

CUSTOMER CASE STUDY

NI-Based HIL Platform for Electric Bus VCU Validation

Application Summary

TMCS developed an **NI-based HIL platform** to validate **Vehicle Control Units (VCUs)** for **electric buses**. Using **NI PXI**, **VeriStand**, **TestStand** and **LabVIEW**, the platform runs real-time **drive cycle** and **fault simulation**, enabling automated, repeatable and traceable testing of performance, safety and diagnostics. **Simulink integration** supports safe virtual validation while reducing prototype use, test time and risk.

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Challenges

An electric bus VCU works with many other ECUs, such as motor control, high-voltage battery, braking and the instrument cluster, over the vehicle CAN network. Validating it on full-size prototype buses is costly and slow, and testing faults and safety functions on a real vehicle is risky. The challenge was to simulate the whole vehicle around the VCU, run complete drive cycles and fault scenarios automatically, and keep every result traceable.

The Solution

TMCS delivered a real-time **NI PXI** platform in which **NI VeriStand** executes vehicle models (braking, battery, motor/drive) and **CAN messages**, including models brought in from **Simulink**. The I/O and CAN interfaces connect to the VCU and other ECUs, and **fault insertion** allows electrical and communication faults to be injected safely. **NI TestStand** automates drive-cycle and fault test sequences, and **LabVIEW** provides the operator interface and reporting.

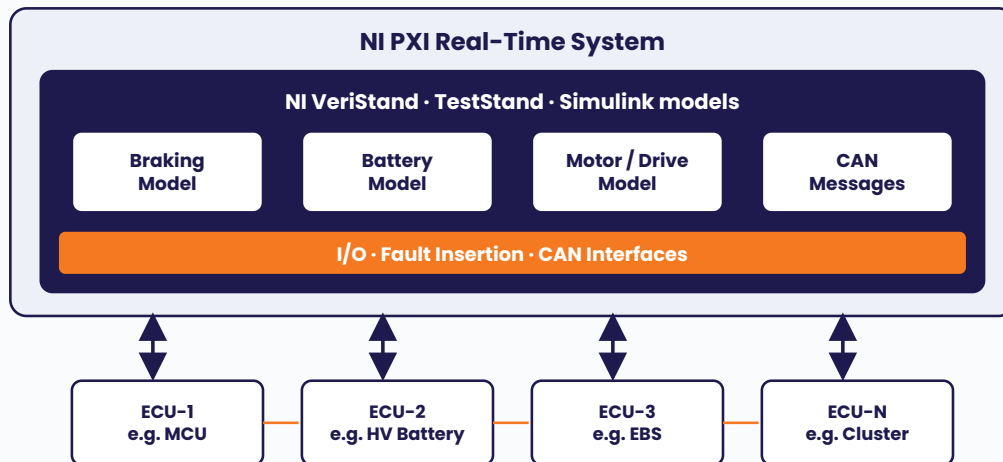


Figure 1: Electric bus VCU HIL architecture

Test Types / Parameters Monitored

Test Type	Description
Drive Cycle Simulation	Runs real-time drive cycles to evaluate VCU performance
Fault Simulation	Injects electrical and CAN faults to verify safe responses
Diagnostics Validation	Checks fault detection, reporting and diagnostic behaviour
Multi-ECU Interaction	Verifies VCU communication with MCU, battery, braking and cluster ECUs
Safety Functions	Validates VCU behaviour in safety-critical scenarios

Specifications & Features

Feature	Description
Real-Time Vehicle Models	Braking, battery and motor/drive models in NI VeriStand
Simulink Integration	Reuses model-based development assets in the HIL loop
Automated Sequencing	NI TestStand executes test campaigns without manual intervention
Traceable Results	Logged data and reports for every test run
Scalable Architecture	Supports additional ECUs, I/O and networks

Technology Used

The platform integrates **NI PXI** real-time hardware with **NI VeriStand** for model execution, **NI TestStand** for test automation and reporting, and **LabVIEW** for the operator interface. **Simulink** models plug directly into the real-time system, and CAN and I/O interfaces with fault insertion connect the platform to the ECUs under test.

Advantage / Benefit

- **Less prototype dependence:** much of the validation happens before buses are built.
- **Reduced test time and risk:** faults and safety scenarios are tested virtually and safely.
- **Automated, repeatable and traceable:** every test campaign is consistent and documented.
- **Model reuse:** Simulink integration connects design and validation teams.
- **Scalable:** the platform grows with new ECUs and vehicle variants.

Conclusion and Future Plan

The HIL platform provides a safe, efficient way to validate electric bus VCUs for performance, safety and diagnostics. Future enhancements may include more ECUs in the loop, additional network protocols and expanded drive-cycle and fault libraries.

Need a HIL platform for your EV programme?

Talk to TMCS engineers about your validation requirements.

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