



# NEWCOM Workshop on Flexible Radios

IMEC, Leuven, Belgium  
5 - 6 February 2007



## Introduction

### **Flexible radios: the quest for the realization of the “anything, anywhere, anytime” dream**

Anything, anywhere, anytime, the query is not new. Still, the slogan having celebrated its 10th anniversary, today ubiquitous broadband wireless communication bringing multimedia services is yet not available. Given the variety in geographical environment and terminals, there is not one ideal solution for the transmission scheme. Supporting multiple waveforms that can adapt to the link and the QoS demands will be required.

Currently, multi-mode wireless systems typically include multiple radios, multiple application processors, etc. The multiplication of hardware and software will prohibit an attractive form factor, as the number of different air interfaces and services enabled in one terminal may increase dramatically. Therefore, flexible radios, featuring both a reconfigurable digital baseband modem and a reconfigurable RF radio, are crucial. Moreover, intelligent control to optimize performance and energy consumption will be crucial.

## Date and Venue

The workshop will be organized on 5 and 6 February 2007, at IMEC in Leuven, Kapeldreef 75, B-3001 Heverlee. Belgium.

## Coordination

The workshop program is coordinated by Liesbet Van der Perre, scientific director of wireless research at IMEC, and Prof. Andreas Polydoros, University of Athens. Organizational coordination by Tom Tassignon, IMEC.

## Program

**The first day (5 February 2007) will consist of a tutorial on Flexible Radio:**

### **‘Flexible radios: making flexibility rhyme with low cost and low power’**

Wireless access schemes will be implemented on Software Defined Radios (SDRs) in the future. A main challenge is to enable SDRs for wireless terminals running on limited battery energy. To achieve this goal, flexible SDR solutions enabling performance/energy scalability are proposed. Complementary, an intelligent controller optimally exploits this scalability, based on cross-layer optimization. The extension of this approach towards cognitive radios looks promising to couple energy savings to efficient spectrum usage.

The list of speakers:

- Liesbet Van der Perre, *Scientific Director for Wireless Research*, IMEC, Belgium
- Antoine Dejonghe, *Senior Researcher in the Wireless Research Group*, IMEC, Belgium
- Sofie Pollin, *Senior Researcher in the Wireless Research Group*, IMEC- Berkeley

### **Agenda:**

14h00-15h30:

- General introduction to the workshop
- Introducing the wireless and technology scene: the wish and need for SDRs
- SDR Baseband platforms: opportunism to combine flexibility and low energy
- SDR front-end solutions: generating elastic waves

15h30-15h45: Coffee break

15h45-17h15:

- Cross layer optimization: exploit flexibility for low energy
- Saving on spectrum resources: the path towards cognitive radio

**The second day (6 February 2007) will consist of invited NEWCOM speakers.**

The list of speakers:

- Prof. Andreas Polydoros, University of Athens
- Prof. Viktor Owall, Lund University
- Prof. Iordanis Koutsopoulos, University of Thessaly
- Prof. Gerd Ascheid, TUAachen
- Prof. Jacques Palicot, SUPELEC
- Prof. Petri Mahonen, Techn. University of Aachen
- Prof. Linda Doyle, Trinity College, University of Dublin
- Prof. Gabriella diBenedetto, University of Rome La Sapienza
- Dr. Thomas Hunziker, University of Kassel
- Prof. Panagiotis Demestichas, University of Pireaus

**Agenda:**

Morning:

9.00-9.30: Prof. Andreas Polydoros, University of Athens

9.30-10.00: Prof. Viktor Owall, Lund University

10.00-10.30: Prof. Iordanis Koutsopoulos, University of Thessaly

10.30-11.00: Coffee break

11.00-11.30: Prof. Gerd Ascheid, TUAachen

11.30-12.00: Prof. Jacques Palicot, SUPELEC

12.00-13.30: Lunch

Afternoon:

13.30-14.00: Prof. Petri Mahonen, Techn. Univ. Aachen

14.30-15.00: Prof. Linda Doyle, Trinity College, Univ. Dublin

15.00-15.30: Prof. Gabriella diBenedetto, University of Rome La Sapienza

15.30-16.00: Coffee break

16.00-16.30: Dr. Thomas Hunziker, University of Kassel

16.30-17.00: Prof. Panagiotis Demestichas, University of Pireaus

**Overview of the received titles and abstracts of the different speeches:**

**Prof. Jacques Palicot**

Title: "From Software Radio towards Cognitive Radio"

Abstract

We will firstly present our understanding and approach of the Cognitive Radio concept: A cognitive radio system is able to adapt its behaviour to its environment through: capabilities of analysis of its situation, smartness to make adequate decisions in function of established criteria, and capabilities of self-reconfiguration to adapt its functionality. Cognitive radio often

focuses on spectrum issues and how to efficiently use the frequency resource. But, based on the previous definition, cognitive radio may be extended at a larger scale. We model the communication system in three main layers:

- The upper layer comprising the classical Application layer of the OSI model and the Human Interface
- An intermediate layer in which we consider the classical, network and transport layers
- A lower layer for the physical and link layers

At each level, we associate examples of sensors which are able to give information related to this layer. In addition, we identify areas of current research which are more or less connected to Cognitive Radio. As the optimization of the overall system is concerned, this is also connected to the cross layer adaptation and optimization topics. We show that this domain is very large and that it is necessary to focus the studies on some topics. Two years ago, we chose 3 main topics of interest. It is these 3 topics will also be described in this talk:

1. Advanced Signal Processing for Cognitive Radio
  - MIMO reconfigurable architecture
  - non-linear problems for amplification of SWR signals
  - new algorithms based on over sampling SWR signals
2. Platform architecture to reach a true WideBand SWR technology
  - Partial Reconfiguration of FPGAs: a pertinent solution to reach the true WB SWR dynamical reconfiguration
  - Hierarchical reconfiguration management
  - Cognitive management based on the Hierarchical Reconfiguration Management
3. Cognitive Radio Sensors.
  - Spectrum sensors
  - Blind Standard Recognition
  - Hole spectrum detection
  - Video sensors
    - An adaptive Coding scheme with transmitter reconfiguration scenario

## **Dr. Thomas Hunziker**

Title: "The URANUS Receiver: A Reconfigurable Multi-Standard Receiver with a Unique Architecture"

### **Abstract**

The URANUS receiver aims at coping with the signal formats found in today's predominant standards, and beyond, in a uniform way and with limited complexity. The baseband receiver components, in particular those for channel estimation and demodulation, must therefore be applicable to the various signal types, be it single carrier, multicarrier, or spread-spectrum signals. Methods from Gabor and filter bank theory are employed for the uniform signal representation and processing while providing some degrees of freedom, which facilitate the adaptation to different signal and channel types. A complexity-limited single-tap modeling of doubly dispersive channels, suiting the time/frequency signal representation, is a further integral receiver part. Optimized so-called prototype functions underlying the signal

representation are presented which minimize the error resulting from the single-tap channel modeling under certain conditions. Furthermore, favorable receiver configurations are discussed for a number of common air interfaces.

## **Prof. Iordanis Koutsopoulos**

Title: "Misbehavior attacks and defenses in wireless flexible radio networks"

### **Abstract**

In emerging wireless networks, the flexibility and programmability across all layers is the major novelty embedded in all designs.

Nevertheless, this flexibility gives rise to issues related to dynamically and a adaptively deviating from legitimate protocol operation. In this talk, we will address the problem of deviation from access layer protocol operation, so called access layer misbehavior. Specifically we focus on detecting such instances and adopt the min-max robust approach that focuses on the detection rule for the worst-case attack.

This framework is meaningful for studying misbehavior because it captures uncertainty and unpredictability of attacks and concentrates on attacks that are most significant in terms of incurred performance losses. It also captures the case of an intelligent attacker that can adapt its policy to avoid being detected. We will also discuss various extensions of the basic problem, as well as countermeasures against the attacks.

## **Prof. Linda Doyle**

Title: "Flexible Radios in Dynamic Spectrum Access Networks"

### **Abstract**

The talk will focus on the work that has been undertaken in the Centre for Telecommunications Value-chain Research (CTVR), Trinity College on reconfigurable networks for dynamic spectrum access. Details of our reconfigurable research platform and some of the experimentation we have carried out will be presented. There will be an emphasis on the role of the flexible radio in the flexible network of the future. The application area of dynamic spectrum access will be addressed.

## **Registration**

The registration fee, to cover costs of coffee breaks and lunch, is 200 €. For students, this fee will be reduced to 100 €.

The number of participants is limited.

All participants are requested to fax the completed registration form, see below, by Jan. 26<sup>th</sup> 2007.

## **Directions**

Please find the information below, and at:  
<http://www.imec.be/wwwinter/about/en/IMECmap.shtml>

## **Hotel Info**

See below, and contact [mso@imec.be](mailto:mso@imec.be) in case you need help.

**Garden Court - Holiday Inn**

Tiensestraat 52  
3000 Leuven  
Tel.: +32/16 31 76 00  
Fax: +32/16 31 76 01 direct reservaties:  
016/31 76 03  
standaard room: 180 euro  
Imec: 125 euro weekprijs  
105 euro week-end  
[Higcleuven@alliance-hospitality.com](mailto:Higcleuven@alliance-hospitality.com)

**Begijnhof Congres Hotel**

Tervuursevest 70  
3000 Leuven  
Tel.: +32/16 29 10 10  
Fax: +32/16 29 10 22  
single room: 140,- euro  
double room: 155, euro  
breakfast included (+parking)  
Touristtax: 1 euro pp/nacht

**Binnenhof Hotel**

Maria Theresiastraat 65  
3000 Leuven  
tel : +32/16 20 55 92  
fax : +32/16 23 69 26  
Single room 987euro  
Luxe single 98 euro  
Double 110 euro  
Luxe double 105?  
Breakfast included  
[info@hotelbinnenhof.be](mailto:info@hotelbinnenhof.be)  
[www.hotelbinnenhof.be](http://www.hotelbinnenhof.be)

**Jackson Hotel**

Brusselsestraat 110-112  
3000 Leuven  
tel : +32/16 20 24 92  
fax : +32/16 23 13 29  
all rooms with bathroom, WC, TV,  
phone, breakfast included

**Ibis Hotel**

Brusselsestraat 52  
3000 Leuven  
tel :+32/16 29 31 11  
Fax : +32/16 23 87 92  
single/double room: 86,- euro  
Breakfast 8,50 euro

**Theater Hotel**

Bondgenotenlaan 20  
3000 Leuven  
Tel (016)22 28 19  
Fax 016 28 49 39  
GSM (0496)55 35 63  
E-mail voor reservaties:  
[reservations@theaterhotel.be](mailto:reservations@theaterhotel.be)  
Ma, di, woe, do-nacht:  
Single douche, 91.80,- euro

Double douche, 112,- euro  
Single bad, 100.80,- euro  
Double bad, 121.50,- euro  
SingleDuplex 126,- euro  
Double Duplex 146.70 euro  
**Vrij, za, zo-nacht:**  
Single douche-bad, 73,- euro  
Double douche-bad, 95,- euro

**Hotel La Royale**

Martelareplein 6  
3000 Leuven  
Tel : +32/16 22 12 52  
Fax : +32/16 29 52 52  
single room with bathroom, TV, phone :  
57euro,-  
double room with bathroom, TV, phone :  
69-82 euro,-  
breakfast included  
[hotel@laroyale.be](mailto:hotel@laroyale.be)  
<http://www.laroyale.be>

**Hotel Professor**

Naamsestraat 20  
3000 Leuven  
tel : +32/16 20 14 14  
fax : +32/16 29 14 16  
Single room: 65 euro  
Double room: 80 euro

**Hotel New Damshire**

Damiaanplein - Schapenstraat 1  
3000 Leuven  
Tel: +32/16 23 21 15  
Fax: +32/16 23 32 08  
single room:115,- corp. rate 98,-  
double room : 130,- corp.rate 110,-  
breakfast included  
[reservations@newdamshire.com](mailto:reservations@newdamshire.com)

**Hotel bremberg**

Bremberg 1  
3053 Haasrode  
Tel: 016/40.19.96  
Fax: 016/40 34 22  
[www.bremberg.be](http://www.bremberg.be)

**Boardhouse**

J. Vandenbemptlaan 6  
B-3001 Heverlee  
tel.: +32 (0) 16 31 44 44  
fax: +32 (0) 16 31 44 54  
[info@boardhouse.be](mailto:info@boardhouse.be)  
Price: 125 euro standaardkamer

**Novotel Leuven Centrum\*\*\***

Vuurkruisenlaan 4  
B-3000 Leuven  
Phone: +32 16 21 32 00  
Fax: +32 16 21 32 01

Imec rate: 103 Euro  
Breakfast: 13 Euro  
E-mail: [H3153-re@accor-hotels.com](mailto:H3153-re@accor-hotels.com)

**The Lodge (close to Imec)**

Kantineplein 3  
3001 Heverlee  
Phone: +32 16 509 509  
Fax: +32 16 509 508  
Single: 99 euro  
Double: 119 euro  
Junior suite single: 109 euro  
Junior suite double: 129 euro  
Family room: 199 euro  
(prices include breakfast)

**Klooster Hotel**

Predikherenstraat 22  
3000 Leuven  
tel. 016/213141  
fax 016/223101  
[kh@martins-hotels.com](mailto:kh@martins-hotels.com)



## How to reach IMEC

### How to reach IMEC ? Here's the map !

#### By car

IMEC is located in Heverlee, Leuven at approximately 25 km from Brussels and its International Airport "Zaventem". It takes half an hour drive by car to reach IMEC from Brussels, capital of Belgium.

Leuven lies at the intersection of two highways, the E40 highway London (UK) - Brussels - Liège - Köln (Germany) and the E314 highway Leuven-Hasselt-Aachen (Germany).

Take exit number 15 on the E314 highway. At the second traffic lights, turn right. The second street on your right (after ≈100m) is the Kapeldreef. The main entrance and visitor parking are on your right. For a visual representation, see our map below.

#### By train

Leuven is situated along the international railroad London (UK) - Brussels - Liège - Köln (Germany).

If you are travelling from another direction then the ones mentioned above, a changeover at Brussels' North, Central or South Station is needed to reach Leuven.

Brussels International airport has its own railway station located in the airport building. You can take a direct train from the airport to Leuven.

For more information about the Belgian Railroad company "NMBS" and its trains go to [www.nmbs.be](http://www.nmbs.be)

#### By bus (Leuven area)

From Leuven station or downtown Leuven city, bus 2 - CAMPUS will bring you to the Kapeldreef in Heverlee (terminus). The busstop is situated just opposite of the IMEC building. For more information about the Flemish bus company "De Lijn" go to [www.delijn.be](http://www.delijn.be)



