



A Short-Term Course on Open-Prototyping Methodologies for 5G Systems

Prof. Raymond Knopp
Eurecom, France

December 26-30, 2017
IIT Hyderabad, India



भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

I Overview

Real-time Prototyping of modern radio systems is now feasible because of the availability of high-performance off-the-shelf hardware platforms such as the USRP B2x0/X3x0 and LimeSDR. Coupled with the availability of standard-compliant implementations of 4G radio-access and core network functions allows for universities and research centers to experiment with commercial devices and innovate in areas such as MODEM technologies and resource scheduling algorithms, along with many others.

The feasibility of such experimental work is clearly demonstrated by the OpenAirInterface (OAI) community led by EURECOM. This software has been used successfully to demonstrate concepts such as CloudRAN by both industry research labs and universities. As an example, China Mobile has demonstrated early CloudRAN concepts using OAI in prestigious industry venues such as the Mobile World Congress (MWC) alongside purely industrial solutions from major equipment vendors. This shows the potential impact that an academic institution can have on major industry players when it comes to early-stage prototyping. More generally, the existence of an open-prototyping community working independently from 3GPP, but including contributors from 3GPP-driven companies, could allow academia and public research centers to have a voice in the development of future standards.

II Objectives

This course will give a detailed overview of the internals of the OpenAirInterface (OAI) radio-access network component called openairinterface5g. We will describe the real-time processing architecture of OAI both for the eNodeB (or basestation) and UE (or user terminal) components. These descriptions will be in the form of two one-hour modules per day, followed by two hours of guided lab work.

The subject matter will cover aspects related to the physical-layer architecture as well as the access-layer protocol stack. A case-study on the use of OAI in data-center deployments will also be shown along the networking technologies for using remote-radio units interconnected with centralized cloud-computing resources. The final day will cover the architectural extensions underway for using OAI to prototype the early specifications of the 5G air-interface.

III Teaching Faculty

[Prof. Raymond Knopp](#), Eurecom, France

IV Course details

Dates: December 26-30, 2017 (5 days): 10 hrs lectures and 10 hrs Tutorial lab sessions

Course Schedule:

Day 1: OAI Physical Layer Processing (eNB)

Lecture 1 (1 hour): Real-time algorithms and process scheduling in OAI eNB

Lecture 2 (1 hour): SIMD Optimizations

Tutorial Lab 1 (2 hours): Unitary simulators of OAI eNB, USRP exercise of OAI eNB

Day 2: OAI Physical Layer Processing (UE)

Lecture 3 (1 hour): Real-time algorithms and process scheduling in OAI UE

Lecture 4 (1 hour): Advanced UE features : MIMO receivers and Carrier Aggregation

Tutorial Lab 2 (2 hours): Unitary simulators, in-lab testing of OAI UE

Day 3: OAI Layer 2 Protocol Stack

Lecture 5 (1 hour): RRC, RLC, PDCP, S1AP Implementation of OAI eNB and UE

Lecture 6 (1 hour): MAC Schedulers in OAI eNB

Tutorial Lab 3 (2 hours): Tracking a complete connection of OAI eNB setup in the lab with a commercial UE, analyzing traffic scheduling, understanding OAI logging and tracing

Day 4: Data-center technologies for 4G/5G RAN

Lecture 7 (1 hour): Architecture Overview

Lecture 8 (1 hour): Fronthaul Interfaces for 4G/5G RAN

Tutorial Lab 4 (2 hours): Hands-on experience with OAI fronthaul. Deployment of a small network in the lab using URSP boards and x86 machines

Day 5: Architectural Extensions for 5G

Lecture 9 (1 hour): Overview of 5G

Lecture 10 (1 hour): OAI 5G architecture (UE and eNB)

Tutorial Lab 5 (2 hours): Mitigating Real-time issues for 100 MHz channels in OAI testbed

Date of Examination: December 30, 2017

IV Registration Details

Who can attend:

- Students at all levels (B.Tech/M.Tech/Ph.D.) and faculty from academic institutions
- Engineers and researchers of both public and private organizations

Registration fee:

- Students from academic institutions: Rs. 1000
- Faculty from academic institutions: Rs. 10000
- Professionals from industry & research organizations: Rs. 25000
- Any participant from abroad: USD 500

The registration fee includes all course material, lab equipment use for tutorials, and free Internet facility at the time of course lectures and tutorials.

The participants who opt for accommodation in IITH will be provided the same on first-come first-serve basis subject to availability at the IITH guest house/hostels on payment basis.

An additional fee of Rs. 1,500/- needs to be paid on the first day of the course for lunch and refreshments.

Registration Process:

1. Pay course registration fee and complete registration for the course in one of two ways:

A. Electronic Fund Transfer (**RECOMMENDED**): Remittance from abroad/India using SWIFT code: SBININBB762, IMCR code: 502002528,
Name of the Bank: State Bank of India,
IIT Kandi, Hyderabad, India, Branch code: 0014182.

SWIFT Code: SBIN0014182 (Within India), Account No: 30859878032 (Current A/C),
Account Name: IIT Hyderabad R&D

Save a copy of online payment receipt for your records and complete course registration online by filling in [this Google Form](#)

B. Demand Draft in favour of “Registrar, IIT Hyderabad”, payable at Hyderabad.
Take a photocopy of DD for your records. Send DD and duly filled in registration form (refer next page for the form) over post to the correspondance address given below. Write on envelop “**GIAN Course on 5G**”

2. Acknowledgement from the course coordinator confirms your successful registration to the course. If any queries, send email with **subject line “GIAN Course on 5G”**

Last date for registration is December 20, 2017 and acceptance is on first come, first serve basis.

For latest updates, visit [the course page](#)

Course Coordinator:

Dr. Bheemarjuna Reddy Tamma
Dept. of Computer Science & Engg.
#306, Academic Building-A
IIT Hyderabad, Kandi, Sangareddy
Telangana, India 502285
Email: office.head@cse.iith.ac.in
Phone: +91-40-2301 7006

Registration Form

GIAN Course on Open-Prototyping Methodologies for 5G Systems
December 26-30, 2017
IIT Hyderabad

Name: _____
Date of birth: _____
Designation: _____
Organization: _____
Mailing Address: _____

Mobile Phone: _____
Email: _____

Registration Fee Enclosed (tick one):

- Students from academic institutions: Rs. 1000
 Faculty from academic institutions: Rs. 10000
 Professionals from industry & research organizations: Rs. 25000
 Any participant from abroad: USD 500

Demand Draft No: _____

Please detach and mail this duly filled in application form along with the demand draft and a photo copy of proof of the present affiliation to the course coordinator.

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The Faculty

Dr. Raymond Knopp is a Professor in the Mobile Communications department at Eurecom, France. His research aims to consider both fundamental and experimental methods to improve the efficiency of communication systems and focuses primarily on physical-layer procedures and access-layer protocols. He is also one of the main developers of the OpenAirInterface (OAI) software packages and assumes the role of General Secretary of the OAI Software Alliance which is a non-profit entity which aims to spread the use of OAI and coordinate the development efforts in the community of enthusiasts worldwide. He also participates heavily in French National and European projects in the area of wireless communications and assumes lead technical and managerial roles in these projects. Through these projects and the OAI Software Alliance, he works closely with major industry players such as Nokia, Orange, Intel, TCL, Cisco, Fujitsu, China Mobile, Thales, Technicolor and many others. He is also co-founder with BUPT, China of the joint lab, Open5G.



Dr. Bheemarjuna Reddy Tamma is an Associate Professor in the Dept. of Computer Science and Engineering at IIT Hyderabad. His research interests are in the areas of Converged Cloud Radio Access Networks, 5G, SDN, IoT/M2M, Network Security and Green ICT. He has published over 80 articles in refereed international journals and conferences. He is a Co-PI of MEITY (Ministry of Electronics & IT, Govt. of India) funded research projects: Cyber Physical System Innovations Hub and Converged Cloud Communication Technologies at IIT Hyderabad. He also led a couple of industry (Uurmi systems, Hyderabad, India and KDDI Labs, Japan) funded consultancy/research projects on Wireless Networks as the PI at IIT Hyderabad. He served as a TCP co-chair for IEEE ANTS 2015 and a TCP vice chair for IEEE ANTS 2014. He is a General co-chair of NCC 2018 to be held in IIT Hyderabad.



Course Coordinator

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[Course Webpage](#)