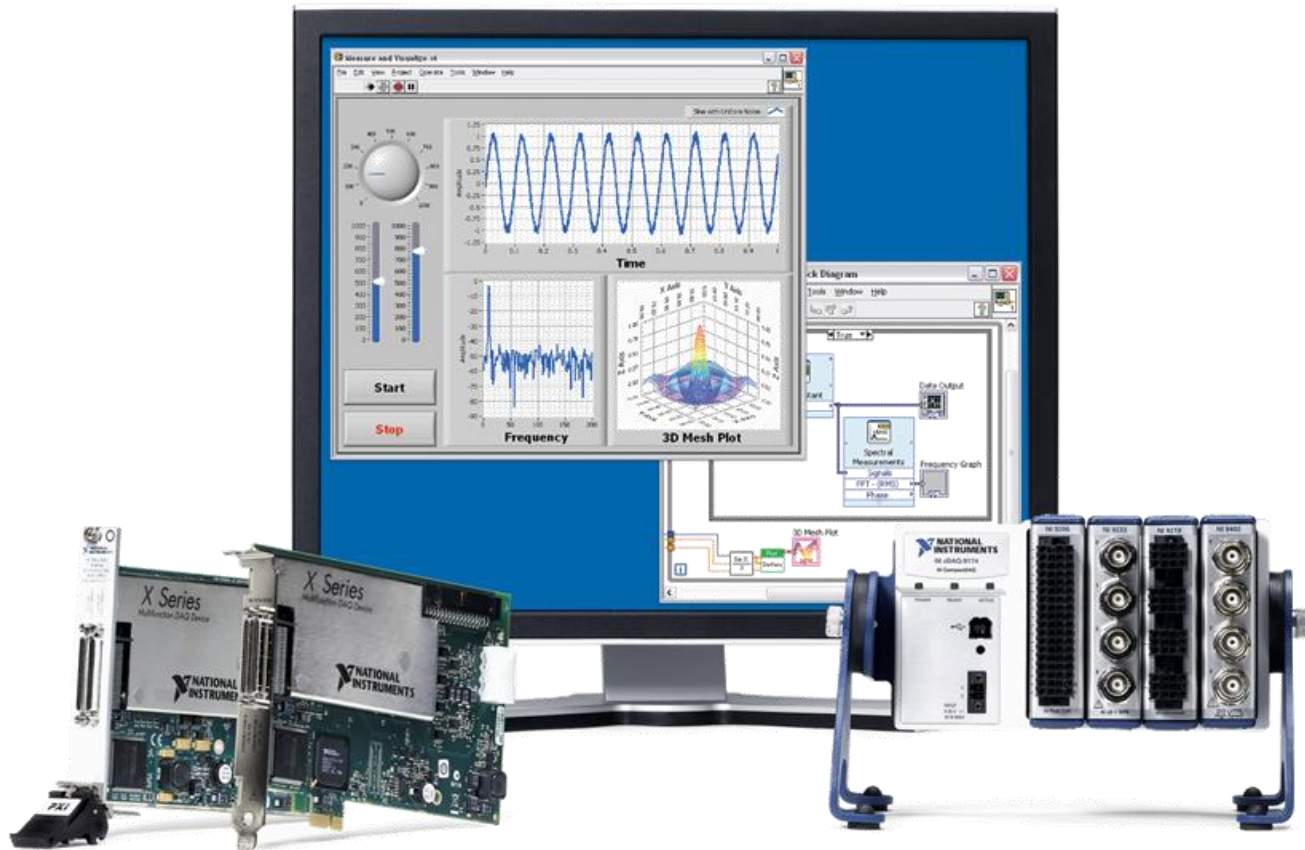




# NIDays

WORLDWIDE GRAPHICAL SYSTEM DESIGN  
**CONFERENCE**





# Introducing X Series Multifunction DAQ and New CompactDAQ Chassis

# Overview

- Typical data acquisition application needs
- Multi-rate testing with CompactDAQ
- New CompactDAQ chassis
- Counter and Timing improvements
- New X series devices
- Synchronization of multiple devices

# Typical DAQ Applications

## Applications

- Engine test
- White goods testing
- Dynamic strain/load test
- Battery test
- In-Vehicle Data logger
- Machine Condition Monitoring

## Common Features

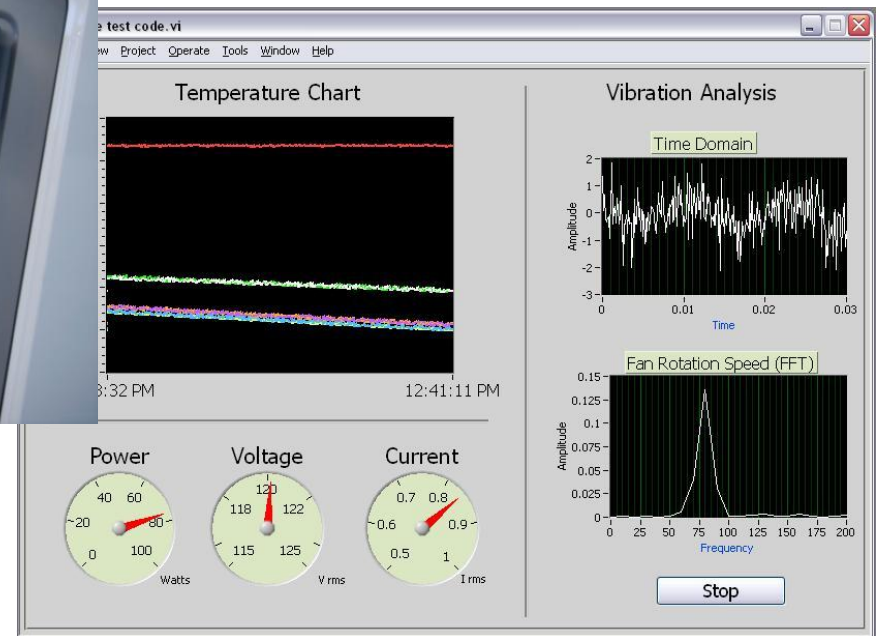
- Mixed Measurements
  - From temp to acceleration
- Synchronization between measurements
- Triggering to external signal
- Tests require reconfiguration
  - Different designs need slightly different sensor setups
- Rugged test environment

# Example Application: Analyzing the Communication of Whales

- Recording of ultrasonic *clicks* from whales
- Fjord & Bælt used high-speed M series DAQ devices with signal processing software based on LabVIEW to monitor the birth and echolocation development of the first harbor porpoise calf ever to survive in captivity.
- Continuously acquire from 10 sensors at 500 kHz generated 30-50 GB of data / day

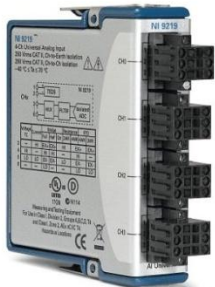


# Example Application: Appliance Test with Multiple Sensors



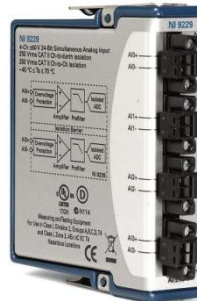


# AI Modules



## Low Speed Modules

- Sample Rate < 100 S/s
- Measurements
  - Temperature
  - DC Voltage/Current,
  - Pressure/Load monitoring
- Example Modules
  - NI 9211
  - NI 9213
  - NI 9219



## Dynamic Modules

- Sample Rate 50 kS/s/ch
- Measurements
  - Dynamic strain
  - Frequency analysis
  - Sound/Vibration
- Example Modules
  - NI 9237
  - NI 9225/29/39/27
  - NI 9233/34



## High Speed Modules

Sample Rate > 100kS/s

Measurements

High Speed Voltage

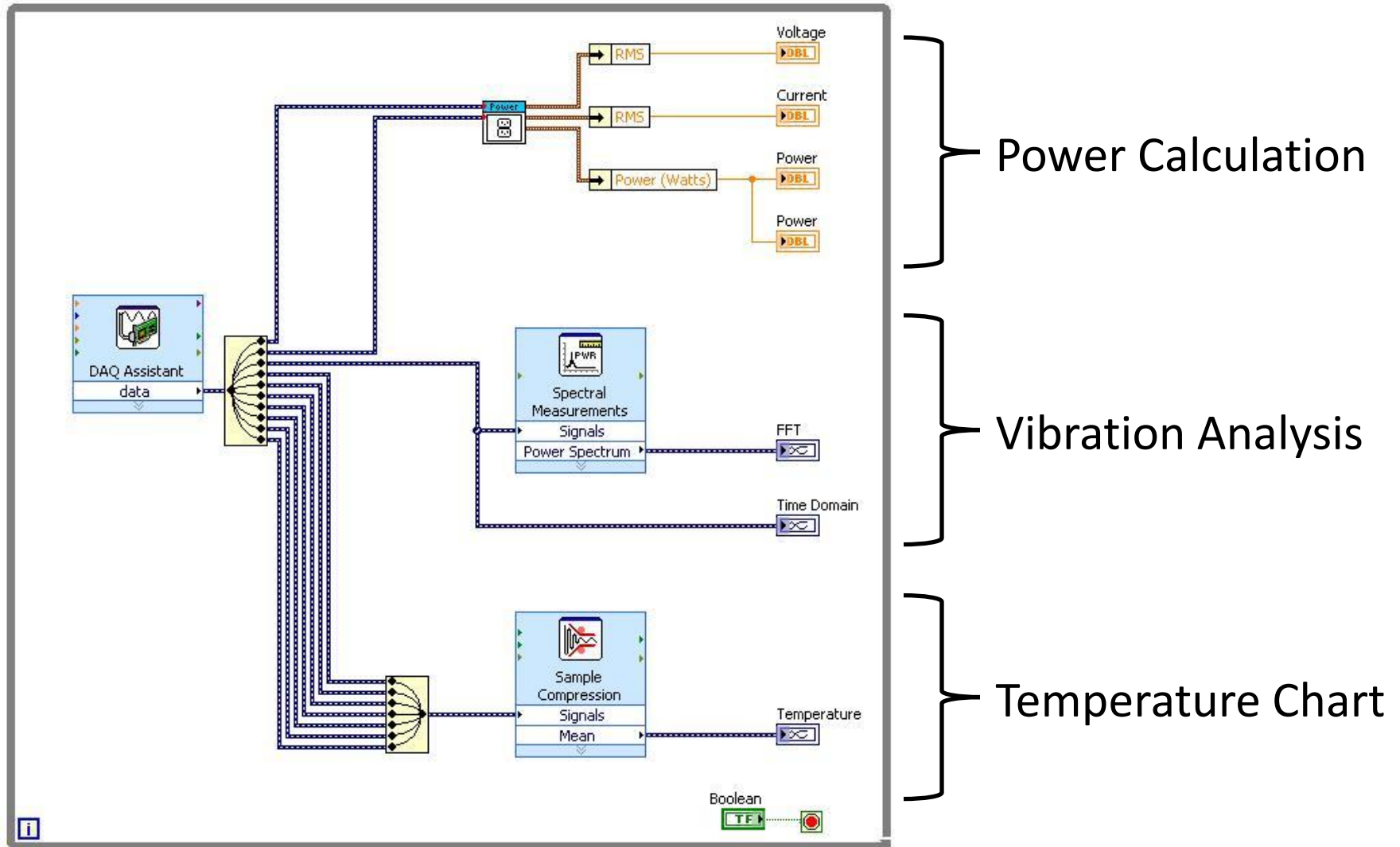
Example Modules

NI 9201/21

NI 9215

NI 9205

# Block Diagram: Appliance Test

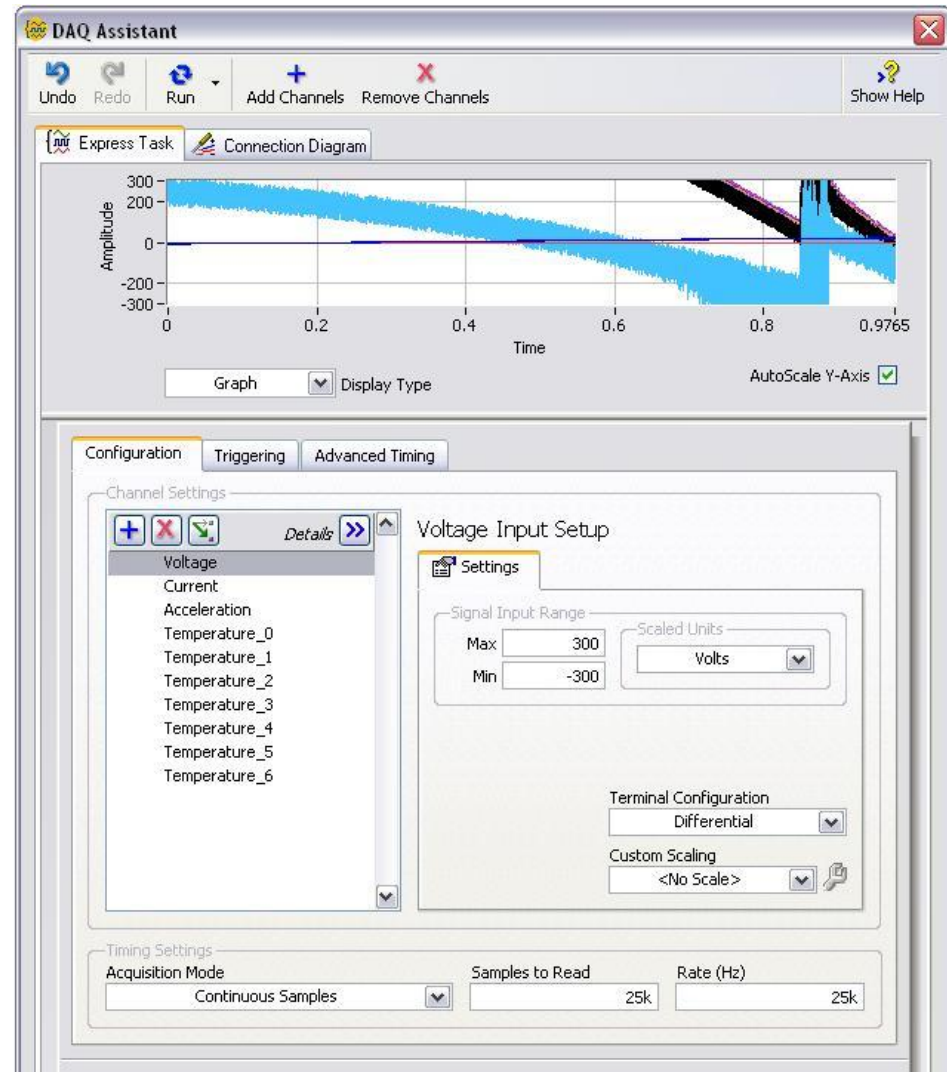




# DAQ Assistant

Different signals =  
confusing graph

All channels run at  
same rate!

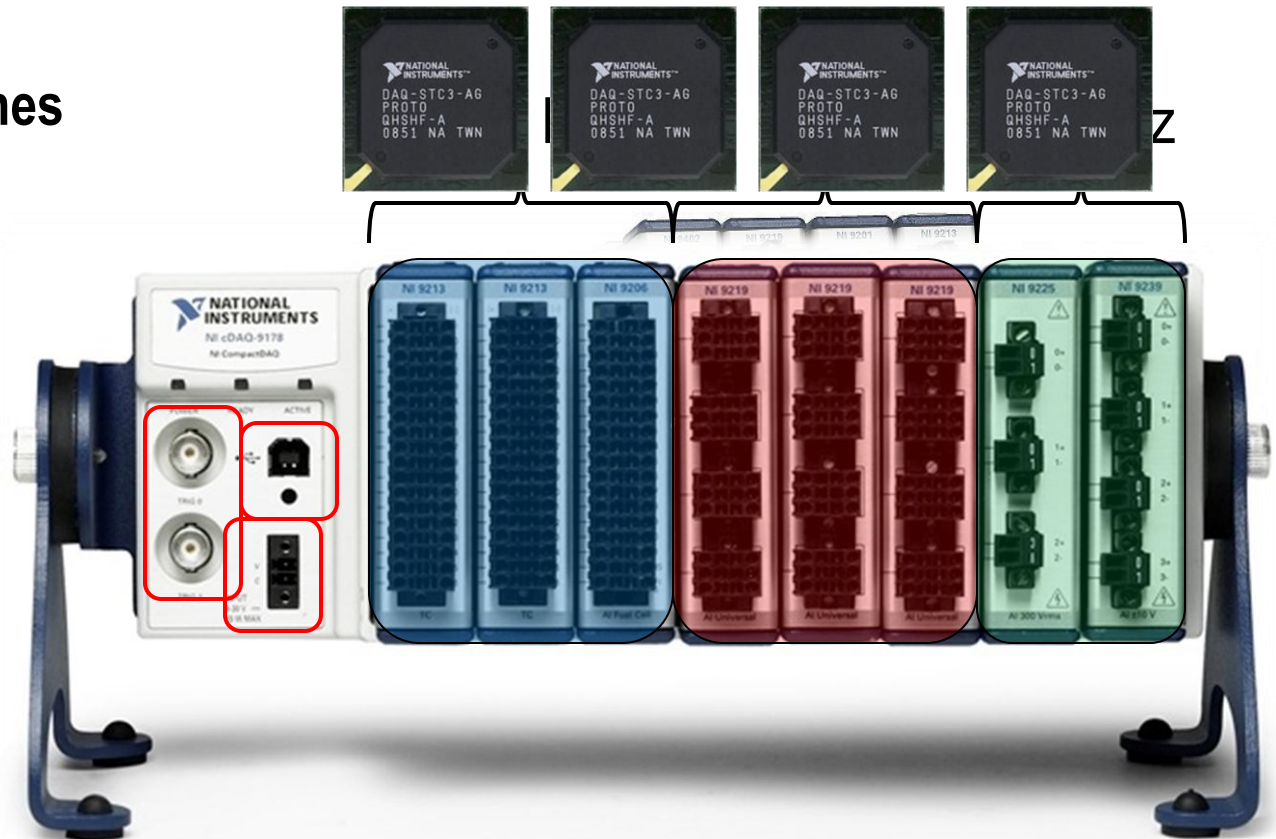




# DEMO – MULTIPLE TIMING ENGINES

# The New CompactDAQ

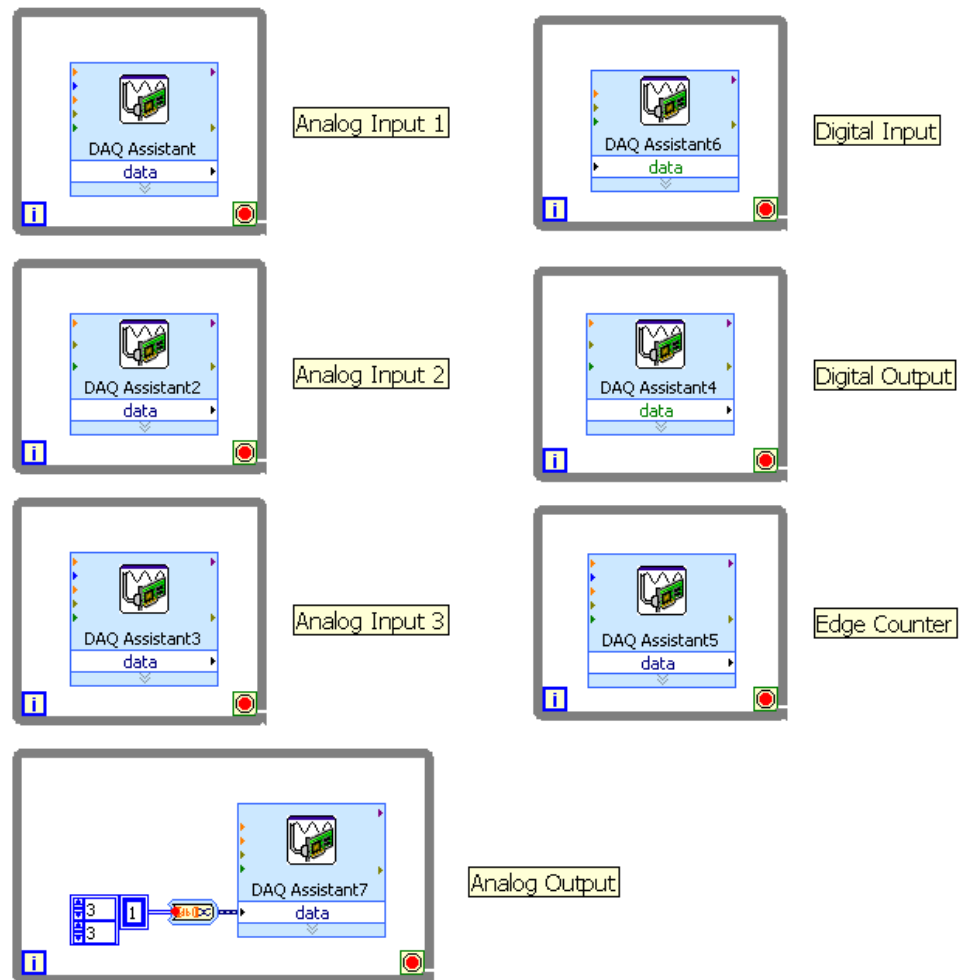
- Multiple Timing Engines
- Four Counters
- Built In BNC Triggers
- Locking USB Cable
- 9-30 VDC Power
  - Screw Terminals
- 4 Slot Chassis
  - No BNC Triggers



# 7 Hardware Timed Tasks

## Available Timing Engines

- 3 Analog Input
- 1 Analog Output
- 1 Digital Output
- 1 Digital Input
- 4 General Purpose Counters\*



\* Not considered a timing engine...but still a HW resource

# NI-STC3 Timing and Synchronization Technology

- Counter improvements
- 100 MHz timebase
- New digital I/O timing engines
- Retriggering on every subsystem



# Counter Applications

## Input

- Counting edges
- Quadrature encoder and position measurement
- Pulse and pulse-width measurement
- Frequency, period and semiperiod measurement
- Two-signal edge separation measurement

## Output

- Finite pulse train
- Continuous pulse train (PWM)
- Frequency generation
- Frequency division



# Counter Improvements

## 4

- You no longer need to “burn” a counter to time other subsystems
- Each one has more functionality than before

# Counter Improvements

- Generating a finite pulse train now takes only one counter



# Counter Improvements

## Buffered Counter I/O:

- Counters each have a 127 sample FIFO
- PCI Express bandwidth of 250 MB/s in each direction
- What is possible?
  - Buffered counter input on all four counters at 10 MS/s
  - Buffered counter output on all four counters at 10 MS/s

**160 MB/s**



# DEMO: COUNTERS

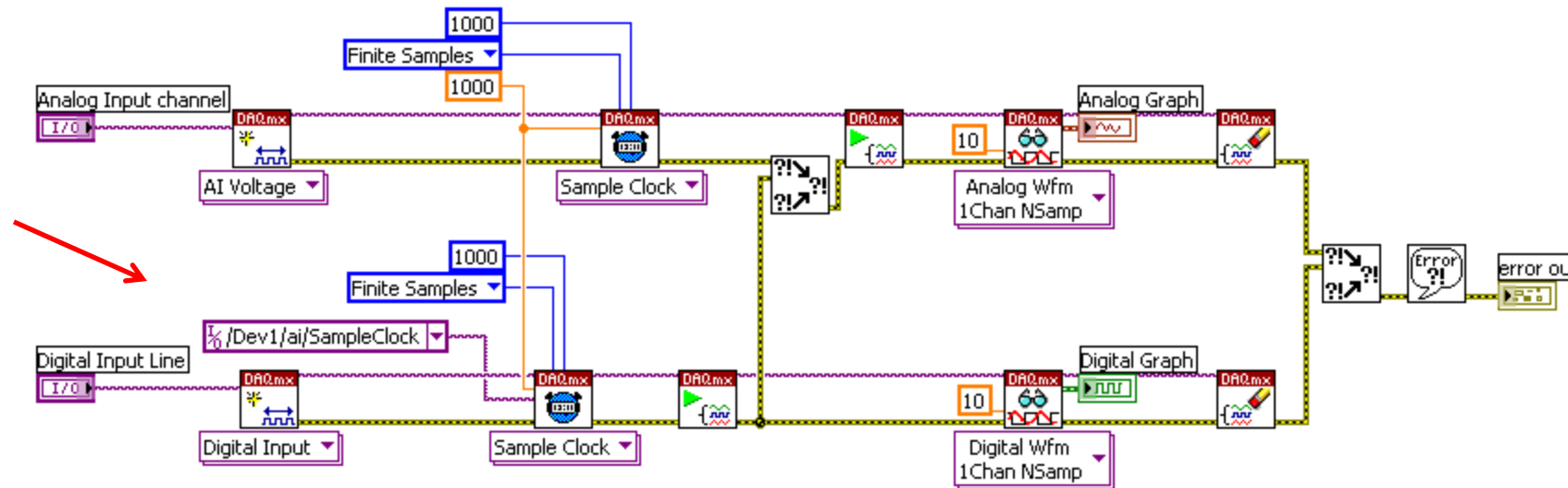
# 100 MHz Timebase Produces More Accurate Sampling Rates



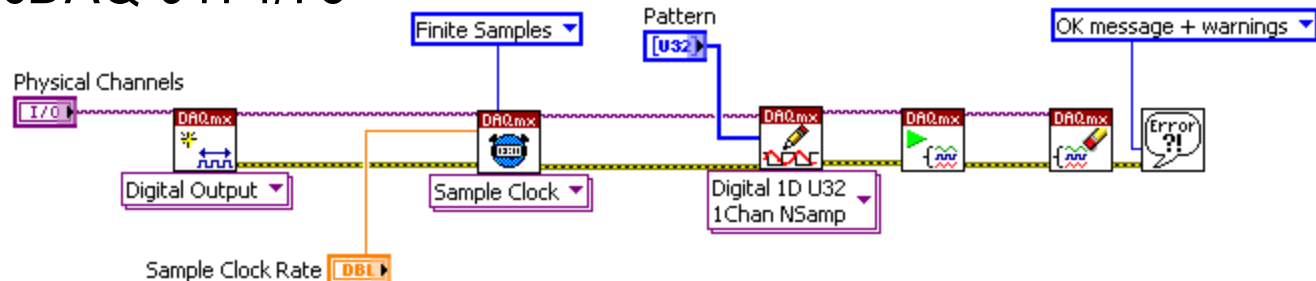
- How to create a 1.25 MS/s sample clock?
  - $20 \text{ MHz}/16 = 1.25 \text{ MS/s}$
  - $100 \text{ MHz}/80 = 1.25 \text{ MS/s}$
- How to create a 1.23 MS/s sample clock?
  - $20 \text{ MHz}/17 = 1.18 \text{ MS/s}$
  - $100 \text{ MHz}/81 = 1.235 \text{ MS/s}$

# Digital timing engines

## NI M Series / cDAQ-9172



## NI X Series / cDAQ-9174/78





# Correlate Timing Engines

AI Task

The screenshot shows the 'Advanced Timing' tab of the Configuration Assistant. Under 'Sample Clock Settings', the 'Sample Clock Type' is set to 'Internal'. The 'Timing Engine' dropdown is set to '<Let NI-DAQ Choose>'. The 'Clock Source' is empty, and the 'Active Edge' is set to 'Rising'. An arrow points from the text 'Set the desired timing engine for AI' to the 'Timing Engine' dropdown.

Set the desired timing engine for AI

AO Task

The screenshot shows the 'Advanced Timing' tab of the Configuration Assistant. Under 'Sample Clock Settings', the 'Sample Clock Type' is set to 'External'. The 'Clock Source' is set to '/cDAQ1/te0/SampleClock'. The 'Active Edge' is set to 'Rising'. An arrow points from the text 'Correlate other tasks to any of the 3 timing engines' to the 'Clock Source' dropdown.

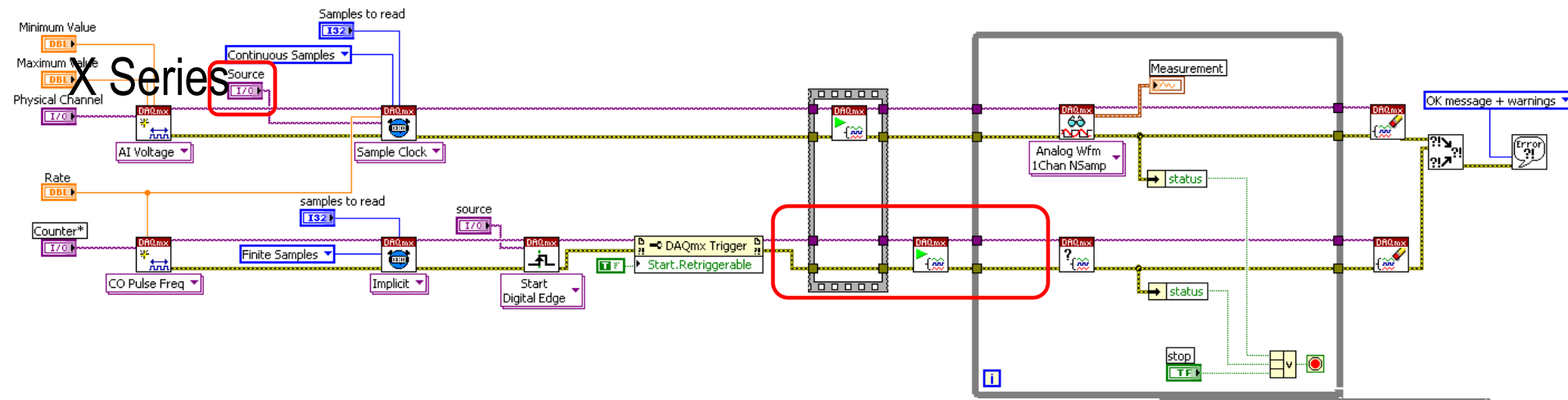
Correlate other tasks to any  
of the 3 timing engines

# Retriggerable Operations



M Series

X Series



X Series devices support retriggering on analog I/O, digital I/O, and counter I/O

# NI-DAQmx Software Optimizations

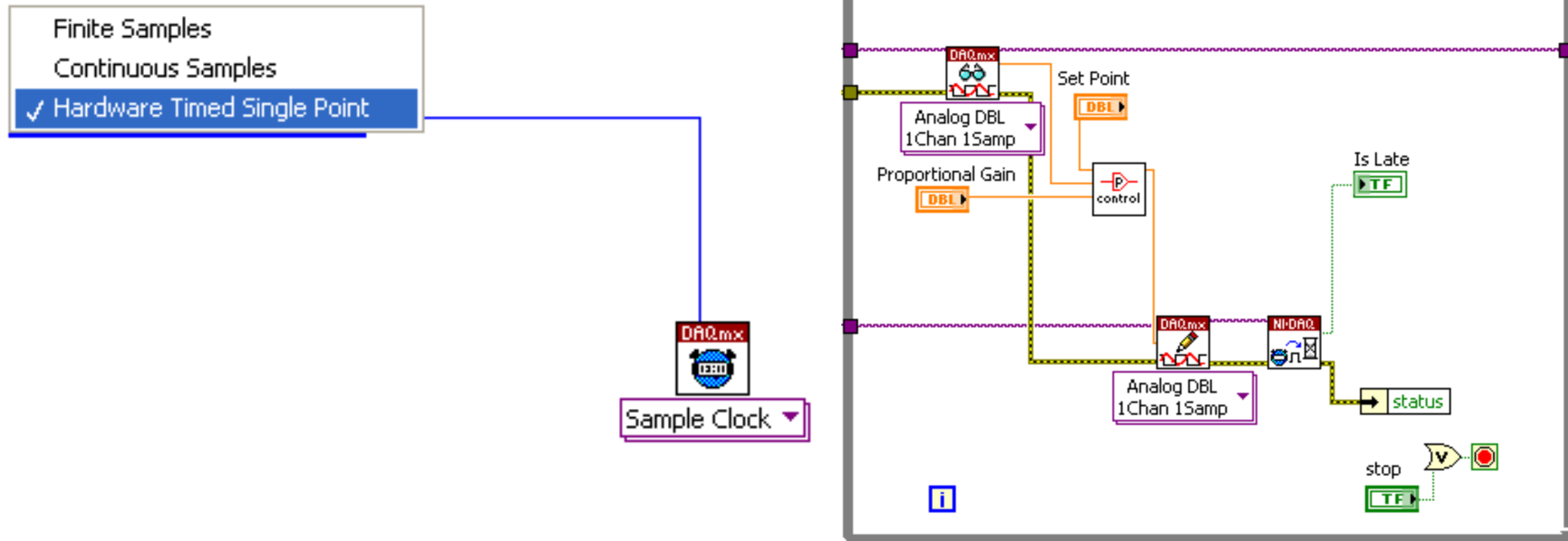
- Easy multicore application development with NI LabVIEW and NI-DAQmx
- Optimizations for low latency and single-point control
- Easy multidevice synchronization and data logging



# Single-Point Control



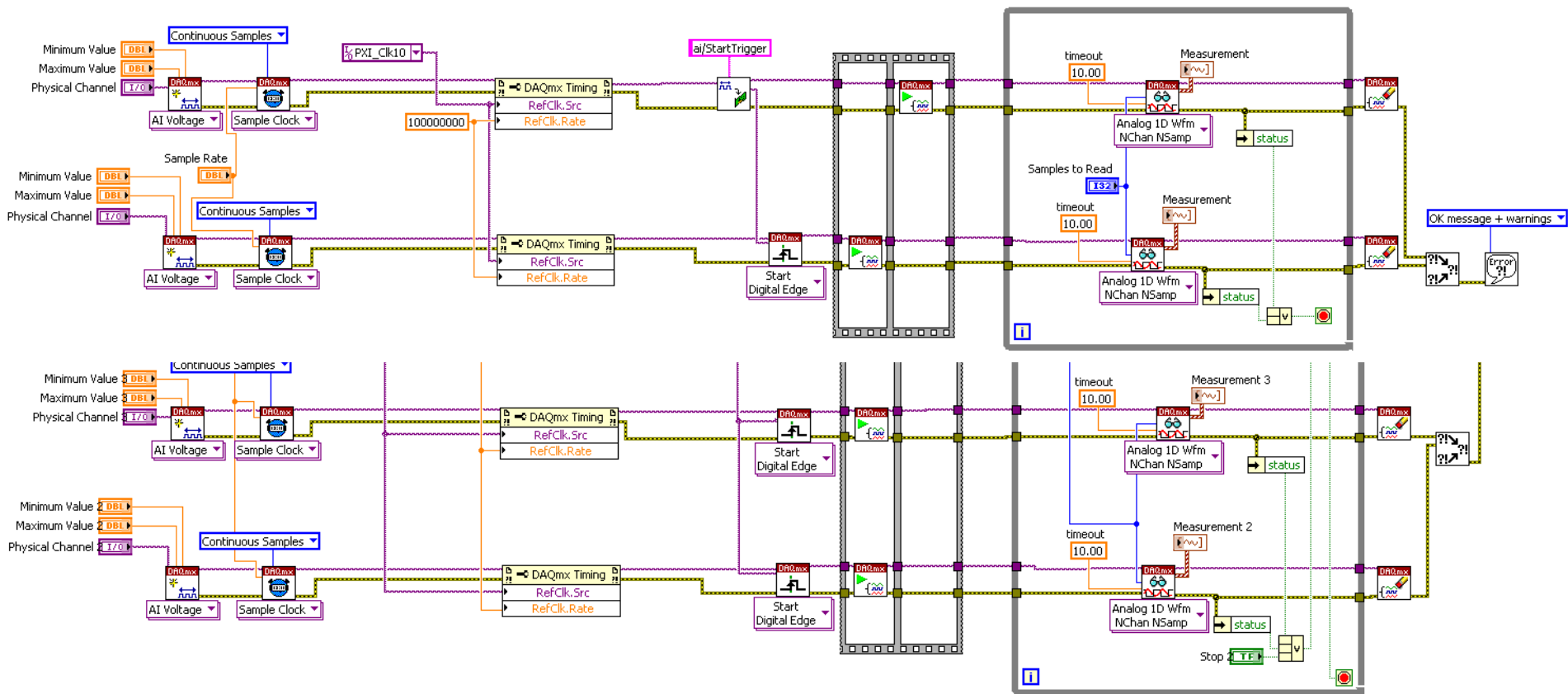
# Optimizations for Single-Point Control



- Analog I/O, digital I/O, and counter I/O support this mode

# Synchronizing Multiple Devices

## M Series

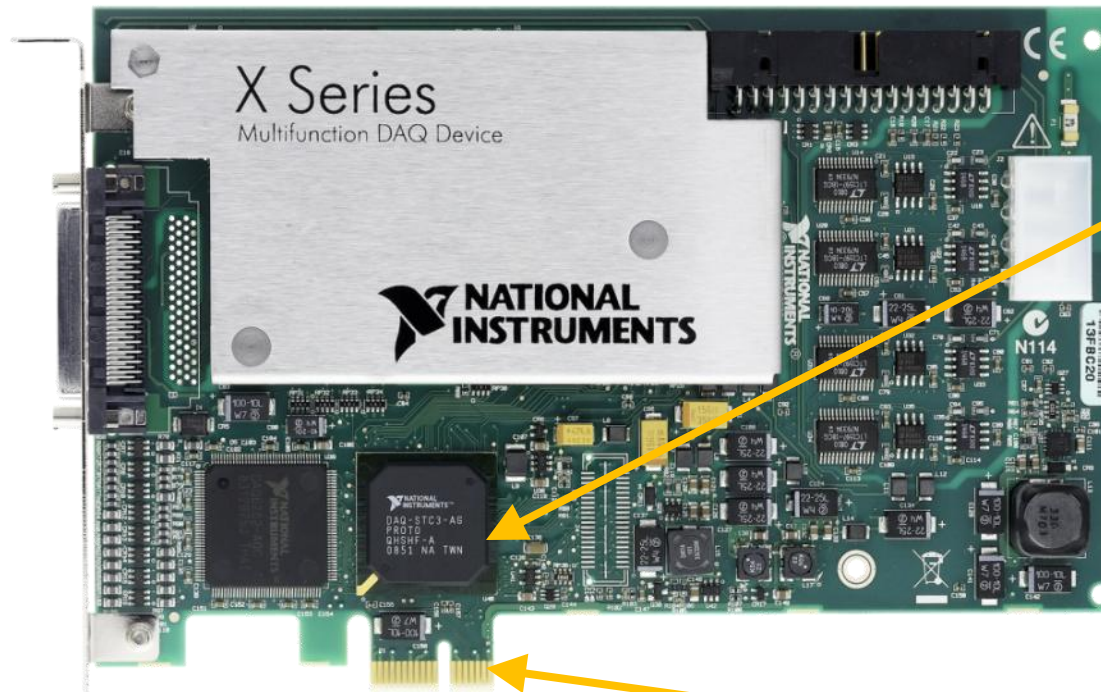






# DEMO: MULTIDEVICE SYNCHRONIZATION AND DATA LOGGING

# X Series Key Features



NI-STC3 timing and synchronization technology

NI-DAQmx software optimizations

High-throughput, native x1 PCI Express interface

Price

250 to 500 kS/s



1.25 to 2 MS/s



1.25 to 2 MS/s/ch  
Simultaneous



Performance

# X Series Multifunction DAQ

- Up to 32 analog inputs, up to 2 MS/s (16-bit resolution)
- Up to 4 analog outputs, up to 3.33 MS/s (16-bit resolution)
- Up to 48 digital I/O lines, up to 10 MHz
- Four 32-bit counters on each device



# What Has Not Changed

## Connector

- VHDCI connector
- Pinouts

## API

- NI-DAQmx 9.0

## Price

- More functionality at the same price points



# Questions?





# Summary

- Three AI Timing Engines
- Built In BNC Triggers
- Four Counters
- Locking USB Cable
- 4 and 8 Slot Chassis



CompactDAQ

- low-cost to 2 MS/s/ch
- Digital timing engine
- easily upgrade existing data acquisition systems
- Native PCI Express interface
- Easy multidevice tasks and datalogging



X Series