Modelling and simulation of end-to-end connectivity in automated optical networks

The primary aim of this research is to explore novel methodologies for representing virtualization in disaggregated optical networks, focusing on resource abstraction, simplified modeling, and validation through simulation. The study will build upon orchestration techniques in Software-Defined Networking to optimize lightpath selection and improve service provisioning by leveraging abstracted resources, such as lightpath segments and wavelength conversion capabilities.

The research activities for the fellowship will be spread over the 12-month period as follows:

- Months 1-4: Literature Review and Problem Definition. The first four months will be dedicated to reviewing existing literature on SDN, lightpath abstraction, and orchestration in disaggregated optical networks. During this phase, relevant metrics for network resource abstraction will be identified and summarized, with a particular focus on how they affect end-to-end service provisioning. Parameters necessary for virtualizing disaggregated network resources, including lightpaths and wavelength conversion, will also be defined. This period will lay the groundwork for subsequent modeling and simulation efforts.
- Months 5-9: Simulation and Validation (Phase 1). With a clear problem definition and set of parameters established, months five through nine will focus on using and improving simulation environments to evaluate the proposed models. Initial simulation campaigns will be conducted to test the accuracy of the analytical models, comparing the results to existing approaches. A range of network and service parameters will be explored, simulating different traffic patterns and network configurations to understand the behavior of abstracted resources in various conditions.
- Months 10-12: Simulation and Validation (Phase 2). The final three months will be dedicated to refining the simulations and validating the models against real-world data. During this phase, the simulations will be fine-tuned, improving their accuracy and addressing any discrepancies observed in earlier tests. The potential benefits of orchestration optimization in SDN, with a focus on multi-metric user requirements such as service reliability and quality of experience, will be investigated in depth. By the end of this phase, the models and simulations should be robust and ready for final analysis and reporting.

Throughout the research, findings will be carefully documented, with particular attention to the implications for network design and virtualization techniques in disaggregated environments. The outcomes will include a validated analytical model for abstracted lightpath resources, along with simulation tools and methodologies that can be applied in future studies. Additionally, the project will offer recommendations for improving orchestration strategies in SDN networks, contributing to the ongoing development of virtualization in optical network design.