



Internship (March–August 2019)

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## Optical Killer-Applications: Physical Impairments Study

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### Background:

The future of Internet depends on meeting ever-increasing capacity needs while curbing the energy consumption's uncontrolled growth in data networks and reducing the end-to-end latency of mobile networks. Optical functionalities (OFs), such as wavelength conversion, all-optical regeneration and optical packet switching, have a tremendous potential to solve these challenges by reducing the required number of optical-to-electronic (O-E) conversions and leveraging the lower energy cost per bit of optical transmissions. Unfortunately, such OFs that ought to be “killer applications” have never gained any significant market share, because they don't easily fit the conventional layered network model.

Our team is currently working on new ways to handle OFs, moving towards making smarter networks aware of these OFs' advantages and drawbacks, leveraging the concepts currently being pushed by software-defined networking. A prerequisite to this is a reliable assessment of the physical impairments incurred by these functionalities and their consequences at a system level (bit error rate, spectral broadening...) We have developed a synthetic model of physical impairments of optical networks, which we integrated into a network simulator that lets us evaluate the possible benefits of OFs such as wavelength conversion.

### Challenges:

- Conceptualization of nonideal and nonconventional optical functions.
- Energy consumption of ultra-high-capacity networks.
- Novel network architectures optimized across layers.

### Proposed work:

This internship will study and compare the physical impairments due to wavelength converters, all-optical regenerators and opto-electronic partial regenerators. It will rely on and extend our model of physical impairments, and extend our current network simulator to compare the benefits of these different OFs at the network level.

This internship may be followed up by a Ph.D. thesis.

### Required knowledge:

- Network architectures (design and modeling).
- Physics of optical communications.
- Software development.