Chromatic Dispersion Monitoring in Flexible Optical OFDM Networks

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Abstract— **A novel chromatic dispersion monitoring scheme for flexible optical OFDM networks is presented. A pair of coded label subcarriers is added to both edges of the optical OFDM signal spectrum. The signal monitoring is performed via simple direct detection, followed by electronic correlation procedures with the designated code sequences. The feasibility and the performance of the proposed scheme have been characterized through numerical simulations.**

Keywords-chromatic dispersion monitoring, flexible optical network.

I. INTRODUCTION

Optical orthogonal frequency division multiplexing (OFDM) is a promising and practical signal format to be employed in future high-speed flexible optical networks. Its signal bandwidth is variable so as to realize scalable and spectrum-efficient transport of ultrahigh-speed (say >100 Gb/s) data. It can support segmentation and aggregation of spectral resources, efficient accommodation of multiple data rates, as well as flexible resource allocation [1]. Moreover, it has shown superior tolerance to the chromatic dispersion and polarization mode dispersion in long distance transmission over optical fiber. In order to provision lightpaths which are dynamically reconfigurable according to different demand requests, the accumulated chromatic dispersion on each lightpath would vary. Hence, chromatic dispersion (CD) monitoring is highly desirable to provide the information of accumulated dispersion for each lightpath, so that efficient compensation at the receiving node can be realized. CD monitoring at each intermediate node can further provide information to facilitate impairment-aware routing or scheduling, so as to meet the quality of service requirement.

Recently, there have been some interesting schemes proposed for optical performance monitoring of optical OFDM signals [2-3]. However, most of them required a sophisticated coherent receiver with channel estimation. The accumulated signal impairments were estimated via statistical sampling at the destination node of the ligthpath. In this paper, we propose a novel scheme to perform chromatic dispersion monitoring at the intermediate nodes, without the need of expensive coherent receiver. At the signal transmitter, a pair of coded pilot optical subcarriers, which carry a unique code sequence, are inserted into the first and the last edges of the signal spectra of the optical OFDM signal, as illustrated in Fig. 1. At each intermediate node, a low-speed photo-detector is employed to receive all incoming wavelength channels and extract the low-frequency components, where the code sequences on all wavelength channels reside. By applying simple correlation operation to the extracted code sequences, the absolute value of the temporal difference of the two correlation peaks is found to increase proportionally with the fiber length that the optical signal has traversed. Hence, the group delay information of the optical OFDM signal could be estimated by examining the temporal difference of the correlation peaks between the two coded label subcarriers. The feasibility and the performance of the proposed scheme have been characterized through numerical simulations. The results showed that the insertion of the pair of coded label subcarriers to the optical OFDM signal imposed negligible penalty to the transmission of the optical OFDM payload. In general, the proposed scheme provides a cost-effective monitoring solution for the optical OFDM signals across intermediate nodes in flexible OFDM networks. This work was partially supported by a research grant from Hong Kong Research Grants Council (General Research Fund: CUHK410512).

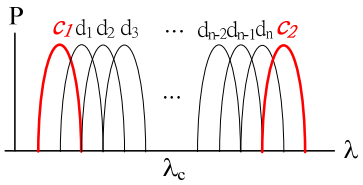

Fig. 1: Optical spectra of the generated optical OFDM signal with two optical coded label subcarriers, c_1 and c_2 (in red).

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