SURVIVABLE ELASTIC OPTICAL NETWORK

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Abstract
Recently elastic optical network have been more popular due to their inherent flexibility and the efficiency with which they allocate fiber bandwidth in elastic optical network, survivability curtail requirement because of the very high bandwidth that it carryon each optical channel. In this paper, we reviews survival elastic network.
Keyword: Elastic optical networks, survivability, spectrum allocation.

I. Introduction

Last few years, there has been a tremendous growth of internet traffic due to multimedia services and cloud computing technique .Cisco analyzed that 2011 to 2016 the average annual growth rate of internet traffic around 29% and in the upcoming years video services will access more than 90% of internet traffic [1] due to this tremendous growth of internet traffic. Survivability is important requirement in elastic optical network. Survivability is the ability of the any network, which continues providing service in the presence of failure [2]-[3]. It is the process of re-configuration and re-establishment of connections in presence of failure. Providing survivability is an important requirement for high speed networks because in case of a failure, a tremendous amount of information can be lost, affecting a huge number of requests. The resource allocation strategy deals with the allocation of resources for the connections. It is also known as provisioning. The main aim of it should be to utilize the resources efficiently. It greatly affects the number of connections accepted. If the strategy is efficient, then more free resources will be available to accommodate more connection requests to increase request acceptance rate. The increased request acceptance rate will result in reduced blocking probability. Survivability is greatly affected by the resource allocation strategy. It is because survivability requires resources to handle the failures and resource allocation strategy provides the resources.

The traditional WDM-based optical network divides the spectrum into separate channels [4]-[5]. The spacing between adjoining channels is either 50 GHz or 100 GHz, which is specified by international telecommunication union (ITU)-T standards as shown in Fig. 1. The frequency spacing between two adjacent channels is relatively large. If the channels carry only low bandwidth, and no traffic can be transmitted in the large unused frequency gap, a large portion of the spectrum will be wasted, which is reflected in Fig. 2.

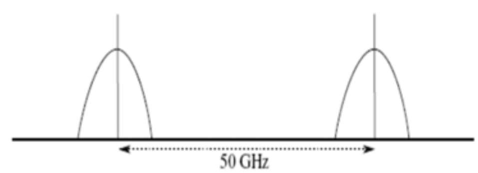

Fig. 1 ITU-T grid

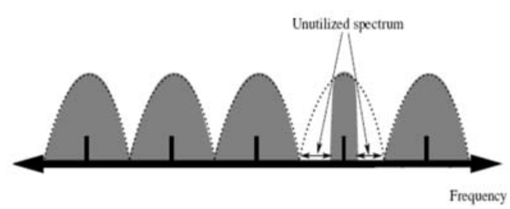

Fig. 2 Spectrum allocation in WDM based optical networks

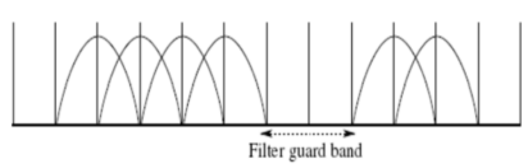

Fig. 3 overlapping subcarriers caused by OFDM technology

Optical OFDM allocates the data to several low data rate subcarrier channels [6]. As the spectrum of adjacent subcarrier channels are orthogonally modulated, they can overlap each other as shown in Fig. 3, which increases transmission spectral efficiency. Furthermore, optical OFDM can provide fine-granularity capacity to connections by the elastic allocation of low rate subcarriers. A bandwidth-variable OFDM transponder generates an optical signal using just enough spectral resources, in terms of subcarriers with appropriate modulation level, to satisfy the clients requirements. OFDM signals are usually generated in the radio-frequency domain, so many transmission properties can be freely set, i.e., different subcarriers can be assigned different numbers of modulated bits per symbol. To establish a connection, each bandwidth variable cross-connect on the route allocates a cross-connection with sufficient spectrum in order to create an appropriately sized end-to-end optical path. This end-to-end path is expanded and contracted according to the traffic volume and user requests, as necessary. The main characteristics of an elastic optical network are bandwidth segmentation, bandwidth aggregation, efficient accommodation of multiple data rates, elastic variation of allocated resources, reach-adaptable line rate, etc. These are discussed in more detail below.

- Bandwidth segmentation: Traditional optical networks require full allocation of wavelength capacity to an optical path between an end-node pair. However, elastic optical networks provide a spectrum efficient bandwidth segmentation (sometimes called sub wavelength) mechanism that provides fractional bandwidth connectivity service. If only partial bandwidth is required, elastic optical network can allocate just enough optical bandwidth to accommodate the client traffic, as shown in Fig. 4, where a 40 Gb/s optical bandwidth is segmented into three sub wavelengths, such as 5 Gb/s, 15 Gb/s, and 20 Gb/s. At the same time, every node on the route of the optical path allocates a cross-connection with the appropriate spectrum bandwidth to create an appropriate-sized end-to-end optical path. The efficient use of network resources will allow the cost-effective provisioning of fractional bandwidth service.
- Bandwidth aggregation: Link aggregation is a packet networking technology standardized in IEEE 802.3. It combines multiple physical ports/links in a switch/router into a single logical port/link to enable incremental growth of link speed as the traffic demand increases beyond the limits of any one single port/link. Similarly, the elastic optical network enables the bandwidth aggregation feature and so can create a super-wavelength optical path contiguously combined in the optical domain, thus ensuring high utilization of spectral resources. This unique feature is depicted in Fig. 4, where three 40 Gb/s optical bandwidths are multiplexed with optical OFDM, to provide a super-channel of 120 Gb/s.
  - Energy saving: It supports energy-efficient operations in order to save power consumption by turning off some of the OFDM subcarriers while traffic is slack.
  - Network virtualization: It allows optical network visualization with virtual links supported by OFDM subcarriers.

In the recent past various paper presented on Elastic optical network. A survival multipath provisioning scheme that provides flexible protection levels in OFDM–based flexible optical networks has been discussed in [7]. In [8], the author has been presented a naval shared protection specific to elastic networks, namely elastic separate-protection at connection. The architecture of the elastic optical network and its operation principle has been described in [9] the author briefly described the different node architecture and compares their performance in terms of scalability and flexibility. In [10], the authors have been reviewed the current states of art of survival elastic optical network which reviews the literature spectrum resource sharing amount backup lightpath, sharing of high- speed high-speed optical transponders, effect of spectrum con-version, bandwidth squeezed restoration (BSR), joint restoration by multiple sub-band optical channels, multi-layer survivability, and energy efficiency.

II. Elastic optical network techniques

The elastic optical network has the ability to support reach-adaptable line rate, as well as dynamic bandwidth expansion and contraction, by altering the number of subcarriers and modulation formats. Efficient accommodation of multiple data rates: As shown in Fig. 4, the elastic optical network has the ability to provide the spectrally-efficient direct accommodation of mixed data bit rates in the optical domain due to its flexible spectrum assignment. Traditional optical networks with fixed grid leads to wastage of the optical bandwidth due to the excessive frequency spacing for low bit rate signals.

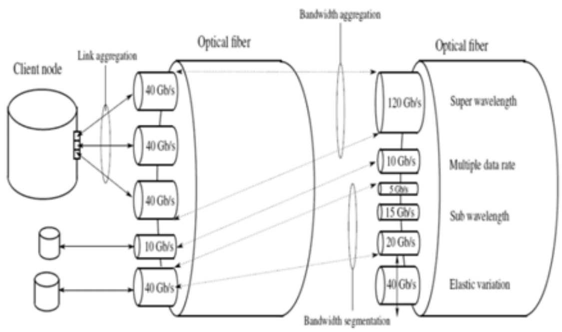

Fig. 4 Unique characteristics, namely — bandwidth segmentation, bandwidth aggregation, accommodation of multiple data rates, and elastic variation of allocated resources, of elastic optical networks

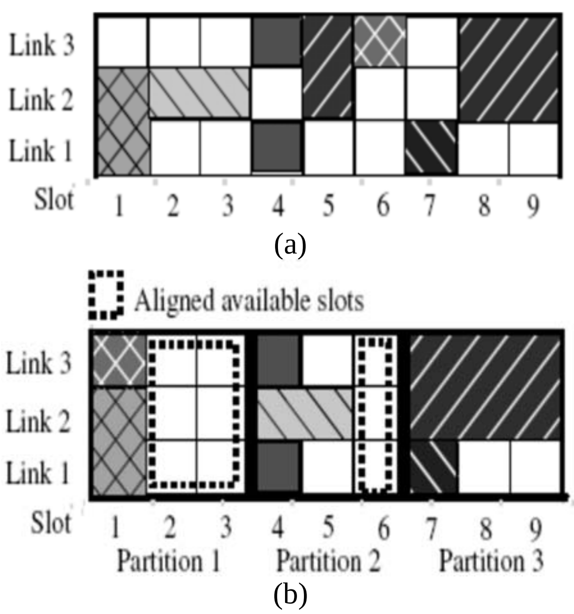

Fig. 5 Comparison of spectrum allocation (a) without spectrum partitioning, and (b) with spectrum partitioning in elastic optical networks

In elastic optical networks, spectrum resources are allocated in a contiguous manner. Accordingly, allocation of resources to short duration connections can increase the number of nonaligned available slots, unless the allocation is well organized. These non-aligned available slots can be reduced by partitioning the total set of subcarrier slots as shown in Fig. 5. This will increase the number of acceptable connections and hence decrease the blocking probability.

III. Conclusion

The Elastic optical network technology is an emerging research area, and a promising technology for future high speed network due to its flexible properties. This survey has introduced and discussed different aspects of Elastic optical networks. In this paper, we reviewed various aspect of survivable elastic optical network and comparison of spectrum allocation, without spectrum partitioning and with spectrum partitioning in elastic optical networks. We also described bandwidth, segmentation, bandwidth aggregation, energy saving and network virtualization techniques in elastic optical networks.

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