Global Scientific JOURNALS

GSJ: Volume 5, Issue 12, December 2017, Online: ISSN 2320-9186
www.globalscientificjournal.com

MULTIPROTOCOL LABEL SWITCHING: REIVEW

KAISER ALI BHAT
kaiserali21@gmail.com
M.Tech Cyber Security
Centre for Computer Science and Technology
Central University of Punjab, Bathinda (Punjab)

Abstract: *The paper discusses the mechanics of using Multiprotocol Label Switching (MPLS) to enable scalability and creating end-to-end networks across any kind of transport medium using any protocol. MPLS eliminates the dependence of OSI model data link layer technologies like ATM, Frame Relay or Ethernet .MPLS is used in the backbone network to facilitate the virtual private networks, quality of service, traffic engineering. This paper presents a detailed overview on MPLS, its architectural terminology, working, services and applications.*

Key terms: MPLS, TE, VPN, Label, IP, LDP

I. Introduction

Traditional routing protocols are used to distribute information on the devices. The forwarding of data packets is based on the destination address only, Policy Based Routing (PBR) being the only exception which bypasses the destination based routing lookup. Lookups are performed on every router; each router makes independent decision to forward the packets.

MPLS uses a new switching technique that uses labels or numbers to forward the packets. MPLS works in between OSI data link layer and network layer and the label switching is performed regardless of L3 protocol. Since MPLS works with other protocol stacks like IP (internet protocol), Asynchronous Transfer Mode (ATM), Frame Relay, Ethernets, Token rings, digital subscriber line (DSL) etc.MPLS also supports Traffic Engineering ,traffic engineered tunnels are created based on traffic analysis which provides load balancing across the unequal paths of the network. Traffic engineering determines the path at the source based on some additional parameters i.e. available resources and network constraints, QoS etc.

II. MPLS architecture

The working of MPLS router is broadly divided into two parts:

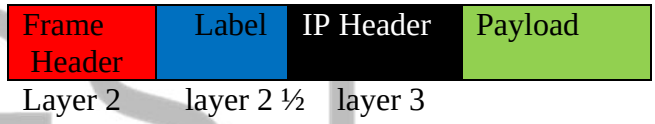
- **Control plane:** It takes care of information (OSPF, BGP, EIGRP, etc) and label exchange (tag distribution protocol, label distribution protocol) between adjacent nodes.
- **Data plane:** looks for forwarding of packets either based on destination address or label.

MPLS works in either frame mode (a 32-bit label is inserted between L2 and L3 headers) or cell mode (uses the ATM header as label).

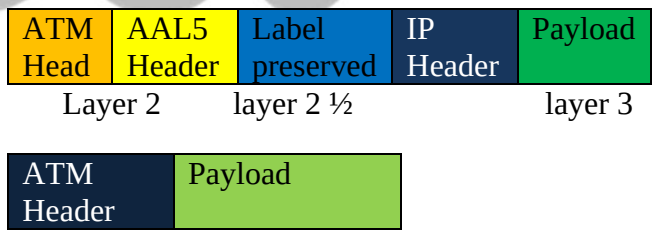
The following functions are performed by the edge router:-

- Routing lookup for outgoing interfaces
- Label assigned is inserted between L2 frame header and packet header if outgoing interface is enabled for MPLS and next hop for destination address.
- Labelled packet is sent.

(a) Frame Mode MPLS



(b)Cell Mode MPLS



Figur.1 Cell &Frame mode MPLS

In cell-mode ATM header's VPI/VCI field is used for forwarding decisions while 32 -bit label is still preserved.

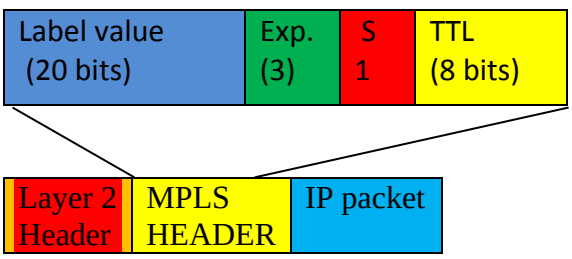
III. MPLS Terminology

- **LSR:** LSR is a device that forwards packets based on some label.
- **Edge LSR:** Edge LSR is a device that labels packets or removes the labels.

LSR and Edge LSR are devices that perform the function of both label switching and IP

routing. The position in the MPLS domain specifies their name. Router that has all the interfaces enabled for MPLS is called LSR while the router that has some interfaces which are not enabled for MPLS is called Edge LSR, as they are on the edge of an MPLS domain. Edge LSR routers also forward packets based on IP destination address and label them if outgoing interface is MPLS enabled.

- **ATM LSR:** All interfaces are enabled for MPLS and forwarding is done of cells only based on labels
- **ATM Edge LSR:** are routers connected to an MPLS enabled ATM network; some interfaces are traditional IP interfaces. The packets are segmented into cells and forwarded into MPLS domain on cell –mode MPLS enabled interfaces and cell traffic in other direction is reassembled into packets.
- **Label:** MPLS uses a 32 bit label that contains the following:
- **A 20 bit field**: This is the actual label and changes on every hop;
- **3 bit experimental field**: That defines class of service by reflecting the IP precedence of the encapsulated IP packet.
- Bottom of stack bit used to determine if this is a last label in the packet, this bit is set to 1 in the last label in the packet. **8 bit time to live (TTL):** this has the same purpose as in the IP header; it is decreased on every hop.



Figur.2 MPLS 32 bit Header

A label does not carry any information about L3 protocol being carried in a packet and a new protocol identifier is used for every MPLS enabled L3 protocol. The following values are used to determine the identity of L3 protocols with most of the L2 encapsulations:

- **Unlabelled IP unicast:** PID=0X0800 identifies that payload is an IP packet.
- **Labelled IP unicast:** PID =0X8847 identifies that frame payload is a unicast IP packet with at least one label preceding the IP header; the bottom of bit indicates when the IP header actually starts.
- **Labelled IP multicast:** PID=0X8848 identifies that the frame payload is a multicast IP packet with at least one label preceding the IP header, the bottom of the bit indicates when the IP header actually starts.

A router that receives the frame where the PID indicates that it is labelled packet uses only top label in stack for forwarding decisions.

- **LSP:** It refers to label switched path and defines a unidirectional tunnel between a pair of routers on an MPLS network
- **LER:** It refers to label edge router (ingress router), encapsulates the packet inside an MPLS LSP for initial path selection.
- **LSC:** It refers to label switch controller, provides the label information when an LSR communicates with an ATM switch.
- **LDP:** It refers to label distribution protocol; it is one of the primary

signalling protocols for distributing labels in MPLS network, has a set of procedures and messages by which label switched routers (LSR) establish label switched path(LSP) through a network by mapping network layer routing information directly on to data link layer switched paths. With the help of LDP LSR collects, distributes and release label binding information to other LSRs in the MPLS network and hence enabling hop- by –hop delivery of packets along the routed paths.

- **FEC:** It refers to forwarding equivalence class .It is a group of IP packets that are forwarded in the same manner such as same destination, same path and same class of service. An LSP is assigned to each FEC that is defined using IP interior protocols such as OSPF.

IV. MPLS APPLICATIONS

Regardless of the application, the functionality is split into control field and data field. MPLS has important applications discussed as follows:

I. Unicast IP Routing: Unicast IP routing requires two components:

- IP Routing protocol such as OSPF, EIGRP, IS-IS, etc.
- Label exchange protocol such as TDP or LDP.

A Routing protocol carries the information about the access of the networks While Label distribution protocol binds labels to networks via networking protocol.FEC corresponds to destination network stored in the routing table.

II. Multicast IP Routing: A dedicated protocol is not required to support multicast traffic across MPLS domain.PIM ( ) version 2 with extensions for MPLS is used to propagate routing information as well as labels.FEC is equal to destination multicast address stored in multicast routing table.

III. MPLS Traffic engineering (TE): Traffic engineering requires OSPF and IS-IS with extensions for MPLS –TE as the internal gateway protocol (IGP).OSPF and IS-IS with extensions hold the entire topology in their databases and with some extra information about network resources and constraints. RSVP or CR-LDP are used for establishing TE tunnels and propagate labels.

IV. Quality of service (QoS): QoS is an extension to unicast IP routing that provide differentiated services .This is achieved by using MPLS experimental bits or by creating separate LSPs for different classes and extensions to TDP or LDP are used to create different LSPs and propagate different classes.FEC corresponds to combination of destination network and the class of service.

V. VPN: MPLS VPNs use an additional label to determine the VPN and the corresponding destination network.BGP with multi protocol extensions is used to propagate VPN routing information and labels across the MPLS domain assigned through LDP or TDP.FEC is equal to a VPN destination network.

VI. AToM: AToM forwards L2 frames or cells across an MPLS backbone network**.** Ethernet Frame Relay, High level data link control or point to point (HLDC/PPP) frames or cells are received by ingress router, L2 frames are MPLS encapsulated and assigned a stack of two labels. The top most labels directs the frame to egress edge LSR and the second label indicate the outgoing interface on the egress

edge LSR .FEC corresponds to outgoing interface.

Conclusion: MPLS was specifically designed for combining intelligence and performance of switching to address the need for a highly scalable delivery of value added IP services. The innovative label based system simplifies IP traffic routing in complex networks without manipulating the IP packets. This paper highlights the technological standards involved in MPLS implementation and mechanism of packet forwarding in an efficient manner**.**

References:

1. E. Rosen A. Viswanathan and R.Callon "Multiprotocol Label Switching Architecture" Internet draft Aug 1999.
2. E. Rosen and Y. Rekhter "BGP/MPLS VPN", RFC 2547, March 1999
3. S. Alouneh , S.Abed,M Kharbutli,B.J.Mohd, "MPLS Technology in wireless networks",2013,Springer
4. D.Bella, R Sperber, "MPLS-TP the new technology for packet networks", white paper
5. S.Smith , "Introduction to MPLS",2003,Cisco press article
6. P.Brittain, A.Farrel , "MPLS Virtual Private Networks" 2000
7. H.Tarmura, S.Nakazawa,K.Kawhara,Y.Oie, "Performance Analysis for QoS Provisioning in MPLS"2004,Kluwer Academic Publisher
8. T.Li, G.Swallow and D.Awduche, "IGP requirements for Traffic Engineering with MPLS,"internet draft, Feb.1999
9." Implementing Cisco MPLS ,(MPLS)V2.1",2002 ,Cisco Press
10. W.Yufeng,W.Wendong,C.Shiduan, "Supporting MPLS-VPN Multicast", 2004,Journal of Electronics vol 21no 1
11. "Traffic Engineering with MPLS in the internet",Xipeng Xiao,Alan Hannan,Brook Bailey
12. Divya Sharma ,Renu Singla "A Detail Review on MPLS" International Journal of Engineering Research and General Science volume 3, March-April 2015