NGAUTO

SOME REMARKS/THOUGHTS ABOUT AUTOMOTIVE MULTIGIG LINK SEGMENTS

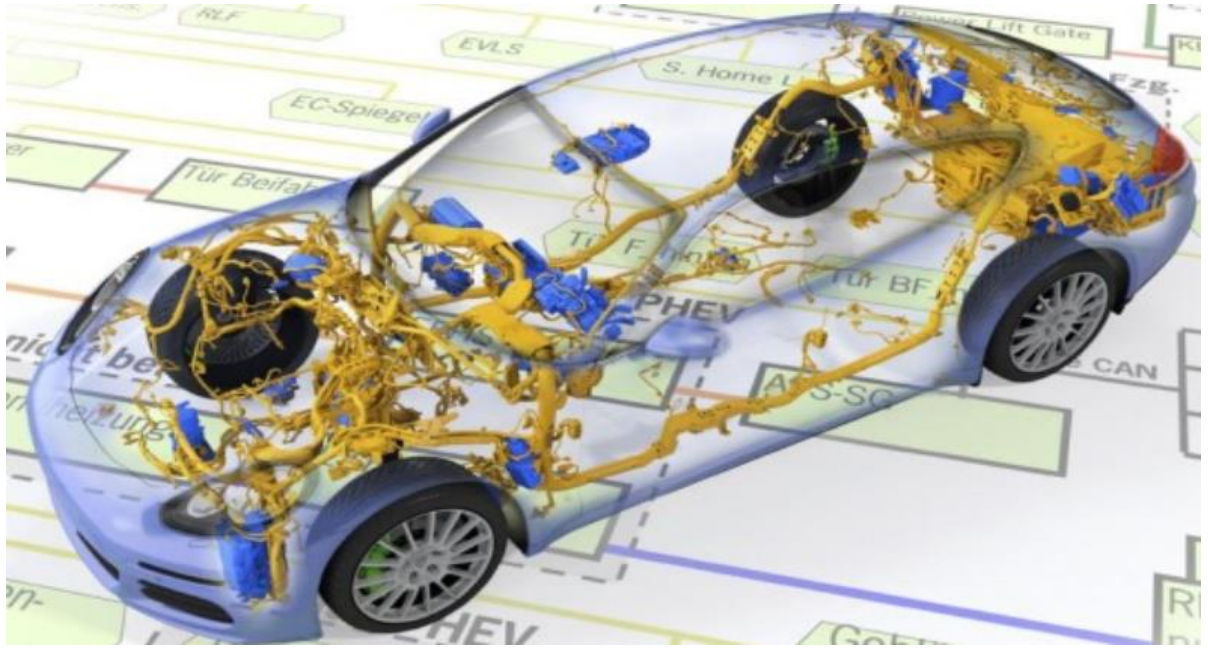
(SINGLE ENDED SIGNALING, E.G. COAX OR DIFFERENTIAL SIGNALING, E.G. STP)

OLAF GRAU

BOSCH

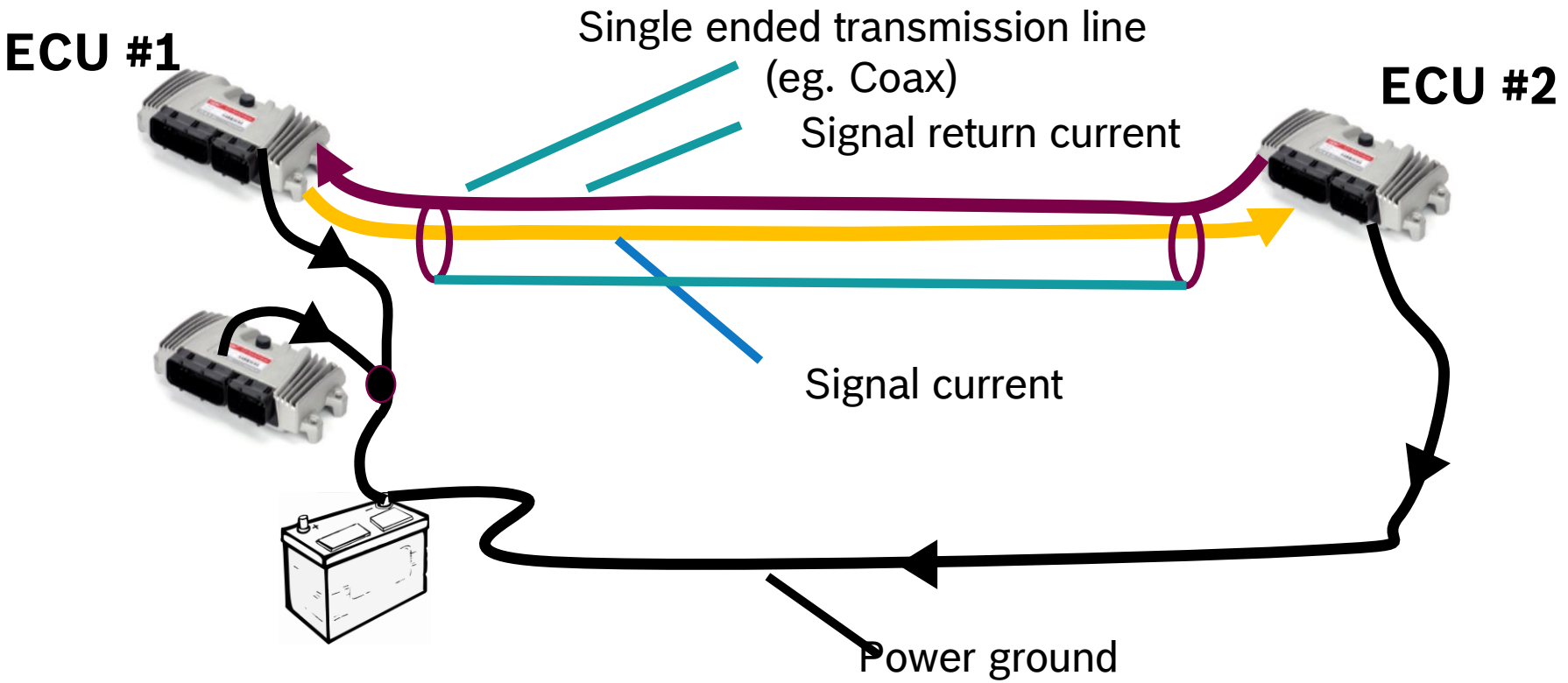
Wiring conditions in a modern car

For space and economic reasons, an automotive wire harness is often **not** designed for having an optimized grounding and noise deflection. Having more and more non metal parts in the car chassis increases the problem of proper grounding conditions.

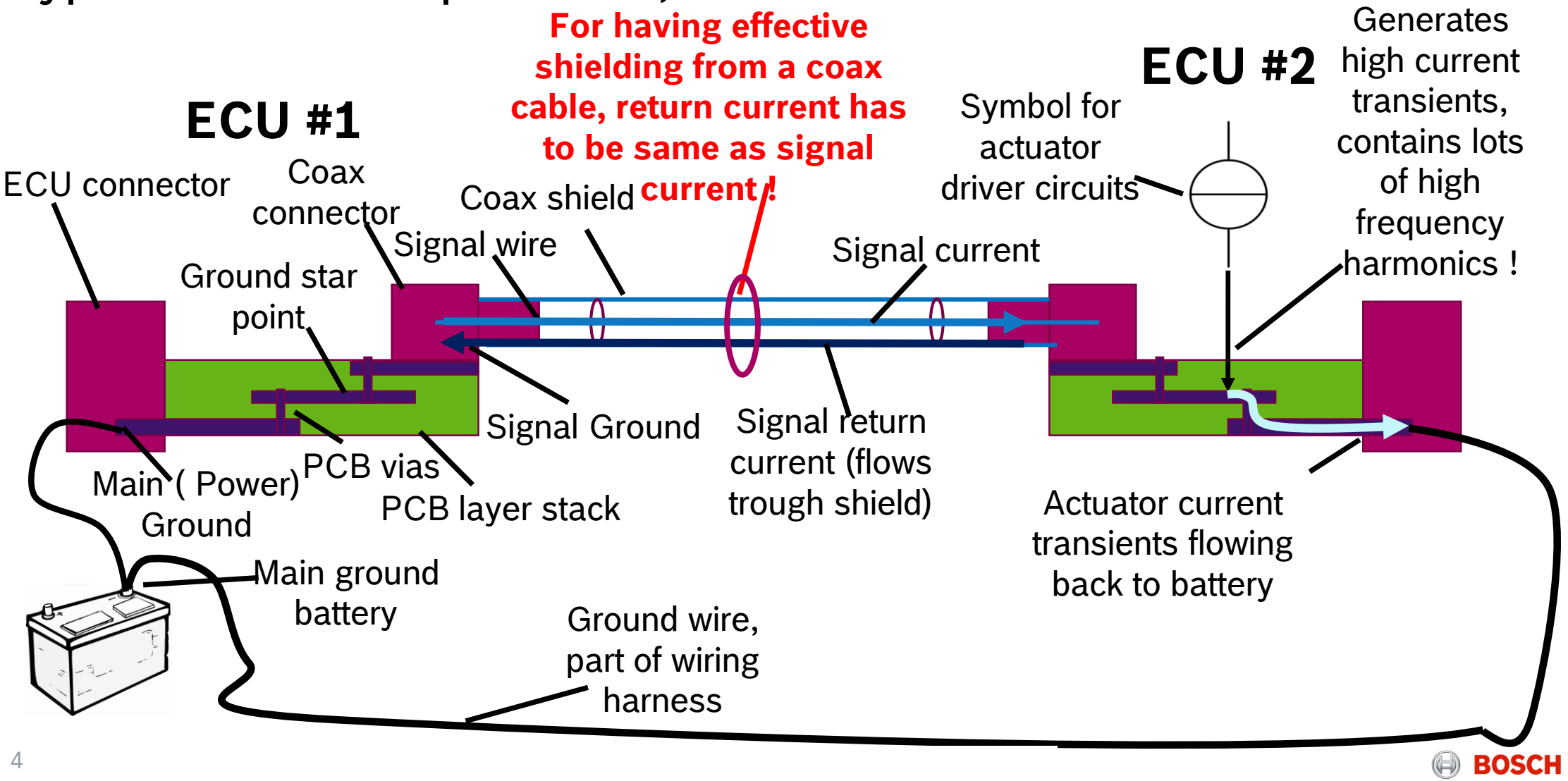


Wiring conditions in a modern car

ECUs are connected with their communication lines (cables), and power supply cables



Typical ECU line up of a car, a closer look



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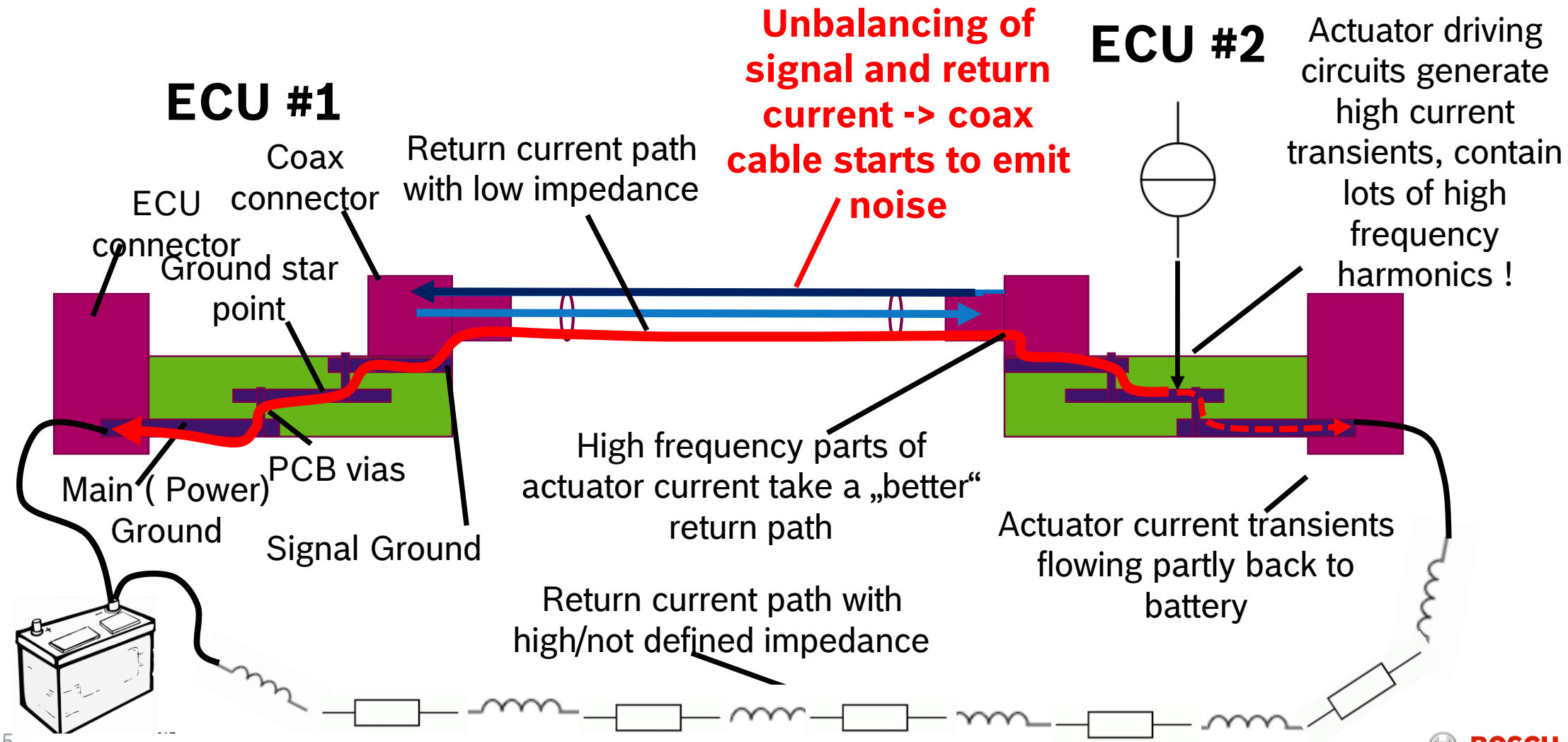
Possible problems by ECU SE interconnection



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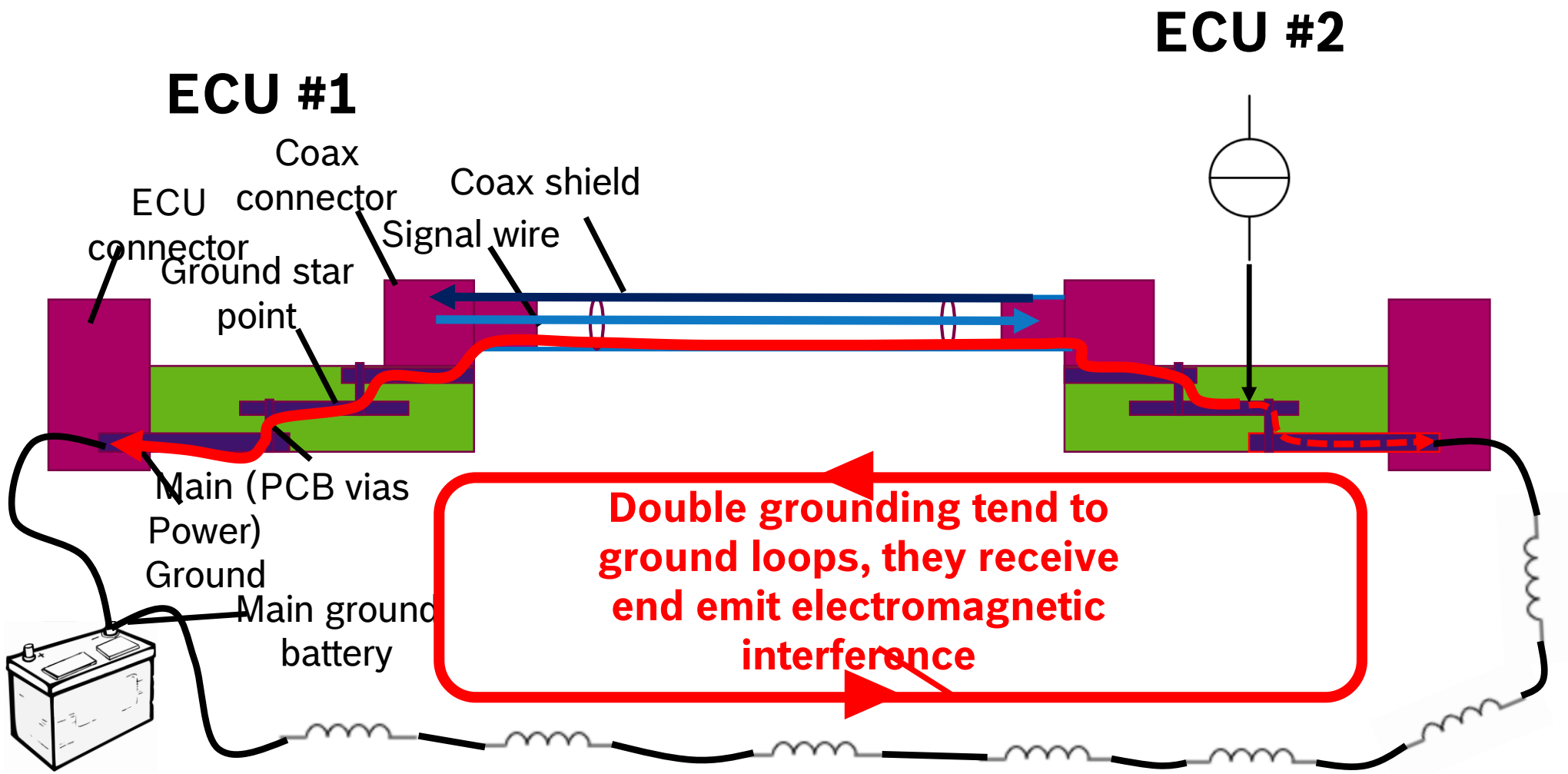
Possible problems by ECU SE interconnection



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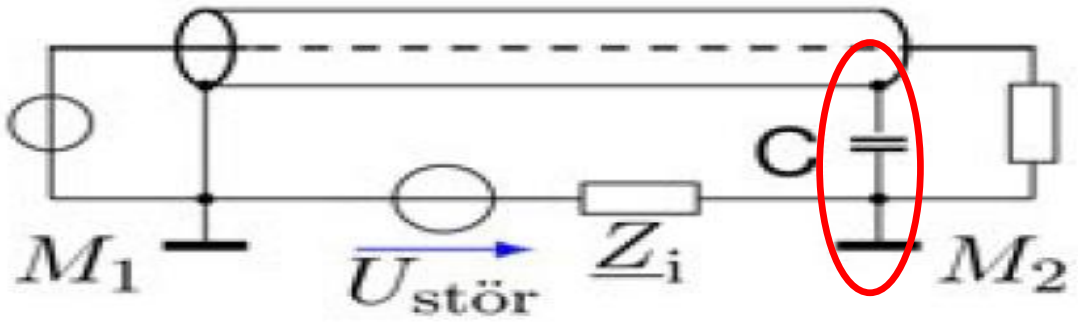
Approach with capacitive grounding

A common approach to eliminate ground loops in single ended systems: one side of the shield is coupled with a capacitor to the ECUs ground, while the other side is directly coupled to ground.

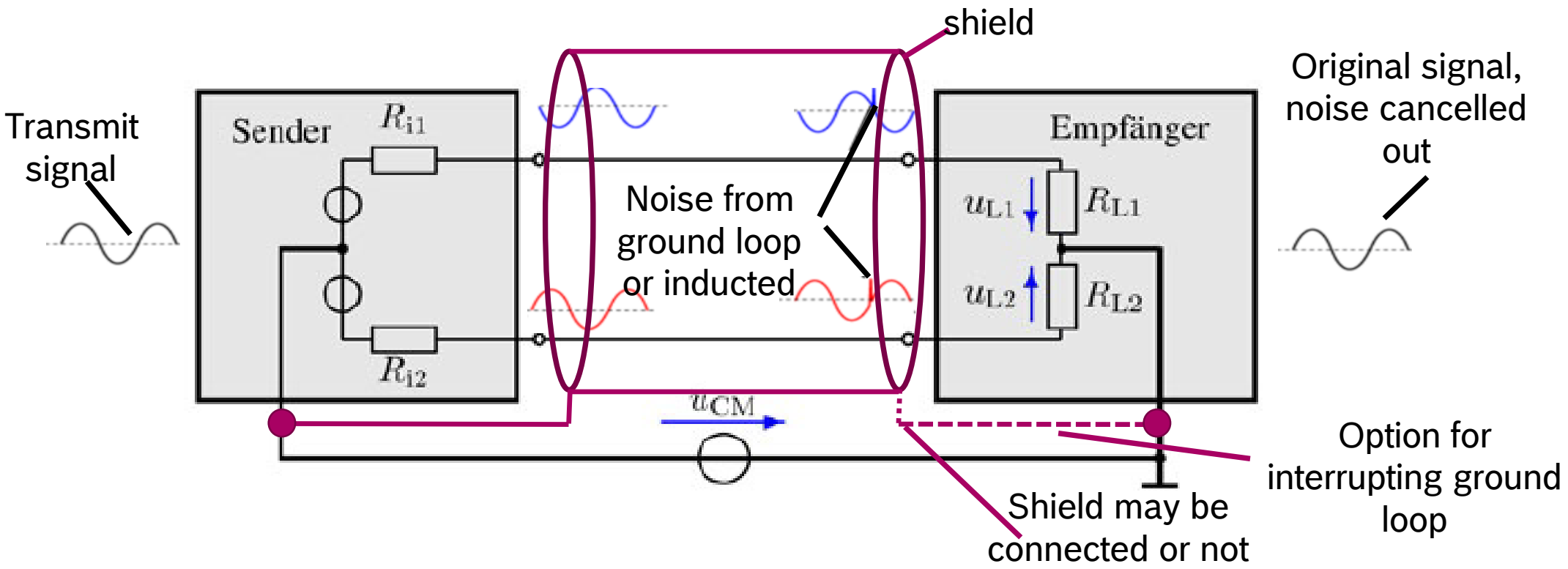


Drawbacks:

- Ground loop interception only for lower frequencies
- Power over coax is not possible
- Difficult to realize galvanic decoupling (48V or HV future automotive power net architectures)
- common mode noise rejection is difficult

Differential signaling in car

By using a differential signal transmission, noise occurs on both signal lines at the same time (common mode noise). Noise will be canceled out by the differential input stage of the transceiver

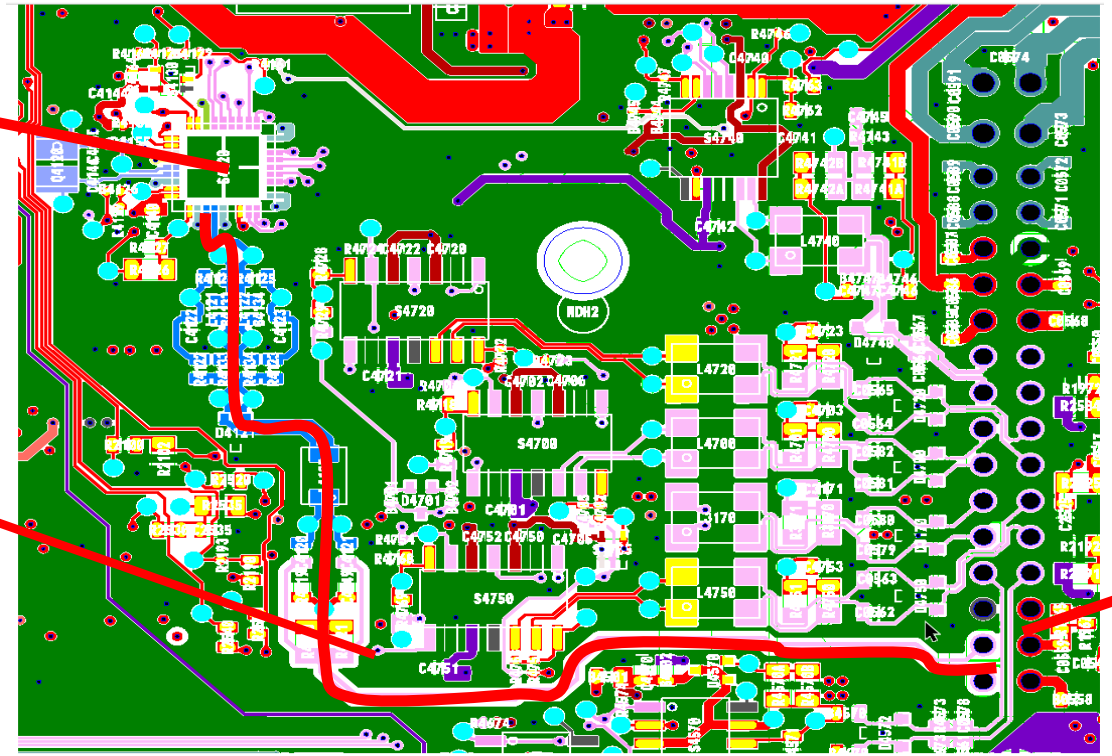


Differential signaling on a ECU PCB

Differential signaling on a PCB gives more freedom in component placing; it is not necessary to place a PHY that uses differential signaling in the connector PCB area:

PHY

Symmetrical and impedance matched Ethernet wire traces over a „long“ distance



ECU connector

Differential signaling in car (e.g. STP)

Advantages differential signaling:

- By keeping the symmetry (delay time, impedance,..) in the PCB layout, it is possible to make the wire traces from the PHY to the ECU connector longer than using a single ended solution-> more freedom in placing parts on the ECU PCB.
- Inside an ECU, differential signaling causes less EMI problems than a single ended wire trace
- Easy Common mode rejection (with an CMC)
- Easy PoDL implementation
- Easy galvanic decoupling implementation possible (transformer)
- Easy to interrupt ground loop

Differential signaling in car (e.g. STP)

Disadvantages differential signaling:

- By differential signaling, low tolerance in cabling and connectors are required, (mode conversion)
- PCB design has to be as symmetric as possible (needs PCB space)
- STP handling while manufacturing wiring looms, causes nearly the same effort like a coax cable

Conclusion

- For the NGAUTO link segment differential signaling should be preferred (STP, TWINAX,...)
- Economical feasibility of STP in comparison of COAX has to be investigated

Thank You !