Minutes of NI Testbed Demo at Bristol

Xuemin Hong and Cheng-Xiang Wang

Date/time: 14:00-16:20, Monday 14th February 2011
Venue: Toshiba Research Europe Limited, Bristol
On-site Attendees: Dr Cheng-Xiang Wang (Heriot-Watt), Dr Xuemin Hong (Heriot-Watt), Prof. Harald Haas (Edinburgh), Prof. Mark Beach (Bristol), Prof. Joe McGeehan (Bristol), Dr Josep Soler Garrido (Toshiba), Mr Robert Morton (NI-UK), Mr Robert Sims (NI-UK), Mr Sacha Emery (NI-UK), Mr Ben Lavasani (NI-UK)
Online Attendees: Mr John Wootton (NI-UK), Ms Sarah Brady (NI-UK), Mr Abhay Samant (NI-India), Mr Prakash Sethia (NI-India), Mr Ramprasad Moudgalya (NI-India); Dr Soon Xin Ng (Southampton), Dr Pei-Jung Chung (Edinburgh), Dr Jian Sun (Shandong University, China), Wuxiong Zhang (WiCO, China)

I. Program

13:00 – 14:00	Preparation and set up of the demonstration	NI team
14:00 – 14:05	Welcome and introductions	Prof. Joe McGeehan / Prof. Mark Beach
14:05 – 14:10	Scope and purpose of equipment demonstration	Dr Cheng-Xiang Wang
14:10 – 14:20	Introduction to NI	Robert Morton
14:20 – 15:00	Live web demo of a 2x2 MIMO WLAN system	NI R&D
15:00 – 15:20	Walk through of the proposed system, highlights, key features, etc	Robert Sims
15:20 – 15:50	Live demo of a 2x2 MIMO setup; Q&A	Sacha Emery
15:50 – 16:00	Introduction of spatial modulation	Prof. Harald Hass
16:00 – 16:20	Wrap up and follow on activities	All

II. Brief description of two NI demos

2x2 MIMO WLAN demo (Live web demo from NI India)

This demo showed a 2x2 MIMO system integrated within a single chassis. The physical layer signal processing was based on the WLAN standard, which can support spatial diversity and multiplexing schemes. Labview (NI software) was used for baseband processing, instrument control, and creating user-interface.

A short text was transmitted periodically (about once per second) via a wired channel (AWGN). The received text is decoded in real-time and compared side by side with the original text. Parameters such as SNR and I/Q imbalance were adjusted to reflect different system conditions. It was shown that the received text was partially corrupted when there is a 1dB I/Q imbalance and when high-order modulation (64QAM) was used.

2x2 MIMO WLAN demo (Live demo at Bristol)

This demo showed a 2x2 MIMO system in two chassis. One chassis is a 2-channel transmitter (vector signal generator) and the other is a 2-channel receiver (vector signal analyser). The transmitter generated real-time FM signals and transmitted it over the air via two patch antennas at a 2 GHz centre frequency. The receiver captured two RF signals with two omni-directional antennas and displayed the signal properties (e.g., phase and amplitude) in real time. It was shown that the signal properties change accordingly with different placements of the transmit antennas.

III. Summary of key Q&As

1. Can NI testbed support fast transmit antenna switching in spatial modulation?

Yes. Transmit antenna switching for spatial modulation can be implemented by at least two means. The first method is to set the RF system to the "pulse" mode so that it can be turned on and off quickly. However, this method may not be able to support high symbol rates. The second method is to create parallel and synchronised waveforms for all antennas. Antenna switching can be emulated by zeroing the baseband waveforms of inactive antennas. The second method can support high symbol rates.

2. Can NI testbed support two-way wireless communication or receiver feedback?

The proposed configuration for the UC4G testbed is a 4x2 one-way MIMO system, which include 4 transmit RF modules in a transmitter chassis and 2 receive RF modules in a receiver chassis. Because the hardware is modular, it is possible to reshuffle the hardware to put two transmit RF modules and one receive RF module in each chassis. In this way two transceivers can be built to support two-way communications, in either a FDD or a TDD fashion. However, two local oscillators are needed for each transceiver.

Another approach to provide receiver feedback is via wired connections (e.g., WLAN) between the transmit and receive chassis.

3. Which LTE release is supported by the Labview toolbox?

Not sure. Likely Release 8.

4. How much bandwidth can be supported by the NI testbed?

In terms of RF bandwidth, the receiver (i.e., signal analyser) supports a 50 MHz instantaneous bandwidth (3 dB), while the transmitter (i.e., signal generator) supports a 100 MHz instantaneous bandwidth (3 dB).

In terms of baseband data bandwidth, the peer-to-peer PXI bus can support up to 800 Mbytes/s of data bandwidth, meaning that it can support up to 50Msymbols/s of symbol rate (assuming 16-bit

quantisation and 4-samples per symbol).

5. Can Matlab be used for the testbed/Labview? How?

There are multiple ways to use Matlab. First, using its own instrument control toolbox, Matlab can be used to control the NI testbed directly. Second, Labview can be programmed to activate and run Matlab using dll files and take over whatever data is generated by Matlab. Third, math scripts in Matlab can be embedded into Labview programs.

6. Is MIMO RF testing a new territory of NI? Are there any existing customers?

NI's MIMO solution has already been adopted by some universities such as The University of Texas at Austin.

7. Does the NI testbed support only offline processing, or can it process data in real time?

Real time processing on the NI testbed is mostly limited by the processing power of the embedded processor or the external PC. Whether a system can be run in real time depends on its computational load. Powerful processors (e.g., multi-core CPU) and FPGA can be easily integrated into the NI testbed to enhance its real-time processing capability. The UC4G testbed is configured with two Flexrio FPGA modules.

8. What are the advantages of NI's MIMO solution compared with its competitors?

The advantages of the NI system include flexible hardware, the support of testbed customisation, and highly optimised software with comprehensive toolboxes.

9. How much do testbed peripherals such as antennas cost?

Peripherals needed for the testbed may include antennas and power amplifiers. Their costs depend very much on the exact technical specifications such as centre frequency and bandwidth. For the NI demo operating at a 2 GHz centre frequency, the patch antenna costs about 25 pounds each.

10. Does NI offer channel emulator products?

Not at the moment but could be in the plan for future products.