

# Double P-Cycle based Dual Failure Survivability

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**Abstract**— Survivability is an important requirement in high-speed optical networks. Network recovery from multiple failures is a major concern. We propose new method to survive the network from dual link failure using Double p-cycle. p-Cycles can attain high capacity efficiency and fast protection switching times in WDM networks. The number of deployed p-cycles and the ability to survive dual fiber duct failures are further important characteristics. A p-cycle is set up for each link and data packets are switched based on priority criteria. When link is failure, the system will select the best route of p-cycles based on priority criteria based on priority criteria it means that the higher priority packets go through shortest distance route and lowest priority data packets go through longest distance route of p-cycles.

**Keywords**---Double p-cycle, Dual failure, Protection, network Survivability.

## I. INTRODUCTION

THE p-cycle protection concept is a promising approach for survivable WDM networks, since high capacity efficiency and fast protection switching times can be achieved. Most research to date in survivable optical networks focuses on single link failures, however, the occurrence of dual failures are not uncommon in a network topology [1].

### A. Survivability

Survivability, the ability of a network to withstand and recover from failures, is one of the most important requirements of networks. It is an important part of optical networks as large amount of data is being carried by these networks. Survivability of a network refers to a network's capability to provide continuous service in the presence of failures. The basic types of failures in the network can be categorized as either link or node failures. Link failure usually occurs because of cable cuts, while nodes failures occurs because of equipment failure at network nodes. Besides,

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channel failures are also possible in WDM networks. A channel failure is usually caused by the failure of transmitting and/or receiving equipment operating on that channel [2].

### B. Protection

Protection is based on reserving backup resources in advance that is protection preplans backup routes that are used in the event of a failure approaches that address link failures in optical networks. Protection can be implemented in a capacity efficient manner and offer much faster recovery Protection schemes can achieve complete recovery in the order of tens of milliseconds. Fault management in optical network is done through reserving backup resources in advance called protection which can be further classified as path protection and link protection [3]. In link protection (also called loop back protection), alternate paths (distinct paths for each wavelength, in general), called backup or protection paths, between the end points of each link are pre-computed. Upon the link's failure, all of the light-paths using the link (called primary or working light paths) are switched at the end-nodes of the link to their corresponding backup light-paths. In contrast, path protection entails the end-to-end rerouting of all working light-paths that use the failed link along pre-computed backup light-paths. Here, the entire route of the working light-paths may be changed. These schemes can provide guaranteed protection since the demand set up completes only if the secondary path is also available. Despite the wide range of survivability mechanisms available and the ease with which our networks can be designed for 100% single-failure restorability, they are still highly vulnerable to failures, and outages are still frequent [2].

### C. Restoration

Failure in a system is a very common scenario to face. Since networking system is very much sophisticated, the failure is some what very natural and high in this case. Failure may occur between two nodes in a transmitted path, again total path can be failed by any situation. Thus a network failure in such system may seriously impair service continuity to a countless number of users. So, network survivability is essential. Networks capable of protecting itself against the failure are called survivable networks. Different restoration schemes have been proposed to ensure survivability. Discovering spare backup resources in online manner after the failure called Restoration. Restoration based recovery takes about 2 seconds to discover a new back up route after failure. It can be of two types that are link restoration and path restoration The advantage of high speed and high network

connectivity should be accompanied by adequate network survivability features. So in case of a link failure a tremendous amount of information can be lost, affecting a huge number of customers' requests. Therefore network survivability becomes an important issue [4].

## II. LITERATURE SURVEY

D.A. Schupke et. al [5] have analyzed that the dual failure restorability and the protection capacity can vary significantly for cycle-configurations with different numbers of deployed  $p$ -cycles.  $p$ -Cycles can attain high capacity efficiency and fast protection switching times in WDM networks. The number of deployed  $p$ -cycles and the ability to survive dual fiber duct failures are further important characteristics which are considered in a pan-European network case study. The  $p$ -cycle protection concept is a promising approach for survivable WDM networks, since high capacity efficiency and fast protection switching times can be achieved. WDM  $p$ -cycles guarantee survival of any single fiber duct failure (e.g., caused by a backhoe). But for larger networks, dual failures—though much less probable than single failures—should be taken into account.

Hongsik Choi et.al [6] have studied that Network survivability is a crucial requirement in high-speed optical networks and analyzed that a failure model in which any two links in the network may fail in an arbitrary order. Three loopback methods of recovering from double-link failures are presented. The first two methods require the identification of the failed links, while the third one does not. However, precomputing the backup paths for the third method is more difficult than for the first two. A heuristic algorithm that pre-computes backup paths for links is presented. Numerical results comparing the performance of our algorithm with other approaches suggests that it is possible to achieve recovery from double-link failures with a modest increase in backup capacity.

Sun-il Kim et.al [7] have studied the the impact of non-simultaneous, two-link failures on different protection schemes and provide an understanding of the different failure scenarios that arise when a multiple failure model is considered and also discuss the tradeoffs between different solutions that may be employed to address multiple failures, and present a simple dynamic protection reconfiguration technique, which can be used to address multiple failures. Quantify the tradeoffs between different protection schemes in terms of capacity cost and survivability from two sequential link failures. In dynamic protection reconfiguration, protection routes are quickly recomputed and resources are reassigned in the event of a failure, optimizing robustness from additional failures. With the use of a simple reconfiguration technique, a network's survivability is limited only by topological constraints, where only complete network disconnections result in broken connections.

S. Ramamurthy et.al [8] examines different approaches to protect a mesh-based WDM optical network from such failures. These approaches are based on two survivability paradigms one is path protection/restoration and second one is link protection/restoration and study examines the wavelength

capacity requirements, and routing and wavelength assignment of primary and backup paths for path and link protection and proposes distributed protocols for path and link restoration. Also examines the protection-switching time and the restoration time for each of these schemes, and the susceptibility of these schemes to multiple link failures. The numerical results obtained for a representative network topology with random traffic demands demonstrate that there is a tradeoff between the capacity utilization and the susceptibility to multiple link failures.

Oscar Diaz et.al [9] have studied that network service recovery from multiple correlated failures is a major concern given the increased level of infrastructure vulnerability to natural disasters, massive power failures, and malicious attacks To address this problem, a novel path protection solution is proposed to jointly incorporate traffic engineering and risk minimization objectives. The framework assumes probabilistic link failures and is evaluated against some existing multi-failure recovery schemes using network simulation.

Dongyun Zhou et.al [10] have studied survivability, the ability of a network to withstand and recover from failures, is one of the most important requirements of networks. Its importance is magnified in fiber optics networks with throughputs on the order of gigabits and terabits per second and this techniques used to achieve survivability in traditional optical networks.

Oscar Diaz et.al [11] have studied that network service recovery from multiple correlated failures is a major concern given the increased level of infrastructure vulnerability to natural disasters, massive power failures, and malicious attacks. To addressed this problem proposed a novel path protection solution that jointly incorporate traffic engineering and risk minimization. Network service recovery from multiple correlated failures is a major concern given the increased level of infrastructure vulnerability to natural disasters, massive power failures, and malicious attacks The framework assumes probabilistic link failures and is evaluated against some existing multi-failure recovery schemes using network simulation.

## III. PROPOSED MODEL USING DOUBLE P-CYCLE

In this section we introduce a restoration method for network survivability to provide single or dual failures survivability using double  $p$ -cycle. A  $p$ -cycle is set up for each link when the link is failure the system will select the best path based on priority criteria. The Double  $p$ -cycle restoration concept is a promising approach for survivable WDM networks, since high capacity efficiency and fast protection switching times can be achieved. the configuration of Double  $p$ -cycles for a network can optimize the performance in case of double failures[1]

### A. Steps of Proposed Algorithm

The following steps are used for Proposed Algorithm are:-

- $N_s$  is source node and  $N_d$  is destination node.
- Calculate the shortest distance between source node ( $N_s$ ) and destination ( $N_d$ ) node

- $D_i$  is data sets where  $i = 1, 2, 3, \dots, n$
- Source data  $N_s$  send data  $D_i$  to neighbor node.
- Compute distance from straddle Node  $N_{k-1}$  to all different routes  $R_1, R_2, \dots, R_n$  respectively by using Ant colony optimization Algorithm
- When there is link failuer in network then node check the data priority it means higer priority packets go through shortest route of p-cycles and lowest priority data packets go through longest distance route of pcycles.

**B. Algorithm For Proposed Method**

Ant colony algorithm is proposed by an Italian scholar Dorigo M who gets the inspiration from ant colony foraging process. Ant colony optimization is a meta-heuristic technique that uses artificial ants to find solutions to combinatorial optimization problems. ACO is based on the behaviour of real ants and possesses enhanced abilities such as memory of past actions and knowledge about the distance to other locations. In nature, an individual ant is unable to communicate or effectively hunt for food, but as a group, ants possess the ability to solve complex problems and successfully find and collect food for their colony[12]. A Single ant is not very intelligent, it looks like there is non-centralized command, but they can coordinate and work together and they can always find the shortest path between a food source and ant nest on the feed time .This study found that’s ants will release a volatile chemical in its dealing path at their foraging, called as Pheromone. In ant colony optimization (ACO) algorithm apart from the actual path its length is remembered ,so that one can estimate how much pheromone an ants lays on a given path. Therefore, the more ants that travel on a path, the more attractive the path becomes for subsequent ants. Additionally, an ant using a short route to a food source will return to the nest sooner and therefore, mark its path twice, before other ants return. This directly influences the selection probability for the next ant leaving the nest. In this way ants relatively quickly begin to travel along the shortest route.[13]

**IV. RESULTS & DISCUSSIONS**

We have stimulate the results of proposed method of the following in which we take an example and using double P-cycle. 1-3-5-7-1 is p-cycle 1 and 4-5-6-9-4 is other p-cycle that is p-cycle 2. Linj 1-5 is staddle link. When both On cycle and Straddle link Failure. According to figure p-cycles that protect span 1-5 as a straddling span. Both p-cycles offer two more disjoint protection routes to span. When On cycle link 1-7 in given figuer fails and also Straddle link 1-5 fails then system select another alternative path on priority bases so from source 1 to reach to the destination 9 uses path 1-3-5-6-9

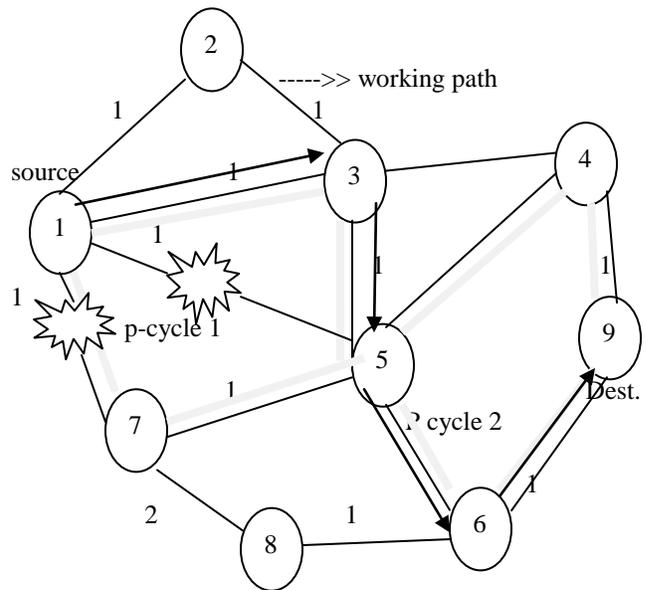


Fig. 1 Example

This p-cycle is able to protect links as shown in following two cases:-

**Case 1:- When On cycle link failure**

On-cycle links means those links that are a part of the p-cycle. in the following figuer link 1-2 is on cycle failure system will find another alternative path to maintain survivability so this means that when link 1-2 fails then data will be send from path 1-5-3-2

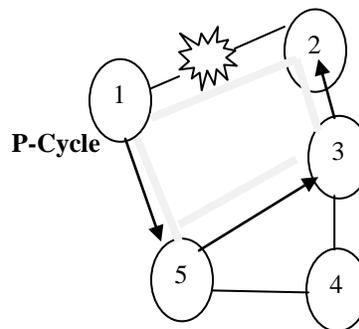


Fig. 2 On cycle link failure

**Case 2:- When Straddle link failure**

Straddle links means those links whose end-nodes are both on the p-cycle, but which are not actually a part of the p-cycle itself. The p-cycle can provide various types of protection link or span failure For both on-cycle and straddling links the protection switching can be made very fast, since only the nodes neighboring the failure need to perform real-time actions. when Straddle link fails as in the given figuer link 1-3 fails the system will selet two alternative paths to make surviveability that is path 1-5-3 or 1-2-3

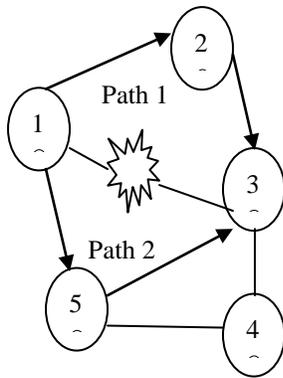


Fig. 3 Straddle link failure

### V. CONCLUSION

In this paper we introduce Ant colony algorithm to protect from dual link failuer. Dual link failure is main problem now a days.so p-cycle is set up for each link when a link is failure packets will divert to new route based on priority criteria and priority criteria is set according to ant colony optimization algorithm .

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