Synopsys Automotive VDK for Level 4 Virtual ECU Abstraction

Introduction

Next-generation vehicles and automotive systems are designed with advanced computing platforms, multiple networks, and an increasing amount of software to operate complex physical systems autonomously. Virtual prototypes of vehicle electronics, also known as electronics digital twins, serve as digital representations for the systems under development. These prototypes are critical for accelerating the automotive industry's digital transformation by enabling earlier development and testing, improving productivity, and facilitating the continuous delivery of safer, more secure, and higher-quality systems at a reduced cost.

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Establishing electronics digital twins for automotive electronics requires powerful simulation technologies enabling the execution of virtual ECUs (vECUs), either individually or integrated into a virtual vehicle. Synopsys is the only company providing a complete range of vECU simulation technologies from Level 1 through Level 4 vECU abstraction.

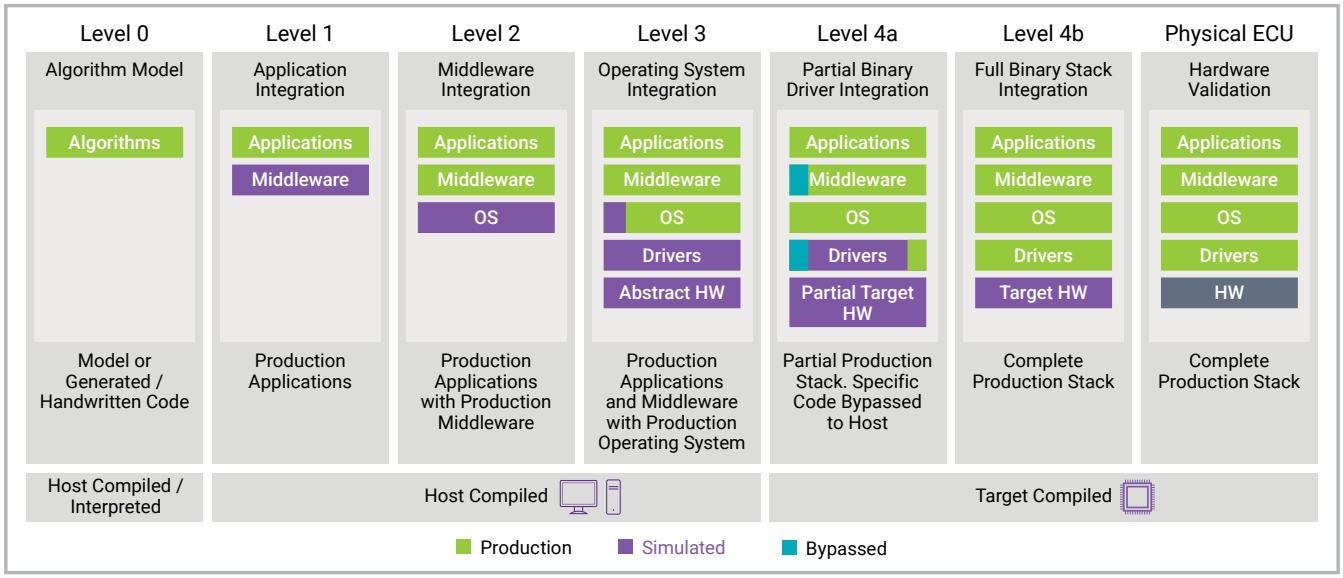

Figure 1: vECU Abstraction Levels

Electronics Digital Twin Level 4 vECU Abstraction Use Cases

Level 4 vECU abstraction refers to the ability to execute target compiled automotive software. This can be used to establish virtual Processor-in-the-Loop (PiL) and virtual Hardware-in-the-Loop (HiL) environments enabling earlier, automated, and more scalable validation from the hardware dependent software to the full software stack. Higher software quality can be achieved in shorter time with the ability to integrate fault injection techniques into CI/CD pipelines.

Level 4 vECUs do not need to fully replicate the entire hardware system in a single, all-or-nothing model. Instead, they offer a flexible approach that can simulate specific hardware components while bypassing others.

- Full binary Level 4 vECUs (4b) can use production code for all software layers. They enable full stack validation, driver testing, system boot and re-flashing/OTA testing, functional safety validation, security testing, and integration in CI/CD flows.
- Partial binary Level 4 vECUs (4a) bypasses specific code as 'Host Functions' via Host Extension and VIRTIO driver substitution, and abstract further hardware component aligned with the intended use cases. Use cases supported by Level 4a are similar to Level 4b but for directed validation with the intent to start validation even earlier and deliver faster simulation performance.

Effectively deploying Level 4 vECUs requires validated and proven libraries of microcontrollers, system-on-chips, ASICs, and board level components.

Unique Collaboration and Expertise + Broadest Portfolio of Automotive Virtual MCUs and SoCs

With the #1 position in silicon design and verification and the broadest portfolio of silicon IP, Synopsys has been engaged with semiconductor companies for decades. This unique position has enabled deep relationships and center of excellence collaborations for the development of virtual models from individual ICs to processors. These relationships deliver key components:

- Access to all required information for early modeling
- Access to software and test suites to ensure the highest model quality
- Joint model development and validation with proactive roadmap development
- Use of virtual models for internal semiconductor SW development and SW/HW validation
- Joint enablement of SW ecosystem
- Simplified access for automotive companies (single source solution)
- Global, expert, and clear support channels for virtual models
- Large service organizations to tailor virtual MCU and SoC starting point to specific needs

The following is an example of ecosystem partners. Please contact Synopsys for specific SoC/MCU or IC model requirements.

MCU and SoC VDKs

- Infineon AURIX™ and TRAVEO™ families
- Marvell Ethernet Switch
- NXP (MPC 5xxx and all S32 families)
- NVIDIA
- Qualcomm
- Renesas (RH850 and R-Car families)
- Samsung
- ST Microelectronics Stellar family
- Texas Instruments

Board level model for IC components

- Analog Devices
- Cypress
- Denso
- Infineon
- Marvell
- Maxim
- Melexis
- Microchip
- Micron
- Nexperia
- NXP
- On Semiconductor
- Qualcomm
- Rohm
- Samsung
- Seiko Epson Co.
- ST Microelectronics
- Texas Instruments
- Winbond
- ZF

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