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Usecases of MPLS Global Label
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Abstract

As the MPLS technologies develop, MPLS label is not only used with the local meaning which is always be understood by the upstream node and the downstream node, but also used with the global meaning which can be understood by all nodes or part of nodes in the network. The document defines the latter as the global label and proposes the possible use cases of global label. In these usecases MPLS global label can be used for location identification, VPN identification, segment routing, etc.

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	2
2. Terminology	3
3. Use Cases	3
3.1. Location Identification	3
3.2. VPN Identification	4
3.2.1. Flow Label of VPN LSP	4
3.2.2. Aggregate MVPN/VPLS over Single P-Tunnel	5
3.3. Segment Routing	5
4. Discussion	6
5. IANA Considerations	8
6. Security Considerations	8
7. References	8
7.1. Normative References	8
7.2. Informative References	8
Authors' Addresses	11

1. Introduction

In the traditional MPLS architecture, MPLS label is always distributed from the downstream node to the upstream node by LDP, RSVP-TE and MP-BGP. These label mappings always have the local meaning which can only be understood by the upstream node and the downstream node. As the MPLS technologies develop, there proposes possible usecases in which MPLS label mapping can be advertised to all nodes or part of nodes in the network. That is, the meaning of the label mapping will be understood by all nodes or part of nodes in the network other than the local upstream node and downstream node. This document defines such type of MPLS label as global label as the opposite of local label.

In the MPLS world there are another pair of label related concepts: per-platform label space [RFC3031] and context-specific label space [RFC5331]. According to [RFC3031] MPLS local label can be allocated from per-platform label space and per-interface label space (in [RFC5331], per-interface label space is generalized as one type of context-specific label space). MPLS global label can also be allocated from per-platform label space or context-specific label space.

The document proposes the possible usecases of MPLS global label. In these usecases MPLS global label can be used for location identification, VPN identification, segment routing, etc.

2. Terminology

CE: Customer Edge

MP2P: Multi-Point to Point

MP2MP: Multi-point to Multi-point

MVPN: Multicast VPN

P2MP: Point to Multi-Point

P2P: Point to Point

PE: Provider Edge

3. Use Cases

3.1. Location Identification

[I-D.bryant-mpls-flow-ident] and [I-D.bryant-mpls-synonymous-flow-labels] propose the challenge of the measurement of packet loss for the multi-point to point LSP. In this case the same label is normally used by multiple ingress or upstream LSRs for specific prefixes and hence source identification is not possible by inspection of the top label by the egress LSRs. Thus [I-D.bryant-mpls-synonymous-flow-labels] proposes the synonymous flow label to be used to introduce some source specific information encapsulated in the packet to identify packet batches from a specific source.

MPLS LDP LSP is one type of multi-point to point LSP. 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. In this usecase, MPLS global label can be allocated for

each network node and advertised in the network. When implement the measurement of packet loss for LDP LSP, such MPLS global label can be used as the flow label to identify the source node of the LDP LSP. When the destination receives the packets it can differentiate flows from specific source node based on the advertised global label binding information for network nodes. In this usecase, MPLS global label is used as the unique identification of source nodes in the network and may save the complex flow label negotiation process between the source node and the destination node.

3.2. VPN Identification

MPLS global label can be allocated for VPN and advertised in the network. In this usecase, MPLS global label is used as the unique identification of VPN in the network and can be used for multiple purposes.

3.2.1. Flow Label of VPN LSP

BGP VPN LSP is another type of multi-point to point LSP which faces the challenge of the measurement of packet loss proposed by [I-D.bryant-mpls-flow-ident] and [I-D.bryant-mpls-synonymous-flow-labels]. In this usecase, the flow label should be introduced to identification of the source VPN. There are two possible ways to use global label as the flow label:

Option 1: The global label is allocated for the same VPN on all PE nodes and advertised in the network. And global labels can be allocated for PE nodes and advertised in the network. Then the flow label should be the source PE label + the VPN label shown in the figure 1.

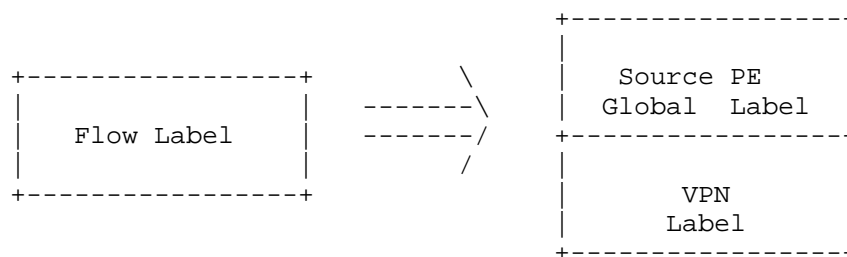


Figure 1: Flow Label using Two Layers of Global Label

Option 2: The global label is allocated directly for source VPN (identified by the pair of { Source PE, VPN }) and advertised in the network. We call such label as Source VPN label. The flow label should be the source VPN label shown in the figure 2.

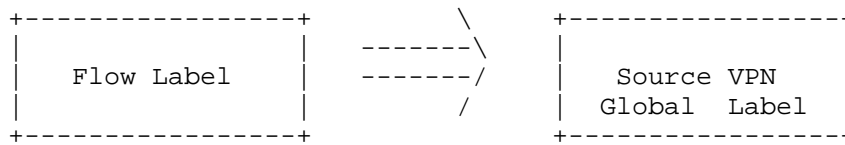


Figure 2: Flow Label using One Layer of Global Label

No matter option 1 or option 2 is adopted, when the destination receives the packets it can differentiate flows from specific source VPN based on the advertised global label binding information.

3.2.2. Aggregate MVPN/VPLS over Single P-Tunnel

In BGP-base Multicast VPN ([RFC6513]) and VPLS Multicast([RFC7117]), in order to implement aggregating multiple MVPN/VPLS Instances on a single P-Tunnel (i.e. sharing one P2MP LSP) , context-specific label is introduced to identify the MVPN/VPLS instance and the label binding is allocated by the root PE and advertised to the leaf PEs. In this usecase the context-specific label is one type of global label to uniquely identify the MVPN/VPLS instance in the network.

The context-specific label can solve the issue of aggregating multiple MVPNs or VPLS instances over a single P2MP LSP. But if the MP2MP LSP is adopted for aggregating multiple MVPN/VPLS instances the solution does not work since there are multiple root PEs which may allocate the same context-specific label for different MVPN/VPLS instances. In order to solve the issue the global label can be allocated to the same MVPN/VPLS instance on all PEs and advertised in the network. Then the global label will become the unique identification of VPN instance in the network. When aggregating multiple MVPNs or VPLS instances over one MP2MP LSP, the corresponding MPLS global label binding with the MVPN/VPLS instance can be encapsulated by the root PE. Then the leaf PEs can determine the MVPN or VPLS instance the received packets belong to based on the advertised global label binding information for MVPN/VPLS instances. The solution can provide the unified solution for aggregating multiple MVPN/VPLS instances over P2MP LSP and MP2MP LSP. And the solution can save the complex control plane and forwarding plane process of context-specific label.

3.3. Segment Routing

Segment Routing [I-D.ietf-spring-segment-routing] is introduced to leverage the source routing paradigm for traffic engineering, fast re-route, etc. A node can steer a packet through an ordered list of segments. A segment can represent any instruction, topological or

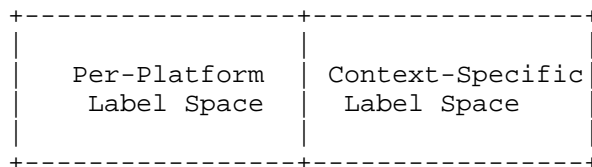
service-based. Segment Routing can be directly applied to the MPLS architecture with no change on the forwarding plane in which a segment can be encoded as an MPLS label and an ordered list of segments can be encoded as a stack of labels.

Segment Routing [I-D.ietf-spring-segment-routing] introduces some segments such as node segment, adjacency segment, etc. SR Global Block (SRGB) is also introduced for allocation of segment. In the MPLS architecture, SRGB is the set of local labels reserved for global segments. When the global segment index is advertised, it can be transitioned to MPLS label based on the SRGB. According to [I-D.ietf-ospf-segment-routing-extensions] and [I-D.ietf-isis-segment-routing-extensions] MPLS global label binding information can also be directly advertised in the network. For example, in the section 2.1 of [I-D.ietf-ospf-segment-routing-extensions], when the Length field of SID/Label Sub-TLV is set as 3, it will represent the label which can be flooded in the whole network. By this method MPLS global label can be directly allocated for specific node or adjacency, etc. and advertised in the network. The solution can save the complex process of SRGB advertisement and transition from the global Segment ID to MPLS label.

4. Discussion

In the MPLS world, we can adopt the dichotomy to divide it into per-platform label space and context-specific label space.

MPLS World



When we adopt another dichotomy to divide the MPLS world into local label and global label, we may face more challenges.

Local Label		vs.	Global Label	
			Special Purpose Label (RFC 7274)	
			MPLS Upstream Label Assignment /Context-Specific Label Space (RFC 5331)	
LDP	(RFC 5036)		Entropy Label	(RFC 6790)
RSVP-TE	(RFC 3209)		Flow Label	(RFC 6391)
BGP LSP	(RFC 3107)			
L3VPN	(RFC 4364)		BGP-base VPLS	(RFC 4761)
LDP-based L2VPN	(RFC 4762)		Segment Routing	
EVPN	(RFC 7432)		(draft-ietf-spring-segment-routing)	
			Domain-Wide Label	
			(Usecases: Synonymous Label/Segment Routing, etc.)	

Figure 3: Division of MPLS World Using Local Label and Global Label

In the figure 3, we can easily understand the local label using for LDP, RSVP-TE, label BGP, L3VPN, LDP-based L2VPN, EVPN, etc. But for the opposite of these applications there may be many usecases which are different from each other, but share the common characteristic that the label meaning can be understood by all network nodes or part of network nodes instead of only the local downstream nodes and upstream nodes for which in this document such label is defined as global label :

-- For special purpose labels, their meaning can be understood by all nodes in the MPLS network. Should they belong to global label?

-- For MPLS upstream label assignment in context-specific label space, all downstream nodes can understand the meaning of the label allocated by the upstream node binding for specific MVPN/VPLS instance. We can see the root PE as one type to central controlled node to allocate label to all leaf nodes. And thinking about the uniqueness of the context determine by the shared P-tunnel, these labels in fact are also unique in the network. Should they belong to global label?

-- For entropy label and flow label, the label is calculated by the ingress node based on specific hash algorithms which is totally different from the local label distributed in the MPLS control plane.

And all nodes along the path will parse the label and according to the uniform meaning to use the label for ECMP. But the label values can be duplicate since they are calculated by different ingress nodes. Should they belong to global label?

-- For BGP-based VPLS and Segment Routing, they can adopt the local label block. But they introduce the global ID and transit them into the local label. Especially for segment routing, when all nodes in the network adopts the same SRGB, the global segment ID is easily transited to a unique global label value in the network. Should they belong to global label?

-- This document proposes some usecases to directly allocate the unique label value and advise the label binding in the network. Should they be directly called as global label or Domain-Wide label as one type of global label?

Since above applications which are different from the traditional MPLS local label, can we define all of them as global label or define some of them as global label and bring some use cases to the local label field? Or maybe such dichotomy using local label and global label does not exist.

5. IANA Considerations

This document makes no request of IANA.

6. Security Considerations

TBD.

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