Informational ADAS as software upgrade to today's infotainment systems

Matthew Watson
Product Line Manager, Automotive Infotainment Processors

Brad Ballard
Business Development Manager, Automotive Infotainment Processors

Texas Instruments

DRA75x "Jacinto 6 Ex/EP" Processors merge Infotainment and Informational ADAS

The automotive cockpit is in the midst of an overhaul to modernize the information and entertainment options available to drivers and passengers. This journey started in earnest in 2011 with the high-volume deployment of larger color display systems, better representing what was available in smartphones and evolving towards tablets. This will continue for several more years at which time the gap ideally closes to only the automotive cycle time as the delta to deliver consumer features to the car.

Fast on the heels of this evolution in improving the user interface and providing modern mechanisms to incorporate driver's digital life in the car was a strong up-tick in the amount of advanced safety capability (often called ADAS, Advanced Driver Assistance Systems) driven through improvements in the cost and performance of sensors and analytical processing (Figure 1 shows a recent ADAS semiconductor forecast). One good example of the importance of ADAS systems is with **Toyota's announcement** that it will "make active safety technology – including anti-collision systems – available throughout its entire U.S. lineup by 2017."

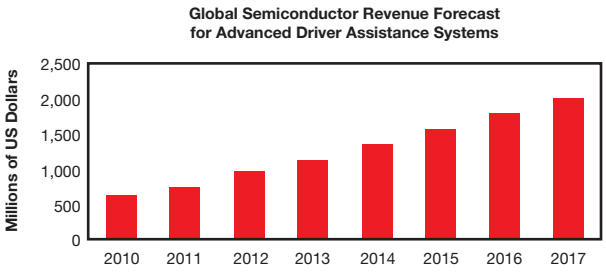

Figure 1. ADAS semiconductor growth forecast

Infotainment and ADAS systems are largely distinct from one another: driven by exclusivity of features and the functional safety requirement for ADAS. However, OEMs have an opportunity to enhance the driver's experience and safety further by leveraging some of the components required in the ADAS subsystem to deliver additional information to the driver. For example, cameras already installed in the vehicle, combined with processing capabilities in the infotainment processor, can deliver applications including 360-degree park assist, augmented reality head's-up displays and driver monitoring and identification. Such systems can be considered as "informational ADAS" given that they don't take an active role in the control of the car. These applications have the ability to integrate with modern infotainment solutions to enhance the driver's experience and offer manufacturers an affordable methodology to merge these innovative features.

Texas Instruments' new DRA75x "Jacinto 6 Ex" processor, a member of the "Jacinto" family of infotainment processors, provides a software-compatible platform to augment existing infotainment products with such informational ADAS features without changing hardware, other than upgrades to the system to route external cameras to the processor.

Pin compatibility with ARM® Cortex®-A15 devices

The DRA75x "Jacinto 6 Ex" processor is an extension of and pin compatible with the "Jacinto 6" infotainment processor family. These two devices share common foundational processing subsystems including dual-ARM® Cortex®-A15 CPUs, auxiliary

dual-ARM Cortex-M4 CPUs for support of real-time, interrupt-intensive tasks, 3D graphics using Imagination Technologies' POWERVR™ SGX544-MP2 dual-core graphics cores and 2D graphics from Vivante Corporation's GC320 core. The "Jacinto 6" device family also includes a Texas Instruments TMS320C66x VLIW floating-point digital signal processor (DSP) that supports a variety of different functionalities including software-defined radio, enhanced audio and speech-processing algorithms. The display subsystem offers concurrent support for up to three 1080p displays and the IVA-HD hardware accelerator supports 1080p60 decode as well as 1080p30 concurrent video encode and decode operations.

For the enablement of informational ADAS, the DRA75x "Jacinto 6 Ex" processor adds a second C66x DSP enabling 1.4 GHz of DSP performance equivalent to 22 GFLOPS / 60 GMACS. This DSP performance can be leveraged for additional radio/audio/speech processing, as well as for image manipulation for camera inputs such as required for warping output of fisheye-lens cameras, stitching multiple camera views together, pre-warping for HUD and more. The "Jacinto 6 Ex" also includes two **embedded vision engines (EVEs)** which are purpose-built ADAS vision accelerators comprised of an optimized vector coprocessor and a 32-bit programmable RISC core. The EVEs are capable of running many common ADAS algorithms faster, and with greater power efficiency than ever before and offer simultaneous analytic processing and infotainment functionalities without performance compromises to either subsystem.

Innovate beyond infotainment within the DRA "Jacinto 6" processor family

The DRA75x "Jacinto 6 Ex" processors were designed to allow Tier 1s and car manufacturers to easily extend their investments in infotainment to new levels, adding innovative new use cases to enhance the driver's awareness of the conditions both inside and outside the car. The enhanced co-processors are designed in such a way to augment the capabilities of the DRA74x "Jacinto 6" while allowing for seamless software and hardware compatibility of their existing infotainment systems.

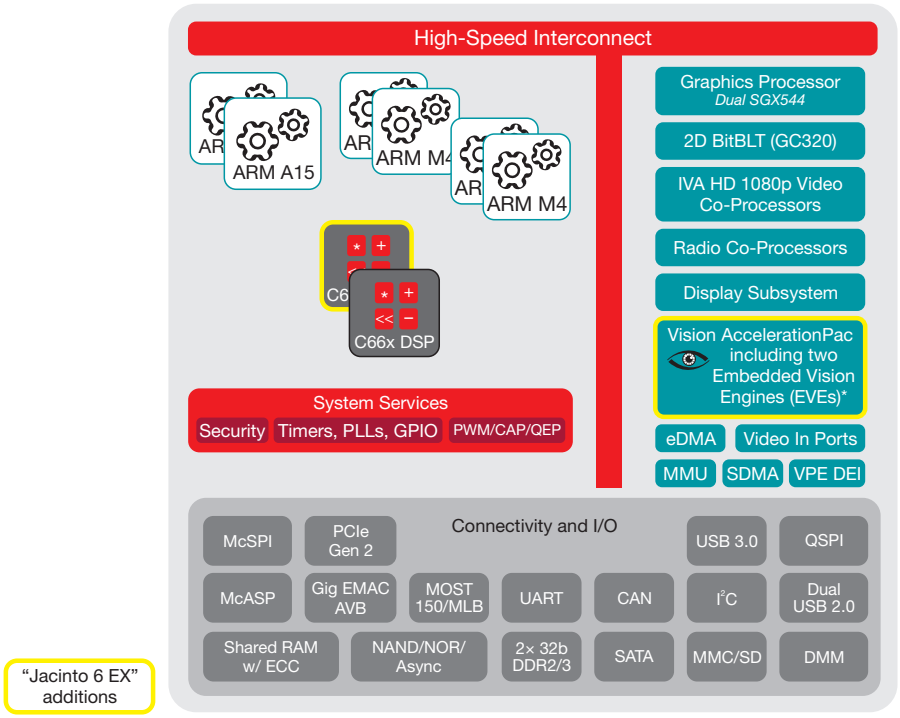

Figure 2. TI's "Jacinto 6 Ex" processor diagram

Additional Digital Signal Processor (DSP): The TI DSP in the "Jacinto" family has been used for several generations to support software-defined radio for HD Radio™ and DAB/DMB audio standards. Additionally, the DSP can support advanced

speech-processing algorithms, active noise cancellation, and advanced multi-zone and multi-rate audio-processing algorithms. The C66x DSP core also allows for value-added features such as rear or surround-view stitched video from high-definition cameras mounted to the vehicle. Further, the second C66x DSP on the DRA75x "Jacinto 6 Ex" makes it possible to concurrently perform both radio/audio signal processing and image manipulation processing, with headroom to spare.

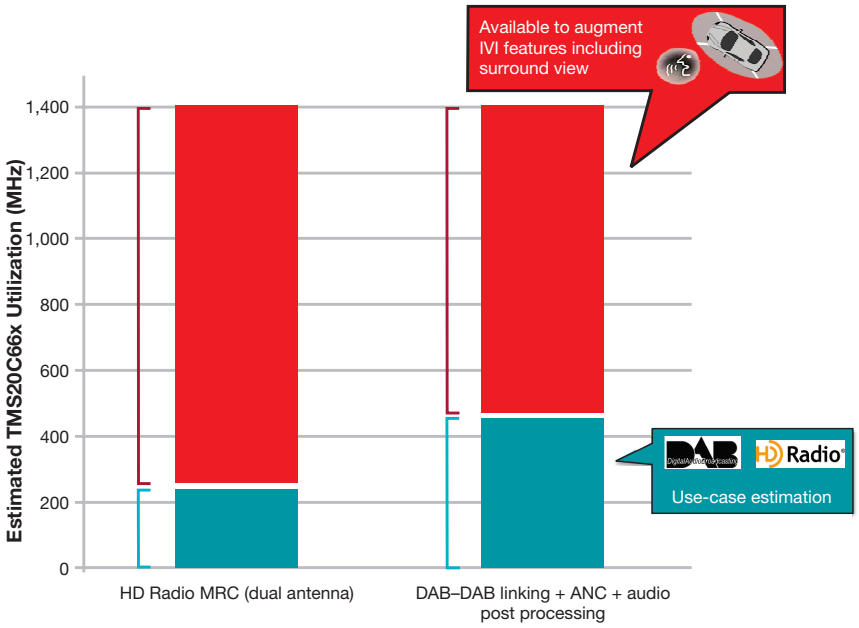

Figure 3. Example DSP partitioning on "Jacinto 6 Ex" combining radio/audio features with headroom for informational ADAS

Embedded Vision Engines (EVEs): The addition of EVEs to the DRA75x "Jacinto 6 Ex" allows for high-performance image manipulation/analytic kernels to run both in parallel with other major processing blocks on the device, and with greater power efficiency than other solutions using general-purpose processors (see performance comparison in Figure 4 below). The EVEs are powerful vector processors that allow offloads of fixed-point array processing tasks from the DSP and can work in-tandem for vision-type algorithms such as object, traffic sign and pedestrian detection; augmented reality navigation, driver monitoring, and driver identification.

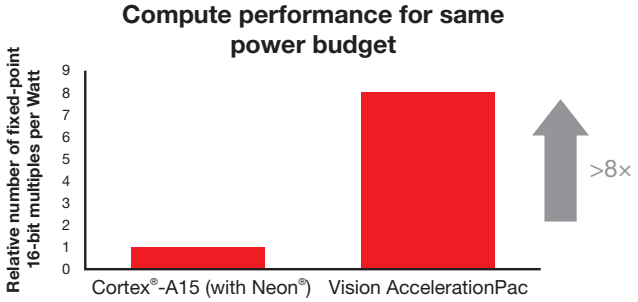

Figure 4. Vision AccelerationPac: >8× compute performance for same power budget with respect to Cortex-A15

Concurrency of infotainment and informational ADAS

The two accelerators, DSP and EVE, combined with the existing "Jacinto 6" capabilities (high-performance ARM Cortex-A15 CPU and auxiliary ARM Cortex-M4 CPU cores, GPU, multimedia, etc.) allow for concurrencies of head-unit features and emerging analytics/image manipulation not previously possible on a single device. Figure 5 below illustrates the DRA75x "Jacinto 6 Ex" capability to combine the I/O and processing behind multiple camera inputs together with infotainment features, as well as cluster and rear-seat functionality.

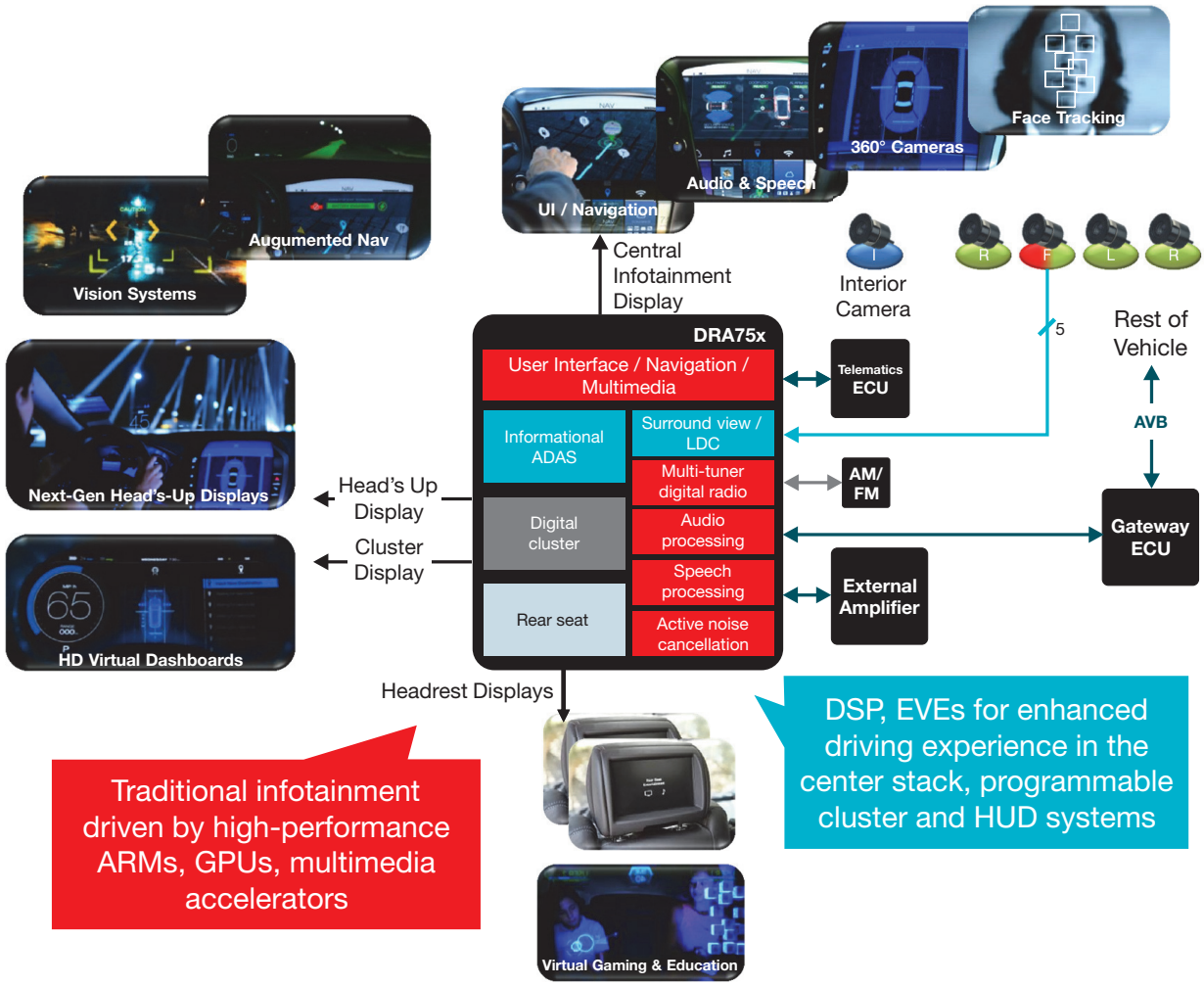

Figure 5. DRA75x "Jacinto 6 Ex" integrated capabilities including informational ADAS

Scale your investment

With the introduction of the DRA75x "Jacinto 6 Ex" processor, combined with the DRA72x "Jacinto 6 Eco" and DRA74x "Jacinto 6" processors, TI now further extends the automotive industry's widest range of infotainment processors offering a blend of general-purpose, graphics and multimedia performance alongside BOM-saving automotive co-processors and vehicle-interfacing peripherals.

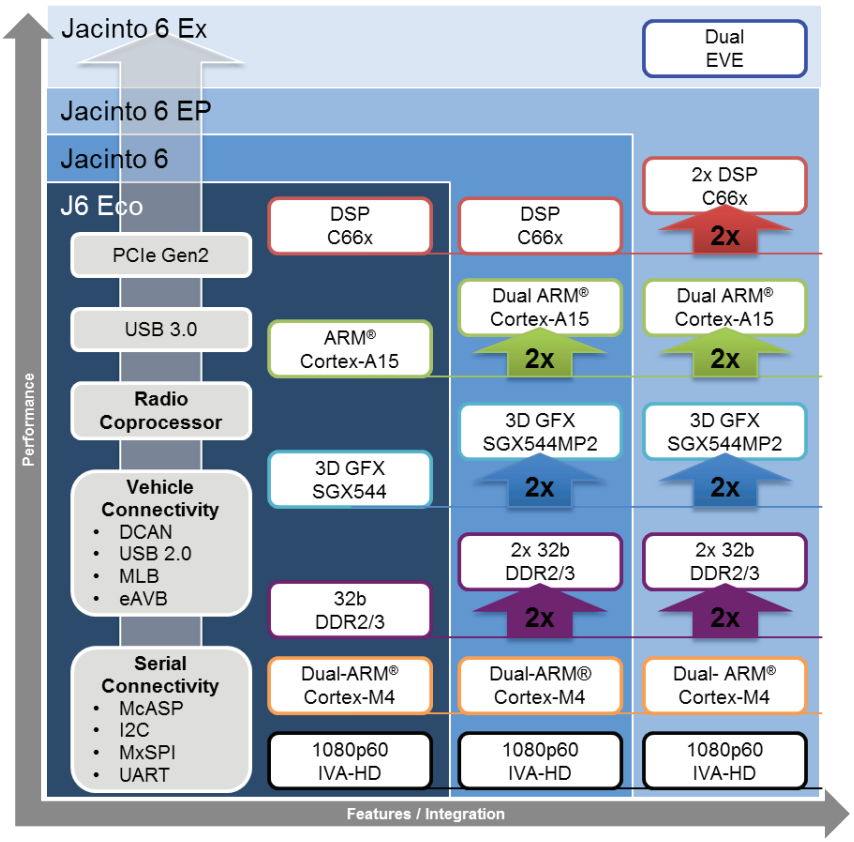

Figure 6. "Jacinto 6" family scalability

As shown in Figure 6, the DRA75x "Jacinto 6 Ex" processor offers a superset of feature/functionality of the "Jacinto 6" family of processors. Most importantly, this enables car manufacturers and Tier 1s who must balance new feature introduction with rapidly increasing R&D costs the ability to augment existing solutions with such image manipulation technologies without any modification to existing infotainment software. The result is lower R&D costs and faster time-to-market with innovative new features that can help make driving safer and more fun.

Summary

With the increasing deployment of cameras and sensors in the vehicle, car manufacturers have more tools than ever at their disposal to make the driving experience safer and more informative to drivers.

TI's DRA75x "Jacinto 6 Ex" processor enables manufacturers for the first time to leverage cameras both inside and outside the vehicle together with existing infotainment platforms without sacrificing performance of either subsystem. Additionally, since DRA75x "Jacinto 6 Ex" is based on the powerful DRA "Jacinto 6" family of infotainment processors, developers have the ability to reuse significant software investment while adding innovative informational ADAS features to the platform.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265