Wavelength Conversion Scheme for Dedicated Protection in WDM Optical Networks

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***Abstract*—Optical communication is the emerging technology for data transmission systems because of their large information-carrying capacity. Wavelength division multiplexing (WDM) in optical networks is a method to deal the Internet traffic more effectively. Various divided channels are used in WDM to enable data transmission on a fiber. Failure of the optical fiber causes loss of huge amount of data which can interrupt communication. To protect such failure, we consider dedicated protection in this paper in which backup paths are configured at the time of establishing connections. If a primary path is failed, the traffic is rerouted through secondary path with a short recovery time. Further, non-wavelength conversion is a wavelength assignment scheme which incorporates with wavelength continuity constraint method. Therefore, the blocking of connections can be increased. To reduce the blocking, we focus a scheme known as wavelength conversion technique in this paper which leads to the less blocking of the connections. In this paper, we carry out the investigation with detailed simulation experiments on different data rates scenarios. In addition, this paper focuses on three standard network topologies which consist of different number of links to identify how the blocking performance varies for each network. Our findings are as follows. (1) The considerable reductions have been achieved in each of the network loads in a particular network topology. (2) The blocking performance for network topology with low number of links and network topology with high number of links are comparable.**

***Keywords*—optical networks; dedicated protection; wavelength conversion.**

I. Introduction

Fundamentally, two network nodes are used to share data in the communication system in which the data is expanded to multimedia nowadays [1][2]. To fulfil the requirements optical fibers are used extensively for data transmission systems because of their large information-carrying capacity. Wavelength division multiplexing (WDM) is an effective technique to utilize the bandwidth of optical fiber [3]. Several non-overlapping wavelength channels are used in WDM on a fiber [4]. In a WDM optical network, the failure of network elements may cause the failure of several optical channels, thereby leading to large data losses [5]. In data transmission, there should be some protection techniques. In this paper, we consider the dedicated protection as the technique for network survivability where the secondary paths (backup paths) are configured at the time of establishing connections [6].

Dedicated protection is described in a network topology with eight nodes and ten links as shown in Fig. 1. Primary paths (P) and secondary paths (S) are denoted by the solid arrows. In this protection technique, secondary paths S1 and S2 are configured at the time of setting up primary paths P1 and P2 respectively. Since secondary path S1 is pre configured, backup traffic can be rerouted through S1 in case of link failure on primary path P1. Therefore, less recovery time can be realized in the dedicated protection due to the pre configuration approach of the secondary path. This is the main benefit can be achieved in dedicated protection over other protection mechanisms. The blocking probability is one of the measuring constraints in which it can be calculated by considering the total connection blocked out of the total amount of the connections arrived at the network. Blocking of a connection may cause due to several reasons. One of the reasons is following the wavelength continuity constraint (or wavelength non-conversion approach) [7]. However, this method can be overcome by another method called wavelength conversion [8-13] to reduce the blocking probability which is illustrated below.

Three connections with their associated wavelength w1, w2, and w3 which consume various links such as Link1, Link2, Link3, Link4, and Link5 are shown in Fig. 2. We assume that only five wavelength slots Slot1, Slot2, Slot3, Slot4, and Slot5 are available in each link. In Fig. 2(a), connection requests arrive in the order of connection 1 (one wavelength is required in the links of Link1, Link3, and Link5), connection 2 (one wavelength is required in the links of Link2 and Link3), and connection 3 (two wavelengths are required in the links of Link1, Link2, Link4, and Link5). We note that, a particular connection consumes same slots in various associated links to fulfill the wavelength continuity constraint. Particularly, a wavelength continuity constraint can be illustrated in such a

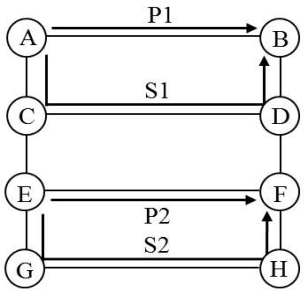

Fig. 1: A scenario of dedicated protection.

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