Optimizing Measurement Speed and Test Execution with Parallel Technologies

Agenda

- Three characteristics of a digital RF analyzer (VSA)that affect overall measurement time
  - Real-time bandwidth
  - Instrumentation bus
  - Processing capabilities
- Parallel test execution with NI TestStand
  - Sequential execution
  - Parallel execution
  - Autoscheduled execution

Anatomy of overall test time for DUT

Set up UUT (Synch, RF Ch, Power Lev) → Acquire data for measurements → Transfer Data to CPU → Perform measurements

Set up UUT
- Test modes in baseband chip software
- Control interface to UUT (Serial, USB, etc…)

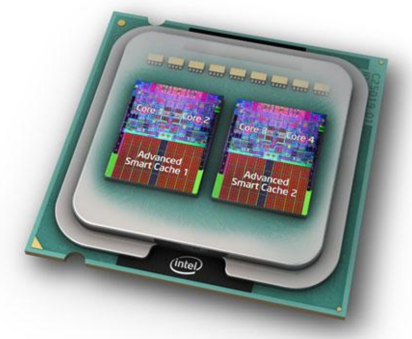
Acquire data for measurements
- **Averaging**
- **Real-time bandwidth**

Transfer Data to CPU
- **Instrumentation bus**

Perform measurements
- **Processor speed**

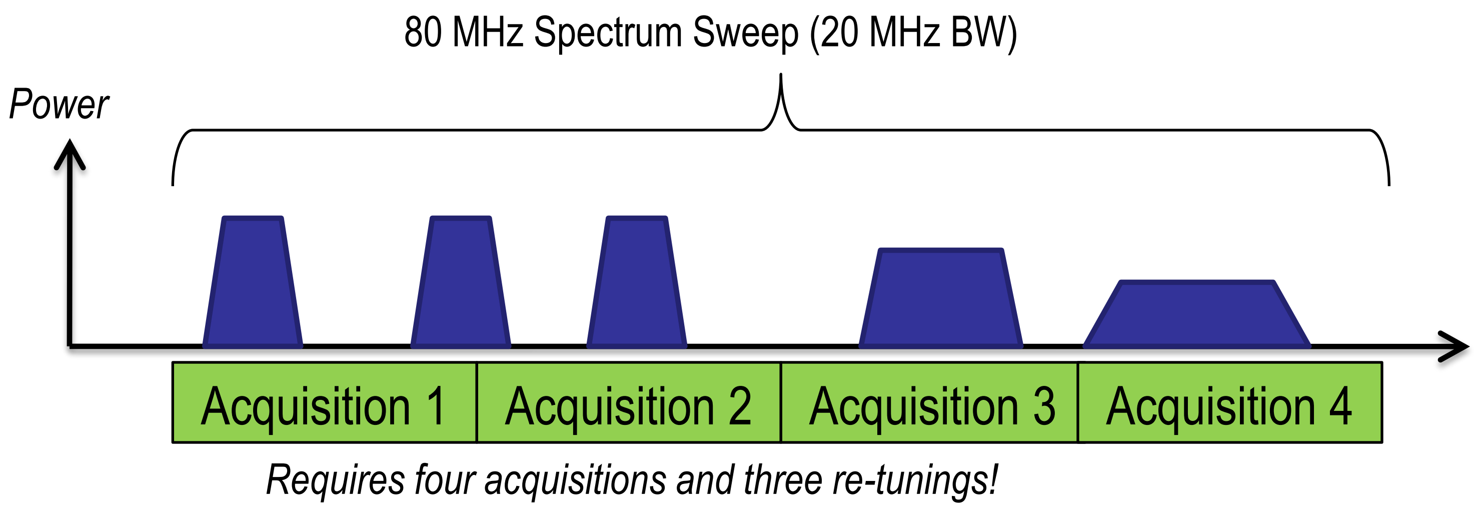
NATIONAL INSTRUMENTS™ TestStand™

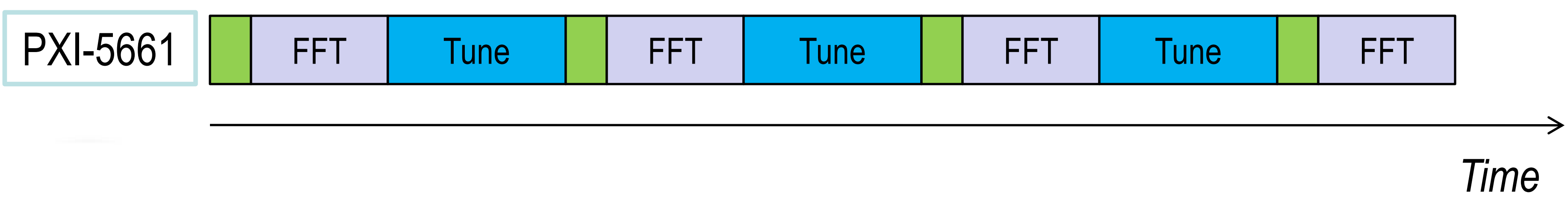
PCI EXPRESS®



Real-Time Bandwidth

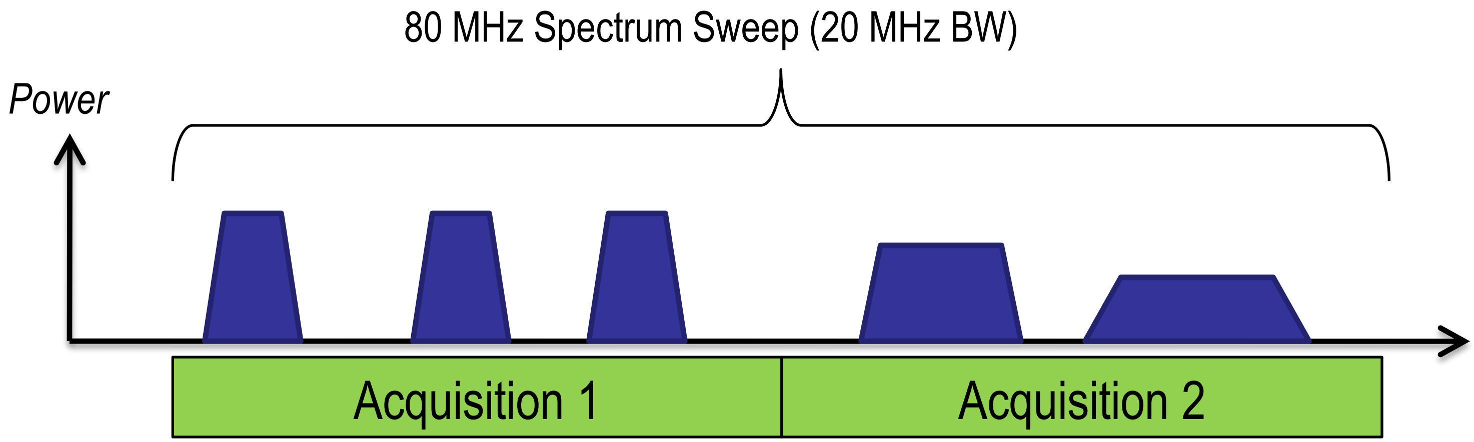
Acquire data with a 20 MHz BW RF analyzer





Real-Time Bandwidth

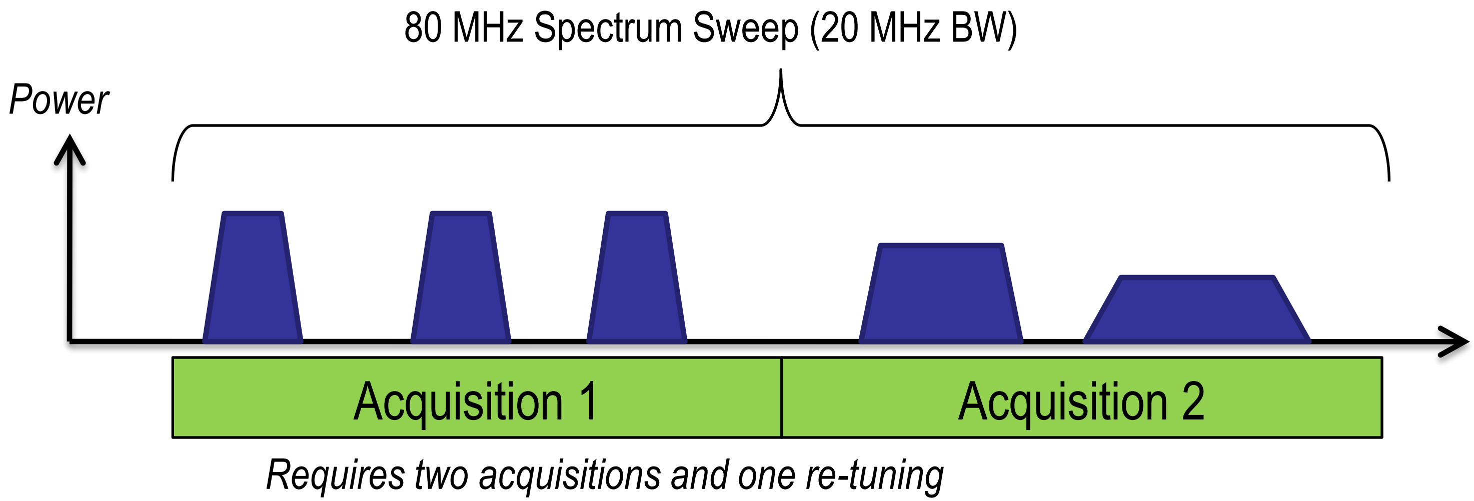
Acquire data with a 50 MHz BW RF analyzer

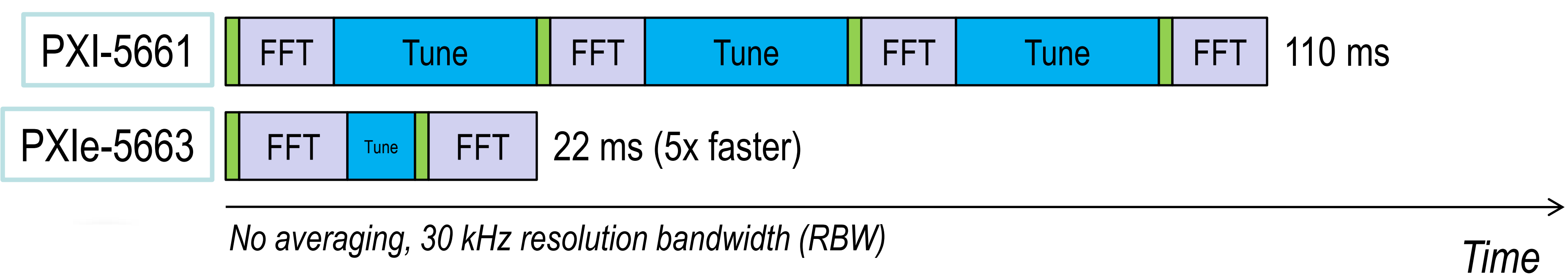


Requires two acquisitions and one re-tuning

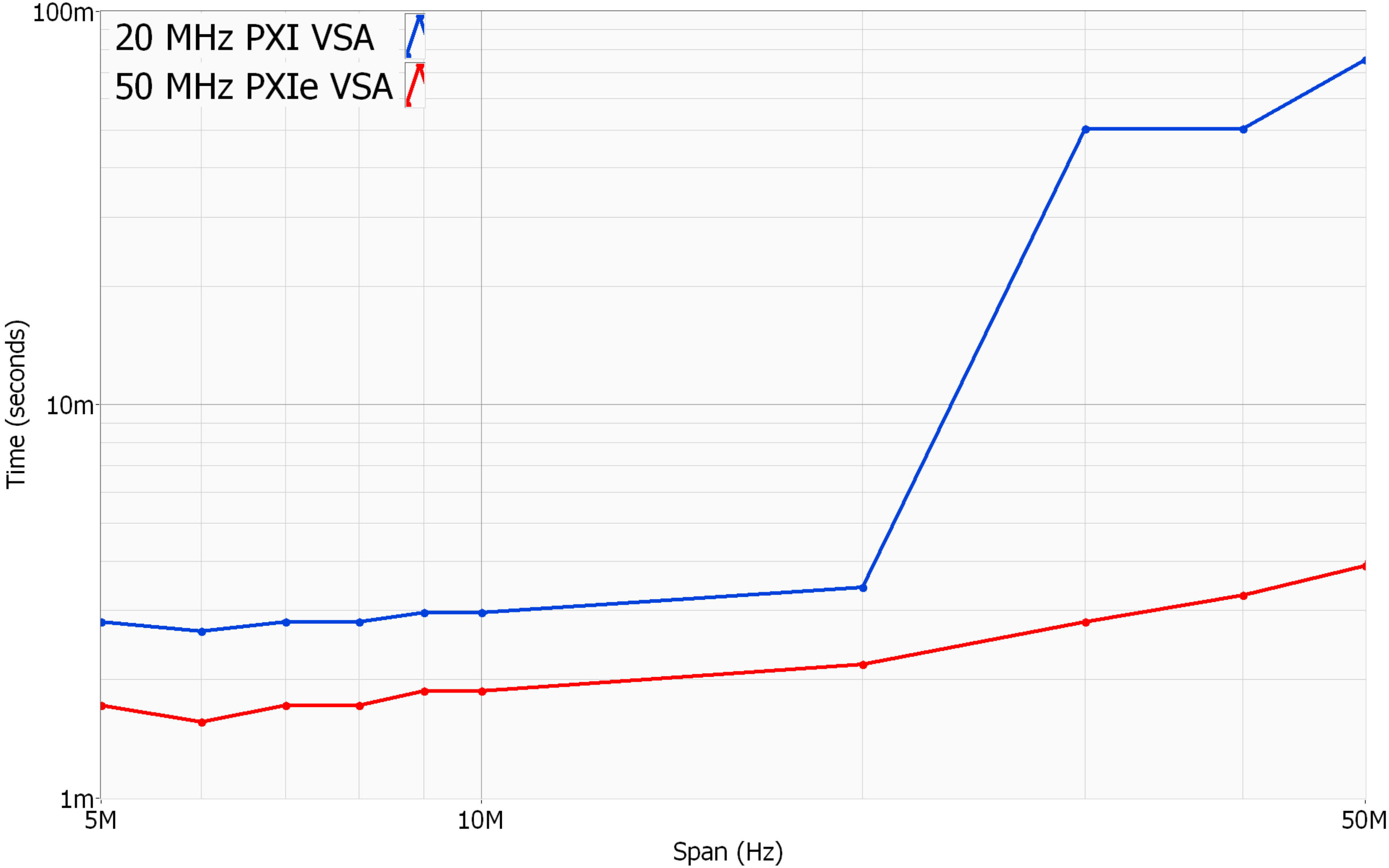
Real-Time Bandwidth

Acquire data with a 50 MHz BW RF analyzer





Measurement Time vs. Span (30 kHz RBW)



Instrumentation bus

Example: 50 MHz spectrum measurement in a 30kHz RBW

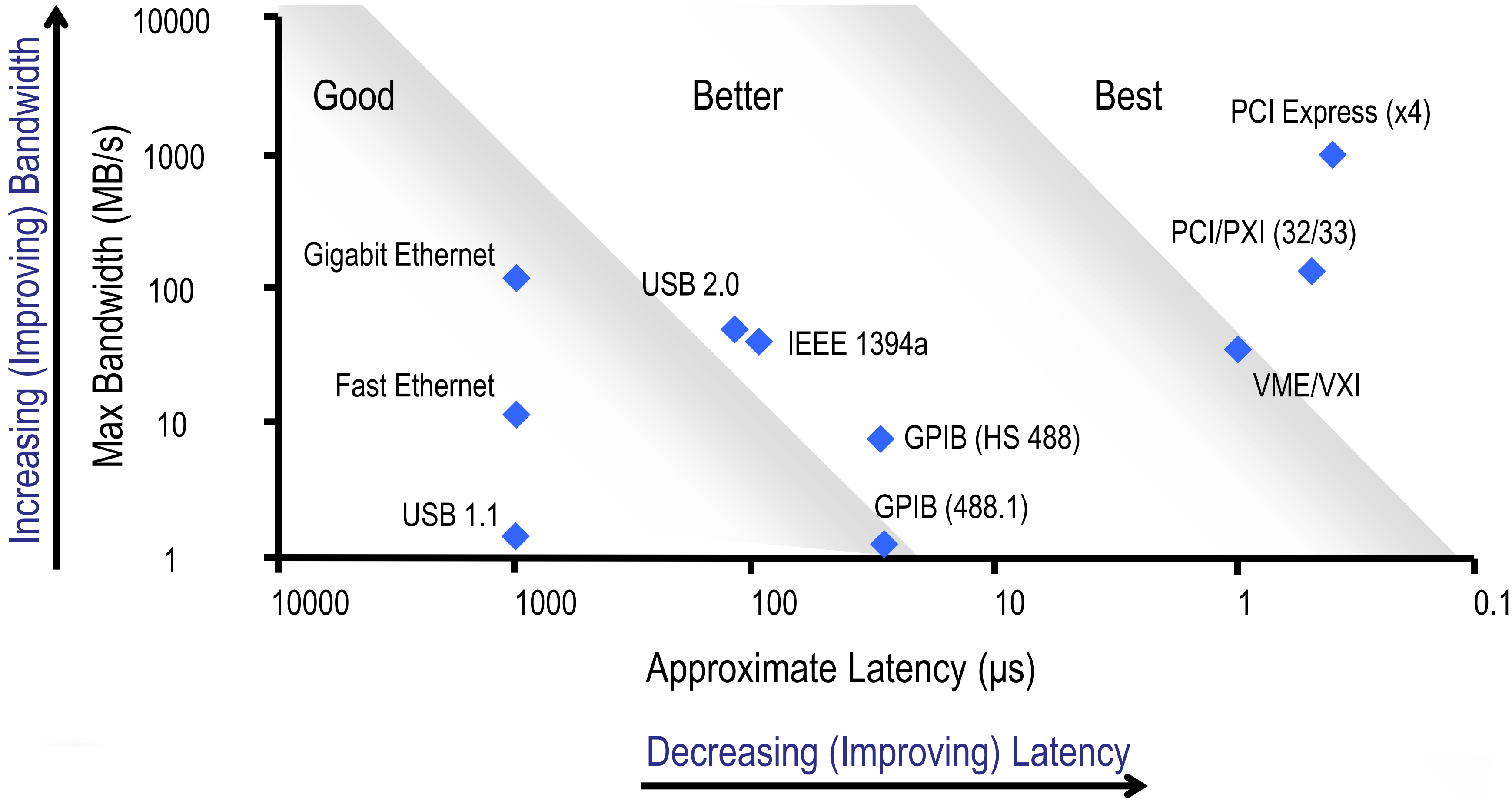
$$AcquisitionTime = \frac{1}{RBW}$$

- For 30 kHz RBW, acquisition time = 33.3 µs

$$FFTSamples = \left(\frac{1}{RBW}\right) \times 1.25 \times Bandwidth$$

- For 50 MHz span, sample rate = 62.5 MS/s
- FFT Samples = 2082 (8328 bytes)

Bandwidth vs. Latency



Instrumentation bus

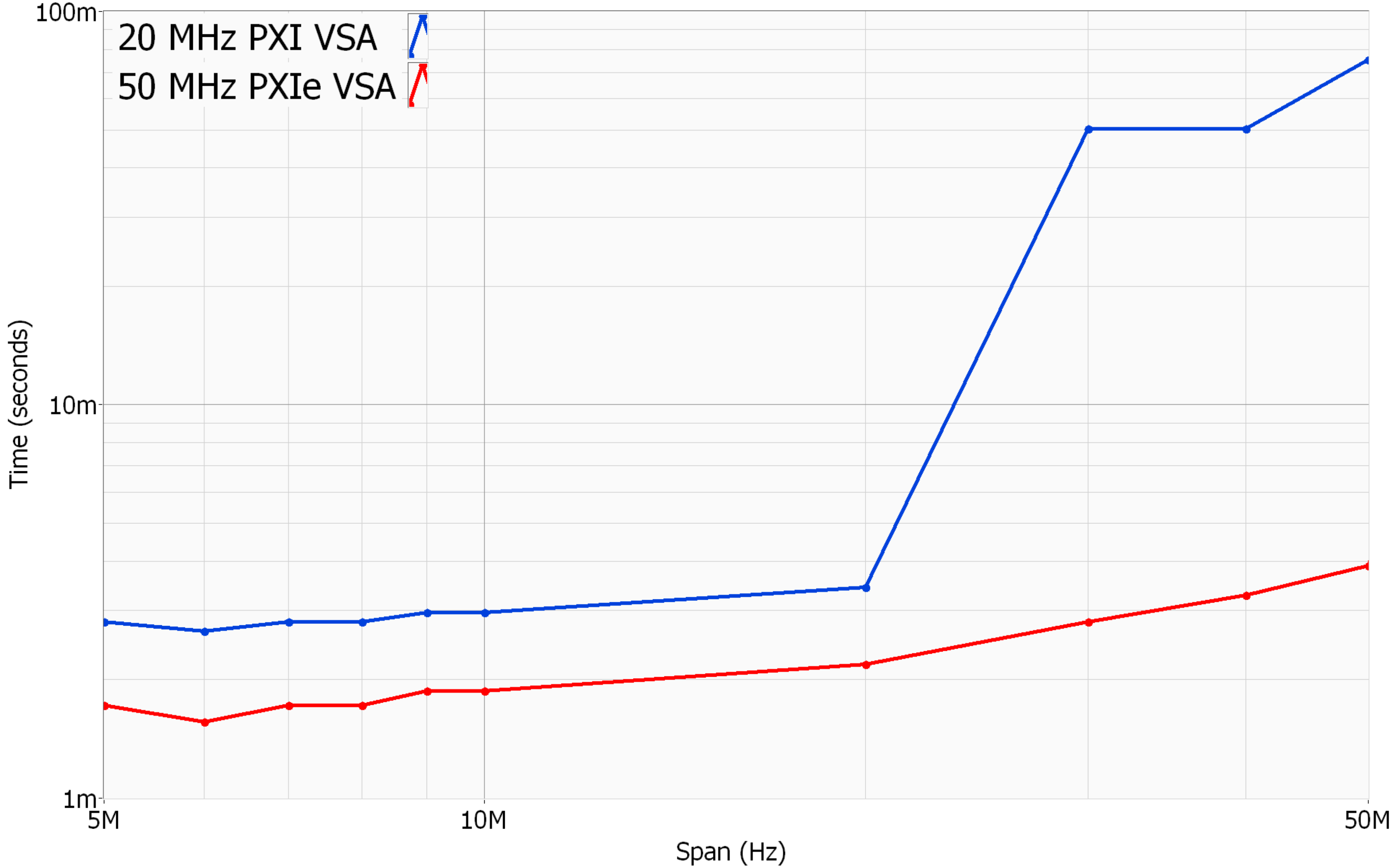
Example: 50 MHz spectrum measurement in a 30kHz RBW

$$\text{Transfer Time} = \frac{DataSize}{DataRate} + Latency$$

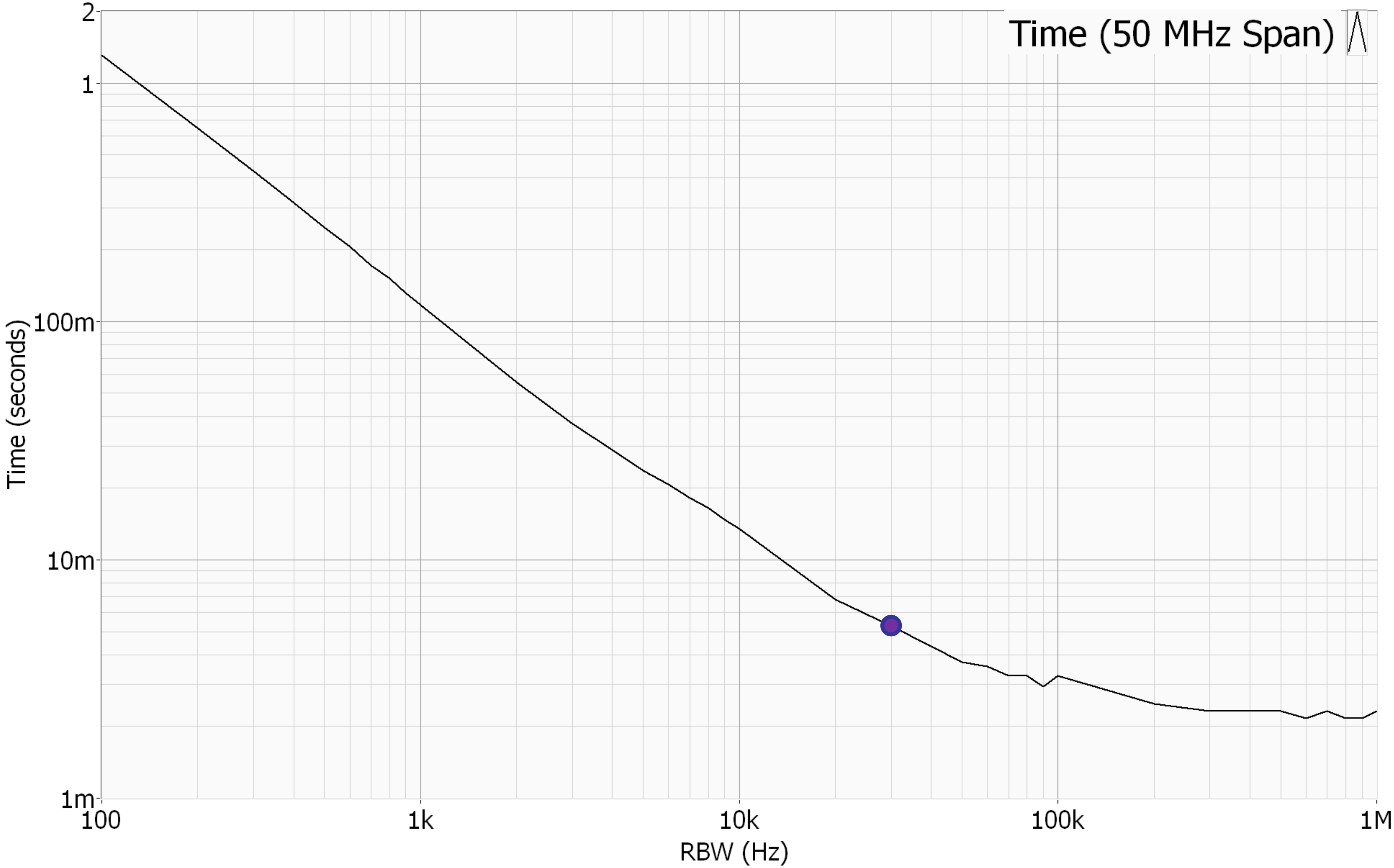
$$\text{Transfer Time} = \frac{8000\,bytes}{800\,MB/s} + 0.7\,\mu s = 10.7\,\mu s$$

$$\text{Acquisitio n Time} + \text{Transfer Time} = 33\,\mu s + 10.7\,\mu s = 43.7\,\mu s$$

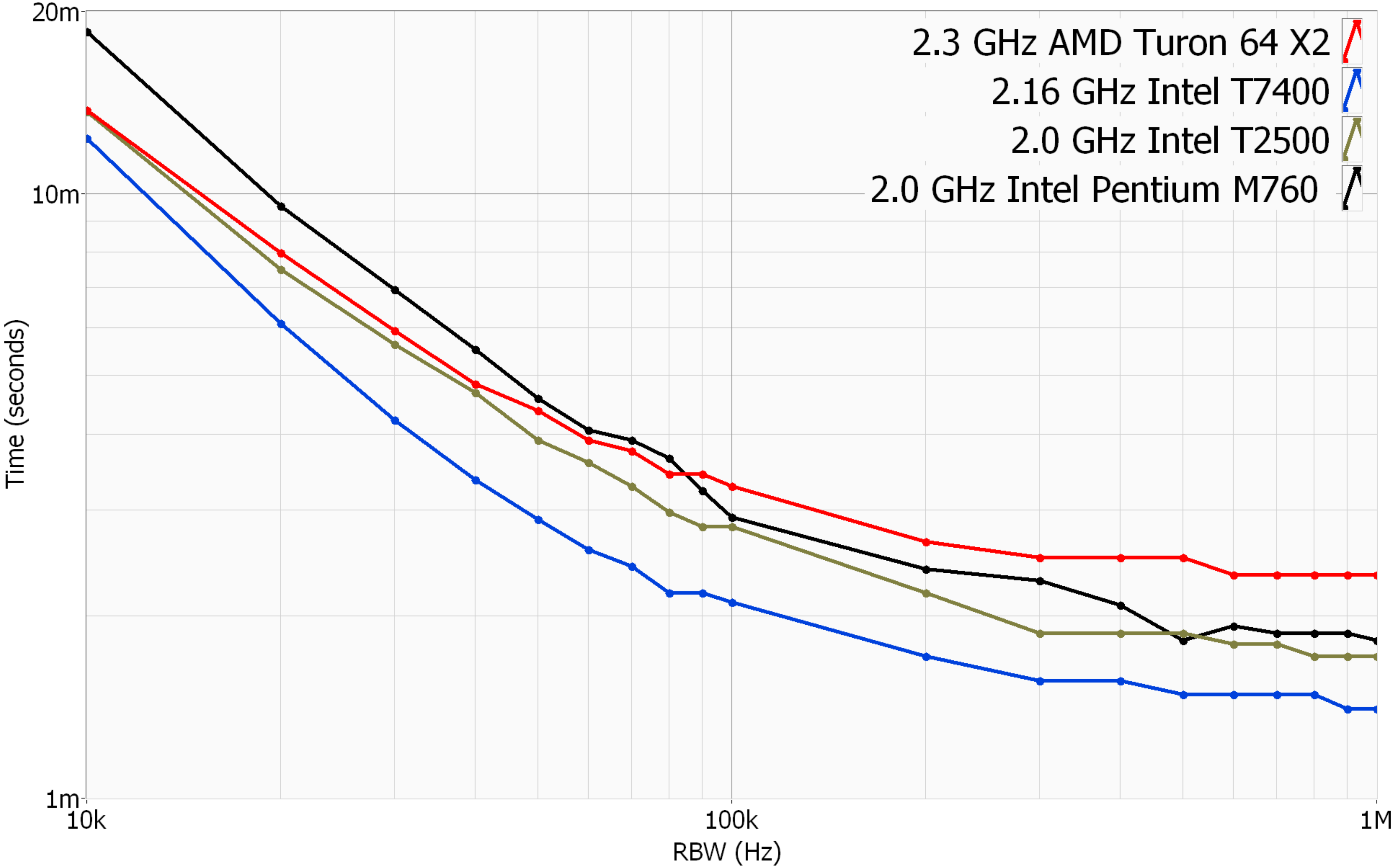
Measurement Time vs. Span (30 kHz RBW)



Measurement Time vs. RBW (PXIe-5663)



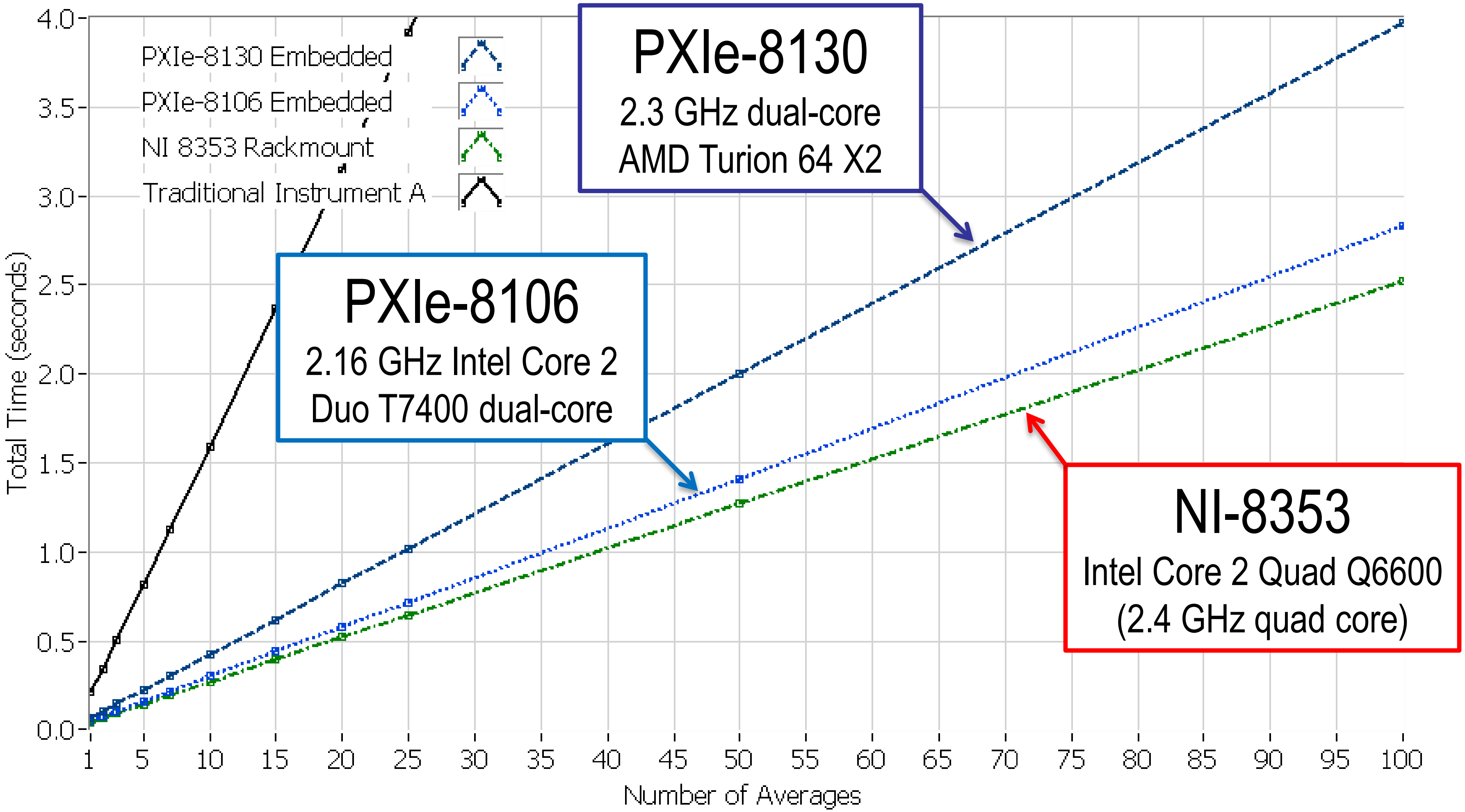
Measurement Time vs. RBW



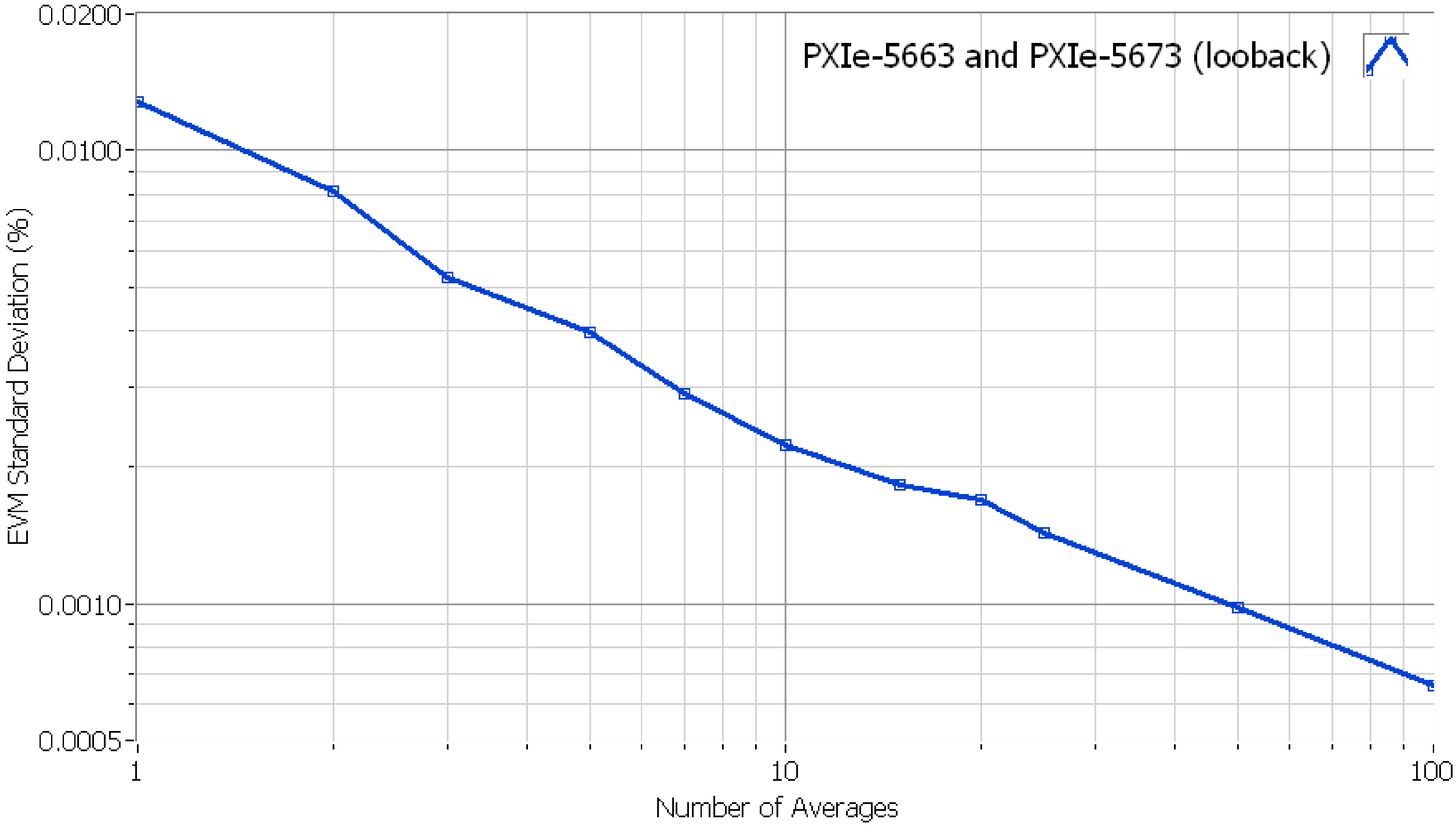
PXIe-5663: WCDMA Benchmark

- WCDMA is a good proxy for instrument performance
- Benchmark compares NI 5663 vs. a traditional instrument
  - WCDMA Measurement algorithms
  - Benchmark accounts for configure + measurement time
- Compares measurement time vs. # of averages

EVM Measurement Time vs. Number of Averages



EVM STD Deviation vs. Number of Averages



*Mean EVM was 0.692% over 2600 chips – inherent instrument EVM ranges from 0.65% to 0.85%

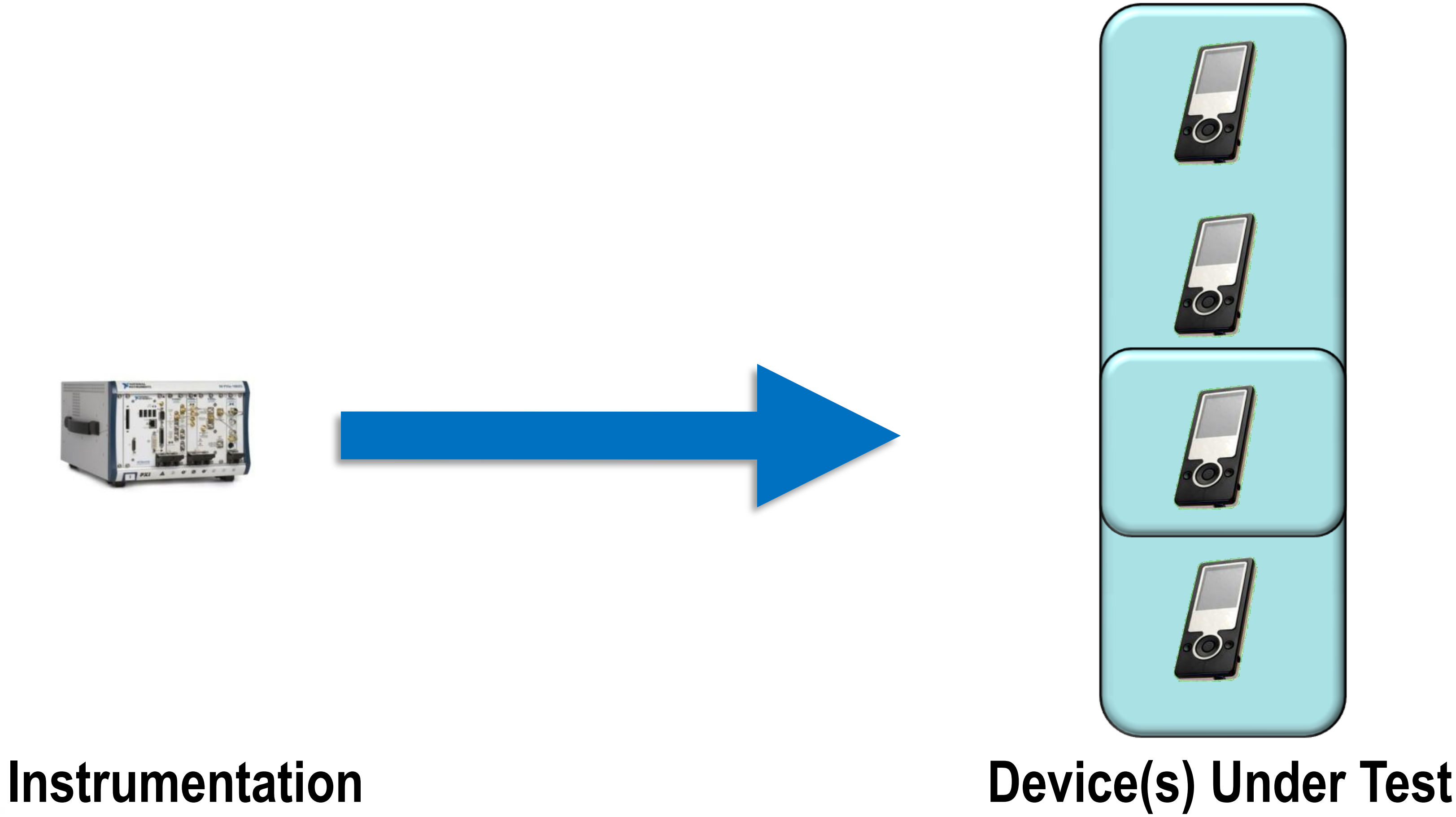
Conclusion

- Measurement speed is important in automated test systems
- CPU processing time is a very important contributor to overall measurement time
- Modular instrumentation enables customization of measurement hardware by choosing a CPU independently of the measurement front end

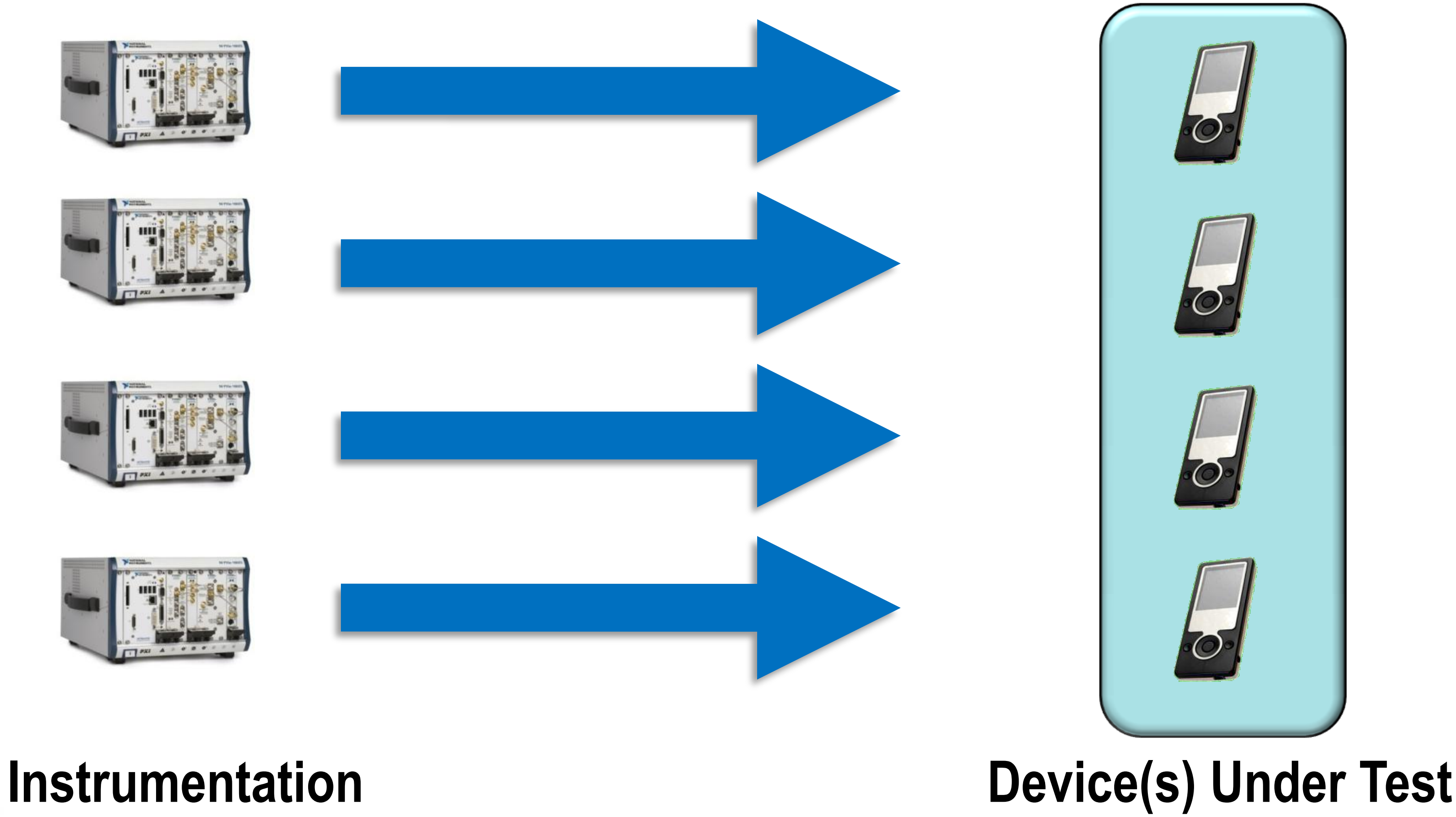
Agenda

- Three characteristics of a digital FFT analyzer that affect overall measurement time
  - Real-time bandwidth
  - Instrumentation bus
  - Processing capabilities
- Parallel test execution with NI TestStand
  - Sequential execution
  - Parallel execution
  - Autoscheduled execution

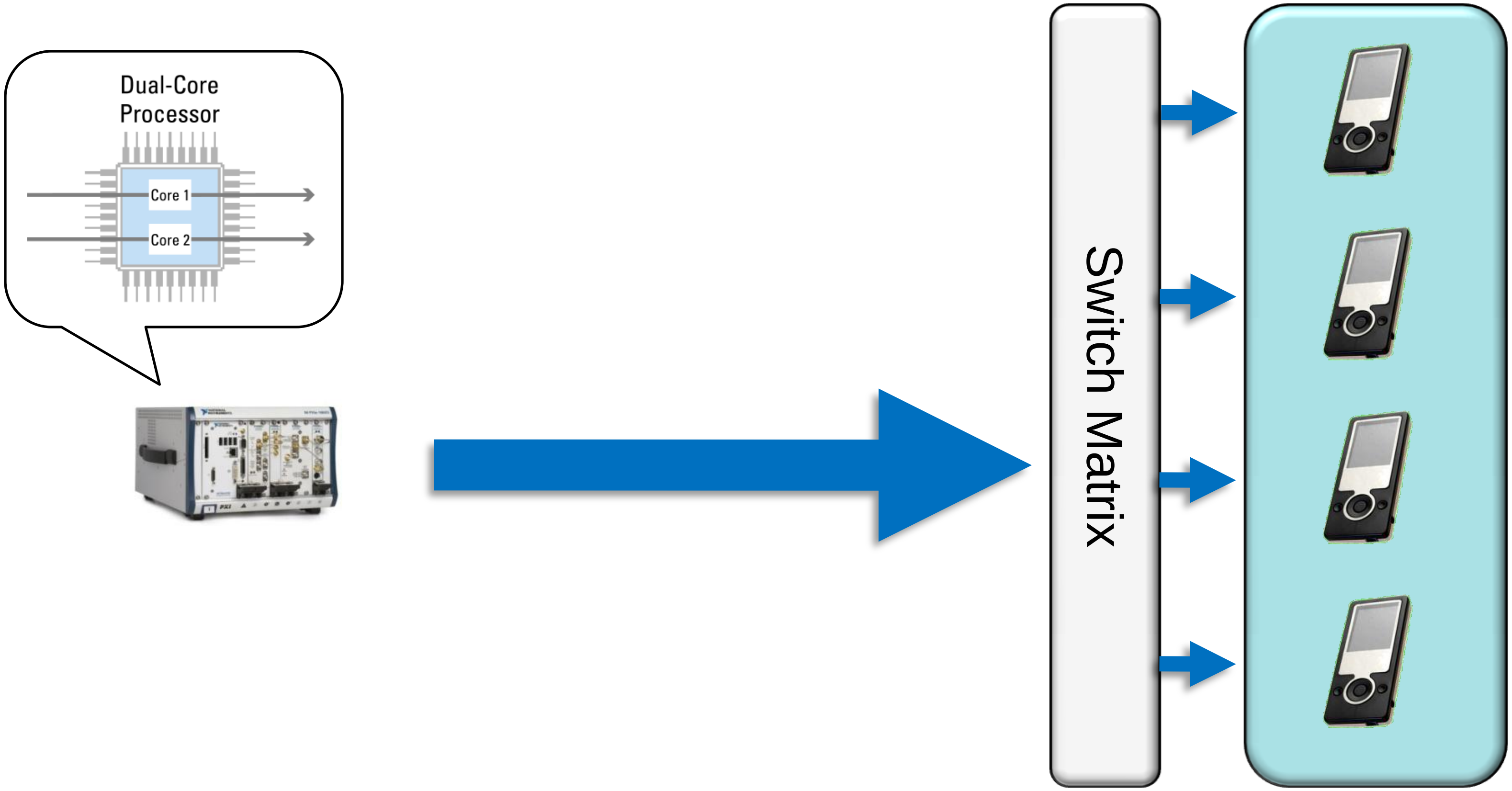
Introduction to Parallel Test



Introduction to Parallel Test



Introduction to Parallel Test



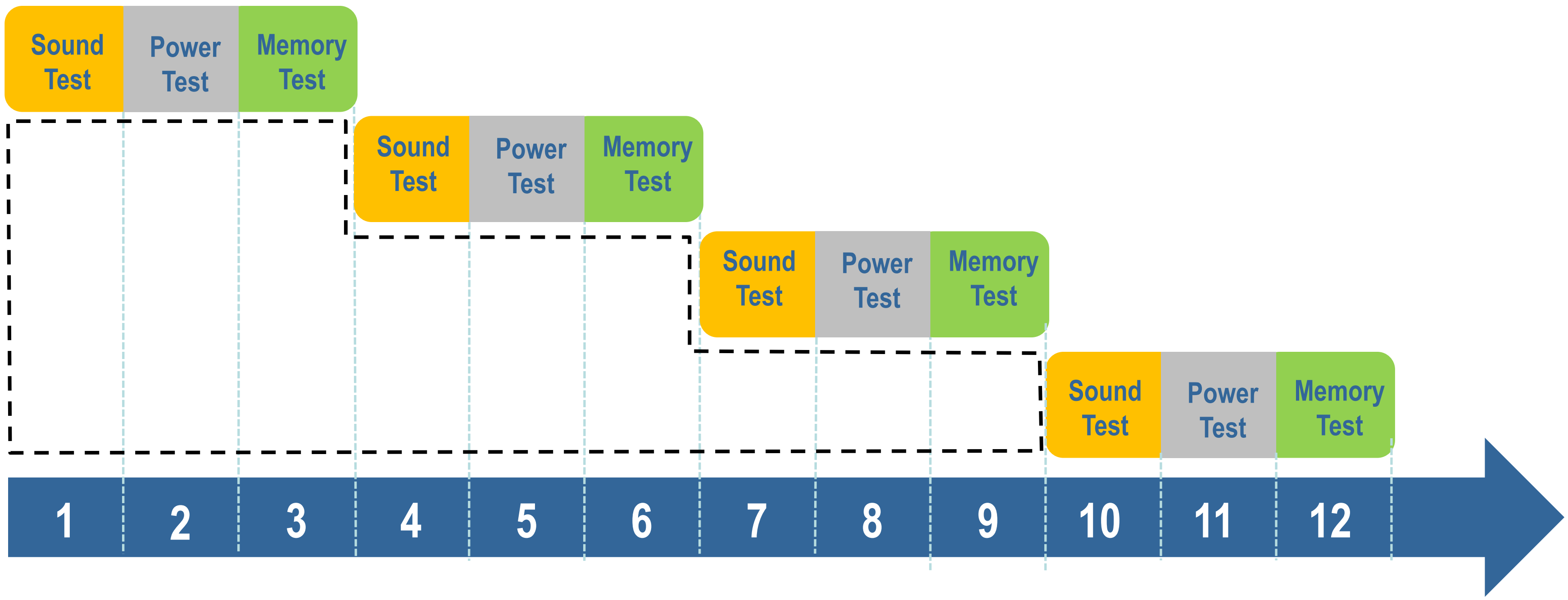
Instrumentation

Device(s) Under Test

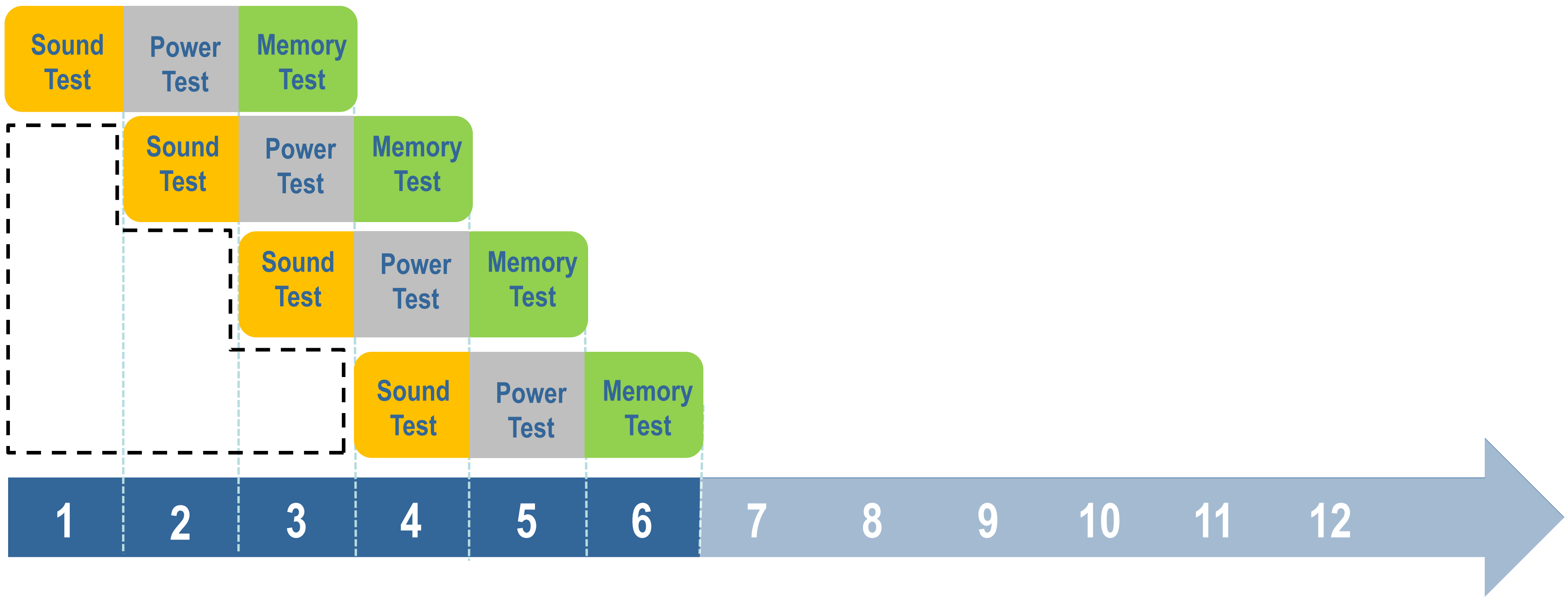
Parallel Test Application

- **Automated Tests**
  1. Sound Quality Test
     - Digitizer
  2. Power Consumption Test
     - Power supply
     - Digital multimeter
  3. Memory Test
     - High-speed digital I/O

Sequential Execution



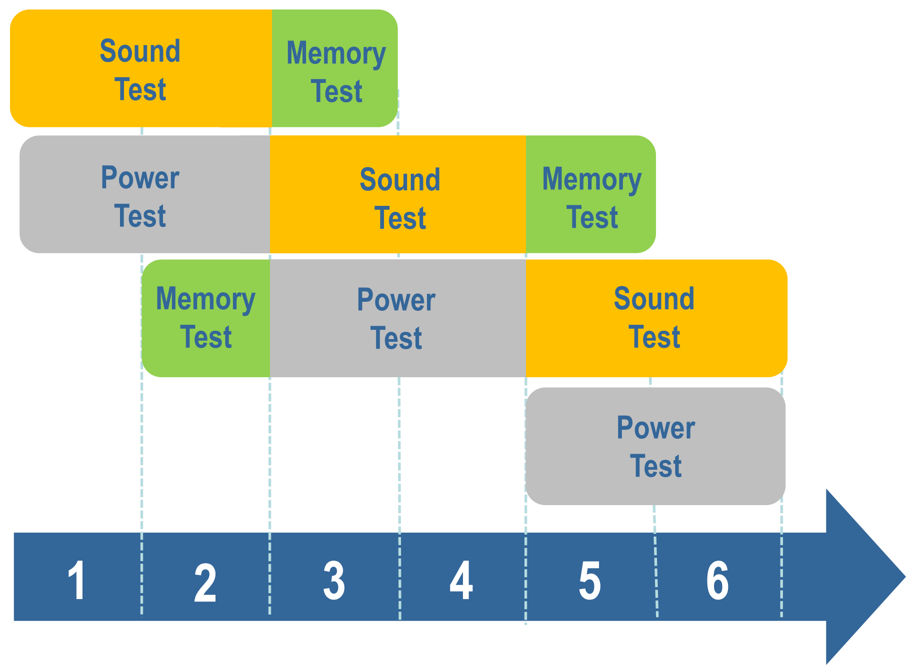
Parallel Execution – Pipelining



Autoschedule Execution

Additional Parallel Optimization

- Balance tasks
  - Try to make tasks take similar amounts of time
  - Use autoscheduling if task times are different
- Consider cores
  - Try to match cores to number of units



More Resources

- Visit **ni.com/multicore**
  - Multicore Programming Fundamentals White Paper Series
  - Webcast: "*LabVIEW Under the Hood: A Decade of Running on Multiprocessor/Multicore Platforms*"
- Visit **ni.com/teststand**
  - Additional demos
  - White papers
  - Best practices