Introducing CompactRIO with NI-DAQmx
CompactRIO Controllers & Chassis

CompactRIO Controllers

CompactRIO Chassis

Board-Level Controllers
CompactRIO and CompactDAQ Controllers

CompactRIO Controllers
• FPGA
• NI Linux RT
• Up to 8 slots for C Series IO
• Rugged specifications

CompactDAQ Controllers
• DAQ ASIC
• NI Linux RT or Windows
• Up to 8 slots for C Series IO
• Rugged specifications
CompactRIO and CompactDAQ Controllers

- Waveform Acquisition
- Closed Loop Control
- Rugged Specifications
- Wide Breadth of I/O
- Headless Operation
CompactRIO with NI-DAQmx

- Waveform Acquisition
- Closed Loop Control
- Rugged Specifications
- Wide Breadth of I/O
- Headless Operation
CompactRIO with NI-DAQmx

Slot by slot programming option for NI-DAQmx or LabVIEW FPGA

TSN for synchronizing distributed systems and measurements

Replacement for CompactRIO and CompactDAQ controllers
cRIO-904x – Maximize Performance
Up to 1.6 GHz Quad Core CPU and Kintex-7 325T FPGA

- TSN-Enabled Ethernet (x2)
- PFI Trigger
- USB Type C - USB 3.1 - Host/Device - Display
- Isolated Power, SD, USB 2.0, RS-232, RS-485, User Button, Reset Button, NI Linux Real-Time, 4/8 slots C Series I/O
cRIO-905x – Get the Most Bang for Your Buck
Entry-level pricing with Atom Dual-Core CPU and Artix-7 FPGAs

- USB Type C
- USB 3.1 Host
- Device/Console
- PFI Trigger
- \( \mu \)SD
- TSN-Enabled Ethernet (1 or 2)
- Isolated Power, Reset Button, Rear and Through Hole Mounting, NI Linux Real-Time, 4/8 slots C Series I/O
I use a CompactRIO or CompactDAQ controller today… what does this mean for my current application?

- **Programming**
  - Same programming experience as CompactRIO or CompactDAQ controllers today
  - Code from existing controllers expected to migrate quickly

- **Performance**
  - No performance degradation to support both programming modes
  - Enabled DAQmx support with hardware, so it does not consume FPGA space

- **Price**
  - No price increase over existing CompactRIO and CompactDAQ controllers
  - cRIO-905x provides a new entry-level price point for CompactDAQ controllers
Data Paths

NIC i210

Processor

PCIe

FPGA

IO Node

CompactRIO
with NI-DAQmx
ASIC

C Series IO
LabVIEW FPGA

C Series IO
Real-Time Scan

C Series IO
Real-Time (NI-DAQmx)

Disciplined Clock

I2C

NIC i210

PCIe

STC8

HIO

Triggers

LIO
sbRIO-96x8/9 – New CompactRIO Single-Board Controllers
Up to 1.91 GHz Quad Core CPU and Artix-7 200T FPGA

Consistent Variant Options
- Physical Dimensions
- Onboard AIO/DIO
- RMC Pinout
- Peripherals

USB Type C
- USB 3.1 Host
- USB 2.0 Device
- Display

TSN-Enabled Ethernet (x2)
I use a Single-Board RIO controller today… what does this mean for my current application?

- **Migration**
  - Same programming experience as Single-Board RIO controllers today
  - Code from existing controllers expected to migrate quickly
  - Same physical footprint and RMC Pinout

- **Performance**
  - No performance degradation to support both programming modes
  - Enabled DAQmx support with hardware, so it does not consume FPGA space
  - sbRIO-96x9 provides a new high performance variant for Single-Board RIO controllers

- **Price**
  - No price increase over existing Single-Board RIO controllers
CompactRIO with NI-DAQmx Highlights

1. Multiple Programming Modes
2. Time Sensitive Networking
3. Upgrade Features
Multiple Programming Modes
Select Programming Mode on a Slot by Slot Basis

**Real-Time (NI-DAQmx)**
- Simple API for waveform and control from processor
- Supports control loop rates up to 5 kHz
- All channels in a task are synchronized
- Real-Time uses appropriate driver, such as NI-DAQmx or XNET

**Real-Time Scan (IO Variables)**
- Single-Point data acquisition and control from LabVIEW Real-Time
- Supports control loop rates up to 1 kHz
- Primarily available to migrate existing applications, new applications are recommended to use Real-Time (NI-DAQmx) instead

**LabVIEW FPGA**
- Single-point data acquisition and control from LabVIEW FPGA
- Supports control loop rates up to 10s of MHz
- Hardware-level determinism and reliability for control loops
- In-line signal processing for live filtering, calculations, and more
DAQmx on CompactRIO

Faster Time to Measurement
- Module identification and debugging in MAX
- API ideal for measurements
- Module calibration

DAQmx Improvements on CompactRIO
- Timing engine per slot for multi-rate and mixed measurement applications
- Deterministic control up to 5 kHz with Hardware-Timed Single Point
- Measurement synchronization with TSN

Waveform Streaming

Deterministic Control
LabVIEW FPGA on CompactRIO

Performance and Flexibility to Solve Current and Future Challenges
- Control loop rates up to 10s of MHz
- In-line signal processing
- Custom timing and triggering

Expanded Measurement Options
- Access to new NI modules (Ex: Serial, CAN, Profibus/Profinet, Functional Safety)
- 3rd party C Series modules
- Connect to custom sensors with a high speed digital interface

High Speed and Advanced Control

Connect to New Sensors and Busses
LabVIEW FPGA vs. DAQmx for Measurement

**NI DAQmx**
- **Post-Processing & Main Application**: Filtering, analytics, logging, communication

**Processor**
- **Main Application**: Logging, communication

**FPGA**
- **In-line Processing**: Filtering, analytics, decimation, custom triggering
- **I/O**

**LabVIEW FPGA**
- **DMA FIFO**
DAQmx vs LabVIEW FPGA Code for Measurement

DAQmx Code

LabVIEW RT Code + LabVIEW FPGA Code

NATIONAL INSTRUMENTS
LabVIEW FPGA vs DAQmx for Control

NI DAQmx
- Up to 5 kHz loop rate
- Simplified Programming

LabVIEW FPGA
- Up to 10’s of MHz loop rate
- Hardware Reliability

Processor  
FPGA  
I/O
DAQmx Code for Control
Time Sensitive Networking Technology
TSN on CompactRIO with NI-DAQmx

- Synchronized networked systems within 1 \( \mu \)s of network time

- Synchronize distributed measurements within 1 \( \mu \)s

- Expand beyond 8 slots using CompactDAQ with TSN and FieldDAQ
CompactRIO Platform Update Recap

- Use the right programming mode for the right measurement or control task
- Distribute measurements and control using Time Sensitive Networking
- Expand your application with more performance and new features
- Quickly migrate your application and use your existing application knowledge
Next Steps

- Speak with your Account Manager to learn more about the new CompactRIO Single-Board Controllers

- Stay for the next session to see how the CompactRIO with NI-DAQmx is being used today
Stay Connected During and After NIWeek

ni.com/niweekcommunity
facebook.com/NationalInstruments
twitter.com/niglobal
youtube.com/nationalinstruments