# Digital Automatic Coupling as an Enabler for Rail Freight Innovations

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## Introduction

**Rail freight** is the backbone of a **sustainable transport system**, but innovations are necessary to increase its competitiveness. Rail freight transport faces **significant challenges** like asset utilization, poor data quality or complex processes. At the same time, freight transport by rail **offers great potential** regarding various aspects. To exploit these capabilities, the share of rail freight in the overall freight transport **must increase** substantially. To cope with these challenges, changes are required. **Automatization and digitalization** play a crucial role in enhancing the competitiveness of rail freight.

One groundbreaking innovation to enable these developments is the **Digital Automatic Coupling (DAC)**, which has the potential to significantly accelerate the transformation of rail freight transport. The vision of future freight transport involves an **intelligent system that interconnects** various stakeholders, processes, and technologies.

This poster presents the DAC and its components, the **Full Digital Freight Train (FDFT)** and **Full Digital Freight Train Operations (FDFTO)** and gives an overview of its functionalities and potential benefits.

## The Digital Automatic Coupling and its components

In September 2021, the European DAC Delivery Programme (EDDP) adopted a modified latch type design from European passenger transport, promising higher forces in the train set. This modification enables the operation of heavier and longer trains compared to traditional screw couplers.

### Key components of the DAC

1) The **coupler head** contains the mechanics for coupling and uncoupling, as well as for force transmission in the coupled state. The pneumatic coupler and the air system with automatic closing flap valves are also located here.
2) The DAC provides an interface for coupling of power and data lines. For this purpose, an **electric coupler** is installed on the coupler head. The availability of data and electrical energy turns a train into a FDFT.
3) To be able to position the coupler head on the wagon and to implement stops for the horizontal movement, the coupler head is braced by the **vertical support**.
4) The forces are transmitted through the **coupler shaft and the socket joint**, which enables horizontal and vertical deflection of the DAC into the draft gear.
5) The **draft gear and support plates** represent the interface to the vehicle. Numerous freight wagons were therefore produced with a standardized installation space (UIC Leaflet 535).

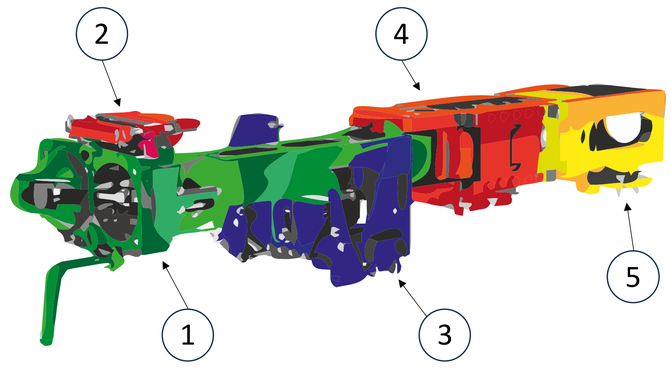



Figure 2: DAC assembly overview

## Full Digital Freight Train Operations

The Full Digital Freight Train (FDFT) is an **intelligent and interconnected system** that can transmit information regarding freight occupation, condition, or destination, among other things. It thus offers the possibility of optimizing the management and monitoring of the freight train and improves the safety and efficiency of the freight transport.

### FDFTO Development Process

For the first time, the future operation for the FDFT has been designed prior to the development of the functionalities and components. This approach enables a common development with the industry on a more detailed and consensual level than in the past.

In total, 26 processes and subprocesses were designed. These processes are now the foundation for the development of the FDFT and formulate the commonly agreed goal of the project.

Development of operations and operational procedures → Development of functionalities → Development of components

### FDFTO Functionalities

Based on the defined operational procedures 21 FDFTO functionalities have been defined that are divided into three groups:

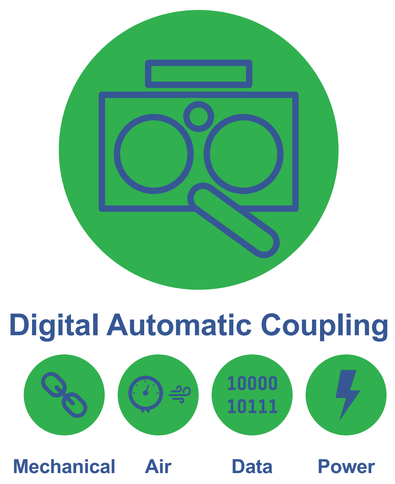
1) General FDFT functions: Train functions are needed to automate and accelerate train operations, especially in shunting. The so-called train functions are functions that the technical FDFT system provides in each train formation to ensure automation of today's manual processes. [1]
2) DAC enabled train functions: Based on the general functionality, an additional layer of functions can be implemented.
3) DAC enabled logistics functions: The enabled logistic functions allow a better user experience for the customer in terms of traceability, additional information, and functionalities, such as surveillance of goods. These functions can be summarized - simplified - as comfort functions.

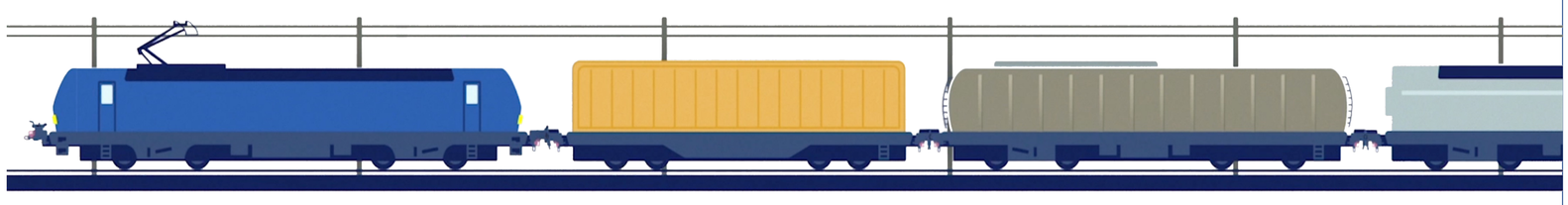
### DAC capabilities

To realize all FDFTO functionalities the Digital Automatic Coupling needs to have different capabilities and interfaces:

1) Mechanical interface
2) Air interface
3) Data interface
4) Power interface

For realizing different functionalities, different capabilities of the DAC are necessary. The three boxes on the right show 21 FDFTO functionalities and the necessary DAC capabilties in saturated colors.




## Conclusions

In summary, the DAC opens a wide range of opportunities to **fundamentally transform rail freight**. Besides the automatic coupling and decoupling, especially the digitalization of the freight train **enables significantly more** efficient processes, the implementation of new functionalities as well as the development of new markets. On the basis of the DAC a **wide variety of innovations** can and will be developed to increase competitiveness and attractiveness of rail freight transport.

Shortly, the **DAC is a unique opportunity** for the whole rail freight sector. Yet, the challenges of complex technical development and political decision-making processes at supranational level are accordingly large. To overcome these, major joint efforts are being made at the European level. The Europe‘s Rail Joint Undertaking **Flagship Project 5 TRANS4M-R** focusses on the technology development of the DAC to lay the foundation for future innovations in rail freight.

## References

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