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EXAMINING OF RECONFIGURATION AND REROUTING APPROACHES: WDM NETWORKS

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ABSTRACT: Optical Wavelength Division Multiplexing (WDM) networks are high capacity telecommunications networks based on optical technologies and components that provide routing and restoration at wavelength level. High Capacity Optical WDM Networks are either reconfigured or reroute to meet the dynamic traffic demand of the various applications. However the demand varies with time and infrastructural development. The reconfiguration and rerouting techniques play vital role in this context. It consists in being able to alter the reconfiguration of the network to adjust it to the new traffic demand. Normally it is required to break off partially or totally the traffic to reconfigure a network. In this review paper, reconfiguration algorithm has been analyzed and it has also compared with rerouting. Considering the amount of data flowing on it, it may not be feasible to frequently stop the network, even for a short span of time. Many parameters have to be taken into account to find out a good solution, and many metrics can be used in order to measure the quality of a solution.

Keywords: Rerouting, Heuristic algorithm, Reconfiguration, Virtual Topology and WDM.

1. INTRODUCTION

With the growth of traffic demands growing exponentially every year, Wavelength Division Multiplexing (WDM) has emerged as an attractive solution for enhancing the existing transmission capacity of optical networks. The enormous capacity offered by optical fibers, can be divided into hundreds of different transmission channels, using the WDM technology [1].

An optical WDM network is configured to transmit a given traffic in order to meet a given objective. However the demand changes with time and infrastructure development. The reconfiguration problem stands in this context. It consists in being able to alter the configuration of the network to adjust it to the new traffic. It is generally necessary to interrupt partially or totally the traffic to reconfigure a network. Considering the amount of data flowing on it, it may not be possible to regularly stop the network, even for a short amount of time. Many parameters have to be taken into account to find out a good solution, and many metrics can be used in order to measure the quality of a solution.

2. LITERATURE REVIEW AND MOTIVATION

A wavelength-routing network consists of wavelength routers and the fiber links that interconnect them. Wavelength routers are optical switches capable of routing a light signal at a given wavelength from any input port to any output port, making it possible to establish end-to-end lightpaths, direct optical connections without any intermediate electronics. In [3], Considered, the problem of designing VTs, for multihop optical WDM networks, when the traffic is self-similar in nature. Studies over the last few years suggest that the network traffic is burst and can be much better modeled using self similar process instead of Poisson process. Examined buffer sizes of a network and observe that, even with reasonably low buffer overflow probability, the maximum buffer size requirement for self-similar traffic can be very large. Therefore, a self-similar traffic model has an impact on the queuing delay which is usually much higher than that obtained with the Poisson model. They investigate the problem of constructing the VT with these two types of traffic and solve it with two algorithmic approaches: Greedy (Heuristic) algorithm and Evolutionary algorithm. While the greedy algorithm performs a least cost search on the total delay along paths for routing traffic in a multi hop fashion, the evolutionary algorithm uses genetic methods to optimize the average delay in a network. In [4], stated, the failure of a single optical link or node in a WDM network may cause the simultaneous failure of several optical channels. This occurs when the higher level is not aware of the internal details of network design at the WDM level. We call this phenomenon "failure propagation. In [5], proposed, A two stage approach for that reconfiguration stage and optimization stage. First provides a tradeoff between the number of changes and objective function value which decides how best the VT is suited for given traffic, and the number of changes limit the disruption in the traffic. The later stage prevents the degradation of the solution due to continual approximation.

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By varying the frequency of the stage, the number of changes can be controlled. It evaluated the effectiveness of the approach by simulation and found that the frequency at which the optimization is performed has an effect on performance. In [7], present, a new approach to the problem of logical topology reconfiguration in congested WDM networks. Previous work considered total reconfiguration of the network, branch exchanges or addition and deletion of lightpaths when the traffic pattern changes.

3. HEURISTIC ALGORITHMS FOR RECONFIGURATION

The virtual topology design (VTD) problem is computationally intractable. It becomes almost impractical to solve when the network size become larger. This is the requirement of heuristic solution. It gives reasonable results close to optimum. Heuristic Logical Topology Design Algorithm (HLDA) aims at minimum congestion in the network. It takes physical topology and traffic as input and it attempts to maximize single virtual hop traffic flow. The assumptions are (a) number of wavelengths/ fiber is fixed. The number of transmitters and receivers available at node has given. By that way we are reducing congestion. We have taken decreasing order of traffic and accordingly node pairs. First it takes first node pair from the decreasing order list and a lightpath will be established if permissible. A lightpath is permissible for the node pair if a physical route, a wavelength on the route, a transmitter at the source node of the pair and a receiver at the destination node of the pair are all available when a lightpath is established between the pair the traffic associated the pair is updated by subtracting from it the traffic associated pair y. Here, node-pair y has the highest traffic after the pair. If a lightpath cannot be established between the node pair the traffic associated is said to zero. Now the node pair which has maximum amount of non-zero traffic is chosen and the above procedure is repeated. The chosen node pair could be either the node pair or y. When all the node pairs with non-zero traffic have been considered, the procedure stops. It may so happen that a few transmitter and receivers are available at some nodes when the procedure terminates. Following heuristic in the Fig. 1 and 2 depicts heuristic algorithm for the reconfiguration with and without optimization. In Fig. 1 algorithm with flowchart terminology has been shown. In the first part we are getting virtual topology for the current traffic without optimization. Once we got the virtual topology, we used optimization technique, for optimizing this topology the topology with particular traffic. Fig.2 elaborates first part of the Fig.1. It uses heuristic because computation is not possible every time. This is the reason for using the heuristic.

4. RELEVANCE OF RECONFIGURATION AND REROUTING IN OPTICAL NETWORK

A key feature of optical networks based on wavelength division multiplexing (WDM) technology is the ability to optimize the configuration of optical resources, i.e., wavelengths, with respect to a particular traffic demand.

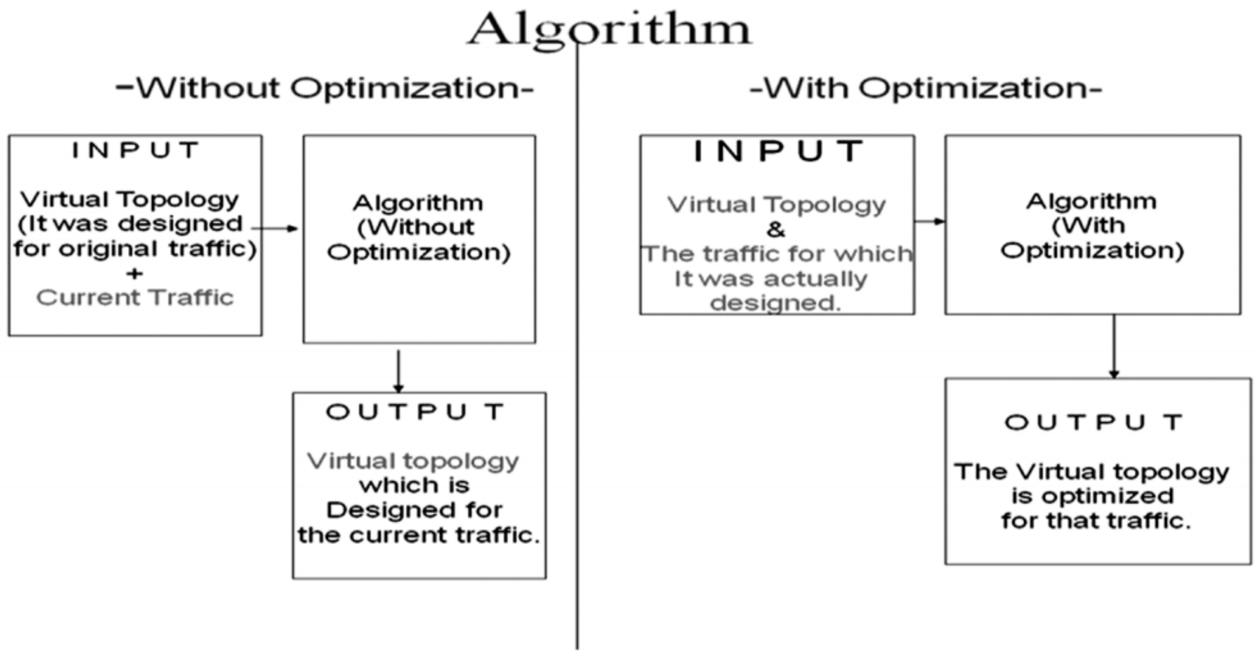

Figure 1:

WDM Network → Graph. NODE → Routing Nodes. NODE PAIR → a Fiber Link between them. W = Number of optical channels are supported by the Fiber Link. It implies the presence of W optical channels are in a each node pair of the graph. PT = Undirected Graph EDGE = Interconnecting Fiber VT = Directed Graph EDGE = The LP on which transceivers and wavelengths need to be reserved. WG = The resources of the WDM Network.

State of the Network (At any instant) : < PT, WG, VT> and traffic in the network.

T1 -Traffic Matrix T2 - New Traffic Matrix VT - CURRENT VIRTUAL TOPOLOG (Designed for T1)

N_{range}-Range for allowed no of changes (To reconfigure VT with the no of changes in that range)

K = No of node pairs considered

H_{avg} = Average Weighted Hop Count

$T_{s,d}$ = Traffic from Source to Destination

$H_{s,d}$ = The number of Hops from Source to Destination in the Virtual Topology.

RECONFIGURATION = → Network Instance → New Network Instance (which fits closest with the new traffic and with minimum disruption in traffic.)

<PT, WG, VT1> + T2 → <PT, WG, VT2>

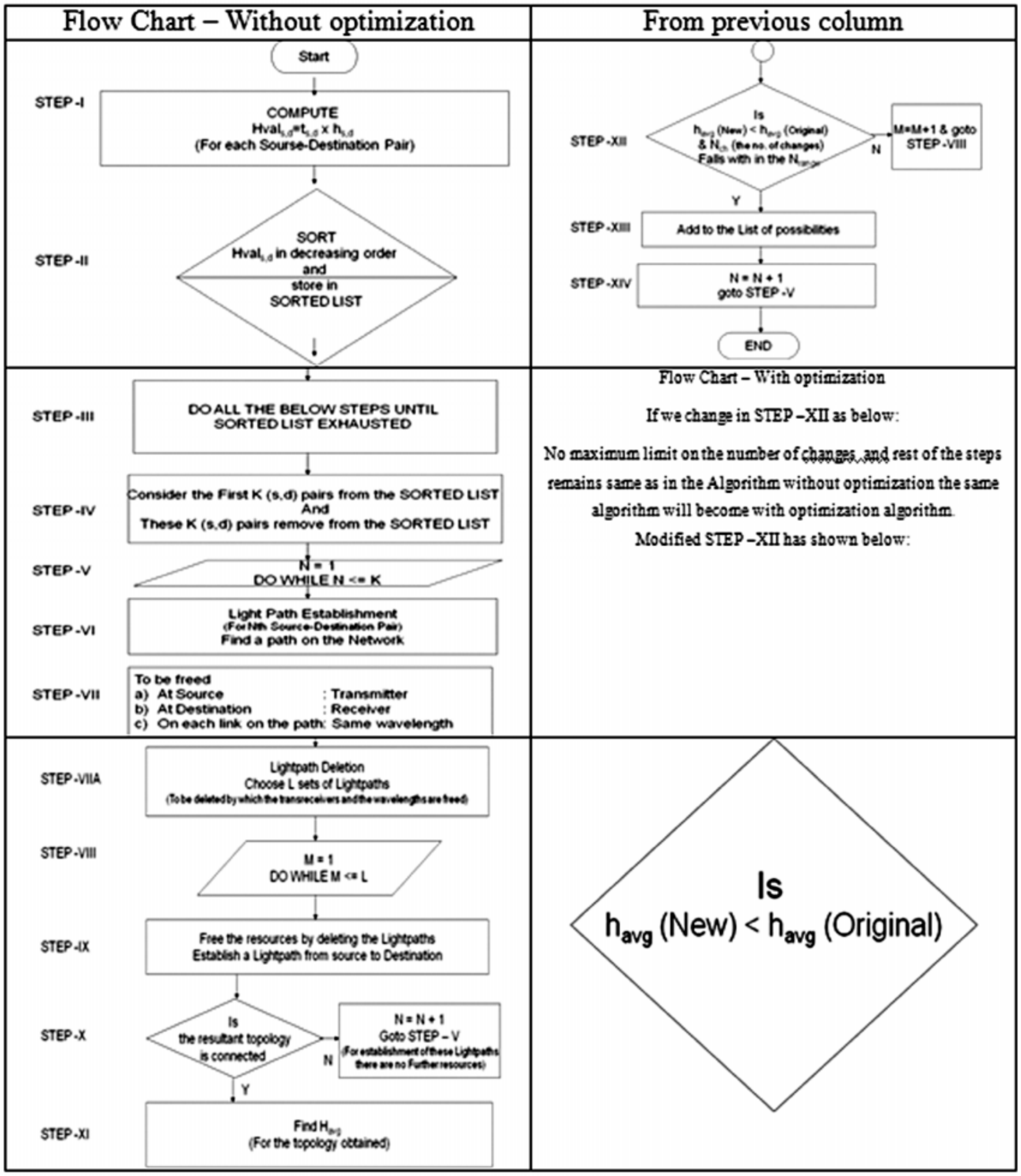

Figure 2:

In the broadcast architecture, this involves the assignment of wavelengths to logical links, while in the switched architectureit additionally involves the routing of bandwidth-guaranteedcircuits known as lightpaths. This paper studies with the problem of automatically updating the configuration of an optical network in response to changes in traffic demand, which entails making a recon?guration policy decision, selecting a new con?guration, and migrating from the current to the new con?guration. A technique is proposed that automatically selects values for parameters inherent in recon?guration algorithms and recon?guration policies, with the goal of maximizing the long-term performance gain due to recon?guration. The effectiveness of the technique is evaluated in the context of a threshold-based recon?guration policy. In the best case, the technique is shown to perform only 4%worse than a carefully chosen combination of static parameter values. However, a simple random assignment of parameter values is shown to perform equally well [11]. Rerouting refers implicitly to dynamic traffic Rerouting is simply the action of switching an existing lightpath or connection from one route to another route without changing the source and destination. In passive rerouting, the idea is that, once a lightpath request cannot Be satisfied by the current network, we could try to reroute some existing lightpaths such that the new lightpath request can be accepted. In wavelength routed optical networks, control mechanisms are required to dynamically set up and tear down lightpaths. Research objectives in this field are mainly the development of control mechanisms which minimize the blocking probability of lightpath requests, the set-up delay and finally the control message overhead. In traditional telecommunication networks, network control is implemented as part of a layered management system. The approach adopted in IP networks separates the control from management focusing on the automation of provisioning and control [12].

5. CONCLUSION

The traffic disruption depends on the number of lightpaths that are disturbed. Hence, the online reconfiguration problem has twin goals of minimizing the total number of changes and objective function values. This review shows a arrangement of reconfiguration and rerouting be capable of be responded for the changing the traffic demand in the network. Further, by simulation of both of these techniques in a particular network against the variation of the traffic can give various results which could be analyzed for the further investigated.

REFERENCE

[1] Sumathi M et.al. "Lightpath Reconfiguration with Traffic Priority Consideration", International Journal of Communication Networks and Distributed Systems, 3 (3) pp. 234- 248, June, 2009.

[2] http://deron.csie.ncue.edu.tw, "Optical Networking: Principles and Challenges"

[3] Sujoy Ghose et.al. "Multi hop Virtual Topology Design in WDM Optical Networks for Self-Similar Traffic", Photonic Network Communications, Vol.10(2), pp.199-214, March, 2005.

[4] Olivier Crochat, "Protection Interoperability for WDM Optical Networks", IEEE/ACM [5] N. Shreenath et.al. "A Two Stage Approach for Virtual Topology Reconfiguration of WDM Optical Network", Optical Network Magazine, pp-58-72, May/June, 2001.

[6] Li-Wei Chen and Eytan Modiano, "Efficient Routing and Wavelength Assignment for Reconfigurable WDM Ring Networks With Wavelength Converters", IEEE/ACM Transactions on Networking, 13(1), pp-173-186, February, 2005.

[7] Pedram J. Fard et.al. "Reconfiguration of MPLS/WDM Networks Using Simulation-Based Markov Decision Processes", Conference on Information Sciences and Systems, the Johns Hopkins University-3531, pp. 263-267, March, 2005.

[8] Manish Shrivastava and Aditya Goel, "Reconfiguration Techniques in High Capacity optical WDM Networks", MANIT Bhopal 2011

[9] C. Siva Rama Murthy and Mohan Gurusamy, "WDM Optical Networks", Prentice-Hall of India, New Delhi, ISBN-81-203-2129-4, 2004.

[10] N. Sreenath and Prakash Ramaswamy, "Virtual Topology Reconfiguration for Node Failures in Wavelength Routed Optical Networks", Joint International Conference on Autonomic and Autonomous Systems, and International Conference on Networking and Services, IEEE, 3, pp 201-207, 2005.

[11] Wojciech Golab and Raouf Boutaba, "WDM Optical Network Recon?guration Using Automated Regression-Based Parameter Value Selection", Natural Sciences and Engineering Research Council (NSERC) of Canada.

[12] Aditya Goel and Manish Shrivastava, "WDM Optical Network: Examining of Rerouting Approaches", International Journal of Information Technology and Knowledge Management, July-December 2011, 4(2), pp. 489-494.