Testing of Rail Applications for the European Satellite Navigation System GALILEO at the DLR – Coupling of Static and Dynamic Testing

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Outline

- Introduction and Motivation
- The Railway Specific Laboratory RailSiTe®
- The Road-Rail-Vehicle RailDriVE®
- Combination of RailSiTe® and RailDriVE®
- Conclusion

Introduction and Motivation

- Galileo: important solution for rail applications, esp. safety-critical ones

- Before setting the Galileo-system into operation a certification process is necessary
  - Validation of the overall system and parts of it
  - Easiest way of testing: validation by a static test-period in a laboratory, e.g. in the railway specific laboratory of the DLR (RailSiTe®)

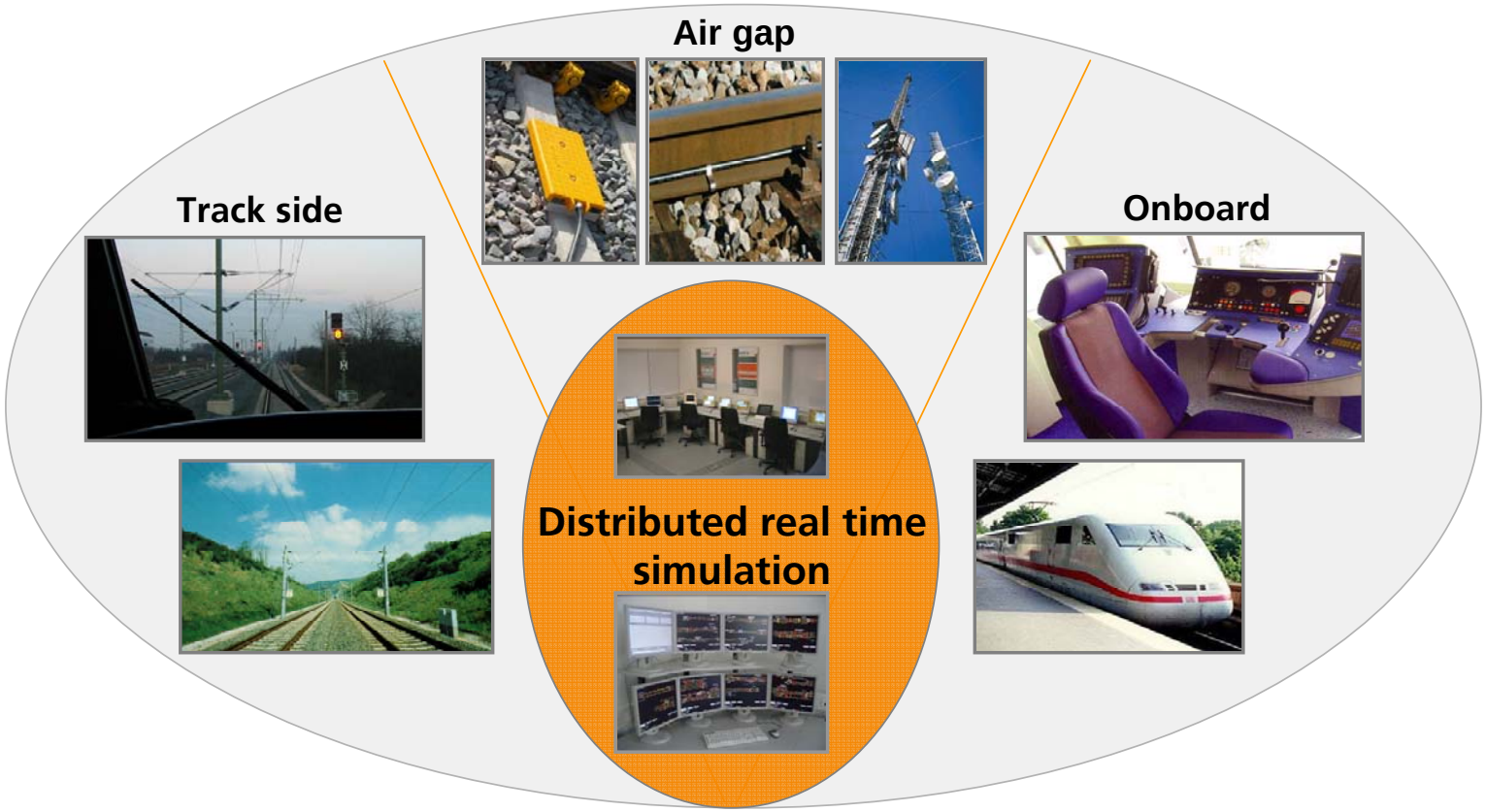
- Dynamic position information cannot be provided by the RailSiTe® but e.g. by a road-rail vehicle which is coupled to the RailSiTe®

RailSiTe® – Rail Simulation and Testing

Railway Specific Laboratory

- Realization of a modular concept for railway simulation environments
- Ability to analyse, test and validate systems, subsystems and components of train control equipment
- Simulation of the complete chain from the interlocking via the trackside, the onboard system and the involved train control system up to the driver interaction

Architecture of the RailSiTe®



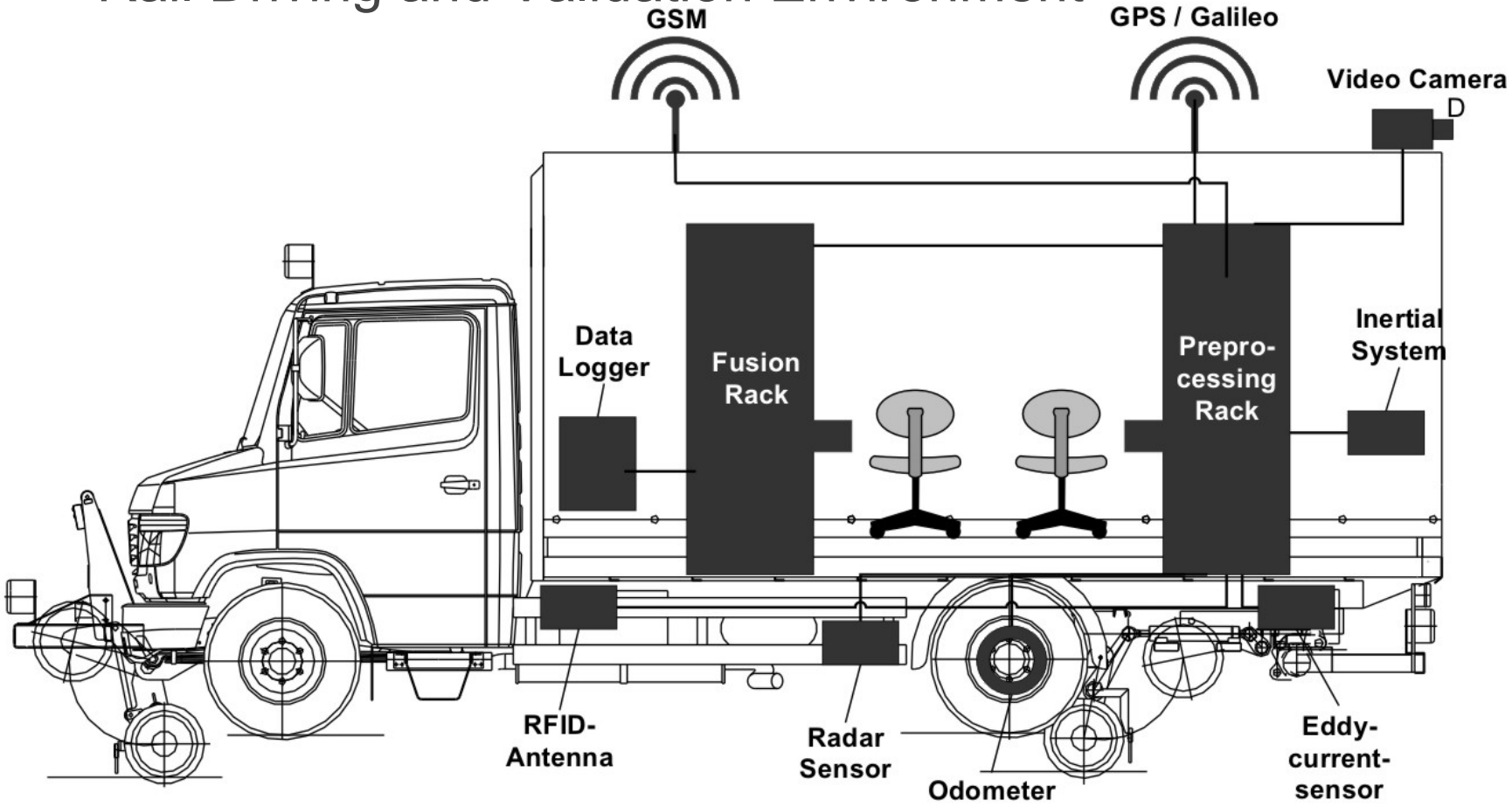
RailDriVE®

Extension of the Principle of the RailSiTe®

- For some sensors the simulation in a lab is possible
- For others a reasonable realistic representation in the lab using simulation would be much more complex
- Therefore a suitable extension of the RailSiTe® is a test bed which
  - moves on real tracks and
  - captures data flows from real sensors in a real environment
- This experimental vehicle is called **RailDriVE®**

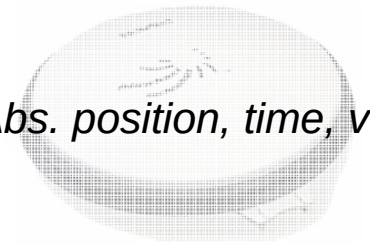
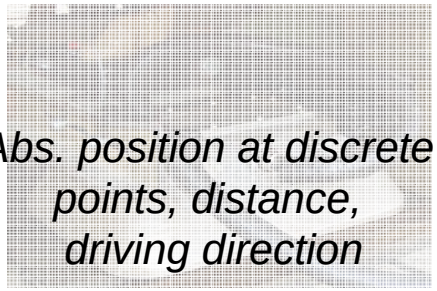
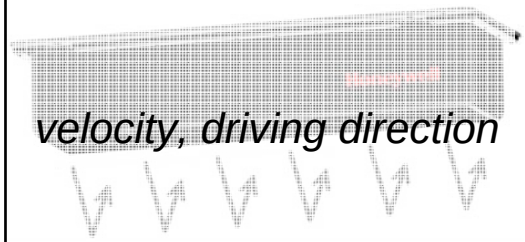
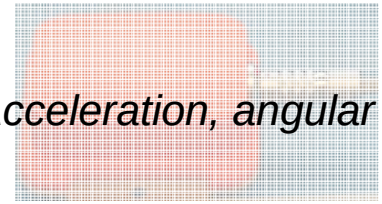
RailDriVE®

Rail Driving and Validation Environment



RailDriVE®

Some of the Sensors for Position Determination

GPS / Galileo  *Abs. position, time, velocity*	Eddy current sensor  *Abs. position at discrete points, distance, driving direction*	Doppler radar  *velocity, driving direction*
Rotational Speed Sensor/ Odometer  *Number of wheel rotations, distance*	Inertial measurement unit  *Acceleration, angular speed*	Other sensors may be installed if required

Combination of RailSiTe® and RailDriVE®

Features of static and mobile laboratory equipment

- RailSiTe®:
  - \+ can deliver perfectly reproducible test conditions
  - – cannot generate dynamic position information

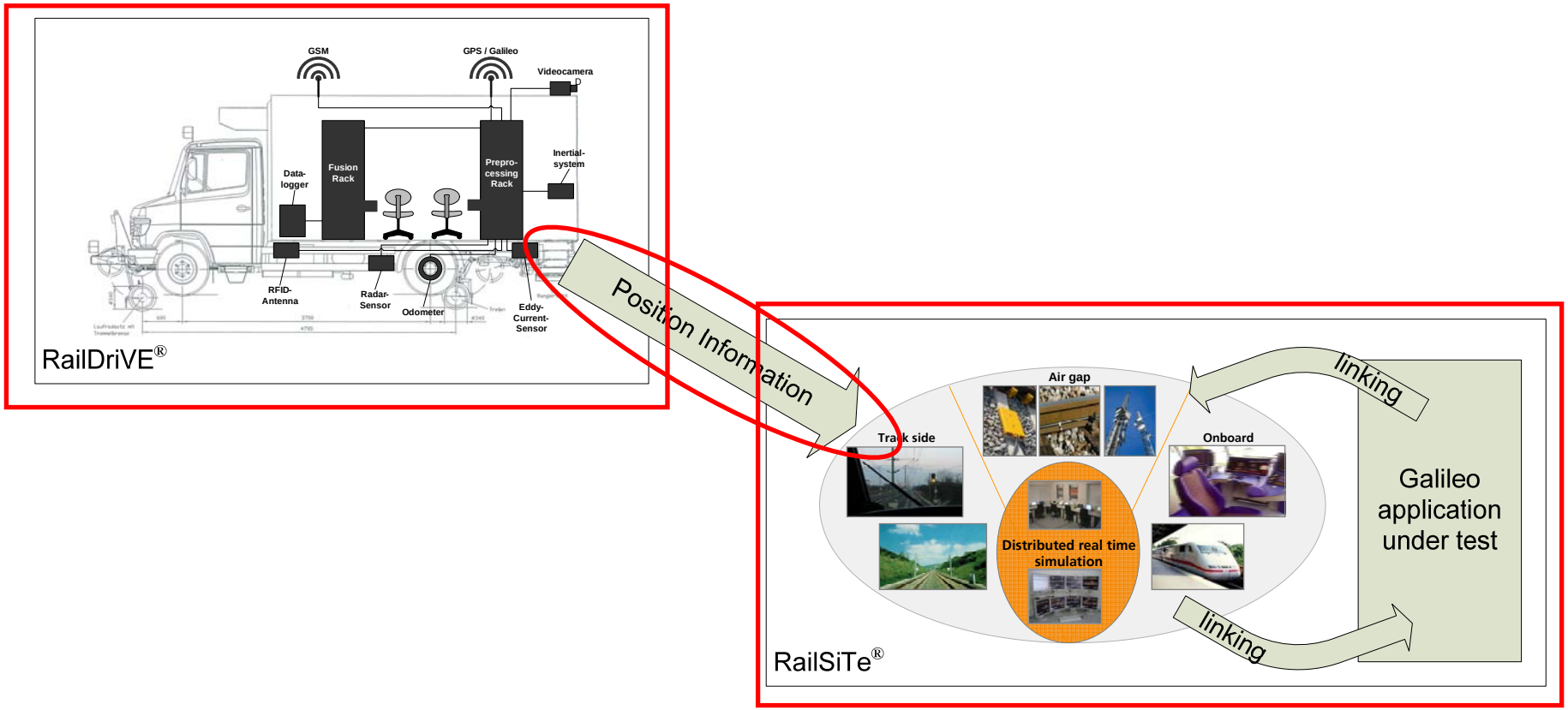
- RailDriVE®:
  - \+ dynamic position information is available
  - – cannot perform reproducible tests

→ Coupling of the two labs seems appropriate for performing certification tests of applications of the Galileo system for the railways

Real-time input of the data into the RailSiTe® is planned

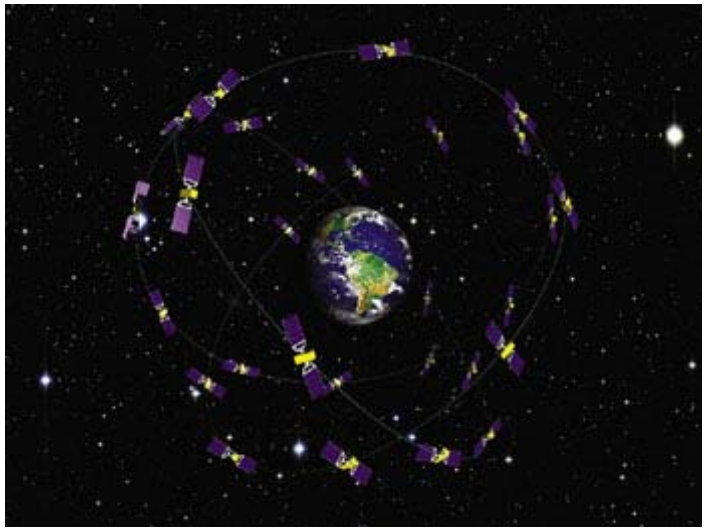
Combination of RailSiTe® and RailDriVE®

Equipment Setup for Application Tests



Combination of RailSiTe® and RailDriVE®

- Tests under ideal laboratory conditions with real dynamic position information and Galileo signals
- Compatibility of the application with the Galileo specifications and regulations
- Further tests with generic test sequences for the certification process of different applications



Combination of RailSiTe® and RailDriVE®
Testing of Several Features of Galileo Applications

- Reaction of the application

- Time to alarm in the case of
  - Divergences between real and estimated position of the vehicle (caused by shading or mirroring)
  - Faulty integrity of the signal in space
  - Loss of the signal in space or
  - An insufficient number of satellites

Conclusion

- A method for the validation and certification of different railway applications using the new Galileo system is presented
- The combination of a static and a dynamic laboratory
  - allows ideal conditions for reproducible, static laboratory tests
  - offers the real dynamic position information necessary for navigational tests
- The test equipment can be used for validation and certification of different railway applications using the new Galileo system.
- First attempts will take place in the second half of this year by running the RailDriVE® on tracks in and near Braunschweig.

Thank you for your attention!