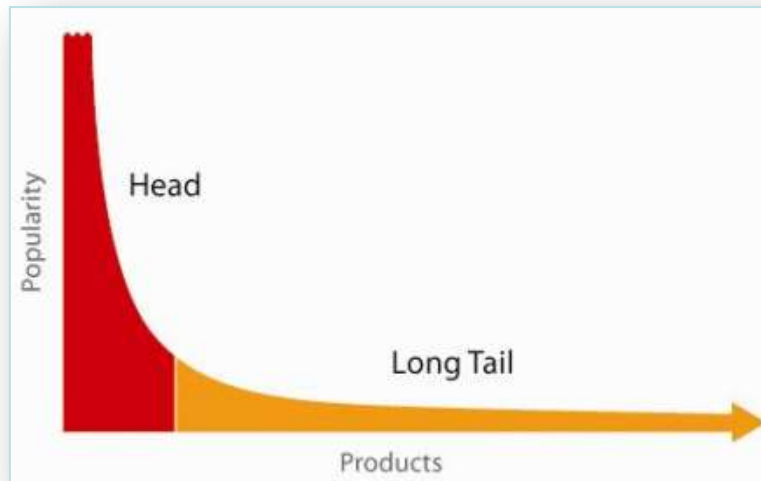


# Strategies in Software Defined RF and Wireless Communications Test

**Srini Badri**  
**Business Development Manager**  
**National Instruments**

# Wireless Technology Driving Applications

- Emergence of the Smart Phone
- Growth of the SOC



# New Long Tail Applications



GPS +  
Glonass  
Receivers



RFID Toll ways



Wireless Smart Meters



# Emergence of the Smartphone

**Ericsson: "T36"**

*First cell phone with integrated Bluetooth*



**Nokia: "9500 communicator"**

*First Nokia phone with integrated Wi-Fi*



**HTC: "EVO"**

*First WiMAX phone in the US*



1999

2000

2002

2004

2006

2010



**Benfon: "esc!"**

*First cell phone to include a GPS receiver*



**Nokia 6200**

*First EDGE phone*



**LG CU50**

*First HSDPA handset in US*

# Emergence of the Multi-Radio SOC

**Broadcom BCM4317**  
*First single-chip Wi-Fi solution (802.11b)*

**TI WiLink 6.0**  
*First integrated A-GPS + Bluetooth + FM*

**Broadcom BCM4325**  
*First integrated WLAN + FM + Bluetooth chip*



Aug-2006

Apr-2008

Feb-2010

Sep-2003

Mar-2008

Dec-2008



**Marvell 88W8688**  
*First Bluetooth + Wi-Fi single chip*

**GCT GDM7215**  
*First integrated Wi-Fi + WiMAX chip*

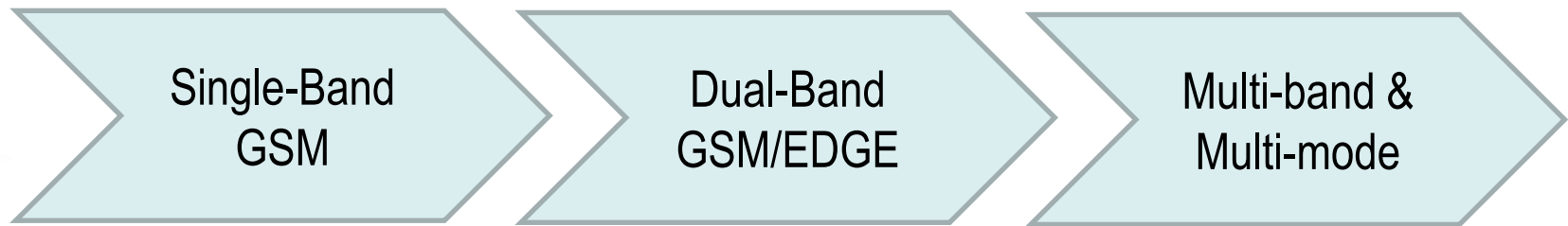
**TI WiLink 7.0**  
*First integrated 802.11a/b/g/n + FM + Bluetooth + GPS Chip*

# New Demands on RF Instruments

- Expanded Test Coverage
  - New wireless standards
  - Future wireless standards
- Better Instrument Performance
  - Better RF measurement accuracy
  - Faster measurement speed

## Evolution of the Cellular PA

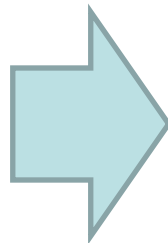
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# Evolution of the RF Instrument



Discrete single-function  
VSA's and VSG's



1-button and 1-function  
VSA+VSG Testers

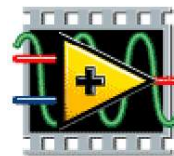


Multicom and testers  
with multiple RFports

# Four Key Measurement Technologies



PCI   
**EXPRESS<sup>®</sup>**



NATIONAL INSTRUMENTS

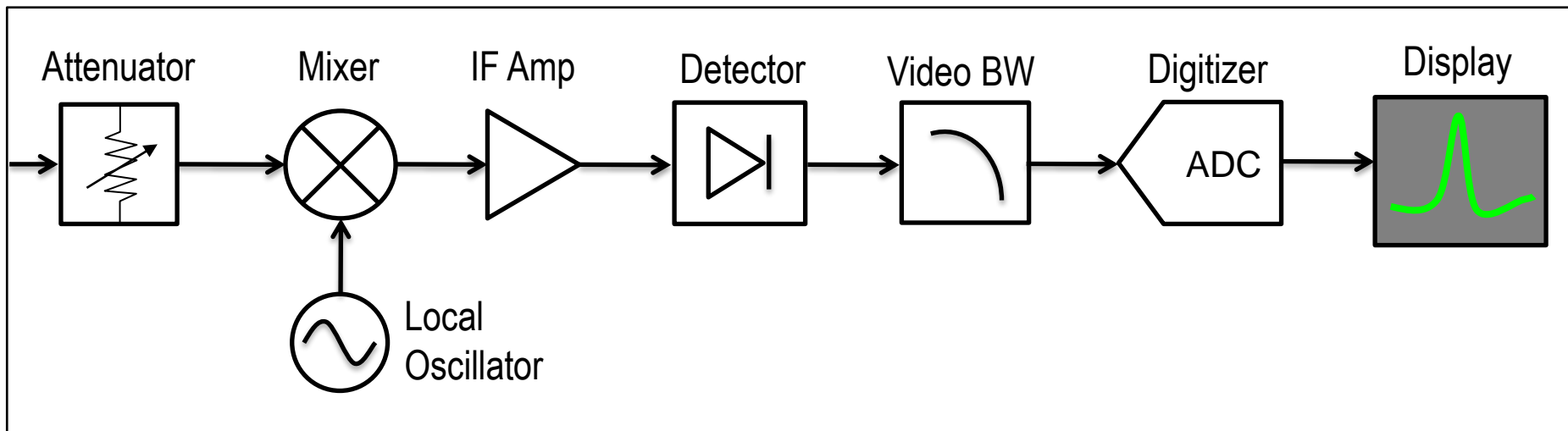
**LabVIEW**

# The Traditional Spectrum Analyzer

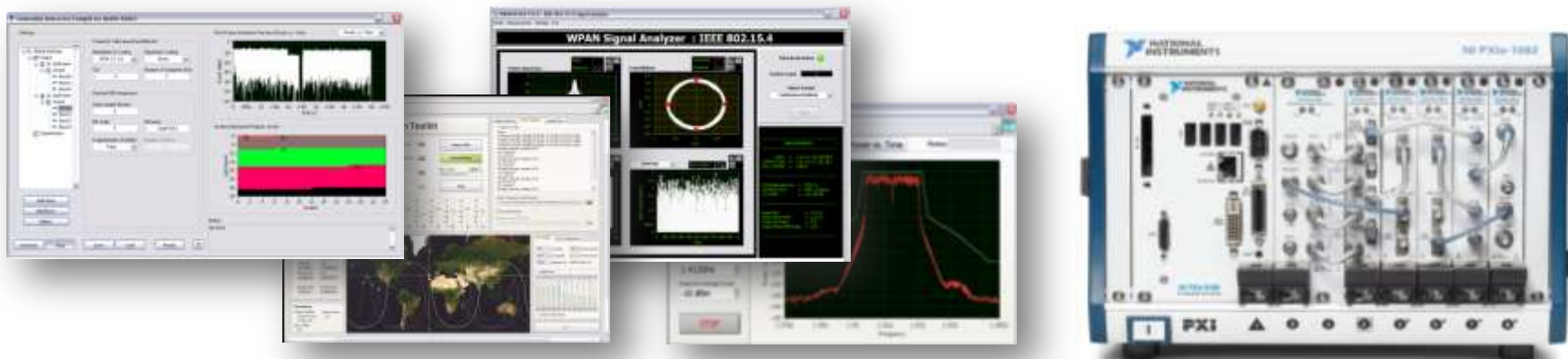
- Uses swept-tune approach
- Automated through GPIB



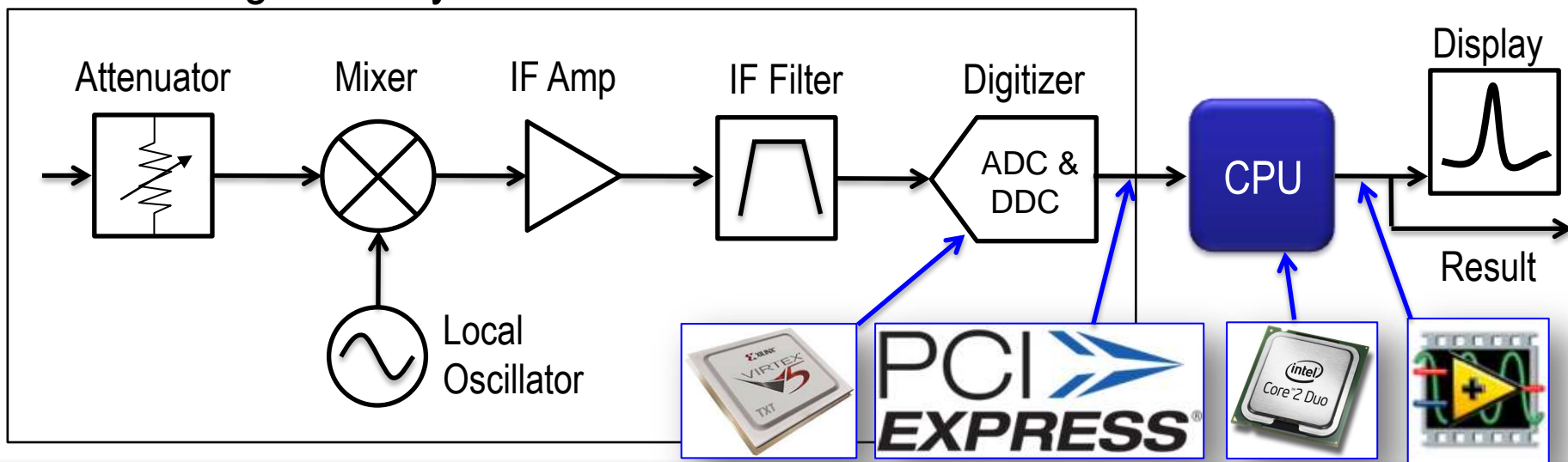
## The Traditional Spectrum Analyzer



# PXI: A New Approach to RF Test



## PXI RF Signal Analyzer



# PXI Combines Standard Technologies

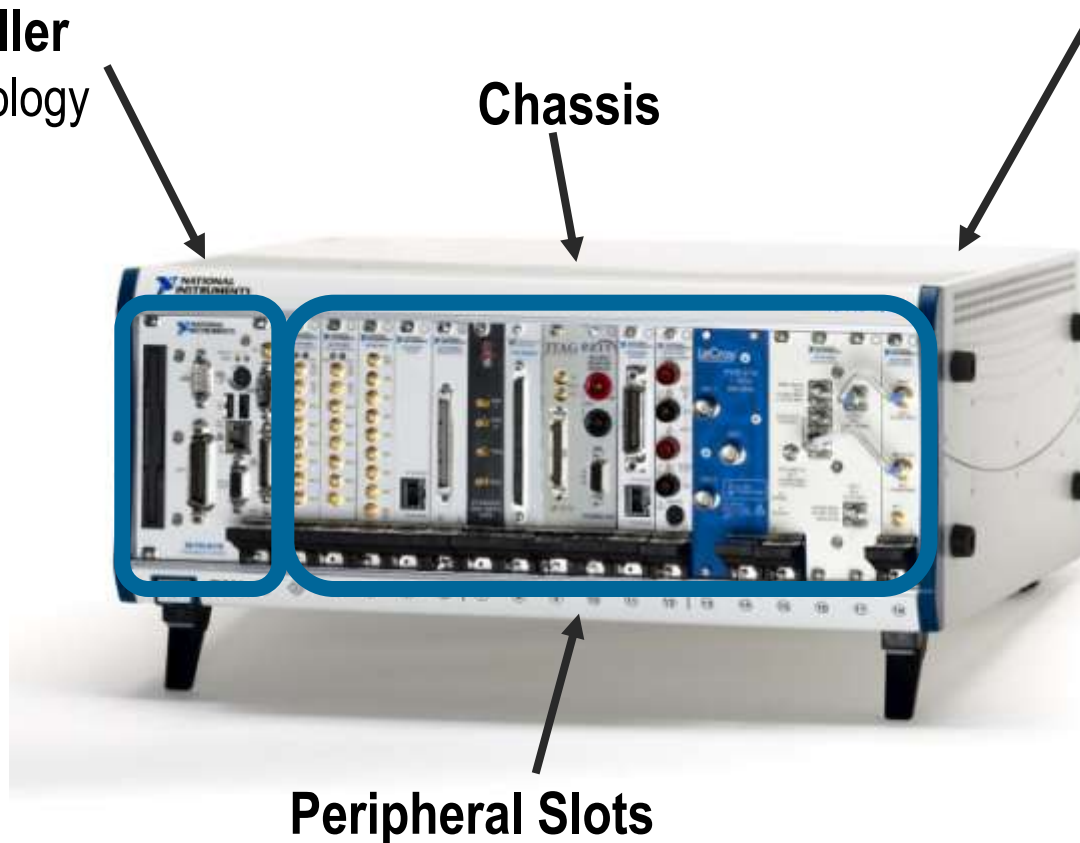
## PXI controller

- OS Technology
- ADEs

## Chassis

## PXI backplane

- Bus Technology
- Timing
- Synchronization

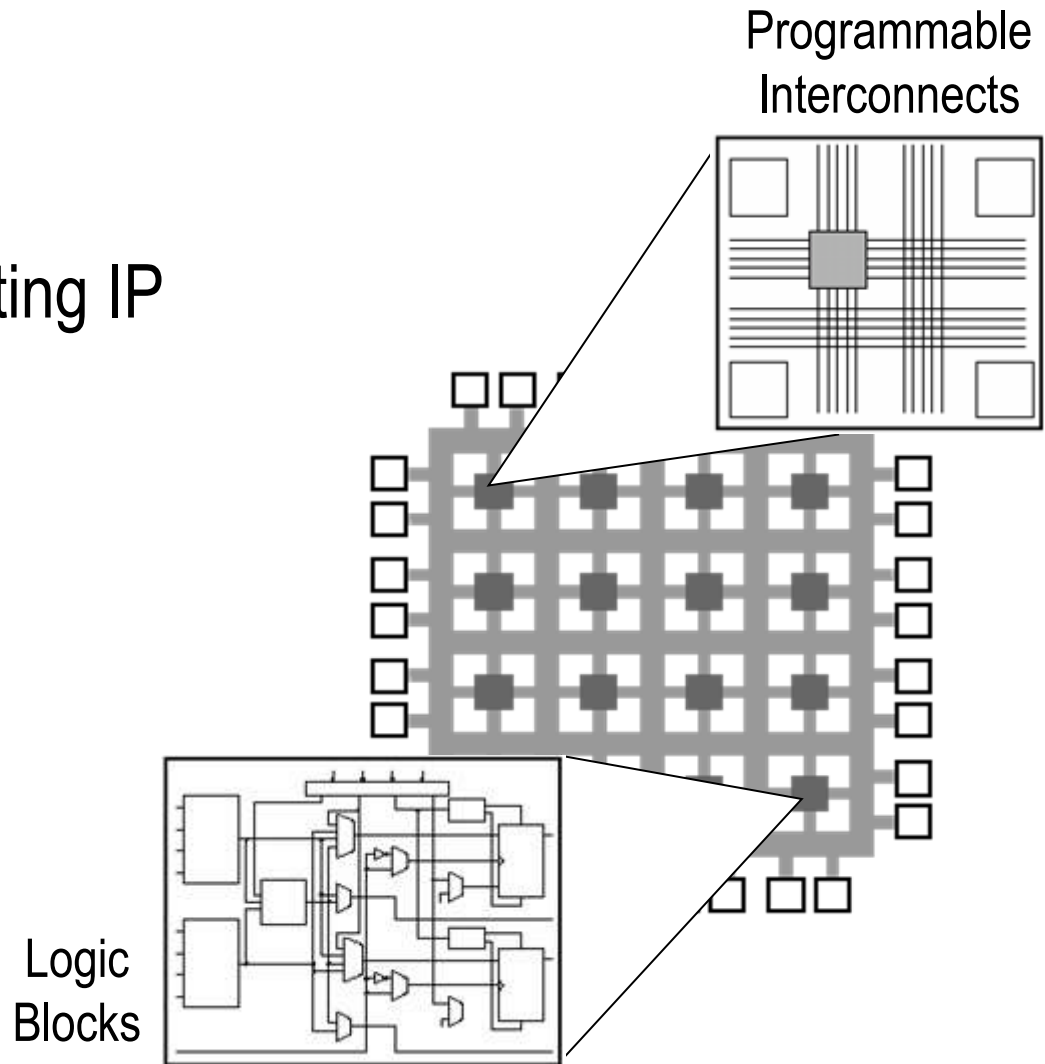


# FPGAs

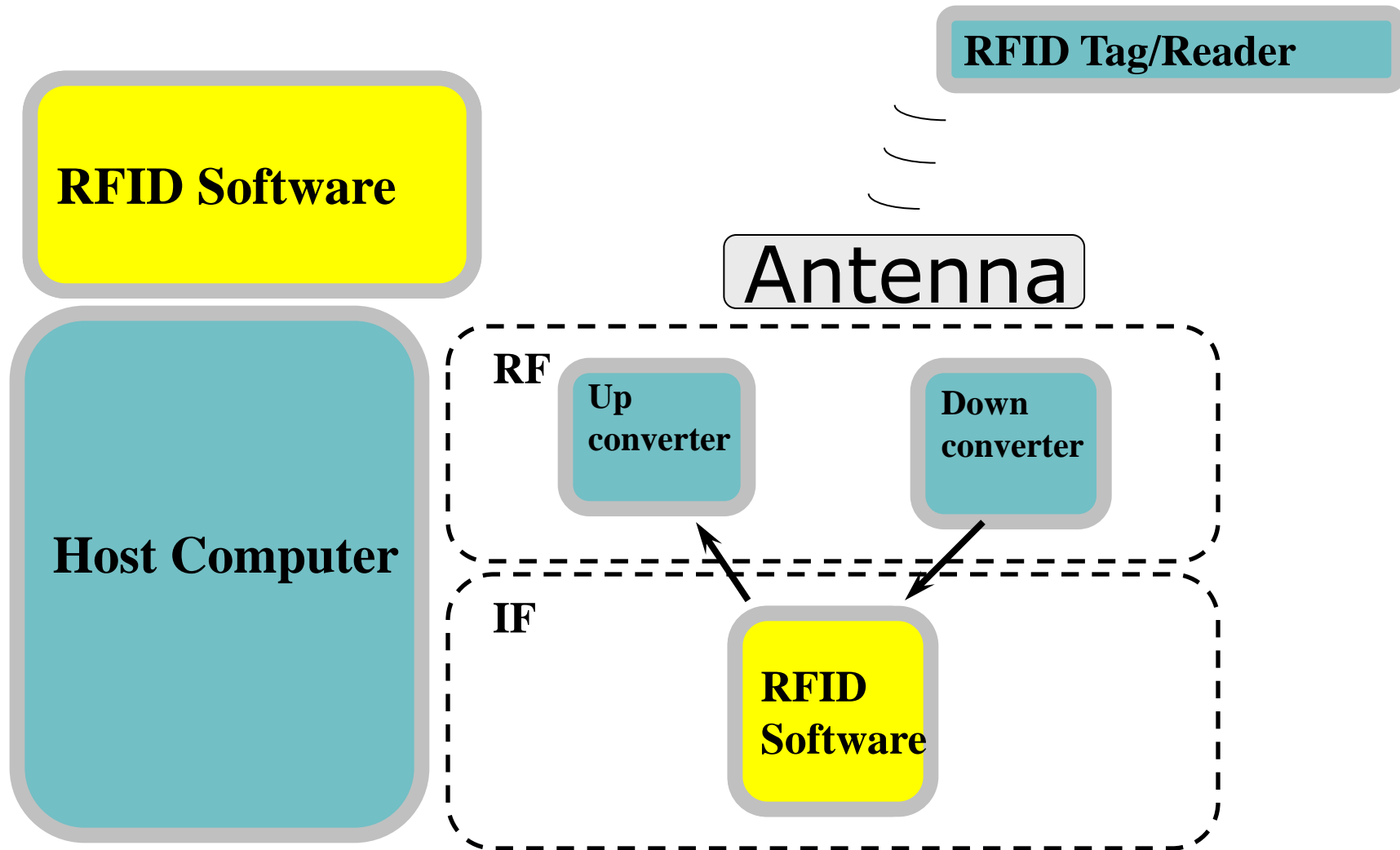


# Benefits of FPGAs for RF

- Processing Power
- Integration with Existing IP
- High Determinism
- True Parallelism
- Reconfigurable



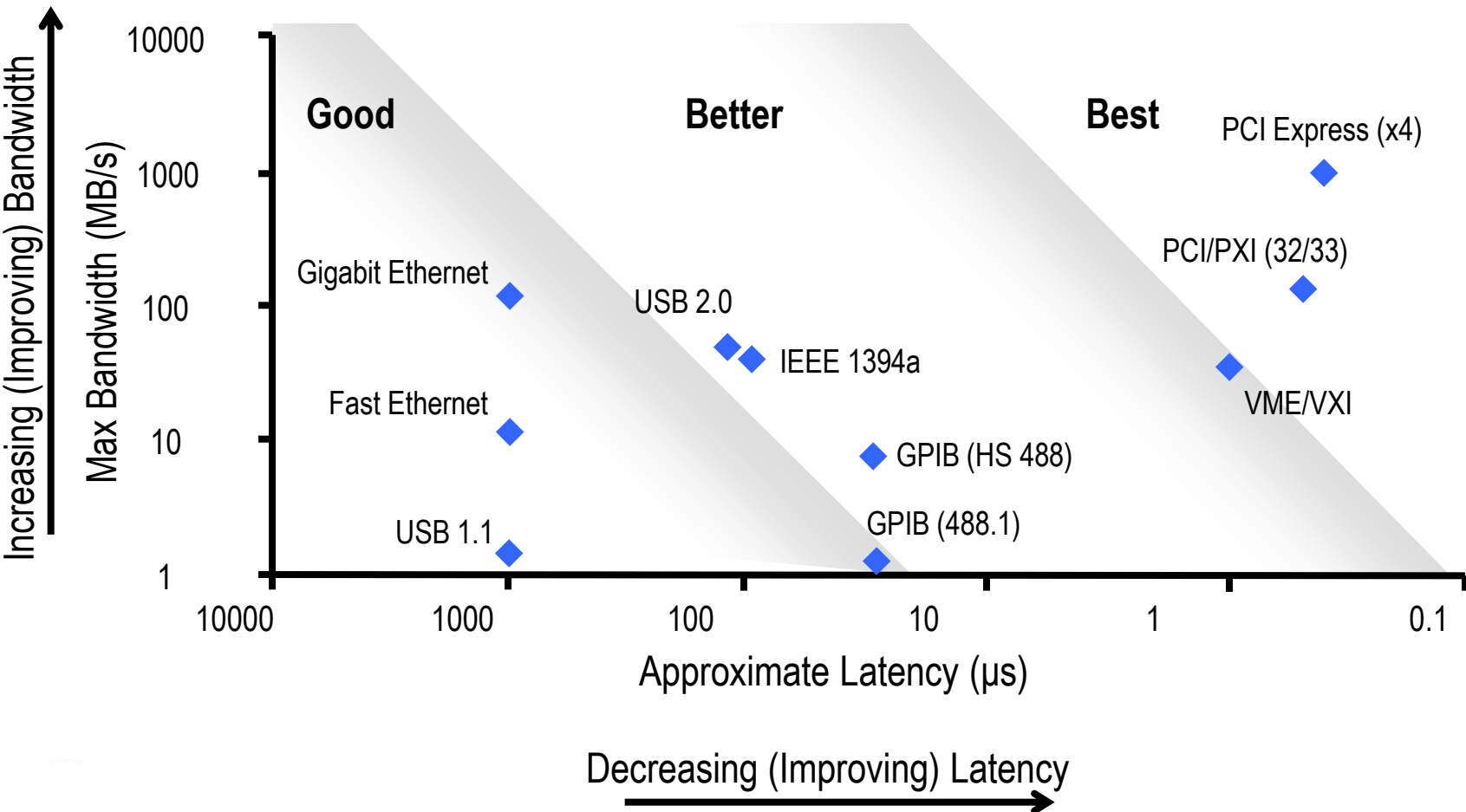
# RFID Test System Architecture



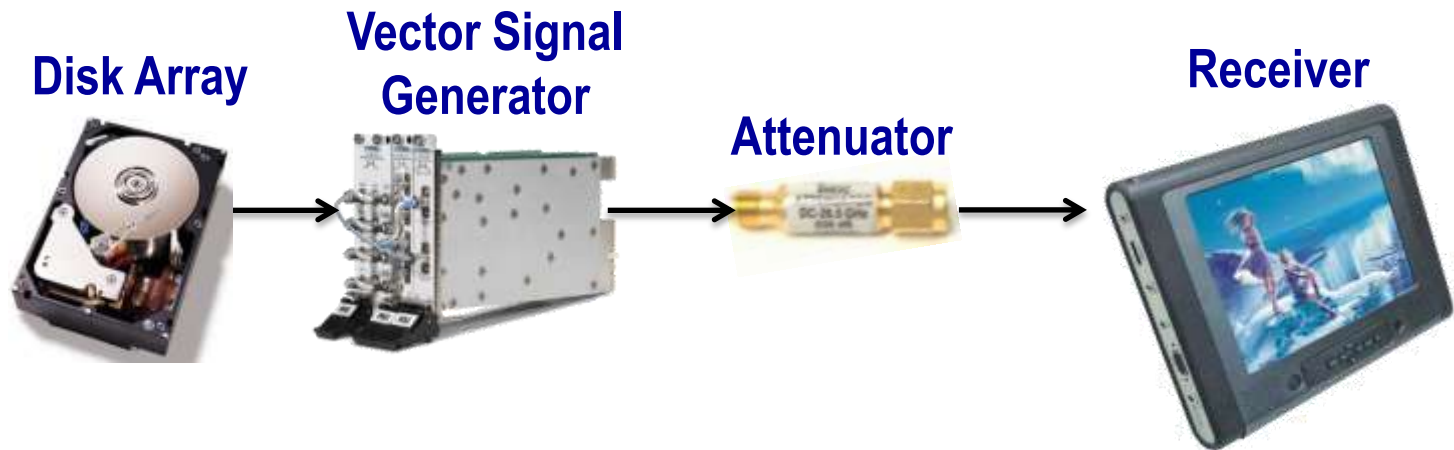
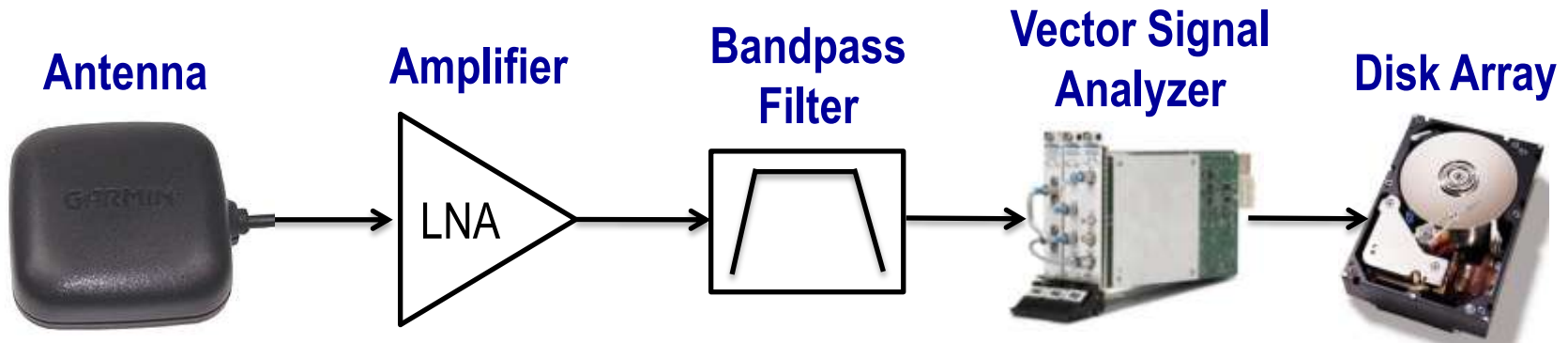
# High-Speed Bus



# Bandwidth vs. Latency



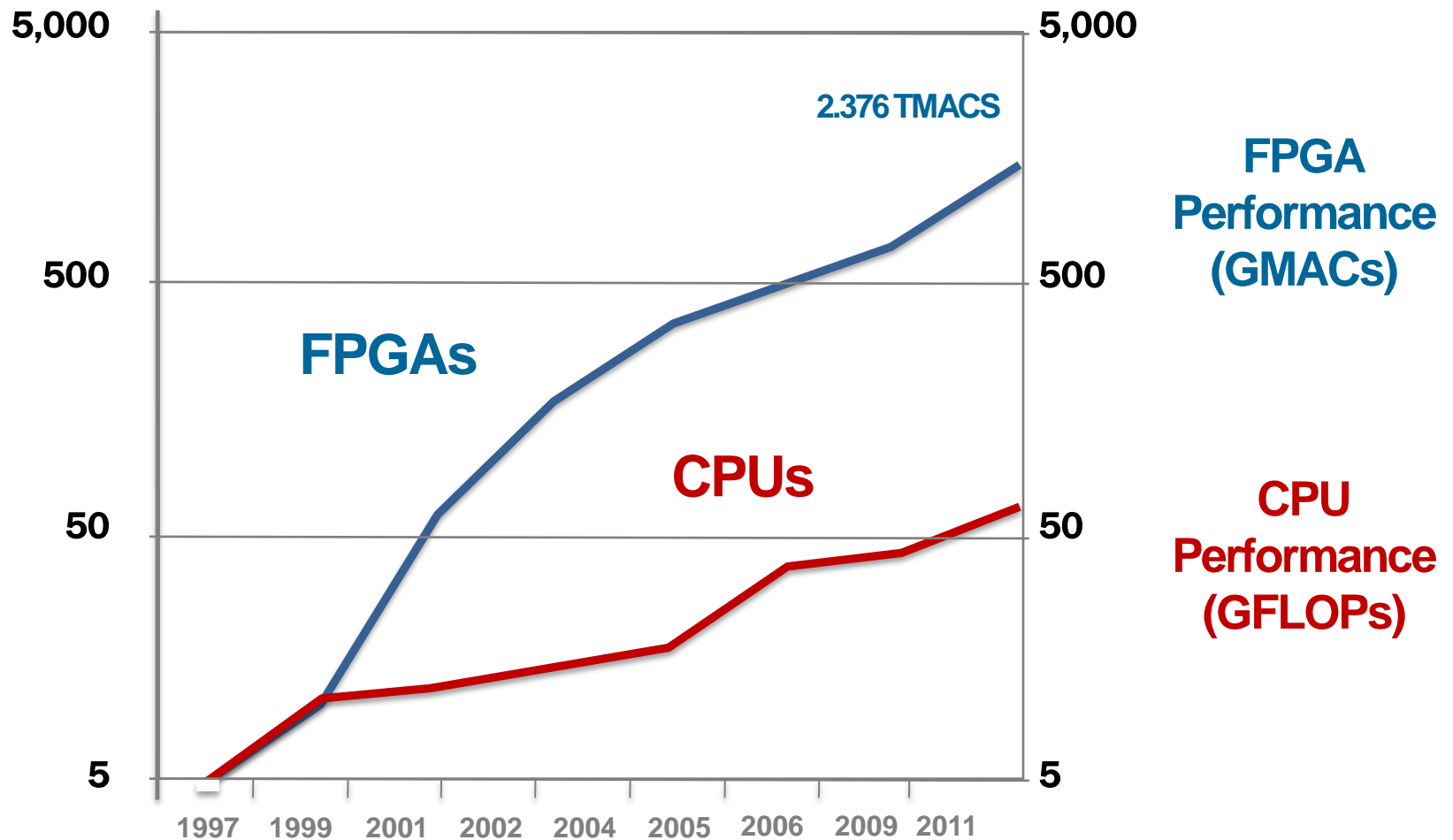
# RF Record and Playback



# Multi-Core CPUs

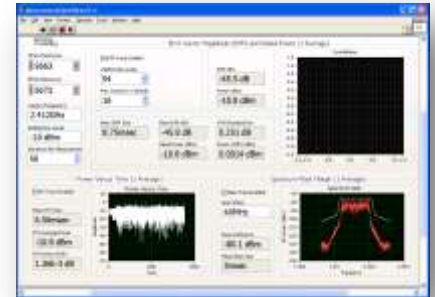


# Parallel Architectures Drive Performance



# Measurement Speed Comparison

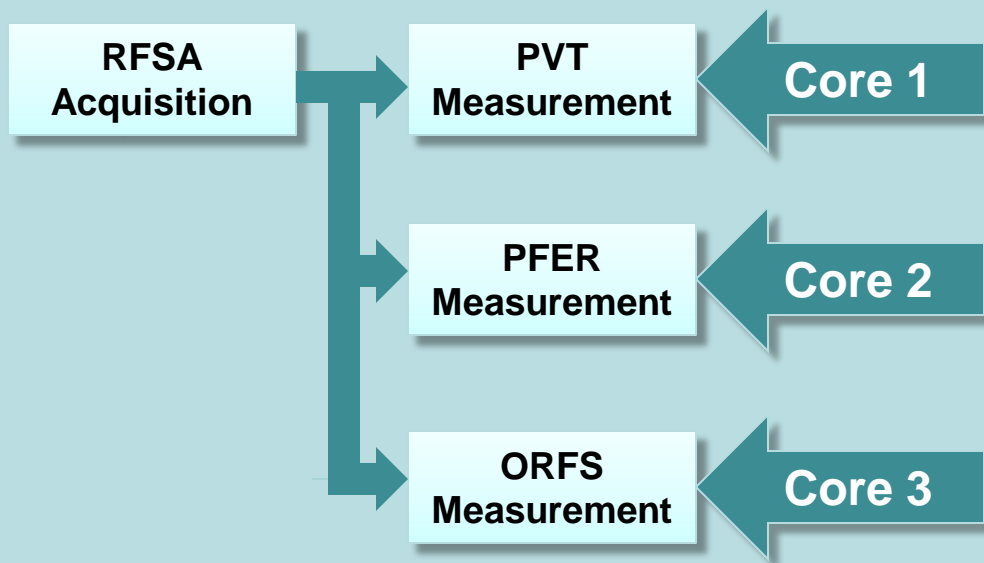
- **Signal type:** 802.11g Wireless LAN (WLAN)
- **Measurement:** Error Vector Magnitude (EVM)
- **Benchmark Details:**
  - Control instruments through programming API
  - Measure time calculated over 100 measurements
- **Results:** 5x to 10x faster than traditional box instrument



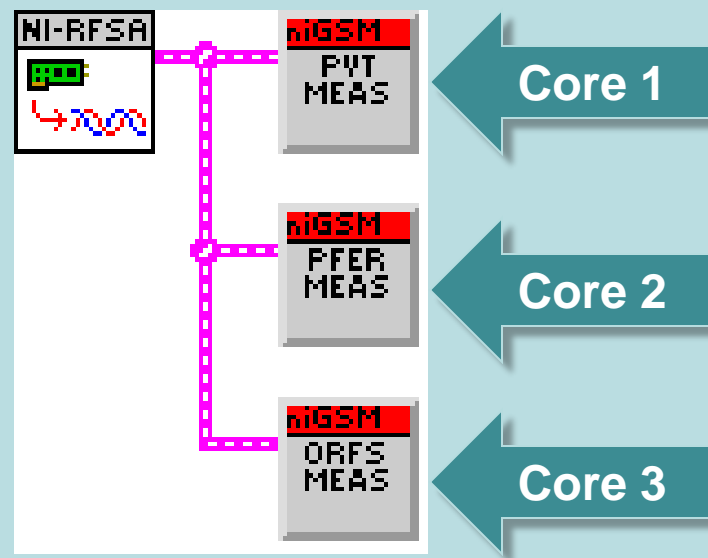
Data Rate (Mbps)	Burst Duration	Modulation Type	NI PXIe-5663E Time
54	0.176 ms	64-QAM	< 10 ms
24	0.364 ms	16-QAM	< 12 ms
6	1.393 ms	BPSK	< 25 ms

# Parallel Test Implementation

## GSM Composite Measurement Design



## GSM Composite Measurement Implementation



# The Power of Software

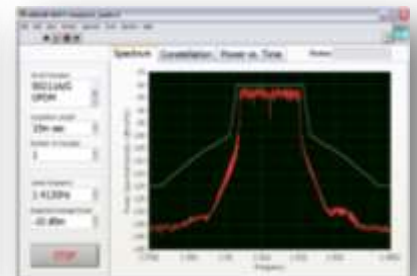
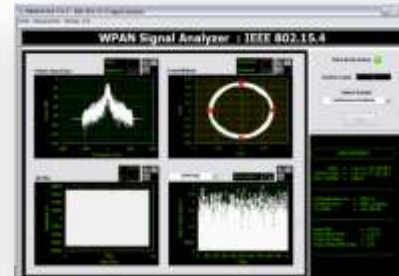
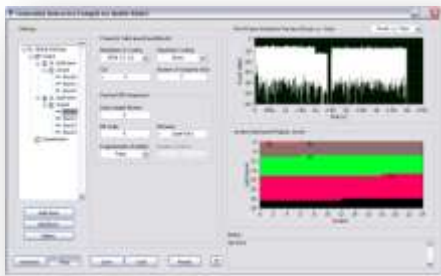


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# LabVIEW

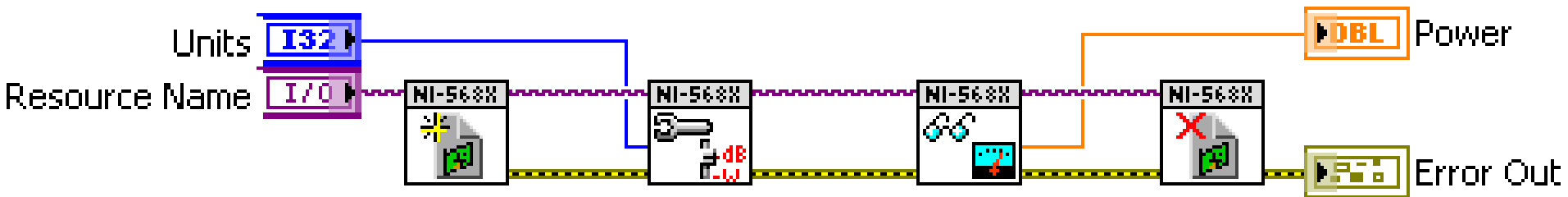
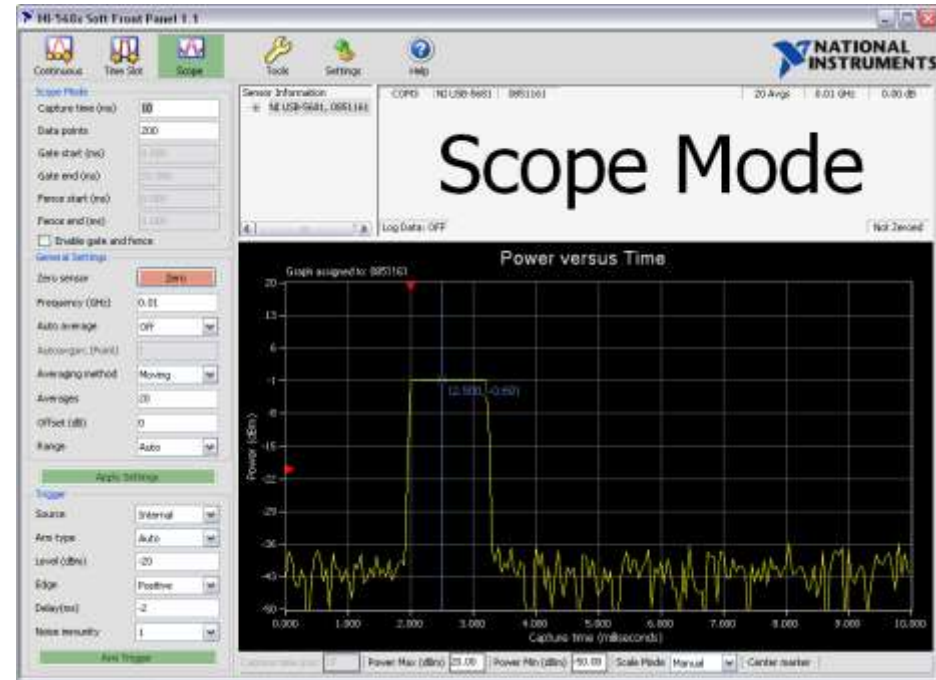
# The Need for Flexible Software

- Wireless standards evolve
  - Cellular
    - GSM/EDGE → WCDMA → HSPA+ → LTE → LTE Adv.
  - Wireless Connectivity
    - 802.11a/b → 802.11g → 802.11n → 802.11k?
- New standards can be addressed with Software

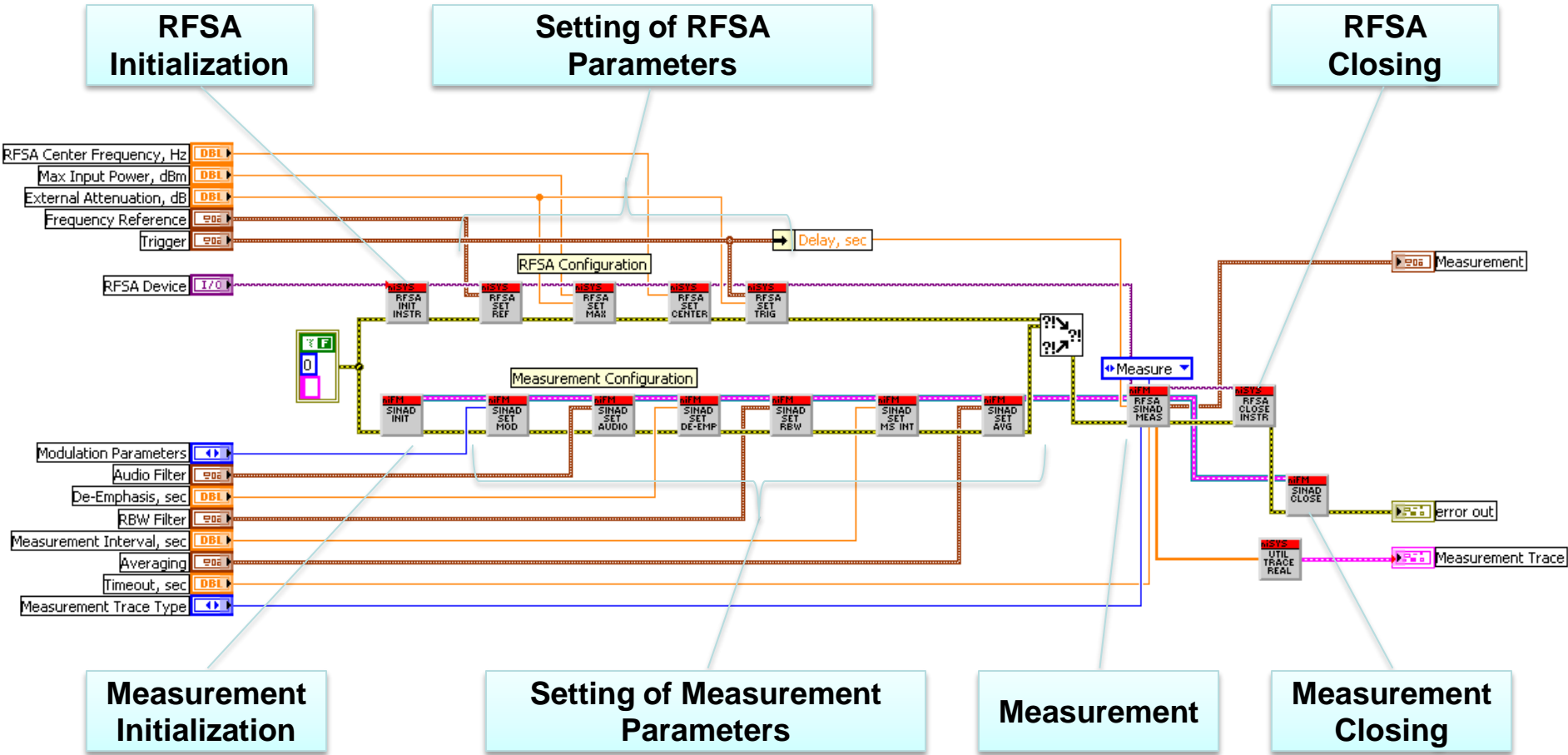


# Software for RF Measurements

- Soft front panel
  - Scope mode
  - Slot mode
  - RMS versus Time
- Programming API
  - Automated measurements



# RF Reference Architecture



# Case Study

# Microsoft Uses NI LabVIEW and PXI to Develop Production Test System for Xbox 360 Controllers

## The Challenge

Developing a comprehensive, low-cost production test system for the Microsoft Xbox 360 wired and wireless controllers.

## The Solution

A flexible, automated test system based on Windows XP, Microsoft SQL Server, NI LabVIEW, and PXI to test the functional performance of the Xbox 360 wired and wireless controllers



# Summary

- Evolution in technology produces an evolution in instruments
- Today's engineers require better instrumentation than ever
- Four key technologies are driving today's instrumentation
  - FPGAs
  - PCI Express
  - Multi-core CPUs
  - Software

