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# Virtualization as a Catalyst for Requirement-Based DevOps in Electrified Powertrain Systems

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Electrified powertrains have evolved into highly software-driven systems, where functions such as energy and thermal management, diagnostics, drivability, charging logic, and safety behavior operate across multiple control units. As software content expands and development cycles accelerate, traditional prototype-dependent workflows can no longer provide the speed, repeatability, and transparency required for modern Software-Defined Vehicle (SDV) programs. To address these challenges, AVL applies virtualization and requirement-based DevOps practices that enable early, continuous, and scalable validation throughout the development process.

**Virtualization**, realized through Software-in-the-Loop and FMU-based plant models, supports unrestricted integration of virtual control units and deterministic regression testing with every software update. These virtual environments replicate cross-domain interactions realistically, allow testing of hazardous scenarios, and significantly reduce reliance on physical prototypes. FMU-based plant models following the Functional Mock-up Interface standard ensure compatibility across domains and provide sufficient model fidelity for system-level validation.

A **requirement-based DevOps approach** ensures that every requirement, from top-level functional intent to failure-handling logic, is linked to corresponding test cases and continuously verified across Model-in-the-Loop, Software-in-the-Loop, Hardware-in-the-Loop, testbed, and vehicle environments. Automated traceability turns compliance with ISO 26262 and Automotive SPICE into an integrated development outcome rather than a documentation task, enabling early detection of regressions and more predictable release cycles.

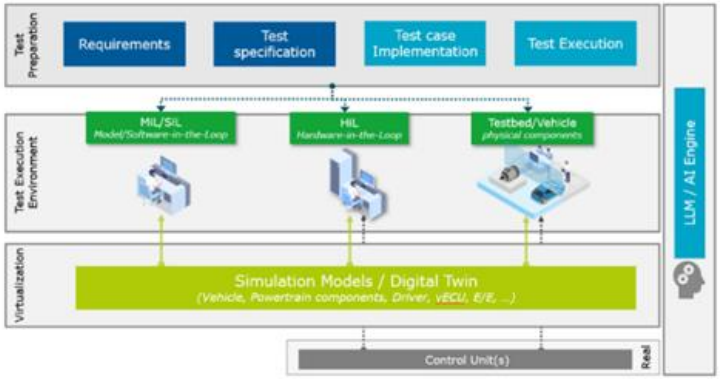


*Figure 1: Seamless Virtualization & Seamless Testing*

**The concept of virtual prototype** brings virtual control units, plant models, infrastructure services, and automated test execution together into a modular and reusable development asset. This environment enables parallel testing activities, efficient supplier integration, and consistent workflows for both model-based and non-model-based software. As illustrated in Figure 1, virtualization forms the backbone of a seamless test strategy that spans early simulation environments through hardware-based testing and vehicle-level validation.

Strong **model- and data-governance** ensure consistent model variants, parameters, and calibration datasets across the entire validation chain. Unified repositories, CRETA integration, structured data management, and automated tracking of unit-under-test configurations maintain alignment between virtual assets and their corresponding physical prototypes.

Looking ahead, **AI-driven automation**, such as MAESTRA AI, enhances this framework by generating test case candidates directly from textual requirements. This increases coverage, reduces manual workload, and strengthens alignment between requirements, architecture, and executable tests.

**In summary**, virtualization transforms requirement-based DevOps into the driving force of SDV development, delivering earlier insight, faster cycles, and safer electrified powertrain software.