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Automotive trends and their implications on the material mix in vehicle electronics

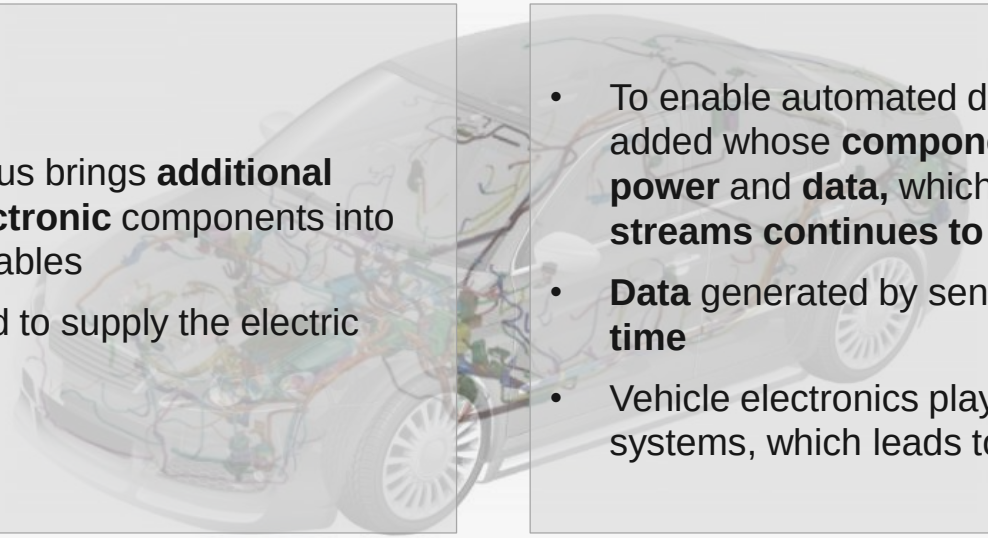
Author: Laura Fautz

Challenges for vehicle electronics through automotive trends

Major trends in the automotive industry

Electric Vehicles	Automated Driving

... and their influence on vehicles electronics.



- Controls the electric motor and thus brings **additional electrical wirings** and **other electronic** components into the vehicle, for example battery cables
- **High-voltage cables** are required to supply the electric drive from the battery

- To enable automated driving, **more functions** have to be added whose **components** need to be **supplied** with **power** and **data,** which also means that the volume of **data streams continues to increase**
- **Data** generated by sensors must be **transmitted in real time**
- Vehicle electronics play a **safety-critical role** in automated systems, which leads to a necessary fail-safe design

This results in the **increasing complexity** and **importance** of vehicle electronics to transmit a **higher amount of power** and signals **faster** and more **reliable**.

Requirements for the vehicle electronics of electrified and automated vehicles

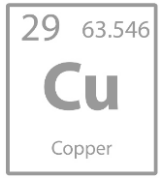
- Save weight and installation space
- Integration of a wide range of electrical components for new features
- High voltage capability (up to 1000V)
- High reliability
- Redundancy for all safety-critical systems
- Highspeed data transmission
- Transmission of enormous amount of data

Changing requirements for vehicle electronics **offer potential for material suppliers to participate** in the market by **optimizing currently used material (mixes).** In terms of quantity, the **cable harness is of particular interest here**, as it has a high total weight and thus a high material demand.

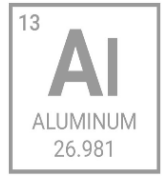
Detailed consideration must be given whether the trends for electric vehicles and automated driving will lead to **increased** or **decreased material requirements** for vehicle electronics.

One of the top priorities is the potential to save weight and installation space through material selection

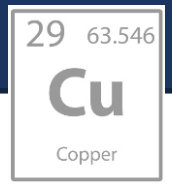
Currently	Predominant use of **heavy copper cable**

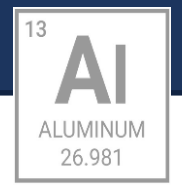


Alternative	**Use of lighter aluminum cables,** because a wiring system made of aluminum could theoretically be around ten kilograms lighter than the copper variant.



Challenges in the use of materials





Copper is around three times **heavier** than aluminum for the same volume and thus contributes significantly to the high harness weight.

For the same weight, copper costs about three times as much as aluminum. At the same time, since the weight of copper cable is higher due to its high density, copper is the significantly **more expensive** material.

Aluminum has a **lower density and conductivity** compared to copper which leads to **increased cross-sections**. This is a challenge due to the limited installation space.

Forms an oxidation layer when exposed to air, which results in **high contact resistance** at the contact points.

Aluminum **"creeps" at higher temperatures**. Classic crimp connections are therefore not reliable enough, because aluminum changes its shape in the micrometer range.

To save weight and installation space a mix of different materials could be the solution in the cable harness

	Copper	Aluminium	Plastic Optical Fibre
Low electrical load	*reduces cable size*		
High electrical load		*reduces cable weight of e.g. battery cable*	
Data transmission			*Fast data transmission*

	Copper	Aluminium	Plastic Optical Fibre
Density	8.9 g/cm³	2.7 g/cm³	**1.19 g/cm³**
Electrical conductivity	**100%**	60%	*Transmits data via light; highest data transmission speed*
Costs	€€	**€**	€€€
Sustainability (GWP)	**1.71**	8.31	5.08 (Plastic Average)

Use of **mixed scenarios** by **changing individual cables**

Further automotive trends and their implications on material demand for vehicle electronics

increasing material demand

New Features

- ✓ additional ECUs
- ✓ additional cables
- ✓ high bandwidth

Through the development towards **automated driving**, new functions are finding their way into the vehicle and thus **also additional components such as sensors and cameras**. These have their **own ECU and require additional wiring.**

Redundancy

- ✓ duplicated cables

Doubling the network connections and data streams is necessary to ensure the required safety. To save space and weight, **innovative conductor materials** and **cables with thinner walls and smaller diameters** can be used.

decreasing material demand

Zonal Architecture

- ✓ reduction of ECU's
- ✓ less cables
- ✓ shorter cable runs

All functions within a physical area are **assigned to a zone**, which means that **fewer cables** are required and **cable routes are shorter**.

Automotive Ethernet

- ✓ high bandwidth
- ✓ low latency time
- ✓ low weight

The **weight of the cable can be reduced** while at the same time increasing the bandwidth and reducing the latency time.

800V Technology

- ✓ thinner cable cross sections

800 volts allow the use of **thinner cables** for the wiring, which **saves installation space and weight.**

Summary and typical questions for businesses

Summary

Vehicle electronics play an **important role in current and future vehicles.** A **increasing number of cables are needed** for automated, connected vehicles as well as for complex infotainment systems, while at the same time **changing architectures and new technologies can reduce the demand**.

As the basic architecture of vehicles is currently undergoing major changes due to emerging trends of electrification and automatisation, **there is potential to optimize the vehicle electronics through adapted material mixes**.

Potential questions for businesses

- **How will the material demand for vehicle electronics develop for different vehicle classes and target markets?**
  Technology trend analysis and market intelligence
- **How can the weight of vehicle electronics be reduced through material innovations?**
  Technology assessment
- **How will vehicle architecture change and what impact will this have on material demand?**
  Technology trend analysis
- **What variables can affect the demand forecast for vehicle electronics materials?**
  Requirement engineering and market modelling

fka GmbH
Steinbachstr. 7
52074 Aachen
Germany

phone +49 2418861 126
e-mail Laura.Fautz@fka.de
web www.fka.de

Laura Fautz