



Contents of Work Package 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

Coordinator of the WP

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Participants of the WP

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VÚKV a.s. – Ing. Jan Čapek, Ph.D.

Main Goal of the WP

2WP05-001 Modified architecture of passenger car for intelligent assistance services.

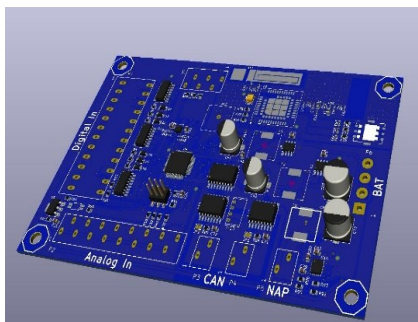
2WP05-002 Functional specimen of car telemetry system – for rail vehicles (freight wagon).

2WP05-003 Subsystem for energy harvesting – for rail vehicles (freight wagon).

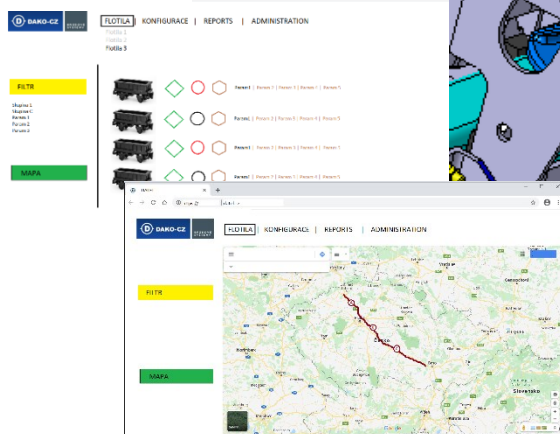


Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

Overview - Functional Specimen of Car Telemetry System. Subsystem for Energy Harvesting.



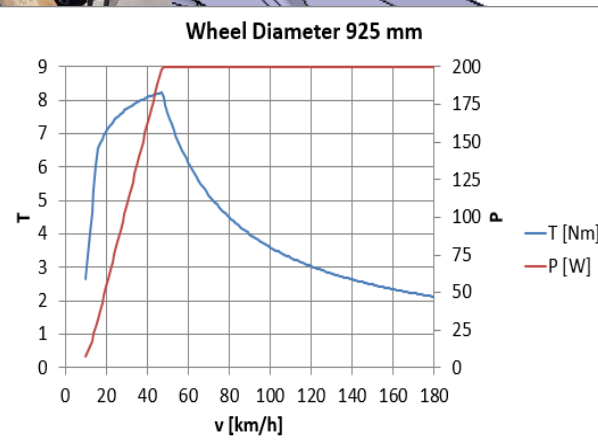
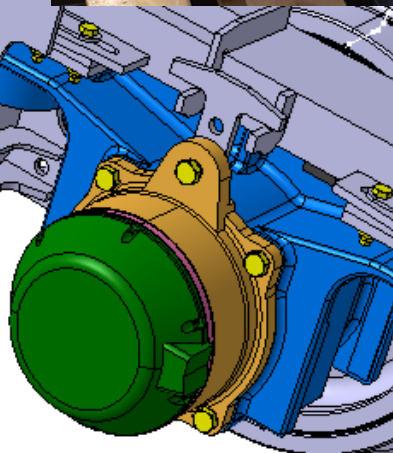
DTU unit



Database and recording



Functional sample with electronics



Torque and power diagram

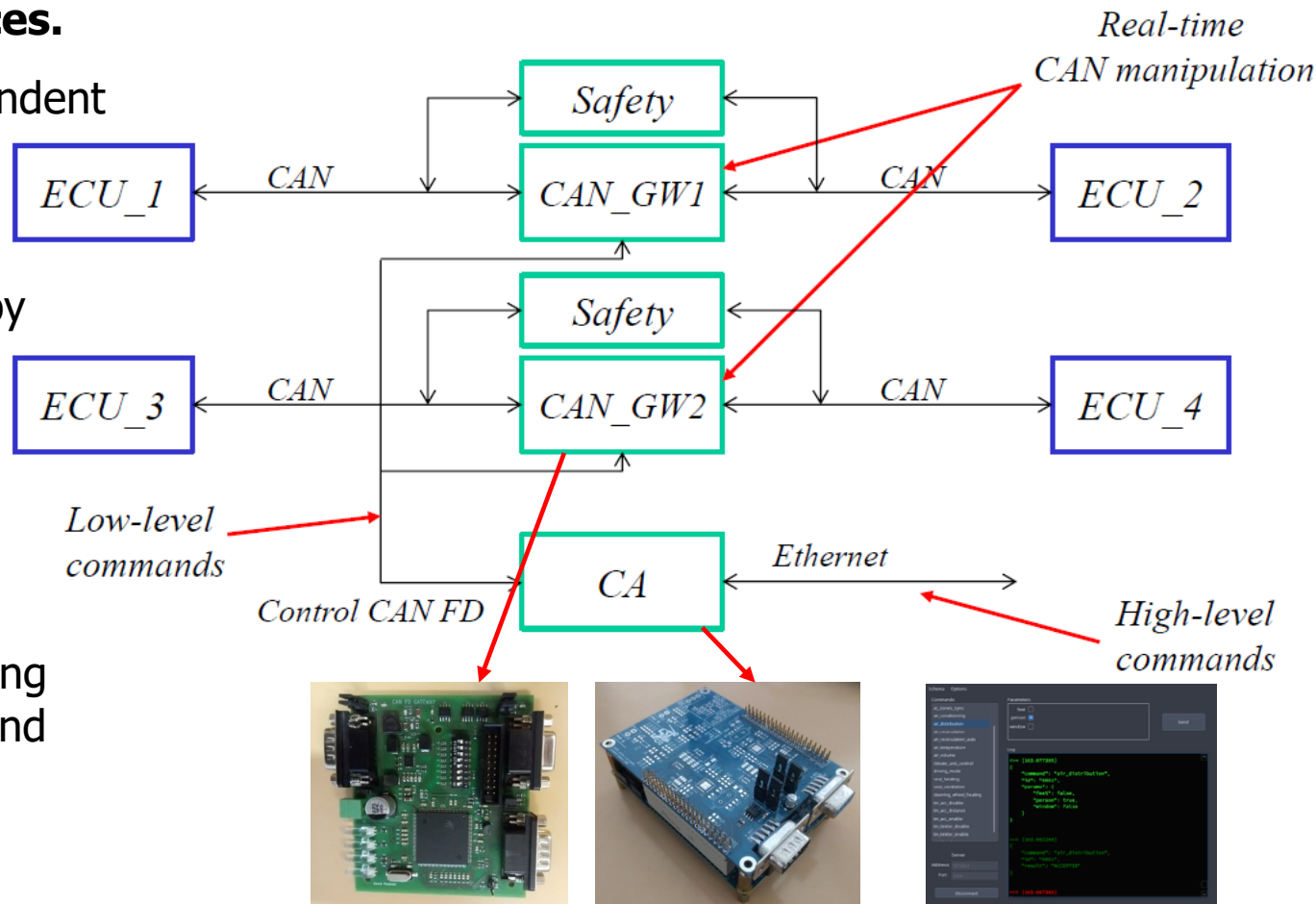
Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

Overview - Modified Architecture Of Passenger Car For Intelligent Assistance Services.

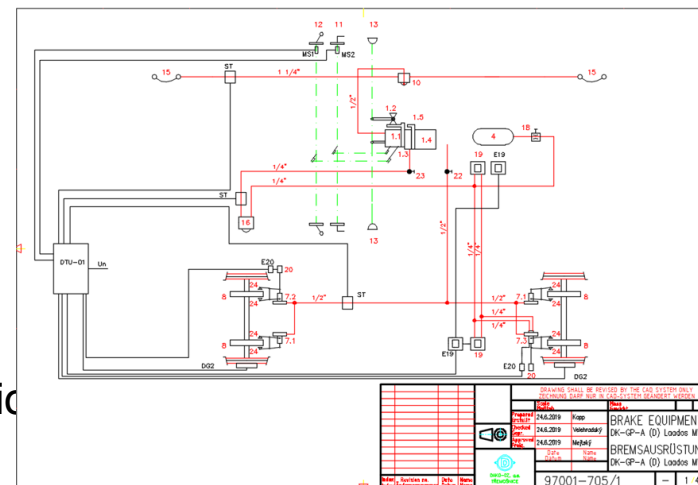
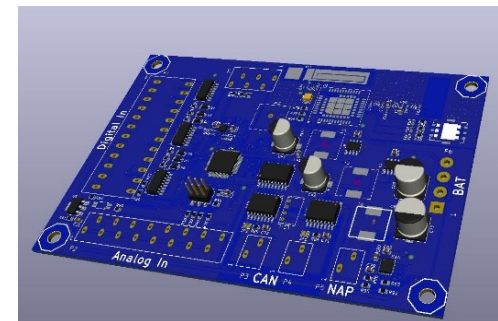
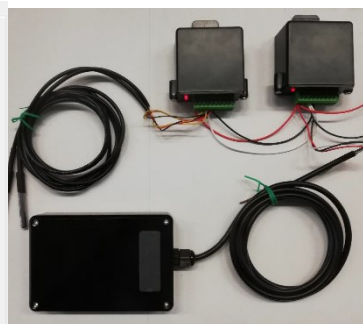
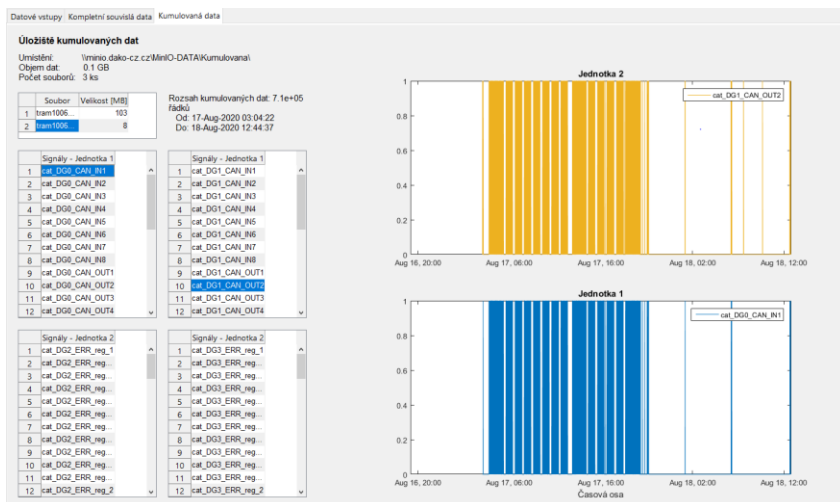
Provides an independent way to control selected vehicle functionalities usually controlled by driver or vehicle passengers.

Supported funcs.:

- ACC + Limiter
- All Air Condition functions including seat, windows and mirror heating
- Drive mode
- ...



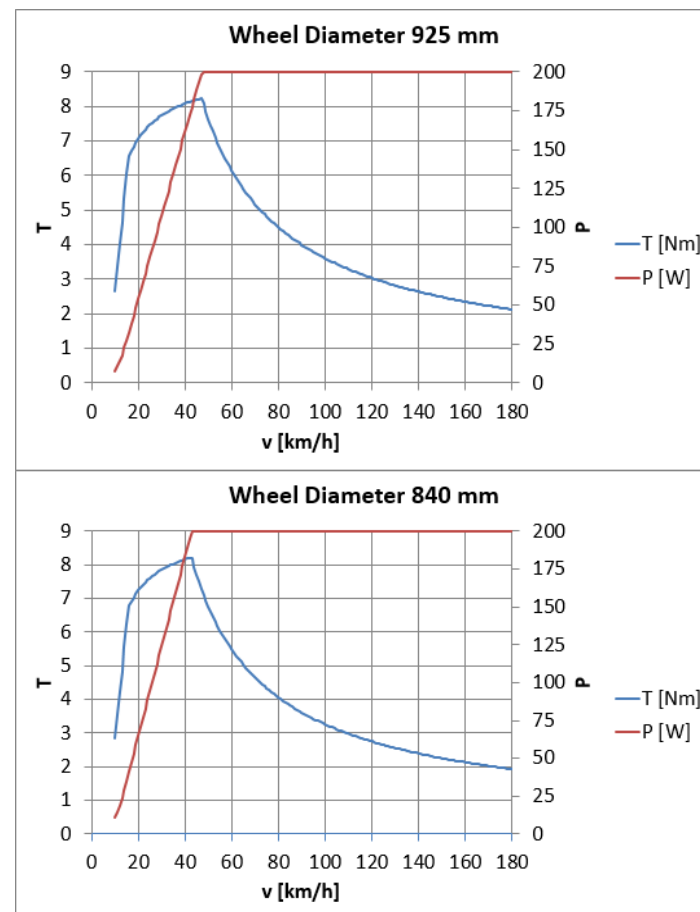
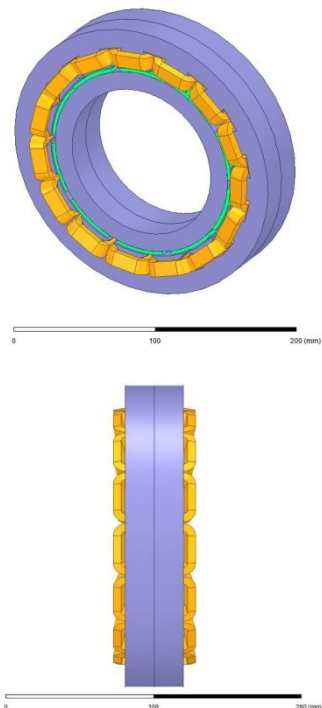
2WP05-002 Functional Specimen of Car Telemetry System



- Measured data from tram Katowice
- Database definition and development
- Structure of sensor implementation on railed vehicle
- Task list for DTU-01 development

Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

2WP05-003 Subsystem for Energy Harvesting



- Proposal of energy power source design
- Torque and power diagram calculated
- Max. temperature and other parameters fixed



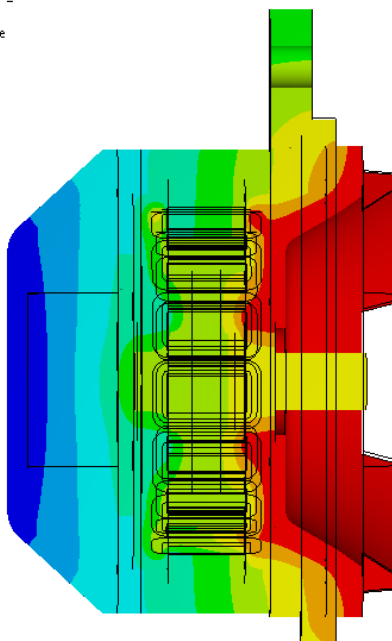
Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

2WP05-003 Subsystem for Energy Harvesting

D: Tamb40_alfa69_Tloz150

All
Type: Temperature
Unit: °C
Time: 1
21. 1. 2020 8:20

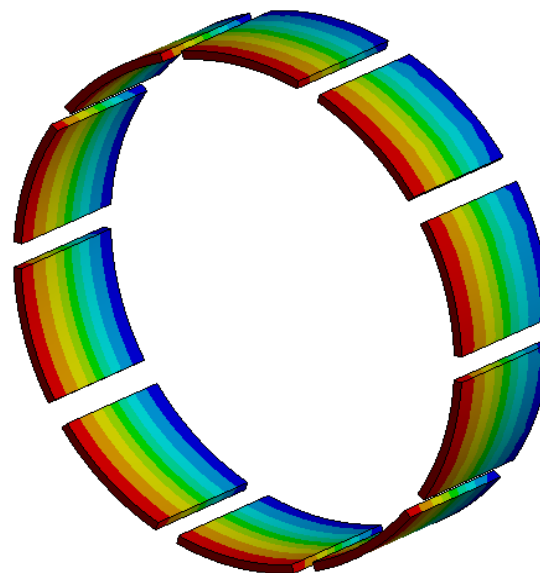
153,73 Max
144,35
134,97
125,59
116,22
106,84
97,458
88,079
78,7
69,321 Min



D: Tamb40_alfa69_Tloz150

magnety
Type: Temperature
Unit: °C
Time: 1
21. 1. 2020 8:23

124,84 Max
124,38
123,91
123,45
122,98
122,52
122,05
121,59
121,13
120,66 Min

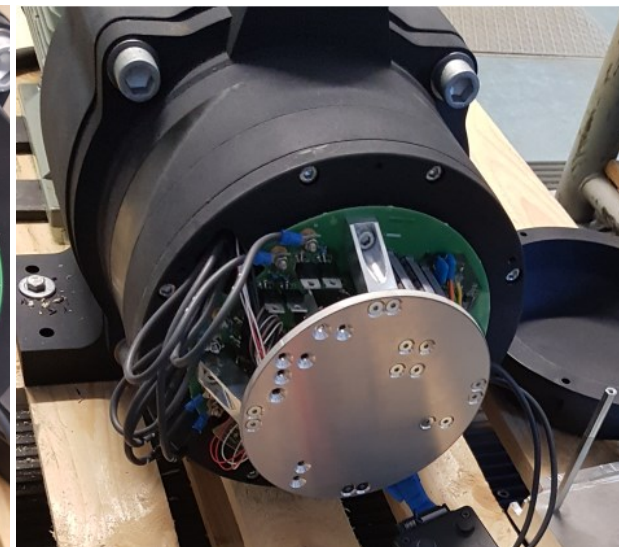
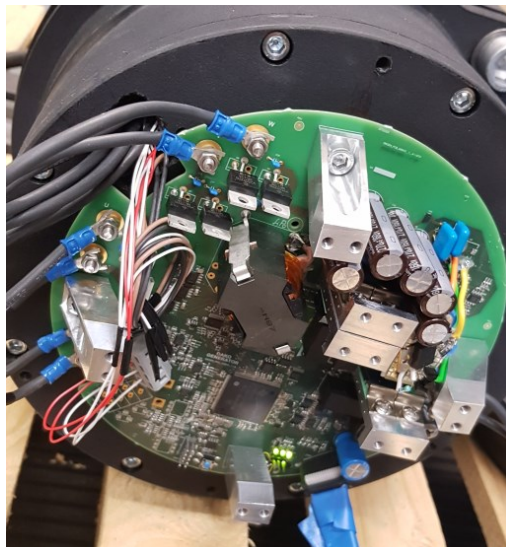


- Temperature distribution at the speed 50 km/h (nominal power 200 W reached)
- Including the maximal bearing temperature 150 °C
- Maximal losses and current are fixed



Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

2WP05-003 Subsystem for Energy Harvesting



Parameters:

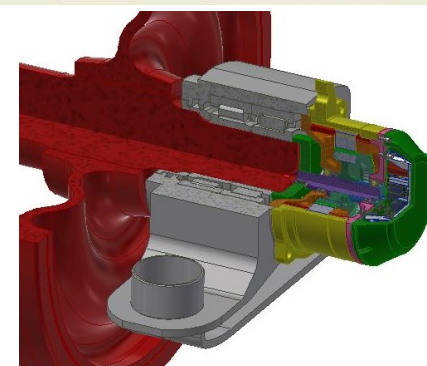
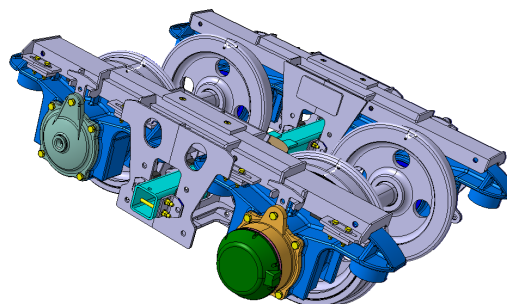
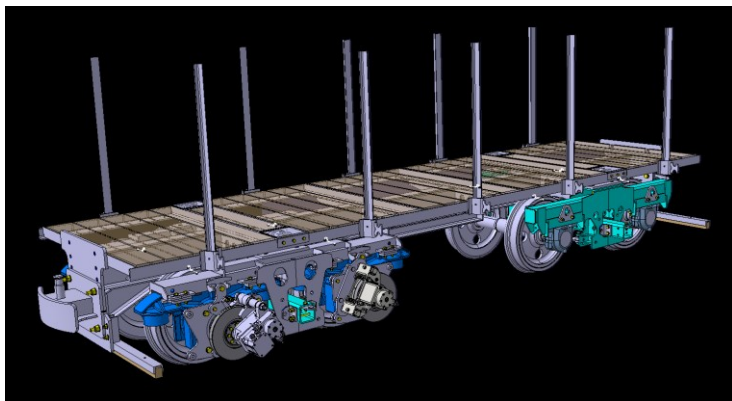
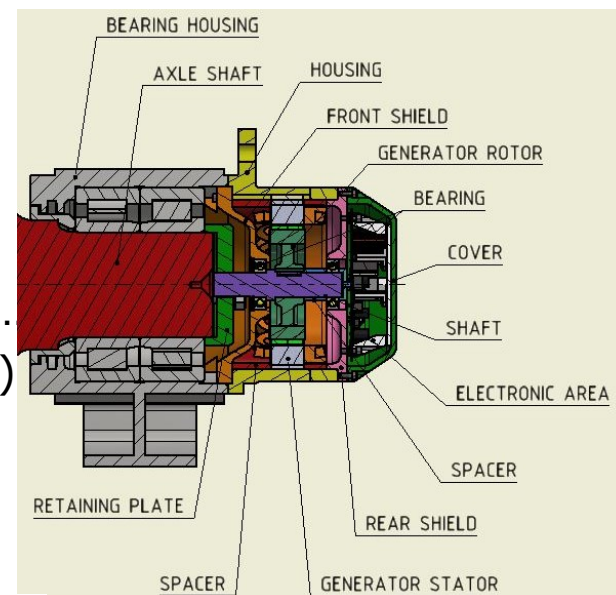
- 24V output ensured at low RPM (1.2 ot/s \sim 12,6 km/h),
- Full power 200W at 4 ot/s (\sim 42 km/h)
- Max current up to 10A (electronic current limitation)
- Shortcut protection, overvoltage protection
- RPM sensor, accelerometer 120G, 2x temperature sensor (stator, bearing)
- CAN bus output (status, errors, diagnostic, debug,)



Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

2WP05-003 Subsystem for Energy Harvesting

- Proposal for the bearing cap modification
- Mechanical design of the energy harvesting system
- Development of test carrier vehicle – 3D models
 - creation of documentation for vehicle production
 - material logistic (semi-products, standardized parts, ..)
 - outsourcing (e.g. Wheelsets and bearings mounting)
 - Production (flame cutting, welding,



Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

2WP05-001 Modified Architecture of Passenger Car for Intelligent Assistance Services

Main goal: modification of vehicle electronic to allow implementation of advanced assistance services based on machine learning methods

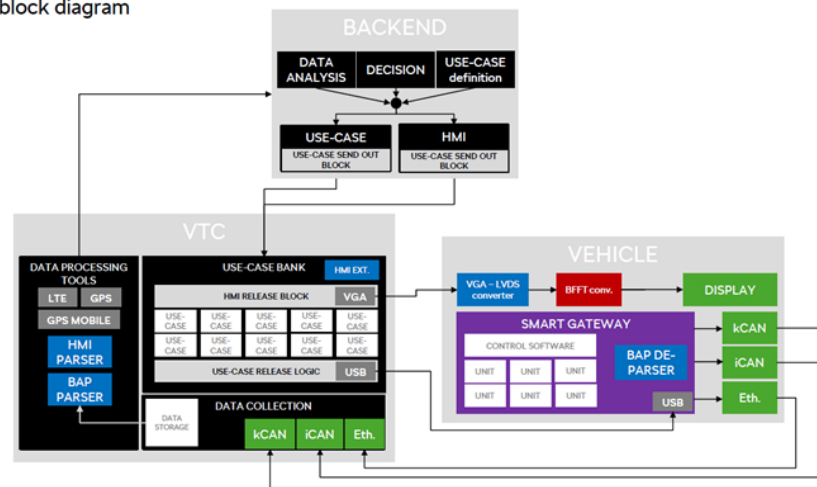
Use cases

- Predictive ACC (Limiter, ...)
- Air conditioning (mode, recirculation, zone settings, windows and seats heating ...)
- Infotainment settings (audio source selection)
- Drive mode
- ...

Implementation

- Manipulation of in-vehicle communication is a preferred way
- Parallel contacts to existing switches finally not necessary

Intelligent car
block diagram





Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

2WP05-001 Modified Architecture of Passenger Car for Intelligent Assistance Services

Behavioral data acquisition and machine learning implementation

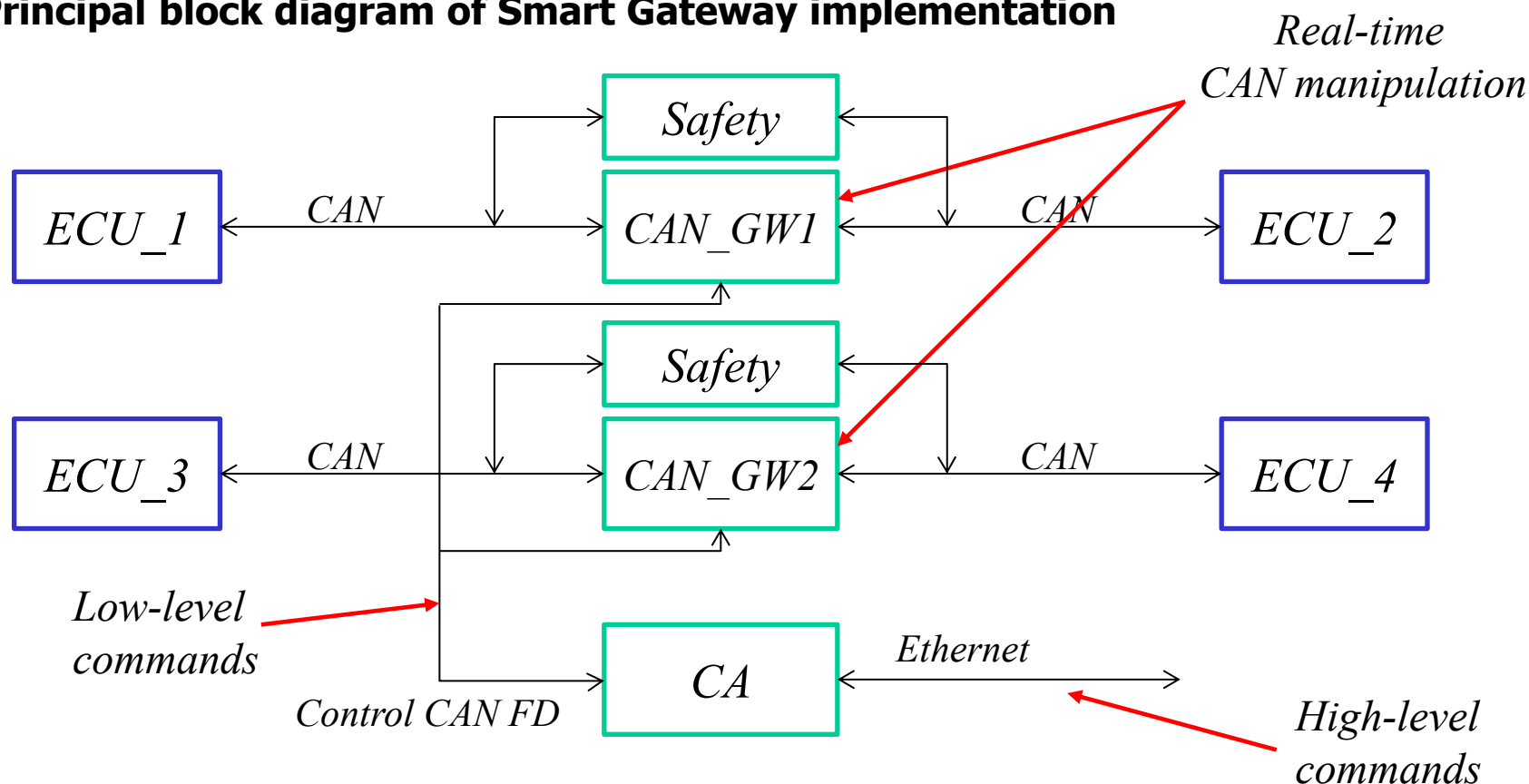
- Designed and implemented by Škoda staff
- Monitoring and data acquisition from in-vehicle networks
 - seats occupation
 - vehicle functions settings
 - time and position monitoring
 - external conditions monitoring (weather, traffic ...)
 - mobile devices presence (identification of driver and/or passengers)
- Based on large data-base of vehicle usage data a machine learning is used to identify typical use-cases
 - driver is asked to approve the suggested activity
 - if he/she agrees, the command is issued to the CA module



Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

2WP05-001 Modified Architecture of Passenger Car for Intelligent Assistance Services

Principal block diagram of Smart Gateway implementation





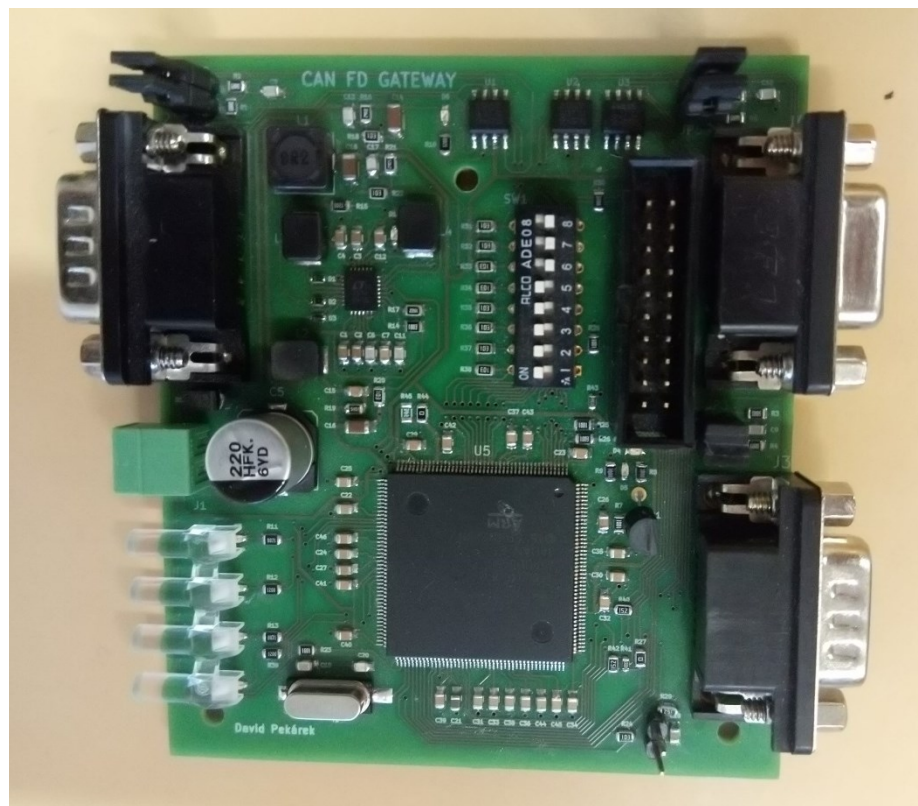
Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

2WP05-001 Modified Architecture of Passenger Car for Intelligent Assistance Services

CAN Gateway implementation

CAN FD Gateway

- Retransmission of CAN messages between ECUs
- Blocking of selected CAN messages
- Modification of selected CAN messages
- Transmission and reception of selected CAN messages
- Safety bridge over the gateway CANs in case of error



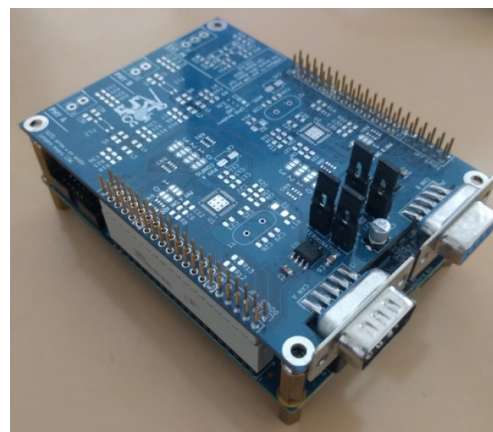
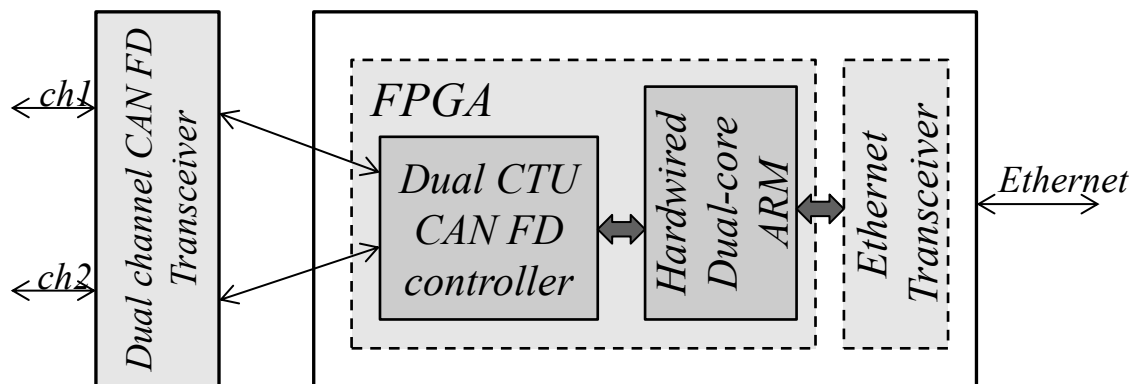
Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

2WP05-001 Modified Architecture of Passenger Car for Intelligent Assistance Services

CA module implementation variant I

Based on DE0-NANO kit

- Communication with MCS via Ethernet (reception of JSON commands, transmission of acknowledgements)
- Decoding commands and generation of CAN control communication for CAN GW modules
- Implements vehicle specific functionality
- Suitable for cloud based AI modules





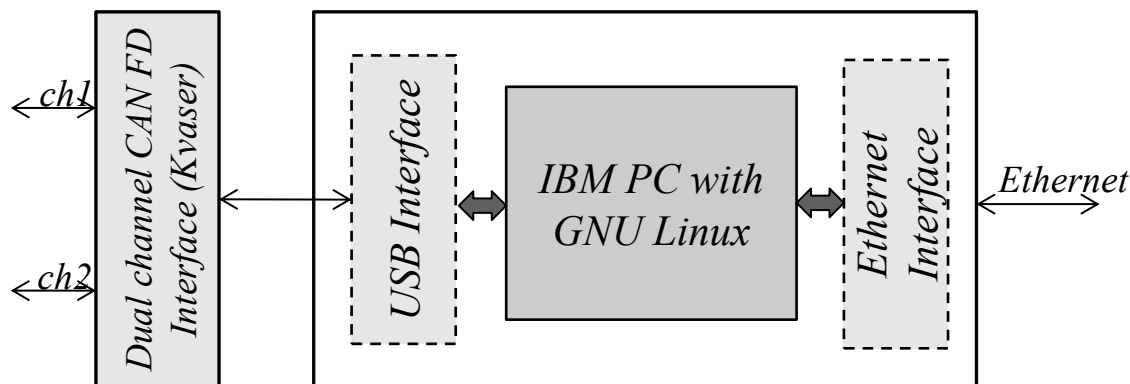
Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

2WP05-001 Modified Architecture of Passenger Car for Intelligent Assistance Services

CA module implementation variant II

Based on ARK-3520 Automotive PC

- Either the same functionality as variant I
- Or the complete framework for AI plug-ins can be run on this HW (for evaluation purposes)
- Suitable for local AI plug-in modules



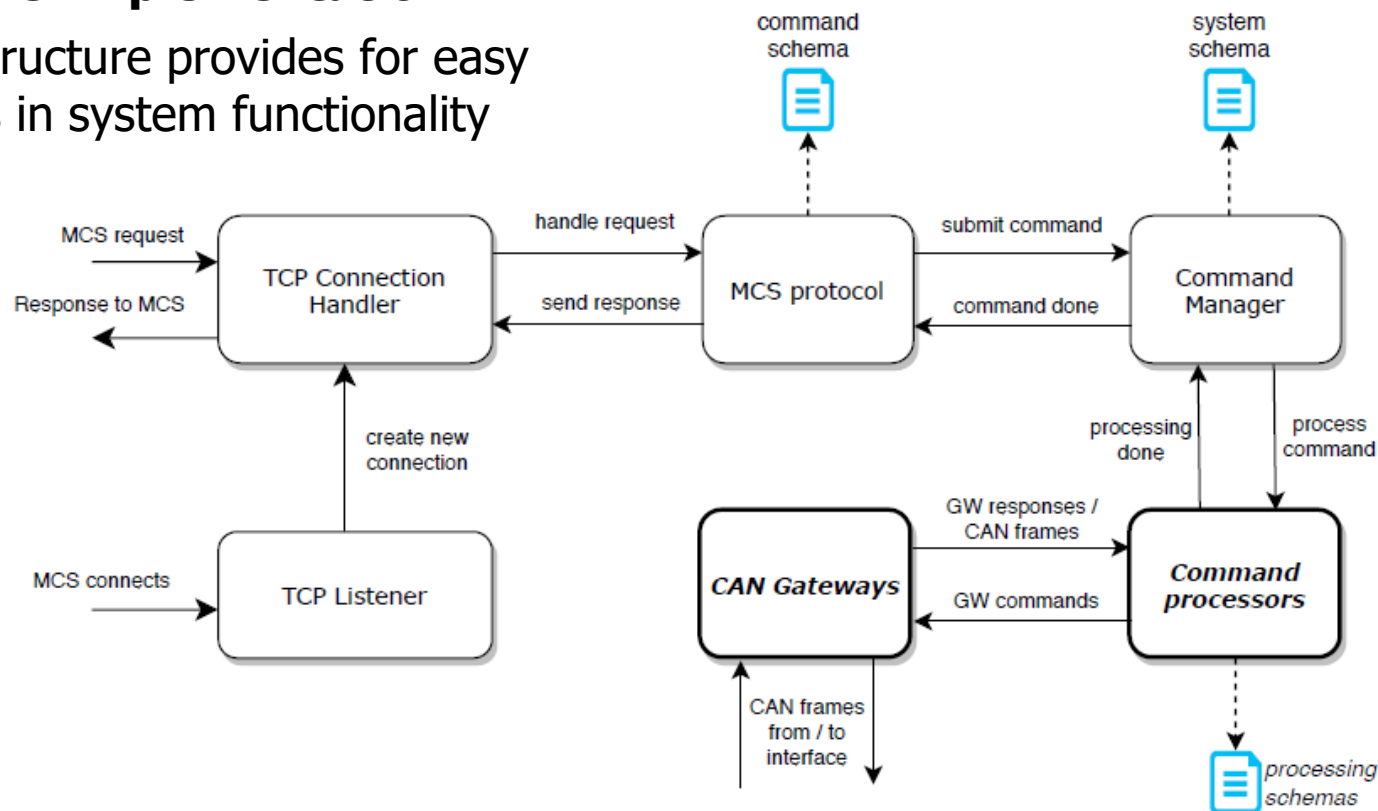


Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

2WP05-001 Modified Architecture of Passenger Car for Intelligent Assistance Services

CA Firmware Implementation

- Modular structure provides for easy extensions in system functionality



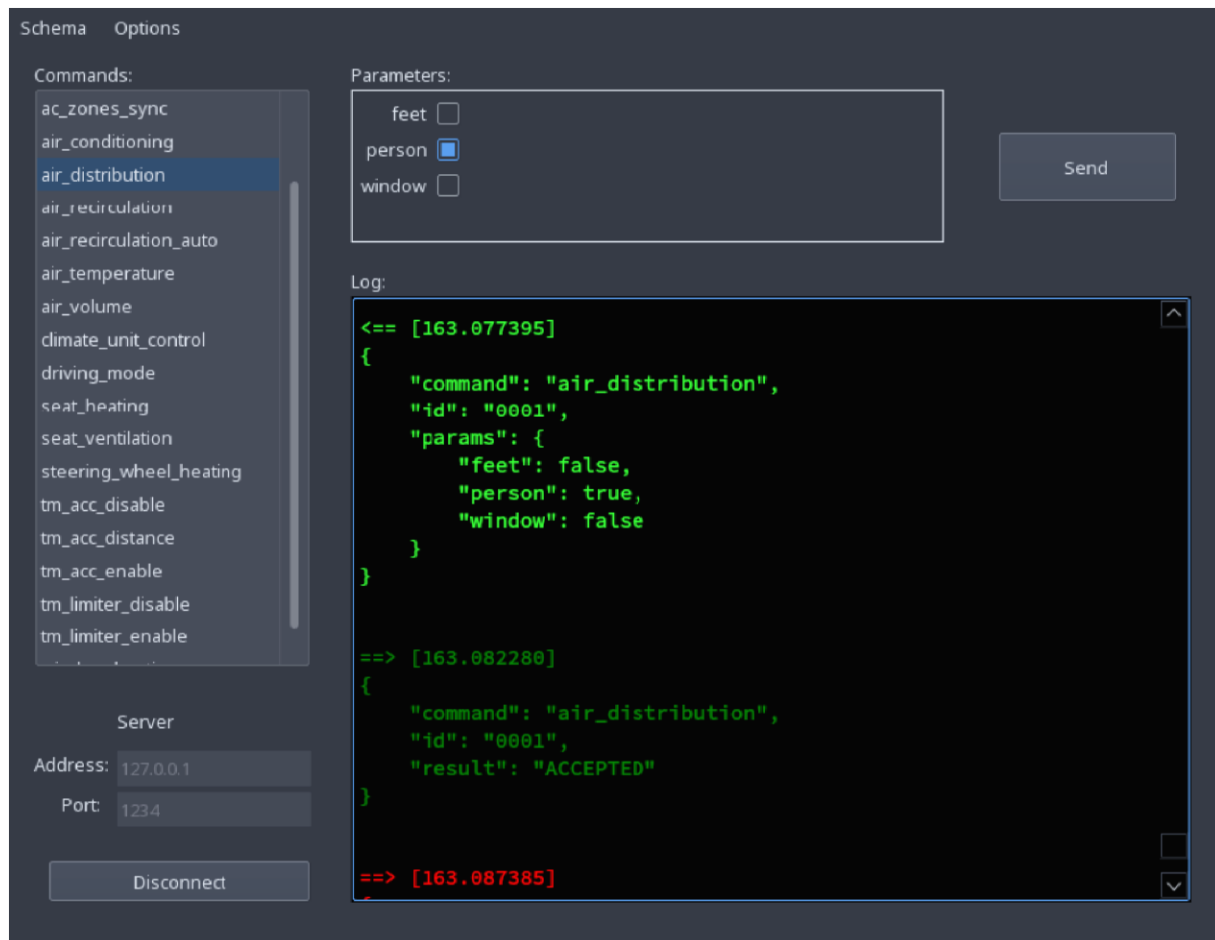


Activities in 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

2WP05-001 Modified Architecture of Passenger Car for Intelligent Assistance Services

CA Firmware Evaluation

- Qt framework based Test Application
- Issues JSON commands instead of MCS
- New commands added using XML configuration file
- Provides for online logging – for debug purposes





Fulfillment of goals and deliverables of 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

Current State of Deliverables, Milestones and Fulfillment of Goals

2WP05-00 Modified architecture of passenger car for intelligent assistance services.

- All system HW and SW components designed and developed
- System built-in into the Škoda Kodiaq vehicle
- System functionality validated within several test trips
- All goals of this subproject reached

2WP05-002 Functional specimen of car telemetry system

- Telemetry system components developed
- All goals of this subproject reached
- It will be tested during long-term usage

2WP05-003 Subsystem for energy harvesting

- Functional system developed, produced and tested
- All goals of this subproject reached
- It will be tested on real railway mounted on selected bogie.



Fulfillment of goals and deliverables of 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

List of Due Deliverables and Their Added Value

2WP05-001 Modified architecture of passenger car for intelligent assistance services.

Final deliverable allows Škoda to develop and test intelligent vehicle functionalities in real car with real passengers. The next step will be to bind this modified vehicle architecture with AI (machine learning) modules, providing actual „intelligent vehicle“ behavior.

2WP05-002 Functional specimen of car telemetry system and

2WP05-003 Subsystem for energy harvesting

Final deliverables will allow DAKO to check various operating parameters of rail vehicles and quickly evaluate effects of changes in the design of vehicle and its components. Also for operator/tenants of the freight wagons this will allow to check the utilization of the wagons and rapidly reduce the lag time or check if there is no misuse like overload etc.



Current contribution of 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles)

Assessment of the Contribution of Deliverables

2WP05-001 Modified architecture of passenger car for intelligent assistance services.

The ability to independently control selected functionality of vehicle can be used in many other applications in future, e.g. for (partially) autonomous vehicles.

2WP05-002 Functional specimen of car telemetry system and

2WP05-003 Subsystem for energy harvesting

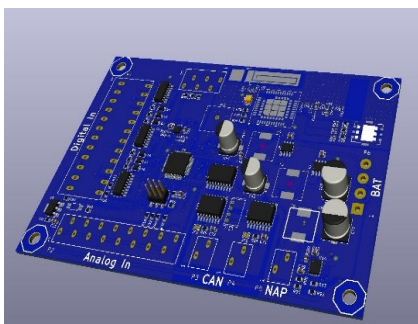
The results can be useful for increase the functionalities of the all existing and even allow installation of new systems on the railway vehicles. There are a plans for continue in the development of the new systems with using the obtained source of electric energy and digital transmitting unit. End the end it will increase the competition ability of the not only the producer.

Acknowledgement

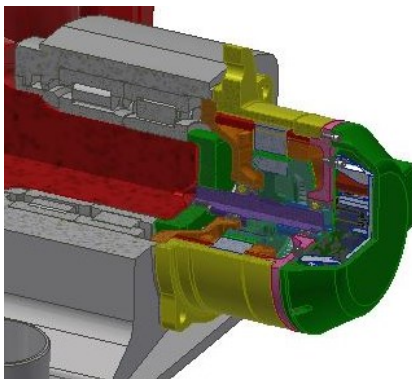
This research has been realized using the support of Technological Agency, Czech Republic, programme National Competence Centres, project # TN01000026 Josef Bozek National Center of Competence for Surface Transport Vehicles.

This support is gratefully acknowledged.

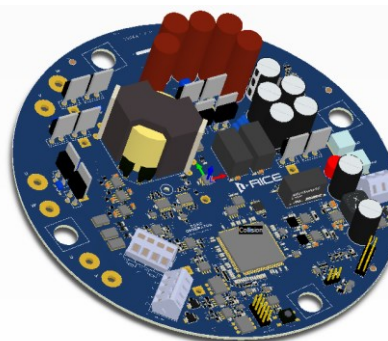
Výtah z prací 2019-2020 na 2-WP05 Vývoj a testování elektroniky pro dopravní prostředky (včetně železničních vozidel) (ZČU - Pavel Žlábek – zlabek@rti.zcu.cz)



Jednotka DTU



Konstrukce generátoru



Návrh elektroniky

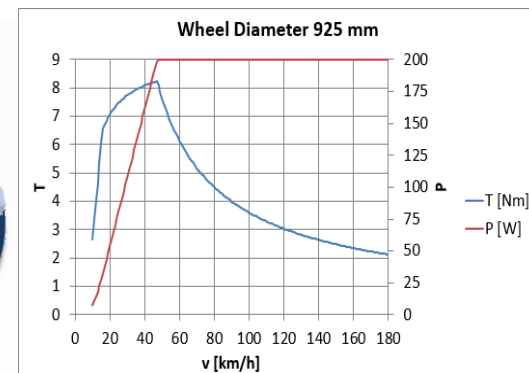
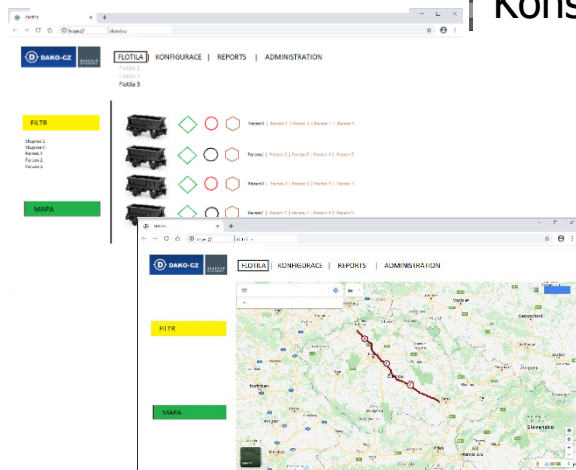


Diagram výkonu a točivého momentu



Databáze záznamů



Zapojená elektronika



Funkční vzorek generátoru

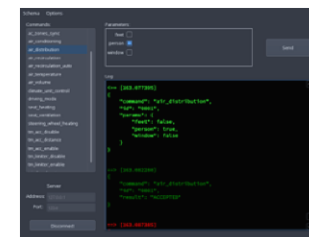
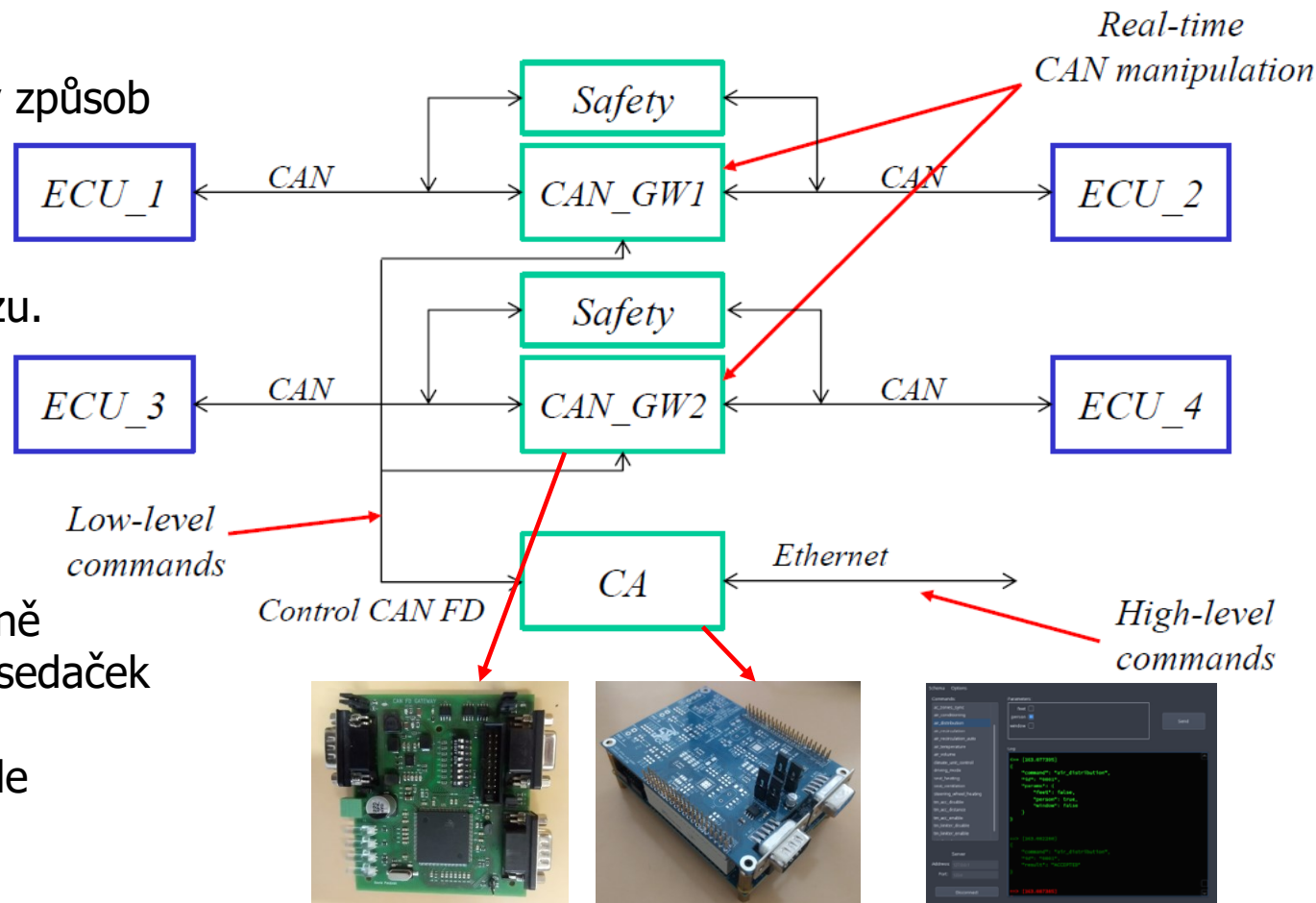
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Modifikovaná architektura osobního vozu pro služby inteligentního asistenta.

Poskytuje nezávislý způsob ovládání vybraných funkcí vozu, které obvykle ovládá řidič či posádka vozu.

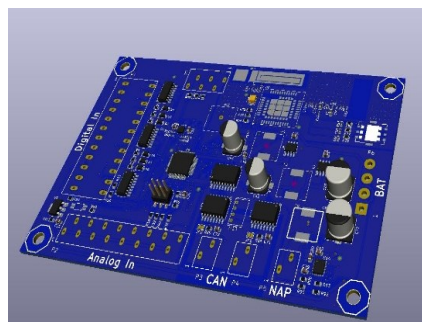
Podporované fce:

- ACC + Limiter
- Veškeré funkce klimatizace včetně vyhřívání oken, sedaček a zrcátek
- Volba Drive mode
- ...

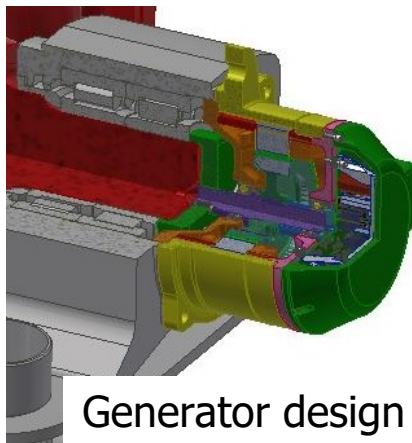




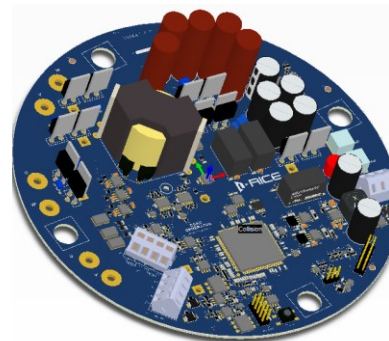
Current contribution of 2-WP05 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles) (WBU - Pavel Žlábek – zlabek@rti.zcu.cz)



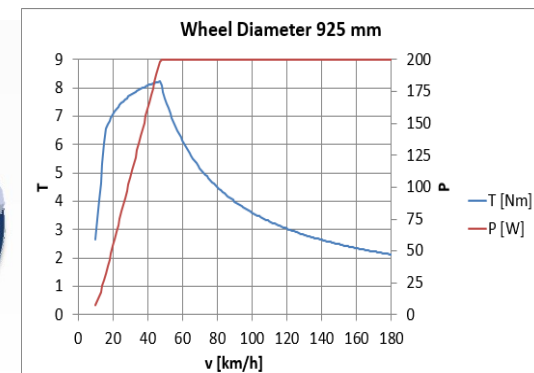
DTU unit



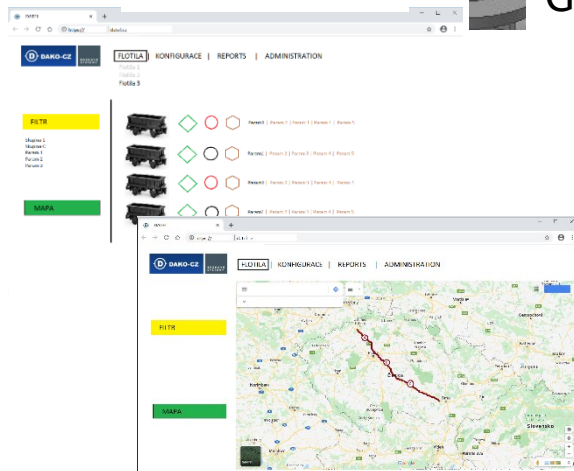
Generator design



Electronic design



Torque and power diagram



Database and structures of records



Electronic mounted



Functional sample



Current contribution of 2-WP05 2-WP05 Development and Testing of Vehicle Microelectronics (including rail vehicles) (CTU – Jiří Novák – jnovak@fel.cvut.cz)

Modified architecture of passenger car for intelligent assistance services.

Provides an independent way to control selected vehicle functionalities usually controlled by driver or vehicle passengers.

Supported funcs.:

- ACC + Limiter
- All Air Condition functions including seat, windows and mirror heating
- Drive mode
- ...

