Revolutionize the automotive cockpit

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Introduction

One of the most exciting aspects of the automotive business is the increased pace in expanding capabilities and features for drivers and passengers, enabled by the ever-expanding adoption of computing technology. Automotive engineers all have the same simple objective: to create automobiles that are greener, safer, more connected and fun.

In addition to market megatrends, there are also foundational shifts (see **Figure 1**). Development cycles are shortening. Vehicles are undergoing significant evolutions, with the rapid introduction of technology that enables enhanced infotainment and connectivity, automated driving and safety features and alternative energy technologies. Features made possible by advanced electronics and software are becoming both must-have features and key differentiating factors. The volume and complexity of data processing in vehicles has increased by an order of magnitude in just a few years.

Recent market studies confirm that purchase triggers for vehicles have significantly evolved in the past few years, highlighting the increased customer interest in new technologies. These technologies include a "connected lifestyle" in the cockpit, the ability to customize the dashboard and a safer and more secure driving experience (**Figure 2** on the following page).

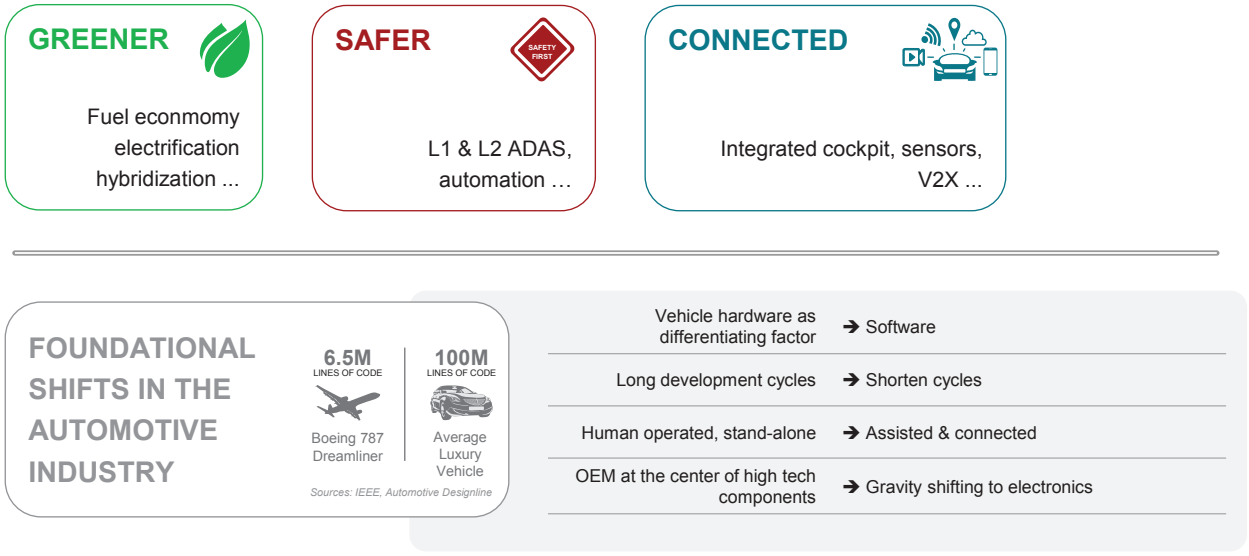

***Figure 1**. Automotive industry trends.*

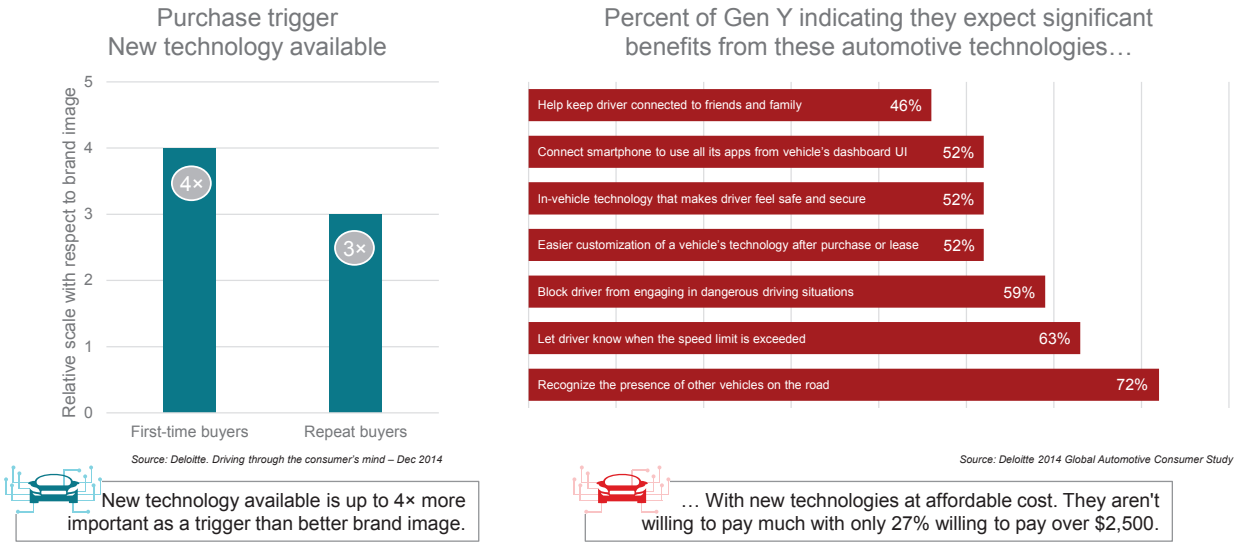

***Figure 2**. Purchase triggers for vehicle are evolving.*

These market trends are reflected in **Figure 2** and show the increased pace of technology deployment in vehicles. **Figure 3** illustrates the anticipated forecast for steady growth of semiconductor content in automobiles.

What does it mean for automotive processors?

Automotive processors have become a fundamental enabler for smarter, safer and connected vehicles. In fact, there's a direct connection between an original equipment manufacturer's (OEM) ability to support the features their customers care most about in new automobiles and the capability of automotive processors, as illustrated in **Figure 4** on the following page.

These automotive processor capabilities include:

- The integration of automotive features and software platforms to optimize the electronic bill of materials (EBOM).
- The delivery of a heterogeneous architecture for best concurrencies, safety, security, power and performance to address new automotive use cases.
- Differentiation via image-, signal- and vision-processing capabilities.

The automotive industry has taken major steps to achieve the exciting goal of integrating connected in-vehicle infotainment (IVI) systems, reconfigurable digital clusters and a number of technologies categorized under informational advanced driver assistance systems (InfoADAS) into a single electronic control unit (ECU) that creates a safer and unique driving experience. Texas Instruments (TI) has invested more than a decade in "Jacinto" automotive processors, as well as the many analog companion chips supporting this trend (see **Figure 5** on the following page).

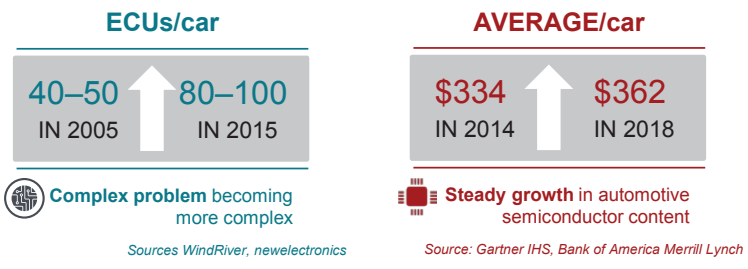

***Figure 3**. Technology and semiconductor deployment in automobile.*

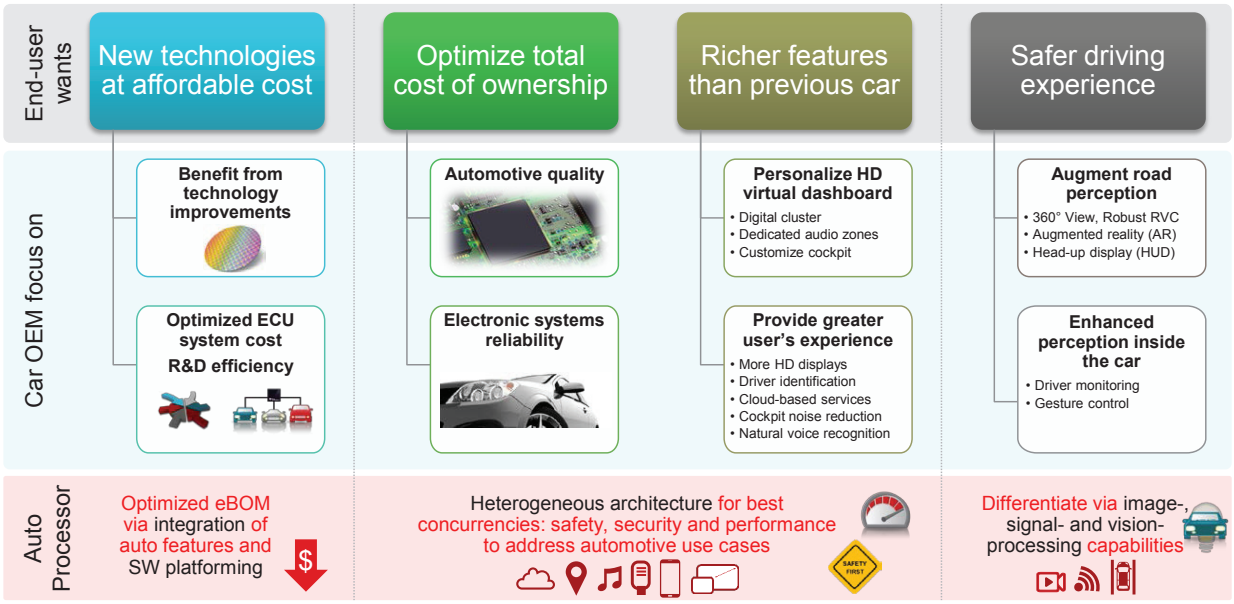

***Figure 4**. Automotive processors capabilities required to innovate beyond infotainment.*

TI's journey to help the industry revolutionize the automotive cockpit

Designed for automotive safety and robustness, TI's "Jacinto 6" automotive processors are a first step to help redefine the traditional infotainment processor architecture. "Jacinto 6" devices integrate more features into the processor without compromising performance in order to pave the way for an unparalleled in-vehicle experience.

"Jacinto 6" adds more real-time data-processing capabilities to the traditional IVI features, enhancing the driver experience by:

- Strengthening the digital signal processor (DSP) and vision-processing engines.
- Introducing the InfoADAS software development kit (SDK), which delivers an automotive-ready framework for enabling ADAS algorithm integration into the infotainment SDK.

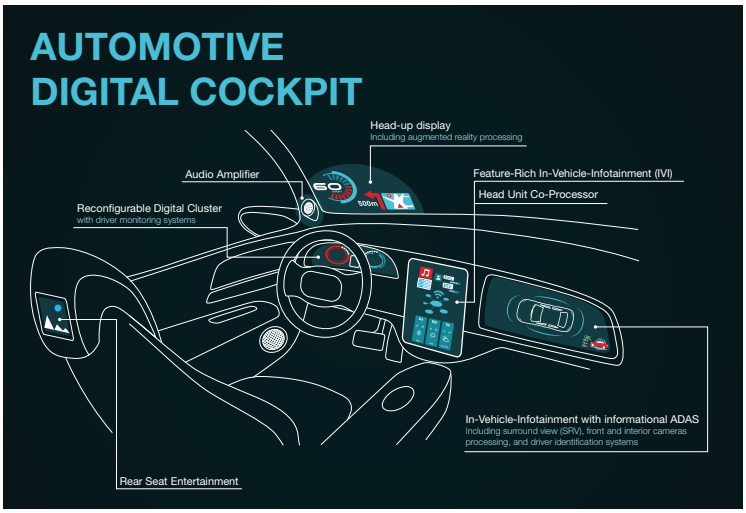

***Figure 5**. Digital cockpit applications supported by TI "Jacinto" processors.*

Taking our concept of informational ADAS and integrated digital cockpit to the next stage, TI implemented real system demonstrations running on single "Jacinto 6" processors at the Consumer Electronics Show (CES) in 2015, 2016 and 2017. We demonstrated that the unique "Jacinto 6" heterogeneous architecture can scale and support multiple cockpit applications, including those that require safety such as reconfigurable digital clusters, to deliver the required performance like fast boot, high-level operating system (HLOS), and safety

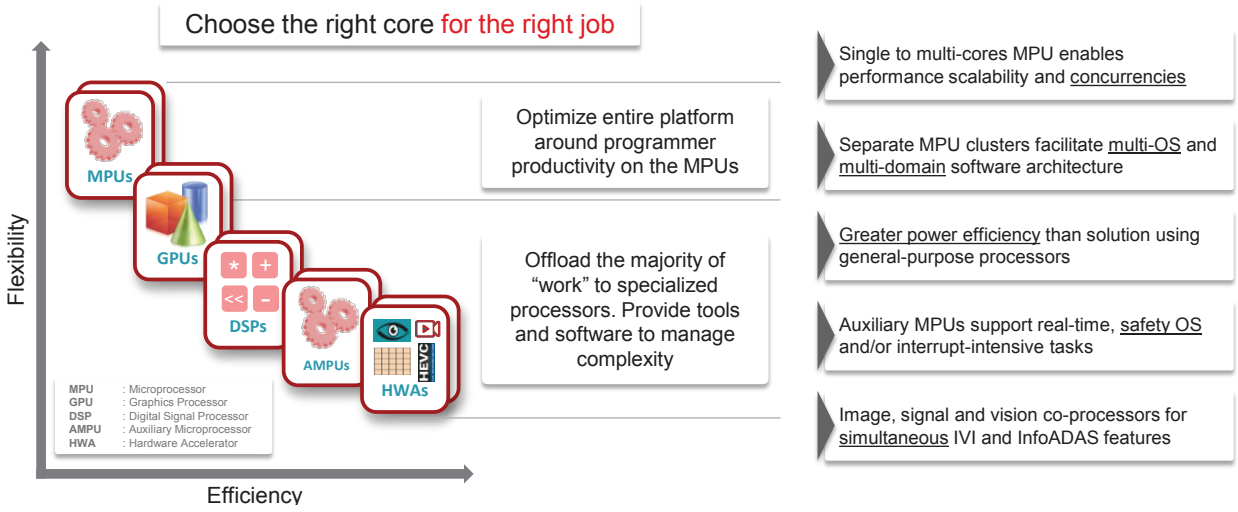

***Figure 6**. Heterogeneous architecture: one size does not fit all.*

OS separation and vehicle stack integration at an optimal system cost. See **Figure 6**.

"Jacinto 6 Plus" devices: built with digital cockpit in mind

Software is one of the biggest investments for Tier 1 manufacturers/OEMs. Software is also the pillar of differentiation. With that in mind, TI's "Jacinto 6 Plus" device extends the robust and proven "Jacinto 6" architecture with both higher-performance cores and additional features. This combination supports TI's objectives to both protect existing software investments and enable industry trends toward more integration without compromising performance and time to market.

The "Jacinto 6 Plus" device scalability:

- Facilitates the reuse of existing hardware and software, with no change other than system upgrades to route external cameras and connect additional displays to the processors.
- Allows head-unit features and emerging analytics/image manipulation, as well as multi-domain/multi-OS capabilities.
- Gives you the ability to integrate on each of the infotainment, vehicle and driver domains more features on a single system-on-chip (SoC), with robust hypervisor implementation supporting multiple virtual machines and graphics processor unit (GPU) sharing.
- Enables shorter time to market by leveraging the same robust and proven architecture of "Jacinto 6", including DSP and embedded vision engine (EVE) accelerators.
- Supports innovation at a reduced cost by integrating several new Internet protocols (IPs), including raw camera Image Signal Processor (ISP), Camera Serial Interface (CSI)-2 ports and Controller Area Network-Flexible Data Rate (CAN-FD), which enable lower system EBOM and support the next generation of interfaces.

"Jacinto 6 Plus" SoCs come with a dual-package strategy. Existing "Jacinto 6" customers can easily upgrade their current hardware and optimize system BOM while integrating cameras and surround-view features with minimal hardware impact, or take full advantage of "Jacinto 6 Plus" capability and performance for enhanced features such as augmented reality (AR) heads-up display (HUD) (**Figure 7** on the following page).

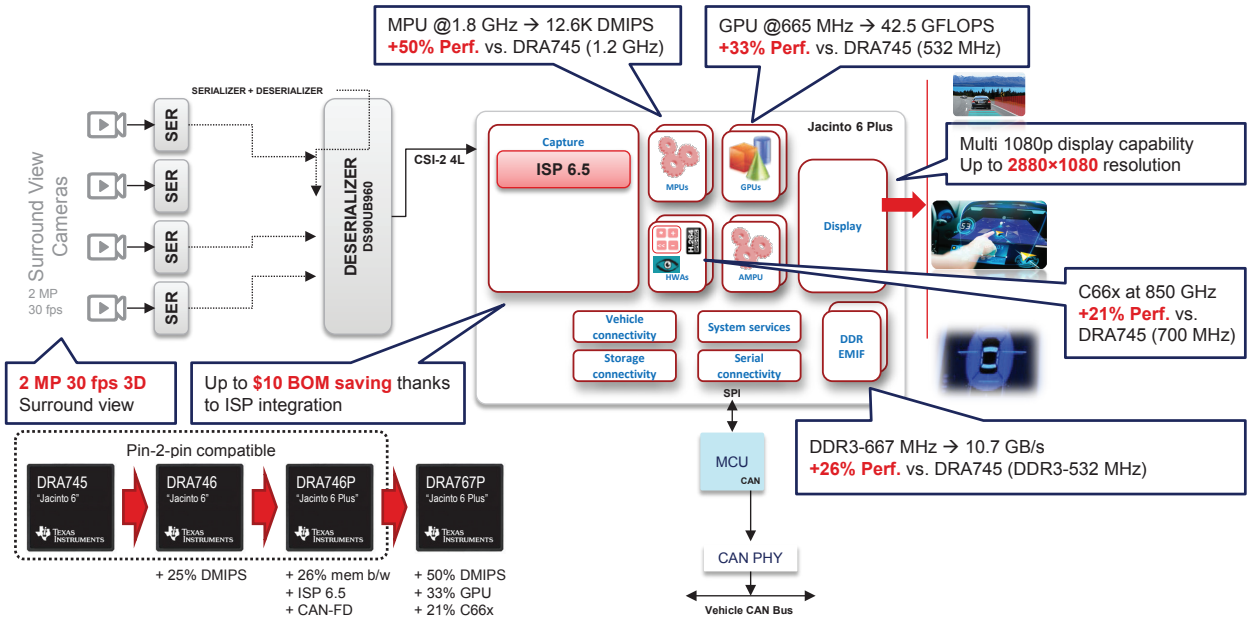

***Figure 7**. "Jacinto 6 Plus" SoC features and performance improvements.*

"Jacinto 6 Plus" SoC is also the solution of choice for designers new to the "Jacinto 6" platform who want reliable, robust and proven technology to design digital cockpit systems without compromising time to market, thanks to the mature hardware and software environment and rich "Jacinto" ecosystem.

The integrated digital cockpit

Soon, drivers will not only rely on traditional instrument clusters and the center stack to give them reliable vehicle and safety information and access maps and media. They will also expect:

- More complex content, including endless media selections from any source, 3-D navigation, ADAS and AR views with the ability to morph size, shape and colors according to the task at hand, all seamlessly blended in high definition on multiple displays.
- Ergonomics to further improve their focus and attention on the road, including augmentation with HUD to show relevant driving information in their direct field of vision.
- Relevant information and safety content according to current driving situations, displayed in the center field of vision to pave the way for autonomous driving.

Any new technology that OEMs intend to use must meet automotive quality and reliability standards (Ex: AECQ100, ISO 26262, ASIL-B, etc.) while adhering to a rigid budget. Similarly, drivers will continue to push to get more for less: greater perception of road conditions and the monitoring of every angle of a vehicle will become standard, as will a richer user experience by leveraging even further connected lifestyles in the cockpit.

These demands will reinforce the need for ECU integration which, at some point, will become mandatory to meet features at a reasonable cost. A purpose-built SoC that meets automotive qualification and safety requirements, enables software scalability and greater R&D efficiency, and delivers the necessary performance and differentiation will become even more fundamental to support market trends in the automotive industry (**Figure 8** on the following page).

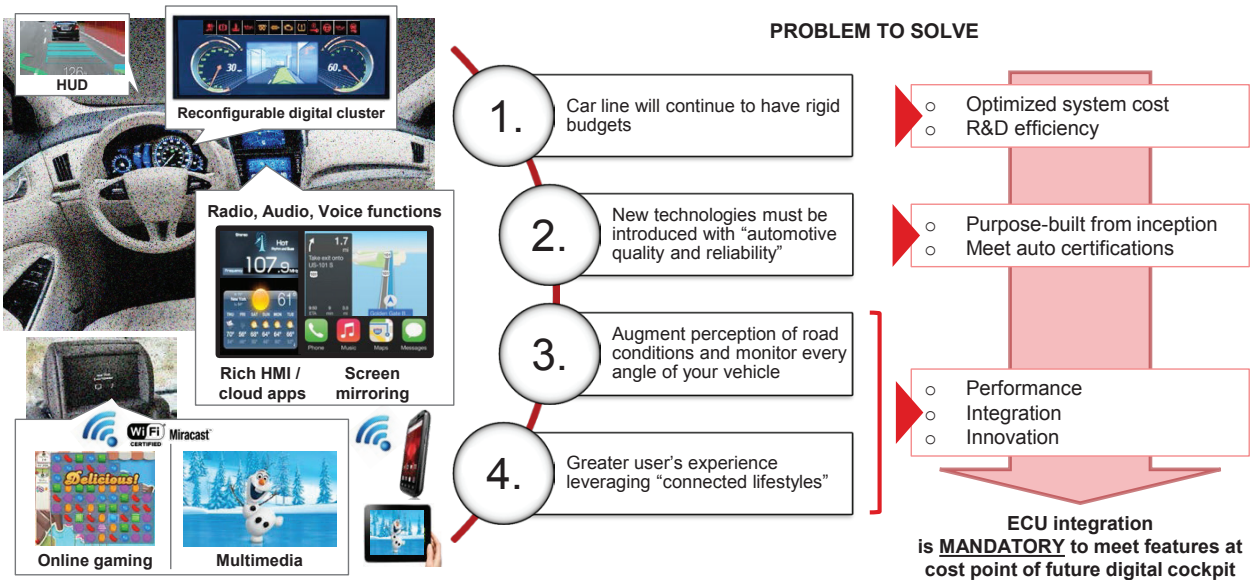

***Figure 8**. ECU integration is becoming mandatory.*

The real challenge won't simply be to deliver additional Dhrystone million Instructions per second (DMIPS) on a general-purpose microprocessor unit (MPU), Giga floating-point operations per second (GFLOPS) on a GPU or enhanced multimedia capabilities, but to have the right balance between these measures and:

- Support for more complex use cases involving multi-OS/multi-domain/multi-display capability.
- The necessary isolation of different domains supporting various Automotive Safety Integrity Levels (ASILs) and safety requirements.
- The vision analytics capabilities of SoCs, which will have to scale from entry level to premium on a single software platform.

Achieving this combination will require not just a boost in device performance, but redefined and adapted architectures to support the even-more demanding integrated digital cockpit use cases. These requirements tie into TI's vision and strategy to drive the future of automotive digital cockpit SoCs.

For more information

To learn more about TI's "Jacinto" automotive processors, visit: ti.com/jacinto

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