



Strategies for network optimization and margin reduction

Description

In the current context of optical network energy optimization, a reservoir of performance improvements lie in the excess margins that are allocated in current networks due to several reasons, notably:

- 1- The network planning tool (in particular, the Quality of Transmission estimator) has uncertain inputs and hence its output is also uncertain; the tool itself is uncertain [design margins].
- 2- The performance of the equipment allocated to serve a demand exceeds the requirement of the demand itself [unallocated margin].
- 3- The network physical layer varies with time (e.g., due to ageing) and the network is designed for its End of Life performance rather than Beginning of Life performance [system margin]

However, two obstacles prevent us from using these margins. First, the layered-network model introduces artificial separations in network handling, which lead to separate local optimizations that may not reach a true global optimum. The latter requires a cross-layer approach, which is an entirely novel way of managing the network.

Second, a dynamic, automated network reconfiguration capability must ensure that some network invariants are not broken, so as not to e.g. degrade existing connections when establishing a new one. What these invariants actually are is not immediately clear; which also means, by complementarity, that the parameters that may be varied when reconfiguring are not immediately clear either.

Objectives

We aim to develop and compare strategies for improving network performance, especially reducing over-dimensioning in link power margins. A special comparison point is between pure physical-layer strategies (e.g. ML-based optimization of amplified links); and cross-layer strategies (e.g. balancing protection guarantees between the physical layer, such as 1+1 protection, and the protocol layer, such as TCP re-emission).

We also seek which network parameters can be modified, and which invariants must be maintained, for a possibly-automated network reconfiguration to be effected without interfering with already-established links. Relevant parameters may be hardware-layer-related (e.g. power levels, modulation formats) or protocol-layer-related (e.g. TCP congestion control algorithms). We especially seek to compare the effect of layer-by-layer optimization and cross-layer optimization

Work program

Over 6 months, the intern will:

- Establish a state of the art
- Contribute to the work effort around our current simulation tools in development
- Start the network optimization work by identifying significant parameters and implementing optimization strategies based on those parameters

Requirements

- Good background in optical communication and networks.
- Programming capabilities (Python, optionally C++)

Environment

This internship is jointly supervised by Cédric Ware, Professor, Télécom Paris and Mounia Lourdiane, Assistant Professor, Télécom SudParis. These institutes are two of the top schools of engineering in France, both founding members of Institut Polytechnique de Paris.

The work will be located on their common campus: 19 place Marguerite Perey, 91120 Palaiseau.

Contacts

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