International Journal of Engineering Research & Management Technology
ISSN: 2348-4039
January-2021 Special Issue ICSCTCE-2021
Email: editor@ijermt.org
www.ijermt.org

EXPLORATION OF VIRTUAL TOPOLOGY RECONFIGURATION OPTIMIZATION TECHNIQUES FOR IP OVER WDM NETWORK

Pushpendra Singh Tomar[1], Dr. Manish Shrivastava[2], Dr. Sunil Phulre[3]
[1]Ph.D. Scholar, [2,3]Professor
[1,3]Department of CSE, [2]Department of IT
[1,3]LNCT University Bhopal, [2]LNCT College Bhopal

ABSTRACT:

Nowadays optical network is very demanded due to availability of higher bandwidth with wide range of coverage. In the recent research numerous works done in the field of optimization of the optical network based on internet protocol (IP) over wavelength division multiplexing which increase the quality of service (QoS) to meet the requirement of real-time communication structure. In this paper about various optimization technique of optical network which increase the demand of such type of network to overcome the network communication problem in all areas has been investigated. In the literature survey we identify that some of researcher work in the field virtual topology reconfiguration (VTR) in IP-over-WDM to optimize the traffic load and modeled it , another solve the problem of versatile use of WDM in robust environment , other work done in the field of congestion control, end-to end delay minimization, dynamic traffic handling and feasible topology designing for the IP-over-WDM network. Those investigations provide the roadmap for optimization the optical network with respect to different prospective and efficient adaptability of optical communication in any circumstance. Through the exploration the virtual topology management under IP-over-WDM network it is understood that the functionality and different optimization approach and develop the hybrid approaches which adapts it into the future optical network using demand construction of virtual topology reconfiguration mechanism.

Keyword: IP-over-WDM, virtual topology, optical network, bandwidth, congestion, end-to-end delay.

INTRODUCTION:

WDM Optical fiber networking techniques have revolutionized the use of high-speed communication networks in the last decade, and can now satisfy the high demands on the bandwidth of existing voice and data traffic. Both wavelength-routing optical WDM networks are considered as possible recruits for the next decade. There is a quick increase in bandwidth demand and in the near future the Internet data traffic could overtake voice traffic. As IP plays a dominant position in large-scale networking technologies and developments in wavelength-driven WDM technologies, IP over WDM networks offers massive bandwidth [1]

For the next generation of Internet networks, becoming the best alternative. The IP through the WDM network is made up of a collection of WDM connections and nodes consisting in any portion of the IP router element and OXC component.

The physical topology [2] consists of WDM routers connected by arbitrary nodes and point-to-point fiber connections. Data transmission from one node to other using light-paths is carried on these types of networks. A Light-path[3] is an all-optical path between two network nodes by assigning the same wavelength to each path connection. Light-paths are generated between IP routers in IP over WDM networks.

A virtual topology [4] is a series of pre-established lights to ensure that all optical communication between nodes is available in response to such traffic demands. The virtual topology is logically defined by light-paths, each described by an individual wavelength, providing end-to-end access to the optical medium for transmission. The incorporation of computational topology into physical topology reduces the number of nodes involved in network propagation.

The Virtual Topology is a graph of nodes in the topology and edges of the real network corresponding to the lights. A virtual topology is designed to reduce such objective functions such as AVT (Average Weighted Hop Count), congestion, etc. The simulated topology originally planned for a single traffic cannot be adapted for shifting traffic. In response to changing traffic demands or due to a lack of network elements, the virtual topology built over IP can require changing. Certain tracks are heavily filled, so new traffic signals are to be set up. Similarly, there could be no traffic on other lightpaths and those lightpaths may be withdrawn. This method is called Virtual Topology Reconfiguration [4] to shift current virtual topology to new one in order to respond to the complex traffic change or the loss of network components. One of the hot topics in the networking science community was the complex reshaping of optical networks.

One of WDM's essential optical network functionality is the reconfiguration [5]. Reconfiguration[6] is accomplished by offering the framework for WDM optical networks where logical links can be integrated through the physical connections. The optical cross links optical and wavelength transmitters and converters, which enable the operators to reconfigure optical network connections in compliance with changing traffic conditions. The virtual topology reconfiguration to handle complex traffic has two distinct approaches[7][8] respectively. For each shift in the traffic a new virtual topology has been developed to ensure improved efficiency, however a significant number of improvements in the light path could be accomplished. The second approach is to reconfigure the objective value of the function and to minimize the amount of shifts in the light direction.

RELATED WORK:

This paper explores the use of optimization techniques with IP-over-WDM technologies for reconfiguration of optical internets. Multiplex (WDM) networking infrastructure using terabits per second bandwidth becomes a normal option for future generations of Internet networks (Optical Internet), Wid-Scope Networking (WAN) and backbone networks due to the capacity of high bandwidth and low latency connectivity demands. Internet Protocol (IP) is also a modern choice for Wavelength Separation. Recently researchers have paid more attention to virtual topology IP reconfiguration over WDM networks. Optimizing Methods find many uses, including linear programming, traffic prediction, network optimization, traffic modeling, etc. In the fields of network engineering. We also introduced in this article a new approach to reconfiguring IP virtual topology over WDM networks using the technologies of optimization. The measured findings indicate that this new method increases computational precision, improvements and weighted average hop count.

A new methodology using the Virtual Topology Reconfiguration (VTR) optimization technique for Multi-hop IP via WDM optical networks with traffic model is being proposed for this study. The suggested heuristic solution has been applied and estimated with Java and tested with MATLAB's optimization model. The findings demonstrate that the new optimization approach provides higher efficiency in terms of AWHTs, computing costs, resource usage and the amount of complex IP shifts across WDM networks relative to the current non-optimization approach. In addition, traffic modeling and traffic prediction based on Fuzzy provide a more accurate estimate of future traffic compared to Fuzzy non-optimization methodologies which lead to an optimal reconfiguration of the given topology to the future traffic demand set [9].

We research architecture criteria for widescreen optical networks of the next decade using multiplexing wavelength division (WDM) and for national coverage. This optical network uses multiplexers of wavelengths and optical switches in routing nodes such that an arbitrary virtual topology can be integrated into any specified network of physical fibers. In order to leverage the relative strengths of both optics and electronics, virtual topology which is used as a packet-shuttering network consisting of a collection of "lightpaths" for all optics is created. Information packets are transported in an optical domain through the virtual topology, but packet transfer from lightpaths via electronic switching is carried out where appropriate. We formulate the problem of virtual topology architecture in an optimization of one of the two possible target functions: 1) minimize the average network delay for a given traffic matrix (corresponding to existing traffic demand solutions) or 2) optimize the magnitude factor by which the traffic matrix can be scaled (to provide the maximum capacity upgrade for future traffic demands).

We also discussed architecture concepts for large optical networks of the next decade using WDM (Wavelength Division) and national cover. Due to spatial reuse of wavelengths, we have shown that such WMD network architecture can provide a high overall device power. Our goal has been to explore a national WDM network compatible with its general architecture, review, upgradeability and optimization. As a first step towards a comprehensive and versatile WDM WAN solution, the virtual optimization issue raised in this paper serves as an example. We assume there is tremendous space for advanced methods and algorithms and a range of research problems need to be tackled. An fascinating research approach is to explore how to merge light way routing and wavelength distribution with the collection of virtual topology and the subsequent packet routing to achieve an optimal solution. An significant matter to be extensively discussed is the complex construction and reconfiguration of light pathways [10].

We consider the issue of creating logical topologies over an optical network of a wavelength without adjusting wavelength. We present an overview of a linear approach which considers a combined problem of optimization in order to route traffic demands and route and allocate wavelengths to light ways. In the formulation, the maximum hops a light path is required to take into account, the many logical relations within logical topology, the multiplicity of physical associations with physical topology and the constraints on symmetry and asymmetry in logical topology. The goal is to avoid traffic delays. Examples illustrate how the rational degree of congestion means equality and inequality. We prove that the equality restriction of certain corners permitted in the design of logical topologies does not cause congestion under some conditions. This reduces the dimensionality of the search field and hence accelerates the search for an ideal linear formulation solution. For small cases, we overcome the linear formulation and display the equilibrium between congestion, the amount of usable wavelengths and maximum number of hops that are permitted on the way. We solve the linear formulation for large networks by relaxing the integer limits. For large networks, we build topology designalgorithms that round out solutions to the relaxed problem. As the entire problem can be linear, there is a lower congestion limit in the solution obtained when the integer limit is relaxed. It is helpful to compare our heuristic algorithms' effectiveness. We introduce a cutting plant after Bienstock and Gunluk in 1995 that enables us to achieve stronger lower limits for congestion and also to reduce the upper limits obtained earlier for congestion.

We note that as we mitigate network congestion, traffic electronics are minimized by wavelength. If we have a collection of nodes in this network that have a strong traffic flow between their members, the total congestion may be minimized by some edges between several pairs of nodes. The processing by wavelength in the network would be minimized. In a high-speed network environment [11], reducing the electronic traffic handling would be helpful.

This thesis explores the issue of the creation of a conceptual topology over a physical topology of the all-optical wavelength network (AON). There are nodes and fiber connections in the network in the physical topology. In an AON physical topology we can establish a light path between node pairs where an optical direct link without any intermediary electronics is defined by a light path. The set of lights and the nodes are the logical topology. Our goal is to build the logical topology and routing algorithm on the topology to reduce network congestion while restricting the average delayed pair of source destinations and the amount of processing needed at the nodes. In the event of a particular network of physics topology and traffic patterns (relative circulation distributions across target pairs) (degree of the logical topology). We can see that missing the delays will lead to rather long delays with very complicated logical topologies. In all our cases, though, forced congestion results in a slight rise. While it is typically a drawback that wavelengths are needed for the resulting logical topology to be incorporated in the physical all-optical topology, we find that this number can be very small in many situations.

This paper addressed the question of constructing a logical topology over a physical topology of a wavelength. The terminology considers processing constraints at the nodes, average time constraints on each s-d pair, and wavelength allocations on the beams. For those of not restricting the number of wavelengths, we formulated this problem for a 6node network as a MILP and resolved it precisely. The findings revealed that 1) the inability to enforce a delay limit contributes to "unnatural" topologies, as nodes geographically positioned close to each other would have to follow long, tight roads to communicate, and 2) the imposition of time limits did not substantially reduce the congestion of the instances. We then proposed a simple logical topology design heuristic (HLDA) that works well when the traffic is concentrated among a small fraction of the total number of source-destination pairs in the network, but does not work well when the traffic is distributed more evenly among the source-destination pairs, since it is a greedy heuristic based on assigning light-paths to s-d pairs with large traffic [12].

We deem the question of developing an optical cross-connection network (OXC) to provide end-to-end lighting services for several label-changed routers (LSRs). A number of heuristic algorithms are introduced to deal with the combination problem of physical topology design (i.e. the number of OXCs required and their fiber link) and the logical topology design (i.e., determine the routing and wavelength assignment for the lightpaths among the LSRs). In comparison with previous studies that were restricted to narrow topologies with few nodes and a few dozen light paths, our algorithms were extended to networks of hundreds or thousands of LSRs in order of magnitude greater than LSRs. We also established lower limits, which can be effectively measured, to describe the efficiency of our algorithms. The number of transceivers per LSR per fiber, the number of ports per LSR per transceiver, and the number of ports on an OXC are provided in the numerical results for up to 1.00 LSR. The findings demonstrate that the use of comparatively few but correctly dimensioned OXCs enables the construction of large optical networks with a high degree of connective performance.

A variety of heuristic algorithms have been identified for the physical, logical topological design of large optical OXCs. Our goal was to minimize the number of OXCs with the number of wavelengths of the fiber connection and some physical topological constraints (i.e. bi-connectivity). We also presented routing heuristics and the assigning of wavelengths and a genetic algorithm for iterating the physical topologies. Our algorithms have been implemented to build networks capable of accommodating hundreds of LSRs and thousands of beams. Our results are almost perfect and shed new light on the network architecture. The most significant finding is that cost-effective networks with relatively few but correctly dimensioned OXCs can be developed that provide rich connectivity among the LSRs [13].

We propose a new solution to the virtual topology issue of reconfiguration for the dynamically demanded complex wave-length, multiplexing-based optical mesh network. By using the calculated traffic features of the Internet backbone, we are suggesting an adaptation method to adopt traffic shifts without first understanding the potential pattern of traffic. Our analysis is distinct from other past studies on the subject and is focused on an expected (or known) pattern of transport to redesign the virtual topology and change the connections to the target topology. The core idea of our solution is to adjust the subordinate optical links by the constant (periodically depending on the time) calculation of the real traffic load on light paths and to respond promptly, by inserting or removing a lightpath at a time, to the load imbalances created by traffic fluctuations. When a load mismatch has arisen, then a light path that is loaded gently is pulled off or when the congestion happens, a new light path is created. In order to detect any over- or under-used light paths, we add high and low watermarks in lightpaths loads and initiate an adaptation stage. We create an optimization problem, in which light paths are added or deleted at the end of a measuring cycle, one light path at a time, and which light paths are added or deleted. This is a mixed-integer linear programmed. This optimization problem. Simulation experimentations with the adapting algorithm show curious consequences of the different device parameters on true network scenarios (high and low watermarks, length of the measurement period, etc.). In specific, this approach is very well tailored to the shifts in the traffic offered.

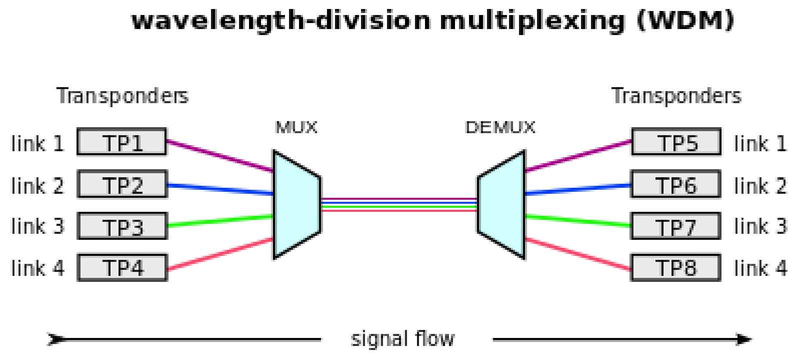
We have presented the adaptation scheme to WDM mesh networks in complex traffic on the basis of a new vision of a virtual topology reconfiguration challenge. In a measurement-adaptation period, we identified the issue as a way to control the traffic fluctuations for the long term, with the following constraints: no assumption on potential traffic rates should be drawn, and the continuous traffic should not be disrupted in a transition point. The traffic features of backbone networks that change slowly and according to the hour of day are the driving force of our work [14].

Our research explores reconfiguring the virtual topology for the dynamically requested optical mesh network in wavelength. It is necessary to reduce the number of recipients that have to be reactivated when reconfiguring the optical network. The average weighted hop count is also necessary to minimize, because it is directly proportional to the network's output. The balance here is between network optimality and damage to the network. In our work we model this deal first as a mixed integer linear problem and then present a complex optical network reconfiguration algorithm. Our algorithm eliminates the use of physical energy, physical hops and the required number of recipients. It attempts with limited network interruption to meet the demand of traffic.

This paper has modeled the problem of reconfiguring mesh optical networks as a linear mixed integer, where the interference to the network and the hop length are to be reduced. By minimizing the reversal required for each optical node, we reduced network interruption. Afterward we suggested a heuristic algorithm to reduce network interruption and then, as far as possible, to minimize hop length [15].

ARCHITECTURE:

Conceptually, the following diagram represents WDM multiplexing. There are 4 optical signals of 4 wavelengths. Each of the four senders produces wavelength data streams. A single long-range fiber channel transmits the signal with an optical combiner. The splitter is dismissed into the initial four data sources at the receiving end.



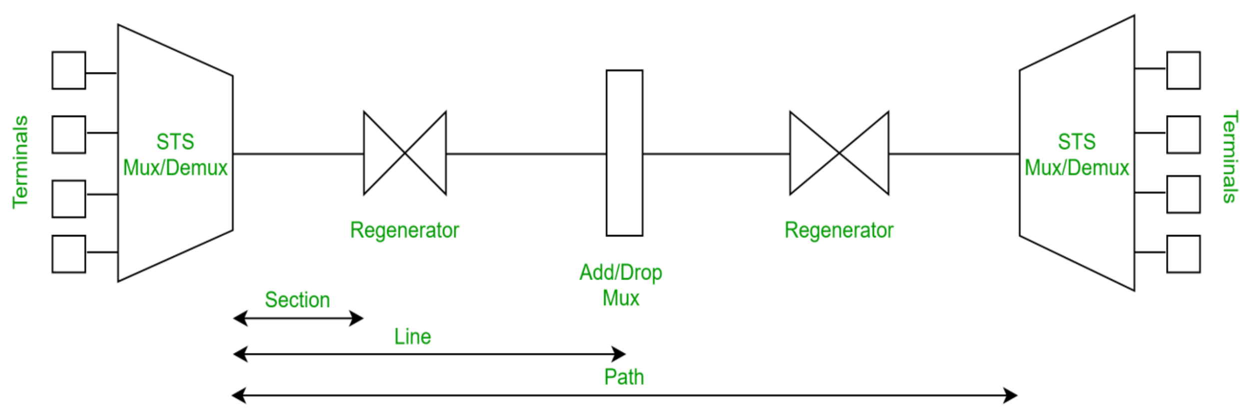
Categories of WDM

WDM is classified into two groups based on the wavelength –

• WDM (CWDM) Course: CWDM normally works on eight channels where there are 20 nm (nanometers) dividing the spacing between channels. It is less energy intensive than DWDM and less costly. The capability of the connections and the assisted distance are however less.

Dense WDM: In DWDM, there are far more channels than in CWDM. • Density WDM (DWDM), It is either 40 with a distance of 100GHz or 80 with a distance of 50GHz. As a consequence, the huge volume of data can be transmitted through a single fiber connection. DWDM is commonly found in main telephone networks and television networks. It is also used for its IaaS applications in cloud data centres.

The implementation of optical networks of second generation introduces another dimension to the hierarchy of protocols - the so-called optical layer. The optical layer is a host layer that serves other layers of the client. As shown in the following diagram, this optical layer provides the light paths to different customer layers.



STS Multiplexer:

Performs multiplexing of signals

Converts electrical signal to optical signal

STS DE MULTIPLEXER:

Performs DE multiplexing of signals

Converts optical signal to electrical signal

REGENERATOR:

It is a repeater, that takes an optical signal and regenerates (increases the strength) it.

Copyright@ijermt.org

Add/Drop Multiplexer:
It allows adding signals coming from different sources into a given path or removing a signal.

CONCLUSION:

The Internet is emerging as the new universal telecommunication medium. IP over WDM has been envisioned as one of the most alluringarchitectures for the new Internet. Consequently survivability is a crucial concern in designing IP over WDM networks. In this paper presents a survey of the survivability mechanisms for IP over WDM networks and thus is intended to provide a summary of what has been done in this area and help further research. A number of optical layer protection techniques have been discussed. They are examined from the point of view of cost, complexity, and application. Survivability techniques are being made available at multiple layers of the network. This paper also studies the recovery features of each network layer and explains the impact of interaction between layers on survivability. The advantages and issues of multi-layer survivability have been identified.

REFERENCE:

1. B.Mukherjee, D.Banerjee, S.Ramamurthy, A.Mukherjee, "Some principles for designing a wide area WDM optical network", IEEE/ACM Transactions on Networking, October 1996, vol. 4, no.5, pp. 684-696.
2. Rajesh M. Krishnaswamy, Kumar N. Sivarajan, "Design of logical topologies: A linear formulation for wavelength-routed optical networks with no wavelength changers", IEEE/ACM Transactions on Networking, April 2001, vol. 9, no.2, pp. 186-198.
3. R.Ramaswami, K.N.Sivarajan, "Design of logical topologies for wavelength routed optical networks", IEEE Selected Areas in Communication, June 1996, vol. 4, no.5, pp. 840-851.
4. R.Dutta, G.N.Rouskas, "A survey of VT design algorithms for wavelength routed optical networks", May 1999, TR-99-06.
5. Y.Xin, G.N.Rouskas, H.G.Perros, "On the physical and logical topology design of large scale optical networks", Journal of lightwave technology, April 2003,vol. 21, no.4, pp. 904-915.
6. D.Banerjee, B,Mukherjee, "Wavelength-routed optical networks: Linear formulation, resource budgeting tradeoffs and a reconfiguration study", Proc. IEEE/ACM Trans on Networking, October 2000,vol. 8, no.5.
7. SaurabhBhandari, "Dynamic Reconfiguration for Optical Network", Proc ICCCN 2005, Oct 2005,pp243-248.
8. SaurabhBhandari, "Optical Wireless Networks", Proc of ICNICONSMCL 2006, April 2006, pp113-117.
9. RamasamyMariappan; N.K. Karthikeyan (2012). Optimization Technique for Virtual Topology Reconfiguration for IP-over-WDM Networks with QoS Parameters. , 30(none), 1037–1047. doi:10.1016/j.proeng.2012.01.961
10. B.Mukherjee, D.Banerjee, S.Ramamurthy, A.Mukherjee, "Some principles for designing a wide area WDM optical network", IEEE/ACM Transactions on Networking, October 1996, vol. 4, no.5, pp. 684-696.
11. Rajesh M. Krishnaswamy, Kumar N. Sivarajan, "Design of logical topologies: A linear formulation for wavelength-routed optical networks with no wavelength changers", IEEE/ACM Transactions on Networking, April 2001, vol. 9, no.2, pp. 186-198.
12. R.Ramaswami, K.N.Sivarajan, "Design of logical topologies for wavelength routed optical networks", IEEE Selected Areas in Communication, June 1996, vol. 4, no.5, pp. 840-851.
13. Y.Xin, G.N.Rouskas, H.G.Perros, "On the physical and logical topology design of large scale optical networks", Journal of lightwave technology, April 2003,vol. 21, no.4, pp. 904-915.
14. A.Gencata, B.Mukherjee, "Virtual topology adaptation for WDM mesh networks under dynamic traffic", IEEE/ACM Transactions on Networking, April 2003, vol. 11, no.2, pp. 236-247.
15. SaurabhBhandari, "Dynamic Reconfiguration for Optical Network", Proc ICCCN 2005, Oct 2005,pp243-248