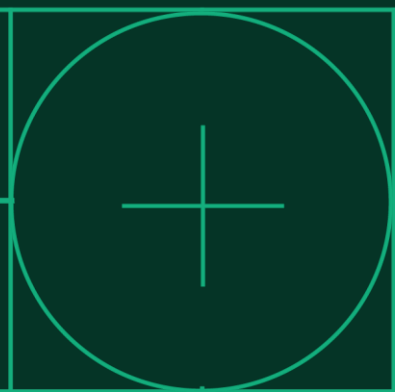
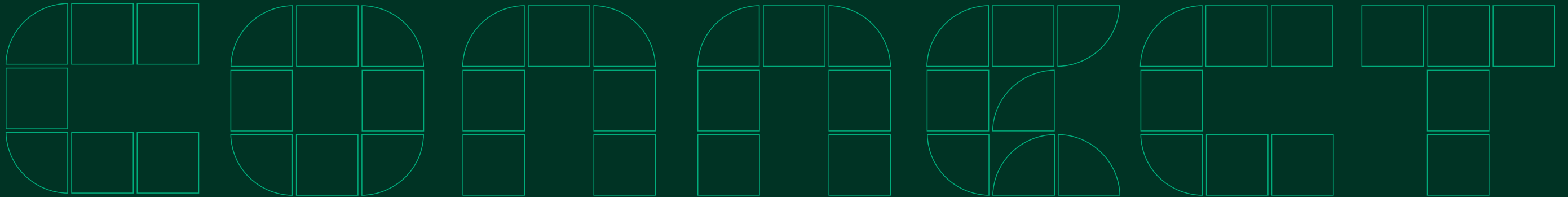


ni connect

2024 AUSTIN





Revamp your Automotive E/E Production Testing

Jessica Kelly, Offering Management Sr. Director

What We DO Know about the Future



Autonomous

Safe

Clean

Productive

Software

Quality

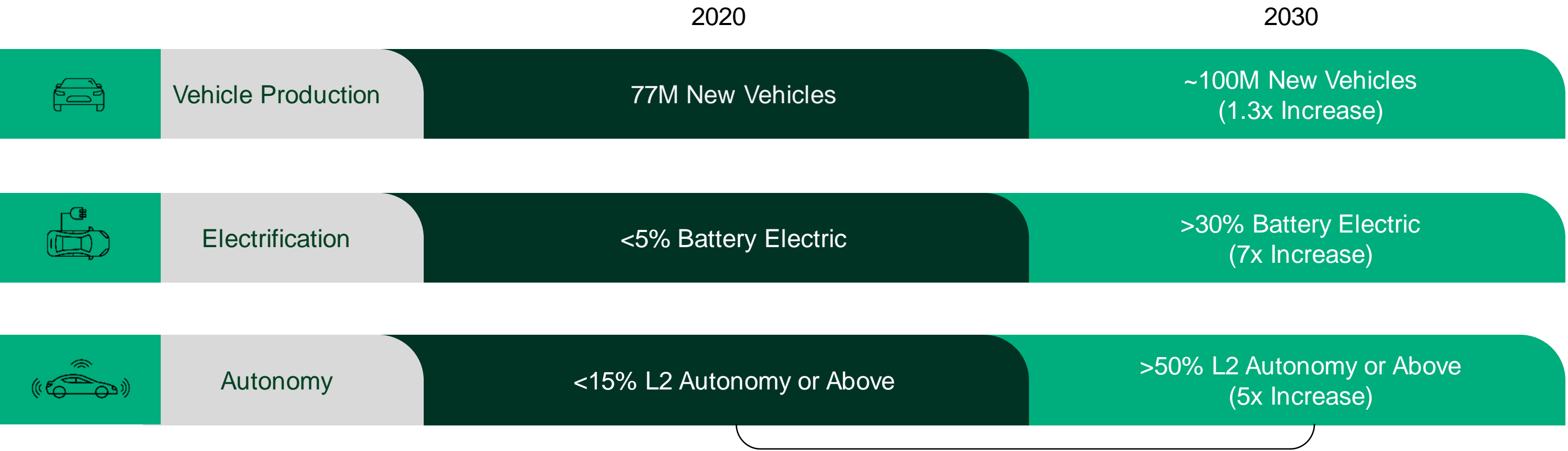
Complexity

Budgets

Timelines

The Road to the Future is Paved with Software

Acceleration of EV and ADAS Roadmaps will Require New Tools and Process to Meet Demand



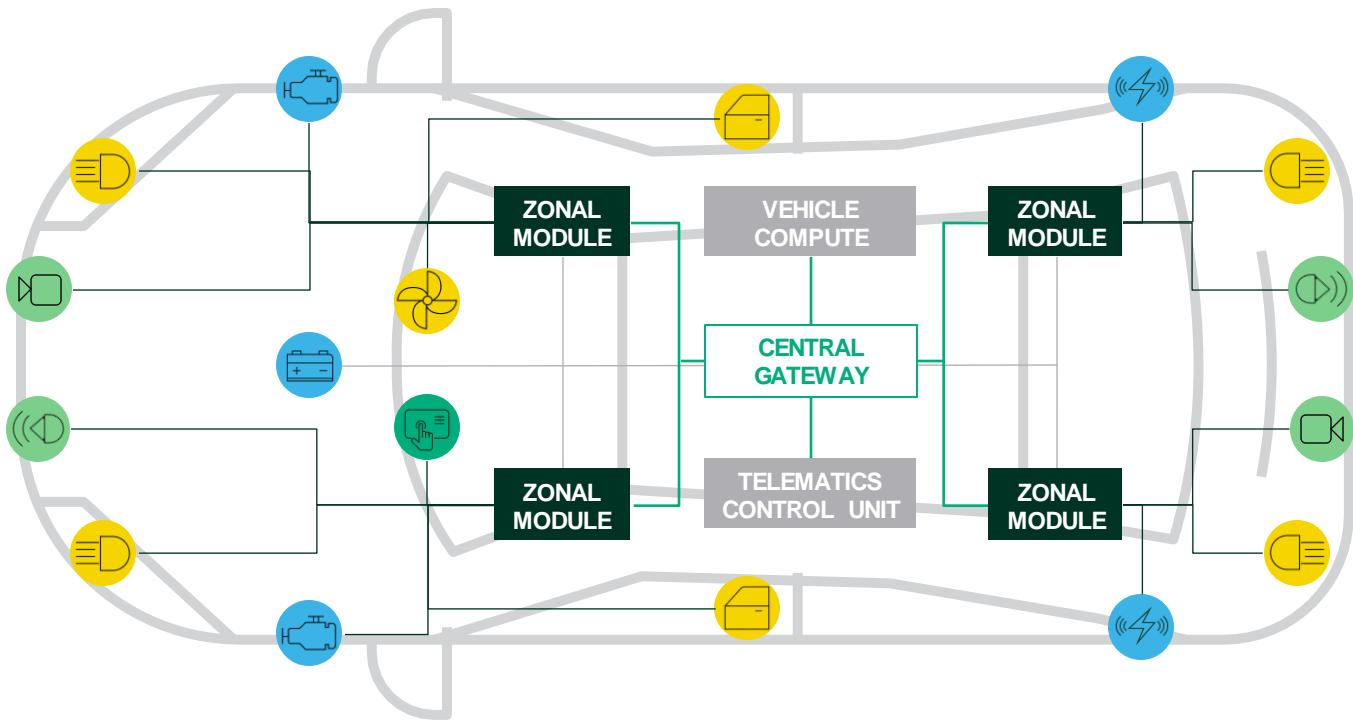
Automotive companies plan to spend
45% of 2021 R&D budget on software

– IHS SURVEY

Software Defined Vehicle (SDV)

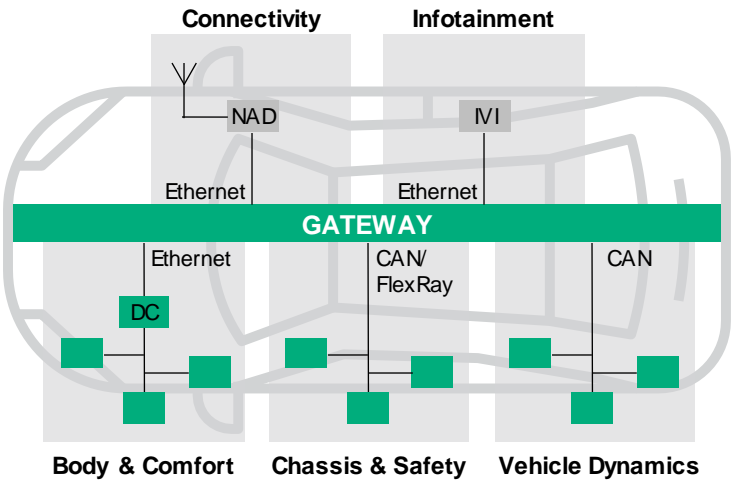
SDV platforms require a shift to centralised ECU architectures

- Fewer ECU's
- Higher Compute
- Mixed function
- Higher BW Busses
- Inherent security



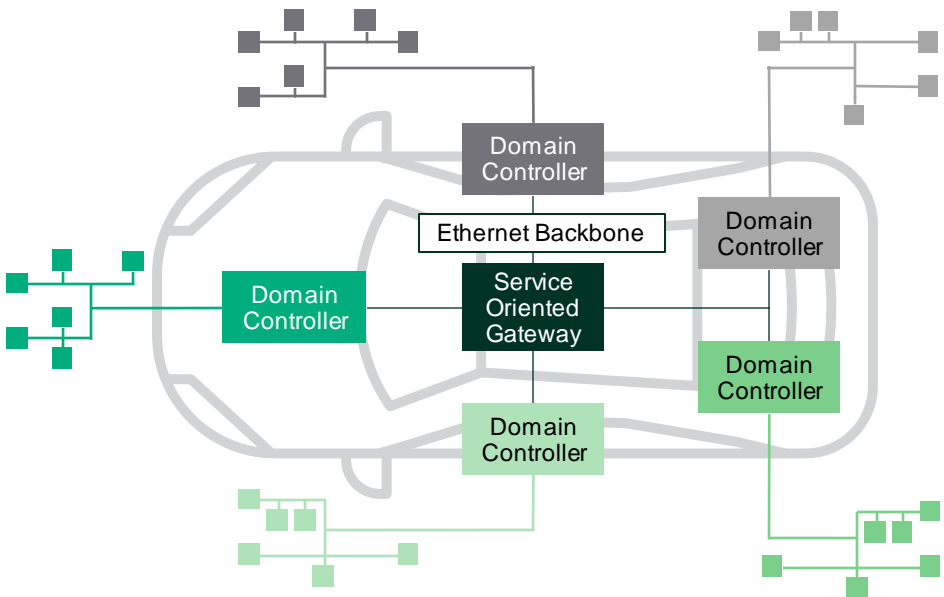
- Zonal Modules
- Large # Sensors
- Connected
- Enhanced Diagram
- Reduced Wiring

E/E Architectures Keep Evolving



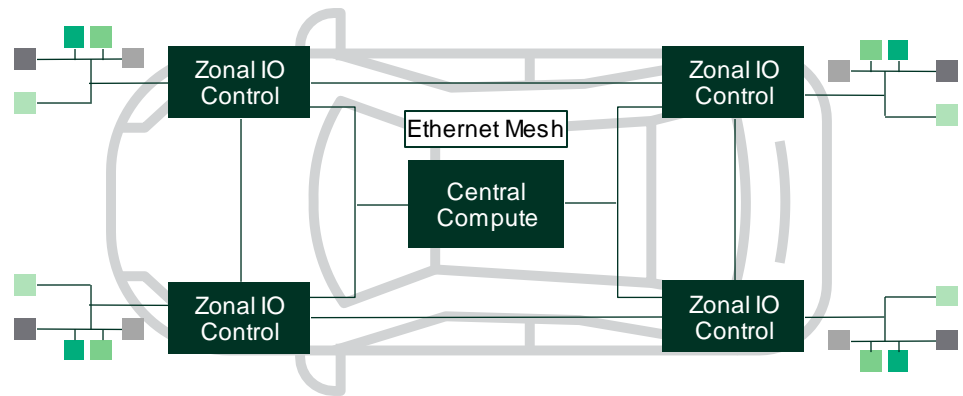
Traditional E/E Architecture

Segmented Interfaces
High Interface Standardization



Domain-Centralized E/E Architecture

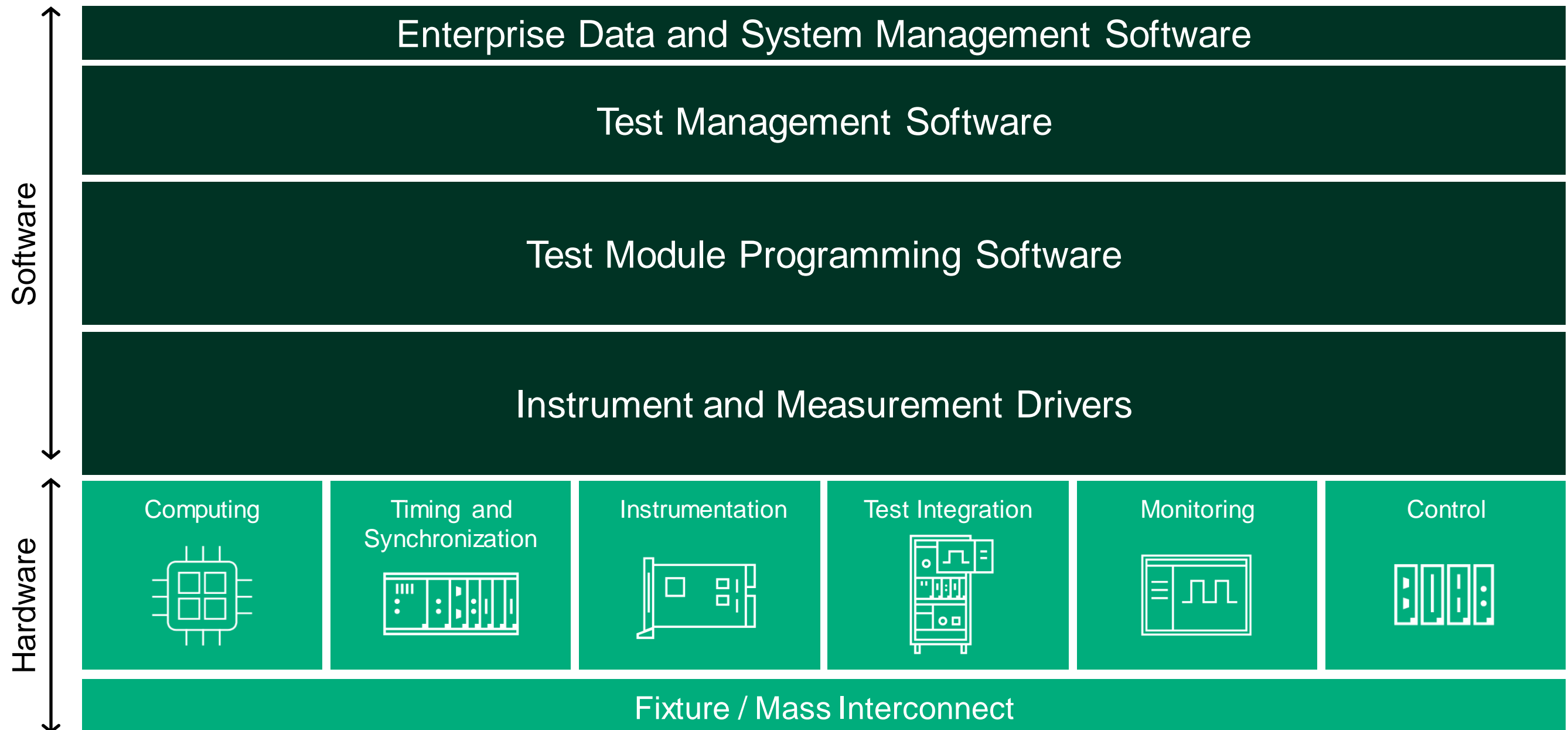
Segmented Interfaces
ADAS and IVI Interface Fragmentation



Zonal/Central E/E Architecture

Converged Interfaces
All ECU Interface Fragmentation

What We Know about the Architecture



Example Test Case – Zonal ECU

Example ECU

Zone Control Unit



Image source: <https://www.valeo.com/en/valeo-domain-controller/>

Test Sequence

- Pin-Test
- Power up DUT
- Programming
- Measure sleep / Wake Current
- Test CAN, LIN
- Test Ethernet Communication
- Test Static inputs (analog, Digital, PWM)
- Test High-Side/Low-Side Drivers
- Test Power Distribution Capabilities
- Test Camera Inputs
- Test Display Outputs
- Test RF interfaces (WiFi, BT, ...)
- Flash OEM SW and Data
- Reset ECU

Example Test Case – Zonal ECU

Example ECU

Zone Control Unit

Power

Automotive Communication Buses
(CAN, LIN, AuthoEthernet, FlexRay)

Onboard Electronics
(Processor, Temperature, Safety, Calibration, Diagnostics)

Zonal Outputs
(Current, Switch, Speed, BLDC, GMSL, FPD-Link)

Zonal Inputs
(Analog, PWM, GMSL, FPD-Link Other)

Test Sequence

Pin-Test

Power up DUT

Programming

Measure sleep / Wake Current

Test CAN, LIN

Test Ethernet Communication

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Example Test Case – Zonal ECU

Example ECU

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Zonal Inputs
(Analog, PWM, GMSL, FPD-Link Other)

Data and System Management

Load Management System + Signal Conditioning
(S/L Unit, External Load, High Speed Channels)

PXI Chassis and Controller

Hardware Synch Test Management Operator Interface

Automotive Communication Modules

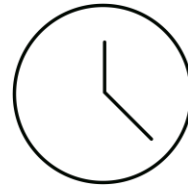
Modular Instrumentation and Switching
(Multifunction I/O, Switches, Loads and Video generation)

Future and Architecture

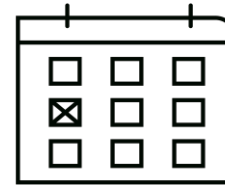
What's More Important?

Development Time is Critical

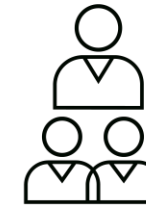
To Meeting Project Schedules



Increasing
Complexity



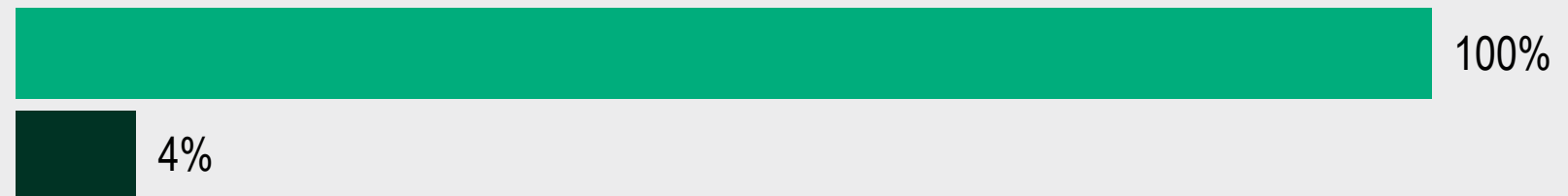
Compress
Test Times



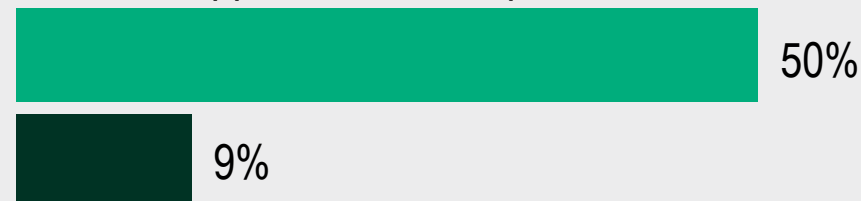
Smaller
Teams

Top 2 factors in considering
a new test system...

Faster Test Throughput/Cycle Time



Software/Application Development Time



■ Best-in-Class Test Companies ■ Other Test Companies

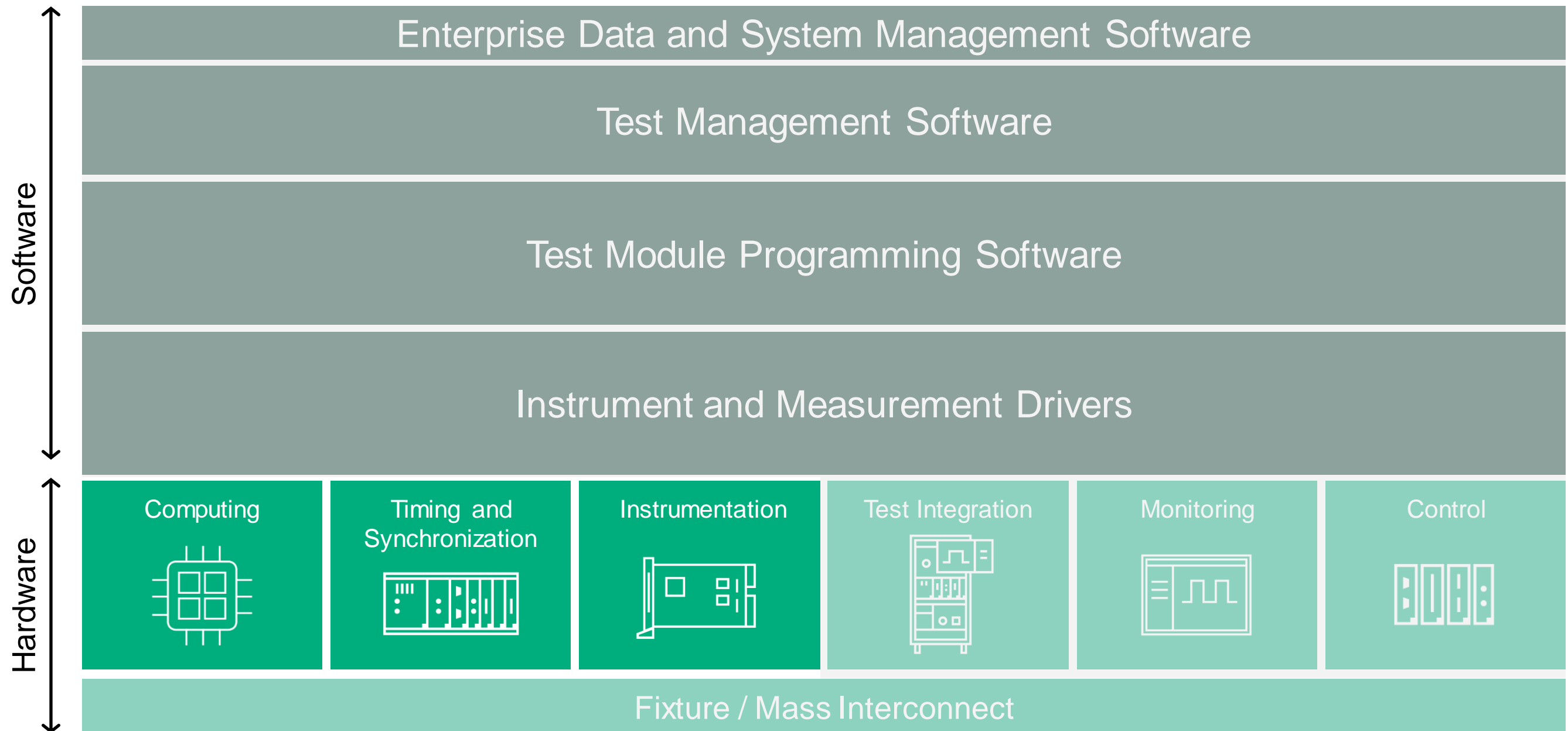
Factor 1

Faster Test Execution

Factor 2

Faster Test(er) Development

Faster Test Execution: Modular Software Architecture



Zone-Controller ECU Functional Test Configuration



PXIe-4150
60 V / 10 A – 300W
Precise DC Power Supply



PXIe-1486 & PXIe-1487
FPD-Link and GMSL Interface Modules
(multiple options & SerDes)



PXIe-8522 & PXIe-8523
4ch, 1000BASE-T1
4ch 100/1000BASE-T1



PXIe-8510
2- or 6-Port
CAN / LIN Interface



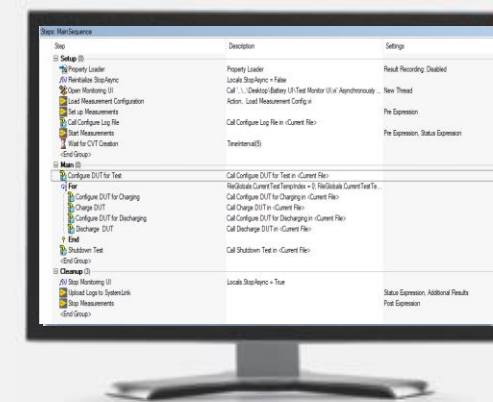
PXIe-1084
PXIe Chassis
All Hybrid Slot



PXIe-8861
PXIe Controller
4 Core Intel Xeon



NI LabVIEW
System Design
Software



NI TestStand
Test Management
Software

+ DMM, DAQ

Broad Modular Instrumentation Portfolio

DAQ and Control

Multifunction I/O

Counter / Timer / Clock

Digital I/O

Analog Input / Output

Vision and Motion

FPGA / Reconfigurable I/O

Instrumentation

Oscilloscopes

High-Speed Digital I/O

DMM & SMU

Signal Generators

Switching

RF Analyzers & Generators

Interfaces

GPIB, USB, LAN

RS232 / RS485

CAN, LIN, XNET

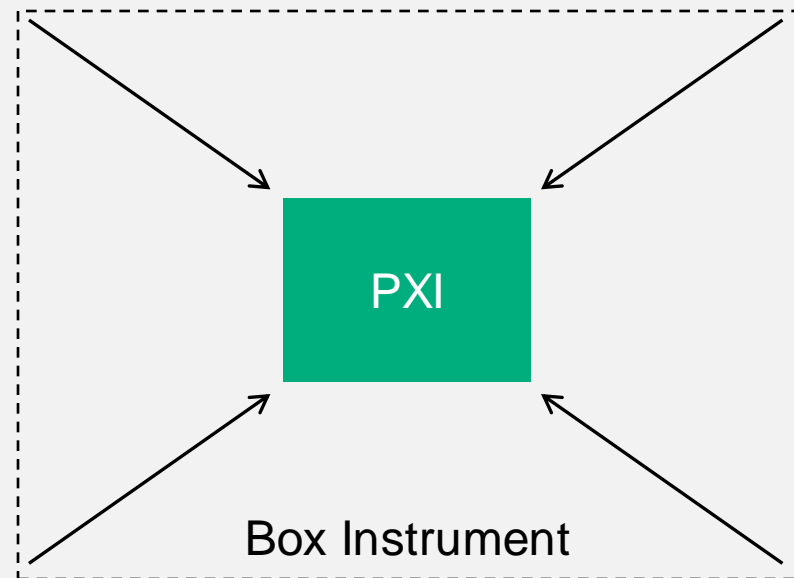
SCSI, Ethernet

VXI - VME

Boundary Scan / JTAG



Reduced Overhead With PXI Form Factor



Size/Footprint



Box Instrument



PXI



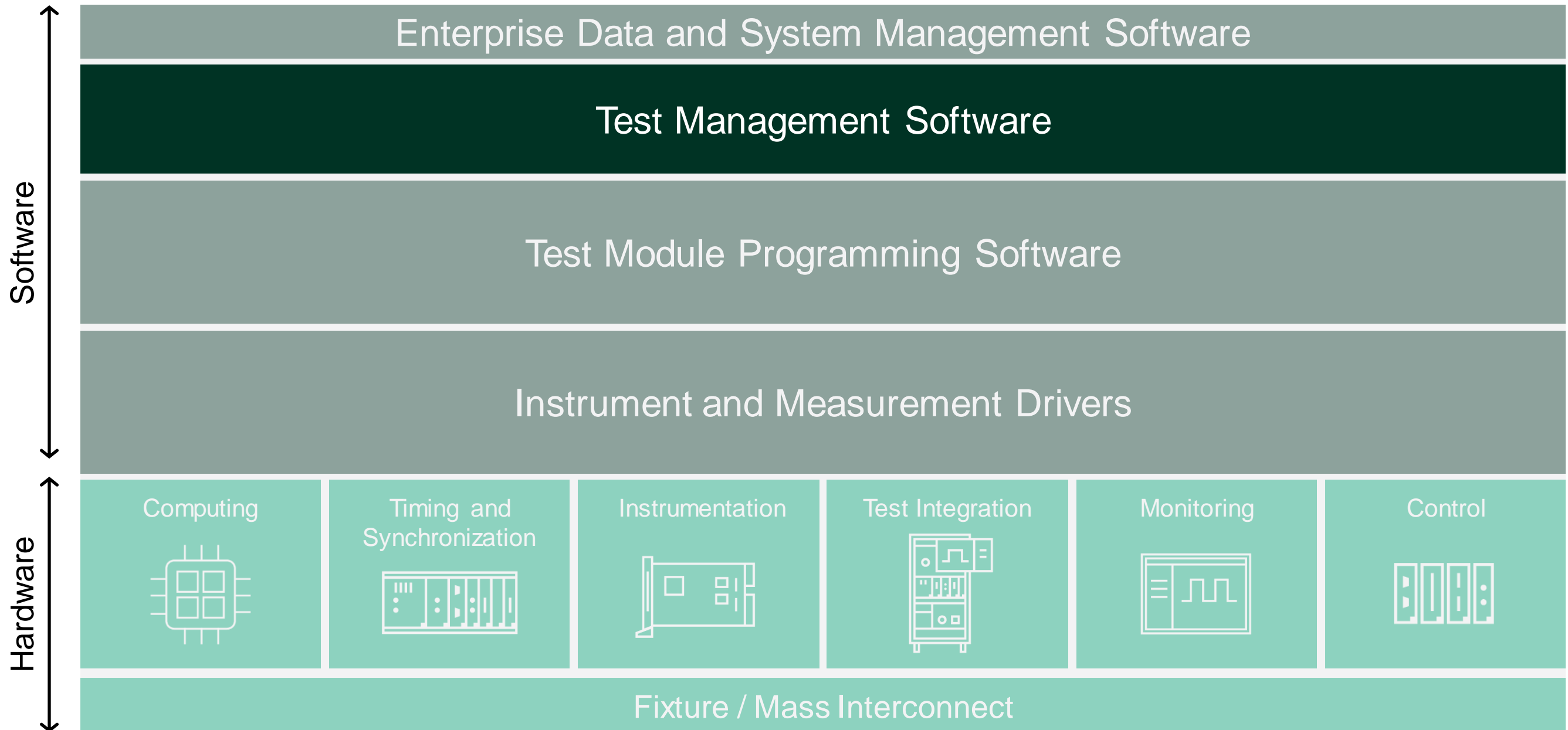
Box Instrument

PXI

Weight/Portability

Power Consumption

Faster Test Execution



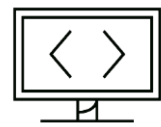


A test executive software that accelerates system development and deployment for engineers in validation and production.



Automate Your System

Create, execute, and debug test sequences using an interactive environment



Leverage Existing Code

Use code from LabVIEW, Python, C/C++, or .NET



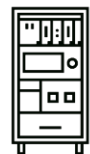
Test More, Faster

Use native parallel execution to reduce test time and functionality for advanced tasks such as sweeping and looping



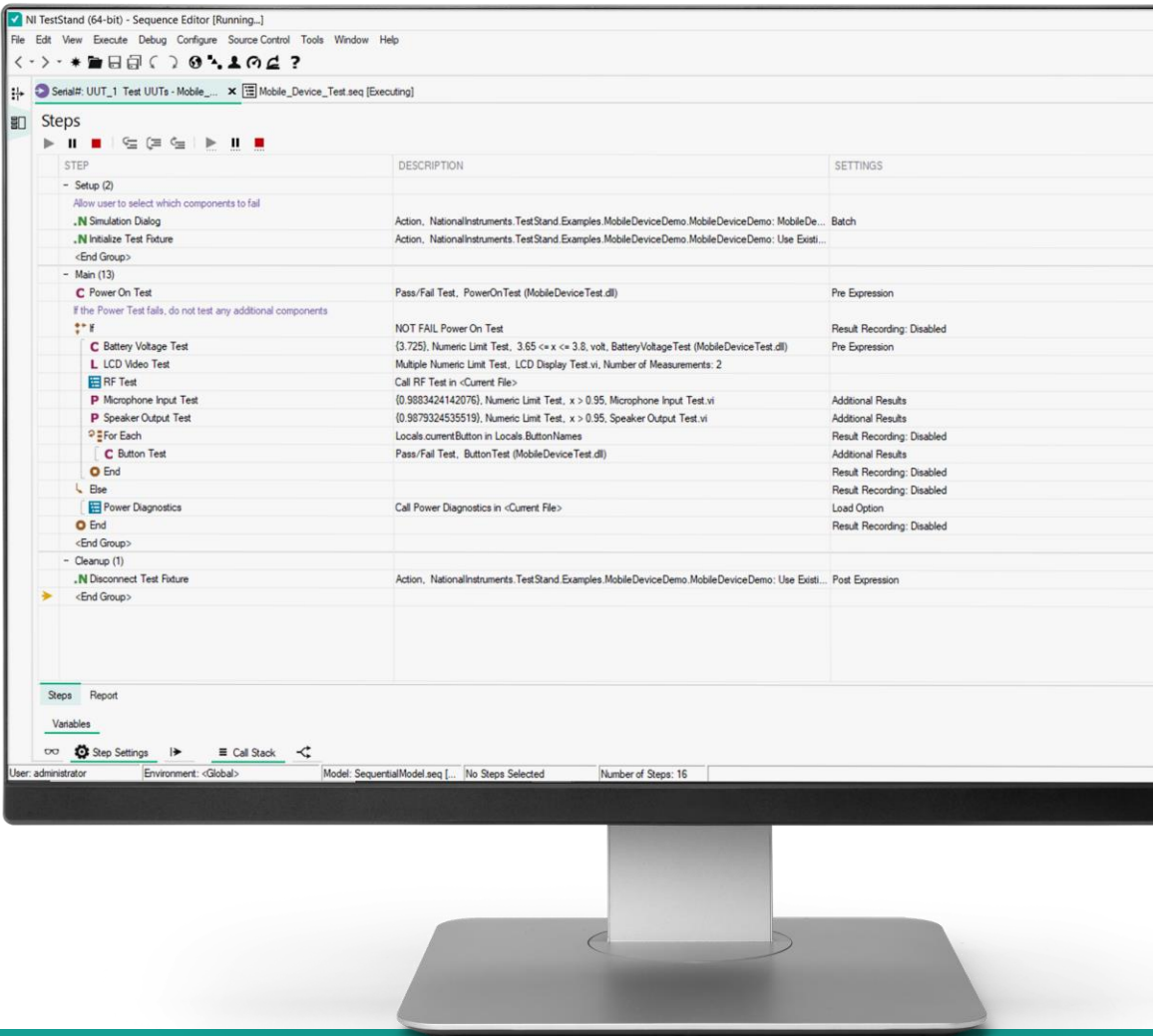
Keep Track of Results

Track units, automatically generate reports, and store results to local or network databases



Deploy To Your Testers

Scale your operations by deploying sequences to numerous test stations with custom or pre-built operator interfaces



Connect TestStand



With **LabVIEW** to quickly develop complex reusable tests

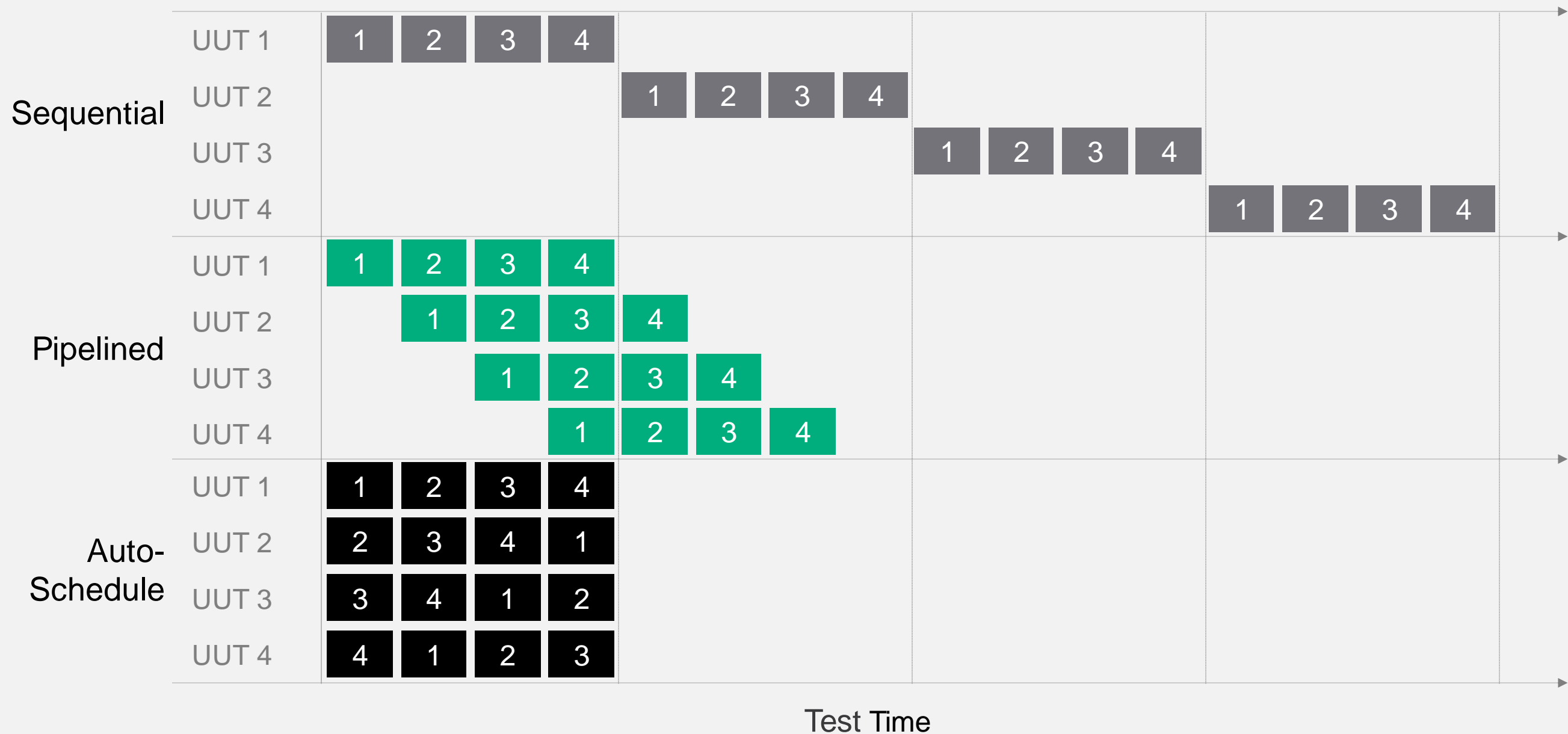


With **Flexlogger** to efficiently acquire and log data from your DAQ hardware



With **InstrumentStudio** for interactive instrument control

Reducing Test Time with Parallel Device Test



TRADITIONAL RACK AND STACK
Testing 802.11 a/b/g

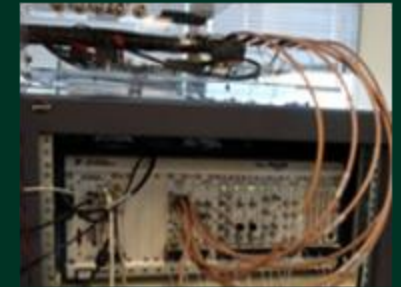
TEST TIME

NI PXI RF AND LabVIEW
Testing 802.11 a/b/g and n

10X FASTER

NI VST, LABVIEW, AND LabVIEW FPGA
Testing 802.11 a/b/g, n, and ac

200X FASTER



QCA Reduces Test Times of WAN Devices



200X reduction in test time

Lower test costs and

Achieves more complete device characterization

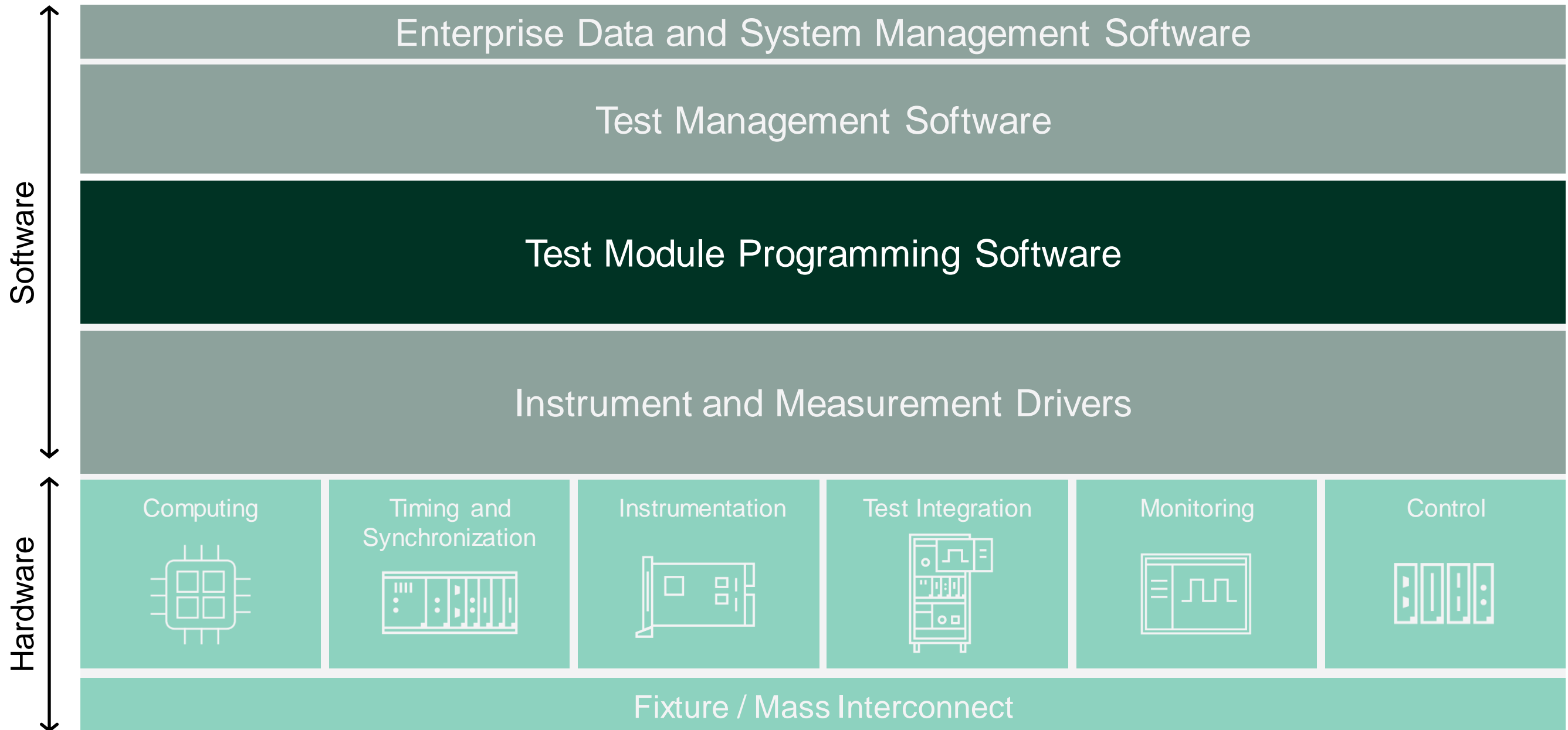
Factor 1

Faster Test Execution

Factor 2

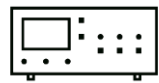
Faster Test(er) Development

Faster Application Development



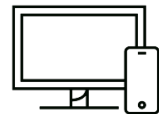


Provides an integrated approach to interactive measurements with the ability to monitor and debug test systems, and more.



Visualize and Control Measurements

Interface interactively with your instruments and measurement IP with customizable front panels.



Share Projects with Colleagues and Systems

Store your layout and instrument configuration as a project for instant repeatability.



Monitor and Debug Applications

Monitor measurements in LabVIEW, Python, TestStand, and others for run-time debugging.



Automate Interactive Operations

Sequence over interactive steps, automate parametric sweeps and produce reports.



Connect InstrumentStudio



With **LabVIEW** to build and share reusable interactive measurement panels



With **TestStand** to quickly build complex test sequences and generate reports



With **your test infrastructure and IP** to lower costs and improve workflows



A graphical programming language and environment engineers use to develop automated research, validation, and production test systems.



Create Professional User Interfaces

View data and control your test system via an interactive UI built from drag-and-drop UI elements



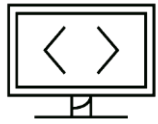
Integrate All Your Instruments

Acquire data from and control any instrument with 1000s of device drivers and industry-standard protocols



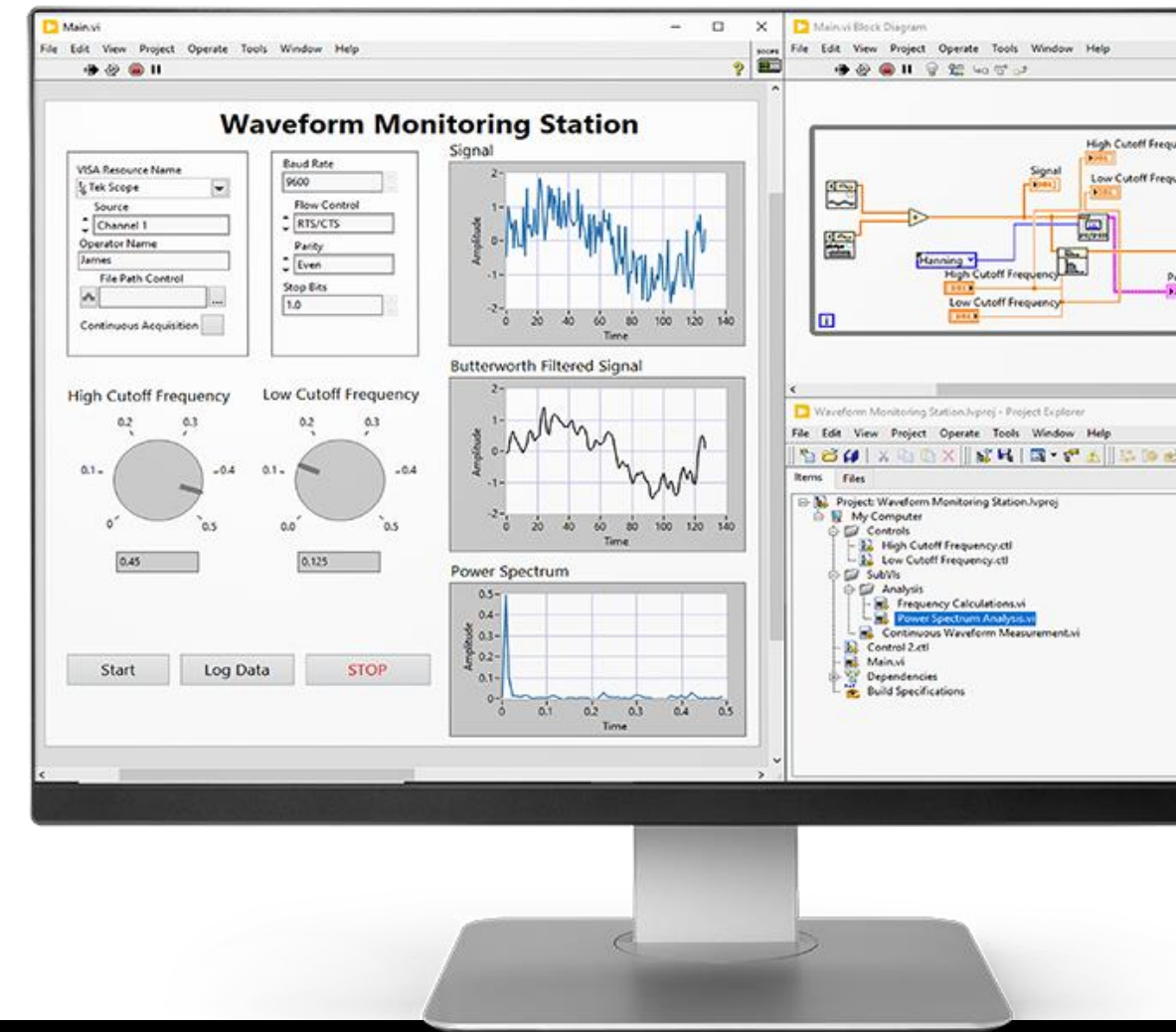
Program Like You Think

Save development time by creating and visualizing applications using data flow programming



Use Other Code

Leverage other and existing code written in Python, C/C++, MATLAB®, and .NET



Connect LabVIEW



With **TestStand** to quickly build complex test sequences and generate reports



With **Flexlogger** to build a customized configuration based datalogger



With **InstrumentStudio** to centralize and share interactive measurements



Streamline lab operations and amplify engineering insights in an integrated, scalable, enterprise solution.



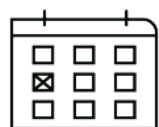
Manage Systems and Assets

Manage and install software for your entire test fleet, monitor test system health, and manage and track NI and 3rd Party instrument utilization



Monitor and Analyze Parametric Tests

Collect and view test results, files and parametric data; filter data for additional insights and track KPIs with dashboards and ad-hoc analysis



Plan Tests and Work Orders

Track incoming test requests, define test requirements, schedule, deploy, and remotely execute tests



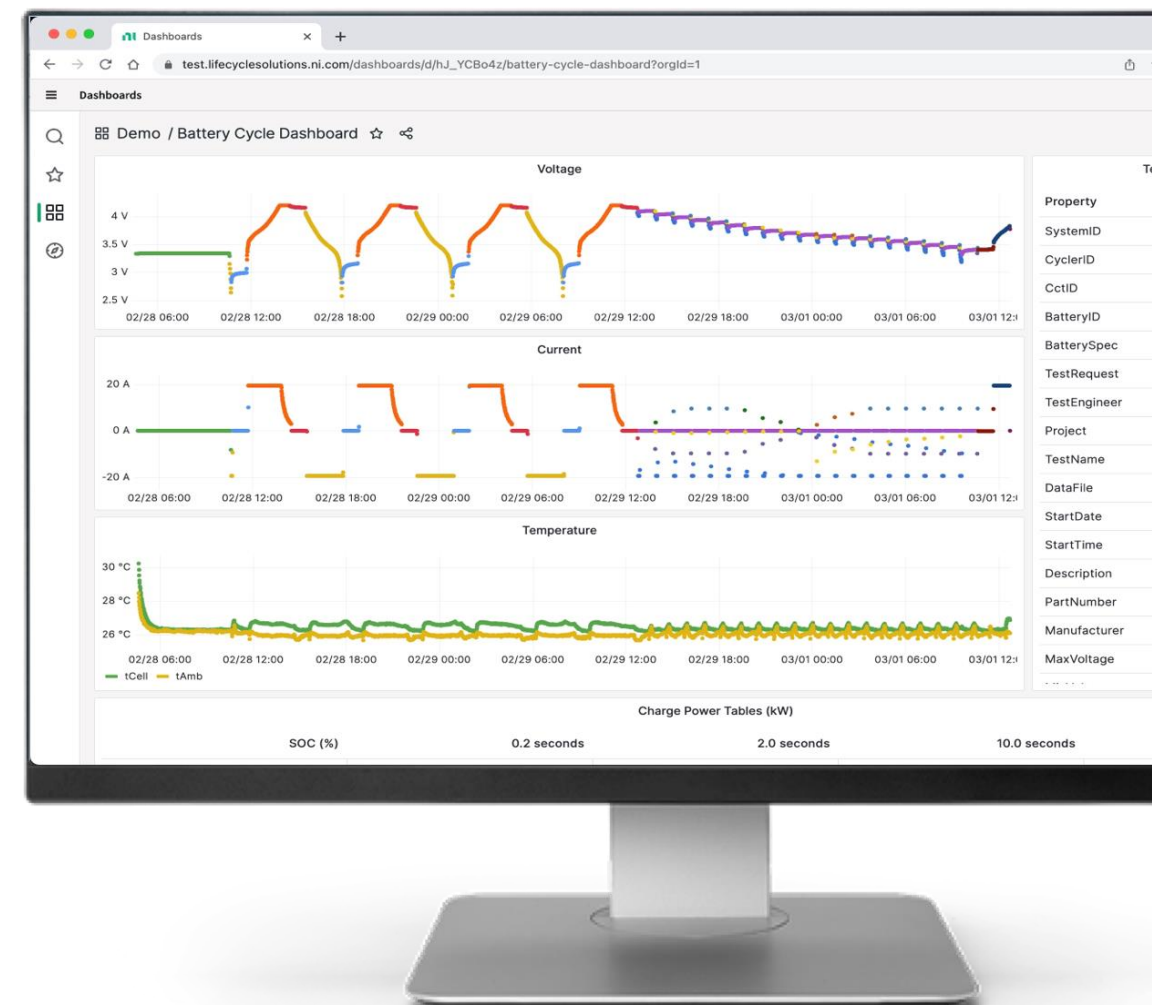
Track Product Specification Compliance

Elaborate requirements into engineering specifications to drive test consistency, quickly discover product issues, and track test progress



Automate Analysis and Reporting

Fully integrated Jupyter Notebook development environment to create Python scripts to extract, transform, and analyze data



Connect SystemLink



With **TestStand** to complete the loop from specifications to measurement



With **LabVIEW** to centrally manage test data and test system status



With **DIAdem** for further analysis and powerful report generation

Test System Software Suite

Test Software

Switch Executive
Configure and Manage
Signal Routes

InstrumentStudio
Configure and Debug Instruments

TestStand
Develop and Execute Test Plan

LabVIEW
Develop Custom Test Steps

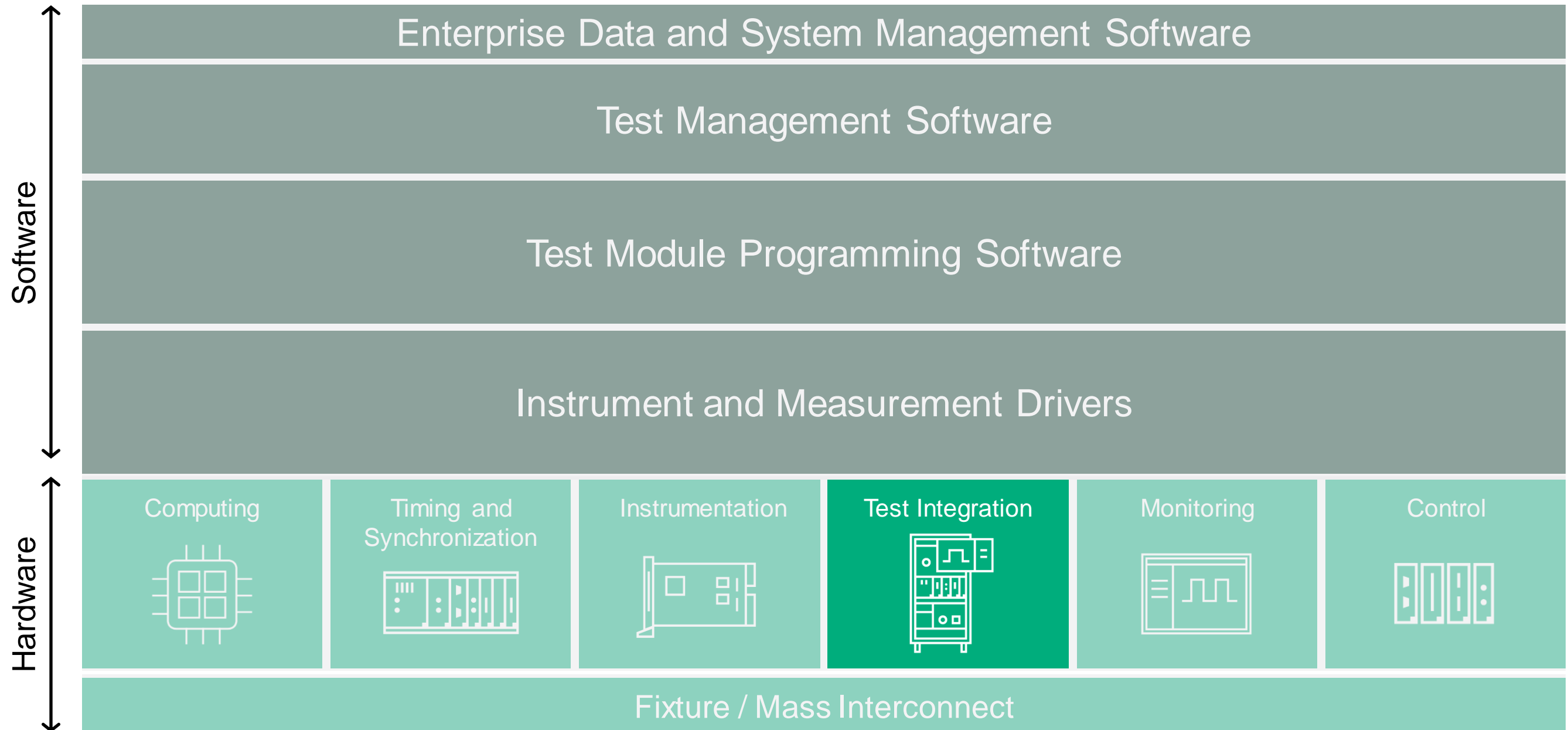
Maintenance Software
Verify System Content and Continuity

SystemLink Client
Connect to SystemLink Server for
Enterprise Data Management

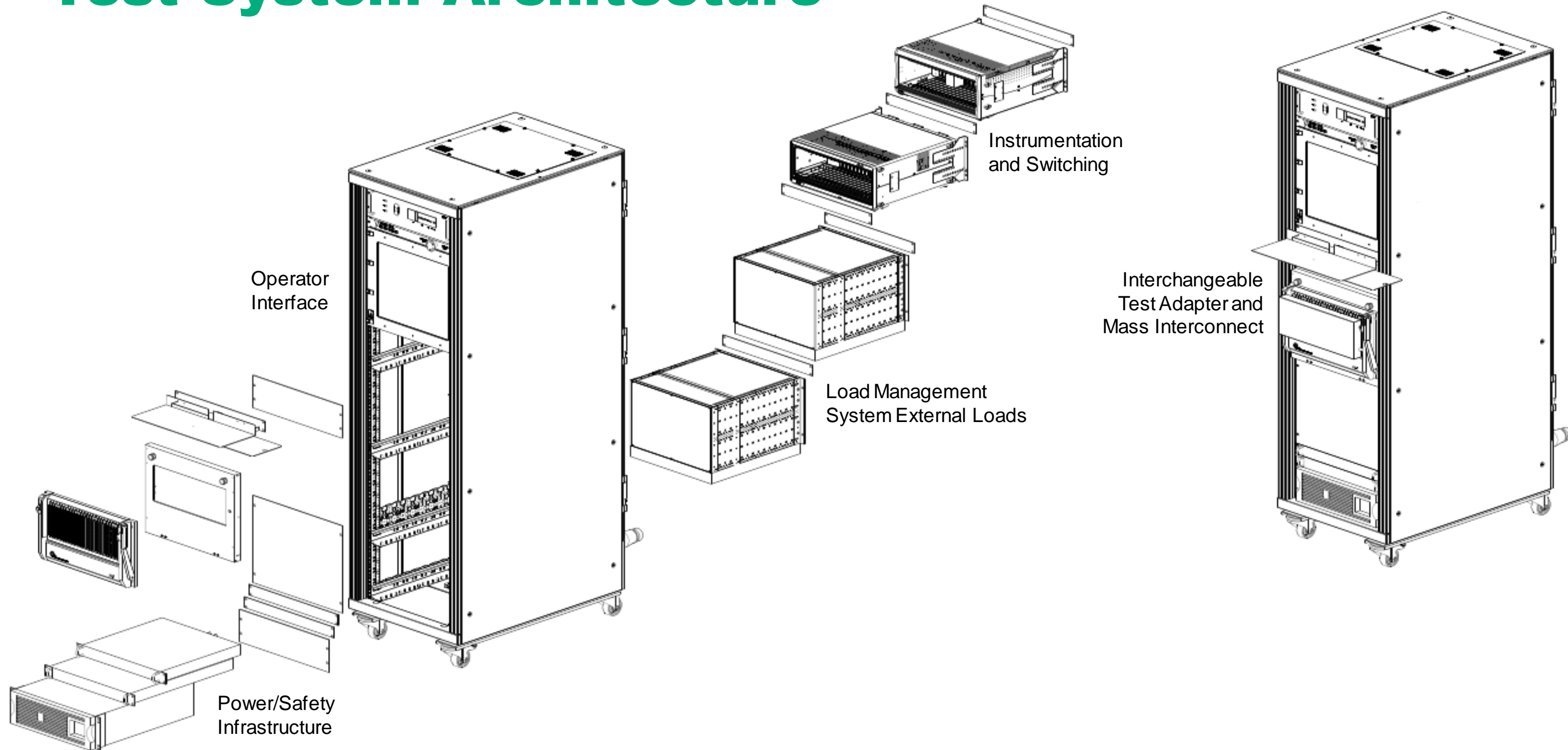
TestStand ECU Toolkit
SLSC measurement API
& SLSC Switch Executive Plugin

System Software

Faster Test(er) Development



Test System Architecture



Rack and Power Infrastructure with NI



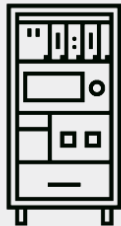
Faster Development

Standardized starting point for test system design



Simplified Procurement

Simplified BOM and vendor management



Flexible Configuration

Customized instrumentation and hardware























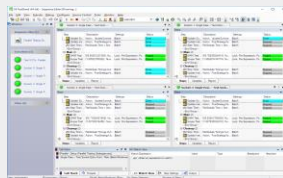
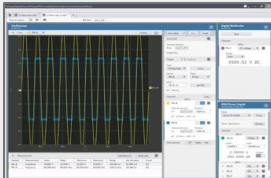
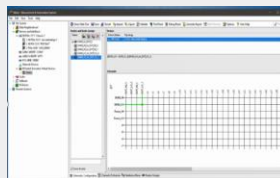
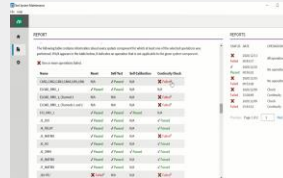


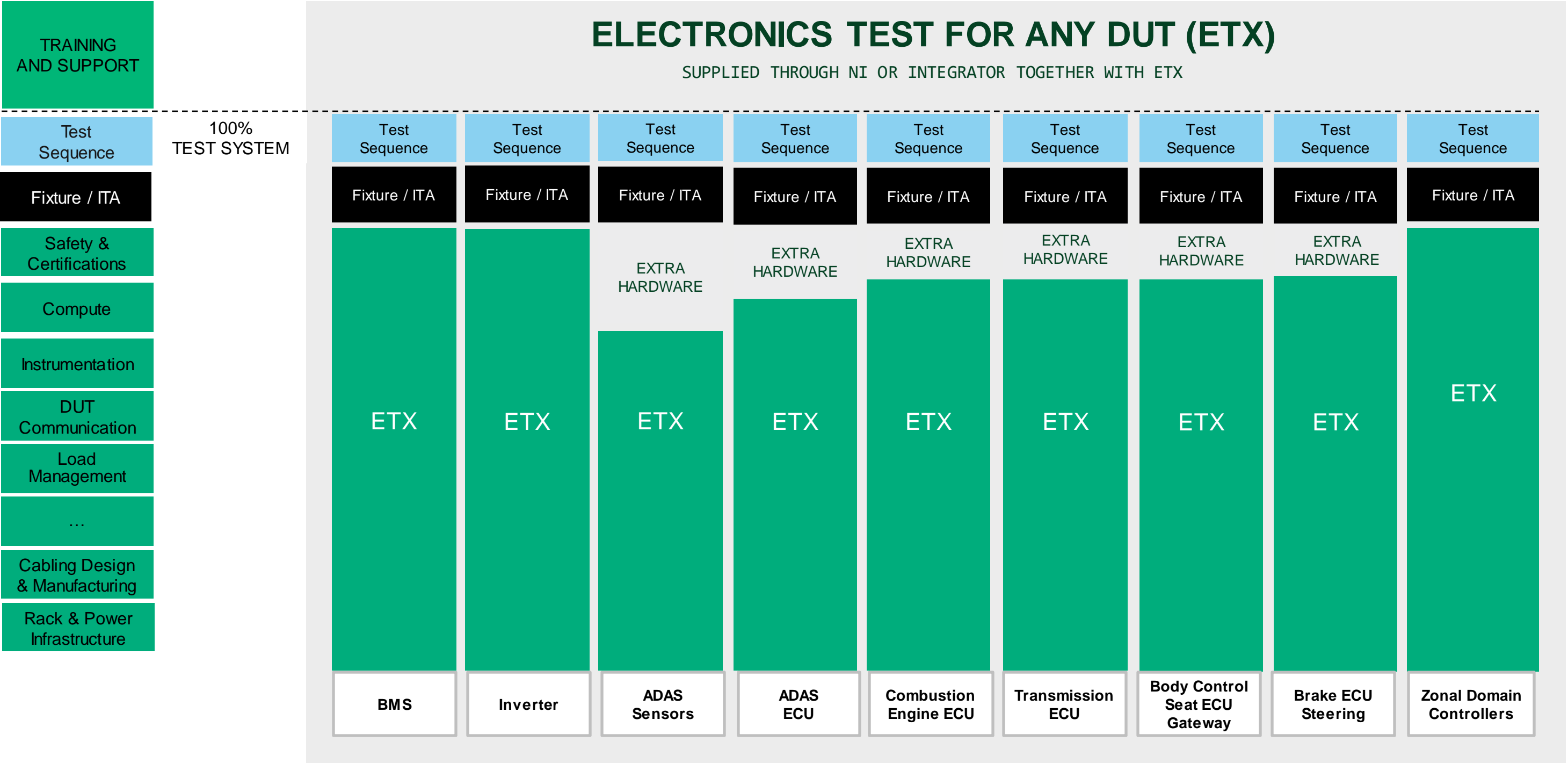
Streamlined Deployment

Expedited delivery and global certification



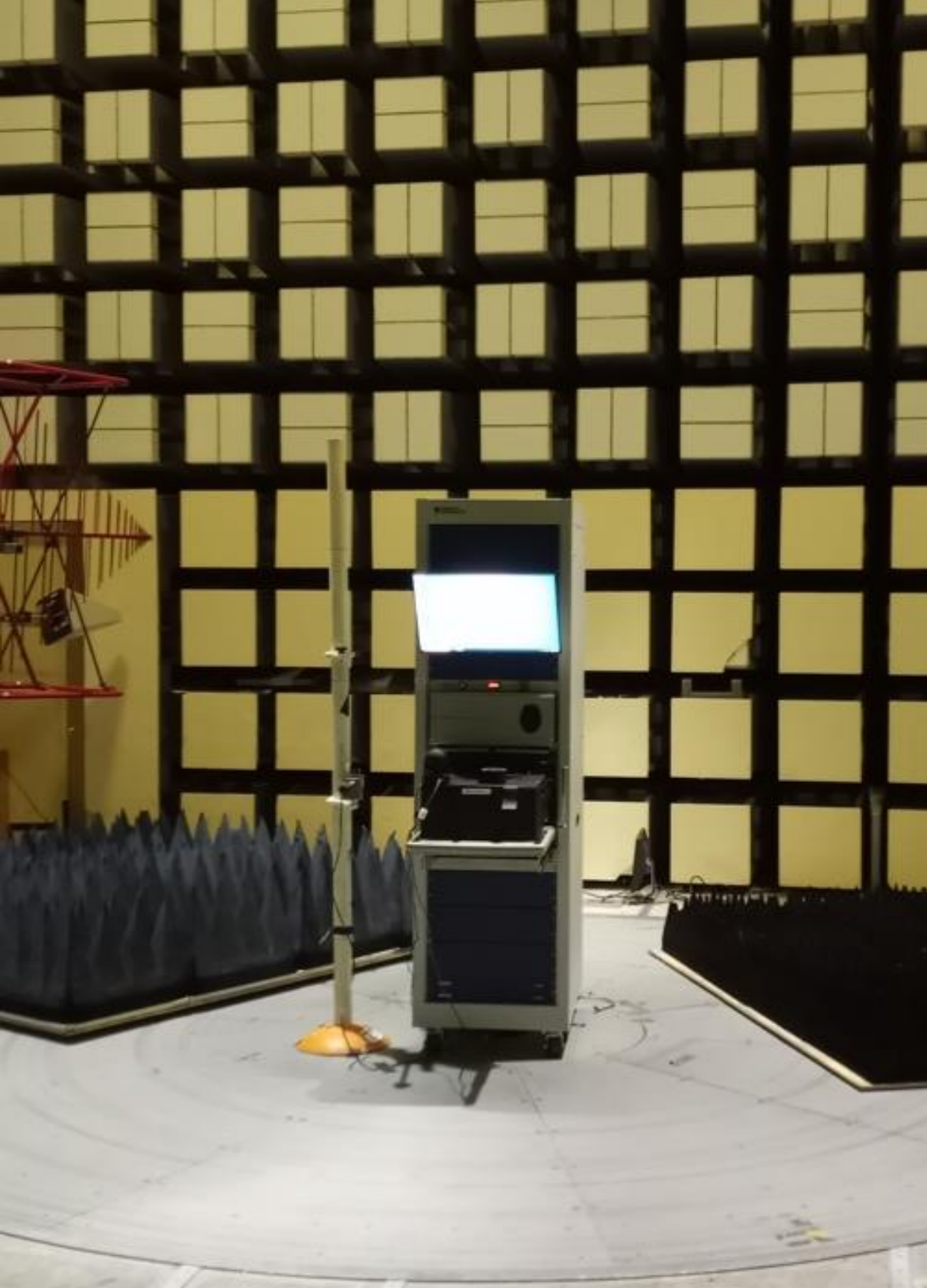
Components of a Test System

EXAMPLES OF COMPONENTS	Communication	 PXIe-8510/6 6-ch CAN/LIN Interface	 PXIe-8523 4-Port Auto 1000BASE-T1	 PXIe-8517 2-Port FlexRay Interface	 PXIe-8430/8 8-Port RS-232 Interface	 PXIe-6515 32 In / 32 Out Digital IO	 PXIe-8861/81 Embedded Controller Windows IoT LTSC USB, GibE, GPIB, Thunderbolt	
	Instrumentation	 PXIe-4081 7.5 digit DMM 1000V / 3A	 PXIe-5110 2-ch, 40 Vpp, 8-bit 100 MHz BW Scope	 PXIe-5413 2-ch, 24Vpp, 16-bit 20 MHz BW Fgen	 PXIe-4322 8-ch, Analog Output Ch-Ch Isolated, 16V, 250kS/s/ch	 PXIe-6386 8-ch, Analog Input 14 MHz/s/ch, 16bit	 RMX-4102 400W (20V, 20A) Power Supply	 RMX-4104 800W (36V, 24A) Power Supply
	Load/ Pin Switch	 SLSC-12251/12252 16-ch, 8A / 8-ch, 30A Load Switch, FET with Current Measurement	 PXI-2564 5A 16-Ch SPST Relay EMR, 10MHz	 PXI-2520 2A 80-Ch SPST Relay EMR, 35MHz	 PXIe-2737/8/9 2A 256-crosspoint 2-wire matrix EMR, 10MHz BW	 PXIe-2532B 0.5A 512-crosspoint 1-wire matrix Reed, 30MHz BW	 PXI-2567 64-ch Relay Driver	
	ETX Measurement Rack	Common DUT Interface – Mass Interconnect						
		 ECUTS 16000 - 24U 15 Instrumentation Slots 12 Load Card Slots VPC 9025	 ECUTS 16001 - 40U 32 Instrumentation Slots 12 Load Card Slots VPC 9025 Free Open Rack Space	 ETX 16002 - 38U Smart rack December 24				
Software	ECU Test System Software Suite with TestStand ECU Software Toolkit							
	 TestStand	 InstrumentStudio	 Switch Executive	 ECUTS Maintenance Software & FDT				
	Version-controlled bundle of software tools for interactive debug, test program development, and tester maintenance.							



Ready to Run

Resulting in 30-40% Faster Development



Safety, Environmental, and Regulatory Compliant System

European Directives:

Electromagnetic Compatibility (EMC) Directive 2014/30/EU

Low-Voltage (Safety) Directive 2014/35/EU

RoHS Directive 2011/65/EU

EMC:

Emissions

EN 61326-1:2013 (IEC 61326-1:2012), Class A

EN 55011:2009/A1:2010 (CISPR 11:2009/A1:2010), Group 1, Class A

Immunity

EN 61326-1:2013 (IEC 61326-1:2012), Basic

Safety:

EN 61010-1:2010 (IEC 61010-1:2010)

UL 61010-1, CSAC22.2 No. 61010-1

Environmental Affairs:

EN 50581:2012

Services and Support Programs

	BASIC (960193-01)	FULL (960193-02)	CUSTOM (960193-05)
Software Support Access to updates and bug fixes	Access to Software Updates	Access to Software Updates	Scope to be defined with customer on a case-by-case basis.
Repair and Replacement Minimize downtime	3-5 Days Replacement	<24h Replacement	
Technical Support Resolve issues quickly	Technical Support 8x5	Technical Support 8x5	
Field and Remote Services Fixed maintenance cost		Troubleshooting & Support	
Life Cycle Management Mitigate obsolescence risk	Standard Product Notifications	Standard Product Notifications	
On-Demand Training Ensure user success	Online Safety and Maintenance Training	Online Safety and Maintenance Training	
	OPTIONS		
Calibration Quality measurements and traceability	Laboratory Calibration On-site Calibration Calibration Replacement		
Bring-Up Assistance Hassle-free commissioning	On-site or Remote Tester Bring-Up		
Training Ensure user success	On-Demand Safety and Maintenance Training Test Engineer VILT Training		
Professional Services	Integration Services, Process & Technology Standardization Technology Refresh & Migrations, Design Assistance, Upgrade Assistance Resident Engineer		

Note: Please refer to the [NI Terms of Service](#) for the description of each individual service under Full-Service Program (960193-02).

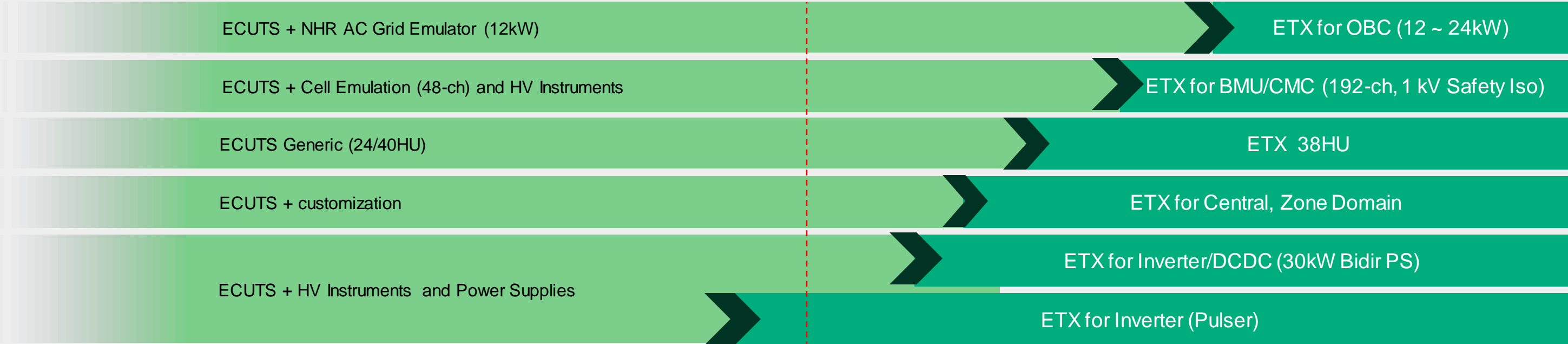
Calibration for Instrumentation

NI provides calibration services for instruments in the ECUTS that require calibration. NI recommends that you adhere to the calibration interval for all supported instruments in your system. For the latest information about available calibration service levels for your instrument, refer to ni.com/r/nical.

NI does not offer calibration services for non-NI products. Please consult each instrument supplier for service availability.

Measurement Category	Instruments	Calibration Interval	Calibration Availability
DMM	PXIe-4082	2 years	NI offers ISO 17025 Accredited Calibration
Function Generator	PXIe-5413	2 years	NI offers ISO 17025 Accredited Calibration
Digitizer	PXIe-5105	2 years	NI offers ISO 17025 Accredited Calibration
SMU	PXIe-4139	1 years	NI offers ISO 17025 Accredited Calibration
PSU	PXIe-4112	2 years	NI offers ISO 17025 Accredited Calibration
Analog Output	PXIe-4322	1 year	NI offers ISO 17025 Accredited Calibration
Electrometer	Keysight B2985B	1 year	NI does not offer, please consult Keysight
Cell Emulation	Aliaro AL-4010	1 year	NI does not offer, please consult Aliaro

ETX Production Test Roadmap



ETX for Inverter (Pulser)
Release
NI ATE CC Gen2



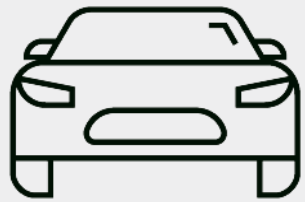
NI ECUTS Platform (Universal use, also used for custom BMS, OBC, DCDC)
Custom Production Test Platform

H2 2024

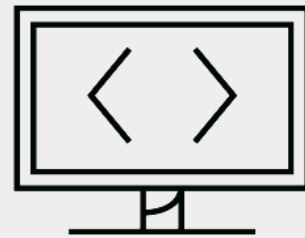
2025

2026

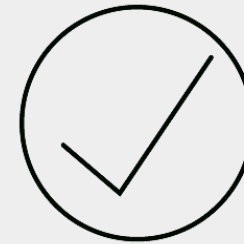
What Do Partners Provide



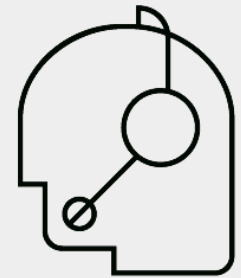
**Automotive
Expertise**



**Professional Software
Development**



**“Last Mile”
System Integration**



**Solution-Level
Technical Support**

Certified NI Technology Partners, iBtest, Ketigen, Altontech, Booster, Shikino and more, can handle all aspects of the project from system assembly, cabling and interfaces.

**SYSTEM
OUT OF THE BOX**

**SYSTEM
FULLY INTEGRATED**



By adopting customizable user-defined test system **using the NI automated test platform**, we achieved shorter development time and faster test speed required for functional tests of powertrain ECUs in manufacturing. We **reduced development time to 1/6 of the previous system and lowered system cost to 70% with 15% faster test time.**

Minsuk Ko, Manager, Ph. D.

Hyundai Kefico



Business Impact Case Study

Products	Develops automotive electronic management system
Company	Korean Automotive Tier-1 supplier with 4 global production sites
NI Products	PXI instrumentation, NI-Switch, NI-DAQ, FPGA, and NI-CAN

BUSINESS RESULTS

46%	83%
Return on Investment	Shorter Development Time
15%	30%
Test Throughput Increase	System Cost Reduction

Before Transformation

Different turn-key testers based on each ECU

Quality expectations continued to rise

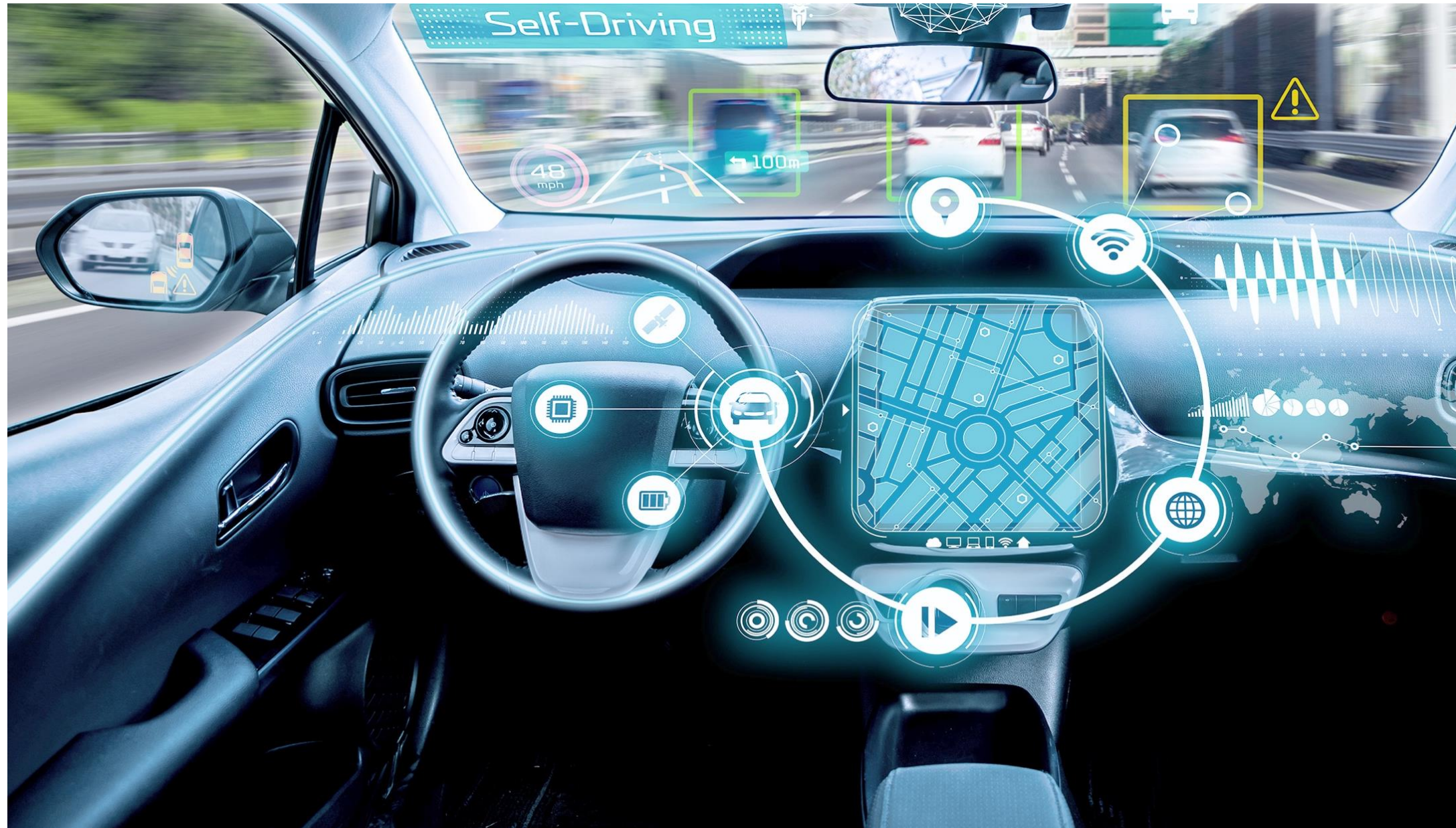
Maintenance and operating cost didn't scale with product line growths

After Transformation

Create a common platform tester to serve multiple ECU types

Reuse test engineering assets by reconfiguring test steps between R&D and Manufacturing

Future-Proof Your Production Test System



Autonomous

Safe

Clean

Productive

Software

Flexible

Customize

Reliability

Standardization



ni connect

2024 AUSTIN

