

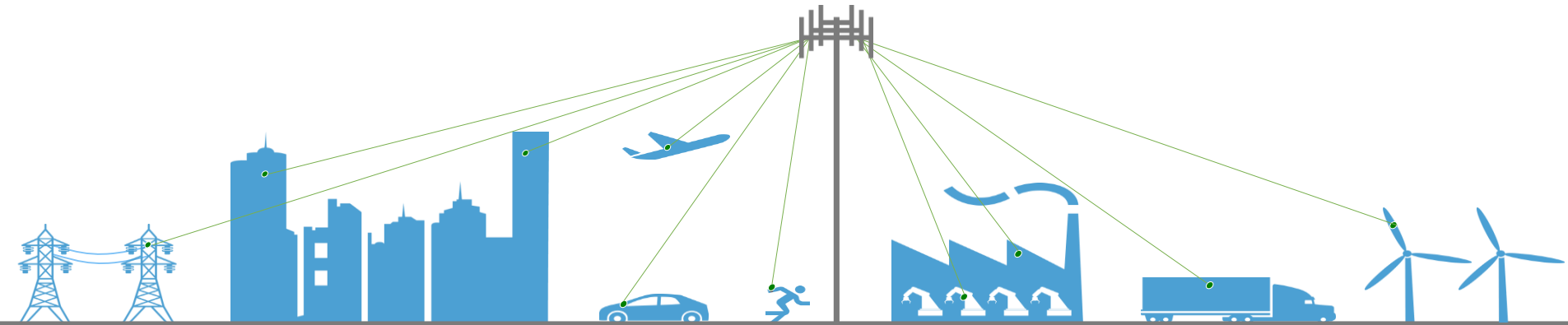




Processing at the Edge: Why a Platform-Based Approach is Ideal for the Industrial Internet of Things

Matt Surridge CLA, Applications Engineer (TL)

3rd November, London



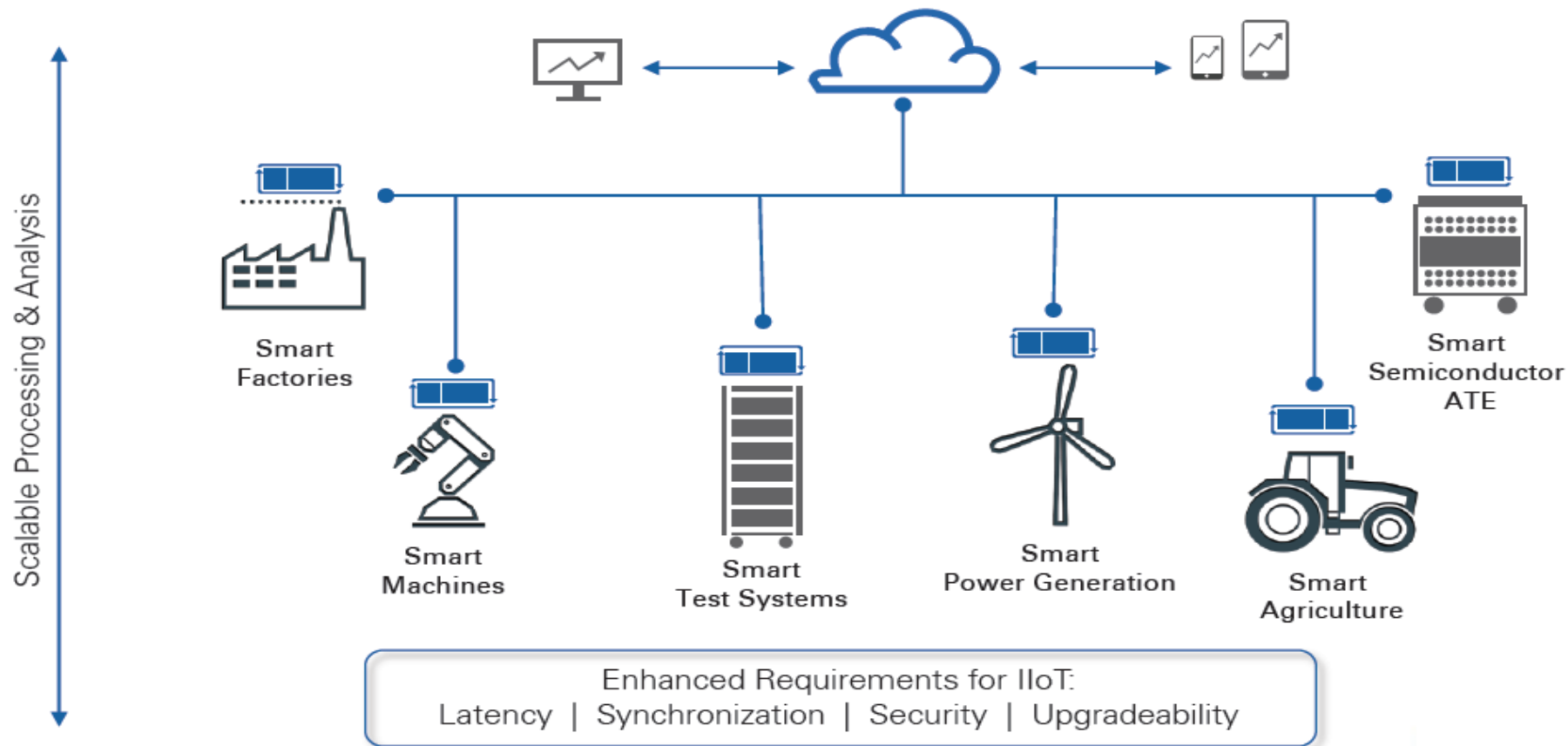
Processing at the Edge: Why a Platform-Based Approach is Ideal for the Industrial Internet of Things

Goals for today's session:

- Understand the definition and impact of the IIoT
- Review typical IIoT system architecture
- Discuss requirements and challenges associated with IIoT systems
- Illustrate benefits of a platform-based approach for designing IIoT systems

Demystifying the IoT

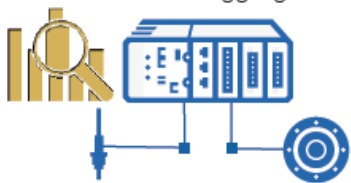
The Industrial Internet of Things



Trends in the Industrial Internet of Things

Intelligent Systems

Sensors, Actuators, Acquisition,
and Data Aggregation



Big Analog Data
Storage
Bandwidth

Intelligent Systems Of Systems

Secure connectivity and
system-to-system communication



Security
Synchronization
Bandwidth
System Management

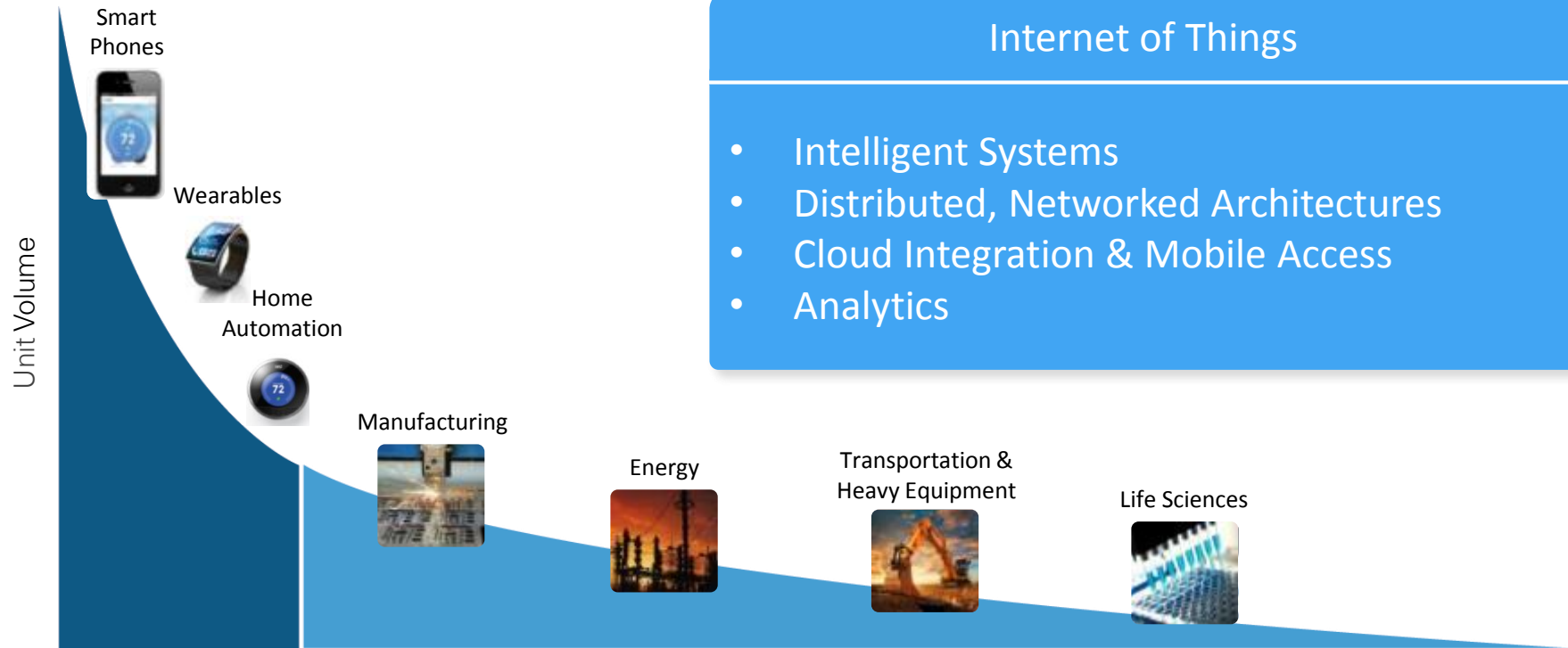
End to End Analytics

Solutions from Device to cloud to deliver
Business insights and customer value



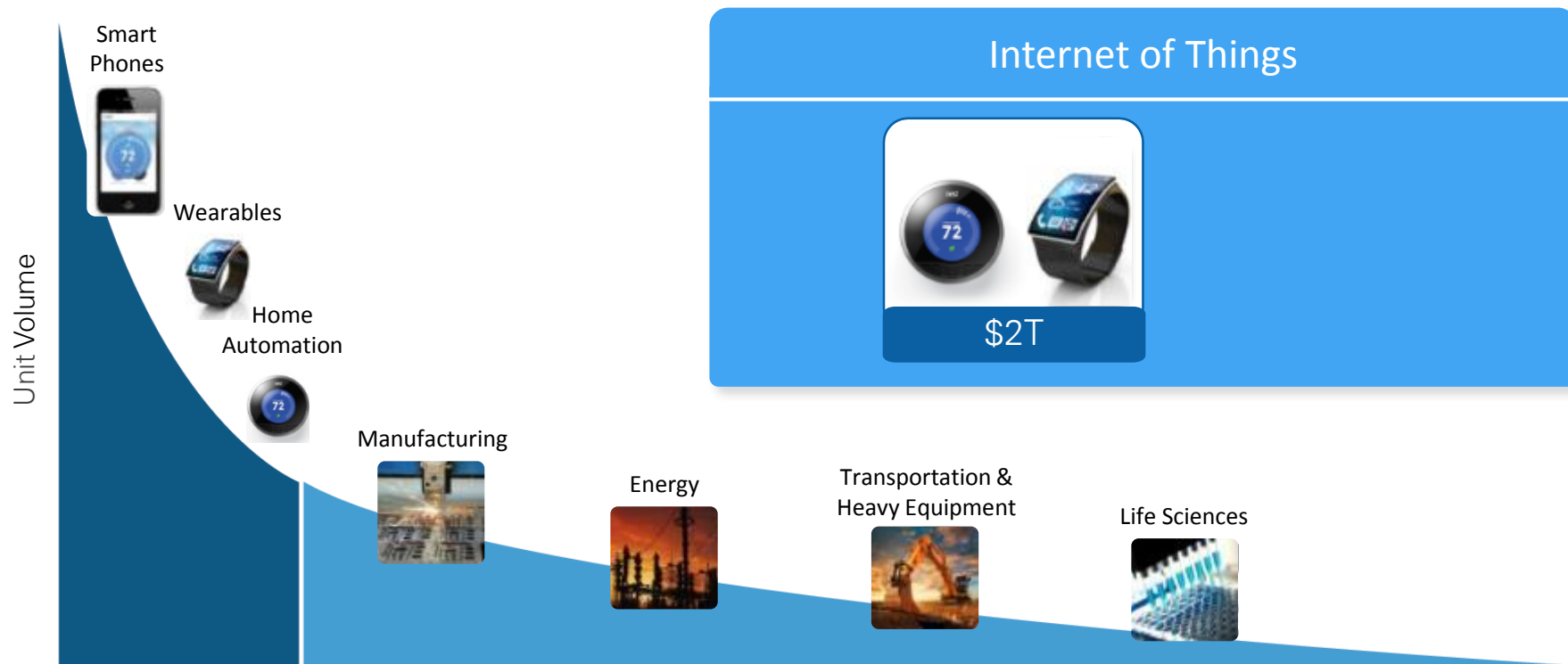
Algorithms
Automated Decisions

The Internet of Things Market



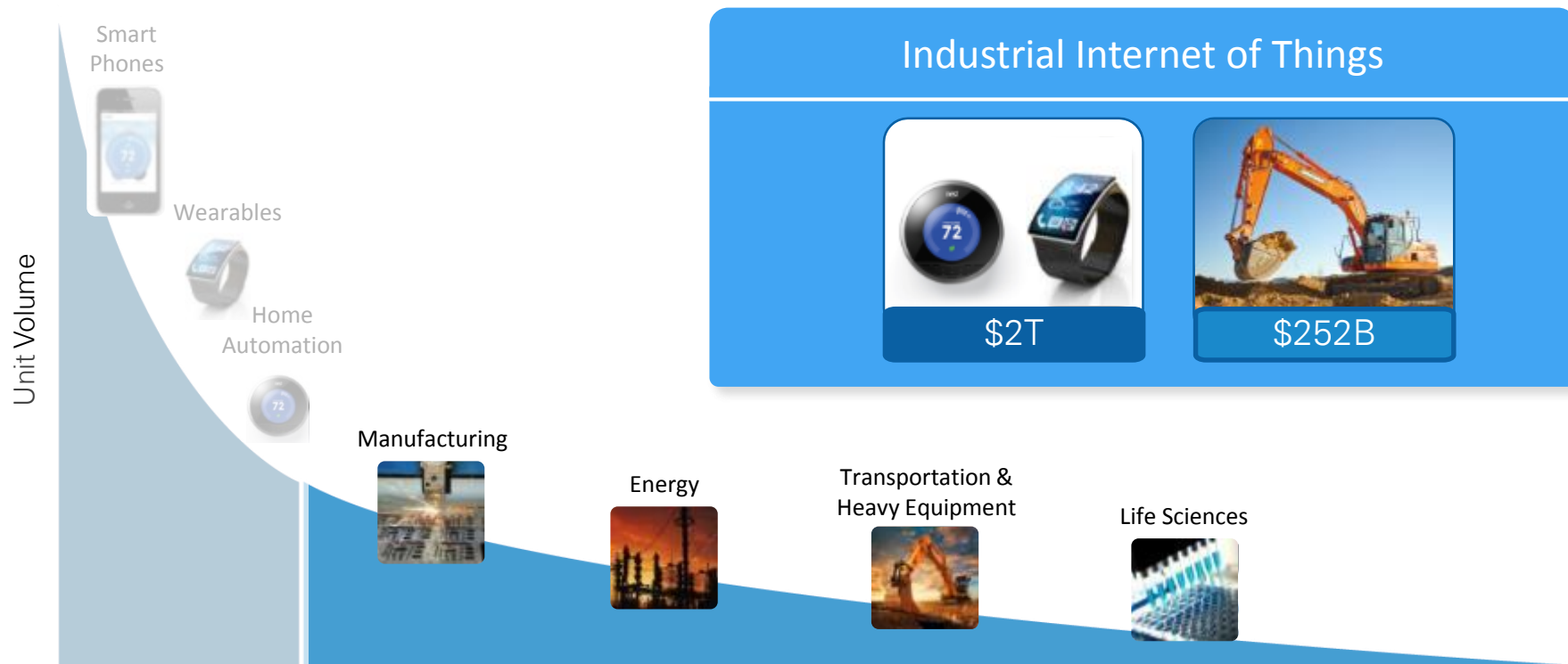
Source: Worldwide Embedded and Intelligent Systems 2014-2018 Forecast and Analysis (IDC #249414, July 2014) and NI Estimates

The Internet of Things Market



Source: Worldwide Embedded and Intelligent Systems 2014-2018 Forecast and Analysis (IDC #249414, July 2014) and NI Estimates

The Industrial Internet of Things Market



Source: Worldwide Embedded and Intelligent Systems 2014-2018 Forecast and Analysis (IDC #249414, July 2014) and NI Estimates

The Power of 1 %

\$30B

fuel cost savings
in aviation
industry



\$63B

productivity
improvement in
healthcare



\$90B

reduction in
CapEx in oil & gas
exploration and
development



\$27B

productivity
improvement in
rail industry



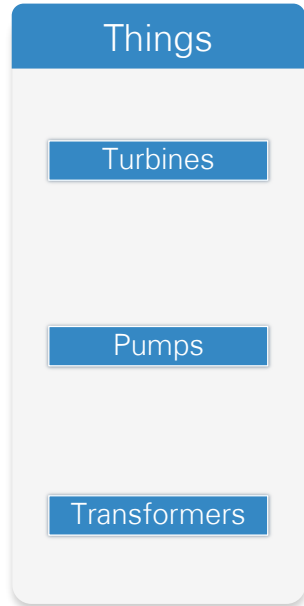
Realizing These Benefits



IIoT System Architectures

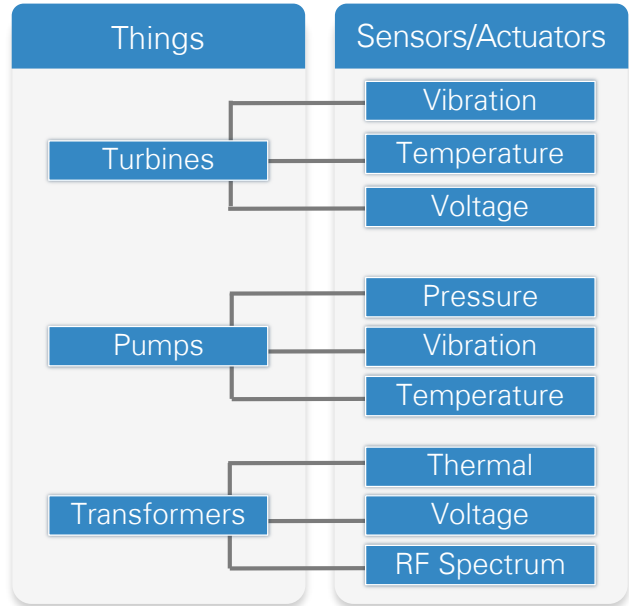
End-to-End Industrial IoT Solution

Start with Industrial Things



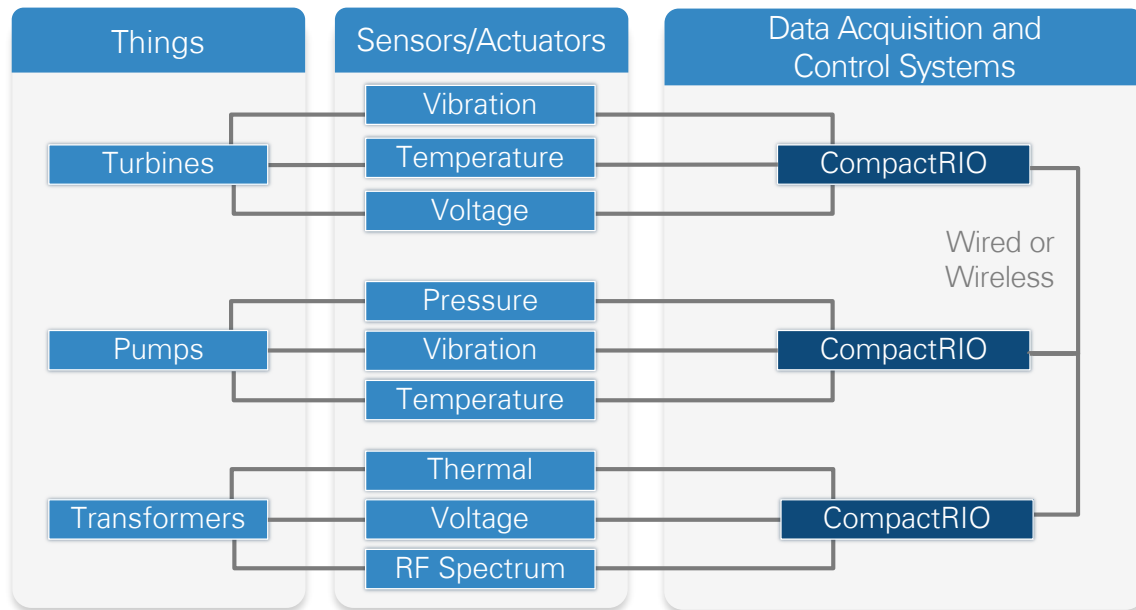
End-to-End Industrial IoT Solution

Add Sensors and Actuators



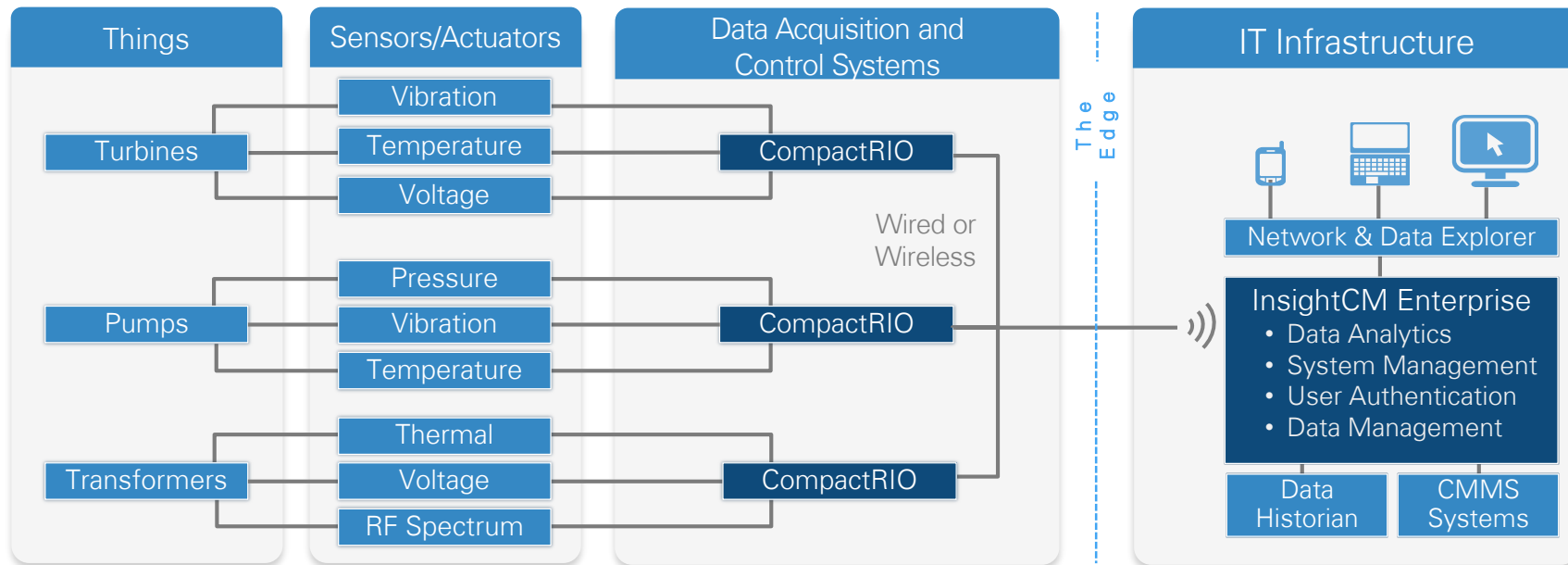
End-to-End Industrial IoT Solution

Automate with Networked Monitoring and Control Systems



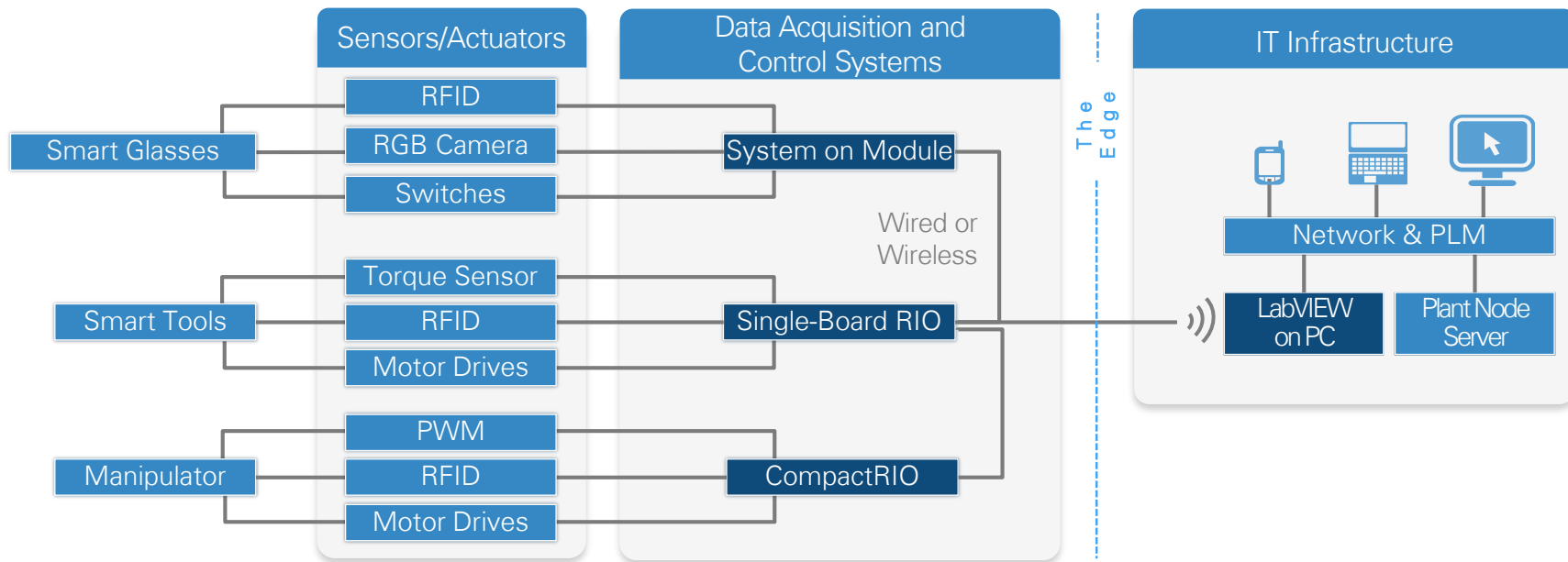
End-to-End Industrial IoT Solution

Connect to the Enterprise, Internet, and Cloud



End-to-End Industrial IoT Solution

Factory of the Future: Factory-Wide Online Monitoring and Control



Airbus Factory of the Future

400,000+ Hole Locations

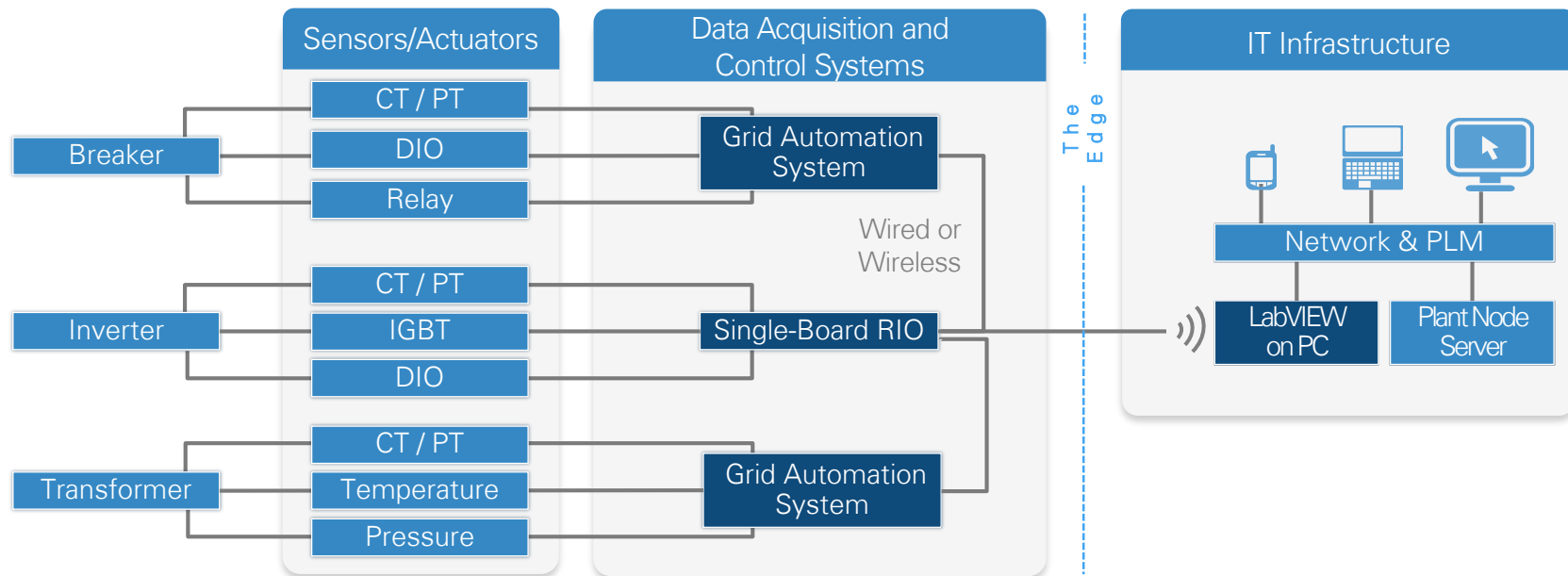
1,000+ Tightening Tools

Increase Quality Assurance



End-to-End Industrial IoT Solution

Grid of the Future: Microgrids with Independent Demand Response



National Grid UK Smart Grid

110 Networked Systems

26 Portable Systems

Monitoring 10,000 km of
Overhead Lines



Common Requirements of IIoT Systems



Computation

"Thinking"
Processing
Analytics
Decision Making



Connectivity

To IO
To the Enterprise
To the Cloud
To other "Things"



Control

Act, Do
Motors, Drives,
Relays, Actuators

Technical and Business Challenges

System Integration Performance Debugging

Life Cycle Management Security Cloud Integration Life Cycle

Synchronization Closed-Loop Control Data Storage

Personnel Networking System Management Analytics

Latency Time to Solution ROI

Simulation Bus Bandwidth Interoperability

Quality of Service "Brown Field" Integration

Software Development Challenges in the IIoT

Tools

Math (.m file script)

Simulation (Hybrid)

User Interface (HTML)

FPGA (VHDL, Verilog)

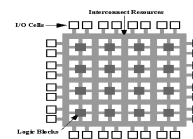
Host Control (C, C++, .NET)

DSP (Fixed pt C, Assembly)

H/W Driver (C, Assembly)

System Debug

Targets



FPGAs



DSPs



**Multicore
Processors**

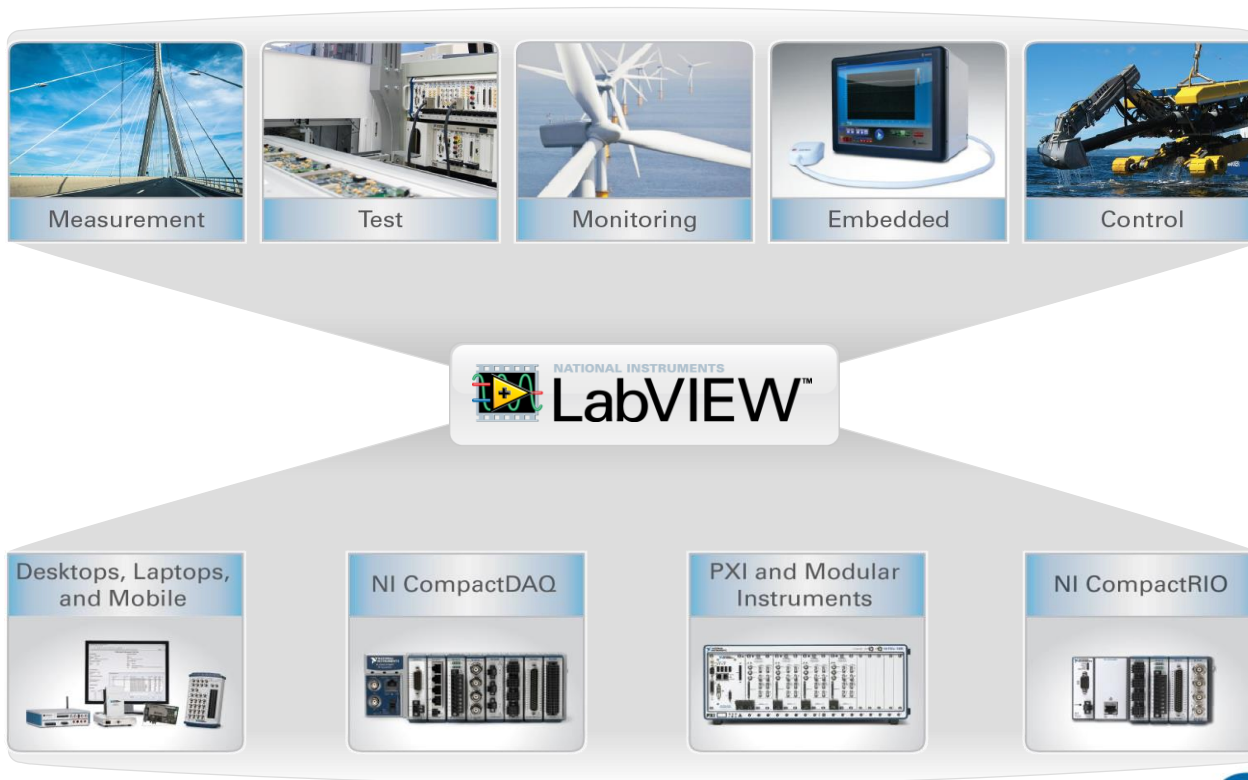
Long learning curves
Limited reuse
Need for “specialists”



Increased costs
Increased time to result

So How Do We Meet These Requirements
And Overcome These Challenges?

Platform-Based Approach

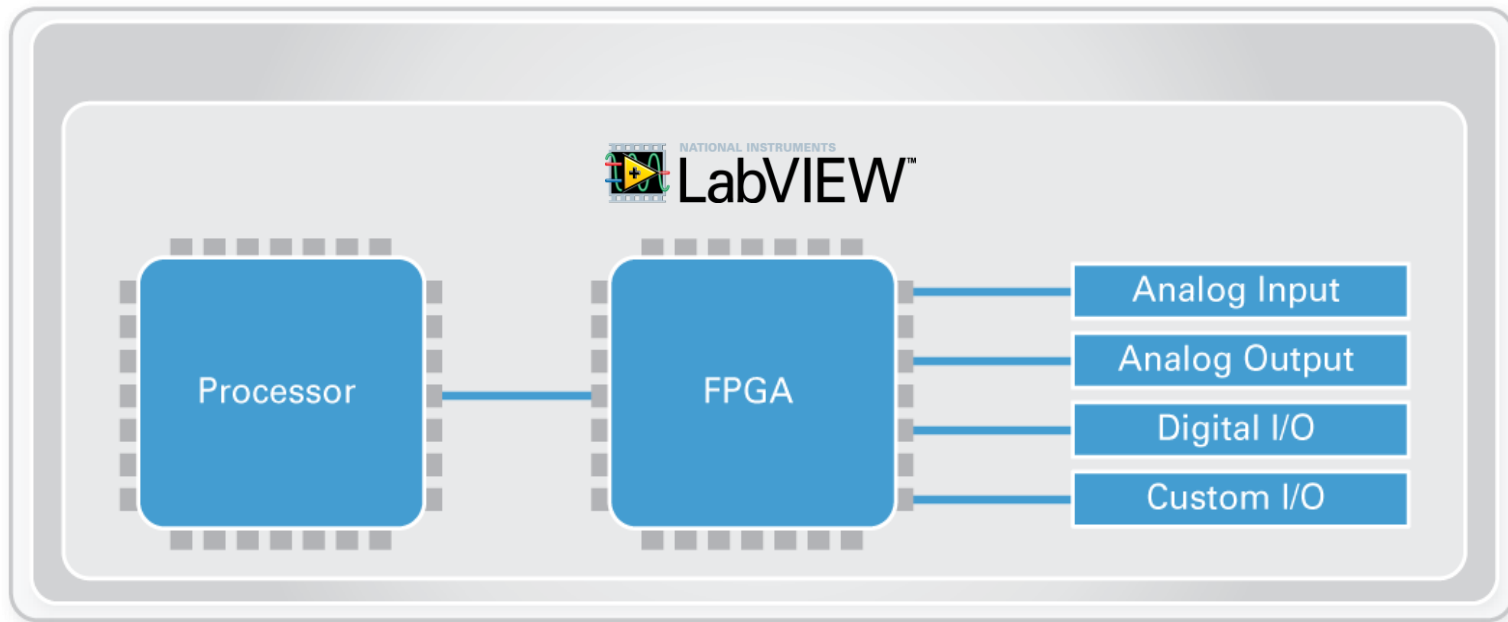


Elements of a Platform-Based Approach

- Off the shelf, yet customizable
- Scalable, modular, and extensible – adapt and evolve through software
- Out-of-the-box integration of hardware and software
- Consistent software toolchain across:
 - Applications: test, measurement, design, control
 - Design phases: simulation, modeling, design, validation, deployment
 - Hardware platforms: CompactDAQ, CompactRIO, PXI
 - Programming Languages: C/C++, IEC-61131-3, .m, G dataflow
- A community and ecosystem of IP, add-ons, and toolkits

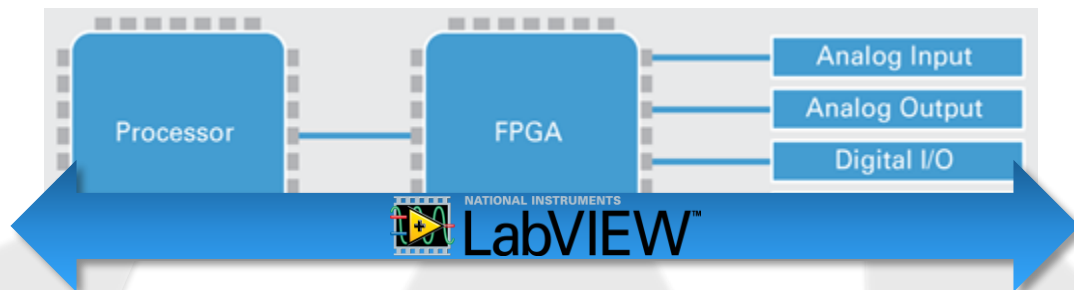
The LabVIEW RIO Architecture:

The Foundation for Innovation in the IIoT



The LabVIEW RIO Architecture:

Ideal for the IIoT



Computation

- Real-Time Analytics
- LabVIEW Math & Analysis Libraries
- Algorithms, Decision making

Connectivity

- Data Transfer Mechanisms
- Network Interface

Computation

- Signal Processing
- Data Reduction

Connectivity

- Custom Timing, Triggering and Synchronization
- Custom Protocols

Control

- Fast, Deterministic, Closed-Loop Control (MHz rates)
- Safety, reliability

Connectivity

- Any Sensor
- Any Protocol
- Industrially Rated
- Signal Conditioning
- Cameras, Drives, Motors, Actuators

Real-Time Operating Systems and the Linux Ecosystem



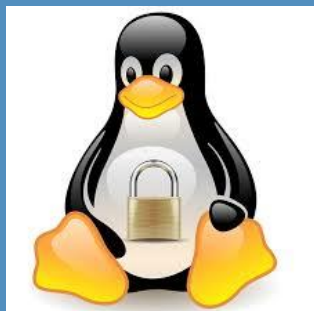
Language

G / Dataflow
C / C++
IEC 61131-3
.m



Database

Raima
MySQL
SQLite
MongoDB
CouchDB



OpenVPN
IP Tables
System Logging
fail2ban
denyhost

Policies
Authentication



Code
Re-use

C/C++
Shell scripting
Python
Ruby
Perl

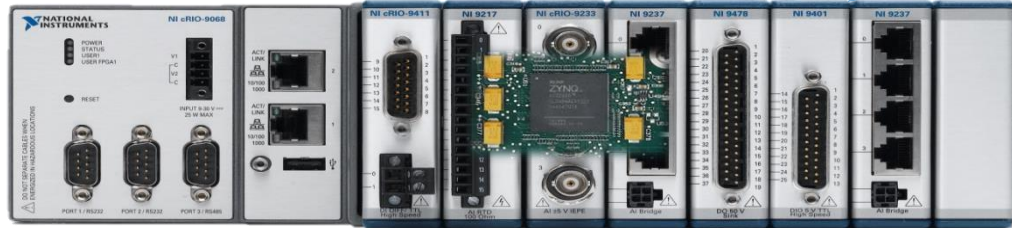
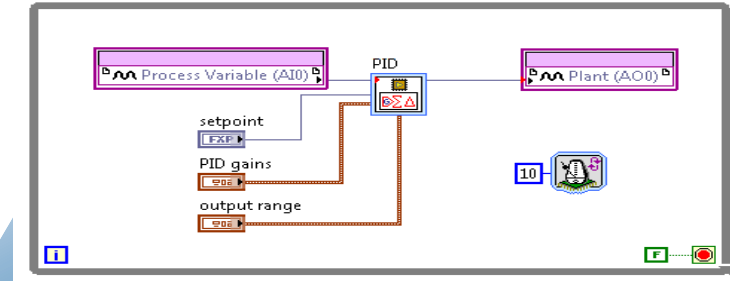


Connectivity

Isshd
IPv6
SNMP
NTP
netstat

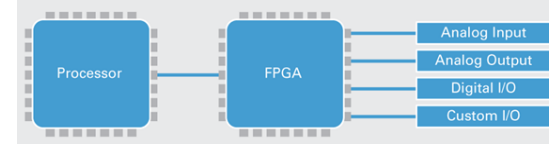
LabVIEW FPGA Module

- Use LabVIEW to design *hardware*, without VHDL experience
- Offload the most critical elements of your application
 - High speed control
 - Inline signal/image processing
 - Custom protocols
 - Custom timing, triggering, and
 - Fast stimulus/response testing



LV FPGA vs VHDL slide

LabVIEW RIO Architecture Products



Single-Board RIO



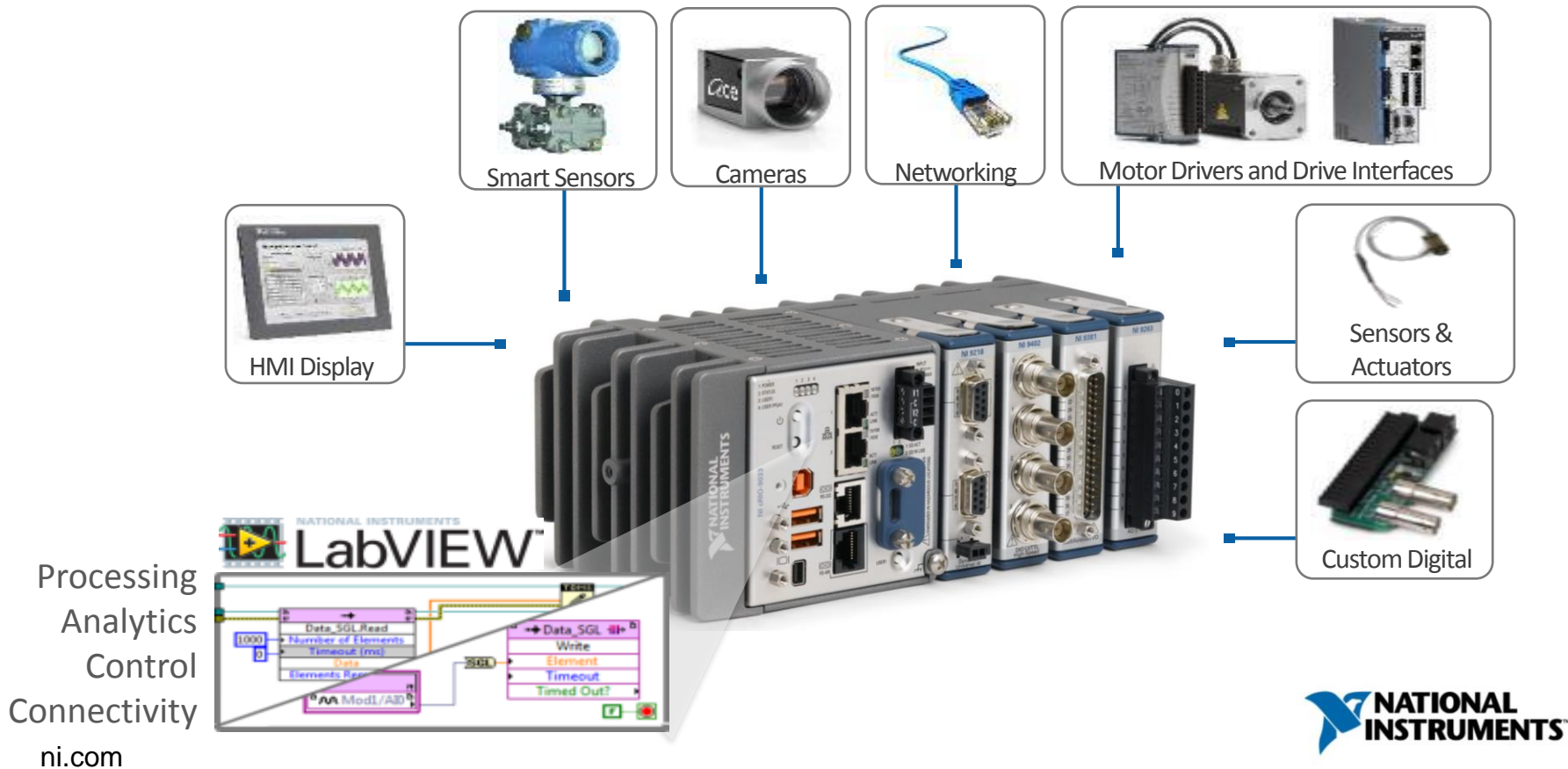
CompactRIO



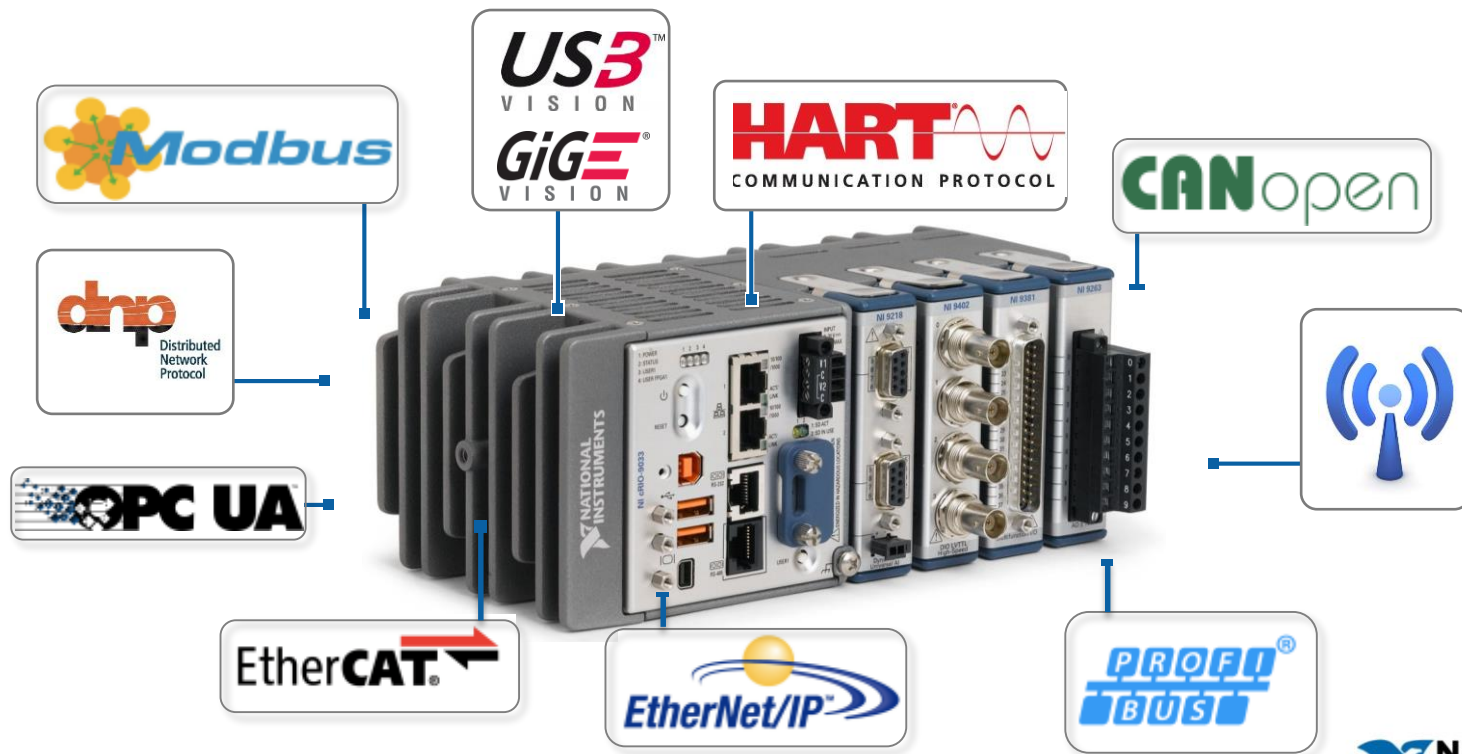
FlexRIO



Intelligent Edge Device for the Industrial Internet

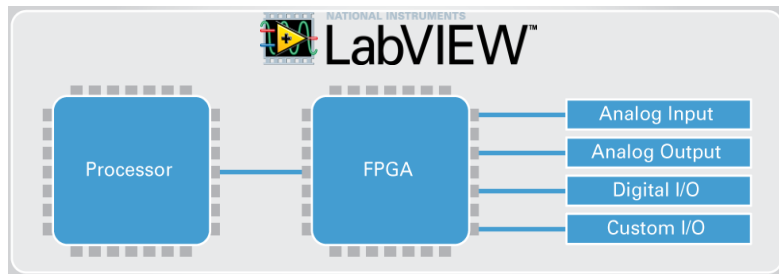


Industrial Gateway Capabilities



Innovate with a Platform for the IIoT

- Eliminate the need to start from scratch
- Satisfy the computation, connectivity, and control requirements for Industrial IoT applications
- Meet changing requirements over time with flexible, scalable, and field-programmable products
- Choose from a variety of high-quality form factors, price points, and performance options
- Leverage a consistent software environment for
 - Programming every element of the system
 - Simulating, modeling, prototyping, development, and deployment
 - Performing edge and end-to-end analytics
- Integrate with existing “brown field” systems



Stay Connected During and After NIDays



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