Planning and Dimensioning Multilayer Optical Transport Networks

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Network planning tools are important for both system vendors and network operators. In the budgeting and implementation stages, a planning tool offering a cost-optimized solution to the network operator can be decisive to the system vendor. After, in the operation stage, the planning tool can be used to re-optimize the available resources, bringing cost savings to network operators. Moreover, as new competing technologies are always being introduced, planning tools are also used to evaluate and compare the various alternatives before advancing to their manufacturing and market introduction. Nowadays, the manual and rule-of-thumb network planning strategies of the past are being replaced by sophisticated software tools.

Over the last few years, we have been actively involved in addressing issues related to the development of planning tools for multilayer transport networks, through a partnership with the worldwide system vendor Coriant. In the framework of this partnership, we succeeded to develop planning tools that, for the first time, take into consideration the various hardware implementation constraints.

As the first stage of the overall network planning process is the deployment of the network links, we started by proposing a genetic algorithm to design near optimal network topologies. After this initial stage, the nodes must be designed. Therefore, mathematical optimization models for the nodes dimensioning to be used in greenfield scenarios were developed. As several alternative architectures with different levels of flexibility are currently available, extensive comparative techno-economic analysis were performed focusing on the CapEx, power consumption, and footprint requirements. As a result, an optimization method for the node architecture was proposed. Simple rules and scenarios where a determined architecture brings advantage were identified. Then, when planning a network, we can quickly optimize the total network cost by selecting the architecture of each node accordingly. The last stage of the network planning process is the capacity optimization during operation. For this purpose, novel mathematical models enabling hitless re-grooming were developed. We also evaluated the savings attained by exploiting hitless re-grooming. Moreover, the traffic conditions where such savings are expected to be more substantial were highlighted. It was observed that the developed methods can assist in mitigating the impact of grooming limitations that arise when deploying more scalable architectures, bringing obvious cost savings.