International Journal of Advanced Trends in Computer Applications
www.ijatca.com

Routing and Wavelength Assignment problem in Optical Networks

[1]**MEENAKSHI SHARMA**
M.Tech in Computer Science & Engg.
Rayat & Bahra Institute of Engineering & Bio-Technology,
Sahauran, Distt. Mohali (Punjab)-140104 INDIA.
mish.sharma22@gmail.com
[2]**NEERAJ MOHAN**
Associate Professor & H.O.D
Deptt. Of Computer Science & Engg.
Rayat & Bahra Institute of Engineering & Bio-Technology,
Sahauran, Distt. Mohali (Punjab)-140104 INDIA.
erneerajmohan@gmail.com

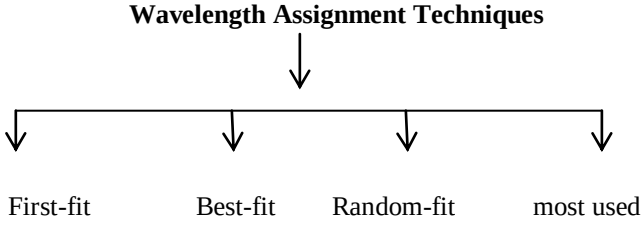
Abstract: *Wavelength assignment and routing has become the important issue in the optical networks. Using the efficient techniques the various network parameters can be optimized and the networks bandwidth can be utilized more efficiently. Most research in the literature was on the static routing and very few works was done on the dynamic routing. With Dynamic routing the network bandwidth can be used effectively and the best route for the data transmission can be calculated online. In this paper existing wavelength assignment and routing technique has been reviewed and analyzed. This literature work has been extended so the network routing strategy can be made better, which results in the efficient utilization of network resources.*

Keywords: Optical Network, Blocking Probability, Routing and Wavelength Assignment, Traffic Gromming.

1. Introduction

Optical fibre is been used as a physical medium for the high data transmission rate since 1960's as it provides the higher bandwidth of the order 4THZ. To take the advantage of the optical communications several approaches has been proposed. One of the approaches is optical circuit switching which is based on the wavelength routing in which a light path is formed using a dedicated wavelength on each link from source to destination [1].

Early applications of the optical communications modulated the data on the single optical carrier. Every optical carrier is referred to as the wavelength. This approach was limiting the efficiency of the optical fiber and data rate, which can be diminished with the new technology for the utilization of the tens of THZ bandwidth of the fib recalled as WDM [2]. In WDM, various wavelength channels are used on the same physical link of optical fiber by frequency multiplexing. WDM technology has prospered to use the bandwidth of the optical fibre communication more effectively with high data rates and minimum data loss.Presentlyall wavelength channel can carry 10 Gb/s and more can be expected in future [3]. WDM is called as the wavelength division multiplexing allows the multiplexing of the various optical carriers on the same fibre thus improving the potential of the communication networks. Optical fiber has very short loss in the band of 1.3µm to 1.55 µm[4]. The numerous benefits of optical fibre are high bandwidth, exempt to interference and noise, high data rate,low cost and easily upgradable using WDM technology. In WDM optical networks routing and wavelength assignment strategies are employed to communicate in the optical network. Thus routing and wavelength assignment (RWA) has become the most challenging problem for the efficient data transmission in WDM networks [5]. There are the various methods of assigning the wavelength and routing for the data transmission in the optical networks.



In WDM optical networks there are various types of routing strategies. Wavelength routing helps to forward the optical signal at the intermediate node in the whole optical plane which forms the end-to-end optical channel which is called as light paths[6].RWA problem can be assumed in two traffic assumptions. Static RWA problem can be applied in the situations where set of network connections are known in advance, light path is established for each connection. In dynamic RWA problem connections arrives to the network dynamically for the short of time. Thus light paths are established and destroyed dynamically [7].

In this paper we will be studying about the various routing strategies and the techniques. We have also studied on how the network parameters can be optimized in future.Using the suitable strategy network resources can be used optimally and the bandwidth utilization can be improved.

Traffic Grooming is a field of study which is concerned with development of algorithms and protocols of design, operation and control of network with bandwidth demands. Traffic grooming helps to aggregate the sub wavelength traffic onto the high speed light paths by considering the factors like network cost i.e. optoelectronic equipment [8]. Nowadays traffic grooming is becoming the important research area especially the dynamic traffic grooming where network traffic grows with time. Traffic grooming has become an active area of research since 1990's.

In literature survey number of methodologies proposed to deal with the RWA problem. One method is to consider the RWA problem a coupled RWA problem (single compete problem) and the other method is to divide this RWA into the two sub problems i.e. Routing problem and wavelength assignment problem[9]. The solution obtained by dividing this problem in sub problems is sub optimal but is practical to use. The blocking probability of a light path request is an important measure of a wavelength-routed network which is used to evaluate the performance of the system. Various factors can affect the blocking probability such as network topology, traffic load, number of links, algorithms employed and whether wavelength conversion is available or not[10].

This paper is organized as follows: In Section II, literature survey has been mentioned. In Section III Research gap has been discussed which describes the motivation behind the proposed work and conclusions are covered in Section IV.

2. LITERATURE SURVEY

In this section, we will review various papers in which multiple strategies are applied and by which various parameters of optical network can be enhanced thus enhancing the performance of the optical network. Increasing throughput by decreasing bit error rate by considering the reduced blocking probability.

Amit Wason et. al.[11] have proposed an efficient wavelength assignment algorithm for dynamic provisioning of light path. This proposed algorithm is based on most-used wavelength assignment algorithm. They have also suggested a mathematical model for WDM optical networks for minimization of blocking probability. The results of proposed algorithm and suggested model are then compared with the conventional wavelength assignment algorithms such as first-fit, best-fit, random and most-used wavelength assignment algorithms. These proposed approaches are very effective for the minimization of blocking probability of optical WDM networks.

Richard A. Barry[12] has proposed an analytic traffic model for circuit-switched all-optical networks to calculate the blocking probability along a path for networks with and without wavelength changers. This paper investigated the effects of path length, switch size, and interference length i.e. number of hops shared by two sessions, on blocking probability and the power of wavelength changers to advance performance. The main attention is given on circuit-switched all-optical networks using WDM and switches used for routing the signals on the basis of their wavelength. By simulations they have indicated benefit of wavelength changers.

Amit Wason et. al.[13] have proposed a mathematical model for the reduction of blocking probability in the WDM optical network. The mathematical model proposed has a closed-form expression and it does not require any simulated statistics. This model has low implementation complexity and the computation is rather efficient. It suggests us to choose the best path and appropriate number of free wavelengths available in the network.

Alexander Birmin [14] has studied the class of all optical network using wavedivision multiplexing and wavelength routing, in which a connection between a pair of nodes in the network is assigned a path and a wavelength on that path. Also, no other connection can share the assigned wavelength. Blocking probability is calculated using generalized reduced load approximation scheme with the two routing schemes i.e. fixed routing and least loaded routing.

Amit Wason et. al.[15] have proposed a low-complexity mathematical model for the calculation of the blocking probability of network. They have also proposed a wavelength assignment technique and routing algorithm which suggests an optimum path as a solution to routing problem that helps in calculation and minimization of the blocking probability. The proposed model and algorithms can be implemented on different network topologies. The network includes NSFNet and EUPAN Network topology and hence it is used to improve its performance on the basis of the blocking probability.

Anuj Singal et. al.[16] have proposed a blocking probability of the network which is presented based on total number of wavelengths in the eight node ring network. They have varied the number of available wavelength and calculated the blocking probability. They showed that the Blocking probability varied from 0.8 to 0.2, 0.7 to 0.1 as number of available wavelength changes from 1 to 9 for most used and wavelength conversion algorithm, respectively. So as Available wavelength increases the blocking probability decreases in ring network. Also the performance of the wavelength conversion algorithms is best as compared to most used algorithm.

Ravi Teja Kogantia et. al.[17] have focused on the analysis of proposed RWA algorithms in large WDM networks. Large networks are generated randomly under dynamic traffic and static traffic, with and without protection of the connection request. In this paper the wavelength requirements are analyzed using different wavelength assignment heuristics under different routing techniques for a set of connection requests. They find that fixed alternate routing connection requests into less number of wavelengths than the fixed routing and that most-used wavelength assignment heuristic performs slightly better than the first-fit wavelength assignment technique.

Uma Rathore Bhatt et. al.[18] have proposed a dynamic routing and wavelength assignment strategies for multiclass WDM optical networks. Each class of service could be characterized by parameters like number of wavelengths, expected call holding time and average arrival rate of request. The proposed strategies have been analyzed and compared with existing strategies on the basis of blocking probabilities for multiclass traffic scenarios. Simulation results on different network topologies shows that the performance of proposed strategies "Fixed shortest/alternate shortest path routing with wavelength reservation (FSASWR)" and "Fixed alternate shortest path routing with least priority wavelength assignment (FASPL)" are much better as compared to existing strategies.

Asuman E. ozdaglar [19] has proposed several optimization problem formulations. They have considered a static view of problem which is than addressed with linear programming formulations and also proposed a integer linear programming formulations. Thus yields optimal RWA policies. Their approach can be used for the no wavelength conversions networks and also can be extended to the sparse wavelength conversion networks. This formulation works for dynamic programming problems which is difficult to solve optimally.

Amit Wasonet. et al.[20] have presented the mathematical model for the wavelength routed optical network to optimize the blocking probability. The proposed model mainly performs better with the networks having higher load and also the simulation results shows that the proposed mathematical model works better than the previous model. In this work the blocking probability lies between 0 to 0.0001 whereas in the previous work it was between 0 to 1. The proposed model shows that the blocking probability depends upon the load and the total number of wavelengths. This model is applicable to the networks of which we have prior information about the load on every link.

Vikas Kaushik et. al.[21] have analyzed the performance of various wavelength assignment algorithms and their effect on the blocking probability along with the traffic grooming concept in optical networks wavelength assignment is of various types like first fit, best fit, most used wavelength assignment. Wavelength assignment is the only concept which distinguishes optical networks from the conventional networks. This paper shows that most used wavelength assignment performs better with and without traffic grooming. The simulation has performed on 16 node optical ring Network.

Amanjot kaur et. al.[22] have worked on the optimization of the blocking probability parameter and used the best fit wavelength assignment strategy. The simulation results showed that the full wavelength converter shows low blocking probability value than the non-wavelength converter router path for the same number of nodes. The blocking probability parameter was estimated using the engset formula. The performance of the network was carried out under the different conditions first with fixed number of channels than with the varying load.

3. RESEARCH GAP

The work reported in the literature was based on the routing and wavelength assignment in the WDM optical networks. Dynamic routing and wavelength assignment

strategy was made to handle the multiclass traffic. The network was divided into the classes according to the available network traffic and the other network resources. The efforts were made to optimize the blocking probability parameter on the EON and NSFNET network topologies. In literature survey we found the most of work was on the static routing of the network traffic and a very few work was done in the area of dynamic routing. We studied that the network parameters can be optimized using the efficient strategy and algorithms. The blocking probability parameter has a great impact on the network performance so it must be limited by using suitable routing algorithm. The network performance depends upon the number of packets blocked during the data transmission. We have studied the various techniques so the optical networks parameters can be optimized.

4. CONCLUSION

The blocking performance for the WDM network is analyzed for a communication network with various nodes and for varying available wavelength. In the literature work various routing and wavelength assignment strategies has been studies and analyzed. The RWA problem can be analyzed separately or as a combined problem. We have also studied that the network parameters can be optimized in the optical WDM networks by applying the suitable algorithm and strategies. A number of routing and wavelength assignment strategies are available in the literature and but still considerable improvements are possible to optimize the results of the network parameters.

5. REFERENCES

1. C. Qiao and M. Yoo, "Optical Burst Switching (OBS) - A New Paradigm for an Optical Internet," Journal of High Speed Networks, Vol. 8, No.1, Jan. 1999, pp. 69-84.
2. L .Xu, H. G. Perrosand G Rouskas, "Techniques for optical packet switching and optical burst switching",IEEE Communications Magazine, Jan. 2001, pp.136-142.
3. Nakazawa M. Weber H.-G.,"Ultrahigh-speed optical transmission technology," Springer, 2007.
4. Rajiv Ramaswami and Sivarajan,,"Optical networks: A practical perspective" Third Edition,1998.
5. Arumugam.M, "An Overview of Optical Communication", Journal of Physics, 57.
6. Himanshi Saini and Amit Kumar Garg," Protection and Restoration Schemes in Optical Networks", International Journal of Microwaves Applications, Journal Volume 2, No.1, January – February 2013.
7. Jason P. Jue," Lightpath Establishment in Wavelength-Routed WDM Optical Networks", Optical Networks, 2001, pp 99-122.
8. K. Kuppuswamy, D.C. Lee, "An analytical approach to efficiently computing call blocking probabilities for multiclass WDM networks", IEEE/ACM, Trans. Netw, 2009, pp 658–670.
9. S. Ramesh, G.N. Rouskas and H. G Perros, "Computing blocking probabilities in multiclass wavelength routing networks with multicast call", IEEE J, Sel. Areas Commun , 2002, pp89–96.
10. H. Zang, R. Murthy, J.P. Jue and B. Mukherjee, "Dynamic lightpath establishment in wavelength routed WDM network", IEEE Commun. Mag. 39, 2001, pp100–108.
11. Amit Wason, R.S. Kaler Optik ,"Wavelength assignment algorithms for WDM", optical networks, Vol.122, pp.877–880, 2011.
12. A. Barry and P.A. Humbler, "Models of blocking probability in all-optical network with and without wavelength changers", IEEE J, Sel. Area Commun, 1996,pp 858–867.
13. Amit Wason and Dr. R. S. Kaler, "Wavelength Assignment Problem in Optical WDM Networks", IJCSNS International Journal of Computer Science and Network Security, VOL.7 No.4, April 2007.
14. Alexander Birmin, "Computing Approximate Blocking Probability for a Class of all Optical Networks",IEEE journal on selected area in communications, vol. 14,No. 5,june 1996.
15. AmitWason and R.S. Kaler, "Routing and wavelength assignment in wavelength-routed all-optical WDM networks", Optik 121, 2010, pp1478–1486.
16. Anuj Singal and R.S. Kaler, "Blocking probability of algorithms for different wavelength assignment in optical ring network", Optik 124, 2013, pp 147– 151.
17. Ravi Teja Kogantia and Deepinder Sidhu, "Analysis of Routing and Wavelength Assignment in Large WDM Networks", Procedia Computer Science 34, 2014, pp 71 – 78.
18. Uma Rathore Bhatt and Sanjiv Tokekar, "Routing and wavelength assignment algorithms for multiclass WDM optical networks", Optik 122, 2011, pp 1466– 1469.
19. Asuman E. Ozdaglar and Dimitri P. Bertsekas, "Routing and Wavelength Assignment in Optical Networks", Grant ONR N00014-99-1-1019.
20. Amit Wason, R.S. Kaler, "Blocking probability optimization in wavelength routed optical WDM networks", Optik 124, 2013, pp 3131– 3133.
21. Vikas Kaushik and R.S chauhan, "Performance Analysis on various Wavelength assignments algorithms with Traffic Grooming", ACEEE, 2013.
22. Amanjot Kaur and Neeraj Mohan, "Traffic Grooming of Optical Networks Using Best-Fit Algorithm", ICSCEE, April 15-16, 2014.