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Usecases of MPLS Global Label
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Abstract

As the SDN(Service-Driven Network) technology develops, MPLS global label has been proposed again for new solutions. The document proposes possible usecases of MPLS global label. MPLS global label can be used for identification of the location, the service and the network in different application scenarios. From these usecases we can see that no matter SDN or traditional application scenarios, the new solutions based on MPLS global label can gain advantage over the existing solutions to facilitate service provisions.

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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Table of Contents

1. Introduction

Currently MPLS label only has local meaning. That is, MPLS label is always allocated by the downstream node to the upstream node. Then the MPLS label is only identified by the neighboring upstream node

and downstream node. MPLS global label has ever been proposed which has the global meaning in the MPLS domain. That is, MPLS global label should be identified by all nodes in the MPLS domain for the same meaning. Since for a long time current MPLS label mechanism is suitable for the distributed network model and can satisfy the

possible requirements, there is not much motivation to introduce the MPLS global label mechanism. As the SDN concept is introduced, the MPLS global label mechanism are proposed again for new solution such as Segment Routing ([I-D.previdi-filsfils-isis-segment-routing]). This document proposes possible usecases for MPLS global label which can be used for identification of the location, the service and the network in different application scenarios. From these usecases we can see that no matter SDN or traditional application scenarios, the new solutions based on MPLS global label can gain advantage over the existing solutions to facilitate service provisions.

2. Terminology

BUM: Broadcast, Unknown unicast, or Multicast

B-MAC: Backbone MAC Address

CE: Customer Edge

C-MAC: Customer/Client MAC Address

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. Usecases

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 must 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 LSP, 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

[I-D.li-l2vpn-segment-evpn] proposes an enhanced EVPN mechanism, segment-based EVPN (S-EVPN). It introduces a new solution based on MPLS global label to satisfy the requirements of 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. It makes the implementation easier and closer to EVPN([I-D.ietf-l2vpn-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 outlayer 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) , the upstream-assigned label mechanism is introduced to associate the MPLS label with one MVPN or VPLS and advertise the label binding via BGP by the ingress PEs. In addition this procedure requires each egress PE to support a separate label space for every other PE. When the packet is received the label space (called as "tunnel-specific label space") should be determined firstly by the aggregating tree over which the packet is received and in the label space the upstream-assigned MPLS label lookup has to be performed. The upstream-assigned label mechanism and multi-instance label-space forwarding mechanism have much effect on the existing MPLS control plane and forwarding plane. MPLS global label are 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 the encapsulated MPLS global label after receive the packets through the packets. The mechanism can simplify the possible change of the existing control plane and the existing MPLS forwarding mechanism in the data plane can be reused. That is, It can simplify the process

of the Multicast VPN and VPLS Multicast while achieve the same object as the upstream-assigned label mechanism.

3.2.2. Local Protection of PE Node

The local protection mechanism for PE node such as [I-D.shen-pwe3-endpoint-fast-protection] has been introduced . If failure happens in the PE node, the service traffic to the PE node can be switched by the penultimate hop to the other backup PE. In order to achieve the object, multi-instance MPLS label space has to be introduced and labels allocated for L3VPN or L2VPN must backup between the multi-homed PEs or be coordinated through possible protocol extensions based on ICCP, etc. For the local protection mechanism proposed in [I-D.zhang-l3vpn-label-sharing] against egress node failure, MPLS global label can be introduced to identify the

same L3VPN instance or L2VPN instance for all joined 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 tunnel to the backup PE. It is only to change the outlayer 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]). To implement service chaining, it is important to use the service header for the packets to be identifed as a specific service flow to pass through specific service functions. In the MPLS network for service chaining, the global label can be introduced as the service header to identify a specific service flow globally. When forward packets of the specific service flow, the global label should be kept in the MPLS stack encapsulation until the service functions are completed.

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.previdi-filsfils-isis-segment-routing] introduces multiple types of segments. The basic segments includes 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. In the MPLS data plane instantiation, MPLS global label is used to identify a specific Node Segment. That is, MPLS global label can virtualize network nodes to comprise the virtual 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.

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