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Provides Unbreakable Security & Communication to the Users on VPN through Multiprotocol Label Switching Technology

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Abstract - Our main contribution in this paper is to provide users with everywhere communication capacity and information access regardless of location. The world is moving towards packet based transport network. Primarily because all of the applications and services that use these networks are packet based and packet based network is best for suited for carrying packets. For above purpose the Multiprotocol Label Switching is Use. Multiprotocol Label Switching is a technology for delivery of packet on a high speed backbone network that incorporates some of advantages of circuit-Switched communication system and packet –switched so as to produce a better performance than the normal IP routing.

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Abstract - Our main contribution in this paper is to provide users with everywhere communication capacity and information access regardless of location. The world is moving towards packet based transport network. Primarily because all of the applications and services that use these networks are packet based and packet based network is best for suited for carrying packets. For above purpose the Multiprotocol Label Switching is Use. Multiprotocol Label Switching is a technology for delivery of packet on a high speed backbone network that incorporates some of advantages of circuit-Switched communication system and packet –switched so as to produce a better performance than the normal IP routing.

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I. Introduction

Increasing demand of the Internet to carry more traffic in reliable manner and provide support for bandwidth guarantee, Quality of Services (QoS), it is important to have a high level of performance mechanism. Traffic Engineering is a process of mapping traffic demand on to the network by minimizing the resource utilization. Multi-Protocol Label Switching (MPLS) is a tool for network traffic engineering and hence is becoming the technology of choice for Internet backbone.

To forward packets MPLS employ labels, for each individual packet an independent and unique label is assigned as the packet passes through the network so that switching of packets can be performed. With these labels routing and switching of the packets is done in the network. Label is a short fixed length packet identifier which is used to identify the particular path. The basic idea of MPLS was developed long before and exits in the form of networking technologies like X.25, frame relay and ATM. As they are first one to be using the label switching technology in the networking world. Label switching technology was developed in mid 90's to enhance the quality of service and performance of network. This technology was used earlier by Lpsilon / Nokia (IP switching). Then IETF (Internet Engineering Task Force) standardized label switching technology and from here MPLS was emerged as a standardized label switching technology.

In MPLS label are used to make forwarding decisions i.e. labels are used to identify the particular path. So process switching is not in use. When the packet enters in MPLS network, layer-3 analysis is done and on the basis of layer 3 destination address label is assigned to each incoming packet. In MPLS network intermediate nodes are called Label Switched Router (LSRs), while other nodes that connect with IP routers or ATM switches are called Label Edge Router (LERs). Those router within MPLS domain that connects with the outside world, thorough which a packet enters the network are called ingress routes and the one through which the packets leaves the MPLS domain is called egress route. In MPLS the basic idea is to bind a label to a packet at the ingress router within the MPLS network and afterward can be applied to make forwarding decisions instead of looking up for the destination address at each point because the label define the fast and effective label switch path (LSP) to direct the traffic all the way to the destination.

Objectives of the MPLS:

- MPLS is a standardized network based technology, which uses labels to make forwarding decision with network layer routing in the control components.
- The objective is to provide a solution that MPLS provide integrated service model including RSVP and support operation, administration and maintenances facilities.
- MPLS must run over any link layer technology and support unicast and multicast forwarding.
- MPLS must be capable of dealing the ever growing demand of traffic onto the network and provide extending routing capabilities more than just destination based forwarding.
- Along with reduced cost and offers new revenue generating customer's services in addition with providing high quality of base services.

a) Architecture of MPLS

Multiprotocol Label Switching (MPLS) is a tunneling technology used in many service provider networks. The most popular MPLS-enabled application

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in use today is the MPLS virtual private network. MPLS VPNs were developed to operate over MPLS networks, but they can also run over native IP networks. This offers providers flexibility in network deployment choices, improved routing system scalability and greater reach to customers. The key element is the ability to encapsulate MPLS packets in IP tunnels. In an MPLS network, each LSP is created over the best path selected by the IGP, towards the destination network. An IGP (OSPF or IS-IS) is used to propagate routing information to all routers in an MPLS domain to determine the best path to specific destination networks. Each hop within the network core forwards packet based on the label, not IP information, until the final label switch is reached where the label is discarded and normal IP forwarding resumes.

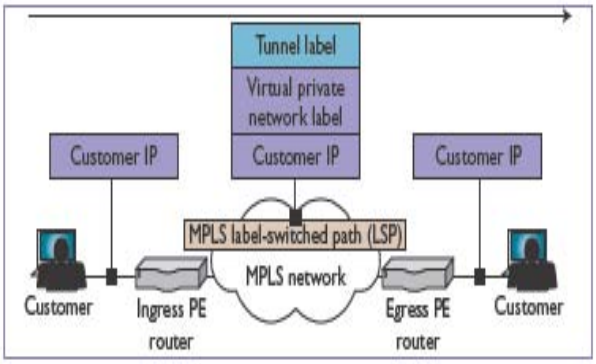

Fig.1 : MPLS Tunneling Architecture

b) Working of MPLS

In MPLS the transportation of data occurs on label switched path and protocols are used to establish LSPs in order to pass information among the LSRs. These LSRs are responsible for performing switching and routing of packets according to the label assigned to them. In MPLS header label is bind to a packet, altogether making a label stack. Packets are switched using label without looking into IP table. The route traversed by a packet within MPLS network between ingress and egress nodes while passing through the intermediate LSRs is called Label Switched Path (LSP).

A label-switched path (LSP) is a path through an MPLS network, set up by a signaling protocol such as LDP, RSVP-TE or CR-LDP. These LSPs form a logical network on a regular physical network and guarantee connection-oriented processing over the connection less IP networks. Each MPLS packets has a header that consist of 4 fields, a 20-bit label value field, 3-bit for class of service field,1-bit label stack (bottom of stack flag).if set will indicate that the current label is the last label in the stack and the 8-bit time to live field (TTL). Entry and exit point with in an MPLS networks are called label edge router where as label switch routers are within an MPLS networks. They Examines only the MPLS header containing the label and forward the packet no matter what ever the underline protocol is. Each LER maintain a special database for destination address to label the packet when a packet enters MPLS network.

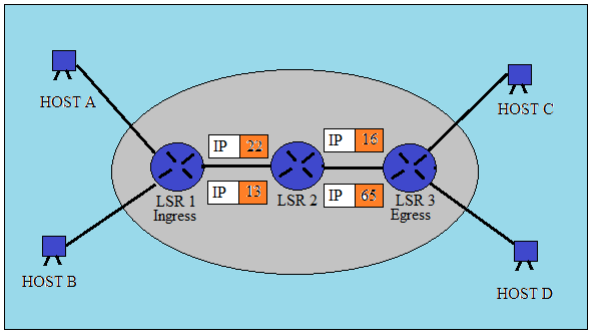

Figure 2.1 : Label Switched Path in an MPLS enabled network

When fault occurs in LSP, due to failure of link or node in the network, the carried traffic in failed LSP has to be transmitted through the backup LSP and the selection of backup LSP is based on the following criteria:

- Reducing the request blocking probability
- Minimizing cost of network
- Load balancing

i. *Reducing request blocking probability*

The major task of traffic engineering is to reduce the request blocking probability, to make sure that maximum numbers of requests are accepted in the network, in order to improve operator revenues and increase client satisfaction. Minimum Interference Routing Algorithm (MIRA) is one of the best algorithms for constraint based routing which reduces the request blocking probability. The basic concept of MIRA is based on the relationship between the maximum flow value between two nodes and the bandwidth (that can be routed between nodes). In MIRA critical links are the links, which cause a decrease in maximum flow values between pair of nodes. Therefore, weights are allocated to the links according to their criticality. In the end a shortest path- like algorithm is used to evaluate the path with minimum critical links. But MIRA suffers from computational complexity problem, as this algorithm frequently computes maximum flow.

ii. *Minimizing costs of network*

To accomplish a minimum cost of network, metrics like minimum hop count or link costs, have been conventionally included in routing algorithms. In order to minimize the cost of network many algorithms are proposed, for example Minimum hop algorithm. Moreover, many other algorithms are proposed to make improvement in Minimum hop algorithm. Minimum hop algorithms are easy and computationally proficient. But in case of heavily loaded network, they give worse result in terms of request refusal ratio. Link cost corresponds to the physical link length, so they are used in algorithms mainly for traffic engineering and they have no huge influence in networking architectures.

iii. *Load balancing*

In network, load balancing plays an important role to decrease congestion. The basic concept of load balancing is to distribute load in such a way that improves the overall performance of network. But in lightly loaded network load balancing shows bad performance, for example routing packets on longer paths.

iv. *MIRA, Minimizing cost of network and Load Balancing*

In this approach three criteria (Load Balancing, MIRA and Minimizing cost of network) are used to calculate the path for the affected traffic. But this approach suffers from the problem computational overhead, because this approach computes all the three criteria throughout the process of packet forwarding.

II. Proposed Solution

Our proposed solution closely relates the integrated solution In order to compute backup path by using above three criteria, the main challenge is to define the optimal weighting (W_1, W_2, W_3) for each element in the cost function given by (Eq. 1). Initially, the weight connected with MinHop should be increased, in order to show, its good performance under lightly loaded network. Therefore equation2 shows, weight (W_1) is inversely proportional to the total network load. So it can be that, weight (W_1) is predominant under lightly loaded network and it starts to decrease as the total network load increases to reach the total network capacity. Next, Minimum Interference Routing Algorithm (MIRA) comes into play, when links criticality is changing (links are getting rapidly loaded). So we see in equation 2 weight (W_2) is directly proportional to the network load. Finally, in equation 3 a new parameter for the load metric element that will control load balancing influence in the overall cost function by limiting its undesirable effects under light load. Moreover, constants a, b and c are used in order to scale the numeric values to a comparable range.

$$Cost(e) = W_1 + W_2 \times criticality(e) + W_3 \times load(e) \quad (1)$$

$$W_1 = a \times \frac{total\_cap}{total\_load}\ ;\ W_2 = 16 \times b \times \frac{total\_load}{total\_cap}\ ;\ W_3 = c \quad (2)$$

$$load(e) = f(x) = \begin{cases} 0 & if\ load(e) < threshold = cap(e)/3 \\ \frac{reserved\ \ bandwidt\ \ h(e)}{cap\,(e)} & otherwise \end{cases} \quad (3)$$

In simulation, we can see that the performance of the method is good in overall situation. The request blocking probability of the proposed scheme is comparable with MIRA results. The load standard deviation values are comparable with values for load balancing under light load. Under high load, the proposed scheme achieves performance bounded by load balancing (upper standard deviation) and MIRA (lower standard deviation) due to the equally combined effect of these algorithms. Finally, we see the influence of the MinHop element under light load; the integrating solution has good performance compared to MinHop. Therefore, these results justify our weighting approach. Even with a set of intuitive weights, we show the relevancy of the three objectives, and the benefit of their combination.

In our proposed solution, we use three criteria (Load Balancing, MIRA and Minimizing cost of network) to compute the backup path based on the below conditions but not all at a time since this increases the complexity of the algorithm as done in main heading Simulation model in 3:

- We compute backup path on the basis of Minhop algorithm, only if the total load is less than or equal to 25% of the total network capacity, because Minhop algorithm gives good result under light load.
- We are using MIRA algorithm to compute the backup path only if total load is greater than 25% and less than 75% of the of total network capacity.
- Load balancing is used to compute the backup path for the affected traffic if total load is greater than 75% of the of total network capacity.

III. Simulation Model

Model:

G = (V,E) is a directed graph representing the network with:

V is the set of vertices (MPLS router)

E is the set of edges

Action

Determine the optimal set of binary variable x(e) and y(e) that:

$$Minimize\colon \sum_{e\epsilon E} cost(e) * [x(e) + y(e)] \quad (4)$$

$$\text{Subject to: } \sum_{e\epsilon out\,(v)}[x(e) - y(e)] - \sum_{e\epsilon In\,(v)}[x(e) - y(e)] = \varepsilon(v) \quad for\ v\epsilon V \quad (5)$$

$$[x(e) + y(e)] \times [load(e) + b] \leq cap(e)\ for\ e\epsilon E \quad (6)$$

With:

$$\varepsilon(v) = \begin{cases} +1 & v = O \\ -1 & v = D \\ 0 & v \neq \{O, D\} \end{cases}$$

$$\text{cost(e)} = \begin{cases} 1 & Min-hop \\ len\,(e) & Minlen \\ \frac{load\,(e)}{cap\,(e)} & load\ balancing \\ criticalty(e) & MIRA \end{cases} \quad (7)$$

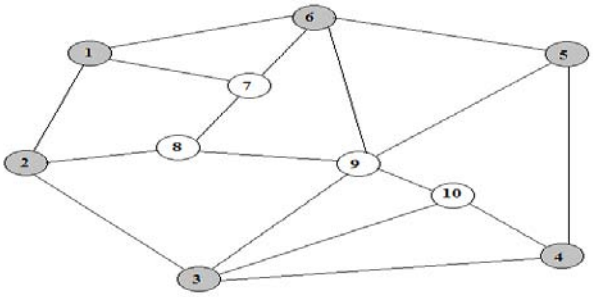

Figure 3 : Network Topology

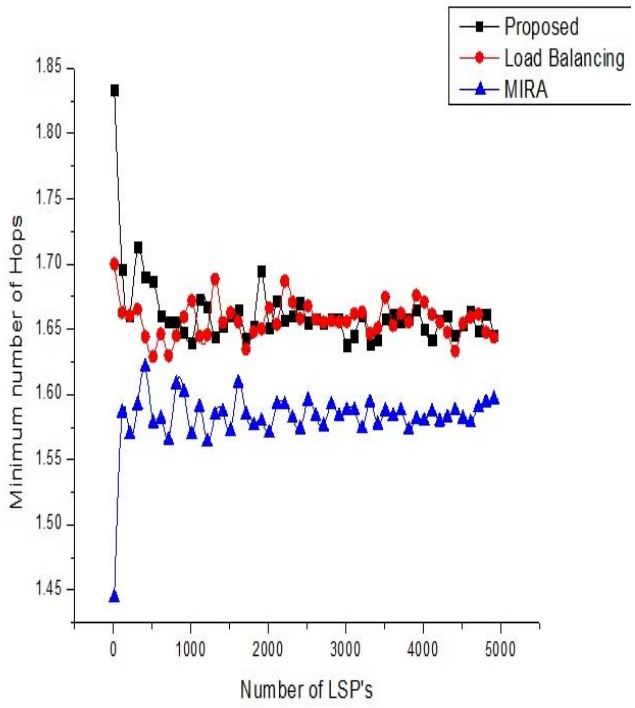

Fig. 3.1 : Blocking Probability

In figures 2.1, we can see that the performance of our proposed method is good in overall situation. The blocking probability (Fig. 3.1) of the proposed scheme is comparable with MIRA results. The load standard deviation (Fig. 3.2) values are comparable with values for load balancing under light load. Under high load, the proposed scheme achieves performance bounded by load balancing (upper standard deviation) and MIRA (lower standard deviation) due to the equally combined effect of these algorithms.

IV. Conclusion

In this paper, we examine that Multiprotocol Label Switching Technology is used for : request reducing blocking probability, minimizing cost of network, and load balancing.

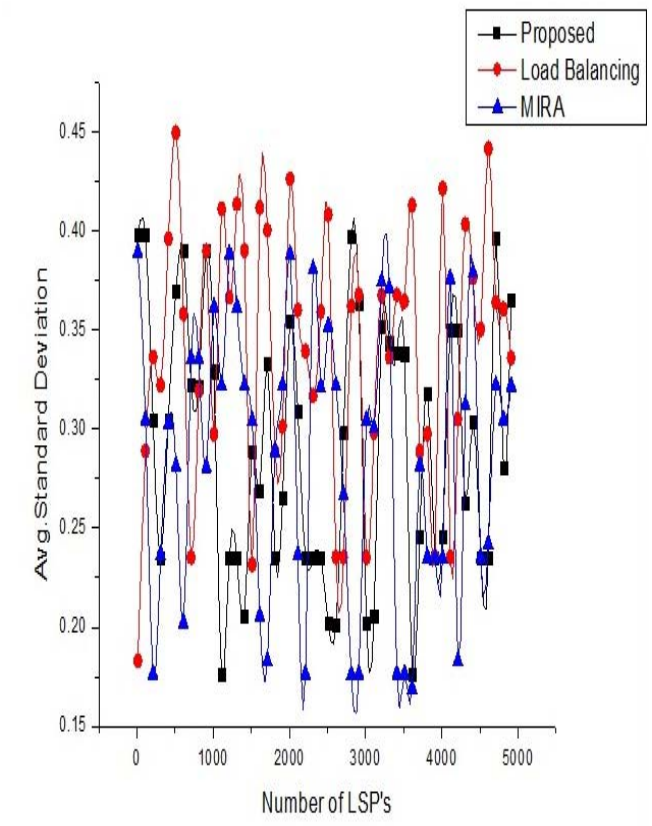

Figure 3.2 : Load Standard Deviation

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