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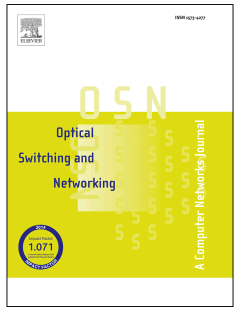

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Optimizing The Cost Function of Power Series Routing Algorithm For Transparent Elastic Optical Networks

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Abstract

In this article, it is investigated the impact of different parameters and which parameters to use by the power series routing methodology adapted for reducing the call request blocking probability in transparent elastic optical networks. Some of the used parameters are specifically related to elastic optical networks, such as: slot contiguity, transmission bit rate and modulation format. The amplified spontaneous emission noise generated by optical amplifiers (booster, in-line and pre-amplifier) as well as the losses and gains observed by optical signals along the lightpaths are considered in our simulations. We verified that, depending on the considered parameters and their quantity, there is a perceivable impact on the network performance in terms of blocking probability of call requests. The results revealed the most important parameters and their combinations that shall be considered by the cost function of the power series routing algorithm in our simulated scenarios of elastic optical networks.

Keywords: Amplified Spontaneous Emission; Elastic Optical Networks; Power Series Routing Algorithm; Routing, Modulation Level and Spectrum Assignment Algorithm; Signal-to-Noise Ratio.

1. Introduction

Basically, the concept of wavelength division multiplexing (WDM) networks is related to the management and switching of multiple optical signals in wavebands (wavelengths) through network optical fibers. In WDM optical networks, the wavelength bandwidth used for each call request is fixed, which means that, independently of modulation format and transmission bit rate used to transmit the optical signal, the same amount of bandwidth is used [1]. On the other hand, in elastic optical networks (EONs), the width of spectrum used by each call request may be variable and strictly dependent on the modulation format and transmission bit rate [1]. It is usually assumed that the spectrum is divided in slots with fine granularity, for instance 12.5, 6.25 or 3.125 GHz, and a sufficient number of slots may be picked to just fit the call request bandwidth.

The problem of finding a route, selecting a modulation format and choosing a group of slots in the frequency spectrum is referred to as routing, modulation level and spectrum assignment (RMLSA) [2]. In current RMLSA, it is usually required that both the slots are chosen contiguously (contiguity constraint) and are kept the same through the entire transparent segment (continuity constraint). The power series routing (PSR) algorithm, proposed by Chaves et al. [3, 4], consists on the application of a methodology to define and to optimize the link cost function in an offline manner. This methodology of designing and optimizing the link cost function consists on the following steps [4]: (1) the input parameters for defining the link cost function are selected; (2) the cost function is described in terms of a series of functions; (3) a global indicator of network performance is chosen to be used as an optimization objective; (4) an optimization technique is used to find the series coefficients that optimize the network performance indicator (e.g. blocking probability of call requests). This optimization process is realized as a planning phase. After the coefficients have been found, they will be kept the same and used along all the analyzed operation phase.

For a given link, several factors that influence the capability of finding available resources to a call request may be used in a combined way through the following expression of cost function [4]:

$$f(x_1, x_2, \cdots, x_P) = \sum_{i_1=0}^{T} \sum_{i_2=0}^{T} \cdots \sum_{i_P=0}^{T} b_{i_1,i_2,\ \cdots\ ,i_P} x_1^{i_1} x_2^{i_2}\ \cdots\ x_P^{i_P} \quad (1)$$

in which P is the number of relevant parameters to com-

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