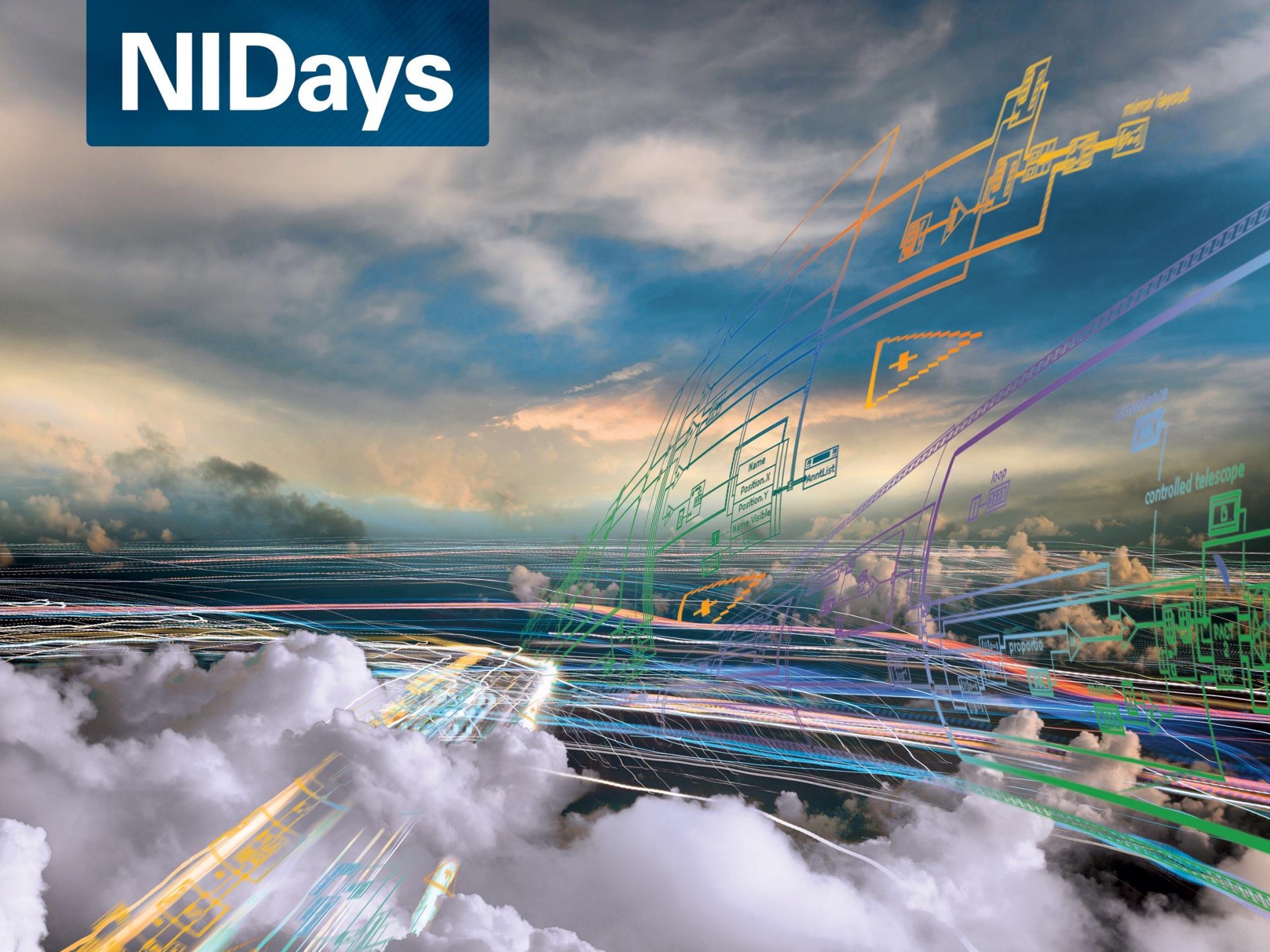


NIDays





Newest Controllers for Industrial Automation

Agenda

- Introduction to RIO Architecture
- Simplify the Systems with New High Performance cRIO



- First NI System on Module – sbRIO-9651



There Are Various Requirements

Monitoring & Low Speed Control Applications



Environmental Monitoring



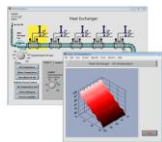
Mobile Robots



Medical Device Control



Special Purpose Machines



Process Control



OEM

Rugged Systems with Control



In-Vehicle Logging



Machine Condition Monitoring



Industrial Machine Control



Pressure Pumping Applications



Structural Monitoring

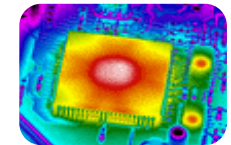


Power Monitoring and Control

High Performance & Control Applications



Multi Axis Motion Control



Machine Vision



ECU Prototyping/HIL



Power Distribution and Control

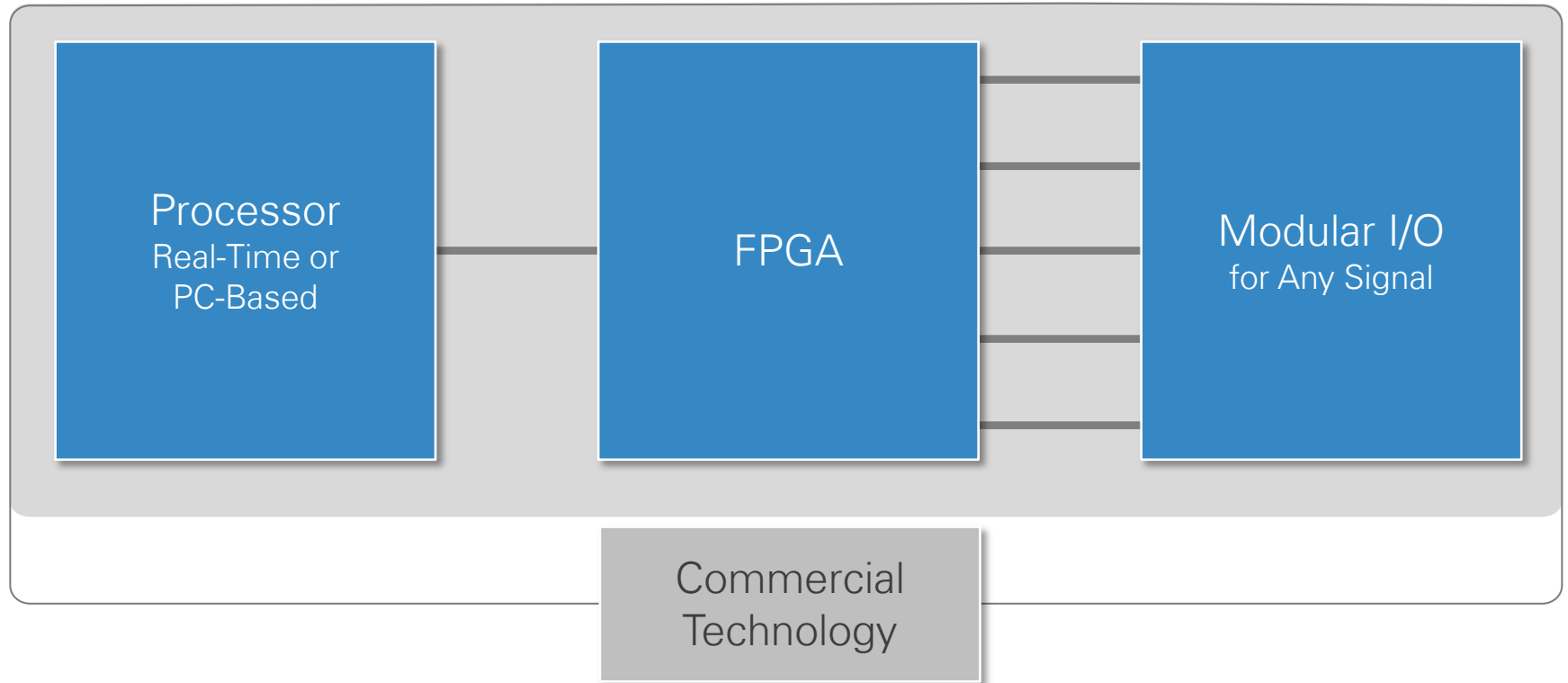


Turbine Control



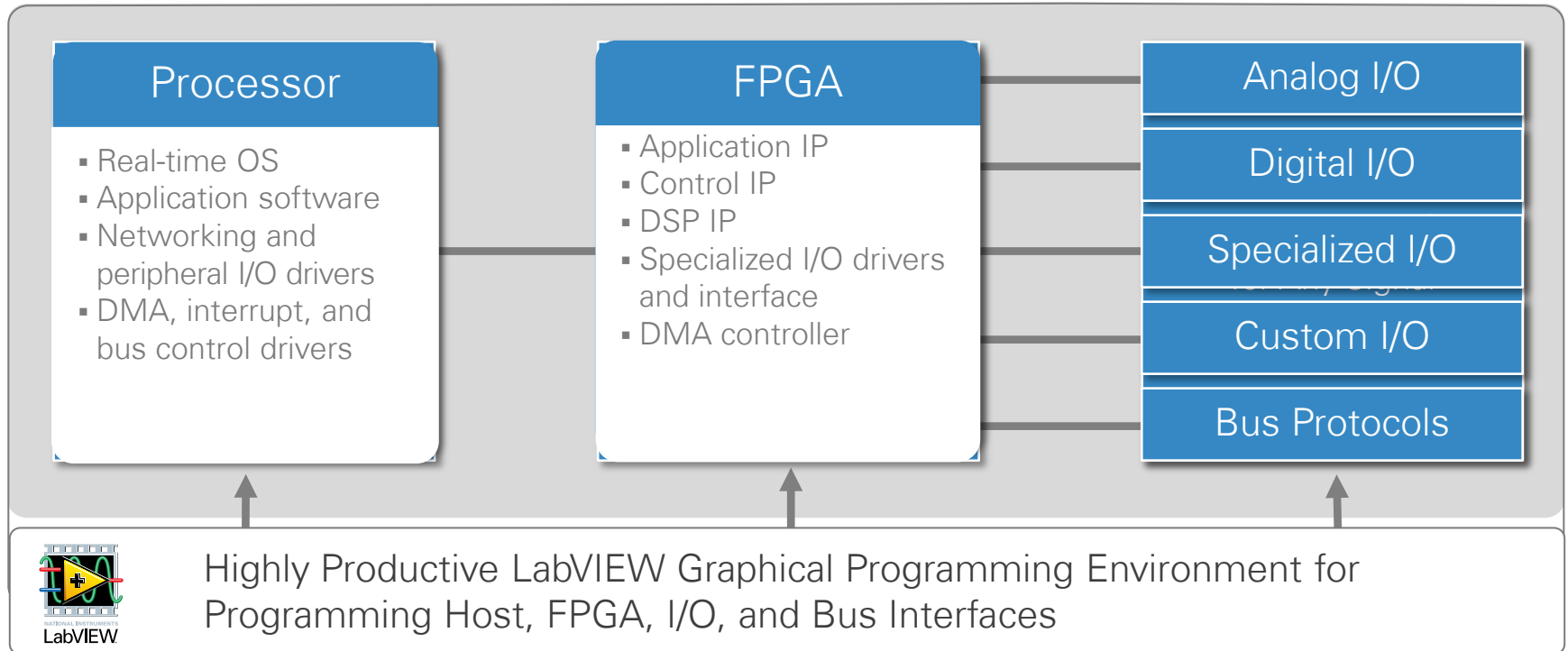
Big Physics

Reconfigurable I/O (RIO) Architecture

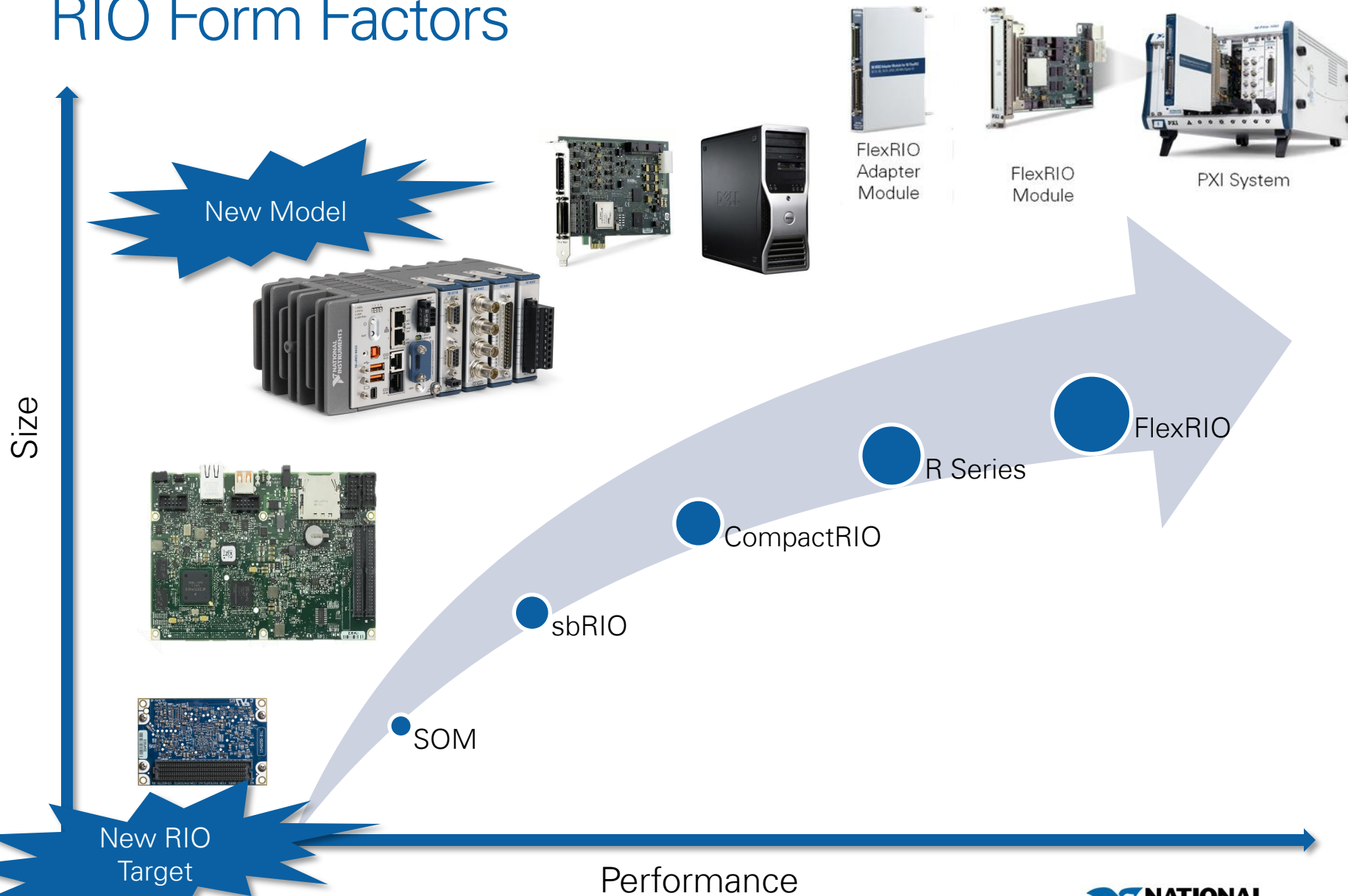


Reconfigurable I/O (RIO) Architecture

We call this the LabVIEW RIO Architecture.



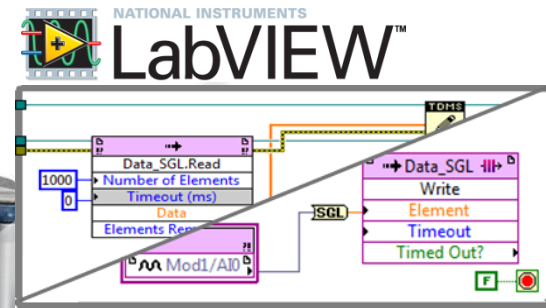
RIO Form Factors



Simplify System Complexity with New cRIO



New Performance CompactRIO



NI LabVIEW System Design

- Program with LabVIEW Real-Time and LabVIEW FPGA modules
- Quickly port existing LabVIEW applications

High Throughput and Performance

- Dual-Core Intel Atom 1.33 GHz processor
- Xilinx Kintex-7 FPGAs with up to 325k logic cells
- 16 DMA FIFO channels for data streaming

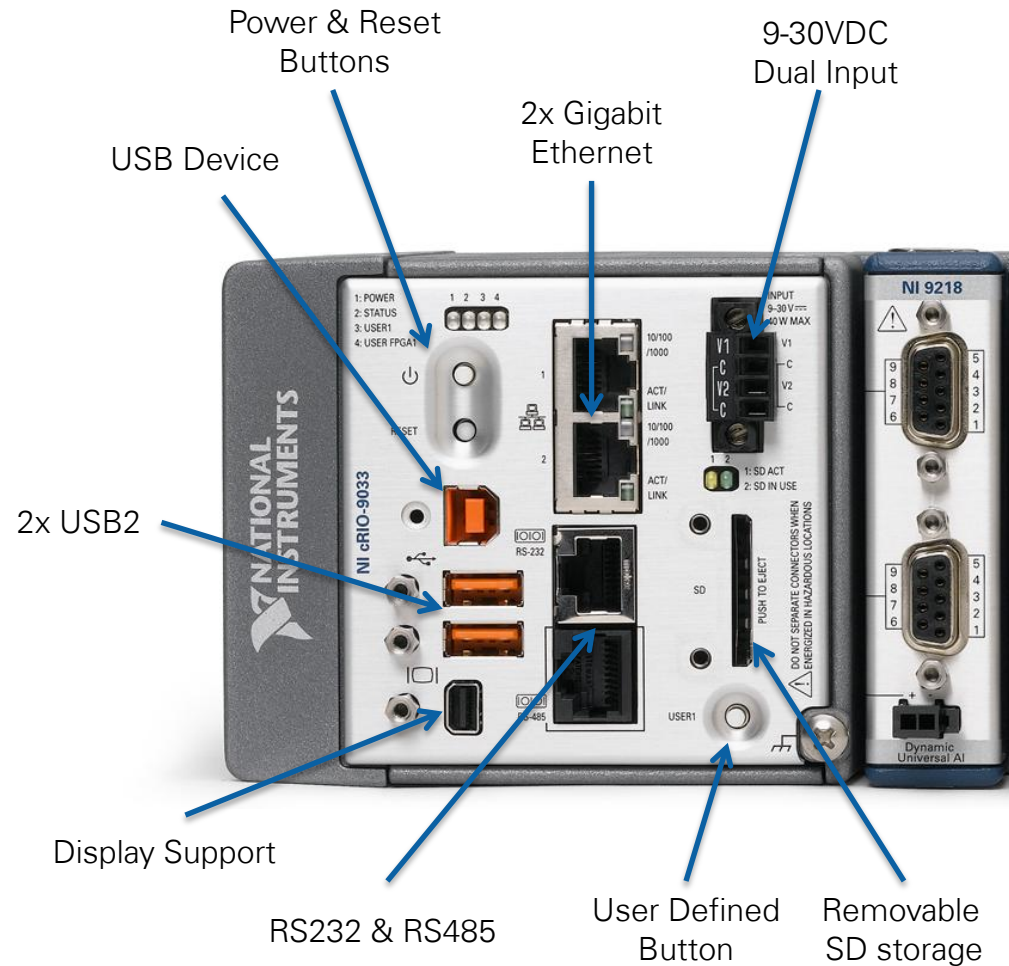
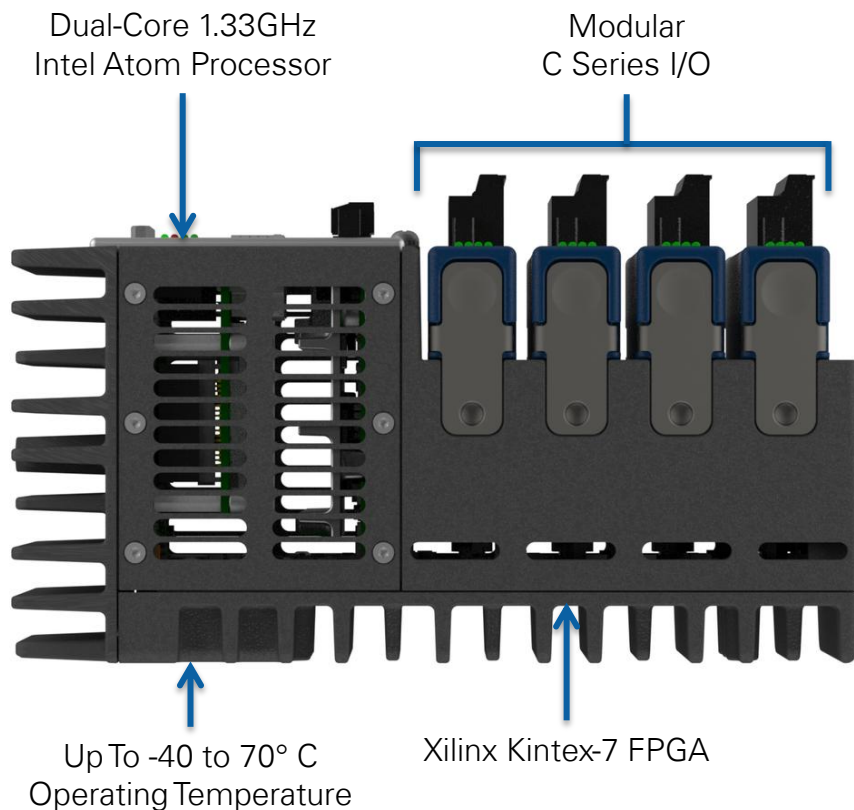
Simplify System Complexity

- Embedded UI driven by NI Linux Real-Time
- Integrate vision with FPGA co-processing
- Removable SDHC data storage

Community and Code Reuse

- NI Linux Real-Time Operating System
- Integrate existing applications and libraries
- Develop, debug, and deploy C/C++ code

New Performance CompactRIO At-A-Glance



Electron Beam Welding Machine

Description

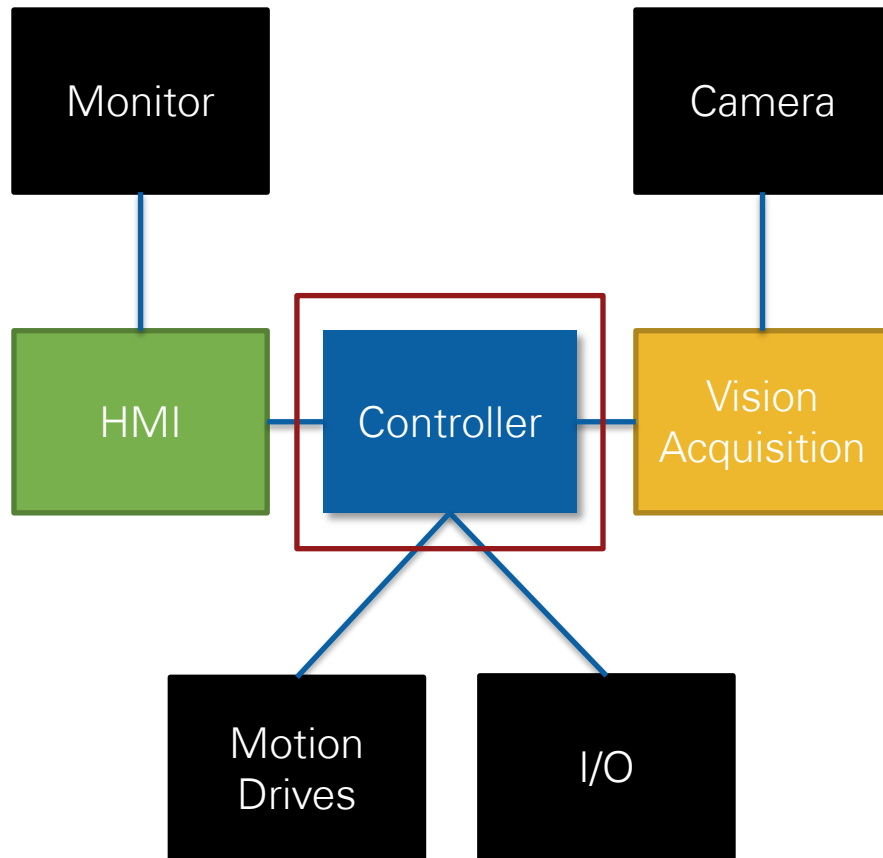
- Electron beam control
- Multiple axis of motion
- Vision guidance
- Local HMI

Challenges

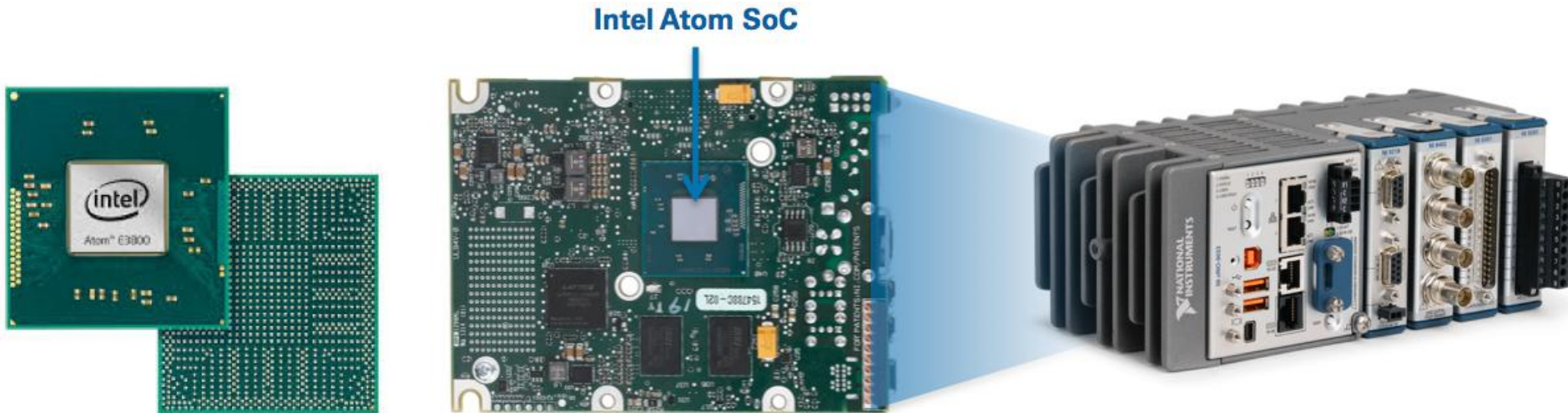
- Increasingly complex control algorithms
- Complicated subsystem integration
- Additional design tools
- Time-to-market pressures



Electron Beam Welding Machine



Intel Atom Dual-Core Processor

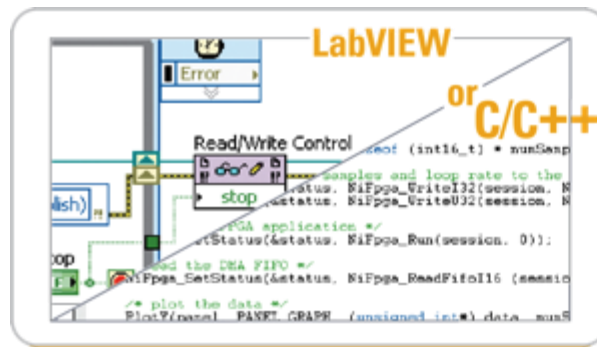
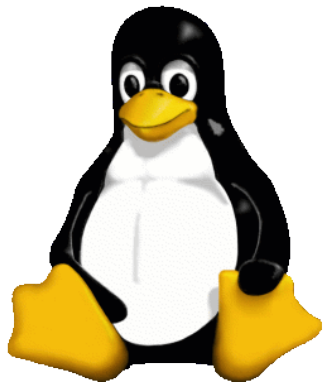


- Cutting edge Intel system-on-chip (SoC) with Silvermont microarchitecture
- High performance, low power, compact size and industrial temperature range
- Rich array of peripherals including GPU, PCIe, and USB (host and device)

Core Speed	1.33 GHz
Cores	2
L2 Cache	1 MB
Graphics Frequency	533 MHz
Memory	64-bit DDR3L-1066
Memory Density	1 GB or 2 GB

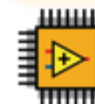
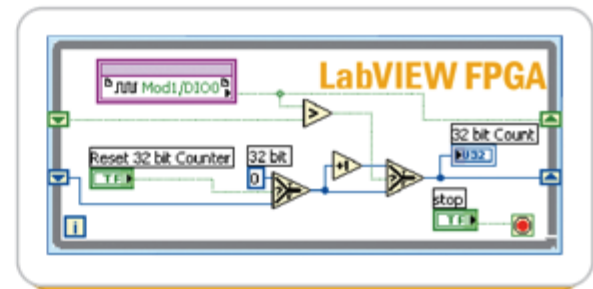
Support for NI Linux Real-Time OS

- Enjoy the **flexibility** of Linux, with the **determinism and reliability** of a real-time operating system.
- **Reuse** C/C++ code in or alongside LabVIEW Real-Time built applications on the latest CompactRIO controllers

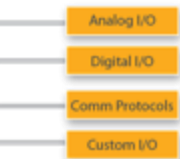


Real-Time
Processor

High-Speed Bus

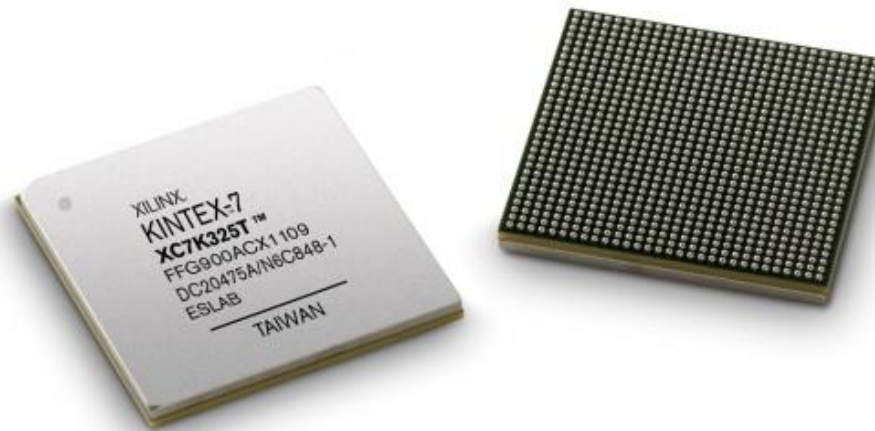


FPGA



Modular I/O

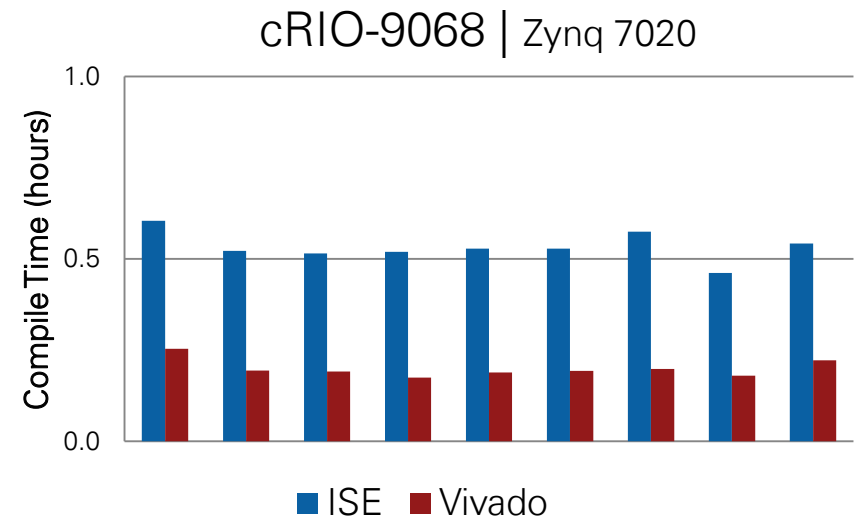
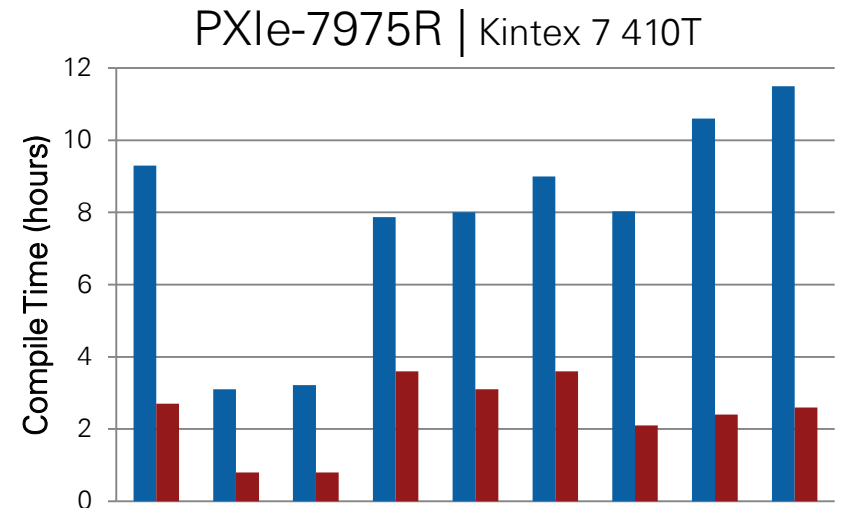
Xilinx Kintex-7 Field Programmable Gate Array



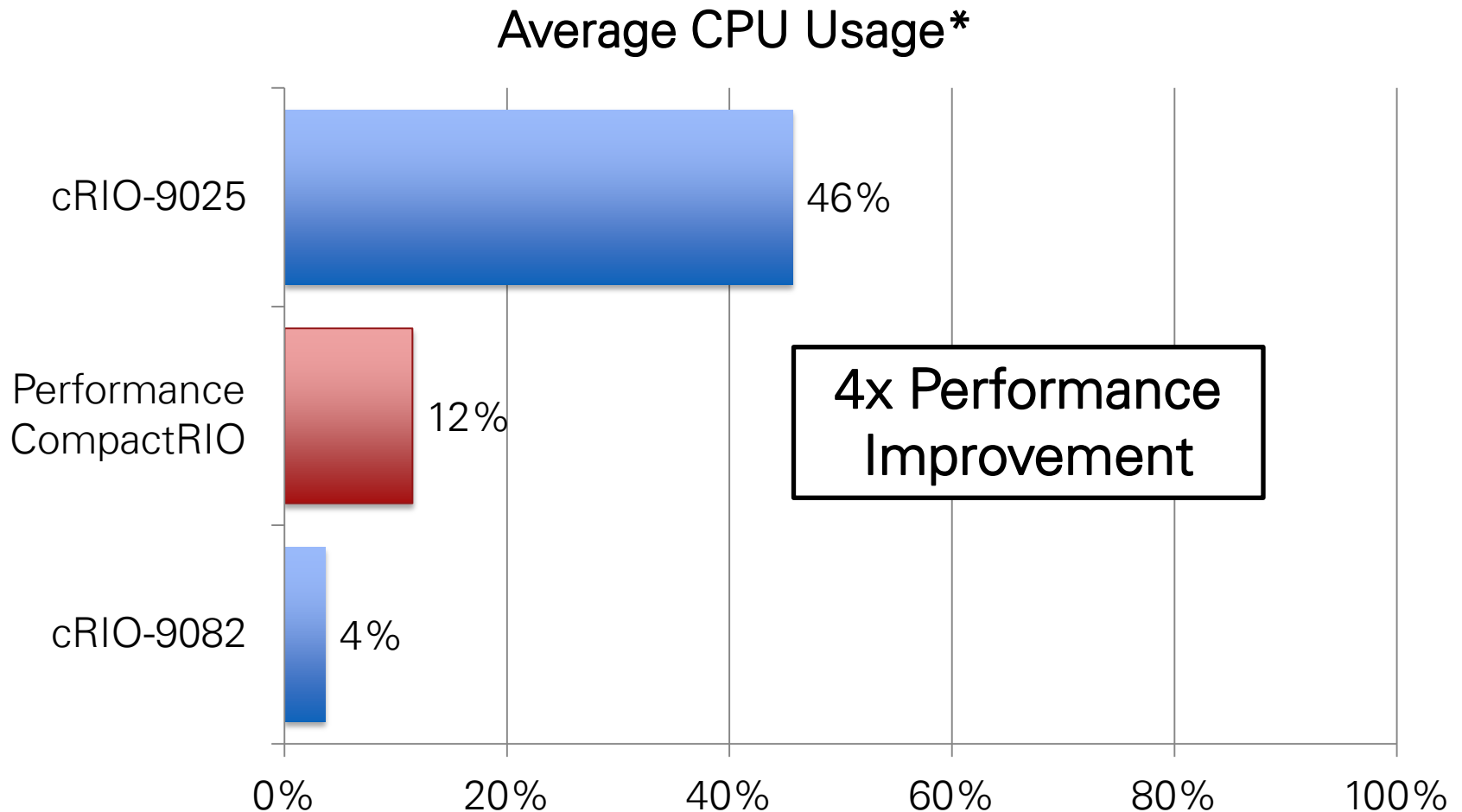
- Almost 3X more CLBs and more than 13X more DSP slices than existing CompactRIO systems
 - Result: Process more channels, develop more complex algorithms, and perform more tasks in FPGA than ever before!
- 16 DMA FIFOs with 250MB/s aggregate streaming bandwidth in both directions
 - Result: You have the freedom to transfer data the way you want.

2-5x Reduction in Compilation Times with Vivado

- LabVIEW FPGA 2014 includes Xilinx Vivado compilation tools for Kintex-7 FPGAs, offering the following benefits:
 - Reliable timing closures
 - Improved resource utilization
 - 2-5x reduction in compilation times

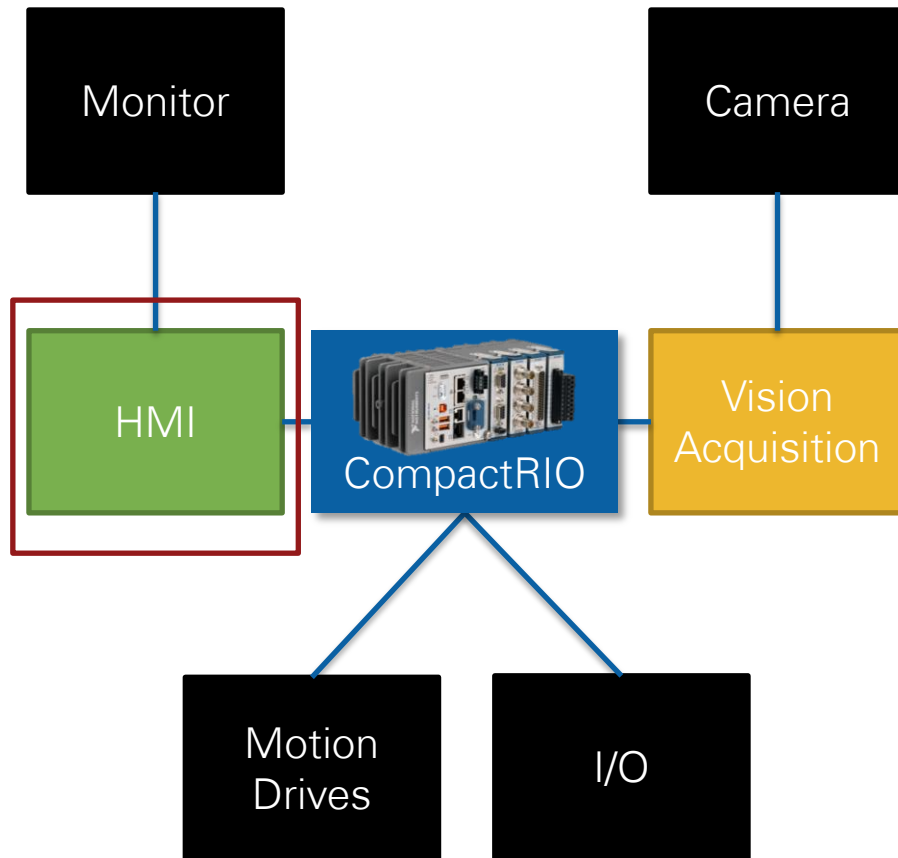


Complex Control Application Benchmark



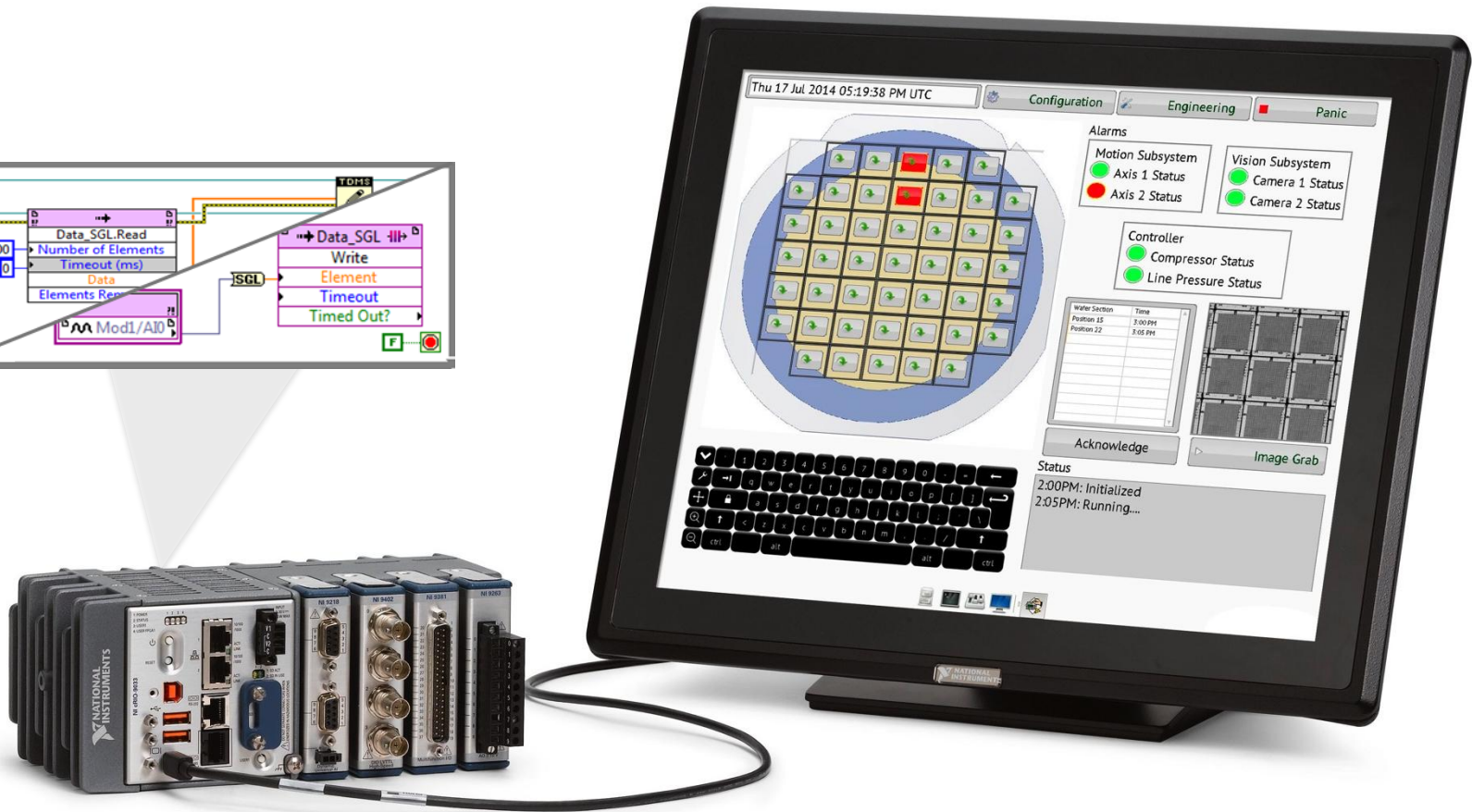
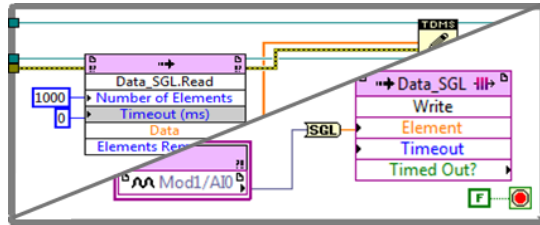
*Control loop rate of 500Hz

Electron Beam Welding Machine

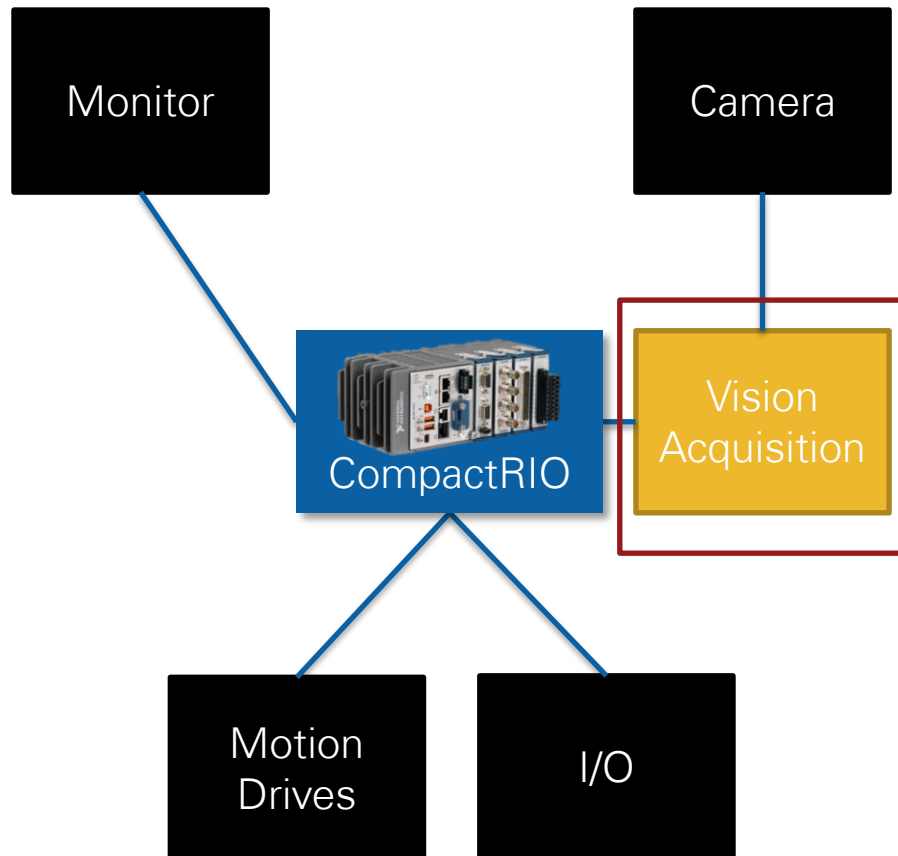


LabVIEW 2014 Real-Time with Embedded UI

Simplify system complexity by implementing a local HMI on CompactRIO

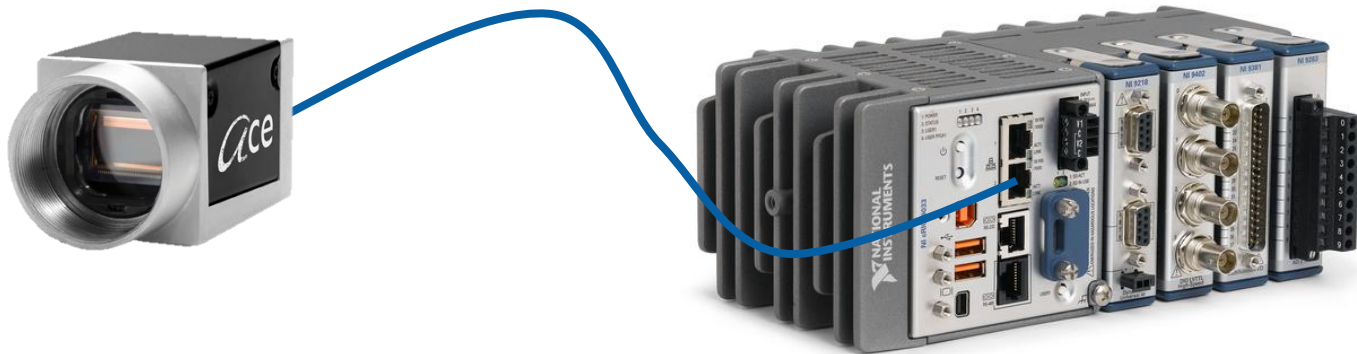


Electron Beam Welding Machine



Implement Local Vision Acquisition

- Connect up to 4 cameras at once
 - GigE Vision provides higher bandwidth and longer cable lengths
 - USB3 Vision through USB 2.0 ports uses less processor resources
- Significant processing power with Intel Atom dual-core processor
 - Use Vision Development module to create advanced image processing algorithms
 - Make control decisions directly from image processing results



Vision Development Module includes Powerful IP

Proven Image Technology

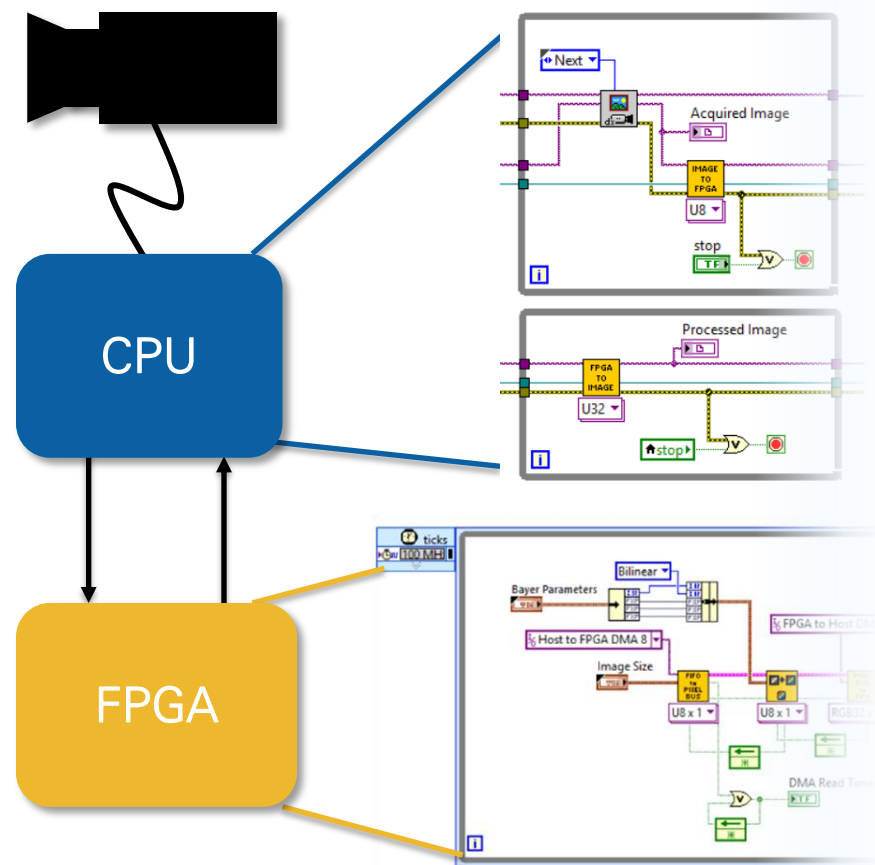
Leverage over **50 FPGA image processing functions** to design high performance vision systems and pass images between CPU and FPGA

Improved Usability

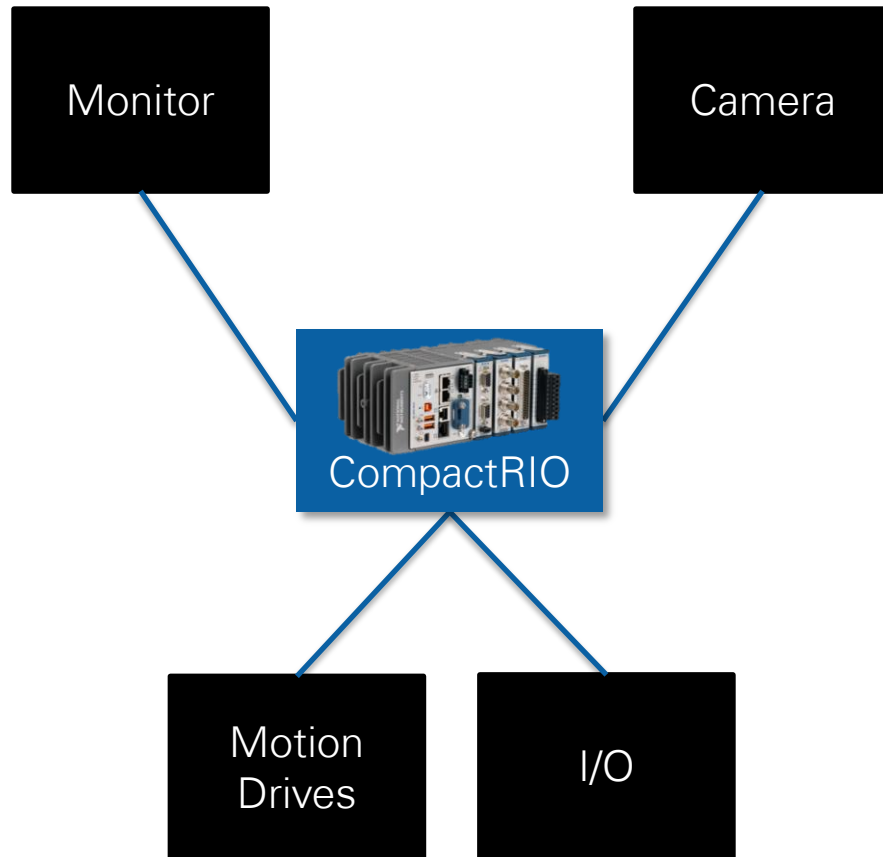
Prototype and generate code using **Vision Assistant** to design high performance vision systems

Find Data Easier

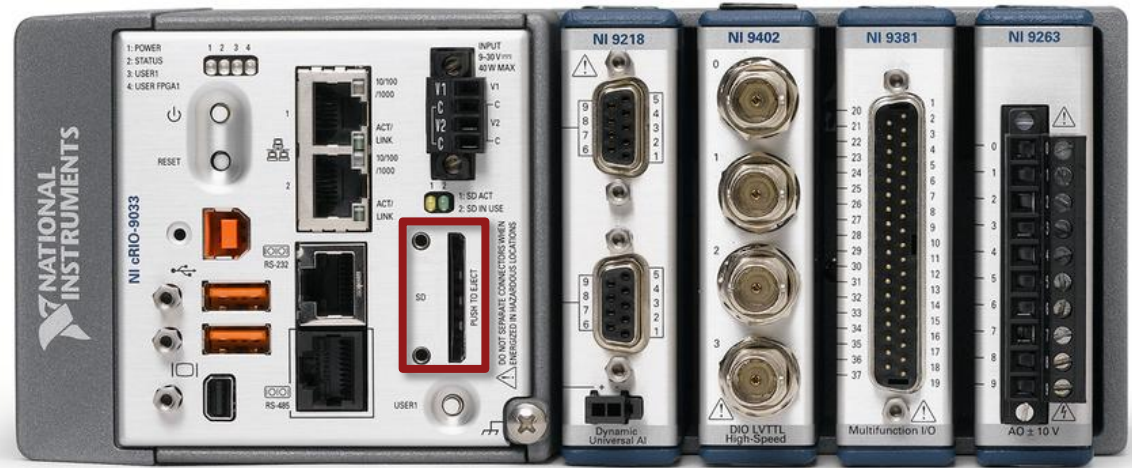
Automatically search an entire image for **1D Barcodes** and perform decoding



Electron Beam Welding Machine



Removable SD Card Storage



- Up to 32GB removable SD or SDHC cards supported
- 16GB and 32GB NI validated cards available at release
- USER1 button configurable to allow online SD card replacement
- NI SD card cover can be tethered to enclosure to prevent loss

Semiconductor Pick And Place

Application: Semiconductor pick and place machine used to package silicon die

Goal: Consolidate subsystems to reduce cost and complexity and improve motion performance

Requirements

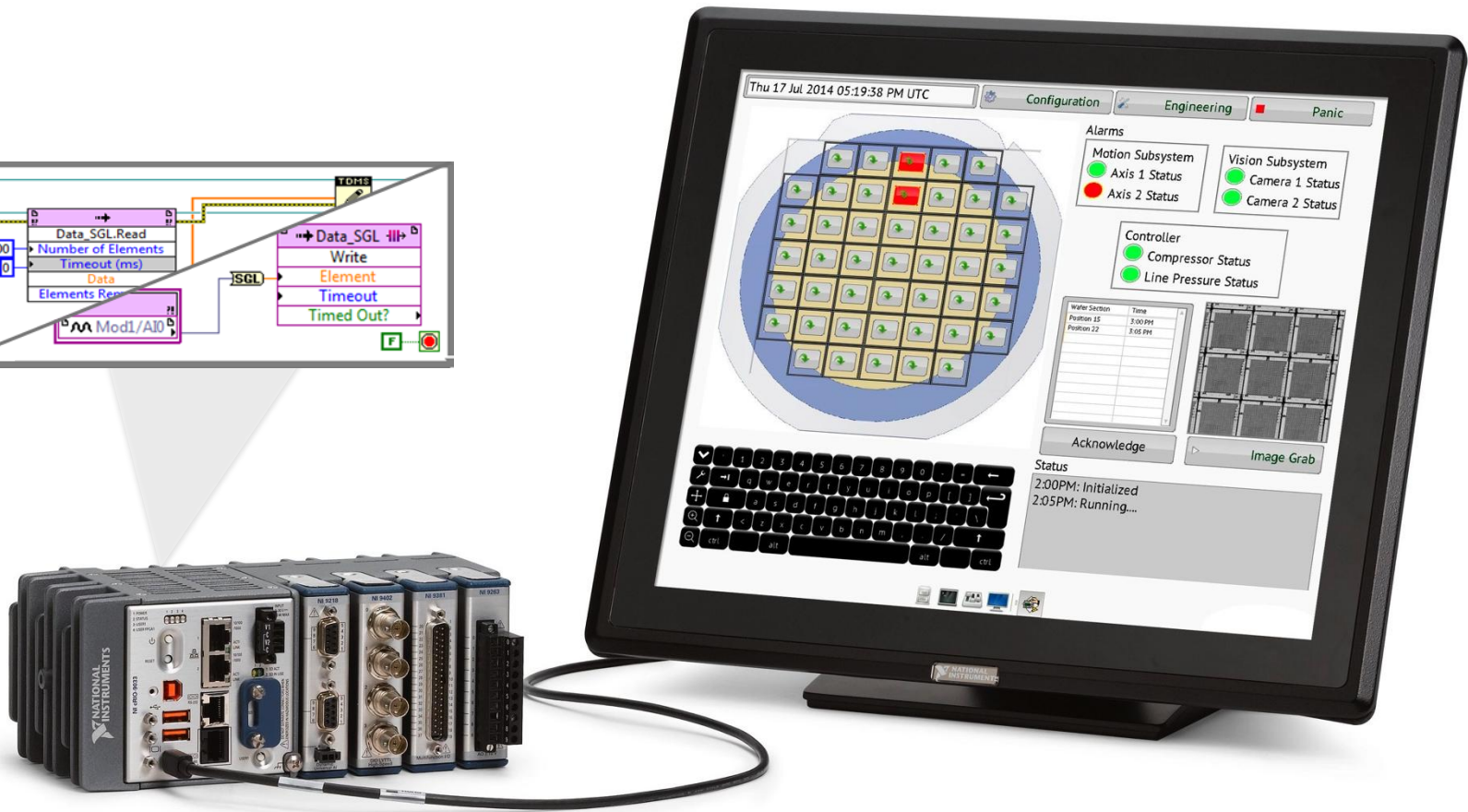
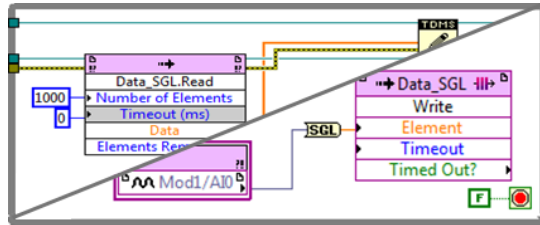
- Integrate 2 cameras for vision guidance
- Precisely control 8 axis of motion
- Implement a local HMI used for startup, calibration, and system status

Result: “By using the new CompactRIO controller in our semiconductor pick-and-place machine, we were able to integrate our local HMI and vision components into one device. This not only reduced our system costs, but it also reduced our development time.” – **Kennes Wang, Master Machinery**



Local HMI Demo

Simplify system complexity by implementing a local HMI on CompactRIO



CompactRIO Advisor

CompactRIO Systems Consist of Four Main Components

Hot swappable I/O modules



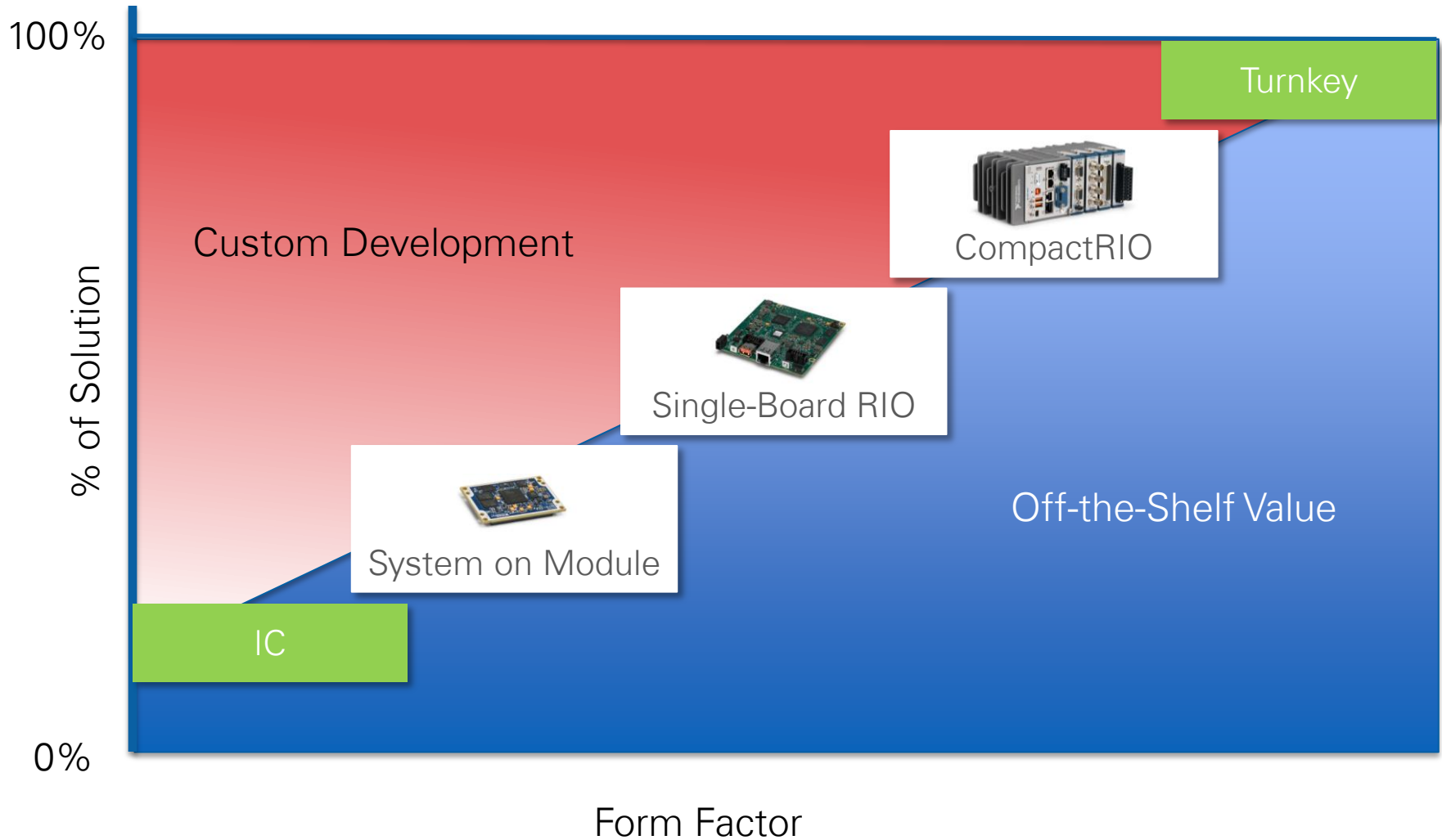
ni.com/advisors

CompactRIO

First NI System on Module (SoM)



LabVIEW RIO Architecture Embedded Targets



Role of a System on Module (SOM)

Embedded System Components:

Operations repeated for each system:

- Processor selection
- Memory
- Storage
- OS
- BSP
- Middleware
- Firmware

Operations different for each system:

- I/O Development
 - Analog/Digital
 - Peripherals
- Application Software
- Mechanical packaging

Role of a System on Module (SOM)

Embedded System Components:

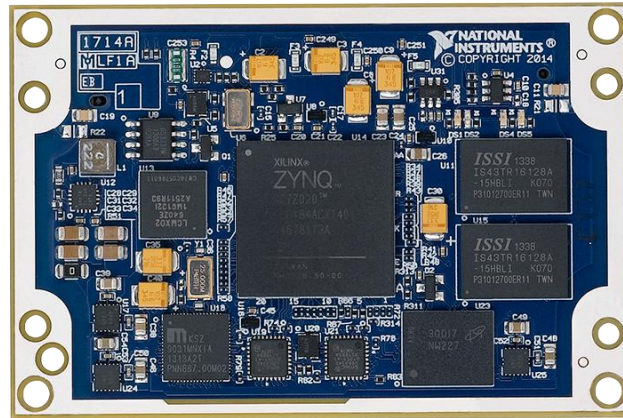
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- I/O Development
 - Analog/Digital
 - Peripherals
- Application Software
- Mechanical packaging

NI SOM Specifications



Processor SoC

Xilinx Zynq-7020
667 MH Dual-Core ARM Cortex-A9
Artix-7 FPGA Fabric

Memory

Nonvolatile: 512 MB
DRAM: 512 MB

Power

Typical Power: 3 W to 5 W

Dedicated Processor I/O

Gigabit Ethernet, USB Host, USB
Host/Device, SDHC, RS-232 (console)

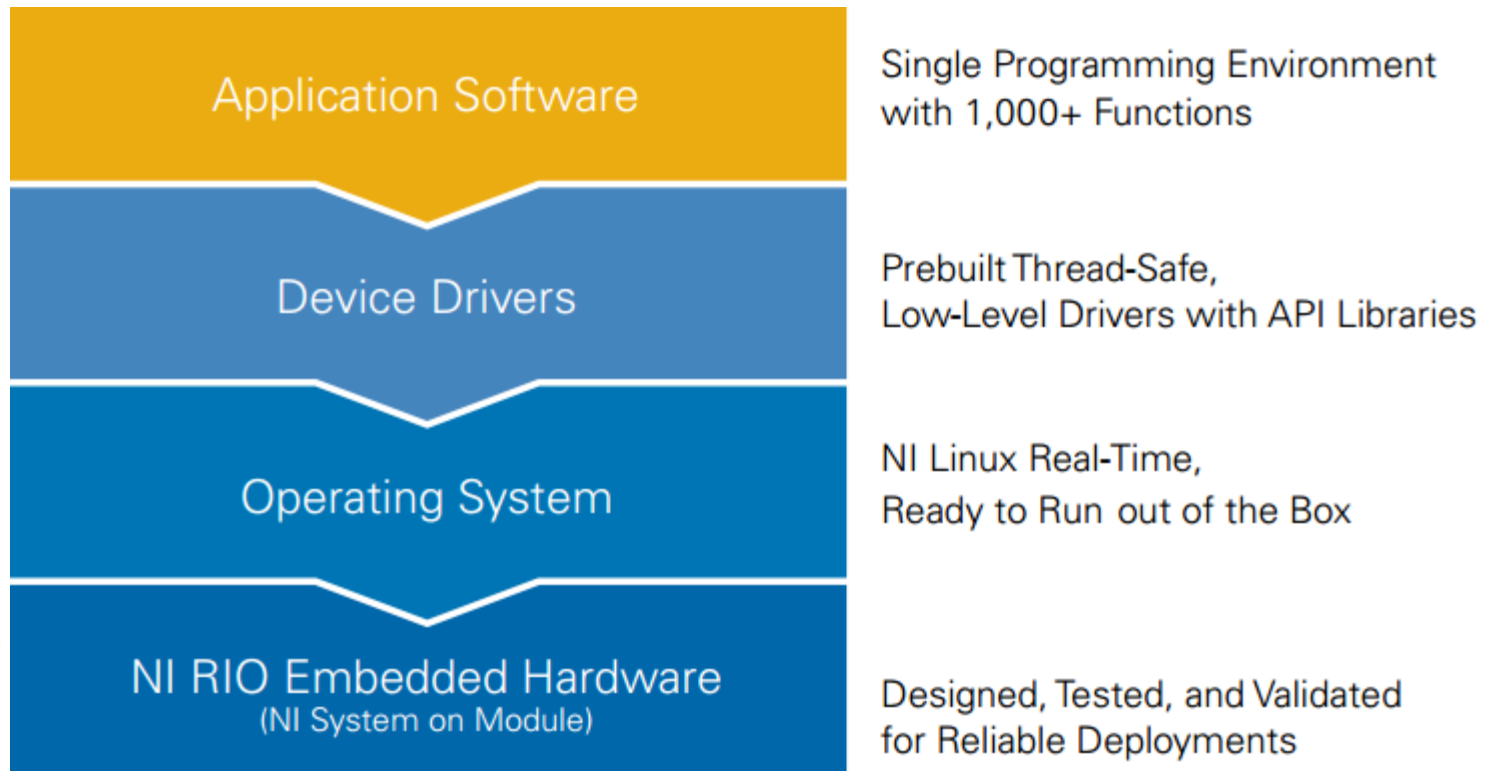
FPGA I/O

160 Single-Ended/72 Differential FPGA I/O
Configurable Peripherals: Gigabit Ethernet,
RS-232 x3, RS-232 x2, CAN x2

Operating Temperature

-40 °C to 85 °C Local Ambient

Integrated, Validated Board Support Package



Developing a Product with the NI SOM



Task

Expertise Required

Developing a Product with the NI SOM



Task

Custom carrier board

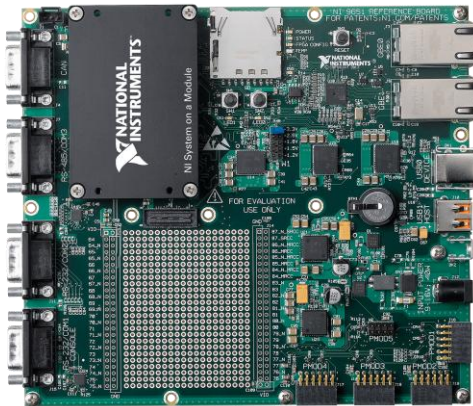


Expertise Required

Electronic Design

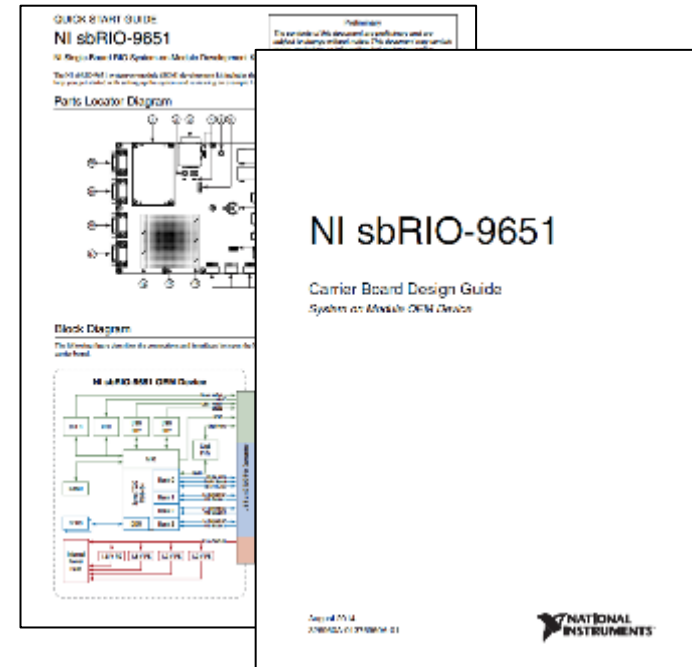
Development Kit

Reference Carrier Board



- Gigabit Ethernet x2
- USB x2
- PMOD x4
- RS-232 x2
- RS-485
- CAN
- SD
- 48 DIO Channels

Design Documentation & Schematics



Power Supply (12 V)



Heat Sink



Standoffs/USB Cable



Developing a Product with the NI SOM

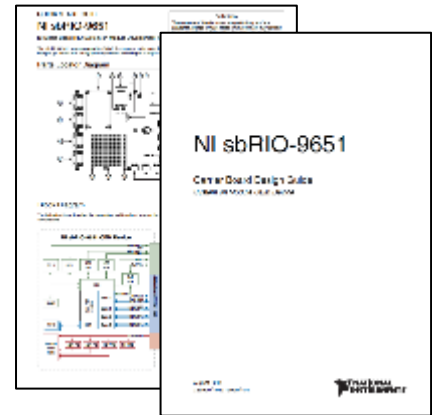
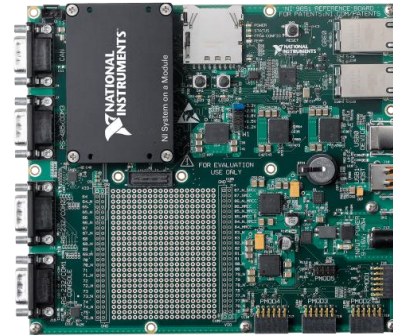


Accelerate Time to Market

Prototype



Deploy



No hardware design

Develop application software

Determine I/O needs

Re-use code

Optimize form factor

Integrate custom I/O



“We developed a first functional prototype for our liver dialysis machine in just seven months using the CompactRIO platform. Using the NI SOM, we estimate that we will save 12 months of development effort for the final product because our application software is already validated.”

- Dr. Bernard Kreymann, CEO and founder of Hepa Wash GmbH

Liver Dialysis | Hepa Wash GmbH

Developing a Product with the NI SOM



<u>Task</u>	<u>Expertise Required</u>
Custom carrier board	Electronic Design
Application software	LabVIEW
Packaging and thermal validation	Mechanical

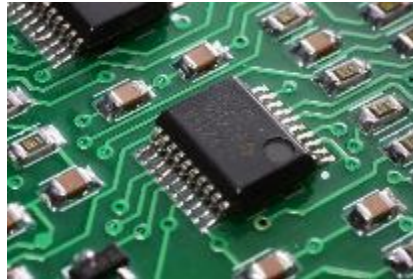
Small Form Factor

About the size of a business card

NI SOM



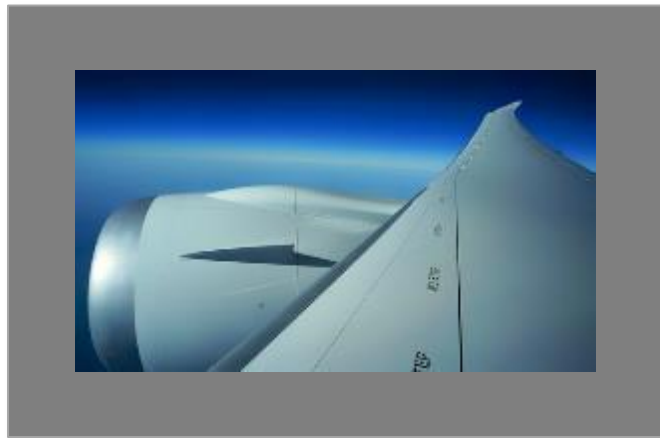
Custom Carrier Board



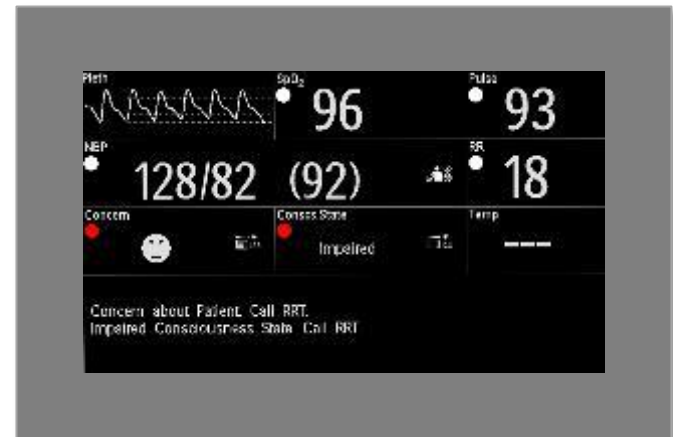
4" Amulet Display



Wearable Device for Manufacturing



Handheld Medical Device





“We estimate that our development costs with the NI SOM are a tenth of the costs of alternative approaches because of the productivity gains of NI’s approach to system design, in particular to NI Linux Real-Time and LabVIEW FPGA.”

- R&D mechatronics technology leader at Airbus

Smart Manufacturing Tools | Airbus

Thank you!

Where to go next?

- Get additional resources on LabVIEW
www.ni.com/labview
- Learn about NI and Data Acquisition
www.ni.com/daq
- Enroll for a instructor-led LabVIEW class
www.ni.com/training
- Attend other free seminars and workshops
<http://serbia.ni.com/dogadjaji>
- Contact our technical consultant and get a free consultation of your project and potential solutions!
Toll-free number: 06 80 204 704

Contact us

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