Increasing Test Coverage and Speed with User-Programmable FPGAs in Semiconductor ATE

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National Instruments
We equip engineers and scientists with tools that accelerate productivity, innovation, and discovery

- **Revenue**: $286M in Q1 2013
- **Global Operations**: Approximately 7,100 employees; operations in more than 40 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
- **Strong Cash Position**: Cash and short-term investments of $327M at March 31, 2013
Moore’s Law and the Expansion of Software

Transistor Count

Date of Introduction


2,300
10,000
100,000
1,000,000
10,000,000
100,000,000
1,000,000,000
2,600,000,000

Intel Xeon—2.6B transistors

1976
8086 processor—6,500 transistors

National Instruments™
Evolution of Instrumentation
What is PXI?

- PXI = **PCI eXtensions for Instrumentation**

  - PC-based platform optimized for test, measurement, and control
  - Advanced timing and synchronization features
  - PCI Express electrical-bus with the rugged, modular, Eurocard mechanical packaging of CompactPCI
  - Open specification governed by the PXI Systems Alliance (PXISA)
Success Factors for PXI

Vibrant Multivendor Ecosystem

Large Telescope Mirror Control
Tokomak Plasma Control
Wind Turbine Testing
CERN Hadron Collider
Early Cancer Detection
Structural Health Monitoring

Applicability Across Industries
PXI Harnesses Moore’s Law

Multicore Processors  PCI Express  Data Converters  FPGAs

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Utilization of FPGAs for Signal Processing

- FPGA Performance (GMACs)
- CPU Performance (GFLOPs)

Graph showing the performance of FPGAs and CPUs from 1997 to 2011, with a peak of 2.376 TMACS for FPGAs in 2011.
Power Amplifier Power Level Servoing

Output Power

Input Power

NI PXIe-5644R Vector Signal Transceiver

VSG

Device Under Test

Power Meter

VSA

FPGA

VSG

VSA

VST

Set PIN #1

Measure Power

Calculate Adjustment

Set PIN #2

Measure Power

Calculate Adjustment

Set PIN #3

Measure Power

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FPGA-Based Servoing Reduces Test Time

Traditional Approach

FPGA-Based Approach

DUT Output Power vs. Time

- Processor
- FPGA
- Analog I/O
- Digital I/O
- Motion I/O
- Custom I/O

LabVIEW™ 2012

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Example WLAN Receive Chain

Each radio must support…
...more bands, more modes, and more modulation types
Vector Signal Transceiver / Device Under Test Integration

Qualcomm DUT

Digital Device Control

FPGA-based DUT Control and Test Sequencing

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Automation Enables More Testing

EVM (dB) Versus Average Output Power

Traditional Instrumentation

-45 - -25 - -5 - 15

-48 - -43 - -38 - -33 - -28 - -23 - -18

40 Test Cases

NI PXI Vector Signal Transceiver

-45 - -25 - -5 - 15

-48 - -43 - -38 - -33 - -28 - -23 - -18

300,000 Test Cases

More Test Coverage = Higher Quality

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Evolution of Instrumentation

802.11a + b + g

Early 2000s
Traditional Rack and Stack

+ 802.11n

2007
PXI Modular Instrumentation

10X Faster

+ 802.11ac

2012
FPGA-Based PXI Modular Instrumentation

200X Faster
Summary

- Increasing device complexity requires a test platform that harnesses the latest technology

- PXI, with a vibrant ecosystem and multi-industry applicability, rapidly delivers the latest CPU, bus, FPGA, and converter technologies

- RF power amplifier and WLAN transceiver test are two examples benefitting from FPGA technology

- Result is lower test times and increased coverage
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- FPGA-based servo and envelope tracking for power amplifiers
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