



VTS PT Chapter/COST-IRACON Joint Winter School on

# Beyond 5G Networks operating in the Millimetre Wavebands enabled by Joint Analogue-digital Signal Processing

Instituto de Telecomunicações, Instituto Superior Técnico

March 5<sup>th</sup>-9<sup>th</sup>, 2018

The School on *Beyond 5G Networks operating in the Millimetre Wavebands enabled by Joint Analogue-digital Signal Processing* will be held at the Instituto de Telecomunicações, Instituto Superior Técnico (Alameda Campus) in the framework of VTS Portugal Chapter and COST- CA15104 IRACON.

These 4.5 days training period will address recent advances in antennas, RF, signal and multi-antenna processing, making use of information theoretic concepts, and designing the necessary modulation and coding schemes as well as spectrum management strategies, to achieve implementable Massive Antenna Array Systems (MAAS) technologies at mmW frequencies, with the ultimate goal of providing mobile communication systems that approach 1 Tbit/s data rate on a per link basis.

Business aspects, cost/revenue trade-off, standardization, public policies for spectrum sharing, entrepreneurship and IPR protection will also be central parts of the training. The event also includes training on research, as it foresees a poster session that will allow the students to share their recent findings ideas with their colleagues and tutors, who will give feedback, suggestions. Academic vision will be complemented by industry/services experience and “hands-on” part of the training (simulation, programming).

**Course fees:** University Student (full time Master or Ph. D. student): 150 €  
Any other participant 225 €

**Location:** Instituto de Telecomunicações, Instituto Superior Técnico  
Torre Norte, 10th-11th floor  
Av. Rovisco Pais, 1  
1049-001 Lisboa, Portugal

**Contact:** Prof. Fernando J. Velez, [fjv@lx.it.pt](mailto:fjv@lx.it.pt)  
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## Course Schedule (**provisional**)

### MONDAY, 5th

2:00pm Overview on 5G / B5G: Scenarios, Standardization and Calendar

Ana Garcia Armada, UC3M, Madrid, Spain

2:35pm From 5G / B5G scenarios to Body Area Networks Channel Models

Luís M. Correia, IST/INESC-ID, University of Lisbon, Lisbon, Portugal

3:45pm Coffee-break

4:00pm From 5G / B5G scenarios to Body Area Networks Channel Models (**cont.**)

Luís M. Correia, IST/INESC-ID, University of Lisbon, Lisbon, Portugal

5:45pm End of the day

### TUESDAY, 6th

9:00am mmWave Channels, radiation, propagation, modelling

Wim Kotterman, Technische Universität Ilmenau, Institut für Informationstechnik. Ilmenau, Germany

10:45 Coffee-break

11:00am Antennas and RF Technologies for the Millimeter Wavebands

Luís Pessoa, INESC-TEC, Porto, Portugal

12:45pm Lunch time

2:00pm Introduction to MIMO

Dirk T. M. Slock, EURECOM, Sophie Antipolis, France

3:45pm Coffee-break

4:00pm mMIMO

Dirk T. M. Slock, EURECOM, Sophie Antipolis, France

5:45pm End of the day

### WEDNESDAY, 7th

9:00-10:45am **Prototyping with Open Air Interface (HANDS ON)** half of the students

Kun Chen, UC3M, Madrid, Spain

10:30-11:00am **The FLEXICELL C-RAN Lab Testbed**, the other half of the students

Arnaldo Oliveira, Instituto de Telecomunicações & Universidade de Aveiro, Aveiro, Portugal

10:45am Coffee-break

11:00am **Prototyping with Open Air Interface (HANDS ON)** half of the students

Kun Chen, UC3M, Madrid, Spain

(Student helper: Rooderson Andrade)

12:15-12:45pm **The FLEXICELL C-RAN Lab Testbed**, the other half of the students

Arnaldo Oliveira, Instituto de Telecomunicações & Universidade de Aveiro, Aveiro, Portugal

12:45pm Lunch time

2:00 pm **Visit to the Antenna and Propagation Labs - presentation and discussion of mm-wave antennas for 5G**

Carlos Fernandes and Jorge Costa, Instituto de Telecomunicações, Lisbon, Portugal

3:45pm Coffee-break

4:00pm Business Plan in Beyond 5G Networks

Rui Ferreira, ISCTE-IUL, Lisbon, Portugal, and Pedro Sebastião, Instituto de Telecomunicações and ISCTE-IUL, Lisbon, Portugal

5:45pm Team Work / Brain Storm – Ideas for the Business Plan (Beyond 5G Networking Product / Service)

7:15pm End of the day

#### THURSDAY, 8<sup>th</sup> (Workshop on MAAS for Millimeter Wavebands B5G Networks)

9:00am *Waveform Contenders Beyond 5G*

Javier Lorca, Telefonica, Madrid, Spain

9:45am Interference exploitation and applications to hybrid analogue-digital precoding

Christos Massouros, UCL, London, UK

10:30am Coffee-break

10:45am Multiple antenna techniques for 5G systems

Inkyu Lee, Korea University, Seoul, Korea (VTS Distinguished Lecturer)

11:35am *System Level Design/Large-scale Distributed-Antenna System (L-DAS) for Energy- and Spectrum-Efficient 5G Communication*

Sumei Sun, Institute for Infocomm Research (I2R), Singapore (VTS Distinguished Lecturer)

12:30pm Lunch break

2:00pm *Cloud RAN, fronthaul/backhaul and virtualization*

Atilio Gameiro, Instituto de Telecomunicações & Universidade de Aveiro, Aveiro, Portugal

2:45pm *Technical, business, and policy issues in 5G Mobile Networking*

Jon M. Peha, Carnegie Mellon University

3:35pm Coffee-break and poster session

4:10pm *Panel on Trends on Beyond 5G Research*

Moderated by Luís M. Correia, IST/INESC-ID, University of Lisbon, Lisbon, Portugal

Participants:

- Christos Masouros (University College London, London, UK)
- Inkyu Lee (Korea University, Seoul, Korea)
- Jon M. Peha (Carnegie Mellon University, Pittsburgh, PA, USA)
- Sumei Sun (Institute for Infocomm Research, Singapore, Singapore)

6:00pm End of the day

#### FRIDAY, 9<sup>th</sup>

9:00pm Parasitic Antennas for mMIMO

Constantinos Papadias, Athens Information Technology (AIT), Greece)

10:45am Coffee-break

11:00pm Business Aspects, IPR Protection and Innovation

Pedro Sebastião, Instituto de Telecomunicações and ISCTE-IUL Lisbon, Portugal, Fernando J. Velez, Instituto de Telecomunicações and Universidade da Beira interior, Covilhã, Portugal

12:45 Lunch time

2:00pm Business Aspects, IPR Protection and Innovation (cont.)

Pedro Sebastião, Instituto de Telecomunicações and ISCTE-IUL Lisbon, Portugal, Fernando J. Velez, Instituto de Telecomunicações and Universidade da Beira interior, Covilhã, Portugal

3:45pm Farewell

## **Accommodation**

Suggestions for accommodation are as follows:

- [Hotel NH Lisboa Campo Grande](#)
- [Hotel 3K Europa](#)
- [VIP Executive Villa Rica Hotel](#)
- [VIP Inn Berna](#)
- [Holiday Inn Lisboa](#) (please send email to Elsa Conceição, [reservashil@grupo-continental.com](mailto:reservashil@grupo-continental.com), and mention the agreement with Instituto Superior Técnico and include “Winter School” in the subject)
- [Turim Alameda Hotel](#)
- [Jupiter Lisbon Hotel](#) (please send the form available [HERE](#) to [patricia.correia@jupiterhoteis.com](mailto:patricia.correia@jupiterhoteis.com) until February 15<sup>th</sup>, 2018 )
- [Hotel IBIS Parque das Nações](#)
- [Zenit Lisboa Hotel](#)

(The Organizing Committee is establishing agreements with some of these Hotels – information will be available soon)