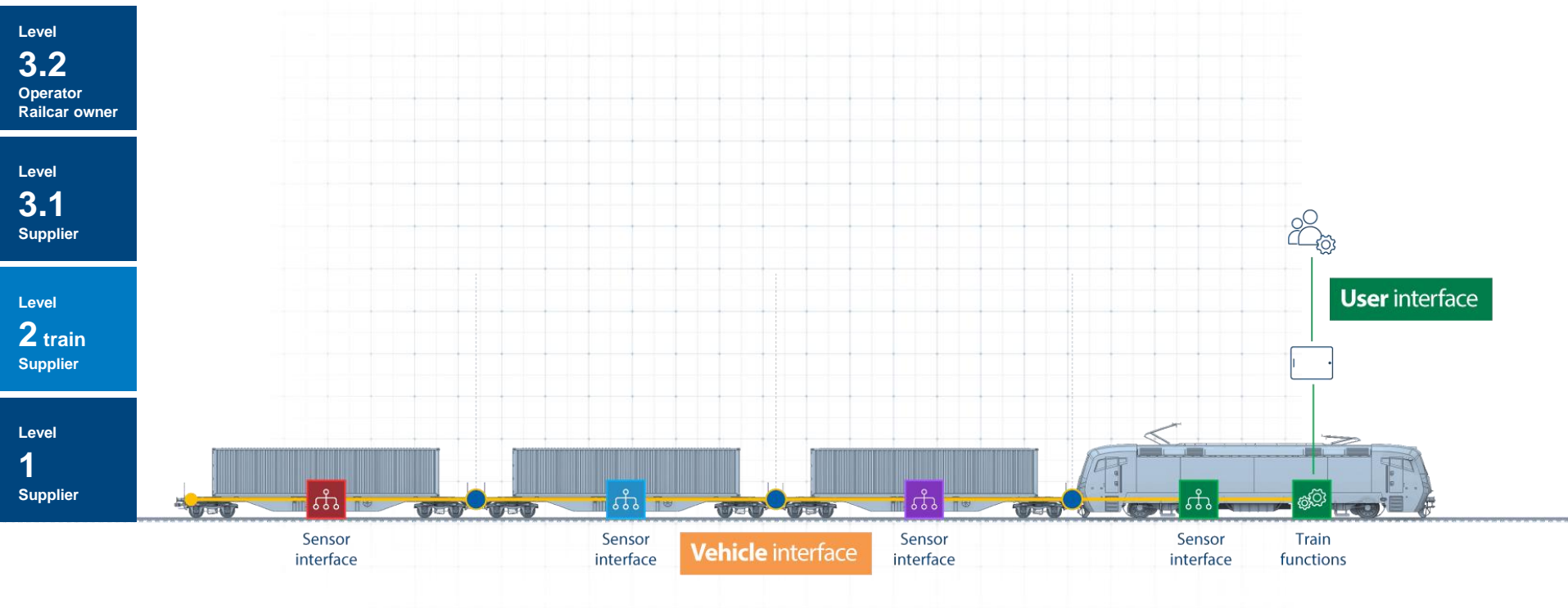
Level
1 consist
Supplier



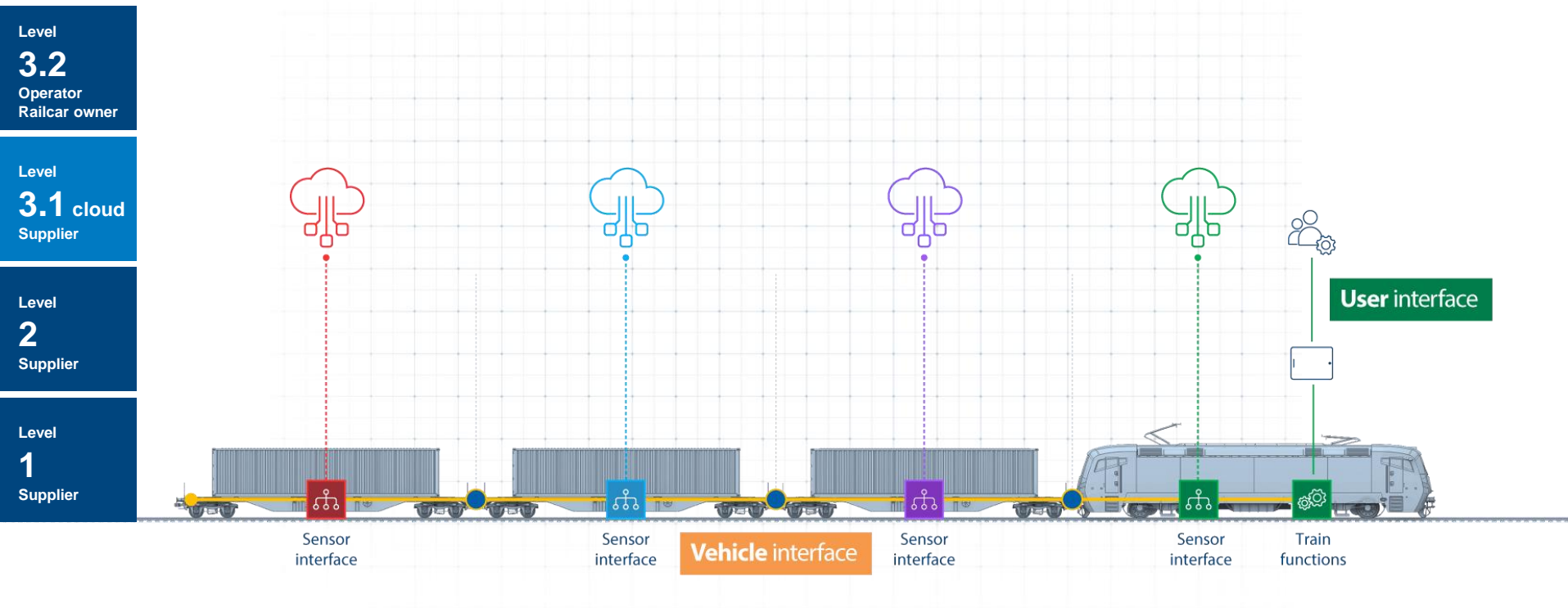
Interoperability – three levels of communication



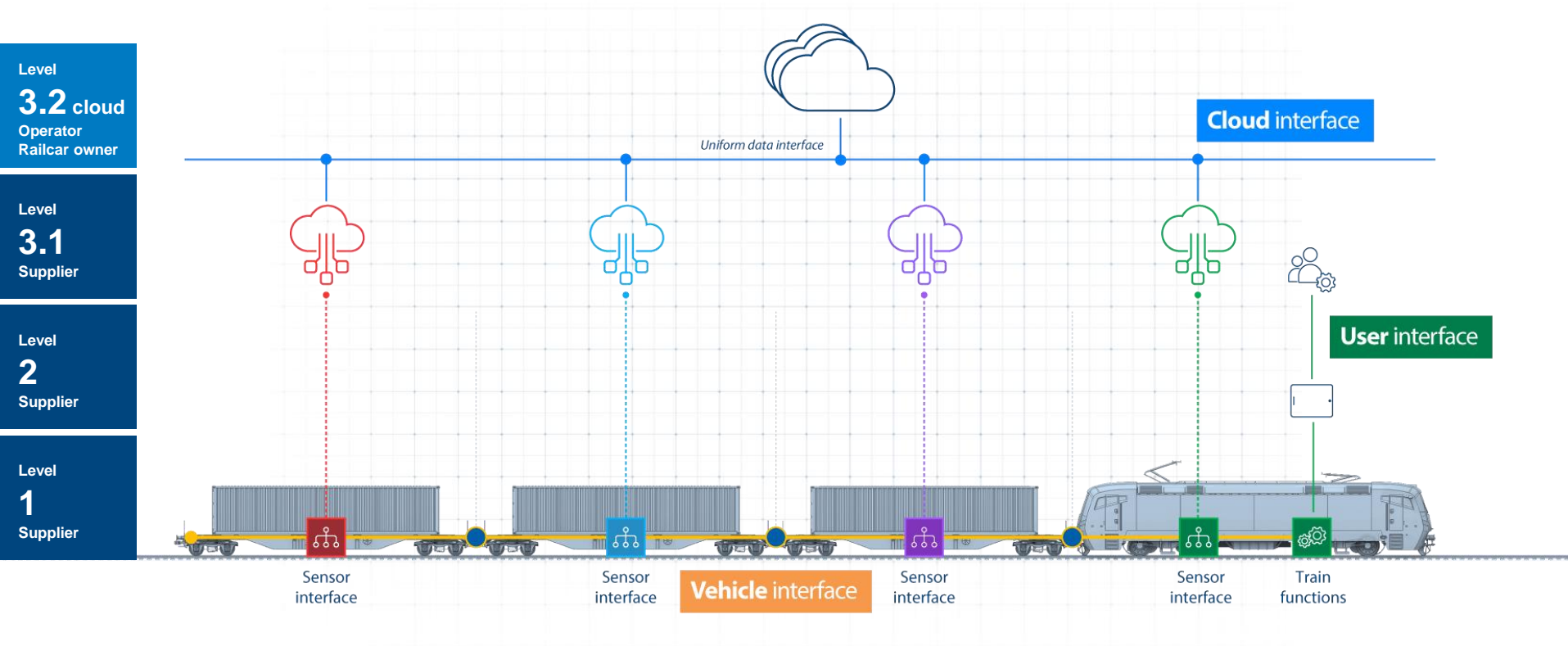
Interoperability – three levels of communication



Interoperability – three levels of communication



Interoperability – three levels of communication





AGENDA

1. Scope of presentation & example of train functions
2. ERJU IP FP5 - Train functions
3. Architecture and interoperability
- 4. Challenges and Knorr-Bremse contribution**

Freight rail sector challenges

Freight rail sector

To fulfill political expectations asap

Migration management

- Separate topic; ERJU FP5 can only demonstrate possibilities for operation and technology

ERJU TRANS4M-R

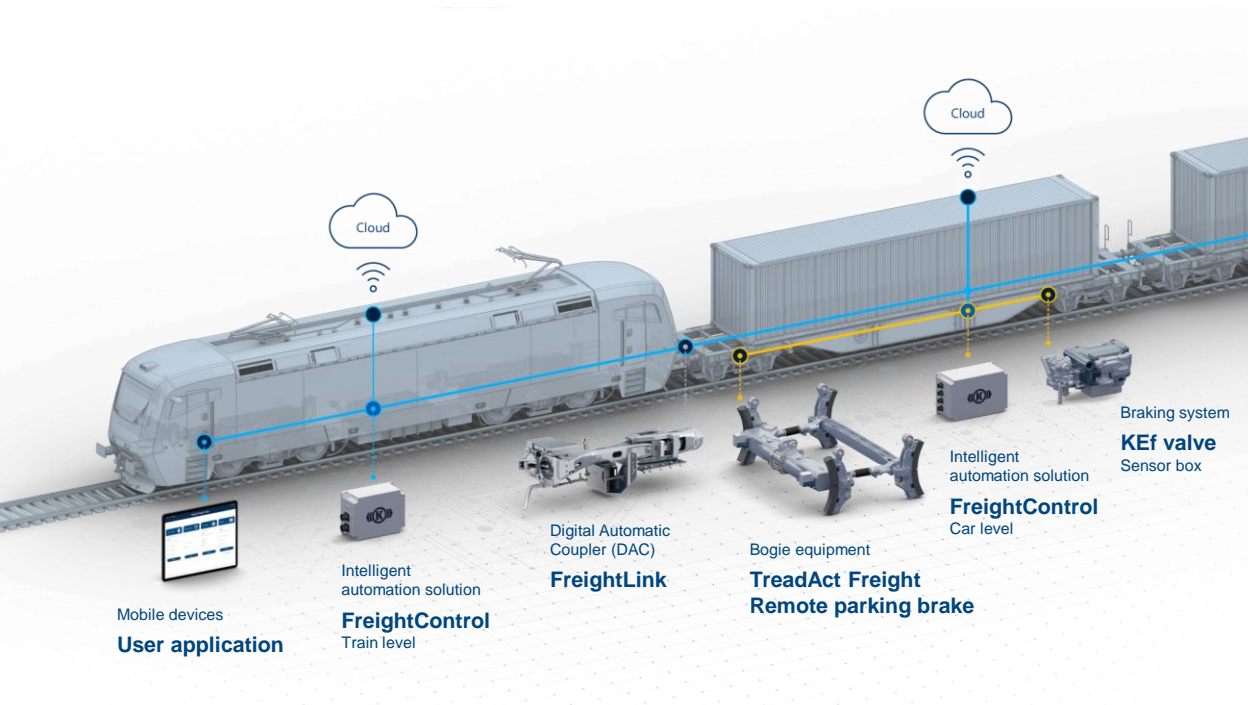
- Operators - Wagon keepers
- Rail freight industry: wagon and locomotive integrator, DAC supplier
 - to provide right solutions: fit for purpose
 - to enable interoperability

For operation after migration

- Reliability management
- Maintenance of new equipment
- Ensure long term interoperability-instrument to be established: reference test system



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

A close-up photograph of a railway track. A central metal rail is heavily infested with ants, which are also crawling on the surrounding moss and vegetation. The scene is outdoors, with green moss and some green leaves visible. The text is overlaid on the image.

Don't leave the railway
to the ants

Thank you