Resource Assignment Schemes for Pre-configured Backup Protection in Elastic Optical Networks

Suthaharan Satkunarajah
Department of Physical Science
Vavuniya Campus of the University of Jaffna, Sri Lanka.

***Abstract*—In this paper, the problem of providing survivability in elastic optical networks (EONs) is addressed. EONs use 12.5 GHz fine granular frequency slots or flexible grids instead of using the traditional 50 GHz fixed grid networks and therefore frequency spectrum is used more efficiently. For providing survivability, a recently proposed survivability scheme known as pre-configured backup protection with sharing (PBPS) is considered because of its benefits over traditional approaches. In PBPS, backup paths can be pre-configured and they can share resources simultaneously. Therefore, both short recovery time and efficient resource usage can be achieved. Resource assignment is a potential issue in which primary and backup paths can be provisioned in various schemes. Resource assignment using First-Fit scheme for the primary and for the backup paths has earlier been studied in PBPS with flexgrid (EONs) networks. Assigning resources for the primary and for the backup paths deploying First-Fit and Last-Fit schemes has already been investigated in only shared protection with flexgrid networks. However, resource assignment to use First-Fit scheme for the primary path and to use Last-Fit scheme for the backup path using PBPS in flexgrid networks has not been investigated and this investigation is the focus of this paper. This investigation includes detailed simulation experiments on different networks topologies. The findings are as follows. Significant blocking reduction is seen in PBPS with EONs using First-Fit for primary path and Last-Fit for backup path when compared to assigning resources using First-Fit for both primary and backup paths. Further, particularly in high network loads, even more blocking reduction is seen when compared to low network loads in all the networks topologies.**

***Keywords*—elastic optical networks; survivability; resource assignment schemes.**

I. Introduction

Wavelength division multiplexing (WDM) in optical networks is a technique to handle the explosive growth of the Internet traffic [1]. WDM divides the transmission bandwidth available on a fiber and it enables data transmission over the channels simultaneously. These channels in WDM are typically using 50 GHz or 100 GHz rigid grid spectrum spacing as specified by the International Telecommunication Union (ITU). A single fiber consists of 4.4 THz total spectrum width which can be divided into 88 channels each of 50 GHz fixed grid [2]. Elastic optical (or flexgrid) networks (EONs) have recently been introduced to use the frequency spectrum more efficiently [3]. In EONs, 12.5 GHz fine granular frequency slots or flexible grids are deployed for provisioning lightpaths instead of using 50 GHz or 100 GHz fixed grid spacing [4, 5]. Assigning the spectrum in flexgrid networks is allowed according to bandwidth requirements and expansion and contraction of lightpaths are enabled according to the traffic volume [6], hence, the frequency spectrum is used more efficiently in flexgrid networks.

Large amount of data would be lost due to component failure like fiber-cut, therefore, considering survivability or protection with backup paths is an important issue in optical networks. Traditionally two types of protection methods are available such as dedicated and shared which are shown with the network topology of eight nodes and ten links in Fig. 1(a) and Fig. 1(b). Pre-configured paths (primary (P) or backup (B)) are depicted by solid arrows and non pre-configured paths (backup (B)) are depicted by dotted arrows. In Fig. 1(a), that is dedicated protection, backup paths B1 and B2 are set up at the time of establishing primary paths P1 and P2 respectively (B1 and B2 are pre-configured). Suppose that, on a component failure on P1, no further configuration is needed, this is because B1 is pre-configured. Therefore, in short recovery time, traffic will be rerouted through B1, while no backup resource sharing is possible among backup paths and, hence, resource usage in this approach is high [7] (six backup links

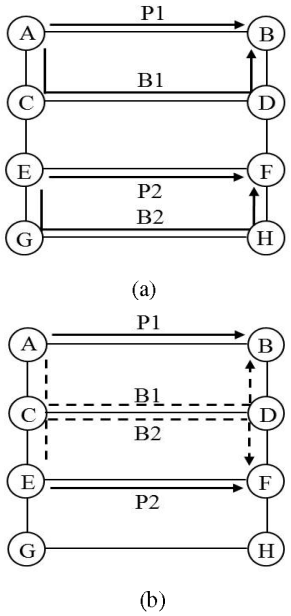

Fig. 1: Traditional (a) Dedicated and (b) Shared protection methods.