Hella tests

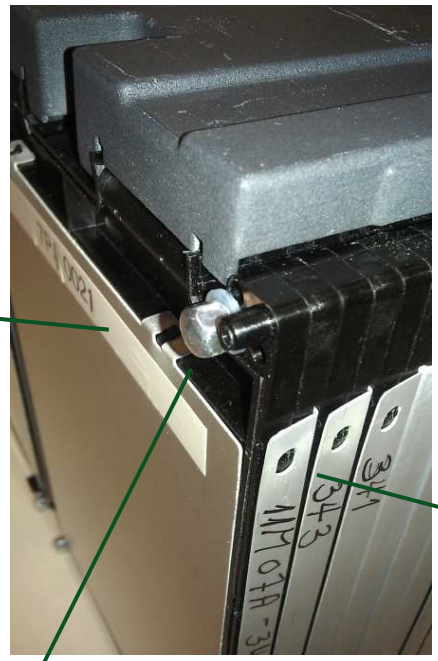
NEDC @ Lippstadt roller test stand

Battery overview

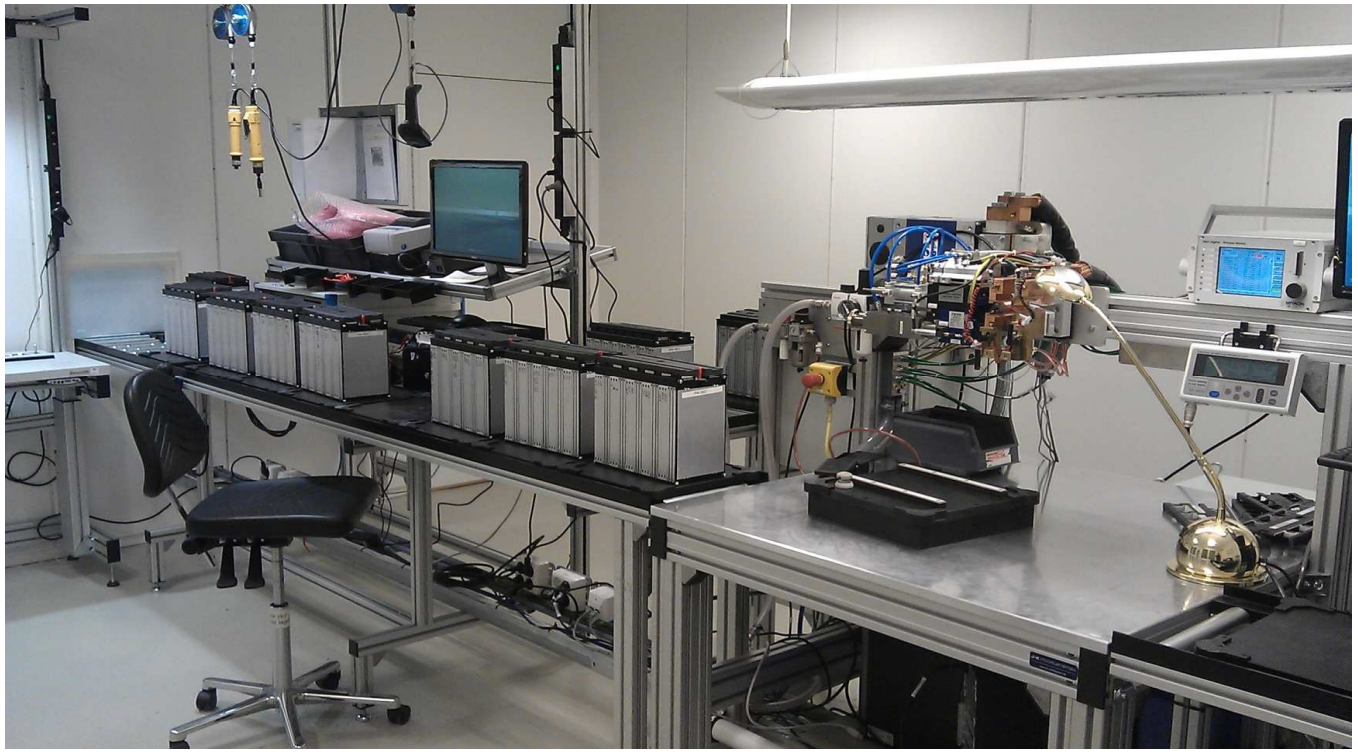
Battery by Miljobil	
Cell chemistry	$Li(NiCoMn)O_2$
Cell configuration	2p6s10s3p
Weight	255 kg
Energy content	26,1 kWh
Energy density	103 Wh/kg
Nominal voltage	220 V
Discharge power	44 kW
Discharge current (cont./peak)	200 / 400 A
Cell ideal operating range	10°C ... 30°C
Cell full operating range	-30°C ... +55°C
Cooling	none

Module assembly

- Cells are assembled into individual cassettes
- Cassettes are stacked together in the correct orientation and clamped with through going bolts
- Busbars are assembled and welded
- The lid with the BMS card is assembled to the module
- The module is ready for integration with the tray
- Fully customisable cassette arrangement for adjustable voltage



Module welding



Complete clean room facility for resistance welding equipment

- **Welding parameters fine tuned for four different settings**
  - Aluminium bimetal/tab
  - Copper bimetal/tab
  - Aluminium pure/tab
  - Copper pure/tab

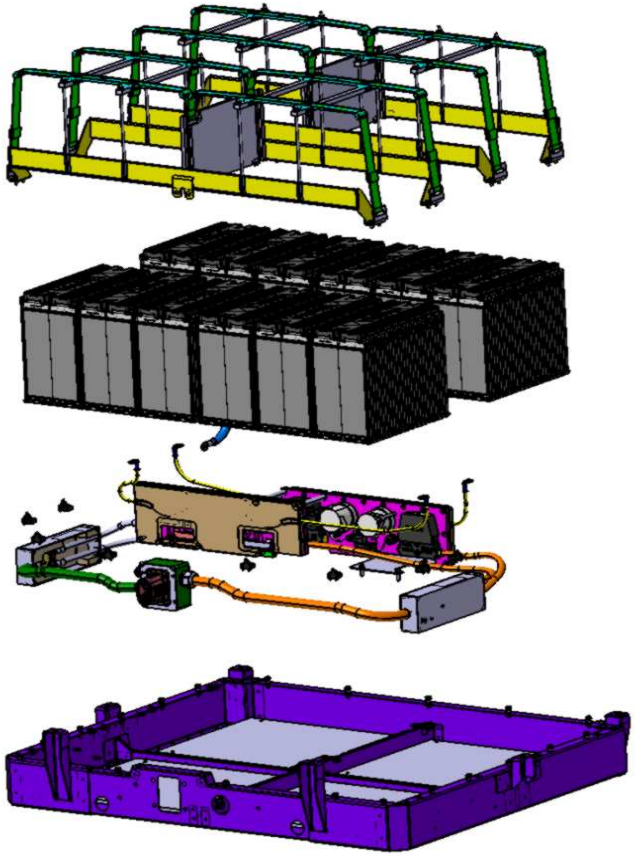
Battery overview (2)

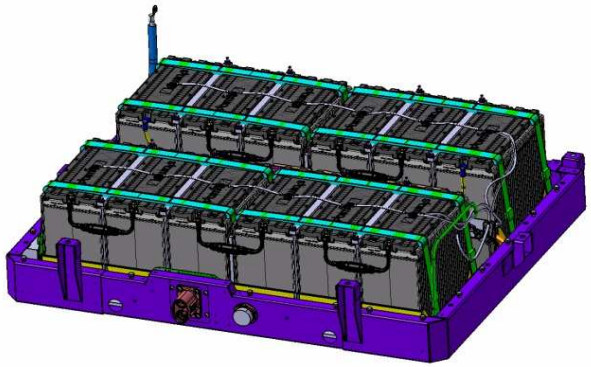
Modules retention allowing individual replacement of modules

Modules with BMS integrated, arranged in two equally shaped strings

HVJB and Main BMS between the two strings

Flat bottom tray with reinforcement structure





Battery assembled, ready for lid and sealing

Modules assembled, retention bars and straps with tightening buckles

Battery test procedures and equipment: vibration

- **Frequency range: 7-60 Hz**
- **Up to 5g continuous acceleration**
- **Up to 8g for 30 minutes**
- **Contiuous logging of acceleration curves from 3 sensors;**
  - Table
  - Jig
  - BMS card
- **Continuous logging of cell voltages through BMS pickups**

In house vibration testing facilities

Battery test procedures and equipment: shock

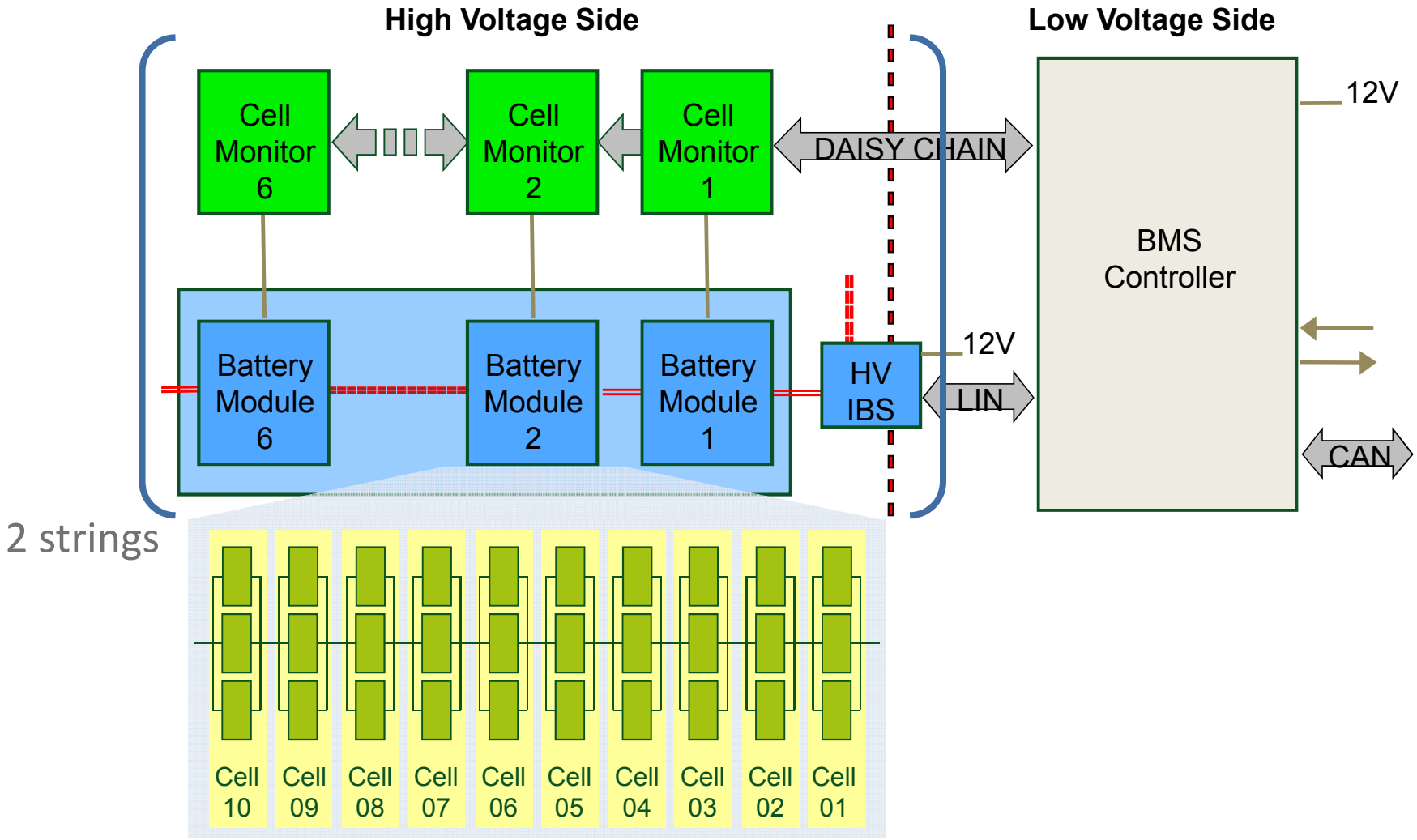
- In line with UN Transportation of Dangerous Goods
- Calibrated to 50g shock load, duration of 11ms
- Three shocks in each direction, along all three axes =>total of 18 shocks

Shock test setup

Control unit architecture (Hella)

BMS concept: partitioning

mirroring HV battery layout



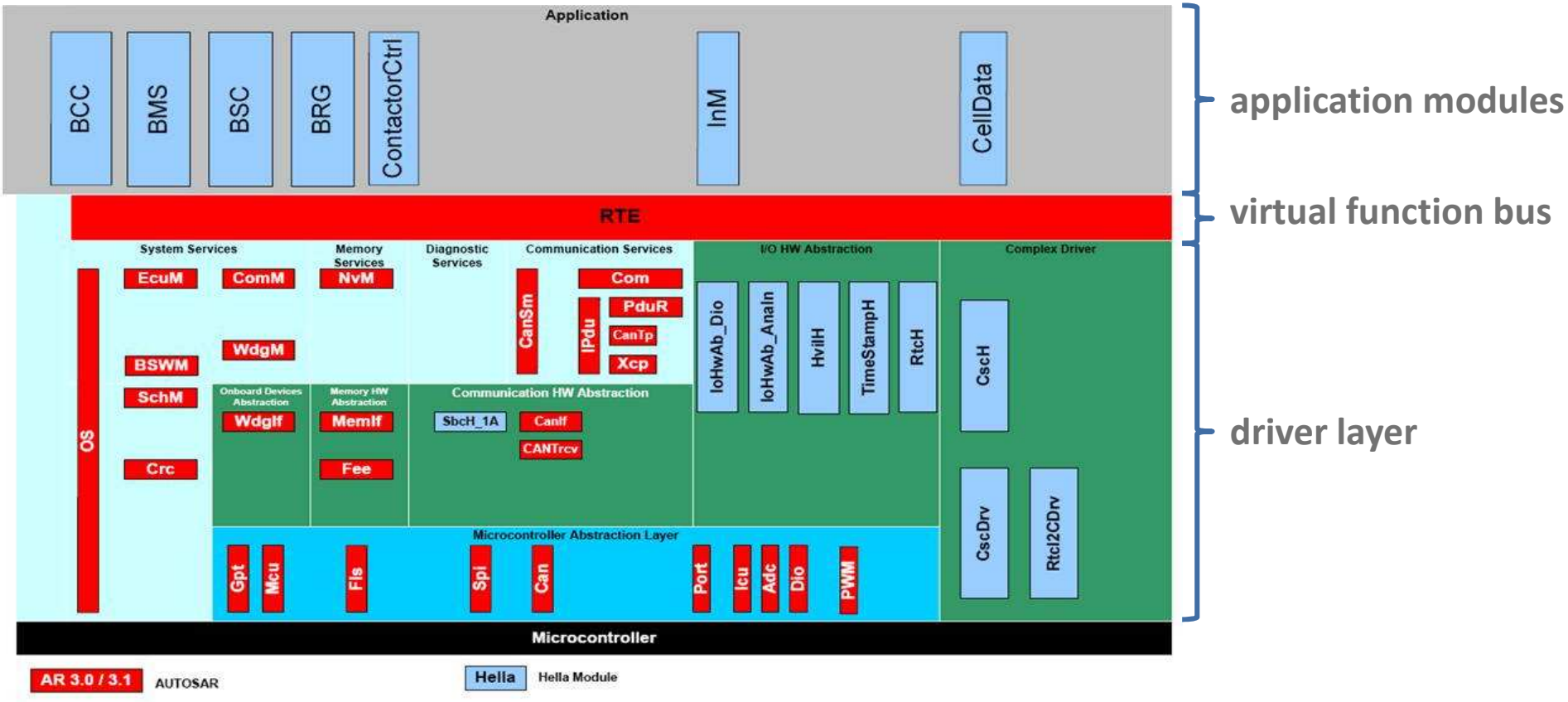
BMS concept: functions

- **main tasks**
  - ensuring the battery safe state and operation
  - ensuring the supply of energy and power
  - ensuring the maximum possible energy / power storage capacity
  - information exchange with other units

- **BMS extent**
  - measurement and control hardware
    - U, I, T measurement; driving main switches; controller
  - measurement and control software

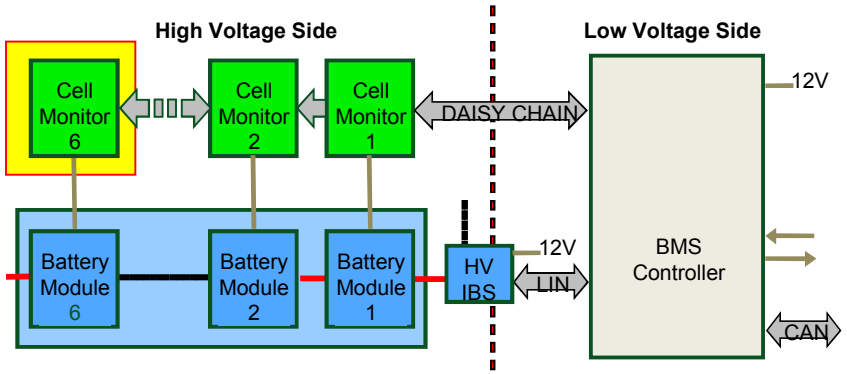
BMS: Software concept

» **Autosar compliant → hardware independent, maintenance ease**



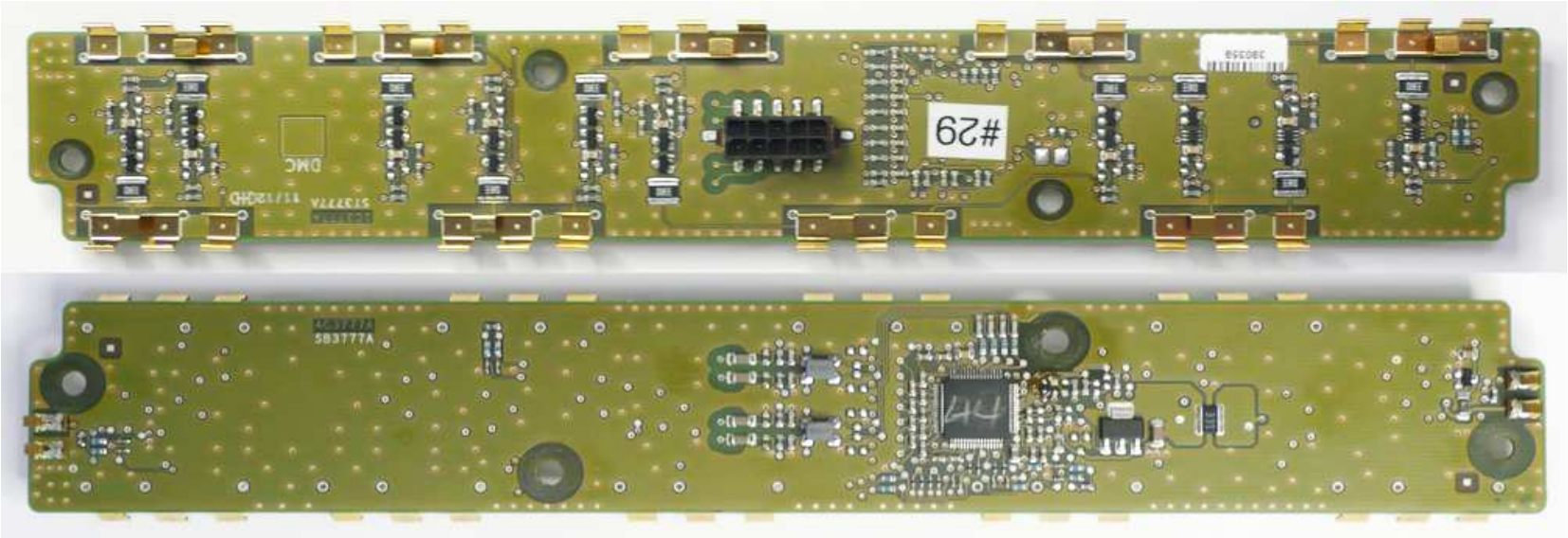
BMS HW: cell monitor

- **Intersil cell monitor IC based:**
  - 10 (12) voltage channels, 4 temperature channels
  - feed off the module; min. 9V / max. 68V
  - daisy chain communication; galvanic isolation
  - daisy chain terminated by TOP device (resistor placement)



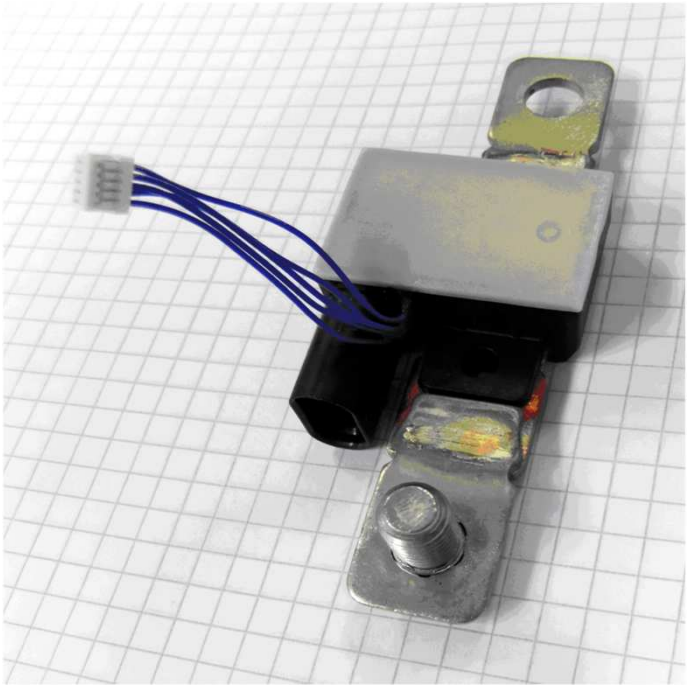
BMS HW: cell monitor – board design

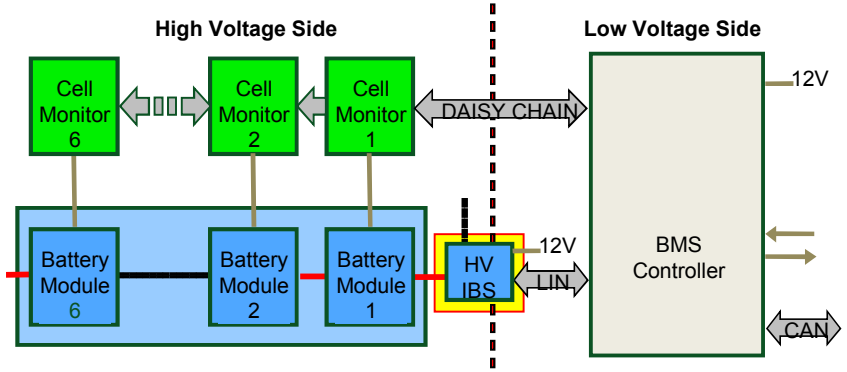
- define package – consider manufacture and maintenance concept
- voltage pickup by means of spring contacts
- define pickup solution and specify springs



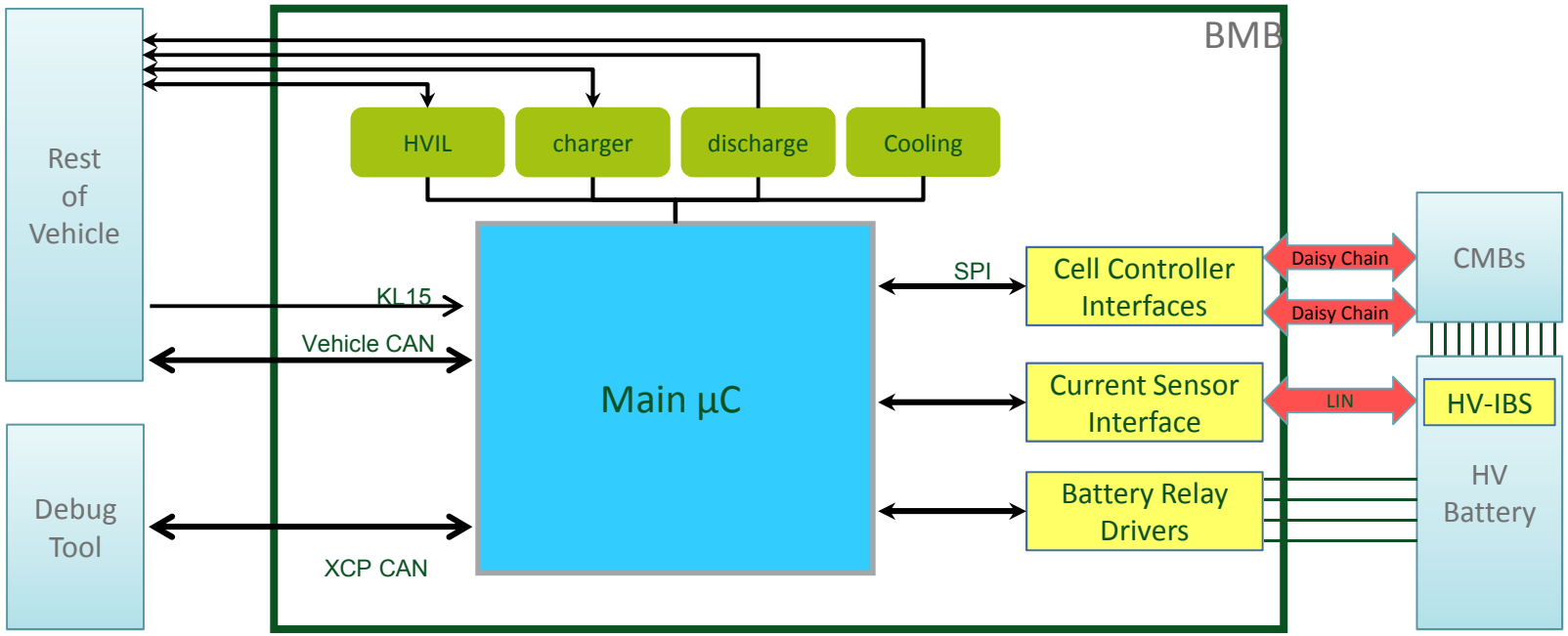
BMS HW: HV current sensor

- **proven design - adapting an available Hella shunt based product:**
  - reprogrammable, JTAG interface
- **specifications**
  - measurement range ±200A (auto ranging, 1mA/12mA/46mA resolution)
  - LIN communication, 100ms refresh rate
  - 12V supply, galvanically isolated

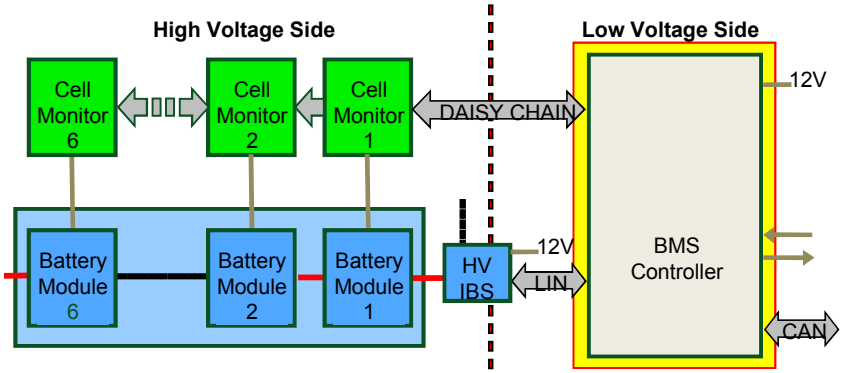




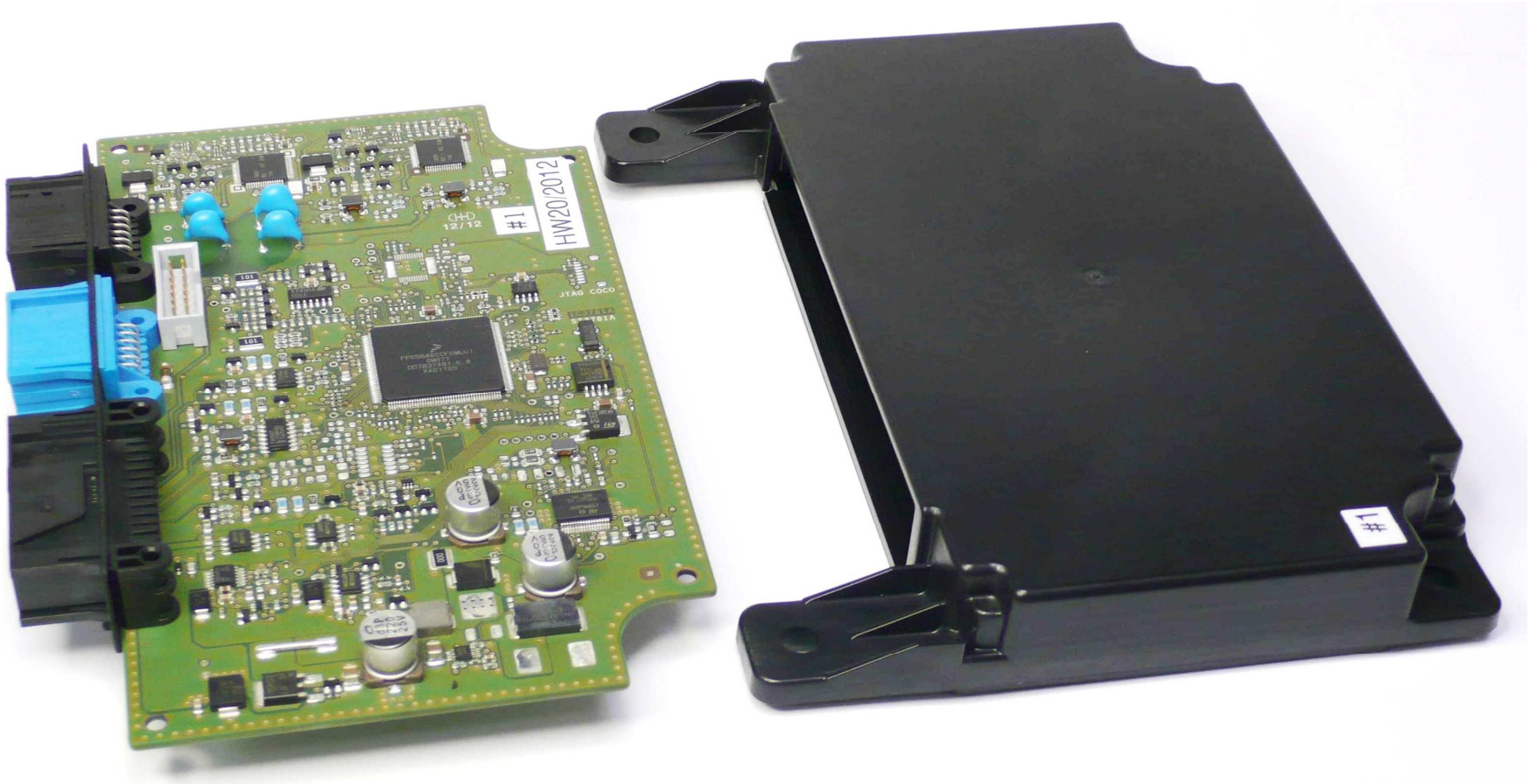
BMS HW: BMS controller



- power feed from 12V
- communication: vehicle CAN, HW I/O, IBS LIN, cell monitor daisy chain

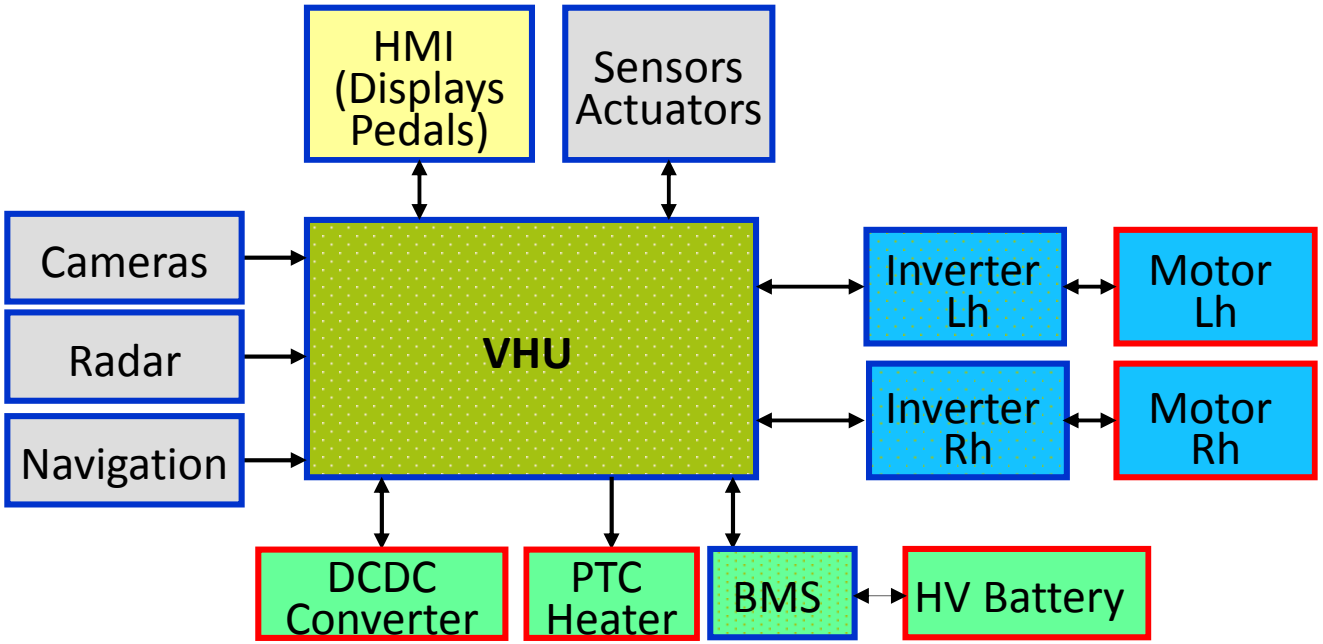


BMS HW: BMS controller



VHU as E/E central node

Vehicle Head Unit



→ Central position in the E/E architecture:

- drivetrain control
- energy control
- HMI input
- sensor input
- peripheral actuators

→ Control function for HV and LV systems

LV
HV

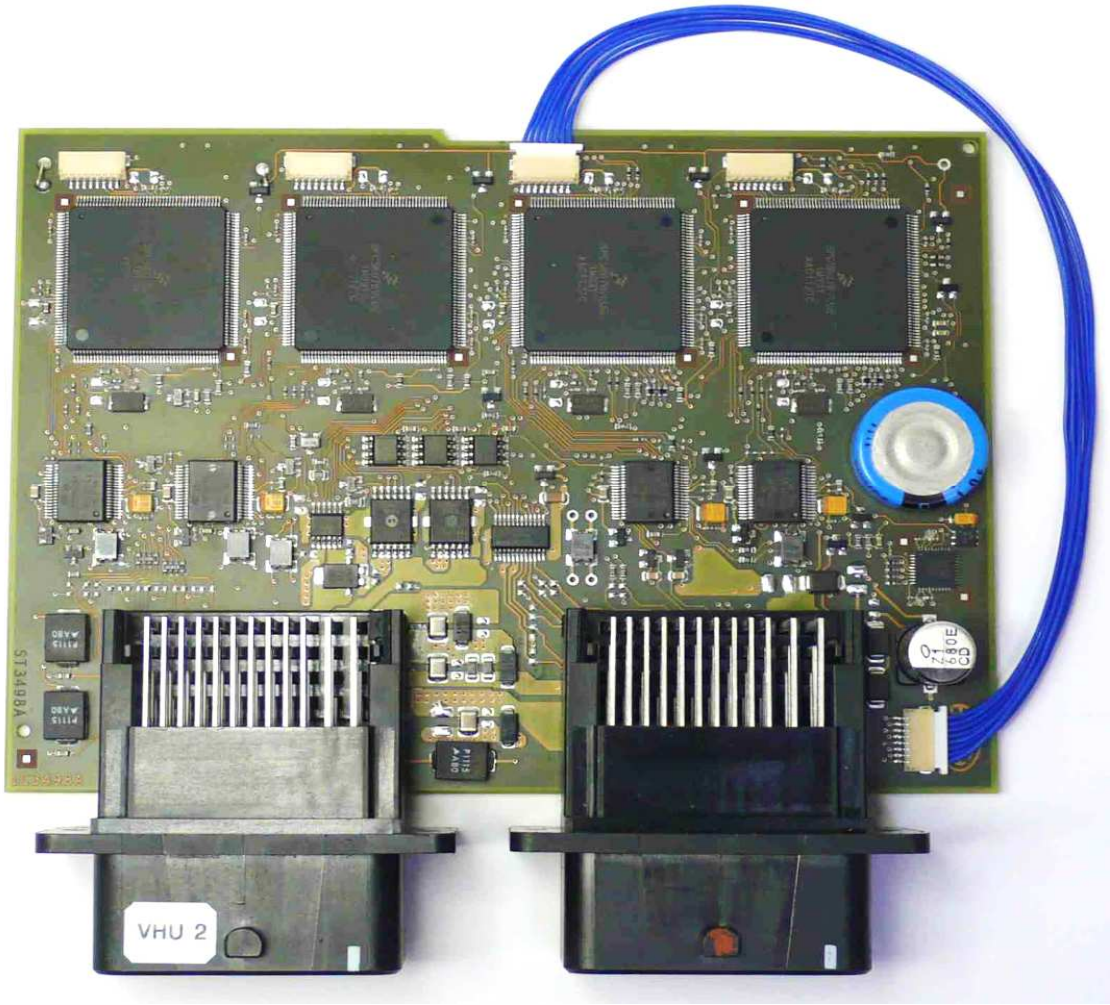
VHU as E/E central node

→ Paired micro controllers
- function supervision
- redundancy
  - drive train
  - HMI
  - sensors & actuators

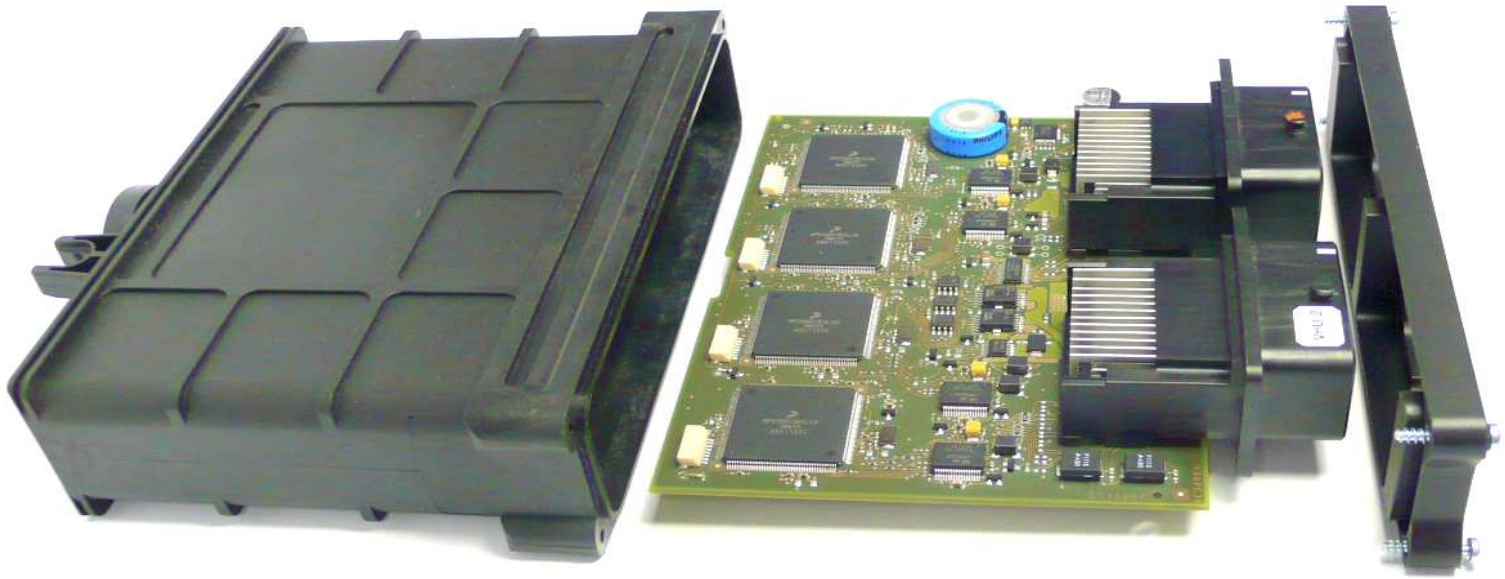
→ System basis chip
- doubling power supply to micros
- watchdog

→ Connectors
- redundant power feed
- redundant CAN

→ AUTOSAR based SW
- decoupled SW modules



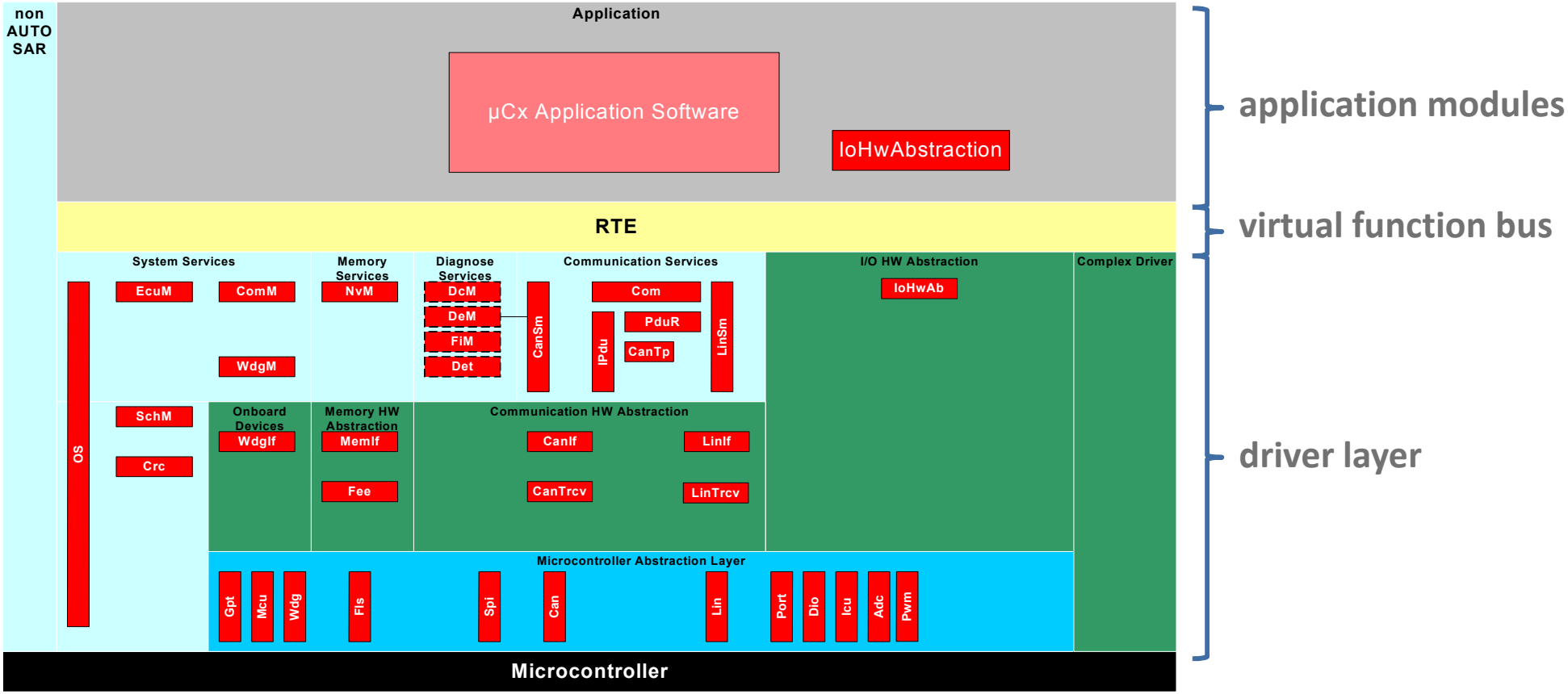
VHU realisation



VHU: Base Software

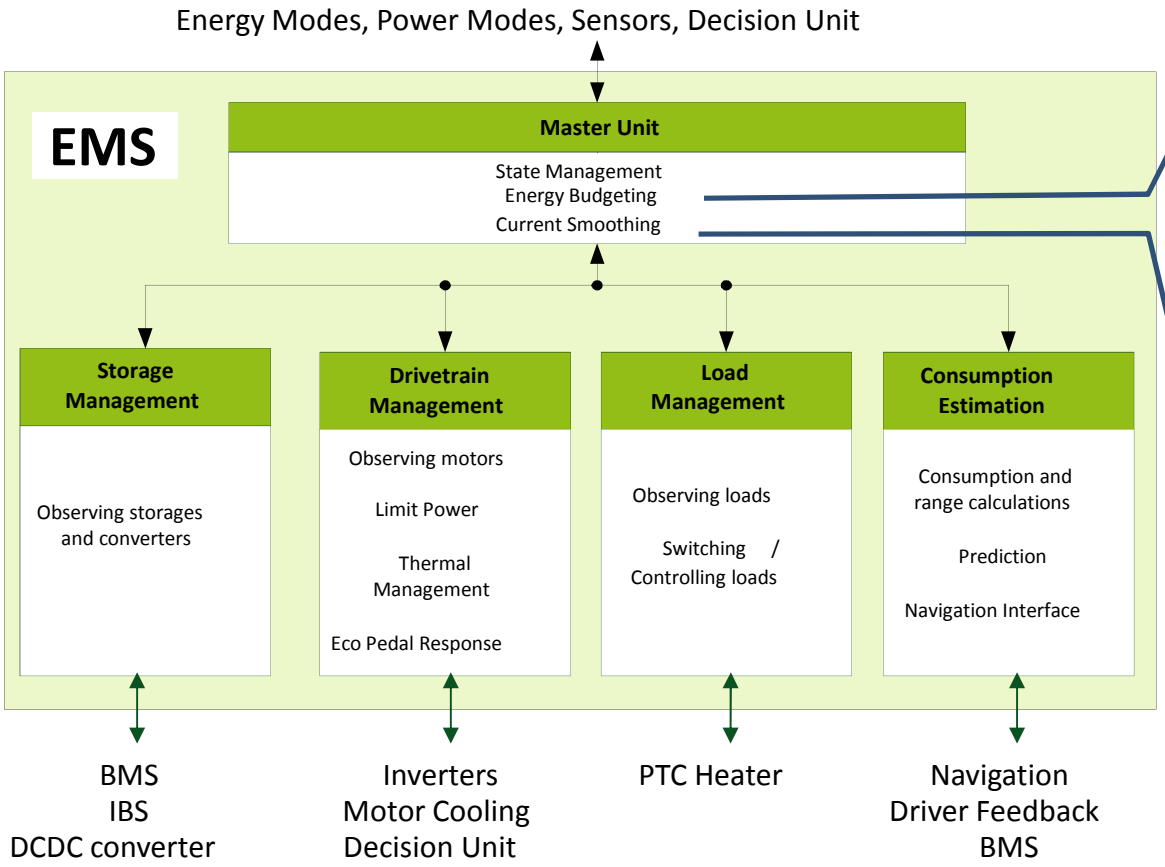
WP510 – Hardware development

- Autosar compliant → hardware independent, maintenance issues
- base for applications (decision units, ADAS, HMI, Energy Management)



Hella: Results for battery and energy management

Vehicle Energy Management Architecture



Key Functions:

- Supervision of current limits and resolve violations
- Distribute the available limited resources (Power, Energy) by limiting the currents of the components due to priorities

Smooth the battery current by load balancing

Energy management: current smoothing

Advantages:

→ Decreased peak power request („virtual capacitor“)

→ Reduced battery stress and increased battery lifetime

→ Stabilized supply voltage

→ Fewer Ohmic losses due to battery and conductor internal resistance

→ Increased power availability for high priority loads

→ Battery design as a tradeoff between power density and energy density

» **reduced power density requirements**

» **higher energy density**

» **higher range**