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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 within an AS on a per address family basis. The attribute carries one or more tunnel endpoints for a NLRI. Additionally tunnel encapsulation information is communicated to successfully setup these tunnels.

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[1.](#) Introduction

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

This note defines a Remote-Next-Hop BGP attribute for Intra-AS and Inter-AS usage which removes that assumption.

The Address Family (AF) of the NLRI exchanged is decoupled from the

address-family of the BGP Remote-Next-Hop address-family. For each NLRI, multiple BGP Remote-Next-Hop attributes of various address-families could be inserted.

## 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 it 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. 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.

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

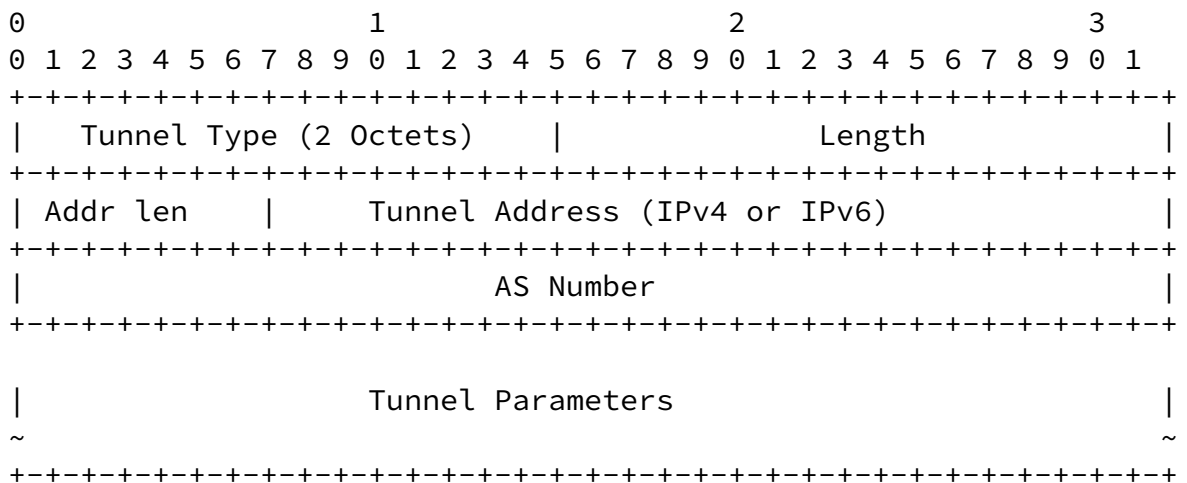
Due to the intrinsic nature of both attributes, that the tunnel encapsulation end-point assumes that the tunnel end-point is both the NLRI exchanged and the originating router, while the BGP Remote-Next-Hop attribute is inserted for an exchanged NLRI by adding a set of tunnel end-points, these two attributes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

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

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

Value (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](#)].

## [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 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 of 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

With the BGP Remote-Next-Hop feature it is possible to build and dynamically create an overlay tunneled network with privacy, 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.

## 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

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