

Proposta de dissertação

Optical-wireless interfaces for pico/femto-cellular access networks

Proposta de dissertação de mestrado no âmbito dos projectos "[Wireless-optical-wireless interfaces for picocellular access networks](#)" e "[Optoelectronic Oscillator Circuits for Communication Systems](#)"

Recognizing that a major challenge towards economically viable of pico/femto-cellular optical-wireless access networks is to implement low cost cell transponders with high efficient electrical and optical functionalities, we propose to investigate electrical optical (E/O) uplink and optical-electrical (O/E) downlink transponder functions using non-linear circuits based on the integration of resonant tunneling diode (RTD) oscillators with laser diodes (LD) and photo-detectors (PDs), respectively. The main advantages of these circuits are their intrinsic RF signals amplification and circuit simplicity, which makes them low-cost and more reliable.

The RTD is a nano-electronic device with a N shaped current-voltage characteristic exhibiting a negative differential resistance (NDR) region that can be used to implement high frequency electrical oscillators. When integrated with optoelectronic devices, such as LDs, can lead to novel optoelectronic functionalities such as optoelectronic voltage controlled oscillators (OVCO). This RTD-LD free-running oscillator when perturbed by radio-frequency broadcasted signals can synchronize and amplify very low power (<-40 dBm) incoming wireless signals, with the laser modulation depth being mainly determined by the NDR extension and not by wireless signal level. The oscillator locking range allows also a dynamic use of the frequency spectra available. This novel OVCO concept works as a wireless-to-optical interface converting a received low power wireless signal into an optical signal sub-carrier.

A complementary circuit is obtained integrating a RTD oscillator with a photoconductive region, the RTD-PD oscillator, that when directly illuminated by a modulated optical signal locks to the optical signal subcarrier. The optical injection locking capacity is used to O/E conversion to implement optical-to-wireless interfaces where the electrical output power is determined by the NDR region extension. The objective of our proposal is to demonstrate simple and low-cost downlink and uplink transponder functions using RTD-LD and RTD-PD oscillators, based on locking to wireless and to optical injected signals, respectively. This proposal foresees a low-cost AP solution with no need of format and frequency conversion or complex optoelectronic and electronic circuitry, such as high power amplifiers. A UK patent application of this concept was filled last November.

Participating Institutions:

- Centro de Electrónica Optoelectrónica e Telecomunicações (CEOT/UAlg)
- Instituto de Engenharia de Sistemas e Computadores do Porto (INESC Porto/FE/UP)
- Department of Electronics and Electrical Engineering, University of Glasgow, UK
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O projecto de dissertação poderá apoiado com uma bolsa de investigação.

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