

Investigation of rerouting system in Optical Network

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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. 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. In this work a 5-Node network has been taken and through simulation different parameters (Such as per lightpath report: Node routes, per lightpath report: link routes, lightpath report: distances, per lightpath report: carried traffic and per lightpath report: wavelength utilization) has been examined.

Keywords

Rerouting, Lightpath, Reconfiguration, Virtual Topology and WDM.

1. Introduction

For the past decade, Internet traffic has been doubling every year, and there is no indication that this rate of growth will slow down in the near future. While the packet switching approach used in the Internet backbone networks has thus far been able to keep up, it is unclear whether electronic routers that have been used at the core of backbone networks will continue to scale to match future traffic growth or optical link rates. On the other hand, optical fiber and switching elements have demonstrated an abundance of capacity that appears to be unmatched by electronic routers. The rate of increase in optical transport capacity has been keeping pace with traffic growth (with 100 Gb/s per wavelength in the next generation). Thus, one way of keeping pace with future traffic demands is to build an all-optical backbone network. However, packet switching requires the buffering of packets, of which optical switches are not capable today, and it is unclear if these functions can be practically realized in optics.

2. Literature Review

In context of rerouting several papers have been studied and few of them are found relevant with our work. Thus we have given emphasis on them and their review have mentioned in next section followed by findings. Finally research objective has mentioned.

2.1 Previous Work

In [1], they discussed lightpath rerouting in optical WDM networks. They investigated two different lightpath rerouting strategies, namely, passive rerouting and intentional rerouting. Through extensive simulation studies, they draw the following conclusions: 1) when there is wavelength conversion, passive rerouting works much better than intentional rerouting; 2) when there is no wavelength conversion, a naive-wavelength retuning algorithm can achieve the most benefit of passive rerouting while path-adjusting does not help too much. The conclusion of their study is that there are two different rerouting strategies, namely, passive rerouting and intentional rerouting. Their main conclusions are as follows: when there is full wavelength conversion, path-adjusting is only the way of passive rerouting. In all the topologies passive rerouting outperforms intentional rerouting a lot, has investigated.

In [2], they had proposed an alternative optical backbone architecture called COPLAR based on a paradigm of coarse optical circuit switching by default and adaptive re-routing over circuits when necessary. This approach is based on the provisioning of long-duration quasi-static optical circuits between IE (Ingress-Egress) router pairs at the boundary of the network to carry the traffic by default. When a provisioned circuit is inadequate, adaptively load balance the excess traffic across circuits with spare capacity so that all traffic can be routed to their final destinations without the need to create new circuits on-the-fly.

In [3], they employed a rerouting approach to alleviate resource inefficiency and improve the network throughput under a dynamic traffic model. They proposed two rerouting schemes, rerouting at

lightpath level (RRLP) and rerouting at connection level (RRCON) and a qualitative comparison is made between the two. They also proposed two heuristic rerouting algorithms, namely the critical-wavelength-avoiding one-lightpath-limited (CWA-1L) rerouting algorithm and the critical-lightpath-avoiding one-connection-limited (CLA-1C) rerouting algorithm, which are based on the two rerouting schemes. Simulation results show that rerouting reduces the blocking probability of connections significantly. Traffic grooming aims at improving resource utilization efficiency in optical networks by effectively packing low rate connections onto high-rate lightpaths. To achieve this objective, they applied the rerouting approach to the dynamic Traffic grooming problem in WDM mesh networks. Two rerouting schemes, rerouting at the lightpath level (RRLP) and rerouting at the connection level (RRCON), were proposed.

In [4], they analyzed the wavelength rerouting in wavelength division multiplexed networks where the light path between nodes is dynamically established. The constraint on wavelength continuity imposed by WDM networks results in poor blocking performance. The design and simulation of wavelength rerouting algorithm on ARPA-2 network and its performance analysis in comparison with conventional routing algorithm based on blocking performance have showed that the time required for processing connection requests is faster. The rerouting algorithm was implemented on ARPA network and found out that it reduces the blocking probability effectively than a routing algorithm.

3. Result and Discussion

A 5-Node Network has been taken as depicted in Fig 1 for examining of different reports, such as per lightpath report: Node routes, per lightpath report: link routes, lightpath report: distances, per lightpath report: carried traffic and per lightpath report: wavelength utilization through simulation.

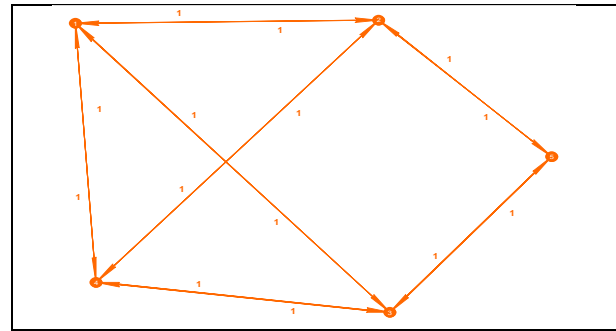


Fig 1: A 5-Node Network

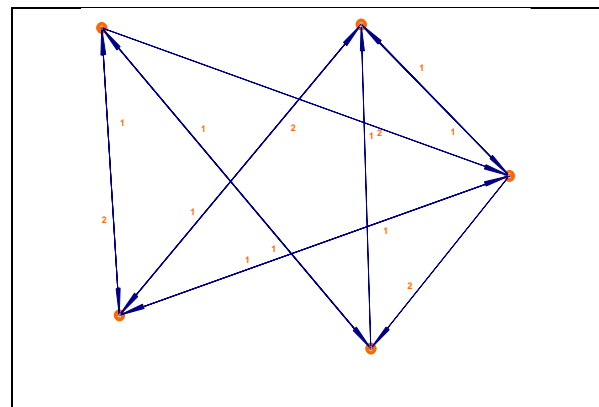


Fig 2: All the lightpath

Table 1 describes fiber link in a 5-Node Network. It has total 14 Links and each link has 9 wavelengths. The total capacity of the network is 56 Gbps. Table 2 is traffic table used in the said network for the performing the simulation.

Table 3 describes the sequence of nodes or in other words the path to reach from one node to other node. For example if we want to go from node 5 to node 4 then we have to go through node sequence 5 2 4. The capacity of the network is 56.000 Gbps. In summary of the table is average Virtual Hops: 1.1219, Average Distance (km): 0.69573.

Table 1: Fiber link

Fiber Link ID	Origin Node ID	Destination Node ID	Available Wavelengths
2	2	1	9
3	2	5	
4	5	2	
5	5	3	
6	3	5	

Table 2: Traffic Table

0.000	5.472	2.435	75.127	50.596
1.493	0.000	9.593	58.527	25.510
22.381	95.974	0.000	2.543	6.991
8.909	65.510	9.293	0.000	1.386
11.900	16.261	67.970	49.836	0.000

Table 4 describes the number physical hops to reach from one node to another node in a said network and the distance between those nodes, for example if we want to go from node 3 to node 2 then number of physical hops will be 2 and the distance will be 1.18 km the total capacity of the network is 56 Gbps. In summary information: Average Virtual Hops: 1.1219, Average Distance (km): 0.69573.

Table 3: Per lightpath report: node routes

Lightpath ID	Source node	Destination node	Capacity (Gbps)	Sequence of nodes
1	3	2	56.000	3 1 2
2	1	4		1 4
3	5	3		5 3
4	4	2		4 2
5	2	4		2 4
6	1	5		1 2 5
7	5	4		5 2 4

Table 4: Per lightpath report: distances

Lightpath ID	Ingress node	Egress node	Capacity (Gbps)	Number of physical hops	Distance
1	3	2	56.000	2	1.18
2	1	4		1	0.52
3	5	3		1	0.39
4	4	2		1	0.67
5	2	4		1	0.67
6	1	5		2	0.82
7	5	4		2	1.04

4. Conclusion

A 5-node network has been designed and exercised with some traffic. Various parameters have been investigated according to the simulation result it has been found that with the use of rerouting network resources can be minimized and optimized. In future parameter can be taken one by one and tested with all the angles towards saving the network resources.

References

- [1] Xiaowen Chu, Tianming Bu and Xiang-yang Li, "A Study of Lightpath Rerouting Schemes in Wavelength-Routed WDM Networks", IEEE communication society proceedings, pp. 2400-2405, 2007.
- [2] Jerry Chou and Bill Lin, "Adaptive Re-Routing over Circuits: An Architecture for an Optical Backbone Network", IEEE communication society proceedings, 2010.
- [3] Wang Yao and Byrav Ramamurthy, "Rerouting schemes for dynamic traffic grooming in optical WDM networks", ELSEVIER Computer Network Journal, Vol.52, pp.1891-1904, March 2008.
- [4] S.revathi, A.jabeena and P.arulmozhiarman, "Rerouting algorithm for wave length division multiplexed networks", International Journal of Advanced Engineering Sciences and Technologies, Vol. 1, No. 2, pp. 102 – 111, 2010.