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学位論文名	Dynamic Lightpath Provisioning Incorporating Four-Wave Mixing Induced Crosstalk and Modulation Format Conversion Interface （四光波混合によるクロストークおよび変調フォーマット変換を考慮した動的光パス設定に関する研究）
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論文内容の要旨

This dissertation introduces a study on dynamic lightpath provisioning towards the design on wavelength routed optical networks accomplishing physical impairment awareness (e.g., FWM-induced crosstalk) and enriching transparency in terms of bit rates and modulation format conversion interface using distributed impairment constraint based routing approach. The content of the dissertation is based on the research which I conducted during my doctoral course at the Department of Electrical, Electronics and Information Engineering, Graduate School of Engineering, Osaka University. The dissertation is organized as follows:

Chapter 1 is an introduction to the contents of the dissertation. It presents a general overview of the current state of optical networking including issues and challenges.

Chapter 2 addresses the details of the effects of four-wave mixing (FWM)-induced crosstalk and its impact on the network performance of wavelength-routed optical networks, as an important factor influencing the performance of high-bit-rate long-haul systems. An analytical study of FWM and the basis of the calculation model used are described. Additionally the necessary fundamentals of on-off keying (OOK) and quadrature phase-shift keying (QPSK) modulation format are introduced.

Chapter 3 describes the novel designed impairment constraint-based routing algorithm for wavelength-routed optical networks and focuses on lightpath computation encompassing physical impairment constraint via a novel cost function, taking into account as a first instance FWM-induced crosstalk. In addition, an implementation to fast establishing the lightpath set up based on the advantages of a hybrid online/offline strategy is proposed.

Chapter 4 focuses on modulation format conversion feature interface, which has been added to the designed dynamic algorithm for high-bit-rate systems. By envisaged transparent modulation format conversion from 2-channels conventional OOK to QPSK in future wavelength-routed optical networks, we have proposed a novel FWM-induced crosstalk-aware dynamic RWA algorithm and have showed by numerical simulation that it can minimizes significantly the network blocking probability.

Chapter 5 summarizes the results of the preceding chapters and draws final conclusions of the dissertation. From all the obtained results, it is concluded that, the proposed FWM-induced crosstalk aware dynamic RWA with modulation format conversion has the feasibility to enrich the network performance, guarantee quality of services (QoS), increase scalability, and support transparency.

論文審査の結果の要旨

This dissertation newly proposed an impairment-constraint-based routing technique, which copes with two main issues: the FWM-induced crosstalk awareness and the transparent modulation format conversion from 2-channel conventional OOK to QPSK in wavelength-routed optical networks dynamic lightpath provisioning. Results are validated via exhaustive discrete event time simulations. The main results obtained in this dissertation are summarized as follows:

Since future telecommunications networks not only require very high information bandwidths but also need to support a wide range of services with different traffic statistics and good quality conditions, in order to address these characteristics, a novel FWM-aware RWA has been proposed and evaluated thorough extensive simulations under different network topologies. The FWM-aware RWA allows establishing end-to-end lightpaths on demand, by updating the network states information stored in a novel cost function. The cost function is evaluated and updated at generating a link state. It validates the computed path under the implemented constraints (network

resource utilization and FWM-induced crosstalk). It is examined at the end of the calculation candidate path through the ICBR approach, following the policy that if the computed candidate on-line path satisfies a fixed permitted threshold then the candidate path is established, otherwise, it is rejected. The algorithm guarantees the quality of services (QoS) by avoiding setting up lightpaths that have been degradated by FWM-induced crosstalk. Qualitatively, in comparison with previous algorithms found in the literature, this approach improves the network performance while guarantees the QoS.

A transparent 2xOOK-to-QPSK modulation format conversion interface in the dynamic FWM-aware RWA has been proposed. Results show a feasibility of transparency between different modulation formats and a significant decreasing of the blocking connection request while simultaneously guarantee the QoS connections.

From all the obtained results, it is concluded that, the proposed FWM-induced crosstalk aware dynamic RWA with modulation format conversion has the feasibility to enrich the network performance, guarantee QoS, increase scalability, and support transparency. Consequently, the proposed scheme is considered as one possible base to develop the network design framework for the future transparent optical communication networks.
The judging committee admits that the thesis is worth the doctoral dissertation.