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CONNECTED MOBILITY DEMANDS END-TO-END SECURE AND ULTRA-RELIABLE HIGH-SPEED, TIME-SENSITIVE NETWORKING INTEGRATION

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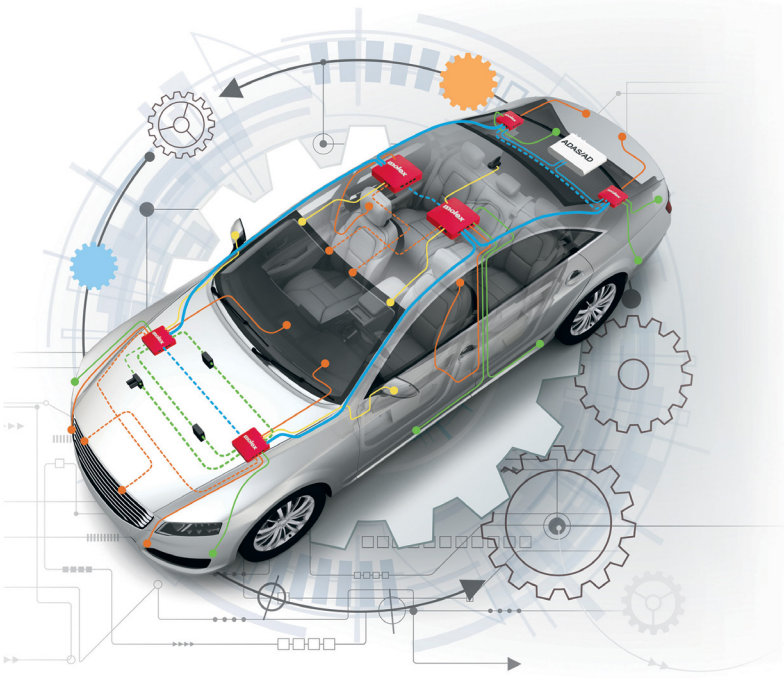
Automotive OEMs and Tier 1 suppliers are facing new challenges as they strive to design and build the next generation of intelligent vehicles. To support the future of connected mobility, they require ultra-reliable, high-speed connectivity solutions, with seamless end-to-end network integration across hardware, software and services. In response to intense industry demand, electronic solutions provider, Molex offers a complete in-vehicle networking ecosystem that enables the automotive industry to meet these requirements. Joe Stenger, Global Product Manager In-Vehicle Networking, Gateway and Switch Solutions, explores the connected mobility megatrend, as it continues to redefine not only cars, but also an entire intelligently interconnected urban transportation infrastructure. Stenger also outlines how Molex's 10Gbps high-speed, time-sensitive automotive Ethernet network platform can fully integrate mission critical applications to deliver signal integrity, network traffic prioritisation, system scalability and security – all of which is essential to optimal autonomous vehicle performance.

A PARADIGM SHIFT IS COMING

The automotive sector stands on the brink of a revolution that will transform vehicles themselves, our relationship with them and how they interact with the environment around them. As with other sectors, the impact of digitalisation and new business models are being felt in the automotive landscape. According to a report completed by Citi*, by the year 2030 the auto industry will be characterised by four types of verticals. These in turn are categorised by four types of vehicles: Robotaxis (mobility on demand), AV subscriptions (driverless capable cars), combination of Robotaxis/ AV subscriptions and traditional ownership. Connected mobility encompasses a range of applications and technologies that represent the future of our intelligently interconnected urban transportation infrastructure, including the advanced driver assistance systems (ADAS), connected infrastructure and V2X (vehicle-to-everything) technologies that will enable automated driving (AD) vehicles. But it will rely on more capable high-speed, ultra-reliable, time-sensitive networks than are currently in general use, both in-vehicle and beyond.

There is a fairly universal agreement across many market studies that the value of the global autonomous vehicle market will grow substantially during the next decade. However, when it comes to the car of the future the Citi report* states that there has got to be greater stakeholder alignment. It goes on to say that when thinking about innovations such as AI, connectivity, electrification and big data, there is perhaps no more obvious use than the Car of Today. The age of mass-market personal cars solved many of yesterday's mobility problems, but also created new ones, such as congestion, pollution, and underutilised urban infrastructure. Vehicle safety, while vastly improved, remains a substantial societal and economic problem which unfortunately is not getting any easier in the age of distracted driving.

The Car of the Future then, as cited in the report, combines advancements in AI, connectivity, computing power, and electrification. Promises not only to address many of these problems, but also to potentially change personal mobility as we know it. The immediate question that arises is: "who pays for it all?" The short answer, is



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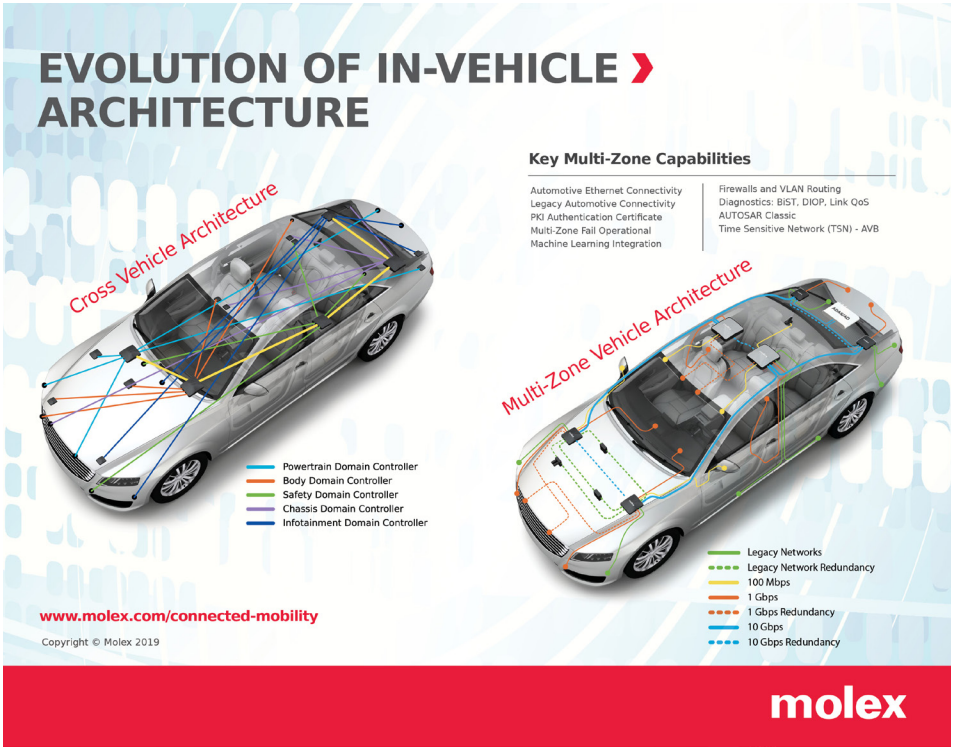
that it can pay for itself, and this creates an historic alignment of stakeholder interests.

The Citi report*, aimed at postulating what kind of changes are coming and how they might affect traditional vehicles, states that the greater stakeholder alignment can be boiled down as follows:

Societal: The unfortunate reality is there are over 1.3 million annual road fatalities. Rising global auto penetration has led to greater road congestion, tailpipe pollution, and underutilised infrastructure. There is also an increasing need to serve an aging population, those with disabilities, and to ensure better access to personal mobility across varying income levels. Ultimately, the human and economic toll of today's vehicle transportation system serves as the backbone of this alignment of interests.

New revenue streams: Vehicle data monetisation and time-spent-in-car, as vehicles become more connected with advanced electrical architectures enabling over-the-air (OTA) updating are new revenue streams being introduced. Those OTA updates also continuously leverage data and learning iterations to improve safety throughout a vehicle's life.

New addressable markets: Urban autonomous Robotaxi networks that can provide low-cost, safe and convenient mobility access while offering what we regard as lucrative financial returns to industry leaders could open new markets. Robotaxis could of course also help address urban congestion, pollution, and infrastructure through less and less vehicle ownership in major cities. There are also new concepts like AV subscription networks which could yield a huge transfer of wealth into new mobility ecosystems, combining the best of traditional ownership with the benefits of shared mobility. That transfer of wealth would spur faster adoption (because of greater affordability) thereby more rapidly transforming the vehicle installed-base into a safer fleet, and eventually, even a smaller-sized fleet. This, it is believed, can be done without compromising a consumer's desire to have an instantaneously accessible vehicle 24/7.



THE NEED FOR SPEED

Electronic and computing technologies have transformed almost every aspect of our lives in a single generation, with automotive experiencing greater change than many industries. The amount of electronics, software and computing power in modern vehicles has revolutionised both how they work and how we view them – more like rolling computers than mechanical devices. The number of electronic control units (ECUs) in vehicles has multiplied from just few up to a hundred (or even more in a high-end vehicle), controlling everything from engine management, ignition timing and fuel injection to anti-lock braking, traction control and, more recently, automated braking and lane or safe distance-keeping for adaptive cruise control (SAE levels 1 and 2 – driver assistance and partial automation). At the same time, there has been an increase in the numbers of interior and exterior sensors, advanced telematics and infotainment systems, plus the multiple electronic control units and distributed automotive networks (usually CAN, LIN, FlexRay and Ethernet) to manage all this data and technology.

And as vehicles become more connected and autonomous, this trend is accelerating exponentially, with massive amounts of computing power, bandwidth and speed required to process the huge amounts of data generated by a fusion of sensors (including cameras, RADAR, LiDAR and ultrasonic) in real-time to make split-second decisions that mimic safe and human-like driving. This means they need a universally standard, reliable and extremely fast end-to-end network architecture – any kind of delay or latency in transmitting vital information within autonomous vehicles could potentially be lethal for passengers, other road users or pedestrians.

Estimates vary, but vehicles may generate and consume up to 40 terabytes of data per day – meaning 5G cellular connectivity is critical, as it promises to connect everything around us to a data network that delivers the speed, responsiveness and reach to unlock the full capabilities of autonomous vehicles. Meanwhile, semiconductor companies are developing breakthrough microchips that will enable high bandwidth data speed at 10 Gbps+ with innovative and multi-zone vehicle architectures – see illustration below - turning cars from rolling computers into data - centres on wheels, enabling autonomous vehicles to make complex, in-application real-time decisions.

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AUTOMOTIVE ETHERNET

As existing automotive networks prove lacking in the face of evolving requirements, Ethernet has emerged as the main automotive data protocol for high-speed data transmission driven by increased data rates and redundancy requirements for autonomous driving, safety and security concerns in connected environments, and the need for standardised, inter-industry protocols. Ethernet offers a mature, stable and proven technology, capable of delivering high-speeds and security. However, automotive Ethernet architectures are subjected to a harsher environment than many traditional Ethernet deployments, and so needs to be more robust – having to cope with extremes of temperature, humidity, water, vibration and shock, and moreover with high levels of electro-magnetic interference (EMI)

As a leading supplier of high-speed networking solutions, Molex is supporting automotive OEMs in the development of in-vehicle networks that are secure, deterministic, prioritised, reliable and high bandwidth. With more than twenty years' experience delivering high-speed Ethernet solutions on the cutting edge of technology for data communications and industrial deployments, Molex is working on network solutions at data rates of up to 50 and 100Gbps for datacentre applications and leveraging and building on its proven strengths in interconnect products and system solutions for cables, connectors, media modules, Ethernet switches and gateways. Our expertise and deep experience in high-speed networking, datacom, rugged industrial and automotive solutions enable Molex to assist OEM's and Tier 1 manufacturers to incorporate next-generation vehicle technology and develop the intelligent vehicles of the future. Molex is addressing increasing demand for in-vehicle network bandwidth by providing end-to-end Ethernet-based solutions that operate across multiple hardware and software components. Its innovative 10Gbps network solution safely combines sensor, control and infotainment data, with integrated multi-zone redundancy and TSN (time sensitive networking) capabilities for maximum reliability, and a multi-layer security approach that integrates device certification to meet stringent security requirements of automotive car makers.

CONCLUSION

Molex has been on the forefront of electronic innovation for decades, serving industries such as, data communications, consumer electronics, medical and industrial. Vehicle manufacturers have long looked to Molex for the intricate system of connectors that support vehicle operation and power the amenities we have become accustomed to — not only basics like turn signals and temperature control, but also rear-view cameras and in-vehicle infotainment systems. Now, its deep automotive expertise and long history of developing high-speed, highly reliable connectivity solutions for demanding industries and applications has uniquely positioned Molex to address next-generation vehicle design.

Molex offers a complete, end-to-end, next-generation automotive in-vehicle connectivity solution – from gateways, switches, communication modules, cables and connectors through to enabling cloud connectivity solutions. Its industry-leading 10Gbps automotive Ethernet network supports superior signal integrity for secure data transmission between multiple hardware and embedded software systems to enable end-to-end data integration and data prioritisation for connected, intelligent and autonomous vehicles. For more information on Molex solution see www.molex.com/connected-mobility.

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