



PhD thesis proposal

Advanced modulation formats for high spectral efficiency optical transport networks

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Scientific background and proposed activity

In a context of continuous development of internet uses and multiplication of carriers, optical access networks allowing a symmetrical bandwidth of several Gbits/s are being massively deployed. Observing further that the spectrum is a limited resource and that new technological breakthroughs must be expected, a new evolution of Core and Metropolitan optical transport networks is anticipated. Mainly determined by the need of a greater transport capacity per wavelength and an increased connectivity of networks, both for economic and technical reasons, this evolution must be done:

- Based on the existing fiber infrastructures and standards (OTN, Ethernet, IP, etc..)
- For mitigating the optical channel's impairments (optical fiber nonlinearities, chromatic and polarization-mode dispersion in optical fibers and photonic devices, phase noise of semiconductor laser diodes, ...) possibly by the use of digital signal processing in the receiver,
- By ensuring the flexibility of optical crossconnect, at least equal to that of today (this despite the increase in bit rates), able to better integrate the constraints associated with different network topologies (ring, mesh, tree, ...) or even allowing a greater integration between core and metropolitan networks on the one hand, and Metropolitan and Access on the other hand,
- By using as few electronic-optical conversions as possible in order to significantly reduce costs and consumption.

Already, various single-carrier solutions for a higher spectral efficiency, such as PolMux-QPSK modulation formats, are in the industrialization or pre-industrialization phase. More recently, experiments using OFDM modulations led to encouraging results even though the optimal operating points (all OFDM parameters), suitable to the canal propagation conditions and implementation, are yet to be established.

However, beyond better performance in terms of spectral efficiency, none of these preliminary studies have taken into account prerequisite constraints of network implementation such as flexibility, transparency, or integration with the network layers.

The main objective of the PhD thesis is therefore to design and optimize a transmission system over optical fiber, at high spectral efficiency on the one hand, as well as creating new opportunities in terms of network flexibility on the other hand, possibly in a reinterpreted approach of core and metropolitan networks. In this context, OFDM and its variants can be revisited and compared to other types of single-carrier modulations. Particular attention will be given to the problems of optical fiber nonlinearities and the reduction of equipment complexity.

Requirements: Digital Signal Processing, Digital Communication Theory, Optical Communications, Photonic Devices.

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Please send with reference number PHD09OT, a curriculum vitae, motivation and reference letters by email to G. Froc or Y. Jaouën