

# Welcome to NIDays 2009 !

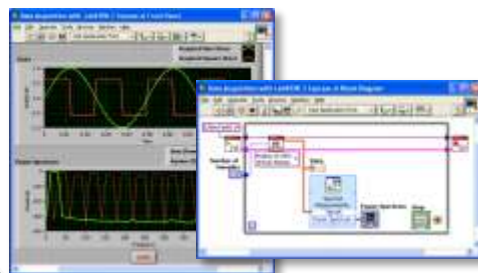
*Juha Palola – Branch Manager NI Finland*

# What We Do

## Low-Cost Modular Measurement and Control Hardware



## Productive Software Development Tools



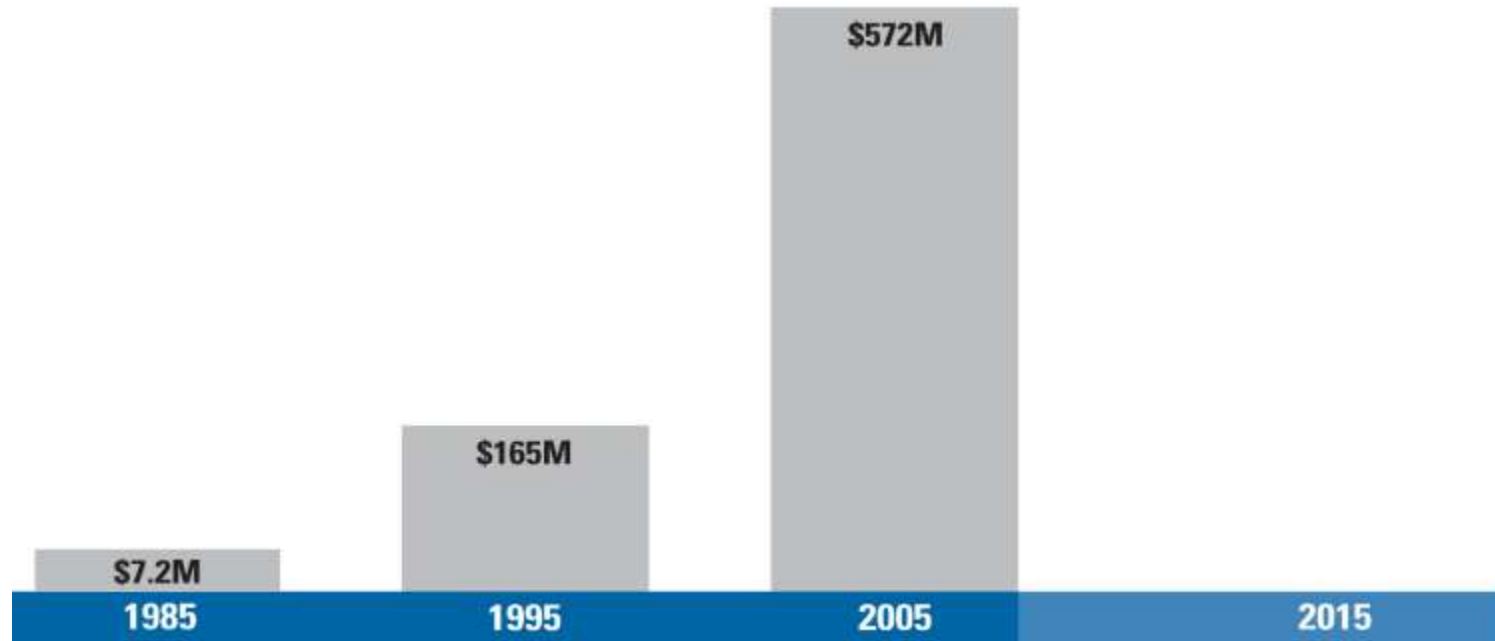
## Highly Integrated Systems Platforms



Used By Engineers and Scientists for Test, Design and Control



# National Instruments: Decades of Innovations



## First Decade

**1985:** Self-financing with GPIB

## Second Decade

**1995:** Virtual Instrumentation with GPIB, NI LabVIEW, and DAQ

## Third Decade

**2005:** Measurement and Automation (Modular Instruments and systems – PXI, FieldPoint, and CompactRIO)

## Fourth Decade

**2015 :** Test & Measurement and Graphical System Design

# Leveraging Technologies to Solve Next Generation Engineering Challenges

Francis Griffiths  
Vice President, Europe

NIDays 2009

# Engineering Grand Challenges



Make solar energy economical



Provide energy from fusion



Develop carbon sequestration methods



Manage the nitrogen cycle



Provide access to clean water



Restore and improve urban infrastructure



Advance health informatics



Engineer better medicines



Reverse-engineer the brain



Prevent nuclear terror



Secure cyberspace



Enhance virtual reality



Advance personalized learning



Engineer the tools of scientific discovery

# Today's Technology: Core Value

Multicore



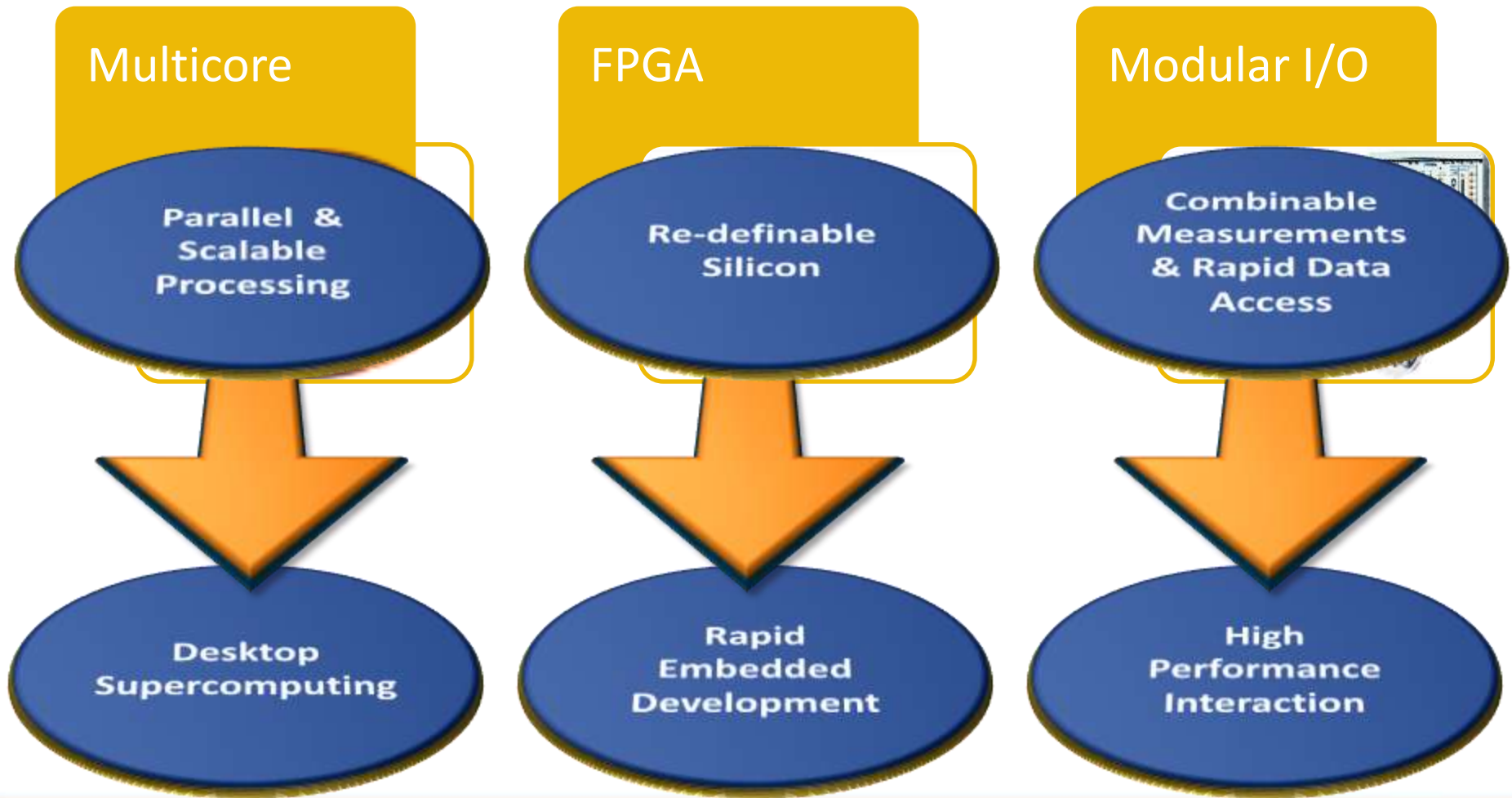
FPGA



Modular I/O



# Today's Technology Potential



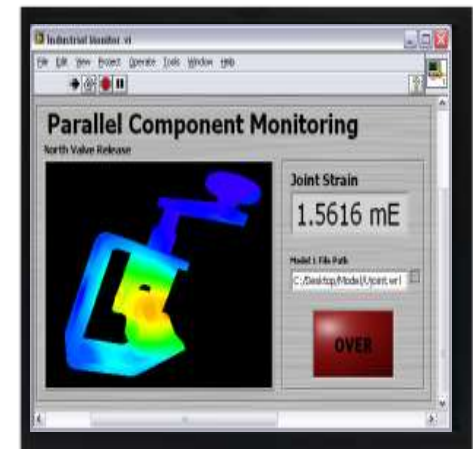
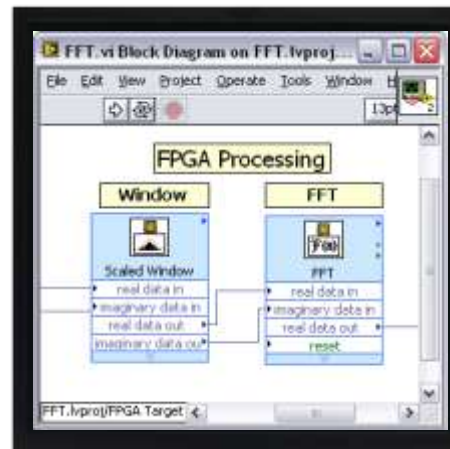
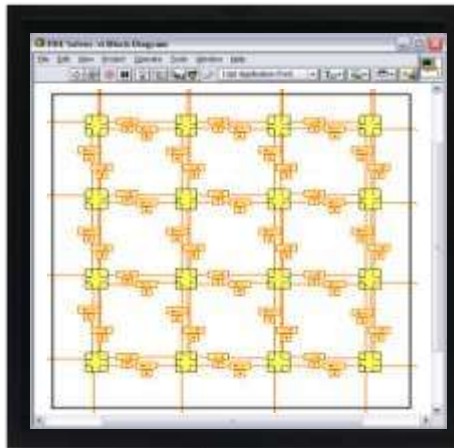


# Access through Graphical Programming

Multicore

FPGA

Modular I/O



**Desktop  
Supercomputing**

**Rapid  
Embedded  
Development**

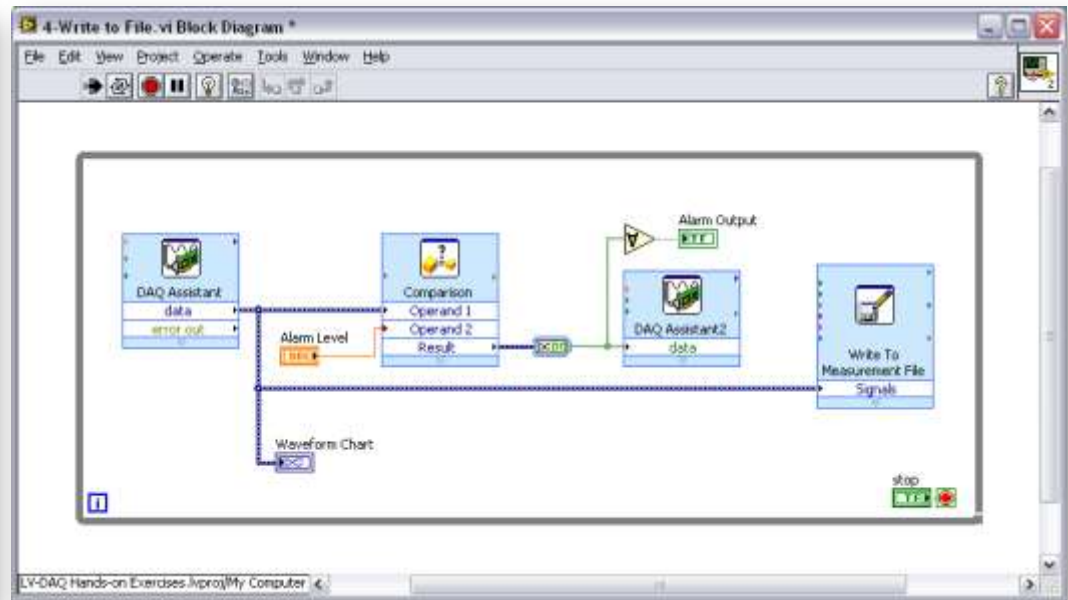
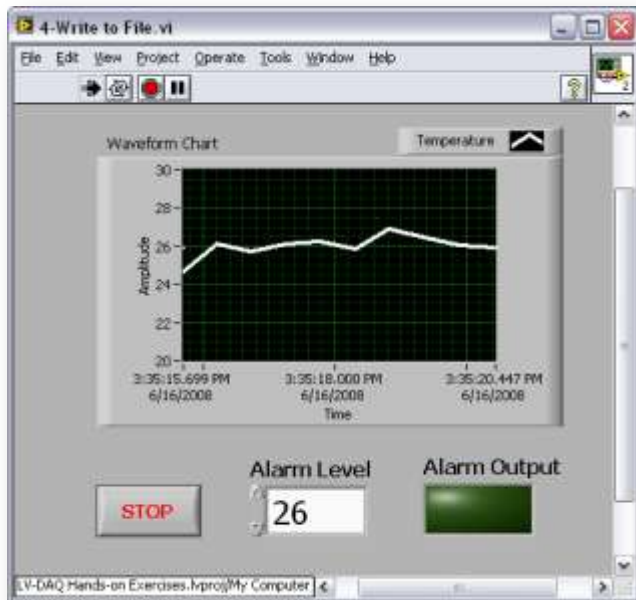
**High  
Performance  
Interaction**



# Graphical Programming:

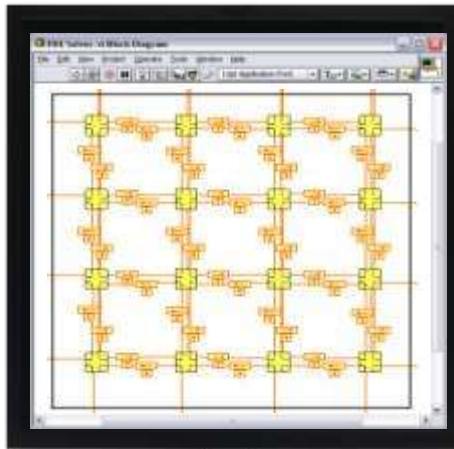
## Simplifying Design of Complex Engineering Systems

- Symbolic
- Dataflow
- Hierarchical
- Interactive
- Inherent User Interface



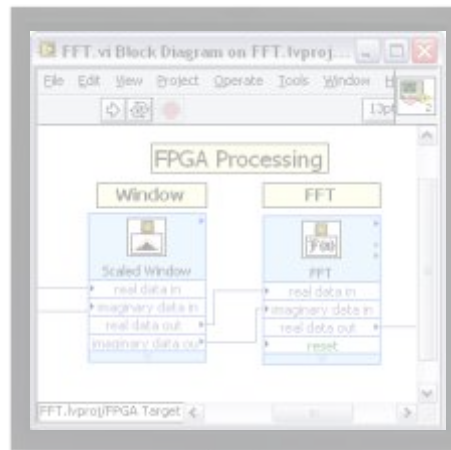
# Access through Graphical Programming

Multicore



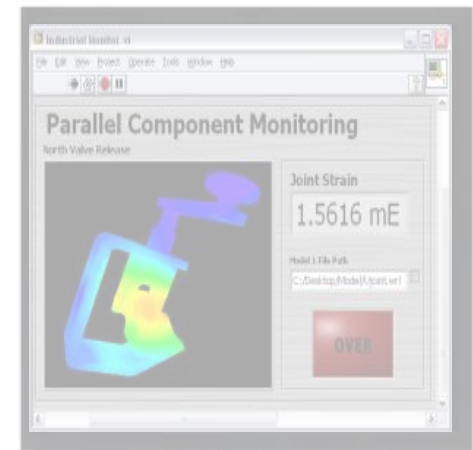
**Desktop  
Supercomputing**

FPGA



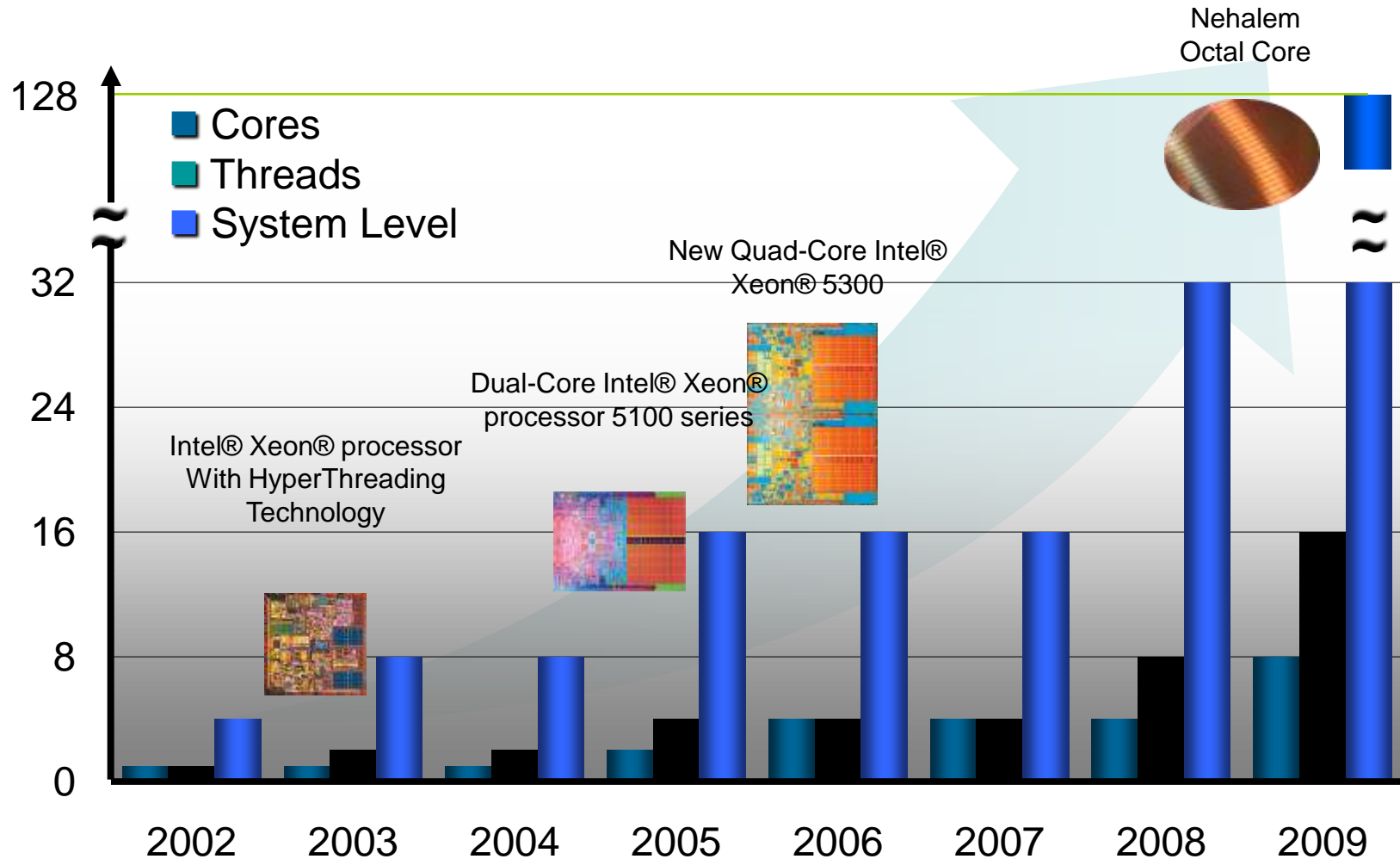
**Rapid  
Embedded  
Development**

Modular I/O

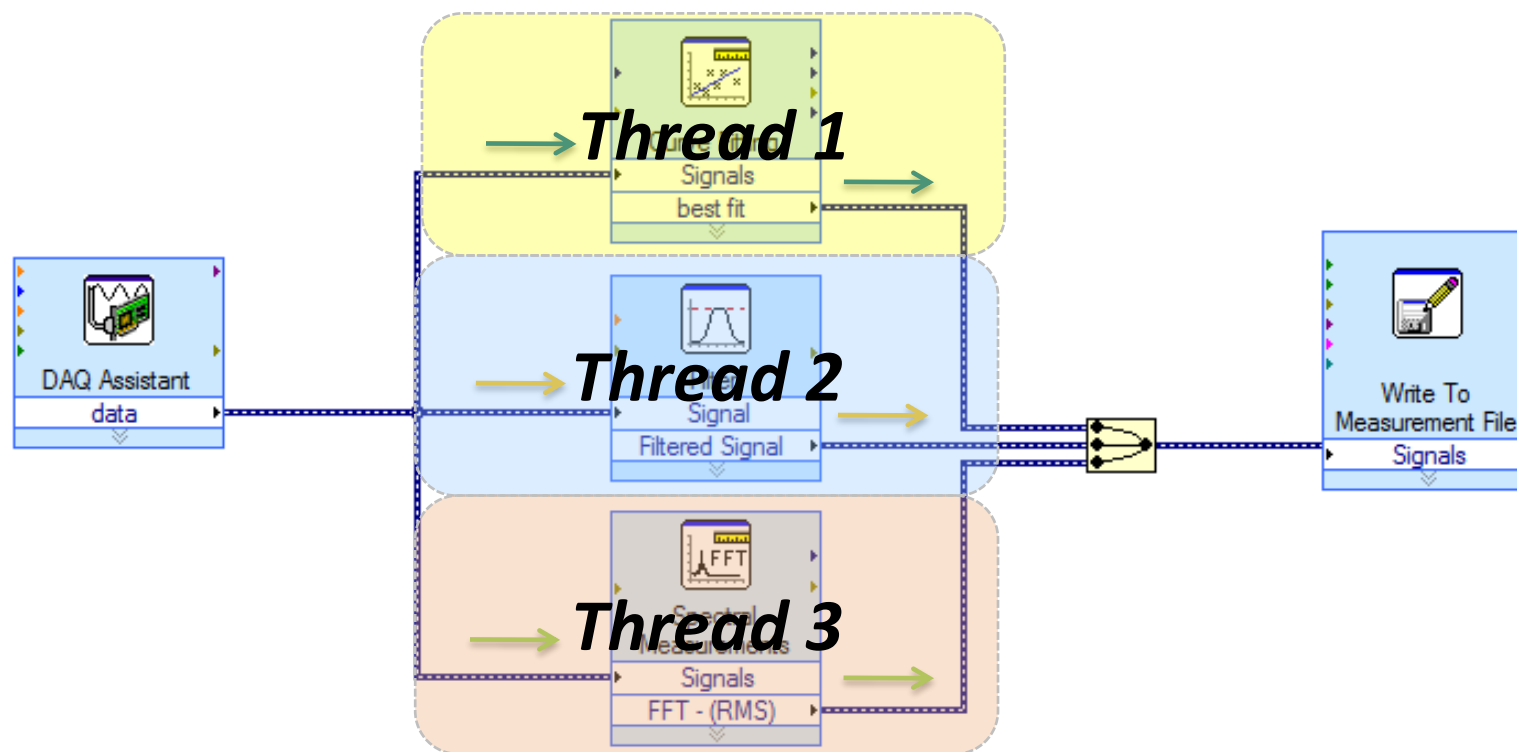


**High  
Performance  
Interaction**

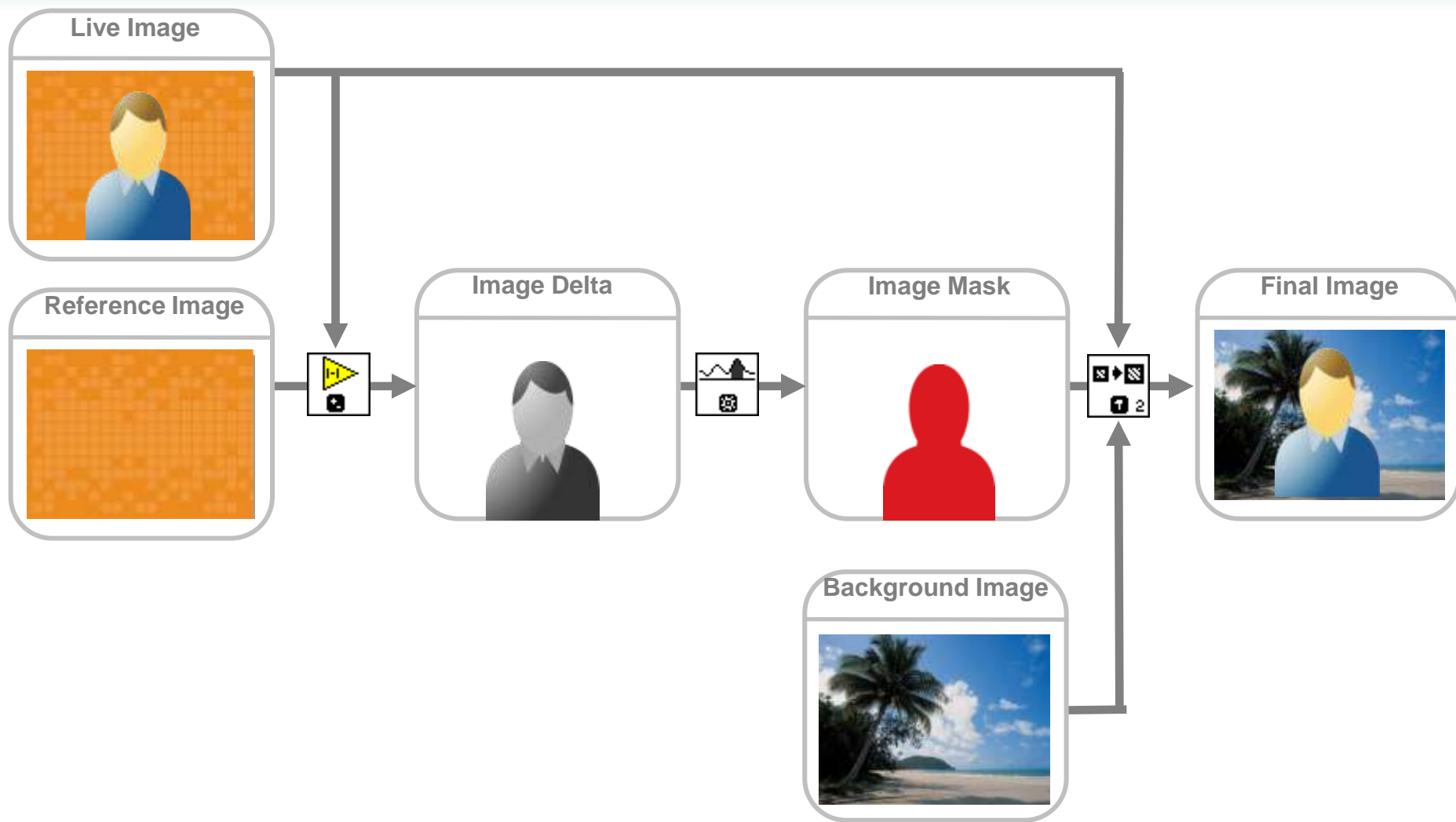
# Multi-core: Scalable Parallel Processing



# Realizing the Potential: Inherent Access to Automatically Scalable Parallelism



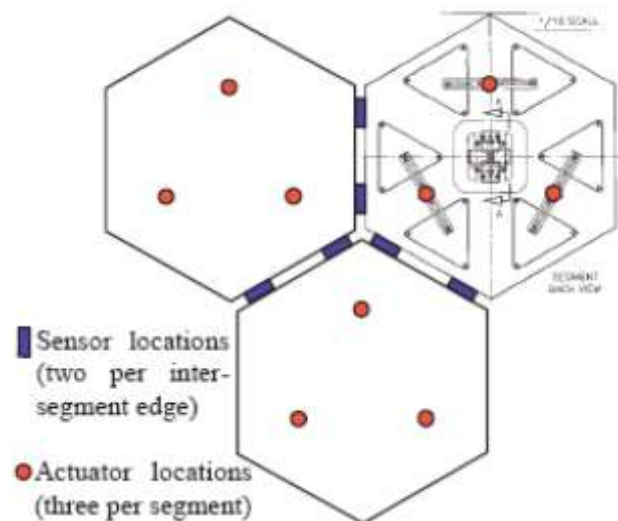
10 Year Anniversary of Multithreading



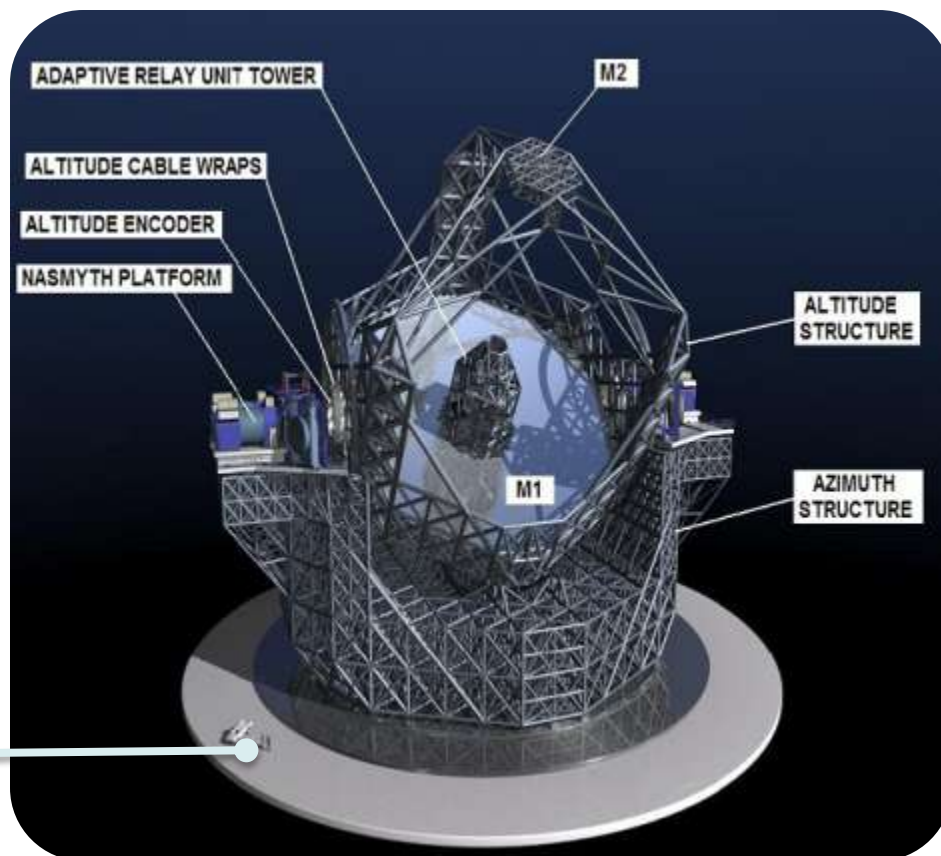
# DEMONSTRATION

## THE LABVIEW GREEN SCREEN

# Case study: Extremely Large Telescope

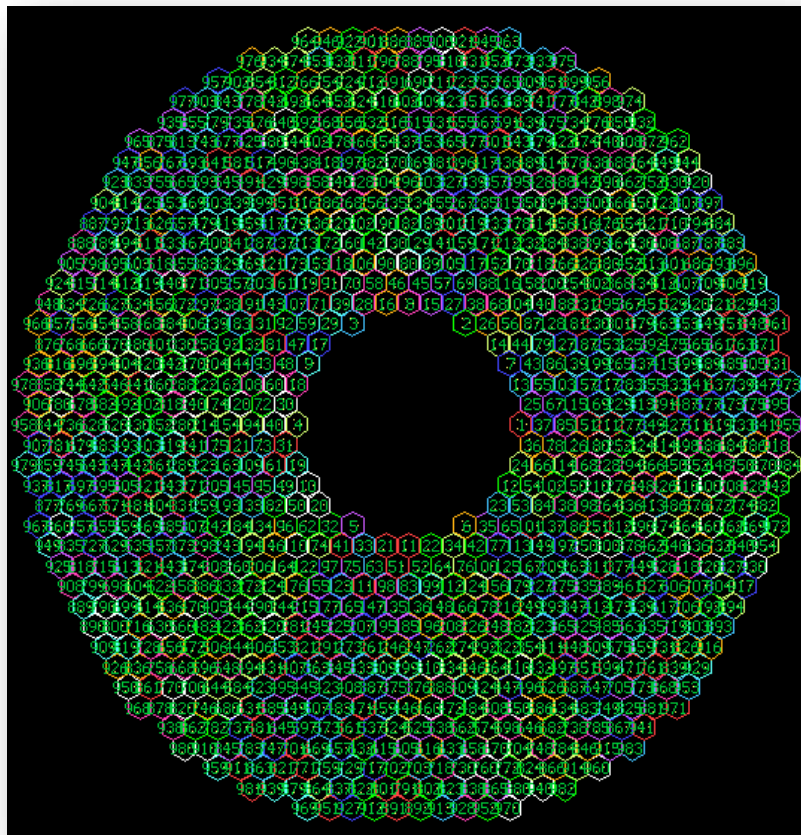


Physicists are getting smaller these days!





# Case study: Extremely Large Telescope



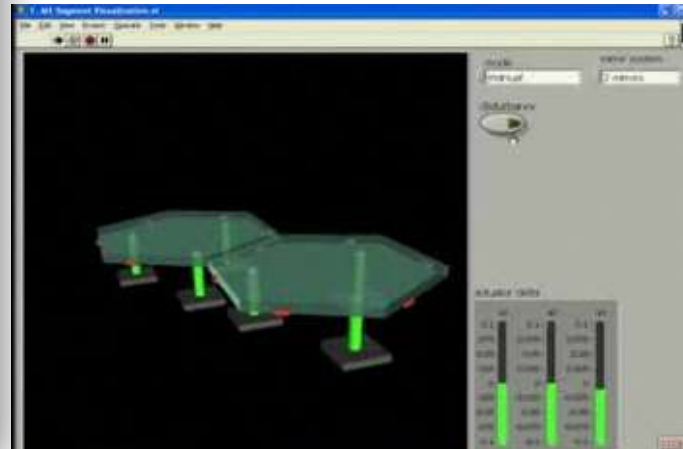
## M1 – mirror

984 hexagonal mirrors

6 sensors each = ~6000 inputs

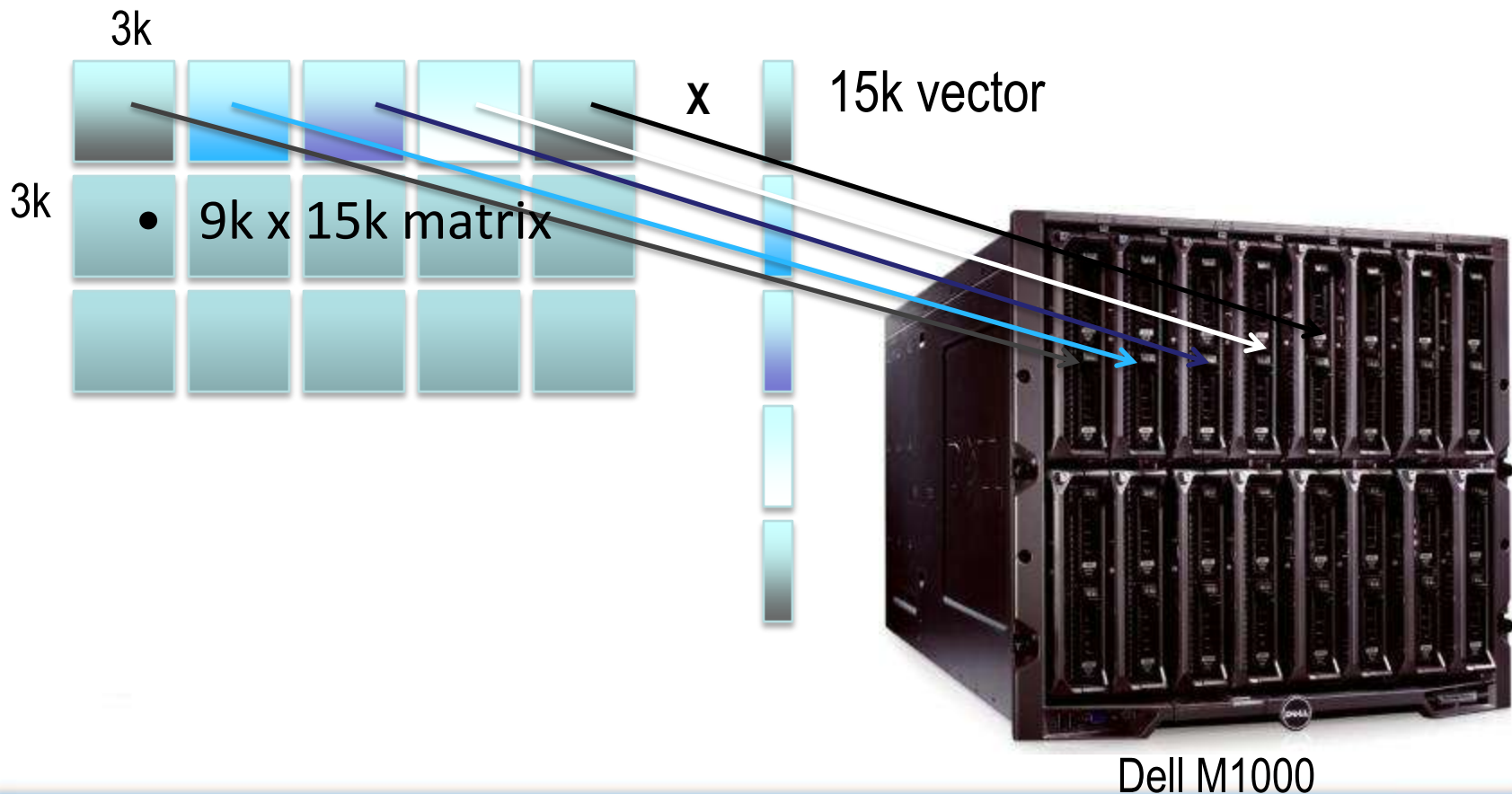
3 actuators each = ~3000 outputs

Control loop = 1 ms (1kHz rate)



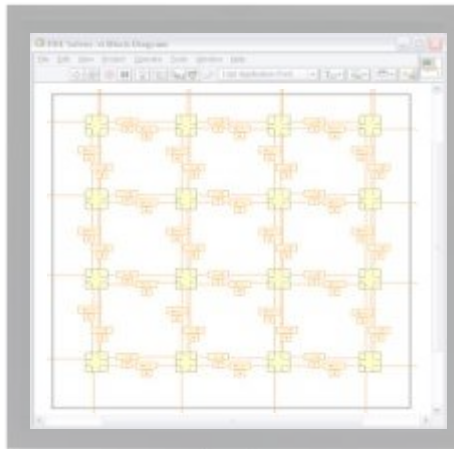


# Distributing LabVIEW computations



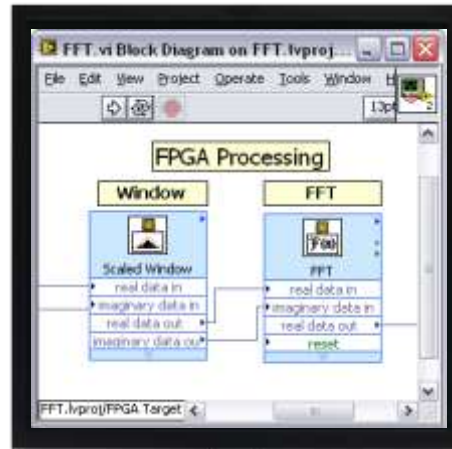
# Access through Graphical Programming

Multicore



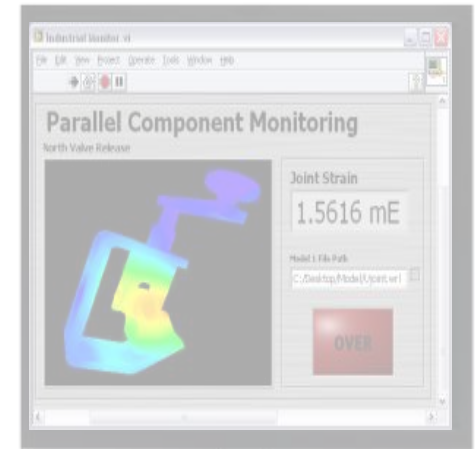
Desktop  
Supercomputing

FPGA



Rapid  
Embedded  
Development

Modular I/O



High  
Performance  
Interaction

# Advances in FPGA Technology

## Size

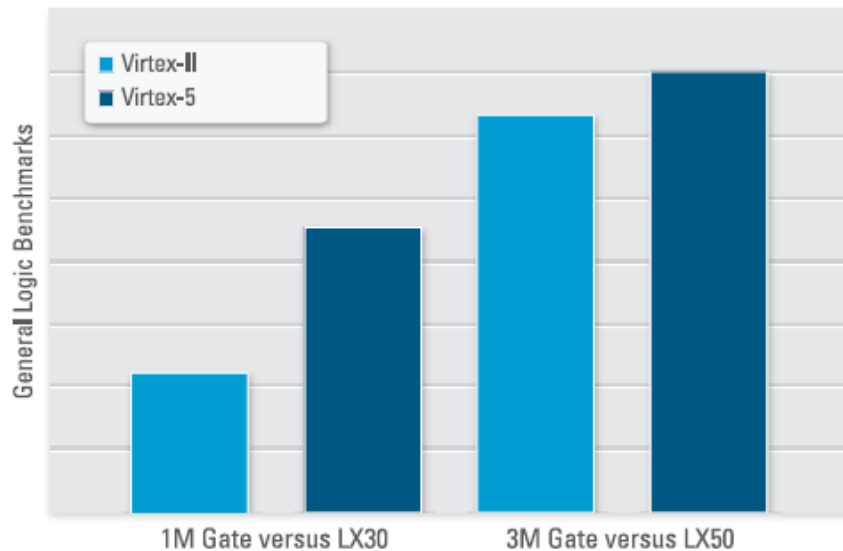


Figure 1. General logic benchmarks show that Virtex-5 FPGAs offer larger sizes when compared to Virtex-II FPGAs.

## Speed

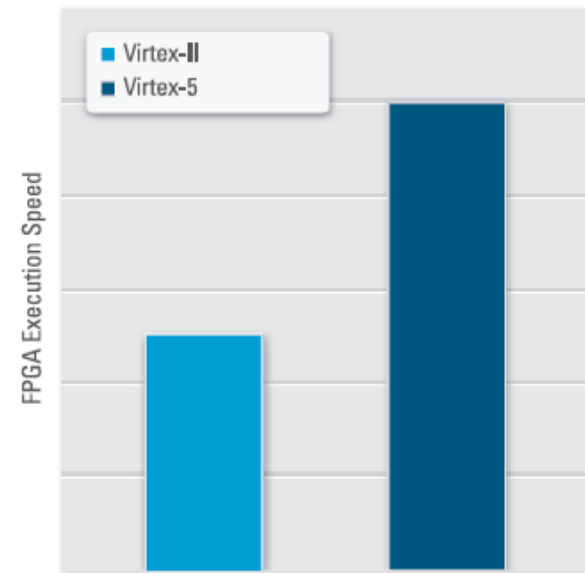


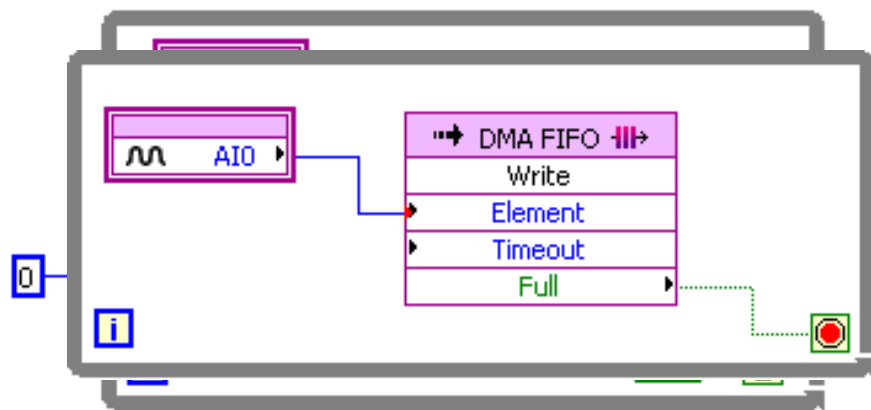
Figure 2. Execution speed benchmarks show that Virtex-5 FPGAs feature faster processing capabilities when compared to Virtex-II FPGAs.

# Realizing the Potential: Simplify Access to FPGAs

# Counter

# Analog I/O

# I/O with DMA



# LabVIEW FPGA

[illegible]

## VHDL ~4000 lines

# Case Study: University of Helsinki

## FPGA Based Real-Time Feedback Control of Optical Tweezers

Anders Wallin

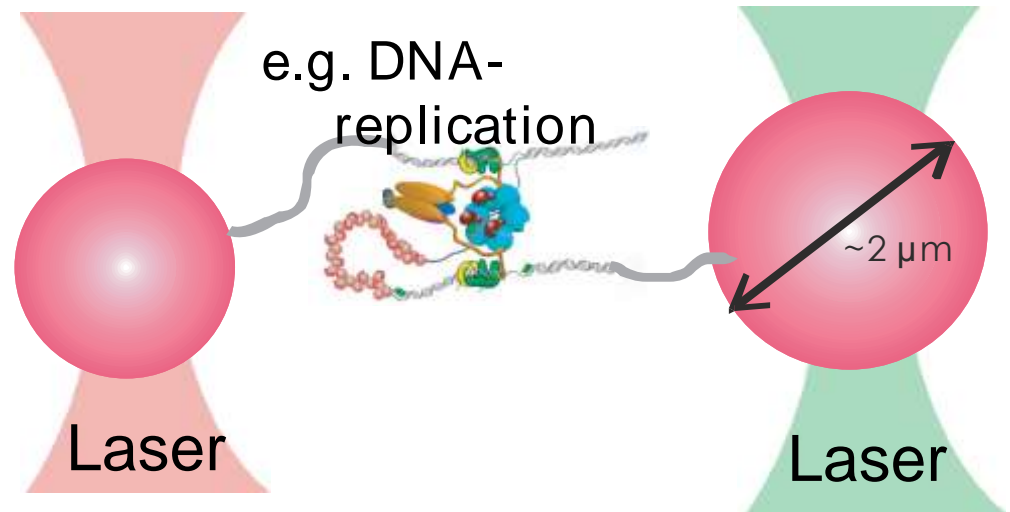
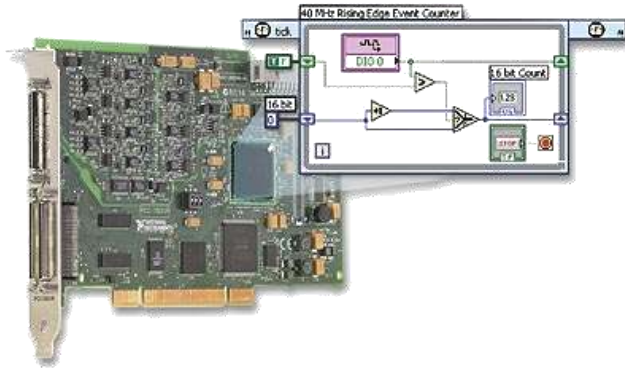
Electronics Research Laboratory  
Department of Physics





# Case Study: Optical Tweezers

Goal: make molecular movies to show how life works at nanoscale



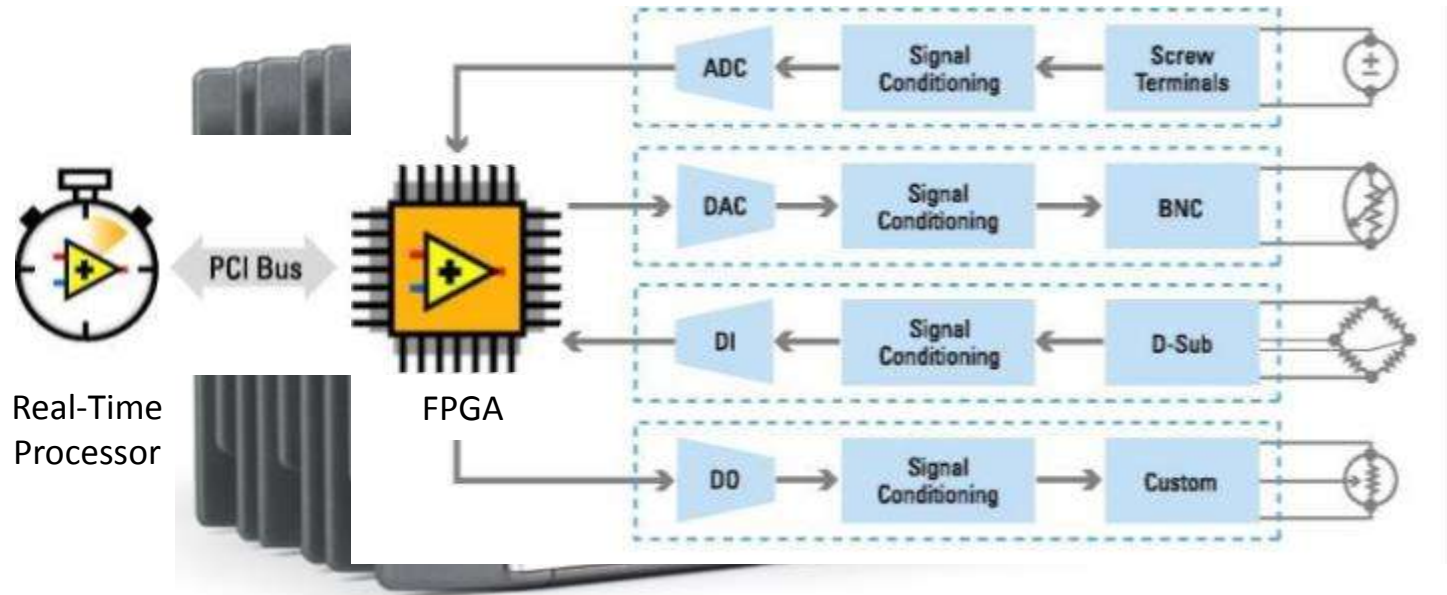
## Optical Tweezers

- *Laser light traps  $\sim \mu\text{m}$  particles*
- *Forces: 0-100 pN*
- *Motion:  $< 1$  nm resolution*

## FPGA-based:

- *Nano-scale motion control*
- *Programmable light*

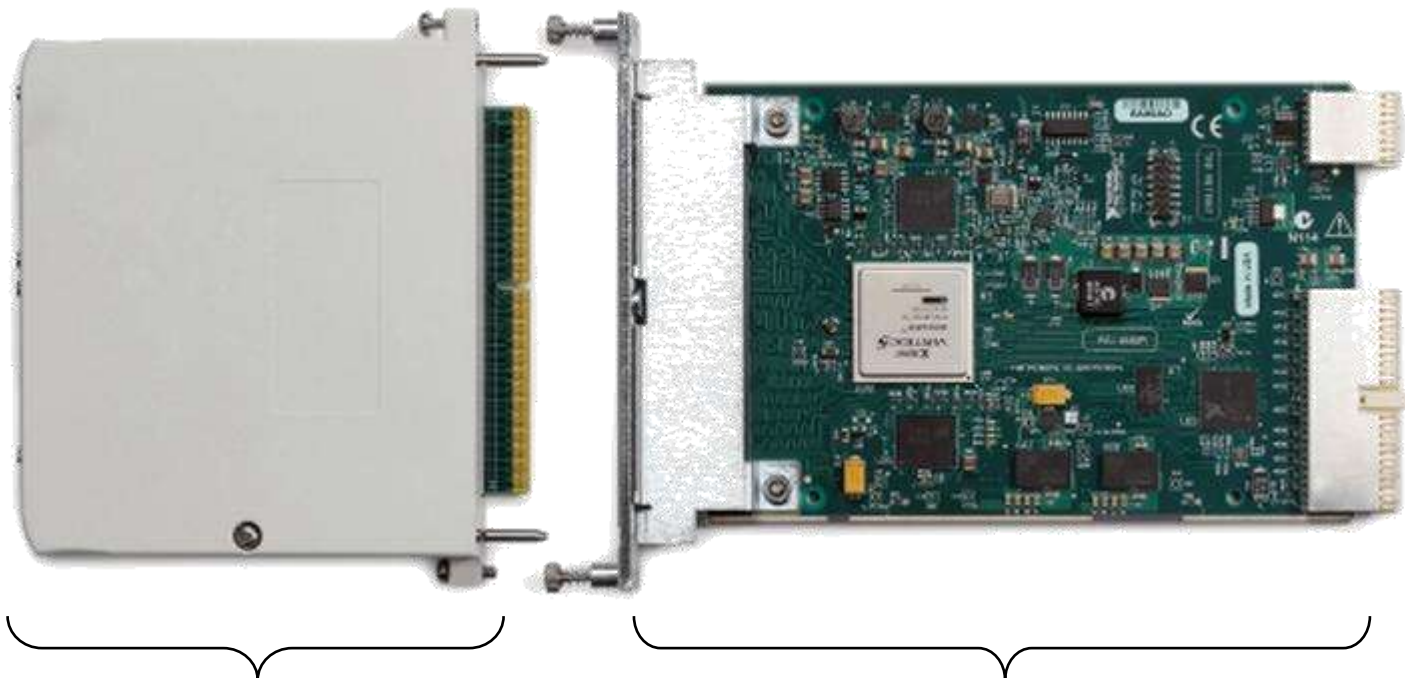
# Blending Technologies for New Architectures: CompactRIO



- **Reconfigurable FPGA** for high-speed and custom I/O timing, triggering, and control
- **I/O modules** with built-in signal conditioning for connection to sensors/actuators
- **Real-time processor** for reliable measurement, analysis, connectivity, and control



# Blending Technologies for New Architectures: FlexRIO



## NI FlexRIO Adapter Module

- Interchangeable I/O
- Customizable by users
- Adapter Module Development Kit

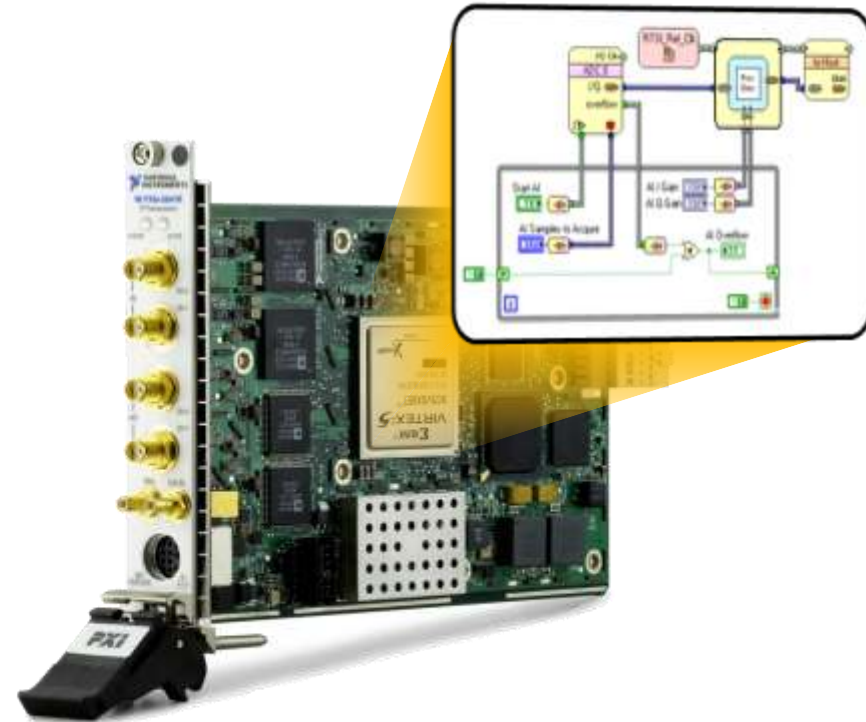
## NI FlexRIO FPGA Module

- Virtex-5 FPGA
- Up to 132 channels
- Up to 128 MB of DDR2 DRAM

# Introducing NI FlexRIO

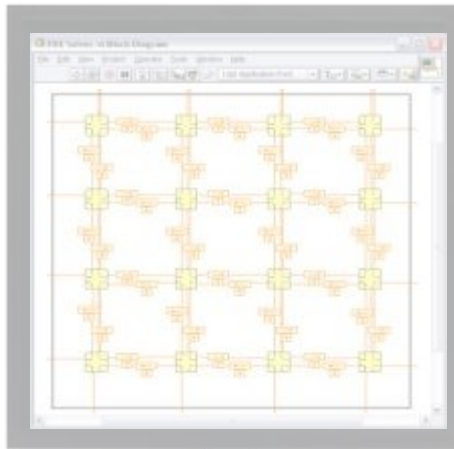
# NI RIO for IF Communication

- PC-based Intermediate Frequency (IF) transceivers with reconfigurable FPGAs
- Programmed in LabVIEW and LabVIEW FPGA
- Targeted at RF Dynamic Test, Software-Defined Radio (SDR), and user-defined IF applications
- 2 AI channels, 14 bits, 100 MS/s
- 2 AO channels, 14 bits, 200 MS/s



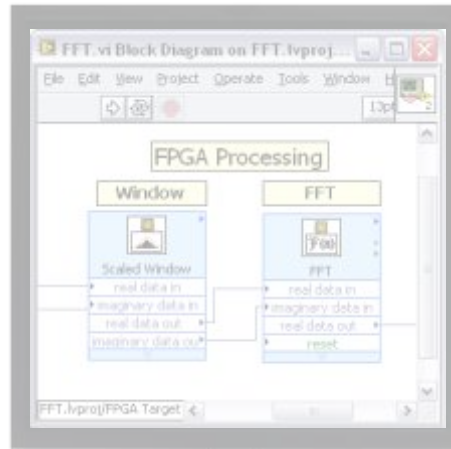
# Access through Graphical Programming

Multicore



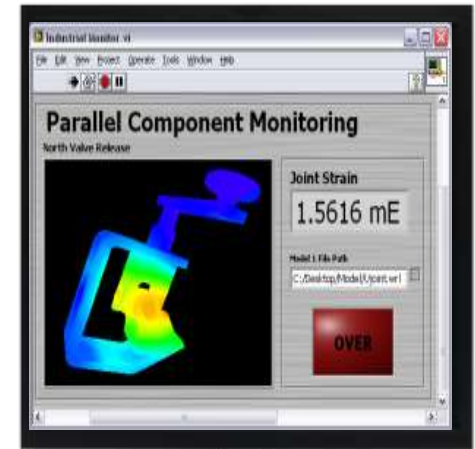
Desktop  
Supercomputing

FPGA



Rapid  
Embedded  
Development

Modular I/O

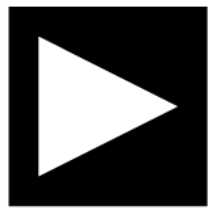


High  
Performance  
Interaction

# Modular I/O:

## Combinable Measurements & Rapid Data Access

- Combinable Measurements
  - Mix and match I/O to meet exact requirements
  - Access to leading edge measurement technology
- Rapid Data Access



**ANALOG  
DEVICES**

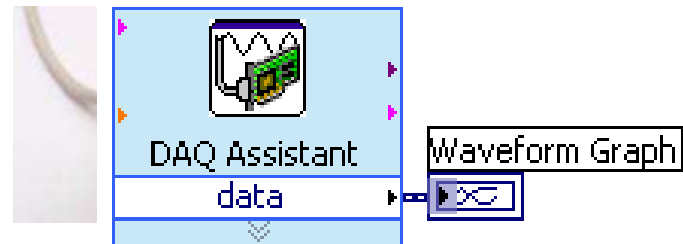
latest bus technologies  
synchronization

**TEXAS  
INSTRUMENTS**

- integrated through a single, unified software language

**PCI  
EXPRESS**

**HI-SPEED  
CERTIFIED  
USB**



# Modular I/O: PXI Platform



More than 1200 PXI Products from Over 70 Vendors



# Modular I/O: C Series Platform



More than 60 Measurement modules



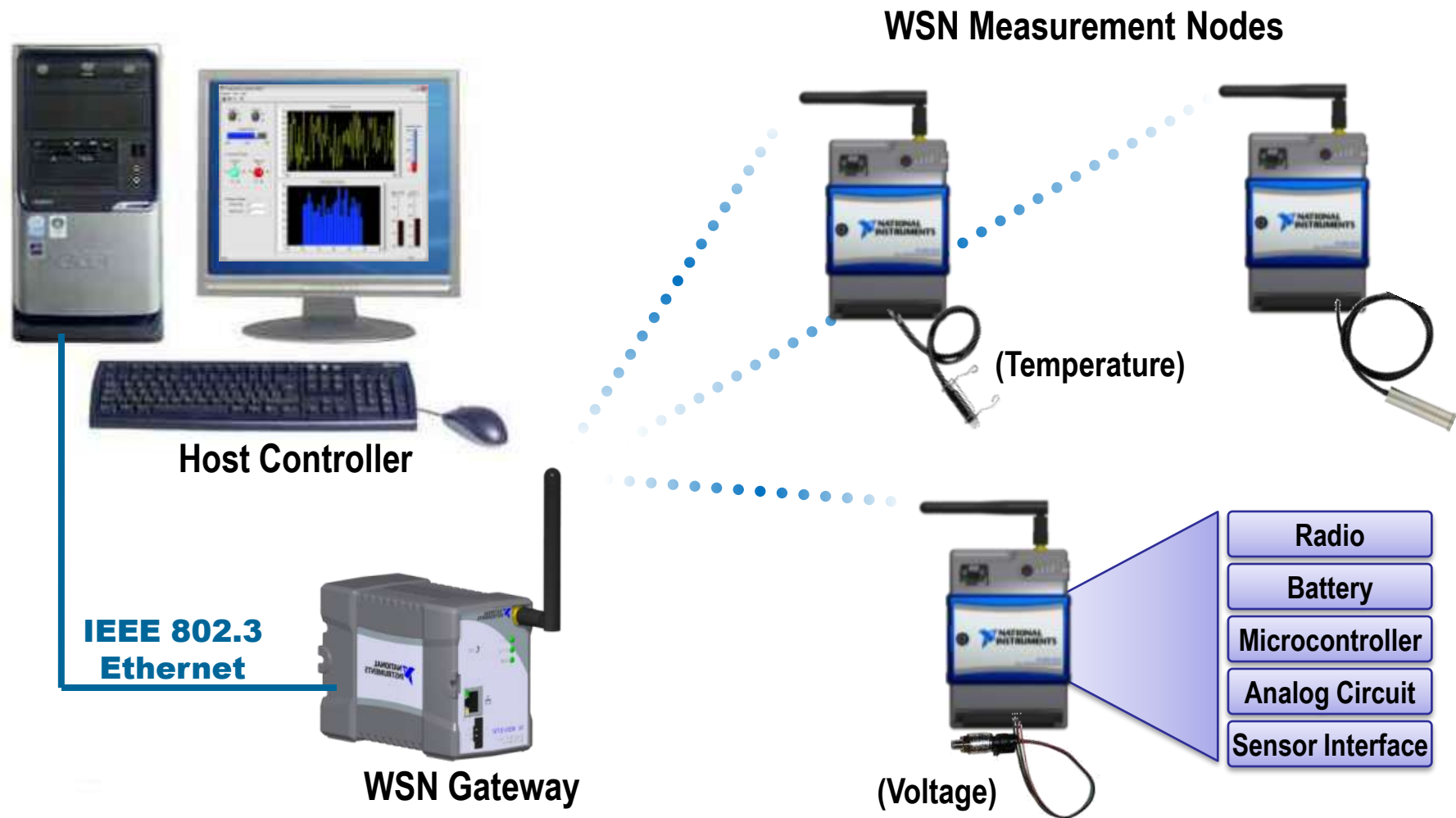
# Introducing Wi-Fi Data Acquisition

- IEEE 802.11b/g radio
- 10/100 Base-T/X Ethernet
- NI-DAQmx driver
- DC powered (9-30 VDC)
- C Series module support
  - NI 9211 (4-ch thermocouple)
  - NI 9215 (4-ch SSH  $\pm 10\text{V}$  inputs )
  - NI 9234 (4-ch IEPE accelerometers)
  - NI 9237 (4-ch strain gauges)
  - NI 9219 (4-ch universal inputs)



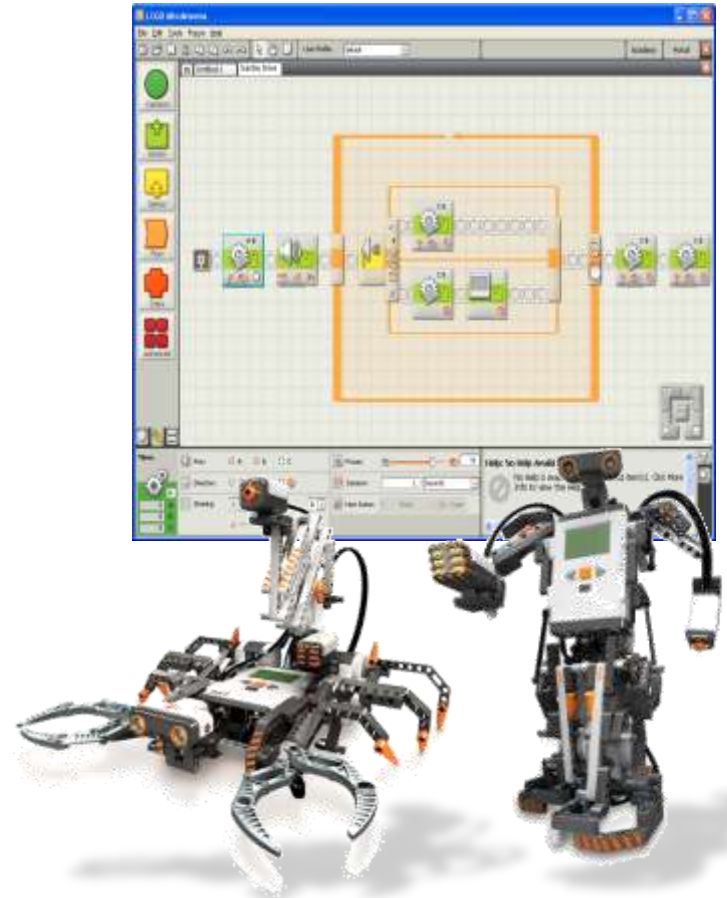
Sneak Preview:

# NI Wireless Sensor Network



# Modular I/O: MINDSTORMS

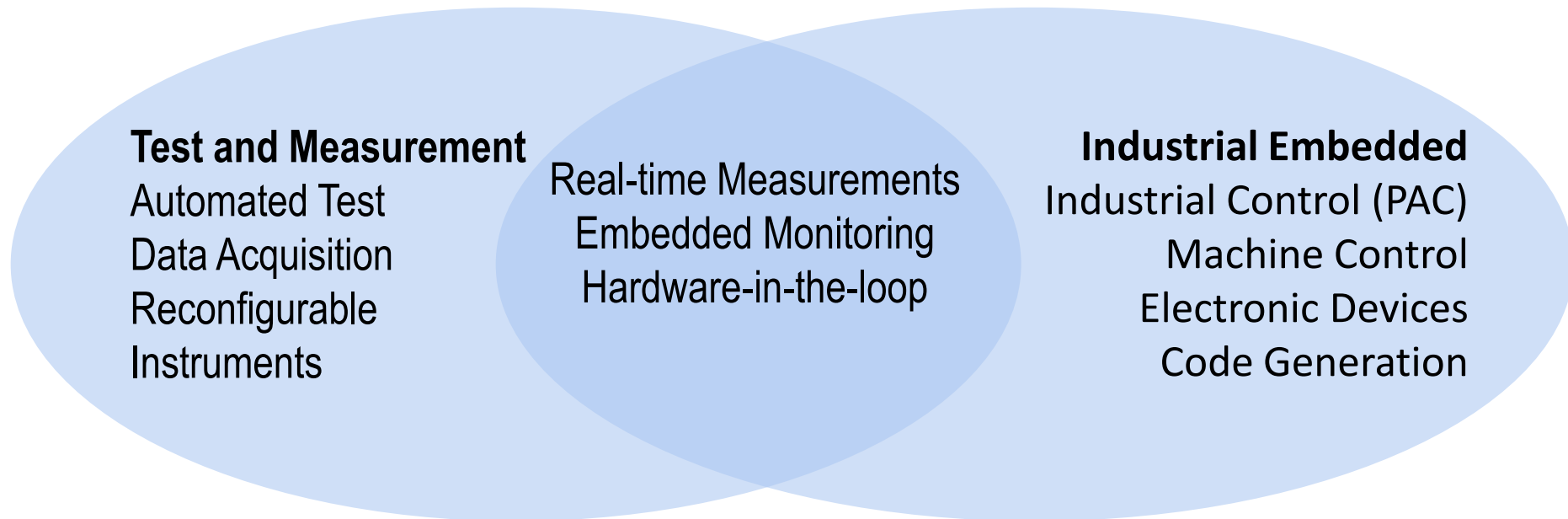
- Motors
- Sensors
  - Light, Sound, Ultrasonic, Touch, and Rotation
- USB 2.0 and Bluetooth



# The Engineering Design Transformation

# National Instruments Vision

## Graphical System Design

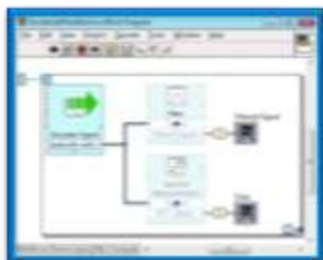


“To do for test and measurement  
what the spreadsheet did  
for financial analysis.”

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

# Models of Computation

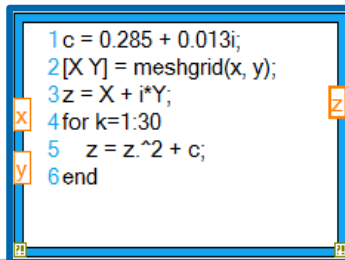
Dataflow



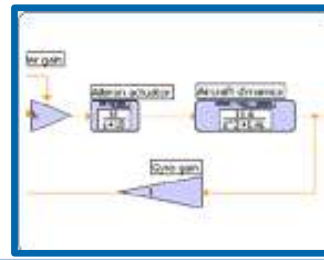
C / HDL Code



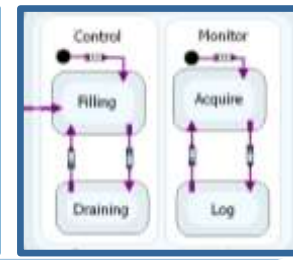
Textual Math



Simulation



Statechart



LabVIEW



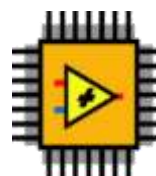
Desktop

LabVIEW



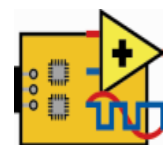
Real-Time

LabVIEW



FPGA

LabVIEW



MPU/MCU



Personal Computers



PXI Systems



CompactRIO



Single-Board RIO



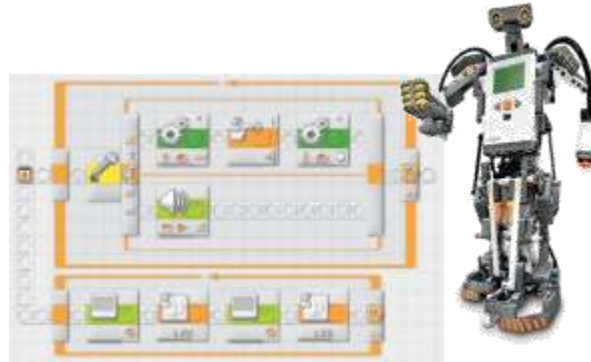
Custom Design



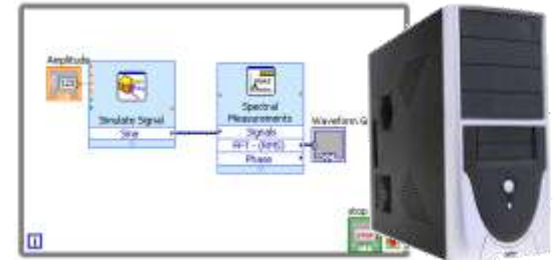
# Graphical System Design: From Kindergarten to Rocket Science



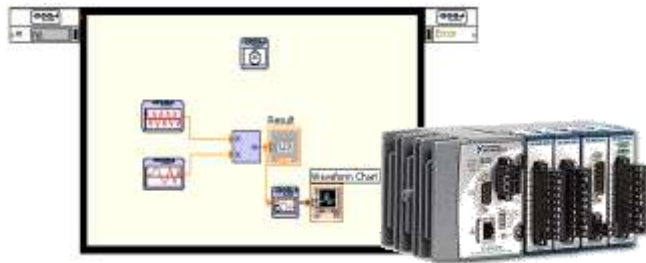
LEGO® Education WeDo Loop



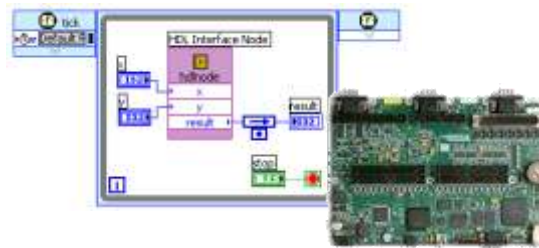
LEGO MINDSTORMS® NXT Loop



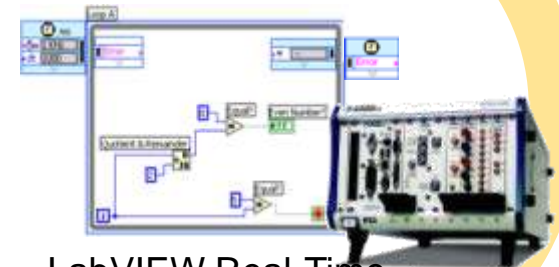
LabVIEW While Loop



LabVIEW Simulation Loop



LabVIEW FPGA  
Single-Cycle Timed Loop



LabVIEW Real-Time  
Timed Loop



# Engineering Grand Challenges



Make solar energy economical



Provide energy from fusion



Develop carbon sequestration methods



Manage the nitrogen cycle



Provide access to clean water



Restore and improve urban infrastructure



Advance health informatics



Engineer better medicines



Reverse-engineer the brain



Prevent nuclear terror



Secure cyberspace



Enhance virtual reality



Advance personalized learning



Engineer the tools of scientific discovery

# Case Study: Tampere University of Technology

Ali Muhammad  
Institute of Hydraulics & Automation

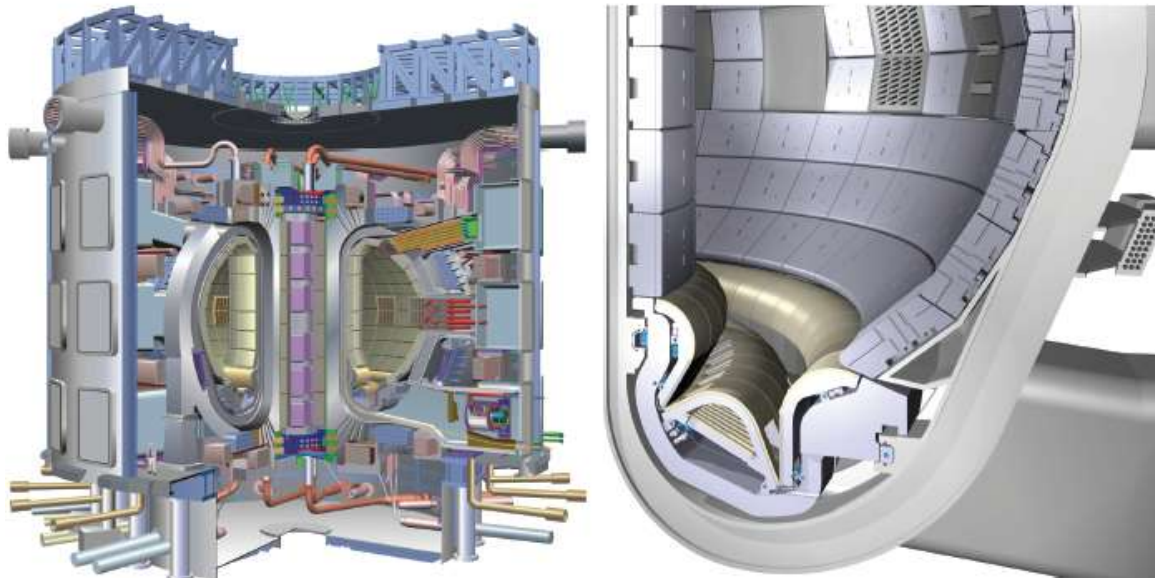
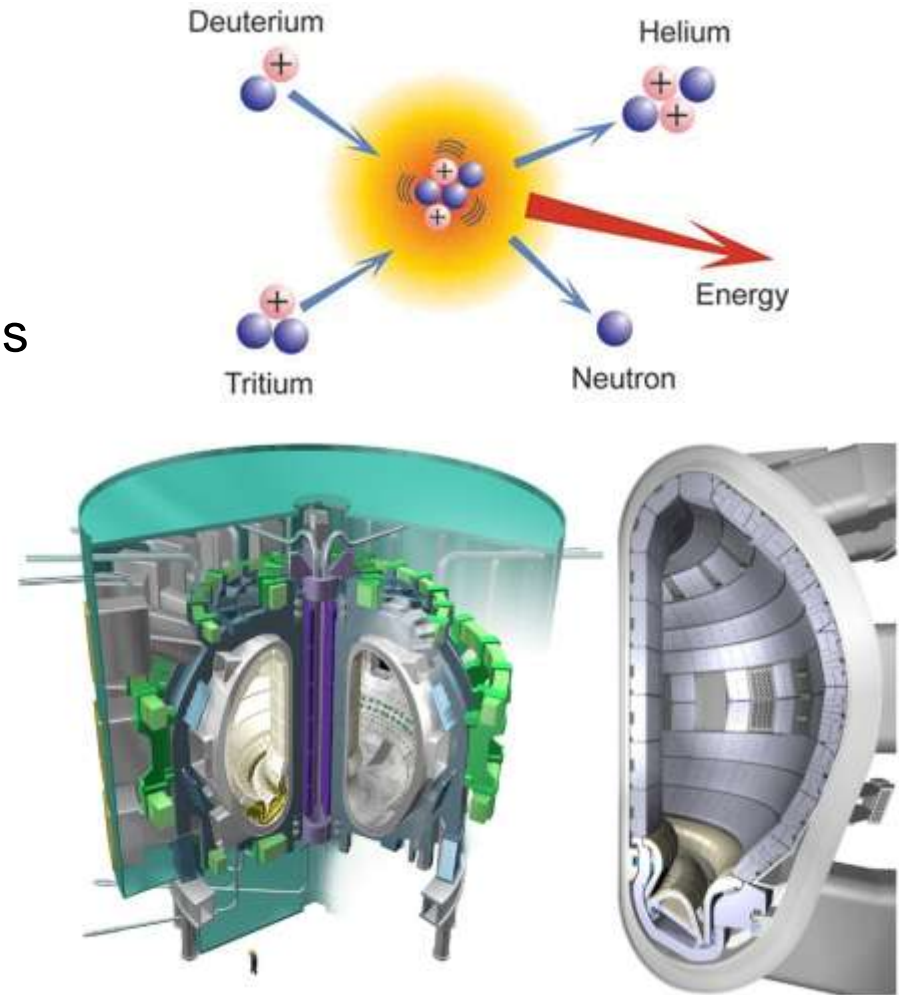


Figure 1. Cross section of ITER reactor (left). Cross section of divertor area and cassettes (right)

# ITER Divertor Test Platform

## *Harness the Fusion Energy*

- Largest project build on earth:
  - EU, USA, India, China, Russia, Korea, Japan
- Reaction temperature: 100 million °C.
- Most radioactive place on earth.
- Requires refurbishment several times during its lifecycle.



# ITER Divertor Test Platform

- High load capacity
- Constricted space
- High demand on position and force control accuracy
- Reliability
  - Fail safe
  - Fault tolerant
  - Recoverable
- High radiation dosage
  - Limited choice of materials, sensors, etc.





# ITER Divertor Test Platform

- Two operators and a supervisor
- Two data projectors with selectable views: camera/process data, 3D virtual model etc.

## Control Software

- LabVIEW and LabVIEW Real-Time
- Binds everything together by utilising various communication methods (UDP, OPC, CAN, SVE)

## Control Hardware

- National Instruments Digital and Analog I/O boards
- LabVIEW Real-Time Multicore PC



# Engineering Grand Challenges



Make solar energy economical



Provide energy from fusion



Develop carbon sequestration methods



Manage the nitrogen cycle



Provide access to clean water



Restore and improve urban infrastructure



Advance health informatics



Engineer better medicines



Reverse-engineer the brain



Prevent nuclear terror



Secure cyberspace



Enhance virtual reality



Advance personalized learning



Engineer the tools of scientific discovery



# Partner Introductions

NIDays 2009

# **Metech offers a complete measuring service solution – Metech support solution**



- Columbia has delivered testfixtures and Interface solutions from Virginia Panel corporation for the Nordic market since 1977.
- Columbia designs fixtures for function- and in-circuit test of all types of electronic units – on component- and board level as well as subsystems and finished product.
- Development of all fixturetechnics: vacuum, pneumatic or mechanical. The fixtures are built standalone, direct connected to the testsystem or integrated in the production line fully automatic.
- Knowledge, modern machine park and the best suppliers of material has made Columbia leading in the Scandinavian market.
- Columbia is agent for **Virginia panel Corporation**. VPC supplies reliable Interface solutions for any type of test platform, VXI,PXI,LXI,SCXI, Rack&Stack etc.


**COLUMBIA**



Endevo



<flander>

Endevo

Part of Flander Group



COMPATIBLE WITH



NATIONAL INSTRUMENTS

LabVIEW™





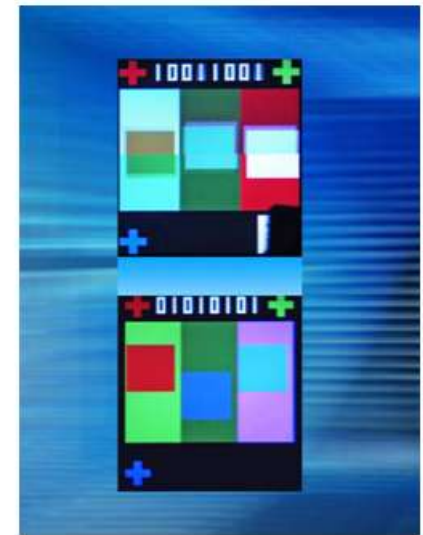
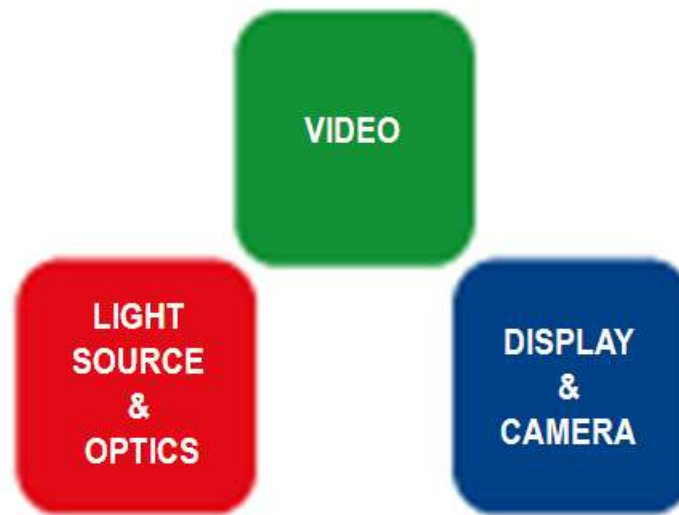
## Twenty Years of Embedded Design



- Annual sales 21.2 M€ (2008)
- 230 employees at 7 locations in Finland
- Leading Finnish R&D services company in the field of embedded systems.
- Full-service design house, delivers system design, electronics design, mechanics design, embedded software design, industrial design and test systems
- Test Systems Division:
  - R&D Test Automation
  - DfT, Test Specifications
  - Testers: Mechanics, Electronics, Software
  - Test System Platforms
  - SPC software, Six-Sigma know-how



High-Tech  
company  
focusing on  
**Optical  
Test and  
Measurement**



Test solutions with NI platforms



## Optimized

image quality by OptoFidelity



# Key expertise

## xMove

Complex test solutions for electronic control units, used in automotive and other industry.

Application areas:

- Functional test
- Hardware In the Loop (HIL) test
- Repair test

## HSDH-RT

**High Speed Data Handling**  
- in **Real Time**  
Complex solutions for telecom, defence and data applications.

Application areas:

- Simulators in general
- High speed data
- RF simulations and analyses

## Large RT-Systems

Real Time systems used in control, measurement and test applications for a number of industries.

Main characteristics:

- Real Time
- Gbps data rate
- >20 interconnected computers
- Handling >2000 signals
- Scalable
- Distributed

The Göteborg design centre

- Engineering expertise in: LabVIEW, LabVIEW-RT, Multicore etc.
- Engineering expertise in: HW-design, FPGA, RF, interface design etc.



# Protacon



Je bent toe aan een rustpauze...

Verdwijnt over 0:02

- Mittaus- ja informaatiojärjestelmät
- Teollisuusautomaatio
- Instrumentointi
- Sähköistys
- IT –ratkaisut ja ohjelmistot
- 170 automaation ammattilaista

- 15 sertifioitua LabVIEW osaajaa



- Tuotannon testausjärjestelmät
- Värähtelymittaukset
- Kunnonvalvonta
- Kannettavat mittausjärjestelmät
- Kokonaistoimitukset





ni.com



# What Virinco do...

*...we specialize in:*

- Automatic Test Equipment
-  ➤ NI TestStand
-  ➤ Test Data Management

*... helping customers to:*

- Organize test & repair data
- Improve production **YIELD**
- Improve product **QUALITY**

# Today's highlights

- 44 people took the CLAD Exam
- 18 Different technical/case study presentations
- 13 Partners in the exhibition area
- New Products Area
- 5 Try-it-Yourself demo stations
- “Quote of the Day”
- LEGO Mindstorms lottery – keep your lottery ticket
- Feedback forms
- USB sticks with presentations

