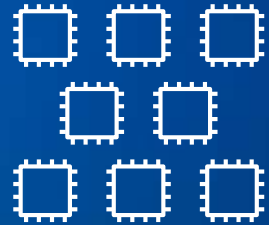
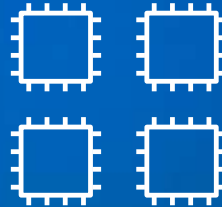
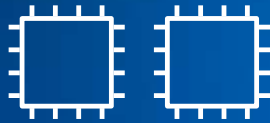
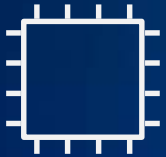


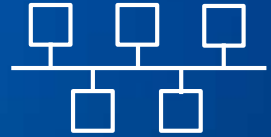
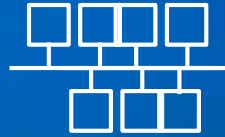
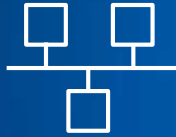
NIDays



Moore's Law



Metcalfe's Law



Battery Life



Lead-Acid



Ni-Cd



Ni-MH



Li-ion

Wireless



1G



2G



3G



4G

Sensors



Accelerometer



Encoder

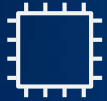


Strain



Microphone

The Internet of Things



Moore's
Law



Metcalfe's
Law



Battery
Life



Wireless



Sensors



Based on Moor Insights & Strategy's report "Segmenting the Internet of Things (IoT)"

INDUSTRIAL

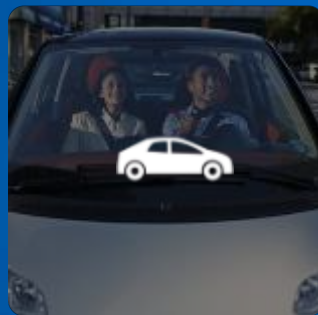
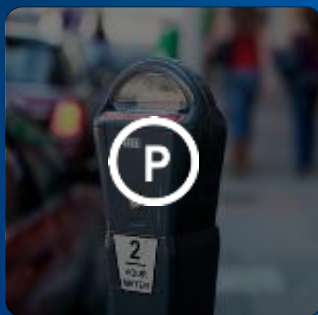
Internet of Things

CONSUMER

Internet of Things



Based on Moor Insights & Strategy's report "Segmenting the Internet of Things (IoT)"



INDUSTRIAL

Internet of Things

CONSUMER

Internet of Things



Based on Moor Insights & Strategy's report "Segmenting the Internet of Things (IoT)"







You and **NI Will** Create the Internet of Things

Graphical System Design





Almost 95% of Fortune 500

8,000 Classrooms





Top 20 5G Researchers



200

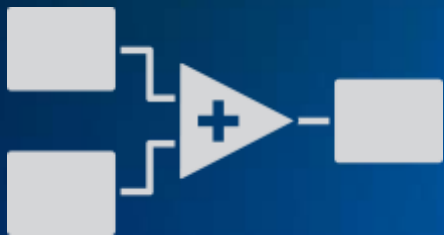
C Series modules

10,000

drivers

1,500

PXI modules



900

Graphical functions

$$y=f(x)$$

800

Text-based routines

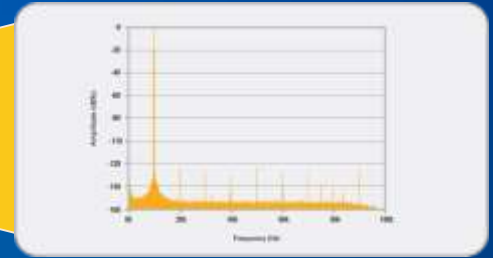
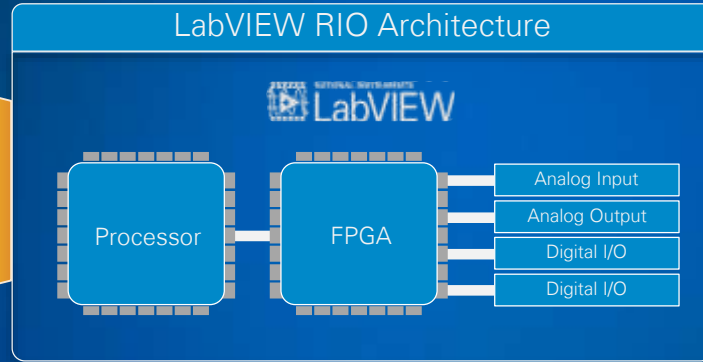


Precision Source Measure Unit



NI System on Module

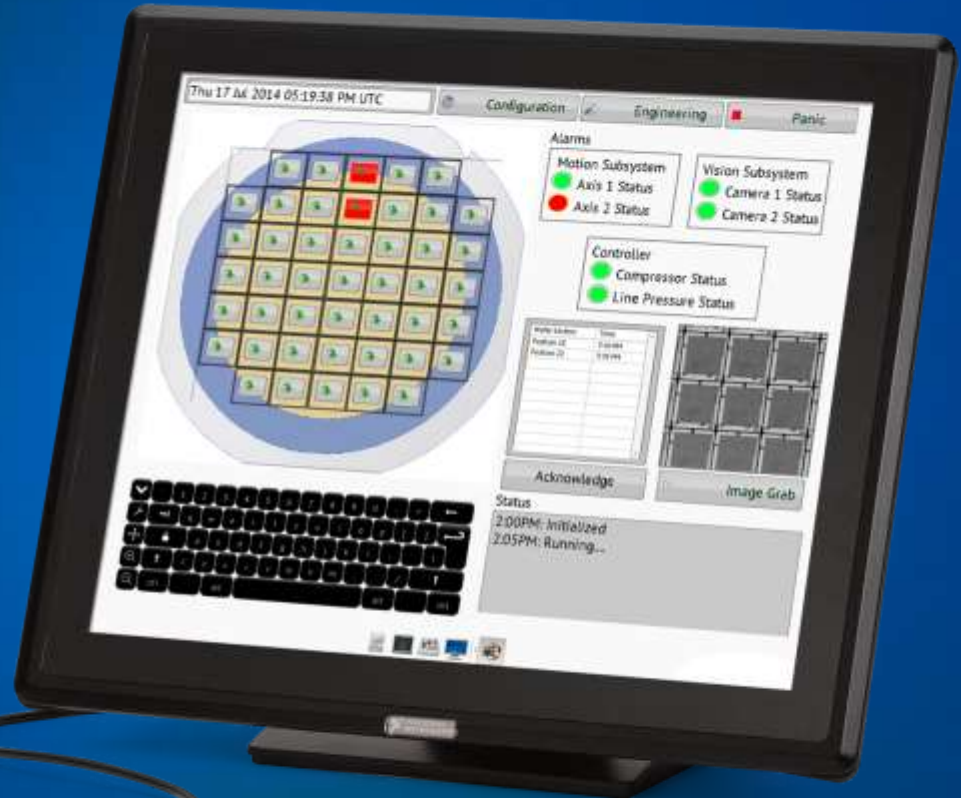




Data Dashboard for LabVIEW



Embedded HMI

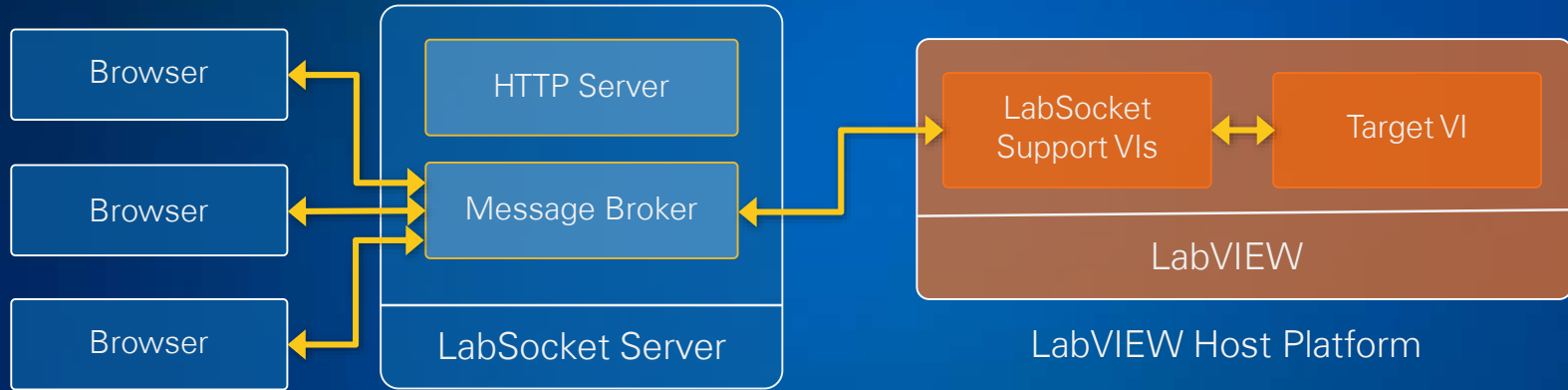




https://

LabSocket

The Easy Way to Extend LabVIEW to the Web



LabVIEW TOOLS NETWORK



LabSocket System

The Easy Way to Extend LabVIEW to the Web

Bergmans Mechatronics LLC
Real-Time Auto Research • Control Solutions • Instrumentation

 **DATA AHEAD**

 **LOCALGRID™**

 **virinco**

 **Signal.X**
TECHNOLOGIES LLC

INNOVATION

LabSocket System

DATA ACQUISITION

XLR8

EMBEDDED CONTROL
AND MONITORING

LocalGrid POA

AUTOMATED TEST

skyWATS

COMMUNITY

Scout TDMS Editor

Code Analysis

Unit Testing

Execution Profiling

Report Generation

Database Connectivity

LabVIEW Professional Development System

Code Analysis

Unit Testing

Execution Profiling

Software Engineering Toolkits

Report Generation

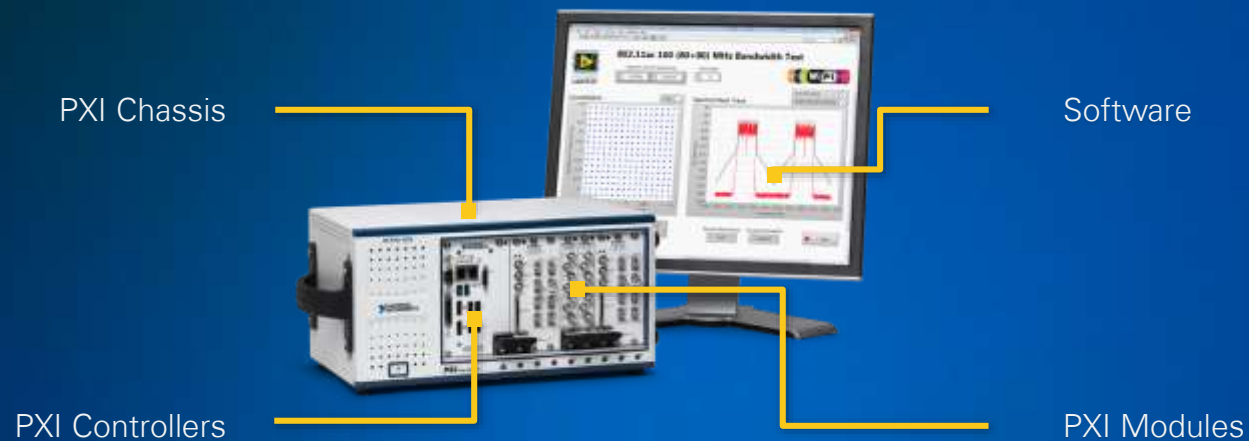
Database Connectivity



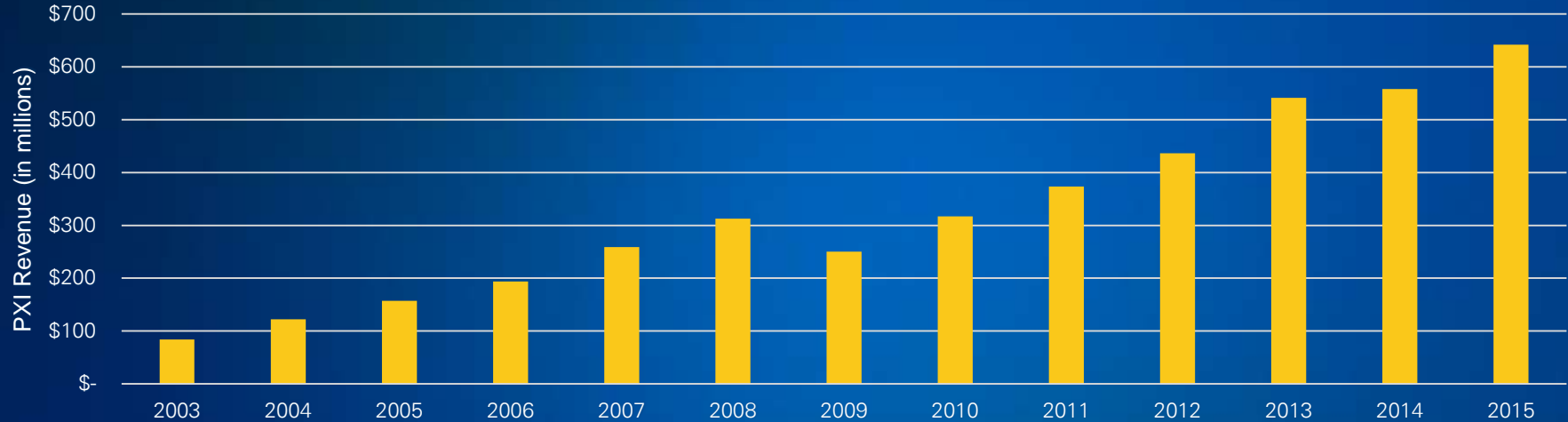
LabVIEW 2014







PXI Growth Continues...



Source: Frost & Sullivan, Prime Data, and NI Estimates

“The global PXI-based instrumentation market in electronic test applications is expected to experience a compound annual growth rate of 17.6% from 2013 to 2020. By 2020, this market is expected to generate over \$1,750 million.”

—Frost and Sullivan, 2014

System Compare | PXI vs. Previous ATE

	PXI Tester	Reduction	Previous Solution
Cost	\$40K USD	11X	\$450K+ USD
Footprint	18 x 24 x 7 in.	15X	98 x 66 x 74 in.
Weight	60 lb	66X	4000 lb
Facility	600 W	16X	10 kW

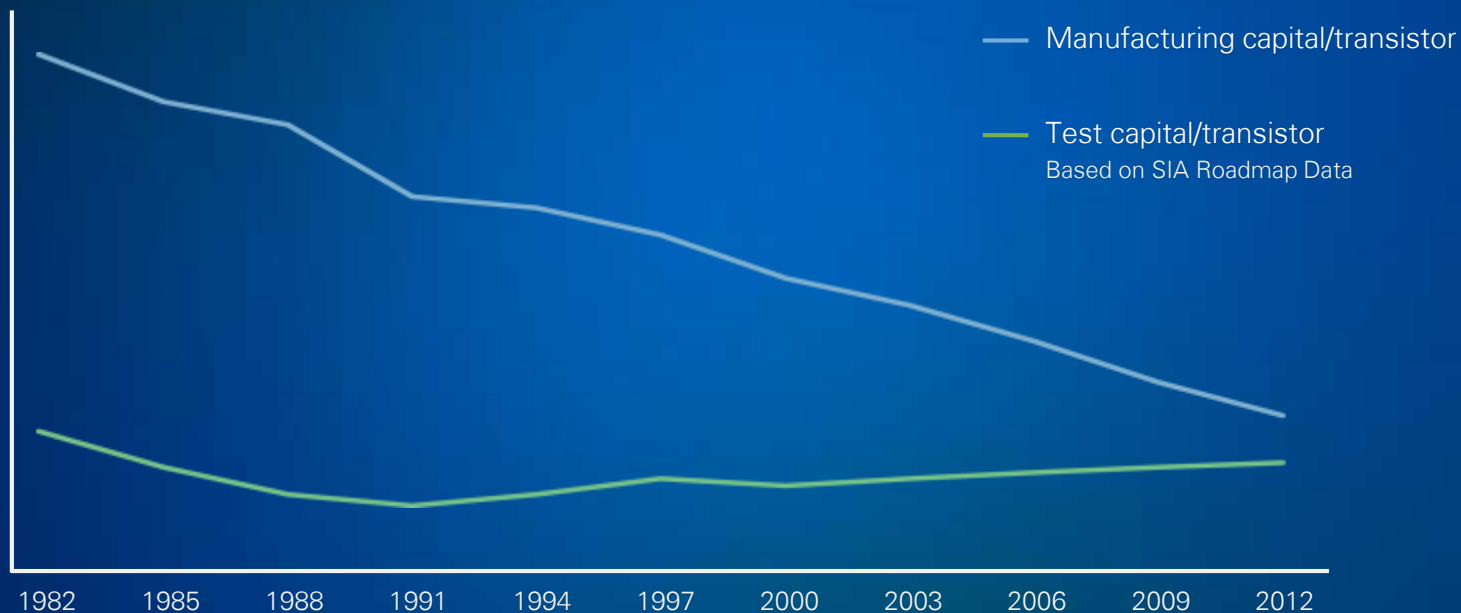
Moore's Law
Digital



More Than Moore
Analog/RF



The Economics of Silicon Manufacturing and Test



Existing NI Capabilities



Hardware



Software



Global Services and Support

Introducing the Semiconductor Test System



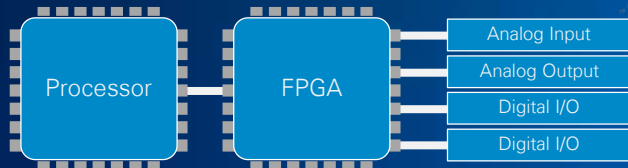


RF Subsystem



- RF Ports
- Port Modules
- Vector Signal Transceiver
- PXI Chassis

LabVIEW RIO Architecture



Global Service Facilities





1700
employees

\$485M
in revenue for 2014

900+
issued/pending patents

Reduce Cost



Improve Utilization



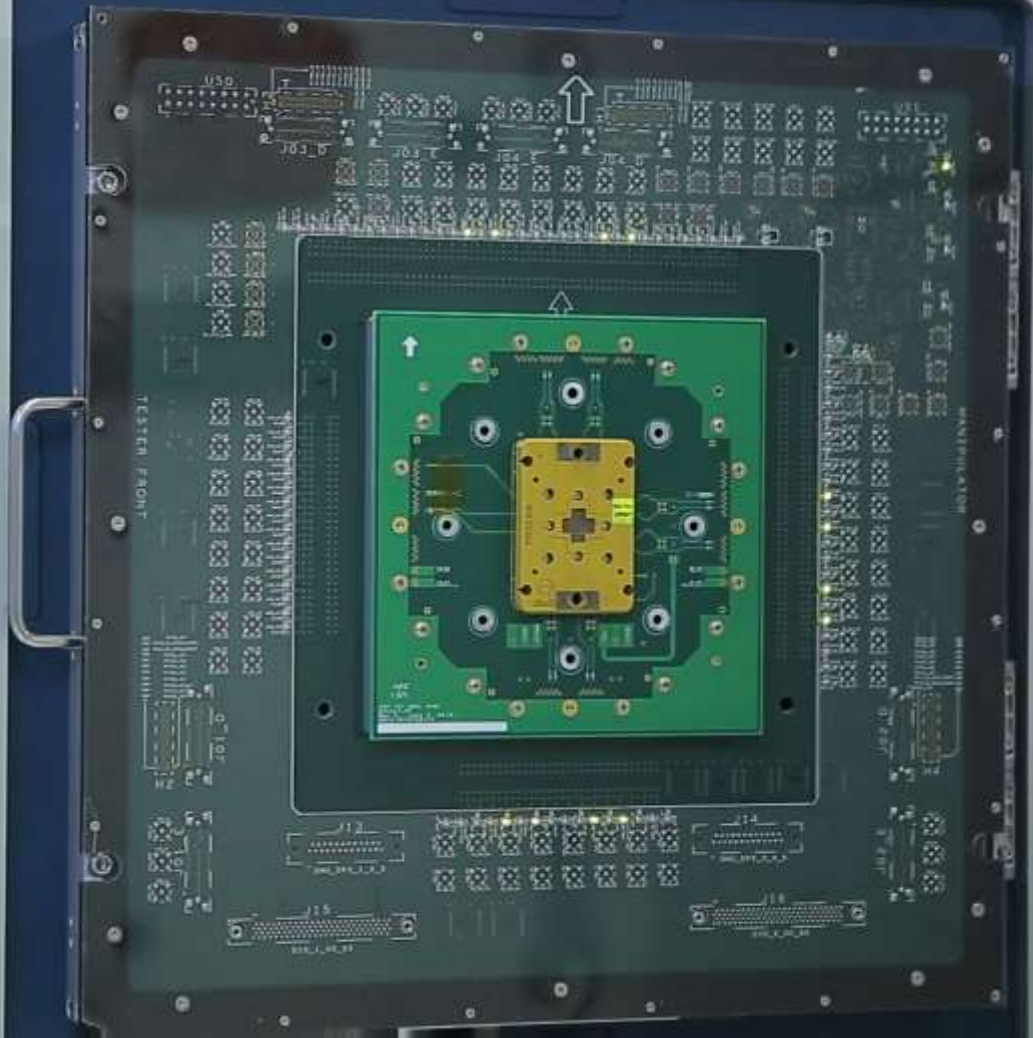
Big-Iron
High Cost



In-House
No Support



MICROBONDING / IN THE ADAPTATION MODULE





Software-Designed Instrumentation



2012 Evolution of NI PXI RF



200X Shorter

2007 NI PXI RF Instrumentation



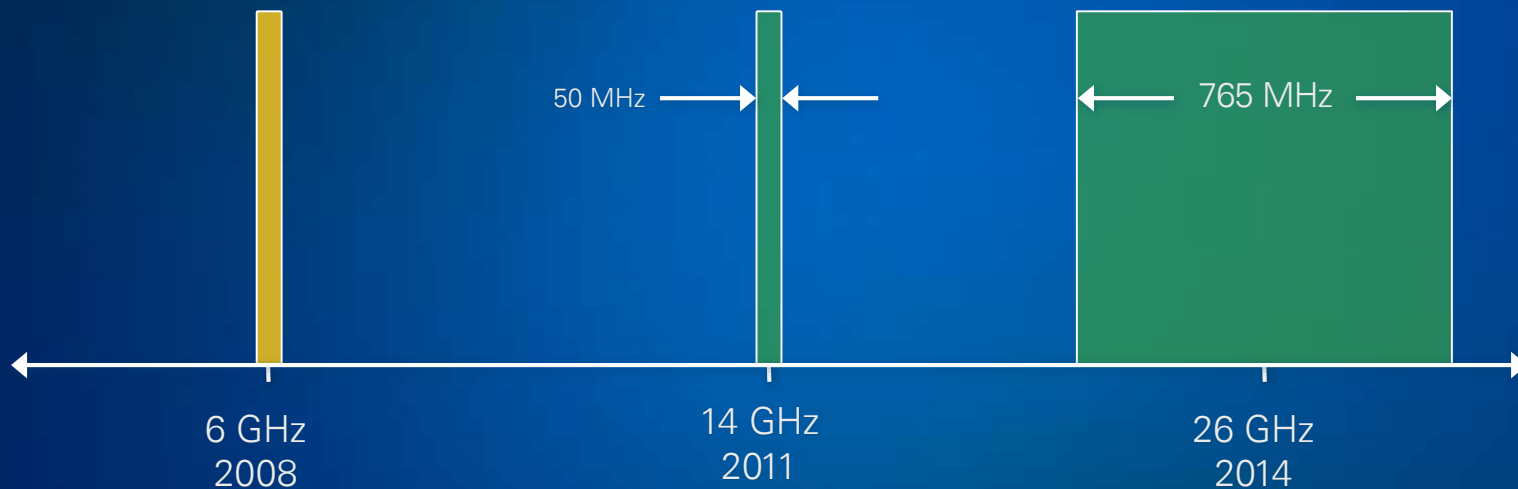
10X Shorter

Traditional Rack and Stack



Traditional Test Time

NI Frequency and Bandwidth Coverage



Spectrum Allocations





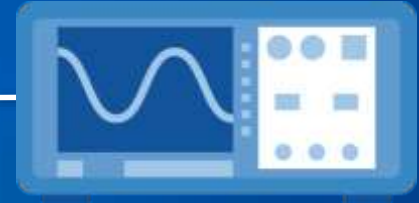
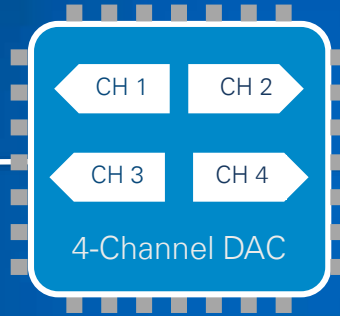
Design Engineer
Maximum instrument performance



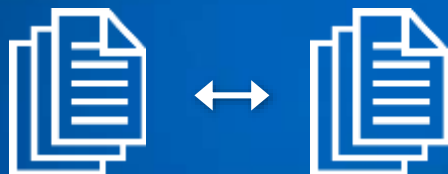
Production Engineer
Fastest test time



NI 26.5 GHz Signal Analyzer



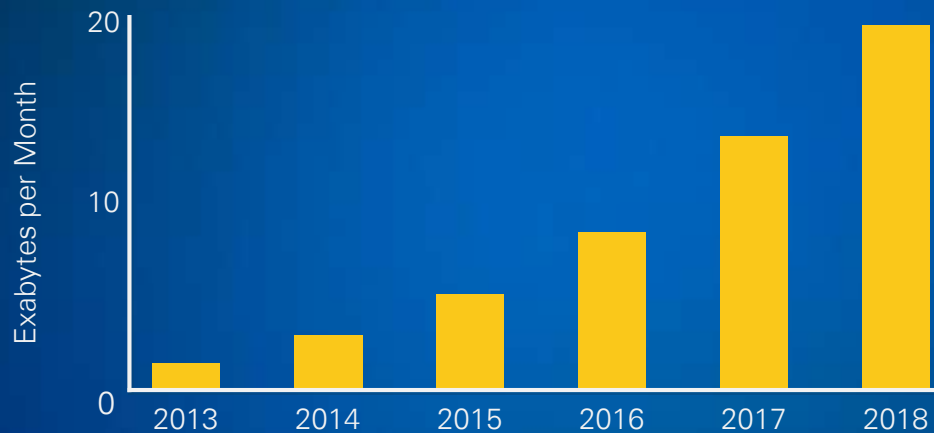
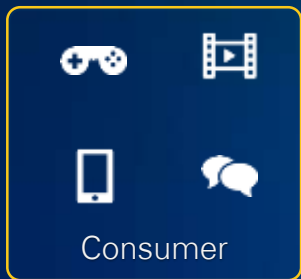
Box Analyzer











Graph Source: Cisco VNI, 2014



1000X

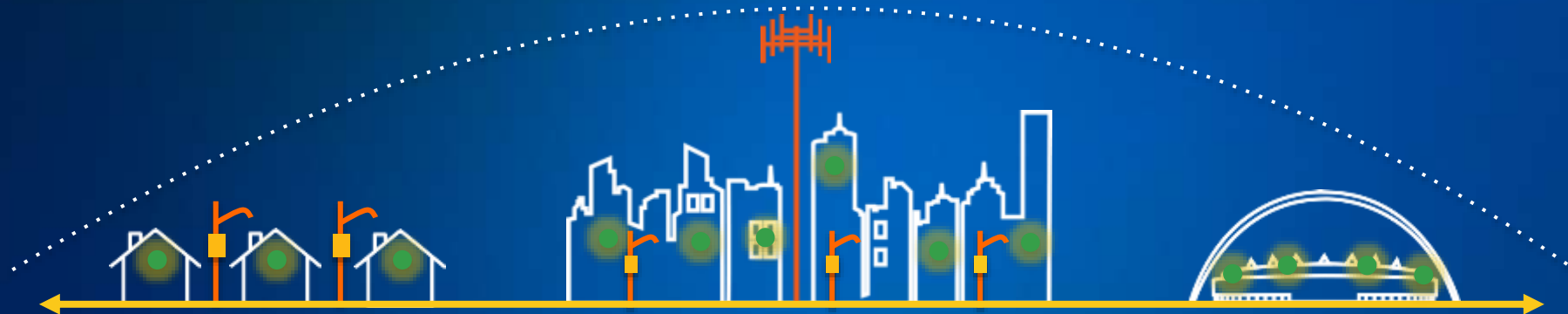
CHALLENGE

SOLUTION

New Spectrum

Spectral Efficiency

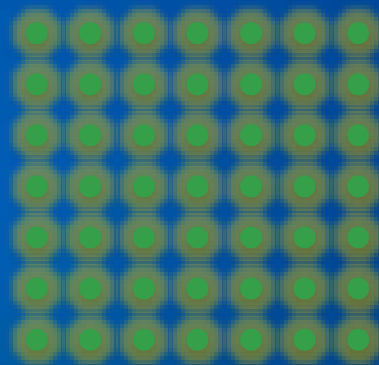
Base Stations





10,000's

Macro Cells



1,000,000's

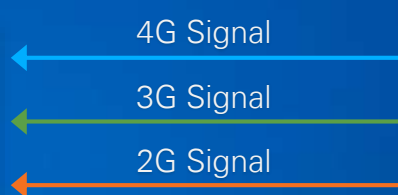
Small Cells



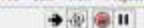
Test Station UI



PXI Test System
VST + FlexRIO



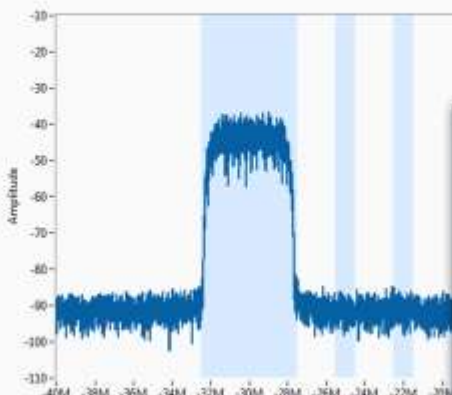
Small Cell DUT



RMS EVM

Channel Power

Mean Frequency Offset



GSM Results

0.12%

-7.9dBm

-0.25Hz

0.12%

-7.9dBm

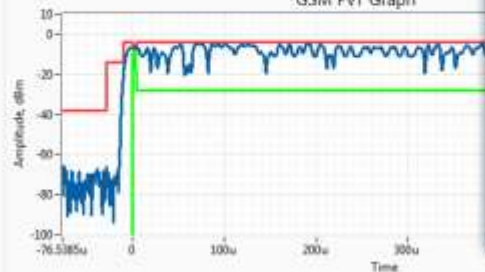
-0.29Hz

0.12%

-8dBm

-0.21Hz

GSM PVT Graph



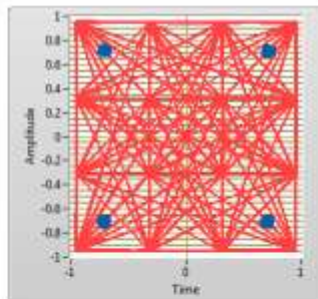
LTE Measurements

RMS EVM, % 0.88%

Average Power, dBm -31dBm

Frequency Offset, Hz 1.4Hz

Meas time, s 1.5s



EVM Results

Channel

pdscch

RMS EVM (%)

0.882541

Channel

pdscch0

RMS EVM (%)

1.69287

Channel

pdscch1

RMS EVM (%)

0.682813

Channel

pdscch

RMS EVM (%)

0.807862

Channel

pdscch

RMS EVM (%)

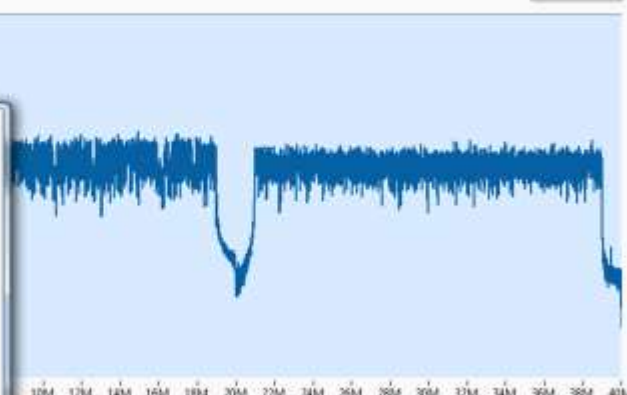
1.22919

Channel

pdscch

RMS EVM (%)

0.795506



0.49%

-25dBm

-0.064Hz

S EVM



LTE Results

0.87%

-29dBm

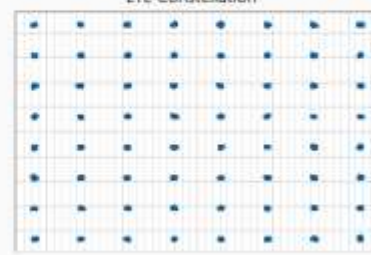
1.7Hz

0.93%

-30dBm

-0.12Hz

LTE Constellation



LabVIEW TOOLS NETWORK



“National Instruments Announces Next-Generation 5G Collaboration With Nokia”

“National Instruments Stepping Ahead

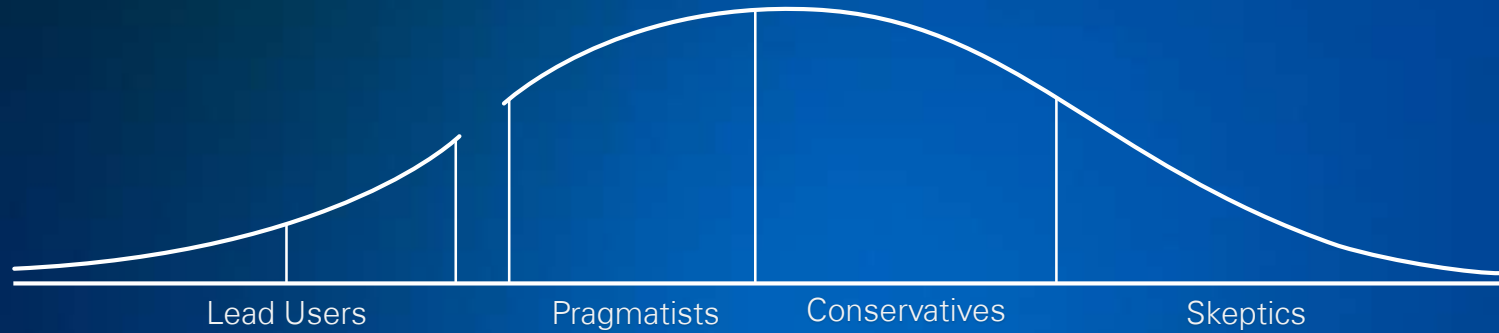
of Agilent Technologies With 5G”

“Prototyping Massive MIMO”

–The Wall Street Journal

–Forbes


–Microwave Journal



NOKIA

ATM | **TEXAS A&M**
UNIVERSITY

College of Engineering
THE UNIVERSITY OF TEXAS AT AUSTIN

Alcatel-Lucent 

Georgia Institute of Technology

SAMSUNG

5G Research Areas

Cell
Densification

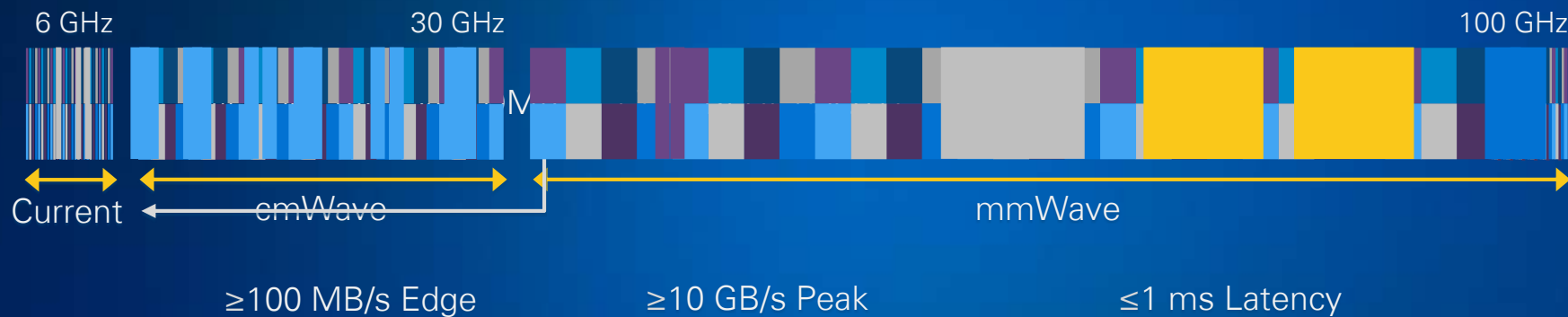
Chip Scale
Antenna Design

MIMO and Beam
Forming

Interference
Management

New Spectrum
and Air Interface

5G Research Areas

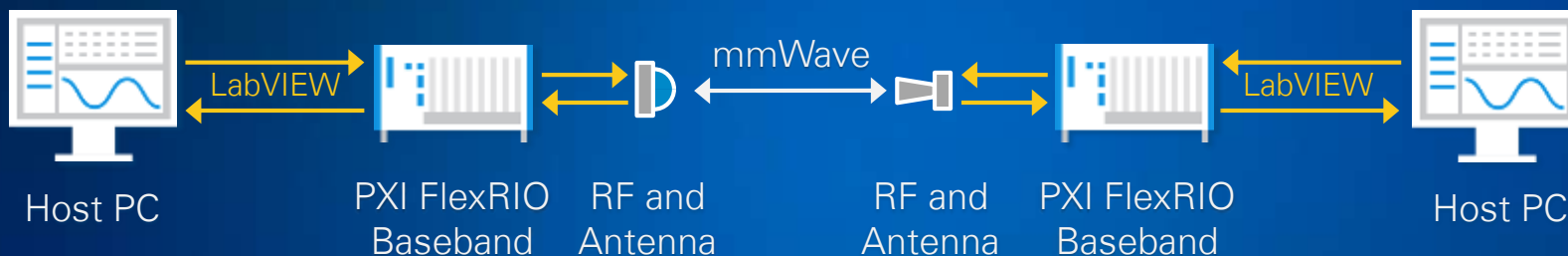


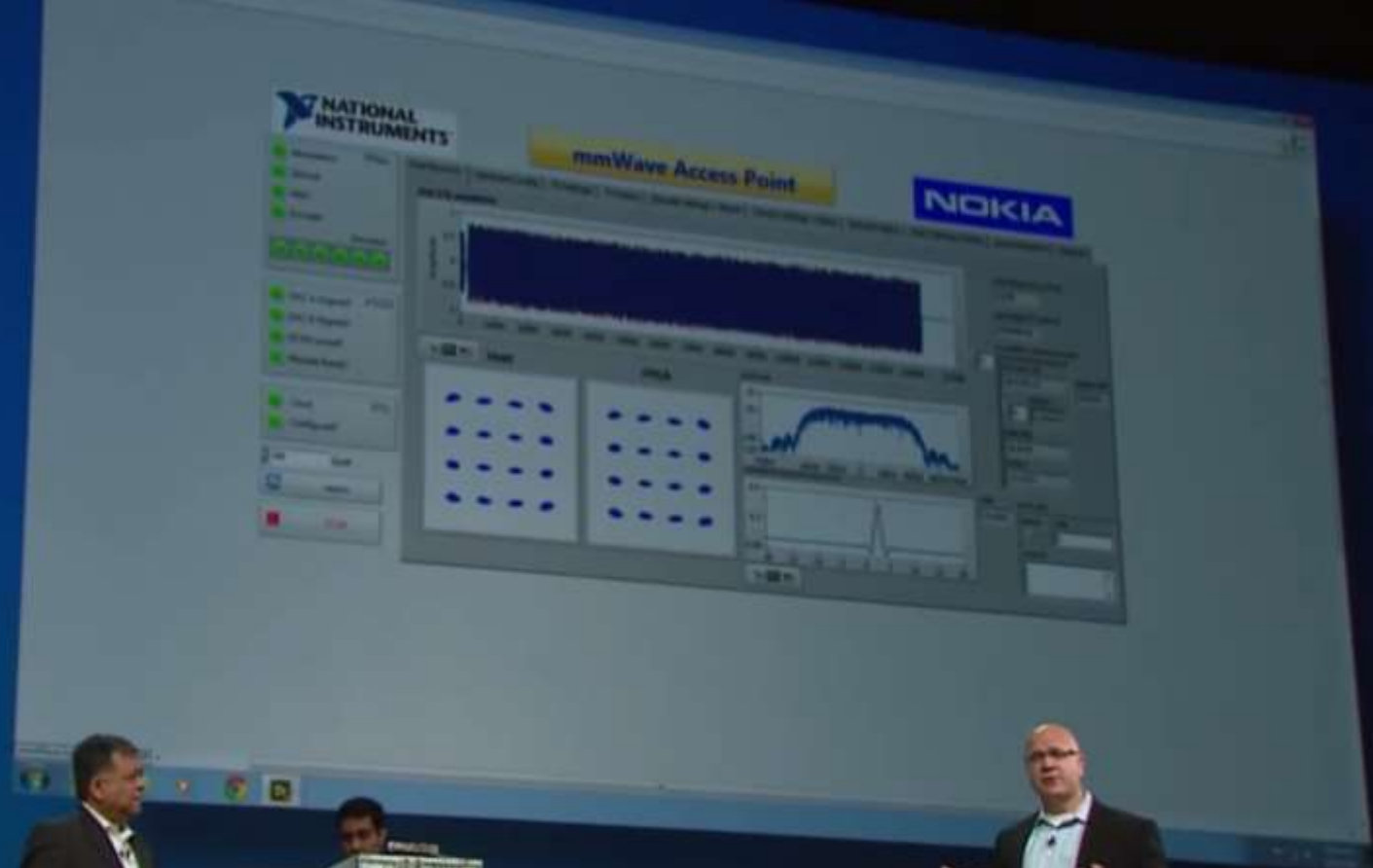
1 GHz Bandwidth
Real-Time Processing
Scalable and Flexible



Cellular Access Point System

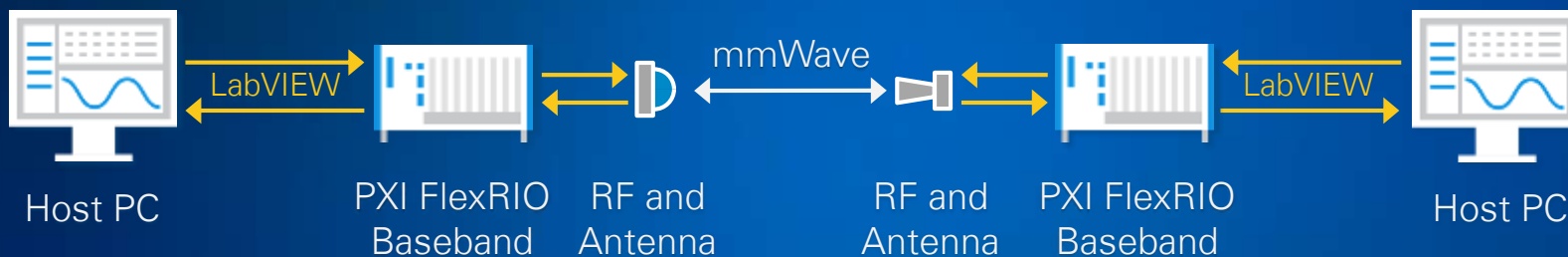
User Device (Handset) System



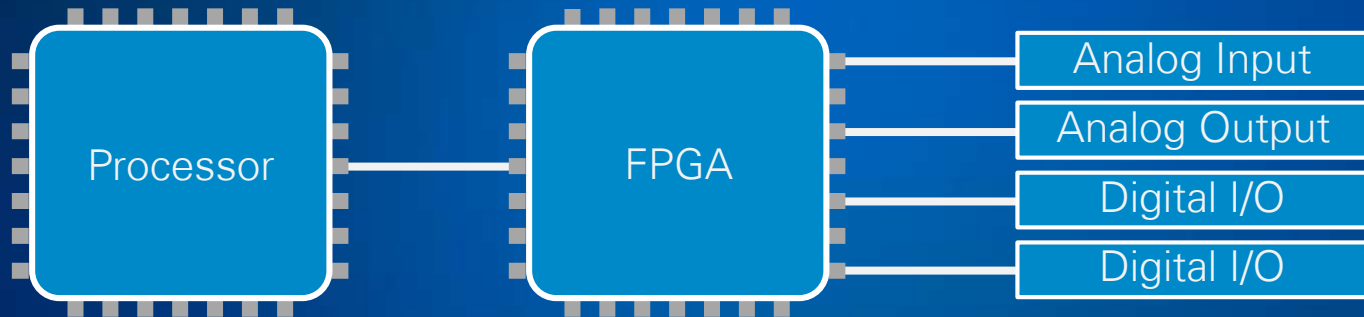


Cellular Access Point System

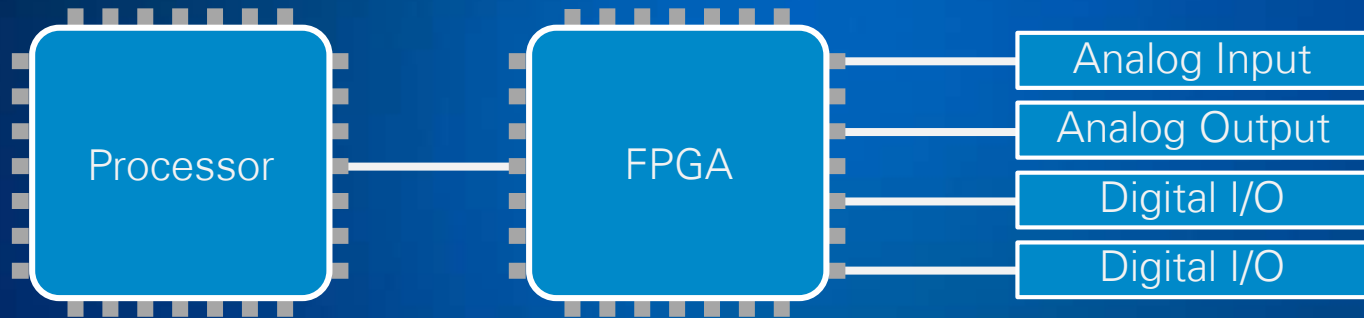
User Device (Handset) System



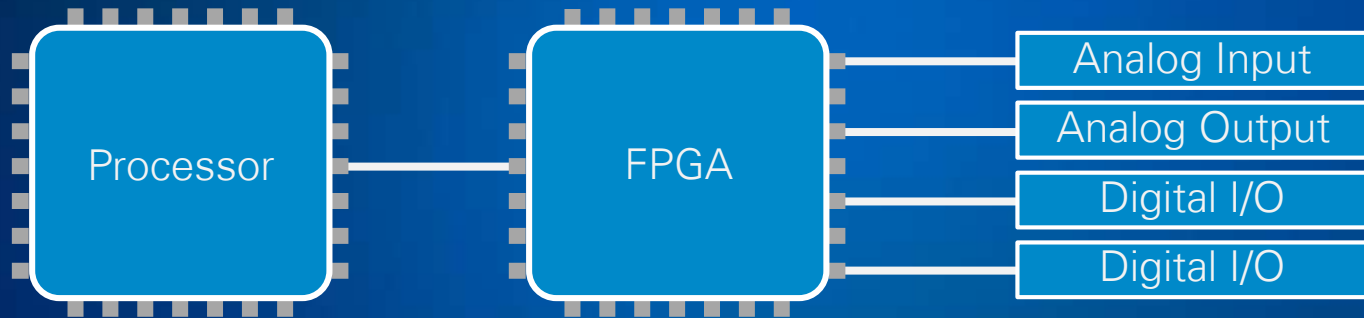
LabVIEW RIO Architecture



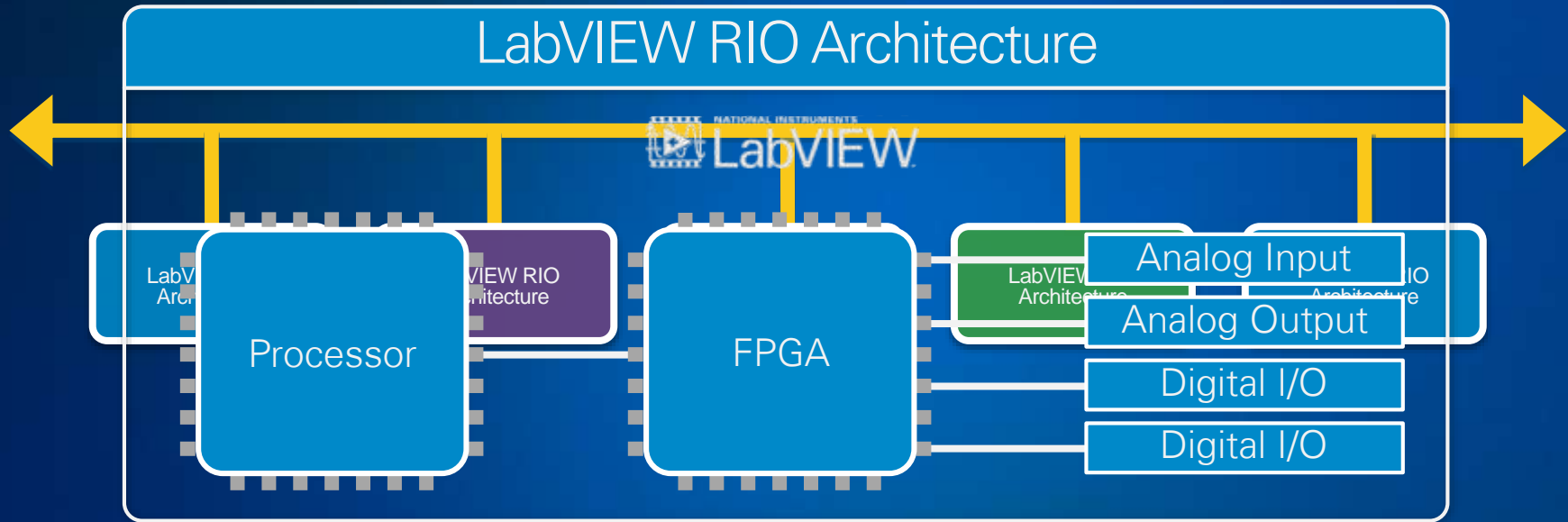
LabVIEW RIO Architecture



LabVIEW RIO Architecture



Increasing Complexity of Industrial Systems



CompactRIO—A Decade of Innovation

World's First Software-
Designed Controller



2004

LabVIEW RIO-Based
Single-Board Computer



2008

High-Performance
Multicore Processing



2011

Linux-Based
Real-Time OS

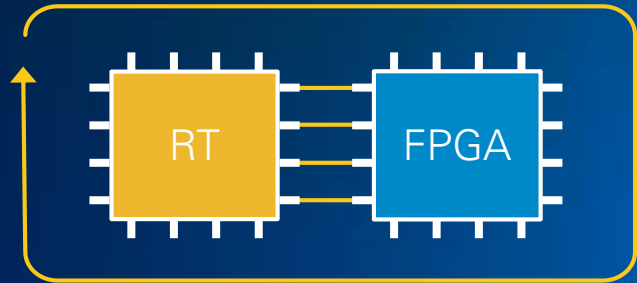


2013

LabVIEW RIO-Based
System on Module



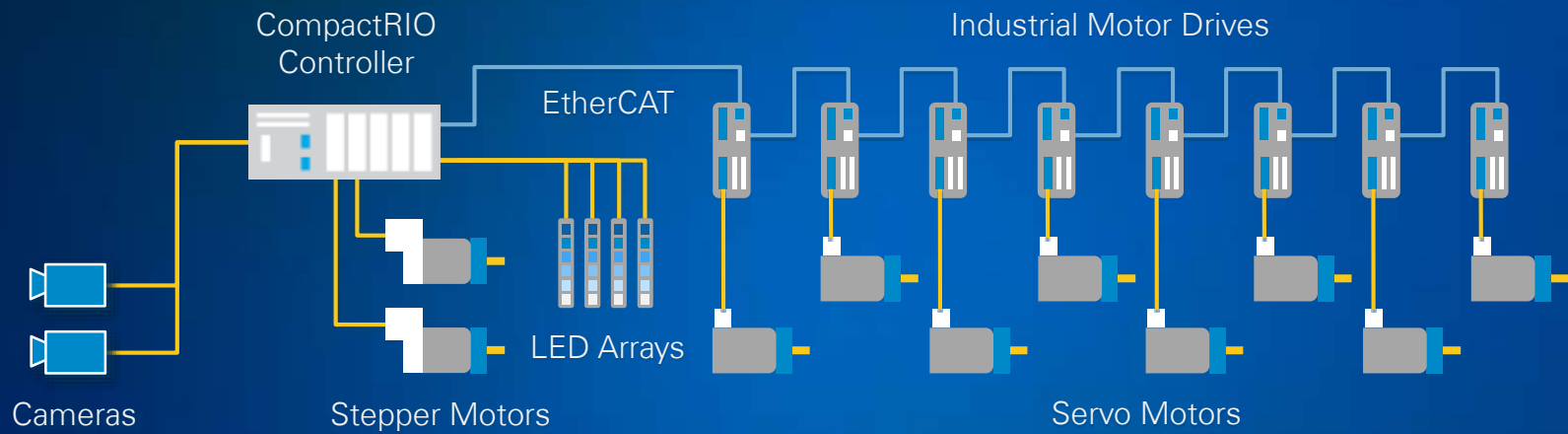
2014

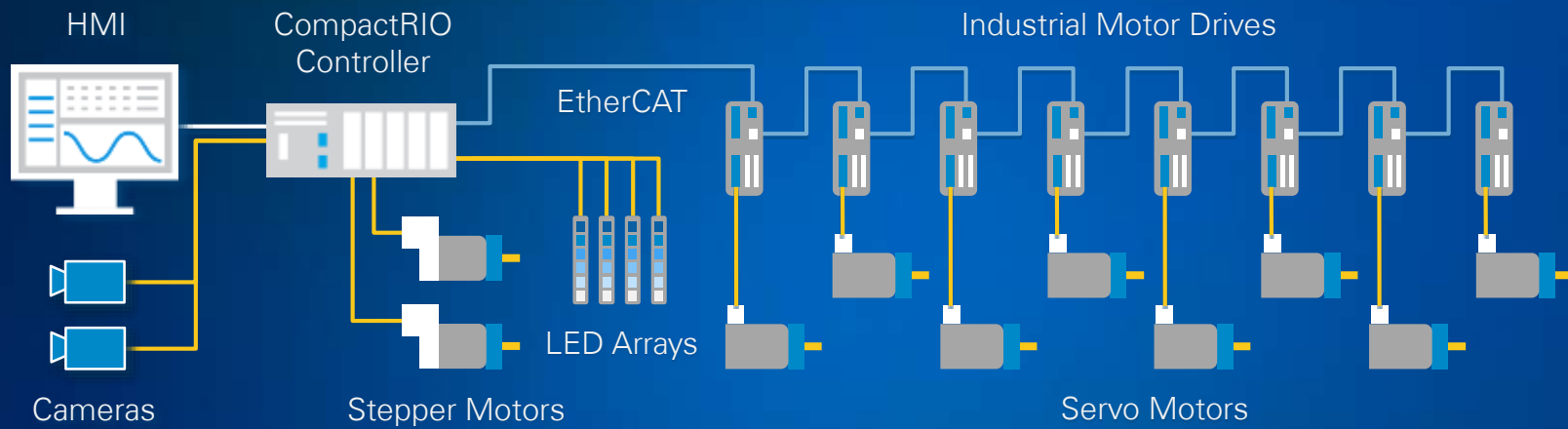


Perform Advanced Control and Analysis

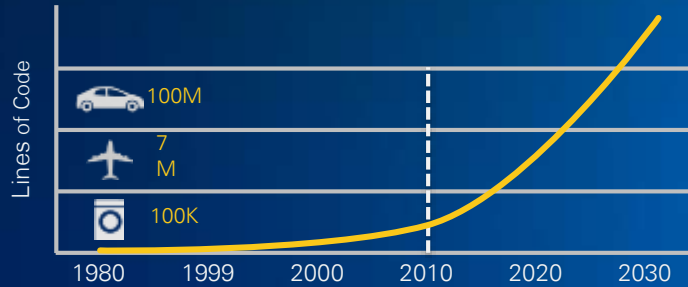


Simplify Your Industrial System



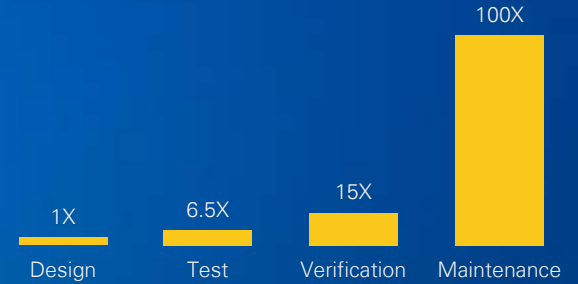


Embedded Software Complexity



10–20 defects
for every
1,000 lines

Cost per Defect

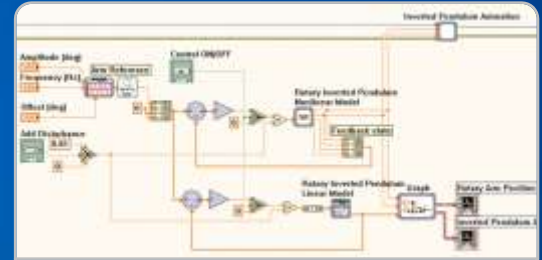




Physical Field Test



Laboratory Test



Mathematical Simulation

JACOBS®

\$11 Billion+
revenue generated in 2013

70,000+
employees worldwide



Expensive Facility Operation

Difficult to Retest

All Data is Critical



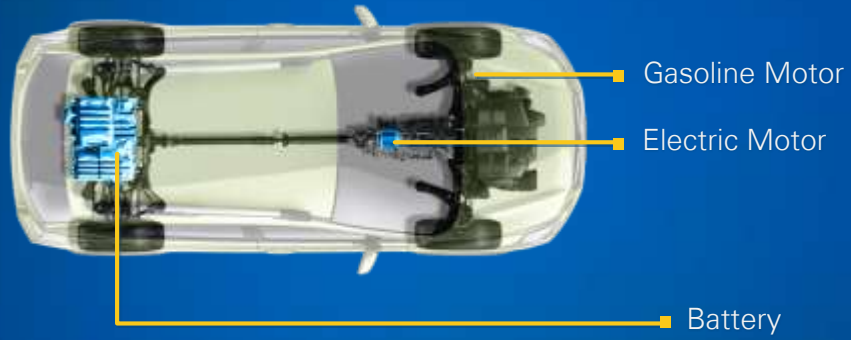
Shortened Development Time
Increased Testing Reliability
Multichassis Synchronization



JACOBS®





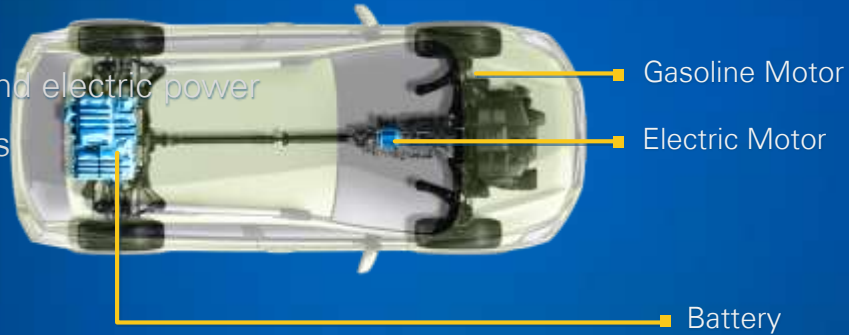


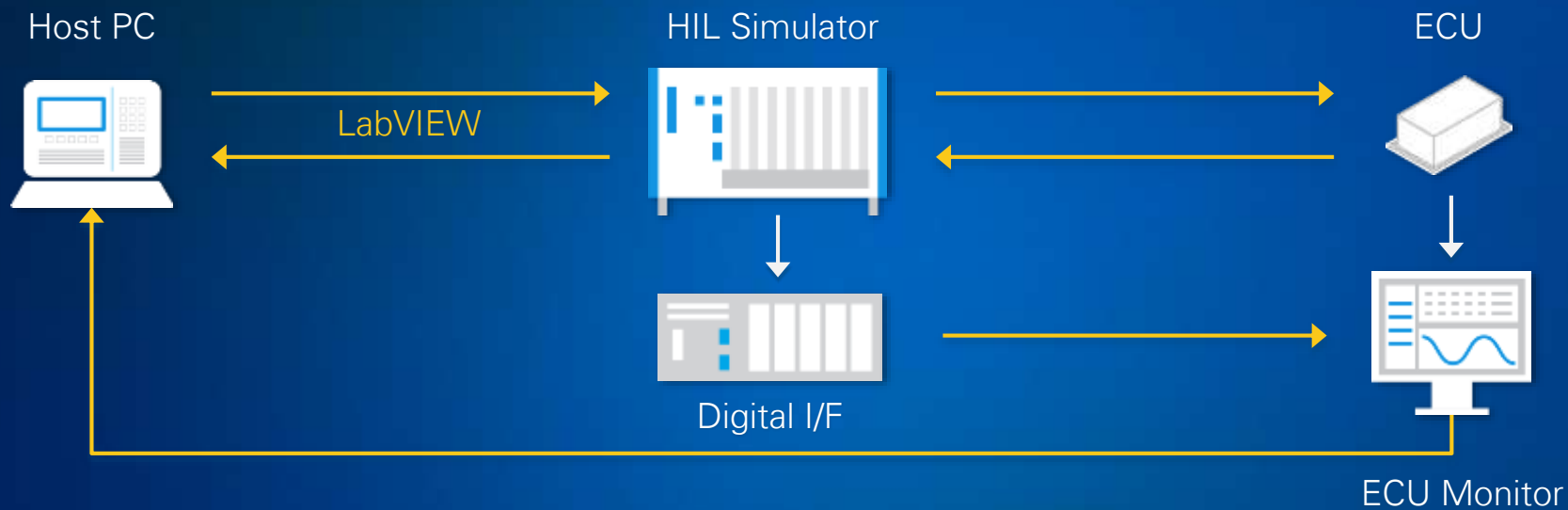
Sophistication of Test

Complex interaction of gasoline and electric power

Microsecond simulation loop rates

Nonlinear models









LabVIEW FPGA
JMAG Finite-Element Models
FlexRIO FPGA + DRAM





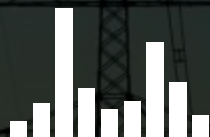


Better Test Coverage
Automated Testing
20X Reduction in Test Time





High Voltage and Current Modules



Synchrophasors and Harmonic Disturbances



Industrial Communication Protocols

The National Grid logo, consisting of the word "national" in a lowercase sans-serif font and "grid" in a bold lowercase sans-serif font, with a stylized orange and white grid icon to the right.

nationalgrid



Embedded Generation



HVDC Interconnect



Decommissioned Plants

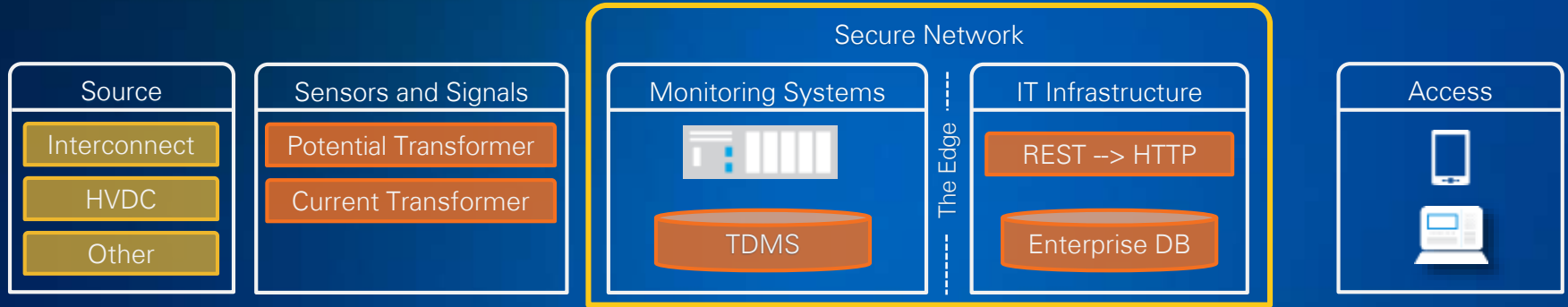


Requirements of Future Grid Instrumentation

Access to Data

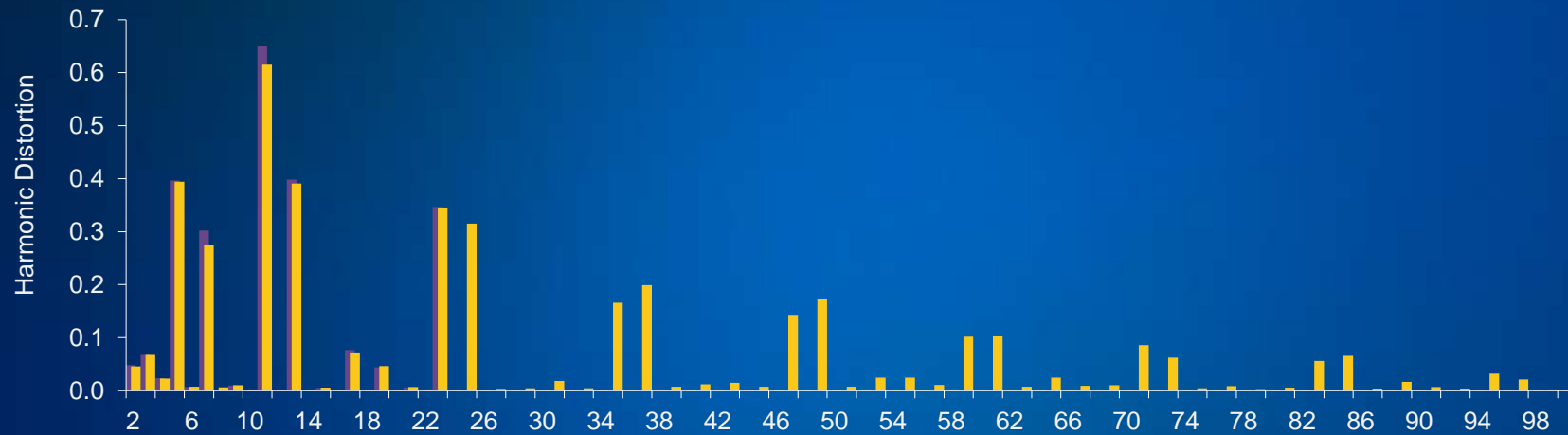
Flexibility

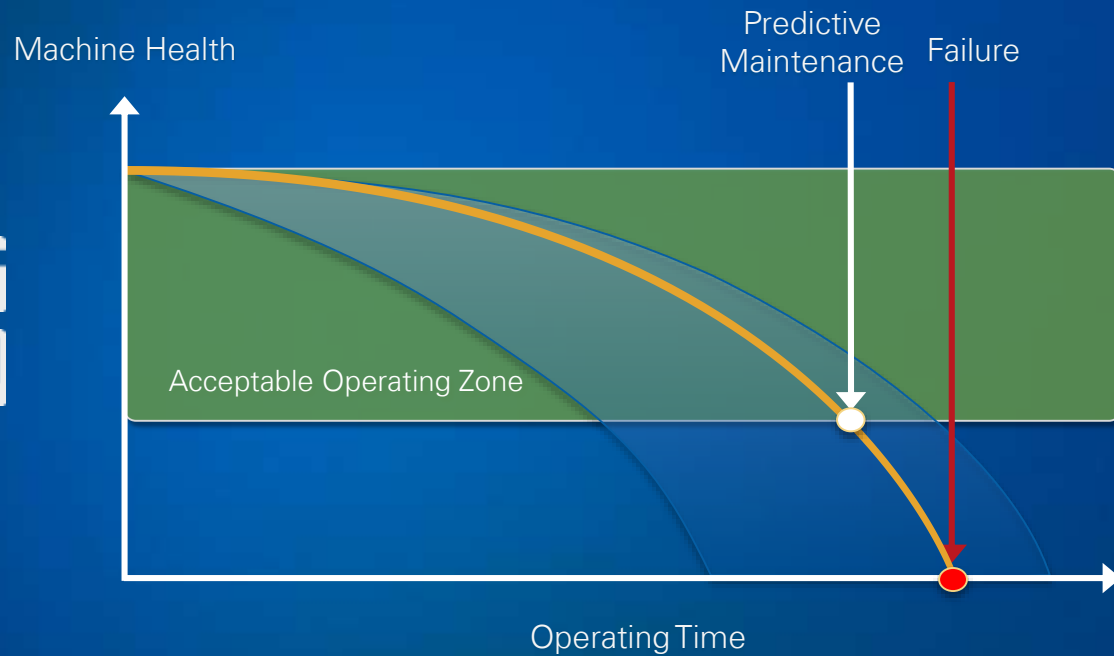
Grid Measurement Capability





Better Grid Measurements With CompactRIO







Steel Processing
China Steel



Rail
London Underground



Oil & Gas
National Oilwell Varco



Mining
Cadatech



Power
Generation
Duke Energy

Big Analog Data Challenges

Data Management

Data Analysis

Systems Management





Good Fan



Bad Fan

CompactRIO
CMS-9068



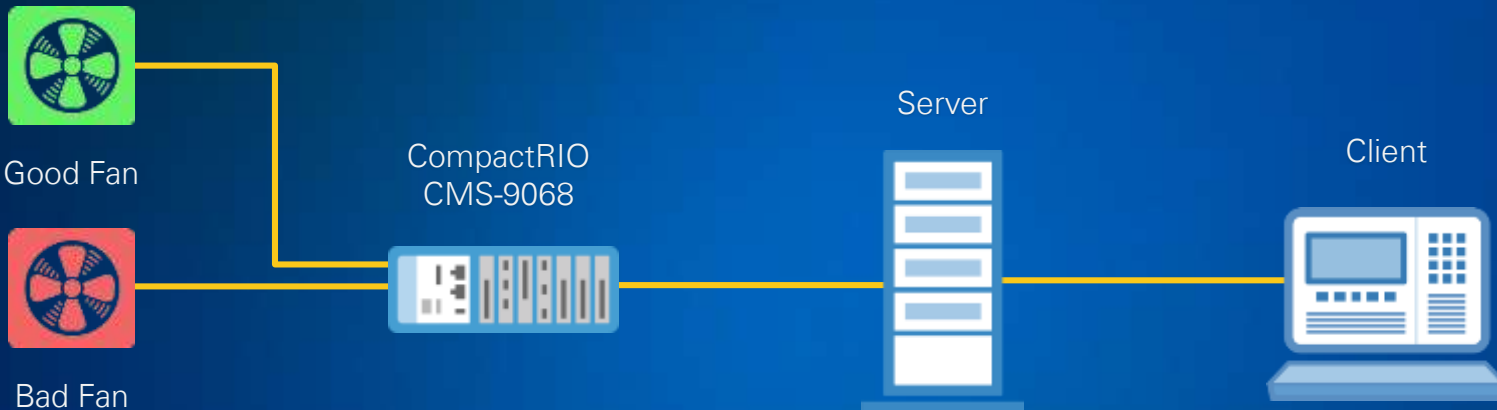
Server



Client

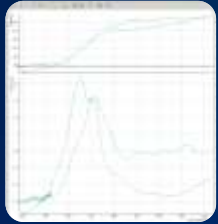


NI InsightCM™
Data Explorer

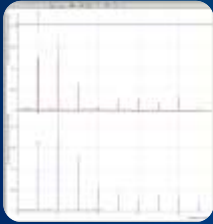


NI InsightCM™ Data Explorer

Bode



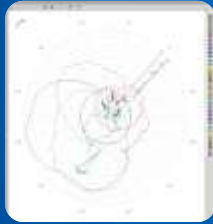
FFT



Orbital



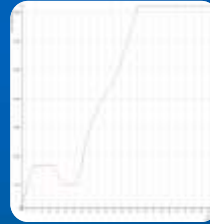
Polar



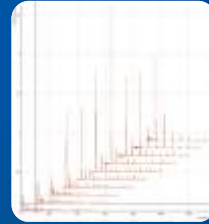
Shaft Centerline



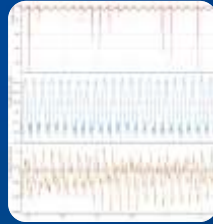
Speed Profile

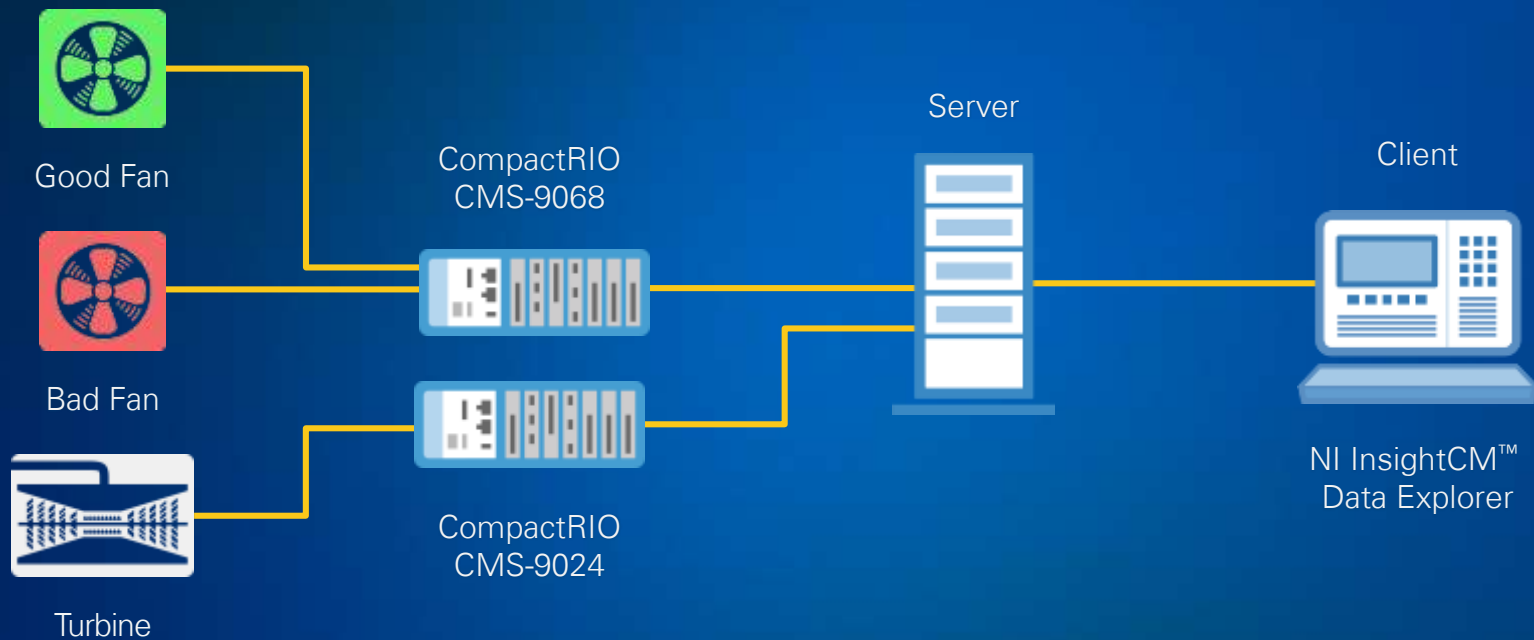


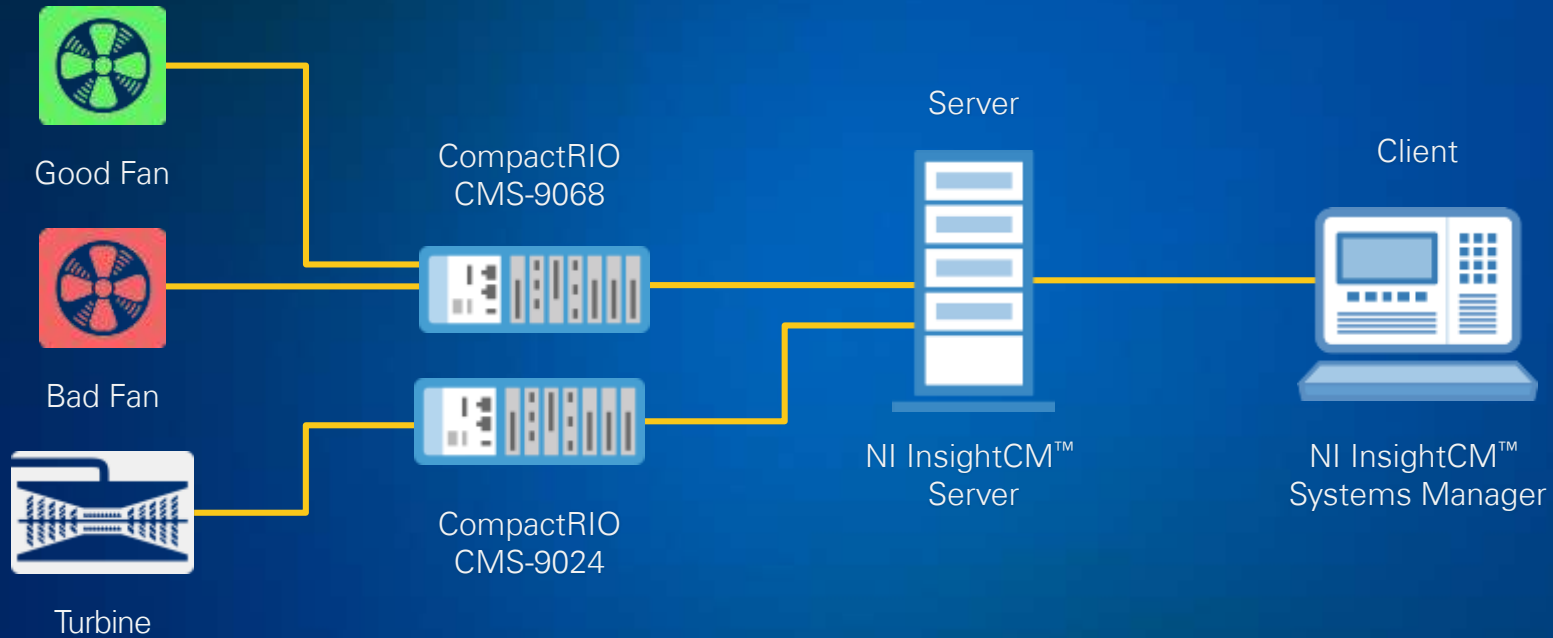
Polar



Trend







NI InsightCM™ Enterprise

Acquire Dynamic and Static Data

Analyze Waveform Data

Visualize Raw Data and Results

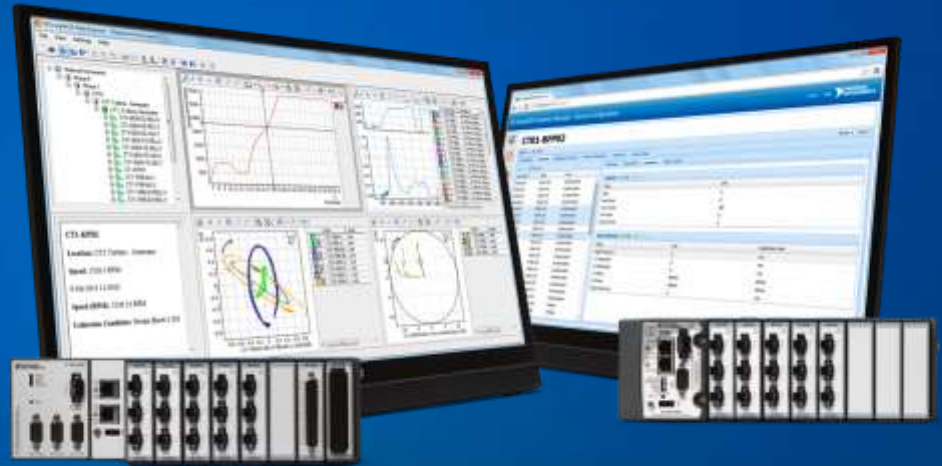
Generate and Manage Alarms

Manage, Mine, and Age Data

Configure, Monitor, and
Deploy Firmware to Nodes

Authenticate Users and Devices

Integrate With IT Infrastructure



NIDays

