Data I/O

TOPICS

Plug-in DAQ devices

Data Acquisition in LabVIEW

Analog Input

Data Logging

Analog Output

Counters

Digital I/O

Università di Roma

Tor Vergata

Ing. ANDREA   MALIZIA

malizia@ing.uniroma2.it

Quantuum Electronics and Plasma Physics Research Group
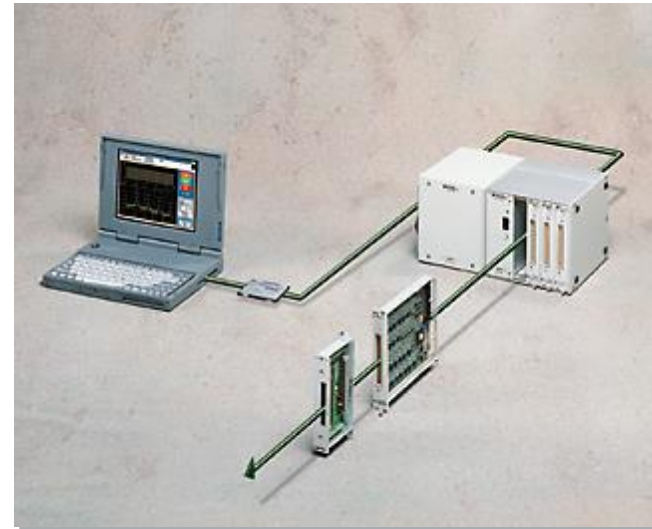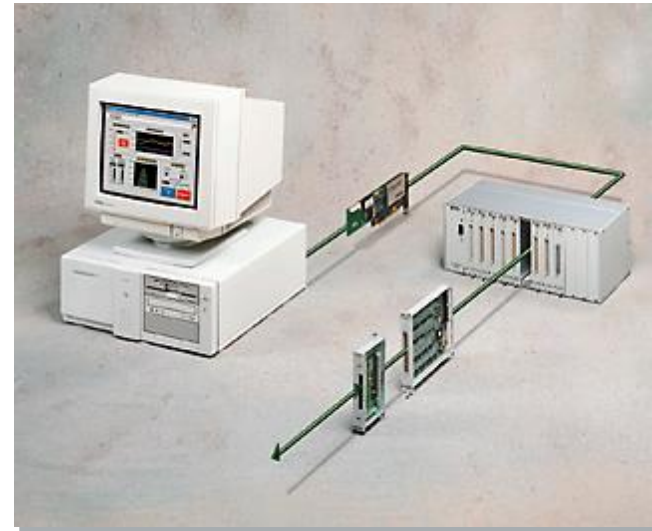
Supervisor : Dr. Pasquale Gaudio

ni.com

NATIONAL
INSTRUMENTS

Overview and Configuration

Fundamental task of a DAQ system is to measure or generate real-world physical signals

DAQ system consists of:
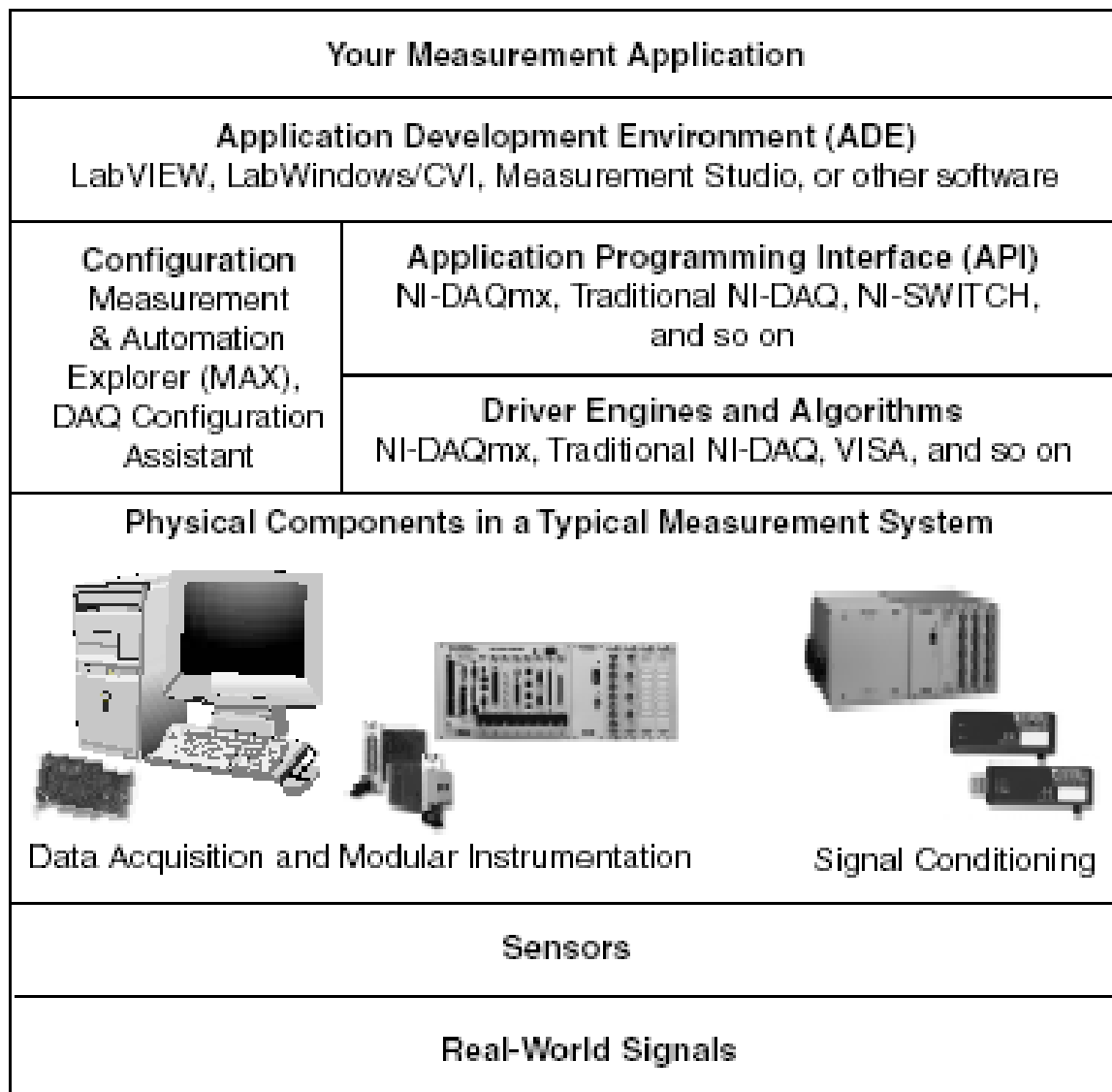- Transducers
- Signal Conditioning
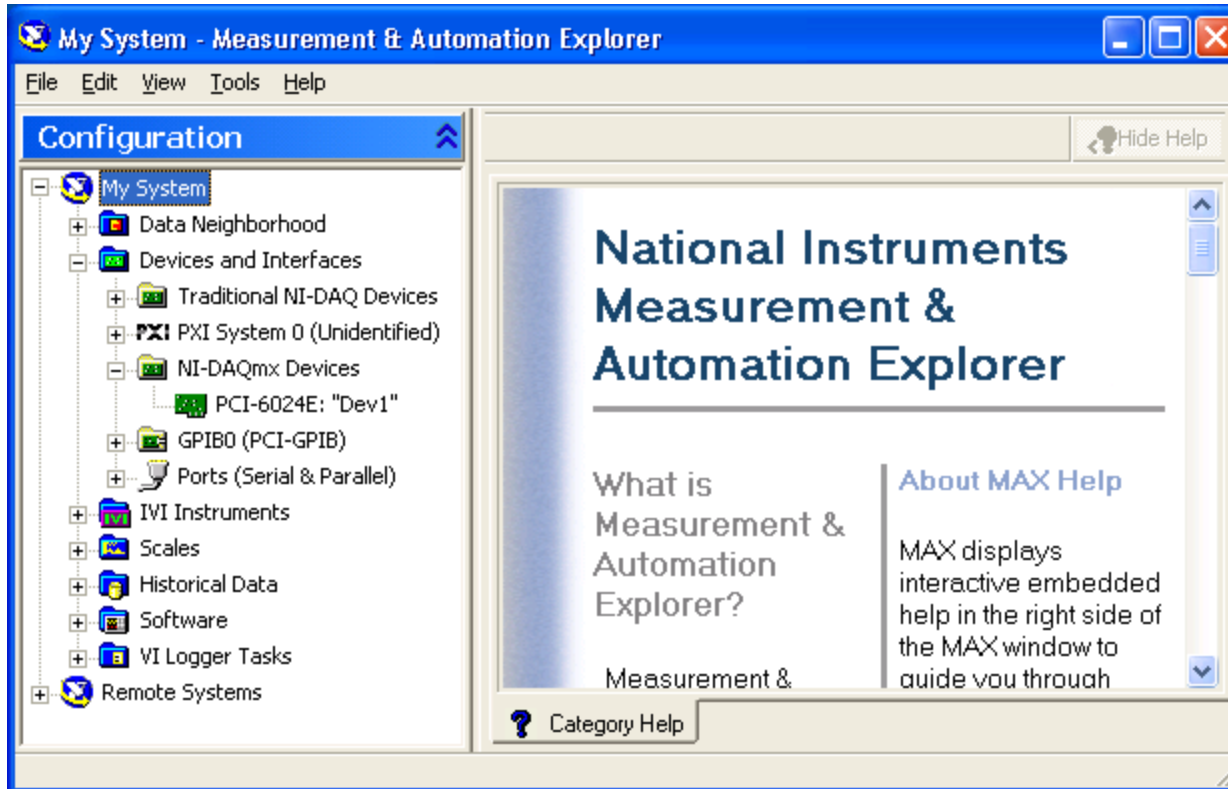- Plug-in DAQ device
- Driver
- Software

ni.com

NATIONAL INSTRUMENTS

Measurement Software Framework

NI-DAQ contains:
- Traditional NI-DAQ
- NI-DAQmx

Your Measurement Application

Application Development Environment (ADE)
LabVIEW, LabWindows/CVI, Measurement Studio, or other software

Configuration
Measurement
& Automation
Explorer (MAX),
DAQ Configuration
Assistant

Application Programming Interface (API)
NI-DAQmx, Traditional NI-DAQ, NI-SWITCH,
and so on

Driver Engines and Algorithms
NI-DAQmx, Traditional NI-DAQ, VISA, and so on

Physical Components in a Typical Measurement System

Data Acquisition and Modular Instrumentation   Signal Conditioning

Sensors

Real-World Signals

NATIONAL INSTRUMENTS

DAQ Hardware Configuration
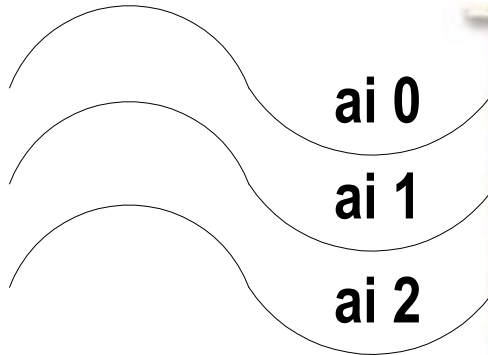

Measurement & Automation Explorer (MAX)
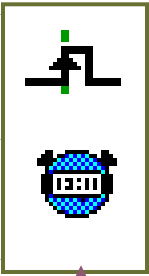
Channels and Tasks

Channel names

Signals

ai 0

ai 1

ai 2

Sine Wave 1

Sine Wave 2

Sine Wave 3
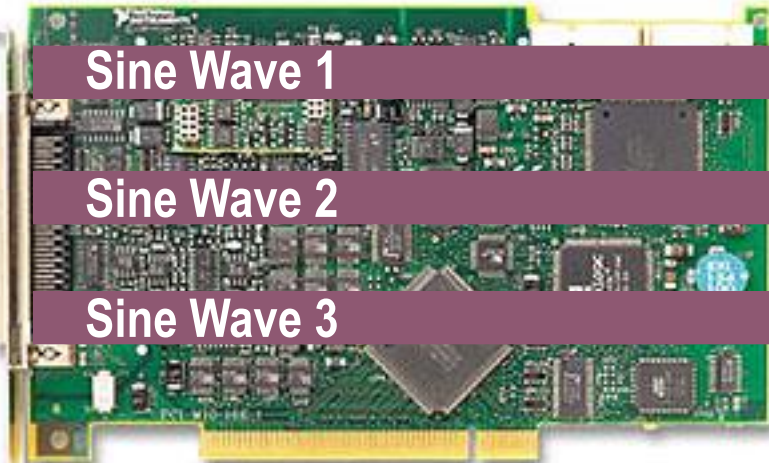
Tasks

Timing and Triggering

NATIONAL INSTRUMENTS
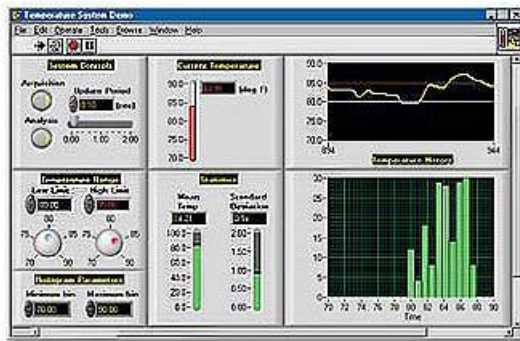
The DAQ Signal Accessory

Ing. Andrea Malizia

NATIONAL INSTRUMENTS™
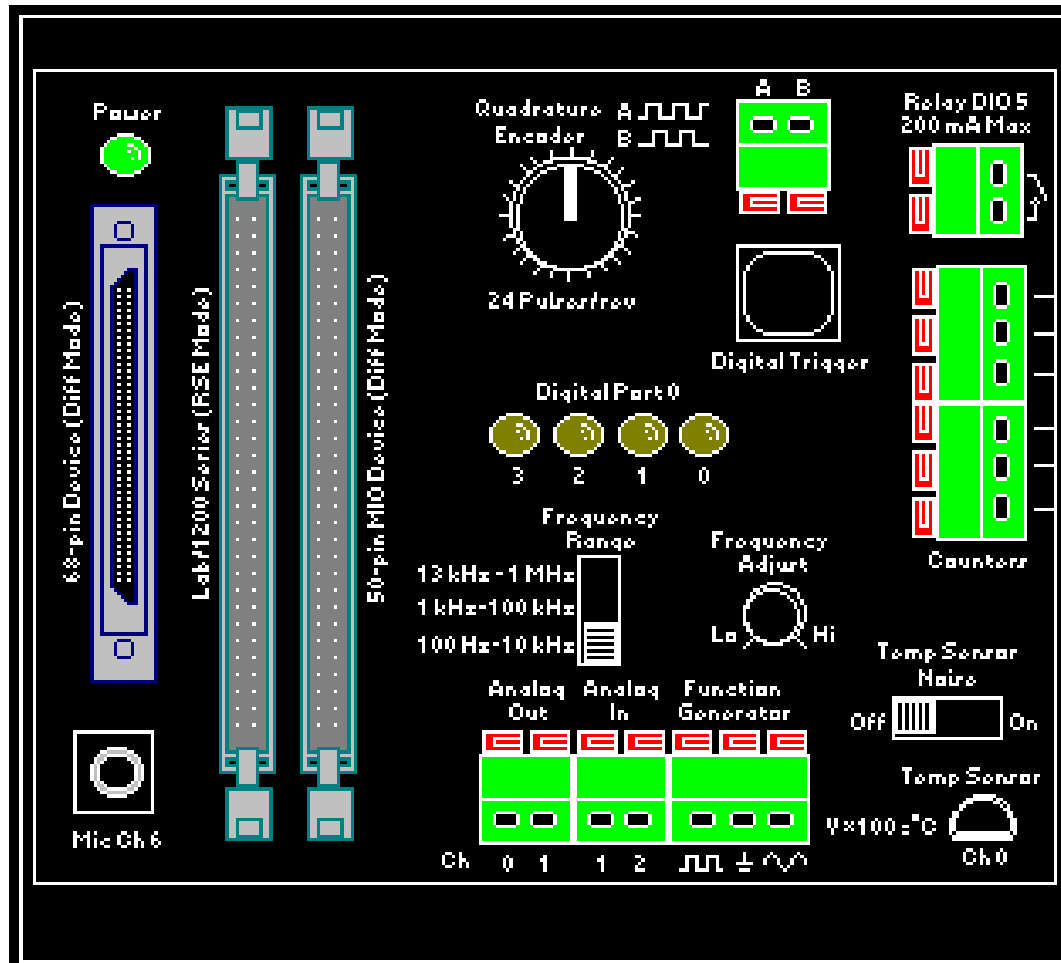
NI-DAQmx versus Traditional NI-DAQ

	Feature	NI-DAQmx	Traditional NI-DAQ
Productivity	Test Panels	✶	●
	DAQ Assistant with code generation	✶	no
	On-line diagnostics	✶	✶
	Scaling to voltage and physical units	✶	●
Performance	50 kS/s with single point I/O	✶	◉
	Measurement multithreading	✶	◉
Accuracy	Instant calibration	✶	●
	Automatic selection of optimal gains	✶	●
	Guaranteed lossless data	✶	✶
Quality	650 Alliance members	✶	✶
	Integration with LabVIEW	✶	✶
	Developer Exchange discussion forum	✶	✶
Compatibility	Compatible with Legacy ISA Boards	no	✶

✶ Best
● Good
◉ Fair

Ing. Andrea Malizia

NATIONAL INSTRUMENTS
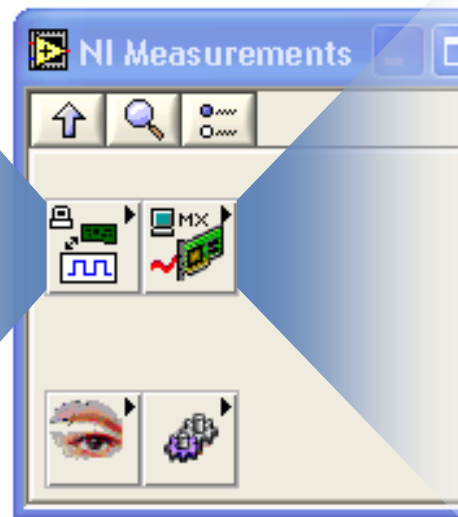
Data Acquisition in LabVIEW

Traditional NI-DAQ
Specific VIs for performing:
• Analog Input
• Analog Output
• Digital I/O
• Counter operations

NI-DAQmx
Next generation driver:
• VIs for performing a task
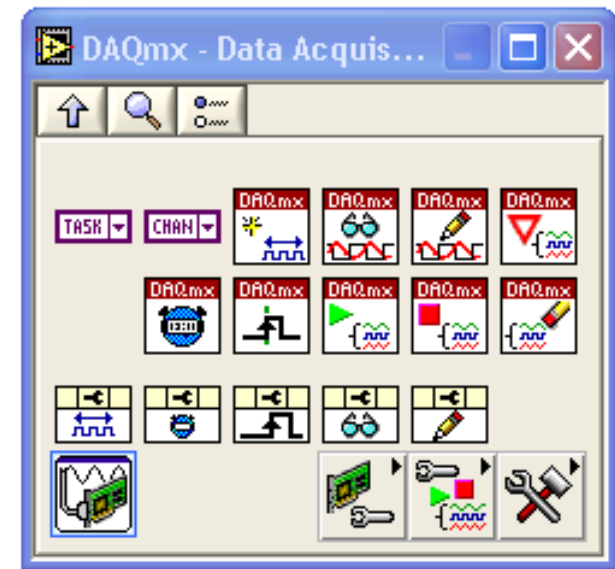• One set of VIs for all measurement types
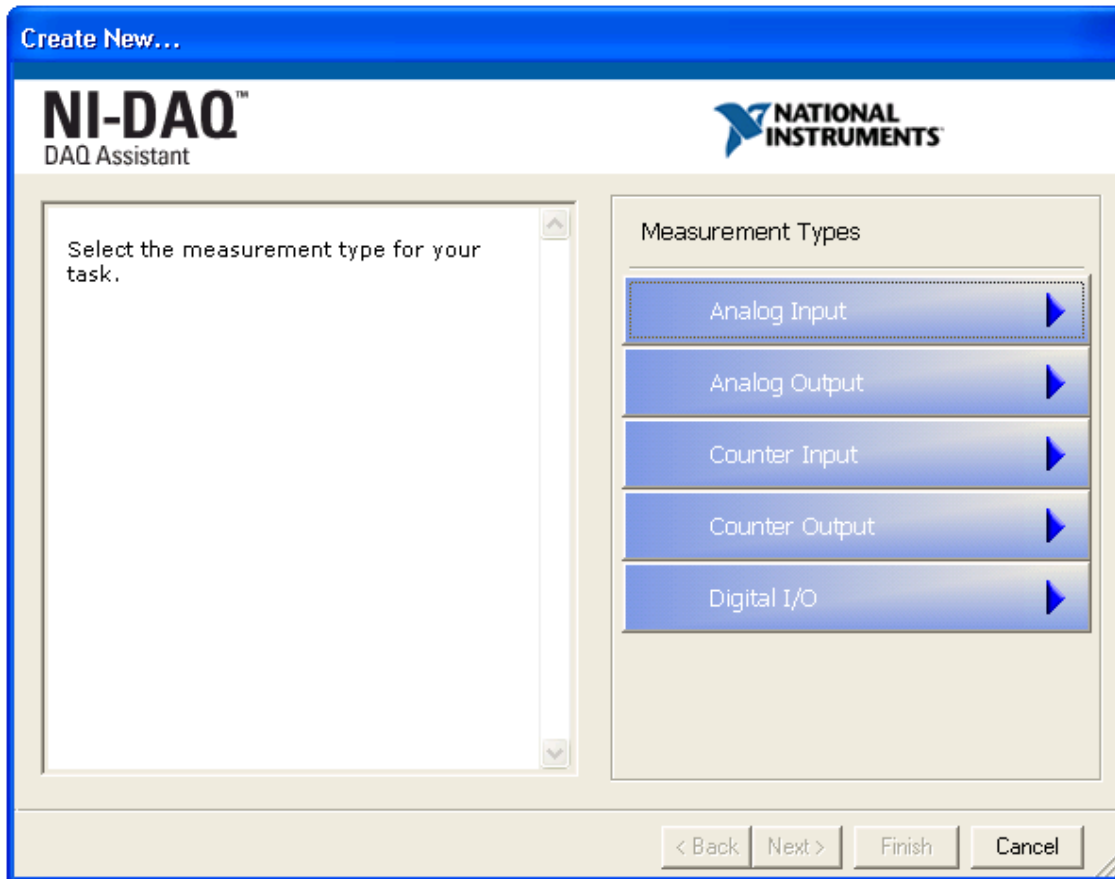
NI-DAQmx Data Acquisition

Single set of VIs used to perform analog I/O, digital I/O, and counter operations

DAQ Assistant Express VI

- Quickly and easily program the DAQ device
- Creates a local task
- Most applications can use the DAQ Assistant Express VI

NI-DAQmx Data Acquisition Task Types

Measurement type can be:

- Analog Input
- Analog Output
- Counter Input
- Counter Output
- Digital I/O

Ing. Andrea Malizia
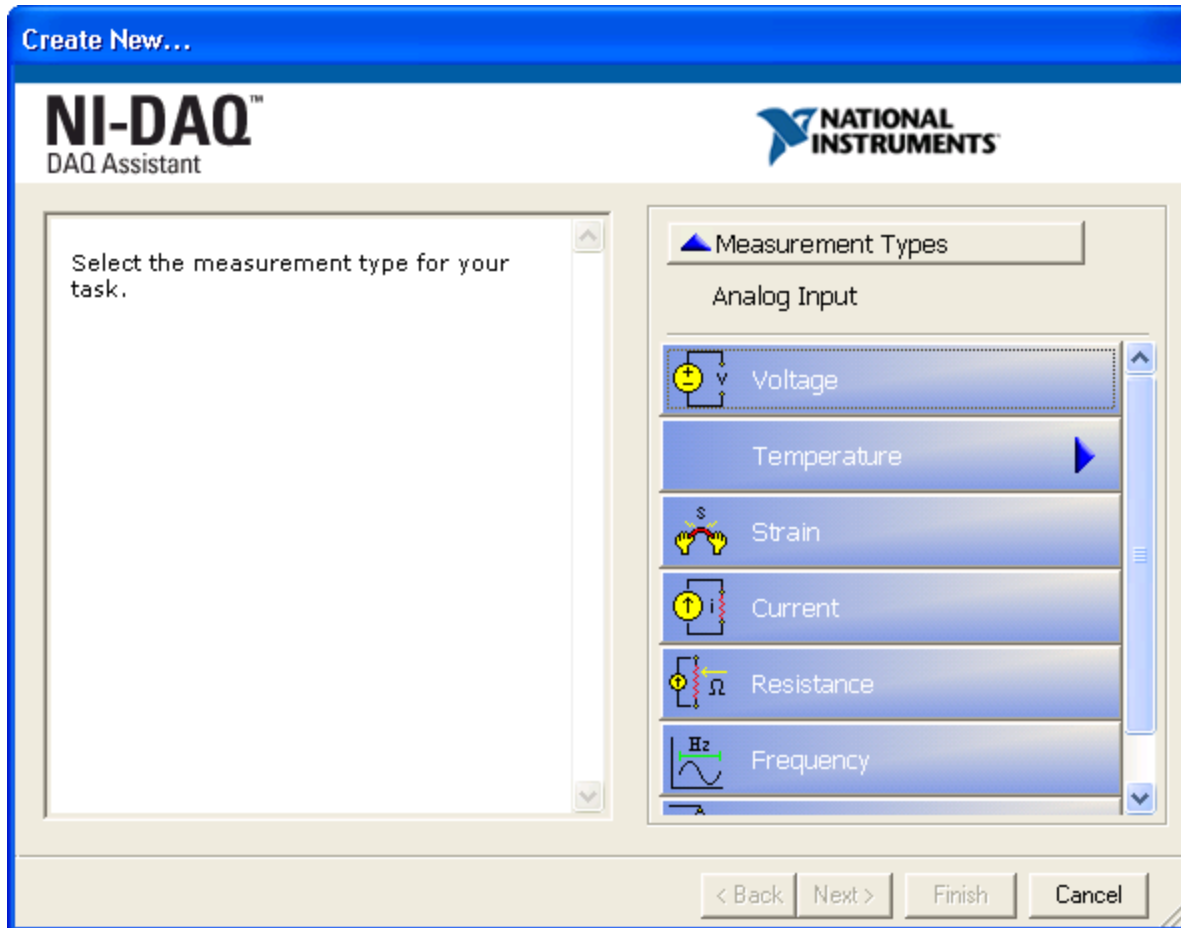
Analog Input

Analog Input task is specific to the measurement

Ing. Andrea Malizia

Analog Input Task Timing and Triggering

Configures the number of samples and sample rate for the task

Configures the start and reference triggers for the task

Ing. Andrea Malizia

ni.com

NATIONAL INSTRUMENTS

Data Logging

- It is often necessary to permanently store data that is acquired from the DAQ device

- LabVIEW includes the ability to read and write a LabVIEW Measurement File

- LabVIEW Measurement File is an ASCII text file

Ing. Andrea Malizia
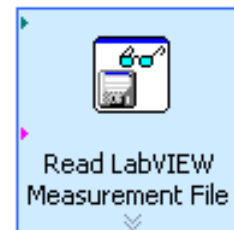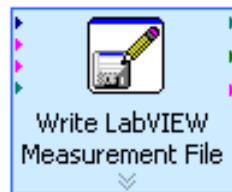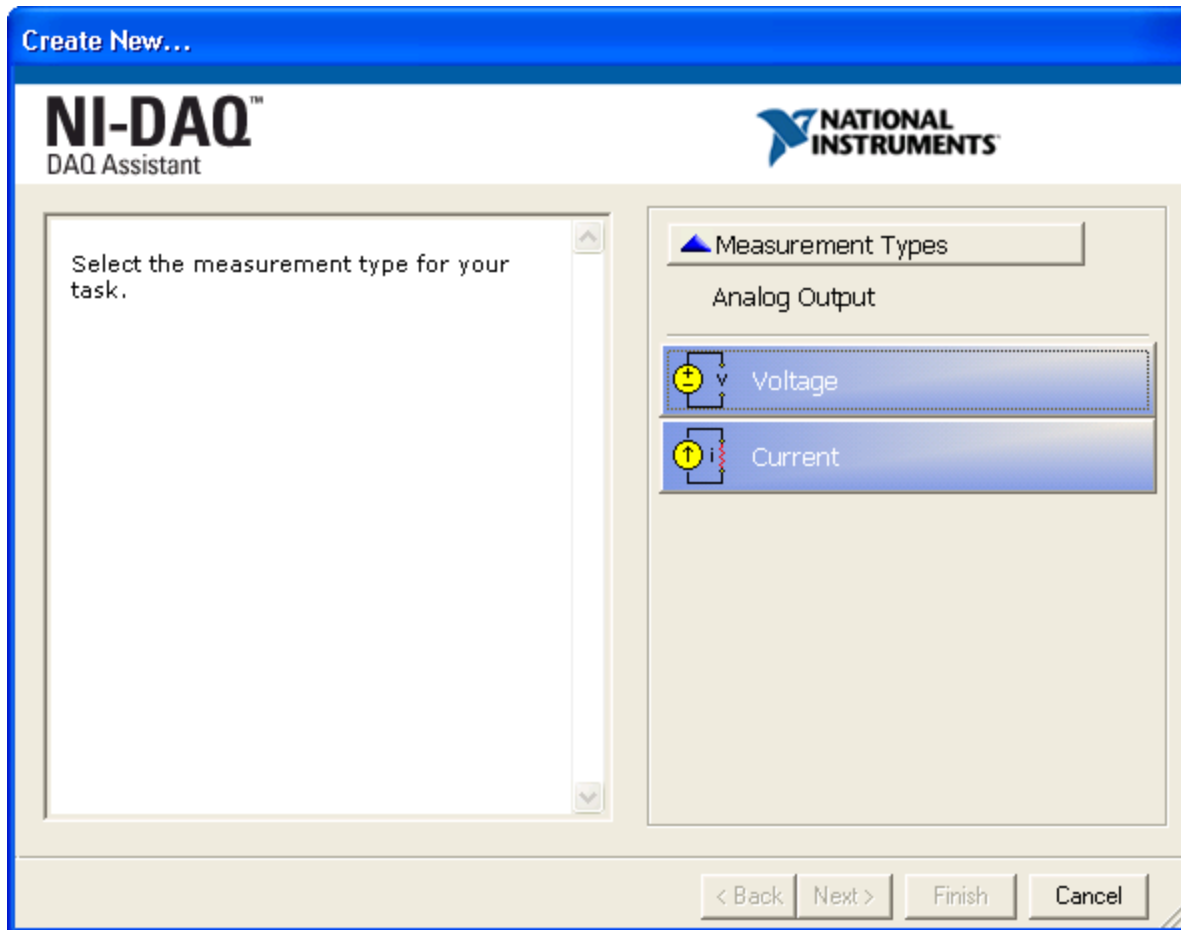
Analog Output

Analog Output task is specific to the generation type

Ing. Andrea Malizia

Analog Output Task Timing and Triggering

Configures the number of samples and sample rate for the task

Configures the start and reference triggers for the task

Ing. Andrea Malizia

ni.com

NATIONAL INSTRUMENTS

Counters

A counter is a digital timing device

Typical uses of a counter:

- Event counting
- Frequency measurement
- Period measurement
- Position measurement
- Pulse generation

Gate   Output

Count Register
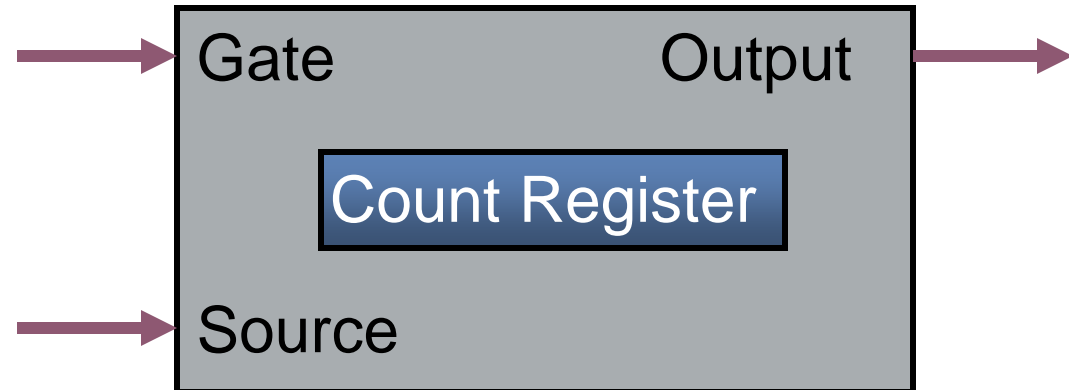
Source

Count register – Stores the current count of the counter
Source – Input that causes the counter to increment each time it toggles
Gate – Input that is used to enable or disable the function of the counter
Output – Signal that generates pulses or a series of pulses

NATIONAL INSTRUMENTS

Digital Input and Output

- Digital I/O can read from or write to a line or an entire digital port

- A digital port is a collection of digital lines

Ing. Andrea Malizia
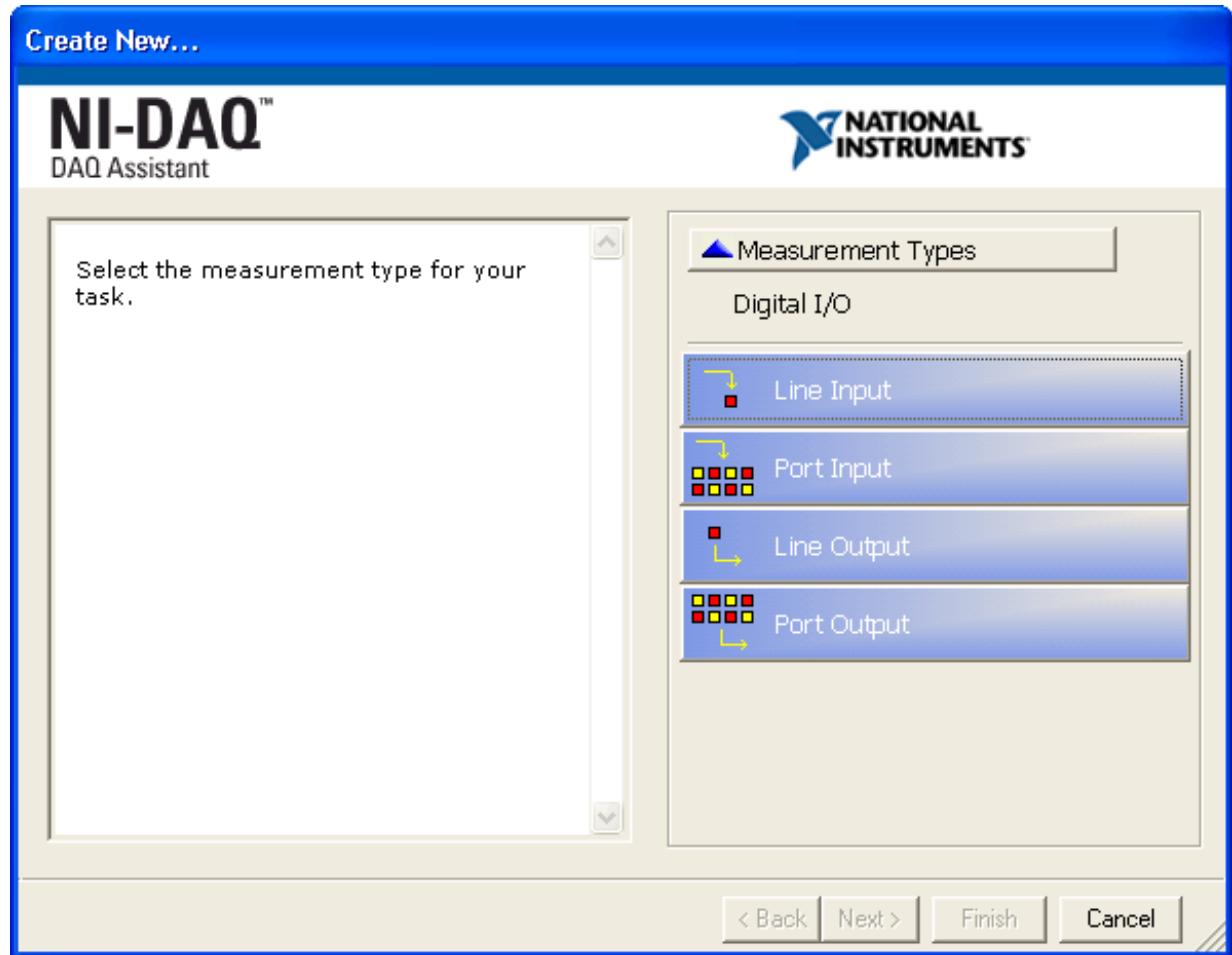
Summary

- MAX is the primary configuration and testing utility that is available for the DAQ device.

- The DAQ Assistant is used to configure the DAQ device and perform data acquisition.

- Most application can use the DAQ Assistant. For applications that require advanced timing and synchronization use the VIs that come with NI-DAQmx.

- The DAQ Assistant can perform Analog Input, Analog Output, Digital I/O, and Counter operations.

Ing. Andrea Malizia

ni.com

NATIONAL INSTRUMENTS

Instrument Control

TOPICS

Instrument Control Overview

GPIB Communication and Configuration

Instrument I/O Assistant

Virtual Instrument Software Architecture (VISA)

Instrument Drivers

Serial Port Communication

Waveform Transfers

Ing. Andrea Malizia

ni.com

NATIONAL INSTRUMENTS

Instrument Control Overview

Control any instrument if you know the following:

– Type of connector on the instrument

– Electrical properties involved

– Software drivers available

⁻ Type of cables needed

⁻ Communication protocols used

Instruments

Computer

Ing. Andrea Malizia

ni.com

NATIONAL INSTRUMENTS

GPIB Communication

GPIB Interface

GPIB Instruments

GPIB Cable

Ing. Andrea Malizia

ni.com
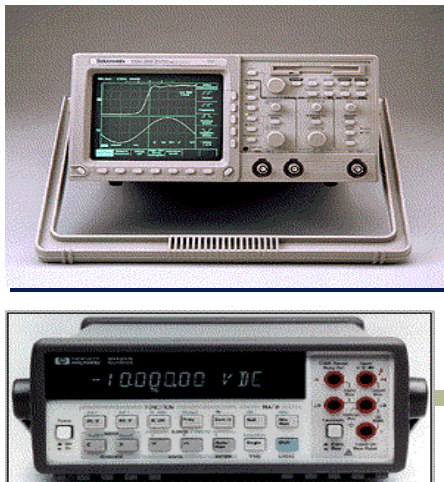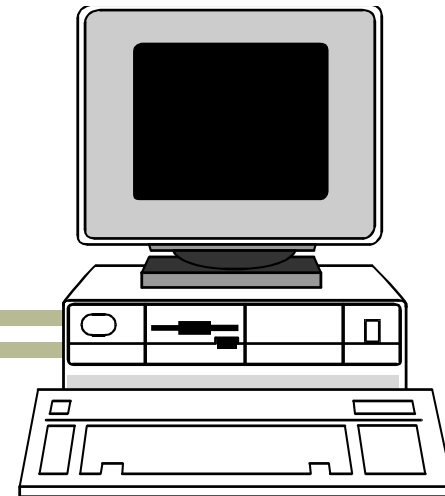
NATIONAL INSTRUMENTS
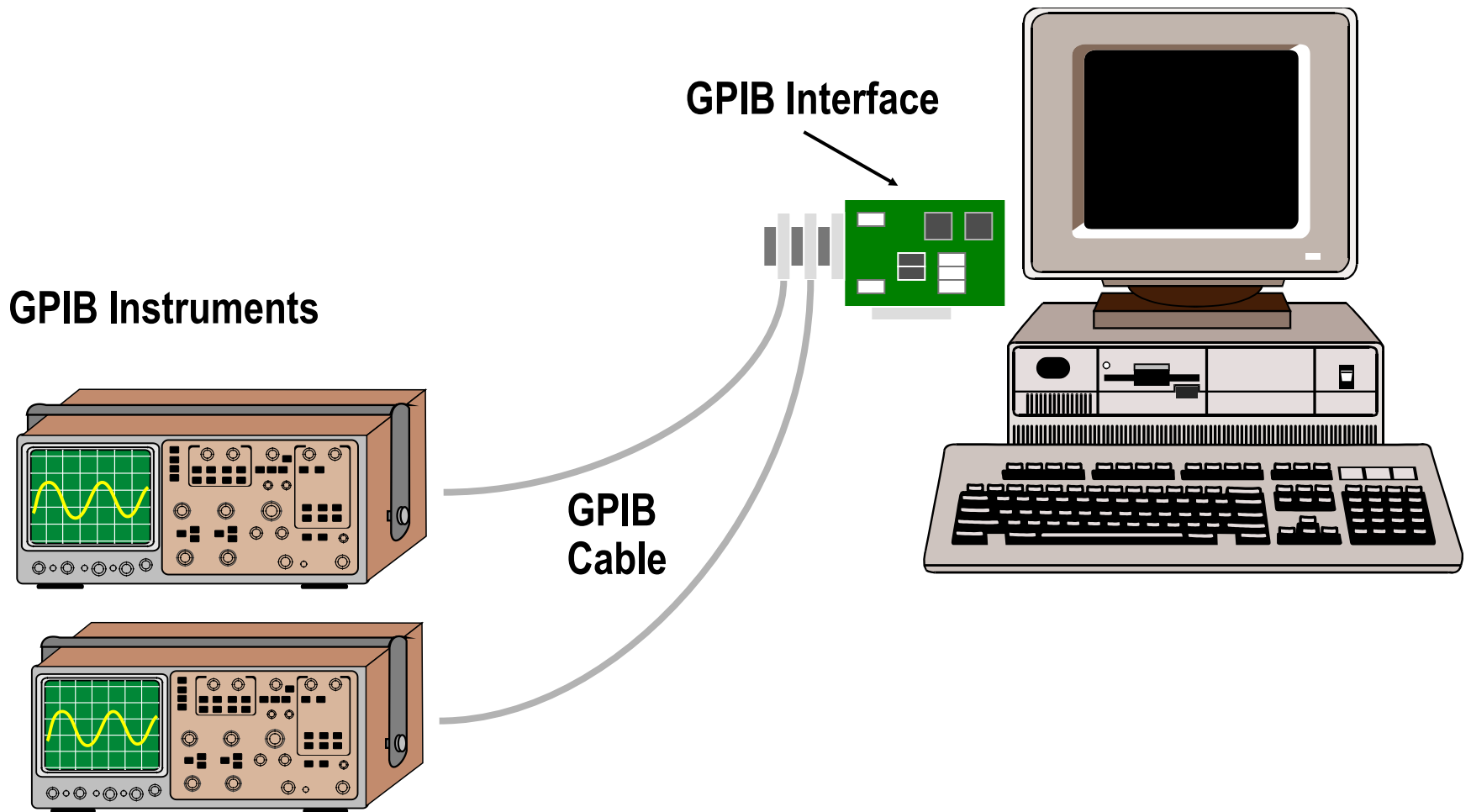
GPIB Software Architecture — Windows

Diagnostics Tools:
GPIB Diagnostic Tool
NI-Spy

**Interface Board
(GPIB, PXI,
VXI, computer
based, etc.)**

**Driver
Software
(*.DLL)**

NI-VISA

**Instrument
Driver VIs**

LabVIEW

Configuration Tools:
Measurement &
Automation Explorer

NATIONAL
INSTRUMENTS
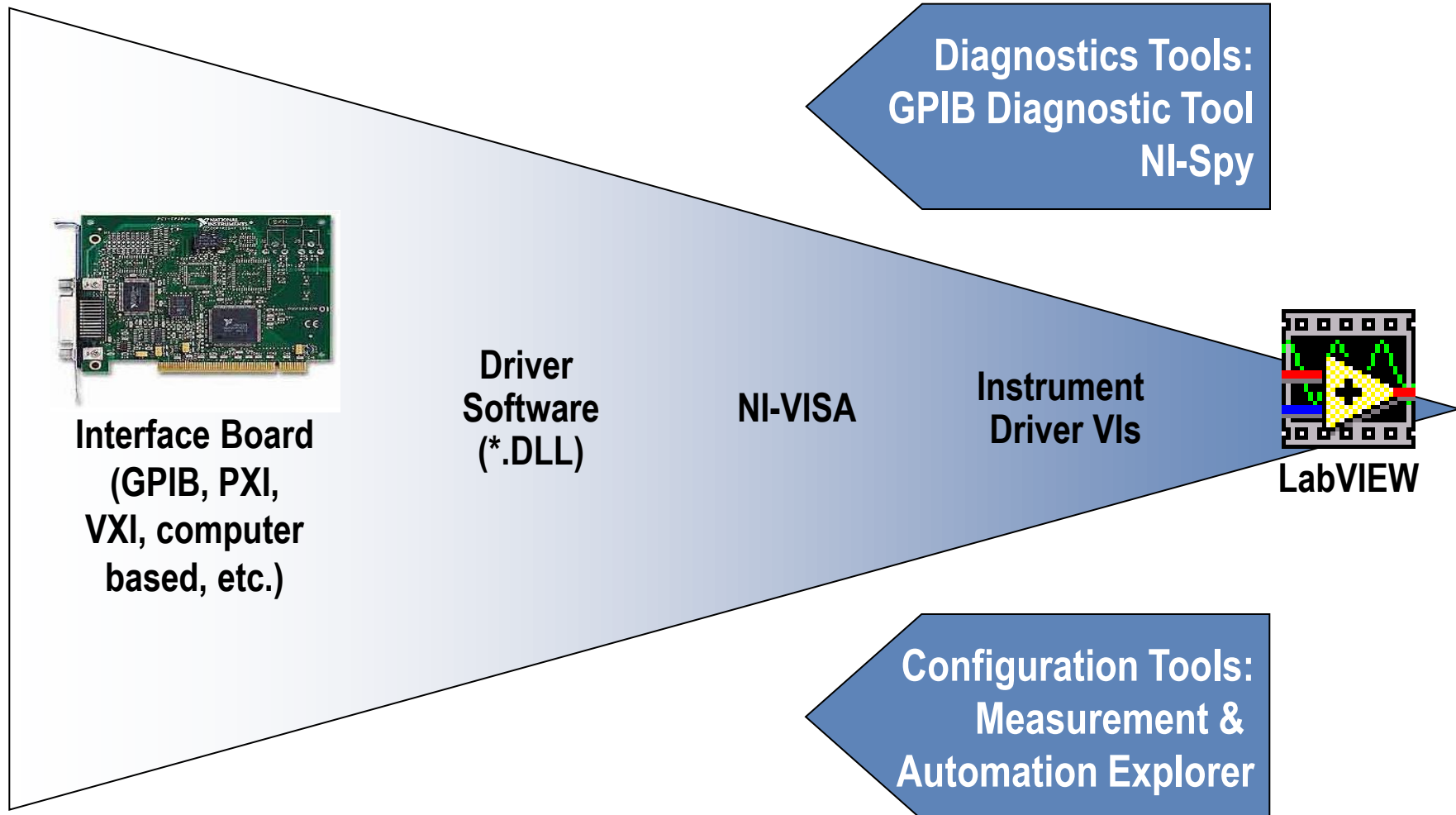
Configuring GPIB Board and Instruments

Measurement & Automation Explorer (MAX)

Ing. Andrea Malizia
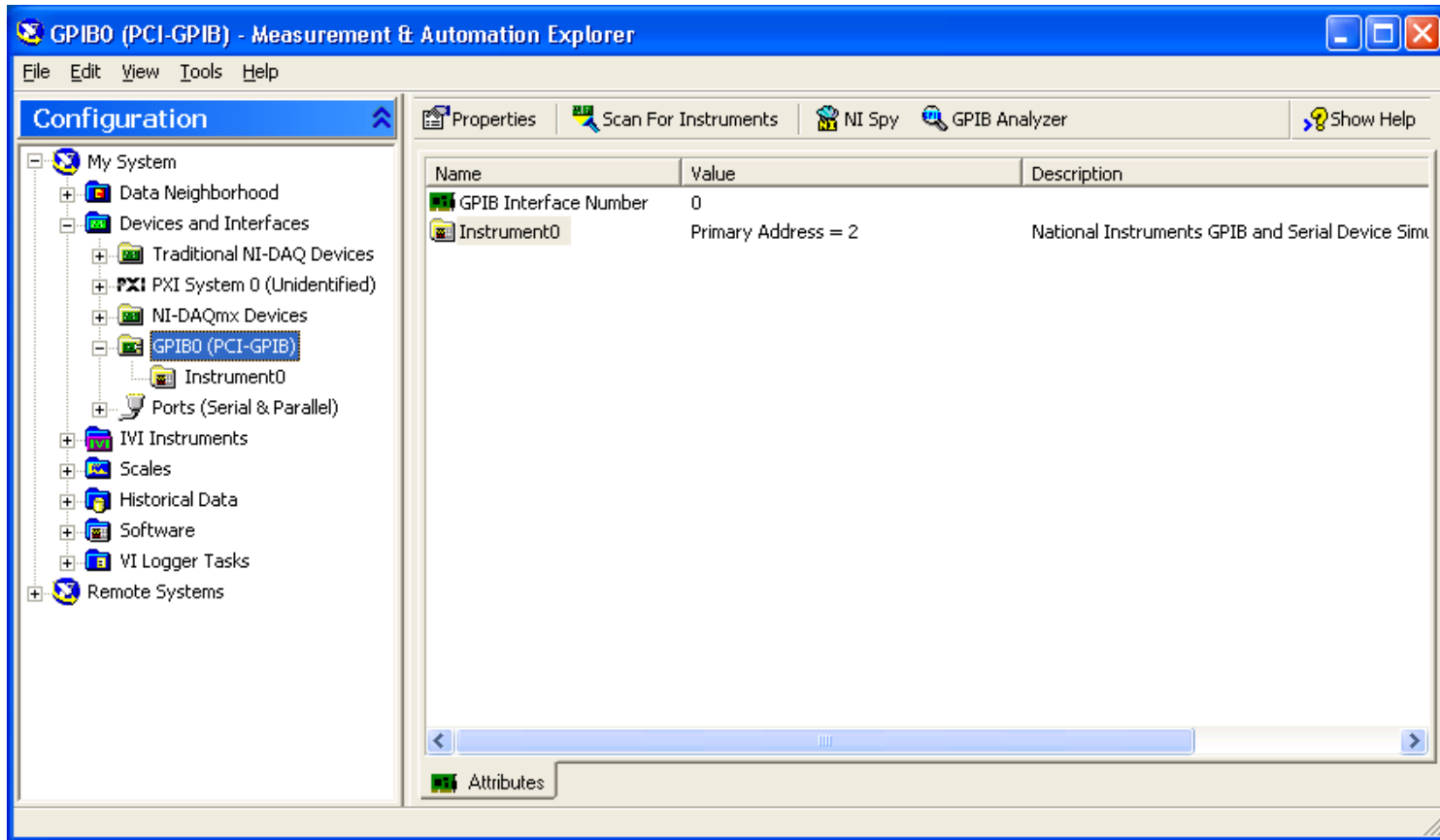
What is the Instrument I/O Assistant?

- Accessed through a LabVIEW Express VI

- Sets up device communication and data parsing step by step through a configuration interface

I/O Assistant

NATIONAL INSTRUMENTS
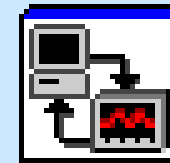
Serial Communication

- Popular means of communication between computer and peripheral device

- Data sent one bit at a time across the cable

- Used for low transfer rates or long distances

- Only a cable is needed since most computers have at least one available serial port

PC Serial Port

RS-232 Cable

RS-232 Instrument

NATIONAL INSTRUMENTS

A case study : STARDUST

Accensione resistenze → Apertura Valvola Elettro-Pneumatica → Apertura Pompa a Vuoto → Raggiungimento Condizioni a Contorno → Pressione : 100 Pa / Temperatura : 25°C e/o 110°C

Accensione Compressore

INIZIO

FINE

Misuratori di pressione

Misuratore Di flusso

Pompa a vuoto

Valvole

Compressore

Chiusura Valvola Elettropneumatica / Chiusura Pompa a Vuoto / Apertura Valvola Ingresso Aria

Apertura Misuratore di Flusso
Rateo di pressurizzazione : 300Pa/s

Inizio Acquisizione dati / Ingresso aria compressa

Acquisizione dati
Frequenza di acquisizione : 50Hz

Misuratori di pressione **Termocoppie**
Misuratore di flusso
Valvole

Programma Labview

NI CompactDAQ

NI 9485
NI 9264
NI 9219
NI 9211

1) *Pressione Interna (mV)*
2) *Temperatura interna (mV)*
3) *Temperatura delle pareti (mV)*
4) *Valore dei trasduttori di pressione (mV)*
5) *Valore del Misuratore di Flusso (V)*

Valori elaborati e salvati

Chiusura di:
•Misuratore di Flusso
•Valvole

Nell'impianto è raggiunta la pressione di 1 atm

1) *Pressione Interna (Pascal)*
2) *Temperatura interna (Kelvin)*
3) *Temperatura delle pareti (Kelvin)*
4) *Velocità del flusso d'aria (metri/secondo)*
5) *Valore del Misuratore di Flusso (Litri/minuto)*

ni.com

NATIONAL INSTRUMENTS

A case study : STARDU...

Apertura Valvola Elettro-Pneumatica → Apertura Pompa a Vuoto → Raggiungin... Condizioni a C...

Accensione resistenze ↑

Accensione Compressore ↑

Ch... Elet...

INIZIO

FINE

Misuratori di pressione

Pompa a vuoto

Misuratore Di flusso

Valvole

Compressore

Misuratori di pressione **Termocoppie**
Misuratore di flusso
Valvole

Programma Labview

NI CompactD...

NI 9485
NI 9264
NI 9219
NI 9211

1) Pressione Interna (mV)
2) Temperatura interna (mV)
3) Temperatura delle pareti (mV)
4) Valore dei trasduttori di pressione (mV)
5) Valore del Misuratore di Flusso (V)

Chiusura di:
• Misuratore di Flusso
• Valvole

Valori elaborati e salvati

1) Pressione Interna (Pascal)
2) Temperatura interna (Kelvin)
3) Temperatura delle pareti (Kelvin)
4) Velocità del flusso d'aria (metri/secondo)
5) Valore del Misuratore di Flusso (Litri/minuto)

Nell'impianto è raggiunta la pressione di 1 atm ←

ni.com

NATIONAL INSTRUMENTS

A case study : STARDUST

Apertura Valvola Elettro-Pneumatica → Apertura Pompa a Vuoto → Raggiungimento Condizioni a Contorno → Pressione : 100 Pa Temperatura : 25°C e/o 110°C

Accensione resistenze ↑

Accensione Compressore

INIZIO

FINE

Chiusura di:
• Misuratore di Flusso
• Valvole

Nell'impianto è raggiunta la pressione di 1 atm

Misuratori di pressione

Pompa a vuoto

Valvole

Misuratore Di flusso

Compressore

Misuratori di pressione **Termocoppie** **Misuratore di flusso** **Valvole**

Programma Labview

NI CompactDAQ

Chiusura Valvola Elettropneumatica   Chiusura Pompa a Vuoto   Apertura Valvola Ingresso Aria

Apertura Misuratore di Flusso
Rateo di pressurizzazione : 300Pa/s

Inizio   Ingresso
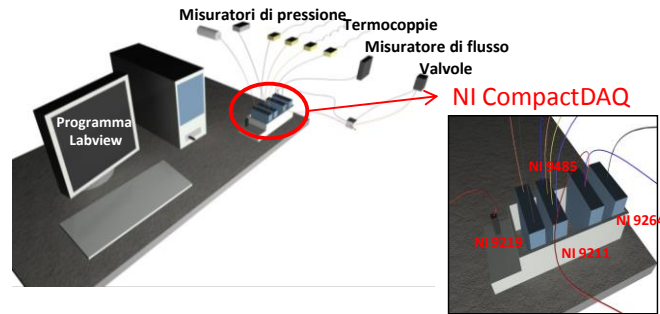
Valori elaborati e salvat
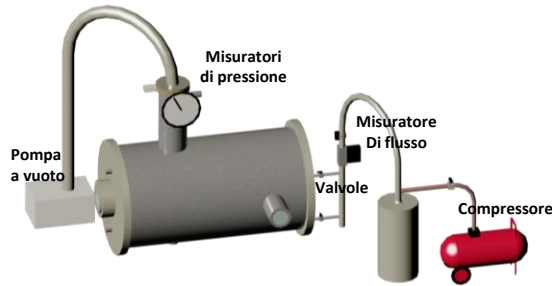
1) Pressione Interna (Pasc
2) Temperatura interna (F
3) Temperatura delle pare
4) Velocità del flusso d'ari
5) Valore del Misuratore

ni.com

NATIONAL INSTRUMENTS

A case study : STARDUST

Apertura Valvola Elettro-Pneumatica → Apertura Pompa a Vuoto → Raggiungimento Condizioni a Contorno → Pressione : 100 Pa Temperatura : 25°C e/o 110°C

Accensione resistenze ↑

Accensione Compressore ↑

INIZIO

FINE

Chiusura di:
• Misuratore di Flusso
• Valvole

Nell'impianto è raggiunta la pressione di 1 atm

Chiusura Valvola Elettropneumatica   Chiusura Pompa a Vuoto   Apertura Valvola Ingresso Aria

Apertura Misuratore di Flusso
Rateo di pressurizzazione : 300Pa/s

Inizio Acquisizione dati   Ingresso aria compressa

Acquisizione dati
Frequenza di acquisizione : 50Hz

NI CompactDAQ

1) *Pressione Interna (mV)*
2) *Temperatura interna (mV)*
3) *Temperatura delle pareti (mV)*
4) *Valore dei trasduttori di pressione (mV)*
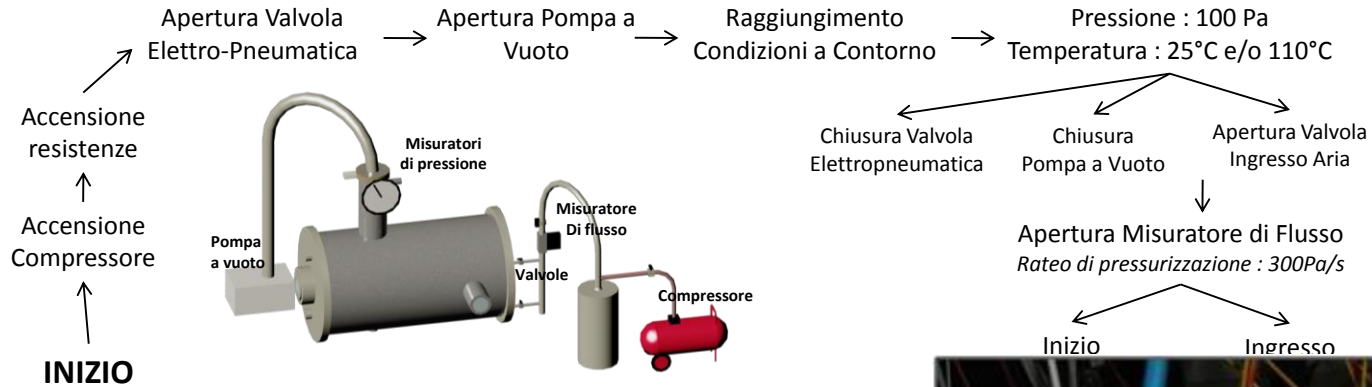5) *Valore del Misuratore di Flusso (V)*

Valori elaborati e salvati

1) *Pressione Interna (Pascal)*
2) *Temperatura interna (Kelvin)*
3) *Temperatura delle pareti (Kelvin)*
4) *Velocità del flusso d'aria (metri/secondo)*
5) *Valore del Misuratore di Flusso (Litri/minuto)*