Research Article

Survey on Different Routing and Wavelength Assignment Techniques in WDM Optical Networks

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Abstract: In Wavelength Division Multiplexing (WDM) the method used to build a light-path connection from a source node to a destination node is called Routing technique. An optical signal quality decreases as it travel through the network due to the physical layer impairments. The light path in wavelength division multiplexed optical networks establishes a connection from source to the destination node by carrying out electronic transition in between the nodes. The primary goal of Routing and Wavelength Assignment (RWA) problem is to increase the number of calls or connection links efficiently by selecting the best route from the available routes. Routing and Wavelength Assignment is a challenging topic in WDM optical networks even we have many algorithms available for minimizing the blocking probability. Here in our work we are providing a literature survey on Routing and Wavelength Assignment techniques in WDM networks and Finally, we will develop a new Routing and Wavelength Assignment algorithm that is going to improve the performance in the network and reduces the Blocking Probability in WDM optical networks.

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INTRODUCTION

There is becoming a new growth in internet data due to increase in bandwidth intensive applications such as Internet of Things (IoT),Cloud Computing, Big Data. For its increasing transmission capabilities, low signal attenuation and less Bit Error Rate (BER) fiber has become a instinctive choice of transmission for supporting rapid requirement of large data transmission and reception and for fast processing [5].

In WDM many data signals modulate optical signals at different wavelengths and out coming signals are integrated and are transmitted at the same time over the single optical fiber. In WDM every communication channel is allocated to a different wavelength and multiplexed onto a single fiber. At the destination wavelengths are spatially separated to different receiver locations. These Optical networks capable of providing required bandwidth. In a WDM network, all users communicate with one another through WDM channels, which are called as light-paths. A light-path should take the same wavelength over all the fiber links through which it spans.

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Advantages of Optical Networks

1. Optical Networks have the following Advantages [9]
2. Capacity of the fiber is high Restoration can be done
3. Can achieve long distance transmission Large Bandwidth
4. Less Weight, Small Diameter Attenuation is less
5. Signal distortion is less Power requirement is less Wavelength reuse
6. Requires less space Cost effective
7. Reliable and Secure Flexible in nature

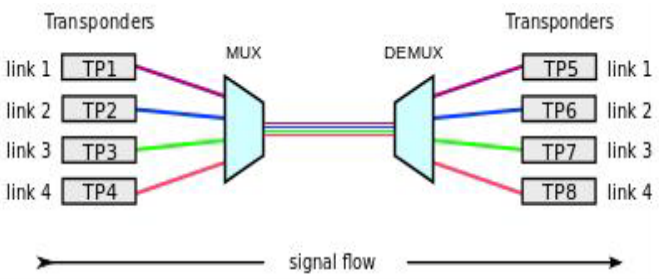

Figure 1: Wavelength Division Multiplexing

Routing and Wavelength Assignment

A Method of identifying a route and relegating a wavelength to the light-path is often referred as Routing and Wavelength Assignment problem. The goal of this problem is to find a route and relegate a wavelengths in such a manner, that should reduce the utilization of network resources, while in the meantime guaranteeing that two light-paths should not offer

the same wavelength on same route. The optimum formulation of the Routing and wavelength assignment is known as NP-complete; in this way, heuristic arrangements are regularly utilized. Usually There are three types of connection requests. They are dynamic, static and incremental. In static connection type the traffic is known in advance and then the connection should establish for the traffic in such a way that should minimize the use of resources In the network such as wavelengths or fibers. in incremental type of traffic connection request arrive successively and should built up a light-path and this will stay for long time in the network. In dynamic type we need to set up a connection after arrival of request and after some amount of time the connection should be disconnected. The main goal behind incremental and dynamic traffic cases is to reduce the blocking of calls and to minimize the utilization of network resources. In both the traffic cases we will consider routing and wavelength assignment as two separate problems in order to achieve more efficiency in solving the problem. [6]

Fixed Routing

n fixed routing, for every source to destination node, an individual route is determined. The net-work try to build a connection between the pair of nodes by using earlier determined fixed route. By doing so if common wavelength is not found on each link, then the connection establishment will not be done and the call has been blocked. This routing is easy to design so exceptionally constrained for routing choices and might lead to large scale of blocking.

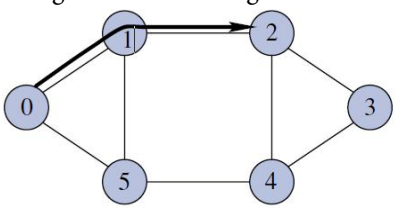

Figure 2: Fixed Shortest Path Routing

Fixed

Alternate Routing: In this every node in the network has to keep up a routing table that contains a number of various paths from each source to destination node. In this we should also main first shortest path, second shortest and so on. A prime path is considered as first route between a pair of nodes in the routing table based on shortest distance. Next the second route is listed in the routing table that should not share any links with the first route. Then the network try to make a connection set up between a pair of nodes from these listed set of routes in order with available wavelength after arrival of a request. If it is not possible to build a connection from these listed routes then that connection request is blocked and lost. In routing table the routes are ordered based on distance so primary route is the first shortest path, secondary is next shortest path and so on. If two paths have same distance then any one path is chosen randomly for connection establishment [1].

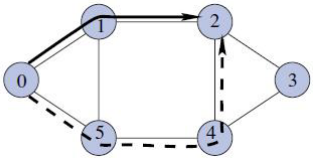

Figure 3: Fixed Alternate Path Routing

In Figure 3 a solid line indicates a prime path and a dotted line indicates the alternate path from node 0 to 2.

Adaptive Routing Based on Global Information

By making use of network state data this methodologies improve the probability of building up a connection.

Centralized Versus Distributed Routing: Adaptive routing adaptive routing might be implemented in either a centralized or distributed manner by making use of global network information. In a calculation, a centralized scheme single element, for example, a network administrator, records or holds complete system state data, and is responsible of discovering routes and establishing light-paths for connection demands. Because a centralized element handles the whole system, there no need of a high level of coordination in between the nodes; but in some cases the centralized entity may become fail. Besides, a centralized scheme does not perform well because it would need to keep up an extensive database to deal with all nodes, connections, and links in the system.

Alternate Path Routing: By using global information, this is another method for adaptive routing. It depends on set of predefined paths between the nodes. After arrival of a connection demand, an individual path is selected from the set of predefined paths, and then a light-path is build up on that path. The measures taking into account for path choice is commonly, either a distance of the path or blockage of path. Based on path lengths we have shortest path algorithm for routing. In this first the connection establishment is done on first shortest path, then the next shortest path and so on.

Unconstrained Routing: Based on global data the other type of adaptive routing method is unconstrained routing that will take all feasible routes between two nodes. By knowing the present state of the network, that is what are the available wavelengths an optimum path has to be selected by assigning a cost to every link in the network. Based on the cost a minimum cost route has to be selected for routing. After each connection set up or detachment the present state of the network has to be updated. There are two types of unconstrained routing namely link-state and distance vector routing. In link-state routing method each node has to maintain a record of network state

information. In a distributed way each node determines a path for connection set up. Then all nodes has to be communicated if there is any changes in the state of the network. Therefore the path set up or release will results in informing about the state of the network to all the nodes. This will results in control overhead. Next it will results in improper routing selection based on the availability of outdated data. With global data the distance-vector approach is also can be used. In this no need to record the state of the network but rather every node should have a table that have information about the wavelength and distance on each link [1].

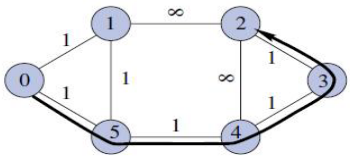

Figure 4: Adaptive Routing

Wavelength Assignment Techniques

We outline the wavelength - assignment approaches as follows.

1. Random Wavelength Assignment (R): In order to determine all the available wavelengths on the necessary route this scheme primly searches the wavelength space. A route is selected at random based on wavelength availability.

2. First-Fit (FF): In this approach, all wavelengths are numbered. A least numbered wavelength is taken instead of a higher-numbered wavelength when searching a wavelength space. Then the first available wavelength is selected. This approach does not require any global information. The computational cost of this approach is lower than the random assignment scheme because each route does not required searching of entire wavelength space.

3. Least-Used (LU): In this wavelength is selected which is used least in the network. After that it will try to manage the load in between the wavelengths. This approach finishes fastly assignment of Long wavelength for routes. Thus the traffic that travels through less number of hops is serviced in the network. Compare to random performance is less and also gives more communication overhead that is global data is needed for computing the least used wavelength. This isalso needed extra storage and computational cost hence practically this is not useful. Most-Used (MU): This is inverse of least used and this will selects the wavelengths which is used mostly. This overcomes the problem of LU considerably. Storage, cost of computation and communication overhead is same as that of LU. This overcomes some of the problems of FF by computing routes by using less number of wavelengths [6].

LITERATURE SURVEY

In [2], they have proposed a heuristic algorithm for assigning a dynamic light-path in translucent networks and have analyzed the heuristic with an optimum algorithm. A present re-generator placement strategy is used superior to the network operation, to determine the nodes having regeneration capability. They have used an A* best first search algorithm for identifying the IA-RWA solution. This algorithm chooses a path (from a set of pre-determined paths) by using least Possible number of regenerators for every pair nodes. They have constructed a search tree for identifying a possible path for any connection request for any source to any destination node. Pre-determined k shortest paths between each node pair (within optical reach) helps the algorithm to reach the destination rapidly. In this they have not carried out the problem of managing the fault in the network.

In [5], the New routing and wavelength assignment strategy for all optical networks without use of wavelength converters is proposed. Simulations were accomplished on NSFnet optical network. In this proposed weight function, few shortest paths are determined for each source and destination by Dijsktras modified algorithm. In this For connection request, the weight is calculated for each route and route with maximum weight is selected. Then they have compared blocking probabilities of existing techniques with first fit approach for different number of wavelengths for varied load conditions.In order to improve further the network performance this can also be extended with partial and sparse partial wavelength converters.

In [7], dynamic RWA scheme is proposed. In this they have used adaptive routing for selecting the route and first-fit approach for wavelength assignment. In order to set up a path between a pair of nodes, first they will determine the delay and bandwidth required on each link. The path which is congested is not considering and the path which is less loaded and having free wavelengths is chosen for path establishment. After that by allocating minimum granularity values calculating the shortest and low traffic path. Finally for alternate path selection RMSA with HSMR algorithm is used.

In [4], the proposed algorithm for routing and wavelength assignment first checks for quality of the light-path and if path have acceptable quality then by finding the Q-factor of that path they will select that path for connection establishment.

In [6], they have given brief explanation about the different type of methods for routing and wavelength assignment for optical networks and finally they have proposed Distributed Relative Capacity Loss method that is well applied for a distributed network and the routing scheme used is adaptive technique.

CONCLUSION

Due to emerging demand for higher bandwidth we are looking for WDM optical networks because of their high capacity and higher bandwidth and long distance transmission. These WDM optical networks carrying high data so if there is any

failure in the link carrying the data then the data is going to lost so setting up a alternate route in case of failure has became a severe challenge now a days. Therefore in our work we have given overview of some of the routing and wavelength assignment techniques which have been used for reducing the probability of blocking of connection set up in the network.

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