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Use Cases of MPLS Global Label
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Abstract

As the SDN(Service-Driven Network) technology develops, MPLS global label has been proposed for new solutions. The document proposes possible use cases of MPLS global label. In these use cases MPLS global label can be used as identification of the location, the service and the network in different application scenarios.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

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1. Introduction

Currently MPLS label always has local meaning. That is, MPLS label is always allocated by the downstream node to the upstream node and the meaning of the MPLS label is only understood by the neighboring upstream node and downstream node. As the SDN concept is introduced, the MPLS global label mechanism are being proposed for new solutions based on the label binding which should be understood by all nodes or part of nodes in the network. This document proposes possible use cases for MPLS global label which can be used as identification of

the location, the service and the network in different application scenarios.

2. Terminology

BUM: Broadcast, Unknown unicast, or Multicast

B-MAC: Backbone MAC Address

CE: Customer Edge

C-MAC: Customer/Client MAC Address

DF: Designated Forwarder

ES: Ethernet Segment

EVPN: Ethernet VPN

ICCP: Inter-chassis Communication Protocol

MP2MP: Multi-Point to Multi-Point

MP2P: Multi-Point to Point

MVPN: Multicast VPN

PBB: Provider Backbone Bridge

P2MP: Point to Multi-Point

P2P: Point to Point

PE: Provider Edge

S-EVPN: Segment-based EVPN

3. Use Cases

3.1. Identification of Location

3.1.1. VPLS Multicast over MP2MP LSP

[I-D.ietf-l2vpn-vpls-mcast] defines the VPLS multicast mechanism only based on P2MP LSPs. In this case BUM (Broadcast, Unknown unicast, or Multicast) traffic SHOULD be transported uniformly through P2MP LSPs. If MP2MP LSP is introduced to transport BUM traffic, there exists issue for unknown unicast traffic. VPLS needs to learn MAC address through broadcast or multicast of unknown unicast traffic. PEs of a specific VSI can learn the source PE of the MAC address according to the P2MP LSP which transports the unknown unicast traffic. If unknown unicast traffic is transported by the MP2MP LSPEV, the MAC can be learned, but the source PE for the MAC cannot be determined since there is no determined root node for the MP2MP LSP. So if the MP2MP LSP is used it has to separate the BUM traffic into two parts: the broadcast and multicast traffic can be transported by the MP2MP LSP; the unknown unicast traffic has to be transported by the P2MP LSP or P2P PW. The process is complex and hard to be provisioned.

MPLS global label can be introduced as the identification of the source PE and the binding between the MPLS global label and the PE is advertised to all PEs. When the unknown unicast traffic is sent by the source PE, the MPLS global label for the identification of the PE could be encapsulated firstly. Thus even if the MP2MP LSP is used, the remote PEs can learn the source PE for the learned MAC address based on the received MPLS global label.

3.1.2. Segment-Based EVPN

EVPN([I-D.ietf-l2vpn-evpn]) introduces a solution for multipoint L2VPN services. Split horizon is an important feature in EVPN to cope with the challenge proposed by BUM traffic. In order to achieve the split horizon function, every BUM packet originating from a non-DF PE is encapsulated with an ESI label that identifies the Ethernet segment of origin (i.e. the segment from which the frame entered the EVPN network). The existing ESI label allocation solutions are different for the different transport tunnel technologies: downstream ESI label assignment for ingress replication and upstream ESI label assignment for P2MP LSP. For MP2MP LSP, there is no solutions of ESI label assignment for split horizon function yet. [I-D.li-l2vpn-segment-evpn] proposes an enhanced EVPN mechanism, segment-based EVPN (S-EVPN). It introduces the global label to identify the Ethernet Segment which can also be used as the ESI label for split horizon. Thus no matter what tunnel technology (including MP2MP LSP) is adopted to transport BUM traffic, there will be unifying ESI label assignment mechanism for split horizon.

Besides unifying split horizon function in EVPN, S-EVPN can also be used as an alternative solution in the central control environment for PBB-EVPN ([I-D.ietf-l2vpn-pbb-evpn]) without the necessity of implementing PBB functionality on PE. PBB-EVPN [I-D.ietf-l2vpn-pbb-evpn] adopts B-MAC to implement C-MACs summarization and PEs in PBB-EVPN can determine the source PE through B-MAC in the PBB encapsulation for C-MACs which are learned in the data plane. S-EVPN introduces MPLS global label for each Ethernet Segment (ES) in an EVPN. It inserts the source ES label into packets

at ingress PE and learns C-MAC and source ES label binding at egress PE. Through the source ES label the egress PE can determine the source Ethernet Segment and corresponding source PE for the learned C-MAC. Owing to the MPLS global label the S-EVPN solution can adopt the unified MPLS method to satisfy the requirements of PBB-EVPN.

3.1.3. MPLS OAM for LDP LSP

MPLS OAM mechanism has been defined for MPLS TE and MPLS-TP. MPLS TE or MPLS-TP LSP adopts the point-to-point model which is easy to count the number of received packets for the specific LSP based on the MPLS label in the encapsulation if packet loss rate need to be calculated for Performance Monitoring. As the network convergence develops, MPLS LDP network needs to interwork with MPLS TE/MPLS-TP network and unified MPLS OAM becomes the realistic requirement. Owing to the MP2P(Multi-Point to Point) or MP2MP model of MPLS LDP LSP, it is difficult for MPLS LDP to implement Performance Monitoring since it cannot count the number of the received packets based on the MPLS label in the encapsulation for a specific flow between two PEs. MPLS global label can be introduced to be used as the source label (Refer to [I-D.chen-mpls-source-label]) to identify the source PE and it can be encapsulated for the traffic transported by MPLS LDP LSP. Thus even if the outer MPLS LDP label is the same for flows from different PEs, the egress PE can differentiate flows from specific ingress PEs based on the encapsulated MPLS global label for Performance Monitoring.

3.2. Identification of Services

3.2.1. Identification of MVPN/VPLS

In BGP-base Multicast VPN ([RFC6513]) and VPLS Multicast([I-D.ietf-l2vpn-vpls-mcast]), in order to implement aggregating multiple MVPNs or VPLS on a single P-Tunnel (i.e. sharing one P2MP LSP) , MPLS global label can be introduced to identify the MVPN instance or the VPLS instance and the label binding is advertised to all PEs. When aggregating multiple MVPN instances and VPLS instances over one P-tunnel, the corresponding MPLS global label binded with these VPN instances should be encapsulated. Then the egress PEs can determine the MVPN or VPLS instance based on the encapsulated MPLS global label after receive the packets through the P tunnel.

3.2.2. Local Protection of PE Node

The local protection mechanisms for PE node such as [I-D.ietf-pwe3-endpoint-fast-protection] and [I-D.zhang-l3vpn-label-sharing] have been proposed. If failure happens in the PE node, the service traffic to the primary PE node

can be switched by the penultimate hop to the other backup PE. In order to achieve the object, MPLS global label can be introduced to identify the same L3VPN instance or L2VPN instance for multi-homed PEs. When forwarding packets for VPN service, the inner label in the encapsulation to identify the specific VPN can be replaced by the MPLS global label. If PE node failure happens, the traffic can directly switch to the backup LSP to the backup PE at the penultimate hop. It is only to change the out-layer tunnel label without having any extra process on the inner label.

3.2.3. Service Chaining

With the deployment of service functions (such as firewalls, load balancers) in large-scale environments, the term service function chaining is used to describe the definition and instantiation of an ordered set of such service functions, and the subsequent "steering" of traffic flows through those service functions. The set of enabled service function chains reflect operator service offerings and is designed in conjunction with application delivery and service and network policy (Refer to [I-D.ietf-sfc-problem-statement]). The source packet routing mechanism can be used to implement service chaining in MPLS networks ([I-D.xu-spring-sfc-use-case]). MPLS global label can be introduced to identify the service functions and the label binding can be advertised in the network. Then the ingress node can compose the MPLS stacked path to steer packets through the required service function path for specific service flow.

3.3. Identification of Network

MPLS is the basic technology to implement virtual networks. VPN can be seen as a typical example to use the MPLS label to differentiate the virtual network instance. Now the virtual network technologies based on MPLS concentrate on the service layer such as L3VPN, L2VPN, MVPN, etc. New requirements on easy implementation of virtual network on the transport layer are being emerged. MPLS global label can also play an important role in the course of achieving the object.

3.3.1. Segment Routing

Segment Routing [I-D.filsfils-spring-segment-routing] is introduced to leverage the source routing paradigm for traffic engineering, fast re-route, etc. A node steers a packet through an ordered list of segments. A segment can represent any instruction, topological or service-based. Segment Routing can be directly applied to the MPLS architecture with no change on the forwarding plane. A segment is encoded as an MPLS label. An ordered list of segments is encoded as a stack of labels. In Segment Routing, the basic segments include

node segment and adjacency segment. A Node Segment represents the shortest path to a node and Node segments must be globally unique within the network domain. That is, In the MPLS data plane instantiation, MPLS global label is used to identify a specific Node Segment. In essence MPLS global label is to represent the virtualized nodes in the network.

3.3.2. MPLS Network Virtualization

As the virtual network operators develop, it is desirable to provide better network virtualization solutions to facilitate the service provision. [I-D.li-mpls-network-virtualization-framework] introduces the framework for MPLS network virtualization. In the framework, MPLS global label can be used to identify the virtualized network topology, nodes and links which can make up the virtual network.

4. IANA Considerations

This document makes no request of IANA.

5. Security Considerations

TBD.

6. References

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