Optimizing Dual Link Failure Recovery with Node P-Cycles in WDM Mesh Networks

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Abstract- Network survivability has become a crucial requirement in all type of networks. It becomes even more significant for wavelength division multiplex (WDM) mesh networks due to their high speed and capacity. These networks are prone to link failures. A link failure may be a single link or dual link failure. A single link failure is easy to locate and fix as compared to dual link failure. A dual link failure recovery technique has been proposed using p-cycles concept. This technique uses replication method for p-cycle circle. It is an enhancement of the original FIPP p-cycle scheme. The replica properties of p-cycle have been used to protect the nodes through same p-cycle available. Creating a new p-cycle always adds to the cost of the network. Whereas using replica of already existing p-cycle significantly reduces the network cost. The proposed technique has been implemented using network simulator in three phases. In first phase, study of already existing node p-cycle implementation has been carried out including simulation of global traffic in accordance to a country traces. Next phase, addresses the simulation of node p-cycle on dual link failed connection. In third phase, the proposed technique is applied by arranging the p-cycle replica which haven't added any additional cost in term of creation and defining the new p-cycle.

Keywords- p-cycle,WDM,mesh networks

I. INTRODUCTION

WDM mesh networks (WDMs) have been increasingly deployed and widely used for various purposes such as broadband Internet access or mobile telephony backhauling [1]. Compared to traditional single hop Wi-Fi networks, the WDM deployments are more flexible and self-configured. Adding more WDM mesh routers to form a WDM infrastructure can easily extend WDM coverage. WDM mesh routers can be further equipped with a gateway functionality to interface with a wired infrastructure, or with an access point functionality to serve as an ingress/egress point for mobile/WDM clients' traffic. Furthermore, with the decline in commodity 802.11 equipment costs, a node is likely to be equipped with multiple radios to simultaneously communicate over these radios using multiple orthogonal channels [2].

WDM optimizes network performance by using multiple radios and can provide gateways to the wired Internet and other WDM services. Due to its unique mesh structure, a WDM has an advantage over traditional MANET and WDM local area network in the areas of reliability, data throughput, ant jamming, and extensibility. WDM has been advocated as a cost-effective approach to support high-speed last mile connectivity and ubiquitous broadband access in the context of home network, enterprise networking, community networking, or metropolitan area network. The IEEE standard for mesh networking started as a Study Group of IEEE 802.11 in September 2003. [3]

Thus, when multiple stations are trying to send at the same time, the (shared) medium becomes contended and the network capacity decreases. Besides, in the case of multi-hop WDM networks, the network capacity becomes further limited because of the contention among nodes in the same path. In a multi-hop path, adjacent links cannot be active at the same time, and exposed nodes cannot be either because of the well-known exposed nodes problem [4].

P-Cycles are currently a genuinely understood plan with numerous fascinating and appealing properties. The first goal with traverse ensuring is proficient and quick insurance against single traverse disappointments. Truth be told, a typical misconception is that traverse-securing p-cycles offer no type of hub assurance. All the more effectively, since beginning, it has been understood that p-cycles do offer innately the same assurance to on-cycle ways crossing a fizzled hub, as does a BLSR ring as for ways in the ring. What has, be that as it may, stayed less clear is the means by which to secure ways that travel a hub on a p-cycle which have straddling relationship to the individual p-cycle. To secure these ways against hub disappointment too, there have been different expansions to this essential hub insurance property for p-cycles. One fundamental thought investigated for hub insurance with p-cycles is the "hub enclosing" standard concentrated on and created. A different profession mostly propelled by including hub security has prompted expansions of the entire p-cycle idea into way fragment or alleged "stream ensuring" p-cycles and to end-to-end way insurance with p-cycles.

II. RELATED STUDY

NirmalaY.Barkeret. al. in [1] explain that as an emerging technology, WDM mesh networks are making significant progress in the area of WDM networks in recent years. Routing in WDM Mesh Network is challenging because of the unpredictable variations of the WDM environment. Traditional mechanisms have been proved that the routing

performance would get deteriorated and ideal metrics must be explored. MewadaShivlal et al. in [2] explained that WDM mesh networks encompass a new area of technology set to play an important role in the next generation WDM mobile networks, and it is going to address the internet provision to user at low cost anytime from anywhere. WDM is characterized by dynamic self-organization, self-configuration and self-healing to enable flexible integration, quick deployment, easy maintenance, low costs, high scalability, and reliable services. Security of such a network has always been an issue. In this paper, authors have analyzed the fundamental security requirements of WDM and the challenges faced by it. We have also discussed the vulnerable features and possible active threats in WDM along with few defense mechanisms against such threats, including solutions to the problems of intrusion detection. This paper serves a baseline for developing a secured, full-proof WDM.

Dominic A. Schupke et.al.in [3],displayed a p-Cycle recuperation depends on an assurance exchanging convention. We detail a few issues for such a convention considering the development from ring systems to p-cycles. Specifically, we propose and assess a convention improvement to give intends to hub disappointment assurance. For the assessment, we depict a number direct program, which is connected to network plan contextual analyses, and figure accessibility models for p-cycles. The contextual analyses demonstrate that the convention upgrade enhances accessibility at minimal extra outline cost. Brigitte Jaumard et.al.in [4],propose another bland stream detailing for Failure-Independent Path-Protecting (FIPP) p-cycles subject to different disappointments. While our new model takes after the decay model detailing proposed by many authors on account of established shared way insurance, its inventiveness lies in its adjustment to FIPP p-cycles. At the point when adjusted to that last pre-arranged pre-cross associated insurance plot, the transmission capacity sharing imperatives must be taken care of contrastingly with a specific end goal to deal with the sharing along the FIPP p-cycles. It takes after that, rather than a polynomial-time resolvable valuing issue as in the model many studies, creators wind up with an a great deal more mind boggling evaluating issue, which has an exponential number of requirements because of some sub visit disposal limitations.

Hongsik Choi et.al.in [5],displayed network survivability is an essential necessity in fast optical systems. Run of the mill methodologies of giving survivability have considered the disappointment of a solitary segment, for example, a connection or a hub. In this paper, authors consider a disappointment model in which any two connections in the system may fall flat in a self-assertive request. Three loopback techniques for recouping from twofold connection disappointments are exhibited. The initial two techniques require the recognizable proof of the fizzled joins, while the third one doesn't. Nonetheless, pre figuring the reinforcement ways for the third strategy is more troublesome than for the initial two. Caroline at.el.in [6],explained that while the upsides of p-cycles and FIPP p-cycles are entrenched, there has been no efficient examination of the amount of data transmission they expend in correlation with the mutual connection or way insurance plans. It was additionally as of late watched that, notwithstanding counting countless is not as a matter of course an insurance for getting great quality arrangements with the established ILP models if apparatuses for expansive scale programming.

Brigitte Jaumard Sue et.al.in [7],explained that segment p-cycles offer an intriguing tradeoff between the established (connection) p-cycles and the way p-cycles (otherwise called FIPP p-cycles), acquiring most favorable circumstances of both p-cycle plans. In their unique structure, portion p-cycles don't offer 100% hub assurance, i.e., don't promise any insurance against hub disappointment for the endpoints of the sections. Joseph et al. in [8], purposed that in the course of recent years, systems have developed from being generally static with genuinely homogeneous activity to being more configurable and conveying a heterogeneous exhibit of administrations. As the applications are eventually the drivers of system advancement, the paper starts with a brief history of circuit, bundle, and wave administrations, alongside the improvement of the comparing transport layers. The exchange then moves to the development of system hub design, with an accentuation on the optical-electrical-optical and optical-sidestep ideal models.

Honghui Li et al. in [9] explained that Survivability is a vital element in the outline of WDM cross-section systems for nonstop administration conveyance on account of disappointments. Section p-cycles (otherwise called stream p-cycles) offer an intriguing assurance approach with a decent exchange off between security limit expense and recuperation speed. In this paper, authors propose another configuration strategy for section p-cycles taking into account an extensive scale-streamlining instrument, in particular segment era strategies (CG). Feng Zhang et al. in [10] explained the system survivability is critical to all today's and cutting edge fast mixed media transmission systems. Two essential methodologies for system survivability are security and rebuilding. The insurance technique ensures the full recuperation and quick speed, while rebuilding strategy may beat in asset use productivity. One of most critical late advancements in survivable system outline is the p-cycle insurance technique, with ring-like speed and work like effectiveness. Broad exploration contemplates have been done on p-cycle based connection assurance.

III. PROPOSED WORK

The proposed experimentation is started with briefing knowledge about WDM mesh network and the basic implementation of WDM mesh network in Network Simulator

version 2. We have used ubuntu operating system which is an open source operating system and provide tool command language and very suitable for coding and programming of network simulator. Network field is used as logical area with various sensing WDM mesh nodes and single sink.

In this research, we have focused on the avoidance of dual link failure by optimizing enhanced node p-cycles concept, which is the enhancement of original FIPP p-cyclescheme by replication method for p-cycle circle. Implementation of proposed work is done through network simulator in three phases.

1st Phase: This phase contains the study of already existing node p-cycle implementation including simulation of global traffic in accordance to a country traces so that scenario given in related paper [29] can be simulated.

2nd Phase: After simulation of node p-cycle, we have created a dual link connection and p-cycle on it so that we can show the issue of dual link failure.

3rd Phase: Proposed work is applied by arranging the p-cycle replica which haven't added any additional cost in term of creation and defining the new p-cycle. We used replica properties of p-cycle policy and process communication and protection of nodes through same p-cycle available. Difference between creating a new p-cycle and replica of already existing one is that newly built p-cycle use to add addition resource list which could include new policy according to nodes and area, weighting information of cycle and listing of cycle with updating all tables of p-cycle throughout the network.

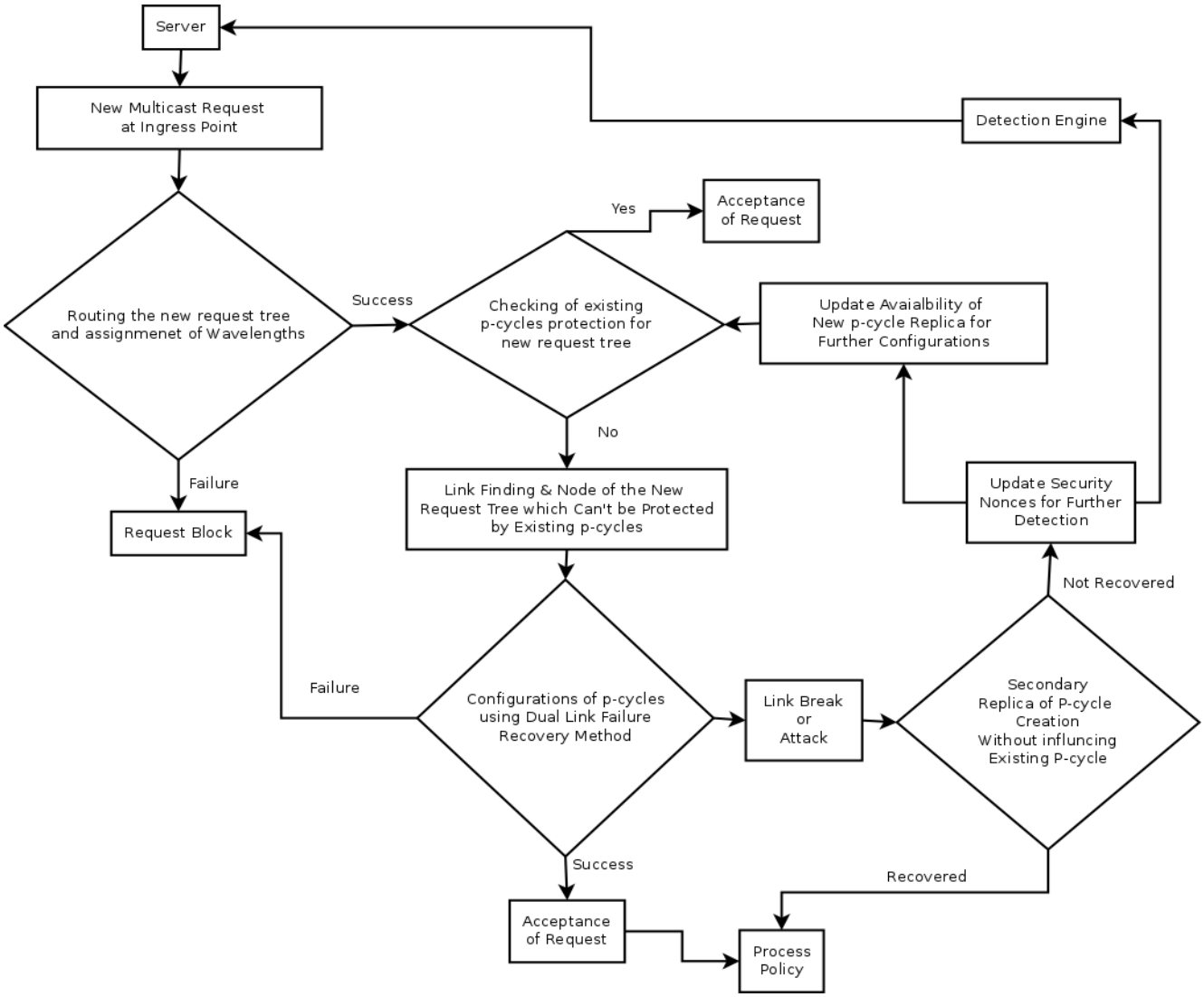

Fig.1: Flowchart for proposed work

This process use to take whole new resources and add up cost to overall network. But with addition of replica only added up updating the network without adding any weighting information, new policy creation and listing of cycle as these things are already taken care by primary p-cycle from which we have created replica p-cycle. Parameters like dual link failure restorability have been used for evaluation.

Once the optimal solution of the linear relaxation of an ILP model has been reached, the next step consists in computing an integer solution, ideally an optimal one. However, in order to guarantee reaching an optimal integer solution, dual link p-cycle method is used for recovering any kind of attack or link break condition in wavelength division multiplexing environment. It requires some effort in order to identify an efficient and scalable branching scheme so replica scheme for recovering is used by utilizing the available nonce for dual link scheme. Further, rounding up scheme is used. It consists in an iterative algorithm, which, at each iteration, selects the configuration variable with the largest fractional value, round it up, and set the variable to that rounded value. We estimate the bandwidth cost in two different ways, the number of link channels on the one hand, and the sum of the geographical distances of the links on the other hand, while assuming the cost to be proportional to these parameters.

IV. RESULT AND DISCUSSION

The proposed research focused on the eliminating any anomaly effecting the p-cycle secure communication from the WDM mesh network. We have started with WDM mesh network analysis under Network Simulator 2. We started with deployment of WDM mesh nodes in the field and unique keys are assigned to the WDM mesh nodes. Energy of the nodes is equal in the initial stage, which is fixed manually by administrator. The simulation randomly generates 5 points (used for limiting the simulation nodes for experimentation purposes) in the range of 10000 m×10000 m plane. The coordinate of the base station is decided. Cluster heads have been selected based on residual energy of the nodes. Nodes with higher residual energy are the candidates for cluster head selection. Node with highest residual energy becomes cluster head. Receive signal strength identifier is used to fetch cluster head and cluster information.

We have generated a secure p-cycle scheme in which base station is provided unique encrypted keys to the cluster head selected which is regenerated by base station after particular interval of time with fetching of history information from the nodes which use to store p-cycle communication. These bits, store the intermediate information of whole network processes in term of traffic travelling through p-cycle. Finally various analyses are obtained by comparing parameters like Capacity Redundancy, Dual Link Failure Restorability and Number of p-cycles.

Table 1 Parameters used for the experimentation

Parameters	Value
Simulator	NS2
Simulation Time	30 sec
No of Subnets	5 Logical subnets
No of Nodes per Autonomous System	5
Traffic Model	Optical
Pause Time	100 sec
Speed	20GBps
Number of Sources	2
Network Diameter	3 hops /km
Demands Working Cost	92
Node Degree	21
Link Length	400

After implementation of proposed optimized p-cycle mechanism, dual link communication is highlighted by network. These values are experimented for optimal values in accordance with simulator configuration and in accordance to values permitted for research.

CAPACITY REDUNDANCY

As expected, extra spare capacity is required by p-cycles for node protection compared with those providing only link protection for each network instance. Working paths are computed in such a way as to guarantee that they are of minimum length subject to the condition that there exists at least one potential protection path that is link and node disjoint with the working path.

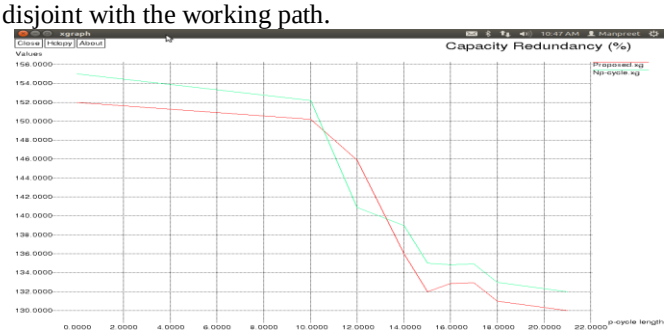

Fig.2: Comparison of Capacity Redundancy

X-axis represents the p-cycle length for communication under NS2 simulator and Y-axis represents the percentage of redundancy. Capacity Redundancy in proposed work is quite low as compared to previous NP-cycle communication. As expected, extra spare capacity is required by p-cycles for node protection compared with those providing only link protection for each network instance. As for node Np-cycle with hop metric, more bandwidth is required than proposed, while providing 100% protection against single link and node failures.

DUAL LINK RESTORABILITY

Dual link restorability is the parameter to provide exact view of the recovery of p-cycles in dual link communication in WDM meshes networks. We compared protection schemes with respect to the dual link failure restoration ratio, which is represented as dual link recovery ration over various network instances.

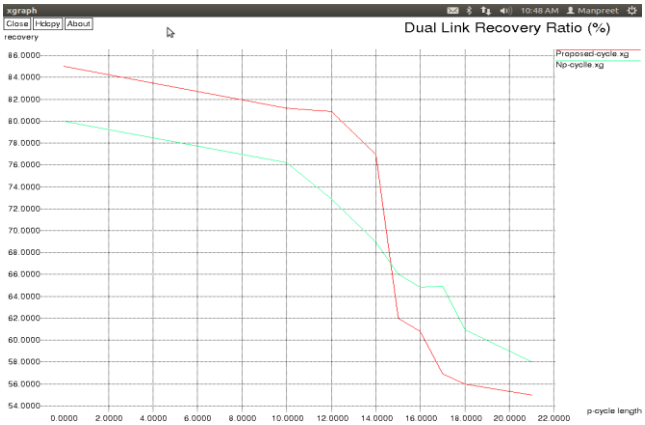

Fig.3: Proposed scheme and existing scheme in term of dual link restorability

X-axis represents the p-cycle length for communication under NS2 simulator and Y-axis represents the recovery communicated per second.

Recovery in our proposed work is better than the previous LP-cycle communication.One of the main processes which area one step better in our case is that proposed p-cycles provide long term advantage with 75% of total p-cycle length. Recovery reaches to high of 84% as compared to 74% in term of NP-cycle scheme**.**

NUMBER OF CYCLES

We next investigate further how the capacity efficiency of proposed p-cycles varies with the topology characteristics with change in number of cycles, and on which kind of topology proposed p-cycles can achieve better performance. Assuming norestrictiononthelengthofthe p-cycles, I n Figure 12,we present the number and length of the cycles in the optimal solutions of p-cycle.

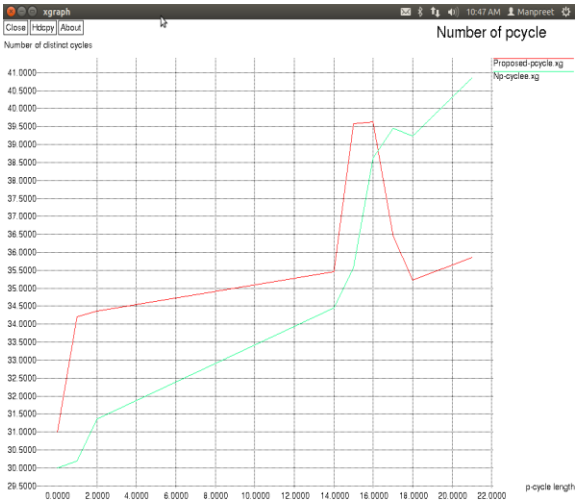

Fig.4: Comparison of proposed scheme with existing technique in term of number of p-cycles

Number of p-cycles in case of proposed work is less than LP-cycle communication .For the overall number of p-cycles, there is a sharp increase of their number as the length limit decreases, especially for the proposed p-cycles, which is a symbol of average management of number of cycles achieved overall.

The numerical results in the previous paragraphs have been obtained without any limitation on the p-cycle length (whether for link, node or path protection), as for most of the related studies in the literature. In opposition to a wild conviction that proposed p-cycles have leeway of limit effectiveness over p-cycles for connection and hub security, numerical results uncover that, in some system cases with elevated requirement deviation for the hub degree, p-cycles guaranteeing hub insurance hold practically identical limit proficiency as proposed p-cycles.

V. CONCLUSION

In this paper, we have studied the comparison of propose work and p-cycle-based schemes in WDM mesh networks for single link or node failures. It includes an enhanced node p-cycle scheme, which improves the first node p-cycle. Numerical results show that ensuring node protection in addition to link protection against a single failure is not significantly more costly in terms of spare capacity than for link protection against a single failure. Contrary to a wild belief that path p-cycles have an advantage of capacity efficiency over p-cycles for link and node protection, numerical results reveal that, in some network instances with high standard deviation for the node degree, p-cycles ensuring node protection hold comparable capacity efficiency as path p-cycles.

VI. REFERENCES

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