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Optimization of Routing Algorithms in Survivable Optical Networks

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Abstract- Survivability of a network refers to a network's capability to provide continuous service in the presence of failures. In a WDM network, as a single channel may be carrying tens of gigabits of data per second, a single failure would cause a huge amount of service disruption to a large number of users. Design of survivable optical networks has therefore attracted the attention of the research community. This paper deals development of an efficient technique for designing survivable routing schemes for optical networks and comparison of the proposed work with the conventional algorithms. In this thesis, we have presented a quick and efficient heuristic for survivable routing. In current WDM networks, it is possible to support hundreds of WDM channels on a single fiber. Therefore, the cost of the transmitters and the receivers, and hence the number of light paths, is becoming the main factor in determining the cost of a WDM network. We have tried to keep the number of light paths required to implement a topology as low as possible. The results shown in thesis prove that the blocking probability of the proposed algorithm increased with the increase in the offered load per unit link. We have also compared the two conventional algorithm first fit routing algorithm and best-fit routing algorithm. The comparison clears proposed algorithm is effective routing algorithm and it can be used for the networks with larger load.

Keywords – WDM, Load, Wireless, Optical.

I. Introduction

As we have mentioned before, a single optical fiber has, at least theoretically, a potential bandwidth of nearly 50 terabits per second (Tbps), which is about four orders of magnitude higher than the currently achievable electronic processing speed of a few gigabits per second (Gbps) [1]. However, because of the limits of the electronic processing speed, it is unlikely that all the bandwidth of an optical fiber can be exploited by using a single high capacity optical channel. For this reason, it is desirable to find an effective technology that can efficiently exploit the huge potential bandwidth capacity of optical fibers. The emergence of wavelength division multiplexing (WDM) technology has provided a practical solution to meeting this challenge. With WDM technology, multiple optical signals can be transmitted simultaneously and independently in different optical channels over a single fiber, each at a rate of a few gigabits per second, which significantly increases the usable bandwidth of an optical fiber [2].

Besides the increased usable bandwidth of an optical fiber, WDM also has other advantages, such as, efficient failure handling, which means we can overcome more efficiently the data communication interruption due to any failure of communication media or the related software, data transparency, means data are more reliable and fault-free, and also reduced electronic processing cost [1]. As a result, WDM has become the technology of choice to meet the tremendous bandwidth demand in current and future networks. Optical networks using WDM technology are being considered as the potential main network infrastructure for the next-generation of telecommunications networks and the Internet [2].

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II. LITERATURE REVIEW

Ahmed Mokhtar et. al. [3], proposed the adaptive routing algorithms to improve the blocking performance of the network. They considered routing and wavelength assignment in wavelength-routed all-optical networks with circuit switching. They adopted a general approach in which they considered all paths between a source–destination (s–d) pair and incorporate network state information into the routing decision. This approach performs routing and wavelength assignment jointly and adaptively and outperforms fixed routing techniques. They also presented adaptive routing and wavelength assignment algorithms and evaluated their blocking performance. They have also obtained an analytical technique to compute approximate blocking probabilities for networks employing fixed and alternate routing.

Yoo Younghwan et. al. [4], presented four adaptive routing algorithms which favour paths with near-maximum number of available wavelengths between two nodes, resulting in improved load balancing. These presented adaptive routing algorithms were simulated and compared with least loaded and fixed routing algorithms for small networks. First-fit wavelength assignment policy was used for simulation of these proposed algorithms.

G. Mohan et. al. [5], considered wavelength rerouting in wavelength routed wavelength division multiplexed networks with circuit switching. The lightpaths between source–destination pairs were dynamically established and released in response to a random pattern of connection arrival requests and connection holding times. They also presented a time optimal rerouting algorithm for wavelength-routed WDM networks with parallel Move-to-Vacant Wavelength-Retuning (MTV-WR) rerouting scheme.

R. Ramaswami et. al. [6], considered the problem of routing connections in a reconfigurable optical network using wavelength division multiplexing. They derived an upper bound on carried traffic of connections for any routing and wavelength assignment algorithm in a network.

R. Ramamurthy et. al. [7], proposed an approximate analytical model that incorporates alternate routing and sparse wavelength conversion. They considered an optical network which employed wavelength routing cross-connects that enabled the establishment of wavelength-division-multiplexed connections between the node pairs. The simulations studied the relationships between alternate routing and wavelength conversion which were performed on three representative network topologies.

III. RESULTS

In this section, the simulation results of proposed routing algorithm have been shown. Then the blocking probability of proposed algorithm is compared with some of the conventional algorithms. The blocking probability of network is calculated depending upon number of channels, load and the number of links. For the results, we have fixed some of the values and varied other to find the output.

We have applied the proposed algorithm on the given network topology. In our simulation results we have fixed the value of channels to 10 and for the given network topology the number of paths is fixed to 10. For the given values we have varied the value of load (in Erlangs) and calculated the results for the given routing algorithm. The path sequence was entered and the load was varied from 10 Erlangs to 1000 Erlangs respectively. The results are shown in figure 1 – 6.

We have applied the proposed algorithm on the network topology shown in figure 1. For figure 2 the Load was dynamically assumed to be [10 10 5 9 2 5 10 8 10 7] respectively by the algorithm and path {1-2-5} was found having minimum load and then this path was selected and was checked for faulty path also this path was fault free and was selected for connection. The value of blocking probability in this case was calculated nearly 0%. Figure 2 show that as the number of channels is increased the value of blocking probability is increased but still its value is very low and is of the order of 0%.

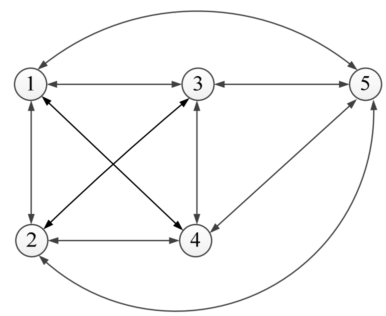

Figure 1. Network Topology

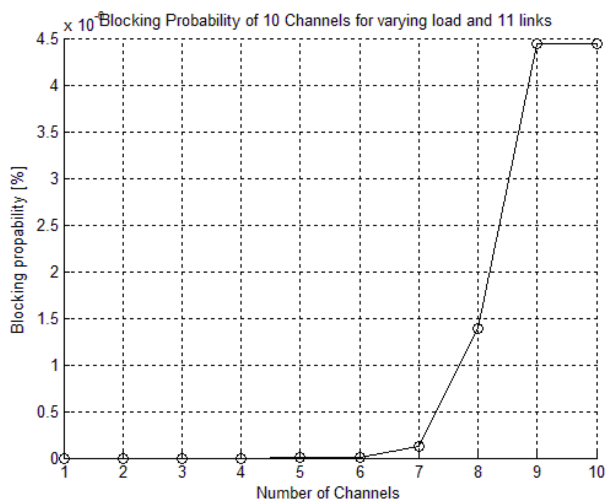

Figure 2: Blocking probability vs Number of channels for the network load = 10 (Erlangs)

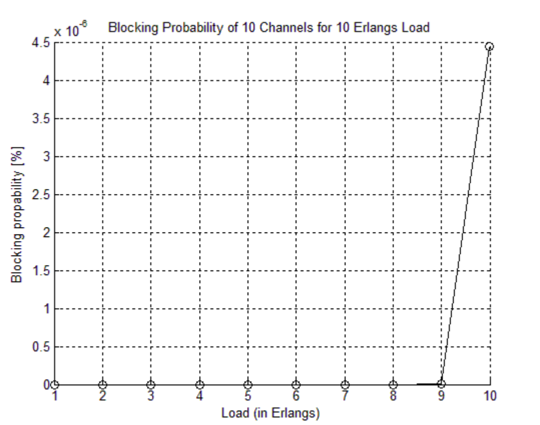

Figure 3: Blocking probability vs Load for 10 channels and Load =10 Erlangs

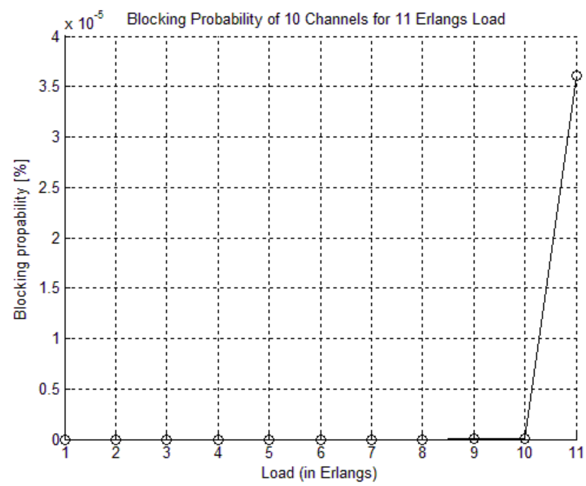

Figure 4: Blocking probability vs Load for 10 channels and Load =11 Erlangs

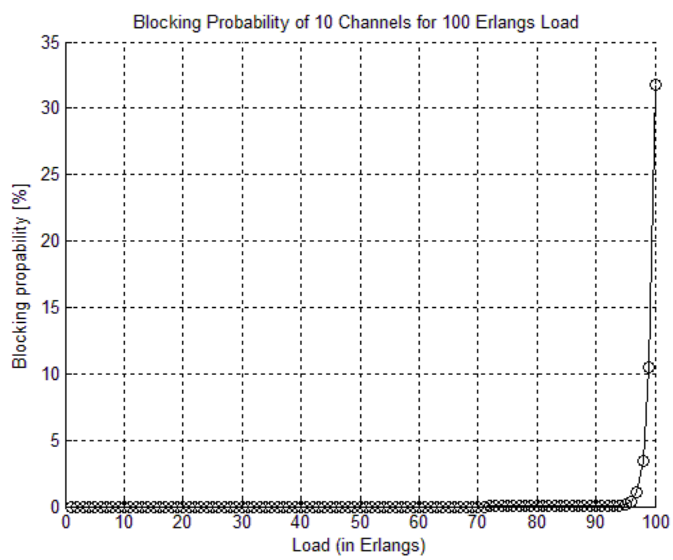

Figure 5: Blocking probability vs Load for 10 channels and Load =100 Erlangs

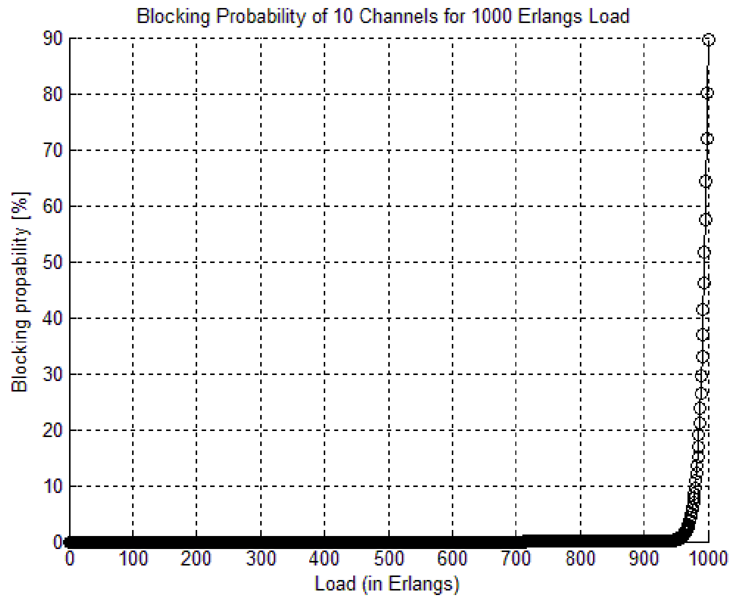

Figure 6: Blocking probability vs Load for 10 channels and Load =1000 Erlangs

The results shown in figure 2 – 6 shows that the blocking probability of the proposed algorithm increased with the increase in the offered load per unit link. We have also compared the two conventional algorithm first fit routing algorithm and best-fit routing algorithm which are shown in figure 7. The figure show that value of blocking probability is in the range of 4 x 10-2 % whereas we have shown in figure 5 that by using the proposed algorithm the value of blocking probability was reduced upto 8.6431 x 10-009%. This show that the proposed algorithm is effective and it can be used for the networks with larger load.

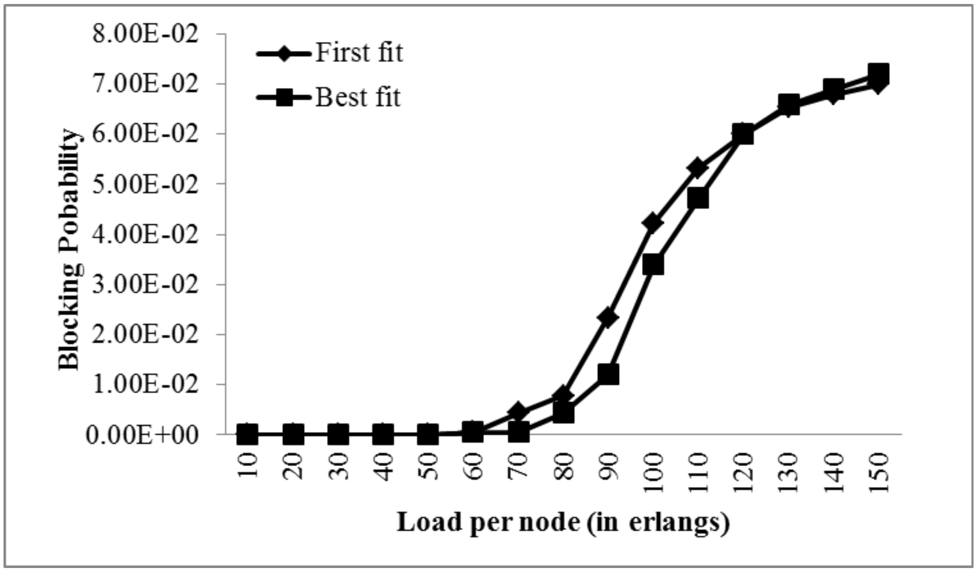

Figure 7: Blocking probability of best-fit and first-fit routing algorithm as a function of load, with14 nodes and 23 links. [8]

IV.CONCLUSION

The objective of this paper was to develop an efficient technique for designing survivable routing schemes for optical networks and comparison of the proposed work with the conventional algorithms. In this paper, we have presented a quick and efficient heuristic for survivable routing. In current WDM networks, it is possible to support hundreds of WDM channels on a single fiber. Therefore, the cost of the transmitters and the receivers, and hence the number of lightpaths, is becoming the main factor in determining the cost of a WDM network. We have tried to keep the number of lightpaths required to implement a topology as low as possible. The results shown in this paper prove that the blocking probability of the proposed algorithm increased with the increase in the offered load per unit link. We have also compared the two conventional algorithm first fit routing algorithm and best-fit routing algorithm. The comparison clears that the blocking probability of the network for proposed algorithm is 8.6431 x 10-009% for proposed algorithm whereas its value is 4 x 10-2 % in case of conventional algorithm, which proves that the proposed algorithm is effective routing algorithm and it can be used for the networks with larger load.

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