



# LabVIEW User Group Meeting

*Long Island Chapter*

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ni.com



# USB Data Acquisition with LabVIEW

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National Instruments



# USB Data Acquisition



[ni.com](http://ni.com)

# USB for Data Acquisition

- Hi-Speed bandwidth makes waveform transfer more feasible
- External components for easy hardware setup and rental PC restriction avoidance
- Easiest device detection of any bus



# USB Specification

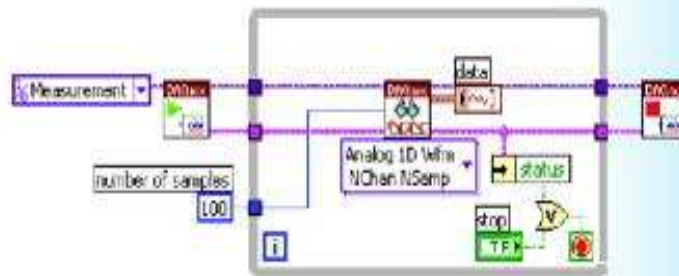
- Designed to help standardize consumer PC products
- **Ease of use** was a top design criteria
- USB 2.0 standardized at the end of 2001
  - Needed for higher-bandwidth devices



# USB Ease of Use with NI CompactDAQ



**DEMO**



# Compatibility

- USB devices are backward compatible
- Hi-Speed devices can operate in a low-speed hub at low speed
- Hub performance with multiple devices varies by manufacturer and design



# Full-Speed versus Hi-Speed

Bandwidth is independent of specification version.

**Not all USB 2.0 devices are Hi-Speed.**

Look for speed rating.

|            |                    |
|------------|--------------------|
| Low-Speed  | 1.5 Mb/s           |
| Full-Speed | 12 Mb/s            |
| Hi-Speed   | 480 Mb/s (60 MB/s) |

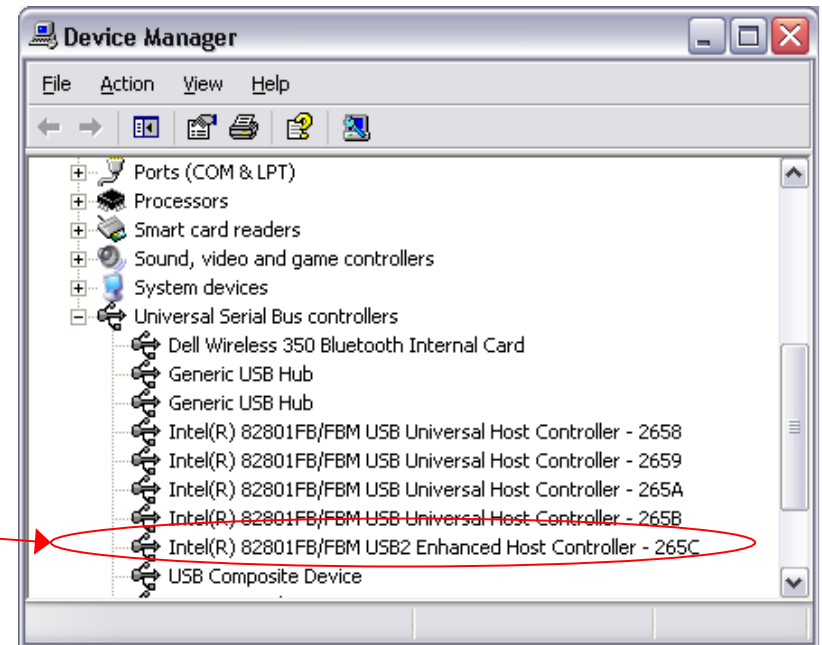




# Available Bandwidth

- Each Hi-Speed root hub has an available 60 MB/s
- Most PCs have 1 or 2 Hi-Speed root hubs
- All connected devices share root hub bandwidth

Look for the word “enhanced” in Windows device manager.

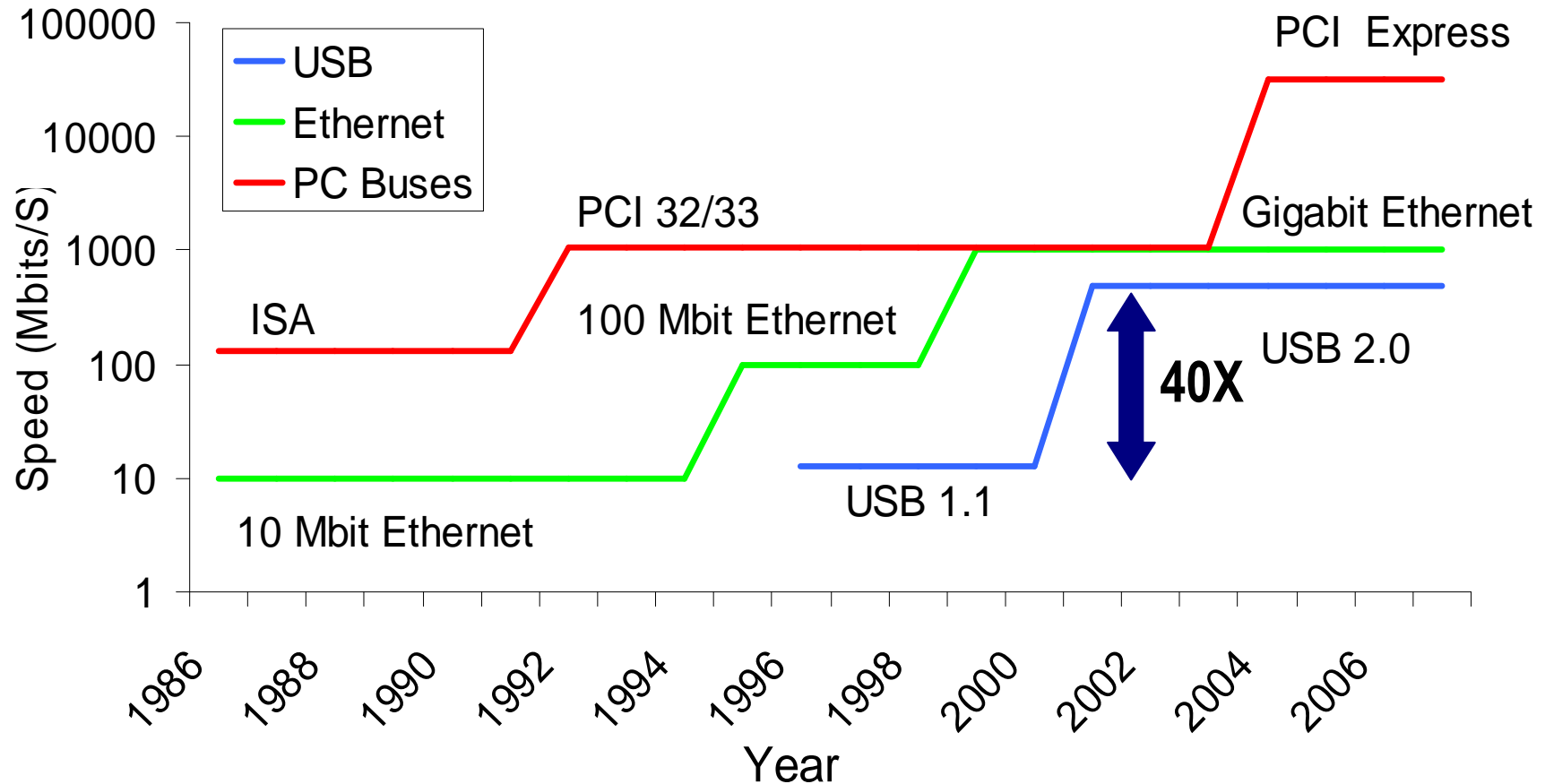


# Different Buses for Different Requirements

- **USB**
  - Easiest setup and user experience
  - No internal PC installation
  - Almost 5X faster than LAN
- **Ethernet**
  - Over great distance
  - Many users for one network device
- **PCI/PXI Express**
  - Highest throughput to PC memory
  - Best synchronization
  - Widest array of measurement modules



# Rapid Evolution of PC Bus Technology



# Hi-Speed Enables Multi-ADC Systems

## DMM-Based Systems



## NI CompactDAQ



# Shared Bandwidth

60 MB/s total per root hub



# USB Distance

- 5 m cables between up to 5 hubs (30 m total)
- Some companies make USB extenders
  - CAT 5
  - Fiber
  - Wireless



# USB Transfers

| Transfer Type | Format      | Retry on Error | Available Bandwidth                    |
|---------------|-------------|----------------|--|
| Control       | USB-Defined | Yes            | 20% of Frame - HS<br>10% of Frame - FS |
| Isochronous   | Raw         | No             | 80% of Frame - HS<br>90% of Frame - FS |
| Interrupt     | Raw         | Yes            |  |
| Bulk          | Raw         | Yes            | Uses All Available Bus Bandwidth       |

No Lost Data



# USB DAQ Improvements

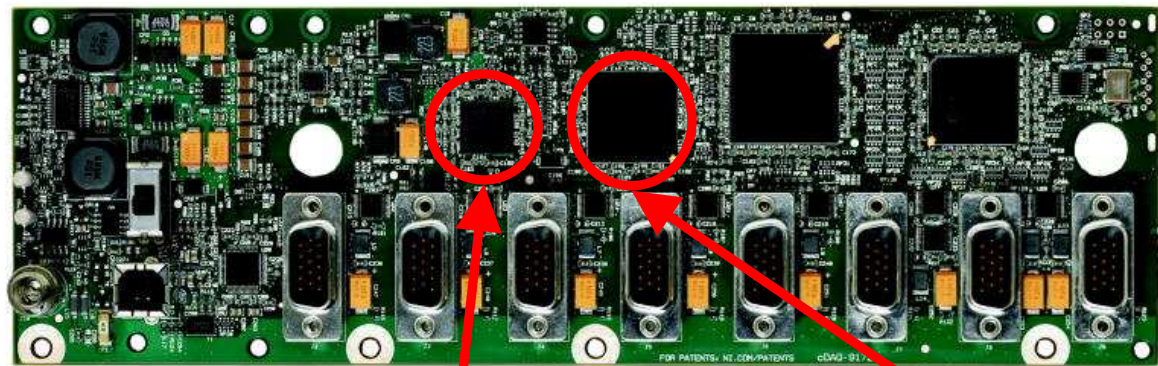
|                              | OLD                                  | NEW  |
|------------------------------|--------------------------------------|--|
| Simultaneous AI/AO streaming | Difficult due to device restrictions | Signal streaming technology for up to 4 data streams |
| Single-point performance     | Less than 10 Hz for some AO          | More than 2 kHz for some AO                          |
| A/D converters               | Single A/D converter                 | Multiple A/D per system for up to 32 total           |





# NI Signal Streaming Technology

- Simultaneous waveform I/O
- High-speed streaming
- NI CompactDAQ and USB M Series



**Microcontroller**

**USB  
Communication**

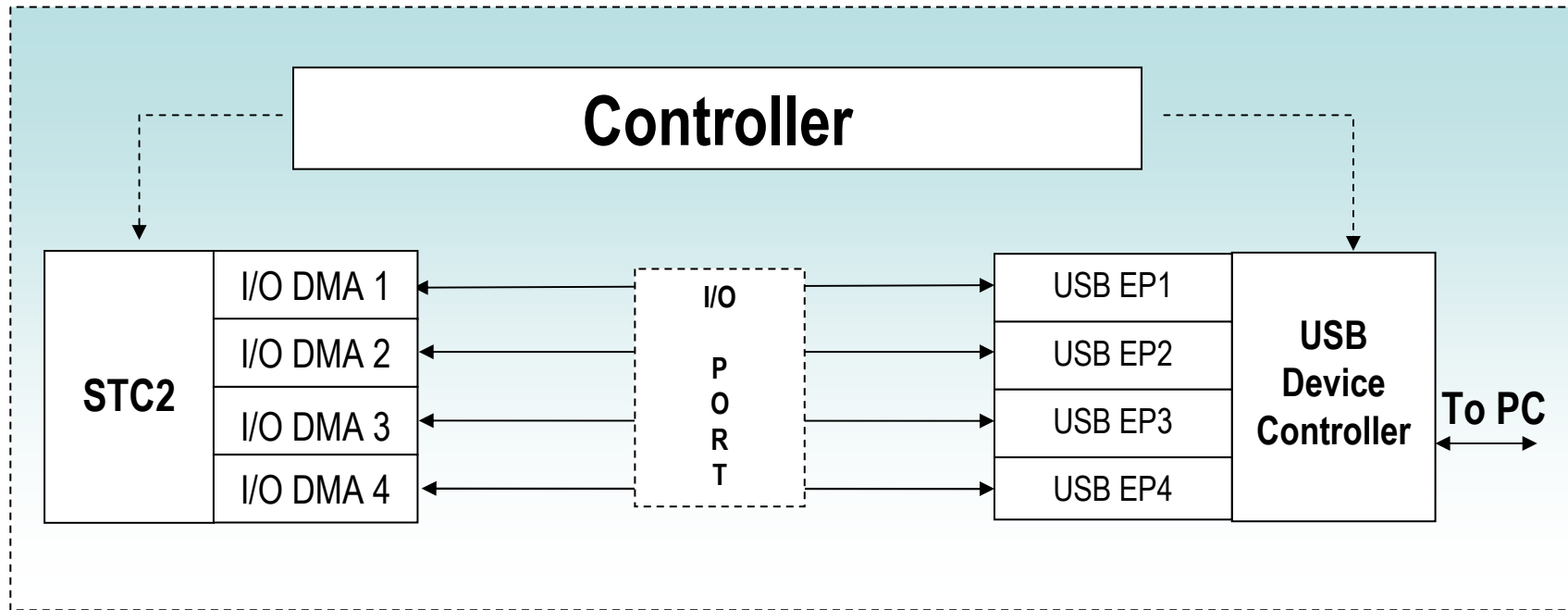


# A More Intelligent Device

- Device contains element of driver



# NI Signal Streaming Technology

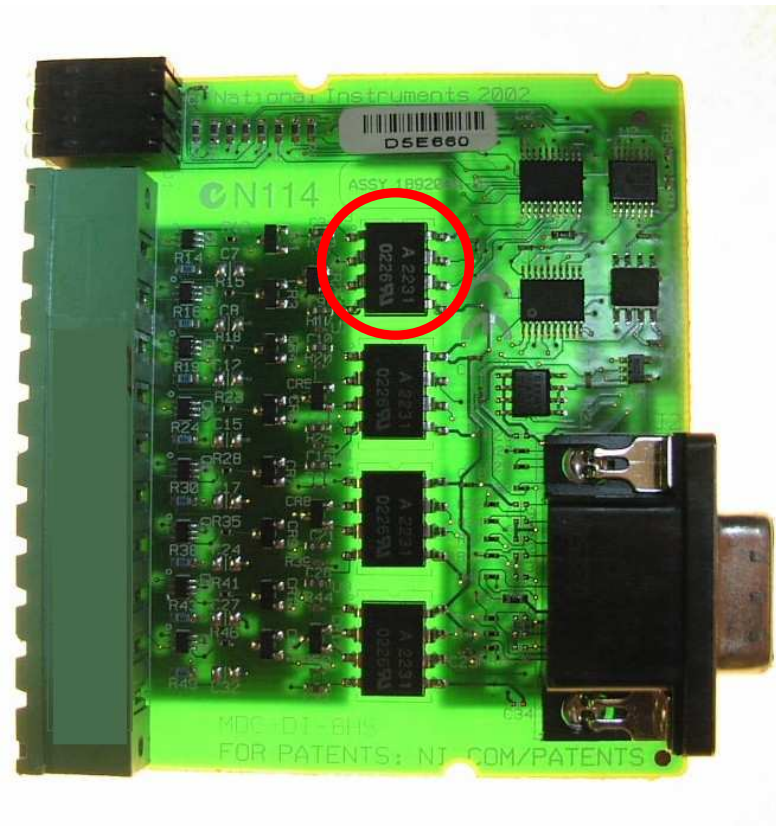


# Demo: Simultaneous Data Streaming



# Isolation Technology

- Avoid ground loops
- System and user safety
- Measure small signals on a large potential



# The NI USB Family

Bus-Powered

Modular I/O for  
Sensors



1.25 MS/s AI/AO

Low-Cost



# Visit the Consultation Zone

- Discuss products and configure your application
- Obtain estimated costs or a quote to take with you
- Request a free consultation – an NI engineer will come to your office to:
  - Discuss your application and specialized topics
  - Demonstrate customized applications, examples, and products
- Schedule an onsite seminar at your location



# Robert Berger

- BS Electrical Engineering from Texas A&M
- Joined NI's Engineering Leadership Program in 2001
- Supported and trained customers for ~4 years
- Migrated to Long Island in April 2007
- Covers Long Island and NYC
- Available for demos, onsite seminars, technical consultation, specification assistance, loaner equipment...

