



Communication Systems : Microwave and Photonics  
M.Sc. Research Internship offer - 4 to 6 months



2012 Internship  
Université Paris-Est  
ESYCOM – ESIEE Paris



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### Behavioral simulation of a 60GHz optical-radio-communication link: system and device analysis of performances of VCSEL and phototransistors

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**Context:** Bandwidth hungry services are increasingly growing (from blu-ray to HDTV, connected TV, local home area networks...). Fast and ubiquitous wireless communications are highly desired in home. According to those trends, novel standards are emerging nowadays. WiFi is following this evolution with the upcoming 60GHz band. Standards, specifications and first product are today available with data rates as high as 5/6Gbps.

However the limitation of 60GHz wireless communication is its short range, limited to up to 5m as atmosphere absorption is very high. This however is strength on security reasons. To overcome such a limitation for the coverage of the whole home area, infrastructures are needed to transmit the data from one room to the other. Two approaches are competing: one is the installation of copper electrical Gigabits Ethernet cables over the home (expensive), the other is the installation of an optical infrastructure with low-cost opto-electronic components that could support both Gbps Ethernet networks and a Radio-over-Fiber (RoF) tunnel.

RoF tunnel options are promising as they bring transparency to the home area network (HAN). Whatever the modulation standard, the optical fiber would be able to transmit directly the wireless signal room to room without modulation/demodulation. This is the task endorsed by a French national project FUI8-ORIGIN. As cost is a primary issue together with performance, ESYCOM lab proposes from 2003 a new device, named as SiGe Microwave Phototransistors (HPT, Heterojunction bipolar Photo Transistor) that should come up on the scene today, and more recently analogue VCSEL.

#### Description of work: (Master dissertation level internship – 4 to 6 months)

#### “Bridging the gap between semiconductor devices and system link performances analysis”

The purpose of the work is to be able to define clear targets for the optimization of analogue VCSEL and SiGe microwave phototransistors. Novel trade-off appears between noise and gain of the link, depending on the architecture of the link. Starting from a clear bibliography on the analysis of directly modulated and externally modulated Radio-over-Fiber link performances analysis, the intern will simulate electrical blocks of few Radio-over-Fiber architectures under OFDM modulations.

As opposed to compact circuit modeling, behavioral modeling is useful to simplify the simulation of devices through taking into account only their system level behavior. The advantage is to provide guidelines for the optimization of the device itself, thus deriving the performances to achieve. From experimental results data, the focus will be on developing further the behavioral model of SiGe phototransistors and analog VCSELs (noise, linearity and bandwidth) and hybrid to compact-circuit models to take into account opto-microwave matching effects.

At this stage the intern should be ready to define the required performances for each block of the system so as to respect 60GHz standards for the transmission performance, mainly EVM and ACLR.

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