



NIDays



3rd November 2015 | QEII Conference Centre, London

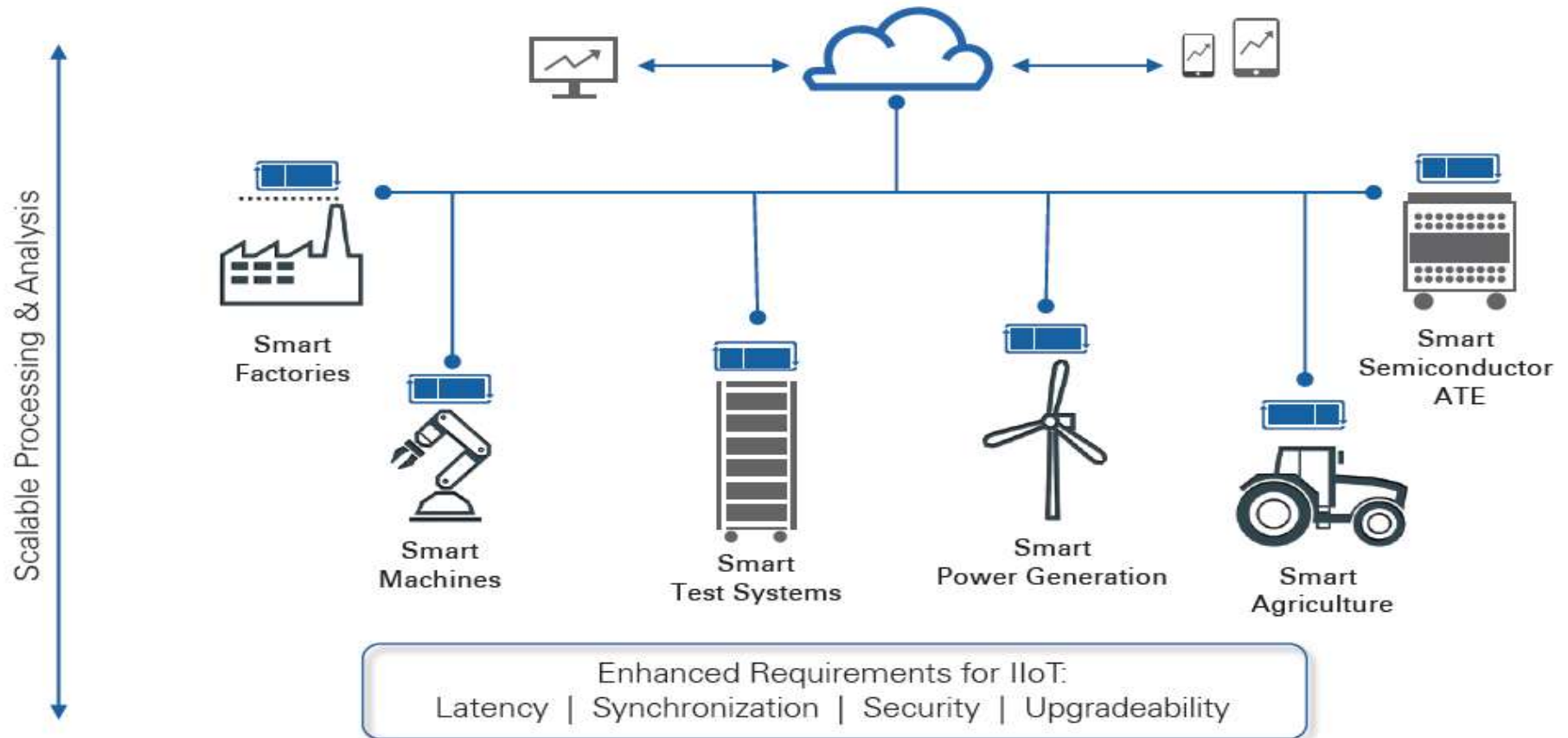


Introducing New Technologies to Enable the Industrial Internet of Things

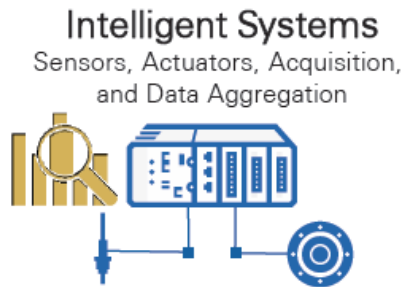
Erik van Hilten

Marketing Engineer for Industrial & Embedded Systems
NIDays 2015

The Industrial Internet of Things



Elements of the Industrial Internet of Things



Intelligent Systems Of Systems

Secure connectivity and
system-to-system communication

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

The LabVIEW RIO Architecture:

Ideal for the IIoT



Computation

- Real-Time Analytics
- LabVIEW Math and Analysis Libraries
- Algorithms, Decision Making

Connectivity

- Data Transfer Mechanisms
- Network Interface

Computation

- Signal Processing
- Data Reduction

Connectivity

- Custom Timing, Triggering, and Synchronization
- Custom Protocols

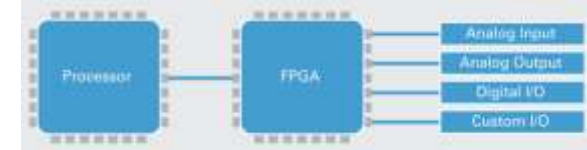
Control

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

Connectivity

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

Embedded Hardware Enabled by the LabVIEW RIO Architecture



Single-Board RIO / SOM



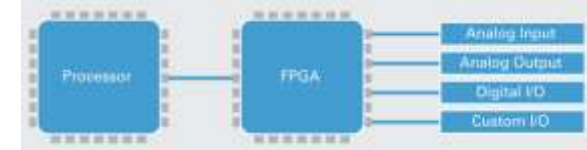
CompactRIO / C Series



R Series / FlexRIO



Embedded Hardware Enabled by the LabVIEW RIO Architecture



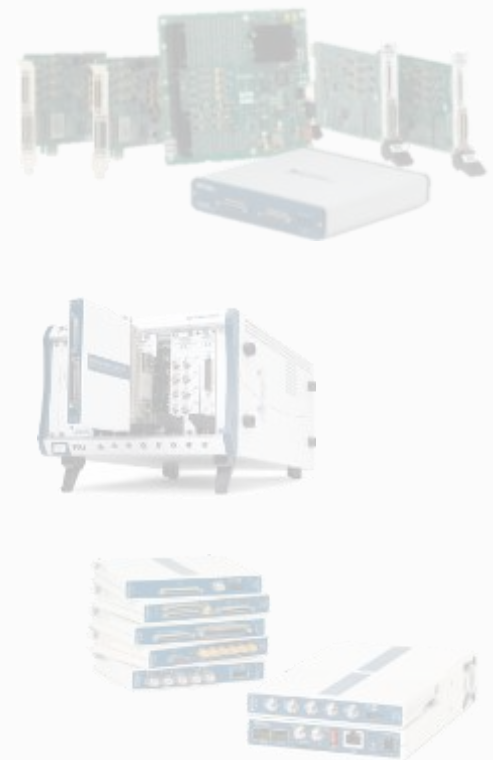
Single-Board RIO / SOM



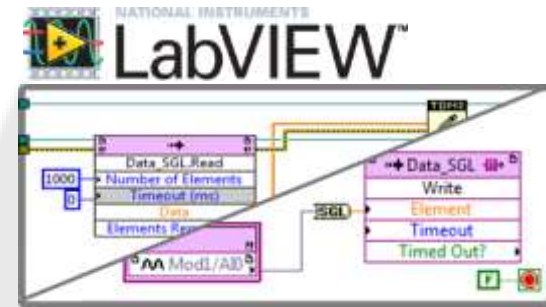
CompactRIO / C Series



R Series / FlexRIO



New Performance CompactRIO



LabVIEW System Design

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

High Throughput and Performance

- Up to a quad-core Intel Atom 1.91 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

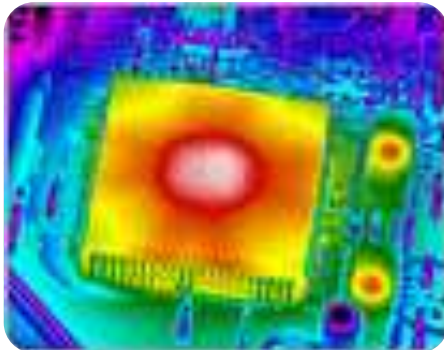
Community and Code Reuse

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

FPGA Accessible DRAM

- Additional temporary storage for large data in FPGA
- 5X faster than accessing main memory via DMA transfers
- 64X larger than FPGA Block RAM
- Use in conjunction with Block RAM

Image Processing



- Process large images
- Use new FPGA IP

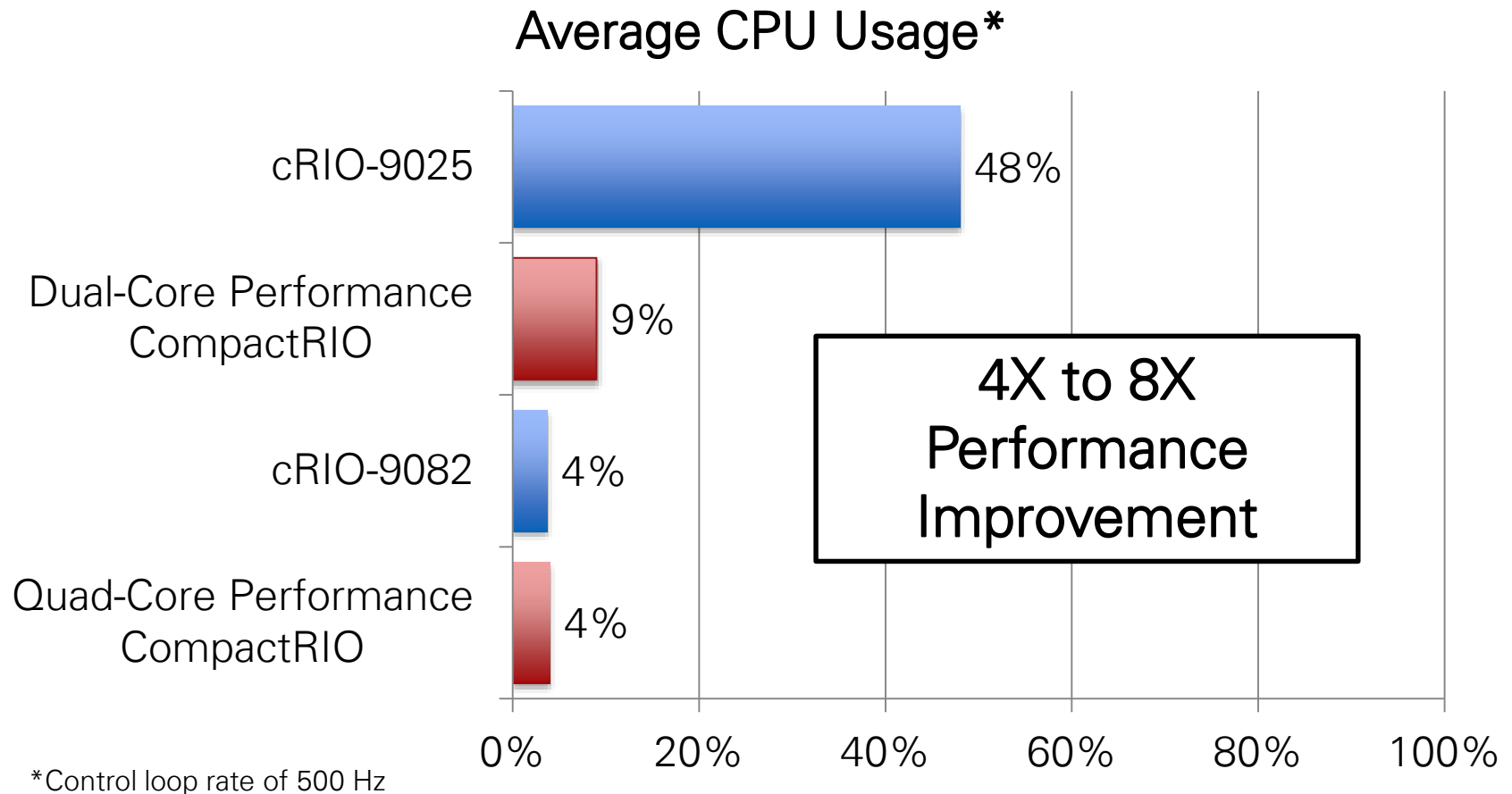
Slow Rotating Machinery



- Store complete rotation data
- Eliminate unnecessary DMA

Complex Control Application Benchmark

Note: Lower CPU utilization is better



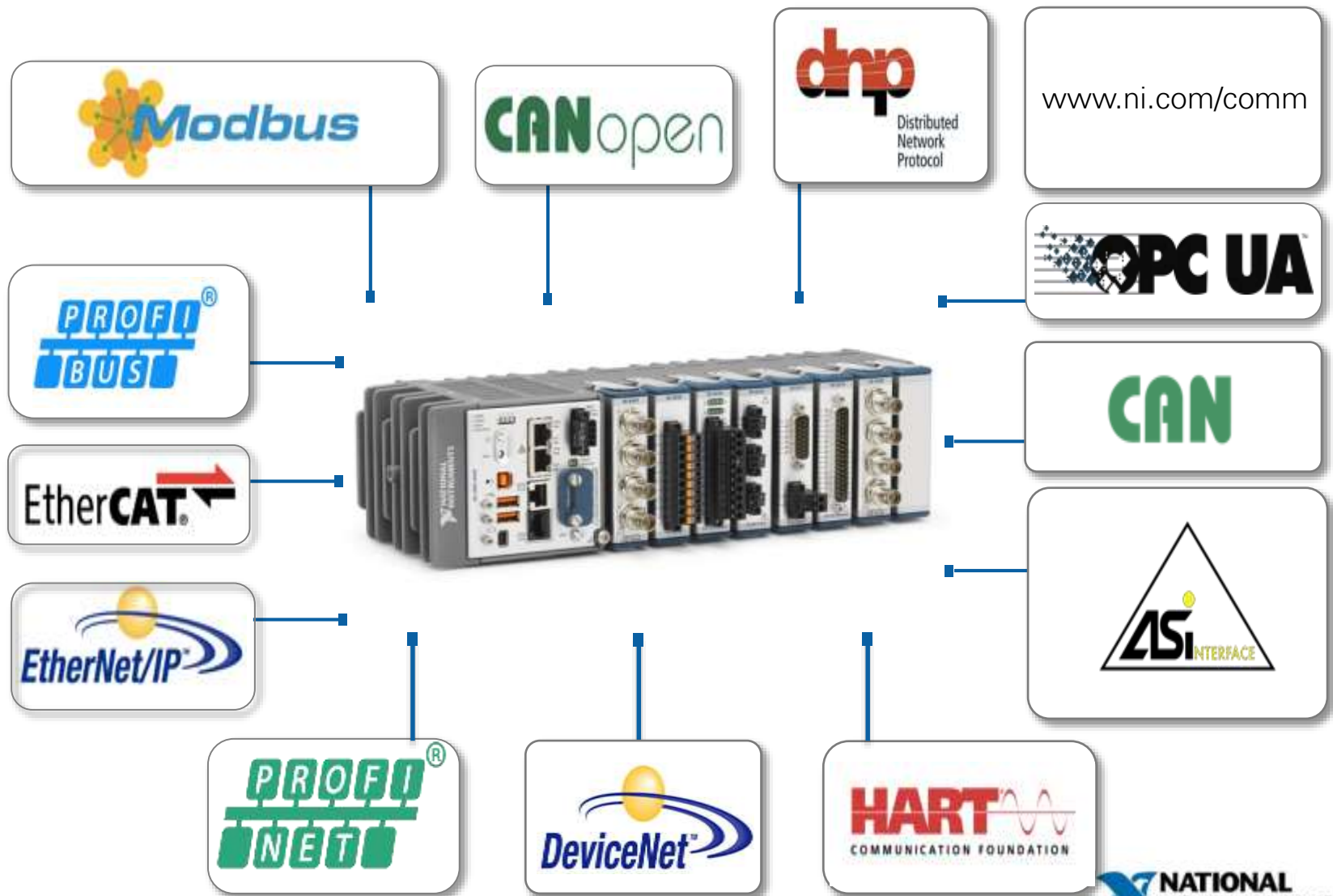
Connect to Any Sensor on Any Bus

100+ Industrial Signal Conditioned I/O Modules

- Voltage Input and Output
- Current Input and Output
- Temperature
- Digital Input and Counter/Timer
- Digital Output and Pulse Generation
- Relay
- Resistance
- Strain and Bridge
- Accelerometers and Microphones
- Timing and Synchronization
- Motion
- Industrial Communications
- Engine Control
- Removable Storage
- Wireless
- Third-Party Modules



Industrial Gateway Capabilities



2015 C Series Module Releases

In-Vehicle Data Logging



NI 9361
8 Ch Diff/Single Ended
Counter Module



NI 9218 LEMO
Dynamic
Universal Module



NI 9860
2 Ch NI-XNET
CAN/LIN

Electrical Power



NI 9246/NI 9247
Ch-Ch Isolated
High Current Input Module

Audio Test



NI 9260
miniXLR 24-Bit AO Module

General Purpose



NI 9209
16 Ch ± 10 V 500 S/s
AI Module



NI 9216/NI 9226
D-SUB 8 Ch RTD
Modules



NI 9216/NI 9226
8 Ch RTD
Modules



NI 9212
8 Ch Isolated
Thermocouple Module

Condition Monitoring

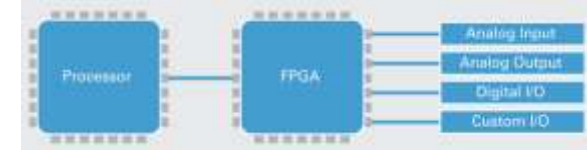


NI 9230
3 Ch 12.8 kS/s Low
Cost IEPE Module



NI 9770
EMSA Module

Embedded Hardware Enabled by the LabVIEW RIO Architecture



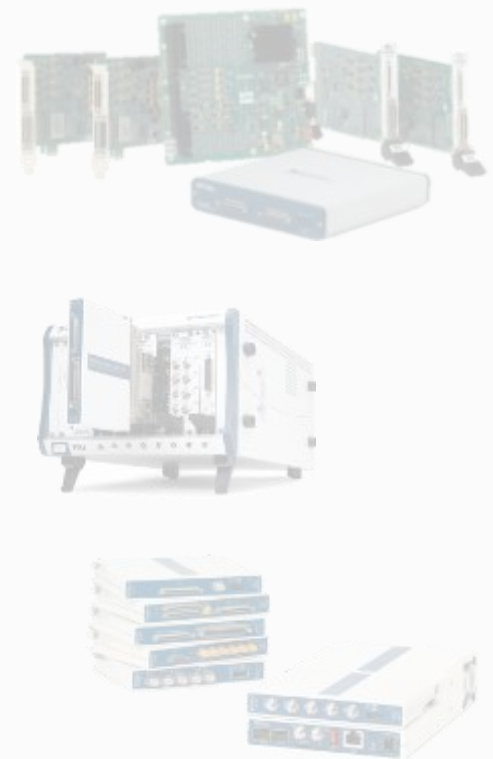
Single-Board RIO / SOM



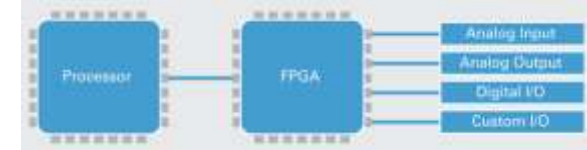
CompactRIO / C Series



R Series / FlexRIO



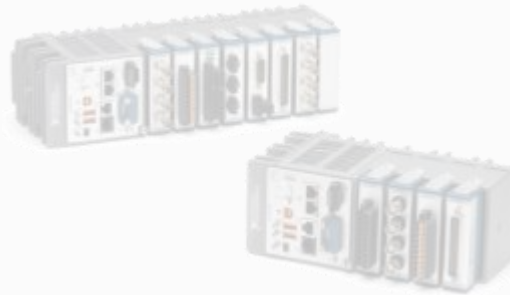
Embedded Hardware Enabled by the LabVIEW RIO Architecture



Single-Board RIO / SOM



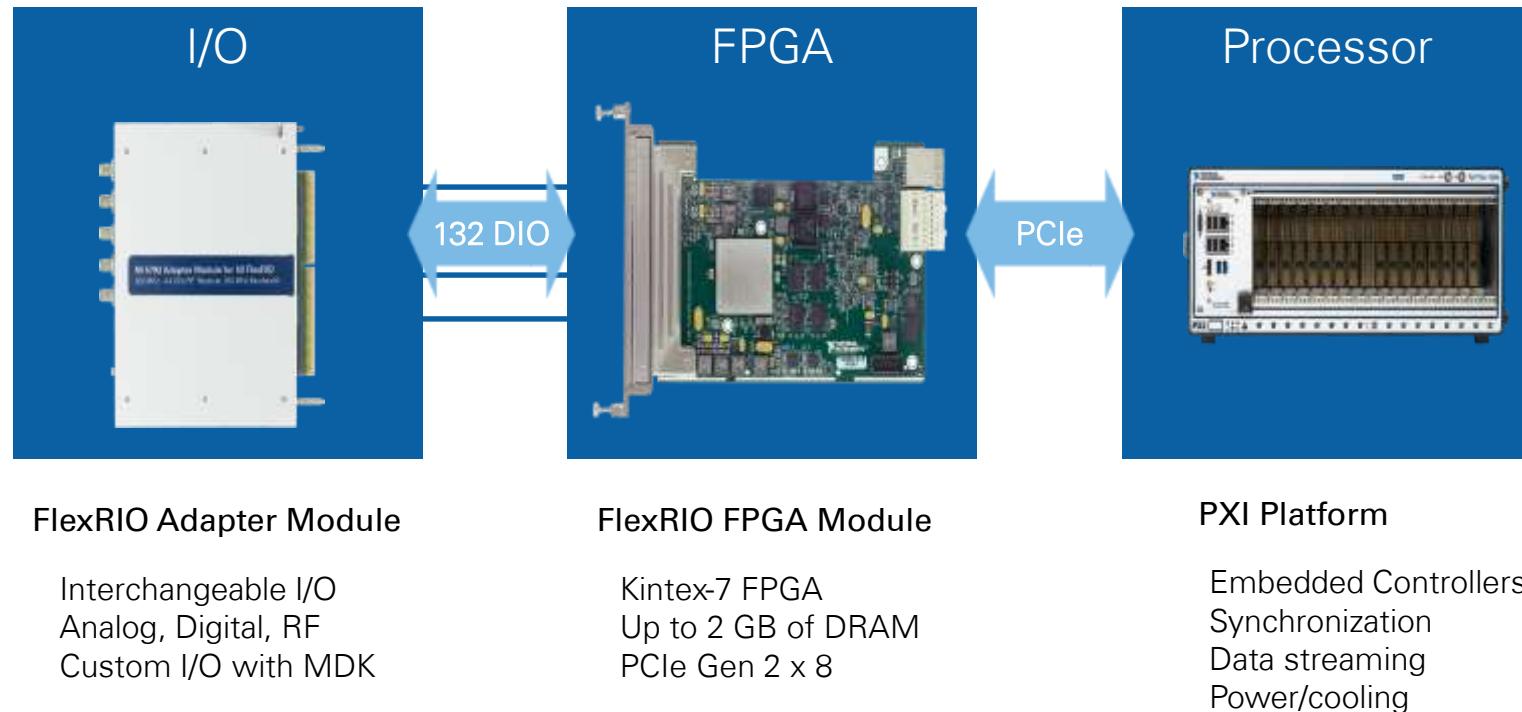
CompactRIO / C Series



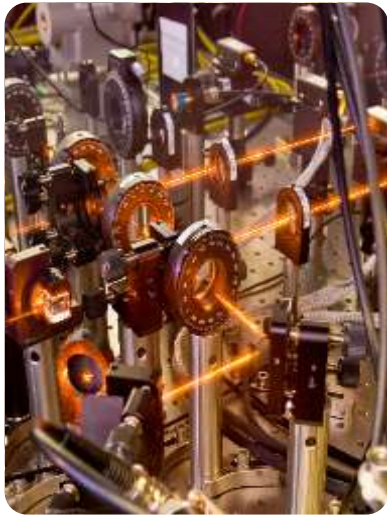
R Series / FlexRIO



FlexRIO for PXI System Architecture



FlexRIO: 2008 - Today



Control the Position of
a Single Atom



Deploy Localized
Weather Radar

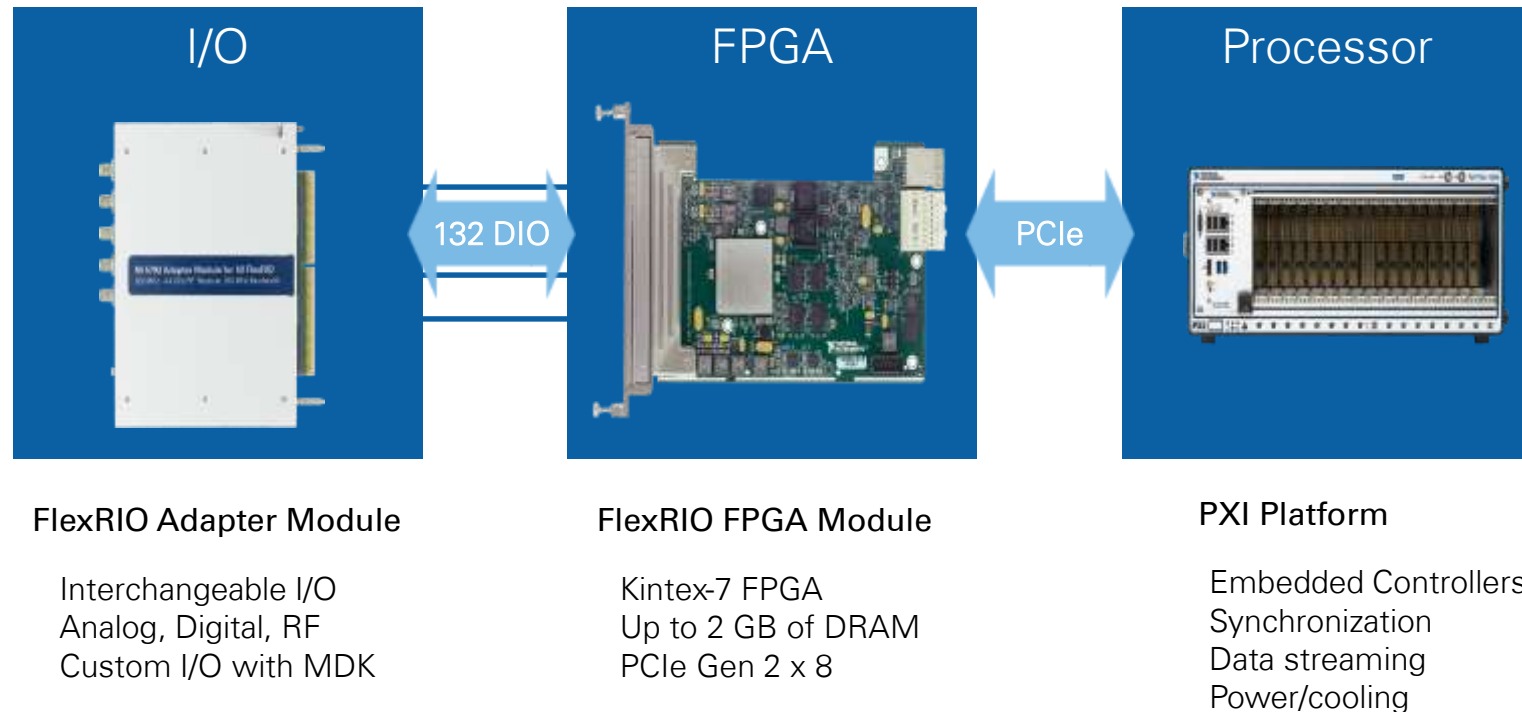


Inspect Composites
with Ultrasound



Characterize
Magnetic Fields

FlexRIO for PXI System Architecture



Optimizing for Deployment



FlexRIO Adapter Module

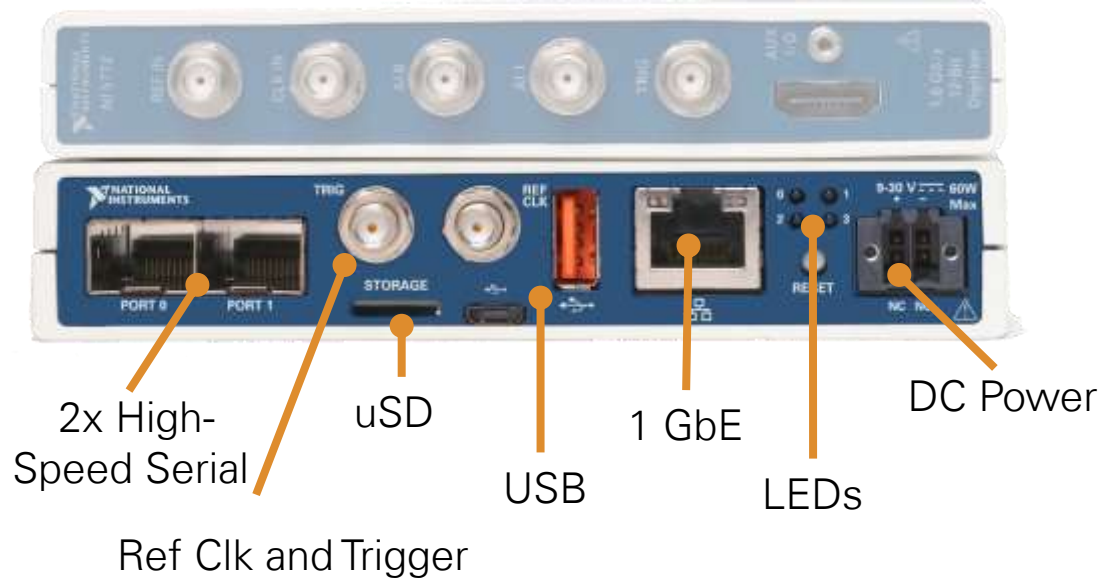
Interchangeable I/O
Analog, Digital, RF
Custom I/O with MDK



Controller for FlexRIO

Kintex-7 FPGA
Dual-Core ARM Processor
High Speed Serial
NI Linux Real-Time OS
Optimized for Size, Weight, Power

New Controller for FlexRIO



LabVIEW System Design

Program with LabVIEW Real-Time and LabVIEW FPGA modules
Decrease development time with a single toolchain

Process Data on Powerful Xilinx FPGAs

Kintex-7 K410T with 2 GB DRAM
2 x SFP+ ports for 2.5 GB/s of data streaming
Reference clock and trigger inputs for synchronization

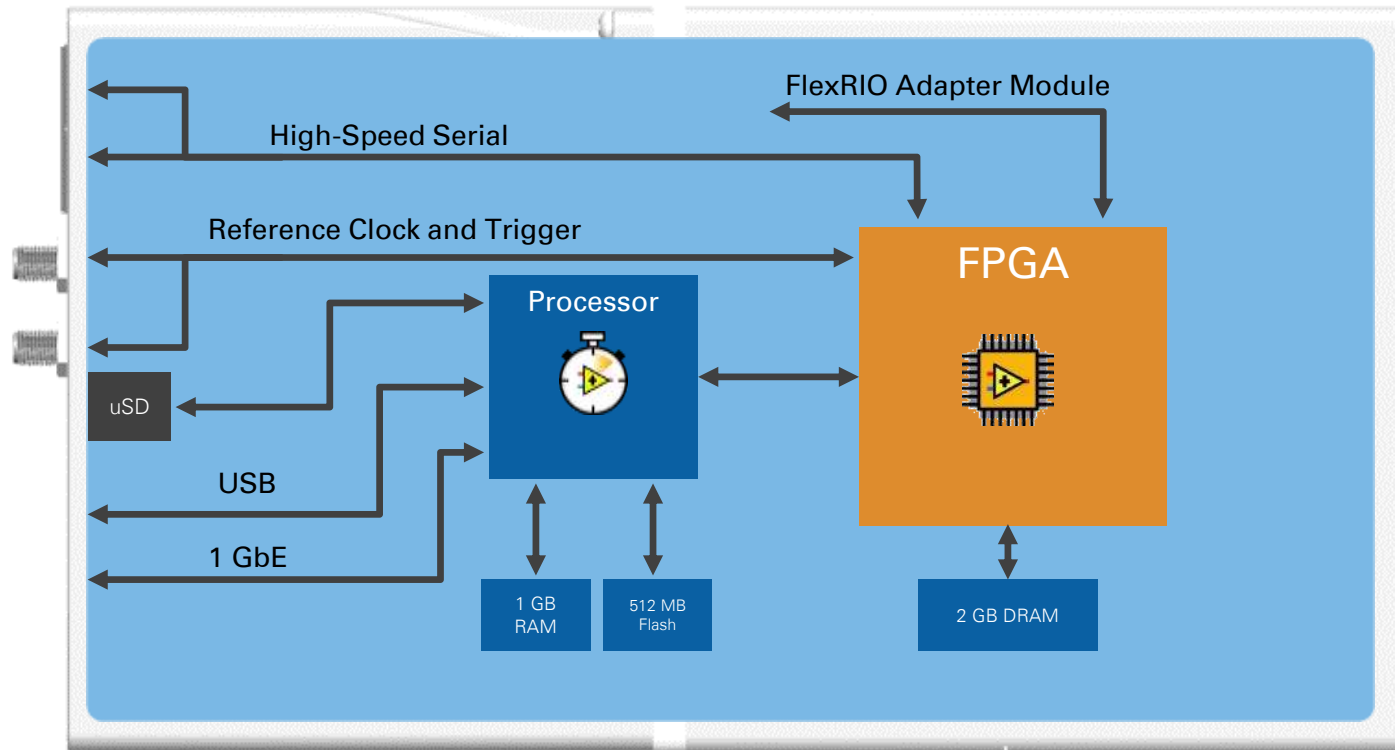
Leverage High-Performance I/O

Analog up to 3 GS/s
Digital up to 1 Gb/s
RF up to 4.4 GHz

Deploy your Solution

NI Linux Real-Time OS
uSD Storage, USB, and 1 GbE Connectivity
Optimized for size, weight, and power

New Controller for FlexRIO At a Glance



Example: Medical Imaging

Challenge

Develop the signal processing backend for an Optical Coherence Tomography machine.

High Level Requirements

Sample at 800 MS/s

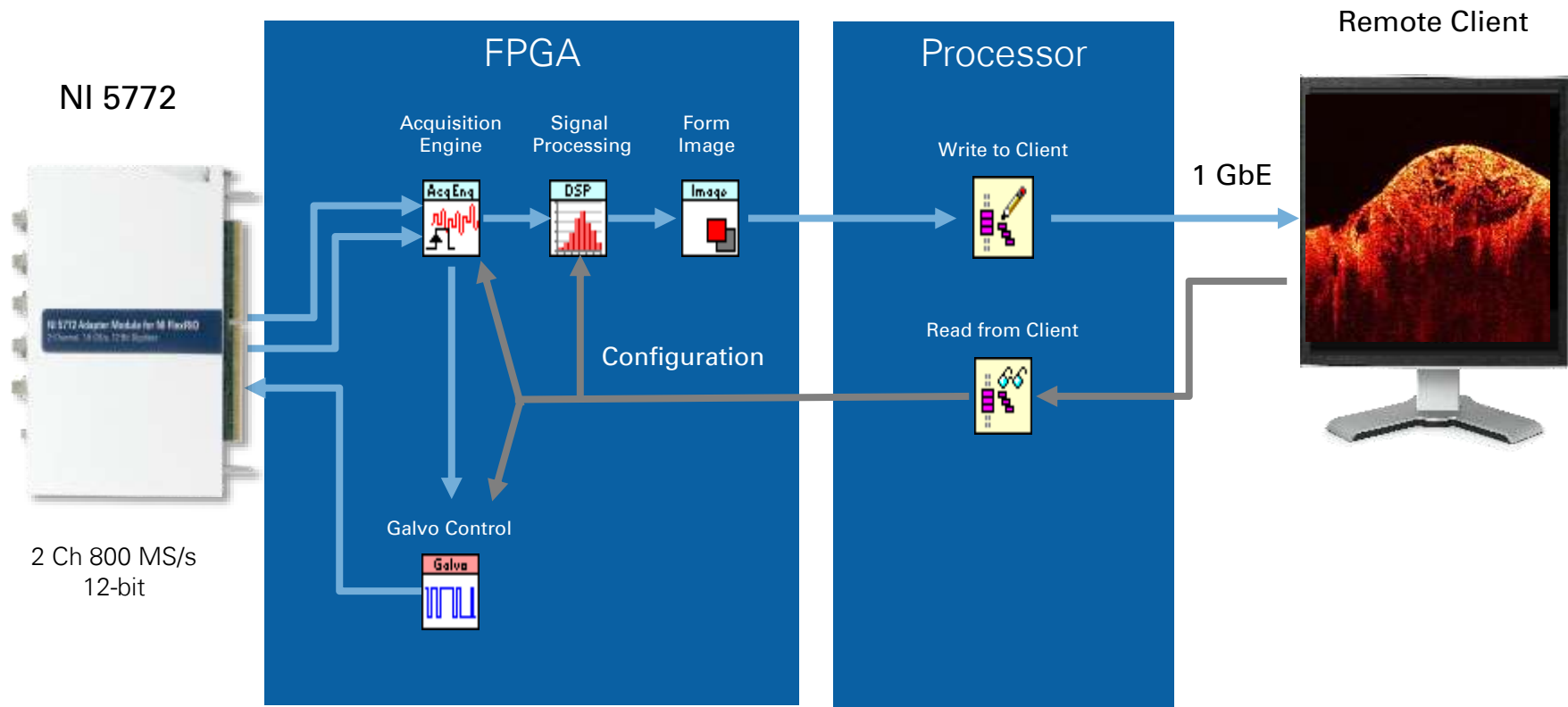
Control fast steering mirrors to perform raster scan

Imaging in real-time

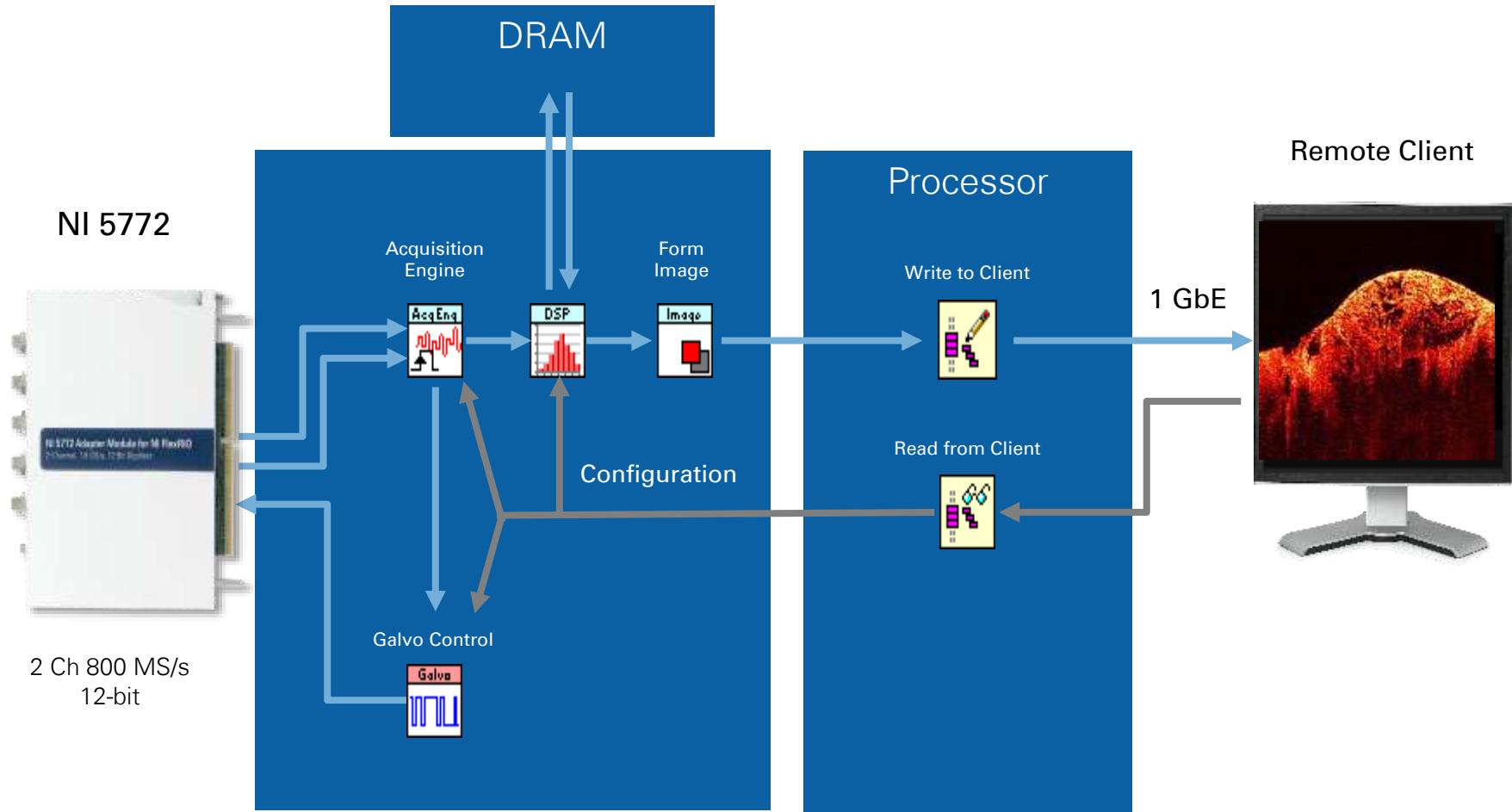
Stream image data over the network



OCT Solution



OCT Solution



FlexRIO Adapter Modules

Digital



100 Mbps
SE DIO

300 Mbps
LVDS DIO



300 Mbps
SE/LVDS DIO

1 Gbps
LVDS DIO



Camera Link

RS485/RS422

Digitizers



2 ch. 3 GS/s
8-bit AI



2 ch. 1.6 GS/s
12-bit AI



4 ch. 250 MS/s
14-bit AI



2 ch. 250 MS/s
16-bit AI



4 ch. 120 MS/s
16-bit AI



2 ch. 120 MS/s
16-bit AI



32 ch. 50 MS/s
12-bit AI



2 ch. 80 MS/s
14-bit AI



16 ch. 50 MS/s,
14-bit AI



2 ch. 40 MS/s
12-bit AI

RF



100 MHz BW
4.4 GHz RF I/O



200 MHz BW
4.4 GHz RF Tx



200 MHz BW
4.4 GHz RF Rx

Transceivers



2 ch. 100 MS/s
14-bit AI
16-bit AO



2 ch. 250 MS/s
14-bit AI
16-bit AO

Signal Generators



2 ch. 1.25 GS/s
14-bit AO



1 ch. 2 GS/s
14-bit AO

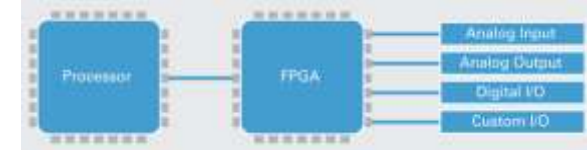


32 ch. 1 MS/s
16-bit AO



16 ch. 1 MS/s
16-bit AO

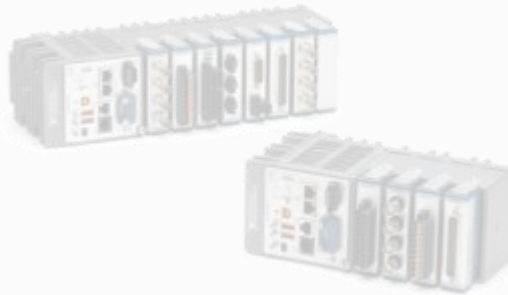
Embedded Hardware Enabled by the LabVIEW RIO Architecture



Single-Board RIO / SOM



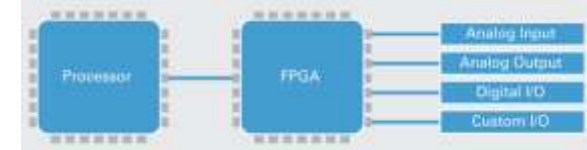
CompactRIO / C Series



R Series / FlexRIO



Embedded Hardware Enabled by the LabVIEW RIO Architecture



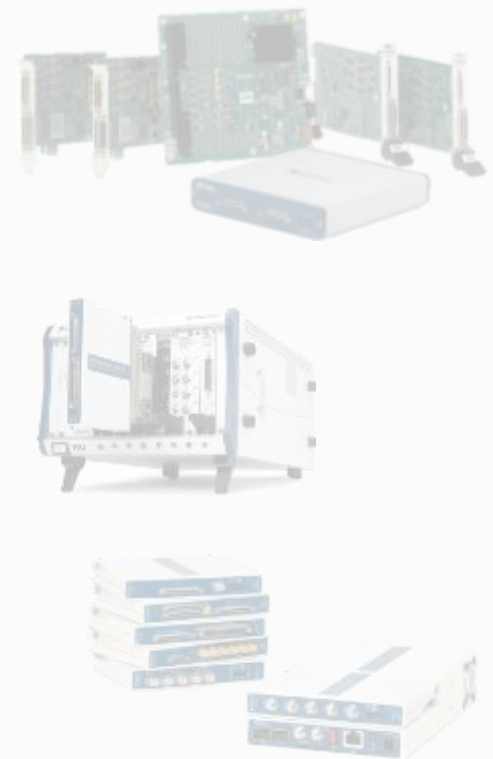
Single-Board RIO / SOM



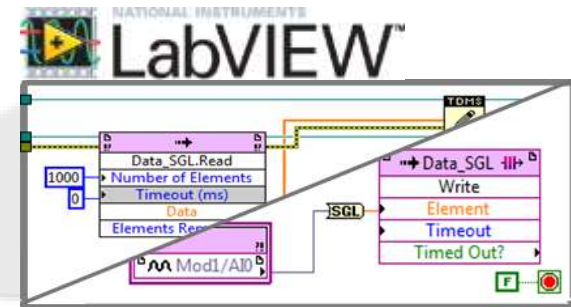
CompactRIO / C Series



R Series / FlexRIO



New Single-Board RIO with Zynq and Linux



Reuse Existing Design

Form, fit, function replacement for existing Single-Board RIO systems
Quickly port existing LabVIEW applications

High Throughput and Performance

Dual-core ARM 667 MHz processor
Xilinx 7 Series FPGA fabric with 85k logic cells
16 DMA FIFO channels for data streaming

New Features to Improve Your System

Improved C Series module support
Gigabit Ethernet, power over RMC, USB device over RMC, and RTC battery

Community and Code Reuse

Unlock ecosystem with NI Linux Real-Time OS
Integrate existing applications and libraries
Develop, debug, and deploy C/C++ code

Real-Time OS and the Linux Ecosystem



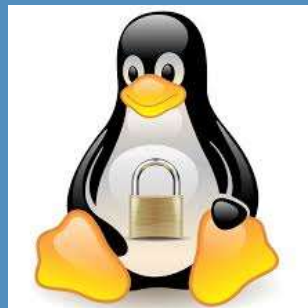
Language

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

Additional Single-Board RIO Features

Power

- Power over RIO Mezzanine Connector (RMC)
 - Power the device with the standard connector OR through the RMC
- Recessed power connector
 - Previous design caused issues when panel mounting
 - Recessing the power connector creates a flat panel mount
- Real-Time clock battery on digital only variant

Connectivity

- USB device over RMC
 - Similar experience to USB device support on CompactRIO
- Gigabit Ethernet and secondary Gigabit Ethernet over RMC
- Improved C Series Support
 - New 2-slot C Series RMC with 24 available DIO
 - Integrate 2 C Series slots into a custom RMC
 - Scan mode support



Can I reuse my existing RMC?

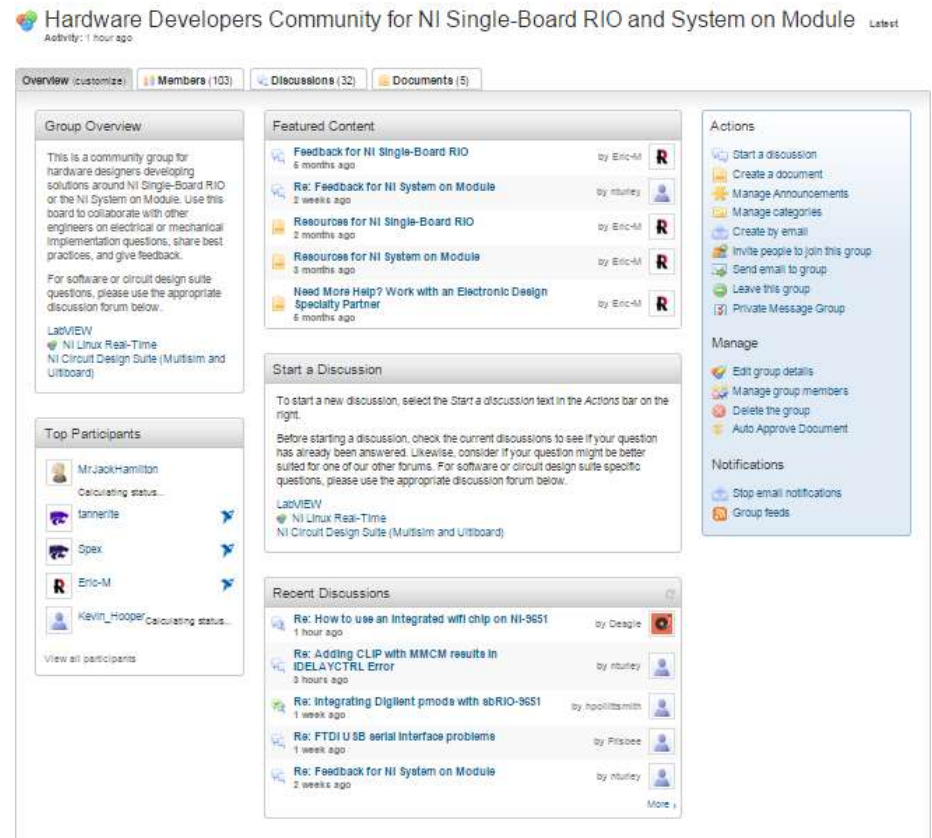
What features are you using?

- Minimum feature set – **Yes**
 - FPGA DIO 0-63
 - USB data pair
 - VBAT - RTC backup battery input
- Extended feature set – **Yes**
 - FPGA DIO 64-95
- Full feature set – **No**
 - General-purpose port

Note: Thermal revalidation is required

Developers Community for Single-Board RIO and System on Module

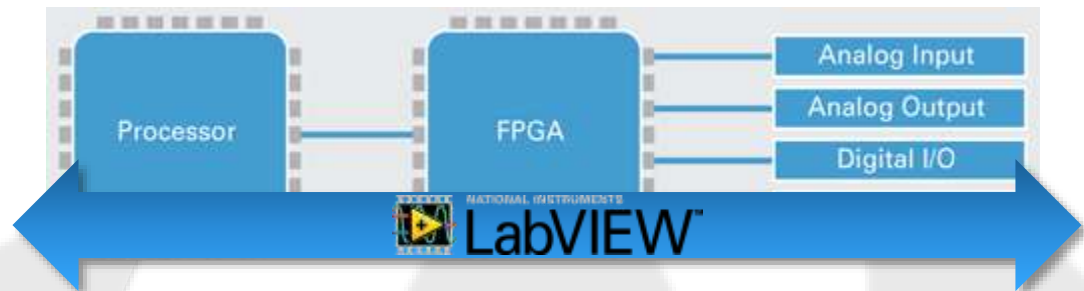
- Resources for getting started developing hardware
- Discussion forums with other customers and NI R&D
- Product Feedback



Hardware developers community: <http://www.ni.com/singleboard/resources>

The LabVIEW RIO Architecture:

Ideal for the IIoT



Computation

- Real-Time Analytics
- LabVIEW Math and 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 loop rates)
- Safety, Reliability

Connectivity

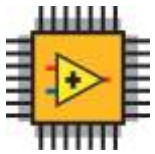
- Any Sensor
- Any Protocol
- Industrially Rated
- Signal Conditioning
- Cameras, Drives, Motors, Actuators

Remember The Power of Software



Meet Your IIoT Application Needs With the LabVIEW Real-Time Module

- On average 11 % faster benchmarked loop rates for single-point I/O applications
- Enhanced security feature support



Develop, Debug, and Compile Faster With the LabVIEW FPGA Module

- Floating-point PID VI for higher precision control
- New examples for working with analog and digital stimuli
- LabVIEW FPGA Compile Cloud Service included with SSP



Make Data Driven Decisions with DIAdem

- Interactively Create Queries to Find the Data Need in Seconds
- Automate Analysis and Reporting Tasks
- Load Over 1,000 File Formats

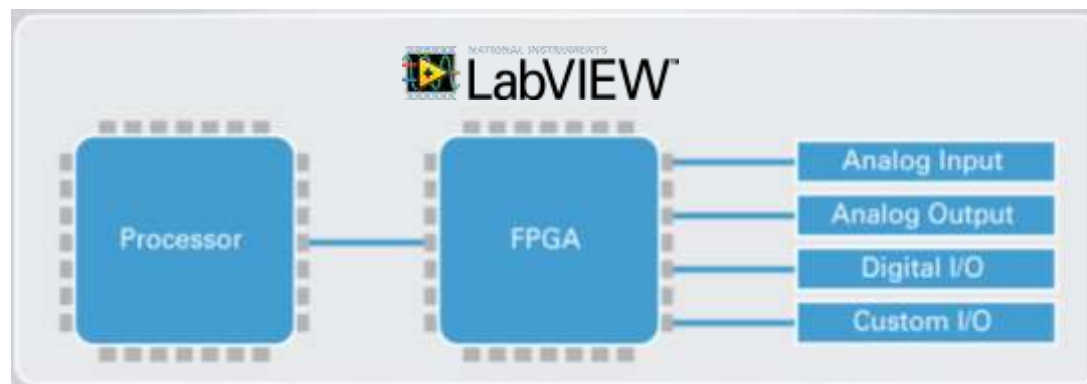


Make Data Driven Decisions Faster with DataFinder Server Edition

- Data Management for the Enterprise
- Find and Load the Right Data in Seconds
- User Management and Security

Innovate with a Platform for the IIoT

- Eliminate the need to start from scratch
- Satisfy the computation, connectivity, and control requirements for IIoT 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



Stay Connected During and After NIDays



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