

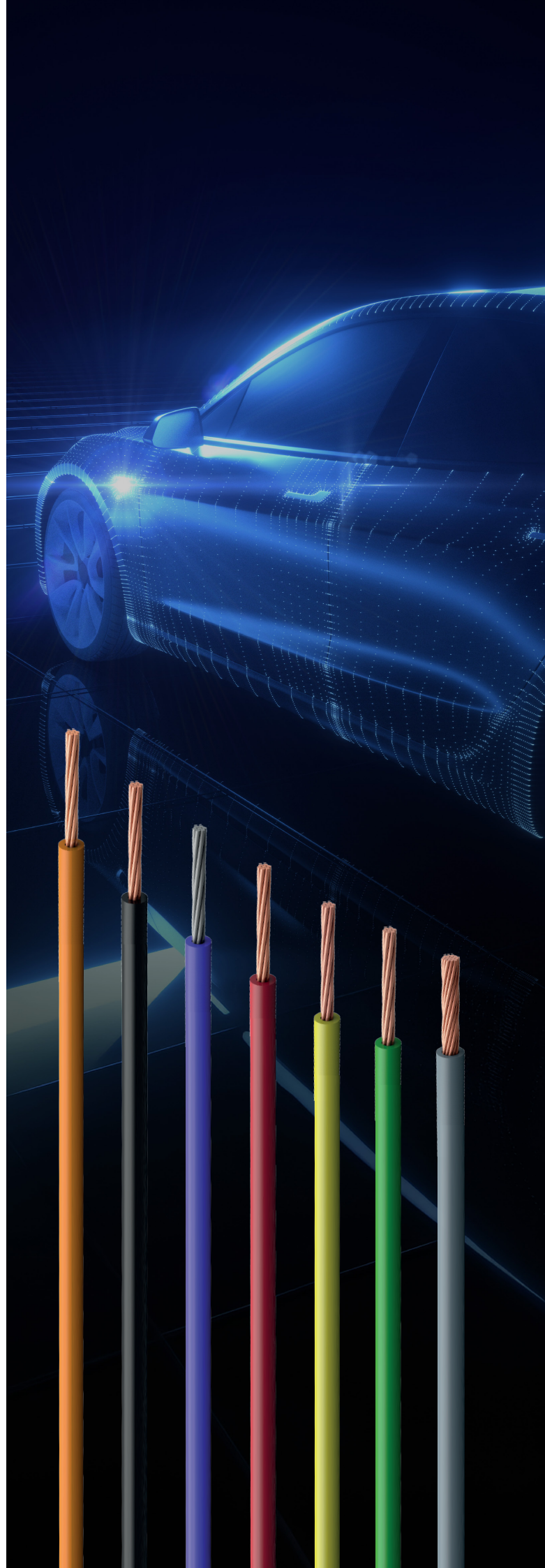
# Accelerating the 48V transition

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## Up to 70% less conductor weight

Why aluminum conductors is the next  
strategic lever for automotive wiring  
optimisation

## White paper



**Increasing electrification (mild hybrids, ADAS, electric auxiliaries) is driving the transition from traditional 12V systems to 48V electrical architectures in modern combustion engine vehicles.**

**This shift significantly increases current demand and wiring complexity.**

As such, the average passenger car has seen its wire content increase:

- Before 2000: **1km/car**
- Around 2020: **3km/car**
- After 2025: **5km/car**

At the same time, OEMs are under strong pressure to reduce vehicle weight, cost, and CO<sub>2</sub> emissions. This opens the way for alternatives to copper conductors such as aluminum. Japanese car manufacturers already use aluminum conductors for specific applications, such as door electrical harnesses, which have demonstrated the possibility to integrate aluminium for dynamic loops and with watertightness.

This paper evaluates:



The impact of aluminum wires in 48V systems.

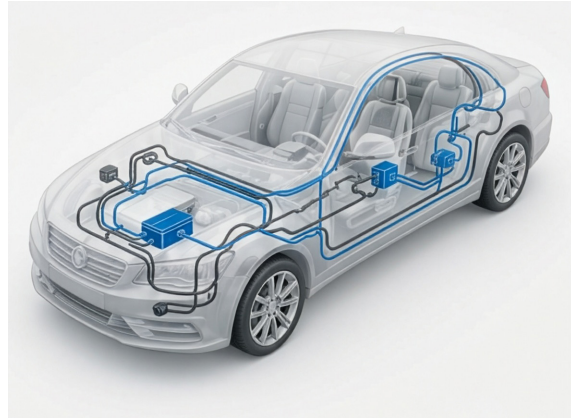


The benefits and trade-offs versus copper.

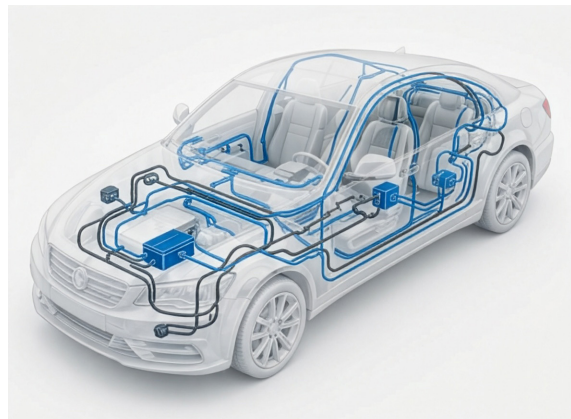


The design and reliability considerations required for safe adoption.

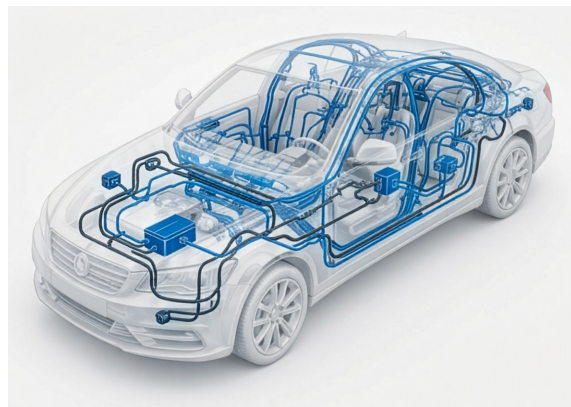
Before 2000 **1km/car\***



Around 2020 **3km/car**



After 2025 **5km/car**



**5x** more wire content  
in about 25 years

# What is a 48V architecture?

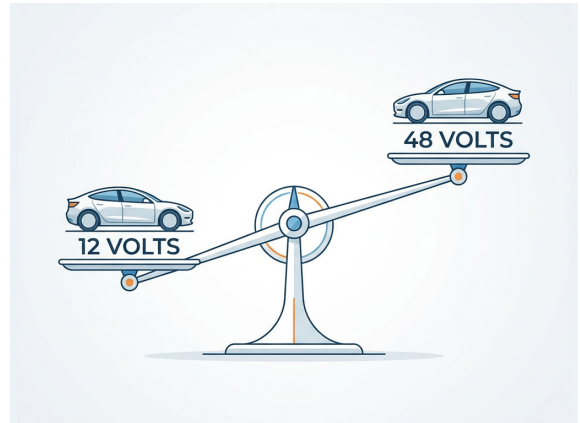
Almost all modern combustion engine cars use 12V architectures (even electrical vehicles).

With the formula  $P = V \times I$ , by increasing the voltage from 12 to 48 volts, the current can be decreased for the same power.

$$12V \times 100A = \mathbf{1,200W} \leftrightarrow 48V \times 25A = \mathbf{1,200W}$$

*Same power, lower current*

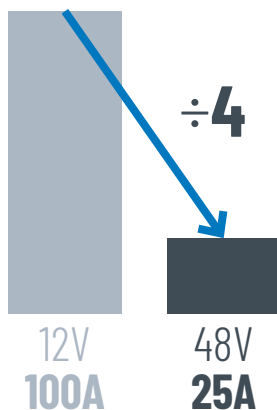
The effect is a conductor cross-section reduction with multiple benefits: lower Joule effect, improved system efficiency and reduced harness space. But deploying a 48V architecture in a car demands significant changes in electronics which do not show immediate savings, if done on its own.



## Effects of increasing the voltage from 12 to 48V

### Current

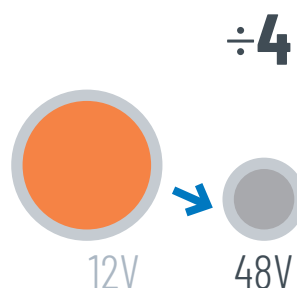
Higher voltage means lower current for the same power.



Current divided  
**by 4**

### Cable cross-section

Lower current allows for a smaller conductor cross-section.



Cable cross-section could be divided  
**by 4**

# Why aluminum wires?

Copper is the globally acknowledged reference electrical conductor.

But since the beginning of the 21<sup>st</sup> century, it has significantly increased in price, making it the first material cost center in an electrical harness, in 2026.

To the increasing copper price are added the signals of growing scarcity for this metal.

What was once a niche market before the 2020s, is making aluminum conductors a necessary commodity.

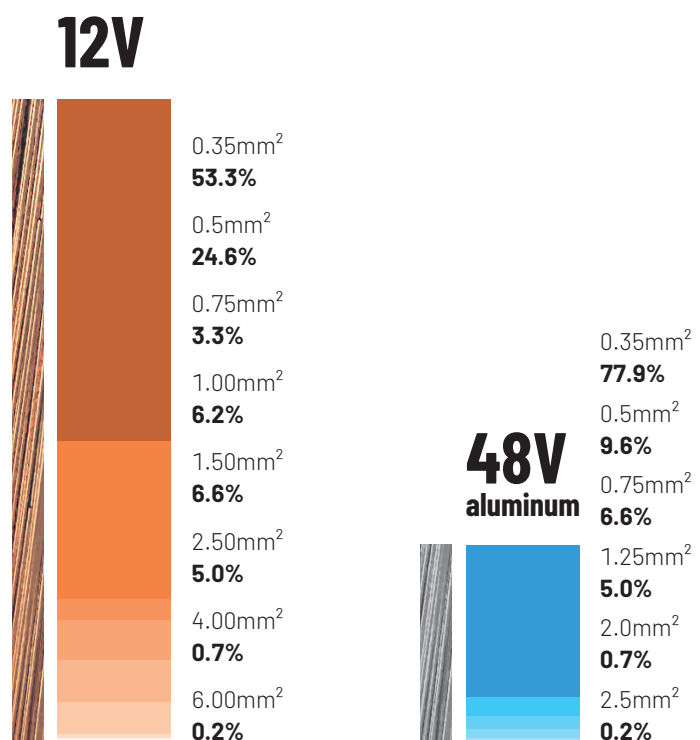


## The benefits of combining 48V architecture with aluminum wires

From a practical aspect, a modern car uses 12V harnesses with 3km of copper wires, on average.

In the below comparison, we will see from a wire point of view only, the impact of switching to a 48V harness architecture, with aluminum wires.

## Wire cross-section mix in a car: current 12V vs. future 48V aluminum<sup>1</sup>



24kg → 7,3kg

**70%**  
lighter



Switching to 48V aluminum keeps initial cross-sections, while dividing wire weight by three.<sup>1</sup>

The cost of the wires in a car will also be divided by three, because of the lower cross-section and the use of aluminum instead of copper.

The insulation materials are compatible with 48V architecture for 100°C to 150°C. Depending on the needed application, PVC, PP and XLPE are the commonly applied insulations.

It is obvious that the shrinking wire cross-section will have collateral benefits, such as thinner protection tubes, overall lower weight and more compact electrical harnesses. The effect should extend to the car manufacturer’s workers on the assembly line, with lighter and more flexible harness branches. It will make the life easier for workers on the car manufacturer’s assembly line and improve overall performance in the assembly process.

|                                           | <br>Copper                                                                  | <br>Aluminum                                                     |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Average cash price July 2026 <sup>2</sup> | 12€/kg                                                                                                                                                         | 3€/kg                                                                                                                                               |
| Price variation over 5 years <sup>2</sup> | 41 %                                                                                                                                                           | 36 %                                                                                                                                                |
| Specific production process               | None                                                                                                                                                           | None                                                                                                                                                |
| Crimped terminals                         | Yes                                                                                                                                                            | Yes                                                                                                                                                 |
| Wire weight per car (3km)                 | 24kg                                                                                                                                                           | 7kg                                                                                                                                                 |
| Estimated shortage horizon period         | 2030-2040                                                                                                                                                      | None                                                                                                                                                |
|                                           |                                                                                                                                                                |                                                                                                                                                     |
|                                           | 12V                                                                                                                                                            | 48V                                                                                                                                                 |
| PROS                                      | <ul style="list-style-type: none"><li>• Mature ecosystem</li><li>• Proven reliability</li><li>• Low complexity</li></ul>                                       | <ul style="list-style-type: none"><li>• Less waste of energy</li><li>• Better performance for A/C, steering, etc.</li><li>• Thinner wires</li></ul> |
| CONS                                      | <ul style="list-style-type: none"><li>• Increase current for more power</li><li>• Heavier electrical harnesses</li><li>• Bigger risk of tension drop</li></ul> | <ul style="list-style-type: none"><li>• Development cost for passenger cars</li><li>• Supply chain only for heavy duty vehicles</li></ul>           |

## In conclusion

The processing and metallurgy technologies have evolved to a level where passenger cars use aluminum wires outside of engine applications, interchanging from the traditional copper wires with relative ease. The switch to 48V electrical architecture is a necessity for the ever-growing equipment that needs to be powered in tomorrow’s combustion engine cars, especially low budget. The combination of aluminum wires and 48V architecture will bring

much needed competitiveness to car manufacturers and suppliers alike.

The readiness of suppliers such as ACOME Group and major connectors makers, combined with the increasing cost-incentives towards 48V electrical architectures make this a credible and tempting lever for car manufacturers seeking lower costs and emissions, while improving the overall performance.

<sup>2</sup>Boursorama.com



### **Mihai IULIUS**

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He has been with ACOME for over ten years, also holding position as Key Account Manager and Sustainability Coordinator for the automotive branch.