



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



2012 Internship  
Université Paris-Est  
ESYCOM – ESIEE Paris



---

### Development of Silicon-based Microwave-Photonics platform up to millimeter-waves: numerical modeling of SiGe HBT

---

**Context:** SiGe Microwave Phototransistors are developed from 2001 in the target of being developed into Radio-over-Fiber systems. Main market is the home area network (HAN). The demand in high data rate and wireless connectivity puts more constraint on the wireless network. New wireless network standards arise such as the IEEE802.11.ad which the extension of the WiFi toward the 60GHz bands. The coverage of the radio cell is narrow, limited to few meters, and an infrastructure is needed to cover the whole home area.

Fiber optics technologies are developed on that purpose with key players being Orange labs, Acome, Prysmian/Drakka in France. 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. While actual vision is to down-convert RF signal to intermediate bands before transmitting through the fiber channel, development of 60GHz direct-RoF which would avoid down- and up- conversions noise limitations is of tremendous interest. SiGe HPTs are good candidate to address this issue as well, associated to analog VCSEL. *Improvement of optoelectronic devices beyond 60GHz is then vital.*

#### **“Increase in frequency of Silicon-based devices for microwave and photonics applications”**

**Description of work:** Within the run of frequency increase, the development of novel technologies requires precise modeling to devise required change in topologies and material parameters. The purpose of the internship is to contribute actively to this domain through the simulation of the physics of a Heterojunction bipolar phototransistor in SiGe and to couple this simulation with electromagnetic computations of its transmission lines. Experimental measurements have been made recently within a 80GHz technology from Telefunken Semiconductor GmbH. A previously PhD thesis have led to the definition of physical parameters within the simulator such as absorption coefficient and bandgap narrowing. A second PhD took these elements to infer some ways of improvement for the device optimization. The topic of this internship will be to enhance the modeling of the HPT through exploiting those experimental results. Comparisons will help to validate or optimize models in a first step. Supported by a clear bibliography of edge-illuminated photodetector, the intern will simulate and propose novel topologies. Then electromagnetic simulations of the transmission line feeding the device will be engaged to analyze it further this topology.

*This internship has the purpose to be continued on with a PhD grant on the topic of:  
“SiGe Microwave-photonics devices on a Silicon platform in the millimeter wave range:  
EM/HDD combined simulations and circuits for further rise in frequency”*

**Location:** Université Paris-Est – ESYCOM – ESIEE Paris, Cité Descartes, 93162 Noisy-le-Grand

**Contact:** Dr. Jean-Luc Polleux, [jl.polleux@esiee.fr](mailto:jl.polleux@esiee.fr)

**Web site :** <http://www.esiee.fr/en/>