

Preface

Next generation optical communication systems will be characterized by increasing data rates, dynamic adaptation to the actual traffic demands and improved energy efficiency. In future all-optical meshed networks it is highly desirable that transparent optical paths can be set up on-the-fly, providing bandwidth-on-demand and shutting down unused resources automatically.

Appropriate design of an optical core network is crucial as the capital expenditure for such a system is extremely high. Currently the split-step Fourier method is employed in state-of-the-art transmission system simulators to solve the nonlinear Schrödinger equation describing the propagation of light in a single mode glass fiber. Unfortunately, even on today's computer systems the simulation of a wavelength division multiplex transmission system with a high channel count and a transmission distance of several thousand kilometers is still very time-consuming with computational efforts of hours to several days. This is why in this book several alternative methods are proposed to reduce the simulation time. They range from a meta-model based optimization method for finding an optimum operation point of a transmission system in a large parameter space with only a very low number of numerical simulations to parallelization techniques for solving the nonlinear Schrödinger equation in an efficient way on a graphics processing unit (GPU) with a high number of cores. Alternatively, fast analytical models for the approximation of various degradation effects occurring on the transmission line can be used.

The design of fiber optical core networks is evolving rapidly from static point-to-point transmission systems to meshed networks with transparent optical cross-connects enabling dynamic reconfiguration of the network and leading to longer transparent transmission distances. During recent years several research projects have been conducted throughout the world investigating on-the-fly provisioning of bandwidth with demand granularities in the order of a wavelength capacity. To exploit the maximum transparent reach the inclusion of physical-layer impairments in the routing and wavelength assignment process is desirable. In this book constraint-based routing and regenerator placement are presented based on fast analytical models for approximating the signal quality. It is shown that the

blocking probability of dynamic wavelength demands as well as the number of required optical-electrical-optical regenerator components can be reduced significantly by the inclusion of physical-layer impairments. Finally, it is investigated how the energy efficiency of an optical core network can be increased considerably by making use of optical bypasses to keep more traffic entirely in the optical layer and shutting down unused components in the IP-layer.

Most of the work presented here has been carried out in close collaboration with industry partners during my time at the Chair for High Frequency Technology of TU Dortmund, Germany. The parallelization techniques on GPUs have already been included in the commercially distributed optical system simulator *PHOTOSS*. Network operation research has lead to the development of a new simulation tool named *CBRSuite*.

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