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A study of Reactive Spectrum Defragmentation Approaches in Elastic Optical Networks

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Spectrum Fragmentation is one of the main factors affecting the efficiency of the Elastic Optical Netwoks (EON) [3], causing the rejection of connection request due to the continuity and contiguity constraints [3]. The Defragmentation Problem is being studied in the literature, and two different approaches were presented: proactive (it takes evasive action to avoid spectrum fragmentation) and reactive (the defragmentation it's triggered when a connection request will be rejected). In this work we study the different Reactive approaches found in the literature, to analyze and compare their performance in a specific scenario and evaluating the effects of the defragmentation on the Routing and Spectrum Assignment (RSA) algorithms.

In Takagi et al. [2] a strategy is proposed, called MBBR, in which if a connection request will be rejected, a route is selected for the request, and all of the established connections in conflict are re-routed, to let the new connection be established. Another approach, called MCDA, was presented for Yin et al in [4]. Here, the shortest path is selected for the connection that will be rejected, and every established connection in conflict is re-assigned to other portions of the spectrum, but in their own route, and then the new connection request is accepted. Lastly, Castro et al. [1] proposes SPRESSO, a defragmentation algorithms that performs as follow: if a connection request will be rejected, a route is selected, and every established connection in conflict is moved towards the contiguous portions of spectrum of their own routes, in order to let enough bandwidth for the connection request to be established. We made simulations to compare the performance of the aforementioned strategies, with the following assumptions. The selected topology was a 14-node NFSNET, every frequency slot (or channel) has 12.5 Ghz, and every optical fiber (link) has 352 frequency slots available. The source and destination of the request, selected randomly, arrive according to the Poisson process. The holding time is constant and equal to 0,1% of the simulation time (1000 units for this case), and the request bandwidth requirements are uniformly distributed between 2 and 16 frequency slots. To focus on the benefits of the defragmentation, we select the Shortest Path First-Fit (SP-FF) as the RSA Algorithm, and evaluate the effects of the defragmentation on it.

Fig. 1 shows performance of the SP-FF algorithms with and without the defragmentation algorithms (MBBR, SPRESSO, MCDA). According to the results in Fig. 1,

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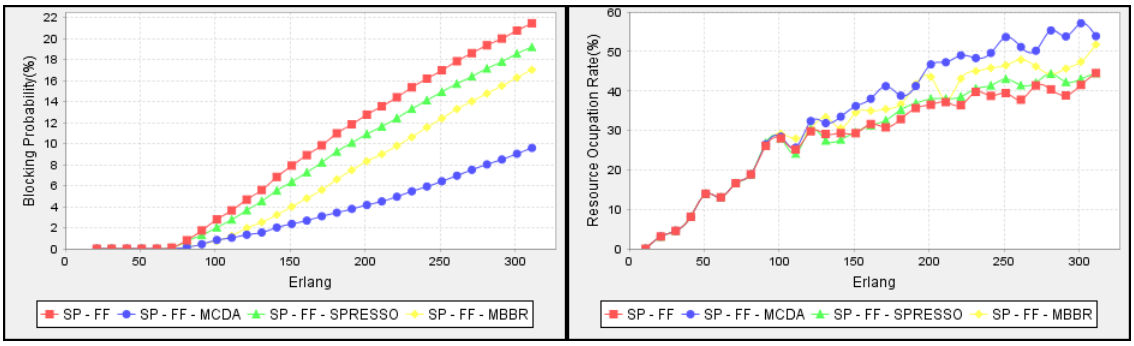
SP-FF-MCDA algorithm achieves better results in this scenario, with the least Blocking Probability (Fig. 1 (a)), and more Resource Occupation (Fig. 1 (b)), meaning that, with this algorithm, the network rejects the least amount of connection request among the others, and holds the established connections more efficiently. These results allow us to reaffirm the importance of the Spectrum Defragmentation in EON, because the SP-FF algorithm with the different defragmentation approaches outperformed the one without. Besides, the blocking probability and the resource occupation are positively correlated, i.e. if one improves, the other one improves as well. In future works, we'll make more exhaustive test with the Reactive approaches, and start the analysis of the Proactive ones.



(a) (b)

Figure 1: (a) Blocking Probability (b) Resource Occupation

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