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BGP Extensions for Enhanced VPN Auto Discovery
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Abstract

A variety of VPN technologies have been widely deployed to bear different services. As new applications develop, a requirement has been proposed for auto-discovery of Layer 3 Virtual Private Networks (L3VPN) and enhanced auto-discovery requirements for other VPN technologies that already have basic auto-discovery mechanisms.

This document identifies some possible applications of these auto-discovery requirements and defines a new BGP NLRI, called the BGP-VPN-INSTANCE NLRI, to satisfy the requirement for auto-discovery of BGP VPN instances. It also defines a new type of extended community, called the Import Route Target, which can be applied to auto-discovery mechanisms of multiple VPN technologies.

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1. Introduction

A variety of VPN technologies have been widely deployed to bear different services. As new applications develop, a requirement has been proposed for auto-discovery of Layer 3 Virtual Private Networks (L3VPN) [RFC4364] and enhanced auto-discovery requirements for other VPN technologies which already have basic auto-discovery mechanisms.

This document identifies some possible applications of these auto-discovery requirements and defines a new BGP NLRI [RFC4271], called the BGP-VPN-INSTANCE NLRI, to satisfy the requirement of auto-discovery of BGP VPN instance. It also defines a new type of extended community, called the Import Route Target (IRT), which can be applied to auto-discovery mechanisms of multiple VPN technologies.

2. Terminologies

This document uses the terminologies defined in [RFC4026]:

A-D: Auto-Discovery

AFI: Address Family Identifier

ERT: Export Route Target

IRT: Import Route Target

LSP: Label Switched Path

NLRI: Network Layer Reachability Information

P2MP: Point to Multi-Point

PE: Provider Edge

RD: Route Distinguisher

VRF: Virtual Routing and Forwarding

VPN A-D: VPN Auto-Discovery

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

3. Requirements of VPN Auto-Discovery

The following subsections are examples of VPN Auto-Discovery requirements.

3.1 Centralized Traffic Optimization

As the development of centrally controlled application such as PCE-initiated LSP [RFC8281] and PCE-initiated P2MP LSP [RFC8623], PCE can be used to initiate setup of RSVP-TE LSP or P2MP LSP for the purpose of traffic optimization. In order to support such applications, the controller should learn the relationship of unicast VPN instances or multicast VPN instances distributed on different PEs. According to the existing VPN auto-discovery mechanism for technologies such as EVPN [RFC7432] or MVPN [RFC6514], the A-D routes are always advertised with the Export Route Target (ERT). The ingress PE can use an Import Route Target (IRT) of the local MVPN/EVPN instance to match the route target advertised with the NLRI to determine the relationship of these VPN instances. But the controller, which can be used as the route reflector of VPN routes, cannot learn the relationship of VPN instances since the Import Route Target information is not advertised with these A-D routes. In order to support such applications the IRT can be carried with A-D routes as specified below.

3.2 Label/Segment Allocation for VPN Instance

[I-D.li-mpls-global-label-usecases] proposes use cases of label allocation for unicast VPN or multicast VPN instances. [I-D.li-spring-segment-path-programming] proposes use cases of segment allocation for steering traffic. In order to support such applications the PEs needs to learn the relationship of VPN instances distributed on other PEs. For L3VPN [RFC4364] there is no auto-discovery mechanism for BGP VPN instances. In order to support such applications, an auto-discovery mechanism for L3VPN is specified below.

4. IRT Extended Community

This document defines a new type of transitive extended community, called Import Route Target.

The IANA registry of BGP Extended Communities clearly identifies communities of specific formats: "Two-octet AS Specific Extended Community" [RFC4360], "Four-octet AS Specific Extended Community" [RFC5668], and "IPv4 Address Specific Extended Community" [RFC4360]. Route Target [RFC4360] extended communities identify this format in the high-order (Type) octet of the Extended Community. The Import Route Target extended community reuses the same mechanism.

This document defines the following IRT Extended Communities:

Type	Sub-Type	Extended Community	Encoding
0x00	TBD1	AS-2byte IRT	2-octet AS, 4-octet Value
0x01	TBD2	IPv4 IRT	4-octet IPv4 Address, 2-octet Value
0x02	TBD3	AS-4byte IRT	4-octet AS, 2-octet Value

Figure 1. IRT Extended Communities

The IRT Extended Community can be used for MVPN [RFC6514], L3VPN [RFC4364], EVPN [RFC7432], BGP-based VPLS [RFC4761], and BGP-AD-based VPLS [RFC6074] and the like. The existing auto-discovery mechanisms of these VPN technologies always carry the ERT extended community. To meet the requirements of applications, they need to carry the IRT extended community with different A-D routes. The local policy, which is out of scope of this document, can be used to control the distribution of IRT information.

5. BGP Extensions for L3VPN Auto-Discovery

5.1 BGP-VPN-INSTANCE SAFI

The BGP Multiprotocol Extensions [RFC4760] allow BGP to carry routes from multiple "address families". In this document a new Subsequent Address Family is specified, called "BGP-VPN-INSTANCE Sub Address Family", which uses a specific BGP-VPN-INSTANCE-SAFI (TBD4).

This document also defines a new BGP NLRI, called the BGP-VPN-INSTANCE NLRI to support the BGP VPN instance auto-discovery. BGP-VPN-INSTANCE MP_REACH_NLRI and MP_UNREACH_NLRI (shown in Figures 2 and 3) are formatted as described in [RFC4760]. The BGP-VPN-INSTANCE NLRI is described in more detail in Section 5.2.

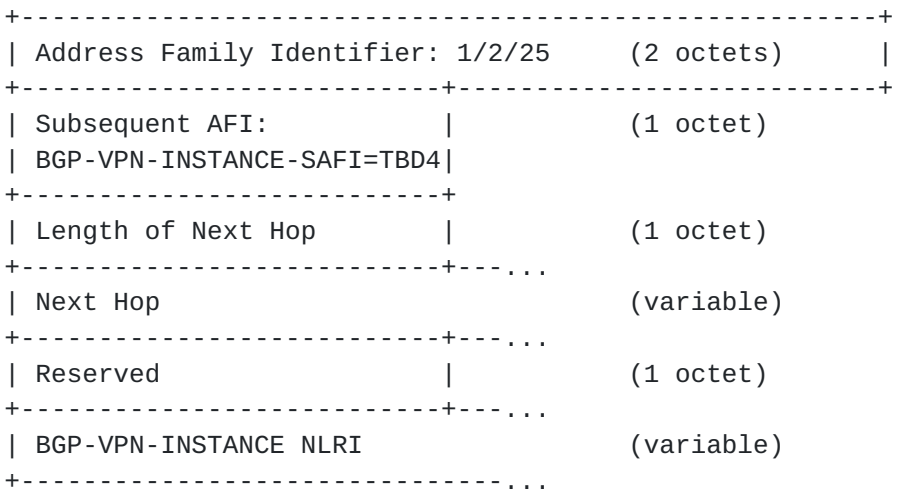

Figure 2. BGP-VPN-INSTANCE MP_REACH_NLRI

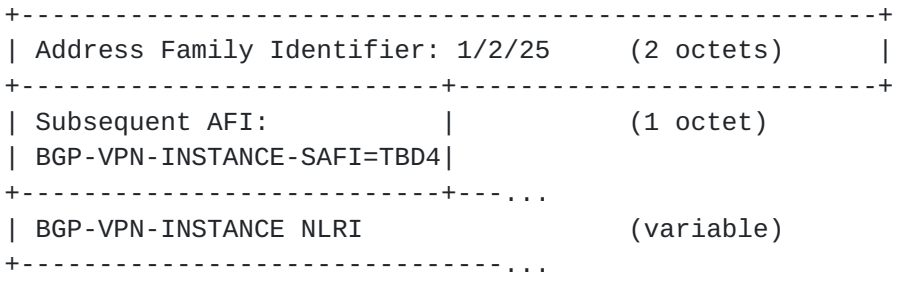

Figure 3. BGP-VPN-INSTANCE MP_UNREACH_NLRI

5.2 BGP-VPN-INSTANCE NLRI

The following is the format of the BGP-VPN-INSTANCE NLRI.

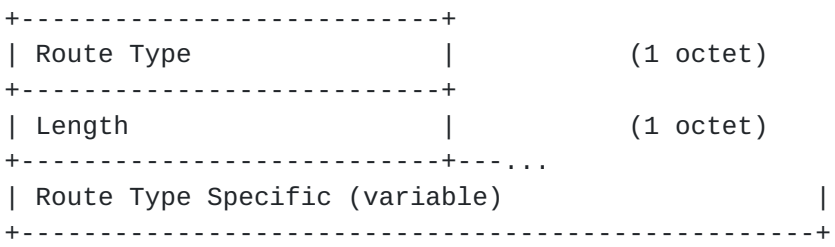

Figure 4. BGP-VPN-INSTANCE NLRI

The Route Type field specifies the encoding of the rest of BGP-VPN-INSTANCE NLRI (Route Type specific BGP-VPN-INSTANCE NLRI).

The Length field indicates the length in octets of the Route Type specific field of the BGP-VPN-INSTANCE NLRI.

This document defines the following Route Type for BGP-VPN-INSTANCE routes:

Type 1: VPN Membership A-D Route

5.2.1 VPN Membership A-D Route

The VPN Membership A-D Route is utilized for VPN Membership A-D between PEs. Its format is shown in Figure 5.

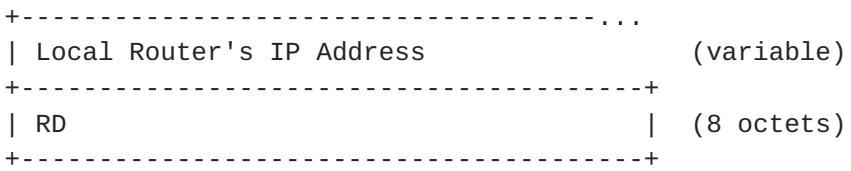

Figure 5. VPN Membership A-D Route

a) Local Router's IP Address: Advertising PE's IPv4/IPv6 address.

b) RD: RD of one VRF on the advertising PE, encoded as described in [RFC4364].

5.3 Procedures

Every PE needs to process all its VRF configuration and generate one VPN Membership A-D Route for each VRF respectively. The Local Router's IP Address field MUST be filled with the Advertising Router's IP address. The RD field MUST be filled with the VRF's RD value.

All ERTs of the VRF MUST be carried in a BGP Update's RT Extended Community Path Attribute with the Membership A-D Route for the VRF. To meet the requirements of different applications, all IRTs of the VRF SHOULD be able to be carried in BGP Update's IRT Extended Community Path Attribute with the VPN Membership A-D Route for the VRF.

If a VRF is created, then its corresponding VPN Membership A-D Route MUST be generated and advertised.

If the VRF whose VPN Membership A-D Route has been advertised is deleted, then the VPN Membership A-D Route Withdraw message MUST be generated and advertised.

If IRTs or ERTs of the VRF whose VPN Membership A-D Route has been advertised are changed, then a VPN Membership A-D Route Update with same Prefix and latest IRTs or ERTs MUST be advertised.

When the receiving PE receives a VPN Membership A-D Route, VPN relationship matching MUST be checked with the IRTs carried in the VPN Membership A-D Route and ERTs of each Local VRF.

When the central controller receives a VPN Membership A-D Route, VPN relationship matching MUST be checked with IRTs and ERTs carried in VPN Membership A-D Routes of different VPN instances.

6. IANA Considerations

6.1 BGP Extended Communities

IANA is requested to assign three BGP Extended Community Sub-Types as shown below.

Transitive Two-Octet AS-Specific Extended Community Sub-Type

Sub-Type	Description	Reference
TBD1	Import Route Target	[this document]

Transitive IPv4-Address-Specific Extended Community Sub-Type

Sub-Type	Description	Reference
TBD2	Import Route Target	[this document]

Transitive Four-Octet AS-Specific Extended Community Sub-Type

Sub-Type	Description	Reference
TBD3	Import Route Target	[this document]

6.2 Subsequent Address Family Identifier

IANA is requested to assign a Subsequent Address Family Identifier (SAFI) from the First Come First Served range as follows:

Value	Description	Reference
TBD4	BGP-VPN-INSTANCE-SAFI	[this document]

7. Security Considerations

TBD

Contributors

The following people have substantially contributed to the solution and to the editing of this document:.

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