

National Instruments

MIMO Technology Demonstration

National Instruments UK & Ireland

National Instruments

- National Instruments (<http://www.ni.com>) is transforming the way engineers and scientists design, prototype and deploy systems for measurement applications.
- NI empowers customers with off-the-shelf software such as NI LabVIEW and modular cost-effective hardware, and sells to a broad base of more than 25,000 different companies worldwide.
- Headquartered in Austin, Texas, NI has more than 5,000 employees and direct operations in over 40 countries. For the past eleven years, FORTUNE magazine has named NI one of the 100 best companies to work for in the America.

National Instruments

Corporate headquarters: *Austin, Texas*

Year established: *1976*

Revenue: \$873 million in 2010

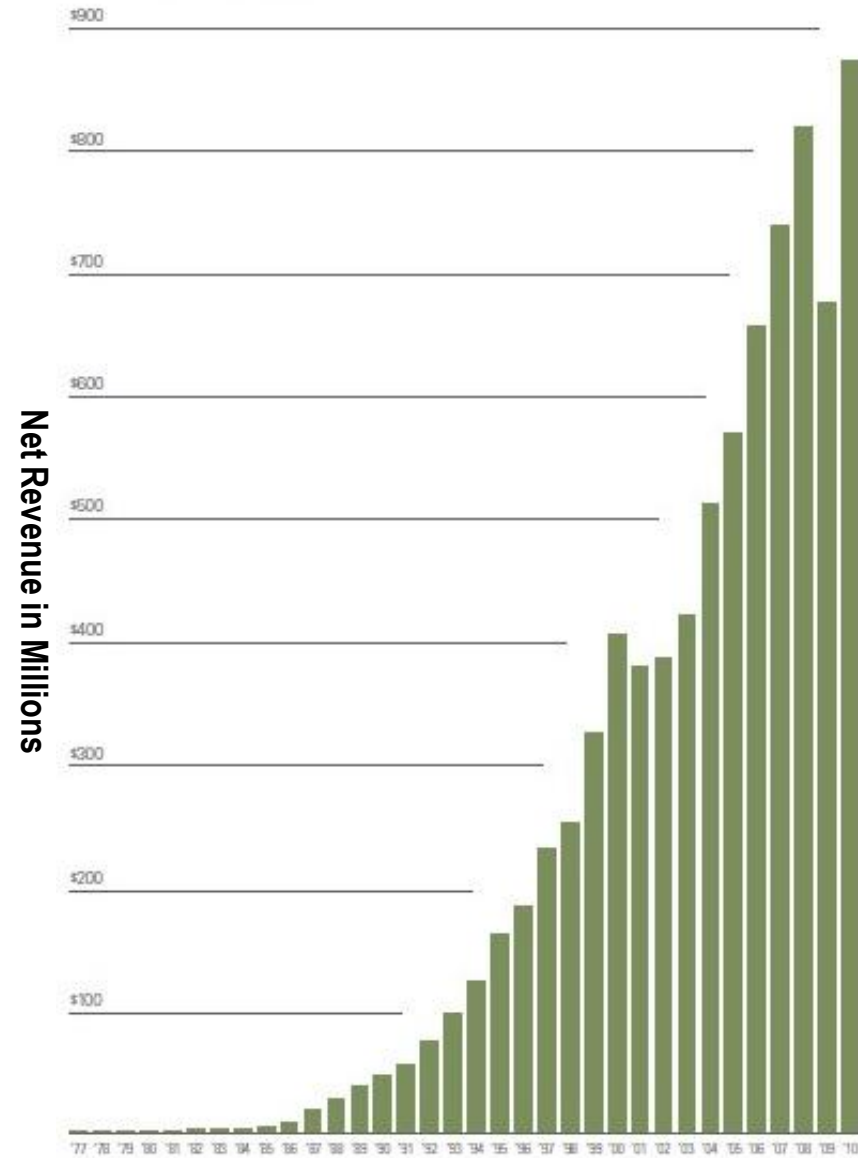
Global operations: *offices in 40 countries*

Investment in R&D: *16% of annual revenue*

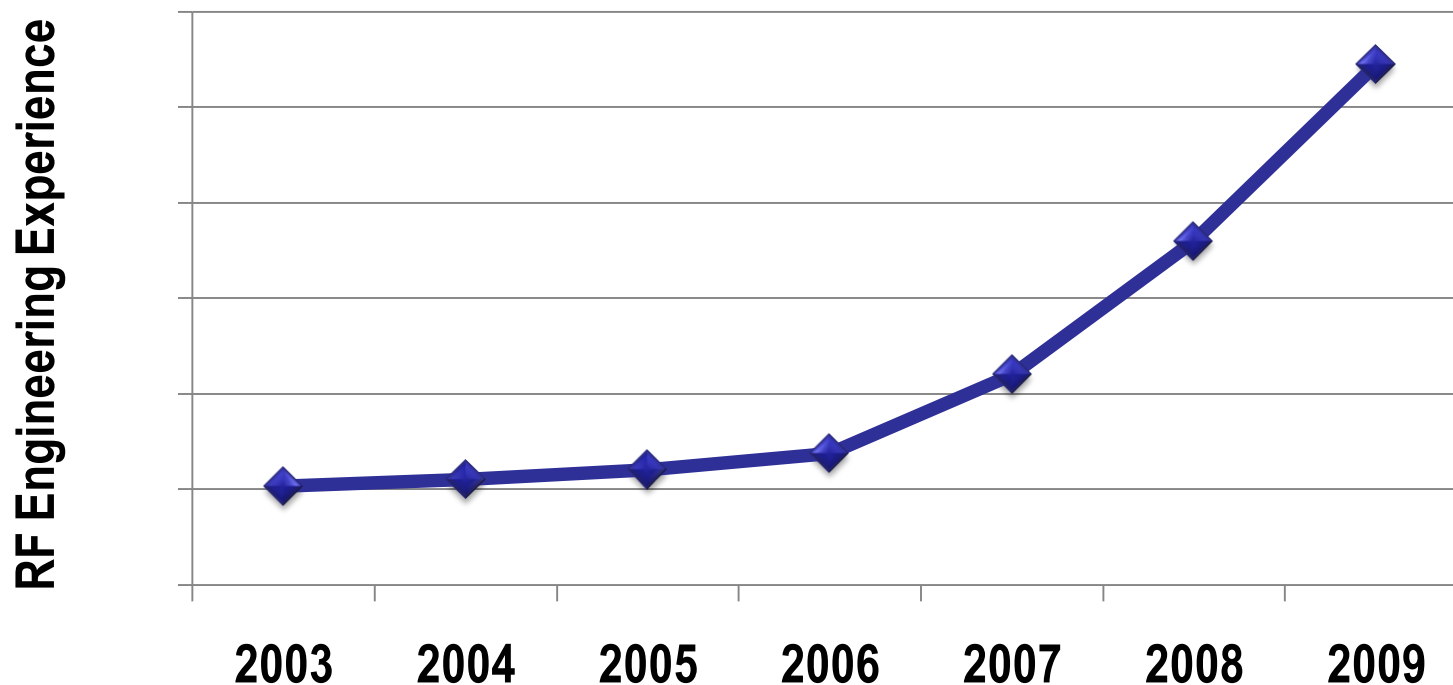
Customer base: *30,000 companies annually*

Network: More than 600 Alliance Partners

Diversity: *no industry makes up more than 15% of revenue*



NI's RF Growing Investment



- Bangalore, India – MT, SMT, Standard-specific Toolkits/IP
- Santa Rosa, CA – RF H/W design center
- Austin, TX – RF H/W design, S/W driver and utilities
- Global – RF Systems Engineers

Diversity of Companies using Virtual Instrumentation



- Over **30,000** customers in over **90 countries**
- No industry represents over **15%** of revenue
- No customer represents over **3 %** of revenue
- **95 %** of companies in the Fortune 500 use Virtual Instrumentation



National Instruments RF Platform

PXI Combines Standard Technologies

Controller

- *Embedded PC or remote PC / laptop interface*
- *Runs all standard software*

Chassis

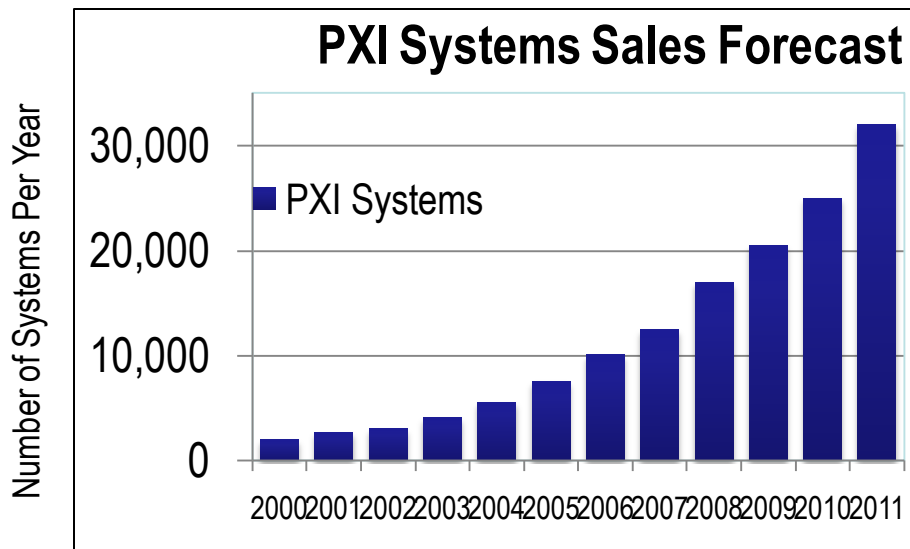
PXI Backplane

- *PCI Express bus*
- *Integrated Timing and Synchronization*



Peripheral Modules

Strong Industry Acceptance of PXI

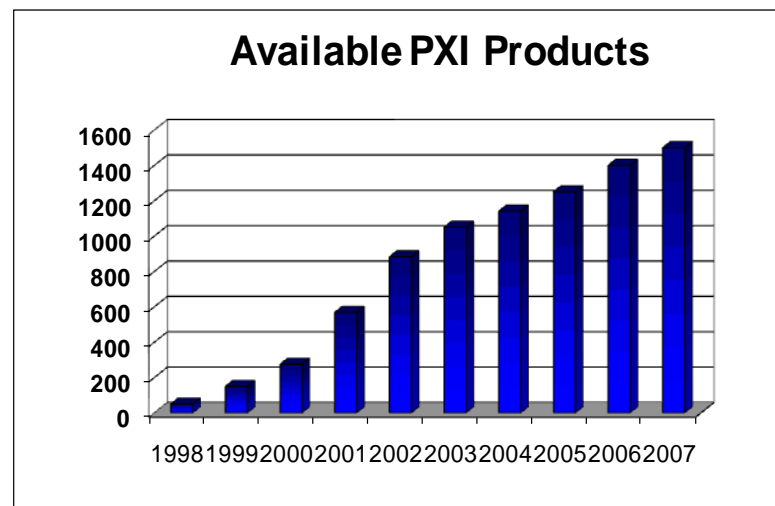


17% growth forecast for 2008 – 2012

Source: *World VXI & PXI Test Equipment Markets*, Frost & Sullivan, April 2005

More than 1,500 PXI Products from 60 vendors

Source: *PXI Systems Alliance*



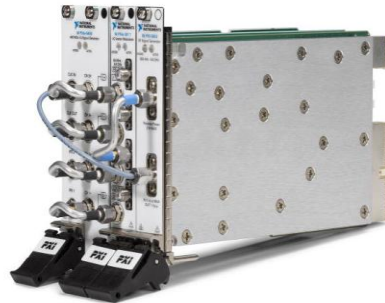
RF Testing Capability

- Software defined instruments
- Fast RF measurement speed
- Standard-specific measurements for WILAN, WIMAX, GPS, GSM/EDGE, WCDMA,...



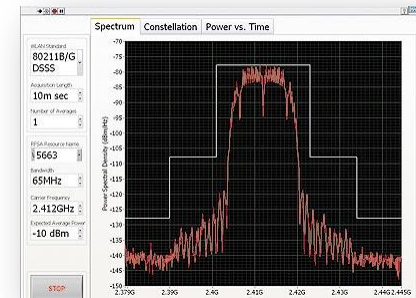
PXIe-5663 6.6 GHz VSA

- 10 MHz to 6.6 GHz
- 50 MHz Instantaneous BW (3 dB)



PXIe-5673 6.6 GHz VSG

- 85 MHz to 6.6 GHz
- >100 MHz Instantaneous BW



RF Software

- Modulation/Spectral Measurements
- Standard-specific toolkits

Advantages of PXI

- Instruments are easy to integrate & control
 - Integrated instrument timing and triggering
- Modularity and Flexibility
 - System easily expanded by adding additional modules
- Size
 - Test bench in a box
 - Lower power consumption
- High level of accuracy
 - VSA's capable of servoing to within 0.05 dB
- Price
- Measurement speed

Faster RF Test Times (W-CDMA Example)

	Leading Box Analyzer	NI PXIe-5663	Speedup
Spectrum Sweep (50 MHz, 10 KHz RBW)	500 ms	12 ms	42x faster
CCDF (10M samples)	500 ms	385 ms	1.3x faster
EVM (5 averages)	80 ms	15 ms	5.3x faster
ACLR (5 averages)	110 ms	8 ms	13.8x faster
Occupied BW (5 averages)	145 ms	8 ms	18.1x faster

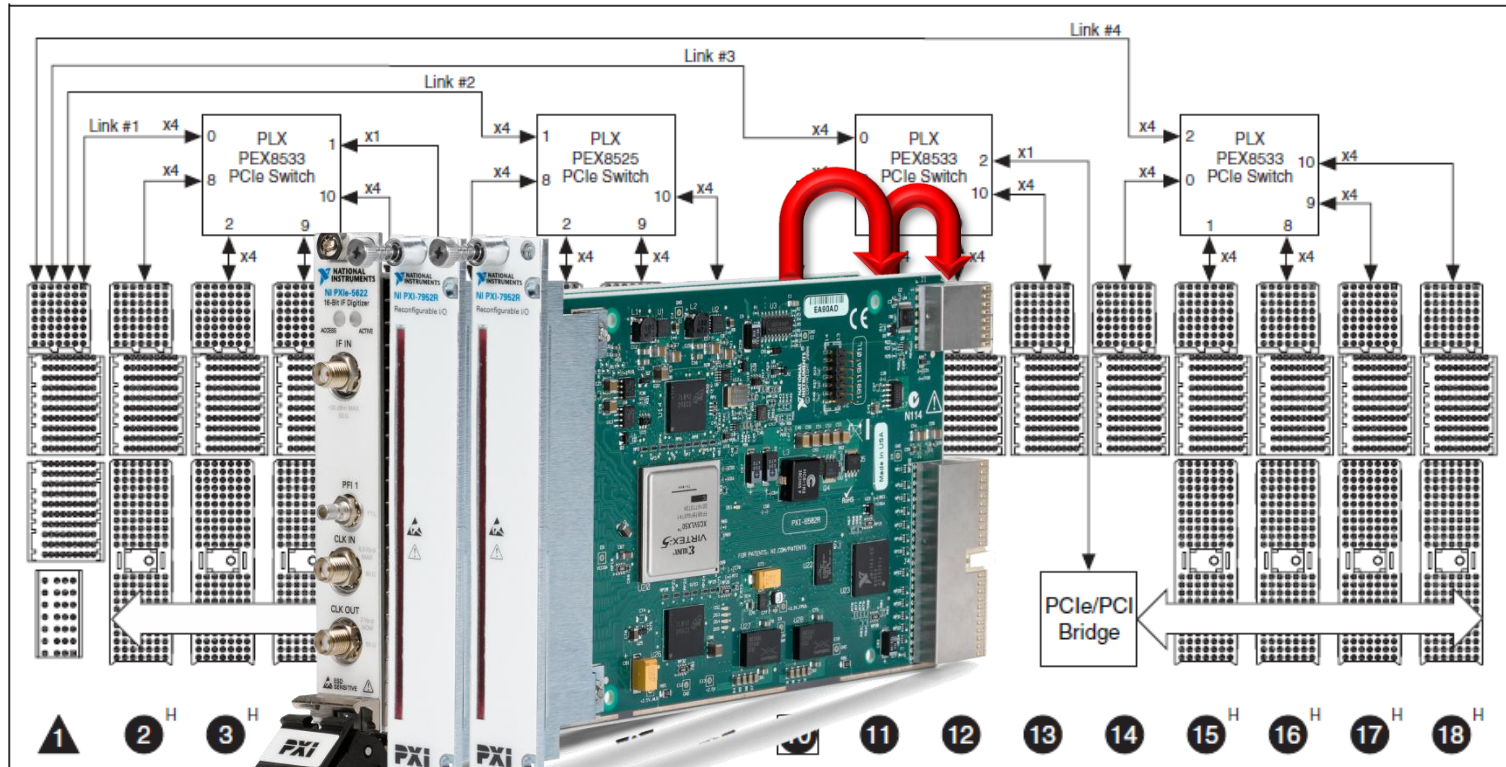
PXI Express NI FlexRIO

- Virtex-5 SX95T FPGA for inline data processing
- Peer-to-peer streaming
 - **800 MB/s** across PXI Express backplane
- Onboard DRAM
 - **2x 256 MB** banks
 - **1.6 GB/s** per bank
- Enhanced Synchronization
 - Share PXI 10 MHz reference clock or DSTAR_A with adapter module



P2P Architecture

Data can be streamed from the RF Acquisition hardware directly to the FPGA on the FlexRIO across the backplane of the PXI chassis, bypassing the controller



MIMO LTE & WLAN Demonstration

LabVIEW WLAN Toolkit

- Error vector magnitude (EVM)
- Power (peak, average, gated)
- Power ramp-up and ramp-down time
- Spectral mask margin
- Spectral flatness
- Frequency offset
- Carrier suppression
- IQ gain imbalance
- Quadrature skew

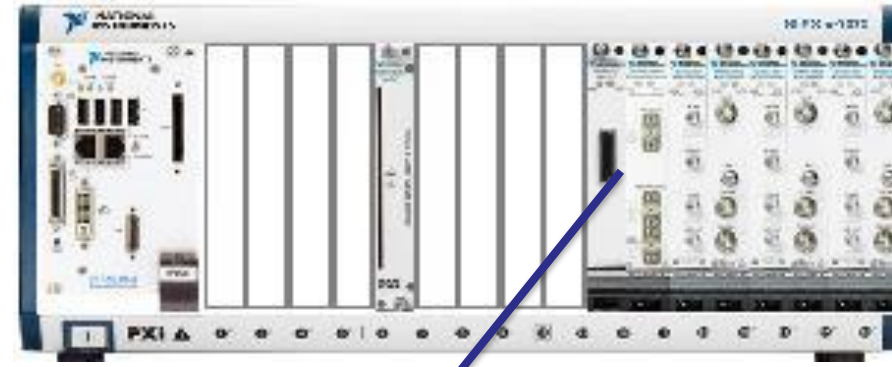
NI MIMO Solution

Proposed Solution

Multi-Channel RF Signal Generator

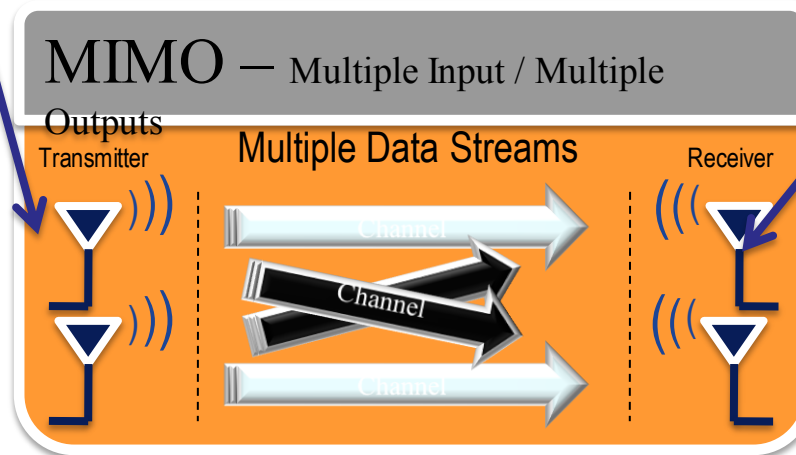


Multi-Channel RF Signal Acquisition



RF Generator system Includes:

- MXI controller for remote PC control
- 3-Ch Phase-Coherent MIMO Signal Generation



RF Acquisition system Includes:

- Embedded controller
- 3-Ch Phase-Coherent MIMO Signal Acquisition
- 6TeraByte Raid Array for data streaming
- FPGA card for inline data processing

The Users

NI RF Wireless Commercial Customers

- NI RF equipment is used by:
- 5 out of the top 7 global semiconductor companies for validation and characterisation of:
 - Cellular Communications
 - WLAN
 - Bluetooth
 - GPS
- 3 out of the top 5 RF power amplifier manufacturers for validation and characterisation
- NI PXI RF equipment is currently being used by several multi billion \$ companies for characterisation of new LTE development ICs

Case Study - Wireless IC Characterization



- Automate manual tests on next-gen ICs
 - Power-management
 - Analog baseband / RF
 - Custom system-on-a-chip
- Automated Characterization Environment (ACE)
 - LabVIEW and TestStand provide software framework
 - Common test management / automation framework deployed globally

“NI TestStand is the backbone of device characterization tests and the software platform that our engineers reuse at all sites worldwide.”

- Marvin Landrum, Texas Instruments

NI RF Wireless Customers Academia

- Universities engaged in MIMO research using NI RF products:
 - NTU Singapore (PWTC).
 - University of Utah
 - University of Maine
 - University of Warsaw
 - Missouri University of Science and Technology

Testimonials

By using the PXI platform and LabVIEW, we reduced test time, shortened time to market, and saved on instrument capital equipment costs, while improving measurement quality.

Min Xu Texas Instruments

<http://sine.ni.com/cs/app/doc/p/id/cs-13199>

“With PXI, we were able to reduce the characterization time of new parts from two weeks to about a day”

*Gary Shipley, Senior Engineer
Triquint Semiconductor*

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