INVITATION to the Defense of my Doctoral Thesis, Rennes, France

3 October 2013

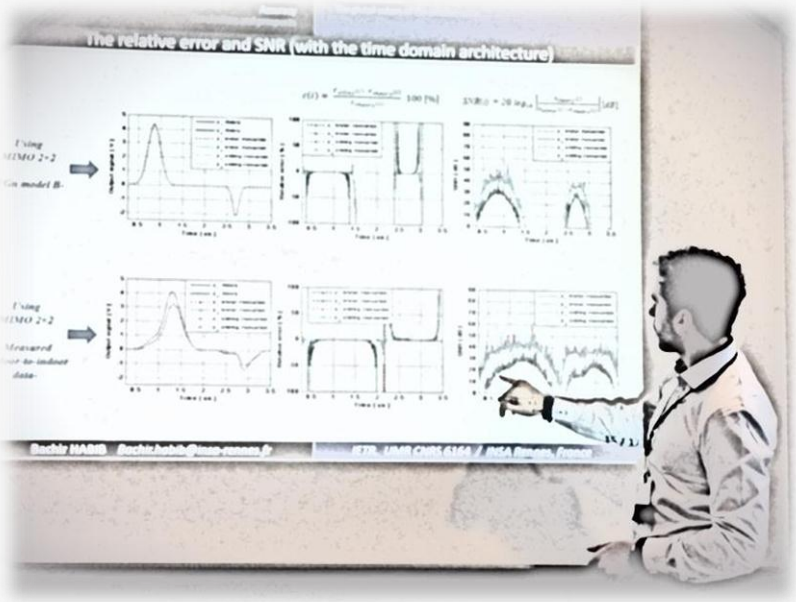

Photo taken in Dresden – Germany while presenting my work during IEEE VTC 2013 conference
http://www.ieeevtc.org/vtc2013spring/

Bachir Habib

requests the pleasure of your company at the

Defense of his Doctoral Thesis

on Thursday, 3rd of October 2013 at 10:30 hrs
Amphi Bonnin, INSA Rennes,
Rennes, France

and

Invites you for a drink

the same evening at 16:30 hrs

Title of Thesis:

MIMO Channel Hardware Simulator for LTE and 802.11ac Wireless Communication Systems

The jury is composed of:

Dominique Houzet	*Professor – Grenoble INP*
Yannis Pousset	*Professor – Futuroscope Chasseneuil*
Emmanuel Boutillon	*Professor – Université Bretagne Sud*
Sylvie Kerouedan	*Lecturer HDR – Télécom Bretagne*
Gheorghe Zaharia	*Lecturer – INSA Rennes / Supervisor*
Ghaïs El Zein	*Professor – INSA Rennes / Supervisor*

You find attached the abstract of the thesis which has contributed in 9 journals and 10 conference papers.

Abstract

To evaluate the performance of the emerging mobile and wireless communication systems, a Multiple-Input Multiple-Output (MIMO) channel hardware simulator is designed and implemented using the recent communication standards. It provides the processing speed required to the real-time performance evaluation and allows comparing various systems in the same test conditions. The objectives of this work mainly concern the MIMO channel models and the digital block architecture of the hardware simulator.

The hardware simulator can be configured with Long Term Evolution (LTE) and Wireless Local Area Network (WLAN) 802.11ac signals. It uses standard channel models, as 3GPP LTE and TGn IEEE 802.11n. It also allows replaying measurement results obtained with the MIMO channel sounder designed and realized at our laboratory. In fact, data obtained during measurement campaigns onboard a ship and for outdoor-to-indoor environments were used. The measured impulse responses are pre-processed in order to make them compatible with LTE or 802.11ac signals. Moreover, time-varying channel models are obtained using Kronecker model with Rayleigh fading.

The simulator must be able to reproduce different types of environment. In this context, many scenarios considering realistic people movements have been proposed. They involve movements in outdoor, indoor, outdoor-to-indoor or heterogeneous environments. An algorithm is proposed and described to switch between the environments in a continuous manner. Heterogeneous wireless communication systems are also considered. These systems provide service through a cellular network using LTE standard and are able to maintain the service when switching to a WLAN 802.11ac, for example.

Two architectures for the digital block of the hardware simulator are proposed. The first operates in the frequency domain using Fast Fourier Transform (FFT/IFFT) modules. A new improved frequency architecture that works for streaming mode input signals is proposed. The second operates in time domain using Finite Impulse Response (FIR) filters.

The architectures of the digital block of the hardware simulator are implemented on a Field Programmable Gate Array (FPGA) Virtex-IV from Xilinx. Their occupation on the FPGA, the accuracy of the output signals and their latency are analyzed and compared. Moreover, a new algorithm, based on an Auto-Scale Factor (ASF), is added for the time domain architecture. This algorithm improves the precision of the output signals.