Optical Network System Existence in Optical Network Systems

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Abstract - *Communication through optical fibers is determinedly integrated as a part of the worldwide data infrastructure that is for the economic growth and wellbeing of community optical fiber is playing a very crucial role. The optical fibers are the main attraction because of high data rates and large bandwidth which can support large number of users. In this research work, a restoration technique is designed which uses reactive approach to overcome single link failure. This Proposed method uses Dijkstra's algorithm to find the shortest path between two nodes in a given network and in case of failure of any link on the working link all the adjacent cycles between end nodes of the failed link are determined. From the found adjacent cycles the shortest adjacent cycle is found out which consists of the source and destination nodes of the failed link.*

Key Words: Optical Networks, Survivability, Link-Disjoint

1. INTRODUCTION

These optical fibres are mainly preferred over copper cables because they are not affected by electromagnetic interference. They are also more secure as it is different to tap inside the optical fibres as it requires skilled labour to do so. Because of the numerous advantages of optical fibres these are a dominant technology now days in long haul and broadband communication services [1]. In earlier days when communication was done using copper cables the bandwidth was limited because of the speed of the electronic processing, they were also affected by electromagnetic interference and communication using copper cables were not secure as they were very easy to tap so fibre optic transmission has been well recognized and efforts are to be made to increase the transmission speed. With the explosive growth of internet it has certainly affected the need to provide not only high unparalleled, accelerating demand for bandwidth requirement and speed, but also requires faster networking infrastructure and different technologies [2-3]. Optical networks are high capacity telecommunication networks which use information in the form of light to penetrate through if by using the principle of total internal reflection (TIR). Since light has higher frequencies and shorter wavelengths, large amount of information can be transmitted using optical networks. Optical networks operate at a rate of terabits per second; hence they provide higher bandwidth Very high speed optical networks are required for establishing the next generation broadband data communication systems. A failure in an optical network may result in significant data and revenue loss due to large amount of traffic over optical links [4].

In today's optical networks, which the rapidly growing optical network the problems like link failure, node failure and failures due to other reasons are increasing and surviving from these kind of failure is very important in an optical network otherwise it can cause the failure of entire network ultimately it will affect the users on the network. On different layers of a network such as the SONET/SDH, WDM, IP and MPL layers survivability can be provided. Even though the higher layers could have their own recovery methods, it is important to make sure of survivability on the WDM layer since the WDM layer has numerous advantages compare to the higher layers i.e. effective utilization of resources, faster recovery time from failure and protocol transparency [5-6]. To protect0the network from failures, survivability0may be provided through protection and restoration0techniques. Protection uses a proactive approach where backup resources are reserved during the time of failure and are only utilized when a failure occurs, while restoration uses a reactive approach where both the end nodes whose link has failed enters in a distributed algorithm after the occurrence of failure to find out an alternative path to restore the network from failure. In protection approach alternative backup paths are reserved at the time of network design and these reserved network resources are only utilized at the time a failure has occurred. The survivability from network failure i.e. the time to overcome network failure is very small but this resource utilization is very low [7]. On the other hand, the restoration approach has better resource utilization between no resources are preserved and after the occurrence of failure network is restored using the current available resources of the network. By using this technique, it can take time to restore a network from failure and the restoration time from failure depends on the time to search the current available using which network can be restored. [8-10] then the adjacent node corresponding to the failed link switches from the failed link to the newly found working link to re-establish the network. After restoration of failed link all adjacent nodes of the failed link update their cycles. Restoration time is also calculated to find time required to restore failed link [11]. The proposed technique is tested in MATLAB by comparing results of proposed technique with existing technique so that improvements can be shown.

2. Problem formulation

Optical networks are high capacity networks that use optical technologies. They can operate on very high data rates exchanging terabytes of information in a second and hence they provide higher bandwidth. Thus any failure can cause loss of data which in turn can cause revenue loss and loss of sensitive information. There are many network components which can cause the failure of connection such as switches, fibre cuts, and transceiver and so on. But the most common failure is link failure Thus survivability plays a very crucial role in recovering from these failures. For survivability networks, protection and restoration become essential part of network design. Our focus will be on developing an improved solution to this problem. In the proposed work Dijkstra algorithm is used to find the shortest path between the source and destination nodes. After link failure occurs the proposed algorithm will find all adjacent cycles and out of the various adjacent cycles the shortest adjacent cycle connecting the end nodes of the failed link is determined.

3. Proposed Technique

Various survivability techniques have been studied and our objective is to propose a survivability technique which is fast. In our proposed technique we have used Dijkstra algorithm to find the shortest path between source and destination. After finding the shortest path which is the primary path the source will transmit data to destination through this path. In case a failure of link occurs on the primary path all the independent cycles are determined. Out of all independent cycles on the shortest cycle which will consist of both the end nodes of the failed link will be found out. Then the end nodes will switch to the newly found protection path. The restored time will also be calculated to find out the time taken in searching protection path. The results proposed technique is evaluated in MATLAB, and the results are compared with the existing techniques to find out improvements.

The sequence of steps for finding shortest path:

Initially all the nodes will be infinity, and then we will the starting node to 0.

The distance of the source node is made permanent and distance of all other nodes is made temporary.

The source node is marked active.

Then from this starting node the distances to all the adjacent nodes are determined by adding the starting node distance to the distance of other nodes.

The shortest distance from the distance of the entire neighbouring node is found out. This is known an update cycle.

Set the node whose distance is the shortest from the starting node is marked as current node and this distance is made permanent.

The steps 4 to 7 are repeated till no nodes are left to be searched out then the final node searched are the destination node

4. Flowchart

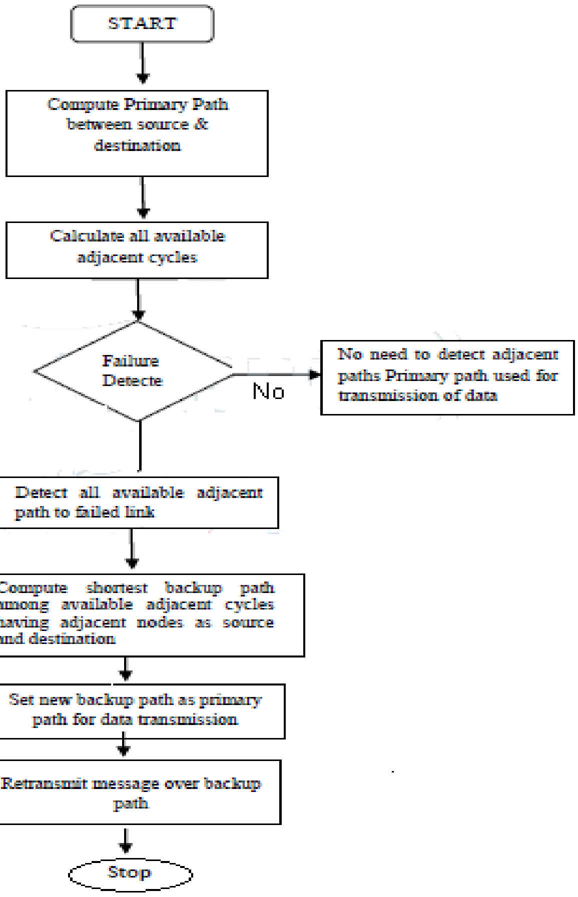

Figure 1: Flowchart for Single Link Failure Restoration

The proposed technique was implemented to the following network design to show the results:

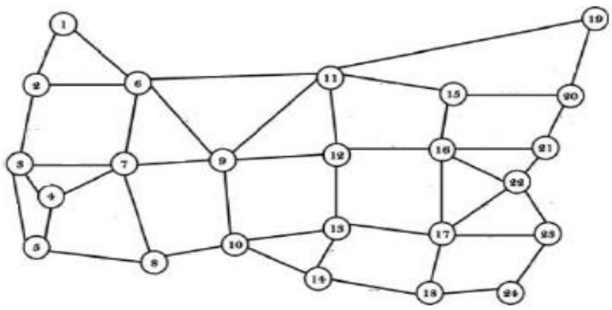

Figure 2: A typical 24-node Network

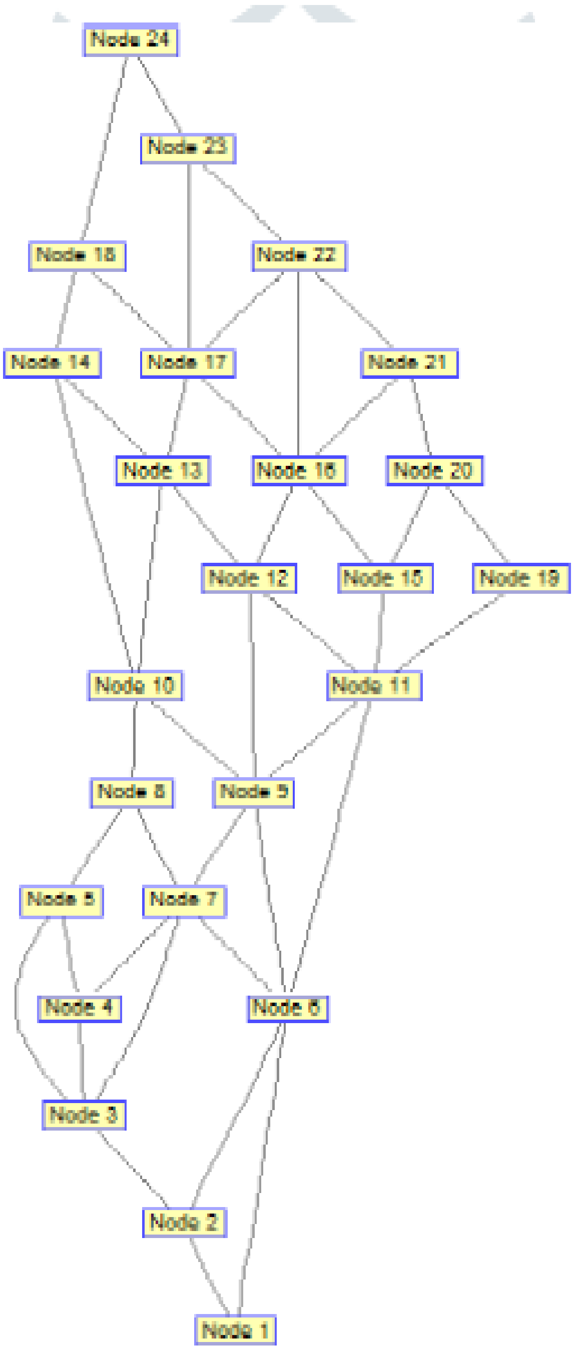

Figure 3: Node network using MATLAB

VII. Improvement in Survivability with Proposed Technique

Case 1: a) Shortest Path between 1 to 13 nodes

By using Dijkstra's Algorithm computed primary path is 1->6->9->12->13. Subsequent to choosing essential way source transmit information to goal. To endure connect disappointment every single free cycle are resolved. Each hub stores its contiguous cycles.

Shortest path from 1 to 13 nodes is 1->6->9->12->13

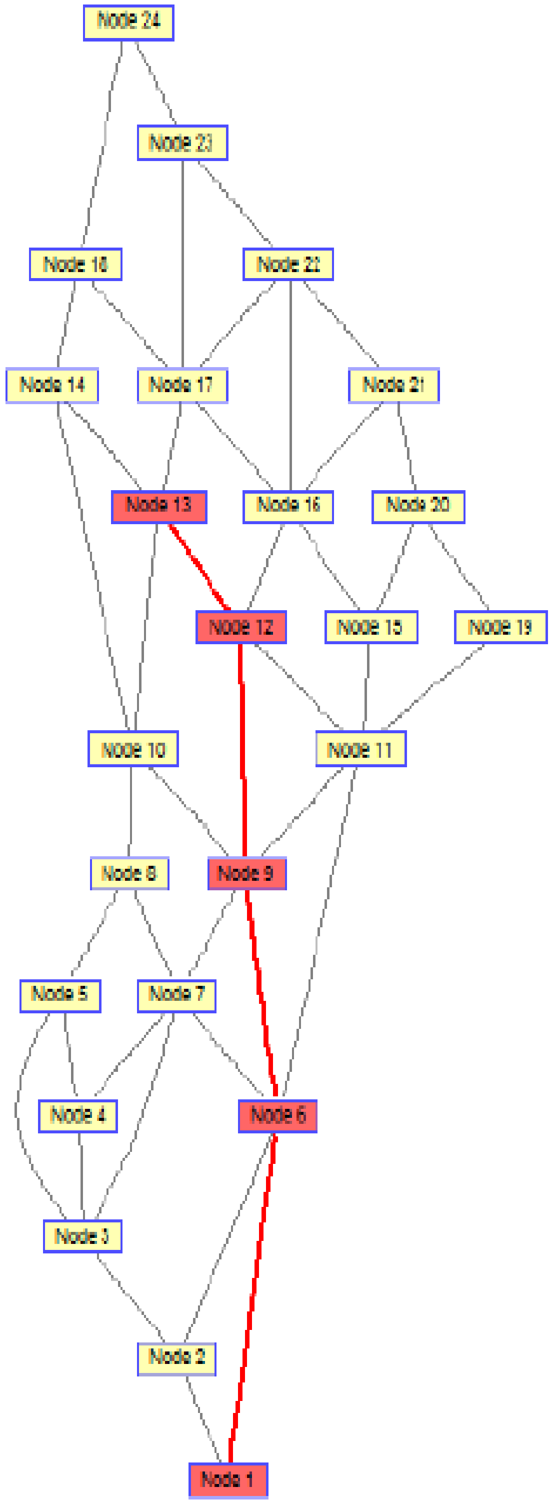

Figure 4: Primary path between nodes 1 and 13

b) If the path between 6 and 9 fails

Now consider a case when link 6->9 fails while transmitting data from source to destination. Link 6->9 has eight adjacent cycles, as 9->7->6 is shortest between these adjacent cycles.Using Proposed Method

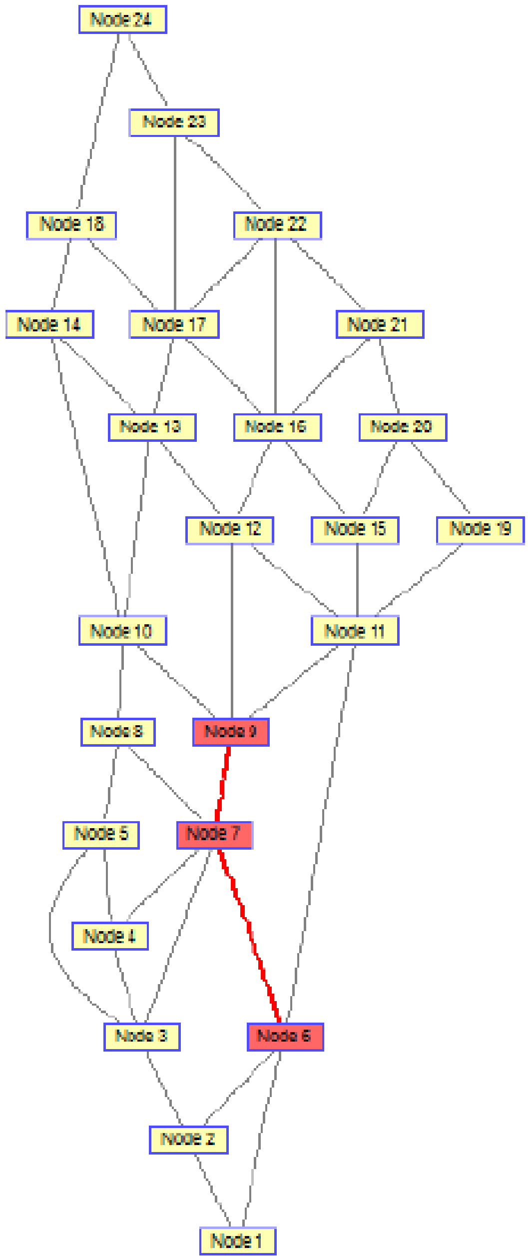

Figure5: Backup path between nodes 6 and 9

b) If Path between 3 and 5 fails

Now consider a case when link 5->3 fails while transmitting data from source to destination. In proposed method, failure is detected by node-5 and link 3->5 is protected by shortest adjacent path 5->4->3. Then node-3 sends FNM to source node by using 5->4->3->2. When FNM reaches source node traffic is retransmit using restored path 2->3->4->5->8->10. Shortest path from 2 to 10 will be now 2->3->5->6->10

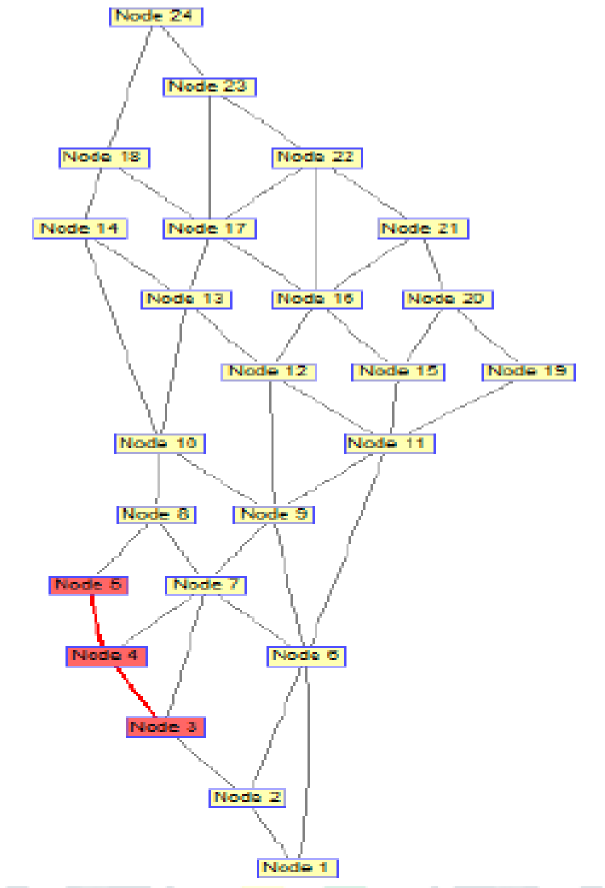

Figure7: Backup path between nodes 3 and 5

Case 3: Path is from Node 5 to Node 18

Consider a case where node 5 acts as source and node 18 as destination. By using Dijkstra algorithm computed primary path is 5->8->10->14->18. Now independent cycles are found out for surviving failure and every node stores it's all possible adjacent cycles. Now consider a case when link 10->14 fails while transmitting data from source to destination. Link 14 will check for the shortest adjacent cycle.In proposed method, failure is detected by node-14 and link 10->14 is protected by its shortest adjacent cycle i.e. 14->13->10. Then node-14 sends FNM to source by using 14->13->10->8->5. When FNM reaches source node restored path is 5->8->10->13->14->18.

Case 4: Path is from Node 2 to Node 19 Consider a case where node 2 acts as source and node 119 as destination. By using Dijkstra algorithm computed primary path is 2->6->9->11->19. After selecting primary path source transmit data to destination.

Now independent cycles are found out for surviving failure and every node store it's all possible adjacent cycles. Now consider a case when link 6->7 fails while transmitting data from source to destination. Link 7 will check for the shortest adjacent cycle. In proposed method, failure is detected by node-7 and link 6->7 is protected by its shortest adjacent cycle i.e. 9->7->6. Then node-7 sends FNM to source by using 9->7->6- >2. When FNM reaches source node data is communicate using path 2->6->9->11->19.

5. Comparison of the proposed technique with the existing technique.

Shortest path	Failed Link		FNM Path	
Existing	Proposed	Existing	Proposed	
1->6->9->12->13	6->9	9->7->3->2->1	9->7->6->1	1->2->3->7->9->12->13
2->3->5->8->10	5->3	5->4->7->6->2	5->4->3->2	2->6->7->4->5->8->10
5->8->10->14->18	10->14	14->13->12->9->7->4->5	14->13->10->8->5	5->4->7->9->12->13->14->18
2->6->9->11->19	6->7	11->12->9->7->3->2	9->7->6->2	2->3->7->9->12->11->19
Path For Retransmission		Total number of nodes for restoration of failed link		Restoration Time
Existing	Proposed	Existing	Proposed	
1->6->7->9->12->13	5	4	2070.336 µs	1660.448 µs
2->3->4->5->8->10	5	3	2070.336 µs	1214.336 µs
5->8->10->13->14->18	7	5	2890.576 µs	2070.336 µs
2->6->9->11->19	6	4	2480.448 µs	1660.448 µs

Table1: Number of nodes to recover failed link by Proposed Technique

6. Graph (Comparison between Existing and proposed algorithm)

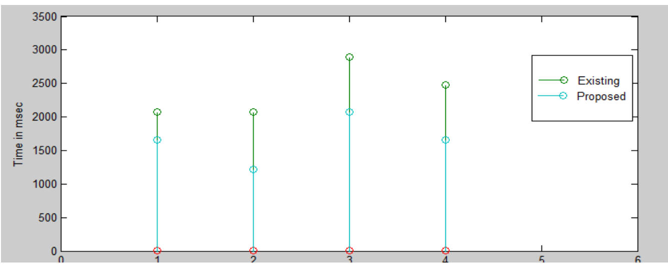

Figure8: Comparison between Existing and proposed algorithm

7. CONCLUSION

The main emphasis of this work is to lookout different restoration and protection methods for surviving link failure in optical network. Our focus is on restoration method that dynamically allocates path to failed link. In this WORK we proposed a quick and effective survivability method for surviving failure of single link in WDM networks because failure of single links is key cause for network failure. The objective is to keep number of nodes required to overcome from failure to minimum and time to restore link have to be as minimum as possible. Dijkstra Algorithm is used to discover primary path and then is used to find shortest backup path among number of adjacent cycles existing corresponding to failed link.

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