

Introduction to application development in NI LabVIEW

Agenda

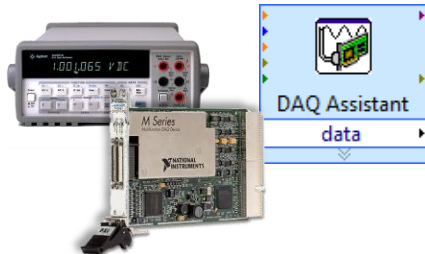
- What is LabVIEW
- The LabVIEW Environment
- LabVIEW Real-Time
- LabVIEW FPGA
- Technical Support and Training



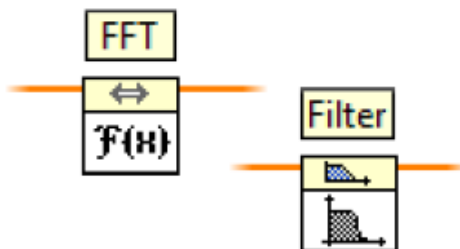
NATIONAL INSTRUMENTS

LabVIEW™

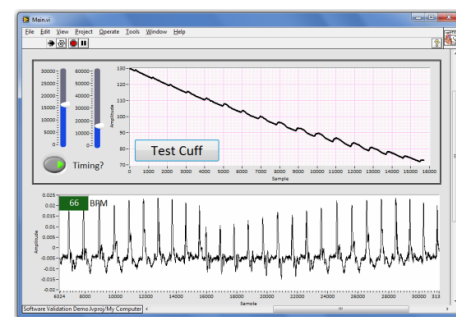
A Highly Productive` Graphical Development Environment for Scientists and Engineers



Hardware APIs



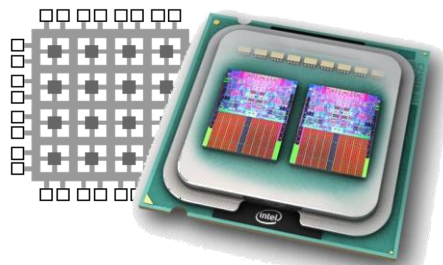
Analysis Libraries



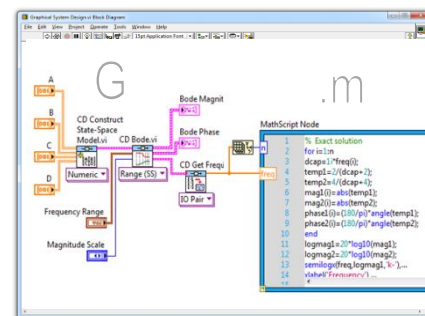
Custom User Interfaces



Deployment Targets



Technology Abstractions



Programming Approaches

The Power of a Platform

140,000+ online members
250+ registered user groups
1000+ job postings online
400,000+ children through LEGO

Community



280+ third-party add-ons
400+ Solution partners
1000+ value added resellers
35+ training courses

Collaboration

NATIONAL INSTRUMENTS

LabVIEW™

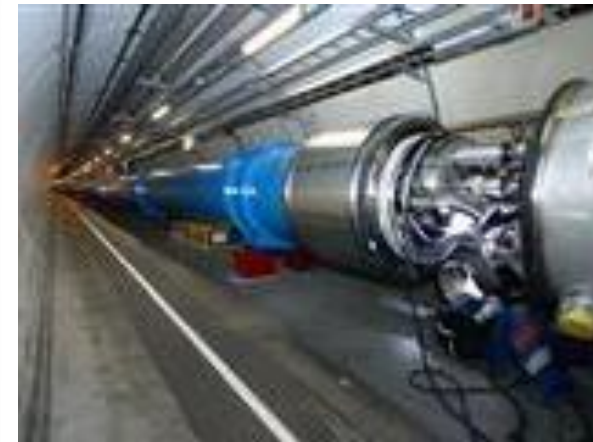
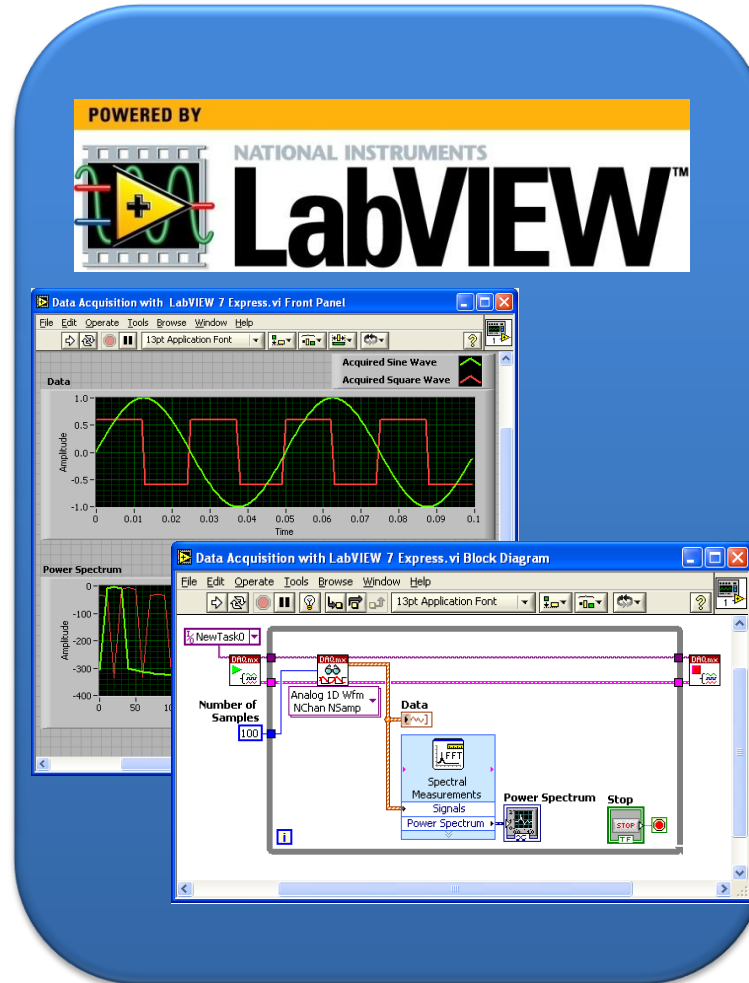
Connectivity

9000+ instrument drivers
8000+ example programs
1000+ motion drives
1000+ smart sensors
1000+ Third-party PAC devices

Empowering Users Through Software



LEGO Mindstorms NXT
*"the smartest, coolest toy of
the year"*

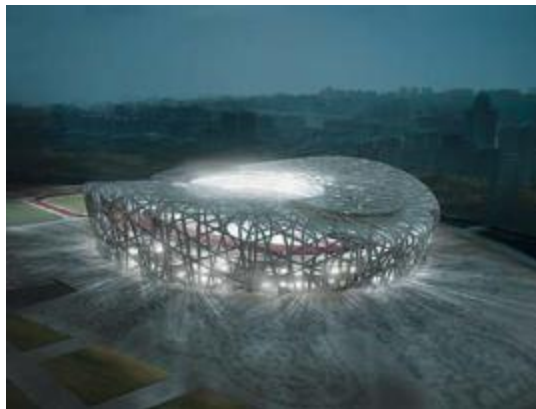


CERN Large Hadron Collider
*"the most powerful instrument on
earth"*

Large LabVIEW Application Examples



High-Volume Production Test



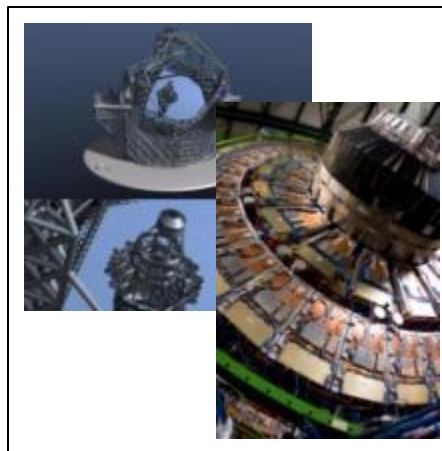
Structural Health at Olympics



Medical Devices



Nexans Spider Robot



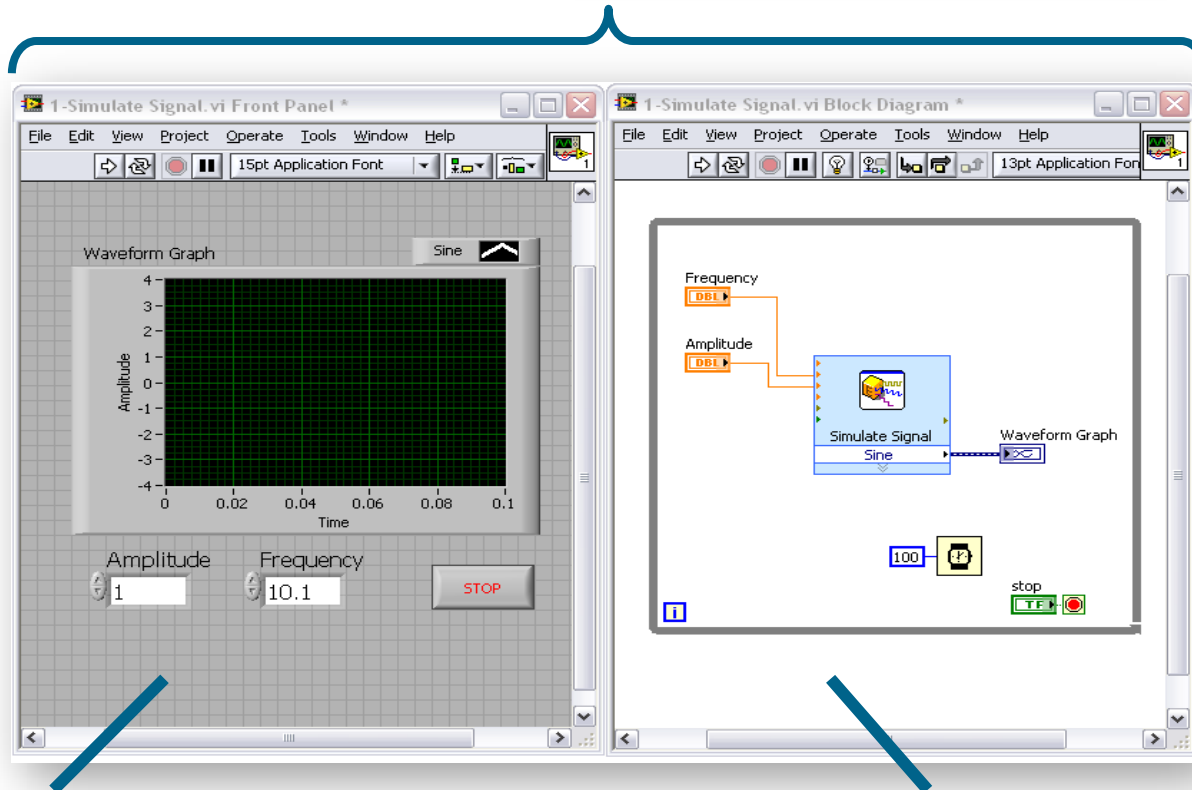
Large Physics Applications



In-Flight Fire Suppression

The LabVIEW Environment

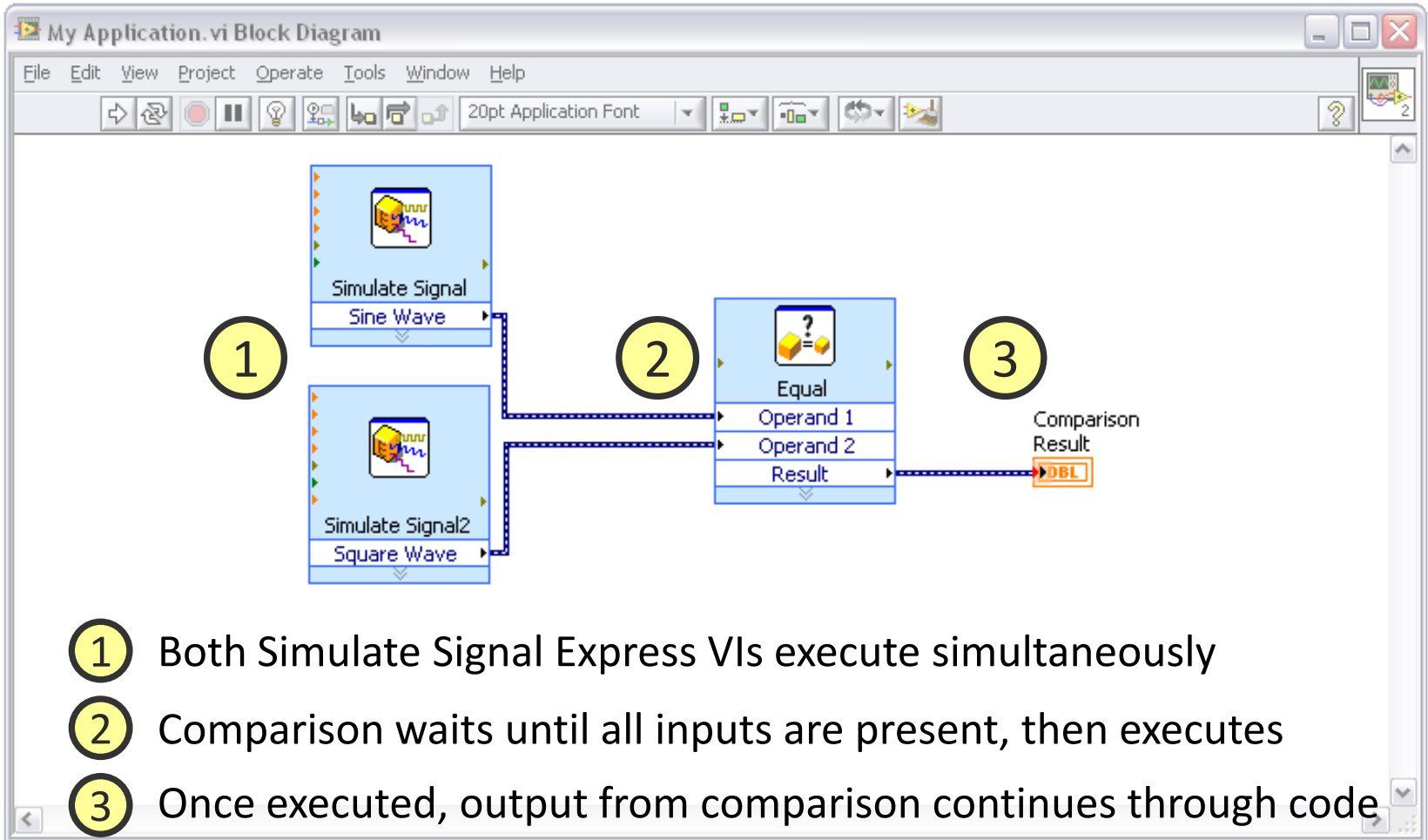
“VI” = program or function



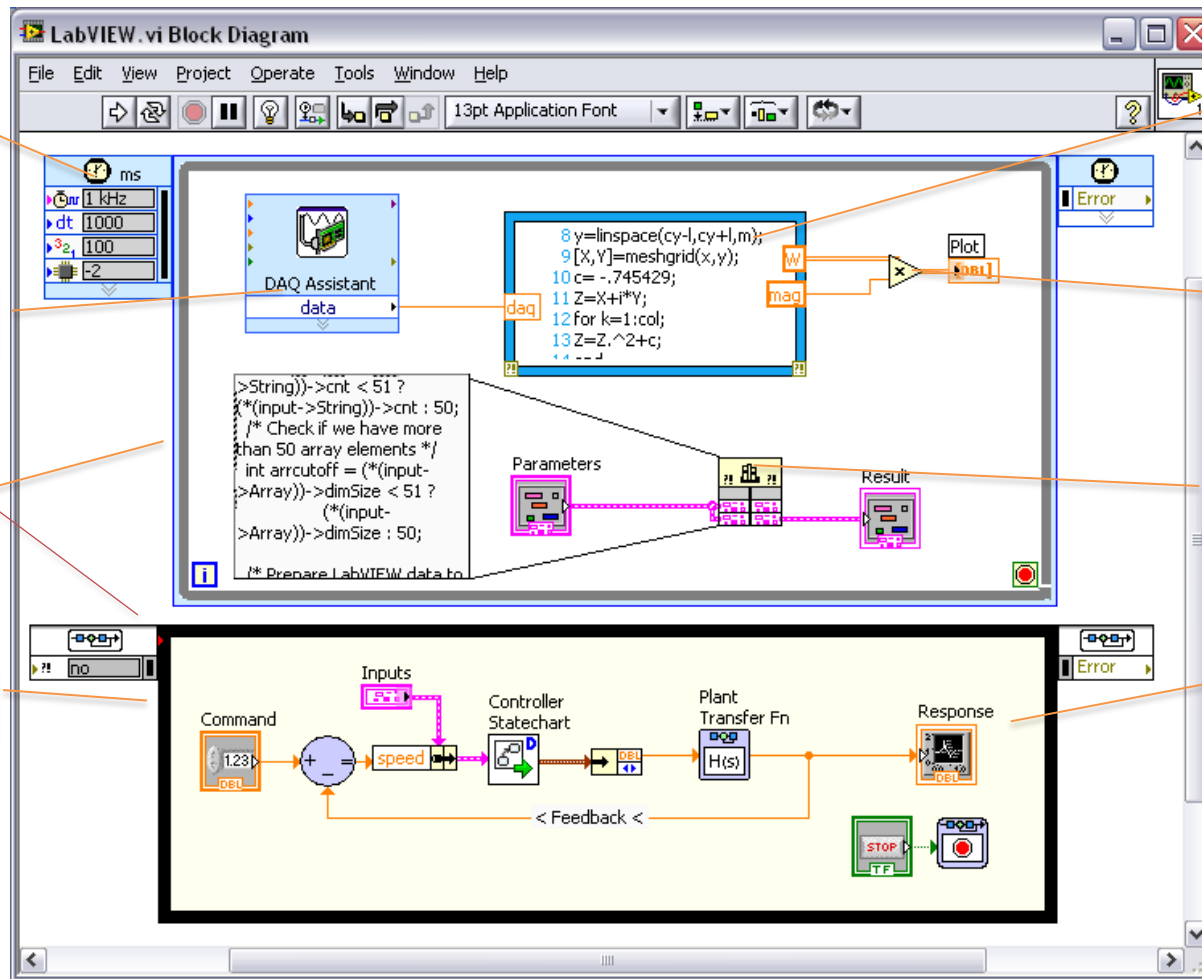
“Front Panel” = user interface

“Block Diagram” = code

Dataflow Programming...



...In a Graphical Development Environment



Timing

I/O integration

Parallel

Statecharts

Textual Math

Data Flow

C and HDL Code

Simulation



LabVIEW contains a programming language

LabVIEW is being used for large, mission-critical applications

Much of LabVIEW and other NI tools are developed in LabVIEW

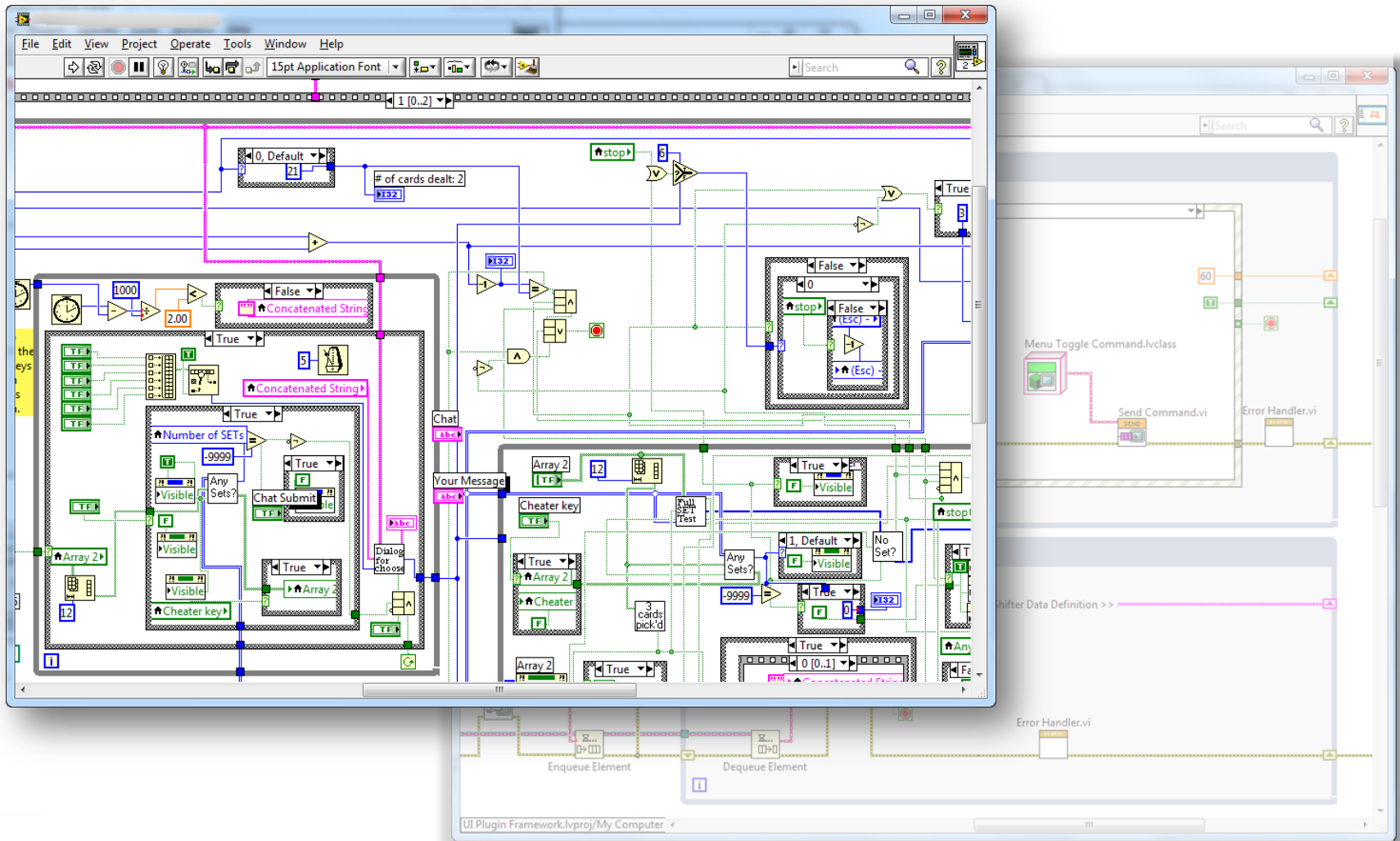
National Instruments develops LabVIEW using an ISO-9001 accredited process

LabVIEW integrates with tools and practices for software engineering

Create installers in LabVIEW to deploy professional, stand-alone software

Software Development Tasks	LabVIEW
Functionality	✓
Event Based Programming	✓
Multi-threading	✓
Object-Oriented Programming	✓
Programming Structures	✓
Built-in Signal Processing Libraries	✓
Native Web Connectivity	✓
Compiled to Machine Language	✓
Productivity Tools	✓
Cross-Platform Compatible	✓
Debugging Tools	✓
Advanced Application Management	✓
User Interface Editor	✓
Wizards / Assistants	✓
Interoperability	✓
Import and Create Shared Libraries	✓
ActiveX and .NET Communication	✓
Software Engineering Practices	✓
SCC Integration	✓
Static Code Analysis	✓
Established Design Patterns	✓
Professional Application Builder	✓

How Do You Know If It Is Good Code?

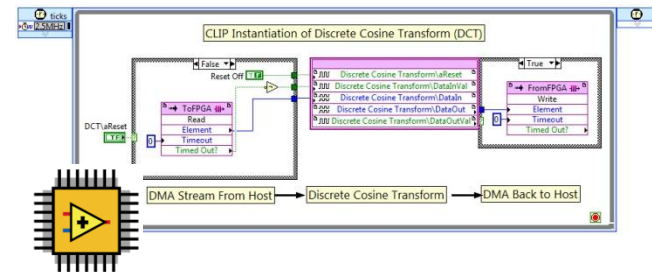


LabVIEW 2011 Real-Time Module



Add-on for creating deterministic, stand-alone systems

LabVIEW 2011 FPGA Module



Add-on for programming reconfigurable FPGA hardware using graphical programming

Critical Applications to Consider

Event Response



Closed-Loop Control



Critical Tests

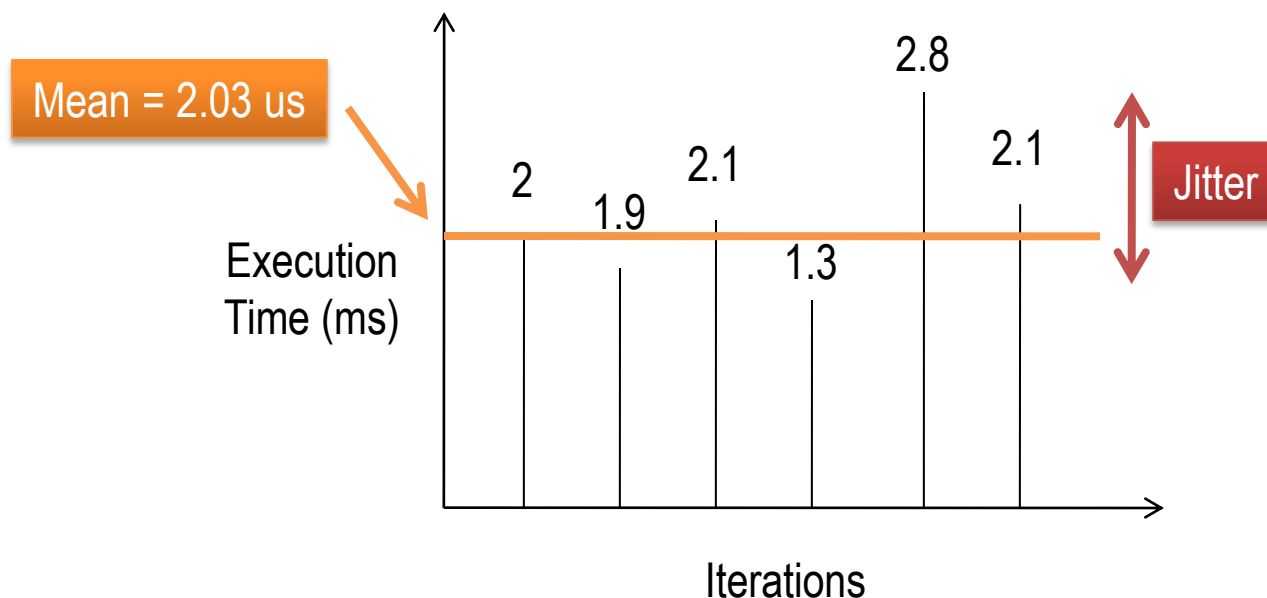


When General Purpose OSs Fall Short

- Design for fairness and user responsiveness vs. strictly prioritizing tasks
- Focus on multitasking instead of maximum reliability / uptime
- Not the result of bad products, only certain design goals

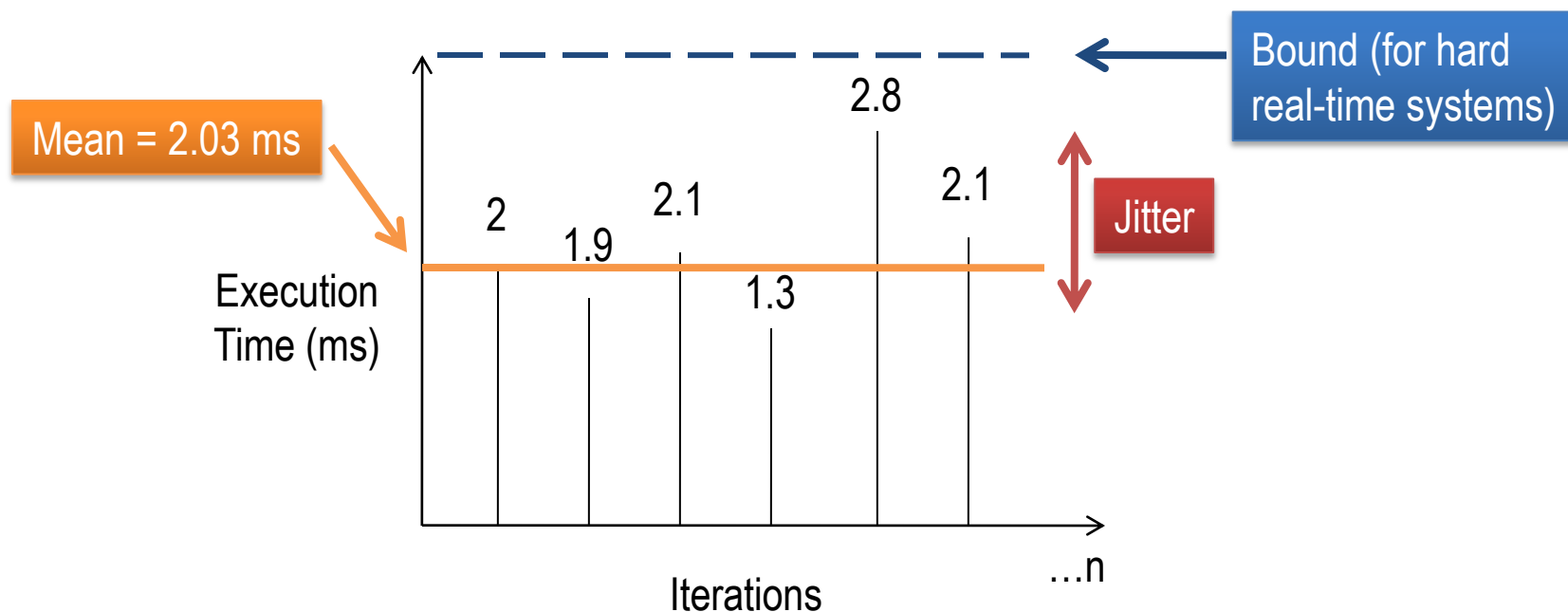
Key Careabouts for Critical Applications

- **Jitter:** execution time variability of a given operation or application



Key Careabouts for Critical Applications

- **Determinism:** a condition that is met if an operation or application has bounded jitter



Using a Real-Time Operating System (RTOS) for Reliability and Precise Timing

- Designed with critical, stand-alone applications in mind (minimal, bounded jitter)
- Use advanced schedulers to ensure that key pieces of code take precedence over others
- Minimize interrupt and thread switching latencies

Real-Time System Design



Development
Tools

Editor, Compiler, and Linker

Debugging and Analysis
Tools

System
Components

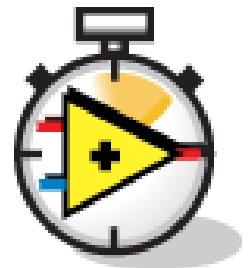
Real-Time Operating System (RTOS)

Board Support

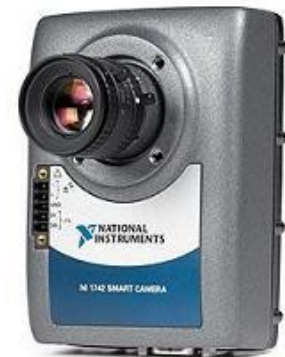
Additional I/O Drivers

LabVIEW Real-Time Module

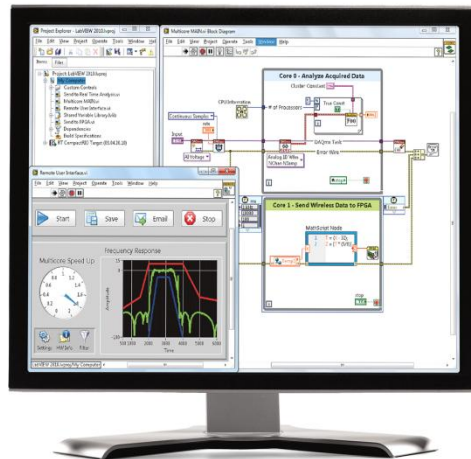
- Deterministic, hard real-time performance (with SMP support)
- Compiler, Linker, Debugging, RTOS, and board support included (requires LabVIEW Full or Pro)
- Hundreds of real-time drivers and analysis functions available



LabVIEW Real-Time Hardware Targets



A Different Model for Development, Deployment, and Debugging



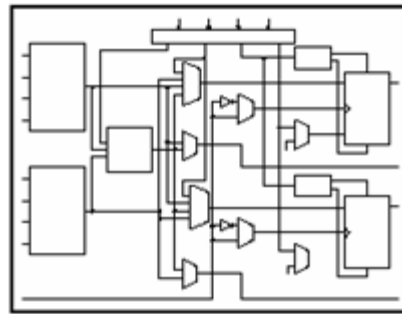
Development PC

Ethernet

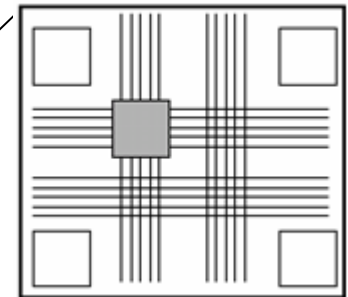
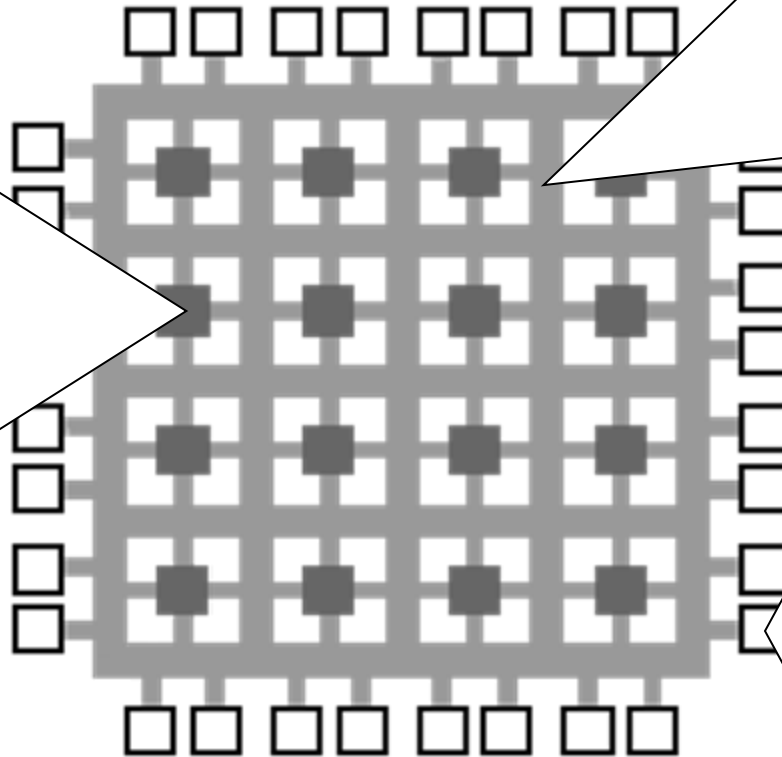


Deployed Real-Time System

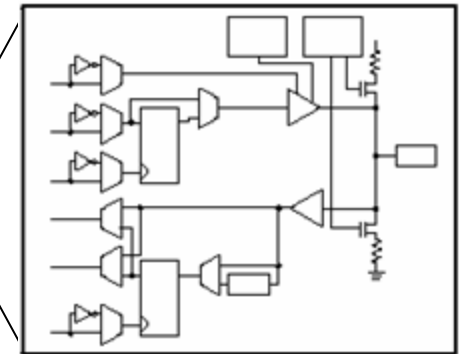
FPGA Technology



**Logic
Blocks**



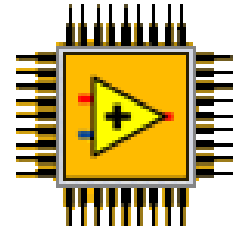
**Programmable
Interconnects**



I/O Blocks

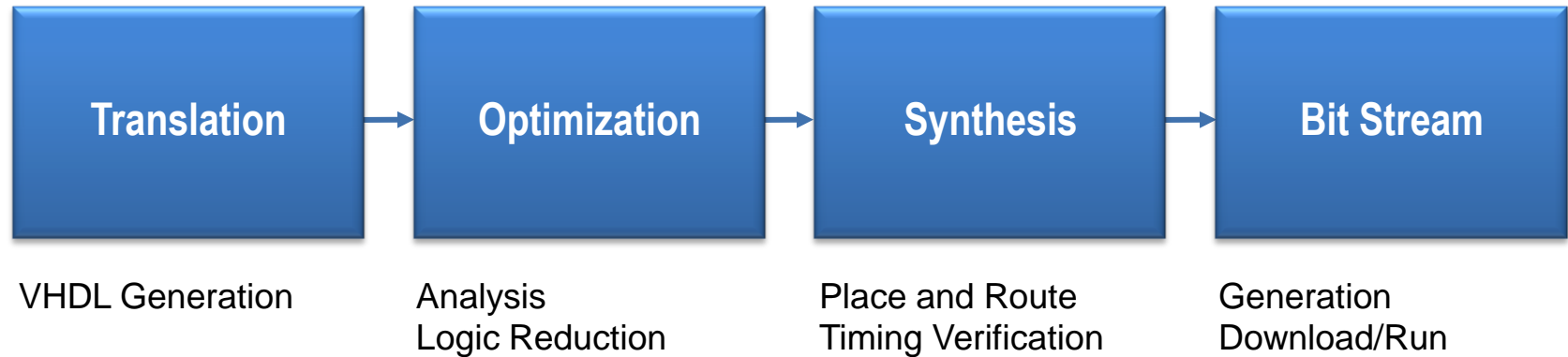


Why Are FPGAs Useful?

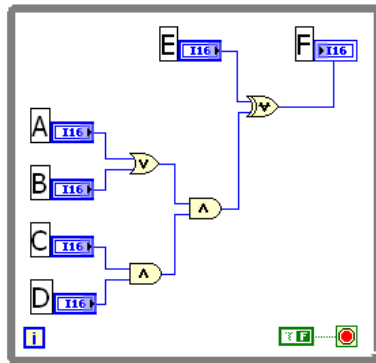


- ***True Parallelism*** – Provides parallel tasks and pipelining
- ***High Reliability*** – Designs become a custom circuit
- ***High Determinism*** – Runs algorithms at deterministic rates down to 25 ns (faster in many cases)
- ***Reconfigurable*** – Create new and alter existing task-specific personalities

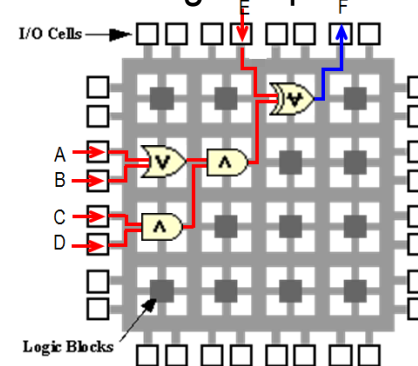
From LabVIEW to Hardware



LabVIEW FPGA Code



FPGA Logic Implementation



NI LabVIEW FPGA Hardware Targets



R Series Multifunction RIO

- General Purpose I/O for Measurement and Control



NI CompactRIO

- Industrial Control and Monitoring



NI Single BoardRIO

- Embedded Systems



NI FlexRIO

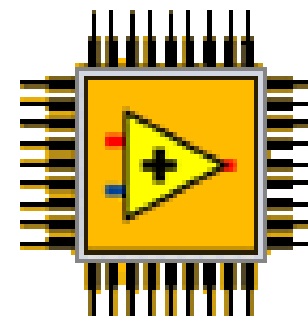
- Manufacturing Test and Design Validation



Other

- RIO IF Transceiver
- PCIe Framegrabbers
- Compact Vision System

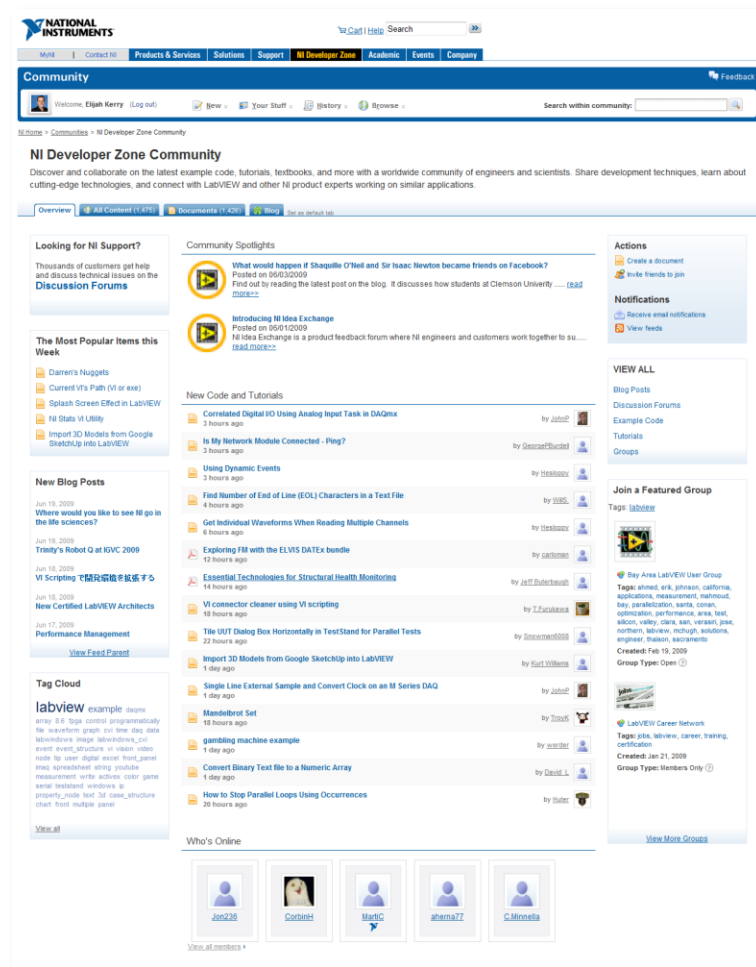
Common Applications



- High-speed control
- Custom DAQ
- Digital communication protocols
- Sensor simulation
- Onboard processing and data reduction

Worldwide LabVIEW User Community

- Over 100,000 members on award-winning NI Discussion Forums
- NI and LabVIEW user-contributed examples, tutorials and blogs
- More than 100 LabVIEW User Groups
- Third-party community web sites in over 15 languages
- Hundreds of third-party add-on tools on the LabVIEW Tools Network



Software Maintenance and Support



Membership in a National Instruments software maintenance and support program allows you to:

- Receive software updates and maintenance releases automatically
- Enjoy direct access to technical support from NI applications engineers
- Access special online software training modules that highlight features, application uses, and development best practices

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Support Lifecycle Roadmap

As of August in:	2007	2008	2009	2010	2011	2012	2013	2014
Versions								
LabVIEW 8.5	Current Release Support	Mainstream Support	Mainstream Support	Mainstream Support	Extended Support	Extended Support	Extended Support	Extended Support
LabVIEW 8.6		Current Release Support	Mainstream Support	Mainstream Support	Mainstream Support	Extended Support	Extended Support	Extended Support
LabVIEW 2009			Current Release Support	Mainstream Support	Mainstream Support	Mainstream Support	Extended Support	Extended Support
LabVIEW 2010				Current Release Support	Mainstream Support	Mainstream Support	Mainstream Support	Extended Support
LabVIEW 2011					Current Release Support	Mainstream Support	Mainstream Support	Mainstream Support

■ *Current Release Support*

■ *Mainstream Support*

■ *Extended Support*

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 Knowledge

NI training helps you build the skills to more efficiently develop robust, maintainable applications. We provide several training options including classroom, self-paced, online, or on-site training at your facility.

NI Certification: Validate Your Expertise

NI certification confirms your technical growth and skill. This professional certification is ideal for differentiating yourself from the competition and making your own informed hiring and outsourcing decisions.

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**Attend the Hands-On Session after lunch
and build an application in 1,5 hours**