

# Welcome to NIDays 2009 !

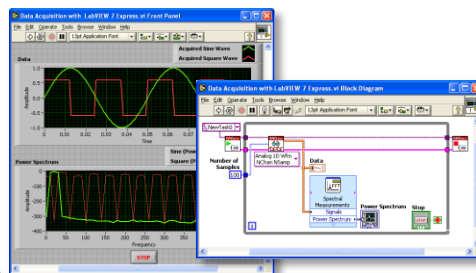
*William Baars – Area Sales Manager NI Netherlands*

# What We Do

## Low-Cost Modular Measurement and Control Hardware



## Productive Software Development Tools



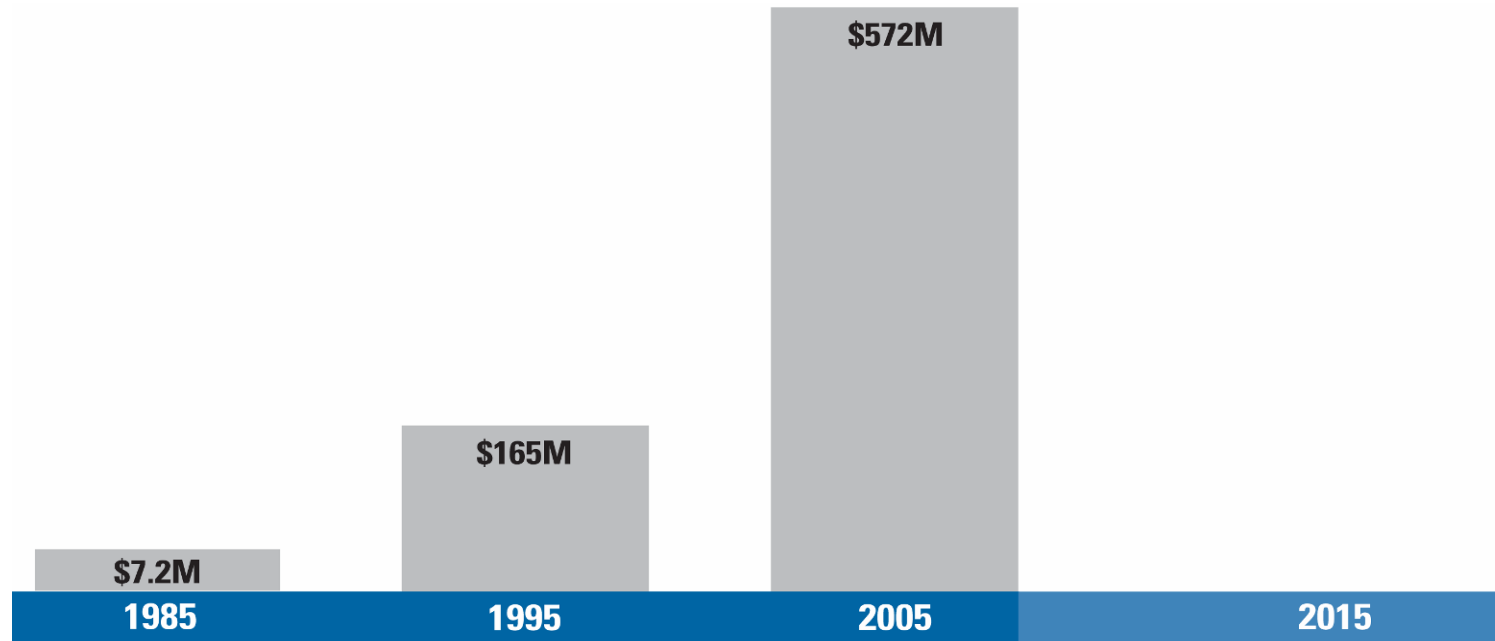
## Highly Integrated Systems Platforms



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

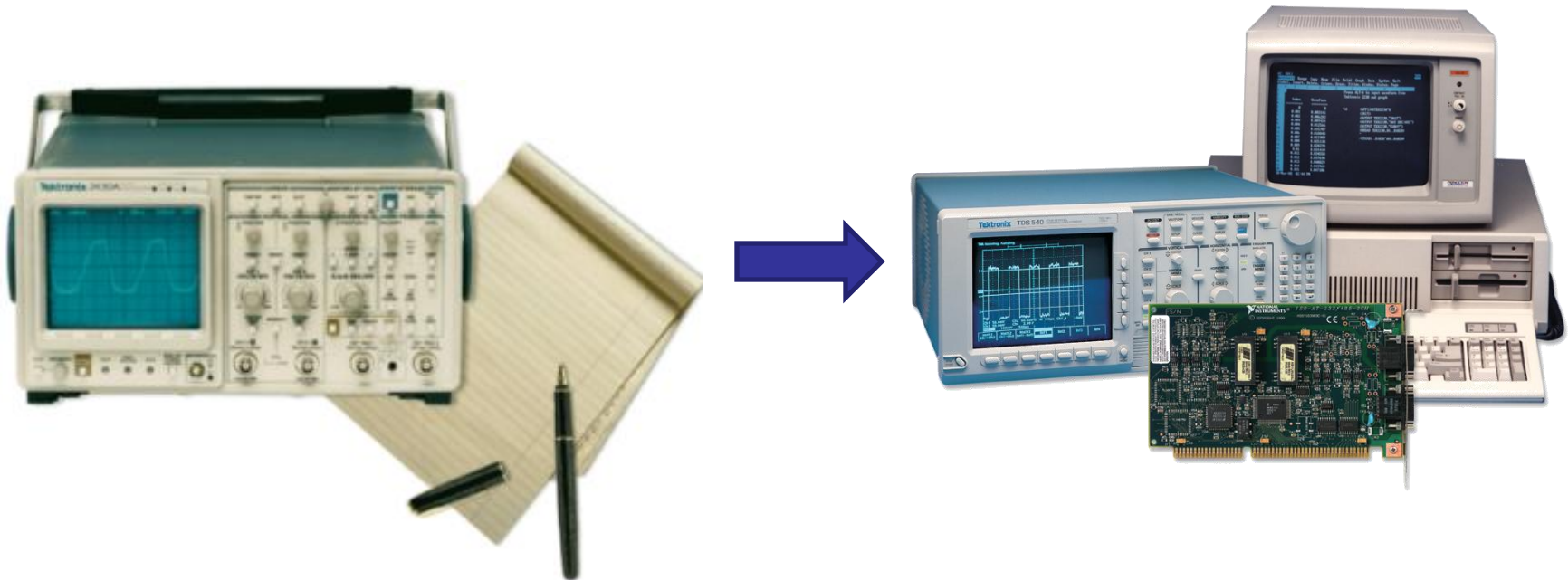
## Third Decade

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

## Fourth Decade

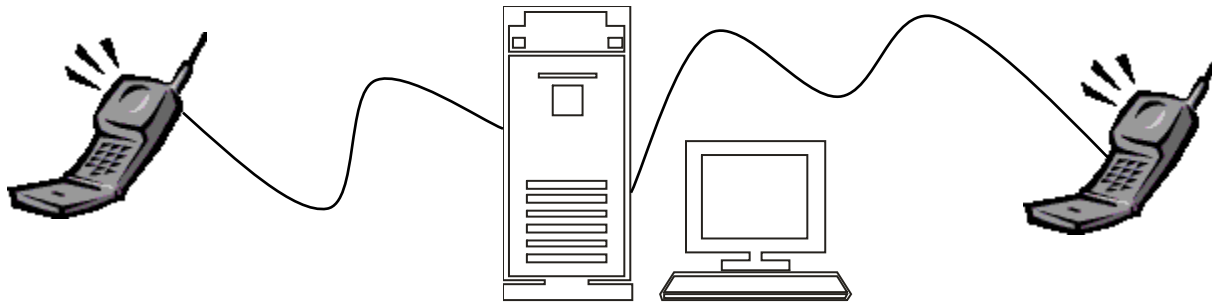
2015 : Test & Measurement and Graphical System Design

# Automating measurements



# GSM test system

- Connect two GSM phones to a PC to test new communication coding standards



- Needed 10x speed improvement over the old system
- LabVIEW (with multithreading), DIO and Audio measurements
- Developed in 6 weeks (*of which 3 weeks for purchasing...*)

# High Power Lab test system

- Testing insulators at 1 Million Volts and 1 Million Amps
- PXI and PXI Instruments:
  - PXI-6133, PXI-5122, PXI-1042Q

*"With our new system we can acquire at a higher rate, we have less external connections and we have a lower system price. "*

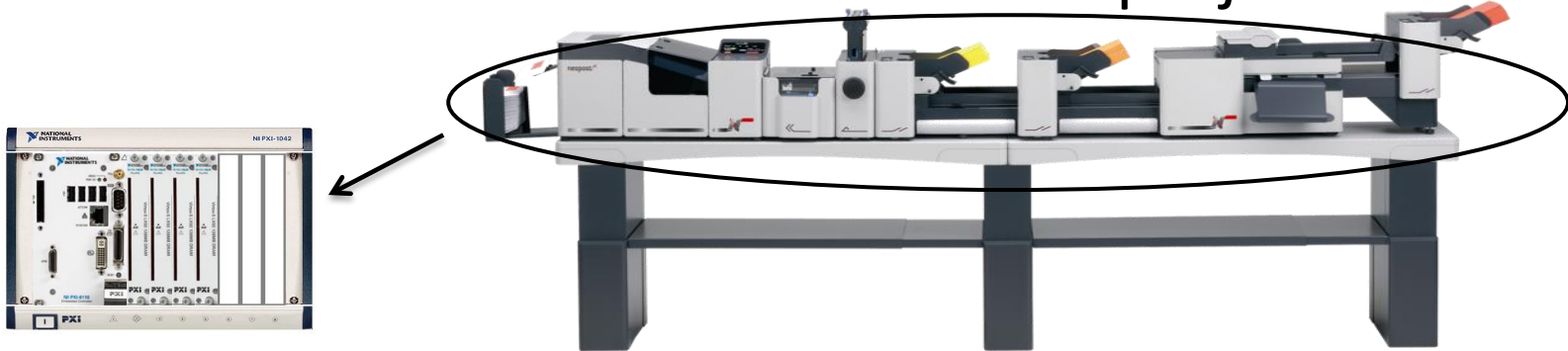
*– Aert Jurriens, KEMA*





# Hardware in the loop testing

- Neopost developed a system to simulate the mechanical signals (encoders / motors / switches) of their mail handling machines. Based on PXI/RT/FPGA and LabVIEW
- This speeds up embedded software development since mechanics is not available at start of project.



# Leveraging Technologies to Solve Next Generation Engineering Challenges

Shelley Gretlein

Senior Group Manager, Real-Time and Embedded

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

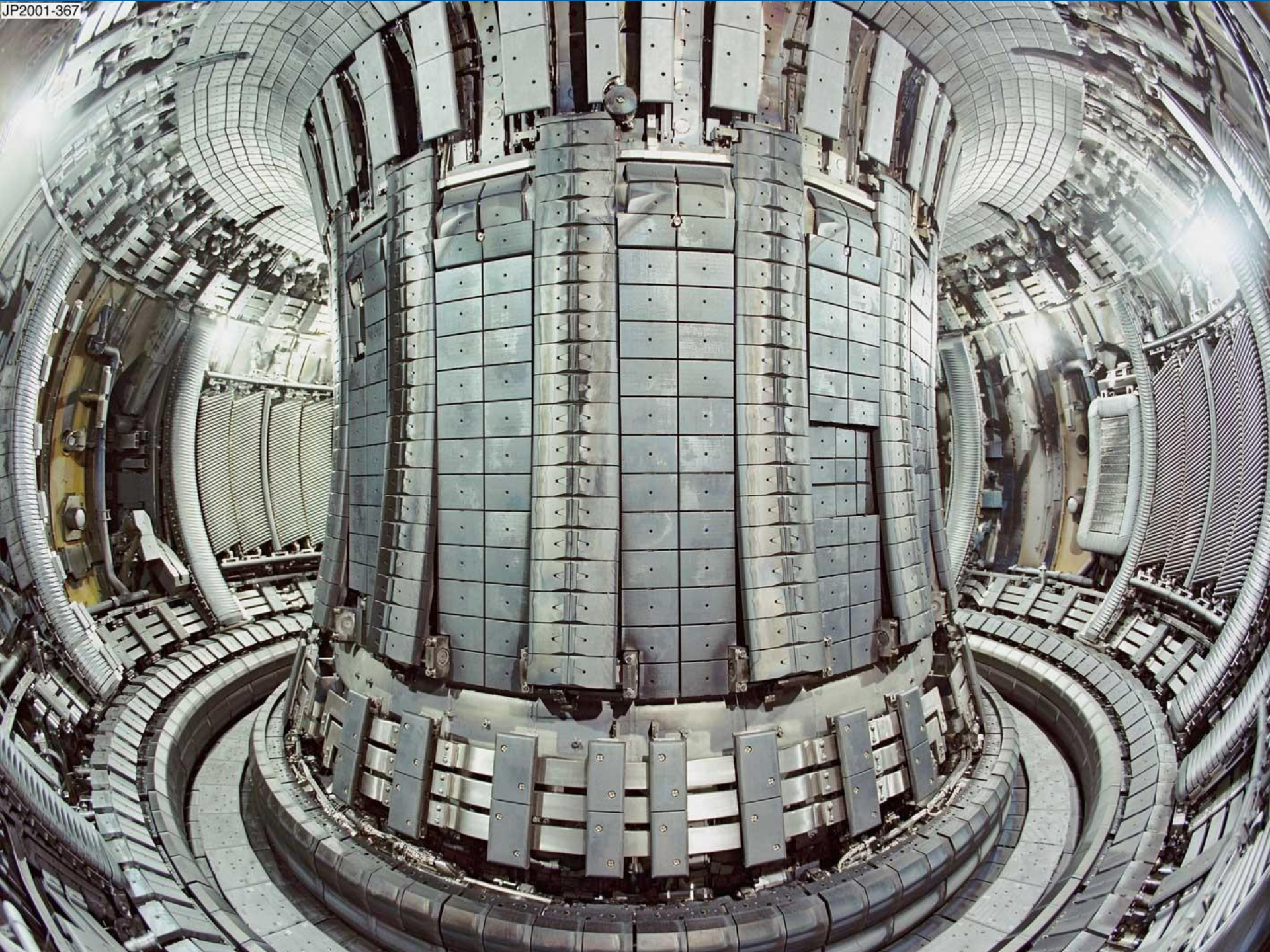


Engineer the tools of scientific discovery















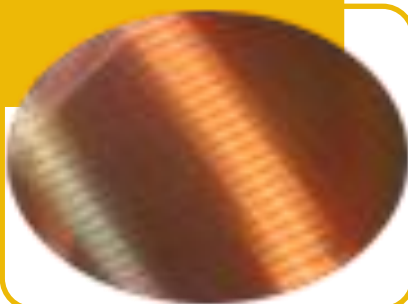




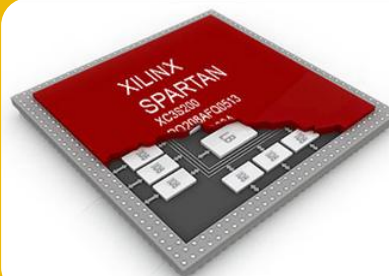


# Today's Technology: Core Value

Multicore



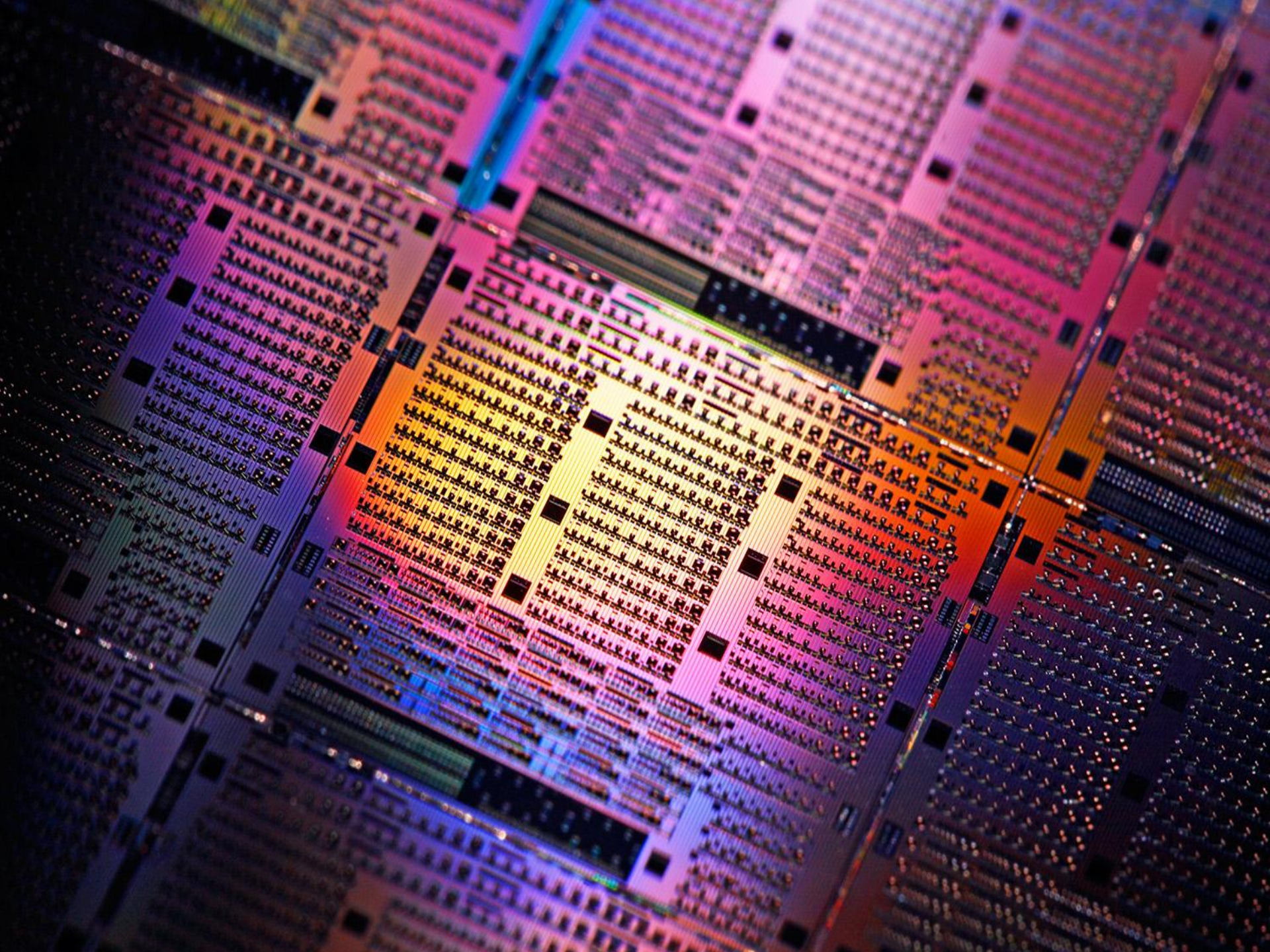
FPGA



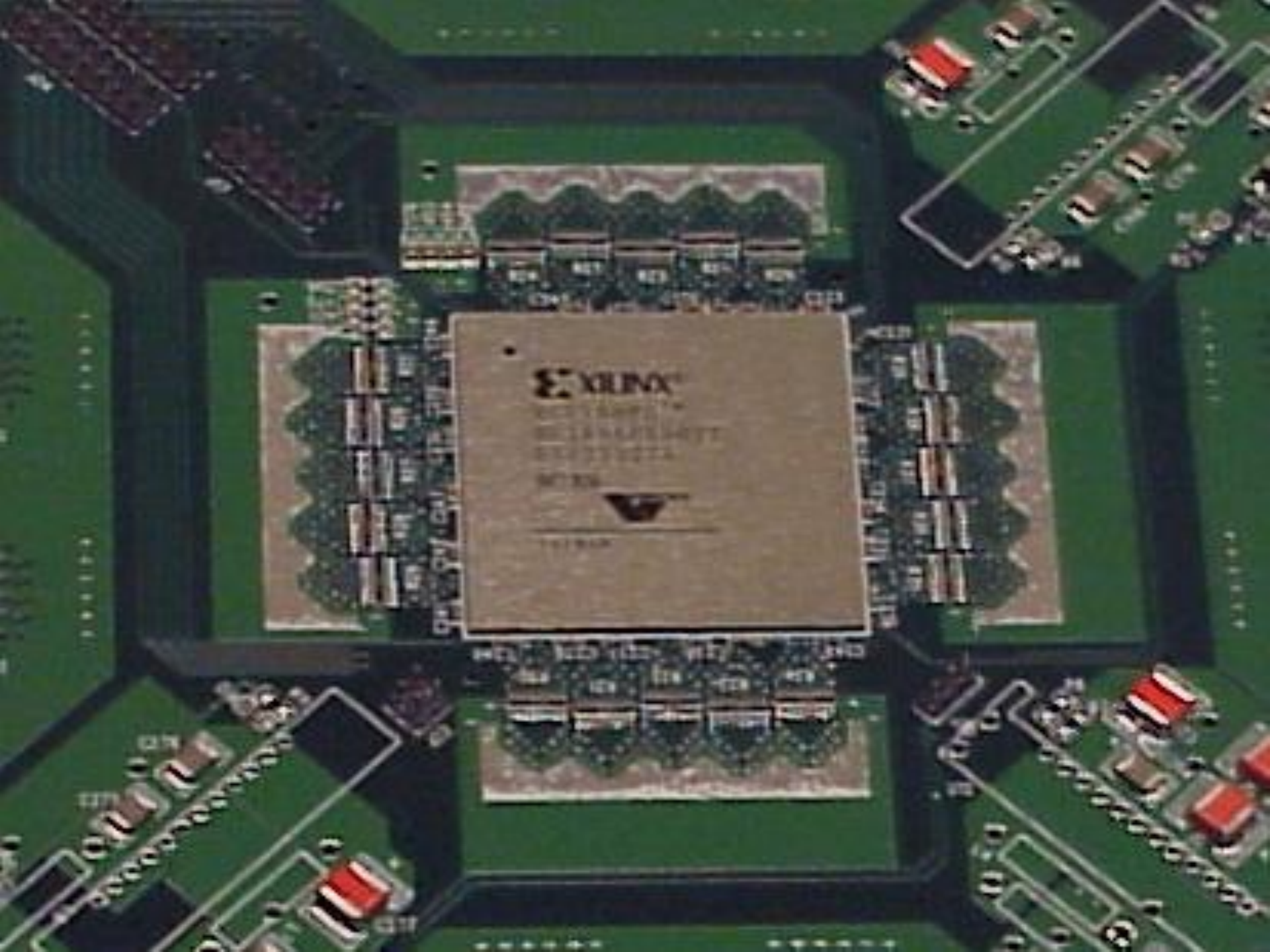
Modular I/O













# Today's Technology: Core Value

Multicore

**Parallel &  
Scalable  
Processing**

FPGA

**Re-definable  
Silicon**

Modular I/O

**Combinable  
Measurements  
& Rapid Data  
Access**



# Today's Technology Potential

Multicore

**Parallel &  
Scalable  
Processing**



**Desktop  
Supercomputing**

FPGA

**Re-definable  
Silicon**



**Rapid  
Embedded  
Development**

Modular I/O

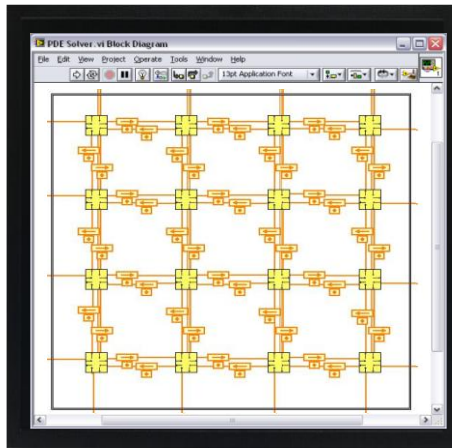
**Combinable  
Measurements  
& Rapid Data  
Access**



**High  
Performance  
Interaction**

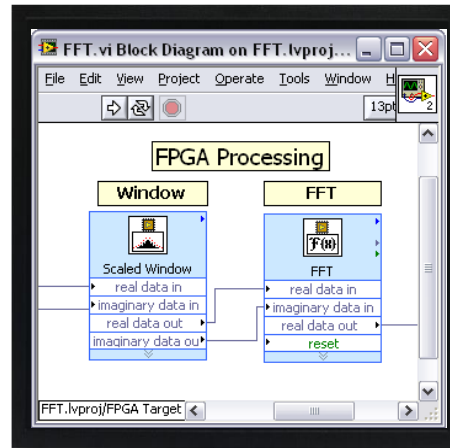
# Access through Graphical Programming

Multicore



**Desktop  
Supercomputing**

FPGA



**Rapid  
Embedded  
Development**

Modular I/O

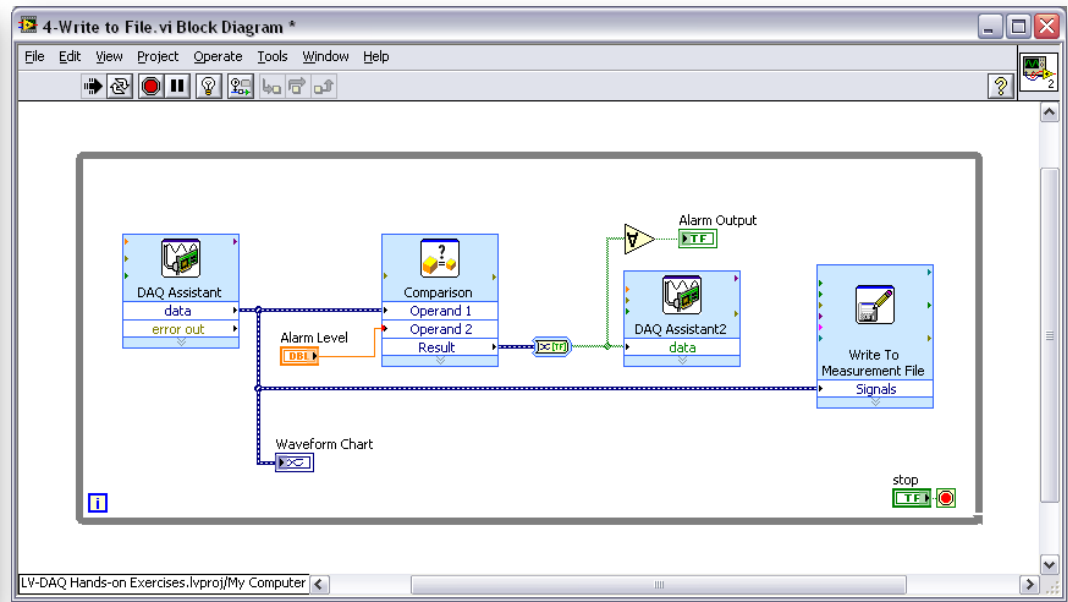
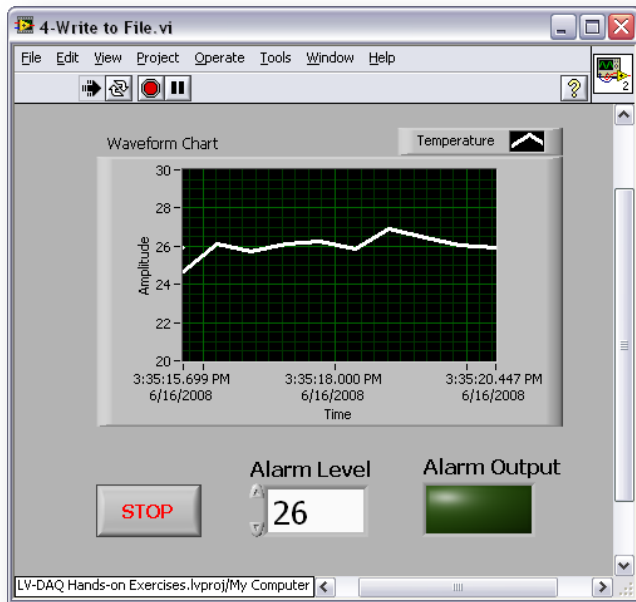


**High  
Performance  
Interaction**

# Graphical Programming:

## Simplifying Design of Complex Engineering Systems

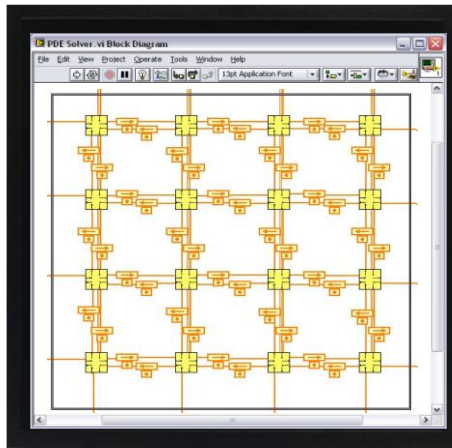
- Symbolic
- Dataflow
- Hierarchical
- Interactive
- Inherent User Interface





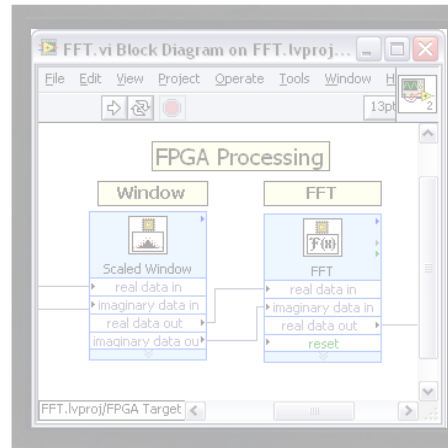
# Access through Graphical Programming

Multicore



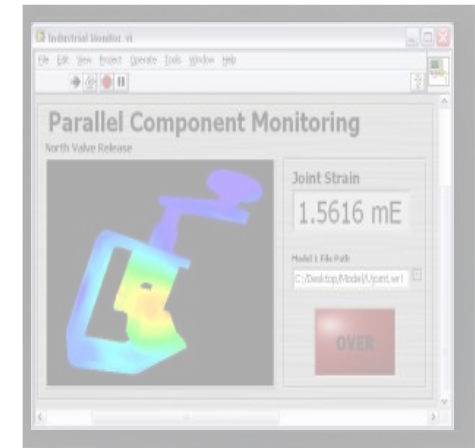
**Desktop  
Supercomputing**

FPGA



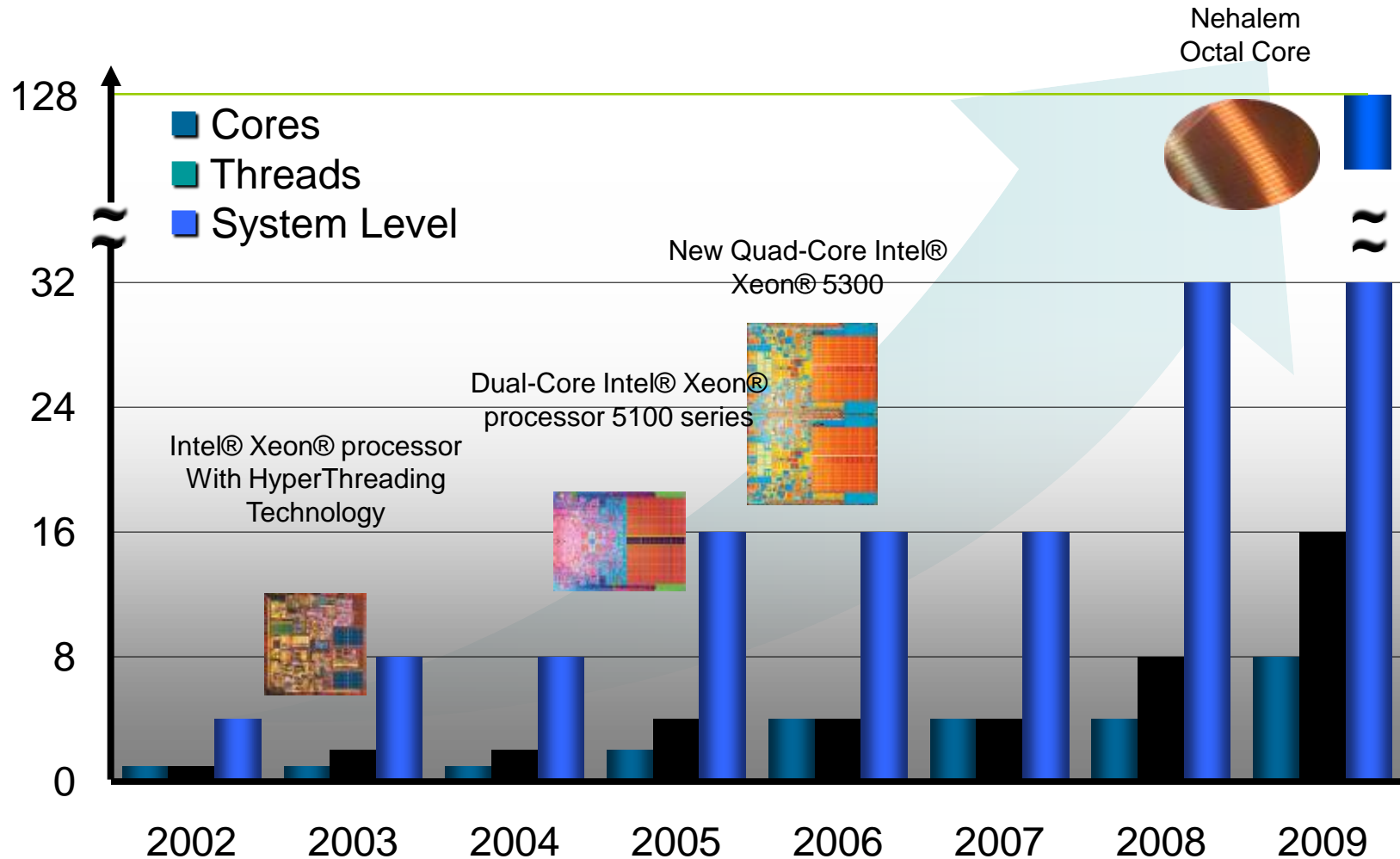
**Rapid  
Embedded  
Development**

Modular I/O

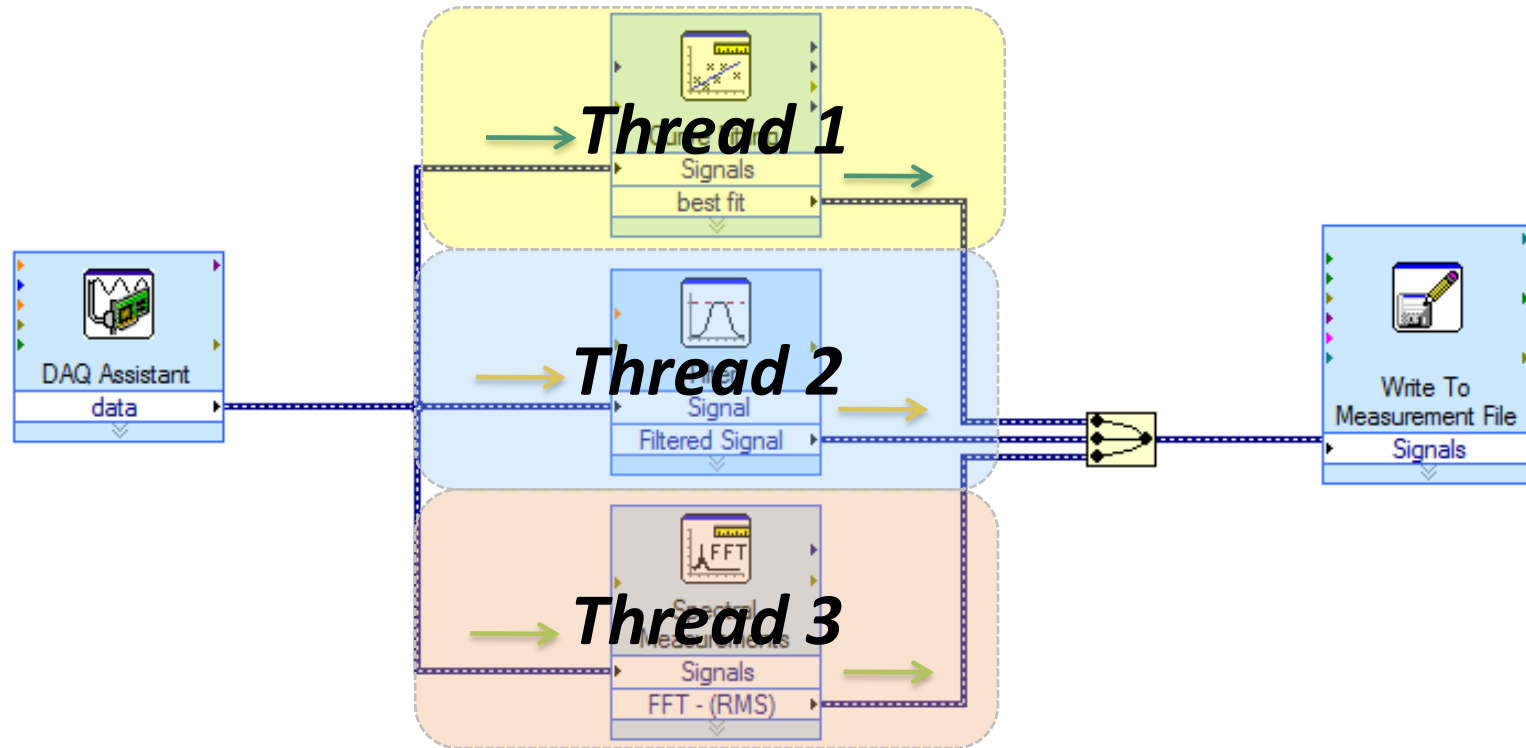


**High  
Performance  
Interaction**

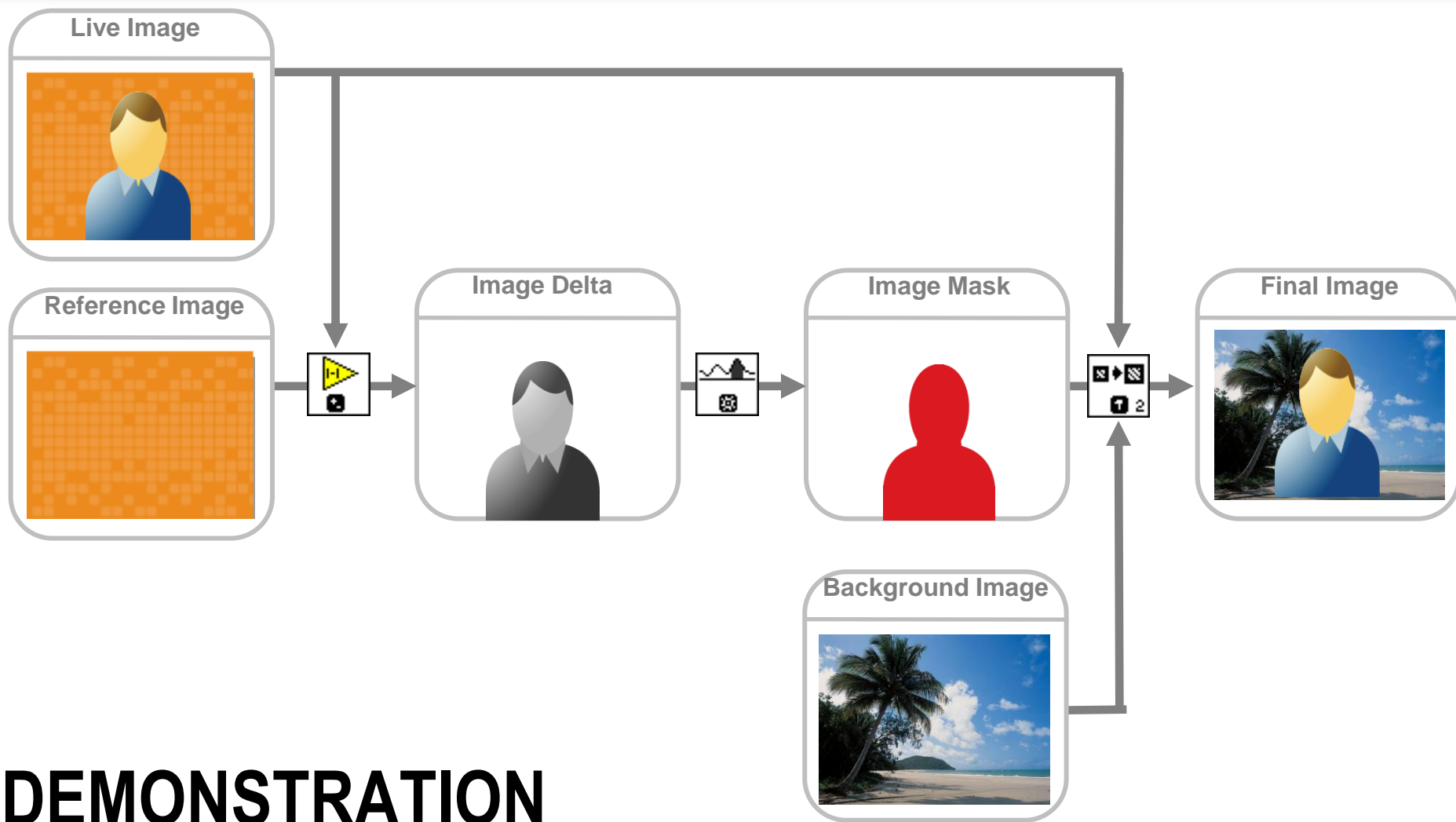
# Multi-core: Scalable Parallel Processing



# Realizing the Potential: Inherent Access to Automatically Scalable Parallelism



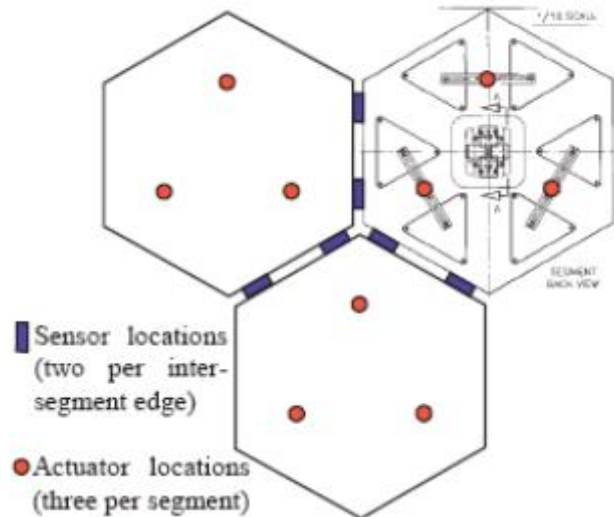
10 Year Anniversary of Multithreading



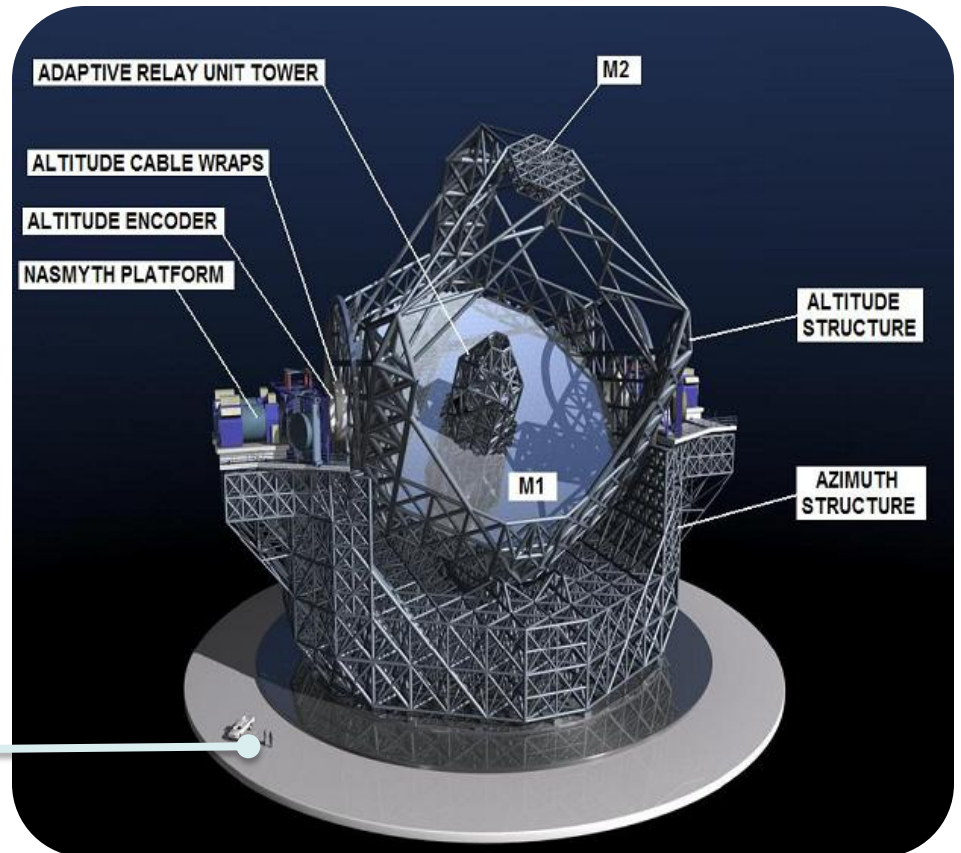
# DEMONSTRATION

## THE LABVIEW GREEN SCREEN

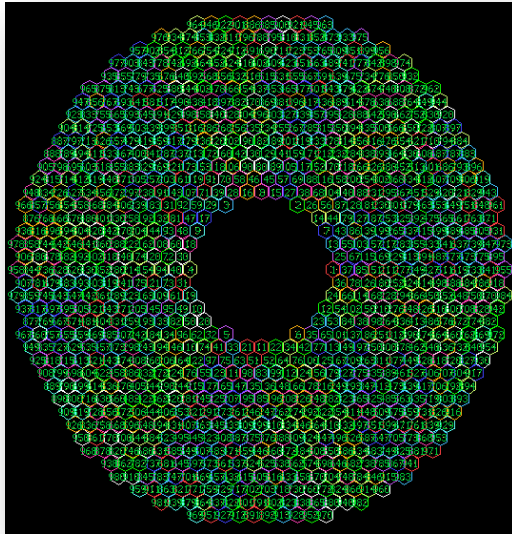
# Case study: Extremely Large Telescope



Physicists are getting smaller these days!



# Case study: Extremely Large Telescope

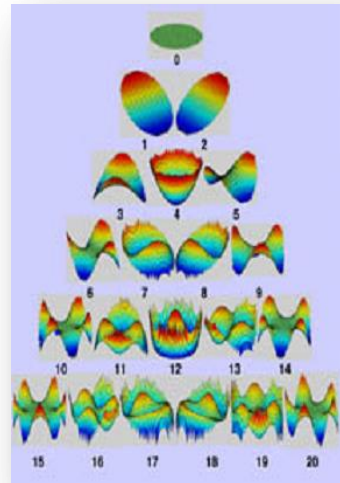


## M1 – mirror

984 hexagonal mirrors

6 sensors/3 actuators each

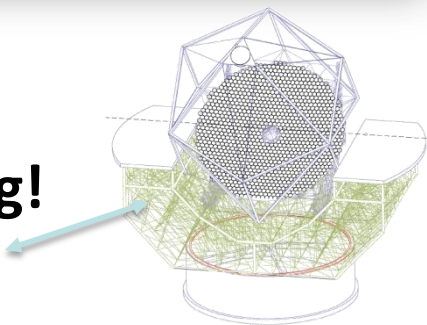
1 ms



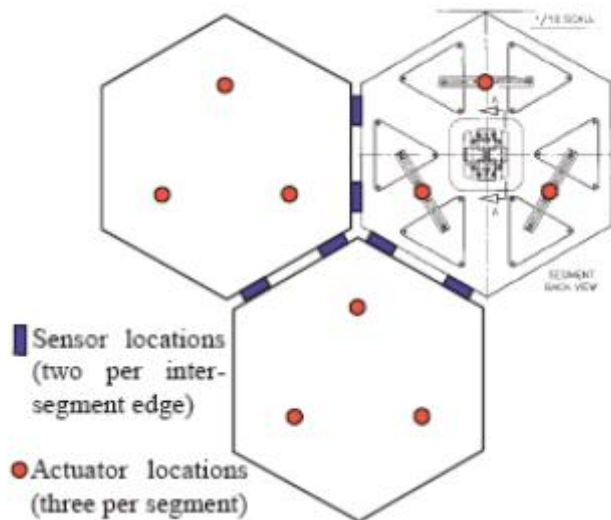
## Fight the modes!

Translates into large matrix operations (3K-by-3K)

Shaking!



# Case study: Extremely Large Telescope



$$\begin{aligned} \text{pinv}(\text{newIM}) &= (\text{newIM}^T \text{newIM})^+ \text{newIM}^T \\ &= ((\text{IM} - e_i a_i^T)^T (\text{IM} - e_i a_i^T))^+ (\text{IM} - e_i a_i^T)^T \\ &= (\text{IM}^T \text{IM} - a_i a_i^T)^+ (\text{IM}^T - a_i e_i^T) \end{aligned}$$

$$\begin{aligned} (\text{IM}^T \text{IM} - a_i a_i^T)^+ &= (\text{IM}^T \text{IM})^{-1} + \frac{(\text{IM}^T \text{IM})^{-1} a_i a_i^T (\text{IM}^T \text{IM})^{-1}}{1 - a_i^T (\text{IM}^T \text{IM})^{-1} a_i} \\ &= (\text{IM}^T \text{IM})^{-1} + \frac{b_i b_i^T}{1 - a_i^T b_i} \end{aligned}$$

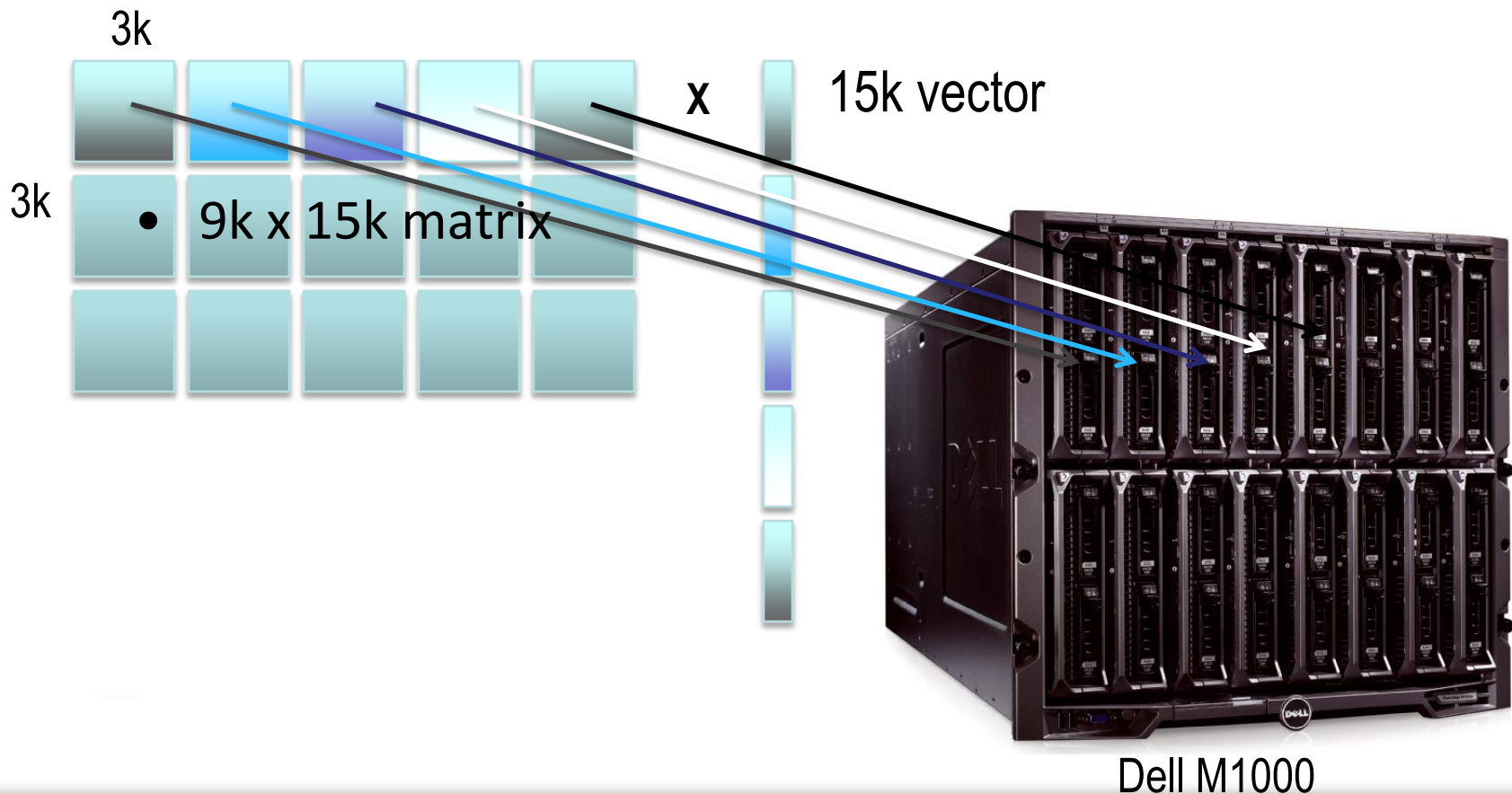
$$\begin{aligned} \text{pinv}(\text{newIM})ES &= ((\text{IM}^T \text{IM})^{-1} + \frac{1}{1 - a_i^T b_i} b_i b_i^T) (\text{IM}^T - a_i e_i^T) ES \\ &= (\text{IM}^T \text{IM})^{-1} (\text{IM}^T \cdot ES) - (\text{IM}^T \text{IM})^{-1} a_i \cdot es_i + \\ &\quad \frac{b_i^T (\text{IM}^T \cdot ES) - (a_i^T b_i) \cdot es_i}{1 - a_i^T b_i} b_i \end{aligned}$$

Requires to recalculate pinv of 3K-by-3K matrix in 100 ms  
 → Sherman Morrison



# Adaptive Optics

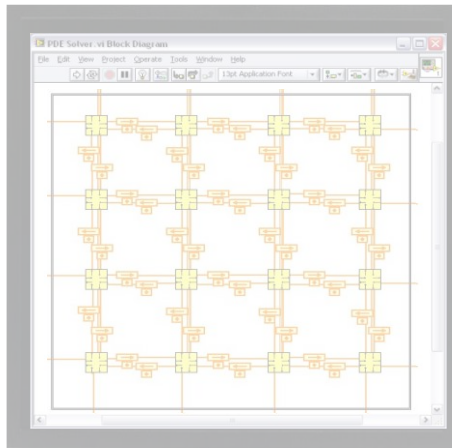
## Distributing LabVIEW computations





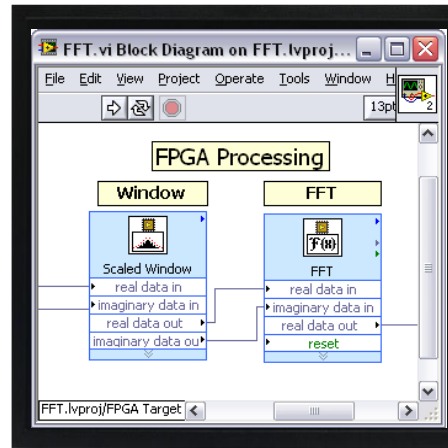
# Access through Graphical Programming

Multicore



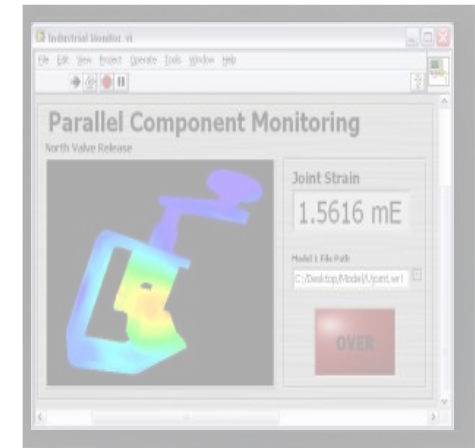
Desktop  
Supercomputing

FPGA



Rapid  
Embedded  
Development

Modular I/O



High  
Performance  
Interaction

# Advances in FPGA Technology

## Size

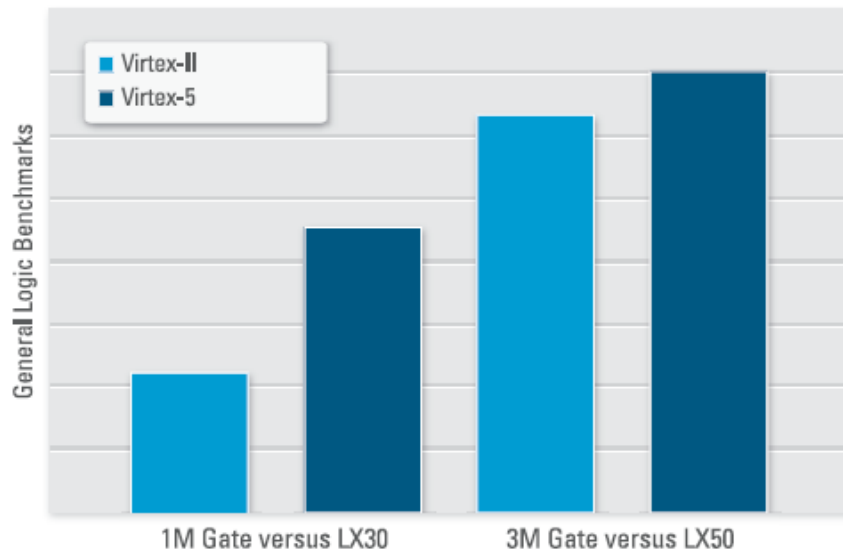


Figure 1. General logic benchmarks show that Virtex-5 FPGAs offer larger sizes when compared to Virtex-II FPGAs.

## Speed

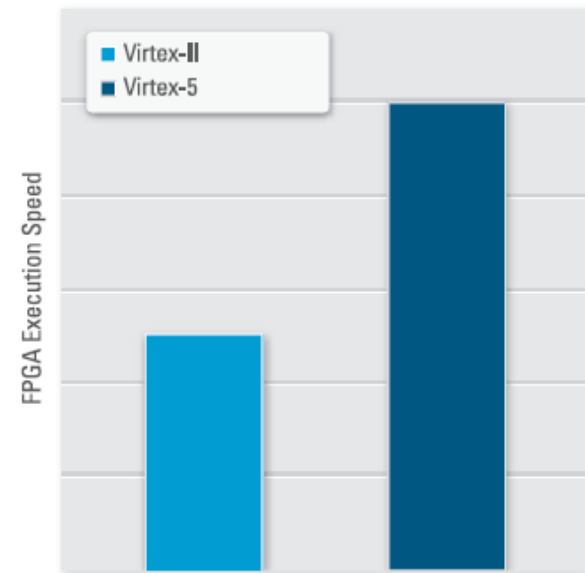


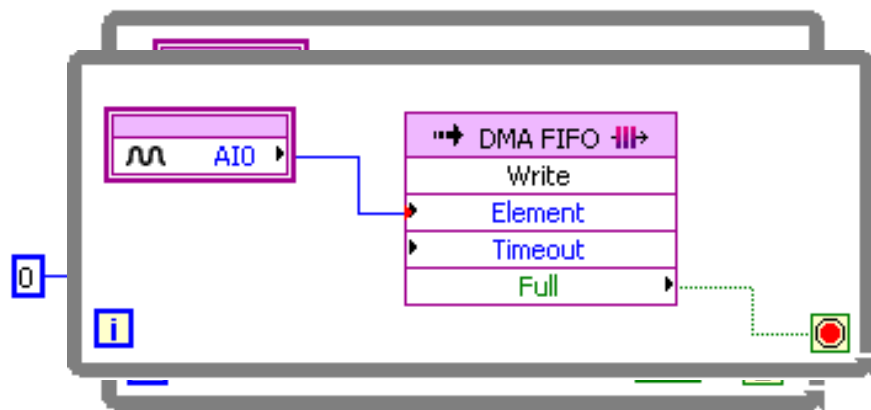
Figure 2. Execution speed benchmarks show that Virtex-5 FPGAs feature faster processing capabilities when compared to Virtex-II FPGAs.

# Realizing the Potential: Simplify Access to FPGAs

# Counter

# Analog I/O

# I/O with DMA

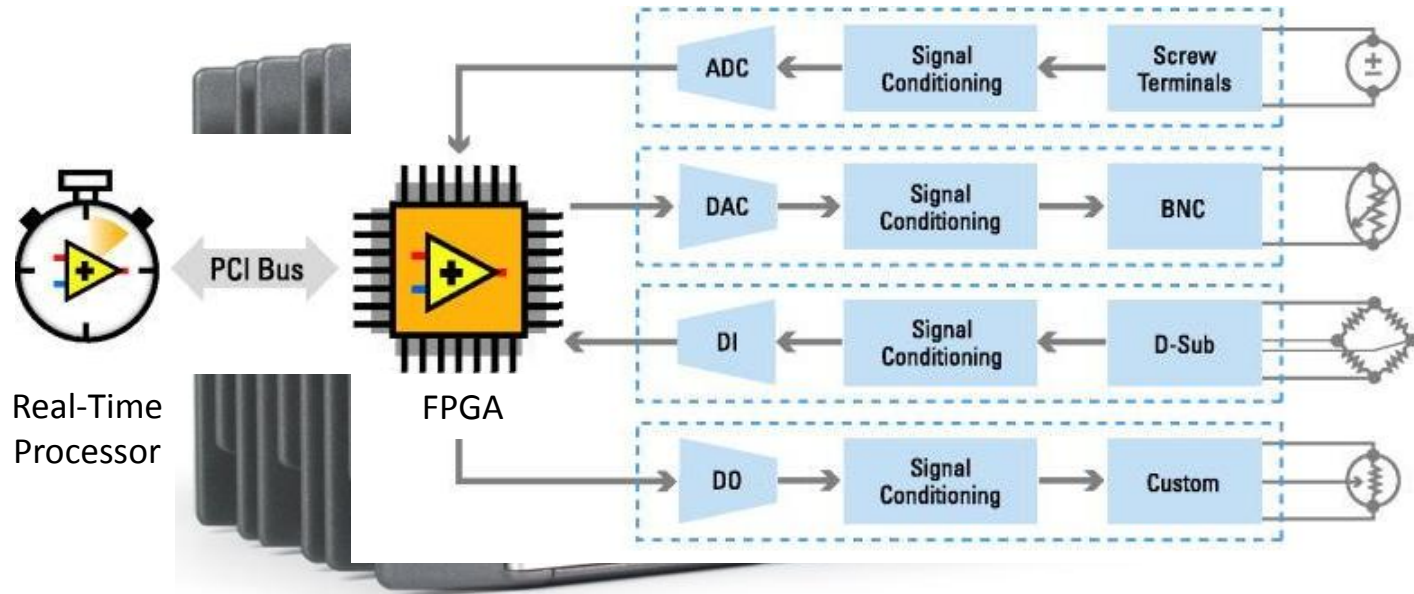


# LabVIEW FPGA

[illegible]

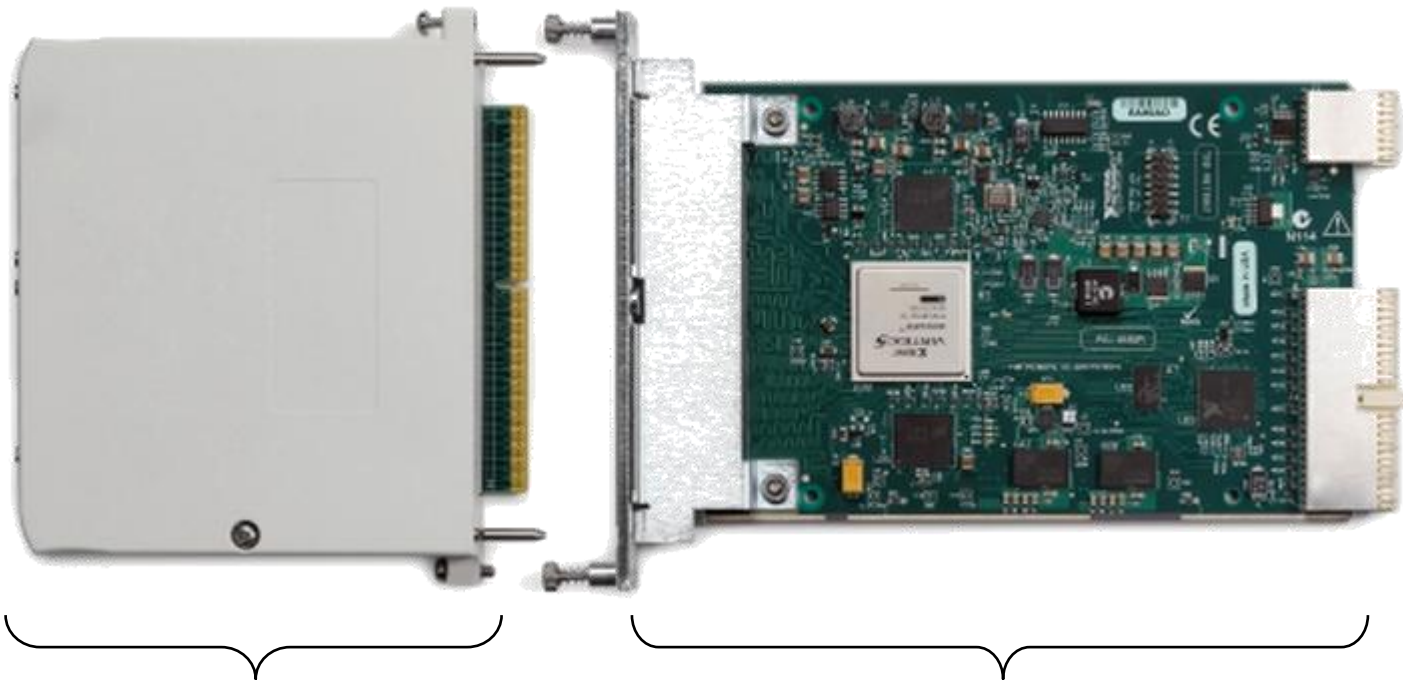
## VHDL ~4000 lines

# 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

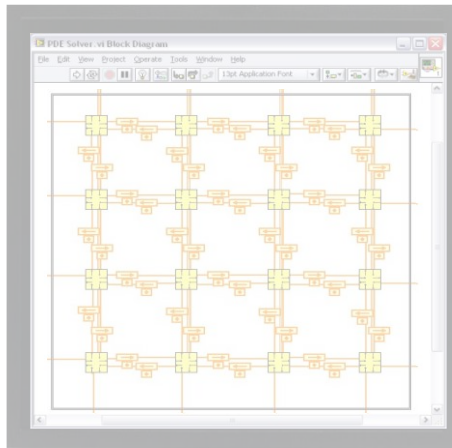
## NI FlexRIO FPGA Module

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

# Introducing NI FlexRIO

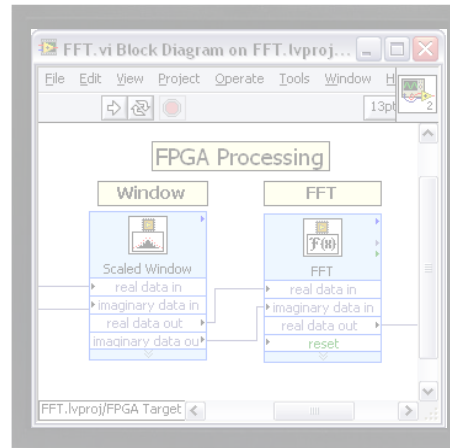
# Access through Graphical Programming

Multicore



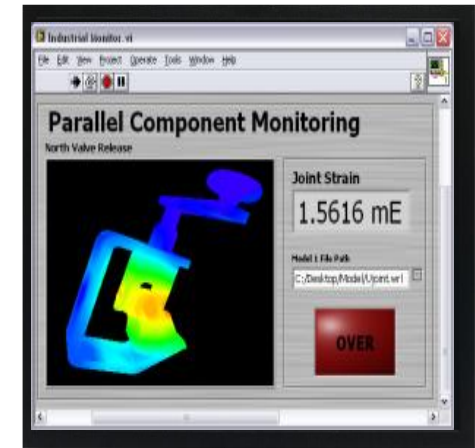
**Desktop  
Supercomputing**

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

the latest bus technologies  
synchronization

TEXAS  
INSTRUMENTS

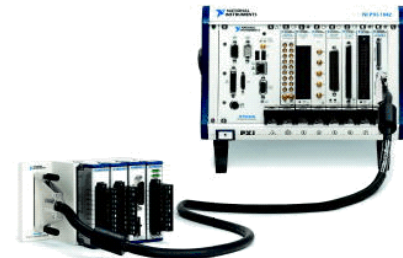
- integrated through a single, unified software

language  
PCI  
EXPRESS





# C Series Modular I/O Platform



More than 60 Measurement modules

# POGO Stick DEMONSTRATION

# C Series Modular I/O Platform



More than 60 Measurement modules

# NI System with Deterministic Distributed I/O



Host Computer

(TCP/IP)



NI cRIO-9074

(Deterministic Ethernet)



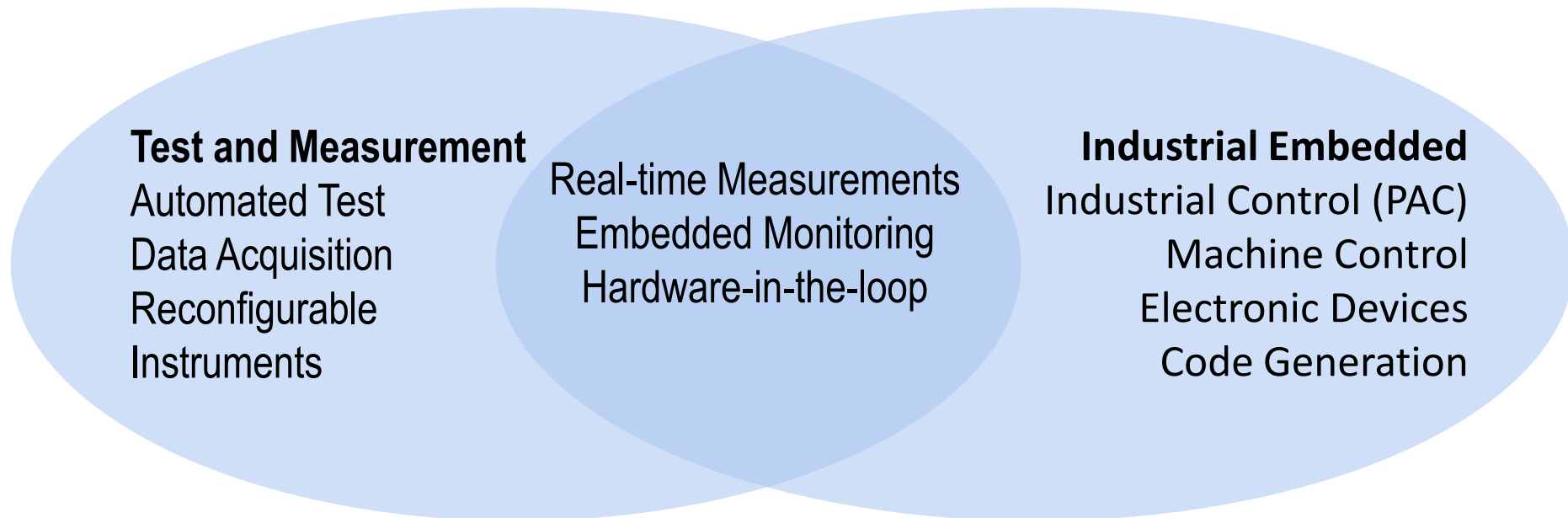
NI 9144 Expansion Chassis



# The Engineering Design Transformation

# National Instruments Vision

## Graphical System Design

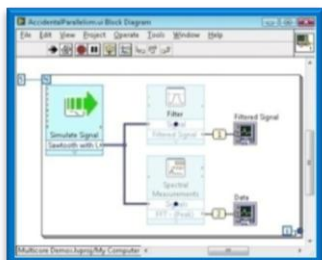


“To do for test and measurement  
what the spreadsheet did  
for financial analysis.”

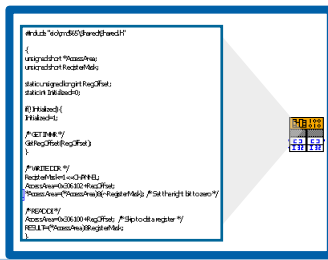
“To do for embedded what the  
PC did for the desktop.”

# Models of Computation

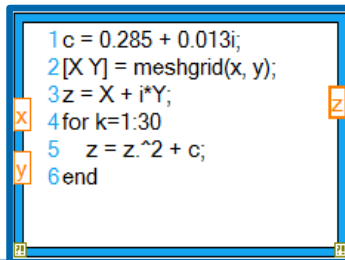
Dataflow



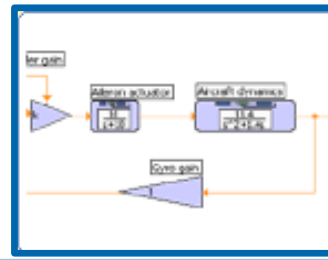
C / HDL Code



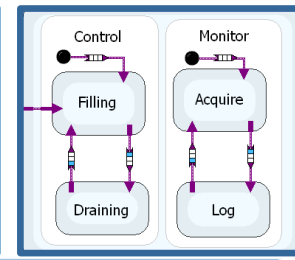
Textual Math



Simulation



Statechart

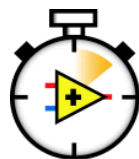


LabVIEW



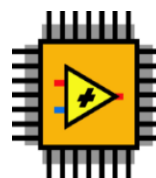
Desktop

LabVIEW



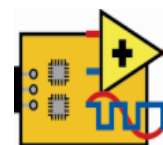
Real-Time

LabVIEW



FPGA

LabVIEW



MPU/MCU



Personal Computers



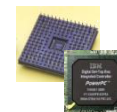
PXI Systems



CompactRIO



Single-Board RIO

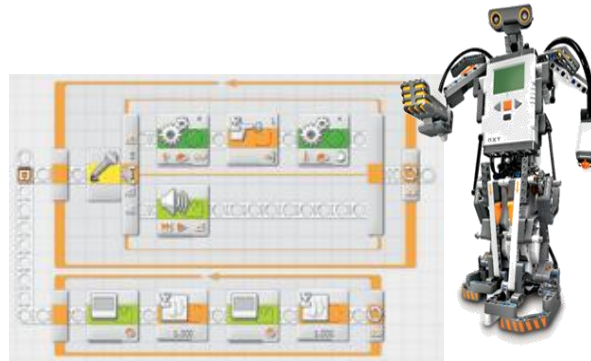


Custom Design

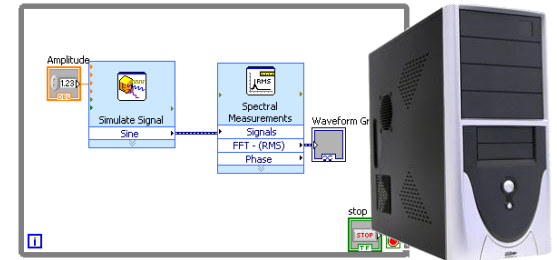
# Graphical System Design: From Kindergarten to Rocket Science



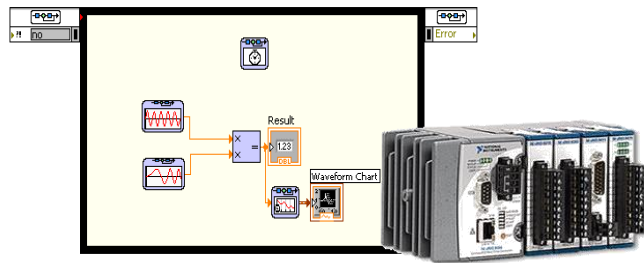
LEGO® Education WeDo Loop



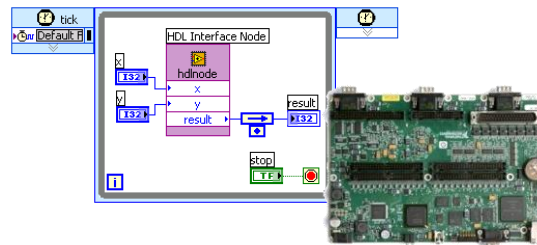
LEGO MINDSTORMS® NXT Loop



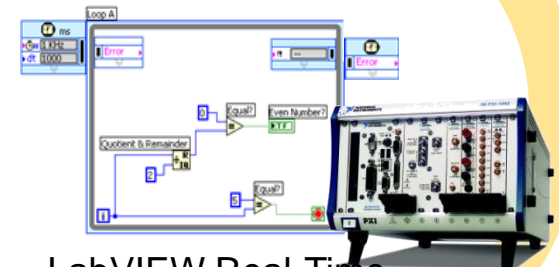
LabVIEW While Loop



LabVIEW Simulation Loop



LabVIEW FPGA  
Single-Cycle Timed Loop



LabVIEW Real-Time  
Timed Loop



# Training and Certification



Together, the National Instruments training and certification programs deliver the fastest, most certain route to increased proficiency and productivity using NI software and hardware.

**NI Training: Build Your Skills and Knowledge**

**NI Certification: Validate Your Expertise and Differentiate from the Competition**

Visit [ni.com/training](https://ni.com/training) to learn more

# 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

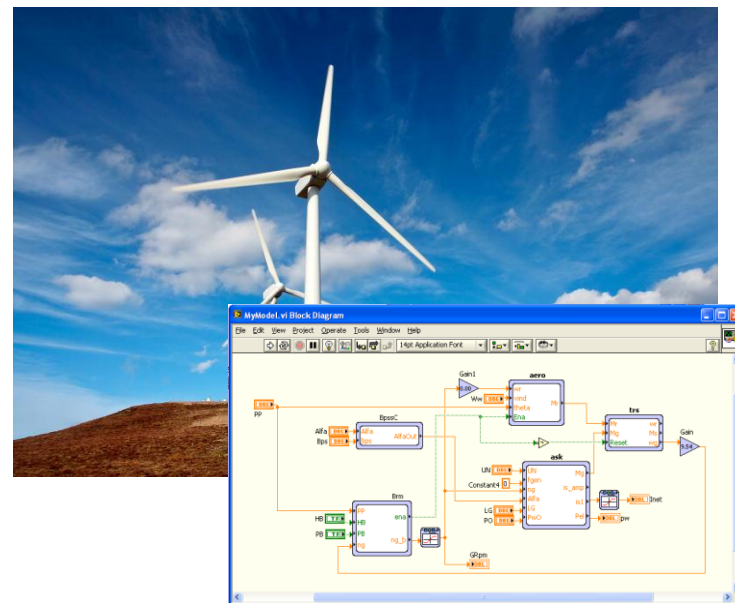
# Wind turbine HIL Testing

## Application:

Design a HIL test system that simulates the effects of wind, pitch and blade position to test turbine controller

## Technologies:

- LabVIEW Control Design and Simulation
- LabVIEW Real-Time, LabVIEW FPGA
- PXI, multicore, FPGA



*“Working in close collaboration with NI support engineers, we were able to successfully create a highly complex wind turbine hardware-in-the-loop test system based on the intuitive LabVIEW graphical programming environment and high-performance PXI platform.”*

# Tumor Treatment Medical Device

## Application

Design a prototype of a medical device for treatment of breast tumors in only four months (no room for firmware errors, strict regulatory guidelines (Class II)).

## Technologies:

- LabVIEW Real-Time, LabVIEW FPGA
- CompactRIO, Panel PC

*“The [CompactRIO](#) embedded system and LabVIEW graphical tools from National Instruments gave us the power to design, prototype, and deploy the control system within our Visica2 medical device quickly and beat our time-to-market goals while saving money by eliminating the need for building custom hardware.”*

Jeff Stevens, Principal Systems Engineer, Sanarus Medical





# Monitoring and control of a solar-powered race boat

## Application:

Controlling and monitoring solar cells, lithium polymer batteries, maximum power point trackers (MPPTs), and a high-efficiency permanent magnet motor for a completely solar-powered race boat.

## Technologies:

- LabVIEW Real-Time, LabVIEW FPGA
- CompactRIO, Panel PC



*“CompactRIO provides a unique combination of I/O variety as well as control and processing capabilities in a small, power-efficient system”*

Folkert Attema, Solar Team ROC Friese Poort

# Testing proprietary computer hardware on naval vessels

## Application

Replace an outdated and obsolete proprietary naval computer test system, used on-board of naval ships.

## The Solution:

Use commercial-off-the shelf components such as NI PXI and the NI PMA-1115 together with LabVIEW FPGA to interface to the dedicated computer bus.

*“Our naval engineers and technicians are very satisfied with the ease-of-use and performance of the NI FPGA PXI-based systems.”*

Royal Dutch Navy



# 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

National Instruments  
Technical Symposium 2008



Actemium  
Lintronics

# Actemium Lintronics

ES-

International



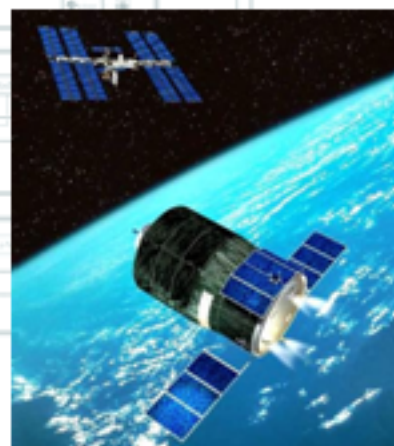
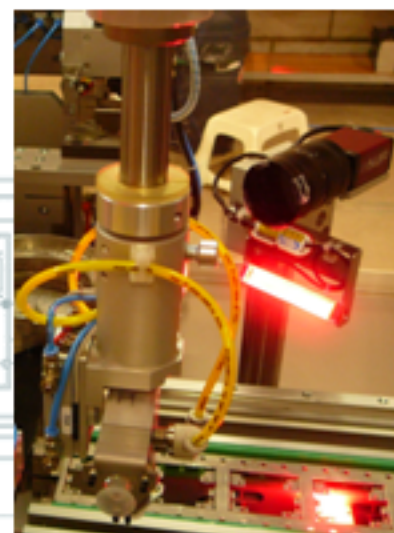
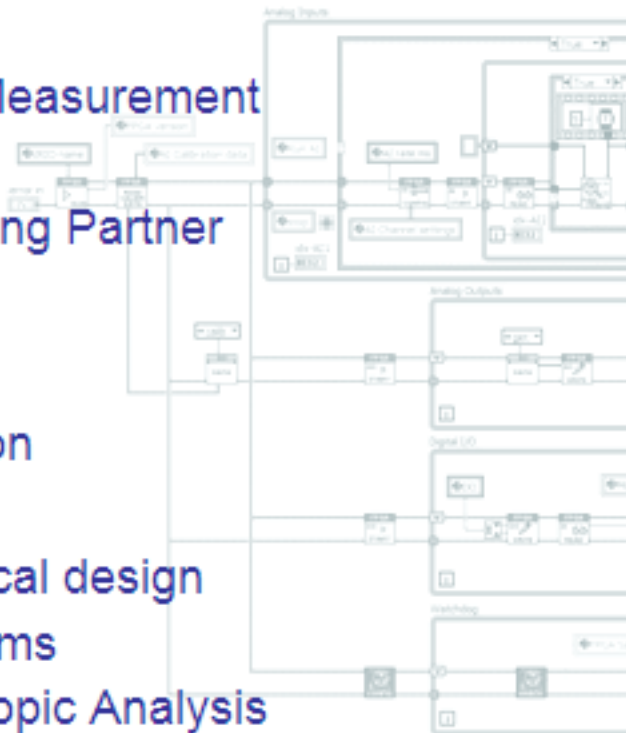
# ES International - CIT Engineering GROUP

## Profile

- Alliance Member for over 10 years
- System integrator
- Specialist in Test & Measurement
- Turn-Key Solutions
- Concurrent Engineering Partner

## Business Units

- Virtual Instrumentation
- Industrial Vision
- Electrical & Mechanical design
- Inkjet Proofing Systems
- Lighting – Spectroscopic Analysis
- Training Centre



INCAA  
Computers





# INCAA Computers B.V.

**Consultancy  
Engineering  
Integration  
Manufacturing**

**Test  
Alarm  
Control  
Vending  
Acquisition**

**CAN  
Ethernet  
Profibus  
PCI/PXI/cPCI  
VME/VXI  
USB**

**Unix  
Drivers  
LabVIEW  
Applications  
Windows / OS-9**

Jabil



# Test Solutions Hasselt, Belgium

## JABIL HASSELT

Design

Prototyping  
NPI

Product  
Validation

Total Test  
Solutions

- Design For Test
- Test Strategy Proposals
- Test Spec Development
- Functional Testers
- SW, HW, BS and Mechanical engineering
- GOS TD Proj.Manag.

→ For internal JABIL

→ For JABIL customers

→ For Local for Local customers

# JABIL

LVUG





13:30 – 14:25 Presentatie LVUG.NL

## The Exploding While-loop

“Object-Oriented Software Architecture and Design Patterns”

LabVIEW Solutions  
Training and consultancy



**ing. Jeffrey Habets**  
Virtual Instrumentation specialist  
Mobile: +31 6 54781259

PO Box: 237  
6000 AE Weert  
Netherlands

Nierhoven 29  
6002 XE WEERT  
Phone: +31 495 549457  
Fax: +31 495 549458  
E-mail: [info@vi-tech.nl](mailto:info@vi-tech.nl)  
website: <http://www.vi-tech.nl/>



# LVUG.NL

LabVIEW User Group



Maxon Motor

***[www.maxonmotor.nl](http://www.maxonmotor.nl)***

**maxon motor**

**driven by precision**

***wereldwijd de vooraanstaande producent van  
precisieaandrijvingen en aandrijfsystemen.***

***Als het om precisie draait. Daag ons uit!***

**maxon motor**

driven by precision

# NBG Industrial Automation

# NIDays 09

*Worldwide Virtual Instrumentation Conference*



## NBG

- ✖ Ontwikkeling van hardware, embedded en PC-software voor industriële en medische toepassingen

## LabVIEW

- ✖ Ontwerpen/programmeren van grote en complexe applicaties
- ✖ Testsystemen
- ✖ Ruime elektronica kennis
- ✖ Turnkey projecten
- ✖ Consultancy

## Tot ziens op de stand

- ✖ Henri van den Bongarth



ISO 9001:2000  
ISO 13485:2003

Prevas



# 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.

T&M Solutions

# T&M Solutions

- Founded in 2001, >7 years experience in delivering Test & Measurement Solutions.
- More than 300 projects succeeded in different industries.
- Offices in Arnhem and Eindhoven,
- Total of 11 technical skilled employees.
- Experienced in small and large LabVIEW projects.





## Mission:

*“T&M Solutions BV goal is to increase customer satisfaction in Test & Measurement automation by being a reliable engineering partner. We can achieve this goal with the help of graphical system design tools.”*

Virinco

# 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**



VI

Technologies

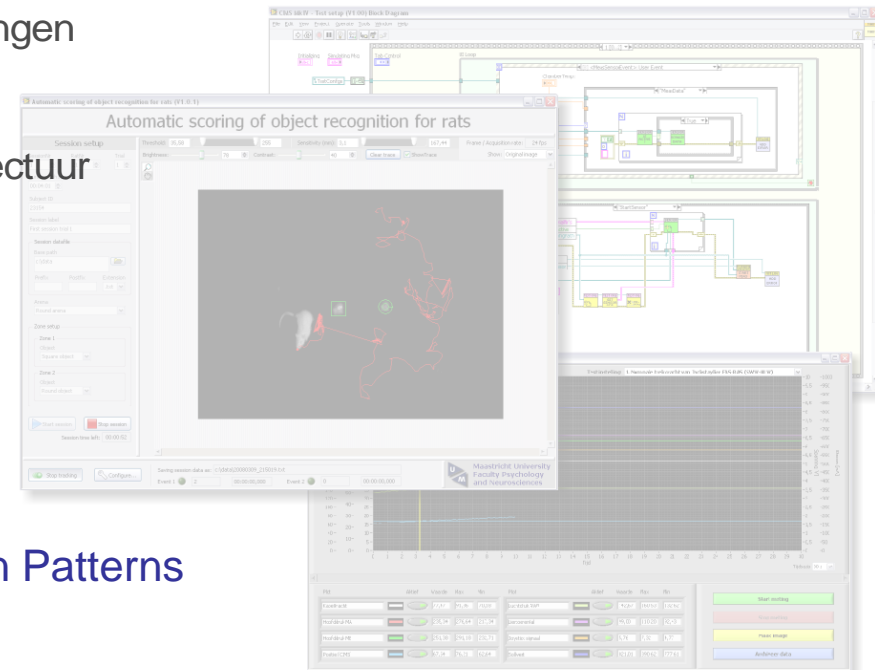
VI Technologies levert diensten op het gebied van de technische automatisering en is met name gespecialiseerd in het leveren van oplossingen op basis van LabVIEW.

- ✓ Ondersteuning en consultancy op het gebied van measurement en automation applicaties op basis van LabVIEW en/of TestStand
- ✓ Maatwerk LabVIEW software ontwikkeling
- ✓ Systeem integratie en turnkey automatiserings oplossingen op basis van LabVIEW
- ✓ Training in LabVIEW (Object Oriented) software architectuur
- ✓ LabVIEW Realtime, FPGA en Embedded



Jeffrey Habets

Track D 13:30: The Exploding While Loop Part III,  
Object-Oriented Software Architecture and Design Patterns  
VI Technologies & LVUG.NL



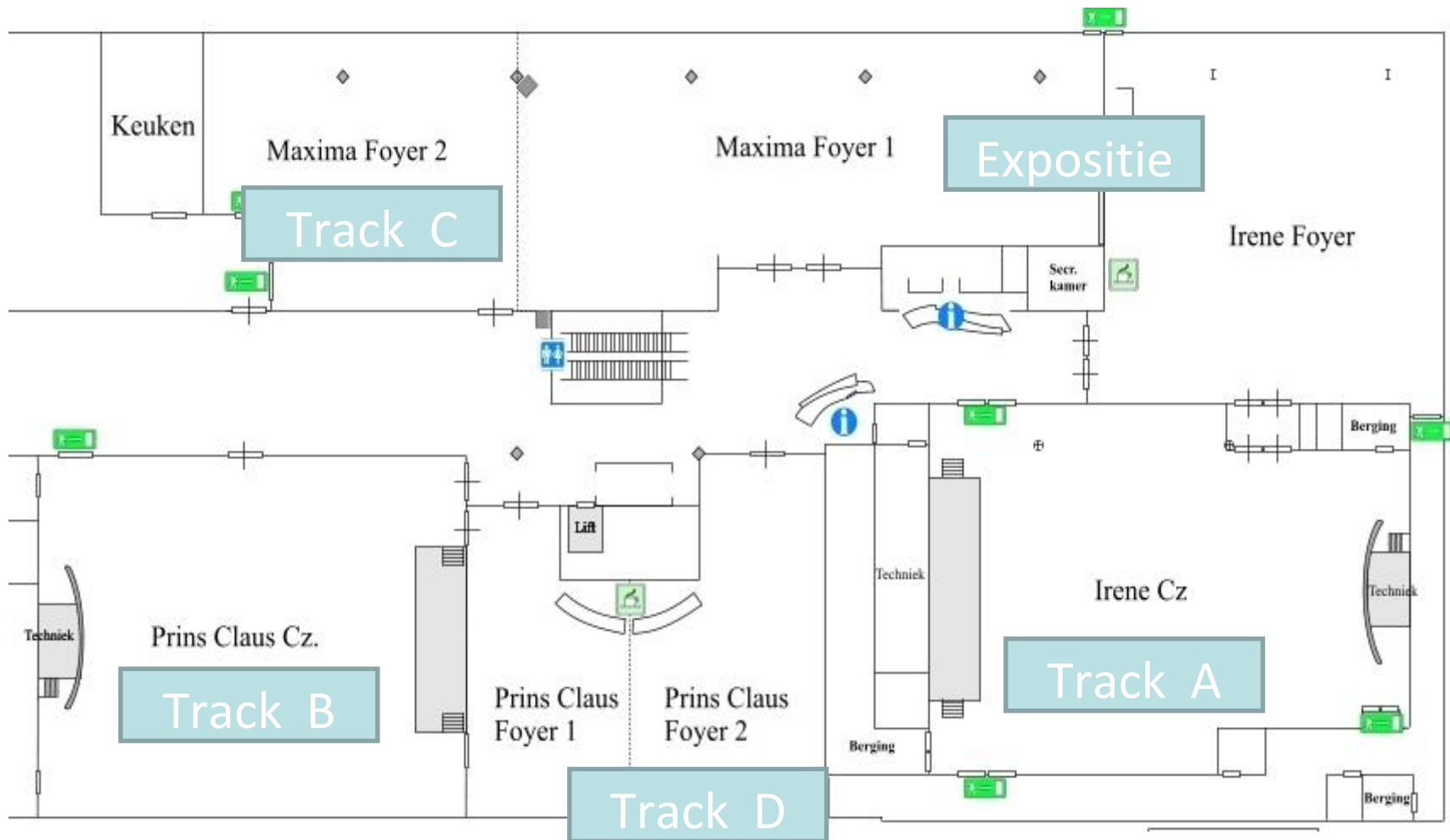
VPC  
(Euroelectron)

## VPC (Euroelectron)

National Instruments  
Technical Symposium 2008

# Announcements





# Agenda

Time			Track A - Congreszaal Irene	Track B - Prins Claus	Track C - Maxima Foyer 2	Track D - Prins Claus Foyer 2
8:30	-	9:30	Registration and Exhibition			
9:30	-	11:00	Keynote			
			Break and Exhibition			
11:30	-	12:30	How to benefit from parallel technologies to optimize automated test systems	Trends in Wireless Test: Benefits of Software Defined Instrumentation for MIMO-OFDM tests	Benefits of FPGA technology	Carya
						NBG
			Lunch & Exhibition			
13:30	-	14:25	Tips and Tricks to improve signal quality in data acquisition systems	Recording RF Signals Off of the Air: Advanced Techniques and Applications	How to get a jump start using CompactRIO	LVUG and VI Technologies
14:30	-	15:25	Seeding the future of test with reconfigurable instruments	Introduction to Software Engineering for LabVIEW Applications	From rapid prototyping to low-cost deployment with LabVIEW embedded tools	Virinco
						INCAA
			Break and Exhibition			
15:45	-	16:40	Rookie's Guide to Sound and Vibration	LabVIEW Programming techniques for multicore systems	How to implement conventional and alternate control algorithms using LabVIEW	T&M Solutions and Prevas
16:40	-	17:00	Wrap-Up / Prize draw			

# Today's highlights

- >30 people took the CLAD Exam
- 18 Different technical/case study presentations
- 18 Partners in the exhibition area
- New products booth
- 5 Try-it-yourself demo stations
- “Quote of the Day”
- LEGO Mindstorms lottery – keep your lottery ticket
- Feedback forms
- USB sticks with presentations



**Have your best NI Days ever !**