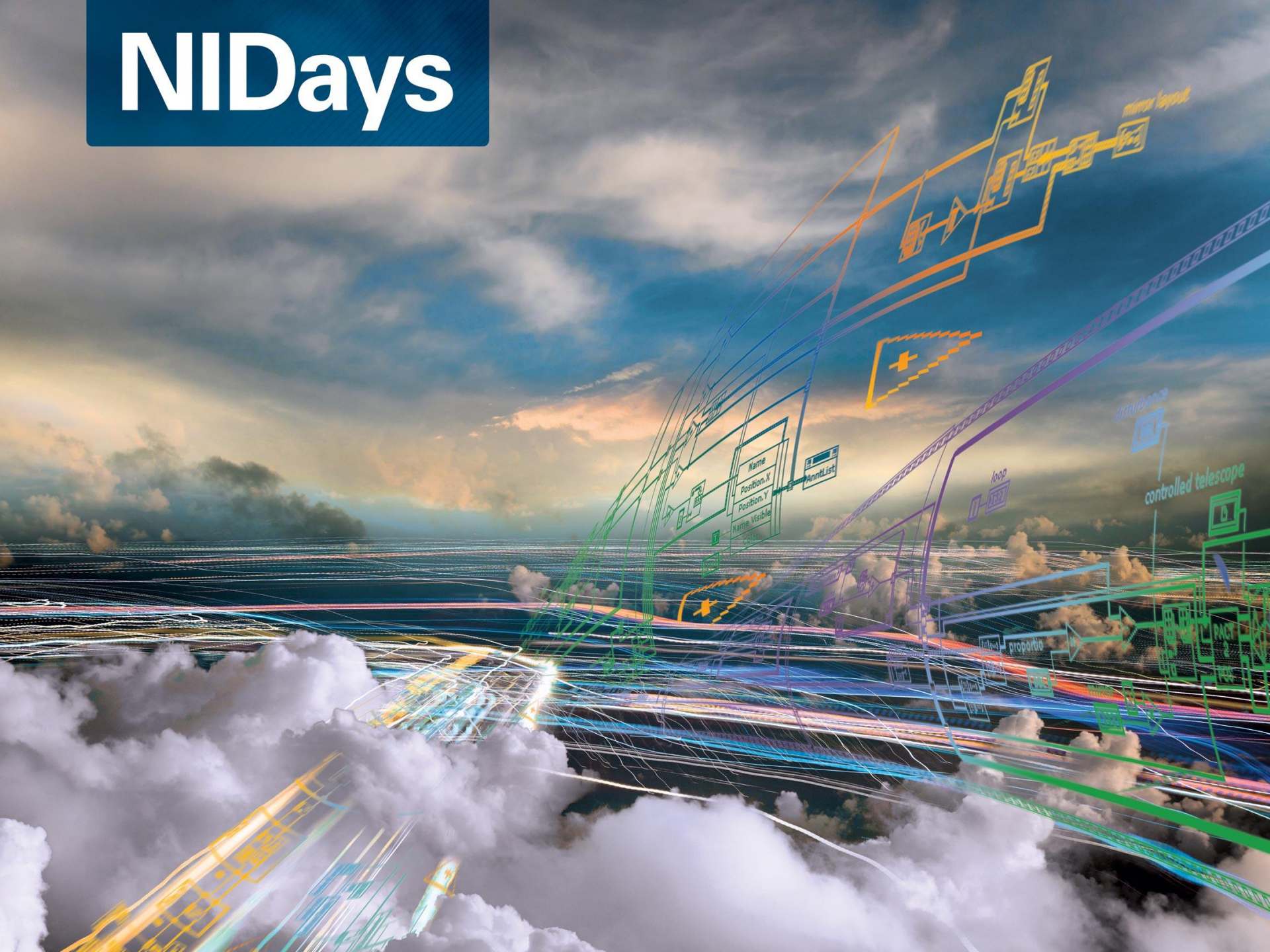
NIDays
Name
Position.X
Position.Y
Name Visible
AnntList
loop
controlled telescope


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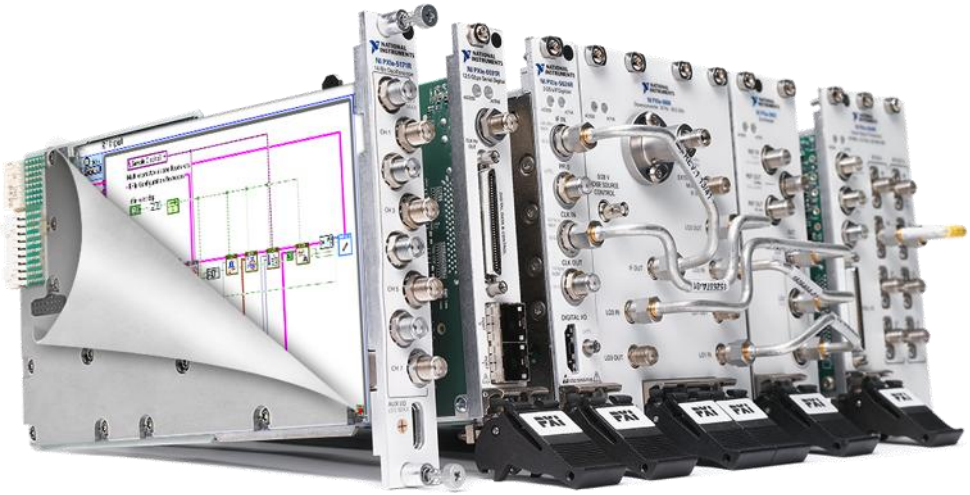

New Software Designed Instruments for Automated Test

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Agenda

- What Is a Software-Designed Instrument?
- Why Software-Designed Instrumentation?
- New Software-Designed Instruments
- Software-Designed Instrument… Software
- Next Steps

What Is a Software-Designed Instrument?

What Is a Software-Designed Instrument?

	Typical Modular Instrument	Software-Designed Instrument
Hardware		

Identical hardware architecture and measurement quality

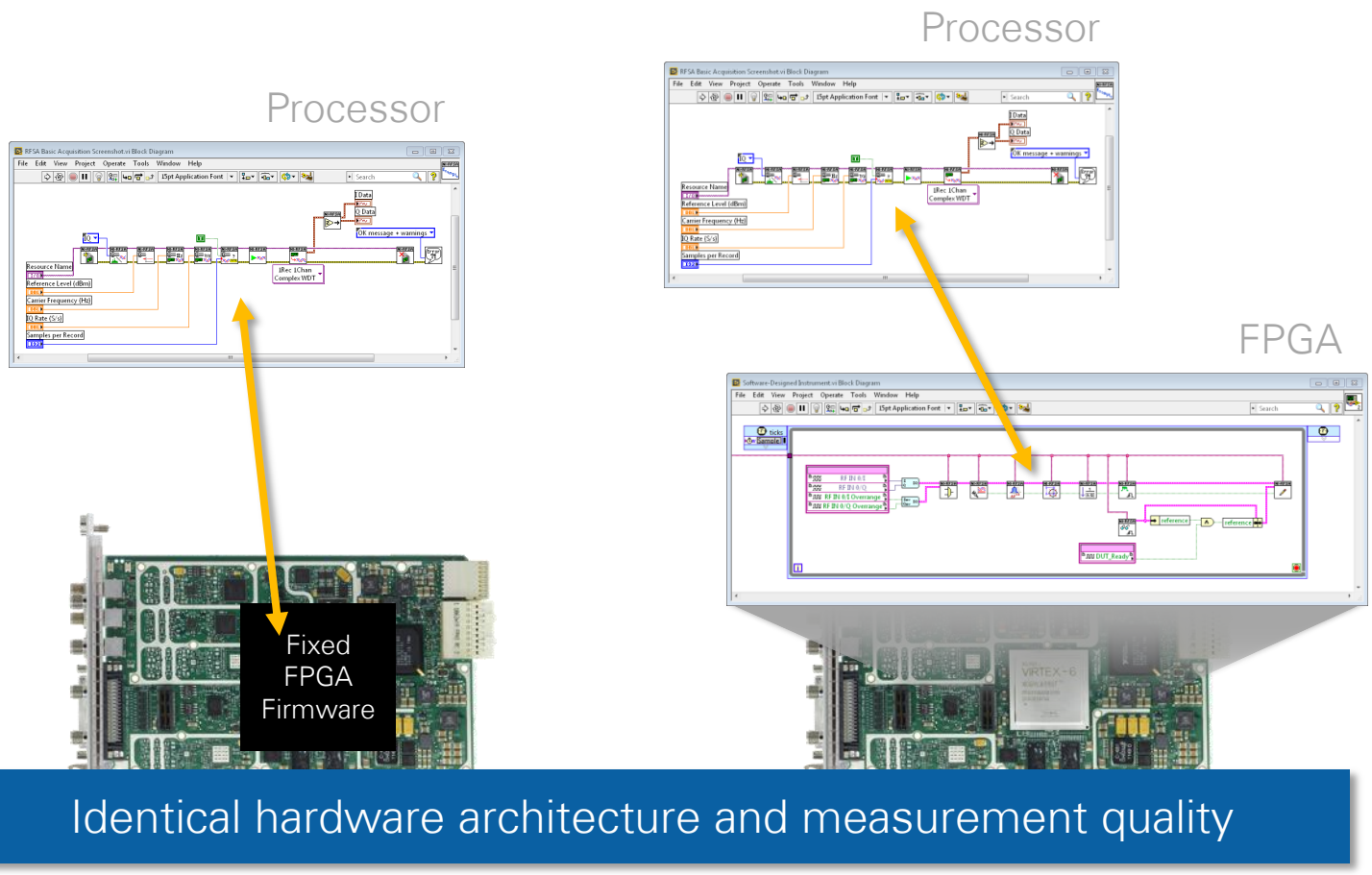
What Is a Software-Designed Instrument?

Typical Modular Instrument

Software-Designed Instrument

Software

Hardware



Identical hardware architecture and measurement quality

NATIONAL INSTRUMENTS

What Is a Software-Designed Instrument?

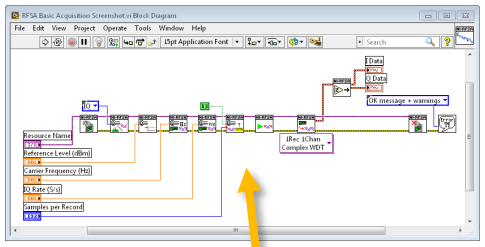
Typical Modular Instrument

Software-Designed Instrument

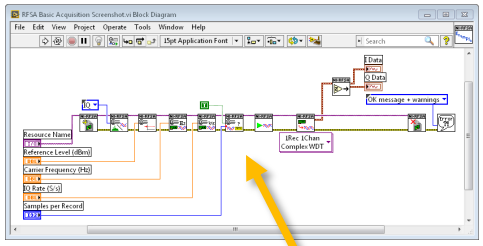
Software

Hardware

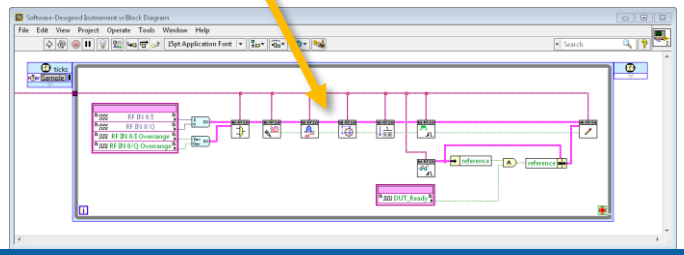
Processor

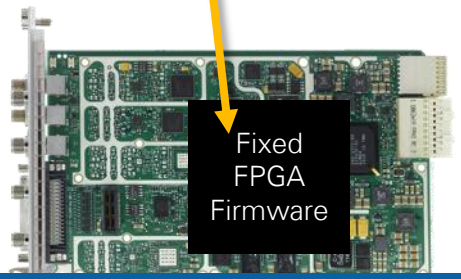


Processor



FPGA





Fixed FPGA Firmware

Out-of-the-box functionality with FPGA enhancements

Identical hardware architecture and measurement quality

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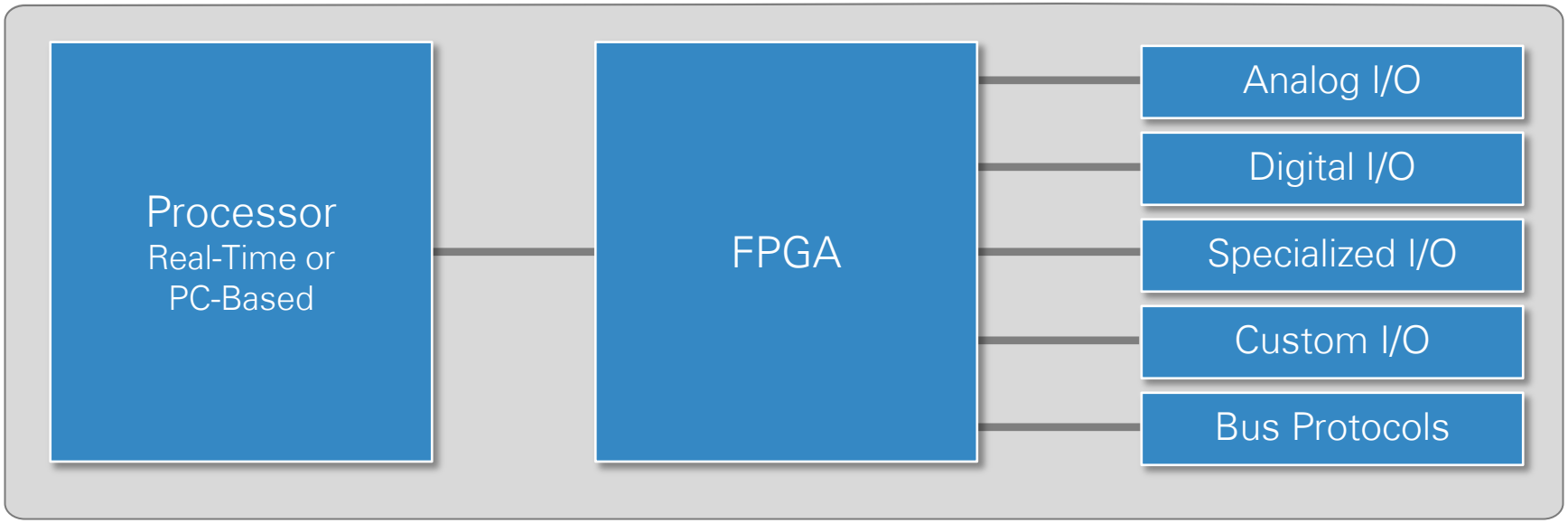
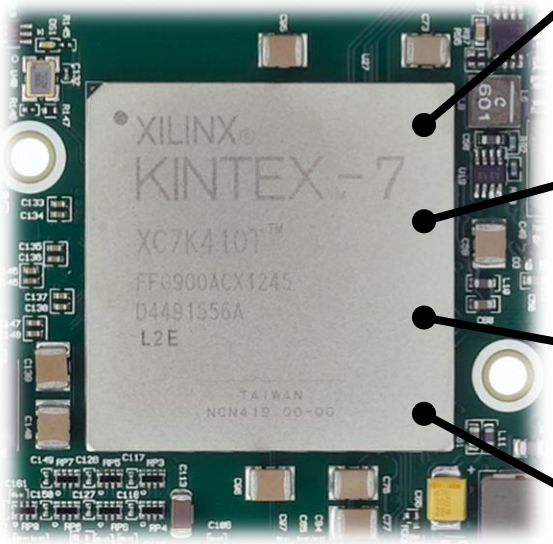
The NI Approach

LabVIEW Reconfigurable I/O (RIO) architecture



Highly Productive **LabVIEW** Graphical Programming Environment
for Programming Host, FPGA, I/O, and Bus Interfaces

Why FPGAs for Instruments?



High-Throughput Processing

- Inherently parallel
- High clock rate
- Algorithm-specific pipelining

Low-Latency Decision Making

- Custom logic in a single clock cycle

Complete Determinism

- Design implemented in a custom circuit

Reprogrammable Logic

- Design can be updated while system is running

User-Programmable FPGAs on Software-Designed Instruments Enable:

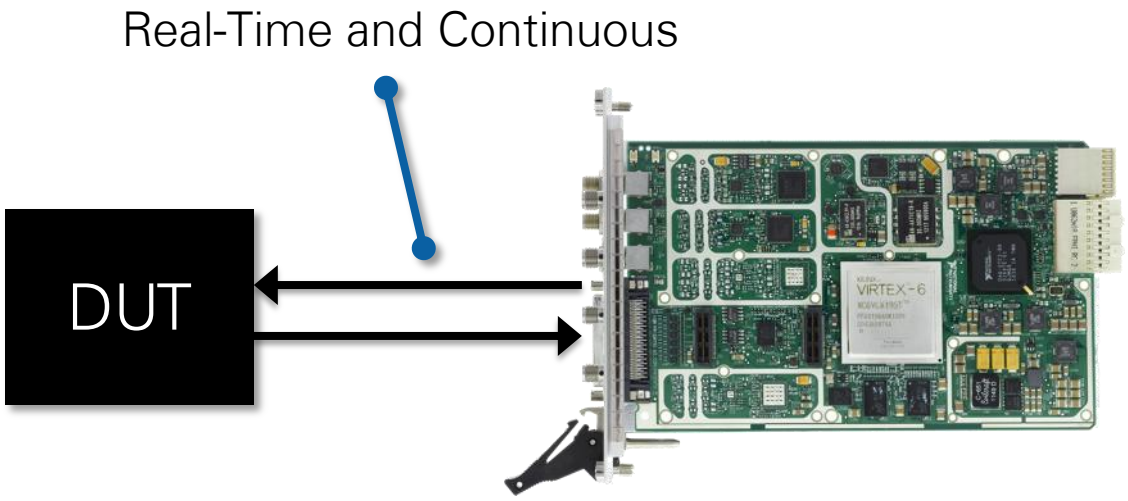
1. On-FPGA Measurements and Stimulus Generation
2. Closed-Loop or Protocol-Aware Test
3. Custom Triggering and Data Reduction
4. Deterministic Test Execution and DUT Control
5. DUT or Application-Specific Personalities

Higher Test Throughput

Hardware Re-Use and Future-Proofing

New, Innovative Tests

Lower Total Cost of Test



1. On-FPGA Measurements and Stimulus Generation

Higher Test Throughput

Hardware Re-Use and Future-Proofing

New, Innovative Tests

Lower Total Cost of Test

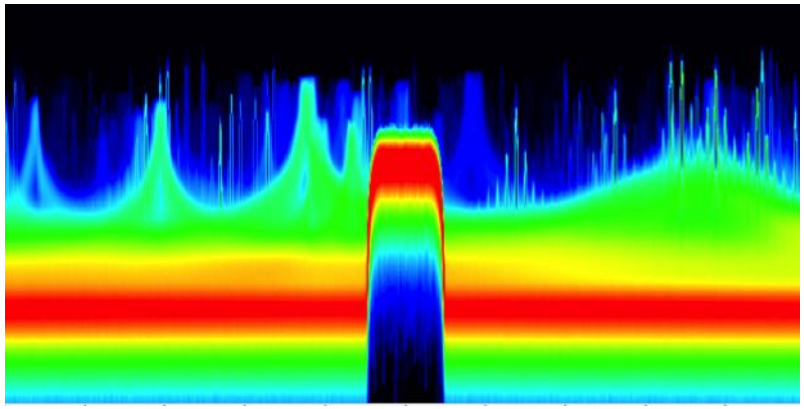
26.5 GHz Vector Signal Analyzer

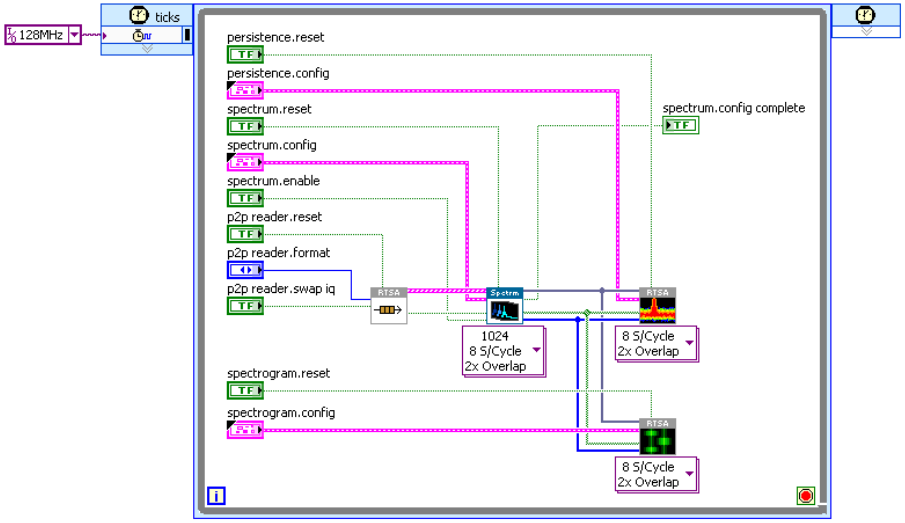
PXIe-5668 Specifications	
Frequency Range	20 Hz to **26.5 GHz**
Analysis BW	**320 MHz below 3.6 GHz** **765 MHz above 3.6 GHz**
Phase Noise (Typ, @10kHz offset)	-129 dBc/Hz at 1 GHz
Noise Floor	<-145 dBm/Hz (26 GHz)
TOI	>+20 dBm (26 GHz)
New Features	**Kintex-7 410T FPGA** **Programmable with LabVIEW**
Slots	7

Real-Time Spectrum Analysis

Features

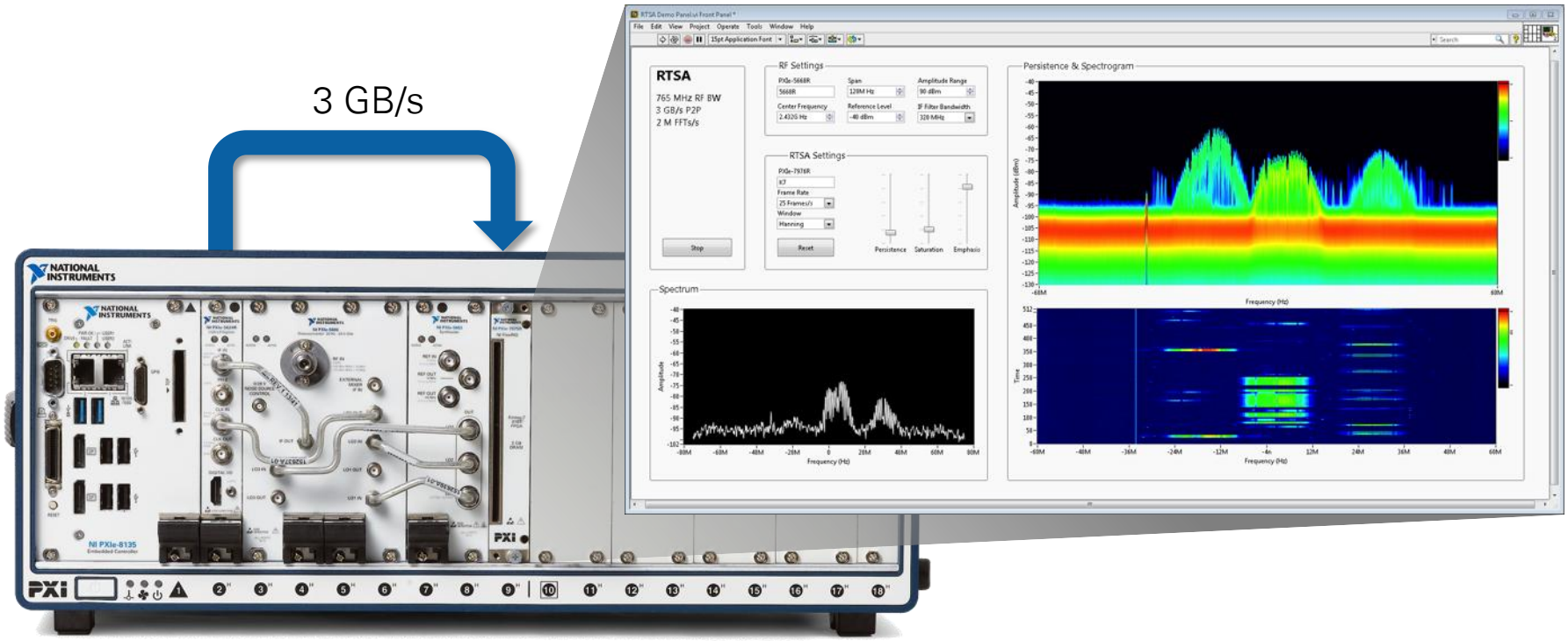
- Gapless persistence, spectrogram, and trace statistics (max hold, min hold, average) calculated on FPGA
- Ability to process up to 2 M FFTs/s using overlapped, windowed FFTs
- Real-time frequency mask triggering
- 100% probability of intercept (POI) minimum duration options:
  - 1 µs or >15 µs
- Source available upon request

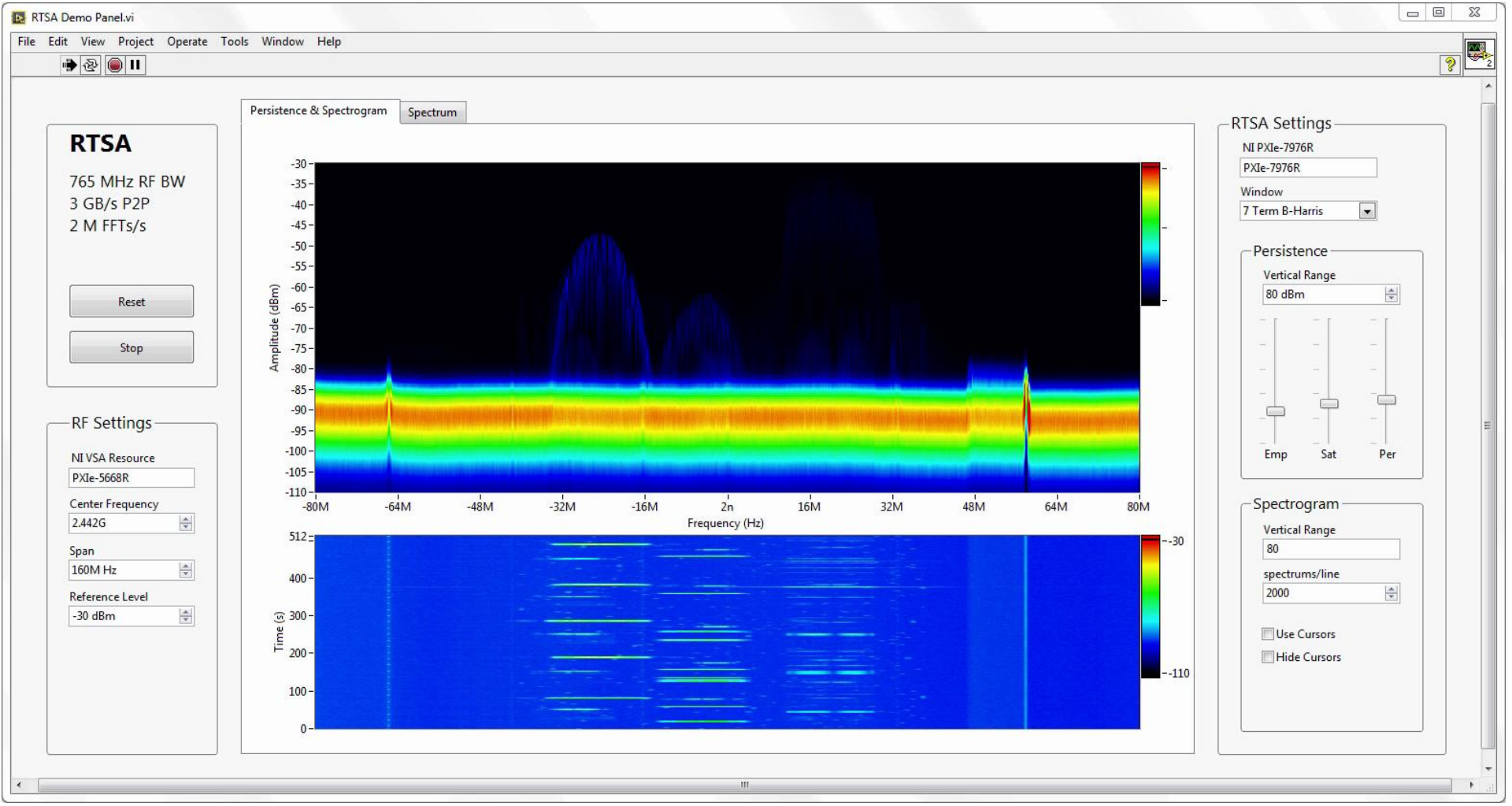




Demo: Real-Time Spectrum Analysis

- PXIe-5668R VSA + PXIe-7976R FlexRIO in PXIe-1085
  - May use other P2P-capable RF analyzers
- Up to 800 MHz RF bandwidth (3 GB/s)





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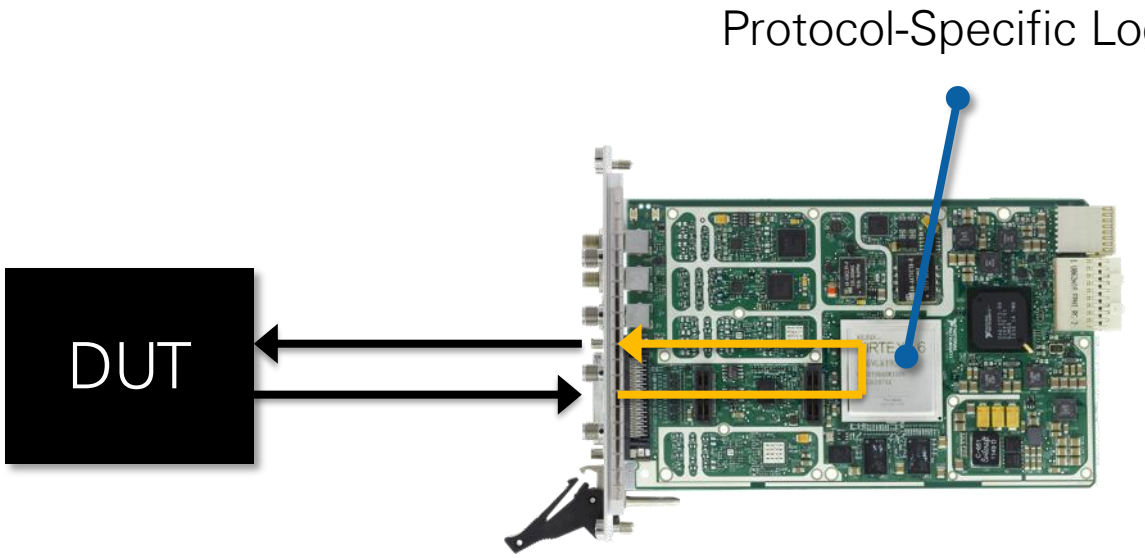

2. Closed-Loop or Protocol-Aware Test

Higher Test Throughput

Hardware Re-Use and Future-Proofing

New, Innovative Tests

Lower Total Cost of Test

High-Speed Serial Instruments

PXIe-6591R & PXIe-6592R Specifications	
High-speed serial interface	Up to 12.5 Gbps Up to 8 TX and RX lanes
Connector	SFP+ or Mini-SAS HD
RAM	2 GB / 10.6 GB/s bandwidth
FPGA	Kintex-7 410T FPGA Programmable w/ LabVIEW PXI Express x8 Gen 2 bus interface (> 3 GB/s)

Available end of 2014

Examples for:

- JESD204B
- Xilinx Aurora
- Serial RapidIO
- 10 Gigabit Ethernet
- CPRI

"FlexRIO-like" VHDL control of Xilinx MGTs

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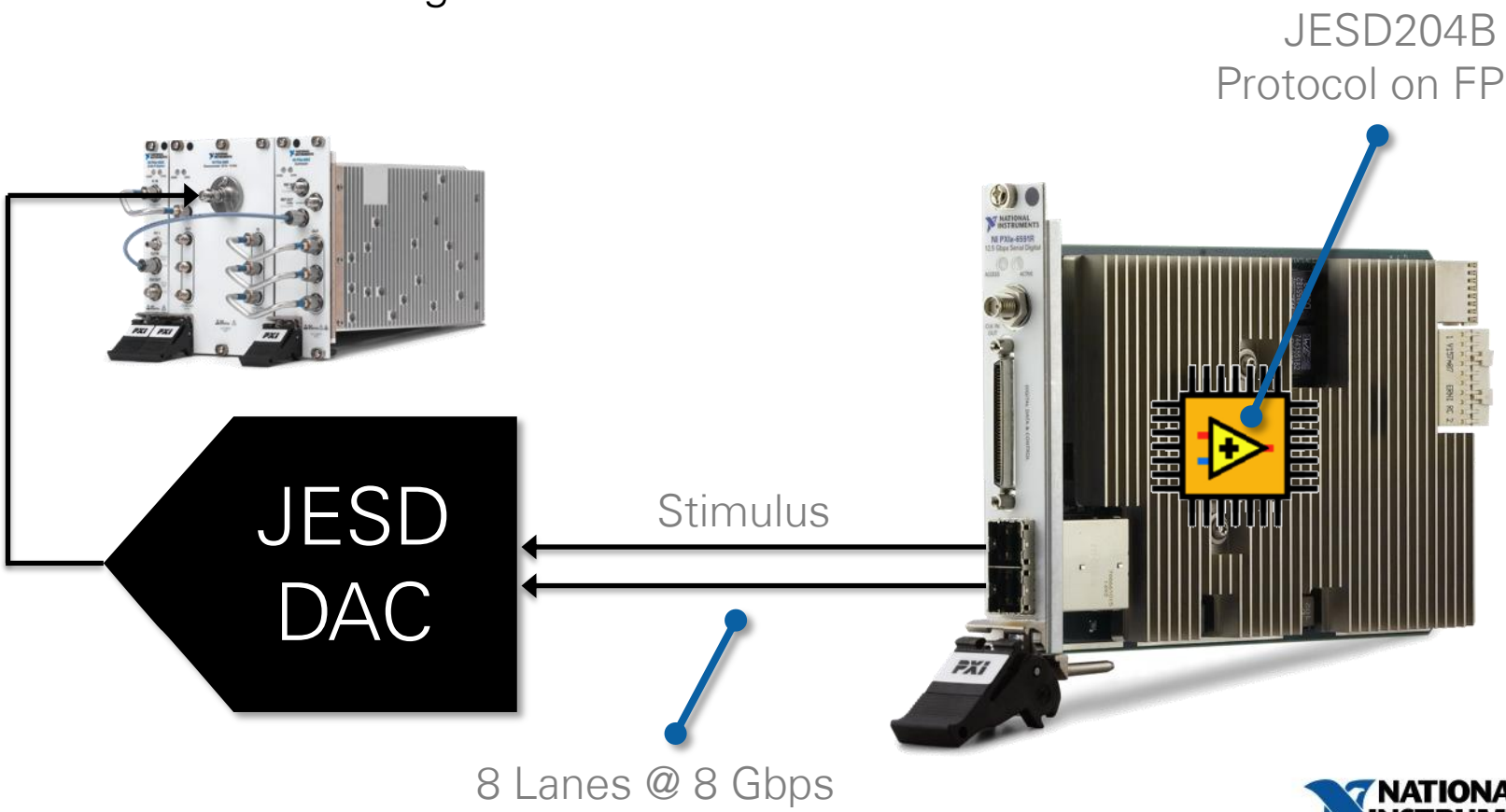
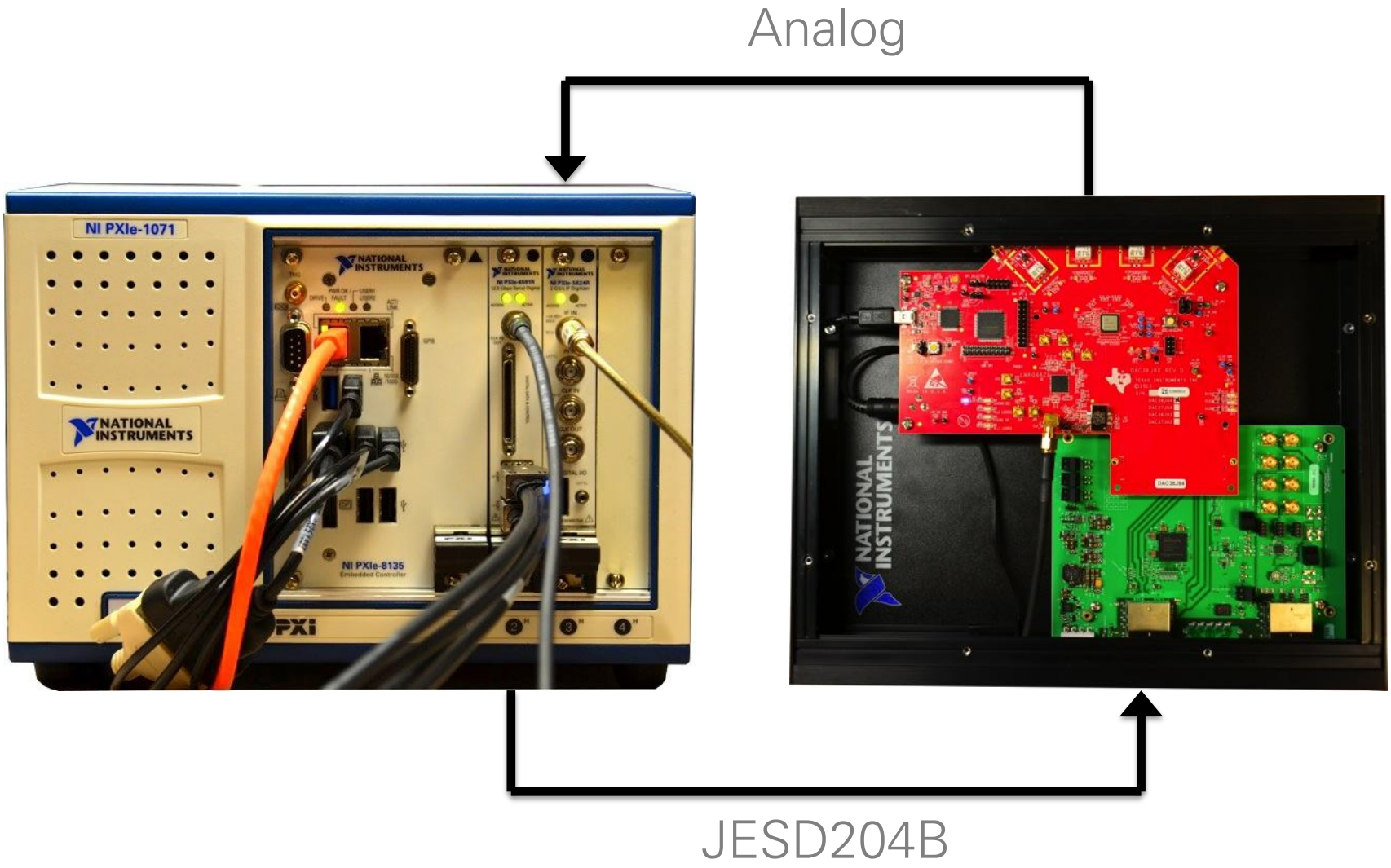
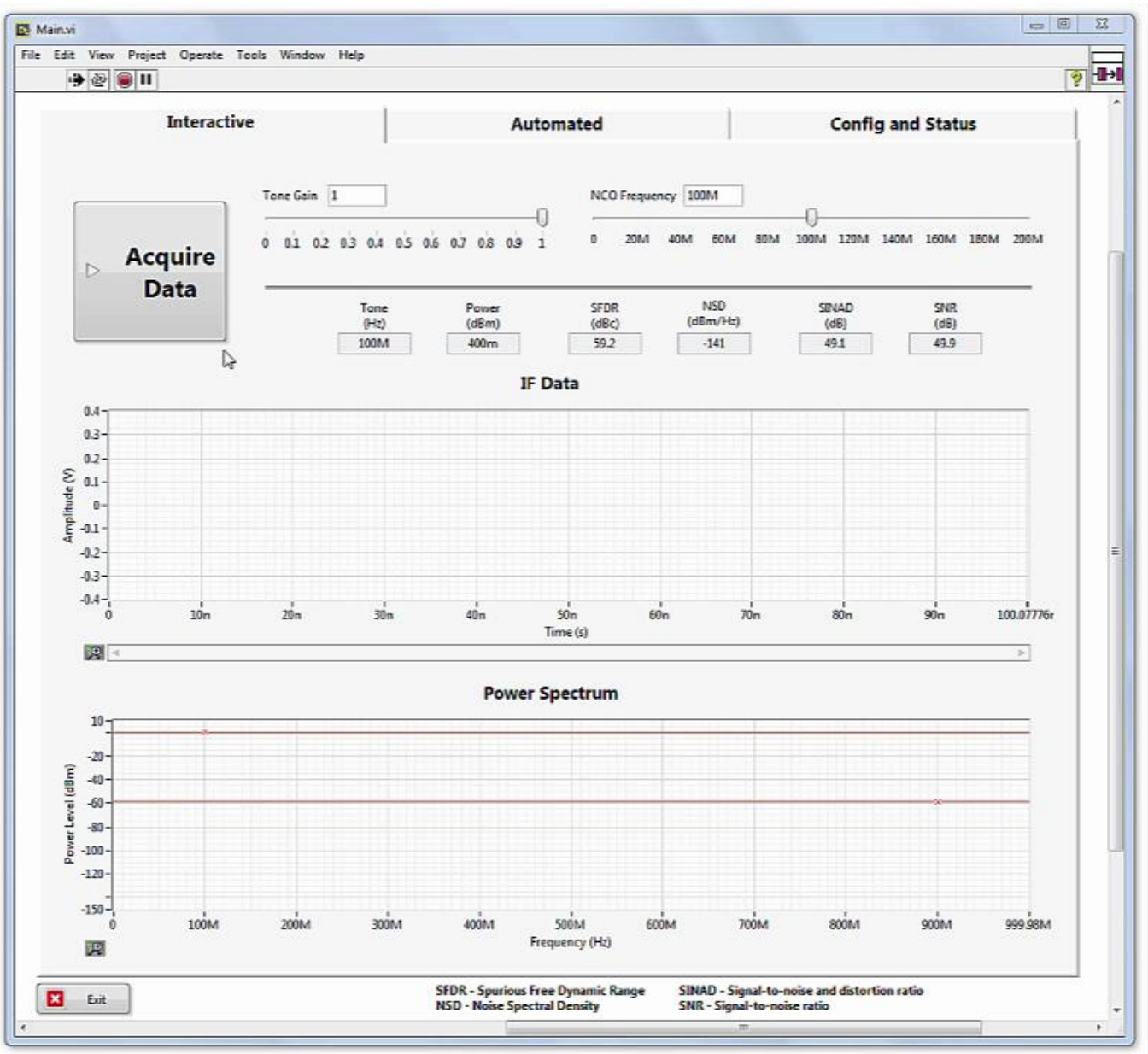
Demo: Protocol-Aware Test

- High-speed serial protocol implemented on FPGA
- Ability to adapt to custom protocol implementations
- No need to synthesize protocol vectors on processor
- On-FPGA stimulus generation

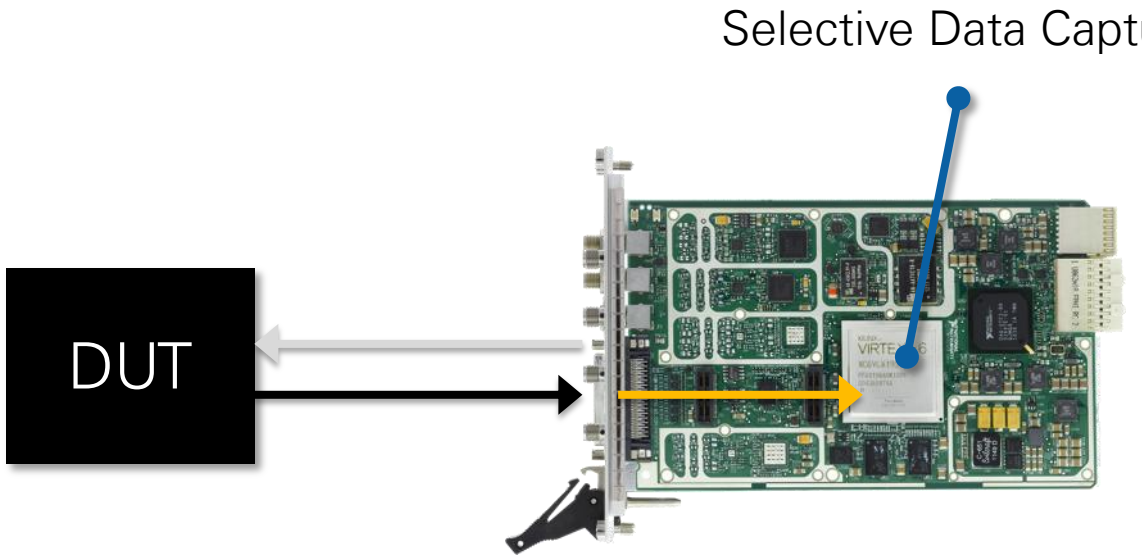


Demo: DAC Test Hardware





NATIONAL INSTRUMENTS



3. Custom Triggering and Data Reduction

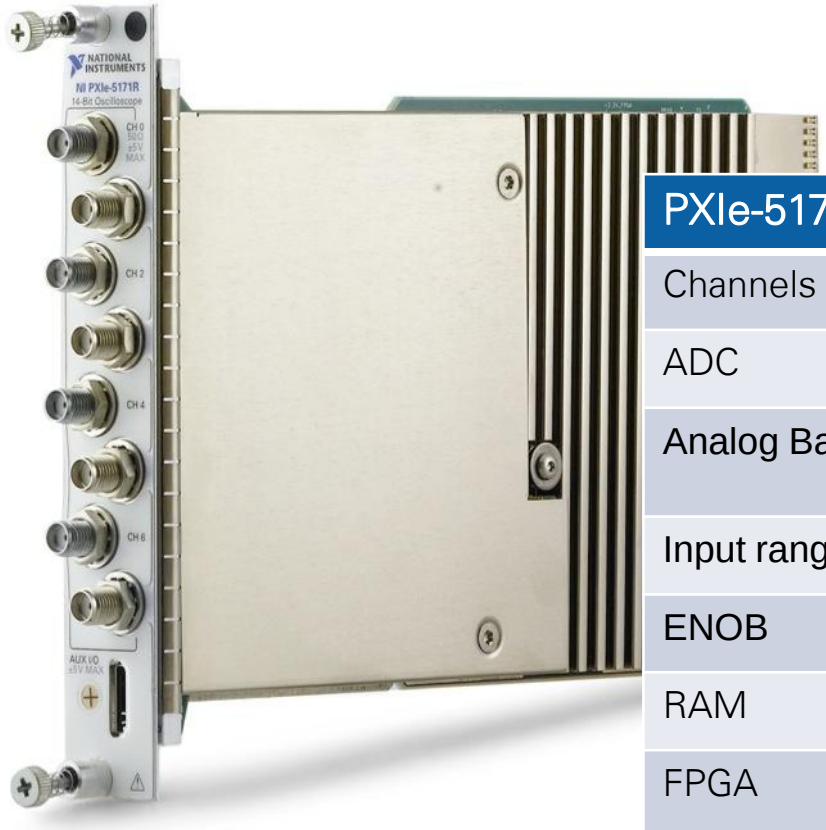
Higher Test Throughput

Hardware Re-Use and Future-Proofing

New, Innovative Tests

Lower Total Cost of Test

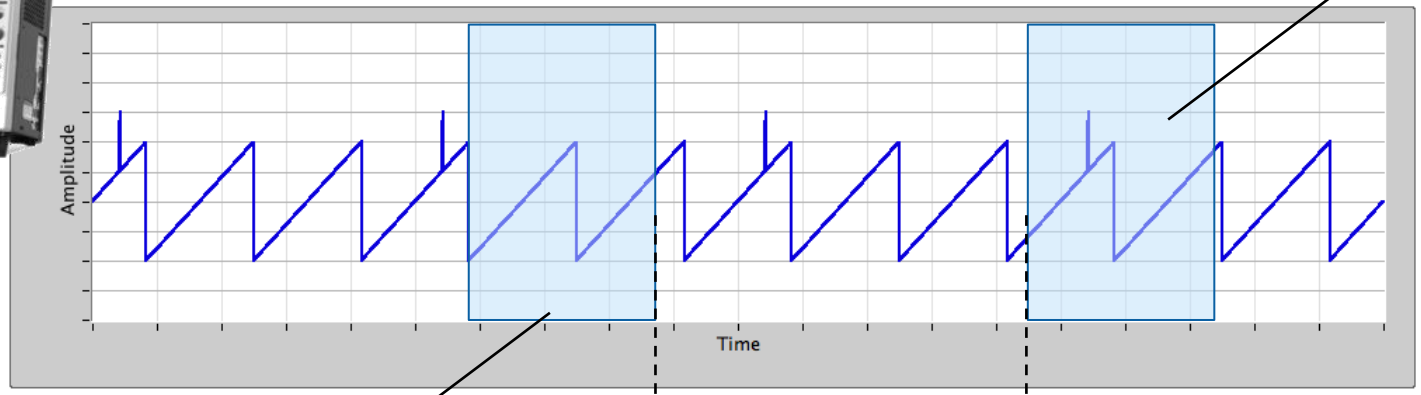
8 ch., 250 MHz Reconfigurable Oscilloscope



PXIe-5171R Specifications	
Channels	8 (simultaneously sampled)
ADC	250 MS/s, 14-bit
Analog Bandwidth	250 MHz Selectable 100 MHz filter
Input ranges	0.2 V_{pp} to 5 V_{pp}
ENOB	> 11 (preliminary)
RAM	1.5 GBit
FPGA	Kintex-7 410T FPGA Programmable with LabVIEW PXI Express x8 Gen 2 bus interface (> 3 GB/s)
No. of Slots	1

Detect Events Faster and Deterministically

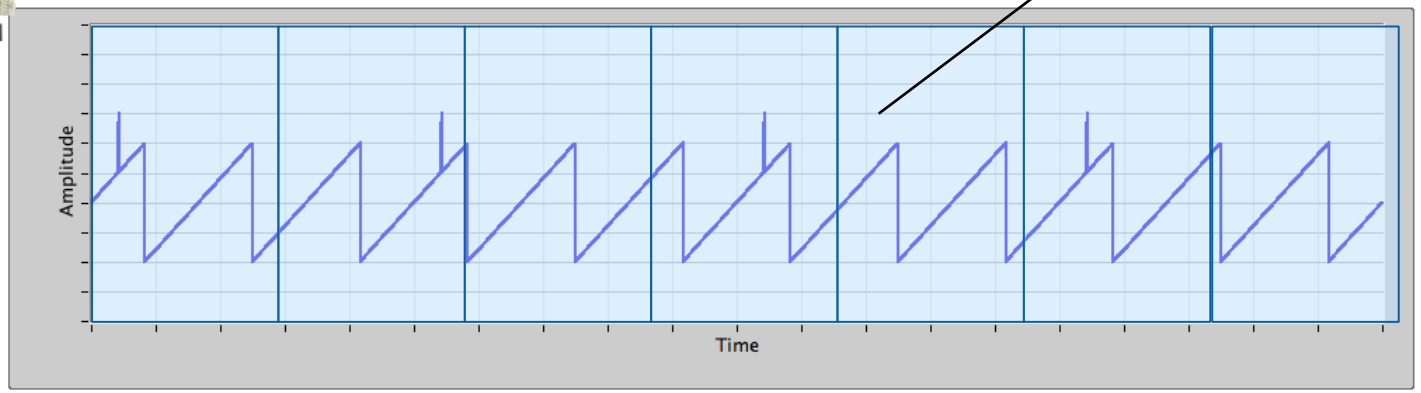
Only some events get captured



Dead time

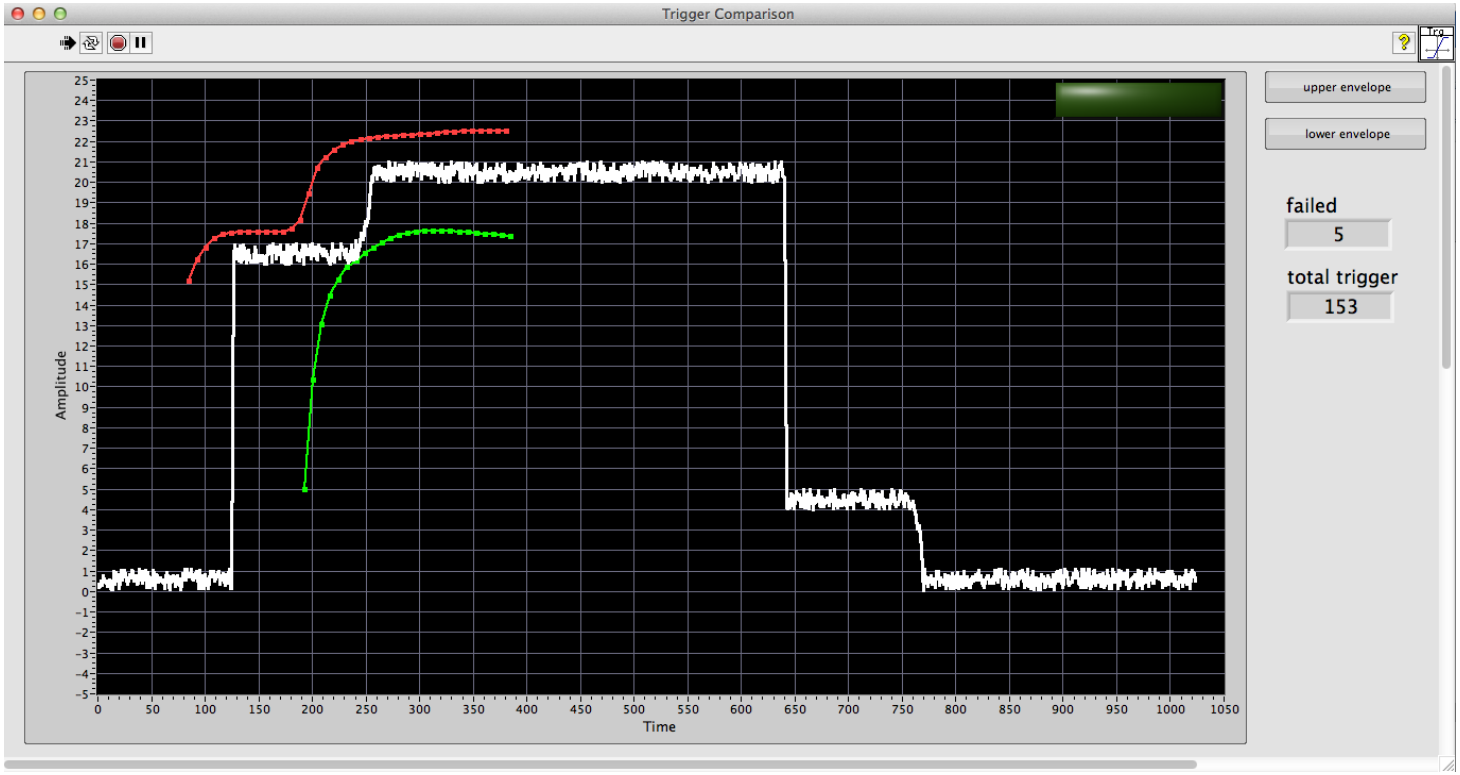
Acquisition window

Continuous acquisition and processing without dead time **capturing all events**



Demo: Time Domain Mask Trigger

- Acquire signals (glitch) that are within a given envelope

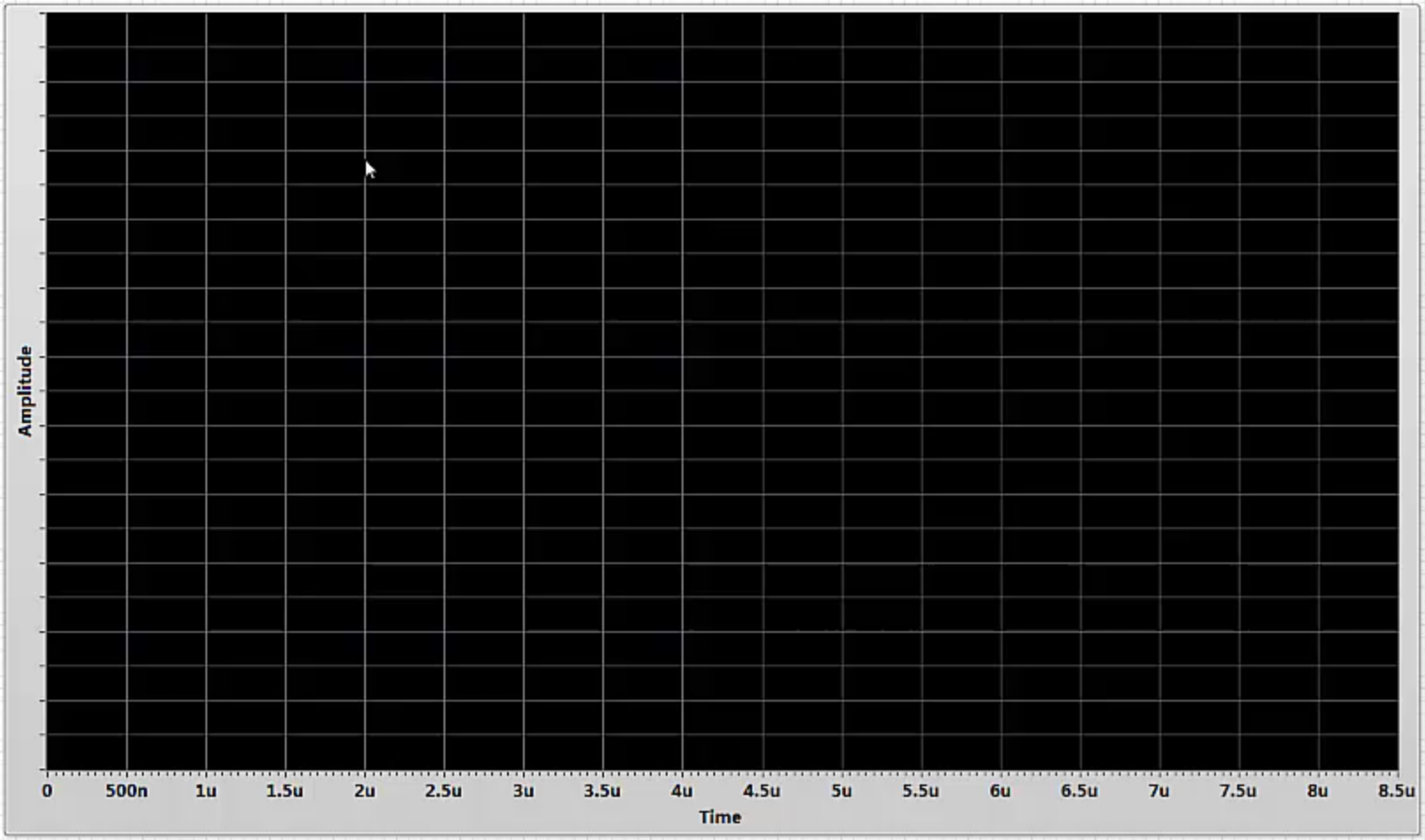


Configured Acquisition With Envelope Trigger Ver4.vi Front Panel on Multirecord Acquisition With Envelope Trigger Support (NI 5171R 8CH).lvproj/My Computer

File Edit View Project Operate Tools Window Help

15pt Application Font

Search

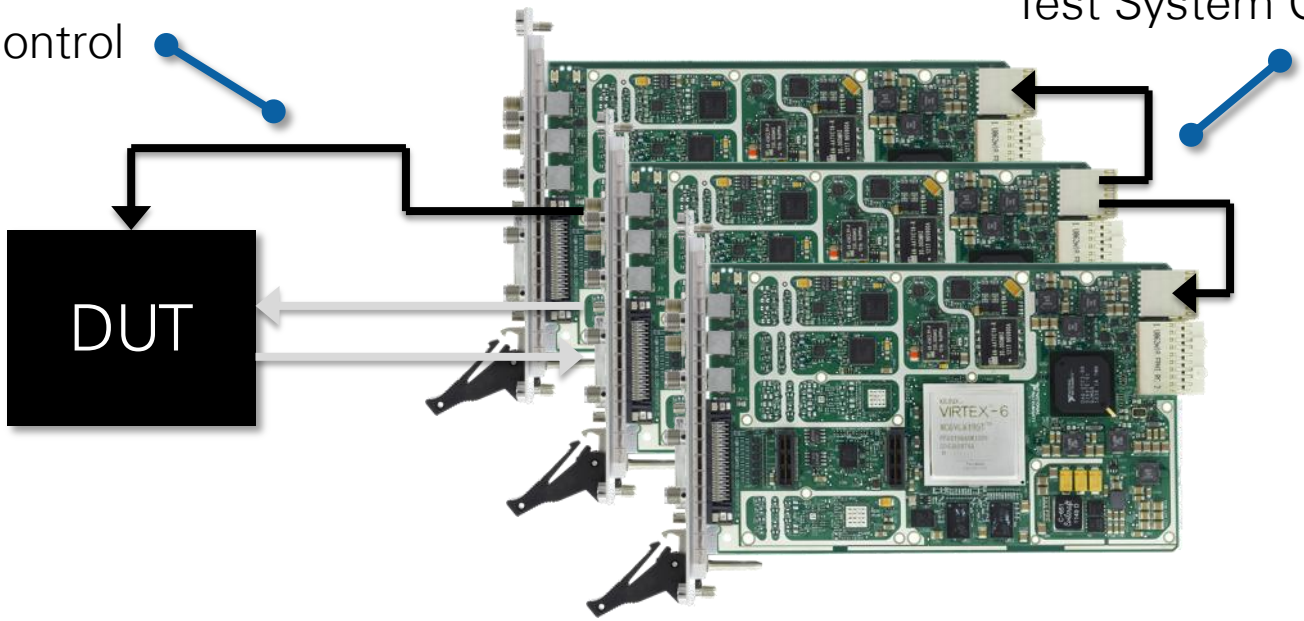


upper envelope

lower envelope

Stop

Multirecord Acquisition With Envelope Trigger Support (NI 5171R 8CH).lvproj/My Computer



4. Deterministic Test Execution and DUT Control

Higher Test Throughput

Hardware Re-Use and Future-Proofing

New, Innovative Tests

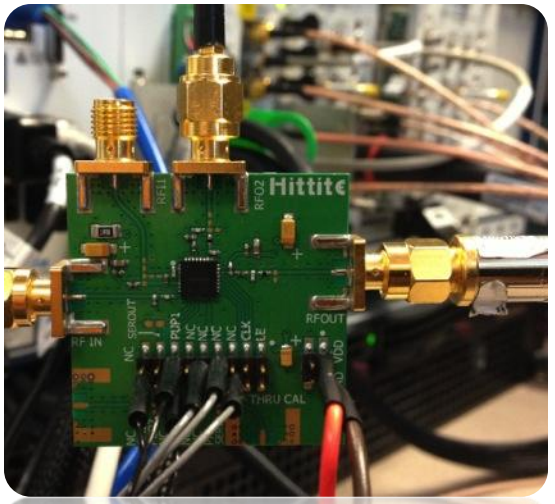
Lower Total Cost of Test

6 GHz, 200 MHz Bandwidth Vector Signal Transceiver

PXIe-5646R Specifications	
Configuration	VSA and VSG with independent LOs 24 DIO lines
Frequency Range	65 MHz to 6 GHz
Sample Rate	**250 MS/s**
Bandwidth	**200 MHz**
Features	• Virtex-6 **LX240T** programmable FPGA w/ LabVIEW • Fast Tuning Mode: <400 µs
New Features	• Support for 802.11ac 160 MHz • Support for LTE-Advanced

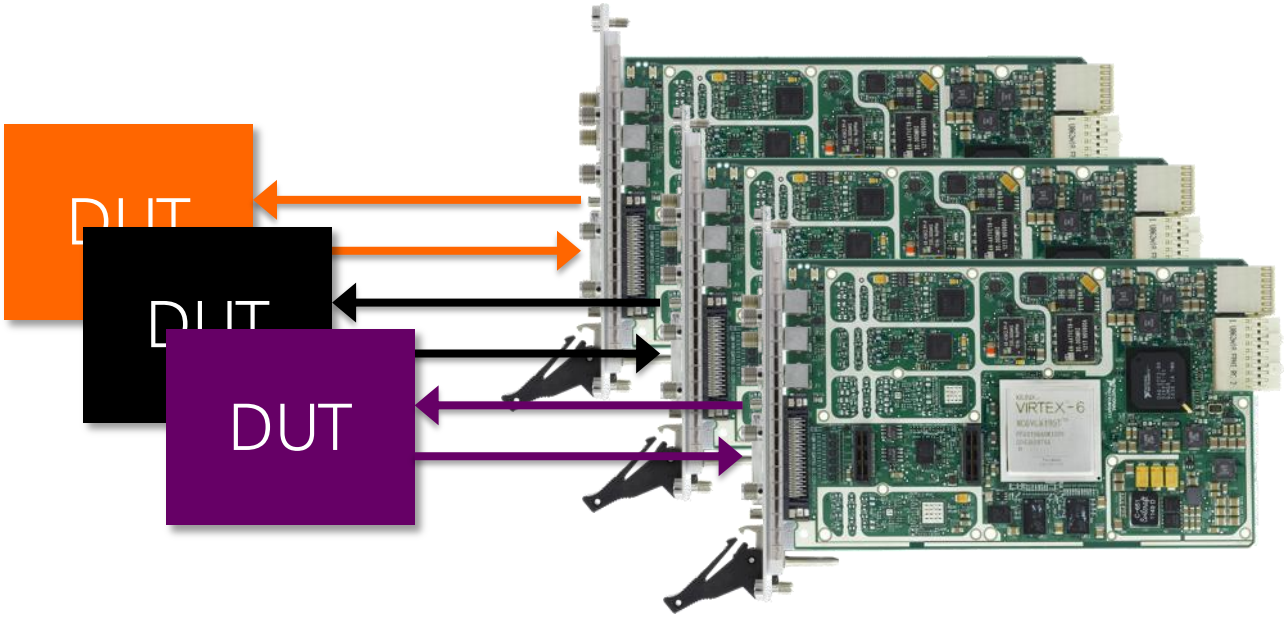
Hittite Production Test

- Using Instrument Driver FPGA Extensions
- 30x lower test times
- Increased test coverage



"With instrument driver FPGA extensions and the LabVIEW programming experience, we can easily take advantage of the FPGA to dramatically decrease our test times while preserving all of the hardware and software functionality we expect from our RF test equipment."

Gorkem Guven, Vice President of Hittite Microwave



5. DUT or Application-Specific Personalities

Higher Test Throughput

Hardware Re-Use and Future-Proofing

New, Innovative Tests

Lower Total Cost of Test

Multiple Personalities

DUT A
- Serial RapidIO
- 1 Lane
- 3.125 Gbps

DUT B
- Serial RapidIO
- 4 Lanes
- 6.25 Gbps

Software-Designed Instrument…. *Software*

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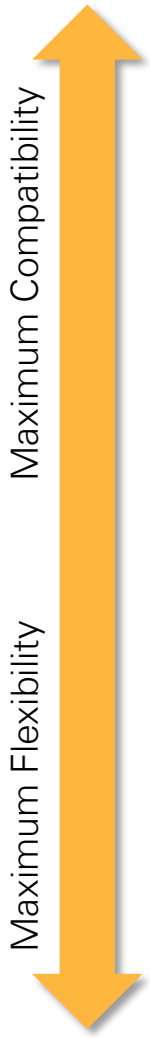
Software-Designed Instrument Programming Options



Instrument Driver

- Industry-standard programming paradigm
- Out-of-the-box functionality

Instrument Driver FPGA Extensions

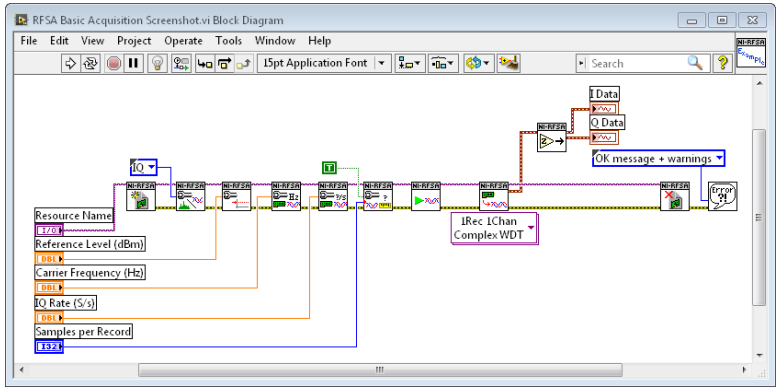
- Industry-standard programming paradigm
- Out-of-the-box functionality
- Application-specific FPGA enhancements

LabVIEW Sample Projects and Instrument Design Libraries

- Variety of architectural templates
- End-to-end customization of processor and FPGA capabilities

Instrument Drivers

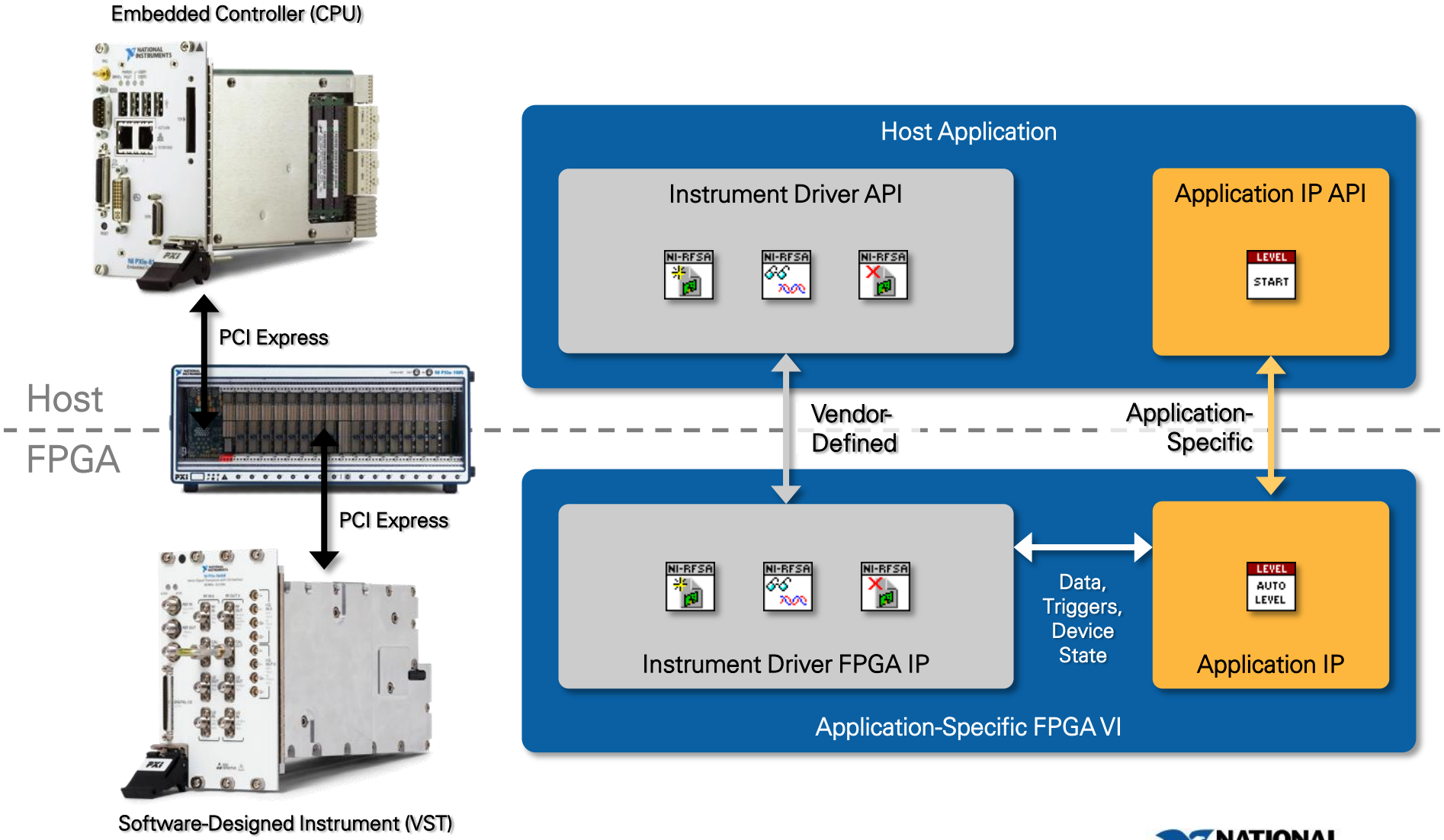
- Primary Benefit: Hardware Abstraction
  - APIs for simplified instrument programming
    - LabVIEW API
    - C/C++ and .NET APIs
  - Code portability
    - Across driver versions
    - Across hardware devices
    - Across vendors (IviScope, IviDMM)
- *NI* Instrument Drivers Add:
  - Configuration in NI MAX
  - Soft front panels (SFPs) for interactive use
  - Example programs that exercise full functionality of the API
  - Integrated API help/documentation



NI-RFSA LabVIEW API

NI-RFSA Soft Front Panel

Instrument Driver *FPGA Extensions*



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Build Your System Online - PXI Advisor

ni.com/advisors PXI

Next Steps

- ni.com/software-designed-instruments
  - Technical content
- ni.com/software-designed-instruments/getting-started
  - Examples and application IP
- High-Throughput LabVIEW FPGA Training
  - Link
- LabVIEW High-Performance FPGA Developer's Guide
  - Link
- Alliance Partners
  - ni.com/alliance – LabVIEW FPGA specialty

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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