



Conclusions from Operational Testing

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für Digitales
und Verkehr

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Introduction

Scope of this Presentation



- Summary of more than one year of operational tests
- Aggregation of most important findings that apply to a large number of test cases and test locations
- Results focus on the DAC principle rather than supplier-specific solutions
- This leads to two very important guidelines for this presentation:

1. Tested DACs are prototypes

- there are already a lot of correctly working functionalities
- operational tests shall facilitate the development of the series product
- therefore, this presentation points to aspects where improvement is necessary

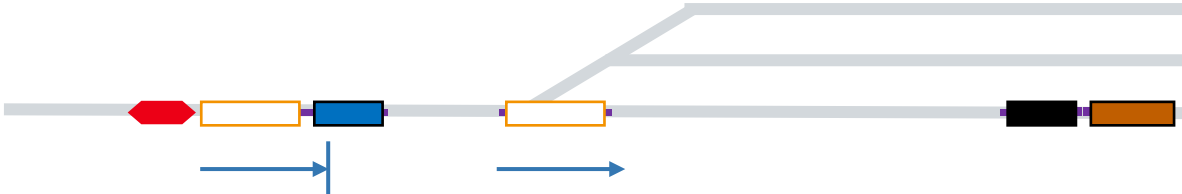
2. Operation

- = **DACs + Vehicles**
- + **Infrastructure + Staff + Procedures**
- results refer to DACs in the current system environment

Ground Level Shunting / General Aspects



Locomotive pulling and pushing wagons from track to track

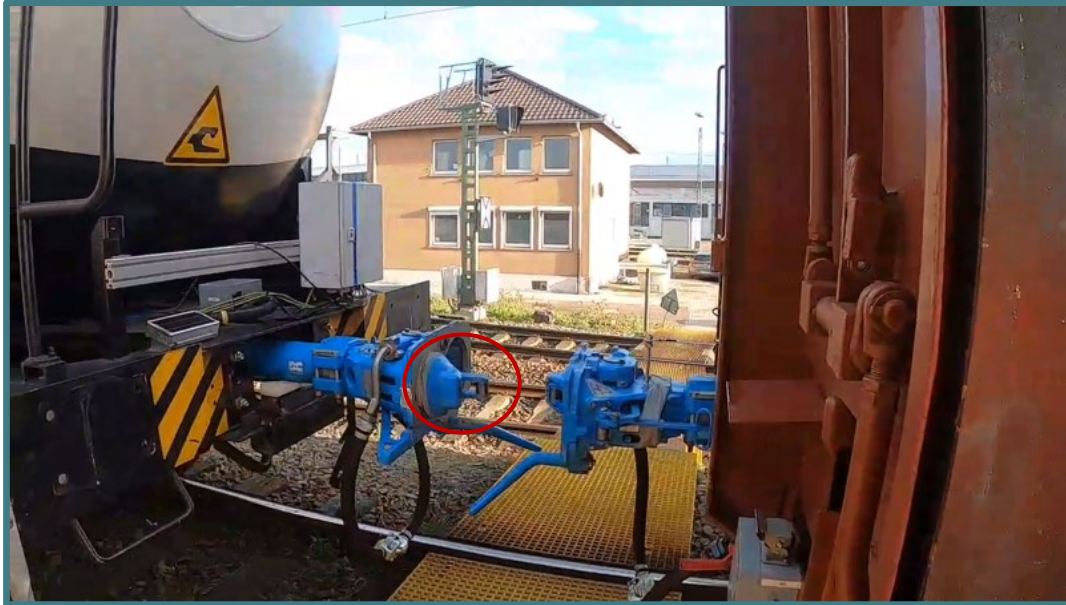


Fly shunting / push off operation:

Locomotive gives uncoupled wagon(s) a push and stops again, wagons continue to roll in designated track

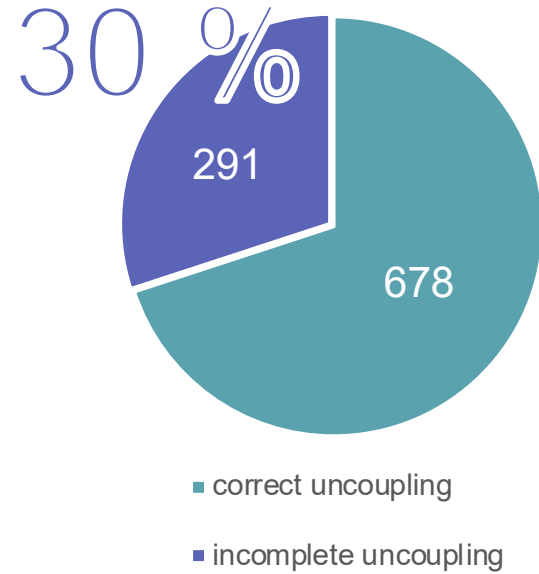
Main Issue 1

Incomplete Uncoupling



Main Issue 1

Incomplete Uncoupling



Incomplete uncoupling happens during ground level shunting as well as during hump operation

Why is this an issue?

- Coupling in this condition is possible. However, wear and tear are increased
- This condition is not noticeable until the vehicles start to move and thus the DACs are separated → especially problematic for one person operation
- The pneumatic brake is usually used for ground level shunting → the brake pipe is filled
 - Incomplete uncoupling leads to abrupt discharging of the brake pipe and thus to loud noise
 - The brakes will immediately apply → if the DAC in coupled position is on the moving part of the train, it will stop again
- The gathering range of the DACs is decreased

DACs coupled in **99 %** of all cases at first contact.

In **1 %** of all cases, DACs coupled at second or third contact (during hump operation)

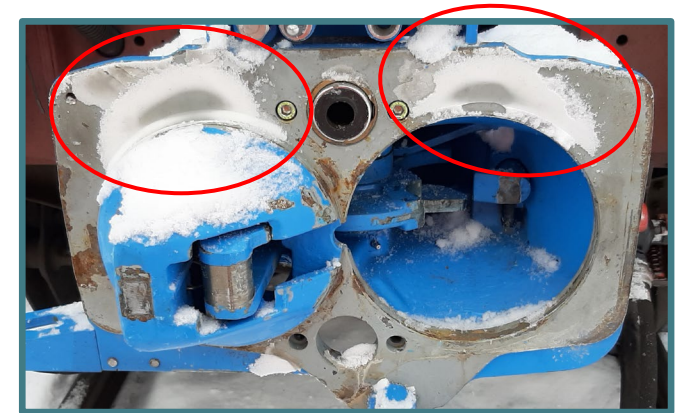
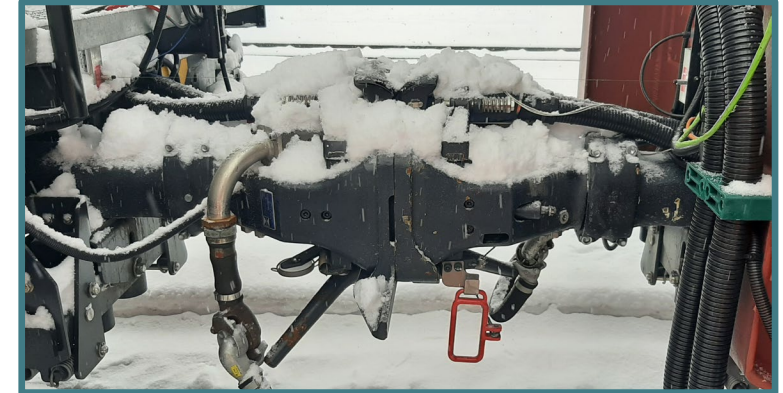
Only situation where single DACs did not couple at all: specific types with snow

Ground Level Shunting / General Aspects

Coupling in Winter Conditions

Tests in real-life winter conditions fully confirmed the Phase I climate chamber results

- Flat coupler front plates (like for passenger train couplers) compress snow to a thin layer of ice that prevents successful coupling
- Coupler front plates with a sufficient capability to push away snow and ice enable for reliable coupling in winter conditions
- A new finding was that the coupling state indicator became hard to see when the DACs are covered with snow



Ground Level Shunting / General Aspects

Dirt / Moisture in Brake Pipe

- Snow accumulated in the DAC's brake pipe mouthpiece during winter tests



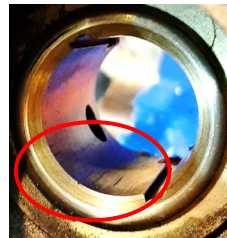
- Some vent holes of brake pipe stop cocks showed larger volumes of oil/water emulsions during/after winter tests



- In spring 2022, one DAC air valve repeatedly failed to entirely close after winter tests
- The same valve failed to open once



- Scratch marks on the valve's components



- Specific tests in a very dusty environment in summer 2022 showed the accumulation of dust particles in the DAC's brake pipe mouthpieces



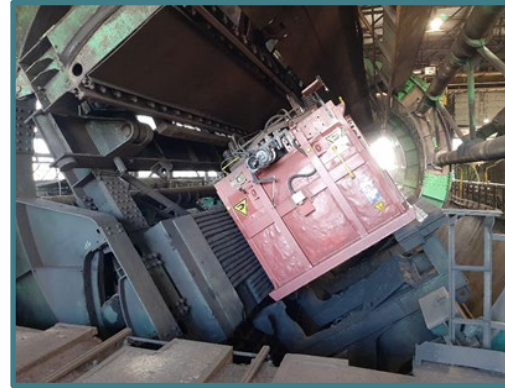
- Further tests showed that these particles will be blown into the vehicles' brake pipes. They pass the valves

→ a cover for the DAC's brake pipe mouthpieces in uncoupled condition should be taken into account

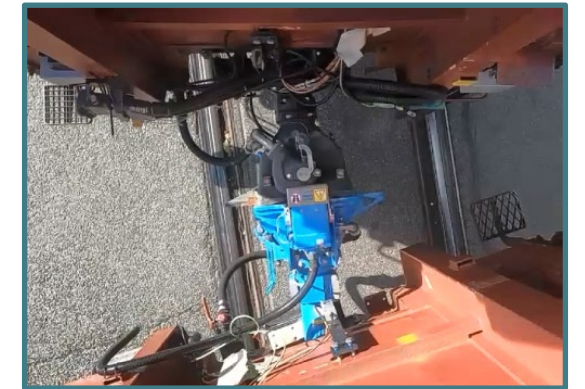
Ground Level Shunting / General Aspects

Industrial Sites

- Industrial sites sometimes have additional operational procedures and/or different infrastructures that are important to be tested



- Narrow curves (radius < 100 m) are not uncommon in these sites
 - The tests in real sites confirmed the Phase I tests results from the test facility:
 - wagons with DACs can run through such curves without any issues.
 - even uncoupling and uncoupling was possible down to radii of 45 m (for wagon type that is allowed for such narrow curves)



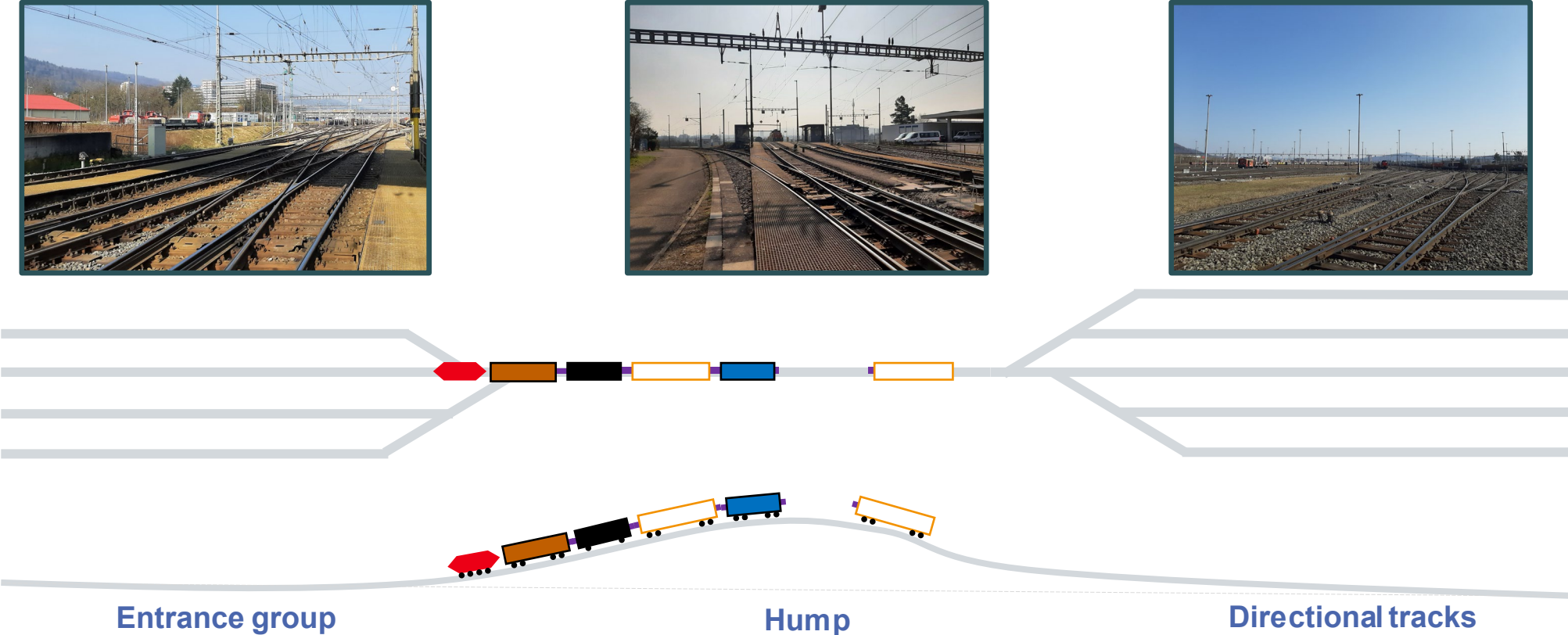
Ground Level Shunting / General Aspects

Shunting Personnel Feedback, other Observations

- Shunting personnel is often sceptical at first but enthusiastic after the first tests
- The colleagues realise how much the DAC could make their work easier
- Ergonomics are very important
 - in all operational scenarios
 - considering shunter's gear
 - push buttons on wagon side are usually the shunter's favourites
 - special tests in France
- Loud noises during coupling and changing direction during shunting are often mentioned by personnel
- Shunting with DACs sounds different than with side buffers – in subjective perception it is louder. However, testing is rather rough
- Acoustic measurements are currently being discussed



Hump Operation



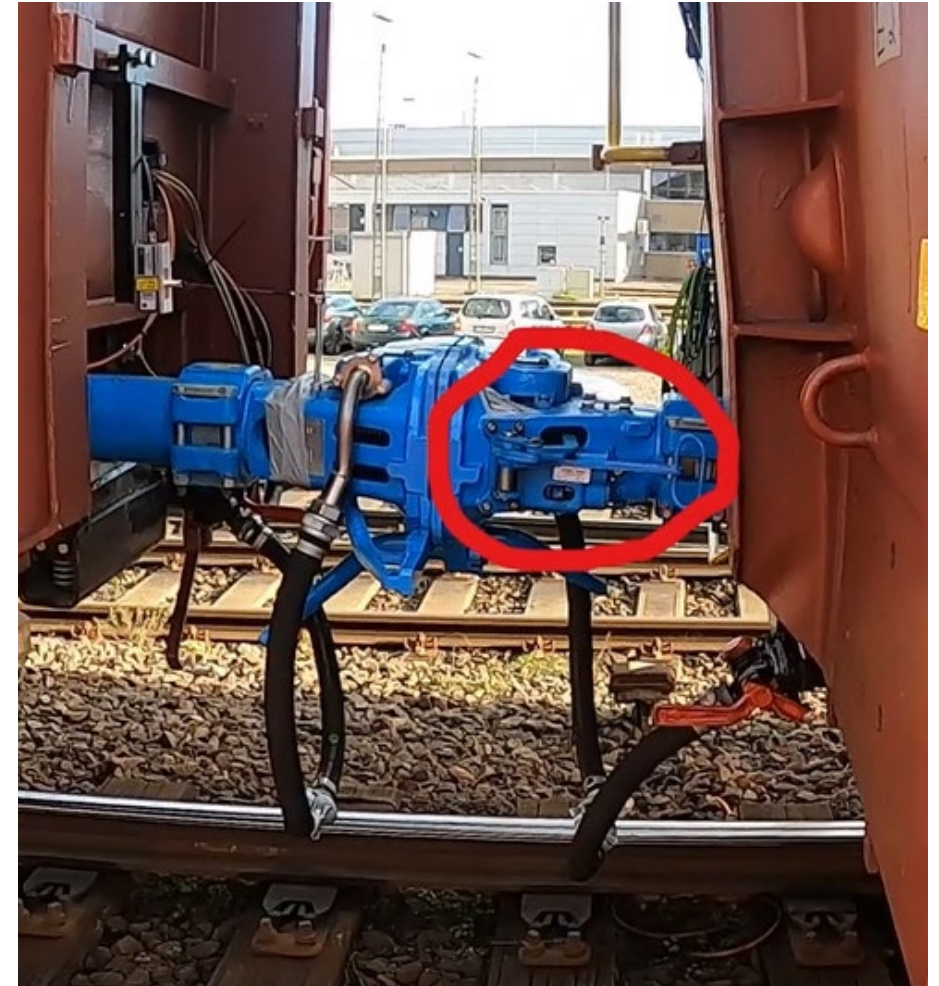
Depending on grade of automation, infrastructural design, national rules etc.,
uncoupling takes place either on hump or in entrance group

Main Issue 2

Prevention of Unintended Coupling

Short video of initially uncoupled DACs where the wagons are pushed towards the top of a hump.

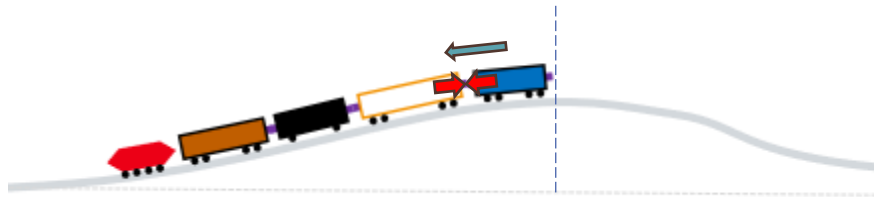
The DACs couple unintentionally during the continuous movement of the wagons.



Hump Operation

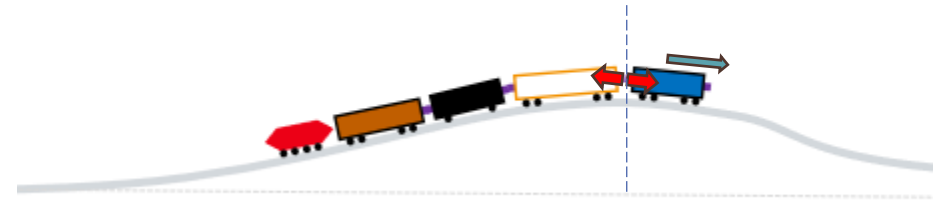
Ideal Position for Uncoupling

Ideal positions for uncoupling in **standstill** hardly exist:



centre of gravity before top of the hump

- compressive forces in the DACs
- uncoupling in regular manner
- wagon will not roll down the hump



centre of gravity behind top of the hump

- tension forces in the DACs
- uncoupling requires significantly higher forces and becomes impossible eventually
- incomplete uncoupling is further favoured

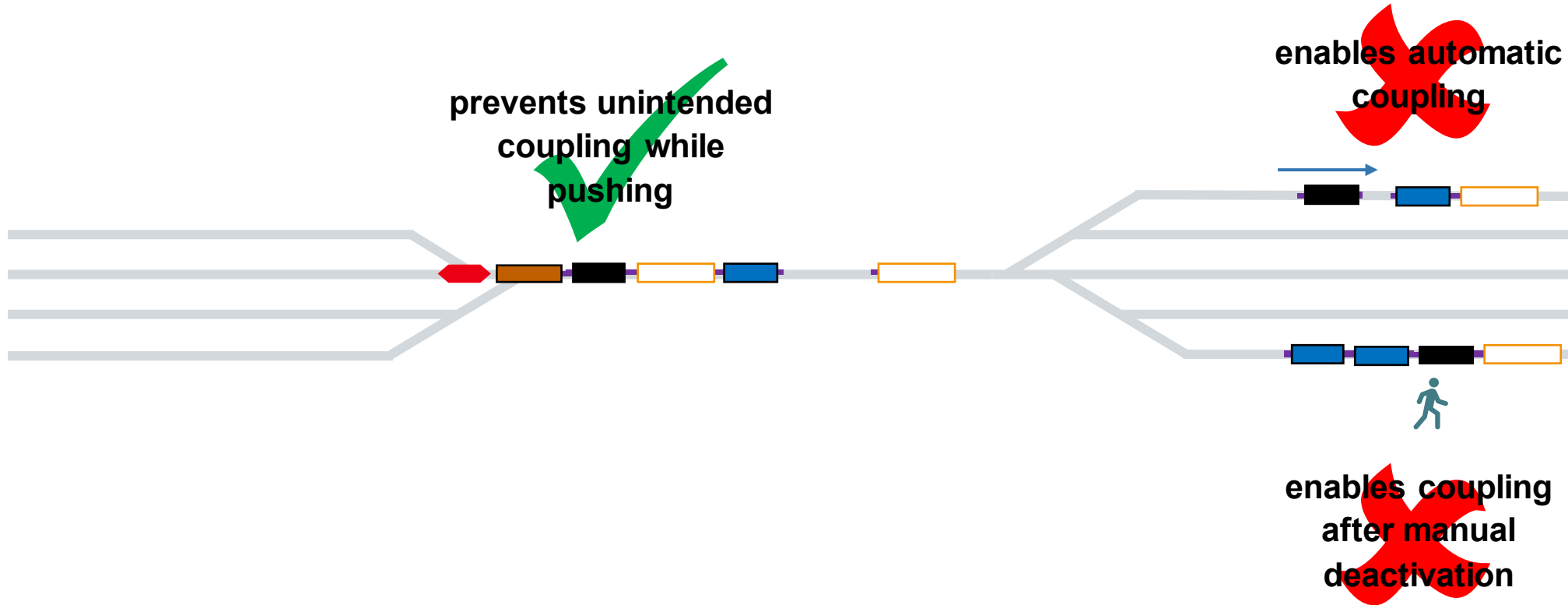
Uncoupling **during movement** improves the situation but there is still not one ideal position due to

- different sizes of wagon groups, different loads, sloshing loads
- different running resistances in switches and curves
- different weather
- different velocities → operation is highly dynamic and can be temporarily stopped at any time

→ to reach **100 % reliable operation**, a solution to prevent unintended coupling is necessary

Hump Operation

Buffer Position



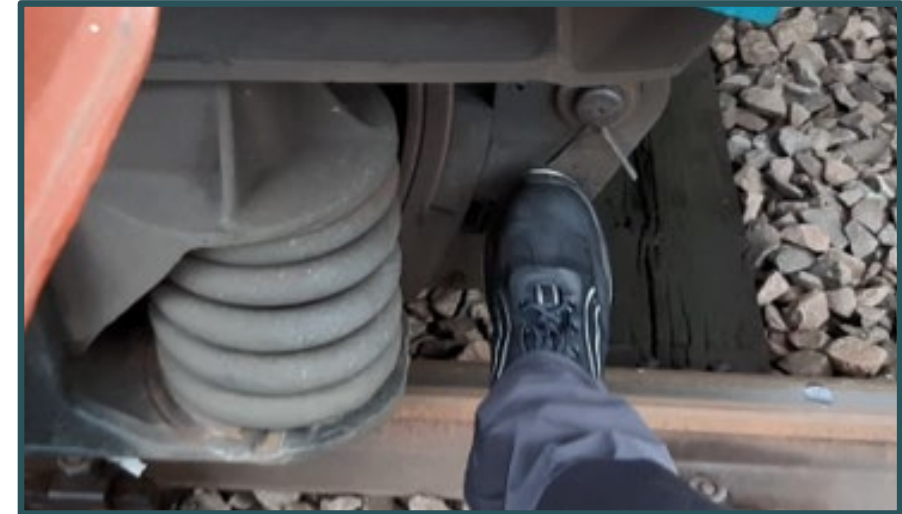
→ current buffer position is no feasible solution for the whole process

→ future solution should switch to “ready to couple” when wagon starts rolling down the hump

Hump Operation

Uncoupling with Unvented Brake Pipe

- Closing the DAC's pneumatic valves during uncoupling leads to a loss of air when the brake pipe is not vented before
- The pressure change in the brake is large enough for some distributor valves to apply the brakes
- Uncoupled wagons remain braked; their brakes must be manually released

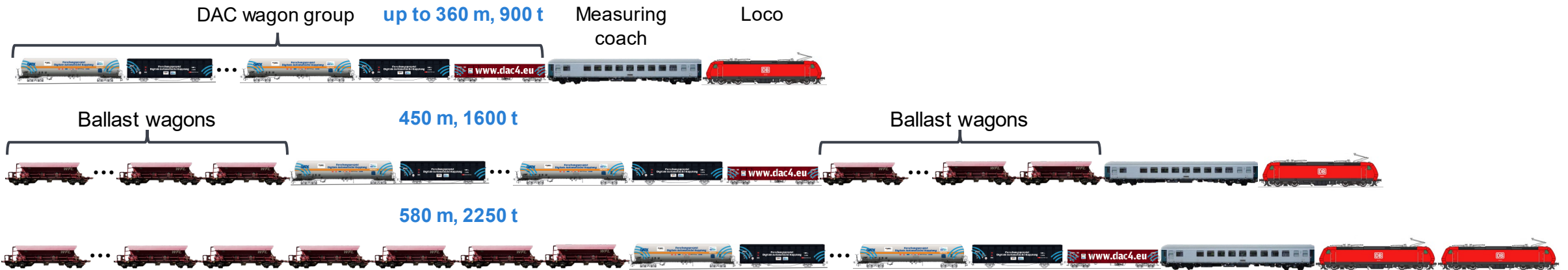


→ Therefore, hump operation with unvented brake pipes is not feasible

Train Runs

Overview

- More than 10.000 km of train runs
- Different train configurations
- Various topologies, including very steep lines with narrow curves (e.g. Gotthard line)



→ No issues during train runs

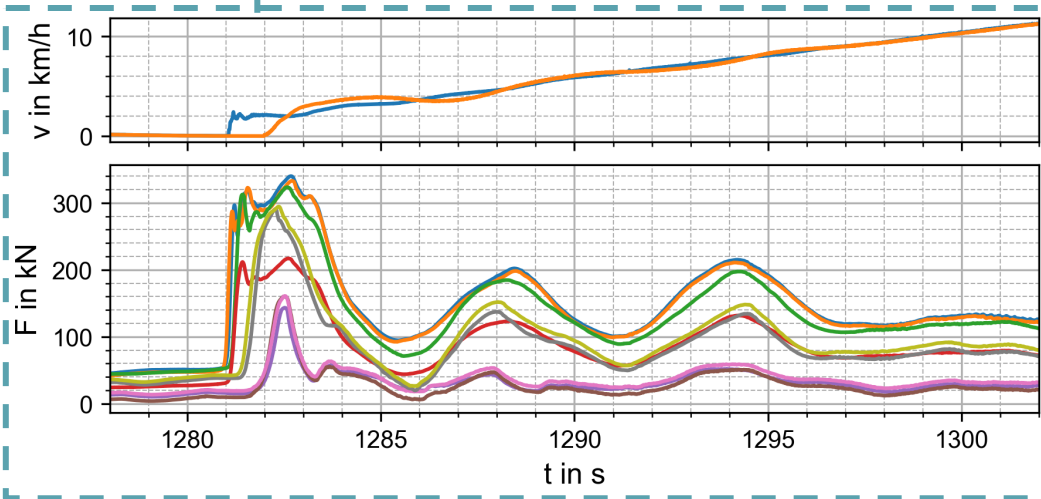
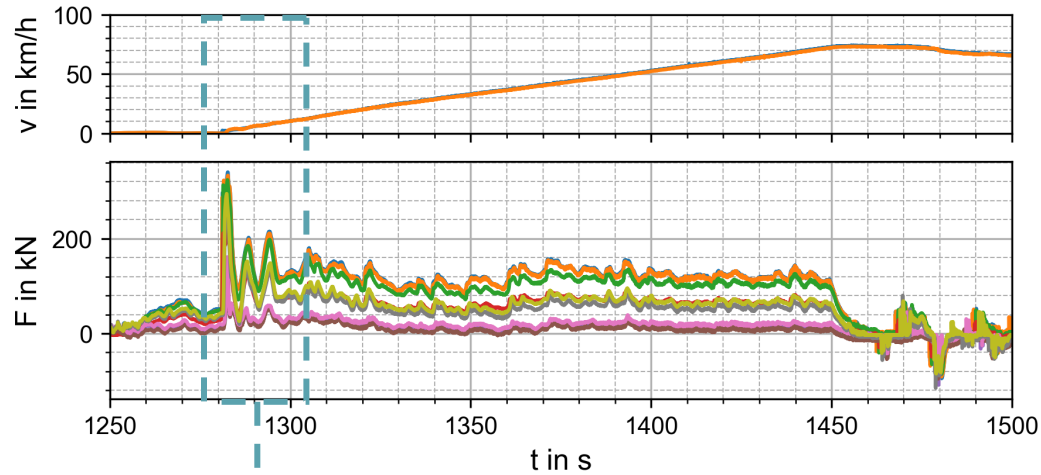
→ Reliable mechanical and pneumatical connection

→ Results for electrical connections will be presented in the following (e.g., special communication tests in CZ)

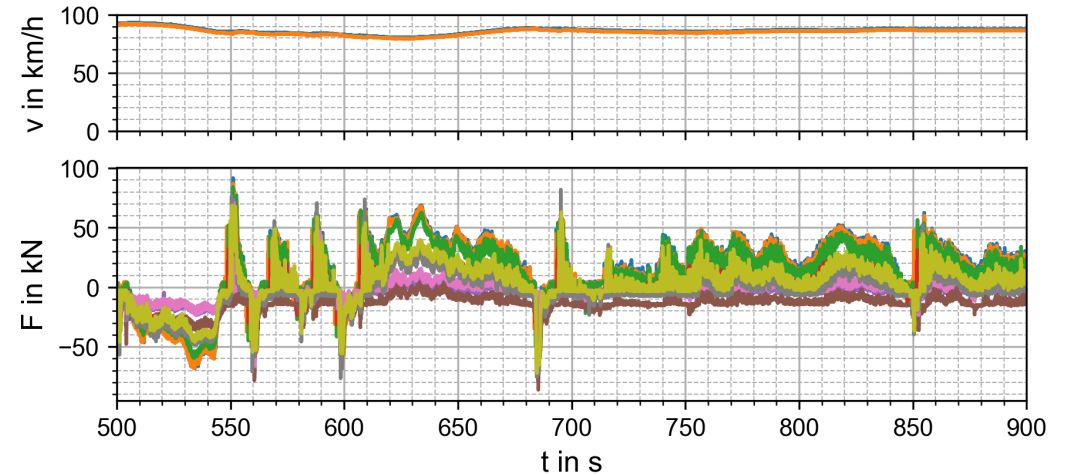
Train Runs

Train Dynamics

Train acceleration phase



Train running at approx. constant speed



- Significant train dynamics
- Probable cause: play in DAC stabilisation joints
- Not directly critical but effects (especially for longer trains) should be checked
- ➔ Further investigations are currently being carried out

	Train Runs	Ground Level Shunting	Hump Operation
Frequent issues		<ul style="list-style-type: none"> Incomplete uncoupling 	<ul style="list-style-type: none"> Incomplete uncoupling Unintended coupling or no coupling in directional tracks
Other observations	<ul style="list-style-type: none"> Train Dynamics 	<ul style="list-style-type: none"> Dirt / moisture in brake pipe Noise 	<ul style="list-style-type: none"> Manual operability / ergonomics Noise
Implementability of current DAC prototypes in current regular operation	high	medium	low

Operation = DACs + Vehicles + Infrastructure + Staff + Procedures



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Thank you!

