
NATIONAL
INSTRUMENTS™

¡Bienvenidos al NI Military Days 2015!

National Instruments Colombia

NATIONAL INSTRUMENTS

Mission-Critical Applications with National Instruments

Long-Term Track Record of Growth

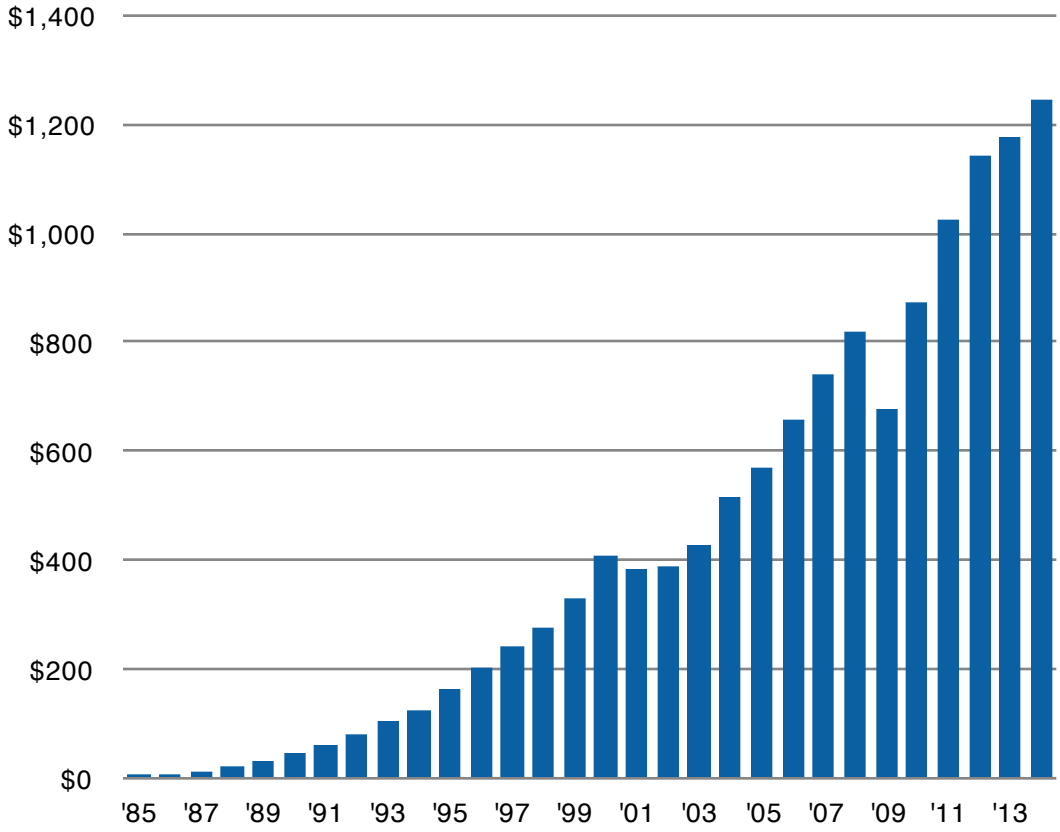
Revenue: $1.24 billion in 2014

Global Operations: Approximately 7,080 employees; operations in almost 50 countries

Broad customer base: More than 35,000 companies served annually

Diversity: No industry >15% of revenue

Culture: Ranked among top 25 companies to work for worldwide by the Great Places to Work Institute



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More than 30,000 companies

…including 90% of Fortune 500

Graphical System Design
A Platform-Based Approach for Measurement and Control

Test

Monitor

Embedded

Control

Cyber Physical

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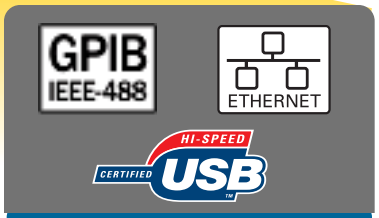
LabVIEW™

Desktops and PC-Based DAQ

PXI and Modular Instruments

RIO and Custom Designs



Open Connectivity With Third-Party I/O

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Addressing Longer Life-Cycles and System Complexity leveraging COTS technologies

In 2002, the DoD began articulating the need for a more flexible, **software-centric approach** to fielding Automatic Test Equipment.

> *"Recent commercial technology allows for the development of **synthetic instruments** that can be configured in real time to perform various test functions….A single 'synthetic' instrument can replace numerous single function instruments thereby reducing the logistics footprint and solving obsolescence problems."*

Evolution of ATE

Rack and Stack

COTS/Modular

Software Defined

1970's

1990's

2000's

1987: VXI Invented

1997: PXI Invented

1998: IVI Foundation formed

2003: ATML

2006: Synthetic Instrumentation

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The Rise of Software

- F-22: 1.7M lines of code
- F-35: 5.7M lines of code
- A380: >7M lines of code
- *Luxury Automobile: 100M lines of code*

Source: IEEE Spectrum

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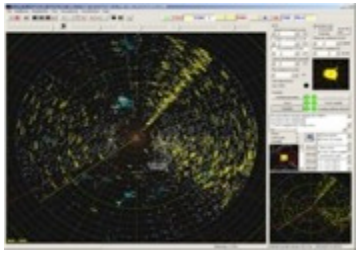
In-line Signal Processing is a key attribute in addressing todays challenges

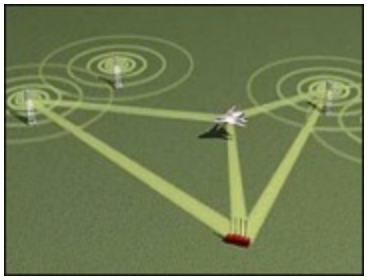
Spectrum Monitoring



Electronic Warfare

Radio

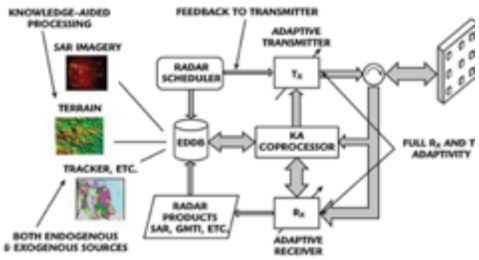
Signal Intelligence



Passive RADAR

Satellite Communication

Counter IED



Cognitive RADAR

Navigation

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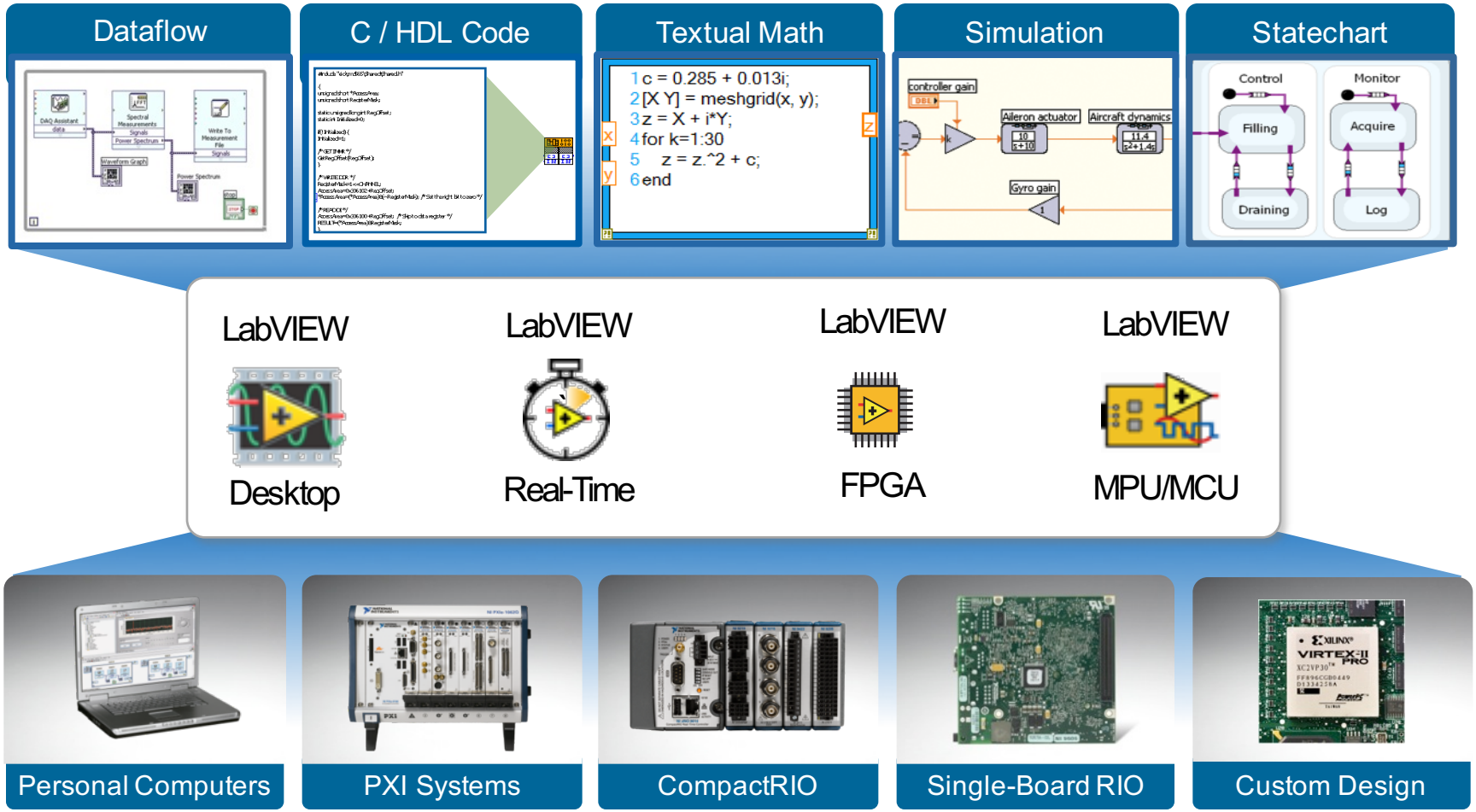
Graphical System Design

High Level Software Abstraction Tools



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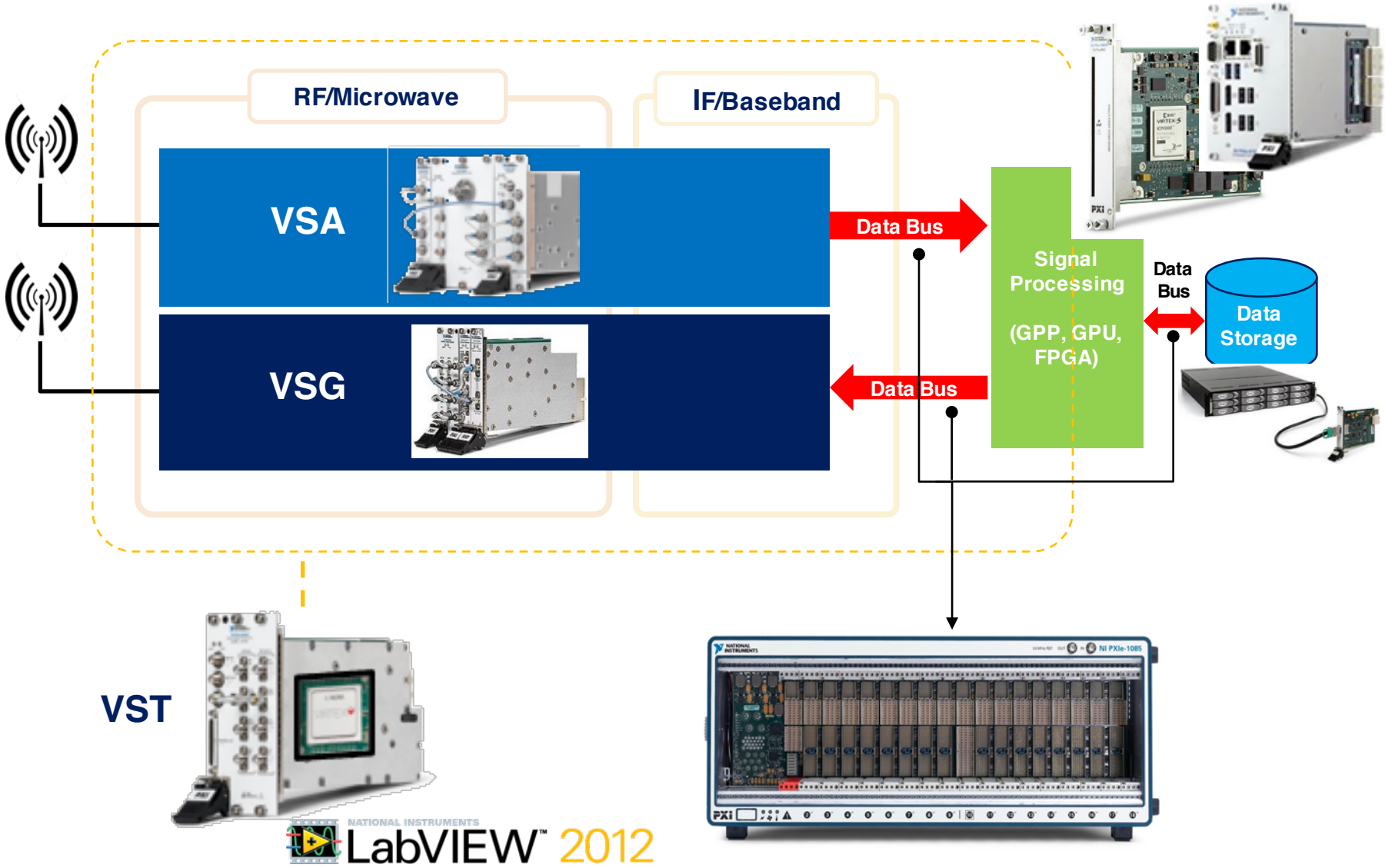
Software Designed Systems – Platform Architecture



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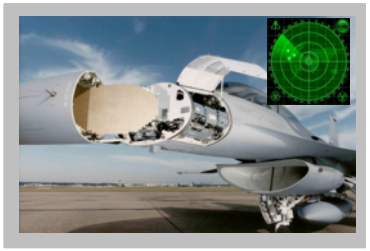
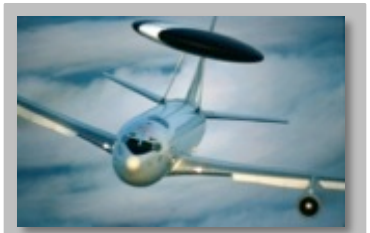
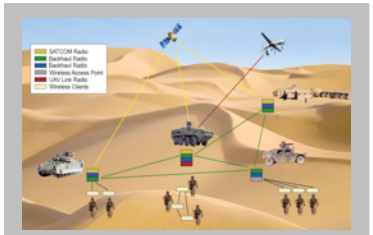
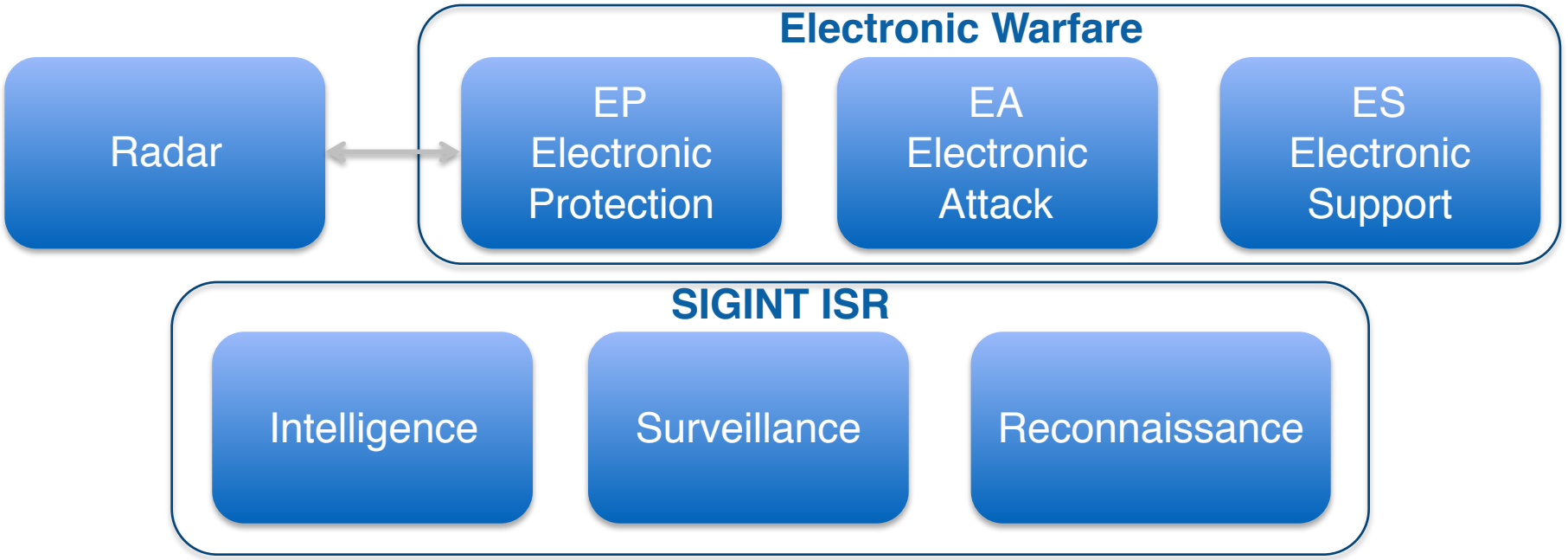
A/D Target Application Areas

RADAR	EW/SIGINT	Communications	Navigation	ATE
				
Primary Radar **Secondary Radar**	**SIGINT** **Spectrum Monitoring** **Jamming/CIED** **ISR**	**SATCOM** **Military Radio** **Telemetry** **SDR/CR**	**Aviojnics Test** **Navigation** **Positioning**	**Depot Level** **Intermediate Level** **Organizational Level** .

Application Challenges



Challenges

- Faster and smaller targets
- Quickly emerging threats
- Counter Measures
- Network centric requirement
- More data
- Embedded intelligence / complex processing
- SWaP constraints

Design/Test Platform Technologies

- Wider bandwidths
- Greater dynamic range
- Tighter synchronization
- Greater processing capabilities
- Better software for algorithm development and collaboration
- Big Data Analysis

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Three Categories of Radar

Primary RADAR	Secondary RADAR	RADAR Research (Passive RADAR)
“Classic” RADAR based on sourcing a signal and measuring the “echo” off of a device.	“Friendly” RADAR systems that measure aircraft/marine position from interrogating a transponder.	Experimental systems such as passive radar, that measure reflections from commercial broadcast signals.

SAAB Giraffe

Airport RADAR

Selex AULOS

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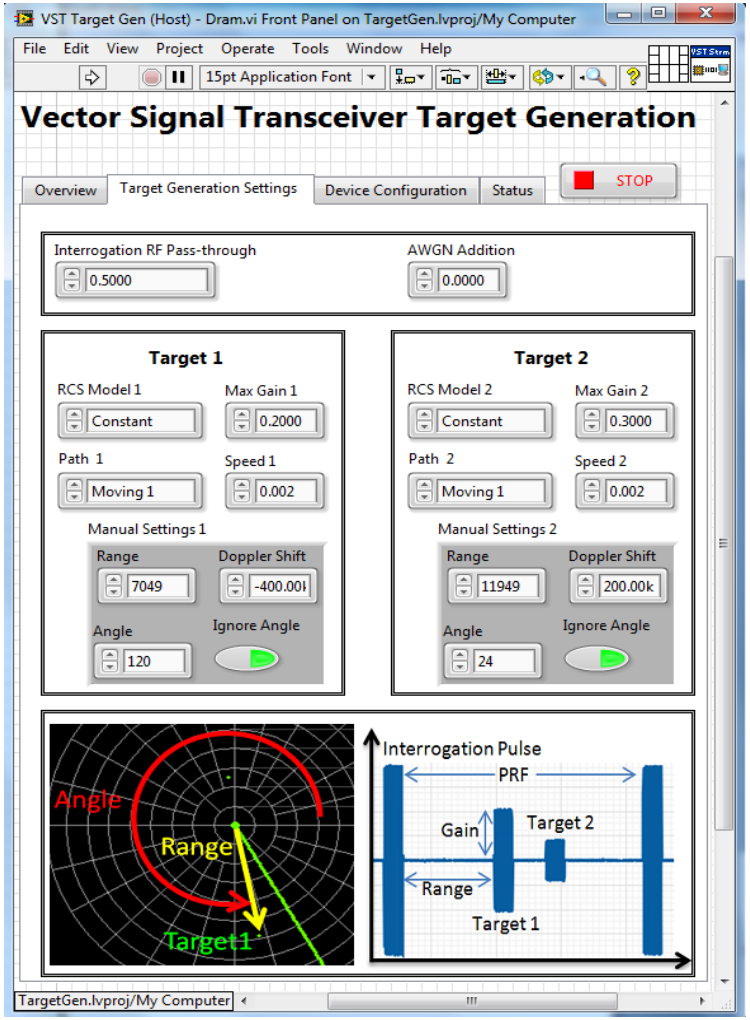
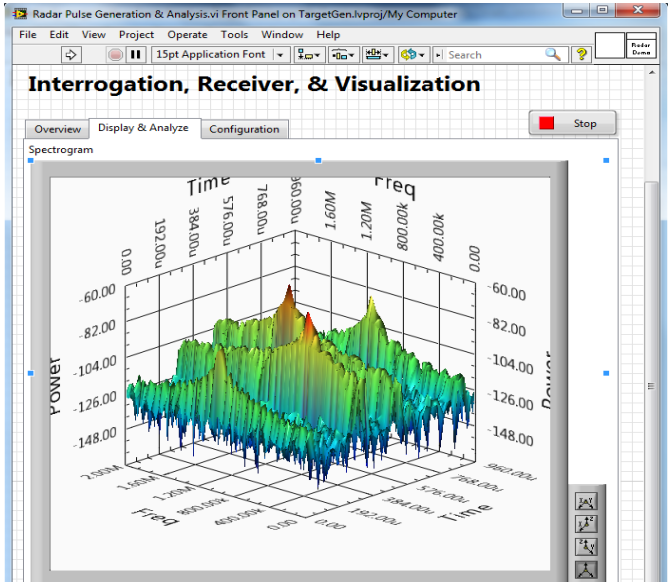
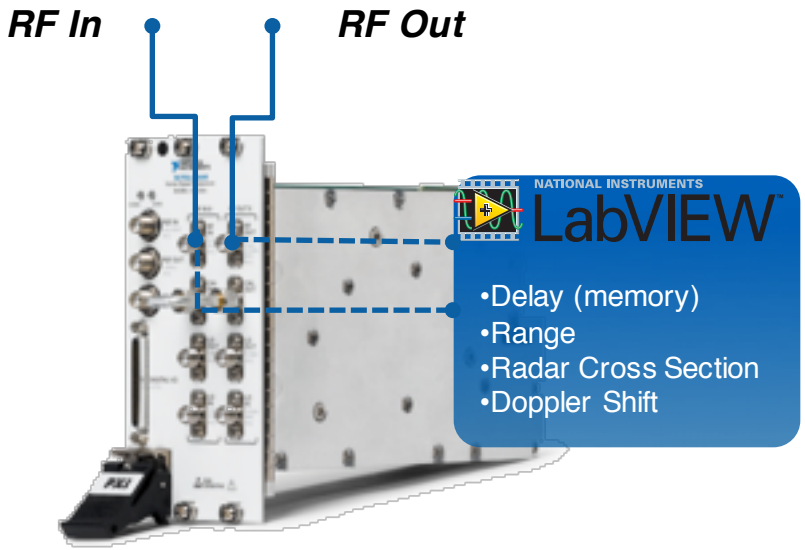
Enabling Concurrent Radar Design & Test

Target Emulation







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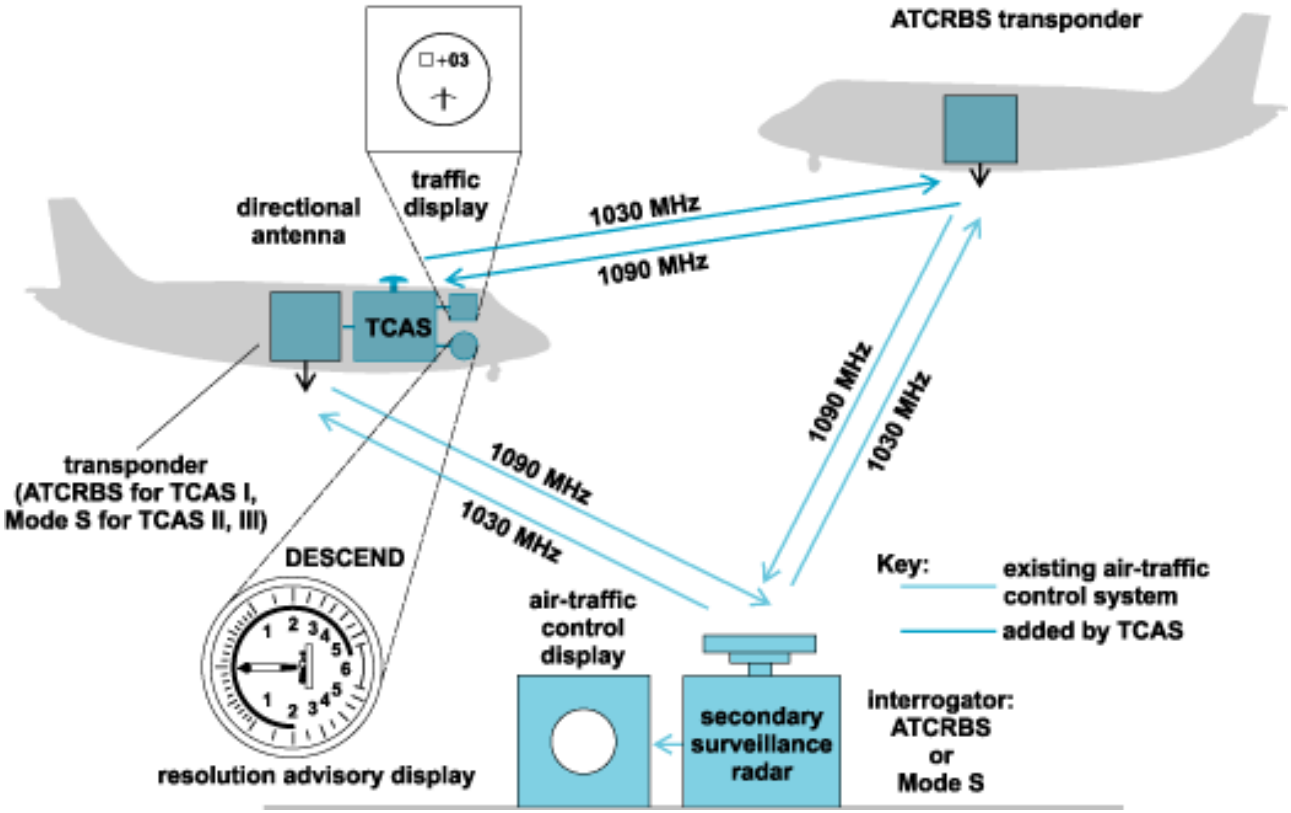
Secondary Surveillance Radar / Transponder Interrogation (TCAS)



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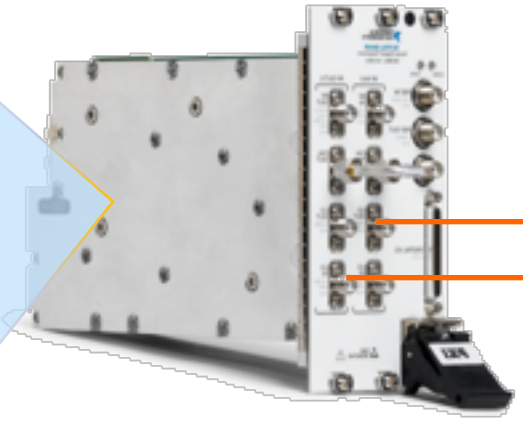
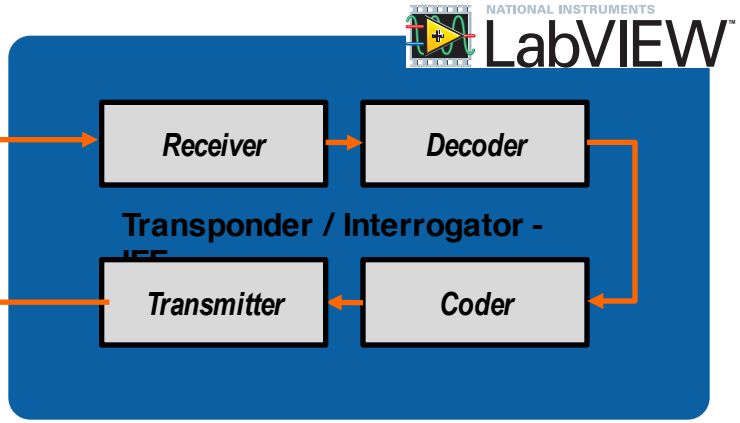
Prototyping Secondary Surveillance Radar

SSR Mode	User
1	military
2	military
3/A	military & civilian
4	military
5	military
C	military & civilian
S	military & civilian





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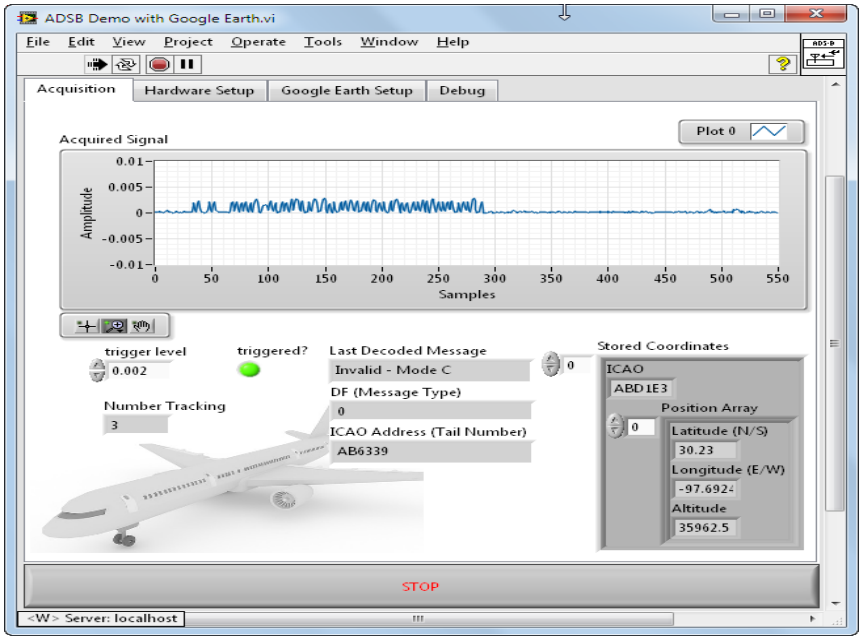
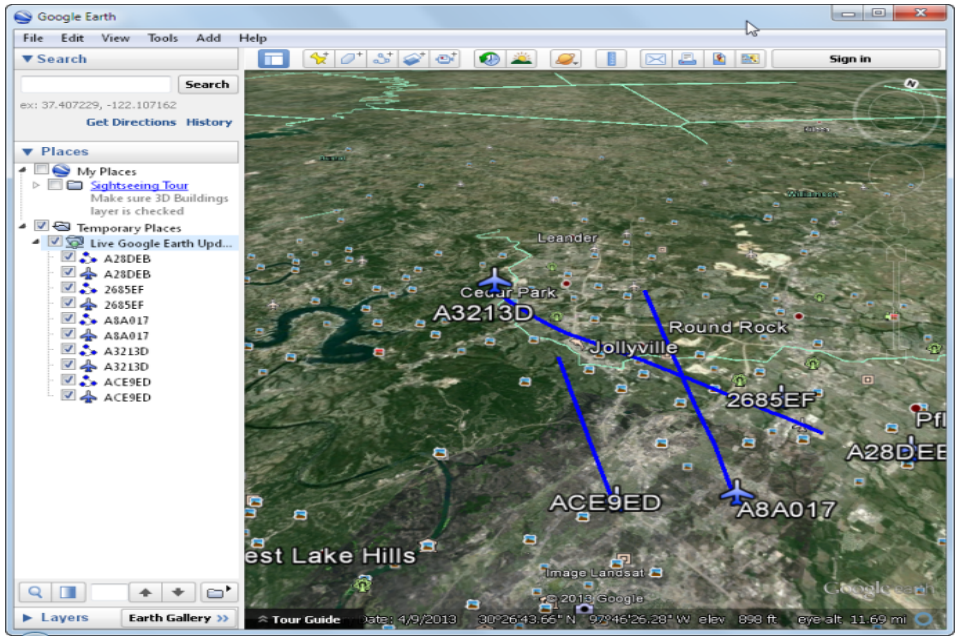
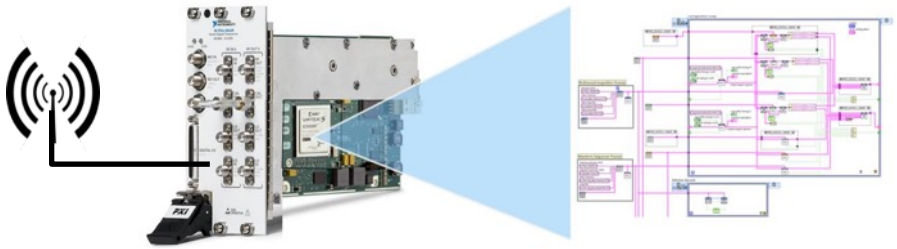
Testing Secondary Surveillance Radar Ground Support





Ground Station



Flight Path Simulation

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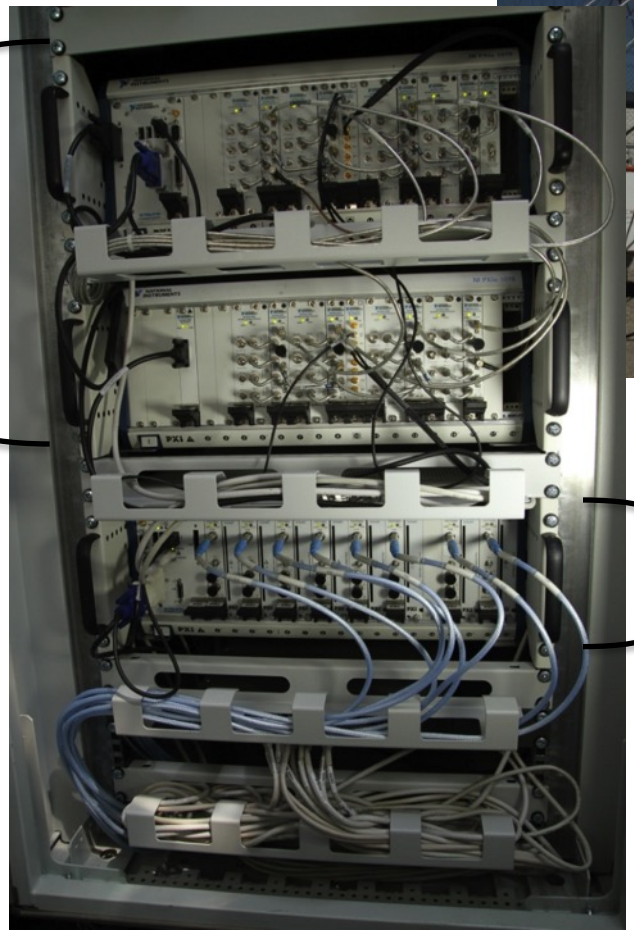
Passive RADAR Design in PXI

"We chose NI products because of the user-friendly environment to develop the software"

- Dr. Riccardo Mancinelli, Selex Sistemi Integrati

Real-World Deployment Example

Selex Passive Radar System



Radar Acquisition System

Radar Test System

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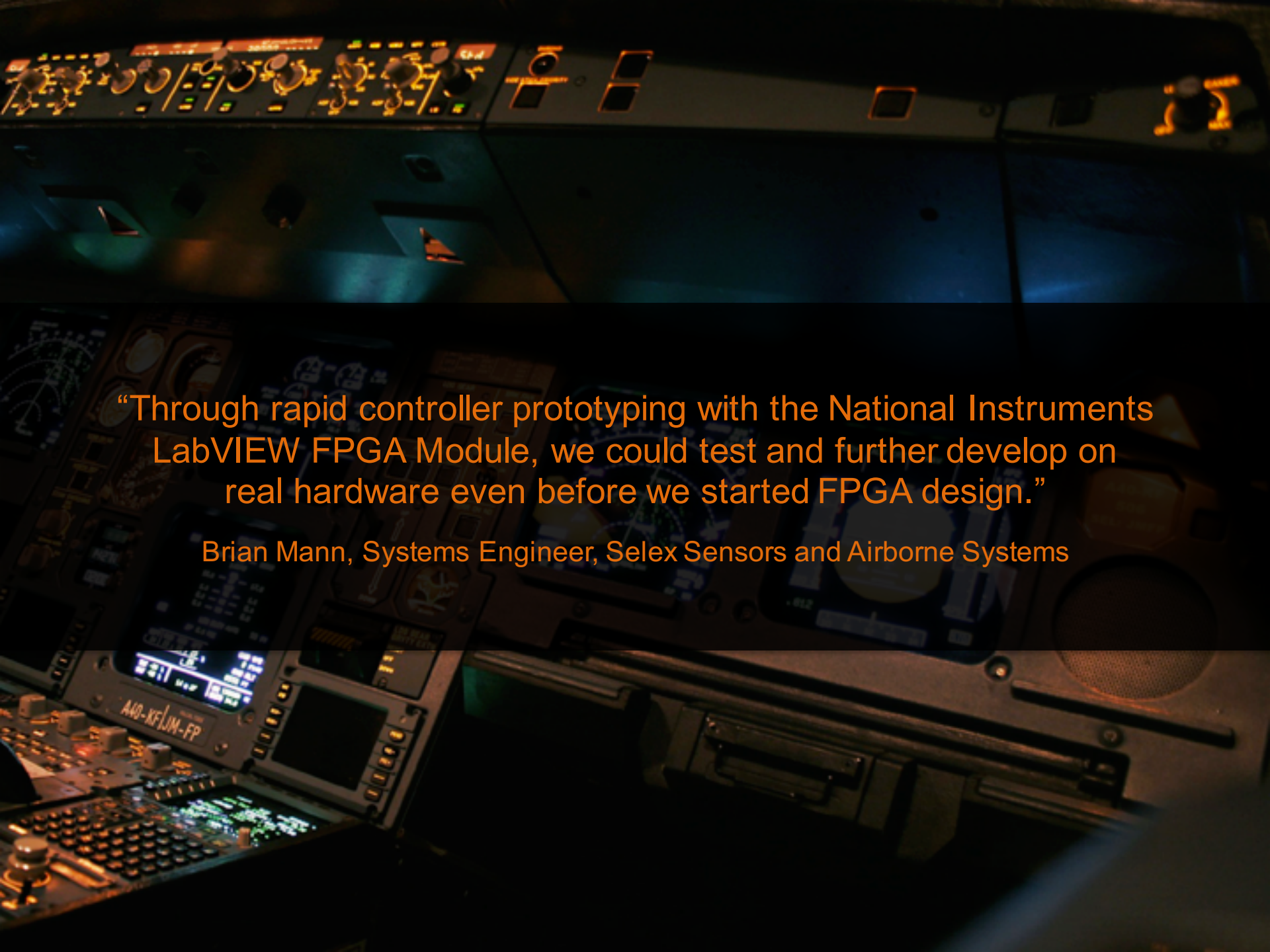

"Through rapid controller prototyping with the National Instruments LabVIEW FPGA Module, we could test and further develop on real hardware even before we started FPGA design."

Brian Mann, Systems Engineer, Selex Sensors and Airborne Systems

EW/SIGINT

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

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PXIe-5654 + AE Signal Generator

Specifications	
Frequency Range	250 kHz to **20 GHz**
Max. Output Power	**+24 dBm**
Attenuation	130 dB
Phase Noise (Typ, @10kHz offset)	-133 dBc/Hz @ 1GHz -122 dBc/Hz @ 10GHz
Switching Speed	100 µs
Level Accuracy	± 0.9 dB
Harmonics (typ, +10dBm output)	**< -50 dBc**
Pulse Modulation	80 dB on/off ratio, typ 15 ns rise/fall time

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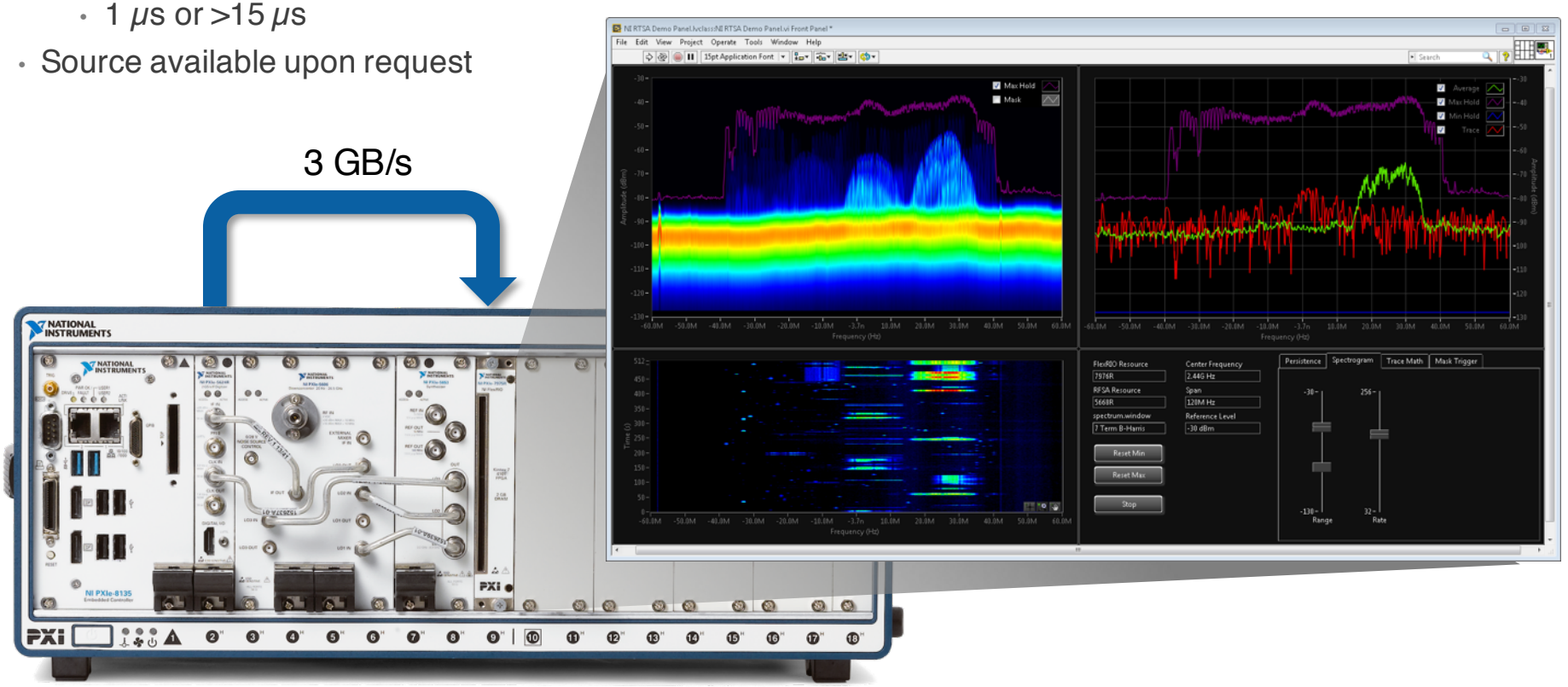
Real-Time Spectrum Analysis

- 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



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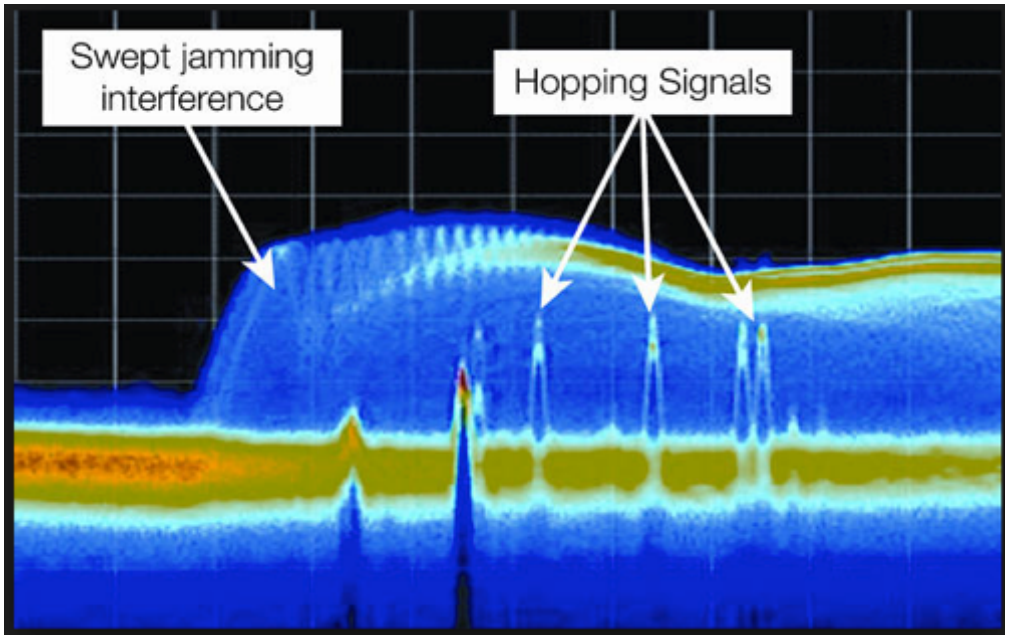
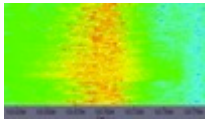
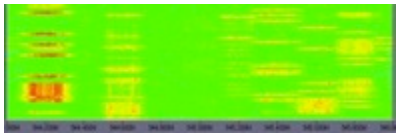
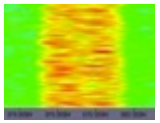
FPGA Signal Processing and Visualization

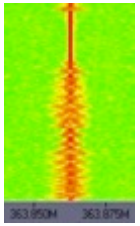


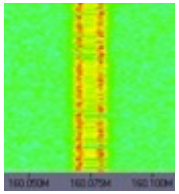
JTFA Images of Example Wireless Stds within Spectrum


FM Radio (Stereo)


GSM


CDMA


Walkie-Talkie (FM)


Paging (FSK)

Provided from VISN Spectrum Monitoring Toolkit

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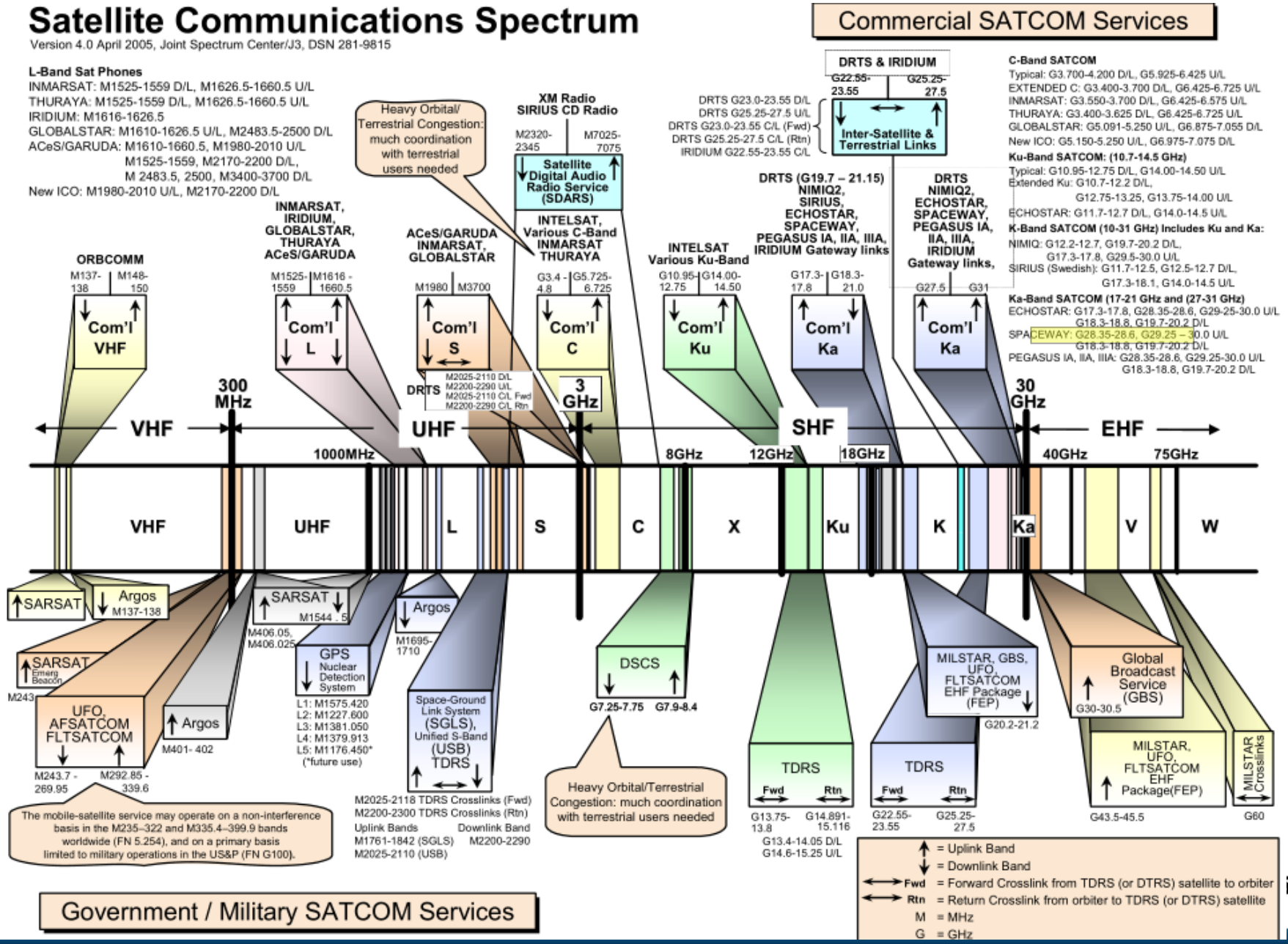
MILCOM

SATCOM Example



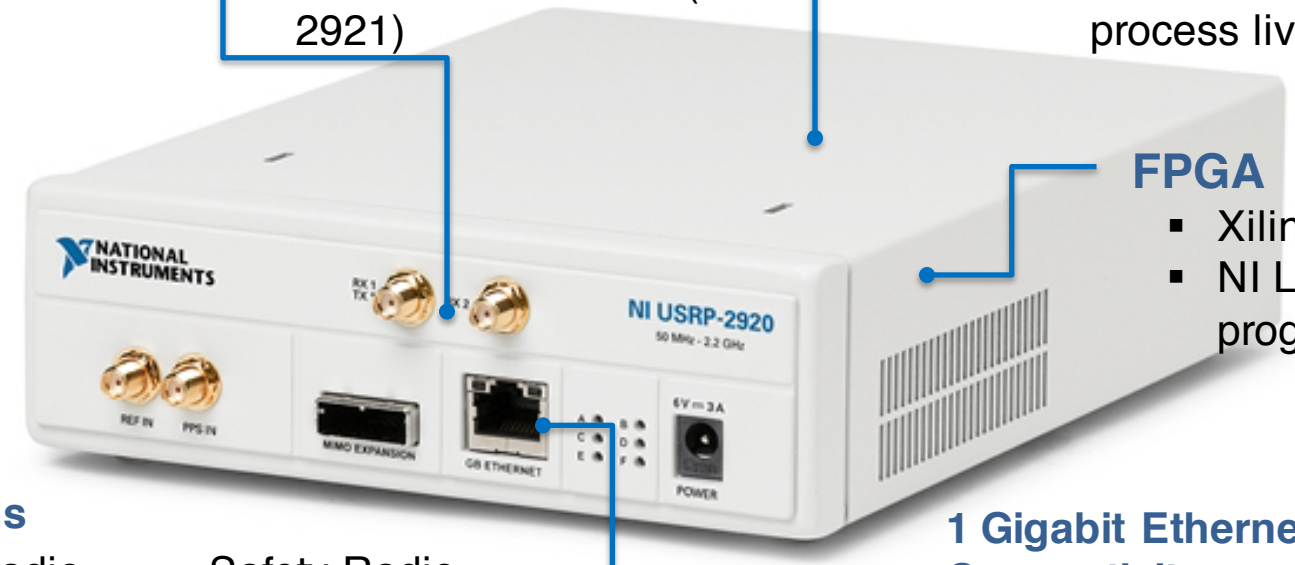
NI USRP – SDR RF Algorithm Prototyping

Tunable RF Transceiver Front Ends

- Frequency Range
  - 50 MHz – 2.2 GHz (NI-2920)
  - 400 MHz – 4.4 GHz (NI 2922)
  - 2.4 GHz & 5.5 GHz (NI-2921)

Signal Processing and Synthesis

- NI LabVIEW to develop and explore algorithms
- NI Modulation Toolkit and LabVIEW add-ons to simulate or process live signals



FPGA

- Xilinx K7
- NI LabVIEW programmable

Applications

- FM & AM Radio
- TV
- GPS
- LTE
- GSM
- Safety Radio
- OFDM
- Passive Radar
- Dynamic Spectrum Access
- ADS-B
- VOR ILS, ETC

1 Gigabit Ethernet Connectivity

- Plug-and-play capability
- Up to 25 MS/s baseband IQ streaming

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Evolution of RF and Microwave Instrumentations
NI PXIe-5644R

The World's First Vector Signal Transceiver

- Up to 6.0 GHz frequency coverage
- Up to 200 MHz analysis bandwidth
- 32 pin High Speed bi-directional Digital
- Integrated RF generation, RF analysis and high-speed digital
- Low-cost, low-power, small footprint
- **Based on the NI LabVIEW RIO architecture**

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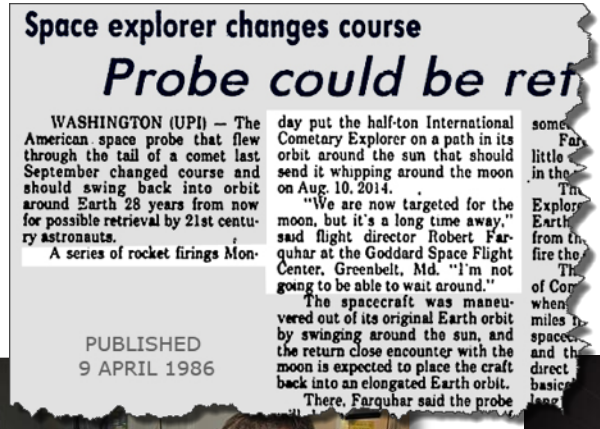
Satellite Communication: ISEE-3 Rebooted After 36 Years

Launch: Aug 12, 1978
Contact: May 29, 2014



Space explorer changes course

Probe could be ref

WASHINGTON (UPI) — The American space probe that flew through the tail of a comet last September changed course and should swing back into orbit around Earth 28 years from now for possible retrieval by 21st century astronauts.

A series of rocket firings Monday put the half-ton International Cometary Explorer on a path in its orbit around the sun that should send it whipping around the moon on Aug. 10, 2014.

"We are now targeted for the moon, but it's a long time away," said flight director Robert Farquhar at the Goddard Space Flight Center, Greenbelt, Md. "I'm not going to be able to wait around."

The spacecraft was maneuvered out of its original Earth orbit by swinging around the sun, and the return close encounter with the moon is expected to place the craft back into an elongated Earth orbit.

There, Farquhar said the probe

PUBLISHED
9 APRIL 1986

Source: spacecollege.org

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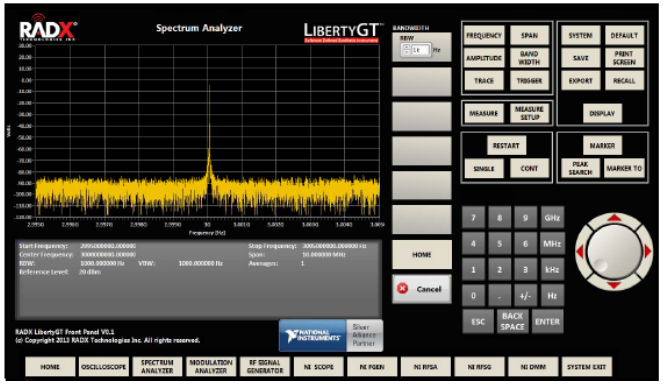
RADX LibertyGT – Radio Test Set

RADX TECHNOLOGIES, INC.
Knowledge is Good!



- RADX LibertyGT COTS Integrated Benchtop Enclosure
  - HD Touchscreen Display
  - Integrated RFIU
  - NI 1085 Components
- Specific COTS NI PXIe Modules
- RADX COTS Measurement Science
- Includes: DMM, Digitizer, CAN, 1553, A/V and more

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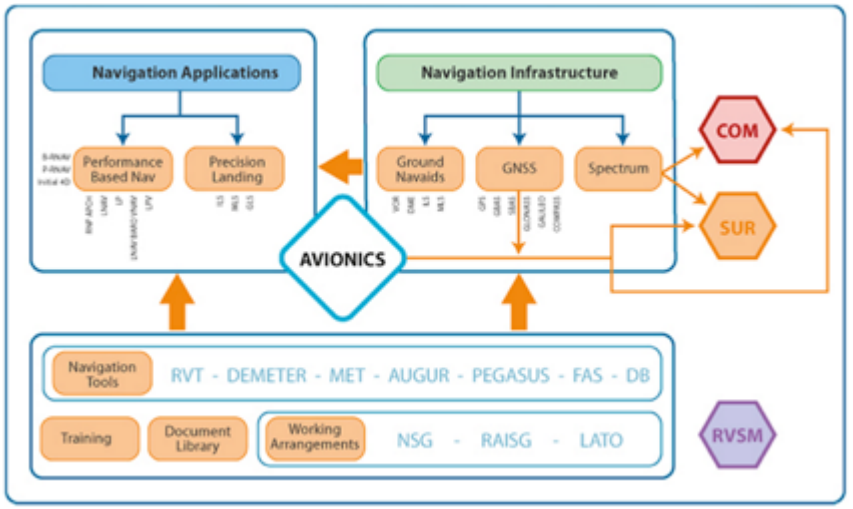
"The National Instruments platform gave us the ability to significantly scale our production test throughput by 400 percent with ROI of 185 percent while rigidly maintaining the quality and performance standards that our military radios are known for."

Joseph Nakoski, Engineering Director, RF Communications Division, Harris Corporation

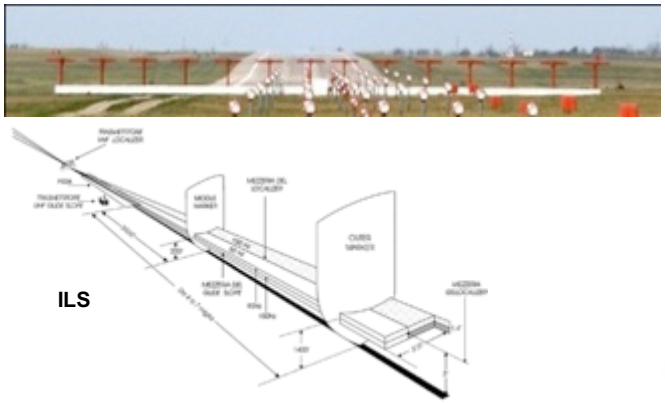
NAVIGATION

CNS/CNI - Navigation

- Autonomous Navigation
  - Inertial
  - Doppler (Radar Altimeter)
- Radio Navigation Aids
  - VOR (VHF Ominidirectional Range)
  - D-VOR (Doppler VOR)
  - DME (Distance Measuring Equipment)
  - ILS and MLS for landing
  - TACAN (TACtical Air Navigation) – military version of DME
  - SSR/IFF
- Satellite Navigation
  - GNSS
    - GPS (EGNOS)
    - Galileo
    - Glonass



http://www.ecacnav.com/Home



ILS

D-VOR/DME ground station

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Full Synthetic Instrument for Navigation

RNAV	Frequency Range
MB	75 MHz
VOR	108.00 - 117.95 MHz
ILS	Localizer: 108.1 - 111.95 MHz Glide Path: 329.15 - 335.00 MHz
NDB	190 - 513 KHz
DME	962 - 1213 MHz
TACAN	960 – 1215 MH
TCAS (SSR)	Transmit on 1030 MHz; Receive on 1090 MHz
ADS-B	1090 MHz (1090ES) 978 MHz (UAT)
IFF	Different Interrogator/Reply Freq (e.g. 1030 MHz / 1090 MHz)
GNSS	GPS: L-Band GALILEO: L-Band GLONASS: L-Band

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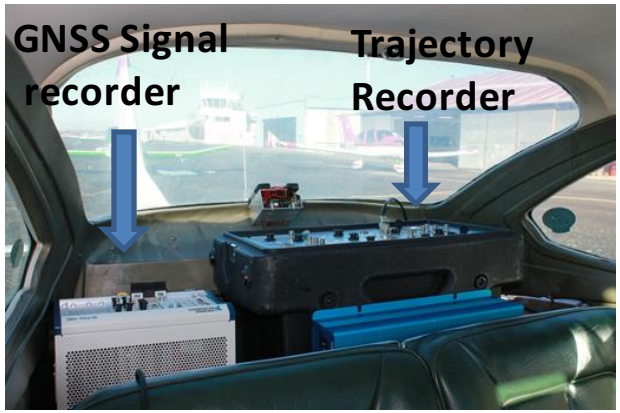
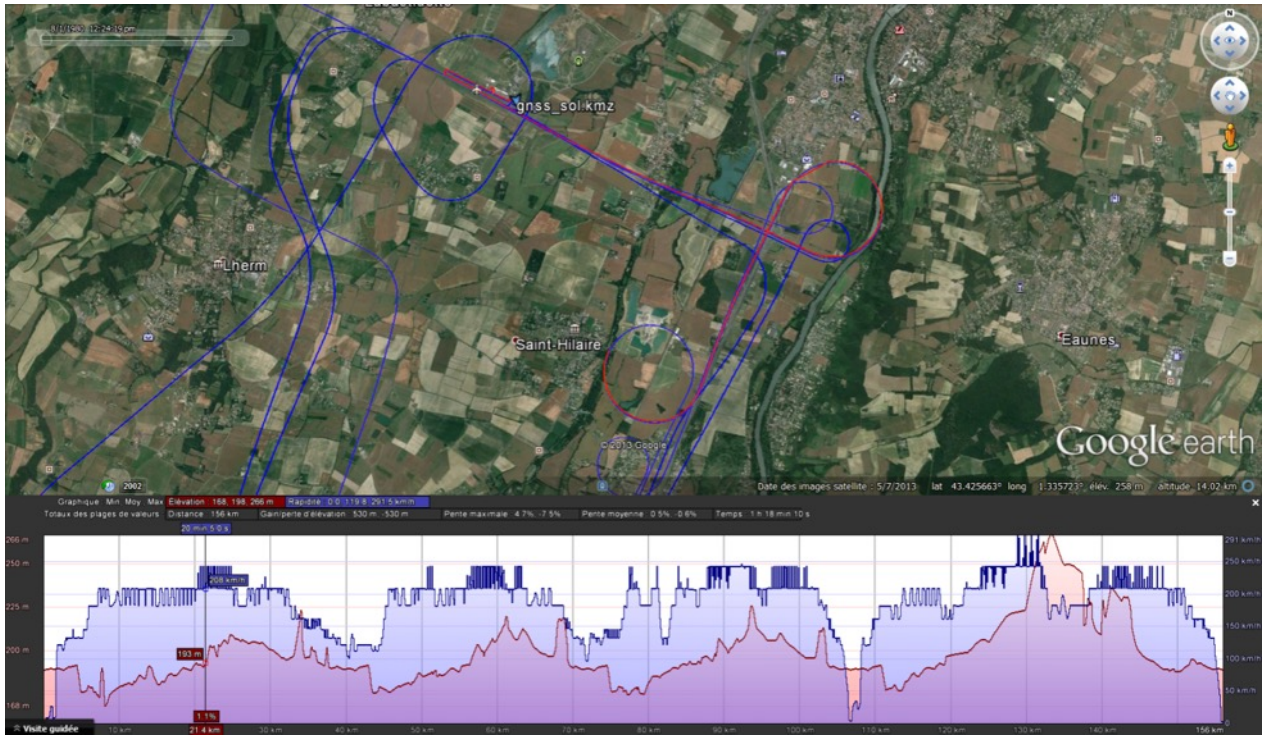
GNSS – Antenna Testing

- Comparison based receiver testing





One Solution – M3 Systems StellaNGC

- Integrated and modular Solution
- Upgradable hardware and software
- Unified platform
- V&V phases optimization
- Investments optimization

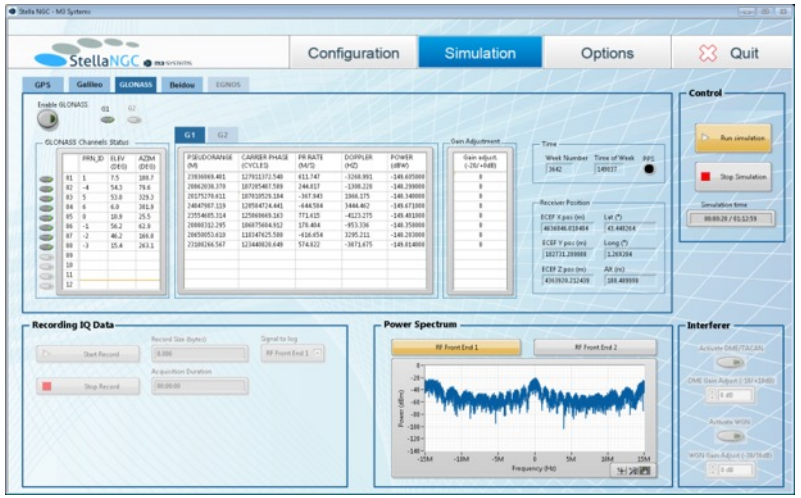
- M3S Software design radio (SDR)

- LabVIEW environment
- NI Vector Signal Transceiver Technology

- Compatible with automation test environment in API version

Signal Simulation

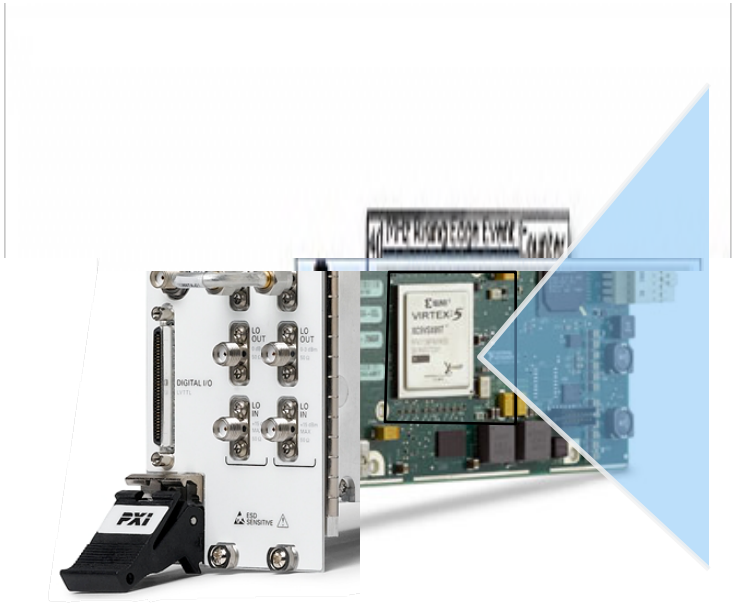
Record & Replay



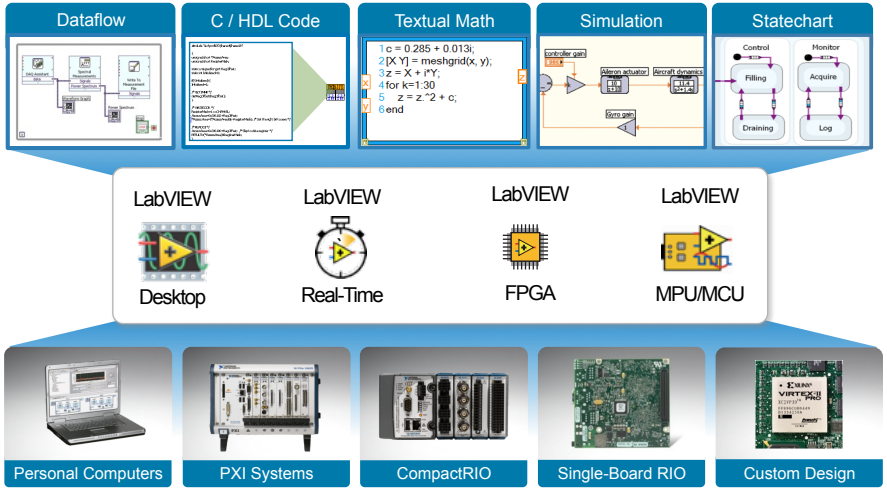
NATIONAL INSTRUMENTS LabVIEW

TestStand™

Redefining RF and Microwave Instrumentation



FPGA-based Hardware Architecture



Graphical System Design with LabVIEW

Software-*Designed* Instrumentation

NATIONAL INSTRUMENTS


Thank you for your time!