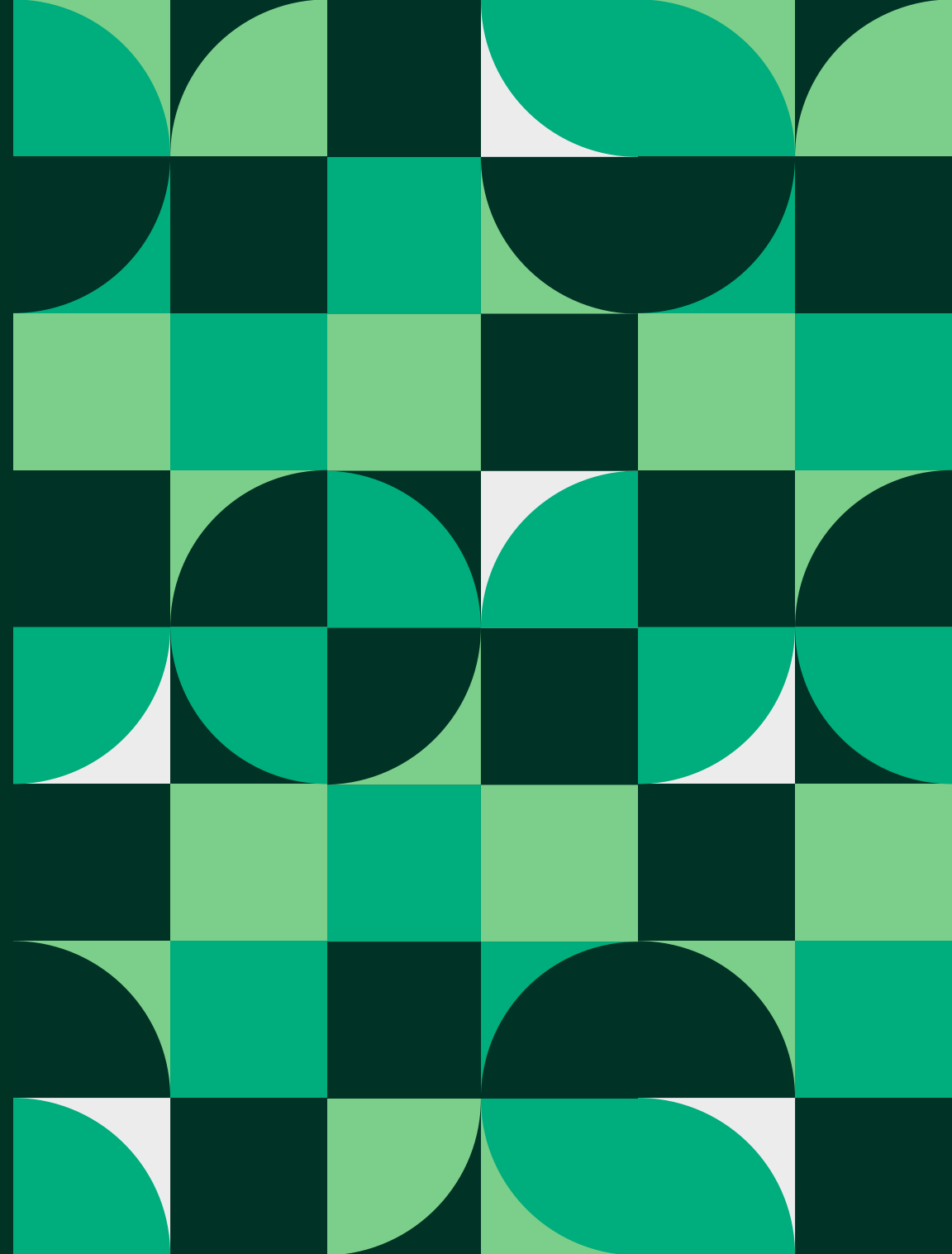


Streamlining Model Integration with VeriStand

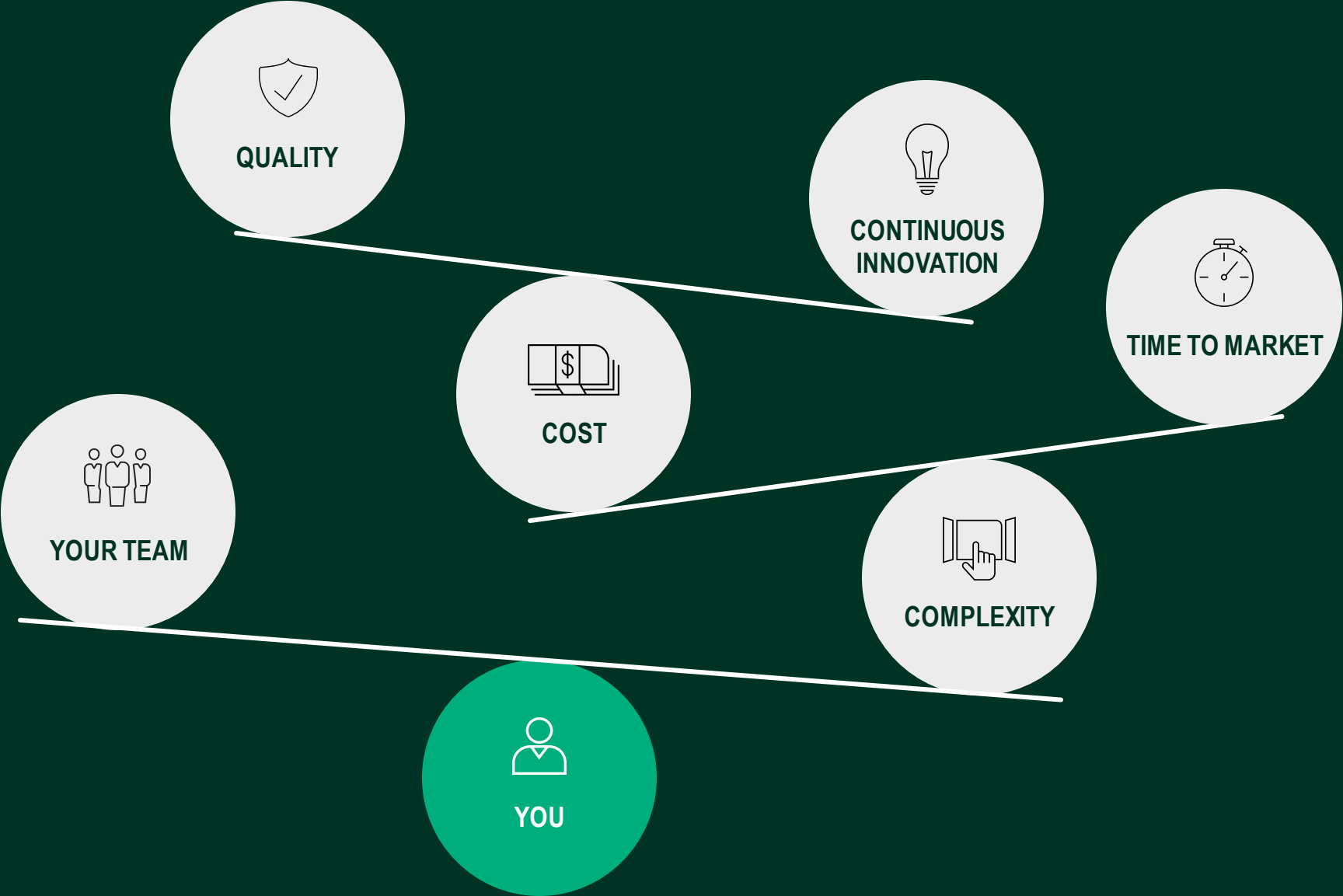
Brian Dexheimer

Product Owner

NI

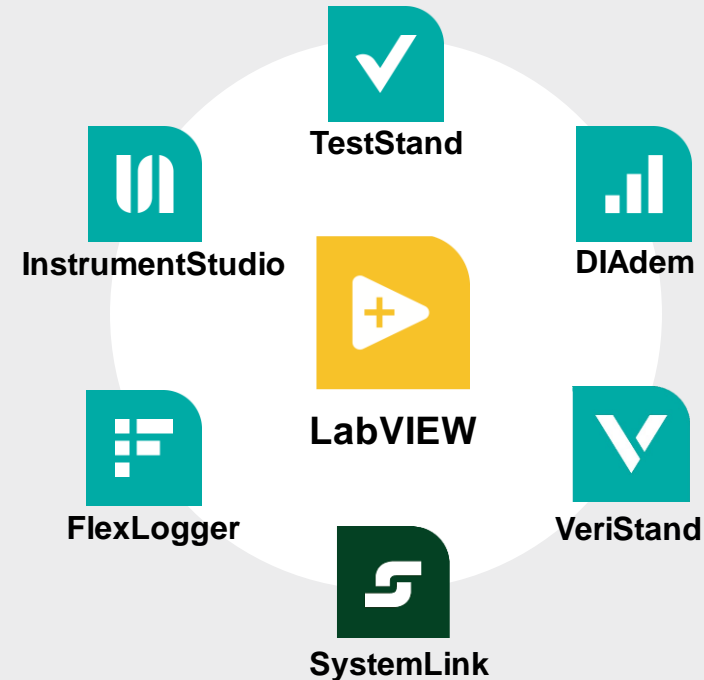


Test Organizations
Must Balance
Competing Requirements



Evolving NI Test Software

Enable Automated Test & Measurement Professionals



1

Strengthen LabVIEW

Deliver new capabilities in **LabVIEW** & **NI Software** to meet the evolving requirements of applications and users

2

Connect LabVIEW+

Bridge seamlessly between tools, tasks and teams to accelerate the productivity of test professionals

3

Build Community

Engage and collaborate with the community to empower their continued success with

Embedded Software Test | Validation Systems

Engineer Profile

Responsible for testing deployed software to **uncover software defects** over a wide range of parameter variations. Challenged by **test case complexity, disparate IP integration** and **diversity of I/O**.

Task Workflow

Configure & Map

Configure hardware → Import & configure models → Map model to DUT signals.

Test & Bring Up

Interactively deploy → Verify test functionality → Bring up DUT and validate manually.

Automate & Execute

Create library of tests → Build Sequences → Integrate test system into larger ecosystem → Monitor and debug

Application Profile

Verify software functionality in a range of conditions not easily created or replicated in the real world. NI recommends **Real-Time PXI & DAQ** hardware with the **LabVIEW+** Suite of software.

Existing Strengths of NI Platform

- Flexible and scalable software
- Configurable framework for I/O, alarming, fault insertion, UI creation, and bus communication
- Extensibility to 3rd party models
- Adaptability to changing requirements

Gaps to be Addressed with Roadmap

- Model integration and reuse
- Automation and sequencing
- System debugging
- Security





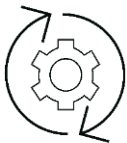
Validates hardware and performs embedded software test for HIL with model integration, real-time stimulus generation, and an extensible software environment.



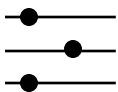
Ready to Run Software for HIL
Create, deploy, and leverage closed loop control on Linux RT for hardware-in-the-loop systems



Quickly Configure Systems
Configure I/O channels, alarming, data logging, stimulus generation, fault insertion, user interfaces and bus communications



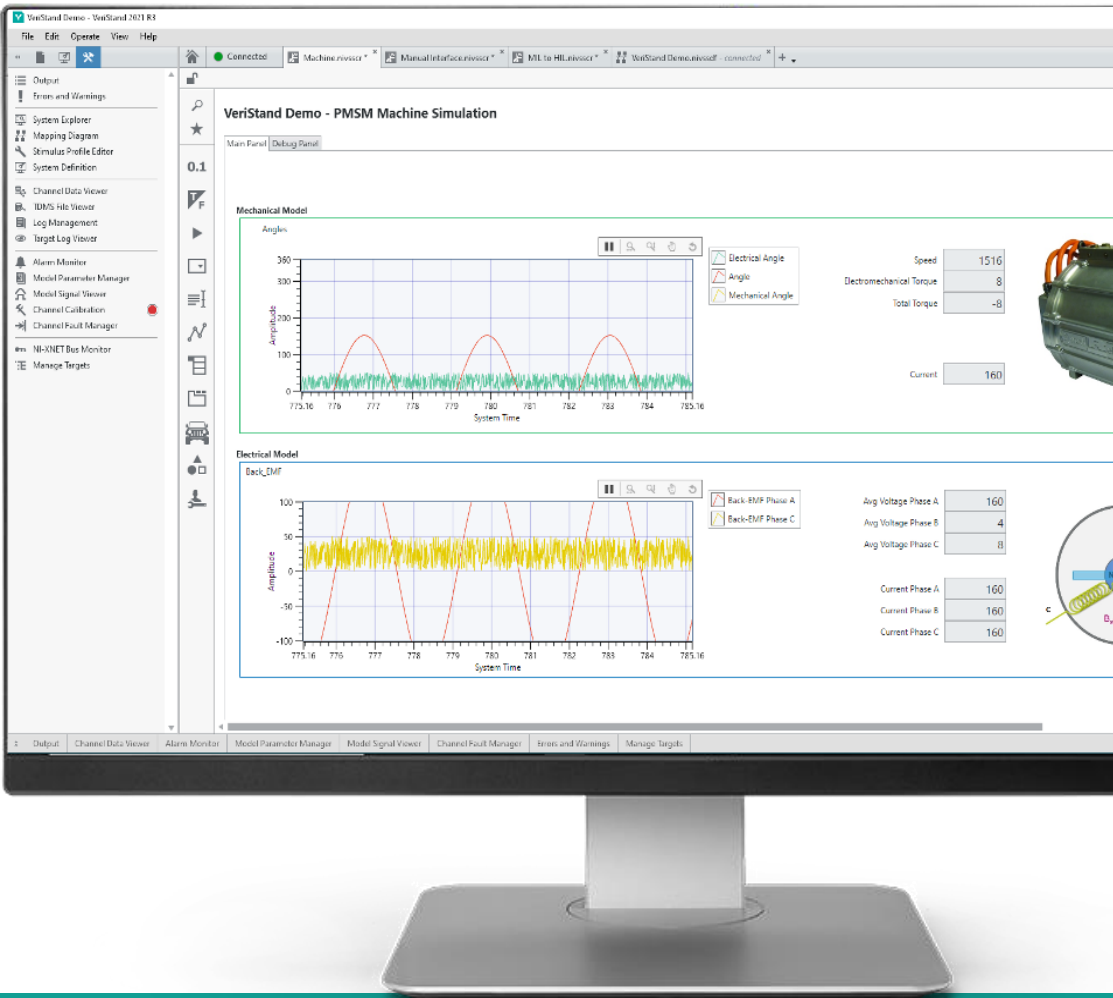
Model Integration
Integrate plant and controller models from Simulink and other 3rd party modeling environments adhering to the FMI standard



Customizability
Adapt to changing requirements with an extensible software environment.
Build plug-ins for 3rd party hardware and additional measurement types



Test Automation
Use test sequences and scripting to configure, orchestrate systems through TestStand, .NET APIs, Python, and ASAM XIL and integrate with CI/CD workflows



Connect VeriStand



With **LabVIEW** to develop plugins to extend your test system with additional functionality



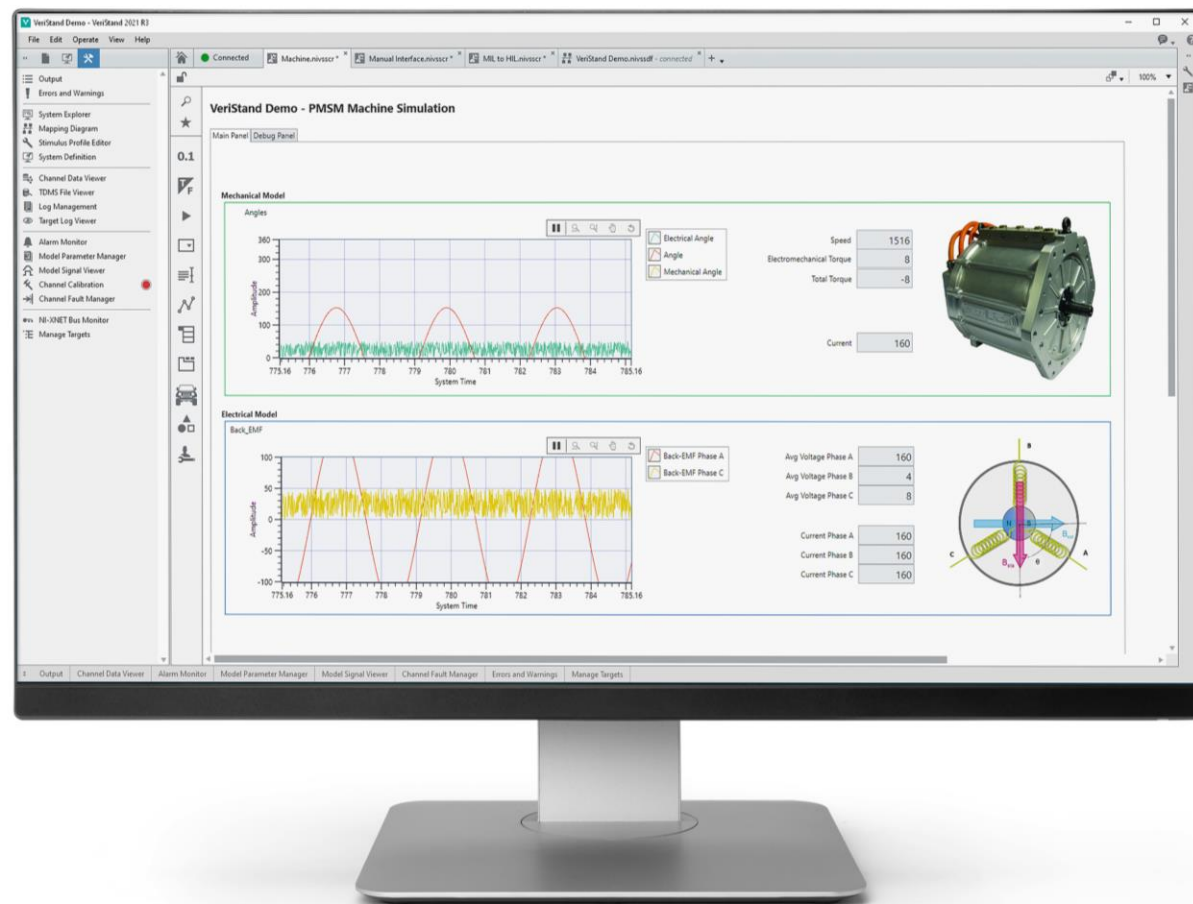
With **TestStand** to build libraries of test steps for higher level orchestration



With **your test infrastructure and IP** to maximize reuse



Accelerate Embedded Software Testing



Ready to Run Software for HIL

Create, deploy, and leverage closed loop control on Linux RT for hardware-in-the-loop systems.

Quickly Configure Systems

Configure I/O channels, alarming, data logging, stimulus generation, fault insertion, user interfaces and bus communications.

Model Integration

Integrate plant and controller models from Simulink and other 3rd party modeling environments adhering to FMI standard.

Customizability

Adapt to changing requirements with an extensible software environment. Build plugins for 3rd party hardware and additional measurement types.

Test Automation

Use test sequences and scripting to configure, orchestrate systems through .NET APIs, Python, and ASAM XIL and integrate with CI/CD workflows.

VeriStand Components

Automate Data Logging
and Test Sequences

Use Host PC to Create UI, Import
Models, and Configure System

I/O and Bus Protocols

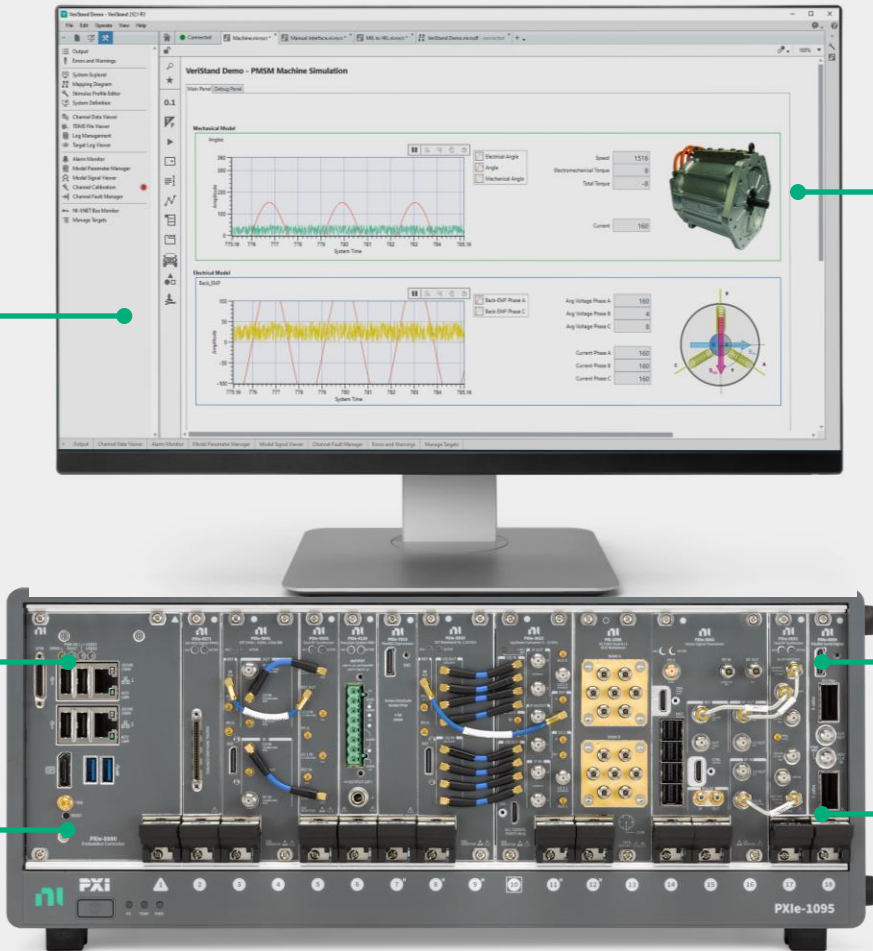
Real Time CPU and
Model Execution

Integrate Optional FPGA for
Nanosecond Control and
Importing VHDL Models

I/O Stimulus

Device Under Test

Embedded Software Testing and
Stimuli Response



Model Based Development



MODELS

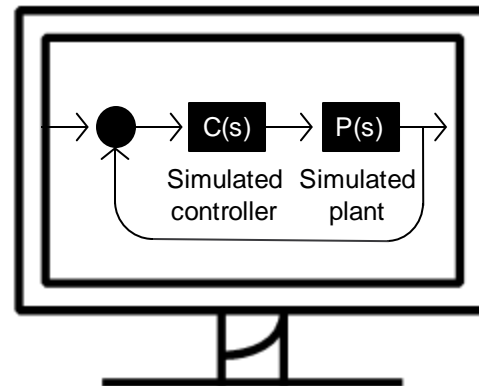


**Model in
the Loop**

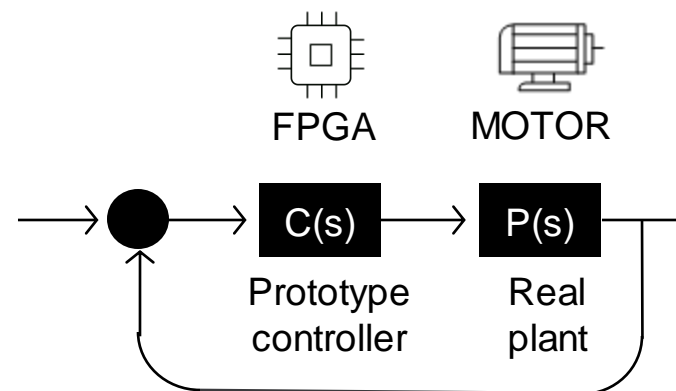
**Software in
the Loop**

**Signal Level
Hardware in the Loop (HIL)**

Design

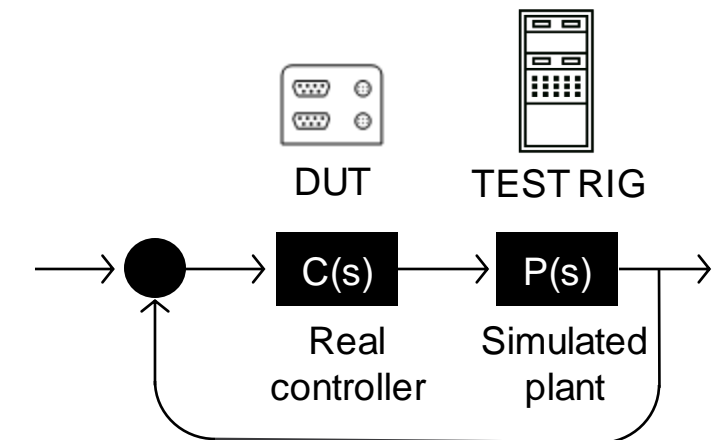


Prototype



Software and Controller Test

HIL, Functional Test, etc.



Real-Time Modeling Environment Support

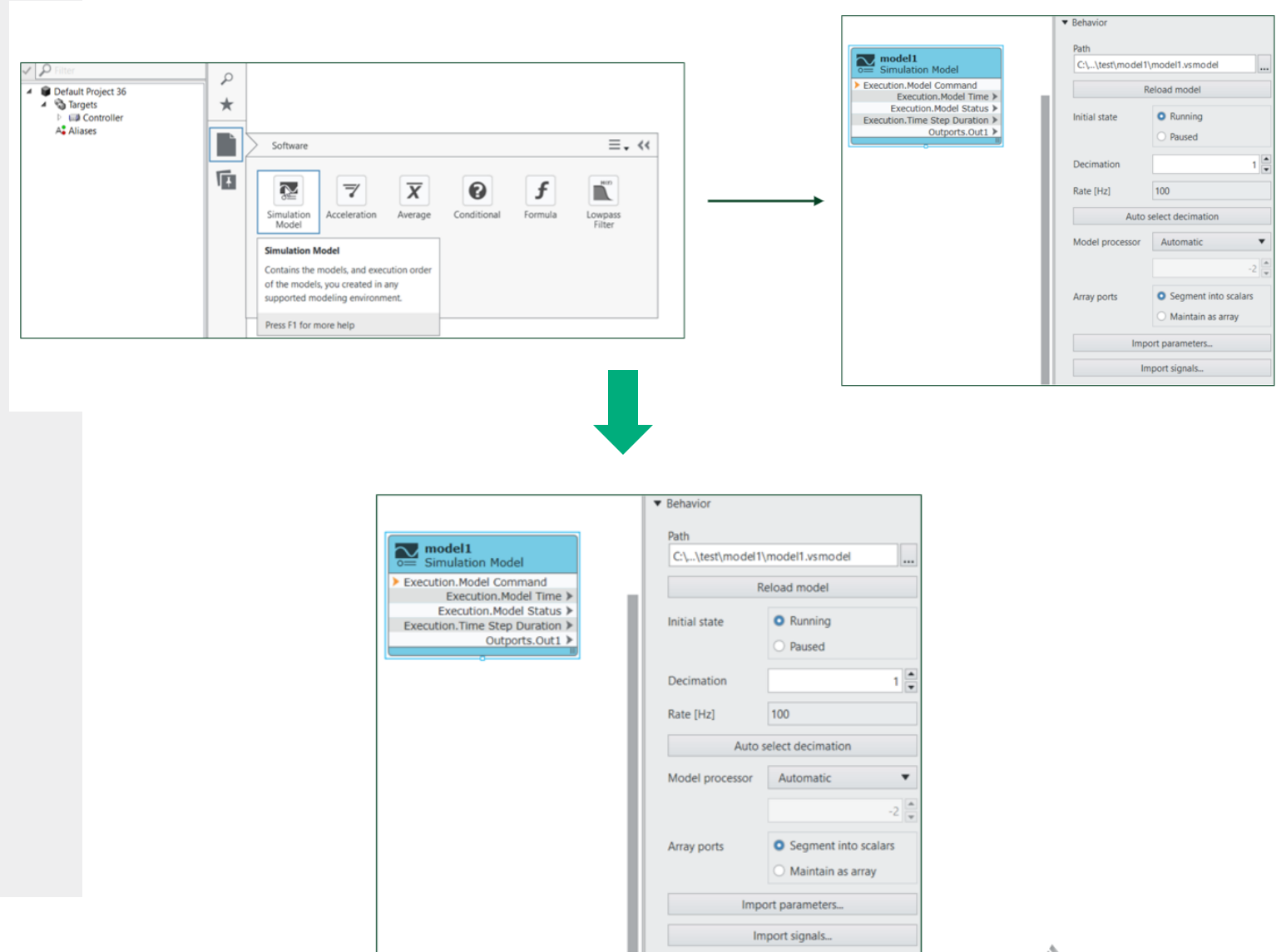
MathWorks Simulink® Software

LabVIEW

C/C++

FMI 2.0/3.0 CoSimulation Support

- AVL Boost
- FMU SDK
- Wolfram SystemModeler
- MapleSim
- Altair Activate
- And Can Support More [Here](#)

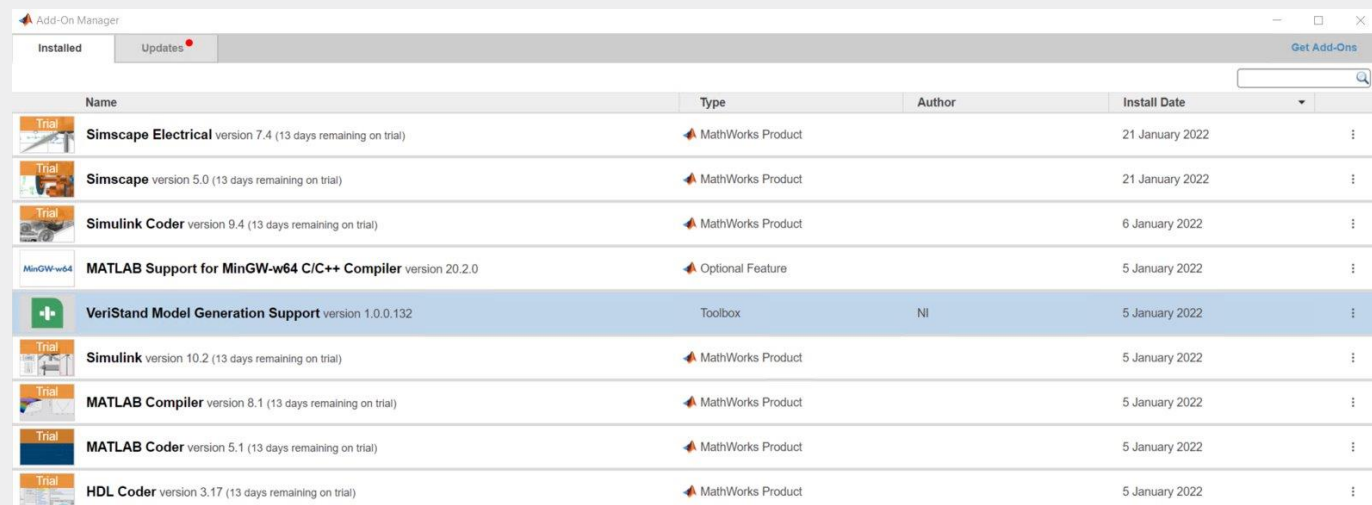


VeriStand Model Generation Support










New Simulink toolbox for CPU model integration

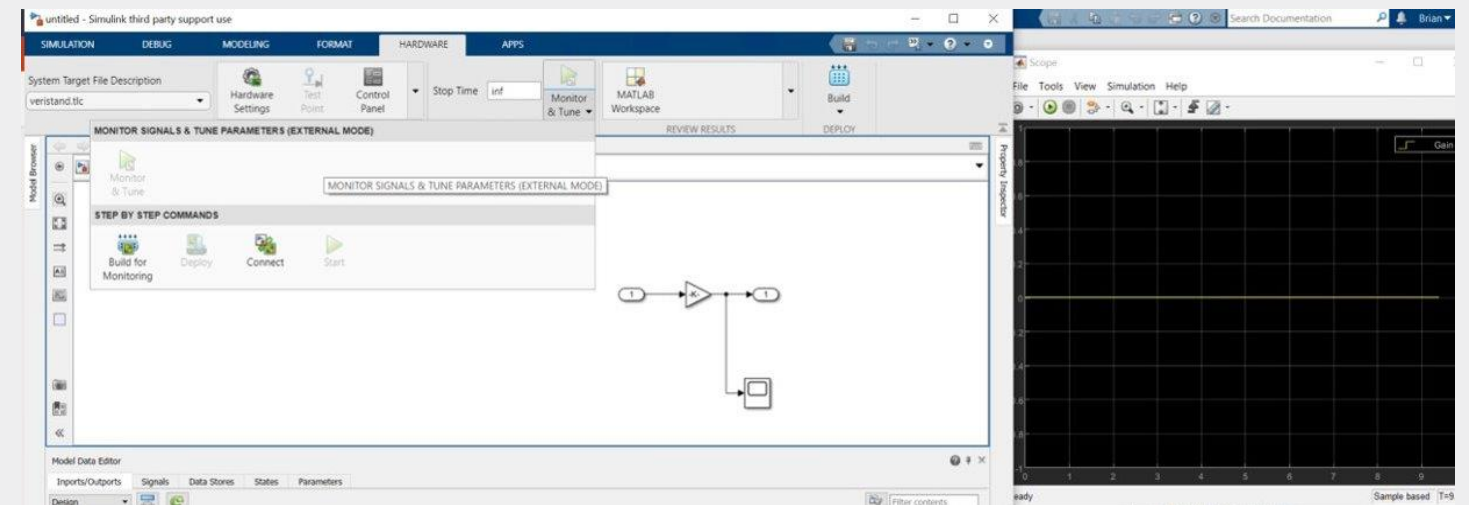
VeriStand 2021 supports new model type: .vsmodels

- Addresses difficulty of getting started, compilation, supporting toolkits, and supporting new versions
- Subsequent releases through 2022 and 2023 expand support, including:
 - External Mode: from Simulink, visualize and debug execution of model executing in VeriStand
 - Import Simulink signals as channels into VeriStand



The screenshot shows the 'Add-On Manager' window with the 'Installed' tab selected. It displays a list of installed toolboxes and their details.

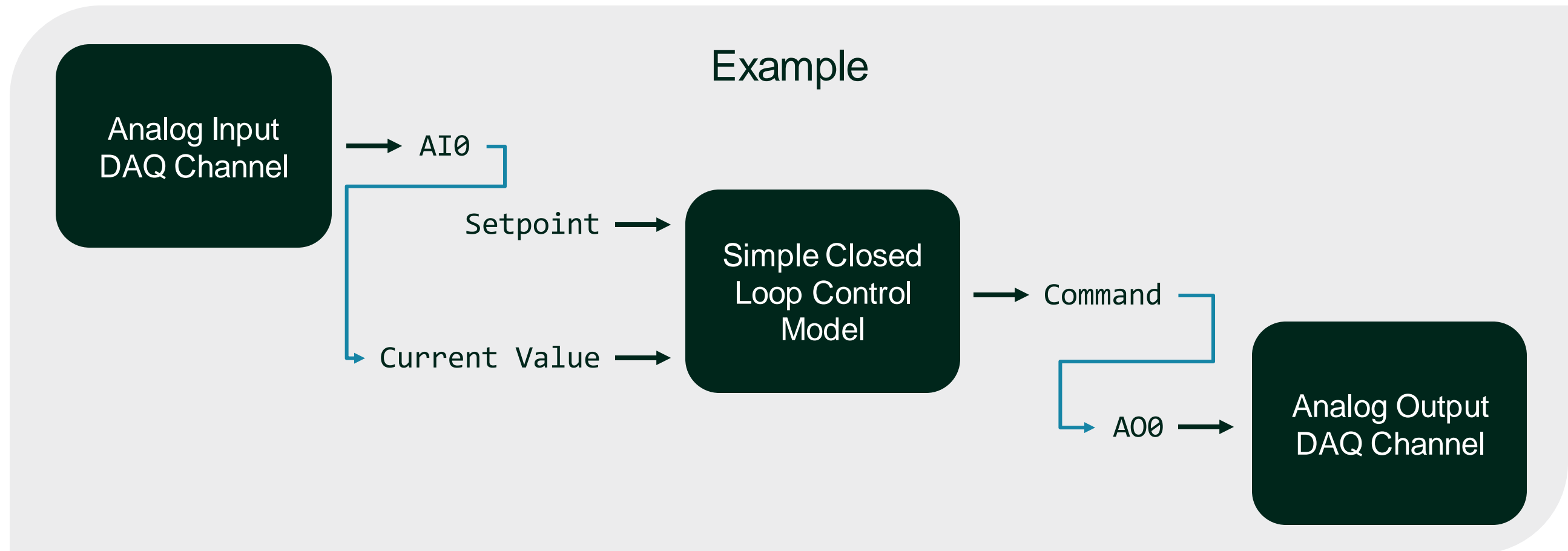
Name	Type	Author	Install Date
 Simscape Electrical version 7.4 (13 days remaining on trial)	MathWorks Product		21 January 2022
 Simscape version 5.0 (13 days remaining on trial)	MathWorks Product		21 January 2022
 Simulink Coder version 9.4 (13 days remaining on trial)	MathWorks Product		6 January 2022
 MATLAB Support for MinGW-w64 C/C++ Compiler version 20.2.0	Optional Feature		5 January 2022
 VeriStand Model Generation Support version 1.0.0.132	Toolbox	NI	5 January 2022
 Simulink version 10.2 (13 days remaining on trial)	MathWorks Product		5 January 2022
 MATLAB Compiler version 8.1 (13 days remaining on trial)	MathWorks Product		5 January 2022
 MATLAB Coder version 5.1 (13 days remaining on trial)	MathWorks Product		5 January 2022
 HDL Coder version 3.17 (13 days remaining on trial)	MathWorks Product		5 January 2022



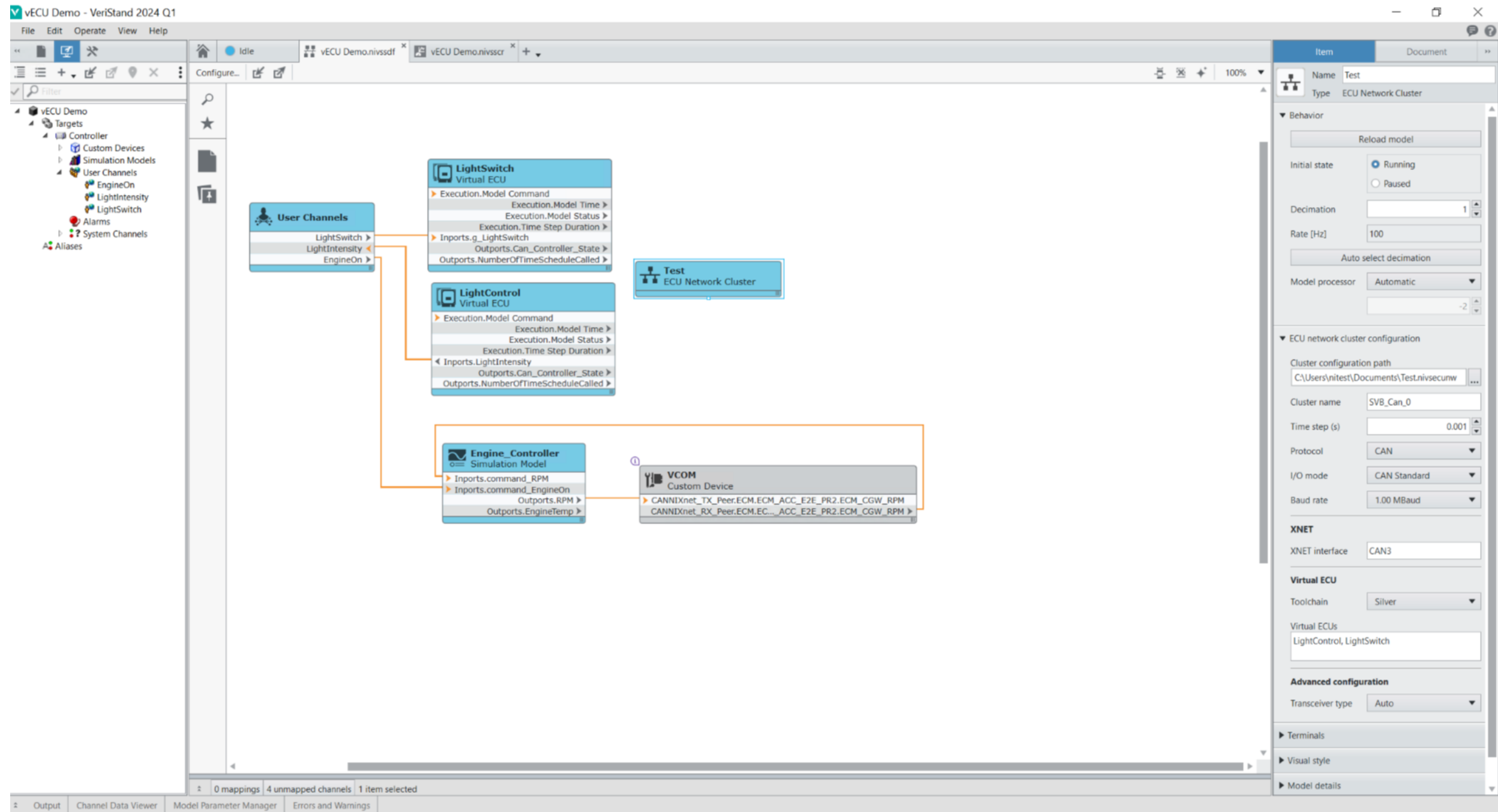
VeriStand Channel Mapping

Channel mappings allow you to transfer data between channels and are processed by the PCL

Source → Destination

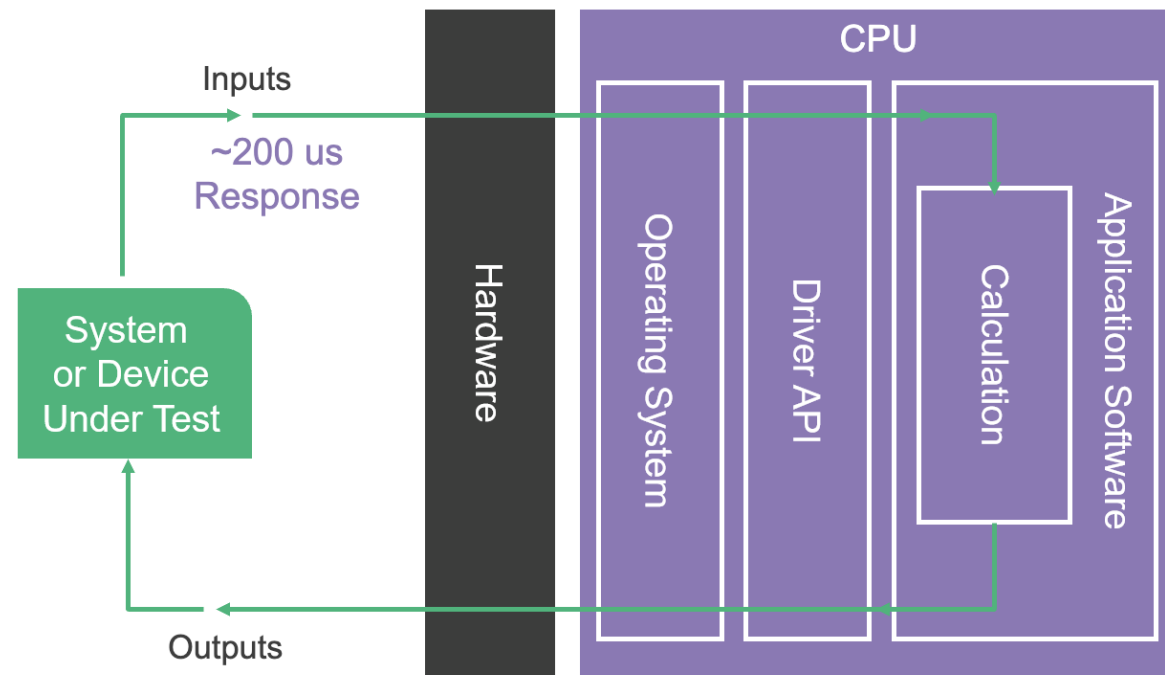


More info on Mapping

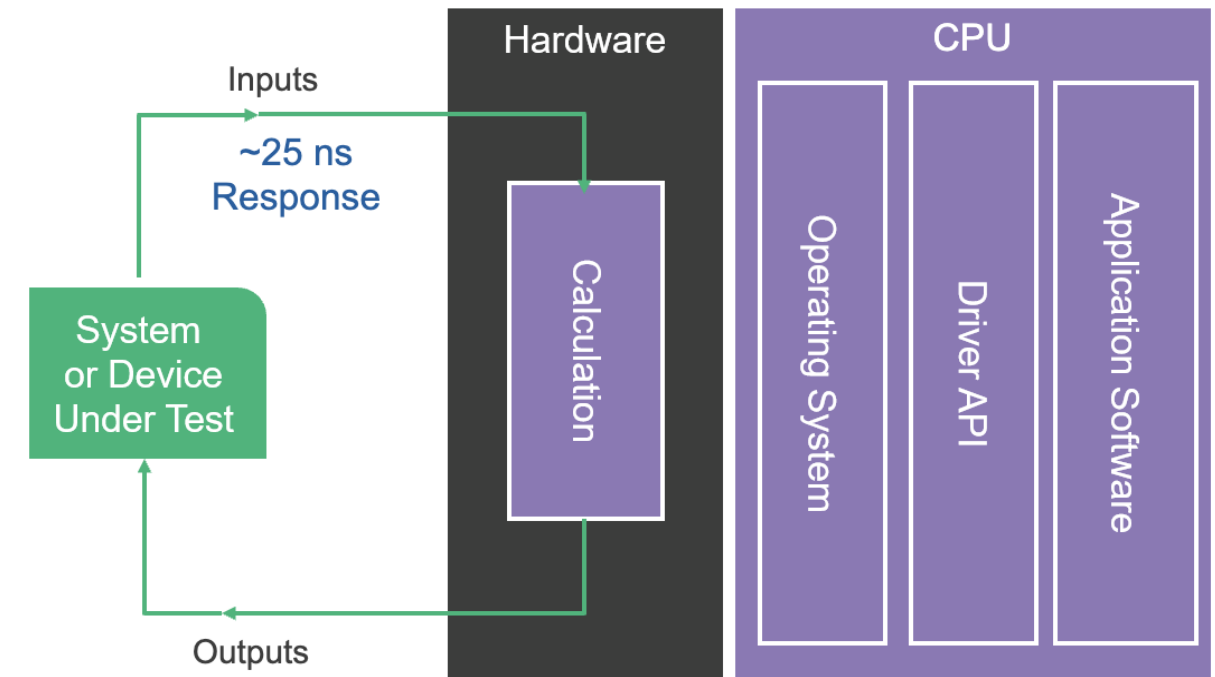


CPU Model Demo

Choosing the Right Approach



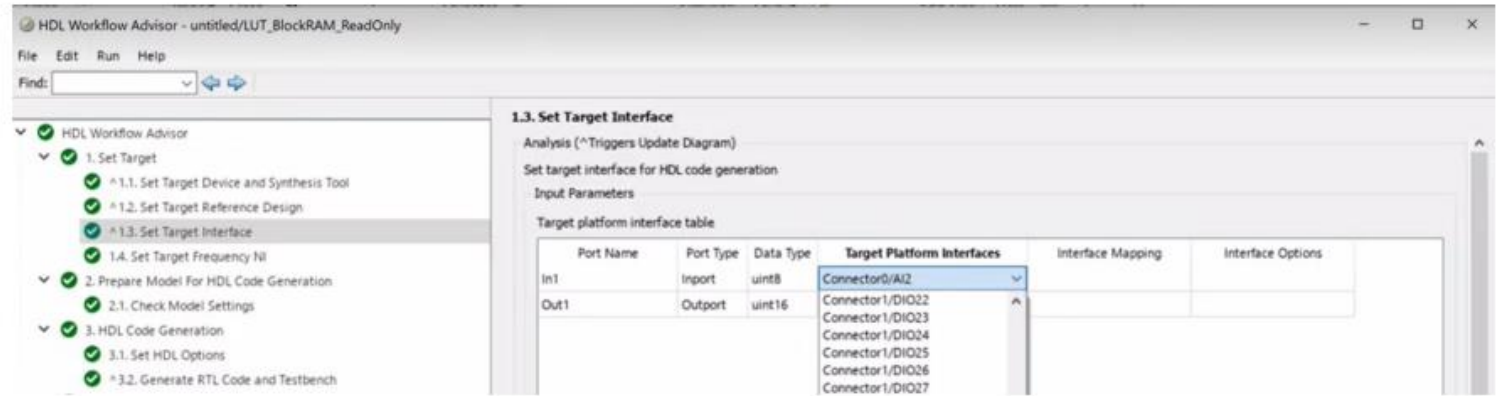
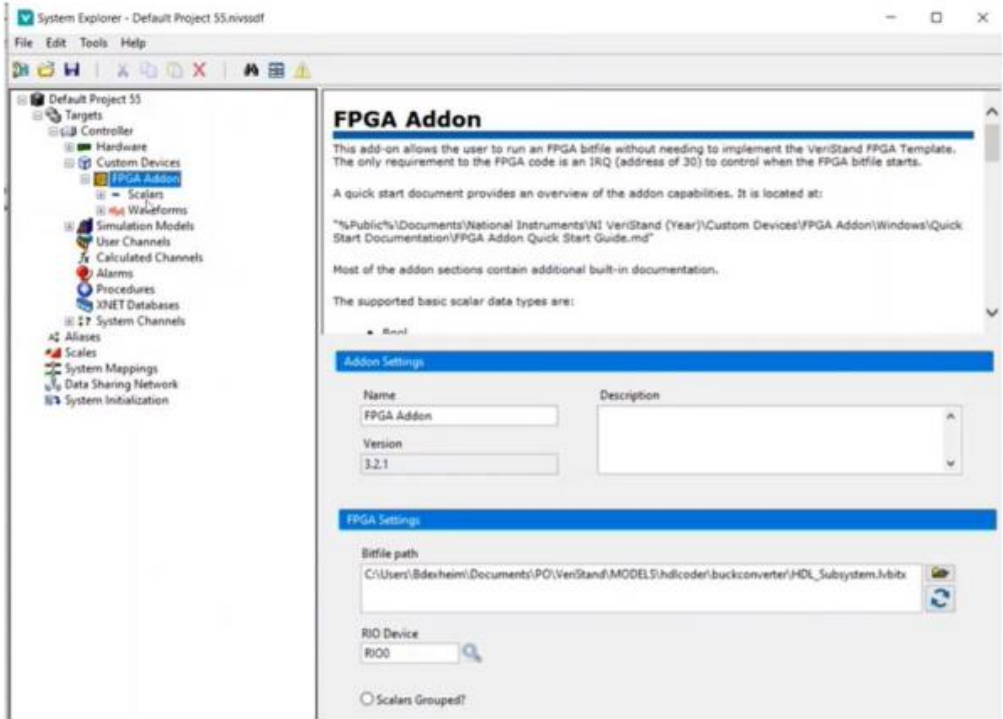
Processor Based Approach



FPGA Based Approach

HDL Coder Support Package for NI Hardware

HDL Code

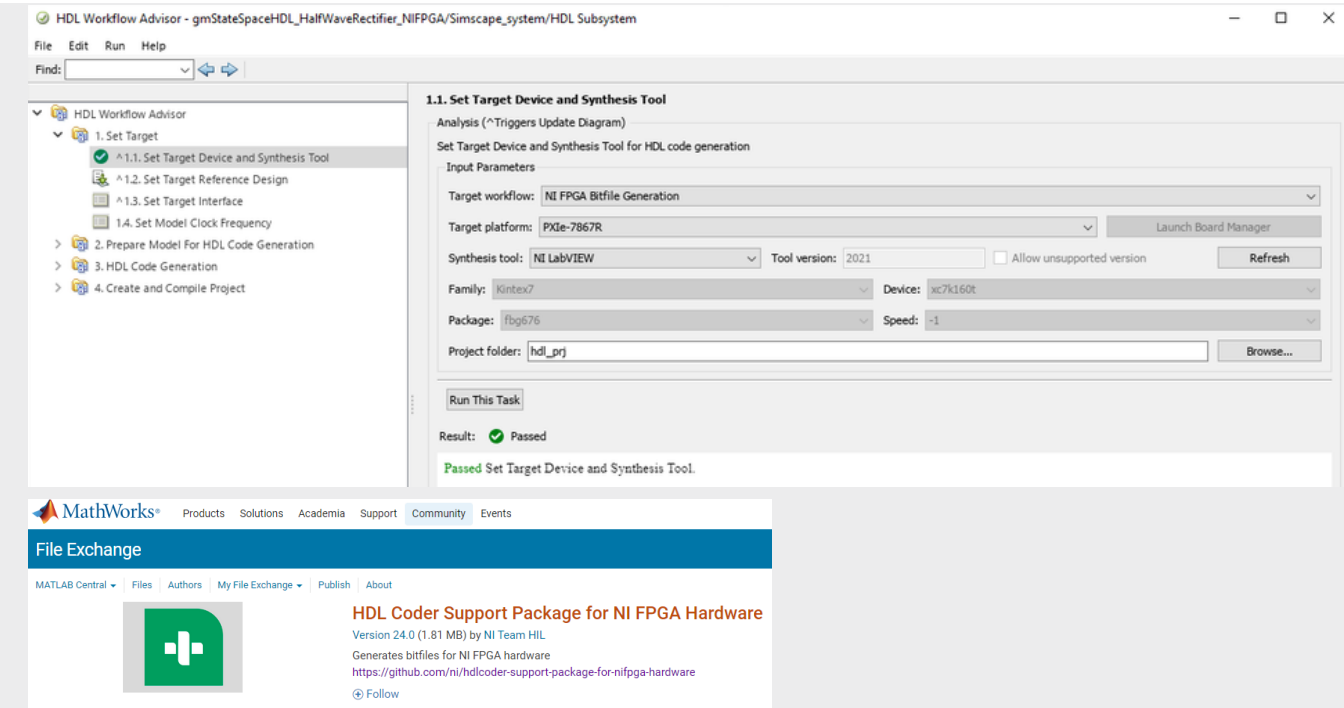


NI R&D Activities - HDL Coder Integration

Previous NI workflow for LabVIEW integration of HDL Coder was not optimal and difficult for customers to use.

Following successful evaluation, NI collaborated with MathWorks to add a new NI Workflow into HDL Coder Workflow Advisor

Capability shipped in R2022b as a MATLAB Add-on; additional improvements in subsequent releases



R2022b

Ship NI Workflow in HDL Workflow Advisor

- Initial support NI R-Series HW
- Support interface type: Register & Board I/O
- Invoke NI LabVIEW for integration and FPGA synthesis

R2023a – 23.0 Release

- Expanded support for NI R-Series boards
- Usability improvements with HDL Coder and NI Workflow

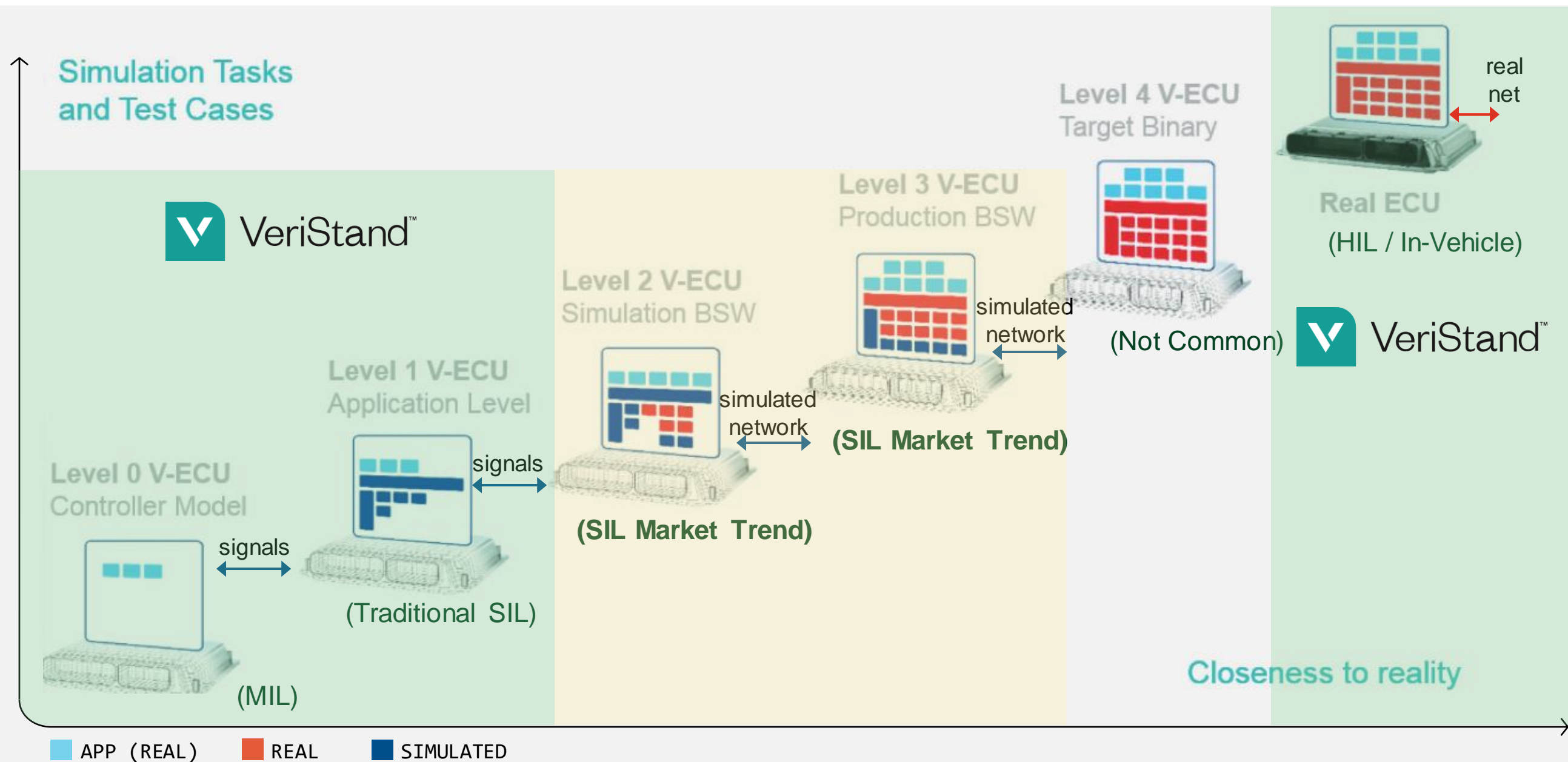
R2023a, 2023b – 23.5 and 24.0 Release

- Added support for NI FlexRIO boards and Xilinx Ultrascale FPGAs
- Bug fixes and usability improvements with HDL Coder and NI Workflow

FPGA Model Demo

Virtual ECU

Virtual ECU Layout



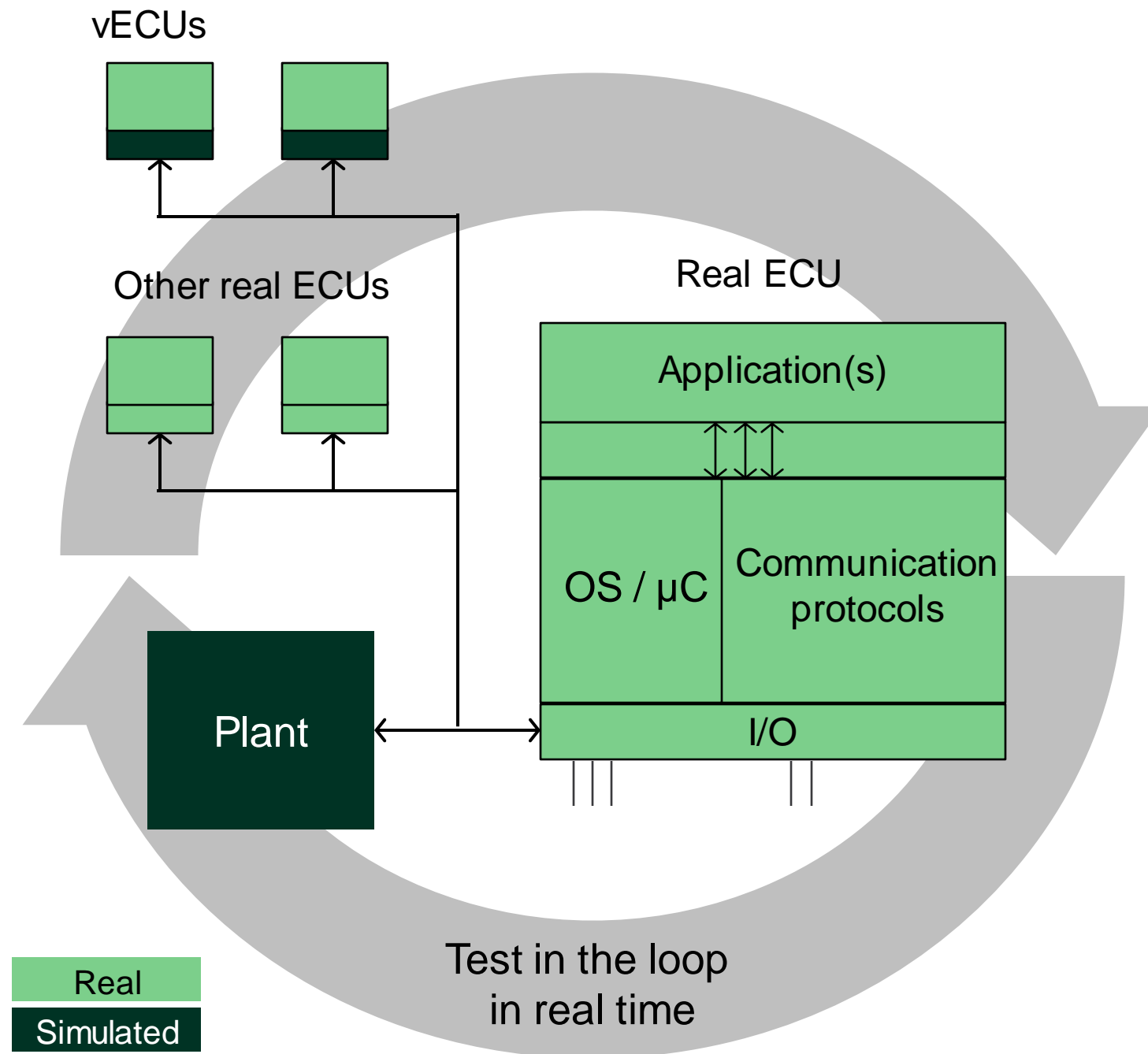
Virtual ECUs and Hybrid HIL

Validate vECU designs with existing test systems and software

Connect simulated buses to real buses

Run models on local RT Target or in cloud containers and connect to HILs

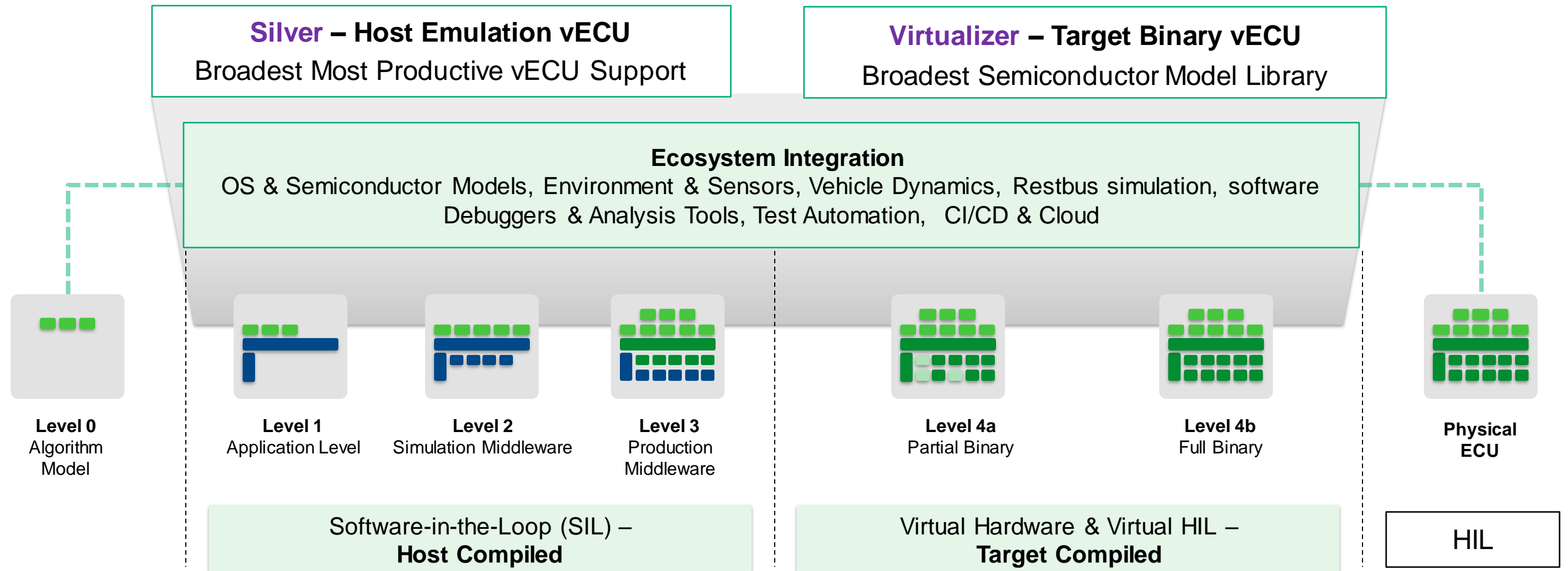
Seamlessly switch between virtual and real ECUs



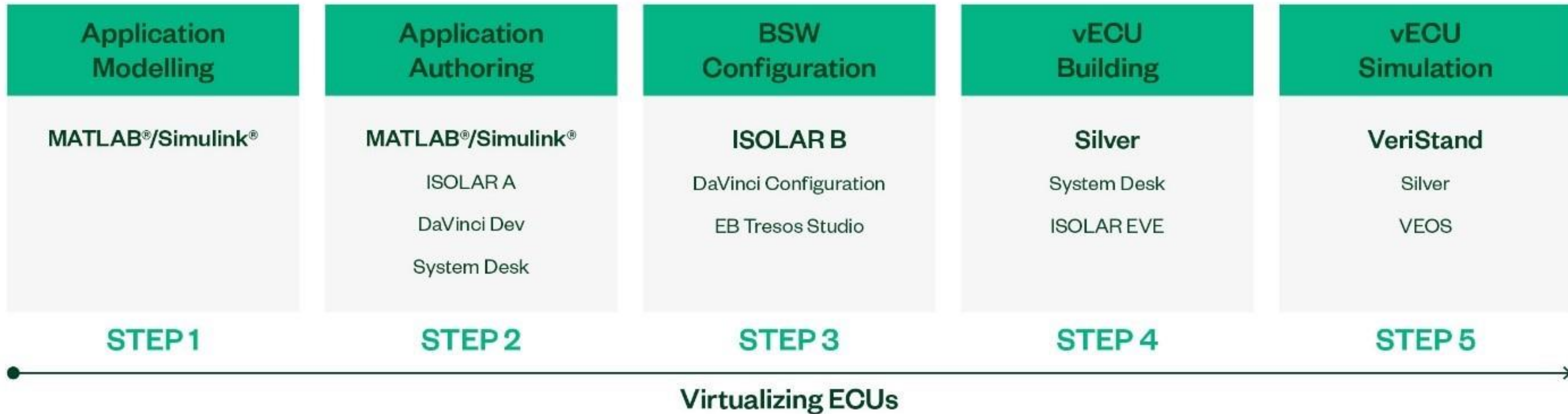
How Do We Make it Virtual?

Synopsys - Complete Multi Abstraction Virtual ECU Technologies

Full Virtual Software/Hardware Abstraction Enables Broadest Use Cases



Steps to Virtualize an ECU



Roadmap

NI and MathWorks/Other Investment Roadmap

CPU Focused Investments:

- FMI 3.0 support – 2024 Q1 delivered
- Expanded data type support in VeriStand – 2024 Q2, more in future releases
- Ease migration from other HIL vendors
 - I/O blocks in subsystems (Q2 released) and reference models
 - Block parameter access
 - Virtual bus support
 - Access to all signals
- Simulink Test / VeriStand support

FPGA Focused Investments

- Ability to customize LabVIEW FPGA code around Simulink generated VHDL
 - Additional hardware support
 - Additional interfaces
 - Custom LabVIEW FPGA algorithms on same FPGA module as Simulink generated VHDL

Resources

Links for Downloads & Support



Short-term product focus

Reduce time to market through automation and orchestration

Streamline Integration with customer's ecosystems with easier reuse of model assets and greater leverage existing test cases

Long-term product focus

Simplify tasks within VeriStand for easier on onboarding and reduced context switching

Enable integrators to create more powerful plugins with enhanced automation capabilities

Ensure secure connectivity with other ecosystem components

Capability	Shipped	2024	2025+
Model Integration			
External Mode Support for CPU Models	2023		
FMI 3.0 Support	2024		
HDL Coder customization with LabVIEW		✓	
Block parameter import from Simulink™		✓	
Improvement for model import/reuse		✓	
Connectivity with Simulink Test™			✓
Automation			
Improved Scripting APIs - Python and .NET	2023		
VeriStand Steps for TestStand		✓	
In-product sequencing			✓
Virtualization			
Import/Run Virtual ECUs within VeriStand	2024		
Usability and Plugin Support			
Improved error handling & debugging tools		✓	
Diagnostics for VeriStand execution		✓	
Updated Custom Device scripting APIs			✓
Automotive networks config simplification			✓
Communications bus template ease of use			✓
System Support			
Improved loop rates for large systems	2023		
Deployment workflow for Linux desktop			✓
Improvements to meet security standards			✓

Roadmap Date: 2024 Q2

Next Release: 2024 Q2

Release Cadence: Quarterly

Roadmap is a snapshot and can change based on a variety of factors, including development execution and customer input.

Sessions and demos of interest

Session/demo	Location/Time
Intro to Hardware in the Loop Test in NI Software	Wed 11:30 AM
HIL Testing Fundamentals	Wed 1:30 PM
SW Test Drive – What's new in VeriStand and HIL	SW/products expo area
HIL and Embedded Software Validation Demo	ADG expo area
HIL for Anything (Aliaro)	Transporation expo area
Traction Inverter HIL (OPAL-RT)	Transporation expo area
ADAS/AD Data Replay and HIL	Transporation expo area
Vehicle Communications Software Suite (Akkodis)	Transporation expo area



NI is now part of Emerson.