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BGP Remote-Next-Hop
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Abstract

The BGP Remote-Next-Hop is a new optional transitive attribute intended to facilitate automatic tunneling across an AS on a per address family basis. The attribute carries one or more tunnel end-points for a NLRI. Additionally, tunnel encapsulation information is communicated to successfully setup these tunnels.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

[RFC5512] defines an attribute attached to an NLRI to signal tunnel end-point encapsulation information between two BGP speakers. It assumes that the exchanged tunnel endpoint is the NLRI.

This document defines a new BGP transitive attribute known as a Remote-Next-Hop BGP attribute for Intra-AS and Inter-AS usage which removes that assumption.

The tunnel endpoint information and the tunnel encapsulation information is carried within a Remote-Next-Hop BGP attribute. This

attribute is tagged on an any BGP NLRI. This way the Address Family (AF) of the NLRI exchanged is decoupled from the tunnel SAFI address-family defined in [RFC5512].

2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" are to be interpreted as described in [RFC2119] only when they appear in all upper case. They may also appear in lower or mixed case as English words, without any normative meaning.

3. Tunnel Encapsulation attribute versus BGP Remote-Next-Hop attribute

The Tunnel Encapsulation attribute [RFC5512] is based on the principle that the tunnel end-point is the BGP speaker originating the update and is inserted as the NLRI in the exchange, with the consequence that it is impossible to set the endpoint to an arbitrary IP address.

There are use cases where it is desired that the tunnel end-point address should be a different address, or set of addresses, than the originating BGP speaker. It is also useful to be able to signal different encapsulation parameters for different prefixes with the same remote tunnel end-point. The BGP Remote-Next-Hop attribute provides the ability to have one or more different tunnel end-point addresses from either the IPv4 and/or the IPv6 address-families, and be able to signal next-hop encapsulation parameters along with any prefix.

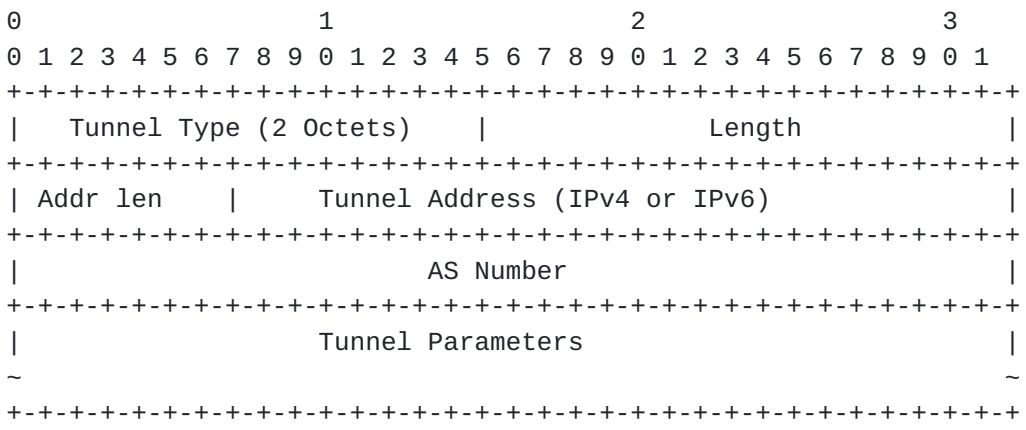
The sub-TLVs from the Tunnel Encapsulation Attribute [RFC5512] are reused for the BGP Next-Hop-Attribute.

Due to the intrinsic nature of both attributes, the tunnel encapsulation end-point assumes that the tunnel end-point is both the NLRI exchanged and the originating router, while the BGP Remote-Next-Hop attribute is inserted for an exchanged NLRI by adding a set of tunnel end-points, these two attributes are mutually exclusive.

4. BGP Remote-Next-Hop attribute TLV Format

This attribute is an optional transitive attribute [RFC1771].

The BGP Remote-Next-Hop attribute is is composed of a set of Type-Length-Value (TLV) encodings. The type code of the attribute is (IANA to assign). Each TLV contains information corresponding to a particular tunnel technology and tunnel end-point address. The TLV is structured as follows:



Tunnel Type (2 octets): identifies the type of tunneling technology being signaled. This document specifies the following types:

- L2TPv3 over IP [RFC3931]: Tunnel Type = 1
- GRE [RFC2784]: Tunnel Type = 2
- IP in IP [RFC2003] [RFC4213]: Tunnel Type = 7

This document also defines the following types:
- VXLAN: Tunnel Type = 8
- NVGRE: Tunnel Type = 9

Unknown types MUST be ignored and skipped upon receipt.

Length (2 octets): the total number of octets of the value field.

Tunnel Address Length - Addr len (1 octet): Length of Tunnel Address. Set to 4 bytes for an IPv4 address and 16 bytes for an IPv6 address.

AS Number - The AS number originating the BGP Remote-Next-Hop attribute and is either a 2-byte AS or 4-Byte AS number

Tunnel Parameter - (variable): comprised of multiple sub-TLVs. Each sub-TLV consists of three fields: a 1-octet type, 1-octet length, and zero or more octets of value. The sub-TLV definitions and the sub-TLV data are described in depth in [RFC5512].

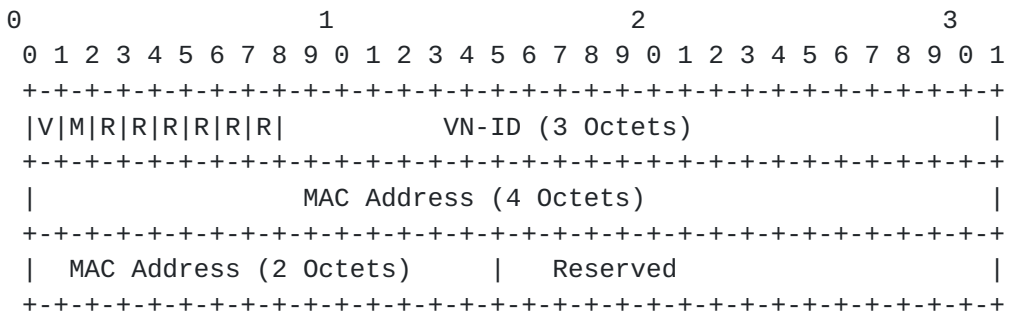
4.1. Encapsulation sub-TLVs for virtual network overlays

A VN-ID may need to be signaled along with the encapsulation types for DC overlay encapsulations such as [VXLAN] and [NVGRE]. The VN-ID when present in the encapsulation sub-TLV for an overlay encapsulation, MUST be processed by a receiving device if it is

capable of understanding it. The details regarding how such a signaled VN-ID is processed and used is defined in specifications such as [IPVPN-overlay] and [EVPN-overlay].

4.1.1. Encapsulation sub-TLV for VXLAN

This document defines a new encapsulation sub-TLV format, defined in [RFC5512], for VXLAN tunnels. When the tunnel type is VXLAN, the following is the structure of the value field in the encapsulation sub-TLV:



V: When set to 1, it indicates that a valid VN-ID is present in the encapsulation sub-TLV.
M: When set to 1, it indicates that a valid MAC Address is present in the
encapsulation sub-TLV.
R: The remaining bits in the 8-bit flags field are reserved for further use. They MUST be set to 0 on transmit and MUST be ignored on receipt.

VN-ID: Contains a 24-bit VN-ID value, if the 'V' flag bit is set. If the 'V' flag is not set, it SHOULD be set to zero and MUST be ignored on receipt.

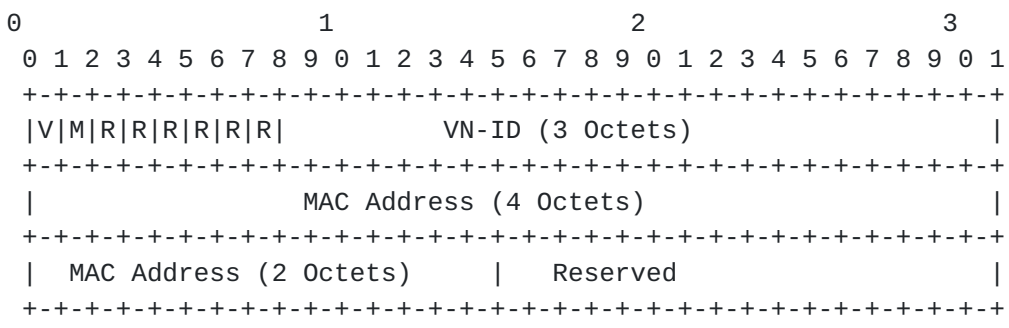
The VN-ID value is filled in the VNI field in the VXLAN packet header as defined in [VXLAN].

MAC Address: Contains an Ethernet MAC address if the 'M' flag bit is set.
If the 'M' flag is not set, it SHOULD set to all zeroes and MUST be ignored on receipt.

The MAC address is local to the device advertising the route, and should be included as the destination MAC address in the inner Ethernet header immediately following the outer VXLAN header, in the packets destined to the advertiser.

4.1.2. Encapsulation sub-TLV for NVGRE

This document defines a new encapsulation sub-TLV format, defined in [RFC5512], for NVGRE tunnels. When the tunnel type is NVGRE, the following is the structure of the value field in the encapsulation sub-TLV:



V: When set to 1, it indicates that a valid VN-ID is present in the encapsulation sub-TLV.
M: When set to 1, it indicates that a valid MAC Address is present in the
encapsulation sub-TLV.
R: The remaining bits in the 8-bit flags field are reserved for further use. They MUST be set to 0 on transmit and MUST be ignored on receipt.

VN-ID: Contains a 24-bit VN-ID value, if the 'V' flag bit is set. If the 'V' flag is not set, it SHOULD be set to zero and MUST be ignored on receipt.

The VN-ID value is filled in the VSID field in the NVGRE packet header as
defined in [NVGRE].

MAC Address: Contains an Ethernet MAC address if the 'M' flag bit is set.
If the 'M' flag is not set, it SHOULD set to all zeroes and MUST be ignored on receipt.

The MAC address is local to the device advertising the route, and should be included as the destination MAC address in the inner Ethernet header immediately following the outer NVGRE header, in the packets destined to the advertiser.

5. Use Case scenarios

This section provides a short overview of some use-cases for the BGP Remote-Next-Hop attribute. Use of the BGP Remote-Next-Hop is not limited to the examples in this section.

5.1. Multi-homing for IPv6

When an end-user IPv6 network is multi-homed to the Internet, it may be assigned more than a single prefix originated by various upstream ASs. Each AS prefers to only announce a supernet of all its assigned IPv6 prefixes, unlike IPv4 where the AS announced the end-users assigned prefix. The goal of this BGP policy behaviour is to keep the number of entries in the IPv6 global BGP table to a minimum, it also it also results in well known resiliency improvements.

For example, if an end-user IPv6 is peering with 2 different Service providers AS1 and AS2. In this case the IPv6 end-user will have at least one prefix assigned from each of these service providers. The devices at the IPv6 end-user will each receive an address from these prefixes. The devices will in most cases, when building IPv6 sessions (TCP, etc...), do so with only a single IPv6 address. The decision which IPv6 address the device will use is documented in [RFC3484].

If one if the links between the end-user and one of the neighboring AS's breaks, a consequence will be that a set of sessions need to be reset, or that a section of the end-user network becomes unreachable.

With usage of the BGP-remote-Next-Hop attribute the service provider can tunnel that packet towards an alternate BGP Remote-Next-Hop at the end-users alternate provider and restore the network connectivity even though the local link towards the end-user is broken.

5.2. Dynamic Network Overlay Infrastructure

The BGP Remote-Next-Hop extension allows signaling tunnel encapsulations needed to build and dynamically create an overlay tunneled network with traffic isolation and virtual private networks.

5.3. The Tunnel end-point is NOT the originating BGP speaker

Note that, in each network environment, the originating router is the preferred tunnel end-point server. It may be that the network administrator has deployed an independent set of tunnel end-point servers across their network, which may or may not speak BGP. The BGP Remote-Next-Hop attribute provides the ability to signal this via BGP.

5.4. Networks that do not support BGP Remote-Next-Hop attribute

If a device does not support this attribute, and receives this attribute, then normal NLRI BGP forwarding is used as the attribute is optional and transitive.

5.5. Networks that do NOT support BGP Remote-Next-Hop attribute

If a BGP speaker does understand this attribute, and receives this attribute, then the BGP speaker MAY, by configuration, skip use or not use the information within this attribute.

6. BGP Remote-Next-Hop Community

place-holder for an BGP extension to signal valid prefixes allowed to be considered as tunnel end-points. To be completed.

7. IANA Considerations

This memo asks the IANA for a new BGP attribute assignment for the BGP Remote-Next-Hop attribute.

This memo also asks the IANA to reserve the following new Tunnel Types for signaling VXLAN and NVGRE encapsulations.

VXLAN: Tunnel Type = 8

NVGRE: Tunnel Type = 9

8. Security Considerations

This technology could be used as technology as man in the middle attack, however with existing RPKI validation for BGP that risk is reduced.

The distribution of Tunnel end-point address information can result in potential DoS attacks if the information is sent by malicious organisations. Therefore is it strongly recommended to install traffic filters, IDSs and IPSs at the perimeter of the tunneled network infrastructure.

8.1. Protecting the validity of the BGP Remote-Next-Hop attribute

It is possible to inject a rogue BGP Remote-Next-Hop attribute to an NLRI resulting in Monkey-In-The-Middle attack (MITM). To avoid this type of MITM attack, it is strongly recommended to use a technology a mechanism to verify that for NLRI it is the expected BGP Remote-Next-Hop. We anticipate that this can be done with an expansion of RPKI-Based origin validation, see [I-D.ietf-sidr-pfx-validate].

This does not avoid the fact that rogue AS numbers may be inserted or injected into the AS-Path. To achieve protection against that threat BGP Path Validation should be used, see [I-D.ietf-sidr-bgpsec-overview].

9. Privacy Considerations

This proposal may introduce privacy issues, however with BGP security mechanisms in place they should be prevented.

10. Change Log

Initial Version: 16 May 2012

Hacked for -01: 17 July 2012

11. References

11.1. Normative References

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11.2. Informative References

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