RESEARCH ARTICLE

Single Fault tolerance Method for Protection Data Flow in the MPLS Network

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Abstract: This paper presents efficient methods for rerouting traffic in the Multiprotocol Label Switching (MPLS) network, when a fault occurs in the working link. The proposed methods have been designed to handle single fault based on the protection switching and rerouting techniques. In this paper three algorithms are developed for fault recovery in the MPLS network based on ingress LSR, alert LSR and core LSR. The proposed methods have been simulated using the Network Simulator (NS2) and the simulation results show that the proposed methods significantly improve the network performance in comparison to similar existing methods.

Keywords: MPLS, Working link, Protection switching, Rerouting, Network simulator, TAP path.

1. Introduction

MPLS stands for Multiprotocol Label Switching. It is a famous networking technology belongs to the family of packet switching networks. MPLS had been designed to overcome the limitations of IP based forwarding. It uses labels which are attached to packets to forward them through the network [7- 9]. The MPLS technology improves QoS by defining Label Switching Paths (LSPs) that can meet Specific Service Level Agreements (SLAS) on traffic latency, jitter and packet loss[1, 2]. Several works related to routing traffic problem in MPLS network when a fault occurs in the working link have been reported [3-6]. Some of these works handle single fault [4-6] and others handle single or multiple fault [3]. Haskin's Method [6] provides a fast rerouting protection mechanism by pre-establishing the alternative LSP (FAP, First Alternative LSP) prior to the occurrence of a failure in the PWP (Primary Working Path). When the ingress LSR receives the first packet from the PBP (Primary Backward LSP) it switches traffic to the alternative LSP. The method provide a minimum packet loss but has a maximum packet disordering. Makam's Method [5], the authors have proposed a method that uses a fault indication signal (FIS) to convey the information about the occurrence of a fault on the original LSP. This method enhance the network performance by eliminate packet disordering but has a maximum packet loss. Hundessa's method [4], follows the principle given in [6] and the main objective of the paper is to avoid packet disorder and reduce the average traffic delay. Chandana's method [3], the authors have proposed a method based on the combination of the protection switching technique and rerouting technique,this method can handle single or multiple faults in MPLS network and achieves less recovery time, reduces packet loss and has high throughput.

The proposed method given in this paper can hand single fault that occur in the MPLS network that enhance network performance and has less space complexity in comparison to other methods. The paper is organized as follows: the proposed methods is given in Section 2, Section 3 show the simulation and results, and Section 4 includes the conclusions and feature works.

2. Proposed Method

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The proposed method is based on protection switching and rerouting approaches which the existing techniques are used for fault recovery in the MPLS network. On the Ingress LSR, protection switching is used to pre-establish the first alternative path (FAP) in advanced to carry the traffic when a fault occurs in PWP, and rerouting approach is only used to establish the second alternative path (SAP) on demand, that is when a fault occurs on FAP. On the Alert LSR (ALSR), rerouting approach is only used to establish a temporary alternative path (TAP) on demand that is when a fault occurs in PWP. Figures 1, 2 and 3 show the proposed algorithms on the Ingress LSR, Alert LSR and core LSR respectively.

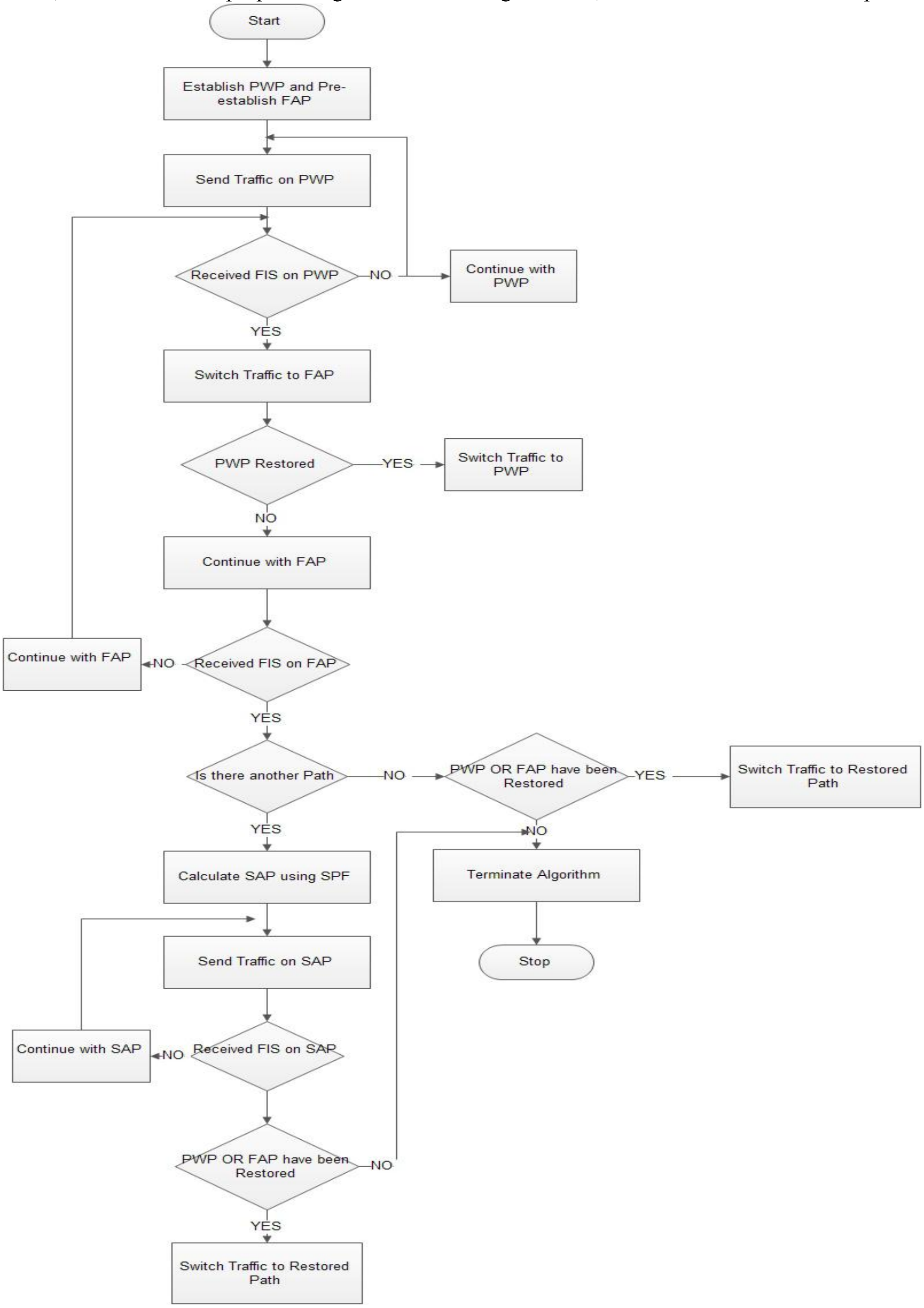

Figure 1. Flow Chart for proposed algorithm on the Ingress LSR

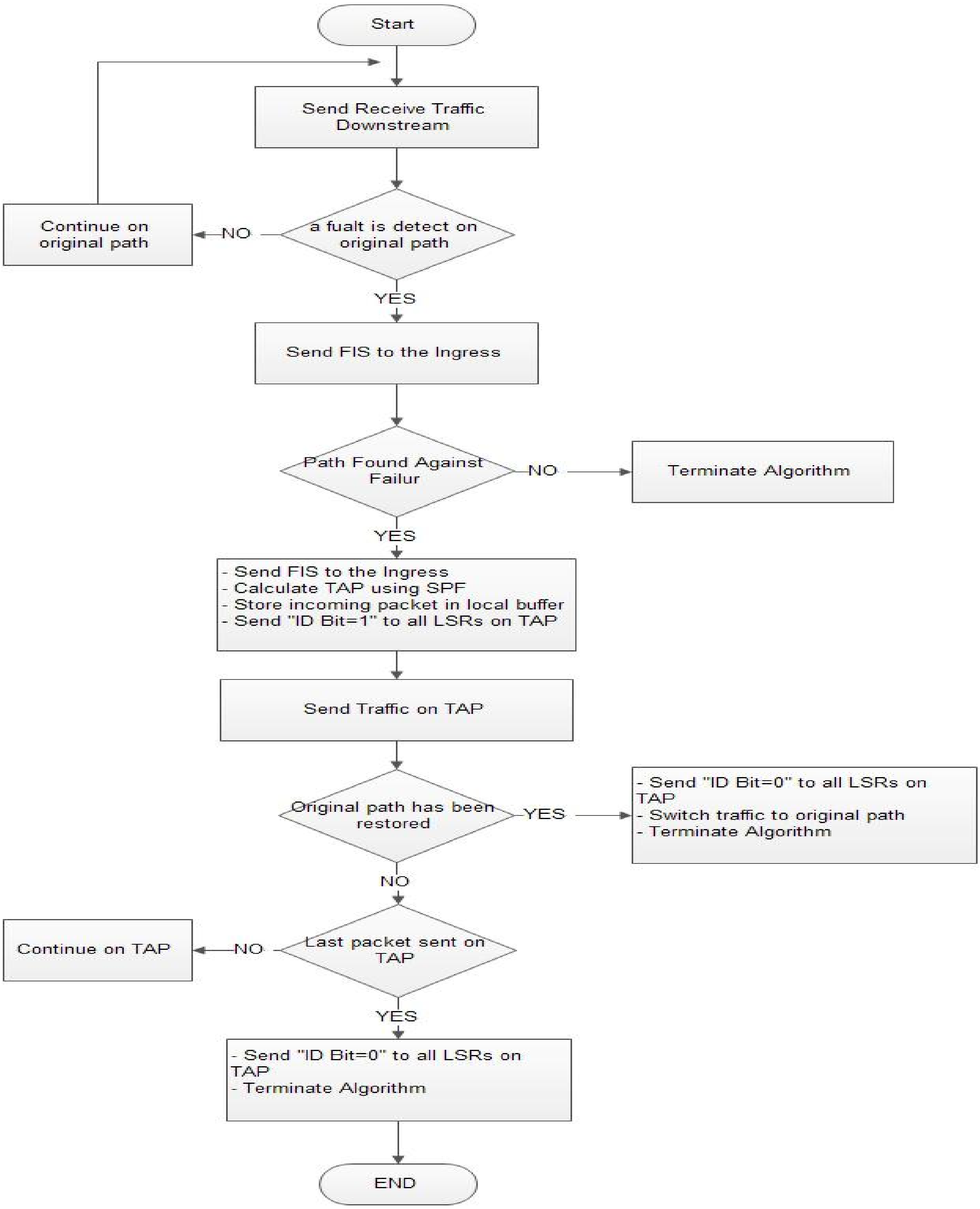

Figure 2. Flow Chart for proposed algorithm on the ALSR

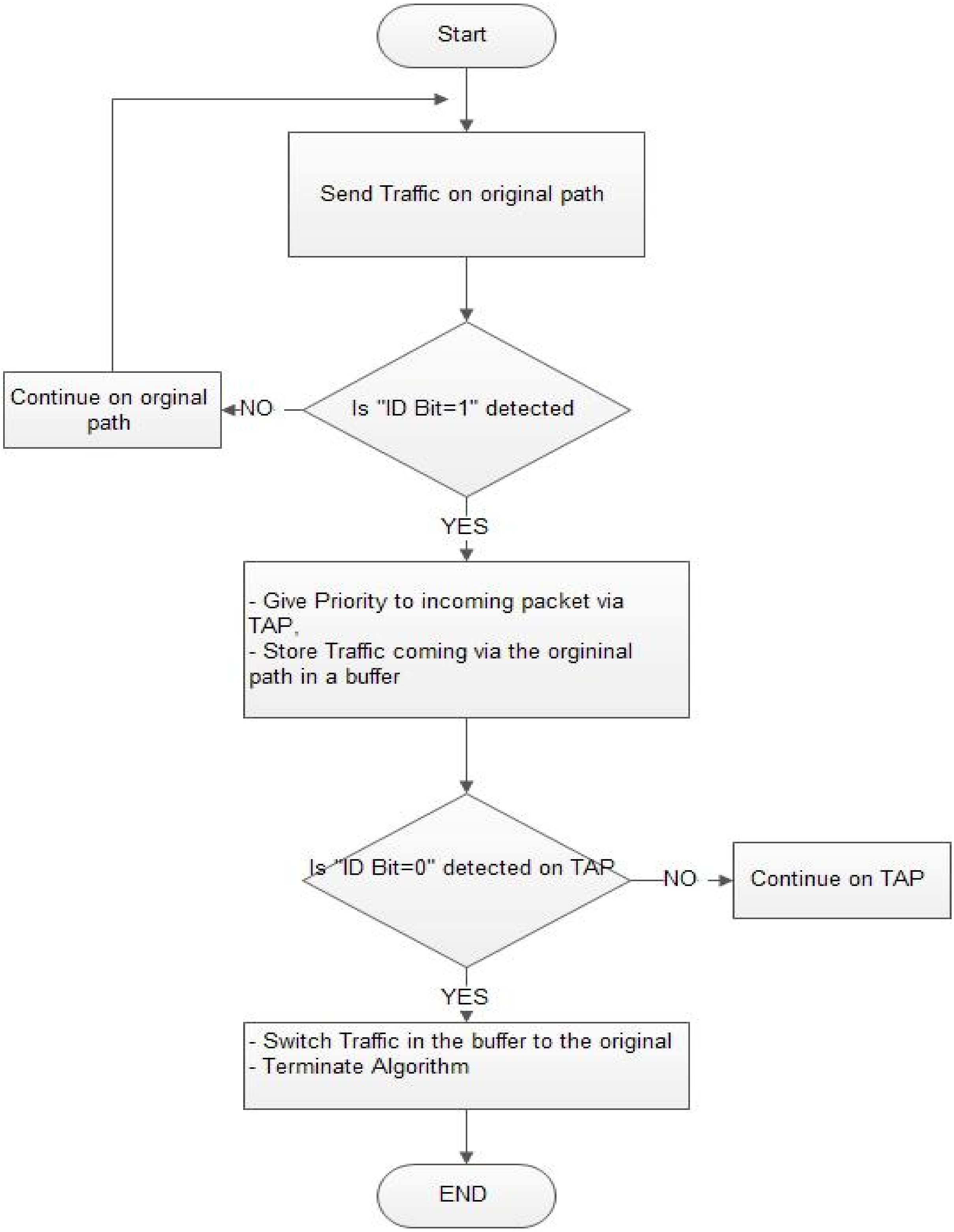

Figure 3. Flow Chart for proposed algorithm on the core LSR

3. Simulation and Results

In this section we will evaluate the results of the implementation of our proposed method for protection of data flow in MPLS network. The simulations are performed on Network Simulator (NS2) [10-12]. All links were set up as duplex with 10ms delay and using DropTail Queuing, which serves packets on First Come First Service (FCFS) basis. Also, the link have a bandwidth of 2Mbps and the types of the transmitted data in the network are multimedia. The simulation parameters used in three runs as shown in Table (1), and the simulated scenario is as shown in **Figure 4.**

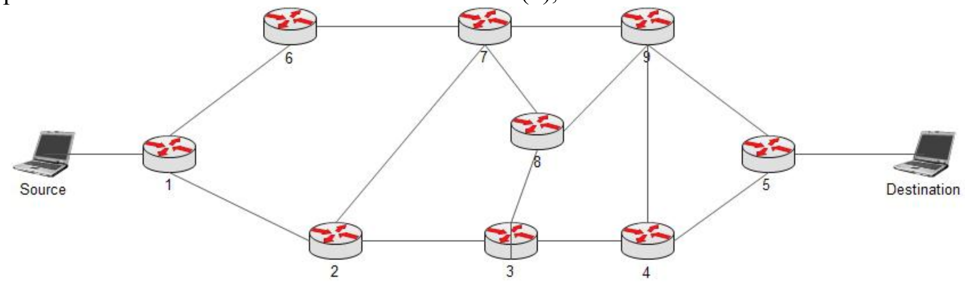

Figure 4. The network topology used in the simulation process

Parameter	Run 1	Run 2	Run 3
Simulator	Ns-2.34	Ns-2.34	Ns-2.34
Simulation Time	60 second	60 second	60 second
Packet Size	128 Bytes	256 Bytes	512 Bytes
Traffic Type	CBR (UDP)	CBR (UDP)	CBR (UDP)

Table 1. Simulation Parameters used in various Runs with Data Rate=400kbps and 1 Mbps

It is assumed that a fault occurs in PWP after 12 second. Figures 5, 7, 9 and 11 illustrate the results based on 400kbps data rate while figures 6,8,10 and 12 illustrate the results based on 1Mbps data rate.

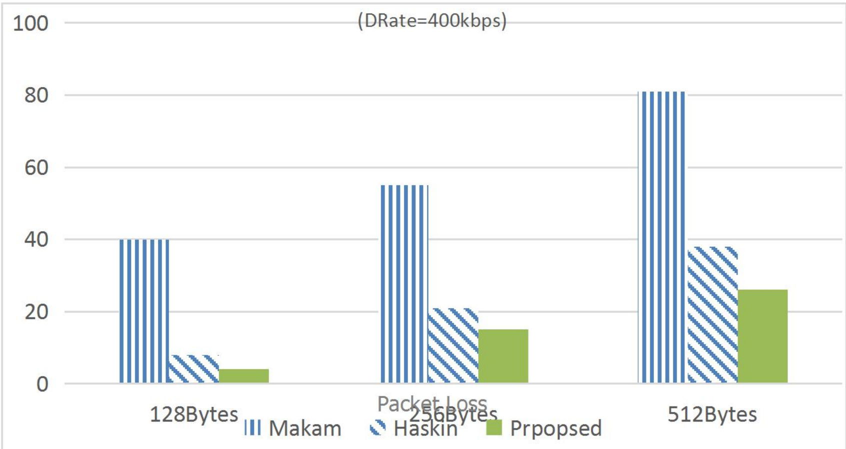

Figure 5. Packet loss versus packet size

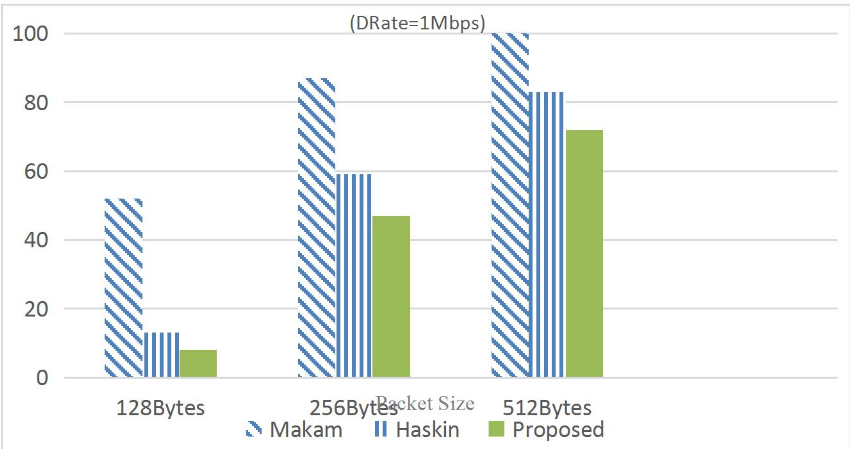

Figure 6. Packet loss versus packet size

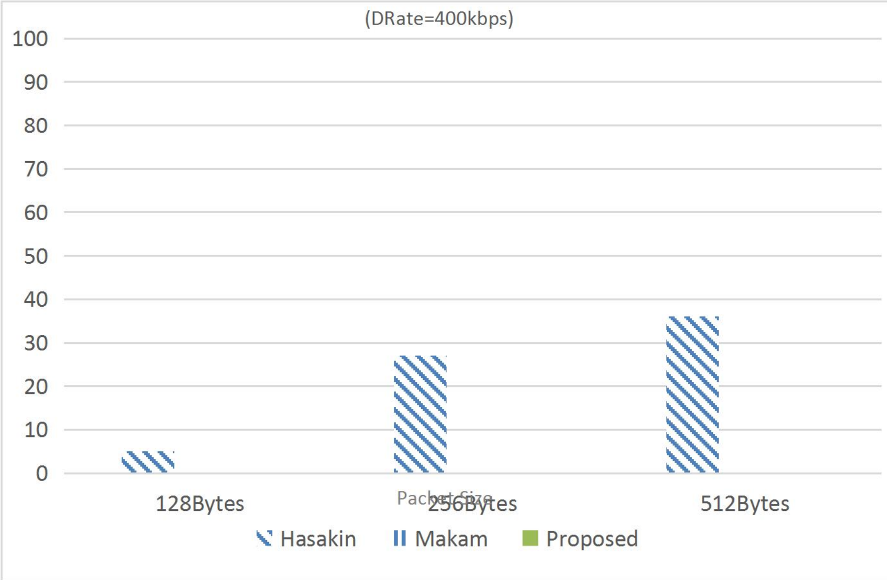

Figure 7. Packet disorder versus packet size

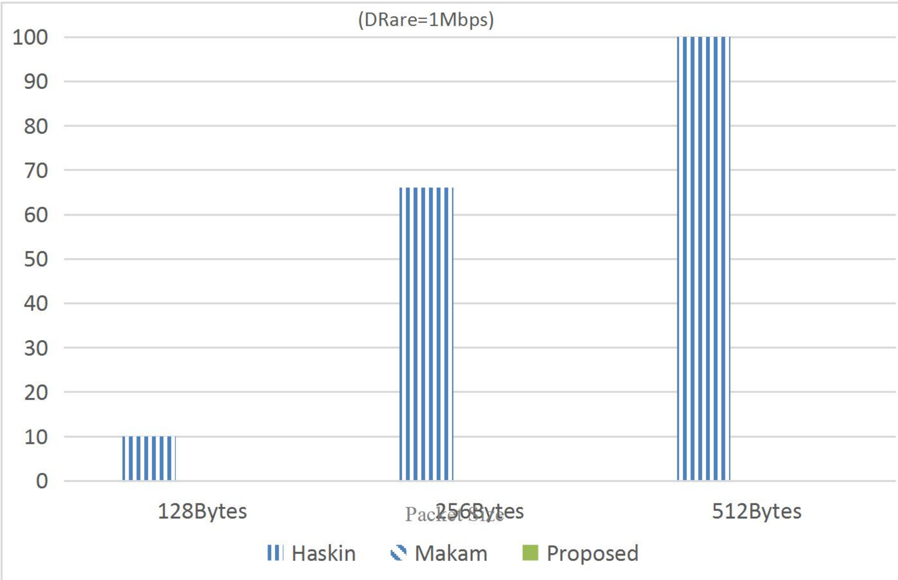

Figure 8. Packet disorder versus packet size

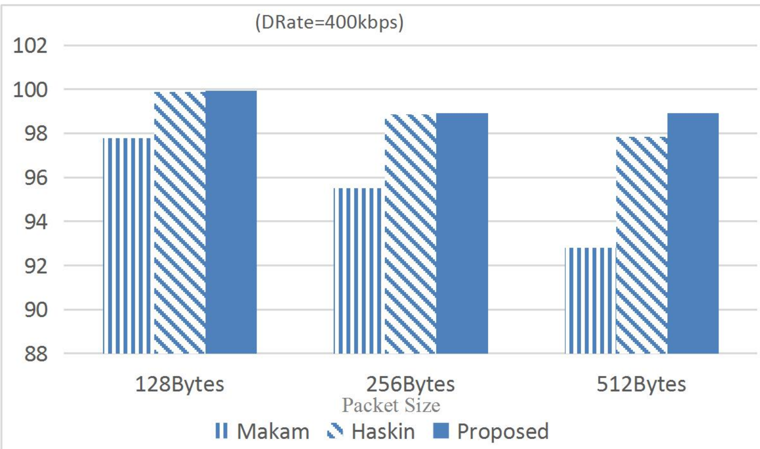

Figure 9. Packet delivery ratio versus packet size

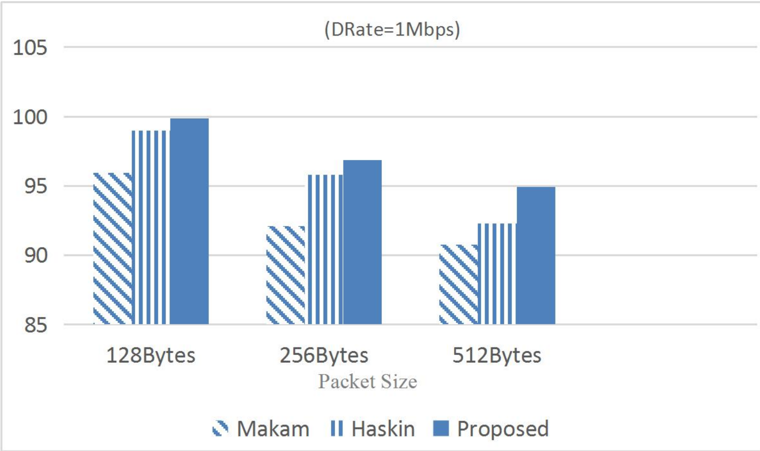

Figure 10. Packet delivery ratio versus packet size

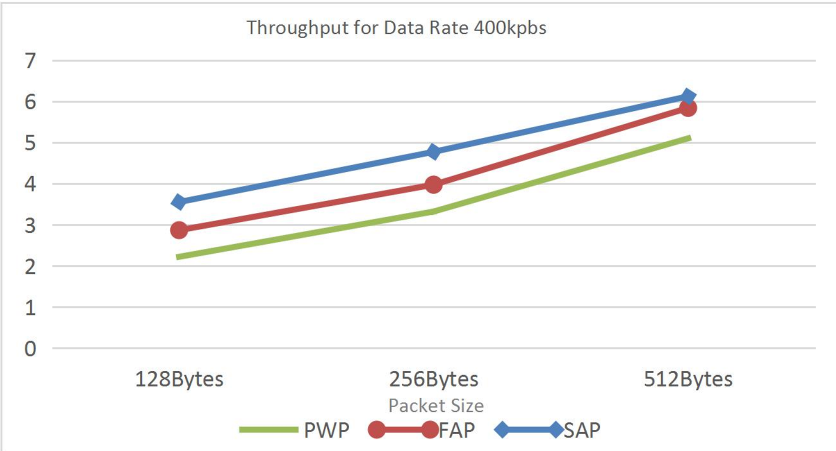

Figure 11. Throughput versus packet size

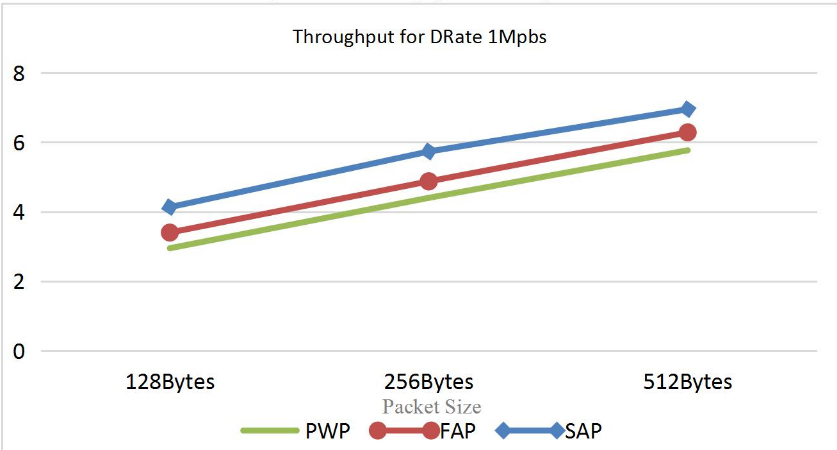

Figure 12. Throughput versus packet size

From the previous Figures 5- 12, a comparative analysis of the performance metrics will be given based on the results shown in the previous figures:

Packet Loss: It is very clear from the results shown in Figures 5 and 6 that the proposed method has less packets loss than Haskin's method and Makam's method under all packet sizes. Makam's method introduces more packets loss than Haskin's method.

Packet Disorder: It is clear from the results shown in Figures 7 and 8 that the proposed method avoids packets disordering as the case with Makam's method. While in Haskin's method, packets arriving from the reverse direction are mixed with the entering packets (incoming packets to the Ingress LSR) which results in packet disordering through the alternative LSP (FAP) during the restoration period. Also, in Haskin's method, packet disorder increases in proportion to the distance between the Ingress LSR and the alert LSR.

Packet Delivery Ratio: the packet delivery ratio is an important performance metric to ensure the arrival of received packets. **Figure 9** and 10 show that the PDR of the proposed method is better than the PDR of Makam's method and the PDR of Haskin's method. In other words, the proposed method gives more PDR than Makam's method and Haskin's method.

Throughput: Based on the results given in **Figure 11** and 12 one can see that the proposed method gives better throughput than Makam's method and Haskin's method. This is because increase in packets loss gives reduced throughput, but the proposed method has achieved better PDR and hence gives good throughput.

4. Conclusions and Feature works

The paper has presented methods to detect single faults in the MPLS network. The method is based on both protection switching and rerouting algorithms that used to reroute traffic in the MPLS network. The main motivation behind the work given in this paper is to obtain the reliable and efficient QoS routing methods for data in the MPLS network when failures occur in the network. The proposed methods avoid packet disorder, reduce packets loss, improve PDR and achieves good throughput, in addition the proposed method has less space complexity compared to other methods. An extension of the proposed method given in this paper is to work with failures occur at the same time in both node and link.

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