Ambarella®
AI envisioned™

Imagination

Case Study

Autonomous driving AI domain controller

October 2025

“By integrating an Imagination GPU inside the CV3AD-655, we are able to achieve exceptional efficiency and visual fidelity, reinforcing Ambarella’s commitment to innovation in intelligent automotive systems.”

Jason Huang
VP of Systems

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AI envisioned™

The Rise of Autonomous Driving

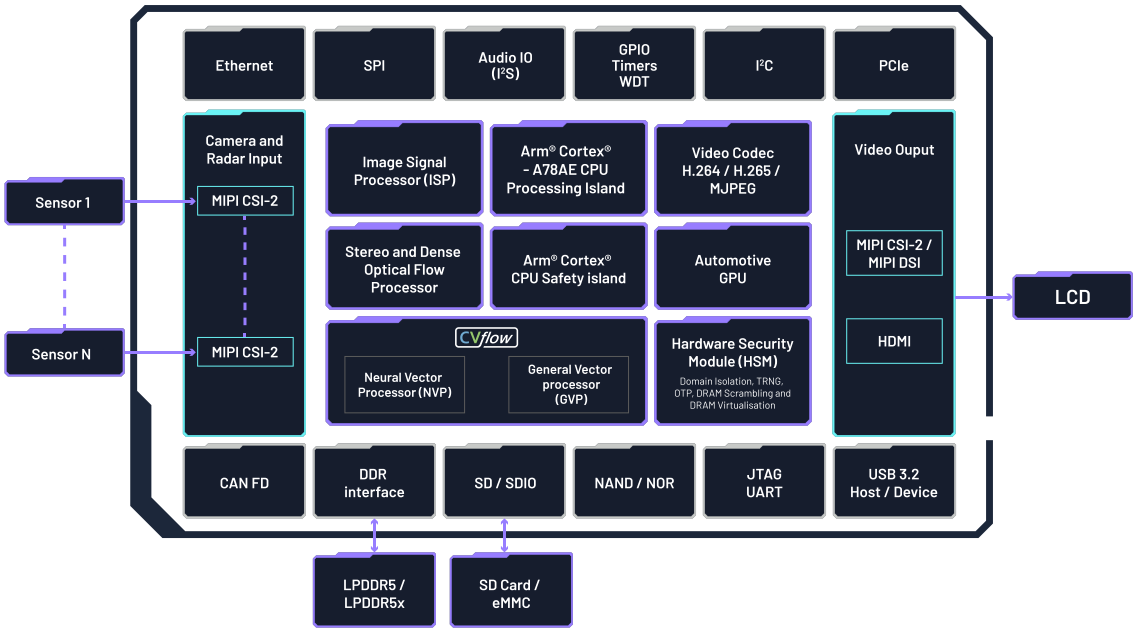
In recent years, the capabilities of Advanced Driver Assistance Systems (ADAS) have flourished. Nearly half of all car sales in the USA offer Level 2 capabilities (such as lane keeping and adaptive cruise control) or higher, and China is pushing the market further towards Level 3 (conditional automation with driver oversight) and beyond.

The advanced functionality offered by these ADAS and autonomous systems requires an exceptional vehicle computing architecture to operate safely and in real-time. To support this, in recent years, vehicle processing has started to centralise from multiple, smaller zonal controllers and into fewer, larger, domain controllers. This not only delivers the performance required, but is also helping Original Equipment Manufacturers (OEMs) lower vehicle production costs.

Developing AI Domain Controller SoCs for Autonomy

Ambarella is a leading provider of low-power domain controllers for autonomous systems. Its Artificial Intelligence (AI) Systems on Chip (SoCs) are perfect for handling the perception, fusion and planning processing tasks that allow a vehicle to understand its surroundings and plan a sensible path in real-time, without draining the vehicle's battery.

Their CV3-AD family launched in 2022. These energy-efficient SoCs combine AI and vector processors, CPUs, an Imagination GPU, advanced image signal processing, stereo and dense optical flow engines, a hardware security module, and a safety island for ASII-D applications. The result is the ideal balance of flagship performance for central processing with industry-leading power efficiency.



Caption: The CV3-AD family block diagram

Case Study : Autonomous Driving AI Domain Controller

Caption: Introducing the CV3-AD AI domain controller SoC family

The **CV3-AD655** is the mid-range product in the CV3-AD family, offering advanced L2+ (also called L2++) and L3 autonomy with enhanced autopilot and automated parking, including support for multiple cameras, radars and other sensors. It includes an **IMG BXM GPU** to power advanced surround view systems and bird's eye view applications.

What tasks does the GPU handle in the CV3AD-655?

The integrated IMG BXM GPU enables high-performance rendering and real-time image stitching from multiple camera inputs, delivering a seamless and immersive 360-degree visualization around the vehicle.

Why is this important?

With ADAS and lower levels of semi-autonomous driving, where a driver handles complex manoeuvres like parallel parking, a responsive and detailed surround view system provides valuable information to the driver on their position in relation to their surroundings and prevents low-speed accidents.

At higher levels of autonomy, visualization of a vehicle's movements in relation to its surroundings plays a key role in enhancing driver awareness of what the system is perceiving. With Level 2++ and Level 3 vehicles, surround view systems and perception 3D renderings make the system's capabilities more transparent and intuitive, which in turn builds driver trust in the vehicle's autonomous functionalities.

Why did Ambarella choose Imagination?

Imagination Technologies is a world-class GPU IP provider with a focus on efficiency for edge devices. It is the most popular GPU IP solution for cockpit and in-vehicle infotainment systems and can be found inside the models of nearly all the major car brands. Its flexible, programmable general purpose compute capabilities are also deployed by SoC architects in ADAS and autonomous domain controllers. Its popularity in vehicles stems from its performance efficiency, its flexibility and its performance-conscious safety solutions.

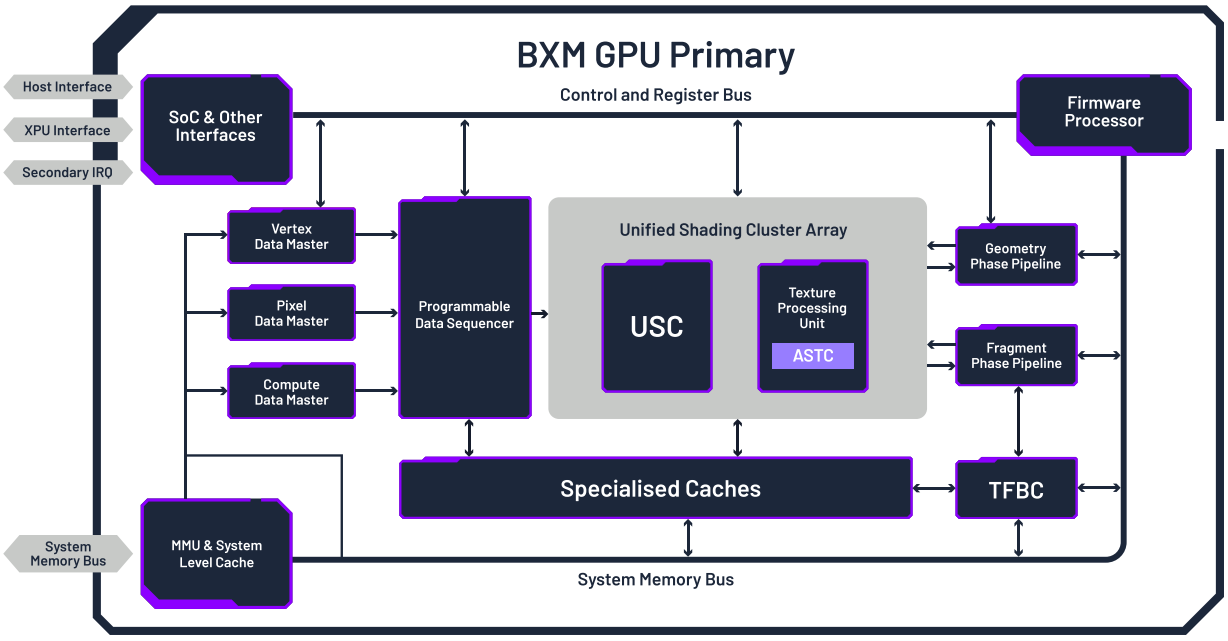
Ambarella is experienced in developing with Imagination's GPU IP; previous iterations of the CV3-AD SoCs have featured the functionally safe IMG BXS GPU IP.

What does the IMG BXM bring to the CV3-AD?

Given the CV3-AD655's focus on efficiency, the IMG BXM GPU provided the right mix of graphics performance, compute capabilities and low-power.

- It has the performance to render a surround view system on a 1080p screen at 60 frames per second, with twice the fillrate of competing cores.
- The innately efficient PowerVR tile-based deferred rendering architecture, with additional geometry and frame buffer compression technologies, keeps power consumption low.
- Features like programmable, high quality anti-aliasing deliver exquisite visual quality.
- The arithmetic logic unit (ALU) guarantees high SIMD efficiency for general purpose compute tasks, like image stitching.
- It has exceptional multi-tasking capabilities, simultaneously processing 2D, 3D, compute and housekeeping tasks via asynchronous computing.
- Its firmware processor manages fine-grained task switching, workload balancing and power management.
- It is a quality managed IP suitable for an ASIL-B(D) SoC

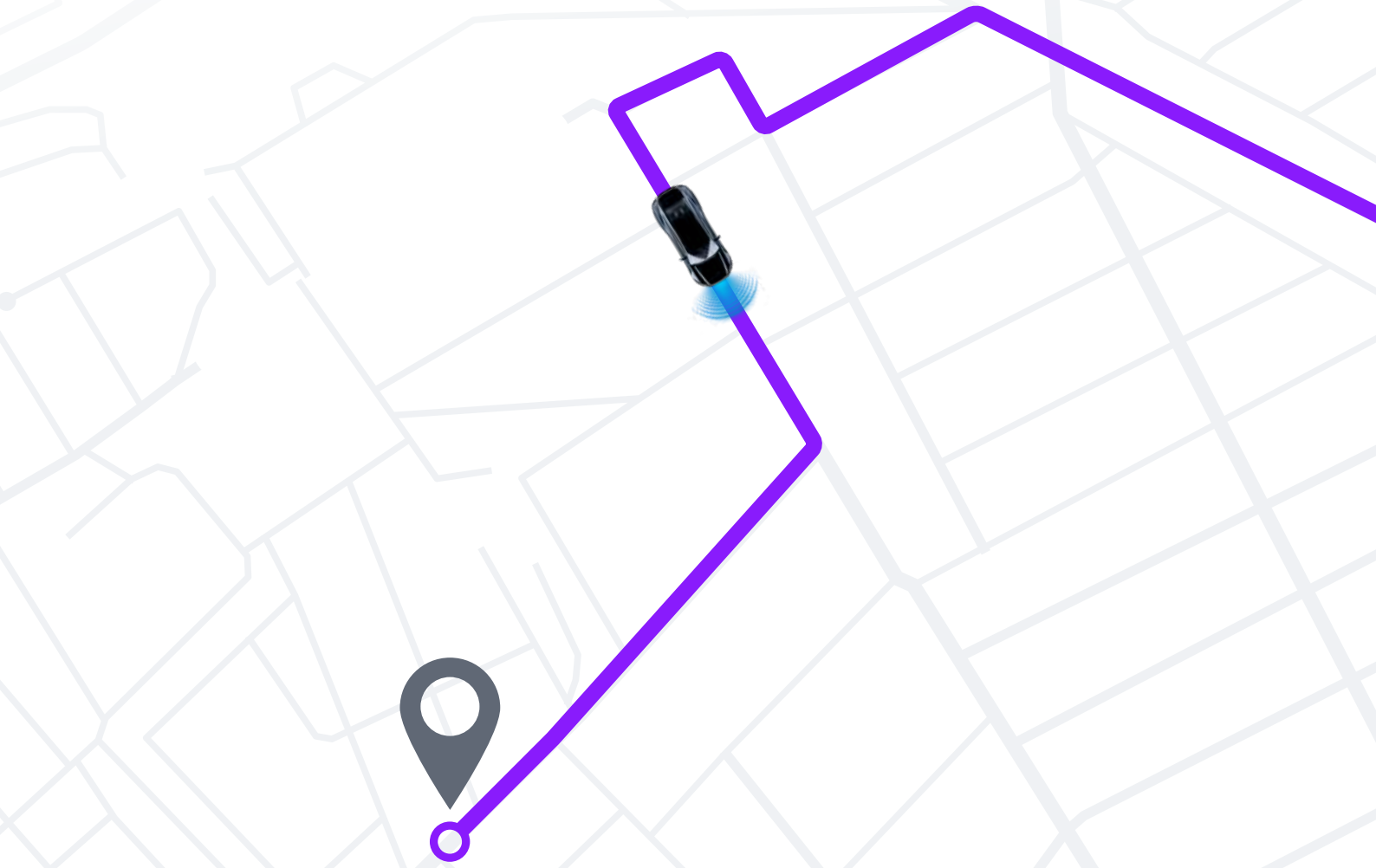
BXM GPU Block Diagram



Caption: Inside the IMG BXM GPU

What's next for the CV3-AD655?

The CV3-AD655 with its Imagination GPU is set to bring high performance autonomy to mass market L2++ and L3 systems while helping OEMs lower total system design costs and manage energy consumption inside the vehicle. Ambarella is already partnering with major tier-1s like Continental/AUMOVIO to bring their full-stack vehicle system solutions to cars from 2027. The goal is to enable safer mobility and shape the path towards an autonomous future.



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