Platform Brief

Intel® Automotive System-on-Chip Platform
Intel® Automotive SDV SoC Family

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Intel® Automotive System-on-Chip Platform: Enables Software-Led Automotive Solutions

A flexible, automotive-grade system-on-chip (SoC), featuring the Intel® Automotive software-defined vehicle (SDV) SoC Family, paves a path for an open compute software-focused, data-oriented architecture for SDV transformation.

There is a growing and continuous demand for advanced capabilities and features in vehicles to meet evolving expectations of today's consumers. This paradigm shift in consumers' expectations and advancement of new energy vehicles necessitates a transformation in the electronic and software architecture of vehicles, transitioning from distributed vehicle architecture to a centralized compute platform–based vehicle architecture. The Malibou Lake platform aims to enable OEMs in consolidating their workloads and offers rich in-vehicle experiences via upgrades throughout a vehicle's life cycle, facilitated by over-the-air (OTA) updates addressing bugs, enhancing software features, and introducing new functionalities.

Introducing the Intel® Automotive SoC platform

The Intel Automotive SoC platform is bringing powerful compute, AI capabilities, and built-in graphics to support software-oriented in-cabin user experience. The Malibou Lake Platform, based on the Intel® Automotive SDV SoC Family, is designed with performance hybrid architecture that balances compute power and energy efficiency. The Intel Automotive SoC platform offers enough performance headroom to consolidate several automotive applications—and even multiple OSs—that would otherwise run on discrete devices.

Designed into a compact package, the Intel Automotive SoC platform is highly flexible and scalable to meet automaker use-case requirements. It's also built on an open architecture that preserves choice in software and vendors. Automakers and solution developers can customize the platform to create unique capabilities and experiences such as distinctive and dynamic 3D instrument panels, intelligent driver monitoring features, highly personalized user experiences, or cloud-connected customer support services.

The Intel Automotive SoC platform provides a simplified path to build compelling automotive feature sets and driver experiences that scale fast and deliver long-term business value.

Open source in-band manageability included

Intel® In-Band Manageability supports the ability of fleet management solutions to deploy software updates and allows owners and managers to remotely monitor vehicle health and collect telemetry from onboard sensors. When paired with interoperable Intel® architecture, this open source framework makes it simple to connect vehicles and vehicle management solutions over any cloud of your choice.

Intel® Automotive SoC platform highlights

Advanced in-car computing

The Intel Automotive SoC platform is designed to deliver unmatched performance to meet SDV and digital cockpit use cases. The significantly enhanced multicore processing hybrid architecture provides faster and time-responsive computing utilizing big Performance-cores and small Efficient-cores.

AI acceleration

The Intel Automotive SoC platform is Intel's first automotive-dedicated CPU to offer built-in AI acceleration with a powerful set of Intel® Advanced Vector Extensions (Intel® AVX) Vector Neural Network Instructions (VNNI) to accelerate convolutional neural networks. Intel® Deep Learning Boost (Intel® DL Boost) VNNI, int8 support, and Intel® Gaussian & Neural Accelerator (Intel® GNA) enable high-performance AI workloads such as natural language processing and video analytics.

In-vehicle connectivity

The Intel Automotive SoC platform supports high-speed data transfer and seamless connectivity options, making it the platform of choice for in-car entertainment, OTA updates, and communication between vehicles and infrastructure.

Fast edge-to-cloud connectivity

The Intel Automotive SoC platform is equipped with Intel® Wi-Fi 6E for high-speed file sharing, smooth video streaming, and ultraresponsive web surfing and gaming. Intel® Connectivity Performance Suite offers intelligent optimization of Wi-Fi performance for low latency and fast network speeds.[4]

Multi-display support

The Intel Automotive SoC platform can drive multiple displays concurrently in 4K60 mode, providing drivers and passengers with a visually rich, interactive, and immersive in-car experience.

Out-of-box hardware virtualization

The Intel Automotive SoC has built-in hardware virtualization technology that abstracts hardware that allows multiple workloads to share a common set of resources. On shared virtualized hardware, a variety of workloads can colocate while maintaining full isolation from each other.

Enhanced security

The Intel Automotive SoC platform incorporates advanced security features, including hardware-based encryption, secure boot, and vendor-controlled security device life cycle. These advanced security features enable OEMs to safeguard sensitive data and protect against cyber threats.

Built-in safety

The Intel Automotive SoC platform offers hardware-based safety features such as error-correcting code (ECC) memory, functional safety mechanisms, and redundancy where necessary.

Scalability

The Intel Automotive SoC platform offers pin-compatible scalability to address the varying compute needs of different vehicle models and SDV use cases, thus streamlining software development and shortening time to market.

Automotive grade

The Intel Automotive SoC is available in an automotive-grade package, qualified as AEC Q100 Grade 3 with an ambient temperature range of -40°C to 85°C.

Intel® Smart Sound Technology

The Intel Automotive SoC platform features an integrated audio DSP that delivers engaging and immersive audio experiences. DSP offload engines and audio interfaces enable surround sound experiences or the consolidation of multiple automotive systems that require sound outputs.

Support for real-time and latency-sensitive workloads

Deploying critical automotive use cases such as cockpit display and passenger safety applications requires more than high-power compute. The Intel Automotive SoC platform supports latency-sensitive automotive use cases with the integration of Intel® Time Coordinated Computing (Intel® TCC) and Intel® TCC tools. It also offers ultrareliable low-latency communication (URLLC) machine-to-machine communication and time-sensitive networking (TSN) support through an integrated 2.5GbE controller.

Intel® Automotive SoC Features	
CPU	Up to 14 cores (up to six Performance + up to eight Efficient)
L3 cache (MB)	Up to 24 MB
Process node	Intel® 7
Graphics	Up to 96 EU, hardware virtualization with SR-IOV
Memory	Up to LPDDR4x-4267; up to LPDDR5-6400
Display	Four concurrent display pipes, each up to 4K @ 60 Hz
Camera input and ISP	Up to eight cameras, 2.5 Gbps per lane
Audio	Up to ~3.2 GFLOPs (4x HIFI3), 6x I2S/PCM ports
Ethernet	1x integrated 2.5GbE with integrated TSN
High-speed I/Os	X5-lane PCIe Gen3, 2x4-lane PCIe Gen4, 1x8-lane PCIe Gen5
Low-speed I/Os	2x USB 3.2 Gen 2x2 Type-C, 4x USB 3.2 Gen 2x1 Type-A, I2C, SPI, eSPI, GPIOs
Storage	1x UFS 2.1
Package size	25x50 mm
Die configuration	Multichip package 2 Dice
Product availability	Q4 2024

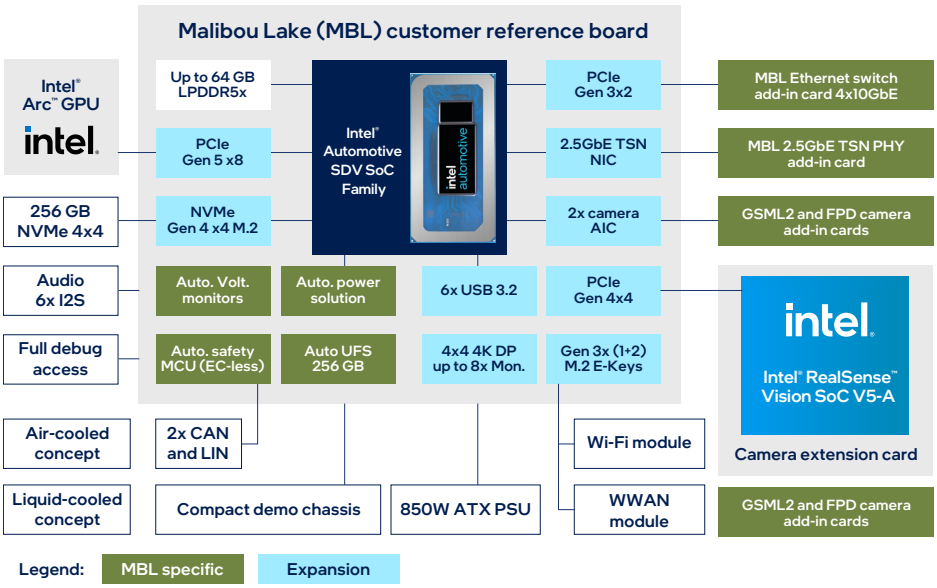

Figure 1. Block diagram of the Malibou Lake (MBL) customer reference platform

Intel Automotive SoC–based platform

The Malibou Lake platform is a ready-to-use reference design that integrates the Intel Automotive SoC platform and high-performance peripherals such as Intel® RealSense™ Vision SoC V5-A and Intel® Arc™ GPUs to deliver detail-rich experiences and immersive entertainment.

Intel Automotive software stack

Through collaborations with others, Intel offers advanced, cloud-integrated SDV features with performance that scales across generations of hardware platforms. The Intel Automotive software stack provides a dynamic, scalable, and reusable framework for enhancing in-cabin functionalities and efficient compute resource utilization.

Key features

Compute consolidation

Achieve unprecedented efficiency with compute consolidation, optimizing the use of computational resources for various in-vehicle applications.

Dynamic workload management

Experience adaptive workload distribution, enabling real-time adjustments of computing resources based on the varying demands of different applications and driving scenarios.

Open architecture for ecosystem integration

Foster innovation through an open architecture that supports seamless integration with third-party applications, services, and emerging technologies, enabling a diverse and expanding ecosystem for OEMs.

OTA updates

Stay ahead of the curve with fleet-wide OTA updates, allowing for the continuous enhancement of software functionalities, security patches, and performance improvements without the need for physical interventions.

Adaptive user experience

Elevate the driving experience with adaptive user interfaces and personalized settings, tailoring the in-vehicle environment to individual preferences and ensuring a user-centric approach to software-defined features.

Efficient resource utilization

Optimize resource utilization across the vehicle's compute infrastructure, striking a balance between performance, power efficiency, and thermal considerations for a sustainable and reliable software-defined solution.

Software overview

The Malibou Lake software stack provides a hypervisor-based virtualization solution that divides the hardware resources between multiple domains. Each domain is designed for workloads with different demands on resources and operating systems: safety, security, infotainment, and Linux-based services:

- Safety-critical workloads, such as safety checkers, are executed by a safety OS.
- Infotainment workloads, such as gaming and video streaming, are provided by the Android Automotive OS.
- Virtualization support for device sharing is provided by a Linux-based service OS.
- Security support is provided by security services executed by a security OS.

The hypervisor-based approach allows for flexibility in configuring and partitioning the system resources to best match the desired use cases and workloads.

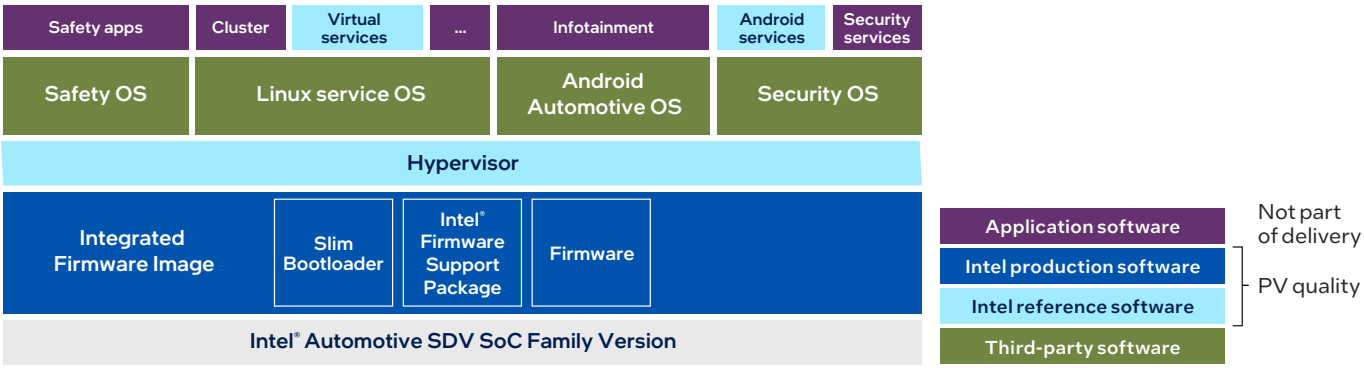

Figure 2. The Malibou Lake software stack

Intel® Automotive Software Ingredients		
Software Category	**Software Baseline Ingredients**	
Applications/tools	▪ Manufacturing tools ▪ Computer vision applications	▪ Media player applications ▪ Intel® VTune™ Amplifier ▪ Intel® Graphics Performance Analyzers
Software development kits	▪ Intel® Distribution of OpenVINO™ toolkit ▪ Intel® oneVPL	▪ Intel® TCC tools ▪ Intel® one API Toolkit ▪ Intel® In-Band Manageability
Operating system	▪ Ubuntu ▪ Android Automotive OS	▪ QNX RTOS ▪ Safety OS (third party)
Core, graphics, media, display, audio, IPU security, connectivity, storage, IOs	▪ Device drivers ▪ Hardware virtualization with SR-IOV	▪ IP firmware
Virtual machine manager	▪ ACRN	▪ QNX
Firmware/ bootloaders	▪ Intel® Firmware Support Package (Intel® FSP) and Slim Bootloader, Coreboot	▪ Manageability and security ▪ Integrated sensor hub ▪ Microcode

Note: Not all features are supported in all operating systems.

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1. Performance hybrid architecture combines two core microarchitectures, Performance-cores (P-cores) and Efficient-cores (E-cores), on a single processor die first introduced on the Intel Automotive SDV SoC Family. Select Intel Automotive SDV SoC Family processors do not have performance hybrid architecture, only P-cores, and have the same cache size as the prior generation.
2. Built into the hardware, Intel® Thread Director is provided only in performance hybrid architecture configurations of the Intel Automotive SDV SoC Family; OS enablement is required. Available features and functionality vary by OS.
3. PCIe 5.0 is available only on HX and H-Series processors.
4. See intel.com/performance-wireless for details. Results may vary.

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