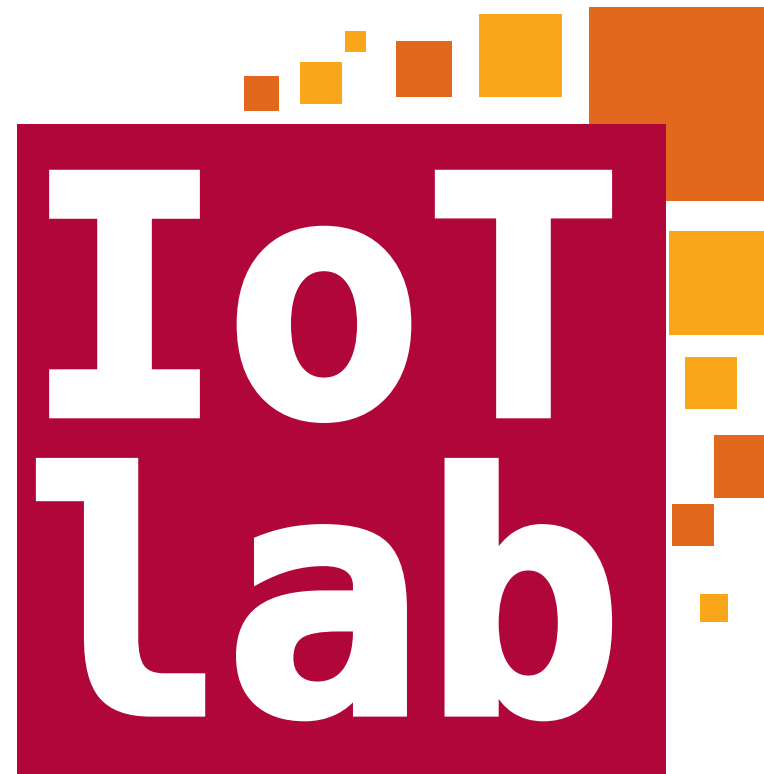




Lukas Pirl

Introduction of IoT Lab in Lecture on Distributed Dependable Embedded Systems

Professorship for Operating Systems and Middleware of Prof. Andreas Polze

Hasso Plattner Institute, University of Potsdam

HPI IoT lab





HPI IoT lab Introduction in EOS lukas.pirl@hpi.de

HPI IoT lab



workshop

general tools

soldering

electronics components

bulk & DIY cables, connectors, etc.

power supply

measurement

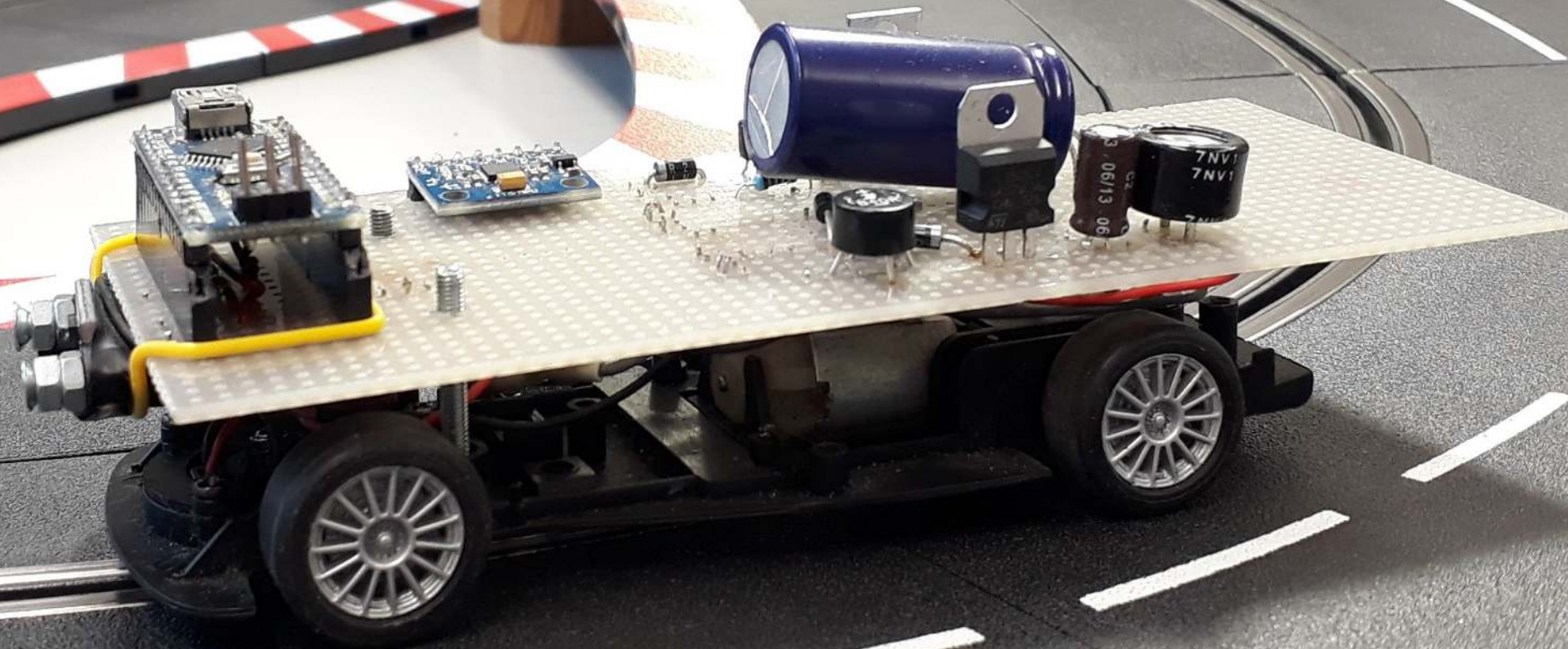
...



<https://www.rigol.eu/Public/Uploads/uplo>

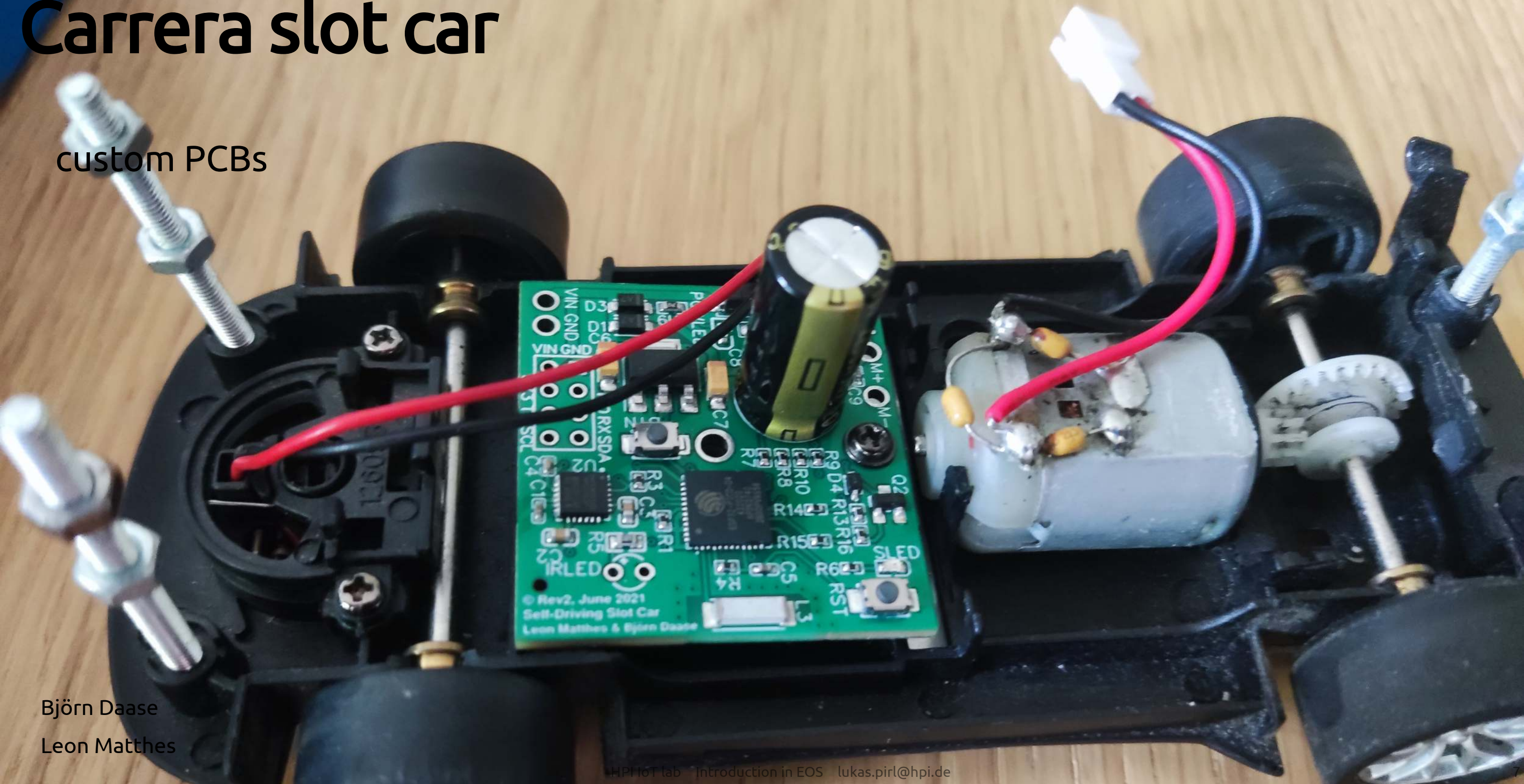
Carrera slot car

self-driving slot car
gyroscope, Lidar, ...



Carrera slot car

custom PCBs



Björn Daase
Leon Matthes

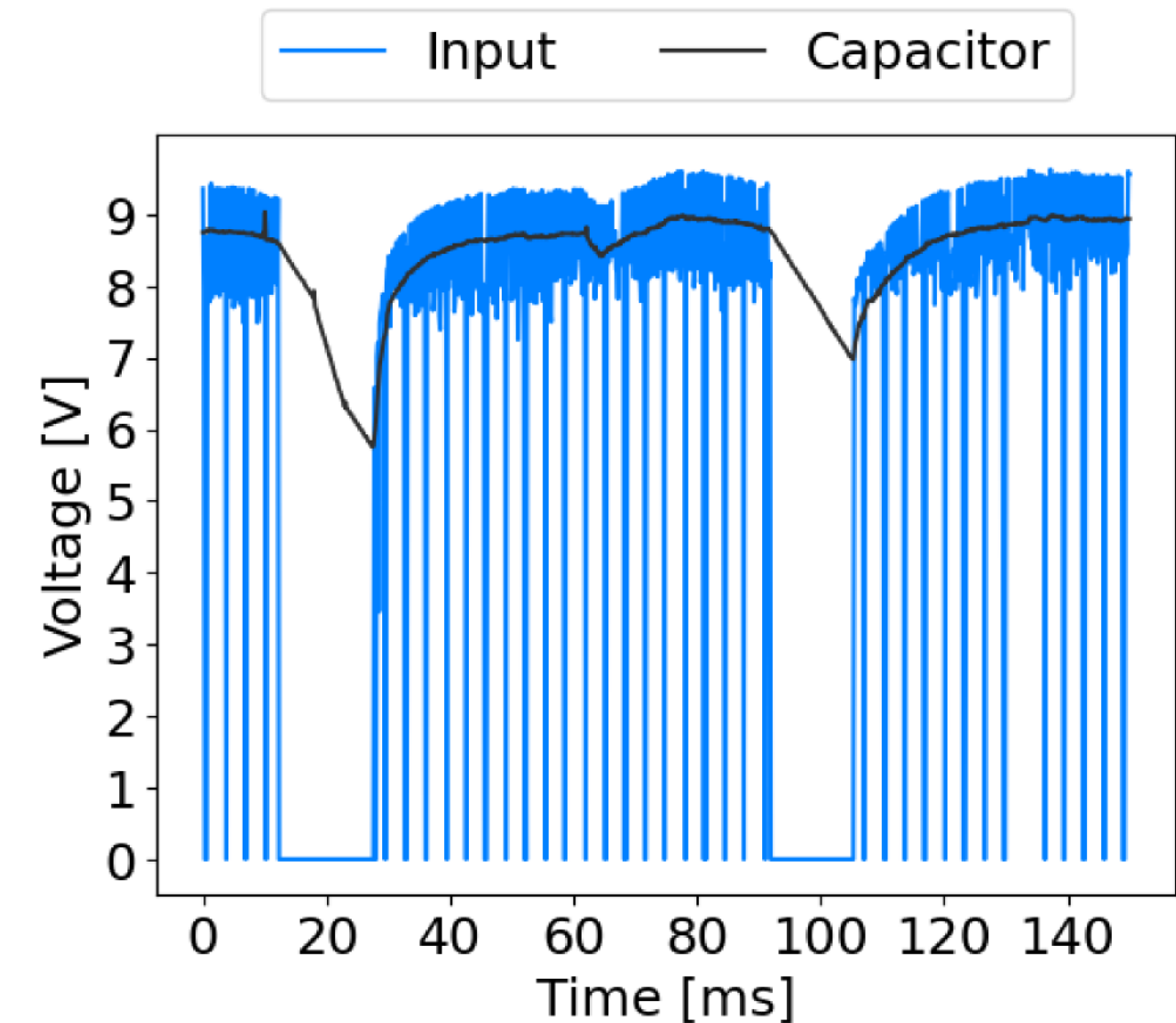
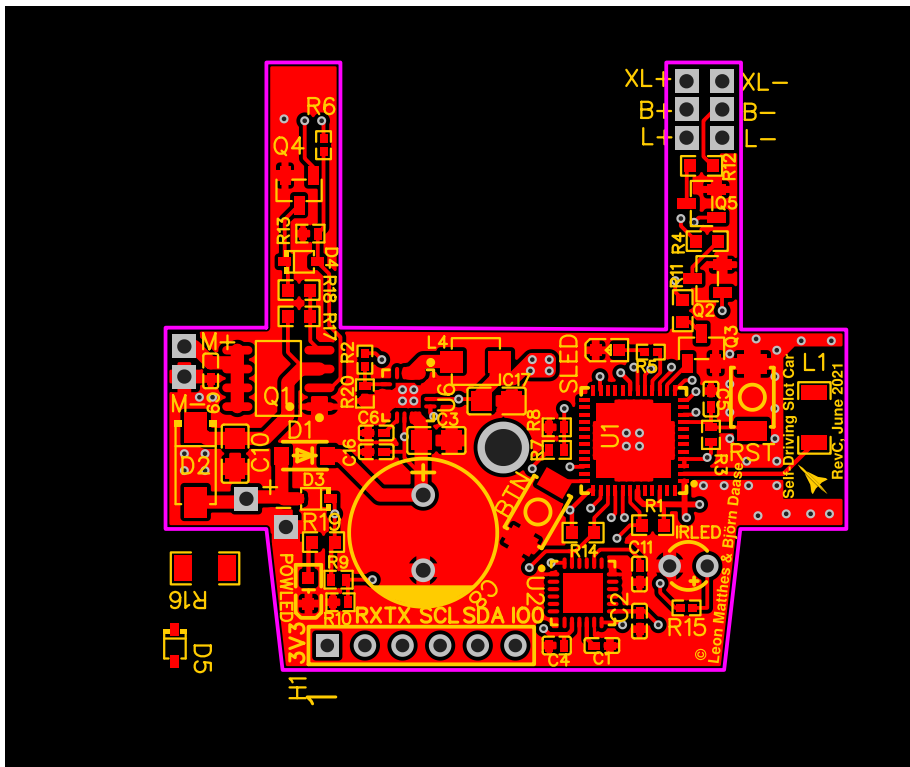
Carrera slot car

challenges

unusual power supply characteristics

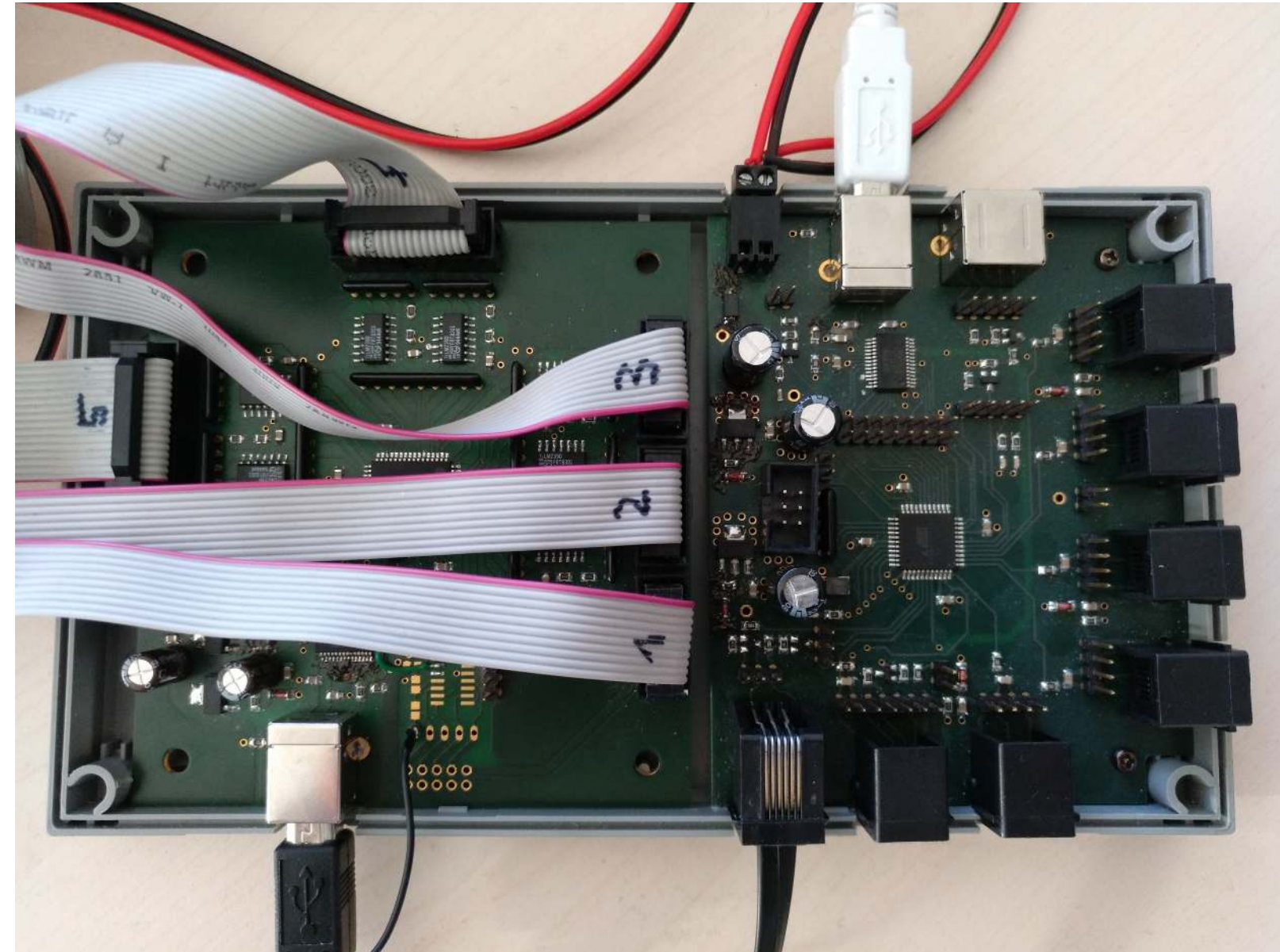
remote/mobile debugging

PCB design



Carrera sensor & actuator board

working with the digital protocol
firmware level
e.g., prevent overtaking the safety car



single-board computers

distributed computing

energy-aware computing

heterogeneous computing

(GP)GPU, big.LITTLE, ...



list of experiment hardware

<https://osm.hpi.de/iot-lab/docs/hardware/generated-overview-of-experiment-hardware-list.html>

embedded devices & OS

devices

Arduino

ESP32

Beckhoff SPS

Lego

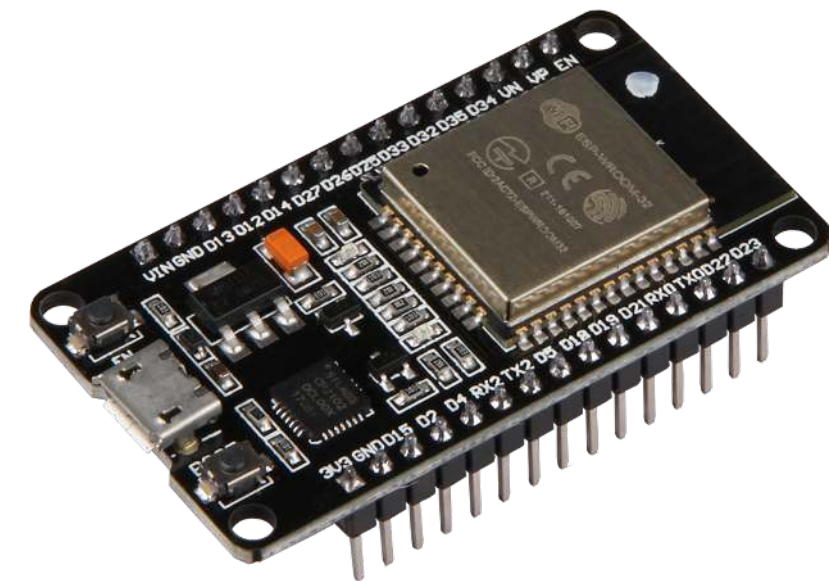
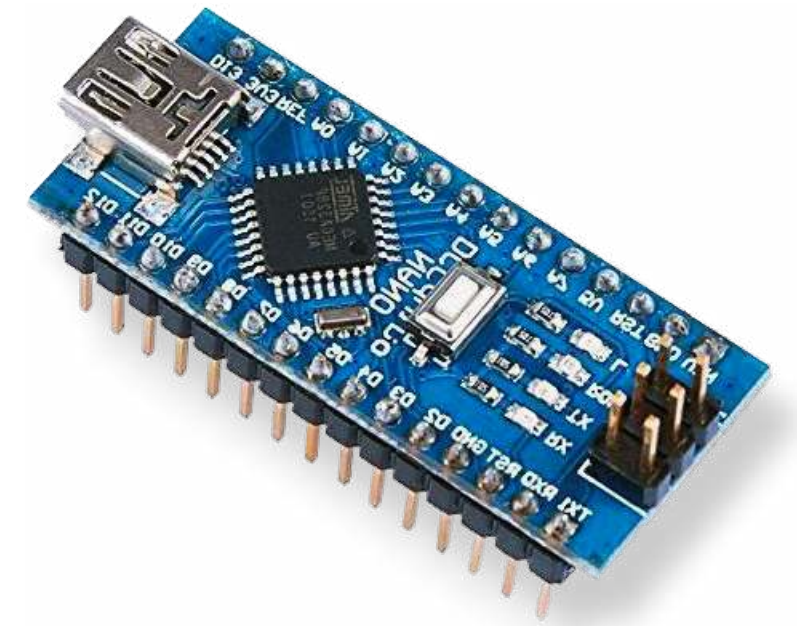
Fischertechnik

... open to suggestions! :)

incl. designing own PCBs

operating systems

RIOT, *RTOS, OpenWRT, embedded Linux, Contiki, Android, ...



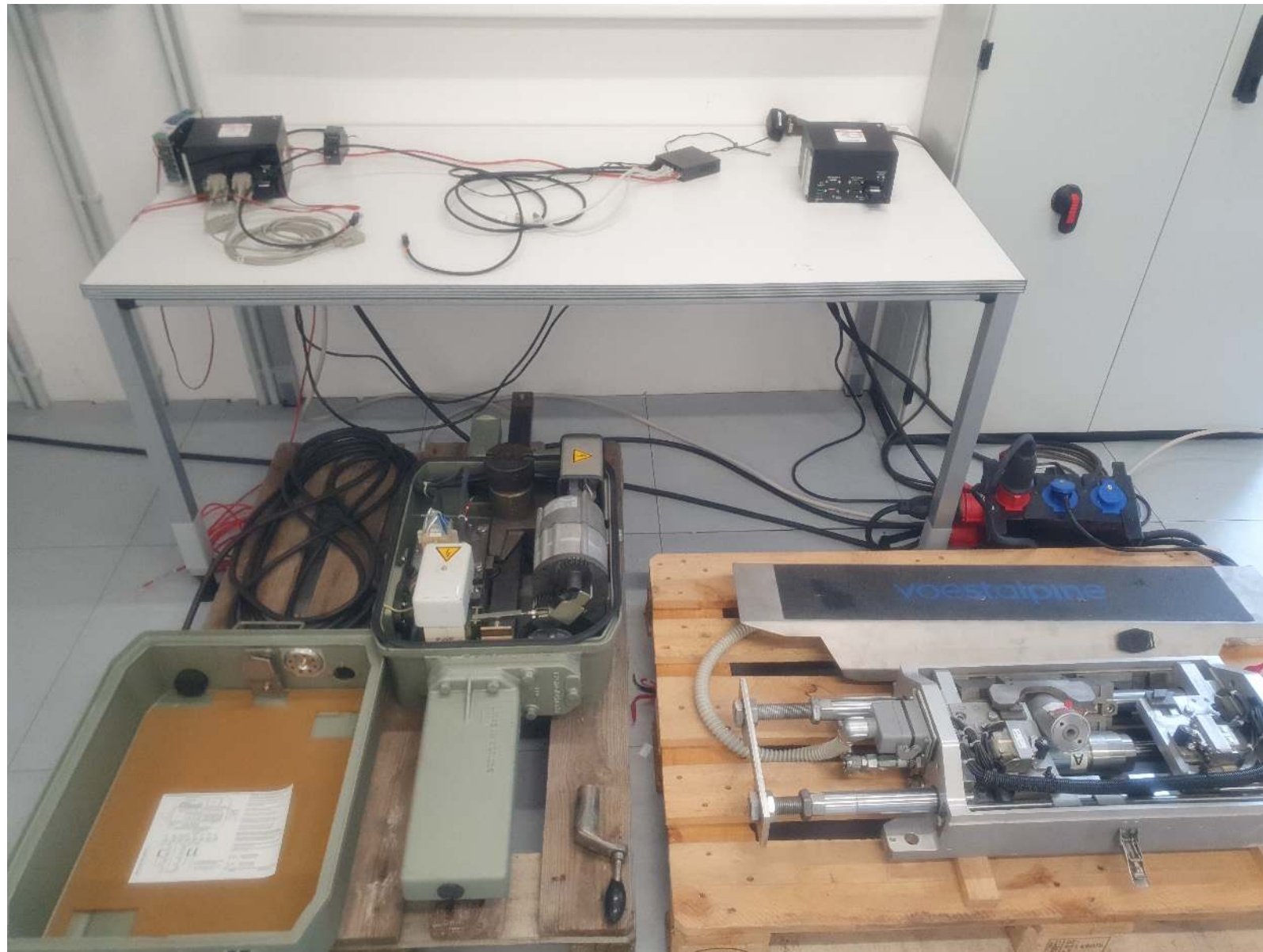
Digital Rail Lab



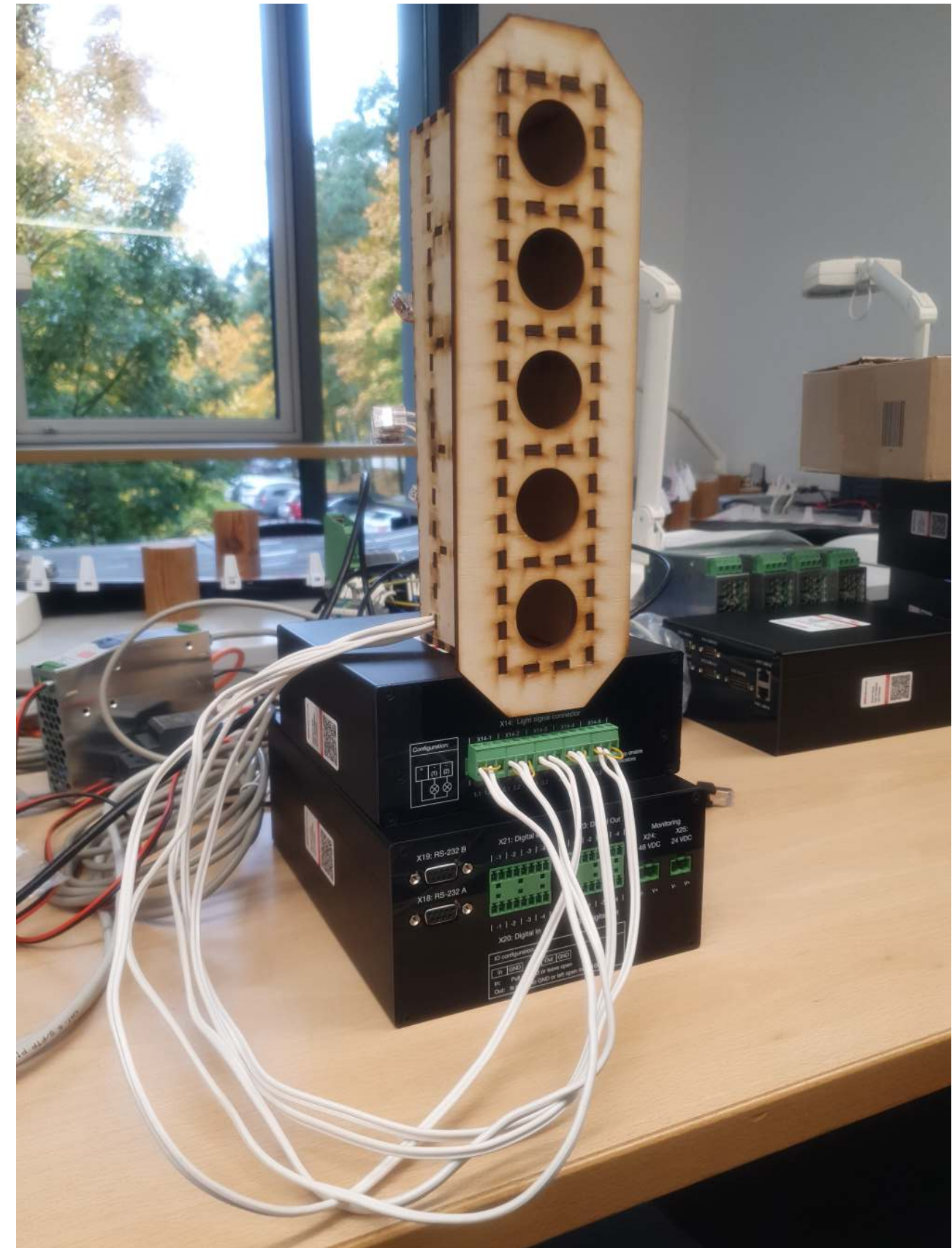
level crossing color light signal

Digital Rail Lab

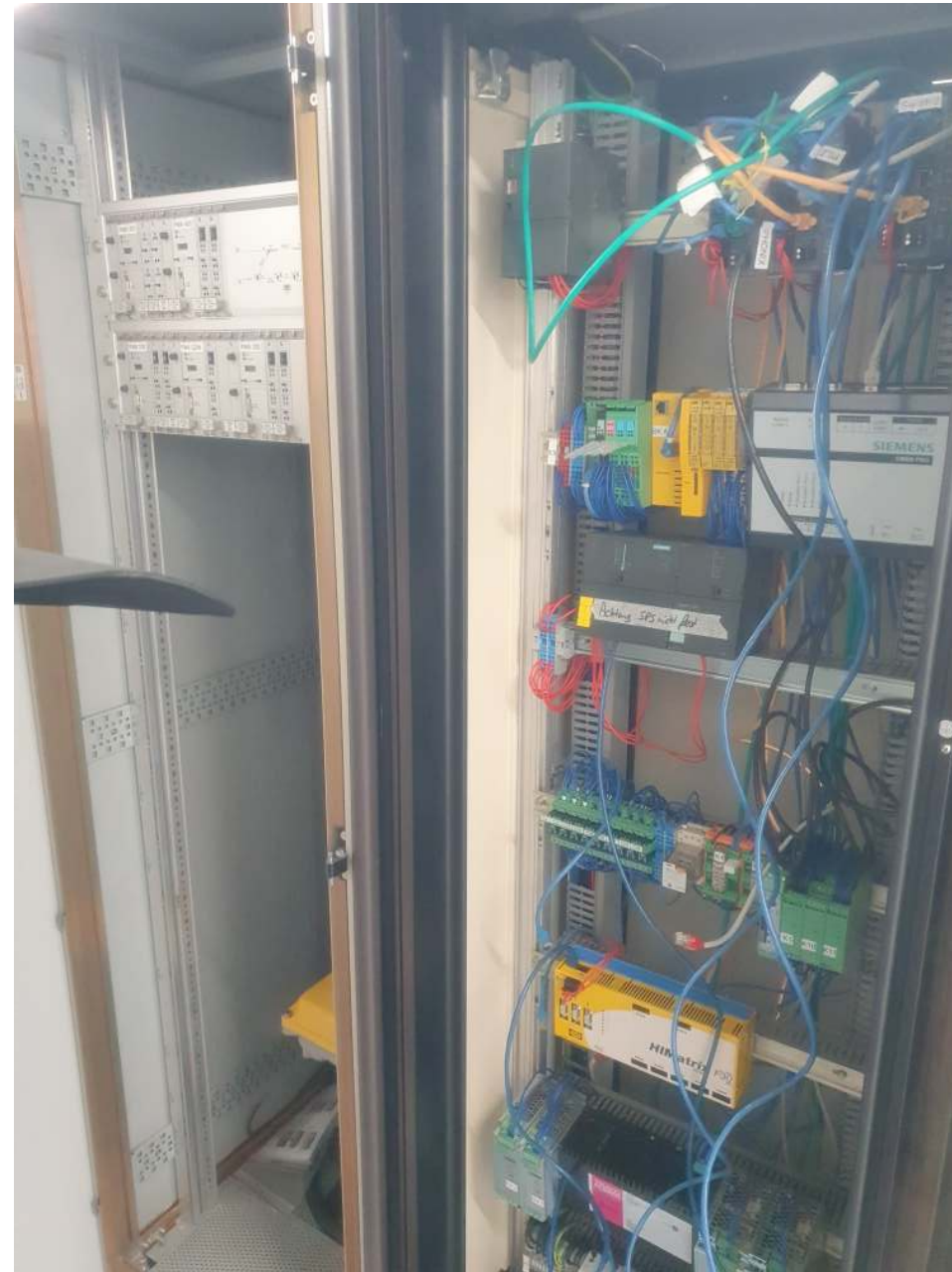
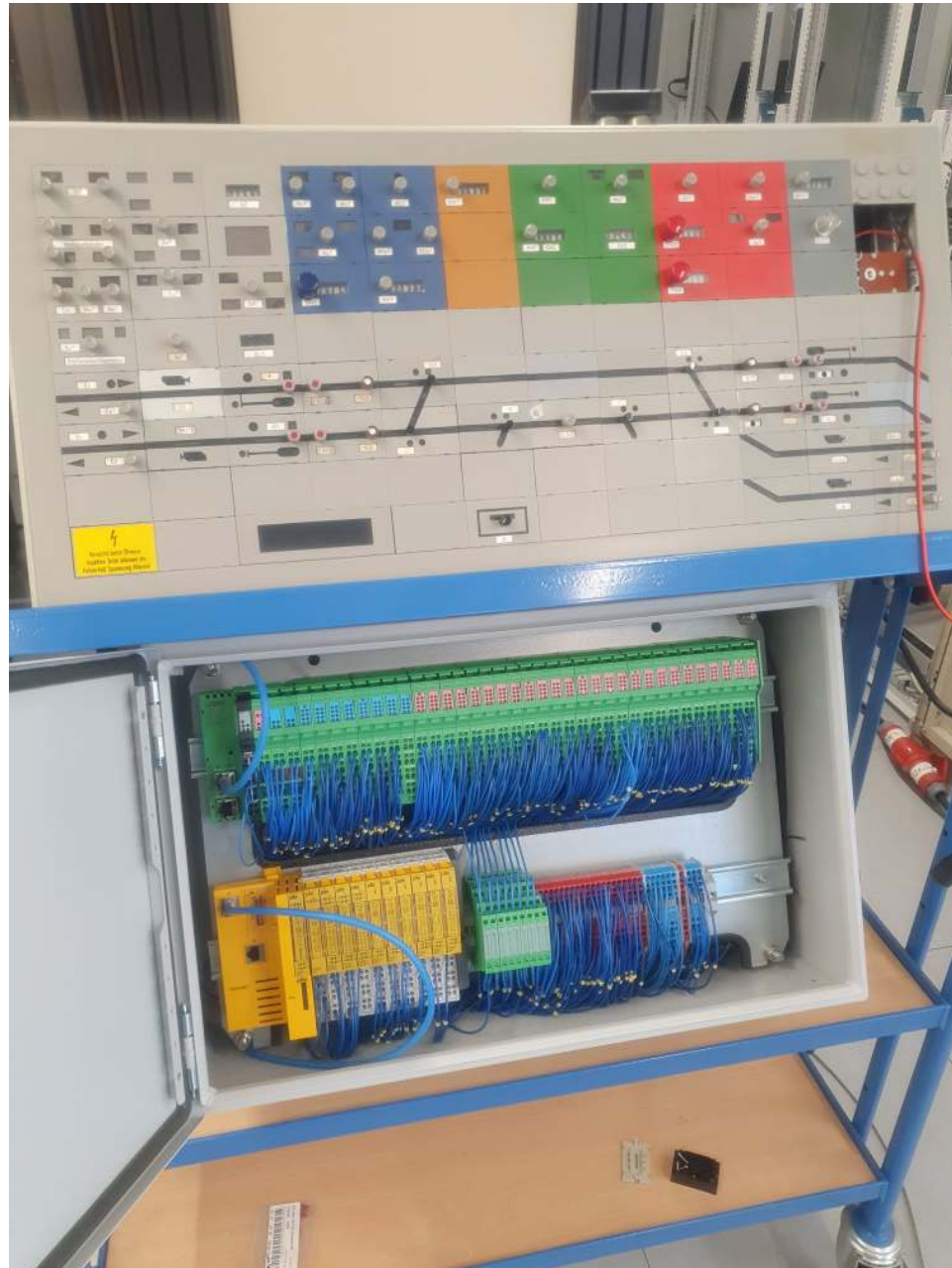
point machines



Digital Rail Lab

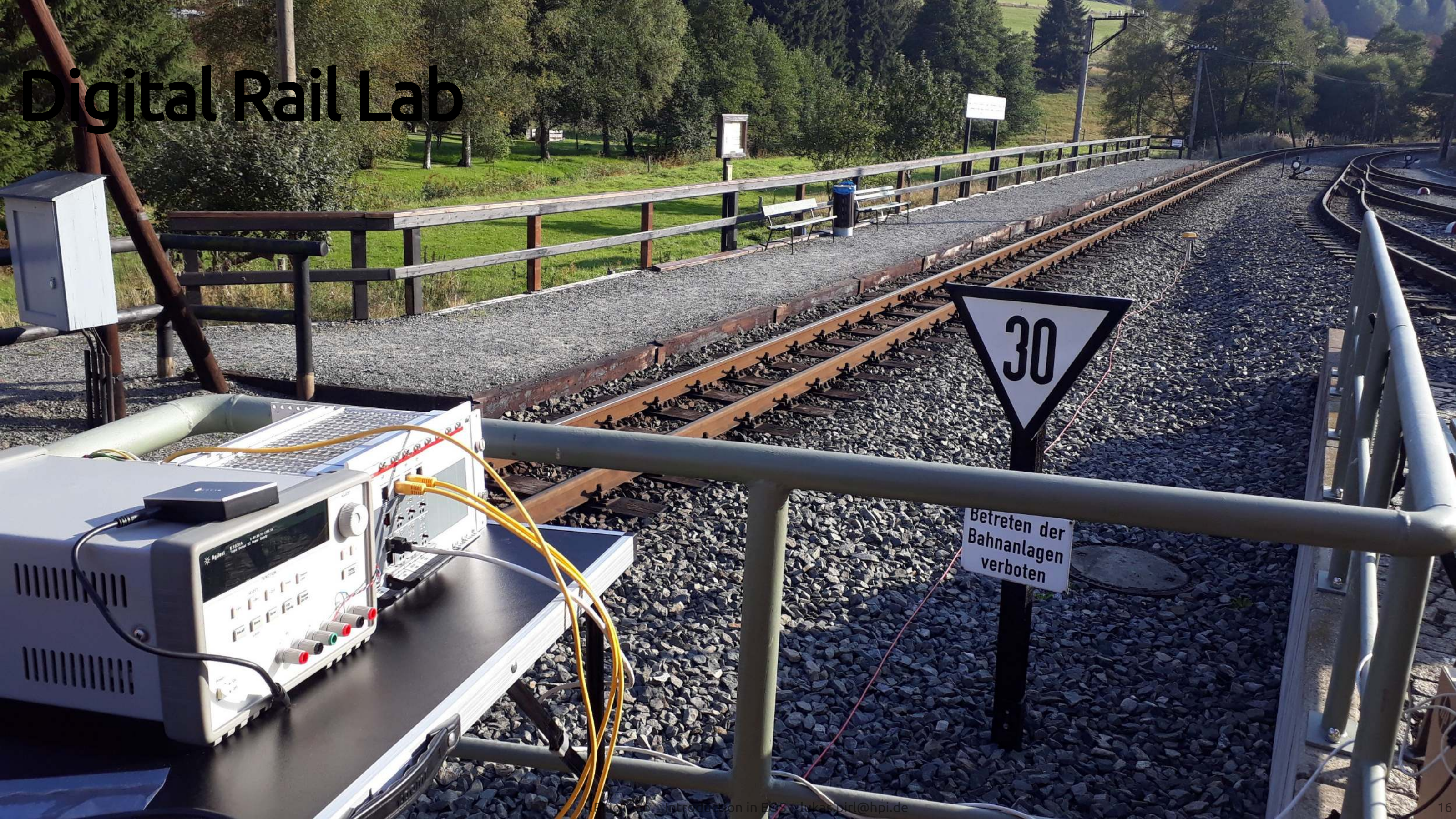


Digital Rail Lab



Hbst-Stw (Hilfsbetriebsstellenstellwerk)

Digital Rail Lab



Digital Rail Lab



Digital Rail Lab



model-generated code counts axles and controls signal

DRSS

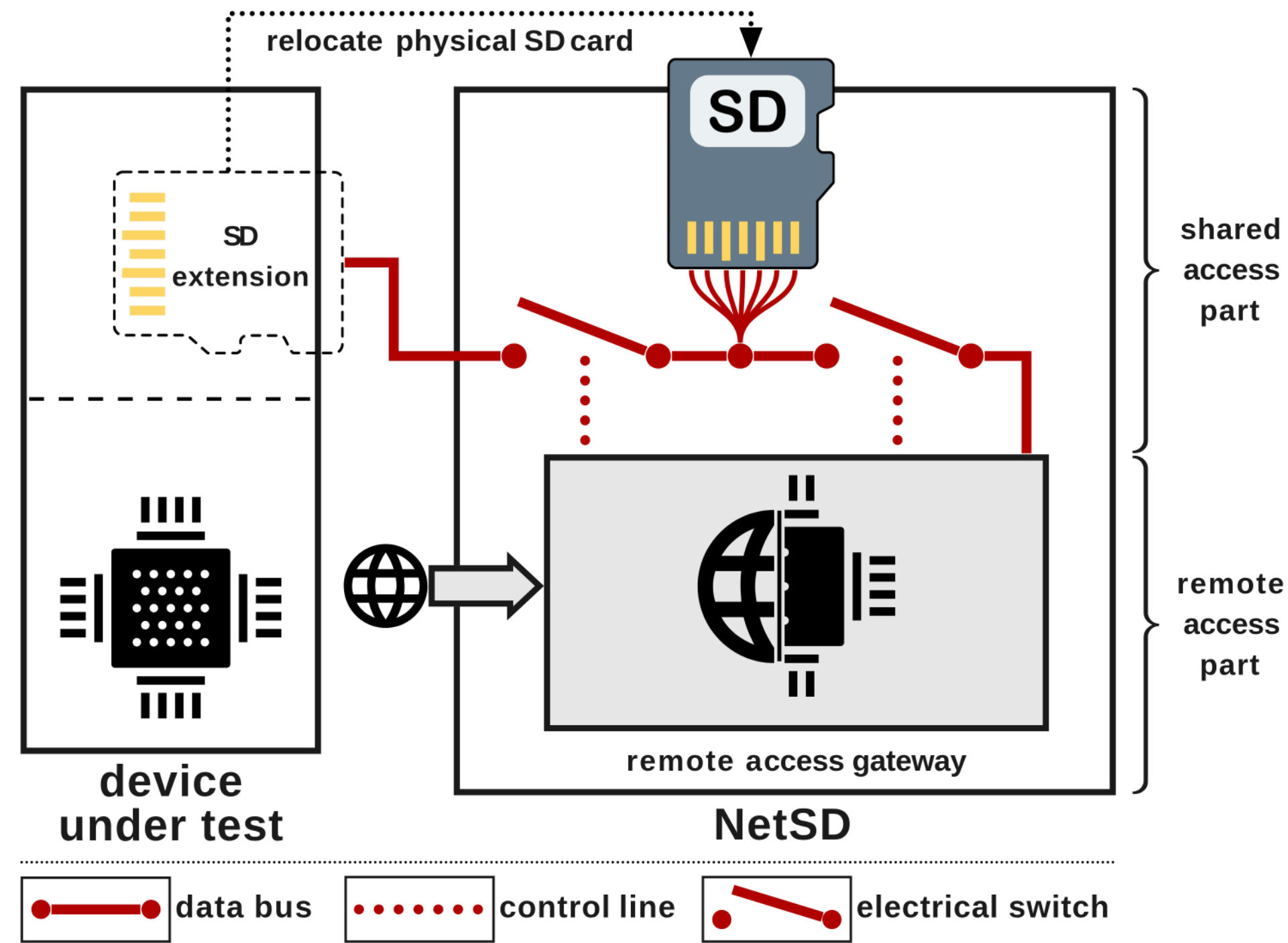
Digital Rail Summer School



DRSS 2025 already done, join 2026! :)

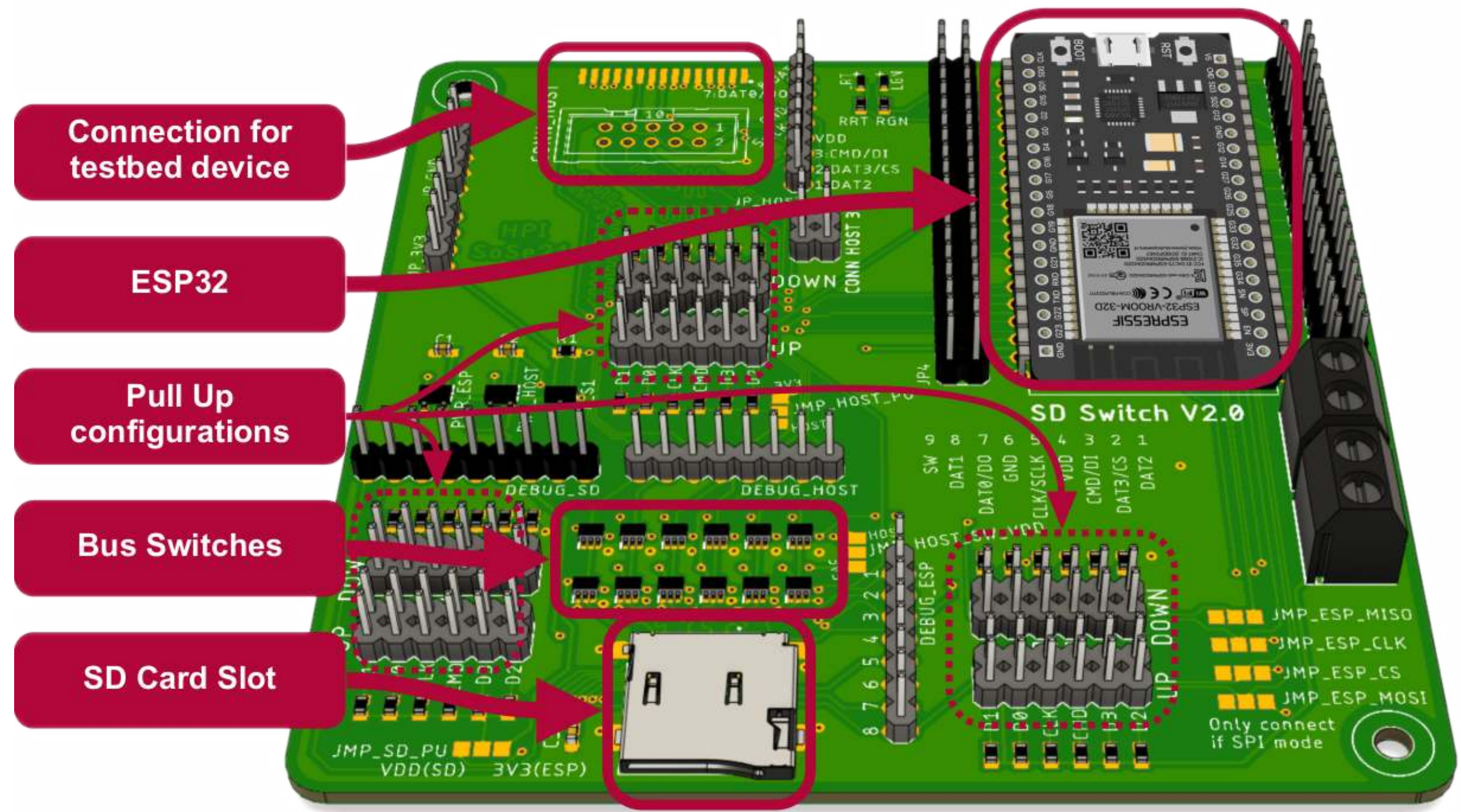
<https://hpi.de/drss>

testbed automation



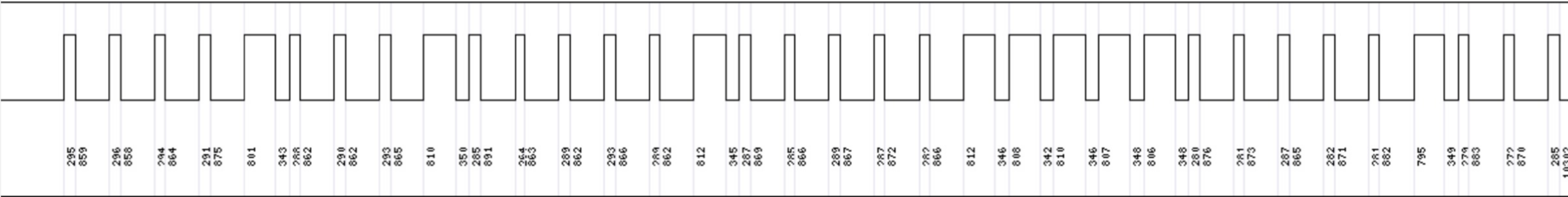
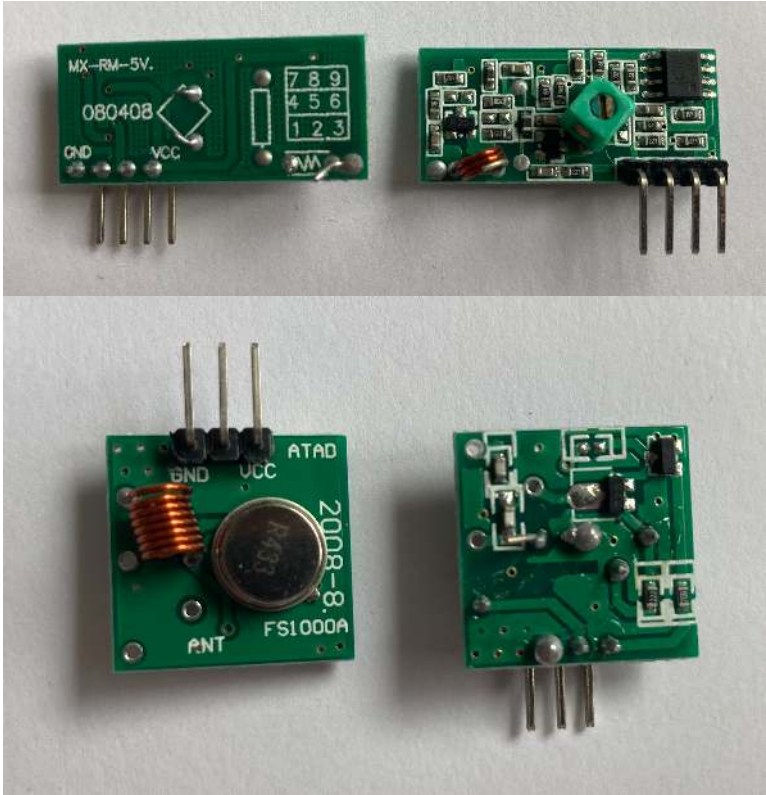
Schröter, V., Boockmeyer, A., & Pirl, L.
NetSD: Remote Access to Integrated
SD Cards of Embedded Devices.

testbed automation



testbed automation

reverse engineering of switchable power sockets



radio technology



LoRa-WAN

radio technology

collision warning for vessels

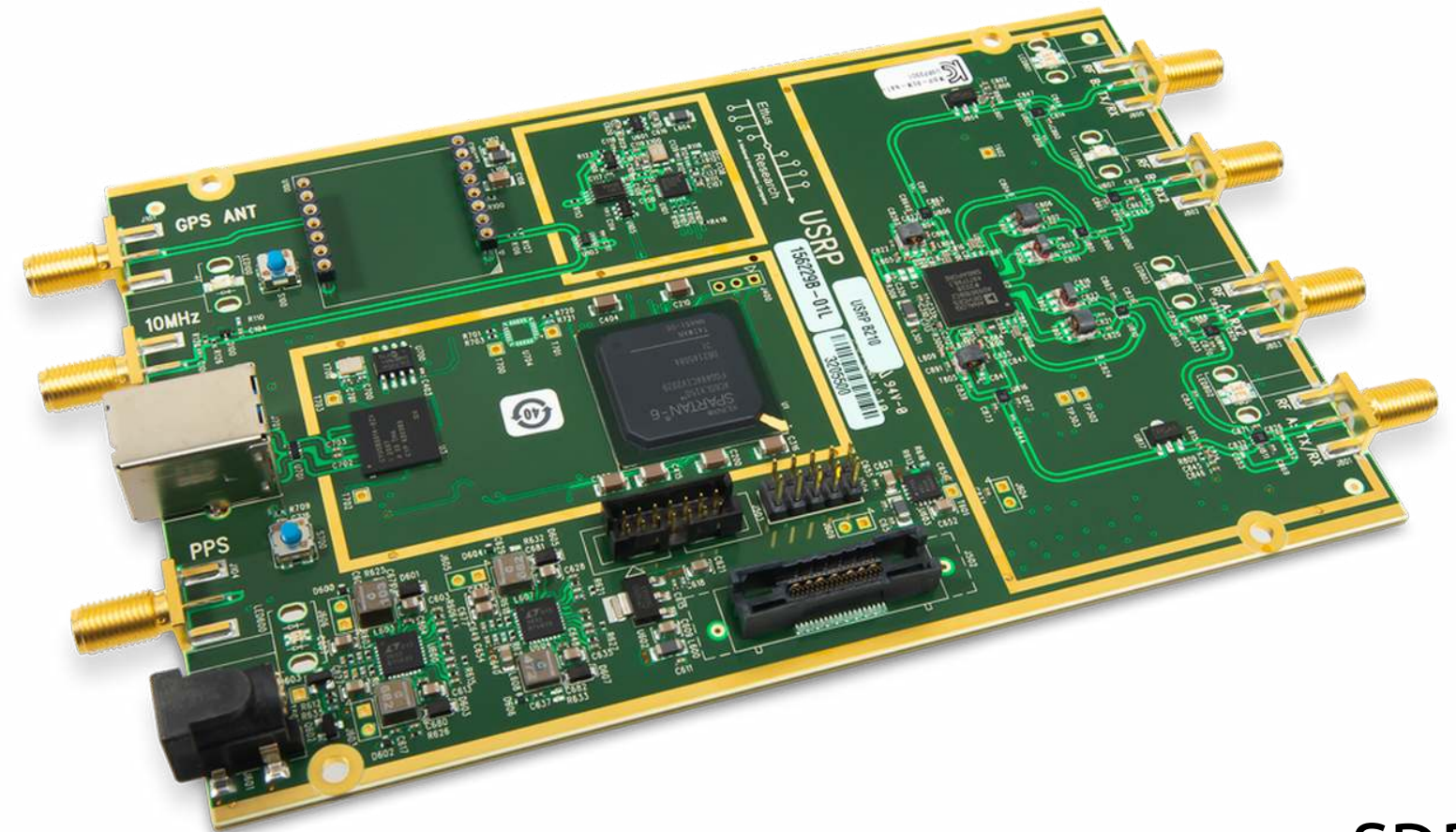
Automatic Identification System (AIS)

Global Satellite Navigation System (GNSS)

security analysis of railway radios

Global System for Mobile

Communications for Railway (GSM-R)



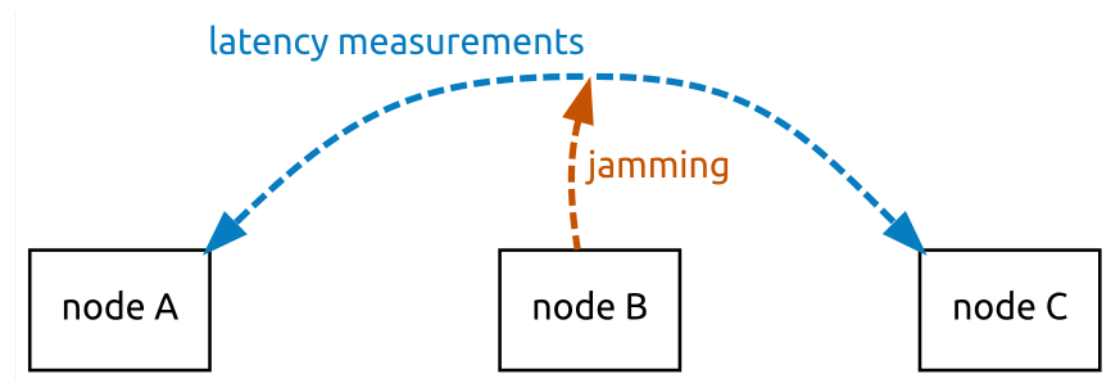
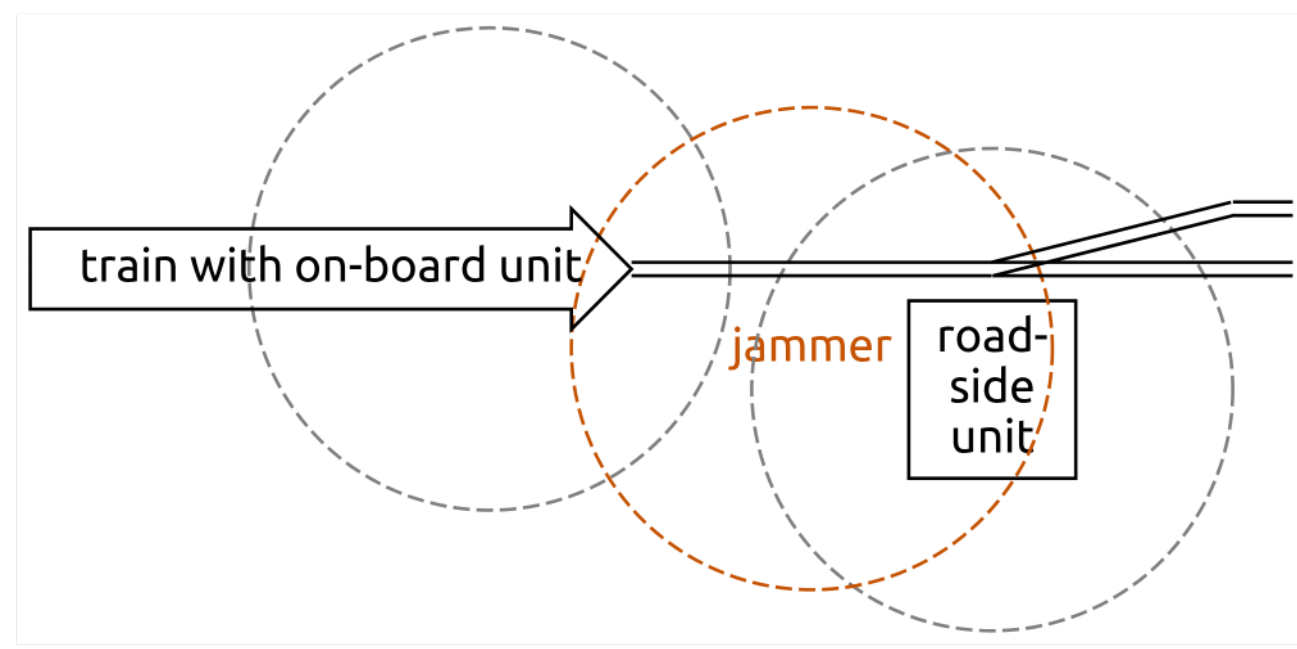
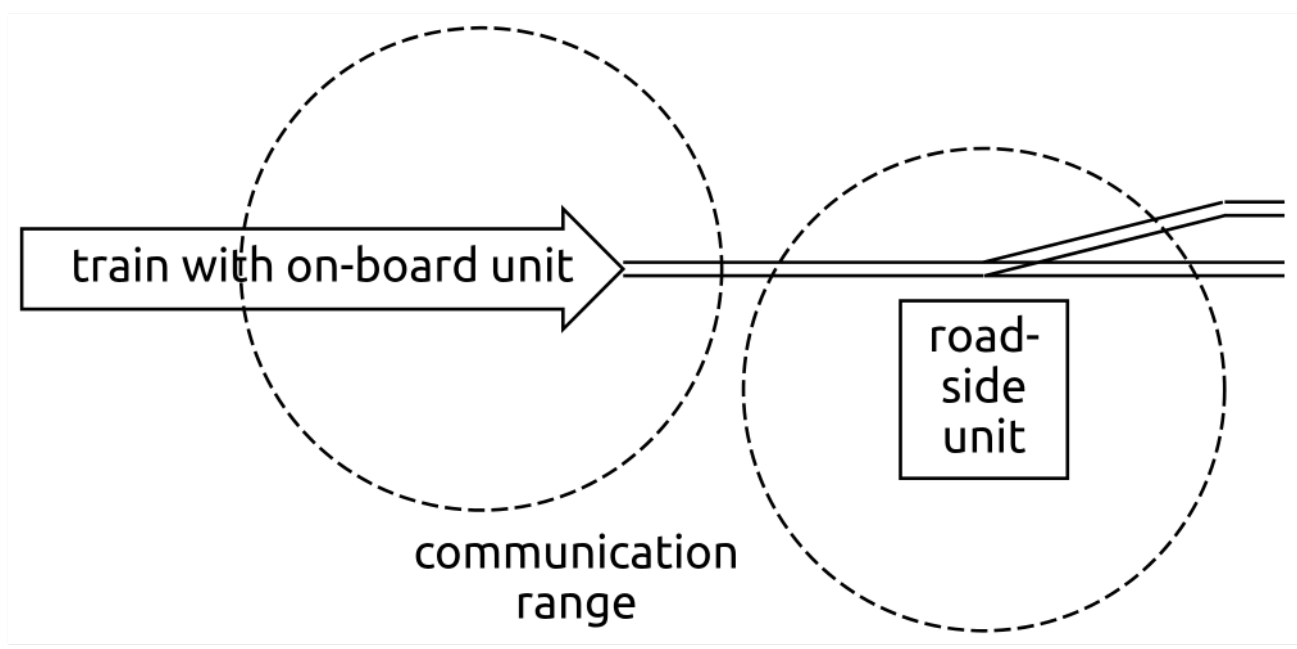
SDR

radio technology

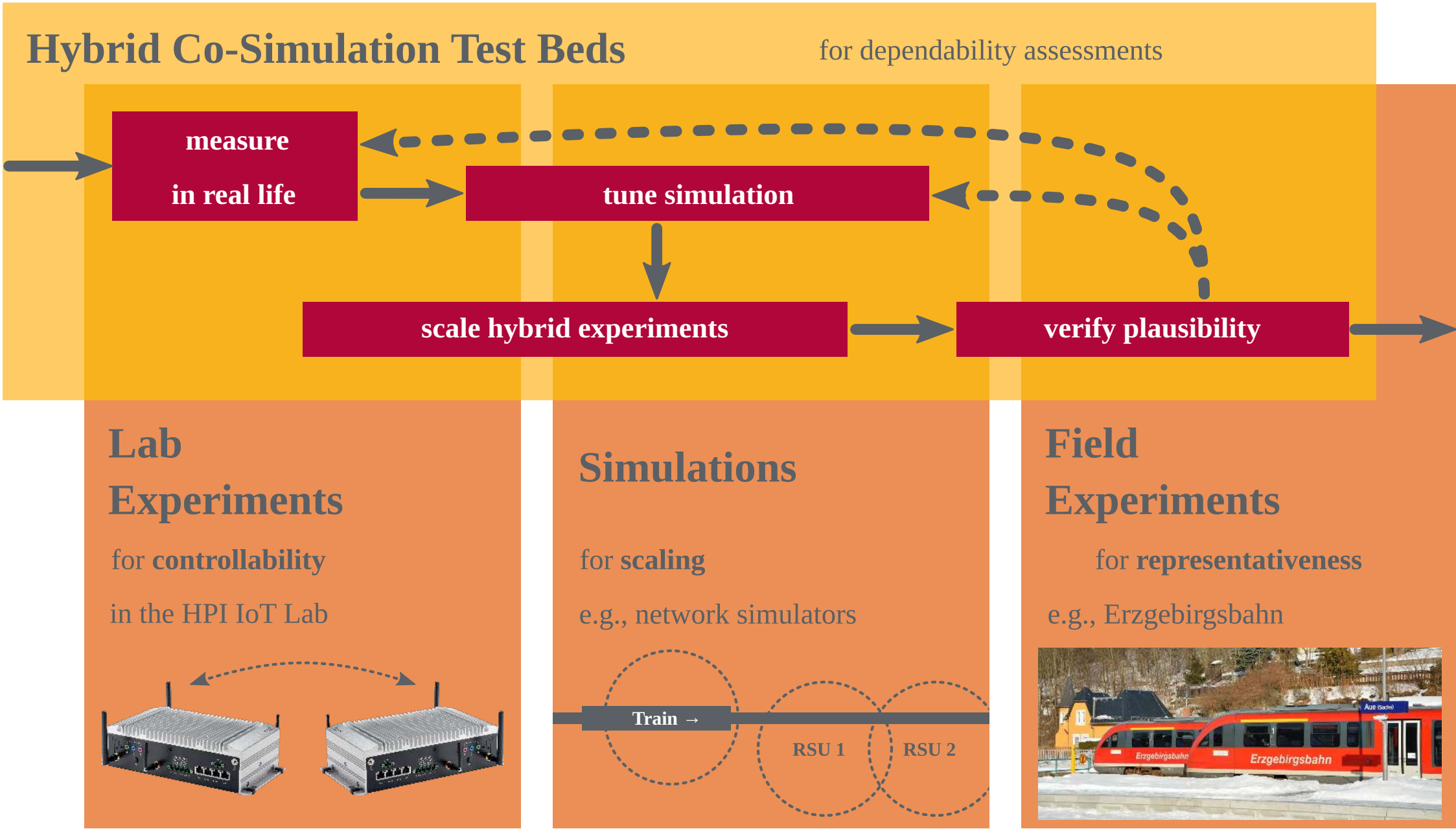


IEEE 802.11p

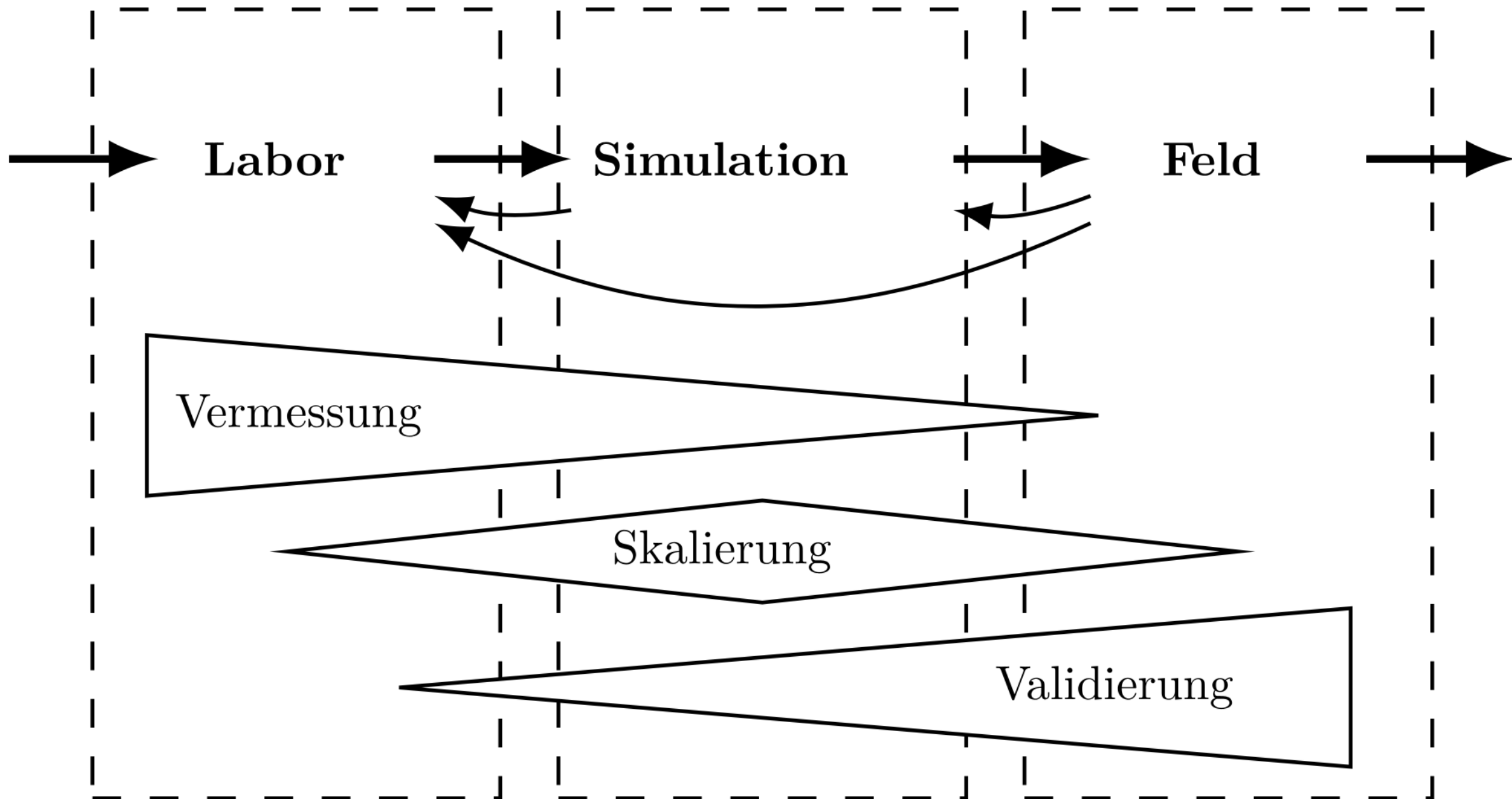
fault injection



development of methodologies



development of methodologies



hybrid testbeds & co-simulation

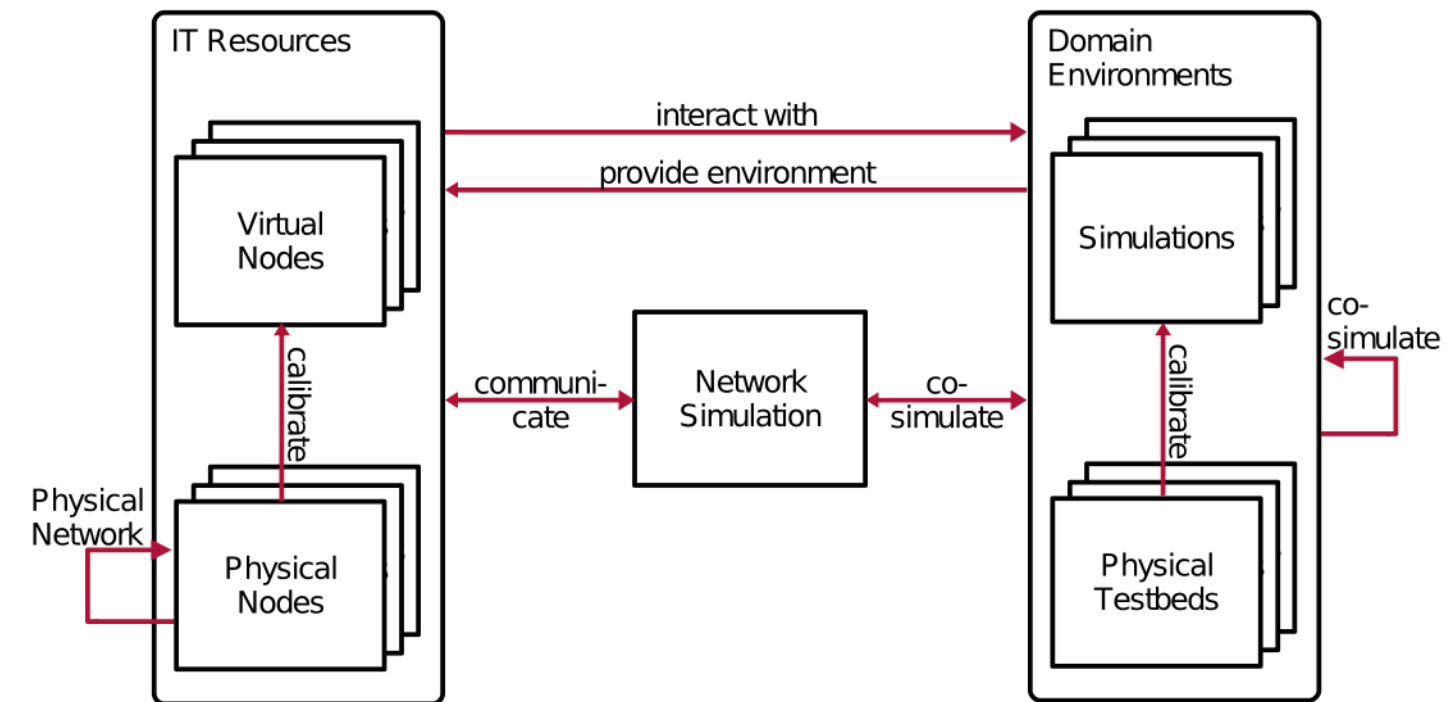
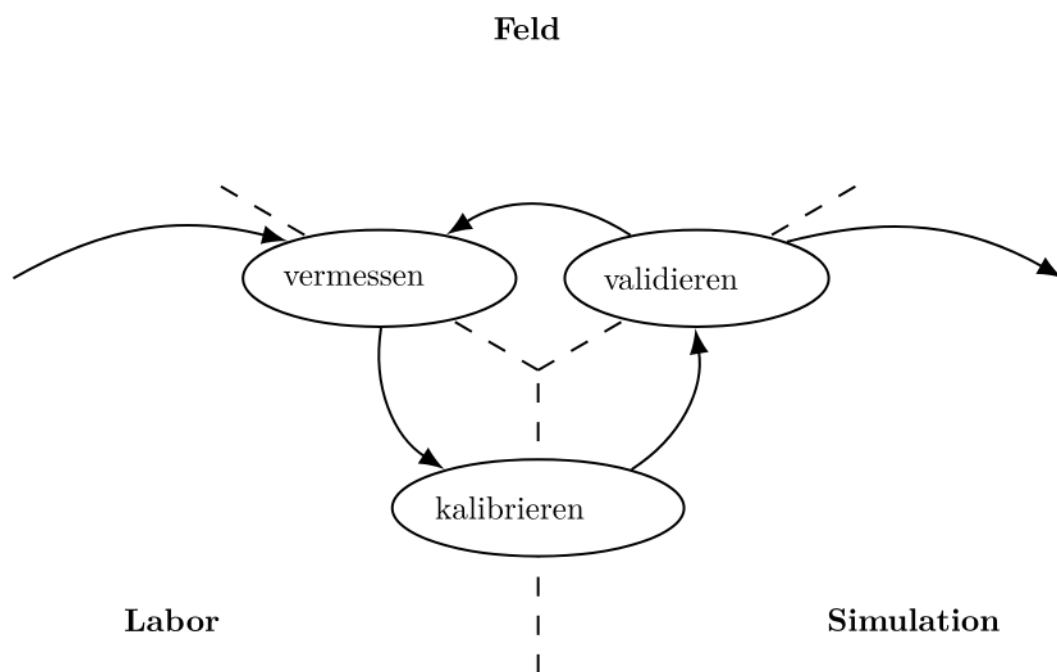
hybrid: software, hardware, and models “in-the-loop”

e.g., simulated wireless & physical wireless network

co-simulation: coupling of multiple domain-specific simulations

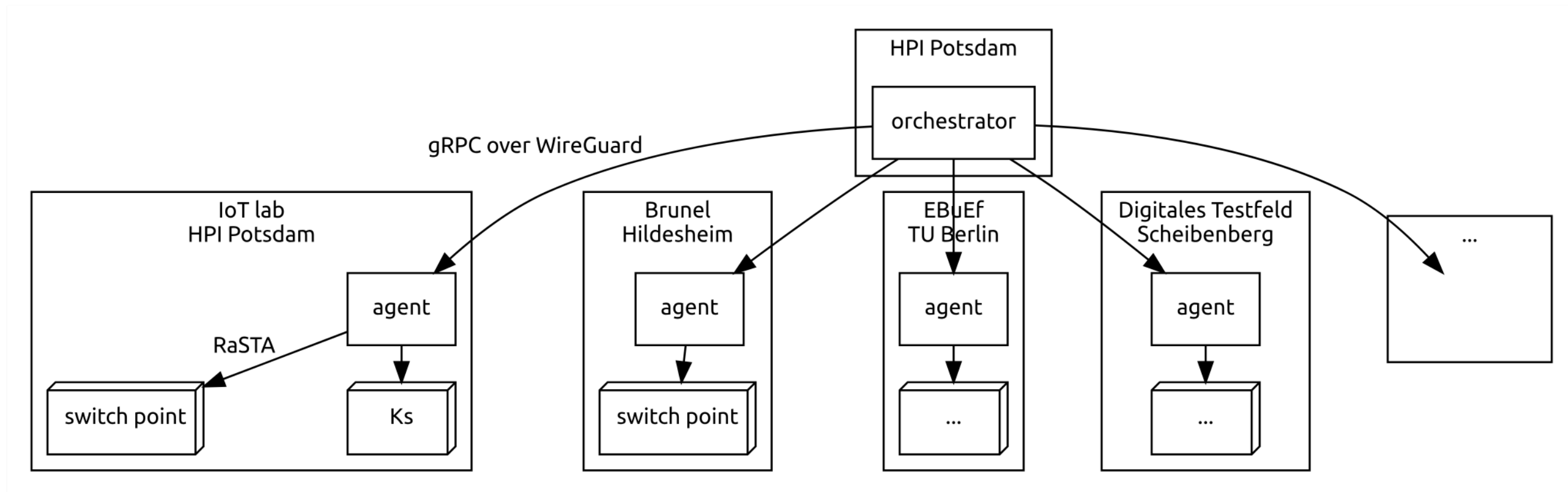
e.g., *SUMO* for traffic & *ns-3* for networking

<https://github.com/diselab/marvis>



distributed testbeds

EULYNX live lab: distributed test environment



HPI IoT lab

... an environment for prototyping and assessments

building, DIY, testing, ...

hybrid, co-simulated, and distributed setups

model-driven and -supported approaches

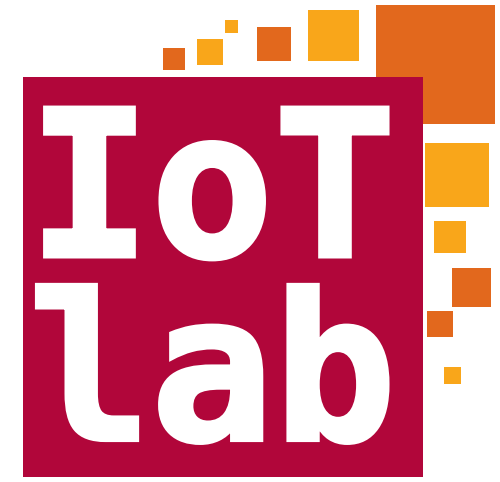
alternatives to specialized hardware

hardware, software and model “in the loop”

simulated environments

across/coupling of domains

dependability



Lukas Pirl

Introduction of IoT Lab in Lecture on Distributed Dependable Embedded Systems

Professorship for Operating Systems and Middleware of Prof. Andreas Polze

Hasso Plattner Institute, University of Potsdam