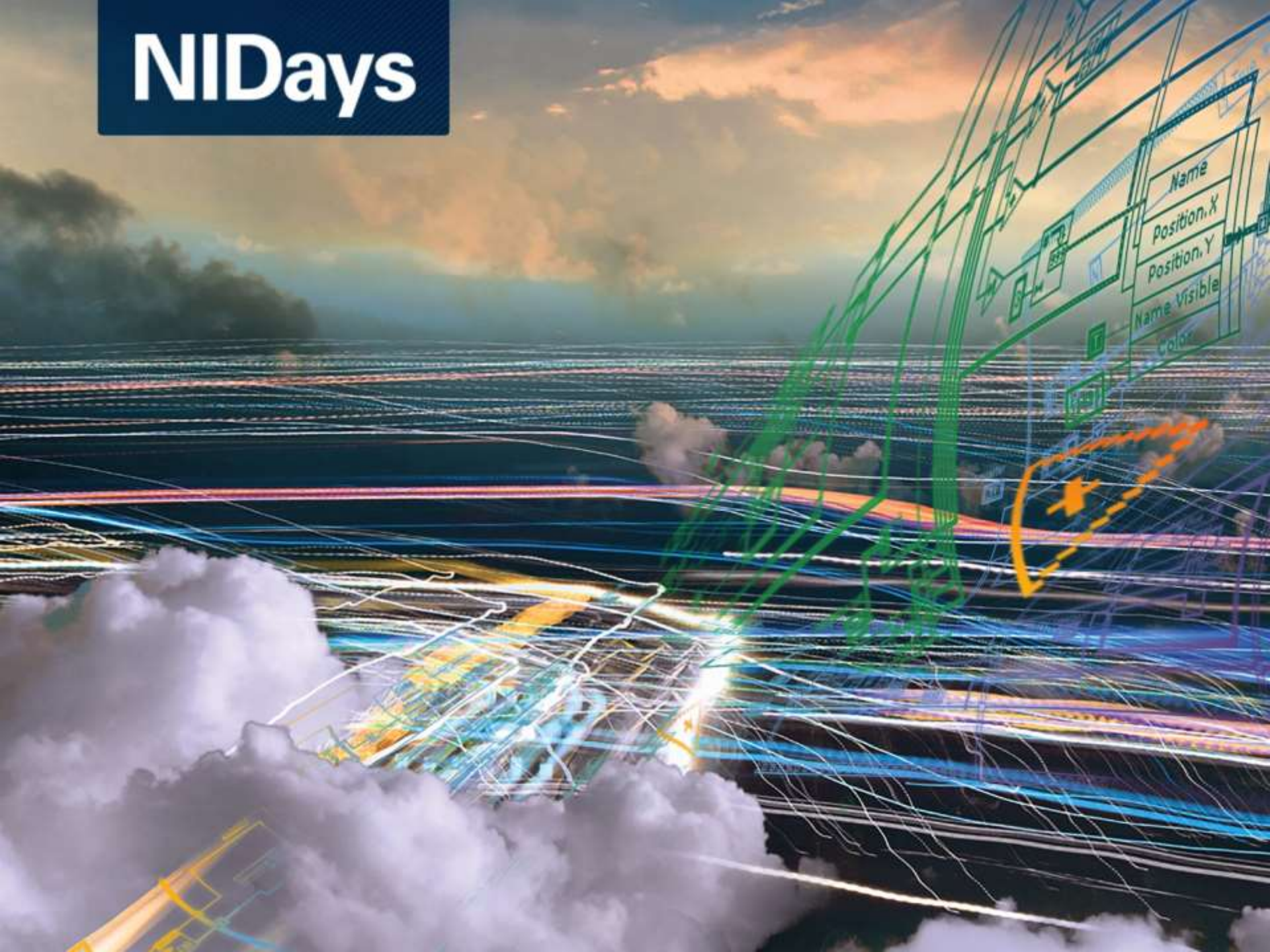


NIDays



Building Test Cell Solutions using National Instruments Tools

Ian Matthews

Business Development Manager

European Aerospace & Defense

Agenda

- **Background to Test Cell Solutions**
- Test Cells Challenges
- Mobile Test Cells (In-Vehicle Acquisition)
- Services and Partner Network

A little background

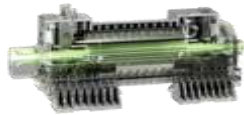
European Aerospace & Defense Network



BAE SYSTEMS



Industry Challenges



Stricter Regulations
and Legislation

New Technologies
and Materials

Higher Quality &
Reliability

More Complex
Products

Faster Time to
Market

Physical/Mechanical Test (Test Cells)
More Complex Tests | More Adaptable and Reconfigurable
Higher Resource Utilization | Wider Test Coverage
Higher Precision | Increased Simulation

Technology Requirements

Test Installation



Channels

Rugged

Performance

Lab



Channels

Rugged

Performance

Mobile

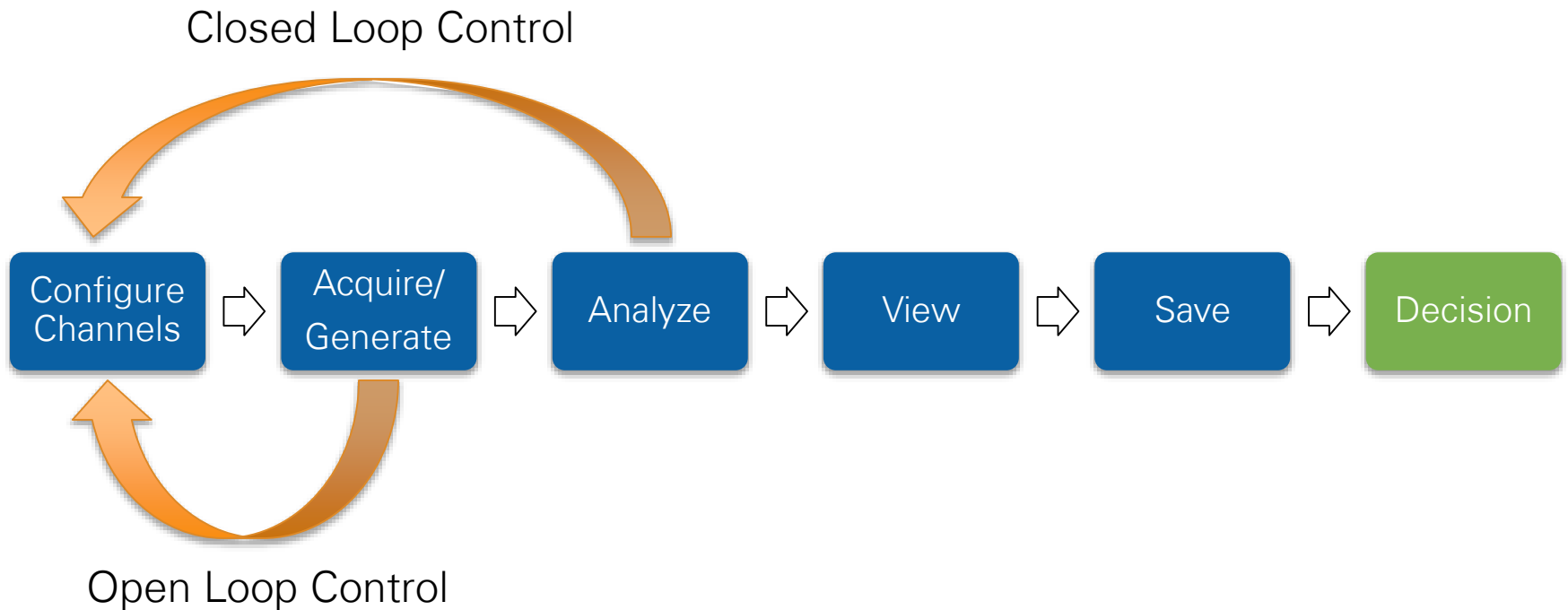


Channels

Rugged

Performance

Measurement Process



Agenda

- Background to Vehicle Test Solutions
- **Test Cells Challenges**
- Mobile Test Cells (In-Vehicle Acquisition)
- Services and Partner Network

Building/room/rig/stand that is outfitted with equipment to simulate the real-world operating conditions for a component/system, and to measure/characterize it's response

Engine/Powertrain Dynos



Engines, Powertrains,
Emissions, Fuel/Lube

Chassis Dynos



Vehicles, Emissions,
Durability, Vehicle
Dynamics

Component Test Stands



Valves, Pumps, Brakes,
Wheels, Landing Gear

Wind Tunnels



Vehicles and
Components

Turbo Machinery Test Cells



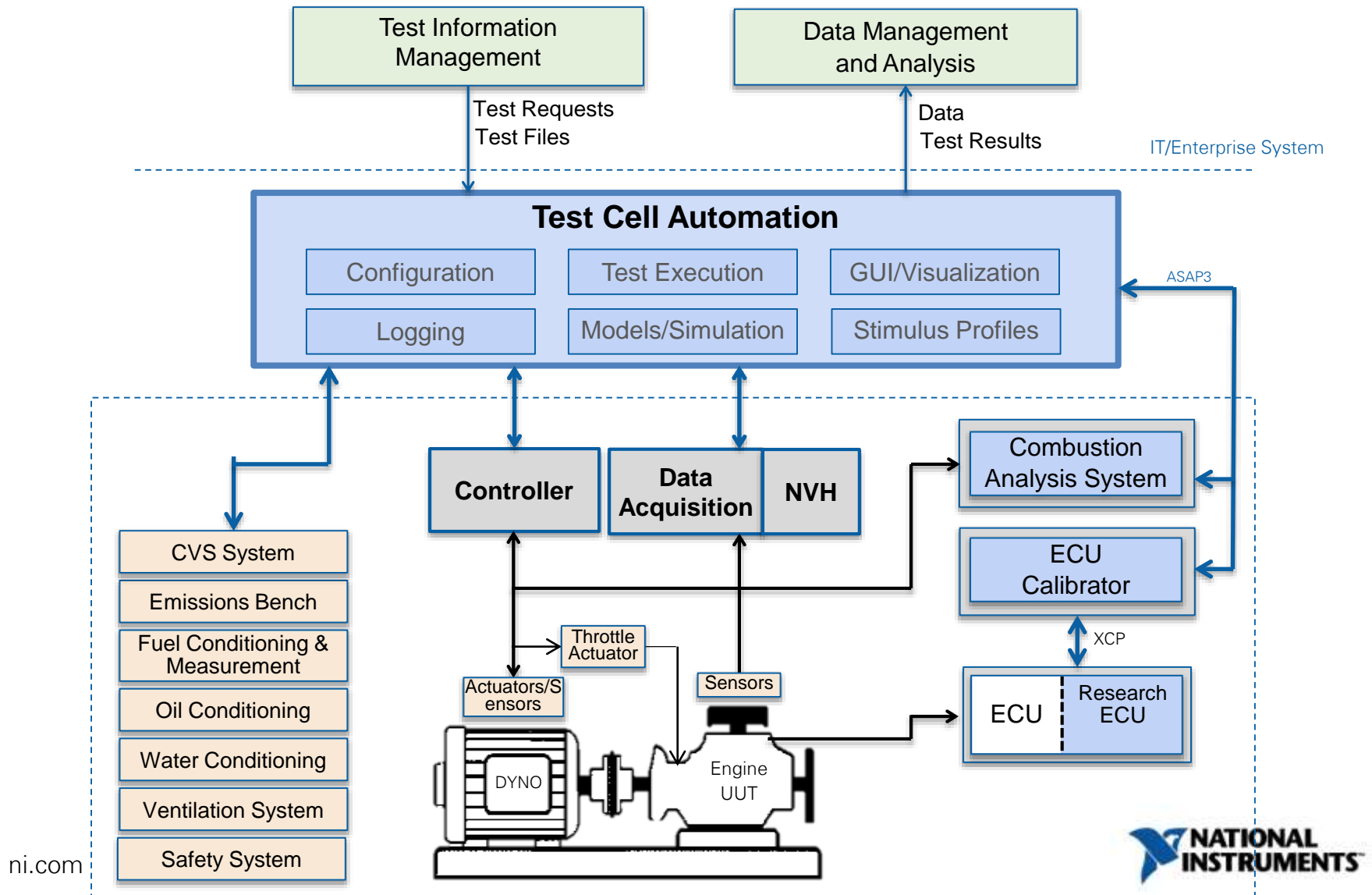
Engines, Steam Turbines,
Generators,
Compressors

Structural Test Rigs

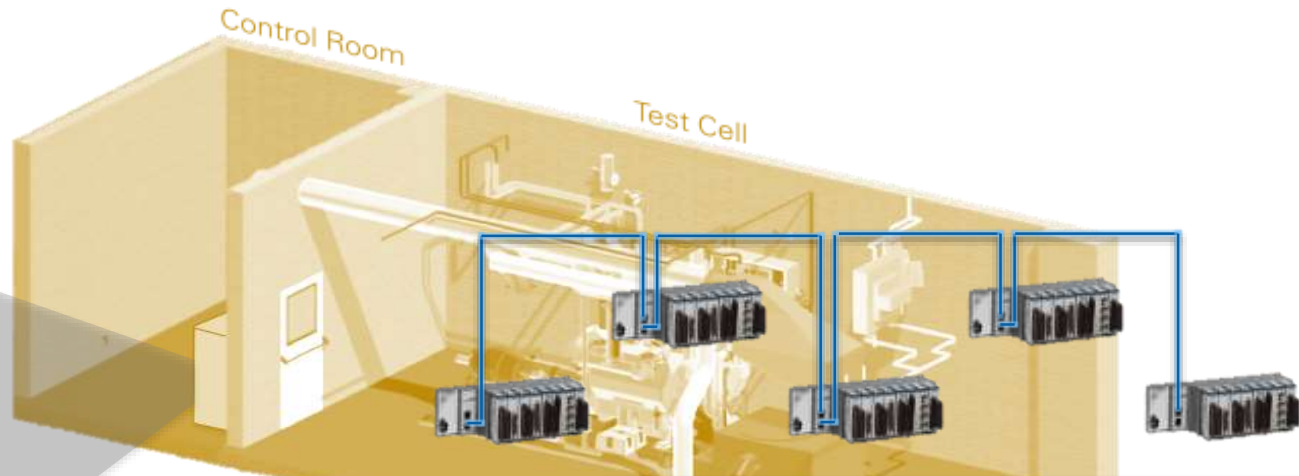


Load testing, fatigue testers,
static and dynamic stress
testing

Test Cell Automation System



Data Acquisition and Control Systems



Centralized System

- High channel density
- Consolidated I/O management
- Highest data throughput
- Typically located in benign environment

Distributed System

- Reduced sensor wiring
- Distributed time synchronization
- Integrate onto DUT for reduced in-cell setup time

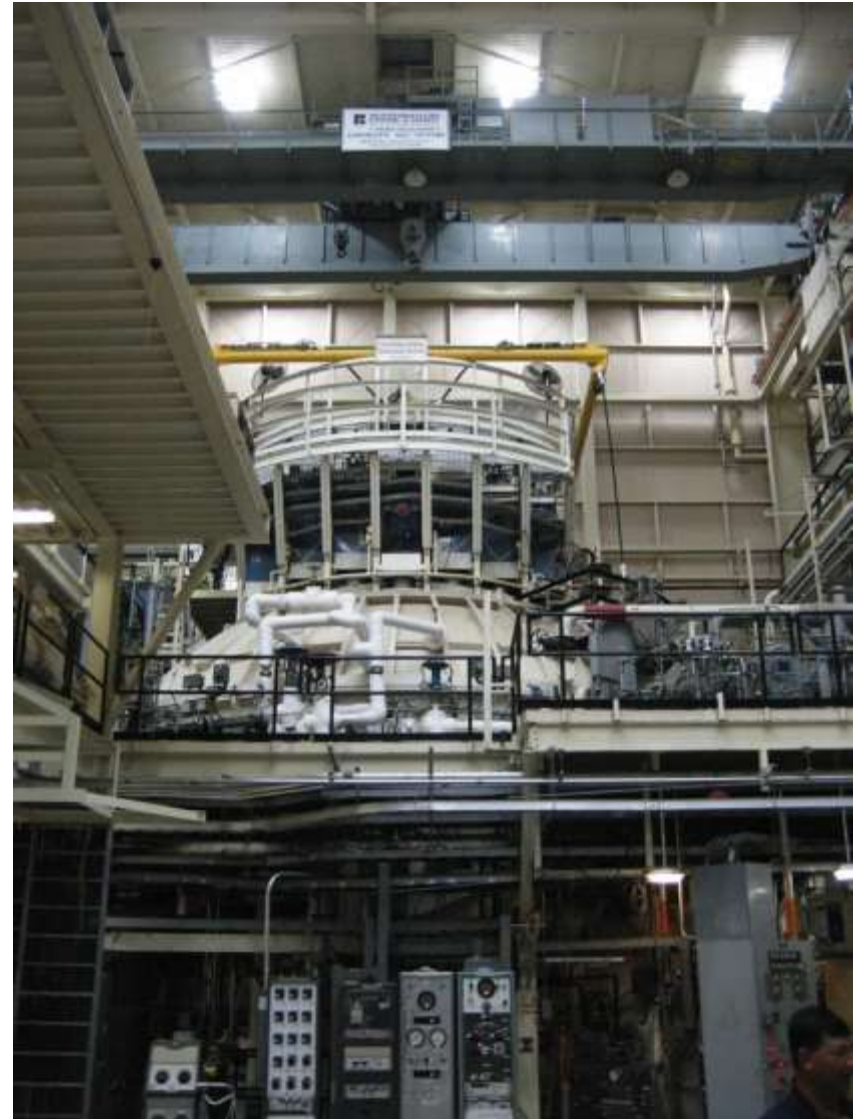
Environmental Simulation

- NASA Chamber B-
Johnson Space Center



"For the first time, NASA can achieve the $\pm 3^{\circ}\text{F}$ end-to-end accuracy requirements for thermocouples with commercial off-the-shelf technology."

-James Dean, Jacobs Technology

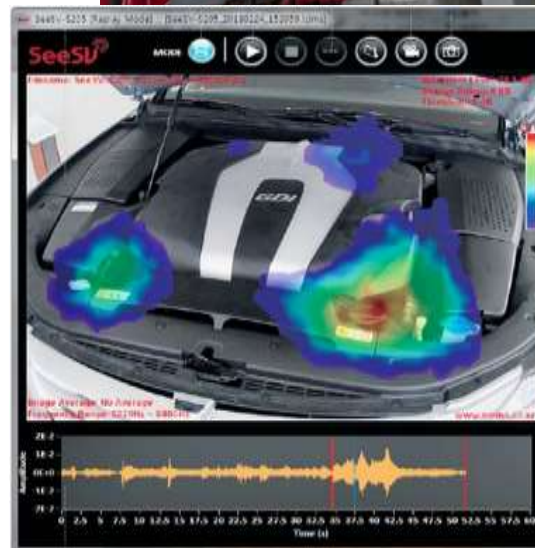


Test Cell Automation System



Measurement and Control I/O for Test Cells

- Sensor and I/O types
 - Temperature, pressure, torque, speed, position, load, strain, etc.
 - Voltage, current
 - Vibration, noise
- Reliable data
 - High-precision and stable signal conditioning and digitization
 - Noise immunity and filtering
 - Calibrated modules and system
- Robust system
 - Real-Time OS
 - Rugged hardware
 - Electrically isolated I/O
- Distributed and synchronized



Hardware Platforms



Standalone Compact DAQ

Benefits – Ease of use, configuration, mix of I/O

Limitations – limited control, no communications protocols, pure data acquisition

Applications – Acquisition, Signal Conditioning



Compact RIO

Benefits – Flexibility, Determinism, mix of I/O

Limitations – Complexity of programming, instrumentation options

Applications – Remote Acquisition / Control / Comms



PXI / PXIe

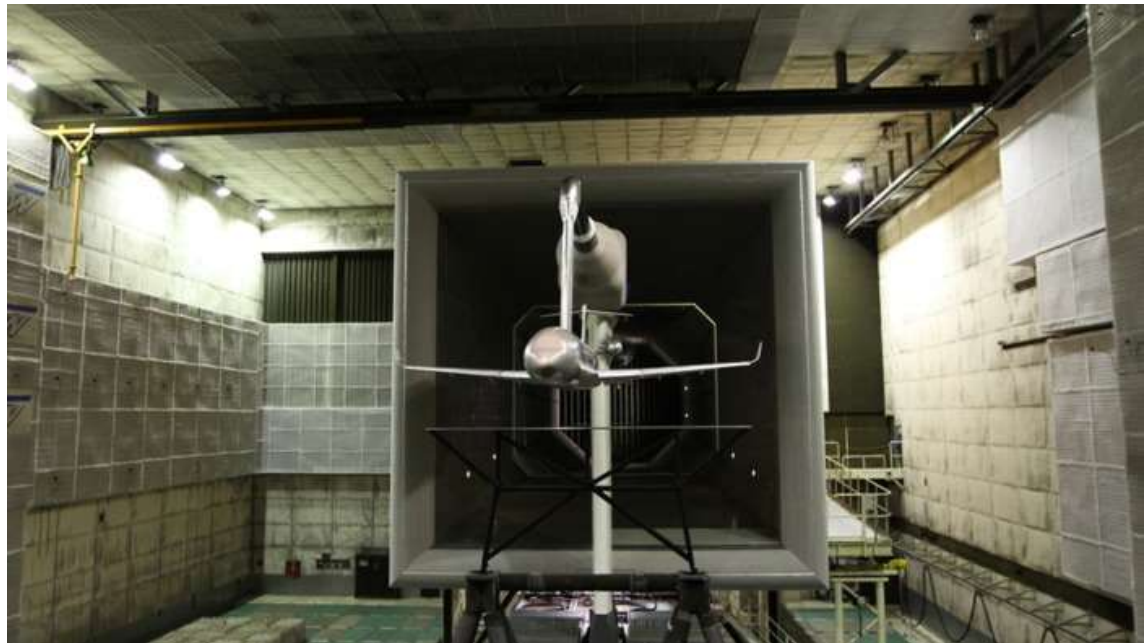
Benefits – High channel count, Synchronisation, Open platform, Instrumentation options

Limitations – Size, Power consumption

Applications – Local & remote Acquisition / Control / Comms

Characterizing Sound Profiles for a New Airbus Aircraft Using NI PXI

- **The Challenge:** Acquiring data at high sample rates from more than 200 microphones and pressure sensors that are distributed in a large wind tunnel while keeping the signals synchronized within 1 μ s.
- **The Solution:** Using the PXI and PXI Express synchronization bus and the external synchronization possibilities to demonstrate close synchronization of the signals, even if their cabling lengths differ by 100 m.



"We chose a National Instruments system because we had good experiences in the past with NI, and the NI modules had the capabilities we needed." - Johan de Goede, National Aerospace Laboratory (NLR)

NI VeriStand™

Real-Time Testing and Simulation Software

- RT Stimulus Generation
- Data Logging
- Test Automation
- Hardware I/O
- Alarming
- Calculated Channels
- Deterministic Model Execution
- User Account Management
- Multi-Chassis Synchronization
- Multi-Chassis Data Sharing
- Closed-Loop Control
- Scaling and Calibration



Multi-Chassis Systems



PXI



CompactRIO



Windows PC



NI VeriStand Helps You...

- **Reduce development time without reducing flexibility**

Architecture design, implementation, debugging, documentation of real-time application, host interface, and communication between them

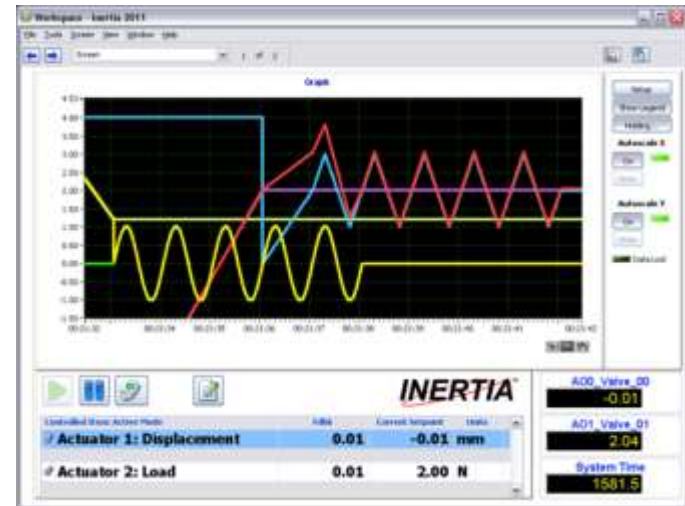
- **Reduce maintenance costs**

OS and I/O hardware support, feature and performance innovation, continuous quality improvement

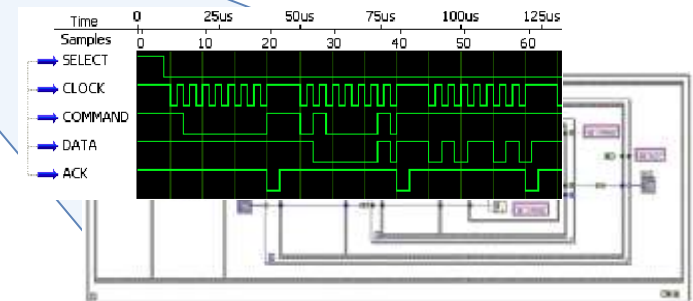
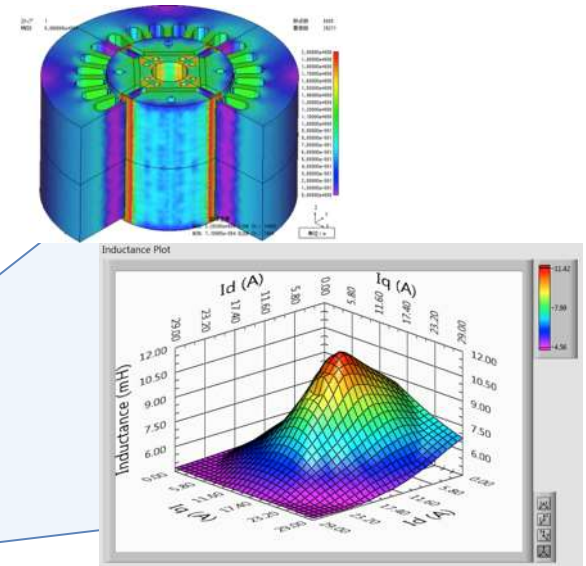
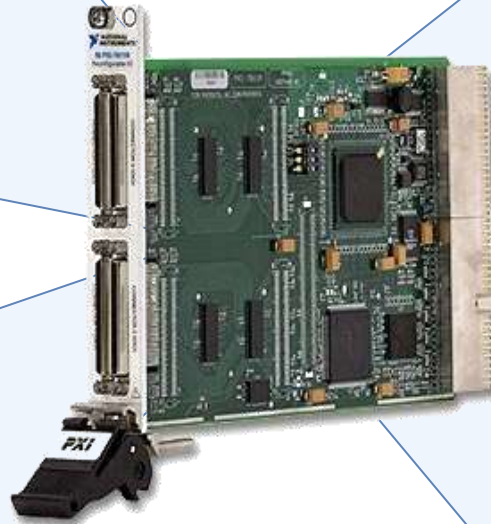
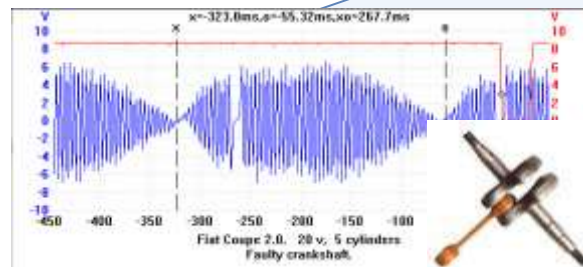
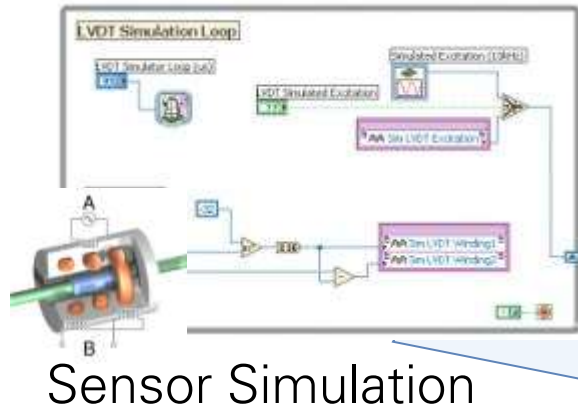
INERTIATM add-on for **NI VeriStand**TM

Tightly integrated suite of NI VeriStand components for closed-loop control of multi-actuator systems

- **Ready-to-use closed-loop controllers**
 - Multi-mode PID with bumpless transfer
 - Dither, rate-limiting, and amplitude control
- **Controller interface utilities**
 - PID Tuning tool
 - Multi-mode workspace object
- **Real-Time Stimulus Profile Extensions**
 - Specially designed test profile editor for test cell applications
 - Tight integration with closed-loop controllers



FPGA-Based I/O Interfaces



Hydraulic Control System Testing



“The out-of-the-box capabilities of NI VeriStand **made it practical** for us to develop an HIL test system, reducing our total testing cost by more than \$740,000.”

– Greg Sussman, CLA, Process Automation



Process
Automation corp.



Why didn't you write the application in LabVIEW?

"We did write some LabVIEW code to customize NI VeriStand, but the cost of implementing a completely custom solution would have been significantly higher and created more technical risk.

With NI VeriStand, we took the existing framework and built on it, cutting our development and deployment schedule by a significant amount. This correlated directly to a lower overall system cost..."

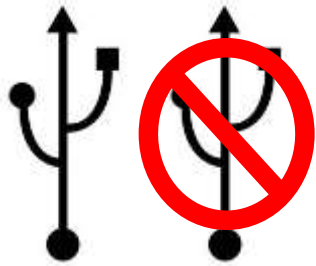
**Greg Sussman, Certified LabVIEW
Architect**
Process Automation

Agenda

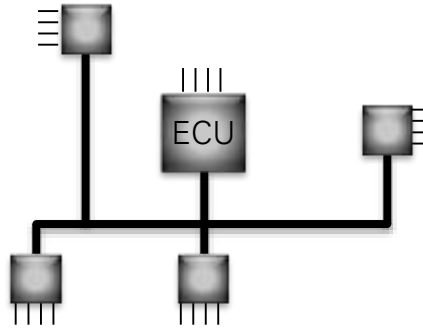
- Background to Vehicle Test Solutions
- Test Cells Challenges
- **Mobile Test Cells (In-Vehicle Acquisition)**
- Services and Partner Network

Technologies and Challenges

for In-Vehicle Test and Data Logging



Tethered/Stand-Alone



Wide Variety of I/O and
Vehicle Networks



High-Performance
Processing Power



Wireless Technologies
Connectivity



Open and Flexible
Software



Configurable, Easy-to-
Use Software

Gas Turbine Data Gathering



Challenge

Building a flexible data acquisition system to validate maintenance on gas turbines.

Solution

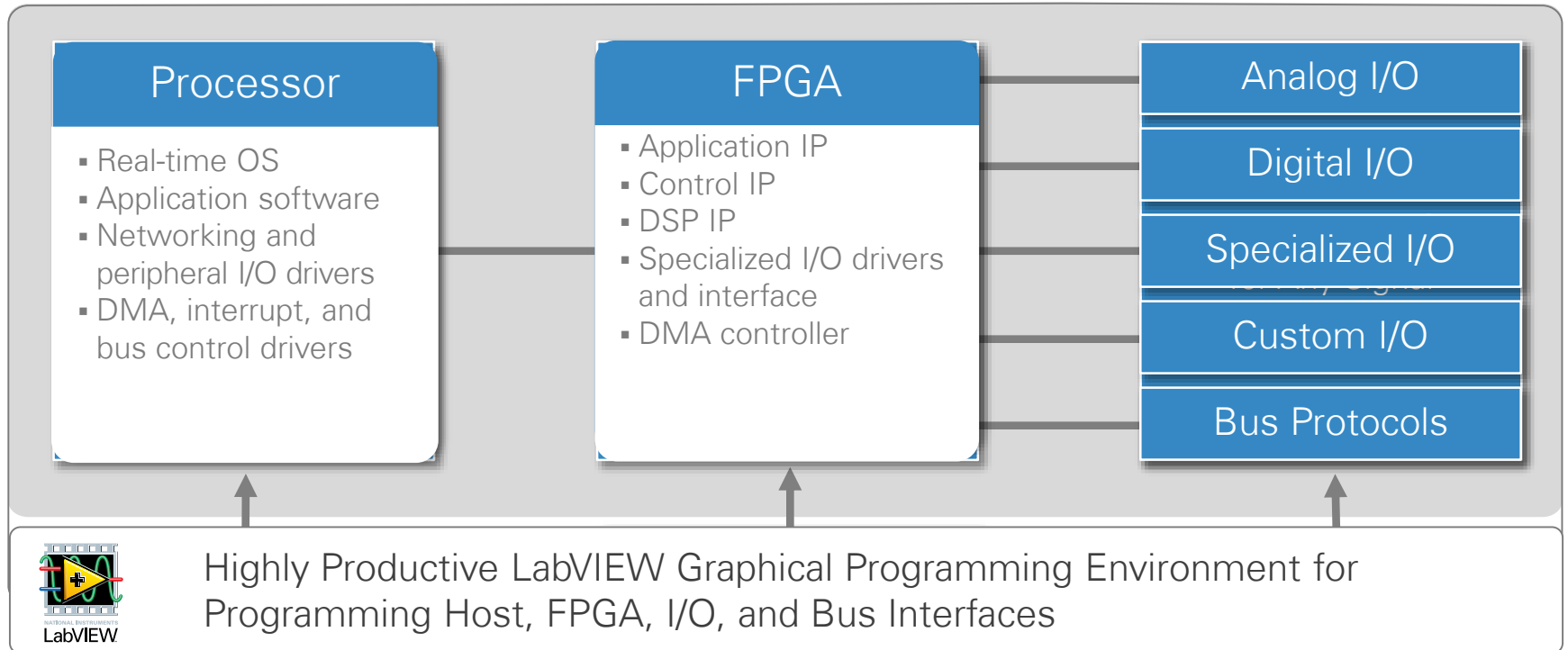
NI CompactDAQ controllers with LabVIEW give the flexibility to quickly change measurements depending on the testing needed.

"Because the CompactDAQ controller is a stand-alone device, we don't have to spend money on a separate computer, signal conditioning or cabling. Using the CompactDAQ platform, we've been able to reduce cost and installation time."

Ryan Ewart
Mechatronics Engineer, Yanos Aerospace

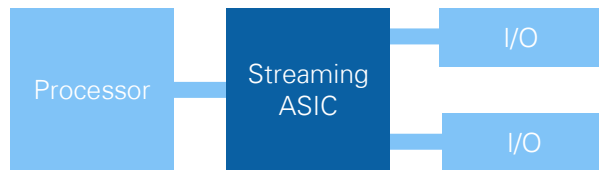
The NI Approach to Flexible Hardware

We call this the LabVIEW RIO Architecture.



CompactDAQ

Acquisition and Rapid Deployment



CompactDAQ reduces system cost and complexity for **measurements and data logging** in **test, diagnostics, and research** applications.

CompactRIO

Control and Complex Applications



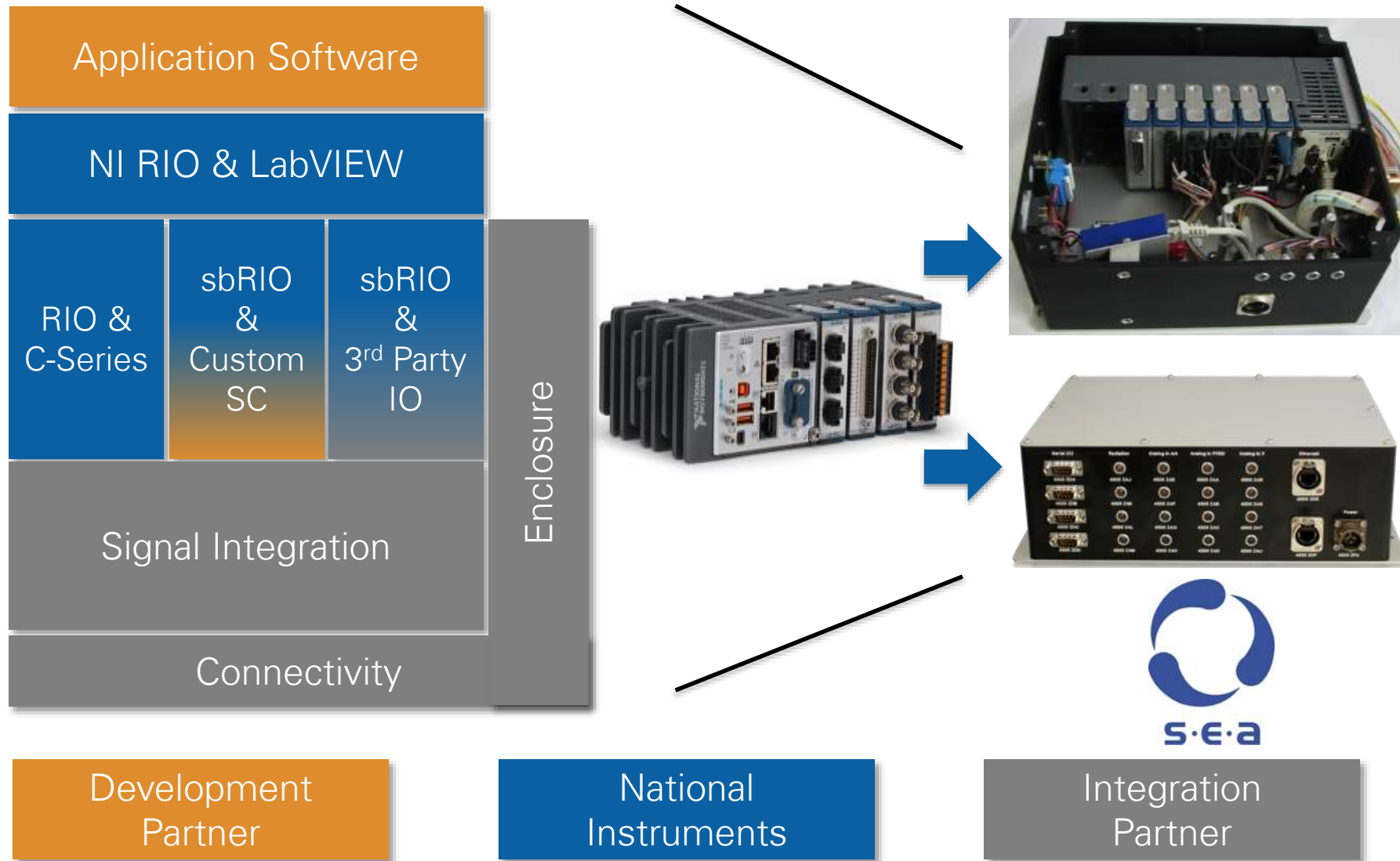
CompactRIO increases productivity and flexibility for **designing, prototyping, and deploying** embedded monitoring and control solutions.

C Series I/O Modules

- Over 100 NI and Partner Modules
 - Analog Input
 - Analog Output
 - Digital I/O
 - Relay Output
 - Counter, Pulse Generation
 - Communication
 - CAN
 - LIN
 - PROFIBUS
 - Motion Control
 - Wireless
 - Engine Control
- Signal Conditioning
- Rugged Mechanicals
- Signal Conditioning/Filtering
- Isolation Barrier



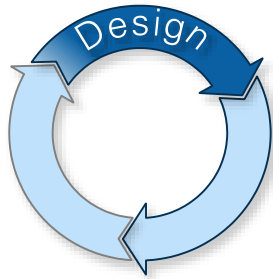
Flexible Platforms for Distributed Measurements



Agenda

- Background to Vehicle Test Solutions
- Test Cells Challenges
- Mobile Test Cells (In-Vehicle Acquisition)
- **Services and Partner Network**

Reduce Risk in Design | Speed Development Reduce Total Cost of Ownership



NI Design Services

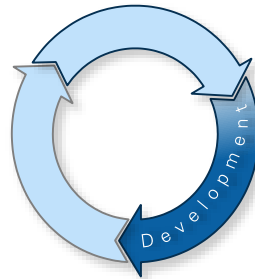
Alliance Partner Program

Training and Certification

Requirements Development

Design Review

Feasibility Study



NI Development Services

Alliance Partner Program

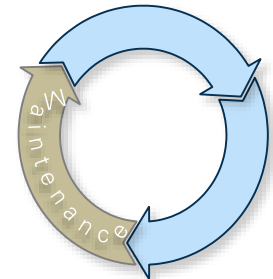
Technical Support

Training and Certification

Software Service Programs

Getting Started Assistance

Custom or Enhanced Products



NI Maintenance Services

Assembly and Installation

Technical Support

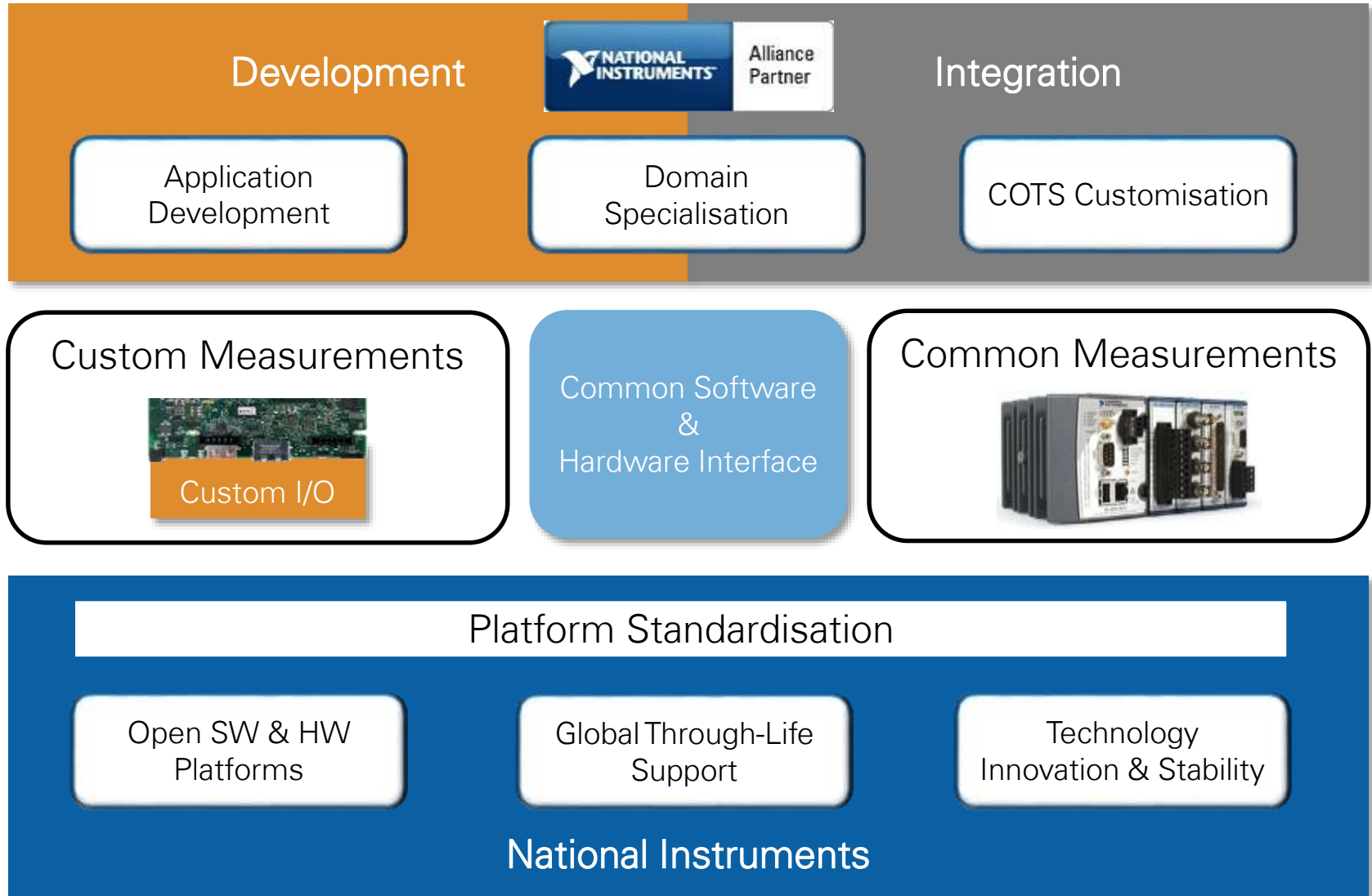
Calibration

Repair

Sparing

Training and Certification

Distributed Systems Example



Partner Expertise

- Architecture SW / HW
- Software Development
 - Test Management – TestStand / VeriStand
 - Test Development – LabVIEW / C
 - Hardware Abstraction – LabVIEW / C
- Global Integration / Through Life Support
- Local Integration / Support
- Domain Expertise
 - Mechanicals & Controls
 - Instrumentation / Switching
 - Avionics Communications
 - Custom Electronics / FPGA



S.E.A. Company Overview



S.E.A. Datentechnik GmbH

Mülheimer Straße 7

53840 Troisdorf, Deutschland

- System engineering company with engineers and scientists
- National Instruments alliance partner since 1990
- Hardware & software development
- System engineering
- Test stands, test beds and control systems for
 - research, development, validation & production applications in all industrial areas
- Space & aerospace, automotive, RF test systems
 - 2010 Alliance Partner of the Year Central Europe*
 - 2010 LabVIEW Add-on of the Year Award*
 - 2013 National Instruments Technical Innovation Award*



NATIONAL INSTRUMENTS
Alliance Partner Network
Electronic Design Specialty



Core competence

Elektronik Development

Aerospace Industry

Automotive Industry

sbRIO Applications



Test and Validation System

Aerospace Industry

Automotive Industry

Semiconductor Industry



Company

- Founded 1969
- Independent
- 1 Mio. Capital Stock
- > 100 employees
- ISO 9001 certified
- Long Alliance Partnership

Application areas

- Automotive
- Aerospace
- Environmental science
- Large Facilities
- Global Solutions

Services

- Conceptual and system design
- Platform based solutions
- Profound application know-how
 - Test process management
 - Test facility automation
 - Test data and information management



Integration, Validation & Simulation benches

- > Test benches (HIL, MIL, SIL) for :
 - > Electrical or electronic systems, Satellites and payloads, Embedded computer, Batteries, EGSE
 - ...
- > Test automation (TestInView, A2C)
- > Simulators for energy, batteries, solar panels, ...
- > Voltage & current protection system
- > Analyses (vibration, acoustics...)
- > Hydraulic, Pneumatic, mechanical bench :
 - > Engine, brake, Exhaust Emission, NVH Engine Test Cells, Powertrain, Chassis Dynamometer, Component, Pump Erosion/Corrosion, Effort/Displacement, Bursting, Landing gear, Thrust Reverse Actuator, Actuators, Ironbirds, Green Taxiing, FLAP & SLATS, ...

Monitoring & control systems

- > Specific or critical site supervision systems
- > Monitoring & control of :
 - > Airport lighting
 - > Vacuum process
 - > Propellants and launch facilities
 - > Windtunnel
- > Embedded computer (Dataloader)



SAFRAN ENGINEERING SERVICES

Provide Test Benches



- Turnkey and end-to-end Test Bench solutions (from design to in operation maintenance)
- Test benches, HIL, SIL, Simulators...
- Hardware (electronics, mechanics...), software...
- Data Acquisition & Real-Time Measurement and Control
- Motion Controllers and Motor Drives
- Communication Buses and Protocols
- High skills in PXI & Instruments Tools



NI VeriStand



LabWindows/CVI



NI TestStand



python



dSPACE



CANopen

CAN

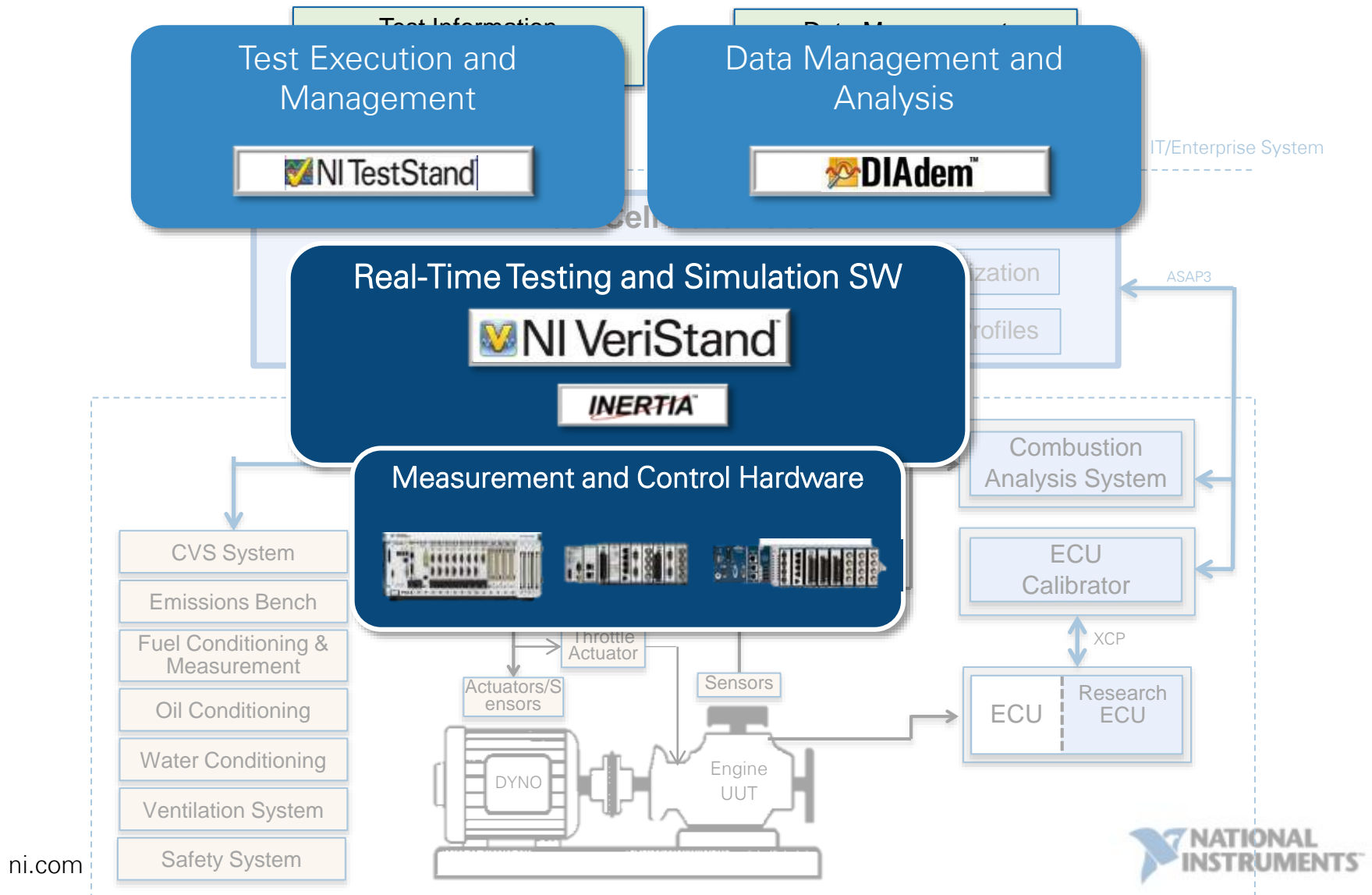
ETAS

Operate Test Activities

- V&V strategy definition
- Test Procedures
- Test execution : V&V, integration, qualification, certification, maturity, endurance...
- Ground & Flight tests
- Test Scripting (Python, TestStand, AutomationDesk,...)
- Test optimization and automation
- Real and deferred time test analysis
- Test analysis reports



Test Cell Automation System



Summary

Trends

- Increasing complexity of test cells
- Integration of specialized control and measurement tools
- Impact of test environment and facility on data

Requirements for future

- Open, flexible and modular systems
- Adaptability and integration
- Robust and reliable systems

Stay Connected During and After NIDays



ni.com/aerospace



facebook.com/NationalInstruments



twitter.com/niglobal



youtube.com/niglobal