



IN-VEHICLE EXPERIENCE WHITEPAPER

*ACHIEVE HIGH PERFORMANCE
PROCESSING, GRAPHICS AND ADAPTIVE
COMPUTING FOR TOMORROW'S
AUTOMOTIVE IN-VEHICLE EXPERIENCE
AND SAFETY NEEDS*

AMD enables flexible architecture for new levels of efficiency and scalability in-vehicle infotainment and ADAS

Automotive system designers are increasingly challenged to keep pace with dynamic and aggressive design and compute requirements. From in-vehicle infotainment (IVI) systems to advanced driver assistance systems (ADAS), the modern vehicle as we know it, is undergoing a radical reimagining as it gains expansive, integrated infotainment within the cabin, and increased autonomy on our roadways.

Automotive Tier Ones and OEMs seek a better way forward when it comes to developing and deploying innovative new IVI and ADAS technologies that are readily scalable and adaptable. The compute and graphics-intensive automotive use cases of tomorrow require a new approach to processing performance and design agility today, which prioritizes integration and modularity to minimize design complexity and costs.

ACHIEVING THE MODERN IN-VEHICLE EXPERIENCE

For IVI systems, automotive OEMs understand that vehicle in-cabin cockpits, instrument clusters, consoles and screen configurations will likely look radically different in the years ahead, fulfilling customer demand for visually immersive experiences. Recent trends suggest that infotainment displays are a prime consideration with customers when weighing their vehicle purchasing decisions, and this will be a major area of competition and differentiation for automotive OEMs.

Enhanced media streaming and high-end gaming entertainment features have additionally emerged as a central focus for in-cabin technology going forward. Automotive designers and consumers alike acknowledge that there's a lot of room for improvement here.

Within the automotive cabin today, graphics are still predominantly serviced by mobile class processing architectures optimized for smart phone like features. The current IVI experience will evolve to deliver PC-like functionality and quality for robust media streaming and gaming features delivered via high-resolution graphics.

ADAPTABLE ADAS & ARTIFICIAL INTELLIGENCE

The automotive market faces new challenges as the future of the industry moves toward highly automated and fully autonomous driving. The result is an increasing reliance on advanced sensors and domain controllers equipped with Machine Learning to bring Artificial Intelligence (AI) to the vehicle.

Future ADAS capabilities will be enabled with increasingly complex sensor network configurations, requiring increased compute performance headroom to support ongoing adaptability. The use cases for cameras and sensors are exploding, with advanced capabilities like surround view, driver and occupant monitoring, and object detection all requiring flexible architectures. AMD's unique architecture enables this through the provision of dedicated scalar, graphics, AI and programmable logic compute subsystems – enabling flexible and most importantly adaptable system designs updating throughout the life of a vehicle.

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ADAS features utilizing camera, radar, and LiDAR require a robust yet streamlined processing platform that delivers high performance at low latency to enable safety-critical functionality. Over time, passengers will increasingly be asked to entrust their safety to vehicle automation, and this transition can be aided by maximizing visualization of the safety information the automation systems are processing. Advanced, PC-class in-cabin graphics for improved information visualization will be valuable, with capabilities like onscreen indicators that visually depict obstructions around the vehicle, for example.

Into the future, as AI plays a more prominent role in our vehicles, processing performance and heterogeneous compute architectures will be critical for AI-guided, real-time decision making and increased vehicle autonomy. FPGAs/programmable logic devices will continue to play a central role for enabling adaptive computing and onboard vehicle intelligence.

The overall demand for high-performance processing, graphics and adaptive computing for next generation IVI and ADAS is expected to skyrocket in the coming years. In the immediate future, forecasts anticipate a 2X increase in performance needs every two to three years for IVI alone, across CPUs, GPUs and graphics displays.

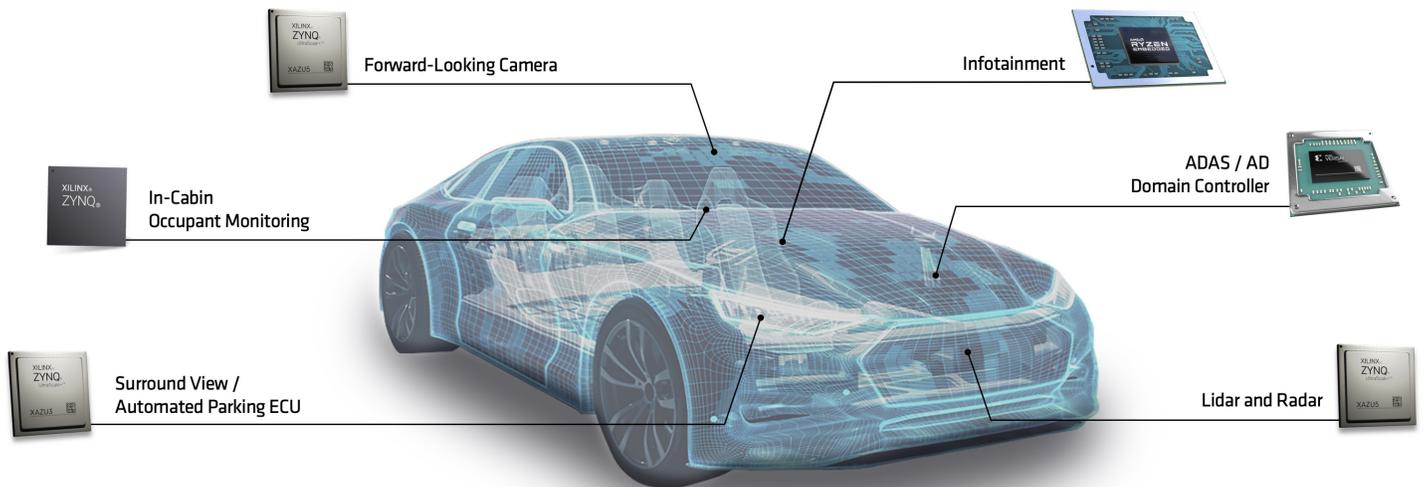
Meeting these growing performance requirements will require expanding the available processing headroom available to accommodate additional workloads deployed to the vehicle through its lifecycle, using over-the-air (OTA) update concepts. OTA services must allow in-field software AND hardware upgrade capabilities, enabling new and innovative features and algorithms to be deployed remotely and securely for future ready designs.

At the heart of these evolving embedded design challenges – from IVI to ADAS – **high performance and adaptability** are the keys to unlocking tomorrow's automotive innovation.

AMD ADVANTAGES IN AUTOMOTIVE

AMD is a recognized leader in high-performance processing and adaptive computing technologies for the automotive market, with a 15+ year legacy in automotive solutions spanning the AMD product portfolios. AMD's consistent growth and innovation in automotive applications has been affirmed with hundreds of millions of devices shipped to automotive Tier Ones, OEMs and startups.

AMD in Automotive



AMD has demonstrated technology leadership in complementary technologies spanning CPUs, GPUs, Adaptive SOCs, Xilinx FPGAs and SmartNICs, delivering multi-generation product architectures and advanced process and packaging technologies for faster and more flexible automotive implementations. AMD's established leadership in modular, integrated 'chiplet' architectures – proven successful in data center implementations – sets a foundation for continued innovation in the automotive domain going forward.

Dedicated AI engine "compute elements" will likewise be invaluable for meeting the coming demands of next generation automotive applications. AMD has helped enable robust AI capabilities in diverse and dynamic markets including data centers, industrial and 5G communications infrastructure from edge to cloud.

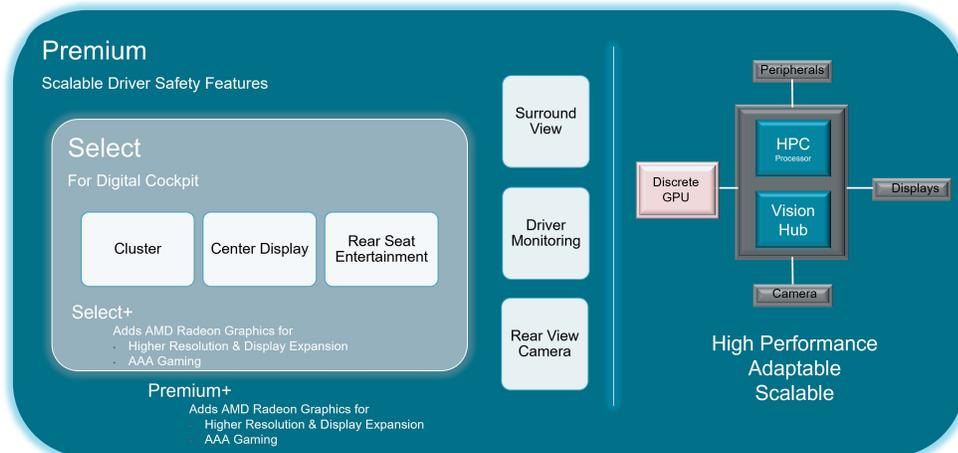
AMD's commitment to excellence in embedded computing and graphics is well established, exemplified today with the AMD Ryzen™ Embedded and AMD EPYC™ Embedded processing portfolios, built atop the breakthrough 'Zen' core architecture. AMD's portfolio of APUs (accelerated processing units) draws on the strengths of AMD's embedded CPU and Radeon™ graphics innovation, combining CPU and GPU in a single chip solution for increased design versatility and an ultra-compact physical footprint.

With over 205M+ shipments globally spanning the Spartan™, Zynq™ and Versal™ product families, AMD's portfolio of FPGAs adaptable SoCs are uniquely positioned to deliver adaptive intelligence and functionality in automotive applications. Enabling customizable interfaces for current and evolving sensor communications technologies.

AMD's Xilinx portfolio meets the requirements of the ISO26262 certification and is built on a heritage of proven functional safety to provide high levels of safety and reliability for customers' automotive applications. Reliability is inherent to the value proposition – with zero recalls on over 205 million automotive-qualified devices shipped, AMD's Xilinx portfolio supports manufacturing history traceability, authentication of the product, and unique identifiers for system/board tracking.

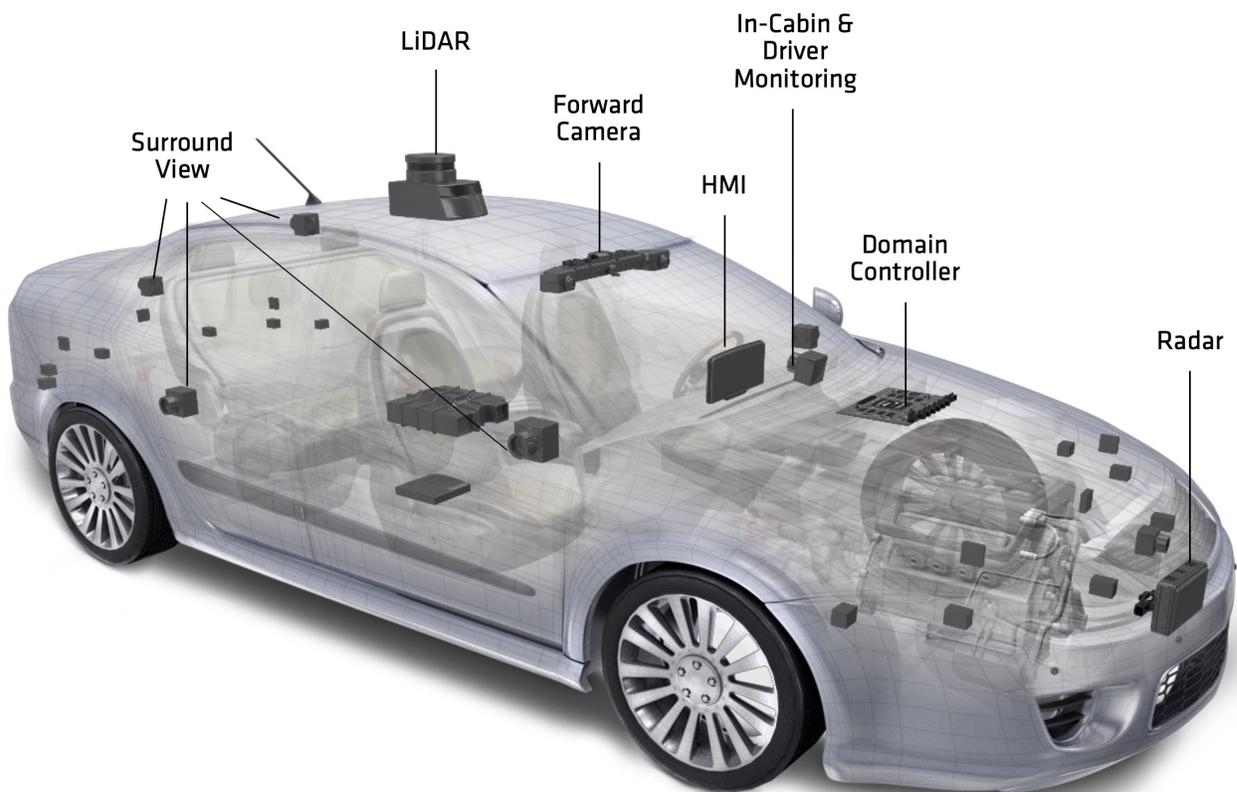
INTRODUCING AMD'S IN-VEHICLE EXPERIENCE (IVX) SOLUTION

AMD'S unique high-performance flexible system architecture for digital cockpit – featuring AMD Embedded APUs and Adaptable SoC devices – is ideally suited for solving tomorrow's digital cockpit compute challenges. Optimized for pre and post processing of sensor data, as well as advanced sensor fusion and machine learning applications, AMD's integrated adaptable compute architecture solution is designed to streamline previously complex interactions of functional elements requiring a heterogenous set of processing engines (Scalar, Intelligent, and Adaptable).

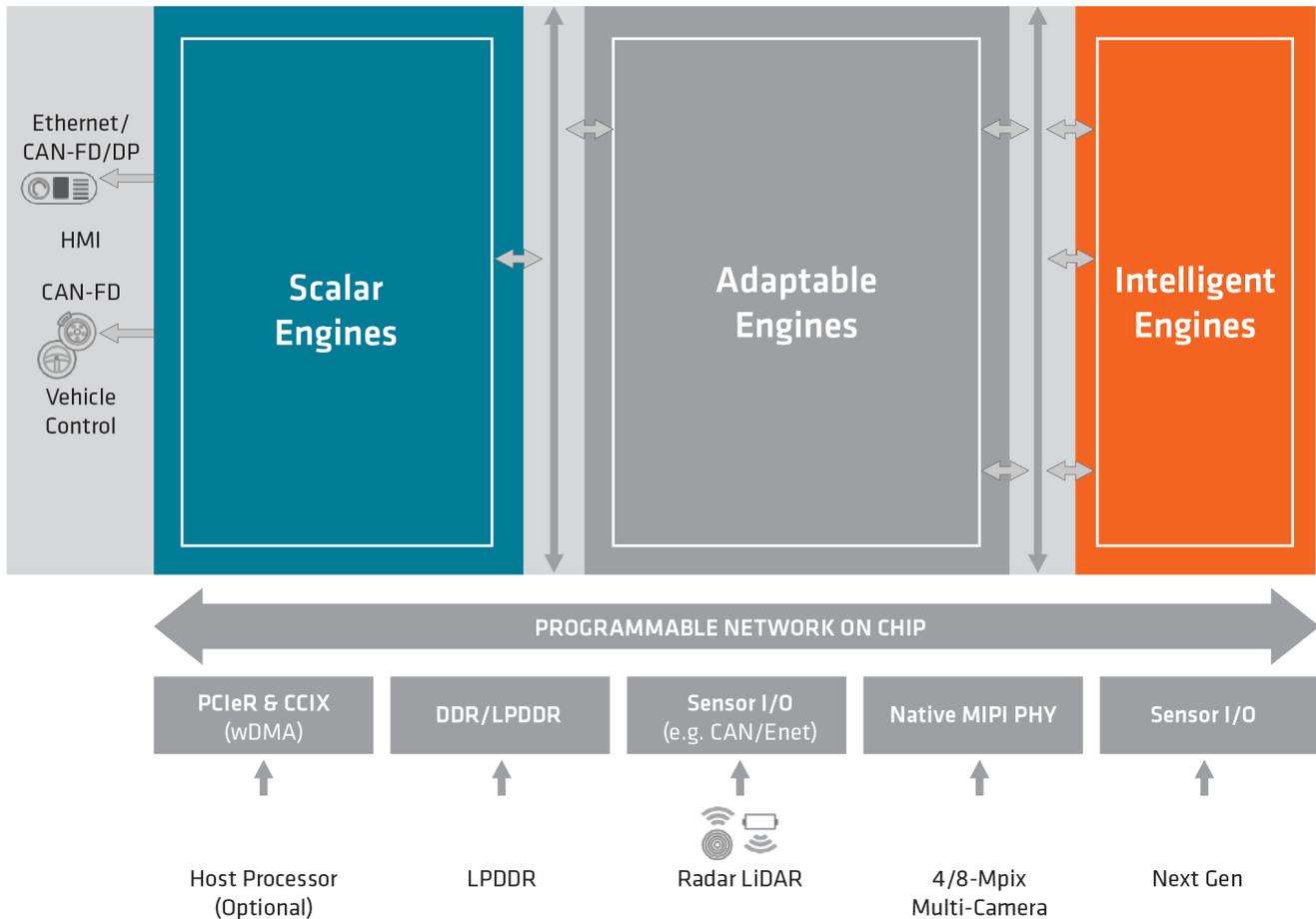


The modular scalability afforded with this approach is hugely beneficial for accommodating varying and evolving feature bundles, with smooth IP portability across devices. Crucially, AMD's IVX Solution for automotive applications is designed to support OTA bitstream updates that enable ongoing in-vehicle software **and hardware** adaptability – and the flexibility to roll-out and monetize new in-vehicle services.

Mapping Vision Functionality



- *PROGRAMMABLE IO FOR SENSOR INGEST AND COMMUNICATIONS*
- *ADAPTABLE ENGINES FOR SENSOR PROCESSING, FUSION, AND DATA CONDITIONING*
- *INTELLIGENT ENGINES FOR COMPUTE ACCELERATION AND LOW-LATENCY AI*
- *SCALAR ENGINE FOR DECISION MAKING AND HMI/VEHICLE CONTROL*
- *SCALABLE COMPUTE FROM EDGE SENSOR TO DOMAIN CONTROLLER*



AMD's commitment to innovation in high-performance processing and adaptive computing technologies positions automotive Tier Ones, OEMs and startups to achieve new levels of IVI and ADAS performance, functionality and scalability. AMD's heritage in automotive applications and proven capabilities in embedded computing and graphics, complemented with advanced integrated packaging techniques, can help to enable unprecedented design efficiencies for a new generation of vehicles.

About AMD

For more than 50 years AMD has driven innovation in high-performance computing, graphics, and visualization technologies. Billions of people, leading Fortune 500 businesses, and cutting-edge scientific research institutions around the world rely on AMD technology daily to improve how they live, work and play. AMD employees are focused on building leadership high-performance and adaptive products that push the boundaries of what is possible. For more information about how AMD is enabling today and inspiring tomorrow, visit the AMD (NASDAQ: AMD) [website](#), [blog](#), [LinkedIn](#), and [Twitter](#) pages.

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