



NIWeek

WORLDWIDE GRAPHICAL SYSTEM DESIGN

CONFERENCE

Innovation in the Era of Graphical System Design

Dr. James Truchard

President, CEO, and Cofounder, National Instruments

Research Instrumentation in the 1960s



Wayne Kerr B121 RLC Bridge



General Radio 1910 Recording Wave Analyzer

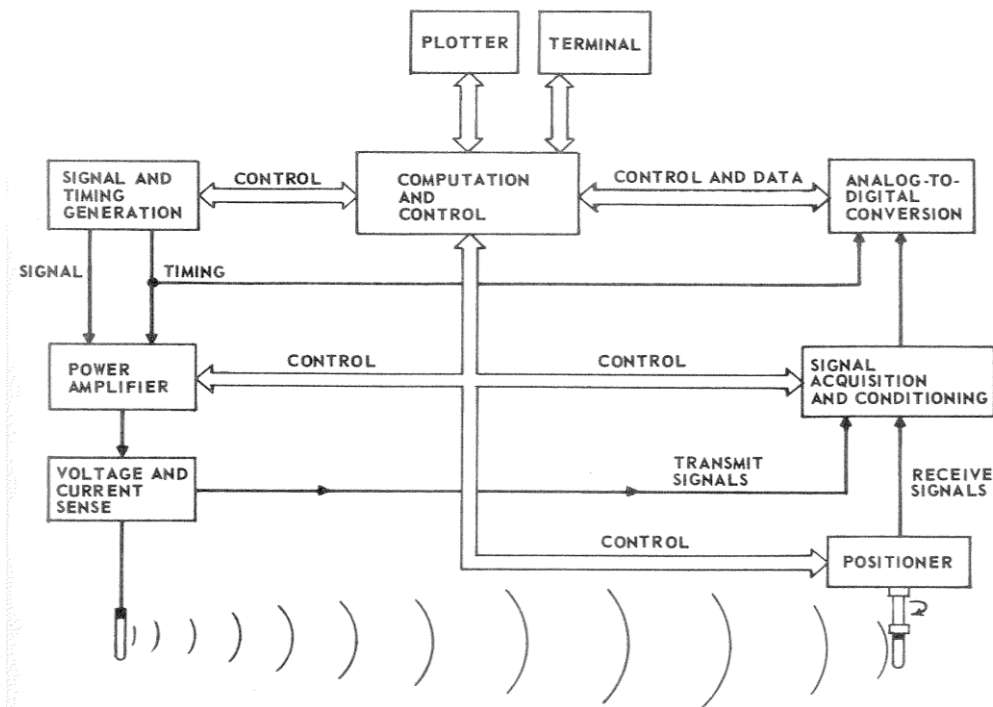


FIGURE 3
SIMPLIFIED BLOCK DIAGRAM OF AN AUTOMATED
ACOUSTIC MEASUREMENT SYSTEM

AN/FQM 12 Sonar Transducer Test System

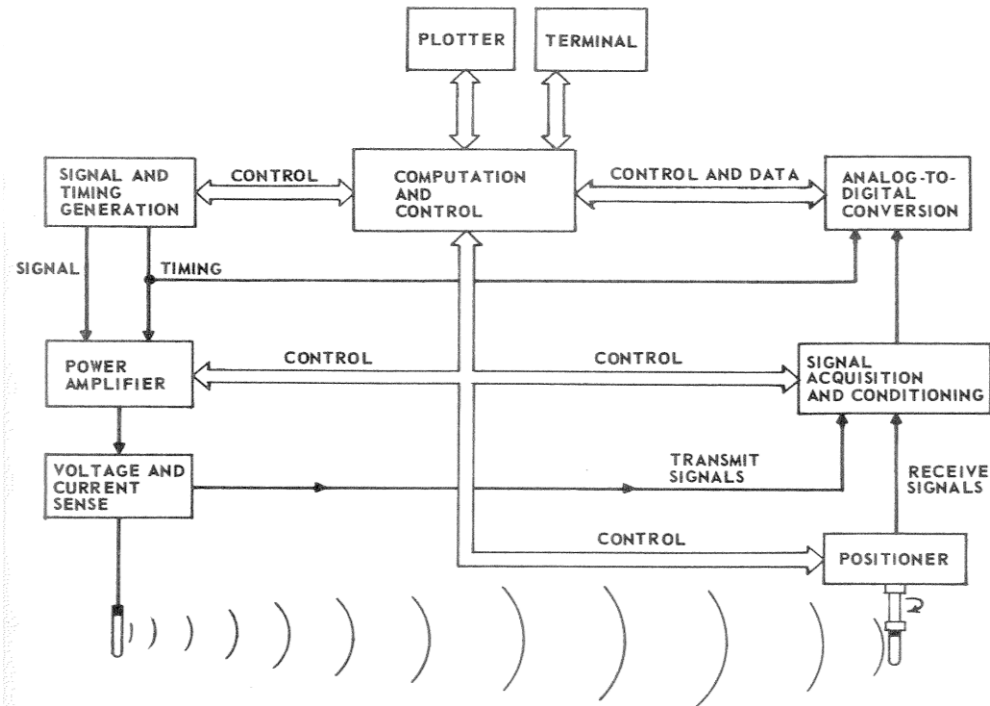
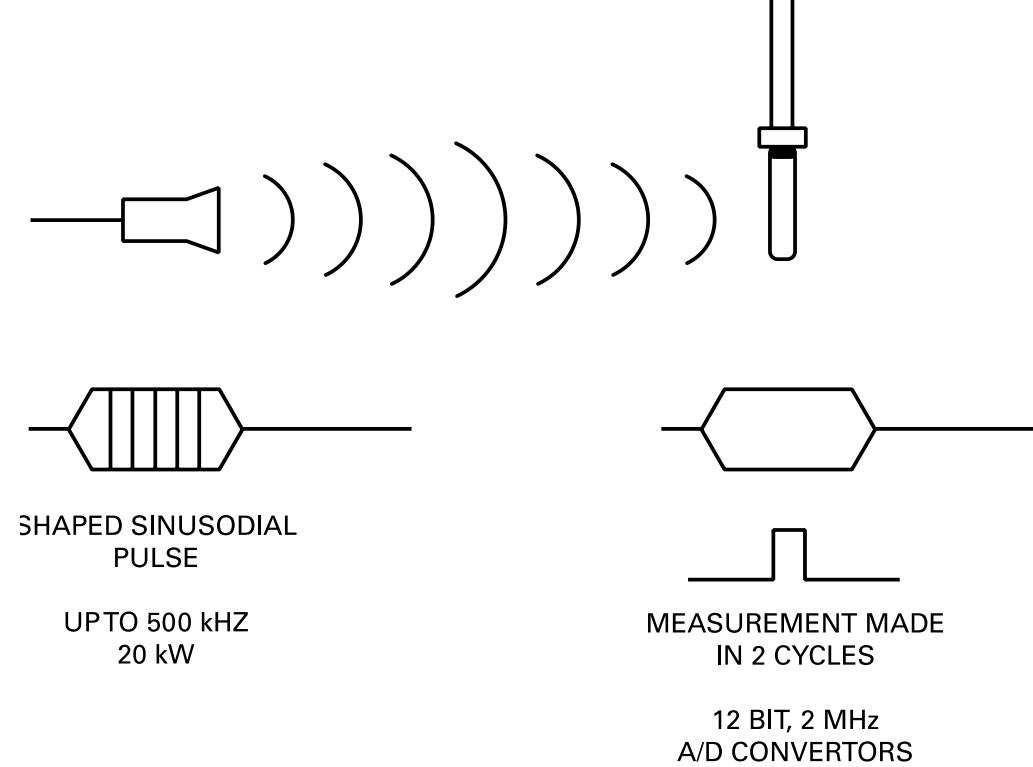


FIGURE 3
SIMPLIFIED BLOCK DIAGRAM OF AN AUTOMATED
ACOUSTIC MEASUREMENT SYSTEM



3 PDP - II'S
WITH UNIX AND REALTIME-UNIX

Evolution of Instrumentation

1920

Vacuum Tubes



General
Radio



1965

Transistors
(Integrated Circuits)

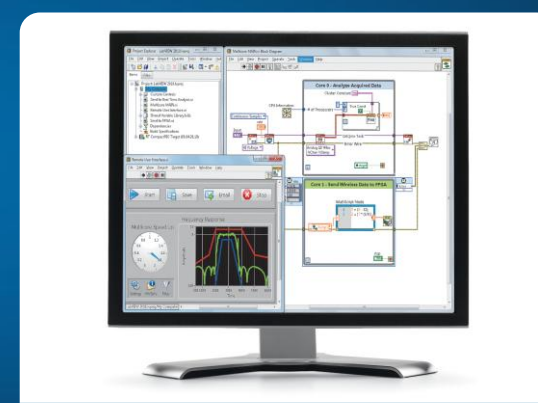


Hewlett
Packard



2010

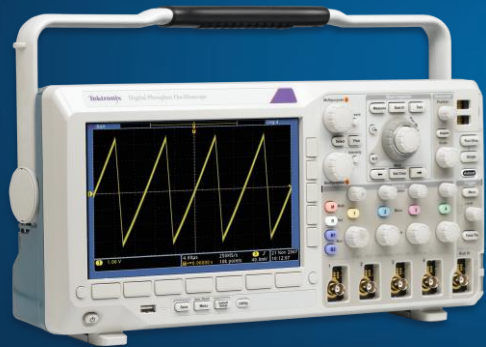
Software



National
Instruments



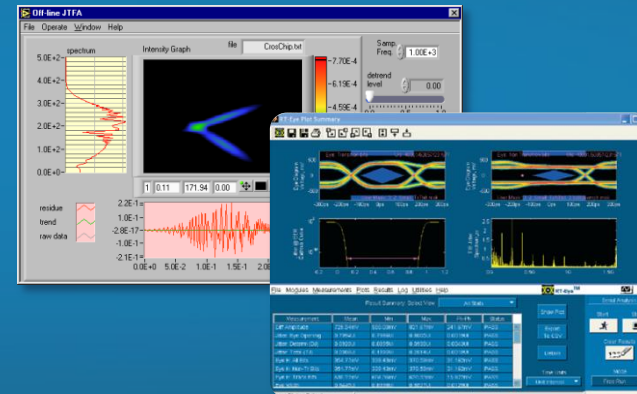
Instrument Use Cases



Stand Alone



PC-Based Analysis



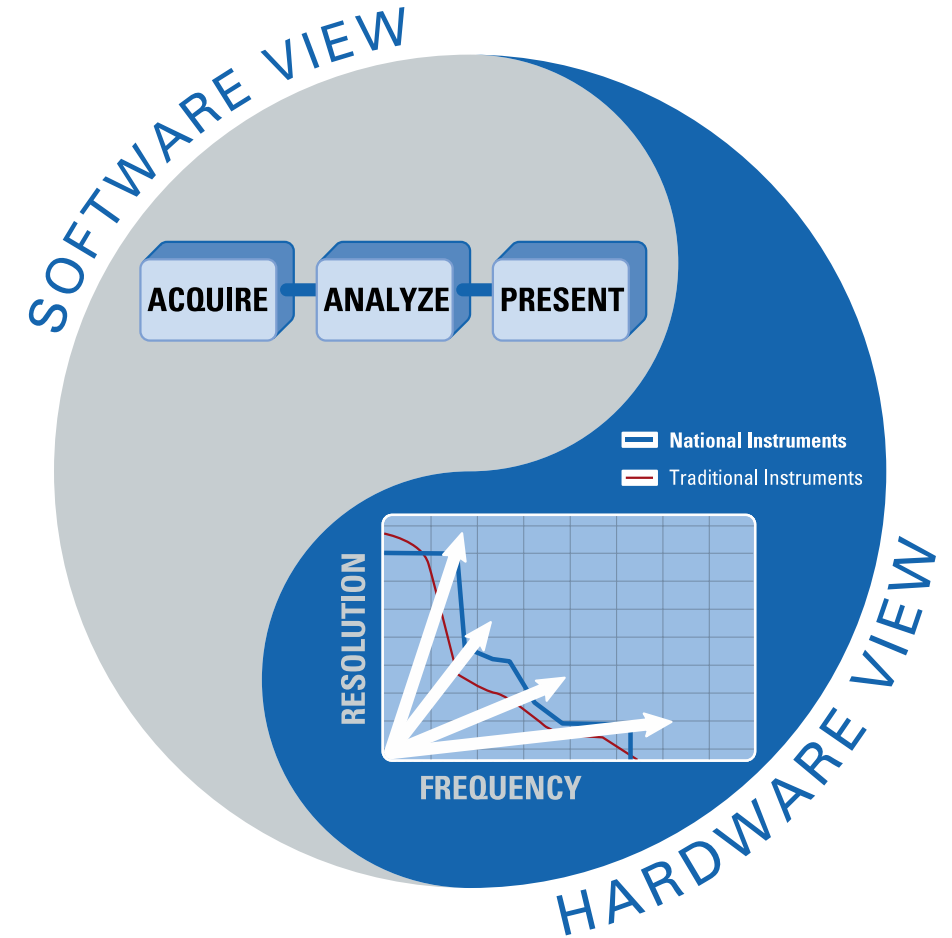
Custom Measurements



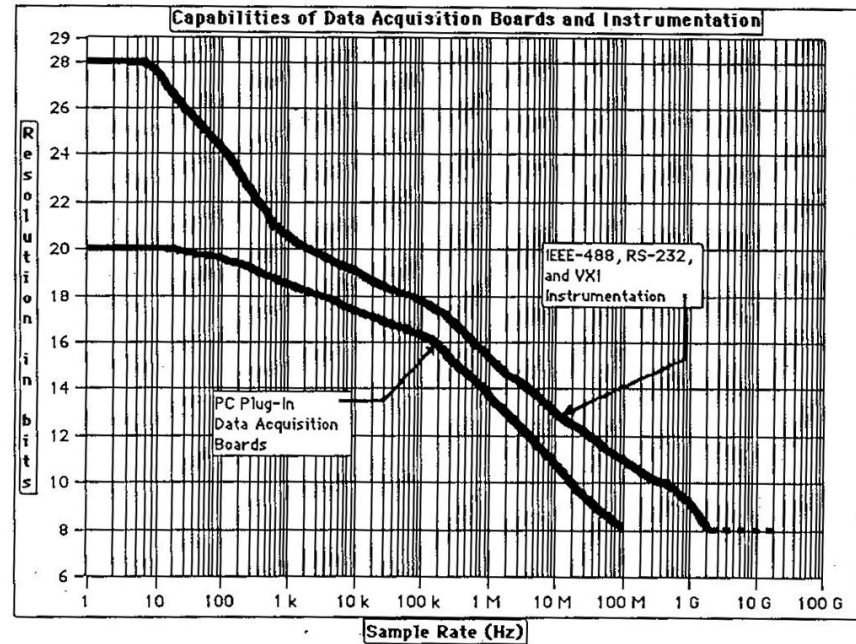
Automated Test

The Virtual Instrumentation Approach

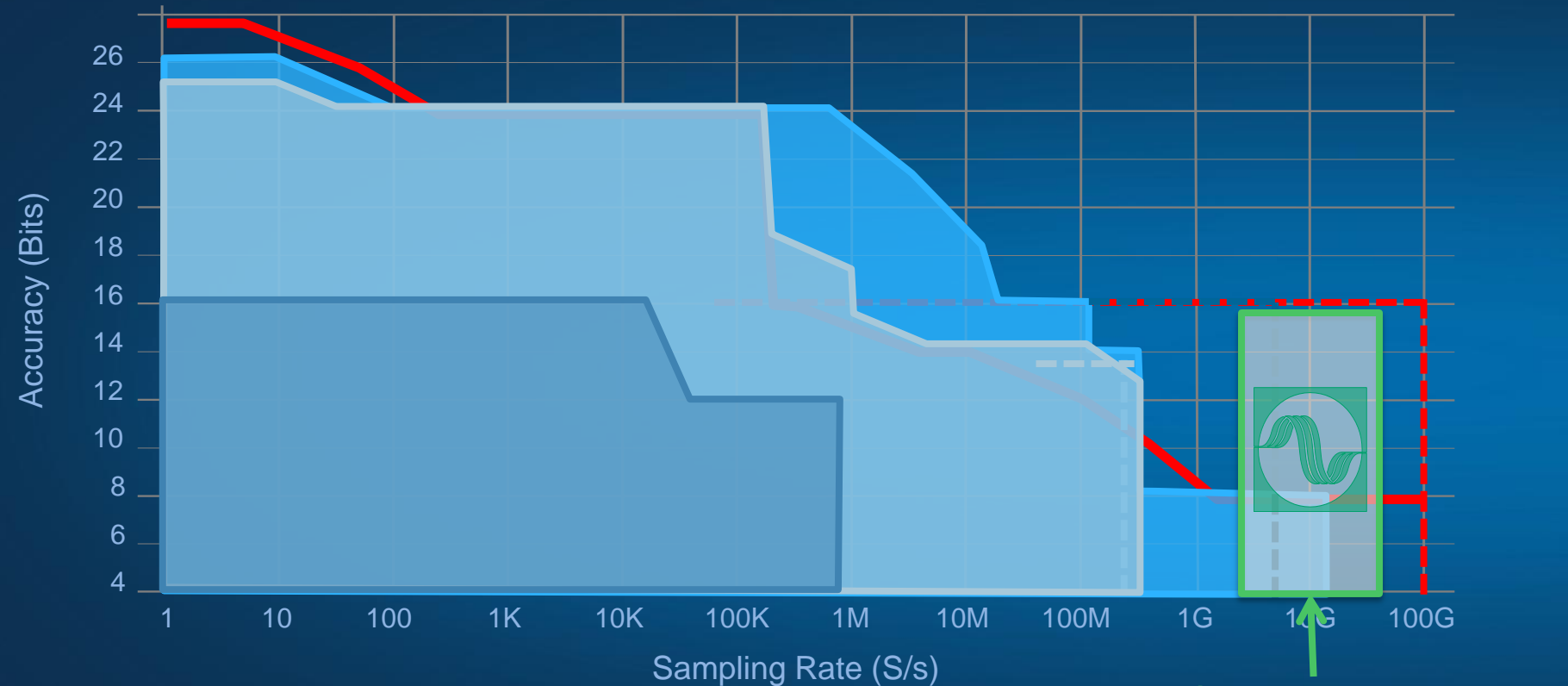
The Software is the Instrument



Trends in the 1990s - Digitizer Technology



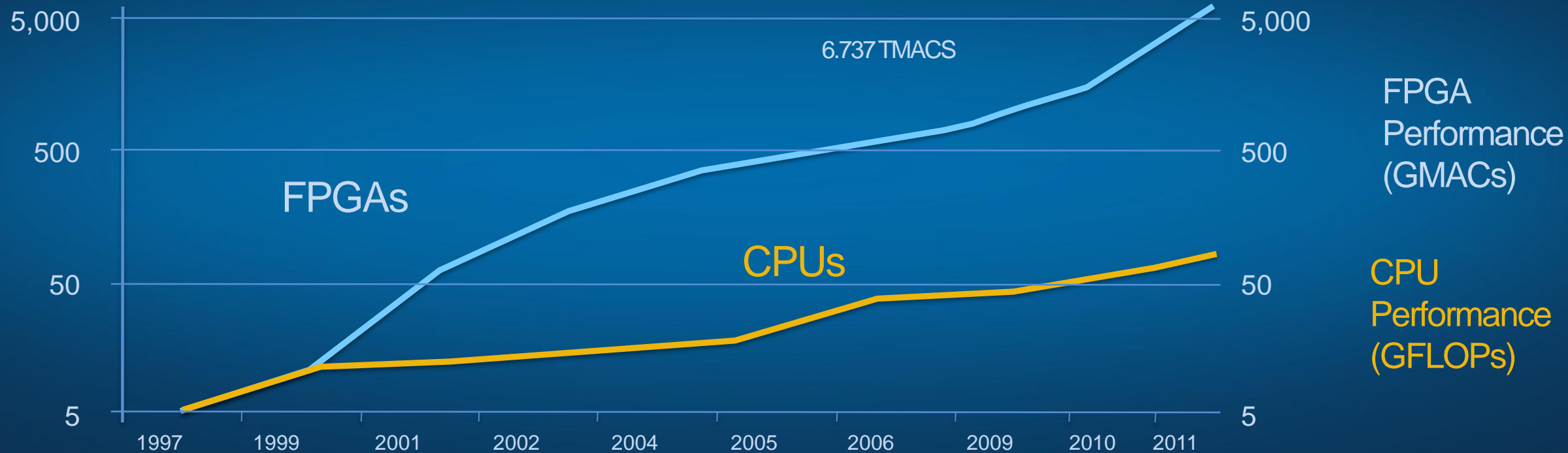
Digitizer Technology Trends in the 1990s



NI Products, 1995 NI Products, 2004 NI Products, 2011 Traditional Instruments

Expanding Measurement Capabilities

Parallel Architectures Drive Performance



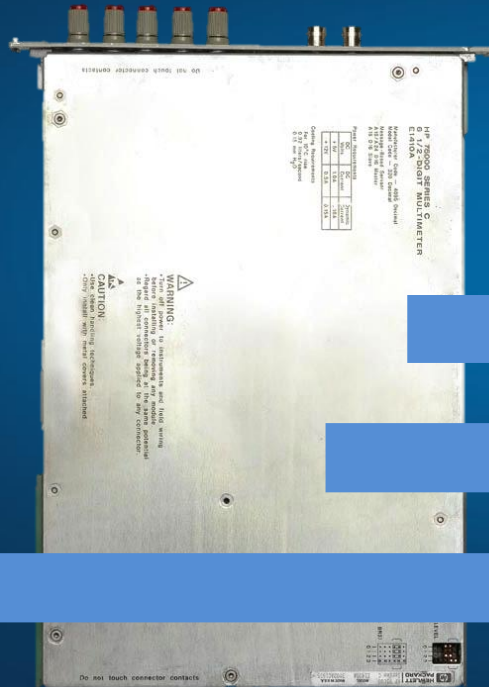
A Mongrel's Way of Software Continuity

1980

1990

2000

2010



RIO

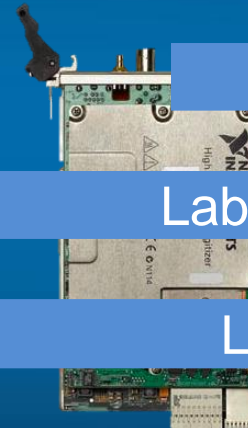
NI TestStand

LabWindows™/CVI

LabVIEW

Instrument Control Interfaces

Transistor | Decreased by a Factor of 2,000 in Size

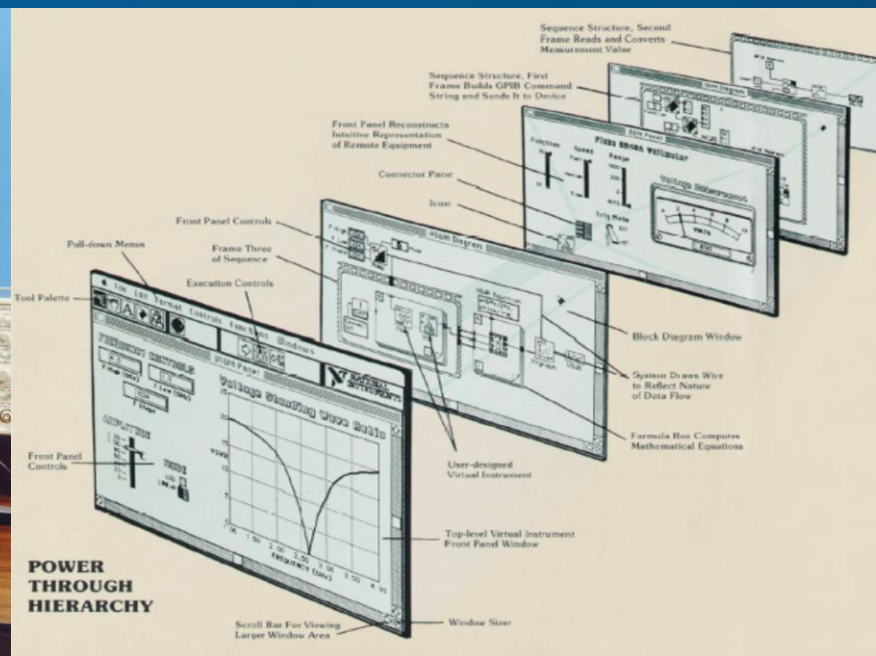
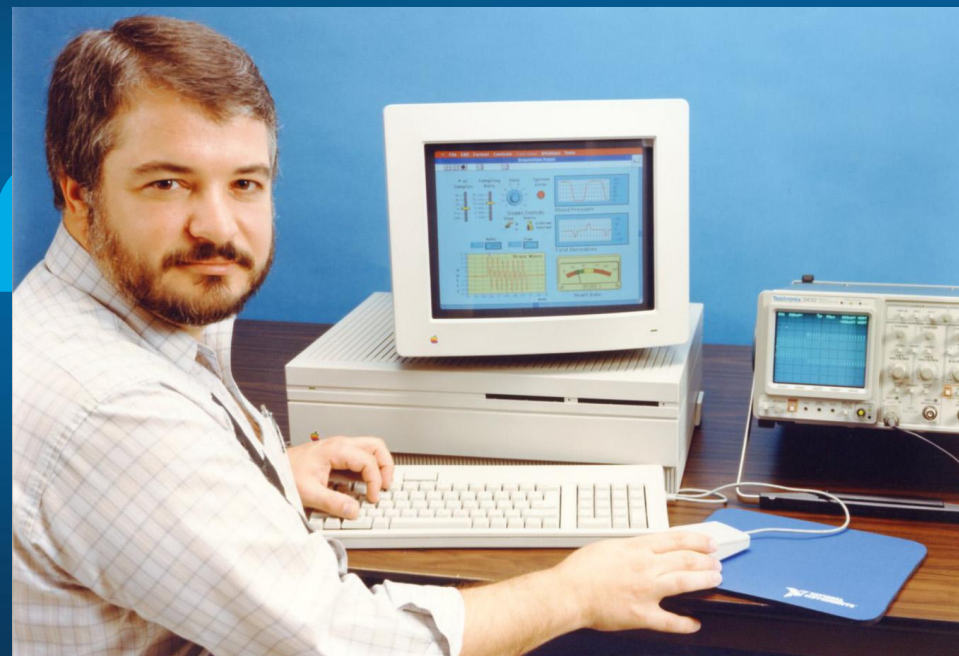


The Apple II with a spreadsheet provided tools in a format familiar to the financial analyst.

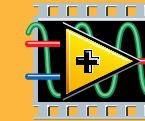
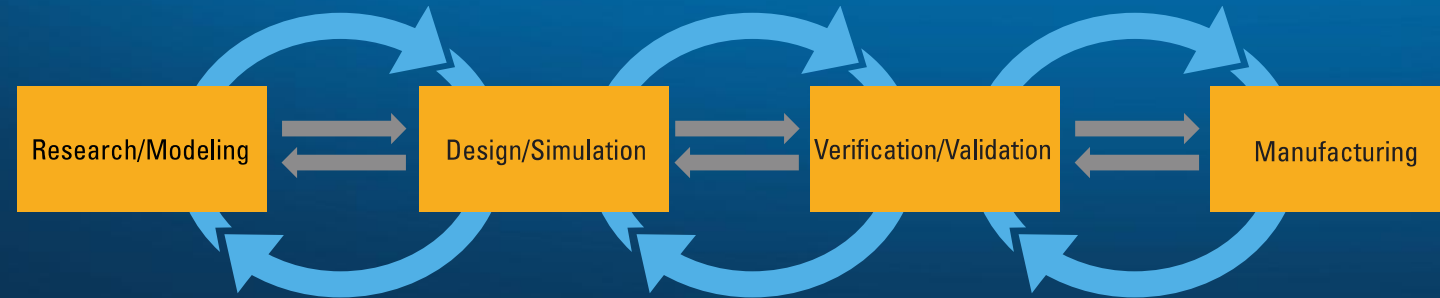
The Macintosh with a graphical programming language provides tools in the block diagram format familiar to the scientist and engineer.

Apple Macintosh Platform

LabVIEW 1.0: 1986



The Next 25 Years – The Expanding Role of LabVIEW into System Design



NATIONAL INSTRUMENTS

LabVIEW™

The National Instruments Vision – Graphical System Design



“ To do for test and measurement what the spreadsheet did for financial analysts. ”

“ To do for embedded what the PC did for the desktop. ”

Graphical System Design

A Platform-Based Approach

Test



Monitor



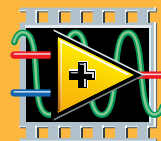
Embedded



Control



Cyber Physical



NATIONAL INSTRUMENTS
LabVIEW™



PC-Based DAQ

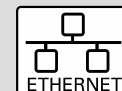


Modular Instruments



NI CompactRIO

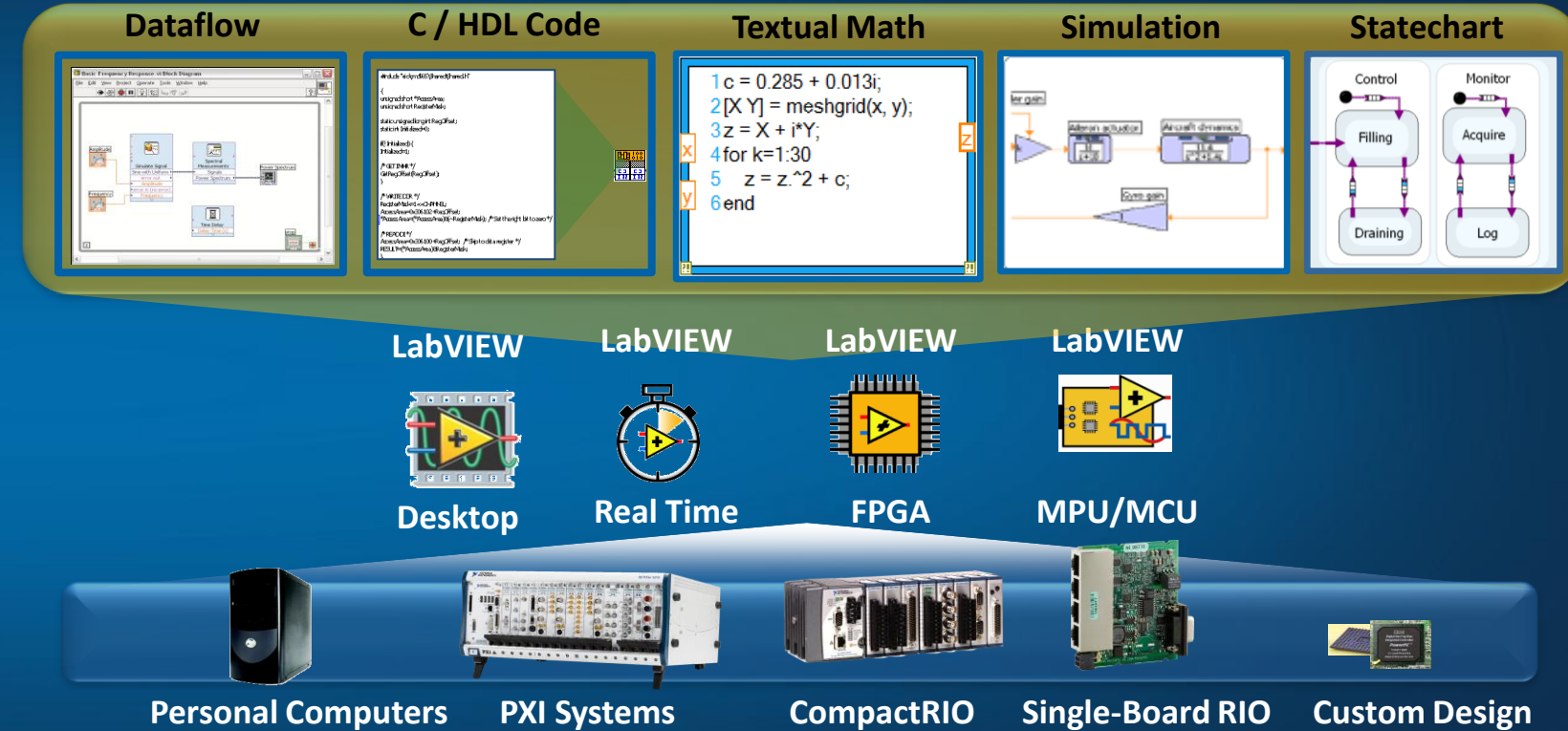
GPB
IEEE-488



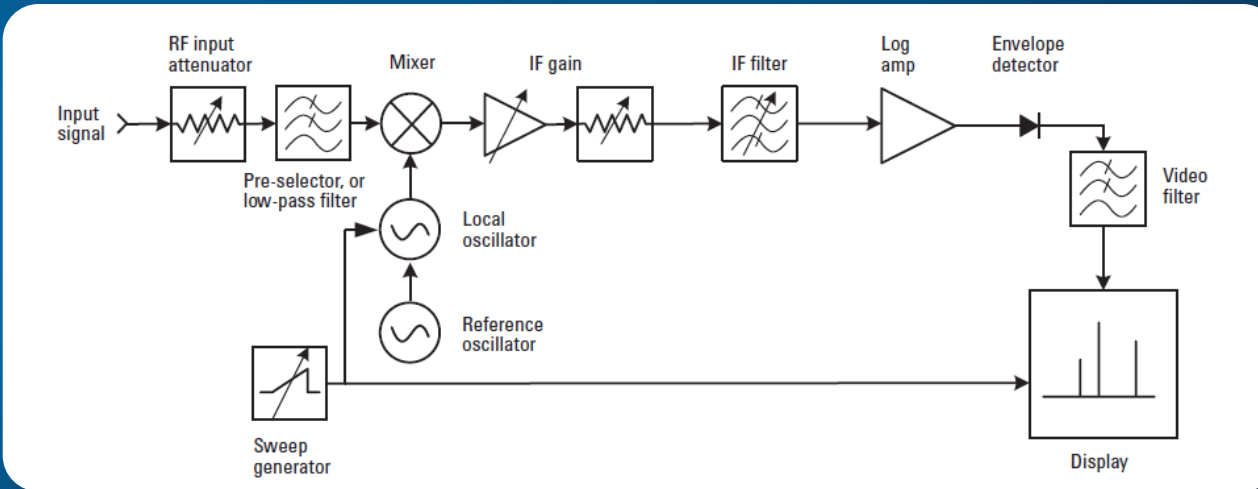
HI-SPEED
CERTIFIED **USB**

Open Connectivity

Exploration to Deployment



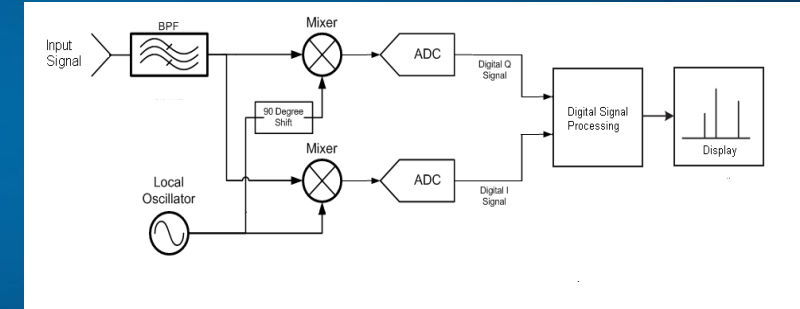
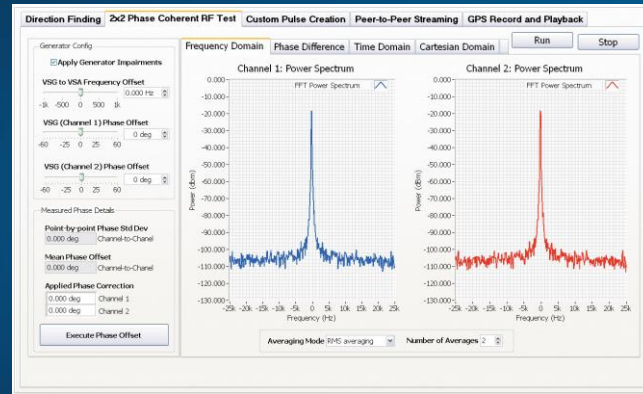
Traditional RF Spectrum Analyzers



Analog Architecture

Software-Based RF Spectrum Analyzers

Modular Hardware Architecture

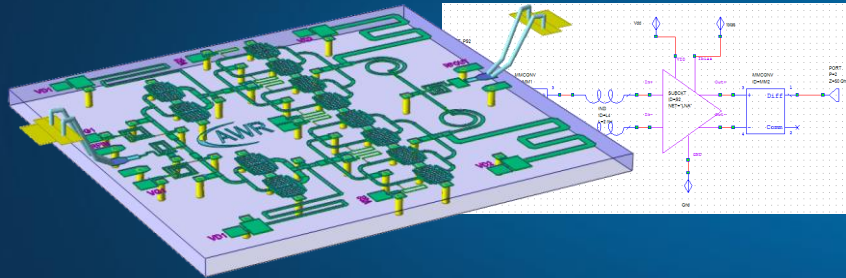


Software for Wireless Standards

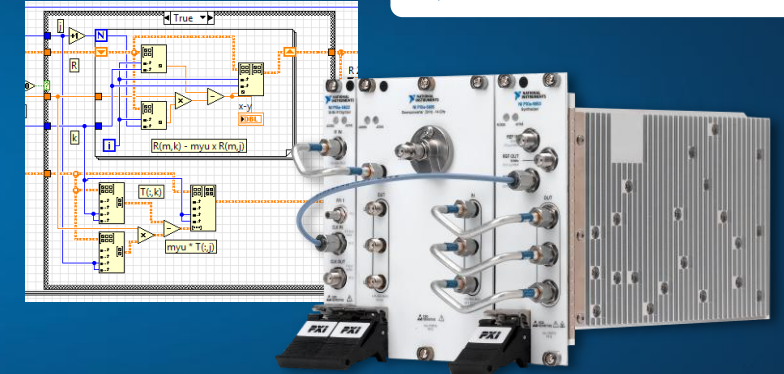
(802.11 a/b/g/n , GSM, EDGE, WCDMA,
RFID, WiMAX, GPS, etc.)

Downconverter — Digitizer — FPGA + Processor

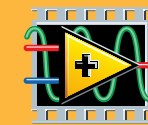
Future of RF System Design



RF/microwave circuit design
Electromagnetic simulation
Link budget analysis



System simulation
Real-time control
FPGA prototype

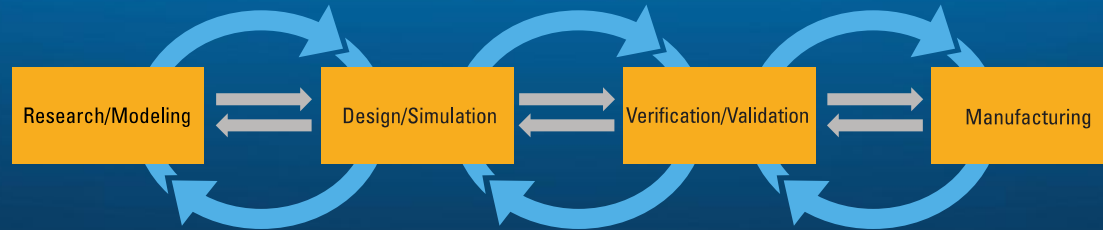


NATIONAL INSTRUMENTS

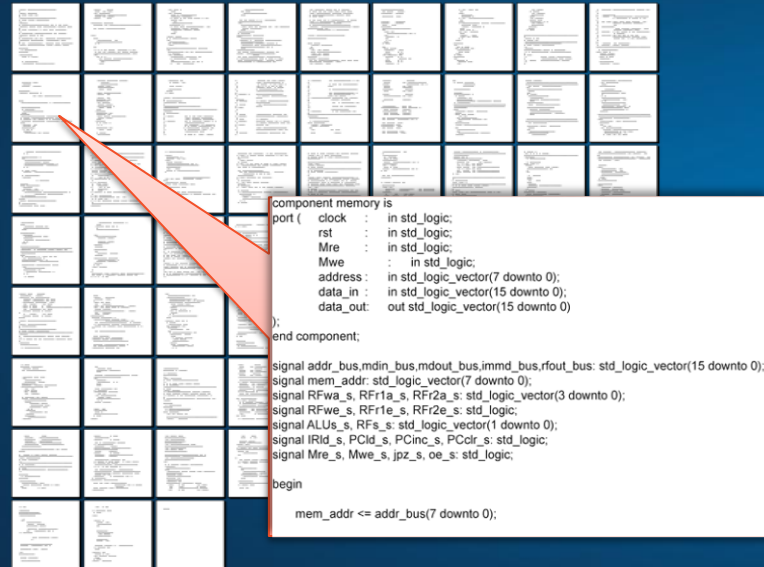
LabVIEW™

Design Verification

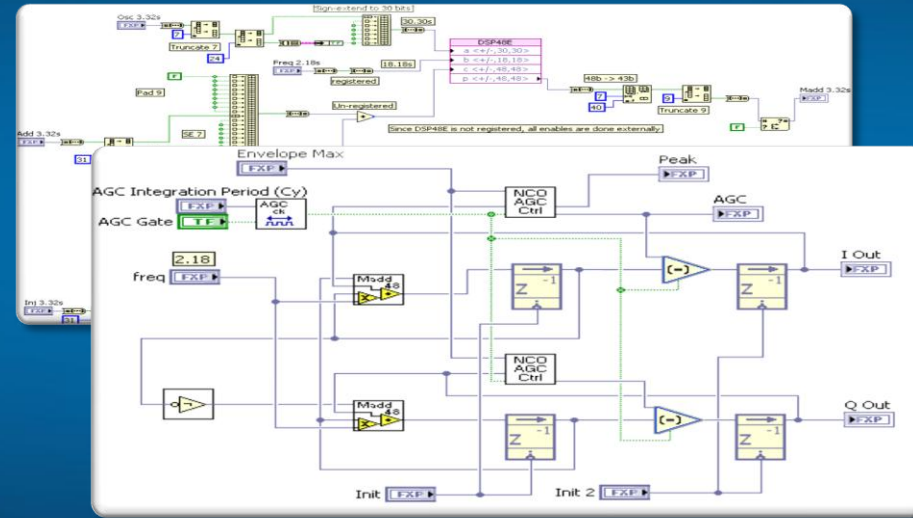
Product Verification



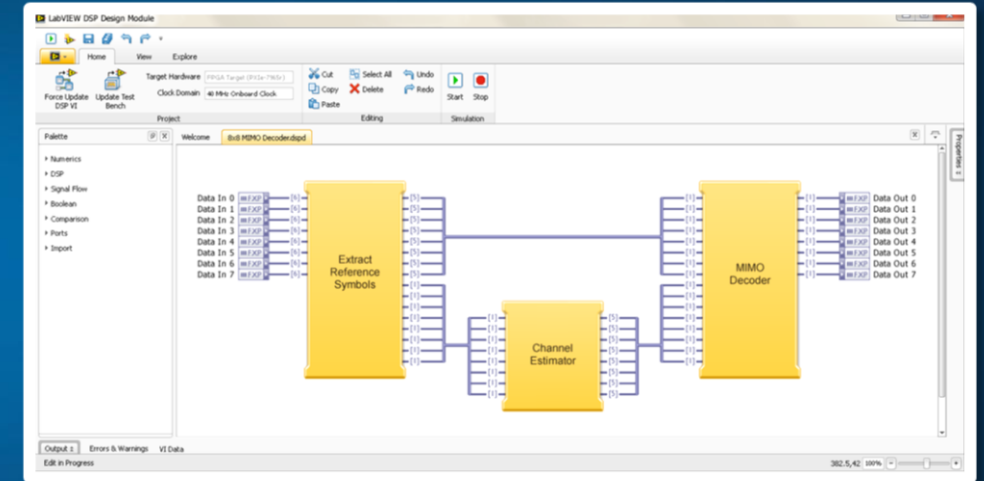
Graphical System Design for RF



HDL/RTL

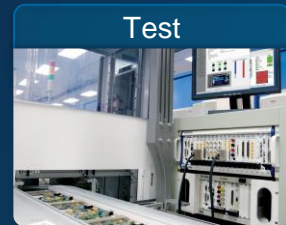


LabVIEW Today



LabVIEW DSP Design Module
Early Access Release

Graphical System Design – A Platform-Based Approach

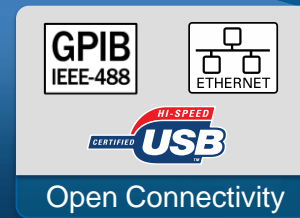


Performance

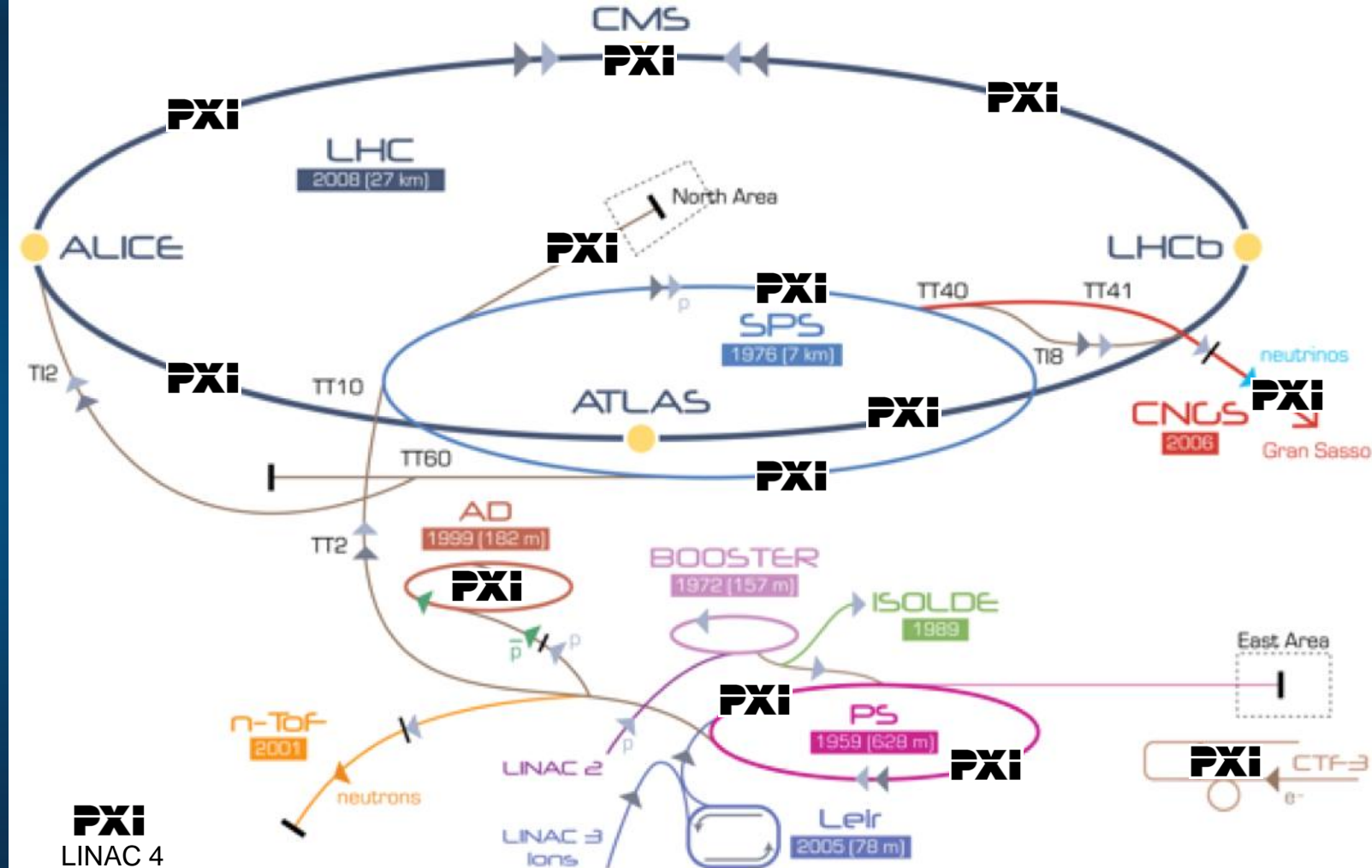
Cost

Integration

Development productivity



PXI in CERN Accelerator Complex





Virginia Tech Wins EcoCAR Challenge

Awards – 1st Place Overall

Shortest 60-0 MPH Braking Distance

Best AVL Drive Quality

Best Dynamic Consumer Acceptability

Best Fuel Consumption

Engineering Grand Challenges



Advance health informatics



Engineer the tools of scientific discovery



Reverse-engineer the brain



Provide energy from fusion



Secure cyberspace



Engineer better medicines



Provide access to clean water



Enhance virtual reality



Restore and improve urban infrastructure



Manage the nitrogen cycle



Develop carbon sequestration methods



Advance personalized learning



Make solar energy economical



Prevent nuclear terror



NIWeek

WORLDWIDE GRAPHICAL SYSTEM DESIGN

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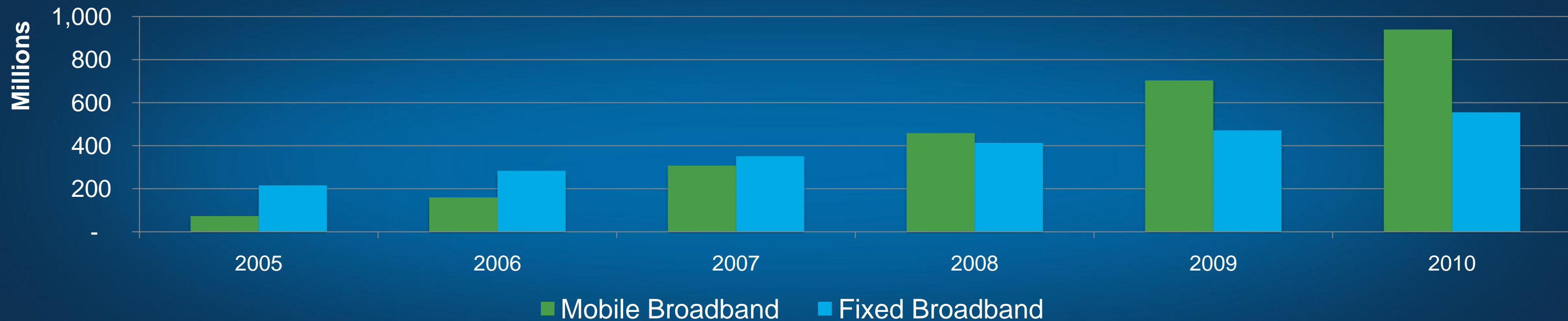
Eric Starkloff

Vice President – Product Marketing

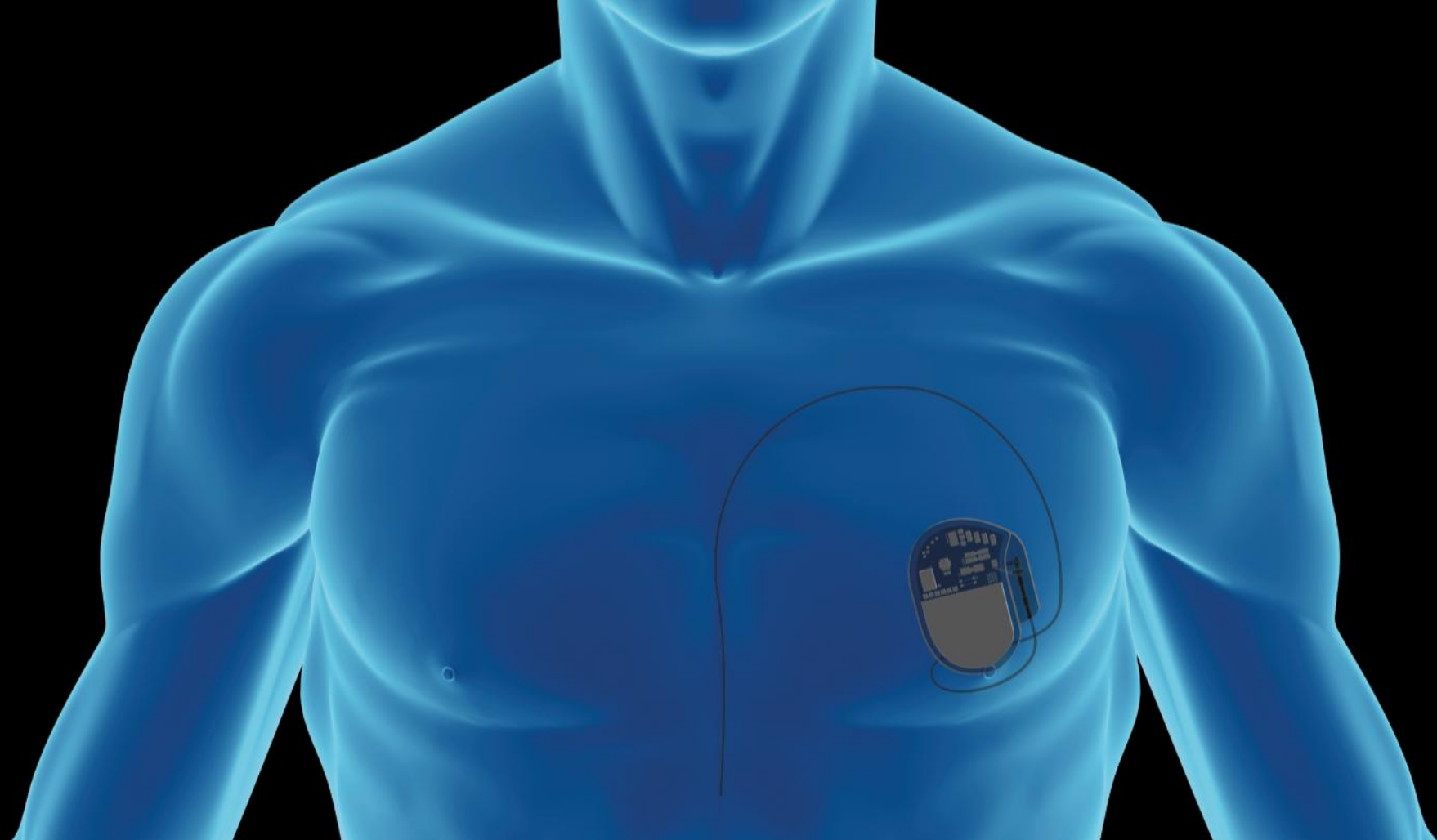
3,300 Attendees

222 Sessions

103 Exhibitors

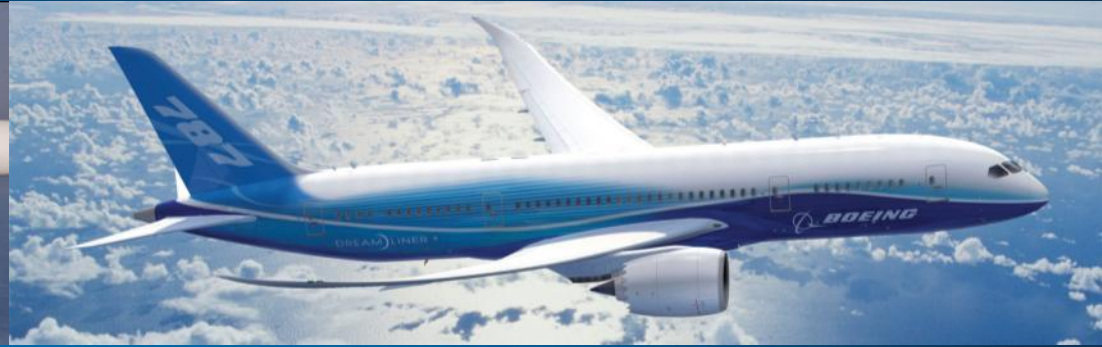
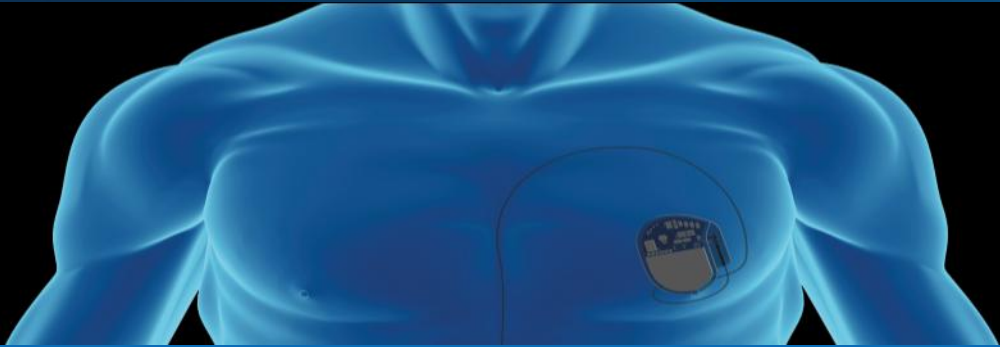


Source: International Telecommunications Union, 2011





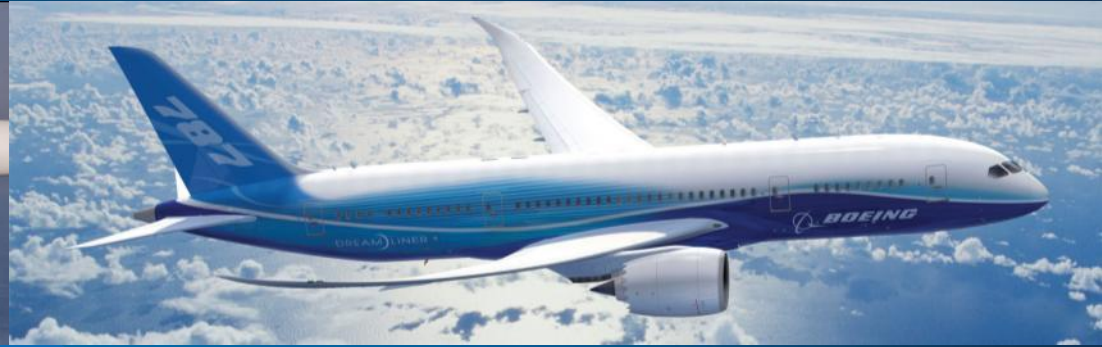
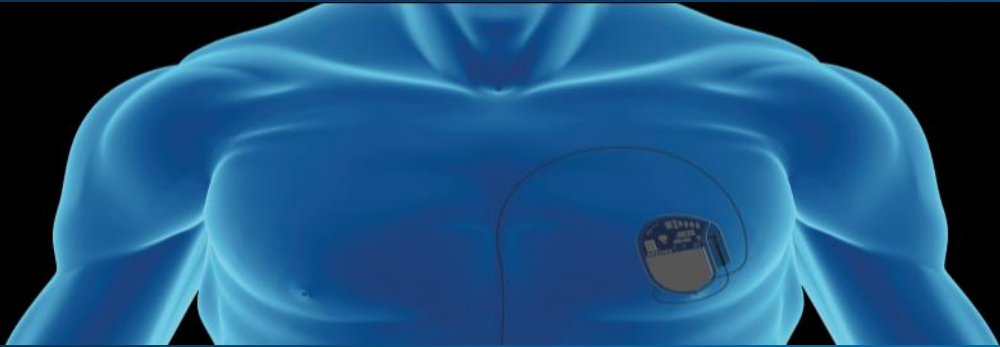




I/O

Processing

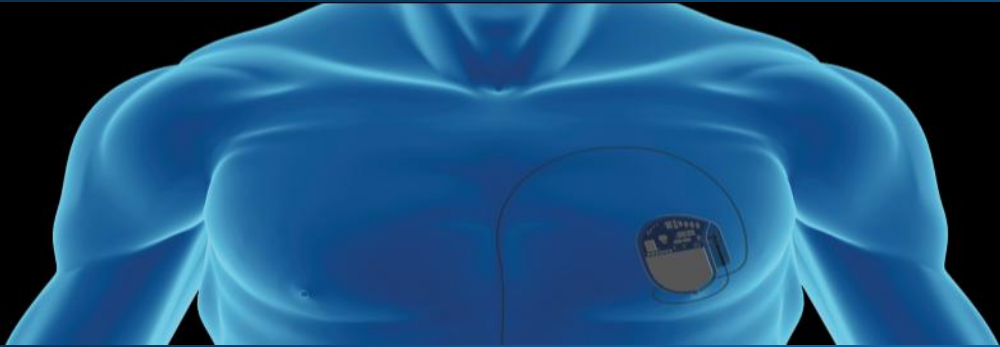
Communication



I/O

Processing

Communication



I/O

Processing

Communication



Test



Monitor



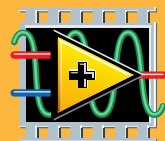
Embedded



Control



Cyber Physical



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PC-Based DAQ

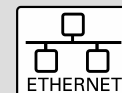


Modular Instruments



NI CompactRIO

GPB
IEEE-488



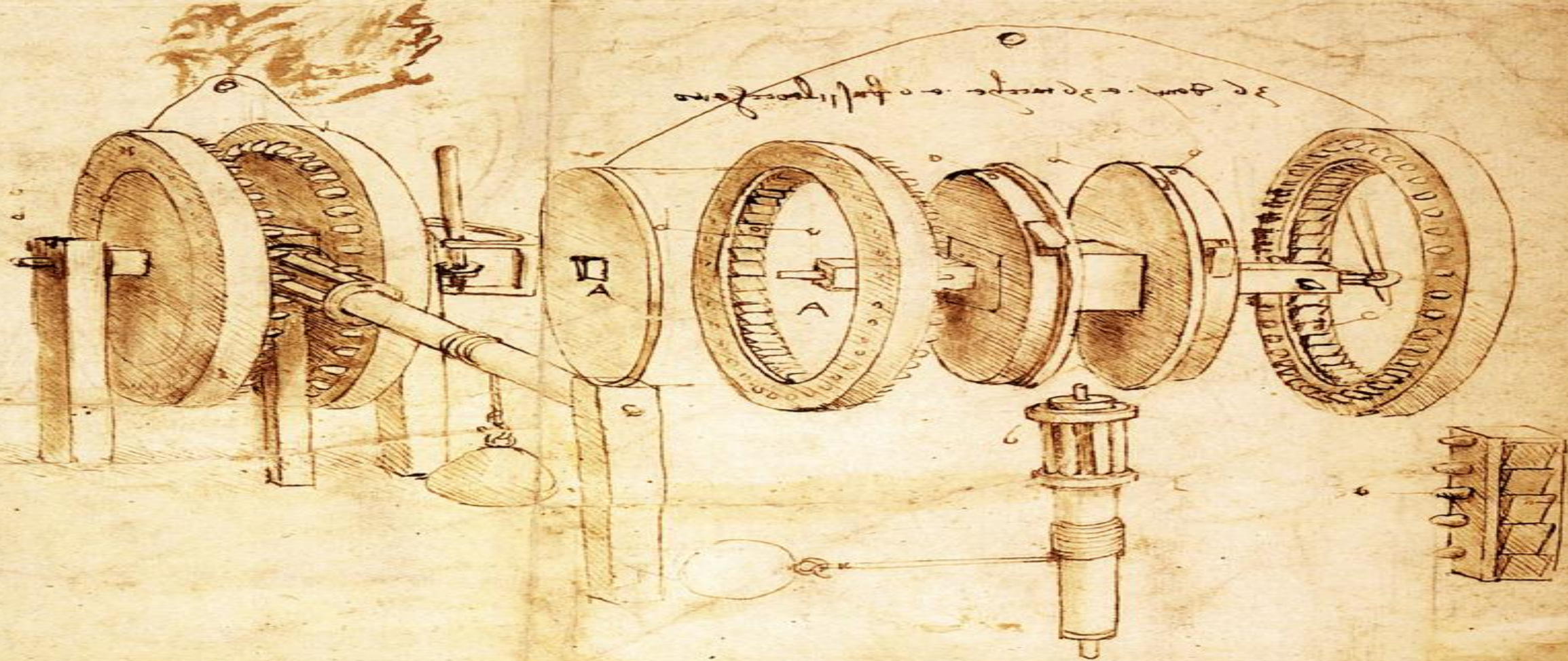
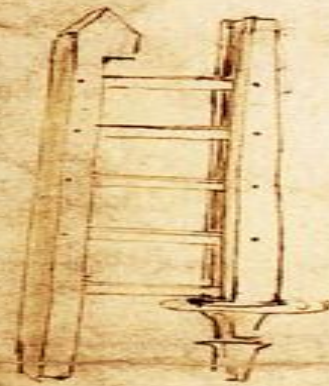
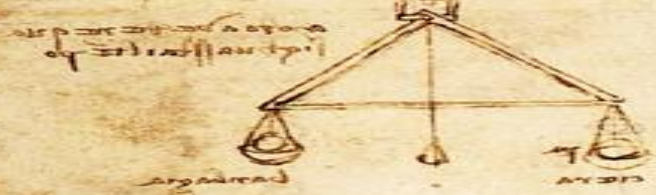
HI-SPEED
CERTIFIED **USB**

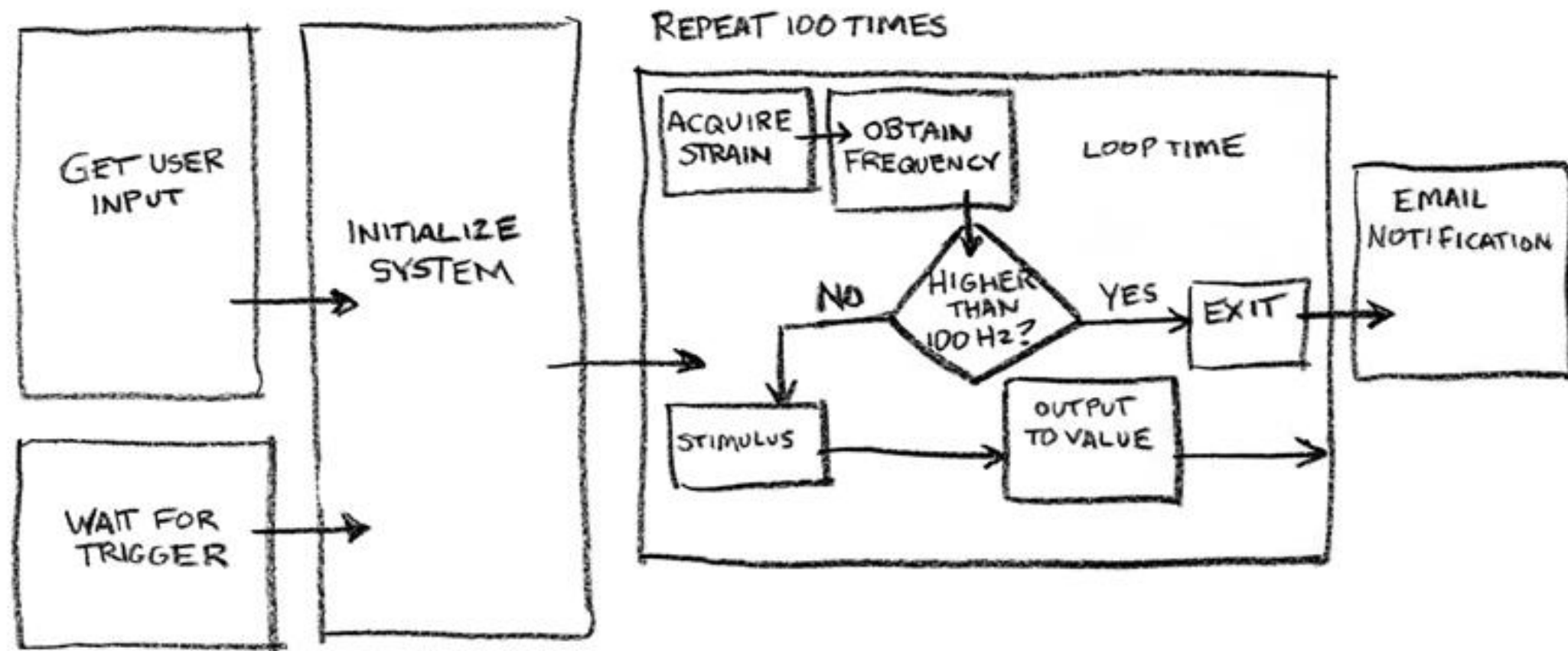
Open Connectivity

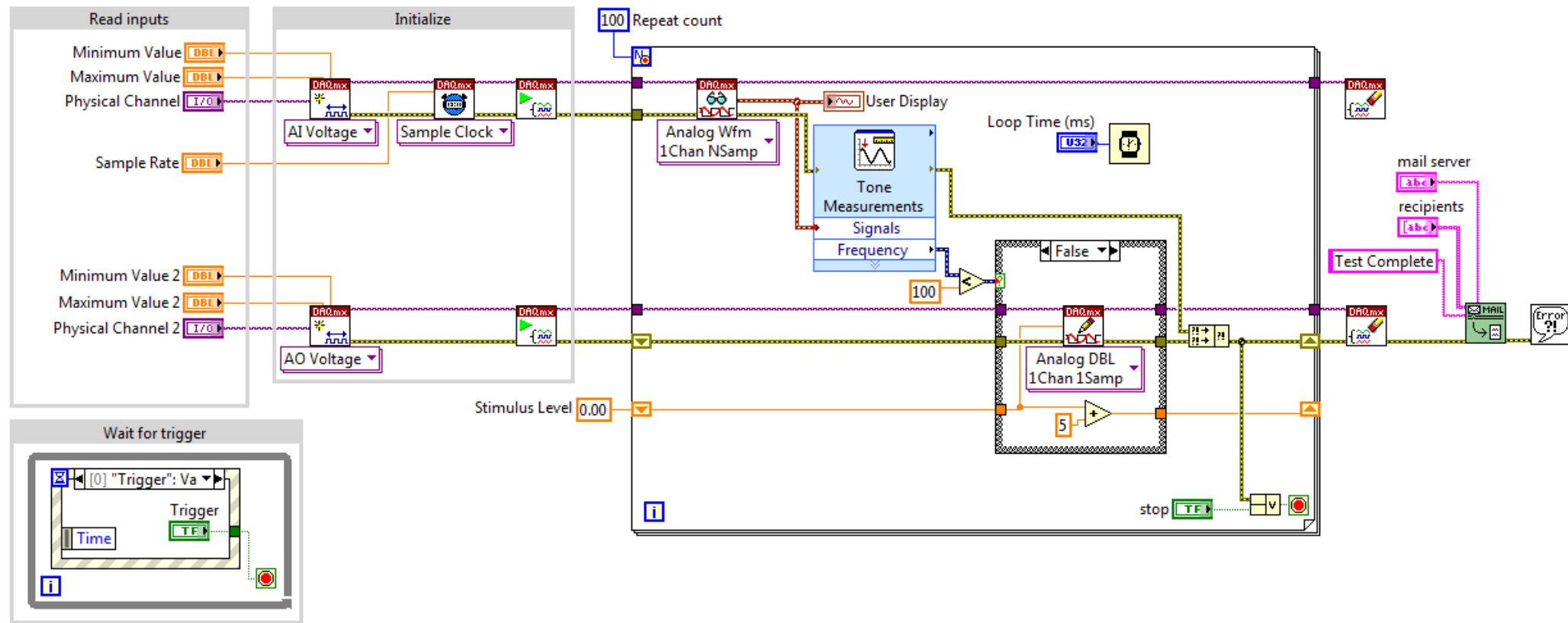
Graphical System Design

Accelerate the development of any system
that needs measurement and control

Abstraction







Abstraction or Obstruction?

Tools should not limit innovation
and scientific discovery

Test



Monitor



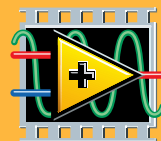
Embedded



Control



Cyber Physical



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LabVIEW™



PC-Based DAQ



Modular Instruments



NI CompactRIO

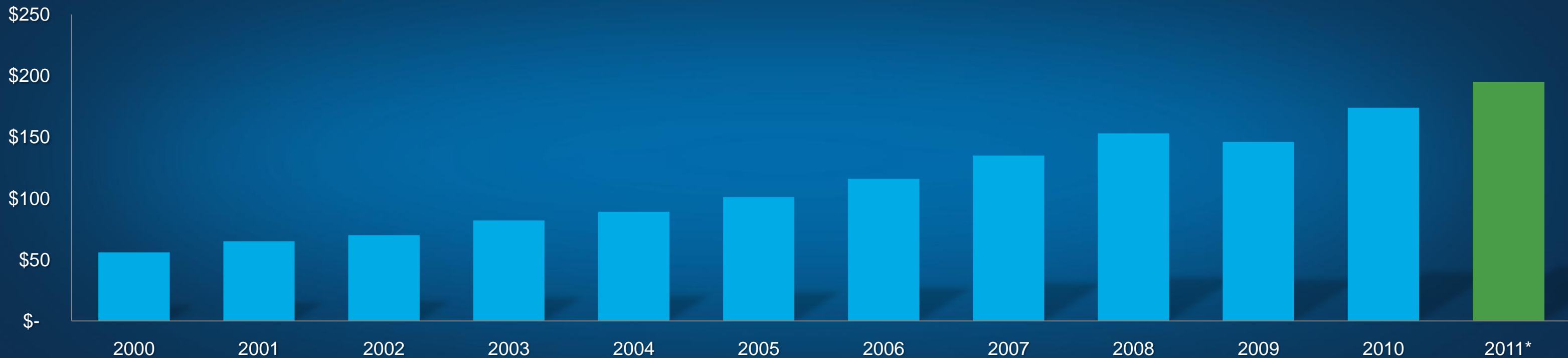
GPB
IEEE-488

ETHERNET

CERTIFIED
HI-SPEED
USB

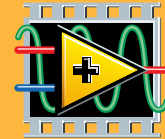
Open Connectivity

NI's Increasing Investment in R&D



*Represents National Instruments expected investment, communicated June 28, 2011.

>20 New Products



NATIONAL INSTRUMENTS

LabVIEW™



PC-Based DAQ

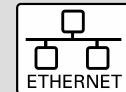


Modular Instruments



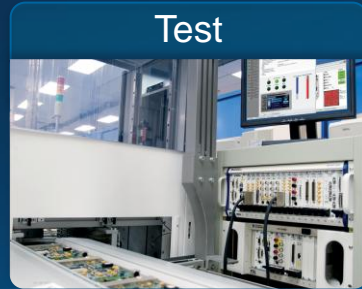
NI CompactRIO

GPB
IEEE-488



HI-SPEED
CERTIFIED **USB**

Open Connectivity



Full aircraft test system

LTE advanced prototype

Power inverter control

Power amplifier simulation and test

“4D” video game

Smart grid control

RF validation and verification

Embedded Software Verification

Ian Fountain

Senior Platform Manager

Jarrold Slocum

Group Manager – Software R&D

Smart Washing
Machine



Modern
Commercial
Aircraft



Luxury
Automobile



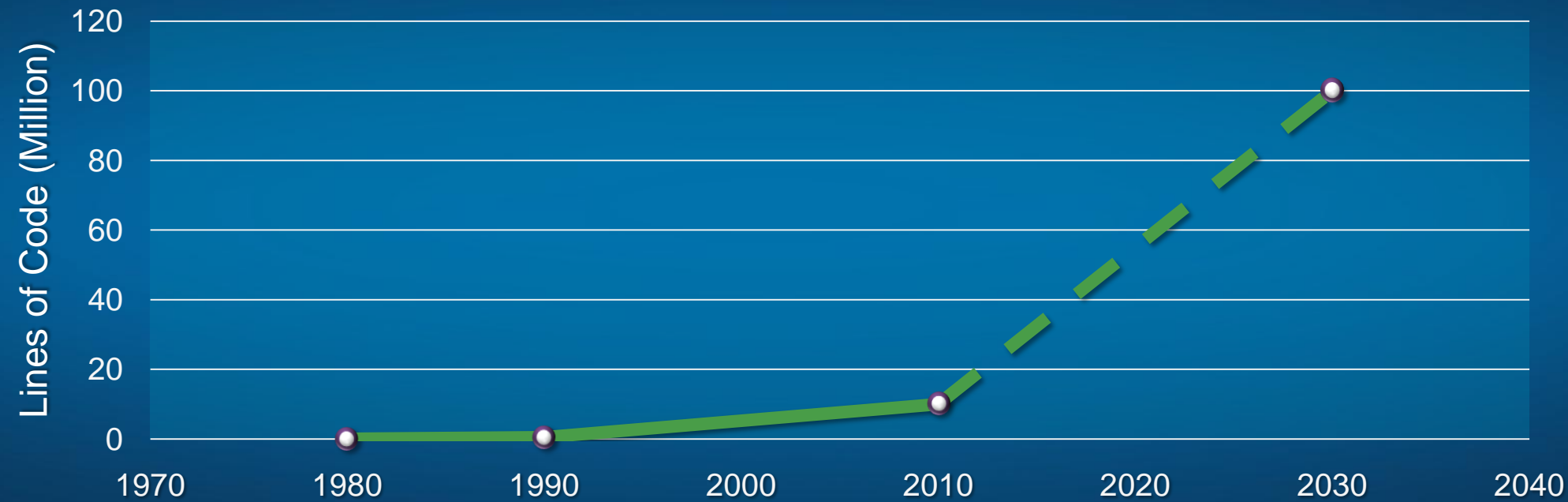
Appox. Lines
of Code

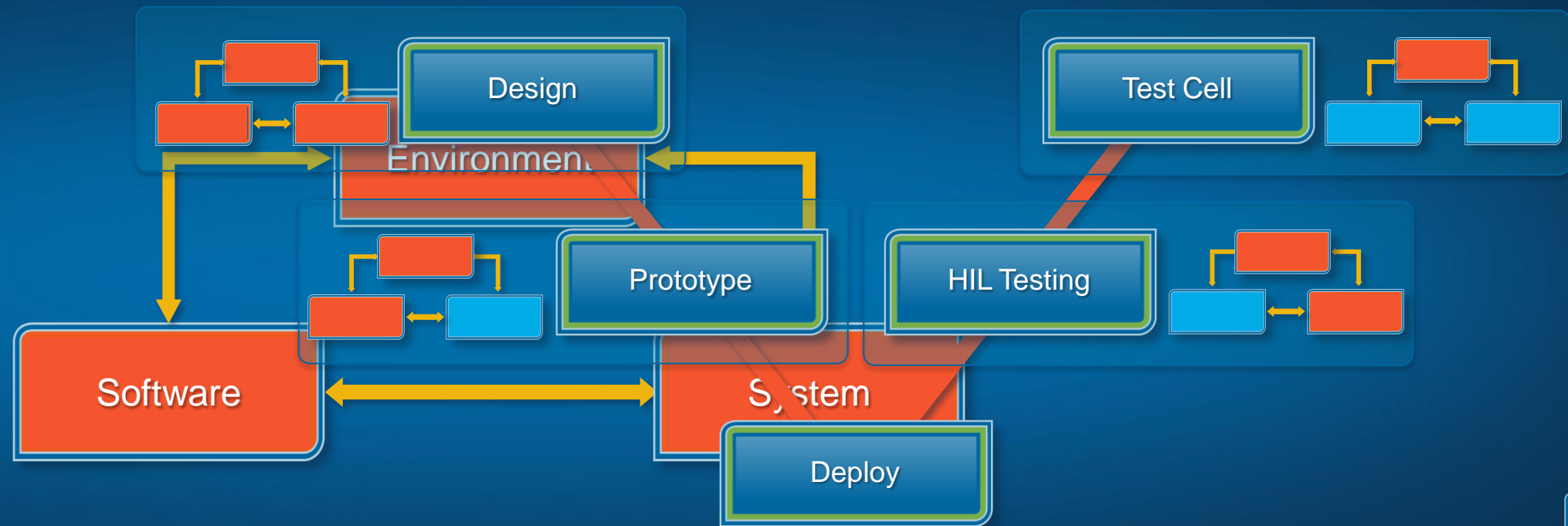
100k

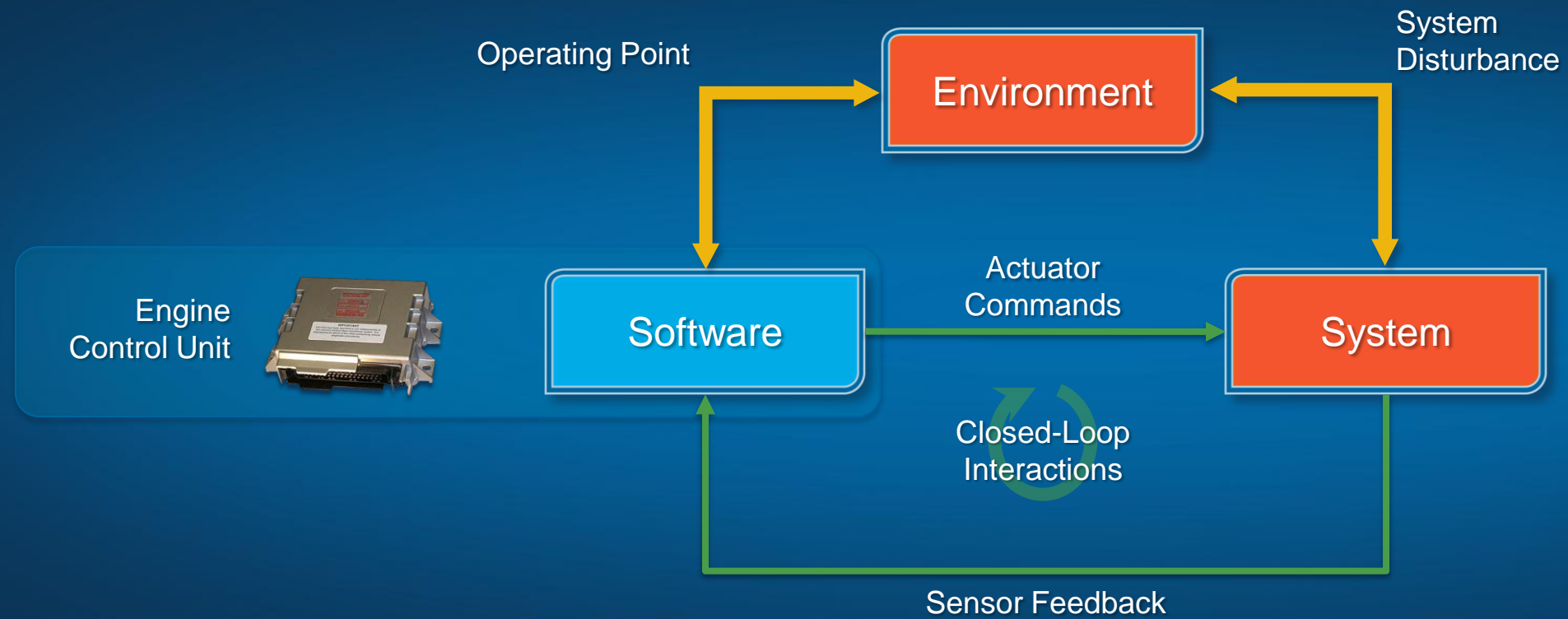
6.5 Mil

10 Mil

Automotive Embedded Control Software







Simulated

Real

Physical Test Cell Applications



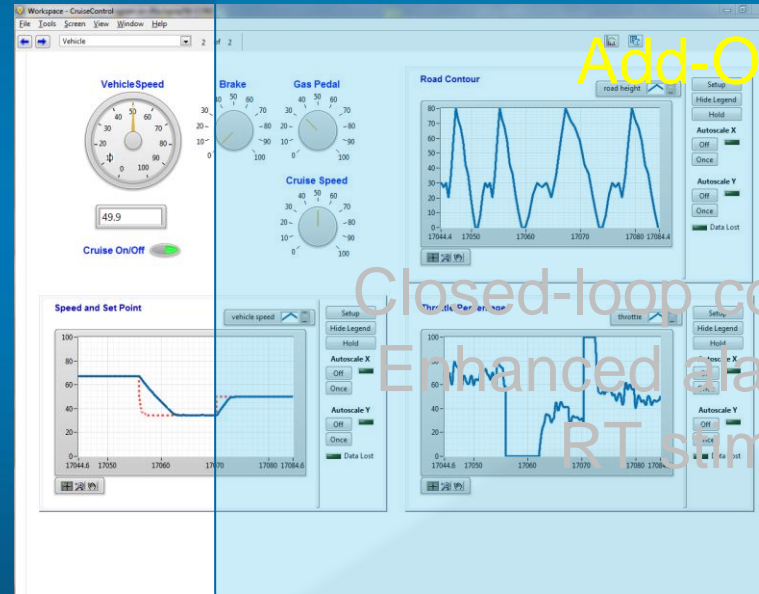
Dynamometer Based



NI VeriStand 2011

INERTIA™

Add-On for Test Cell Control



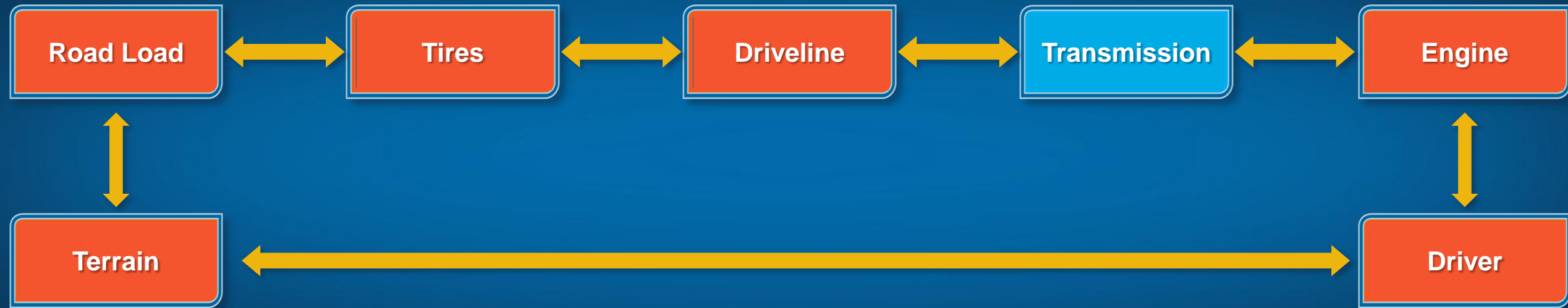
Closed-loop controllers with mode switching
Enhanced alarming and control loop tuning
RT stimulus profile extensions

by Wineman Technology, Inc.



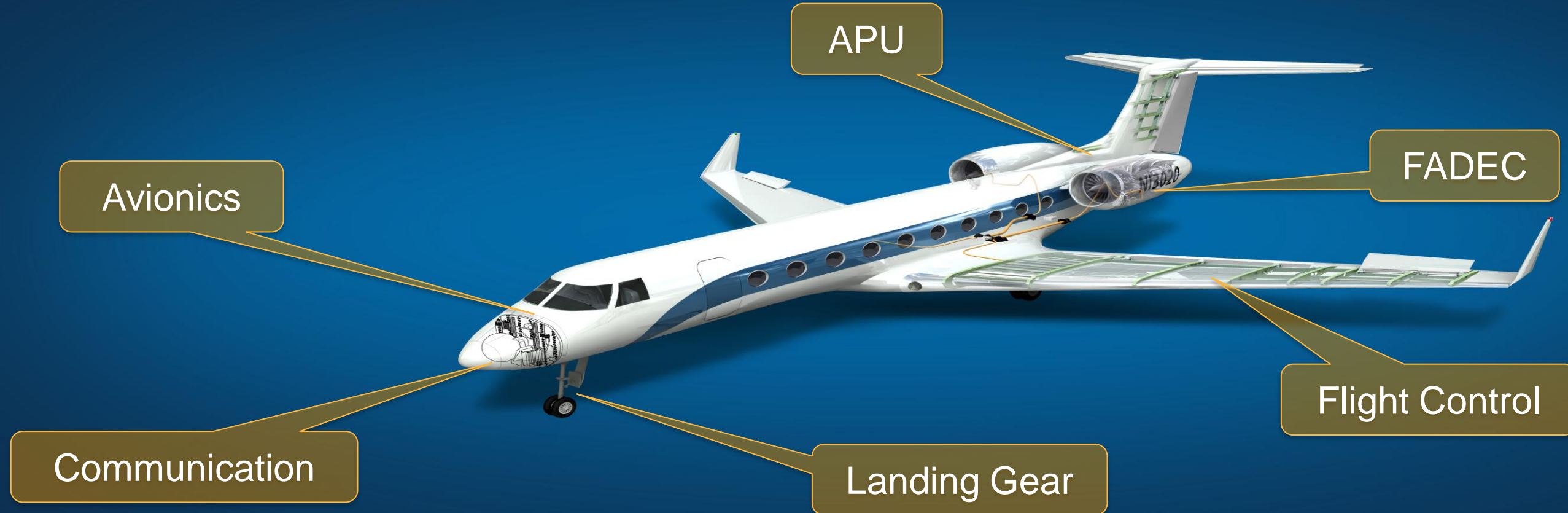
Simulated

Real



Simulated

Real



NIWeek

WORLDWIDE GRAPHICAL SYSTEM DESIGN
CONFERENCE

Embedded Control & Monitoring



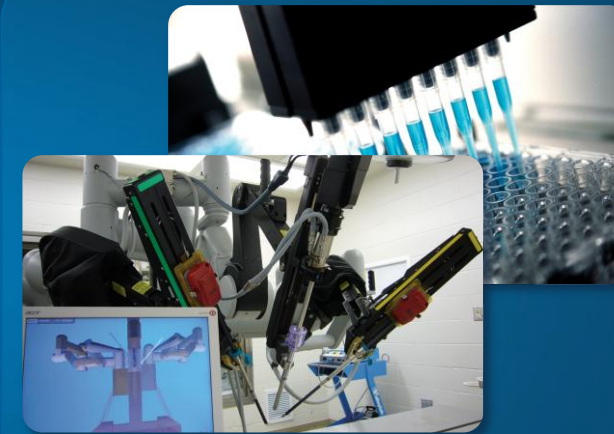
Energy



Industrial Machines
& Robotics

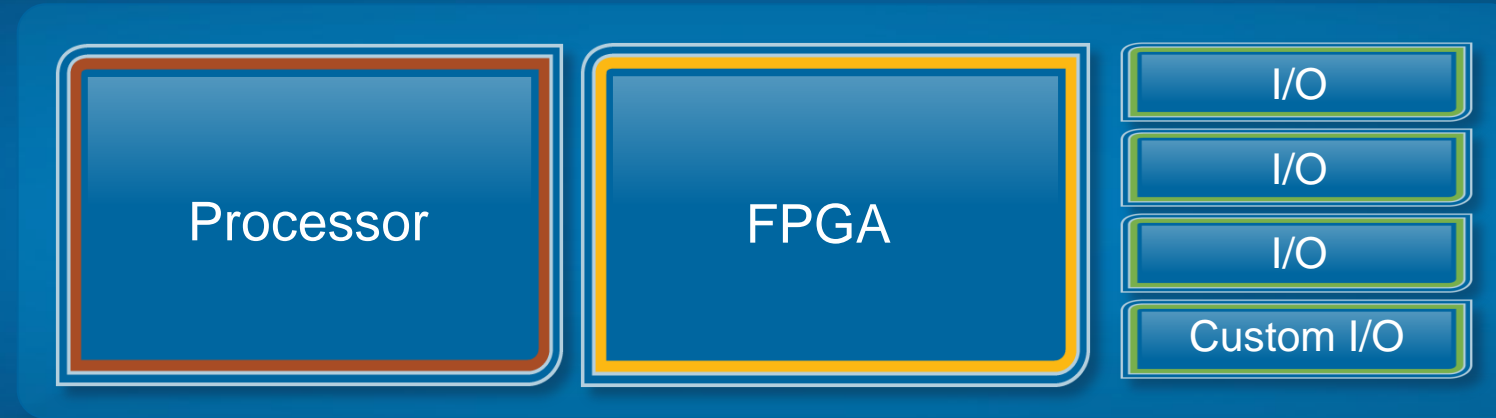


Transportation
& Infrastructure



Life Sciences

Reconfigurable I/O (RIO) Architecture



NI RIO Technology Curve



Michelle Tinsley

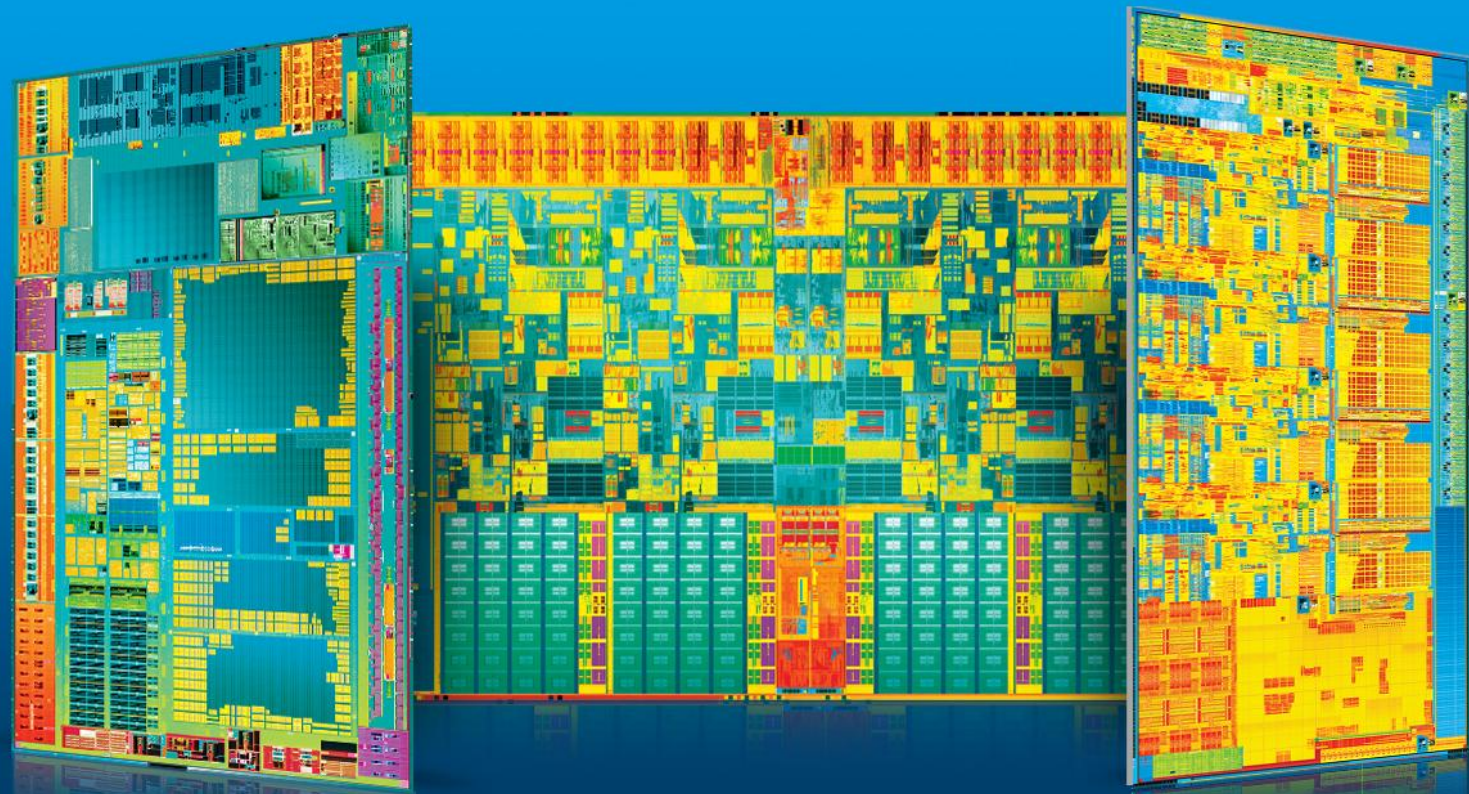
General Manager, Embedded Computing Division
Intel Corporation

Ben Black, Ph.D.

Systems Engineer
National Instruments

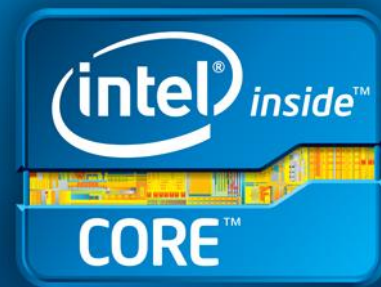
15 BILLION
CONNECTED DEVICES BY 2015



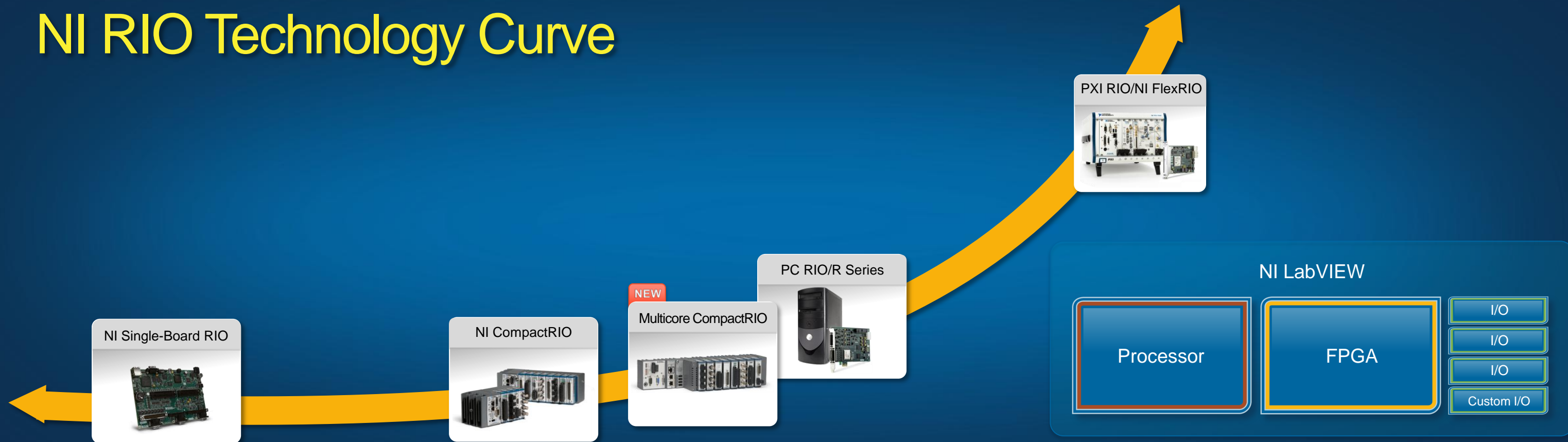


INTEL PROCESSOR FAMILIES

*MEETING THE DEMANDS OF
EMBEDDED DEVICES*



NI RIO Technology Curve



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CONFERENCE

Brian MacCleery

Principal Product Manager for Clean Energy Technology



Substation Transformer



Siemens Recloser / Smart Switch



13.8 kV Vacuum Breaker



NI CompactRIO
Digital Controller

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WORLDWIDE GRAPHICAL SYSTEM DESIGN

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Bill Kramer, Ph.D.

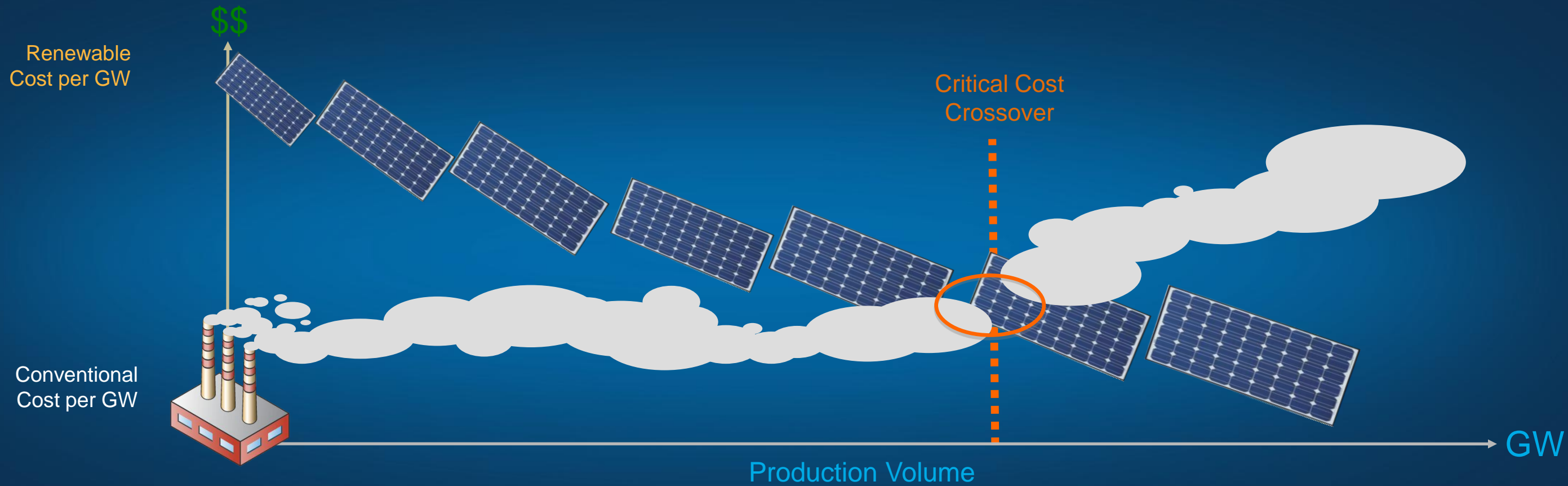
R&D Manager – Energy Systems Integration Technologies
National Renewable Energy Lab (NREL)



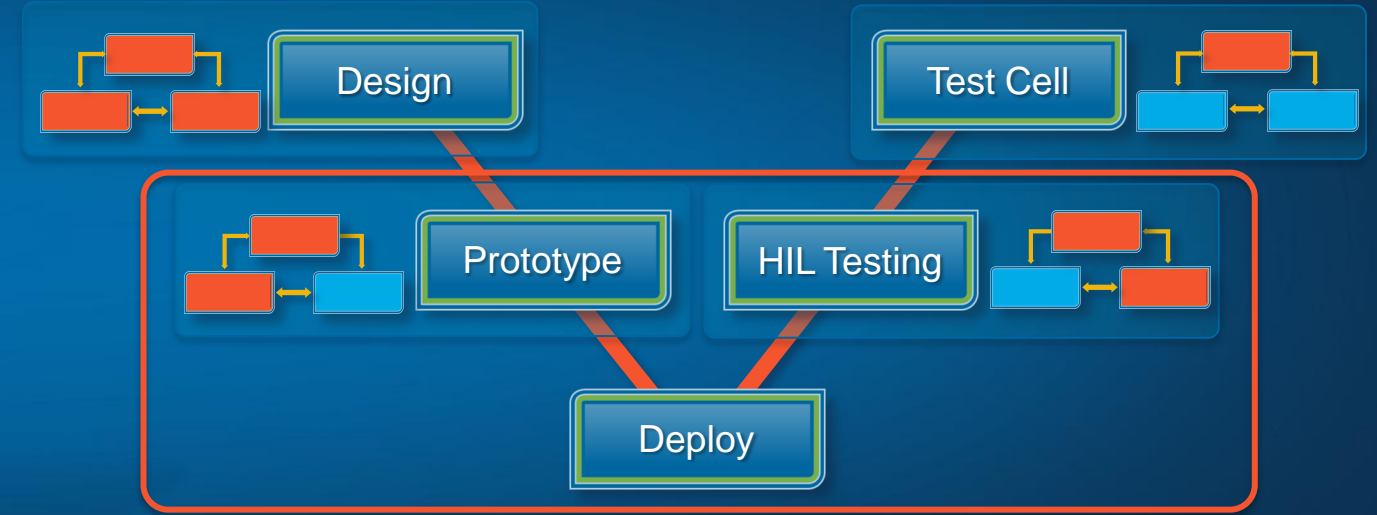
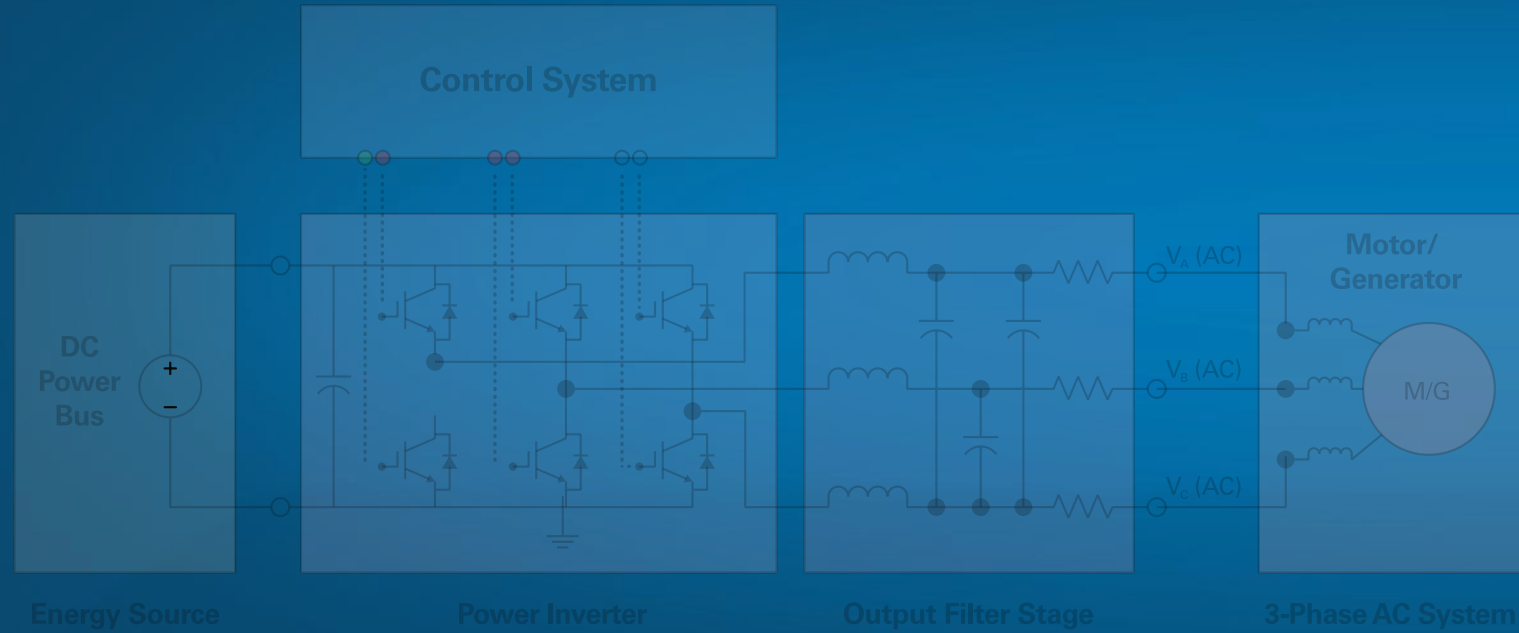
Renewable Energy Innovation



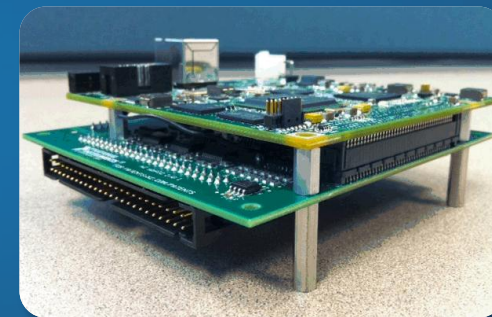
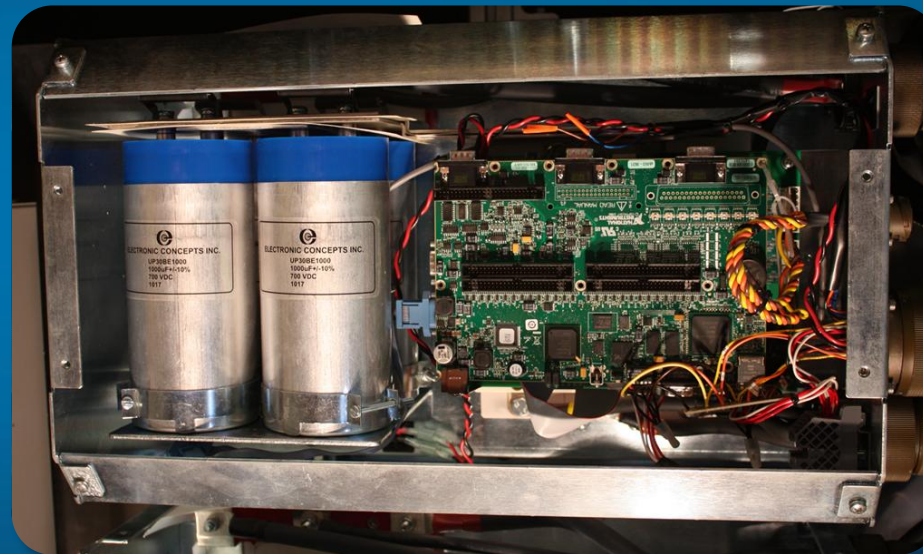
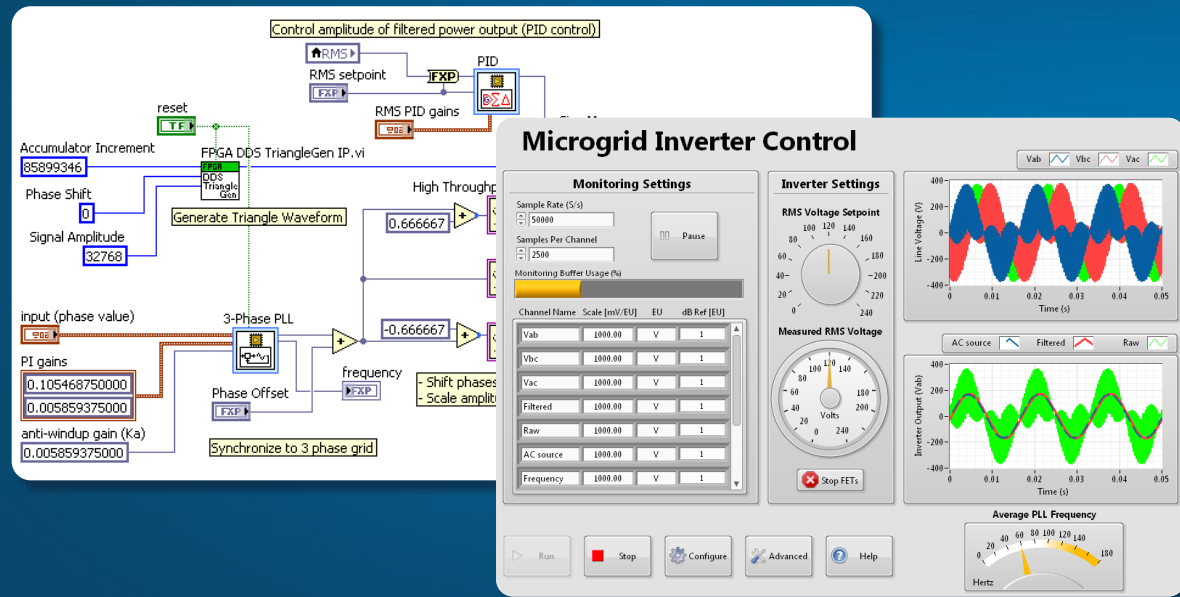
Smart Grid and RE Grid Integration | Battery and Thermal Storage | Vehicle Technologies | Buildings Technologies | Wind | Water | Solar | Biomass | Hydrogen | Geothermal



Power Electronics System



NI Single-Board RIO General-Purpose Inverter Controller

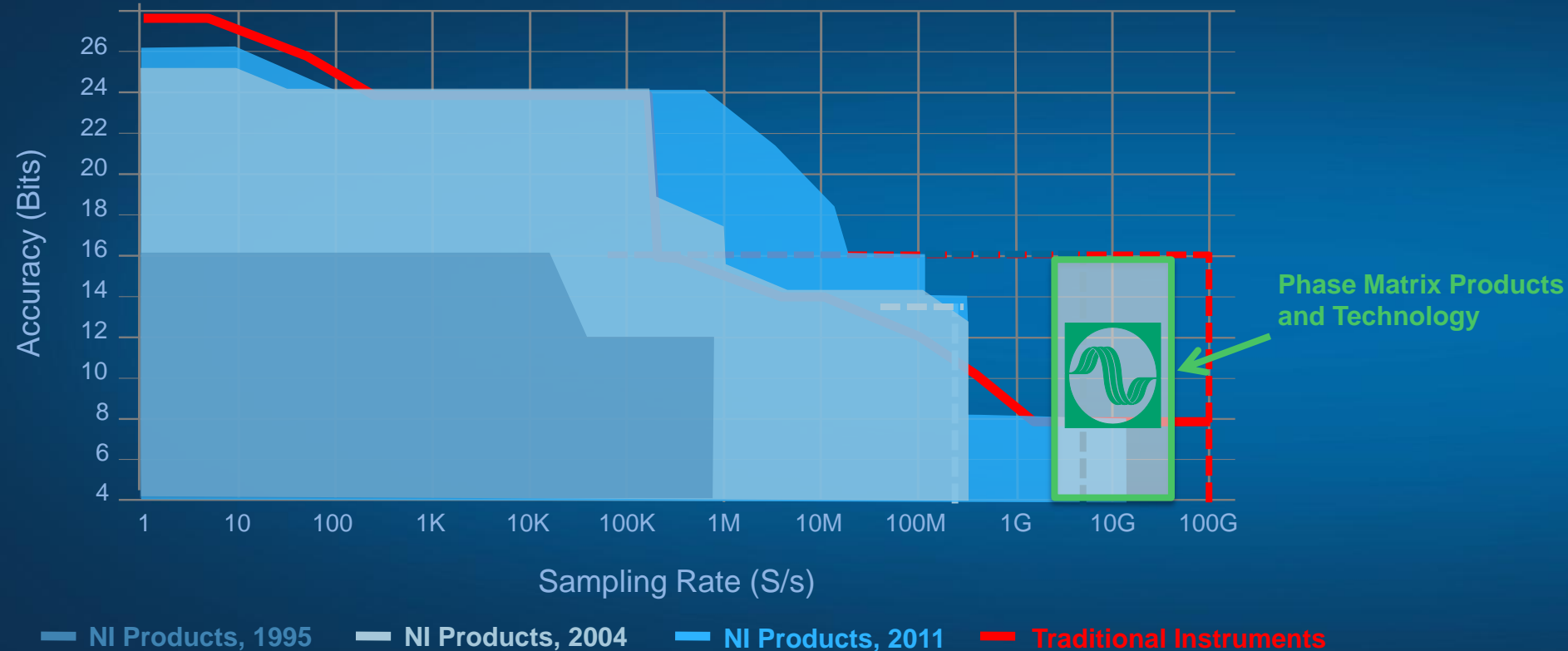


NI RIO Technology Curve



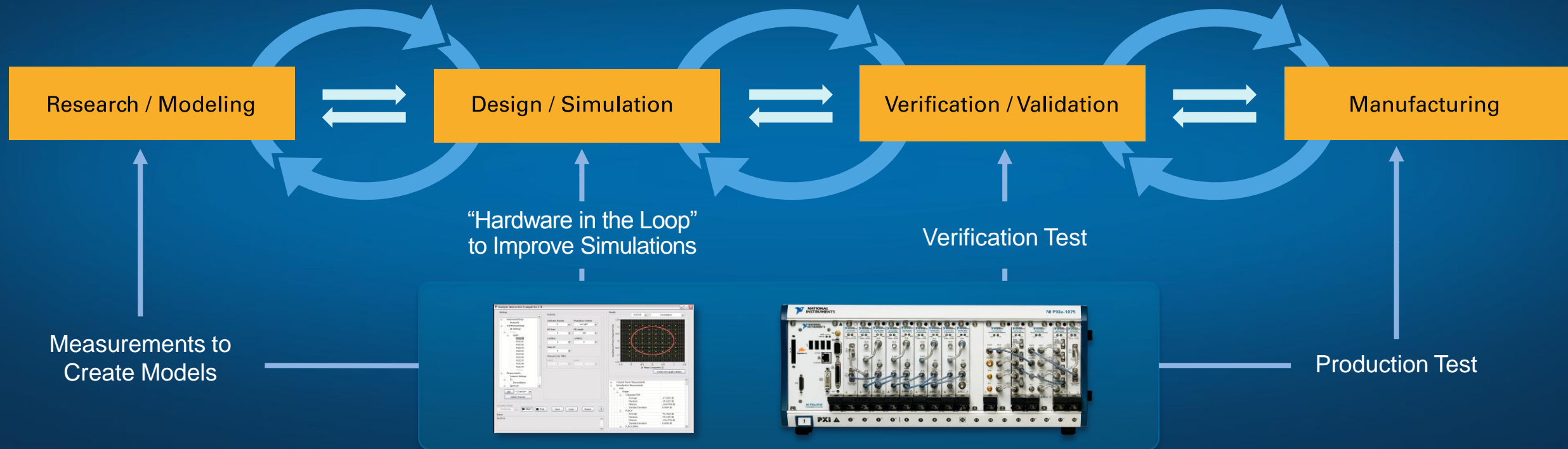
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CONFERENCE



Expanding Measurement Capabilities

Measurements Enhance RF Design



Sherry Hess

Vice President – Marketing
AWR

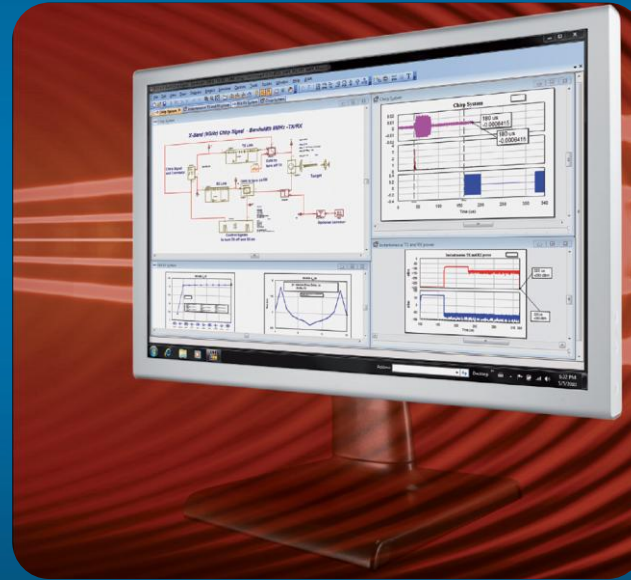
Josh Moore

Solutions Architect
AWR



RF and Microwave Design

Visual System Simulator



Microwave Office





NIWeek

WORLDWIDE GRAPHICAL SYSTEM DESIGN
CONFERENCE

Jin Bains

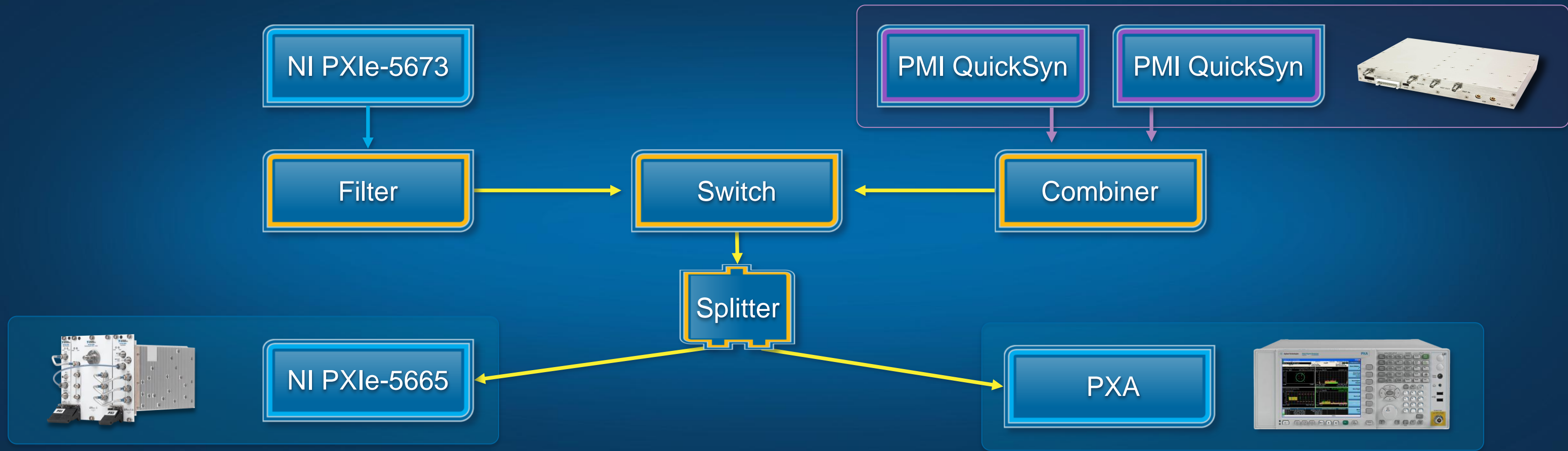
Director – RF R&D

Raajit Lall

Product Marketing Manager – RF

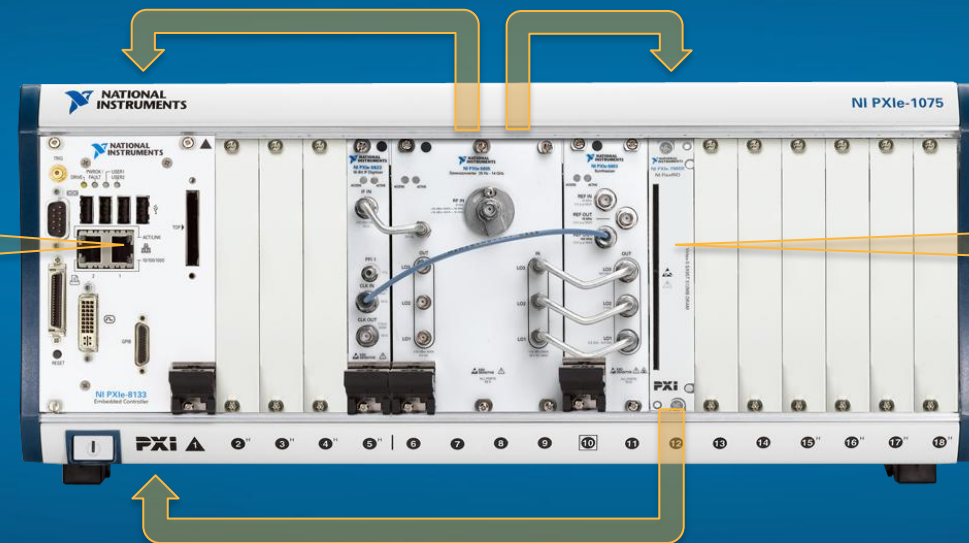
QuickSyn Microwave Synthesizer





Data Streaming Peer-to-Peer

NI PXIe-8133

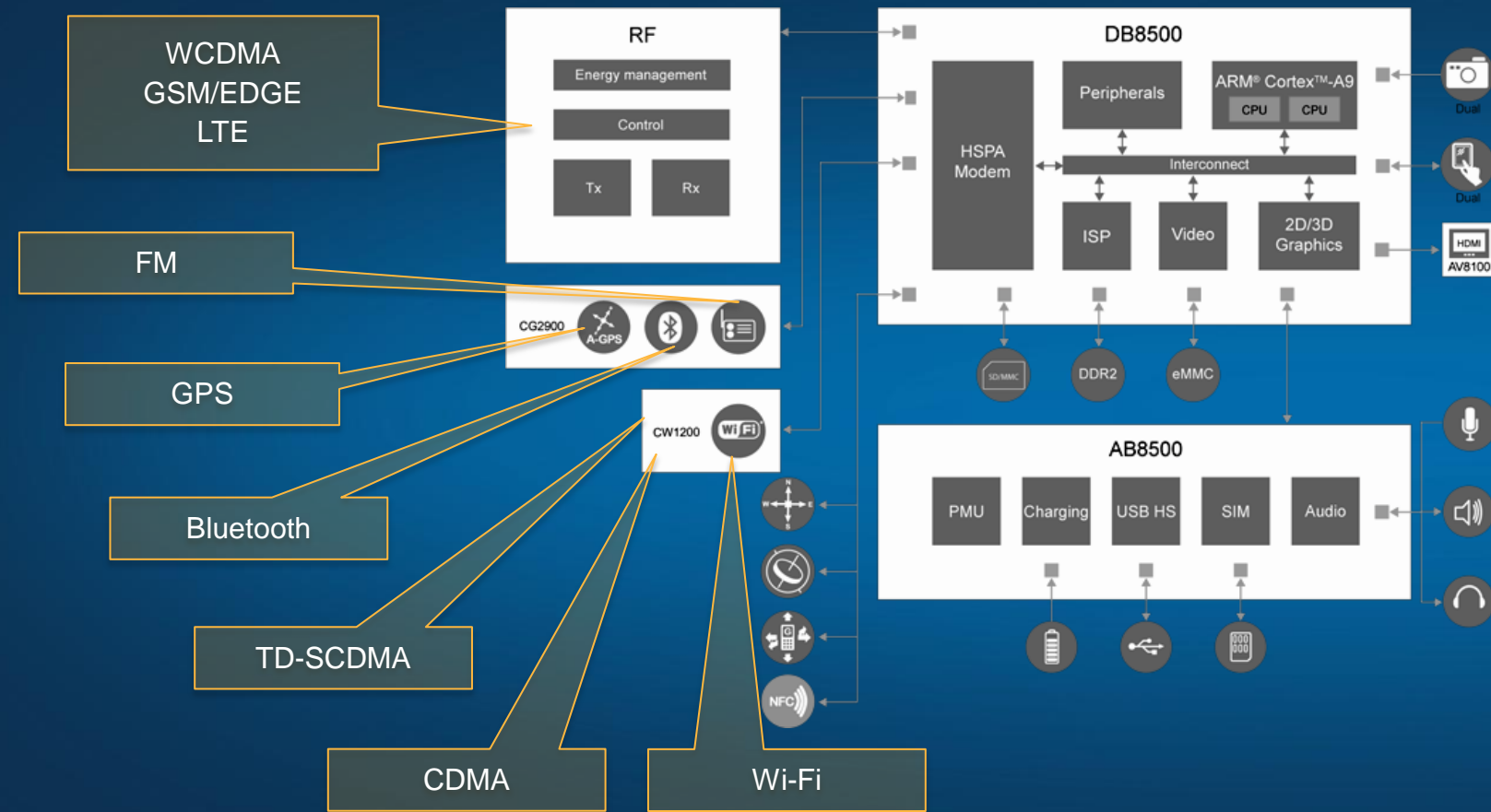


FFT
Averaging

Sylvain Bertrand

RF Broadband Validation Manager

ST Ericsson



NovaThor Platform

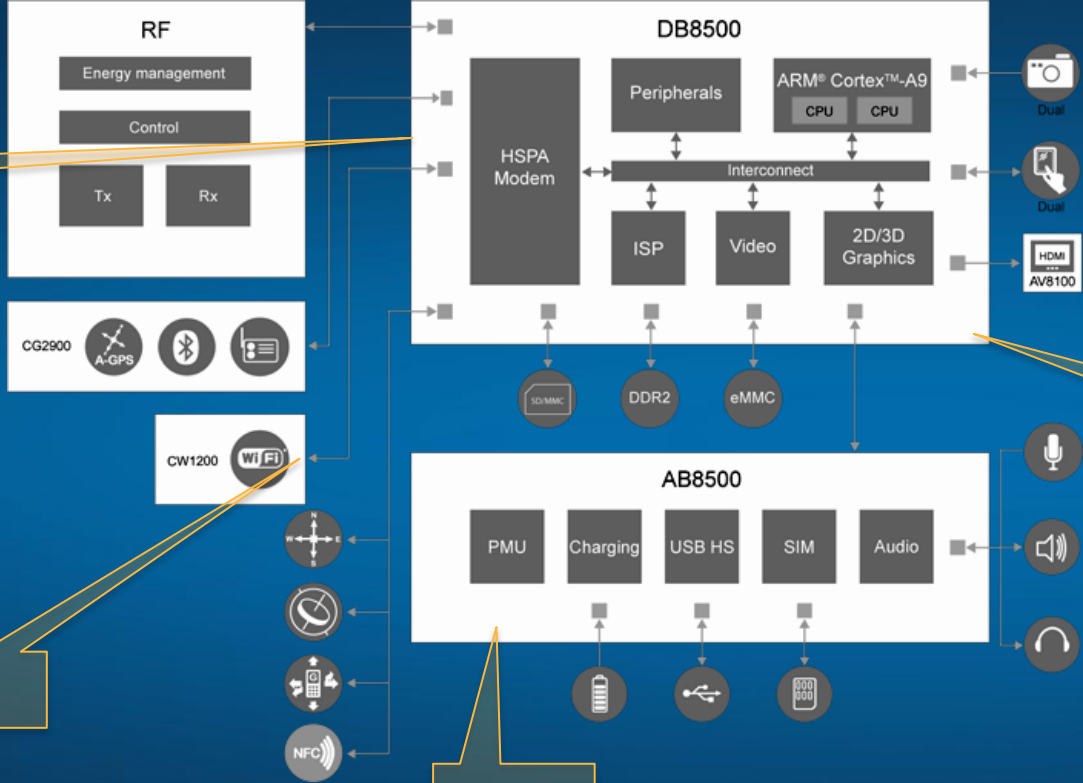
DigRF V3/V4

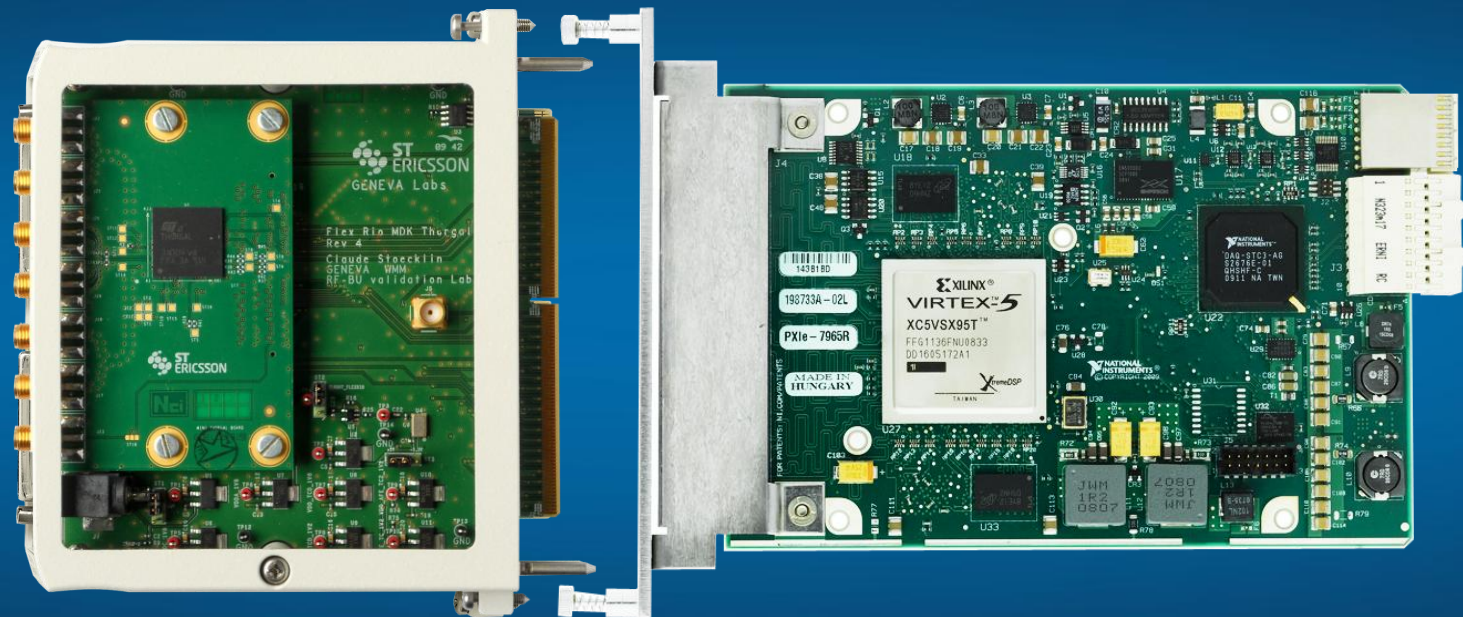
SPI

I²C

Custom

NovaThor Platform





Test Time			
Test	Previous Solution	PXI Solution	Improvement
WCDMA ACP	400 ms	30 ms	15X
LTE EVM	1.2 s	390 ms	3X
Total Time (800,000 measurements)	3 day	8 hrs	10X

Cost			
	Previous Solution	PXI Solution	Improvement
RF Analyzer + SW	\$85,000	\$29,999	2.8X
RF Generator + SW	\$77,000	\$23,999	3.2X
Total Cost	\$162,000	\$54,000	3X

NIWeek

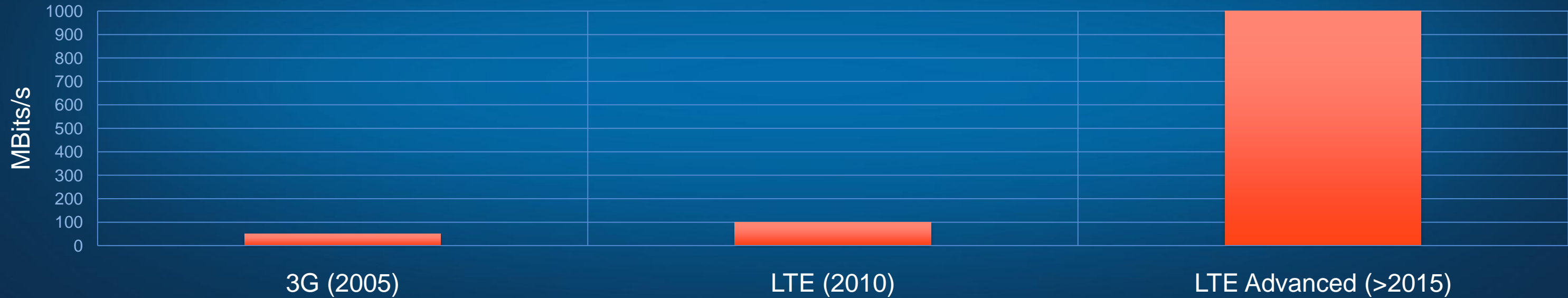
WORLDWIDE GRAPHICAL SYSTEM DESIGN
CONFERENCE

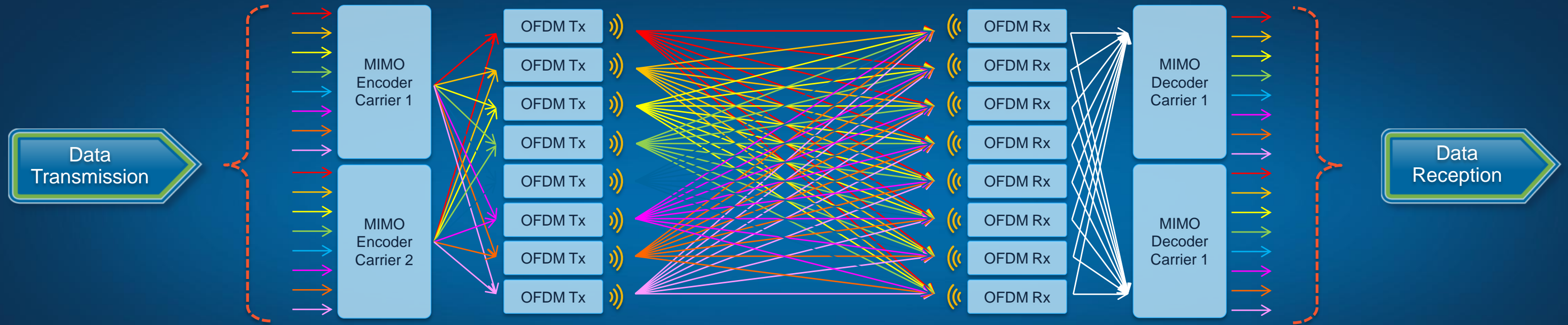
Ian Wong, Ph.D.
Senior Software Engineer

Yong Rao
Senior Software Engineer

Cellular Evolution

Peak Data Rates



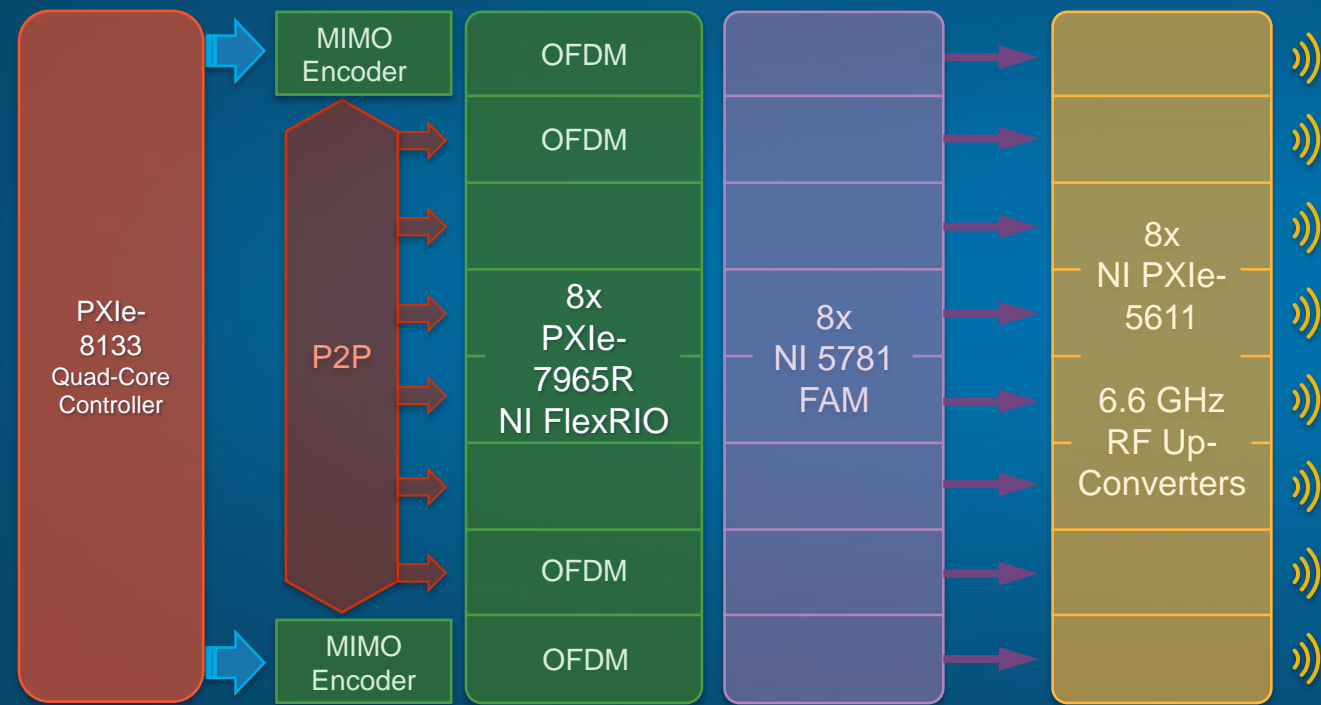


8x8 MIMO Wireless Channel

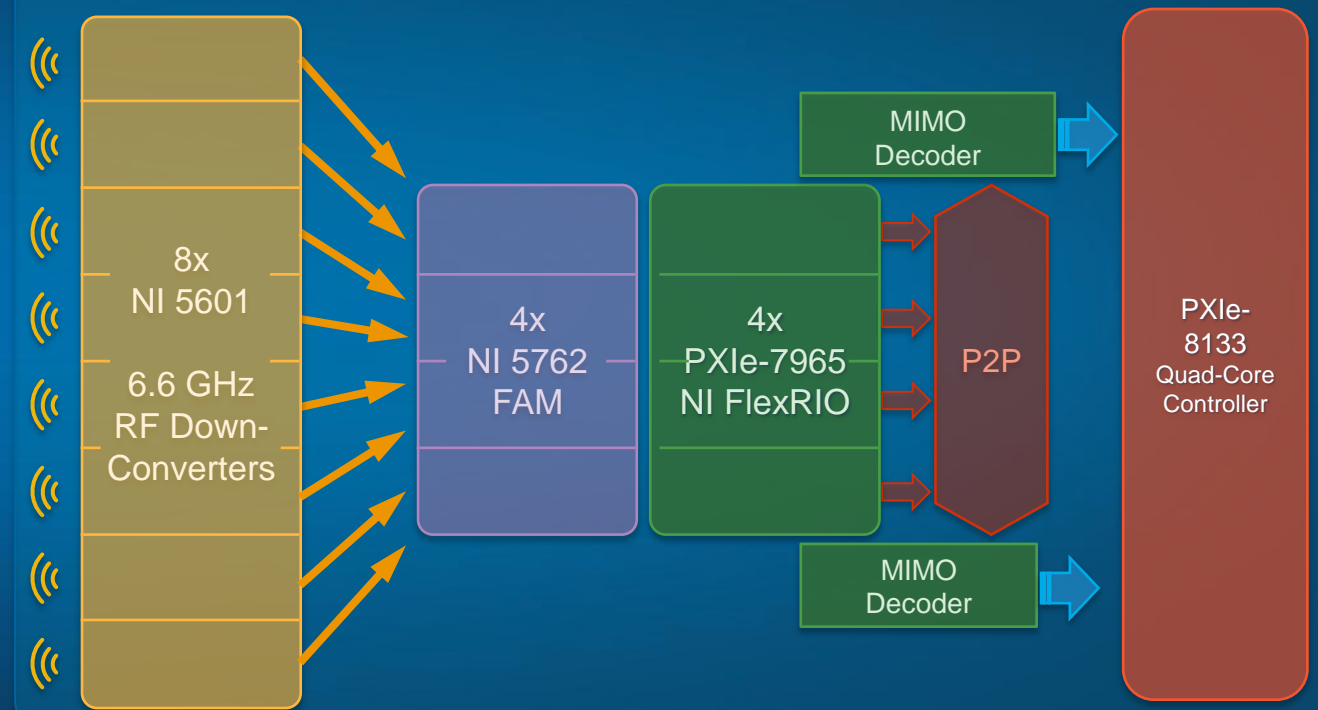
1 Gigabits per second!

(your current home Internet is probably at 7 Mbps)

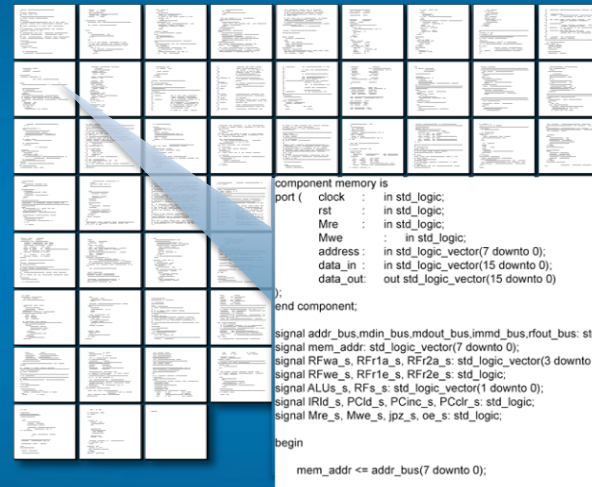
8x8 LTE Advanced Transmitter



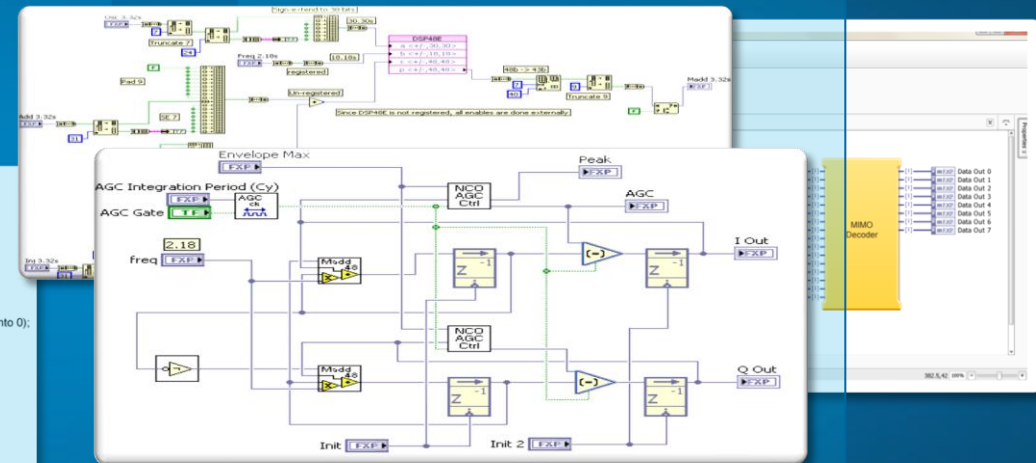
8x8 LTE Advanced Receiver



Graphical System Design for RF



HDL/RTL



LabVIEW DSP Design Module
LabVIEW Today
Early Access Program

NIWeek

WORLDWIDE GRAPHICAL SYSTEM DESIGN
CONFERENCE

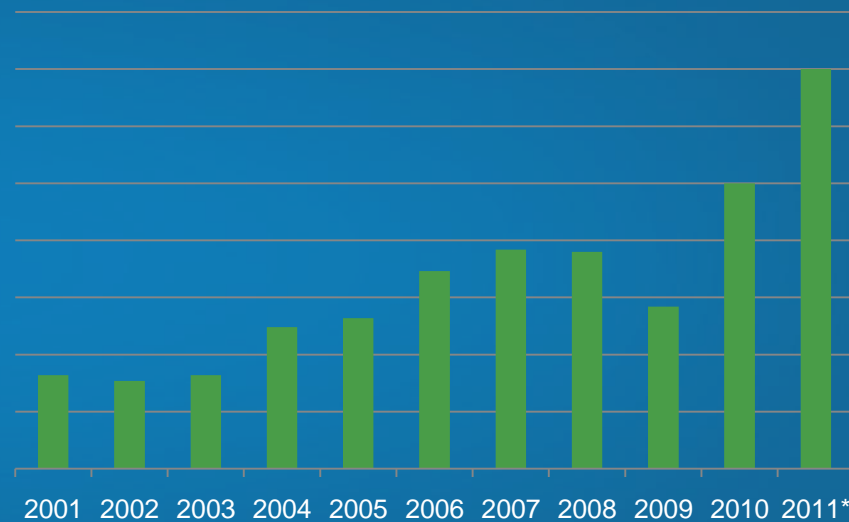
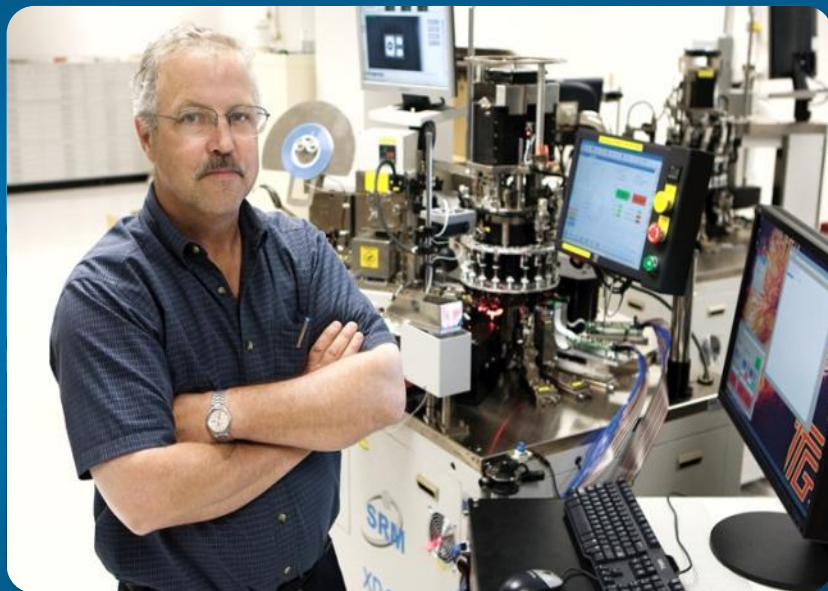
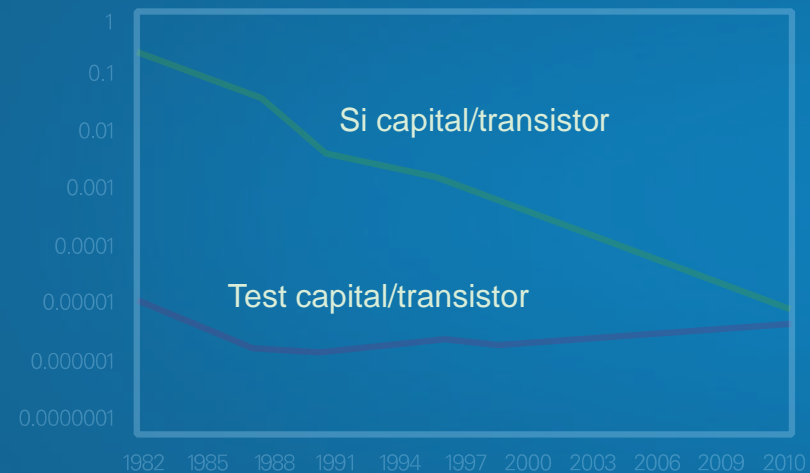
Charles Schroeder

Director – Product Marketing

Rolando Ortega

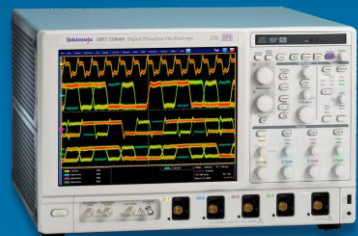
Staff Hardware Engineer

Cost of Silicon Manufacturing and Test





Software Defined

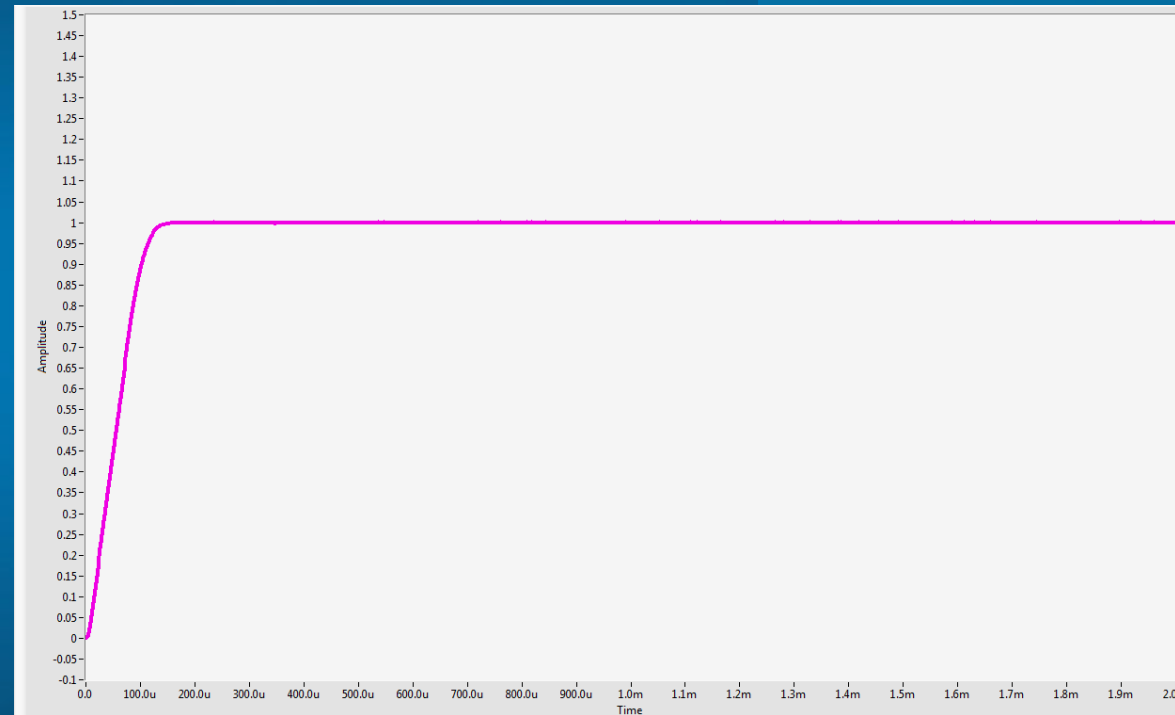


Best in Industry Performance

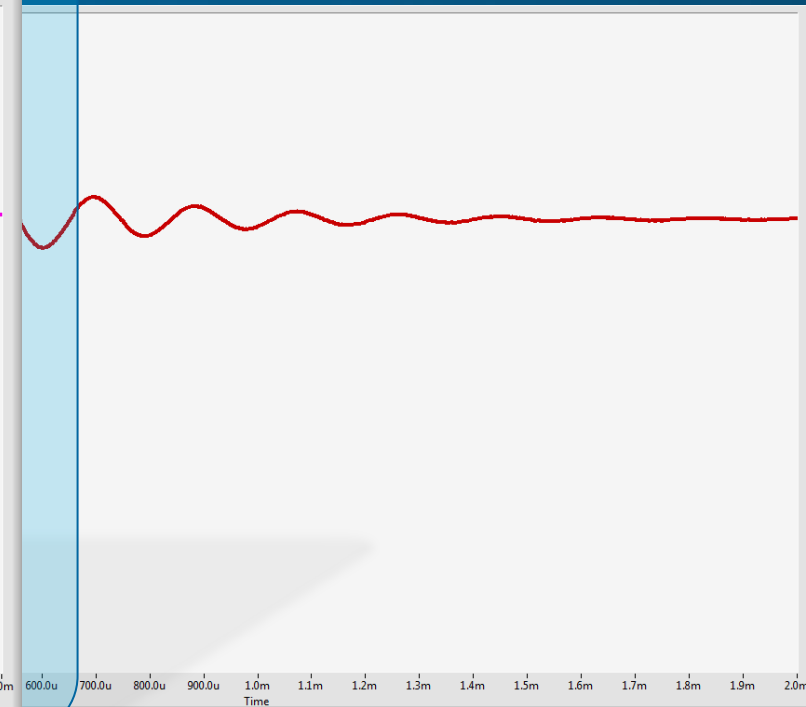


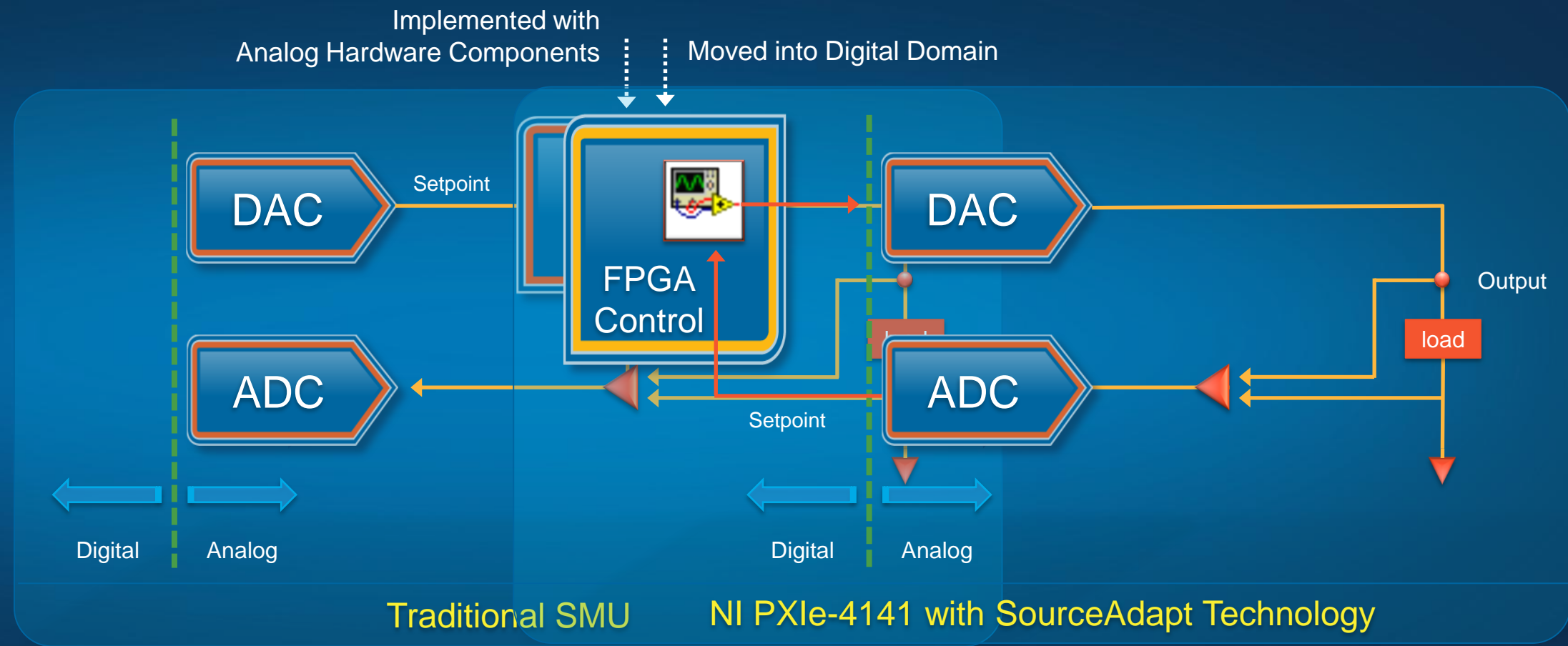
Traditional Semiconductor

Ideal Response



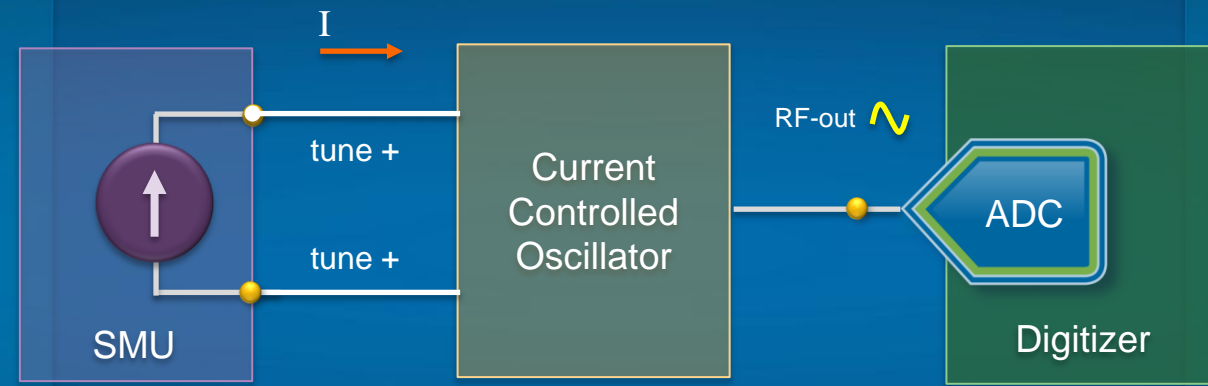
Non-Ideal Response







NI PXIe-4141 SMU
with SourceAdapt Technology



NI PXIe-5186 Digitizer
5 GHz, 12.5 GS/s

Tektronix®

Enabling Innovation

Sampling Technology

+



Software, Streaming, and
Synchronization

=





+



=



NI PXIe-6556



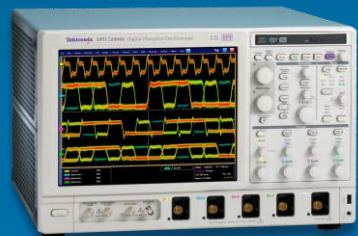
NI PXIe-6556



NI PXI-5922



Software Defined



Best in Industry Performance



Traditional Semiconductor

NIWeek

WORLDWIDE GRAPHICAL SYSTEM DESIGN
CONFERENCE

Duncan Hudson

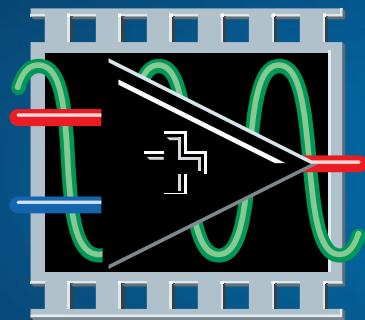
Director – LabVIEW R&D

Elijah Kerry

Product Marketing Manager – LabVIEW
Certified LabVIEW Architect

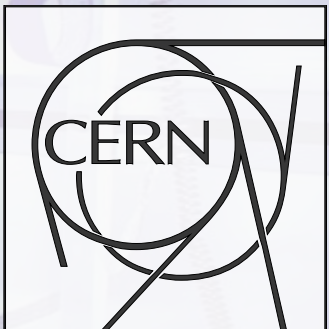
Chris Delvizis

Product Marketing Manager – Data Acquisition



NATIONAL INSTRUMENTS

LabVIEW™ 2011

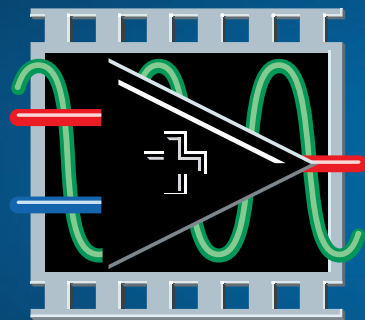




 **ANALOG
DEVICES**



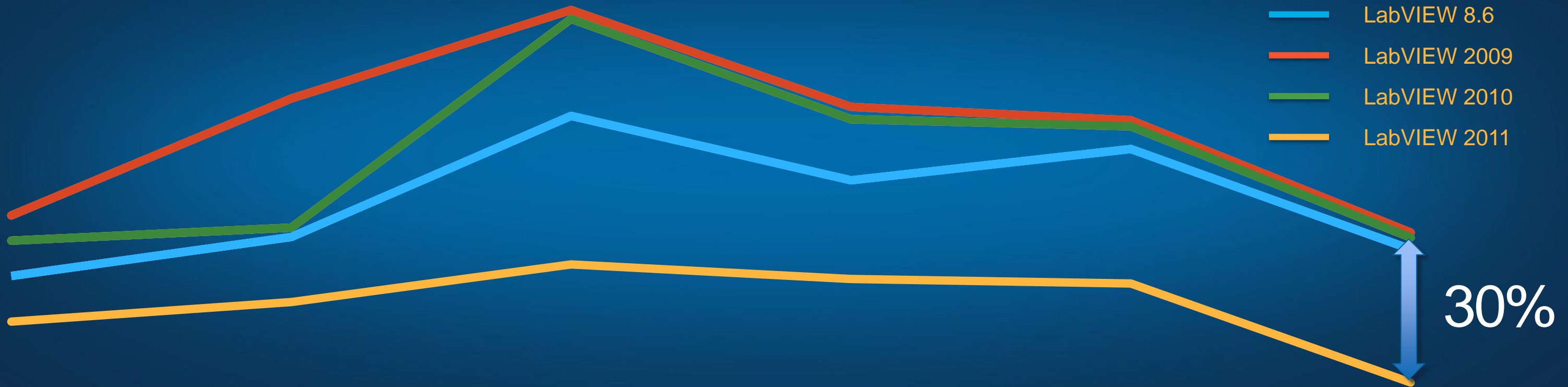
SPACEX



NATIONAL INSTRUMENTS

LabVIEW™ 2011

Software Bugs Inflow Per Month



“I’m really encouraged by this release
– it was a good time to stop and
concentrate on stability, and I think it’s
hit the mark. I upgraded our
VIE Hardware Explorer and 2 plugins
(NI-DCPower and a panel from a live
project) and found no real issues.”
– Christopher Relf,
VI Engineering, USA

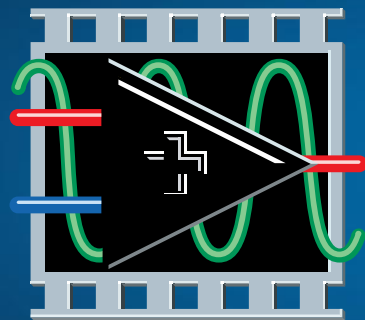
“In fact the transition of the older code was so smooth that I was first in doubt that I have a real beta. I am very glad that this time the efforts were focused on stability. For the way I use LabVIEW, reliability is more important than new features. The positive experience with the beta indicates that LabVIEW 2011 will indeed be a stable release.”

– Urs Lauterburg, Physics, University of Bern, Switzerland

“I'm sorry, this beta was too good for my program. The
only bugs found were bugs I introduced myself!”
– Albert Geven, Philips Research, Netherlands

“The beta seems very stable. One needs to squeeze pretty
hard to get some bugs out and most are cosmetic.”

– Christian Altenbach, Jules Stein Eye Institute at UCLA, USA

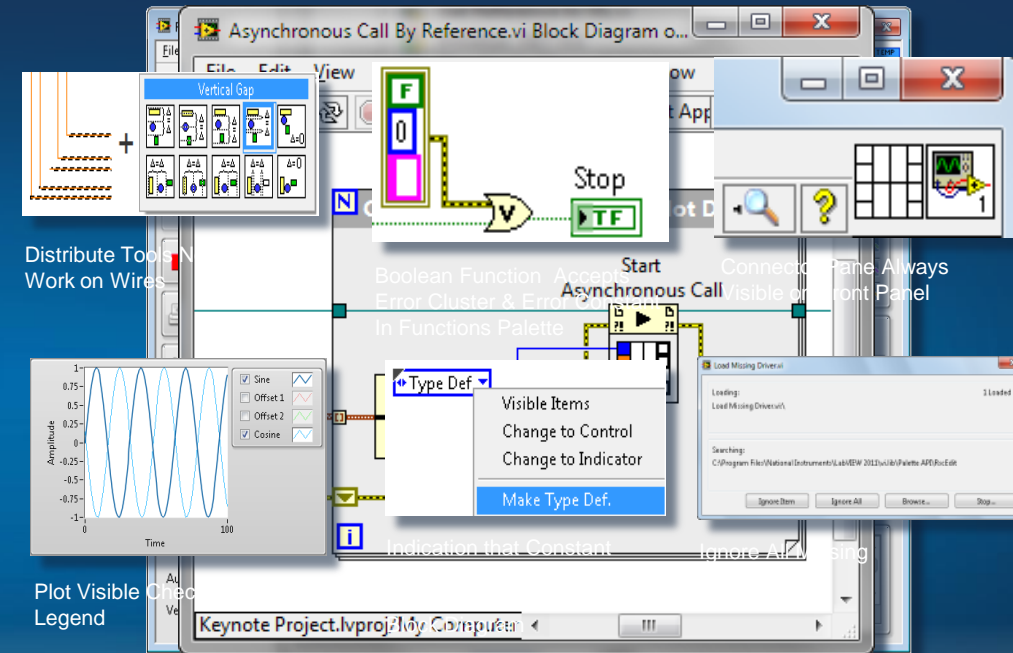


NATIONAL INSTRUMENTS

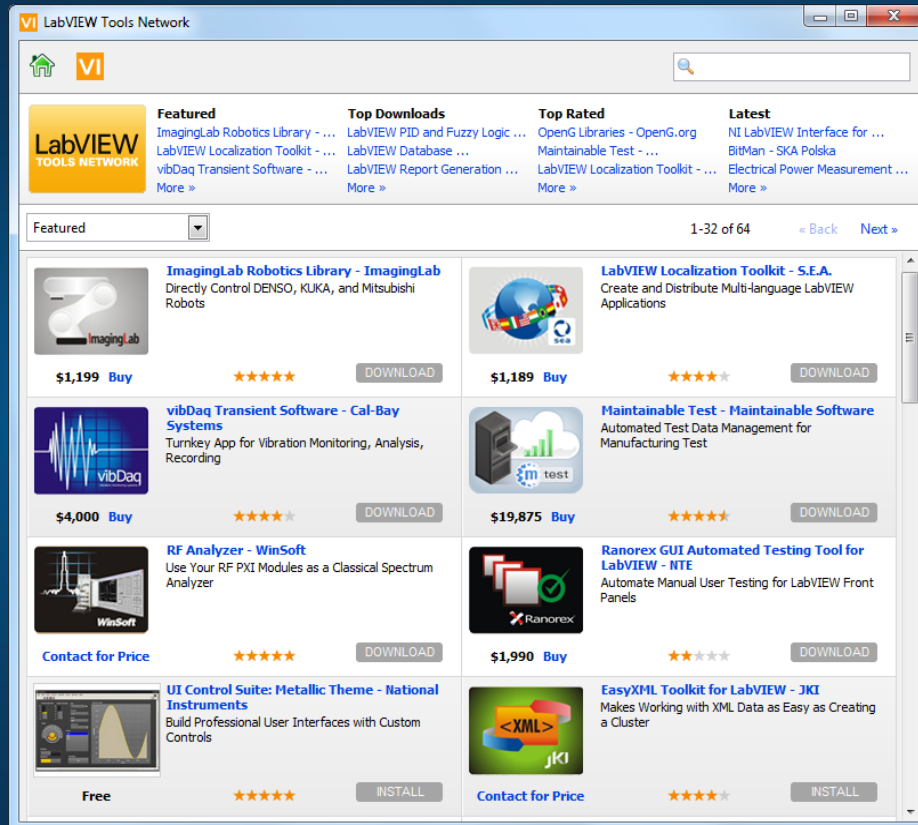
LabVIEW™ 2011

New Features in LabVIEW 2011

[Improved Multithreading
and Exchange Features]



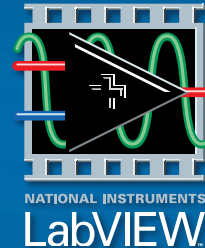
13 New User-Defined Control and Indicator Features



LabVIEW Tools Network

For engineers, by engineers

Engineering Libraries



Included Engineering Libraries

NI Toolkits and Modules

LabVIEW Tools Network

Assemblies and IP

NI Drivers and Modular Instruments

Deployment Platforms

9,000 Instrument Drivers

Standard and Custom Buses

Hardware Connectivity



ni.com/day1

Millions of Applications

One Platform

Graphical System Design

Test



Monitor



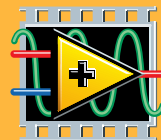
Embedded



Control



Cyber Physical



NATIONAL INSTRUMENTS

LabVIEW™



PC-Based DAQ



Modular Instruments



NI CompactRIO

GPB
IEEE-488

ETHERNET

CERTIFIED
HI-SPEED
USB

Open Connectivity



NIWeek

WORLDWIDE GRAPHICAL SYSTEM DESIGN

CONFERENCE