

Overview

This demo compares the speed and performance of the NI PXIe-5665 vector signal analyzer and the Agilent PXA signal analyzer for

1. Linearity
2. EVM on LTE (Long Term Evolution)
3. ACP on WCDMA (Wideband Code Division Multiple Access)

Performance is shown in terms of linearity, EVM and the ACP measurements made on the standards. Speed is measured as the amount of time taken by both instruments to change modes (to LTE or to WCDMA) plus the acquisition and processing time. Amount of time taken to transfer the data to the PC in both cases is negligible compared to the measurement/processing time.

Hardware Setup

For the LTE and WCDMA test, the NI PXIe-5673 vector signal generator is used. The filter is used only for the WCDMA signal to reduce the noise floor as much as possible (since we are making an ACP measurement on the WCDMA signal). For the linearity test, two Phase Matrix QuickSyn microwave frequency synthesizers are used to generate tones that are combined using a combiner. All signals are split to the NI PXIe-5665 and the Agilent PXA.

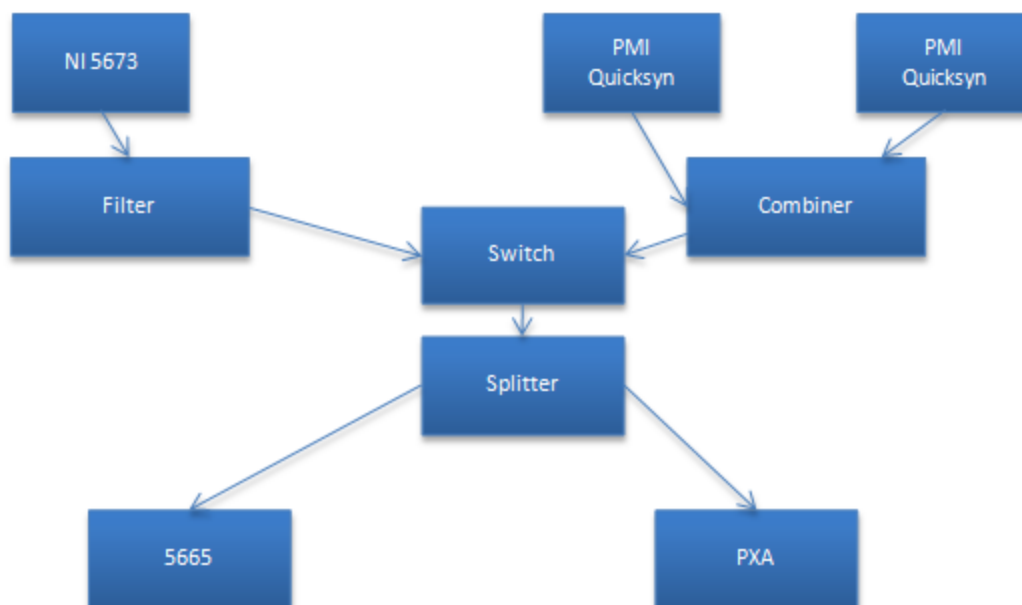


Figure 1 – Hardware setup and connectivity

This setup ensures that the same signal is reaching the NI PXIe-5665 and the Agilent PXA at the same time. There is a slight loss through the splitter.

Instruments Used

- NI PXIe-5665 14 GHz High-Performance Vector Signal Analyzer
- NI PXI-2596 26.5 GHz 4x1 dual RF Multiplexer
- NI PXIe-5673 6.6 GHz Vector Signal Generator
- NI PXIe-1075 18-Slot 3U PXI Express Chassis with NI PXIe-8133 embedded controller
- Mini Circuits ZFSC-2-11-S Splitter
- Agilent N9030A PXA Signal Analyzer
- SMA-to-SMA Cables (X 3)
- WCDMA SAW Filter (248.6 MHz nominal frequency)
- Phase Matrix QuickSyn modules (X2)

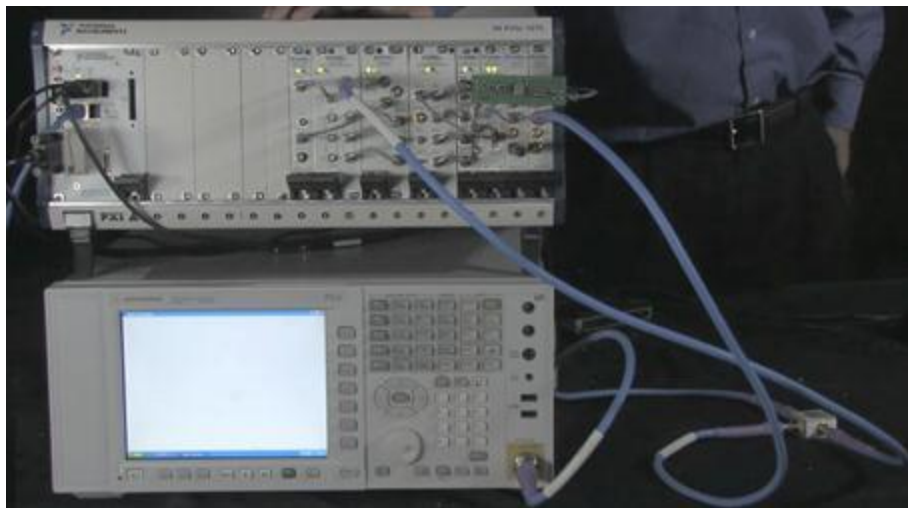


Figure 2 – Hardware setup showing instruments and connections

Instrument Control

The NI PXIe-5665 is in an NI PXIe-1075 chassis with the NI PXIe-8133 controller that features PXI Express technology to transfer data from the instrument to the host PC. The Agilent PXA is controlled through an LXI connection (Ethernet). The amount of time taken to transfer the data through LXI on the PXA is about 900 μ s, whereas it is about 1 μ s on the NI PXIe-5665 because it takes advantage of PXI Express technology. The image below shows that the bandwidth for PXI Express is above 1 GB/s whereas the latency is less than 1 μ s.

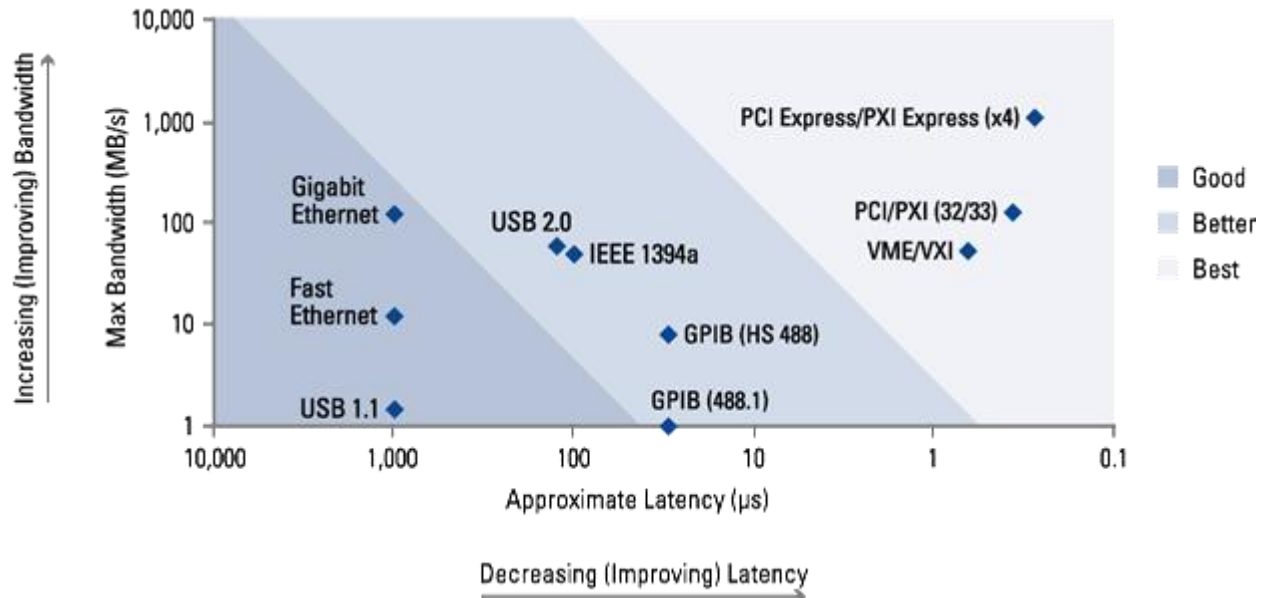


Figure 3 – Bandwidth vs. latency chart for multiple instrument control buses

Software Setup

The primary system design software used is NI LabVIEW. The following toolkits/drivers are used to control the NI PXIe-5665:

- NI LTE Measurement Suite
- NI WCDMA/HSPA+ Measurement Suite
- NI-RFSA driver
- NI Modulation Toolkit for LabVIEW

The following software is loaded on the Agilent PXA:

- LTE Measurement application
- W-CDMA Measurement application
- Phase Noise Application

The PXA is controlled through ASCII commands using LabVIEW and instrument control drivers.

LTE Standard Details: The LTE standard that is generated is an UPLINK signal with a center frequency of 1 GHz and a bandwidth of 5 MHz. It is generated at a power of -10 dBm.

Five averages are being performed on both the NI PXIe-5665 and the Agilent PXA.

WCDMA Standard Details: The filter being used is a SAW filter with a 248.6 MHz nominal frequency. This filter has a 6 MHz bandwidth. The WCDMA is DPCCH UPLINK and has a center frequency of 248.6 MHz.

Results

Timing Tests

For the timing test, both the NI PXIe-5665 and the Agilent PXA were put through two different standards (LTE and WCDMA). An EVM measurement was made on LTE and an ACP measurement was made on WCDMA. The set-up time (switching to the standard) and the measurement time are displayed on the screen below. The “Total Acquisition Time” includes the set-up and the measurement time.

Total NI Acquisition Time = 609 ms

Total Agilent PXA Acquisition Time = 12.8 s

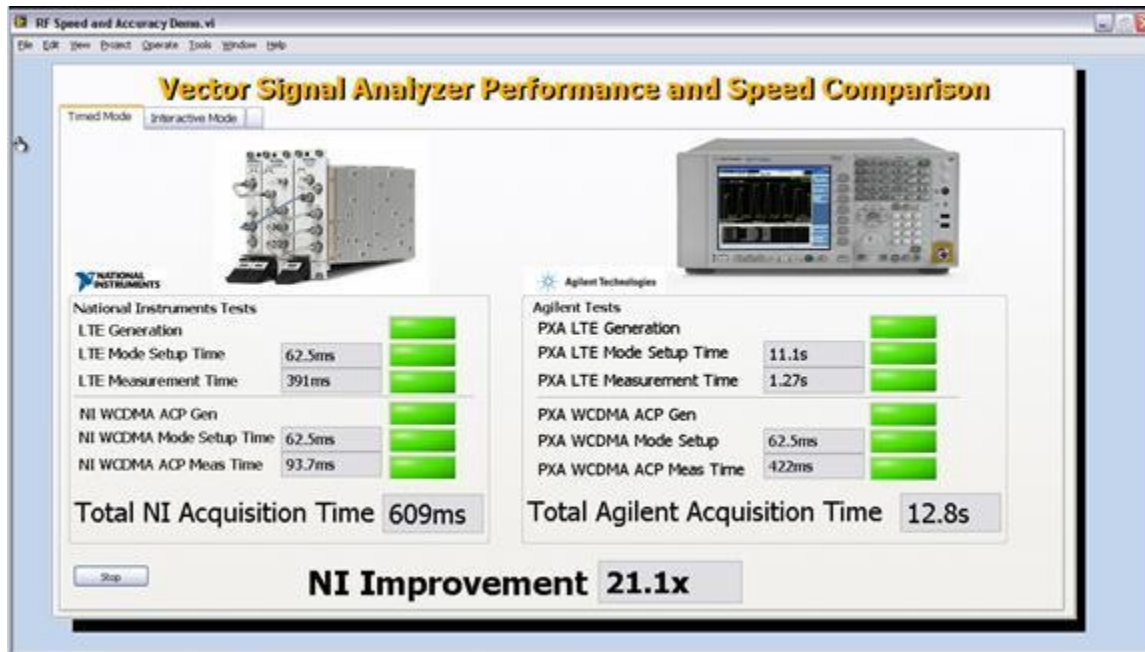
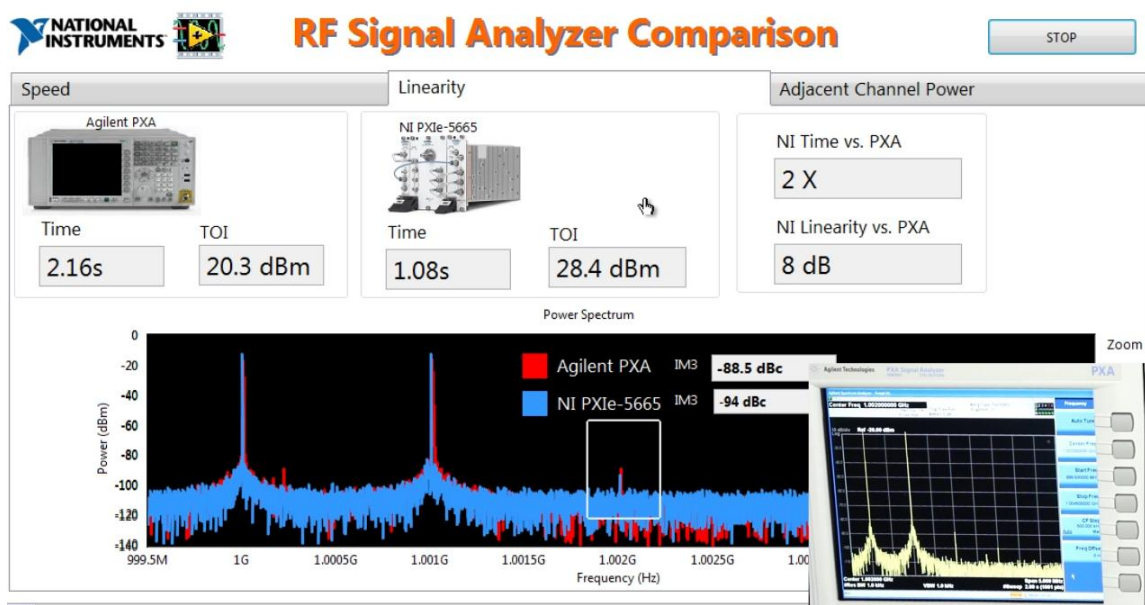


Figure 5 – Timing test results for the NI PXIe-5665 and the Agilent PXA

Linearity Test

For the linearity test, the NI PXIe-5665 shows a TOI of about 28.4 dBm whereas the Agilent PXA shows a TOI of 20 dBm.



Cellular Standard Performance Tests

For the accuracy test, both the EVM on LTE and the ACP measurement on WCDMA are displayed.

1. EVM on LTE - The average reading on the NI PXIe-5665 is about -56 dB and the average measurement on the Agilent PXA is about -50 dB, making the NI PXIe-5665 5-6 dB better than the PXA in measurement.
2. ACP on WCDMA – This test showed both the NI PXIe-5665 and Agilent PXA reading -80 dBc as the mean ACP measurement so both instruments were equal in performance for this test.

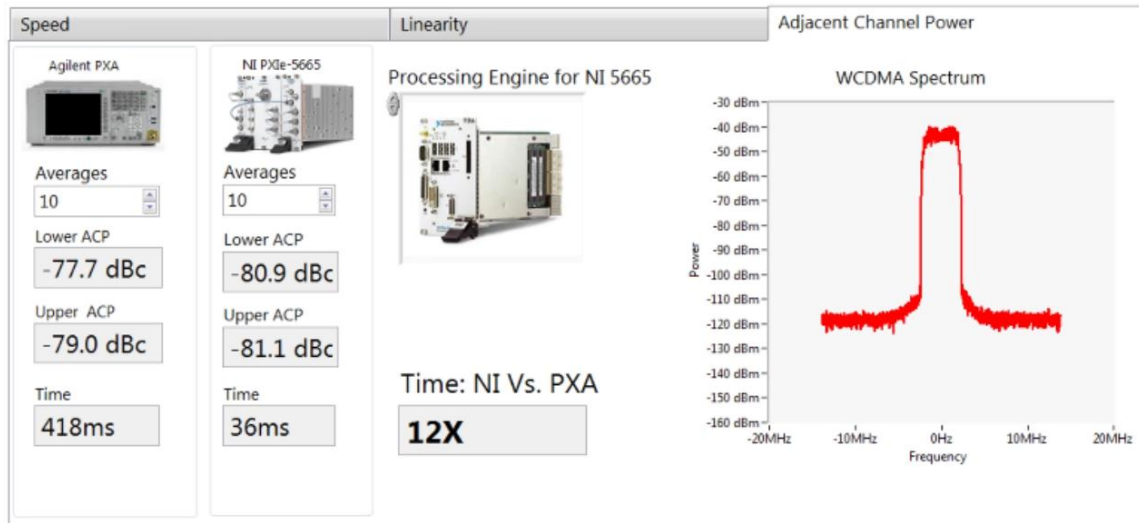
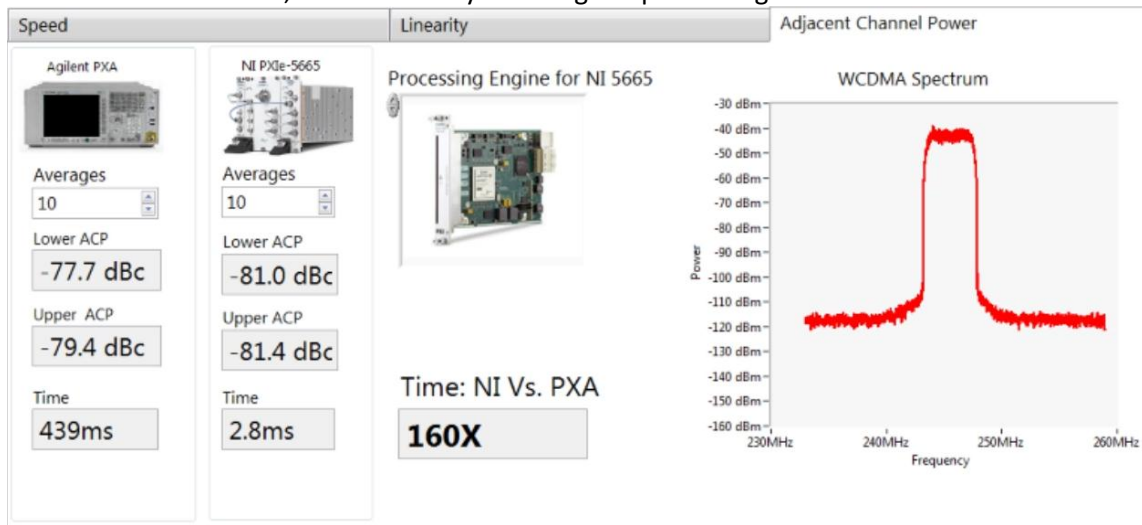


Figure 6 – EVM and ACP measurements on LTE and WCDMA signals respectively

Use of NI FlexRIO

In the above ACP measurement the processing is done on the NI PXIe-8133 controller. The processing can also be moved to an onboard FPGA on the NI FlexRIO board. For this demo, the averaging and FFT are moved to the FPGA, thus drastically reducing the processing time.



This is an example of the flexibility provided by NI FlexRIO. Other use cases include hardware implementation of algorithms, protocol implementation and real time stimulus response applications.