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Routing and Re-routing Scheme for Cost effective Mechanism in WDM Network

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Abstract

WDM in optical networks are high capacity networks based on optical technologies in which RWA (Routing Wavelength Assignment) is a main issue. In this paper we have given overview on different rerouting schemes and also the survivability concept in case of failure occurs in network. That means most of the attention devoted in this paper on used of routing and wavelength assignment (coloring) scheme in first phase and rerouting in later phase. Therefore, after analysis it is clear that as compared to other schemes our propose rerouting at connection level (RRCL) scheme which is a cost effective approach with respect to different metrics terms. Finally we can say rerouting at connection level scheme works well in WDM optical networks and we demonstrate the performance of RRCL scheme through simulation results.

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Keywords: Routing & Wavelength Assignment (RWA), Wavelength Division Multiplexing (WDM), Rerouting at connection level (RRCL) scheme, Network Congestion (NC), Network Converter Requirement (NCR), Network Wavelength Requirement (NWR)

1. Introduction

In recent days, there is a demand of high bandwidth due to use of Internet and various applications like multimedia. For this purpose there is a need of WDM network, which tap high bandwidth. Wavelength division multiplexing (WDM) is one of the technologies which able to divide the vast amount of bandwidth into a number of high-speed channels, which located at different wavelength [16]. Therefore we can say that, WDM is used in optical network for transmission of data, which helps in reducing the bandwidth and is widely used for long communications [17]. The below figure (1) shows the Wavelength Division Multiplexing (WDM),

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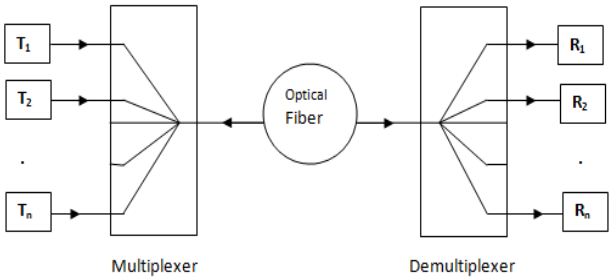

Fig. 1. Wavelength Division Multiplexing (WDM)

The routing is a mechanism of choosing best alternative path in the given network. There are two types of routing, static routing and dynamic routing. As one of the important problem of WDM optical network is RWA (Routing and Wavelength assignment) which is nothing but for finding route between source and destination nodes, an algorithm is used for route selection and wavelength assignment to that route. Such an algorithm called as a Routing and Wavelength Assignment algorithm in which a Heuristic algorithm is used. The wavelength assignment also called as coloring, in which wavelength to be assigned. That means we say performance of WDM based optical network primarily depends on routing and wavelength assignment techniques used, then these schemes are evaluated in different metrics term used [18].

As per the literature survey the basic objective to RWA problem is to minimize the number of wavelengths required to successfully route and assign wavelengths to all the lightpath. In this paper a heuristic algorithm i.e. an algorithm used for finding out solution for a given problem for minimizing different parameters in routing and wavelength assignment (RWA). After applying routing and wavelength assignment scheme we compare it with rerouting scheme. Generally the rerouting scheme can be classified as rerouting at lightpath level or at connection level. In this paper we have to propose rerouting at connection level (RRCL) scheme.

Survivability of a network is the concept in which if any of the failure to be occur in the network then without disturbing continue the process. In WDM system, failure may be occurs in node, link or may be in channel [12] [16]. The node failure occurs because of equipment failure, link failure occurs if the large number of users can used that same link continuously and channel failure due to failure of transmitting and receiving of equipment on that particular channel i.e. survivability of a network is nothing but to provide continuous service regardless of the any type of failure.

The paper is arranged in following different sections. In section 1 we introduce the WDM network and the overview of routing and wavelength assignment. Section 2 gives explanations on routing algorithm. In section 3 we explained wavelength assignment algorithm. Then in section 4 we explained our proposed rerouting scheme at connection level (RRCL). Section 5 gives performance evaluation with simulation results in section 6 and finally we conclude and lay out the future work in section 7.

2. Routing algorithm

With the different categories like as fixed routing, exhaust routing, passive routing and alternate routing [17] we have routing algorithm is the one which establish the path between Source-Destination (S-D) and then the messages to be follow in between them. Generally, Routing algorithm establishes the paths to follow messages to reach their destination [19].

There are various algorithms to find out the shortest path or minimum distance between the nodes in the network but to find shortest path we use below algorithm with following steps.

2.1 Dijkstra's algorithm:

The various steps of Dijkstra's algorithm are as given below,

1: Consider distance between each node of the network.
2: Then enter SD (Source-Destination) pairs.
3: Now consider first SD pair.
4: Put all number of nodes in variable.
5: Let,
Length of source as zero &
Length of nodes to infinity
6: Find out minimum path by,
$L(k) = \min \{Old(k), L(a) + w(a, k)\}$ (1)
Where,
k = Total number of nodes 1 to N.
a = Source of link
W (a, k) = Weight (distance) between a & k.
7: Calculate Number of hops required,
Number of Hops = (Total Number of nodes in Route – 1) (2)
8: Then calculate NC on each link by using,
$Lmax = \max (k, j) L_{k,j}$ (3)
Where,
Lmax = Maximum used link,
k = Source of link,
j = Destination of link

3. Wavelength assignment algorithm

After applying Dijkstra's algorithm for finding of minimum distance between the nodes in section 2 now the assignment of a wavelength to each lightpath performed in such a way that no two light paths occupy same wavelength on a given link.

For wavelength assignment scheme steps are given by,

1: Allocate wavelength as 1.
2: By considering link assign wavelength to SD pair.
3: Take first link then check NC of that link. For that check whether,
i) As NC =1, apply same wavelength to SD pair.
ii) As NC is greater than 1, then apply different wavelengths to SD pairs.
4: Continue till end of all SD pairs.
5: After that find maximum number of wavelengths assigned for network,
NWR = Max (no. of wavelengths) (4)
6: Again start by first link and check NC,
i) If NC =1, then say network converter not required &
ii) If NC is greater than 1, then say network converter is required.
7: Repeat until all physical links in the network.

4. Proposed algorithm

For a given network, now by comparison with existing work here we propose a Rerouting algorithm which is apply in different terms like rerouting at light path and at connection level. The rerouting at connection level (RRCL) scheme shows at establishment of connection it is work effectively as compare to another one and also it used to minimize the number of parameters as, Network Congestion (NC), Network Converter Requirement (NCR), Network Wavelength Requirement (NWR) and Number of Hops etc.

RRCL algorithm

The various steps of rerouting at connection level (RRCL) are as,

1: Take first route of SD pair and check whether any optional node is available for the route or not.
2: If optional node is available, consider it as destination for link. Then update the link in current route, in such a way that link not affects the traffic of other SD pairs.
3: Continue process till Destination of first route reached.
4: The same process is applied until all routes in the given traffic. Then we have to get changing route of SD pairs.

The various steps of RRCL algorithm are in below figure (2),

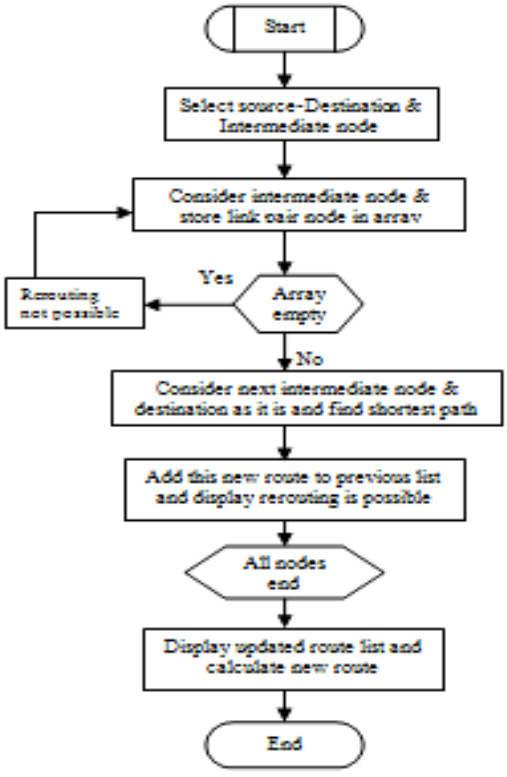

Fig. 2. RRCL Algorithm

5. Performance evaluation

To evaluate the performance we illustrate optical WDM network with 6 nodes and 9 links by applying routing scheme to find out best available route and also wavelength assigned by wavelength assignment algorithm to each of lightpath.

By implementing the Heuristic algorithm on 6 nodes and 9 links network as shown in figures (3) & (4) respectively, shortest path for source to destination pairs are calculated before rerouting and after rerouting. For that we considered some traffic on the network and assigned route from the source node to destination node. Then parameters like Network Congestion (NC), Network Wavelength Requirement (NWR) and Wavelength Converter Requirement (NCR) were calculated. After that we applied proposed rerouting (RRCL) scheme on the same network to minimize above parameters as compared to existing algorithm that we get in routing algorithm. In below figures we show the simulation results to be distinguished in between the existing algorithm and by our proposed scheme.

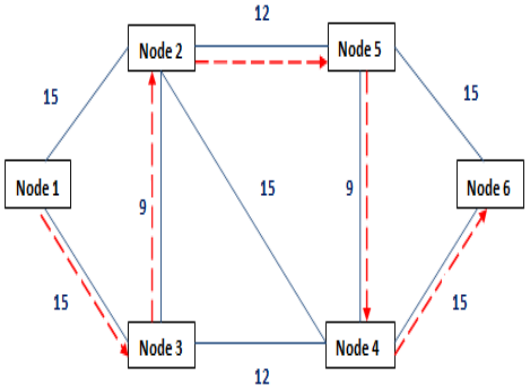

Fig. 3. Simulated Network before re-routing

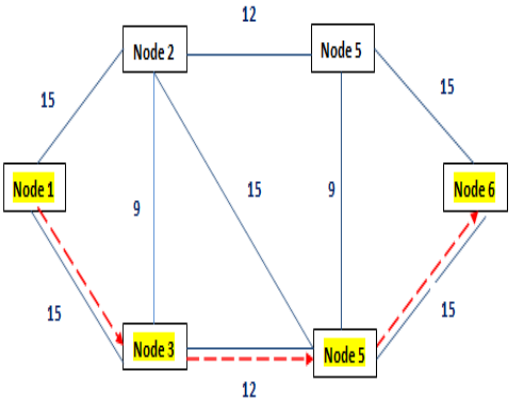

Fig. 4. Simulated Network after re-routing

6. Simulation results

In order to evaluate the performance of proposed scheme and the comparison to be taken with respect to existing strategy a code has been developed in MATLAB R2008a environment to run the simulation. It accepts parameters like number of nodes & total number of links in the network, weight of each link, SD pairs in network etc. Then it gives network congestion, network wavelength requirement and network converter requirement as output. Below figures (5), (6) & (7) shows the different metrics as discuss above with comparison between before rerouting and after rerouting phases performed.

Related to simulation results as the number of terms are reduced in rerouting scheme so it is advantageous to say that proposed rerouting algorithm provides better performance than the routing algorithm.

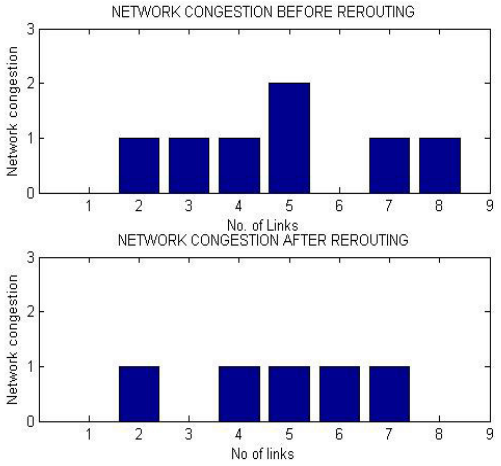

Fig. 5. Network Congestion (NC)

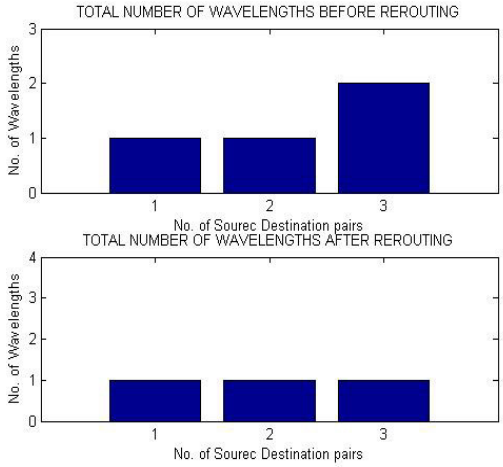

Fig. 6. Network Wavelength requirement (NWR)

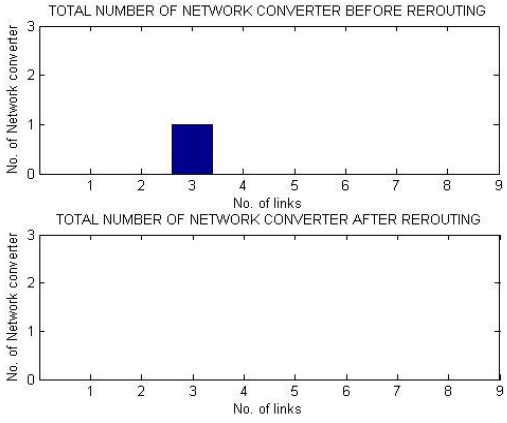

Fig. 7. Network Converter Requirement (NCR)

7. Conclusion

In this paper we overview rerouting strategies and survivability concept by considering RWA as main problem in WDM network. The proposed rerouting at connection level (RRCL) scheme as compared to existing routing algorithm in the aspect of implementation of network and we observed simulation results between before rerouting and after rerouting phase, which shows RRCL scheme is effective way to maximize the number of resources with minimizing number of hops and number of wavelengths. It also minimizing congestion problem. So by minimizing all that parameters cost of the network get reduced.

As future work, this algorithm will be implemented to solve the multicast network problem in an optical network using WDM and it would be interesting to see how this algorithm to be work to solve given problem by simulation results.

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