

# Matthias Hofmann

Siemens

# SIEMENS



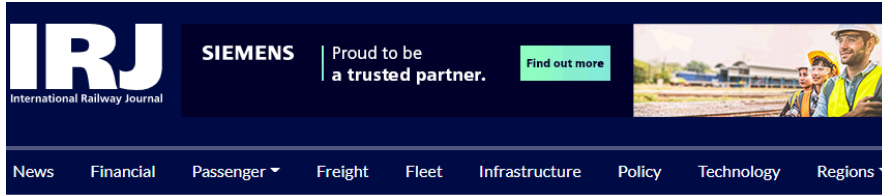
P



**Assisted and driverless tram operation –  
The first commercially useful  
applications are on the horizon**



# Agenda



## Technology

### Siemens Mobility targets 2026 launch for Autonomous Tram in Depot technology

Testing is currently underway in Potsdam.

Aug 23, 2021  
Written by  
Richard Clinnick



Source: IRJ, 23. August 23, 2021

Richard Clinnick

- How it all started
- Research project AStriD
- Ingredients for the automated depot
- Conclusion and future outlook

## Driverless operation – Nothing new for rail vehicles, but ...

- **Metros and airport shuttles:** Operate in a closed environment, controlled by external, infrastructure based systems
- **Trains and trams in urban environment:** Have to master complex traffic situations autonomously, without centralized, external control
- **Main tasks are:** Permanent surveillance of environment and forward-looking driving to prevent collisions

### Similar to the automotive industry

Autonomous driving can only be developed and trained in the real traffic environment



## Since 2018 - Siemens Mobility's test field in Potsdam

- **The key is real-life learning**

Development of autonomous driving must be done in the field environment – the complex situations can only be “learned” in real-life traffic



- Implementation of a test field for autonomous driving in Potsdam
- Tram Demonstrator presented at InnoTrans 2018

# The Guardian

## Germany launches world's first autonomous tram in Potsdam

The Guardian goes for a ride on the new AI-driven Combino vehicle developed by Siemens



Source: The Guardian, September 23, 2018

## The demonstrator masters all relevant driving tasks



Approaching  
a signal



Approaching  
a station



Crossing  
pedestrians



Crossing  
cars



## First level of autonomous driving – automation of the depot

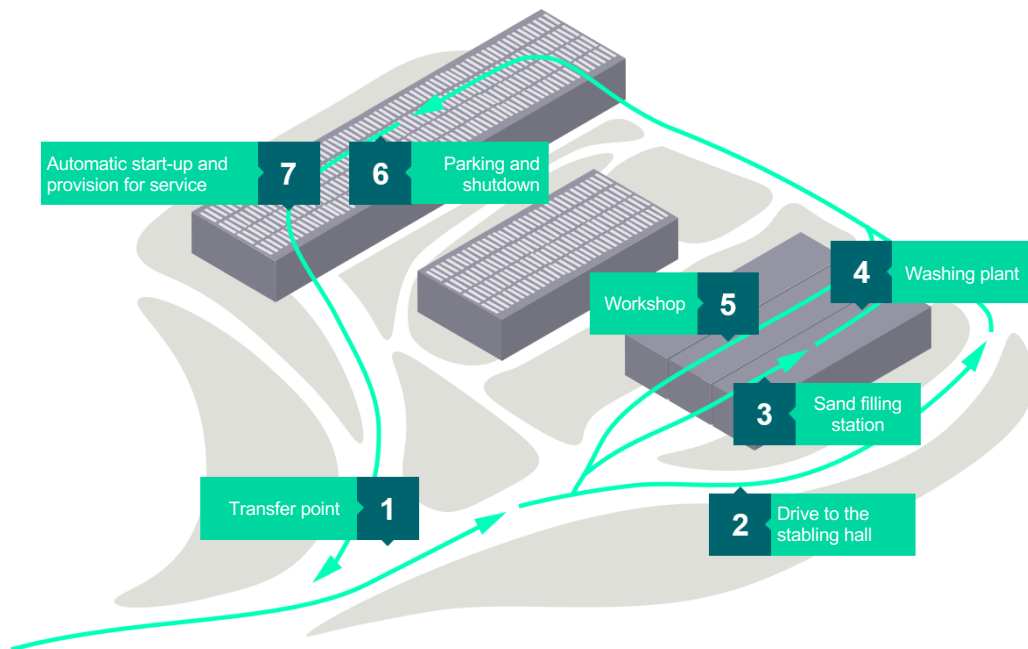
Protected, enclosed area – ideal test field

- Lower technical complexity
- Approval easier



First commercial application

- Shunting activities and service processes (vehicle washing, sanding)
- Parking and provision of the vehicles





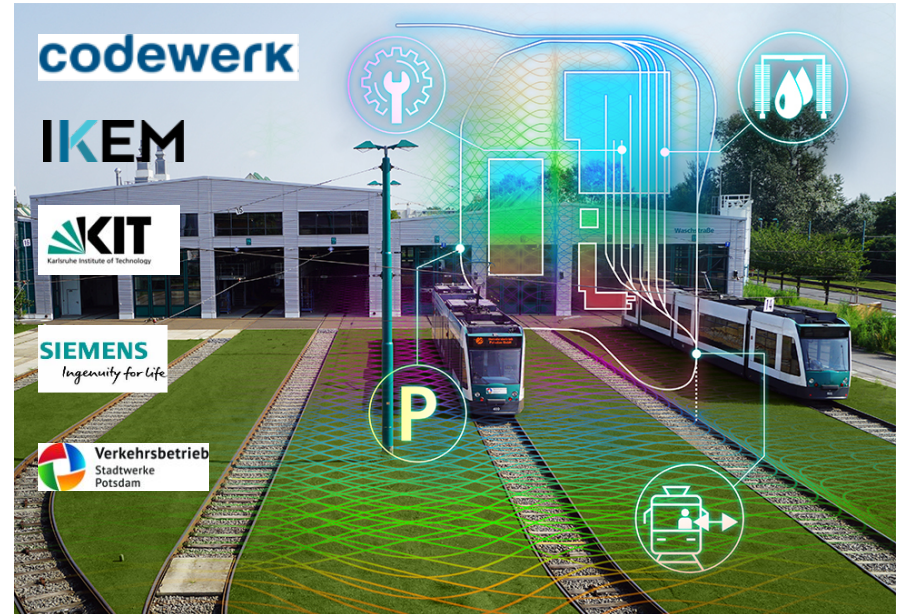
## Project AStriD (AutonomouS Tram in Depot) – Investigation of automated depot operation

**AStriD is the next major milestone for autonomous driving of the tram**

### BMDV\* – mFUND funding project

- Implementation and testing of a fully automated depot based on autonomously driving trams
- Realization in the tram depot in Potsdam
- Also includes the consideration of
  - Legal framework for approval and operation
  - Analysis of economic effects
  - Transfer to generic concept

\* German Ministry for Digital and Transport



## Ingredients for the automated depot: Autonomous vehicle with integration into the overall system

### • Autonomous tram

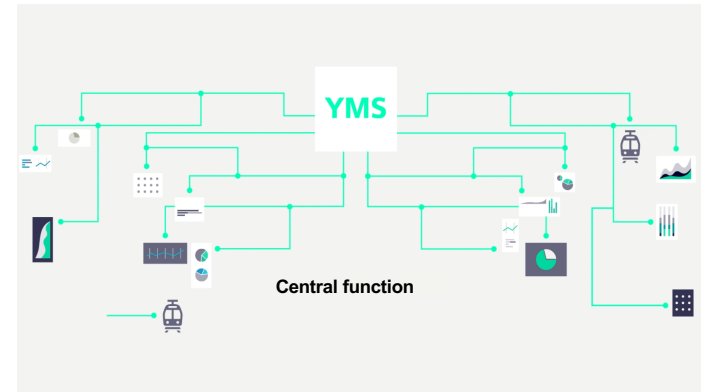
- Automation by “driving machine” - ATO
- Collision avoidance via sensor-based obstacle detection
- Localization based on an digital map, also in buildings
- Remote operation (in case automation fails)

### • YMS - Yard Management System

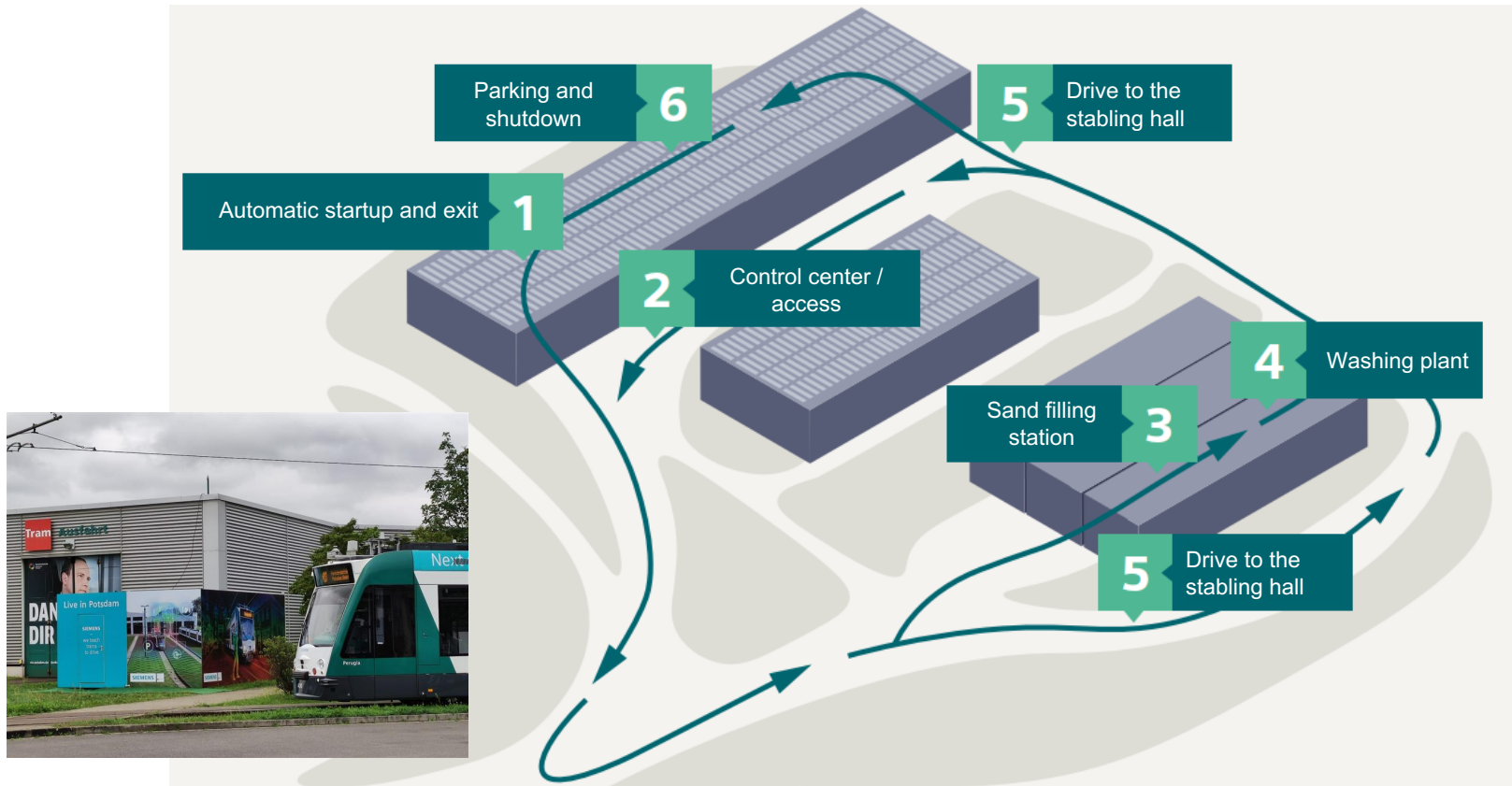
- Higher-level system for planning and controlling depot processes
- Route request at the interlocking
- Starting of vehicle missions (startup and shutdown, shunting)
- Control of the infrastructure facilities (washing plant, hall gates)

### • Communication between all connected systems

### • Safety supervision system “Virtual ATP”



# 23.08.2021: World premiere of depot automation with a tram without personnel on board



## Legal research - Results and recommendations

### Status Quo of legal framework

- No existing legal framework that addresses autonomous driving functions of rail vehicles (in Germany: valid only for Automotive since 2021)
- Suppliers, operators and authorities are highly uncertain (safety level, verification and approval process, liability)



No approval for commercial use possible

### Recommendation for action:

- Perform type homologation to define the process and the requirements for technology and verification
- Use the German law on autonomous driving as a template for the rail sector

## Outlook: Market readiness for Siemens' automated depot planned by 2026

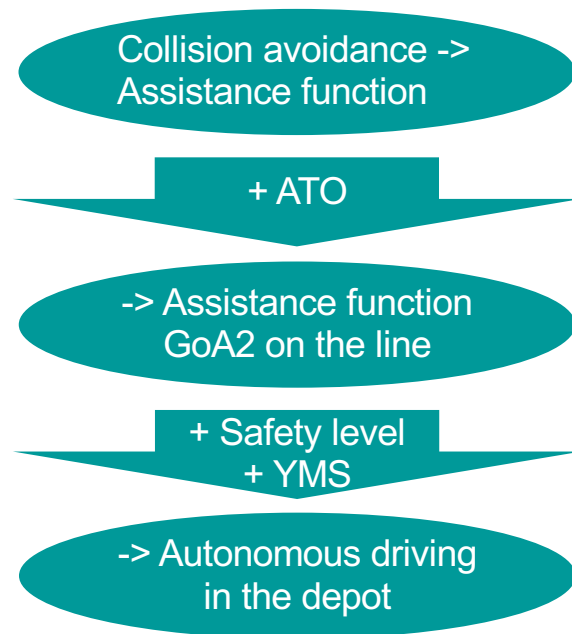
To achieve market readiness there are still several challenges that need to be solved

### Approval and homologation of technology:

- Implementation of legal and regulatory framework
- Definition of required safety level

### Industrialization on the basis of modular building blocks

- Safe collision avoidance (under all environmental conditions)
- Yard Management System
- Interconnectivity and communication
- Virtual ATP as overall system safety supervision



# Contact

Publisher: Siemens Mobility GmbH

**Matthias Hofmann**

Program Manager assisted and autonomous driving

Phone +49 173 36 46 924

E-Mail [matthias.c.hofmann@siemens.com](mailto:matthias.c.hofmann@siemens.com)

