Distributed Traffic Grooming Technique for dynamic traffic in all Optical WDM Networks

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ABSTRACT

Ample growth in network traffic users has caused sporadic nature of traffic load.The traffic load has a direct effect on the throughput of the network. Reducing the block probability, improving the throughput and Quality of Service is of major concern. In this paper, Distributed dynamic Traffic Grooming RWA (DTG) techniqueis proposed for selecting the optimal path based on the unpredictable traffic load conditions. Traffic is classified into classes based on priority. Paths are selected on the basis of blocking probability.A single failure can cause a tremendous loss of data. Survivability is guaranteed by preconfiguring a backup path. The simulation results show a reduction in blocking probability and improvement in throughput which improves the QoS of the optical network.

Keywords: Optical networks, WDM, blocking probability, throughput, survivability, grooming**.**

1. INTRODUCTION

Advancement in technology has caused an increase in traffic users. Traffic load is unpredictable ranging from online HD streaming to transfer of mails. Priority for the load is sporadic. Optical Wavelength-Division Multiplexing (WDM) is a promising technology to support the blooming growth of Internet and telecommunication traffic in wide-area, metro-area, and local area networks. A single fiber strand has over a terabit-per-second bandwidth and a wavelength channel has over a gigabit-transmission speed for a second, the network may still be required to support traffic connections at rates which are lower than the overall wavelength capacity. The capacity requirement of these low-rate traffic connections can vary in range from STS-1 [1] (51.84 Mbps or lower) up to full wavelength capacity. The connection requests with same source and destination can be grouped together in order to improve the efficiency of transmission. In [2] the authors described that the network cost can be reduced by traffic grooming process. Traffic grooming is the process of combining the same source and destination requests to avoid intermediate Optical/Electrical/Optical (OEO) conversation and those groomed requests are served for further Routing and Wavelength Assignment (RWA). The way in how grooming and routing affects the quality of service demands and network throughput is explained in [3], [4]. In [5] paper proposed that traffic grooming when combined with priority based on path selection lead to better performance of the network in terms of lower blocking probability and congestion. Traffic grooming mechanism with an RWA approach utilized only [6] – [10] where a number of slow connection requests are multiplexed into a high capacity wavelength groomingchannel to enhance overall channel utilization. Paper [11] proposed that by grooming traffic for a random holding time improves the efficiency. Grooming of requests with same source and different destination was compared with grooming of requests with same destination and different sources in [12]. It was found that same source with different destination grooming is more effective than same destination with different source grooming. In WDM mesh networks, an auxiliary graph model approach for traffic grooming was proposed in [13], [14]. The failure in path (traffic groomed) network leads to loss of many connections, which are groomed on the same path. So backup path provisioning [15] is essential for protection of these connections against failures. In [16] hierarchical routing was combined with traffic grooming in order to reduce the impact of link failure. In this proposed work, DTGR technique concentrates on both traffic grooming and survivability in order to improve the efficiency and reduce the blocking probability of WDM network.

2. PROPOSED WORK

In order to improve the network performance and minimize its cost, it is very important for the network operator to be able to "groom" the multiple requests. Requests arrive at a poison rate with random data rate and priority. Traffic grooming is the process of combining the requests with same source and destination but with different data rate in order to improve the efficiency of transmission. Static and Dynamic traffic grooming techniques are applied based on traffic requests. All the information are known in advance before connection setup for static. But for dynamic traffic grooming no prior information for any requests like source id, destination id bandwidth request and holding time. In this proposed algorithm we consider dynamic traffic grooming techniques hence it is difficult to process compared with static traffic grooming policy.

Distributed Dynamic Traffic Grooming Algorithm (DTGA) classifies data into high and low priority before transmission from the source to the destination. It uses multiple dedicated paths for the different classification of data. I.e. High priority data through the primary path and low priority data through the secondary path. There is a backup path which supports these two optimal paths on account of a path failure (any of the two paths). The three optimal paths are shortlisted from the all possible paths between a source and destination based on the value of blocking probability of the paths. I.e. Primary path has the least blocking probability followed by the secondary path followed by the backup path. After a successful data transmission, the source monitors the blocking probability of the used path and compares it with a threshold.

DTG Algorithm (DTGA)

1. Collect all requests, r for time T.
2. Compute paths, R_j^P for the requests
3. Send packets through R_j^P
4. Calculate BPofR_j^P
5. Arrange R_j^P according to their BP values in ascending order
6. Choose R_j with the least BP (BP1) as Primary path (P^1), Second lowest (BP2) as the Secondary path (P^2), and third lowest (BP3) as the Backup path (P^3)
7. Compute the threshold value (Thresh)
   a. If Thresh < 0.6(say)
      Set Thresh = 0.6
   b. If Thresh > 0.6
   Set Thresh = Thresh
8. Classify packets based on priority & on data rate
   a. High priority and high data rate - Send through P^1
   b. Low priority and high data rate - Send through P^2
   c. High priority and low data rate - send through P^1
   d. Low priority and low data rate - send through P^2
9. Compute BP of P^1 (Max1) and BP of P^2 (Max2) & compare them with the threshold value.
   a. If Max1 or Max2 > Thresh

      Go back to Step 2
   b. If Max1 and Max2 < Thresh

      Go to step 7
10. Check for link failure among the two optimal paths
    a. On account of link failure, transmit the data in P^3.
    b. If there is a failure in the P^3 restart the algorithm
11. Calculate the throughput using the following expression

$$Throughput = (1/(2*T))*(count * length\ of\ the\ frame)$$

where T - is the total time taken for a successful transmission
count - is the no of frames successfully received

3. RESULT ANALYSIS

The technique is analysed with number of simulations. Blocking probability was initialized in order to provide the feel of running network environment. Dynamic requests were created with different priority. Path computation is performed with the help of Dijikstra algorithm. Paths are arranged in ascending order of blocking probability. Primary, secondary and backup paths are selected for the requests. The requests are now arranged with the order of priority and data rate. Threshold value for blocking probability is set. Transmit the High Priority data (both HPHS and HPLS) in the Primary Path and in the Secondary Path, Low Priority data (both LPHS and LPLS). After a successful transmission compare the monitored blocking probability value of the optimal paths with the given threshold value. If the monitored value of any one path exceeds the threshold, restart the algorithm. Otherwise, if the node has further data to be sent, continue the transmission in the same optimal paths depending on the priority of the data. On account of an unsuccessful transmission, find out the reason which caused the unsuccessful transmission. If there is a link failure (notified by the expiry of the timer set after the transmission of a data frame), send that data frame through the backup path. If there is a link failure in the backup path also, restart the algorithm. Compute the throughput value after the transmission of the data frames for a network without the backup path and network with a backup path. It will be found out that the throughput for the network with a backup path will be more compared to the network without the backup path. Figure 1 shows the simulation result of throughput without backup and Figure 2 represents with backup for the same requests.

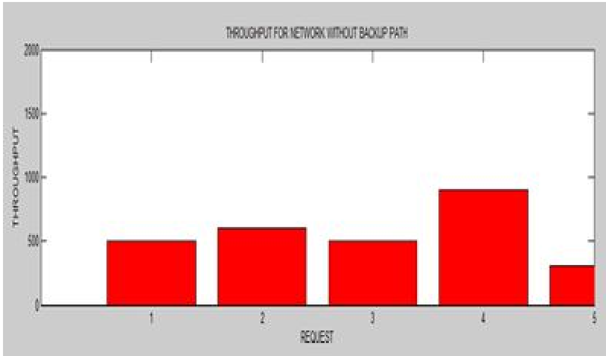

Figure 1: Requests Vs. Throughput forwithout backup path

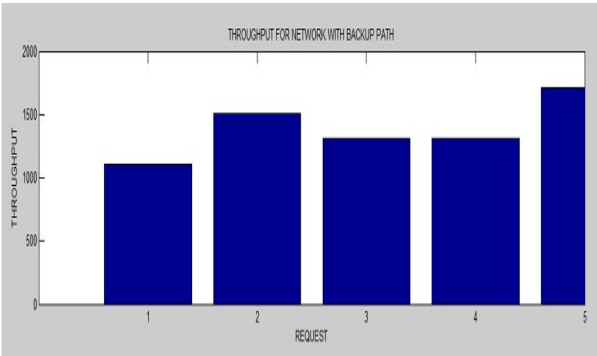

Figure 2: Requests Vs Throughput for with backup path

4. CONCLUSION

In this proposed work multiple dedicated paths are selected for transmission of different kinds of data by using a Distributed dynamic traffic grooming RWA algorithm (DTGR).The path selection is based upon minimal blocking probability. This approach is self-regulating, it automatically adapts to various traffic conditions across the network. Using simulation results we have also proved that the blocking probability has been reduced and throughput has also been enhanced, thus improving the overall QoS.

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