

Network Working Group
Internet Draft
Intended Status: Standards Track
Expiration Date: January 28, 2012

D. Walton
E. Chen
Cisco Systems
A. Retana
Hewlett-Packard Co.
J. Scudder
Juniper Networks
July 27, 2011

Advertisement of Multiple Paths in BGP

[draft-ietf-idr-add-paths-05.txt](#)

Status of this Memo

This Internet-Draft is submitted to IETF in full conformance with the provisions of [BCP 78](#) and [BCP 79](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

The list of current Internet-Drafts can be accessed at <http://www.ietf.org/1id-abstracts.html>

The list of Internet-Draft Shadow Directories can be accessed at <http://www.ietf.org/shadow.html>

This Internet-Draft will expire on January 28, 2012.

Copyright Notice

Copyright (c) 2011 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](#) and the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect

to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Abstract

In this document we propose a BGP extension that allows the advertisement of multiple paths for the same address prefix without the new paths implicitly replacing any previous ones. The essence of the extension is that each path is identified by a path identifier in addition to the address prefix.

1. Introduction

The BGP specification [[RFC4271](#)] defines an "Update-Send Process" to advertise the routes chosen by the Decision Process to other BGP speakers. No provisions are made to allow the advertisement of multiple paths for the same address prefix, or Network Layer Reachability Information (NLRI). In fact, a route with the same NLRI as a previously advertised route implicitly replaces the previous advertisement.

In this document we propose a BGP extension that allows the advertisement of multiple paths for the same address prefix without the new paths implicitly replacing any previous ones. The essence of the extension is that each path is identified by a path identifier in addition to the address prefix.

1.1. Specification of Requirements

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 [[RFC2119](#)].

2. How to Identify a Path

As defined in [[RFC4271](#)], a path refers to the information reported in the path attribute field of an UPDATE message. As the procedures specified in [[RFC4271](#)] allow only the advertisement of one path for a particular address prefix, a path for an address prefix from a BGP peer can be keyed on the address prefix.

In order for a BGP speaker to advertise multiple paths for the same address prefix, a new identifier (termed "Path Identifier" hereafter) needs to be introduced so that a particular path for an address prefix can be identified by the combination of the address prefix and the Path Identifier.

The assignment of the Path Identifier for a path by a BGP speaker is purely a local matter. However, the Path Identifier MUST be assigned in such a way that the BGP speaker is able to use the (prefix, path identifier) to uniquely identify a path advertised to a neighbor. A BGP speaker that re-advertises a route MUST generate its own Path Identifier to be associated with the re-advertised route. A BGP speaker that receives a route SHOULD NOT assume that the identifier carries any particular semantics; it SHOULD be treated as an opaque value.

3. Extended NLRI Encodings

In order to carry the Path Identifier in an UPDATE message, the existing NLRI encodings are extended by prepending the Path Identifier field, which is of four-octets.

For example, the NLRI encodings specified in [[RFC4271](#), [RFC4760](#)] are extended as the following:

```
+-----+
| Path Identifier (4 octets) |
+-----+
| Length (1 octet)         |
+-----+
| Prefix (variable)        |
+-----+
```

and the NLRI encoding specified in [[RFC3107](#)] is extended as the following:


```
+-----+
| Path Identifier (4 octets) |
+-----+
| Length (1 octet)         |
+-----+
| Label (3 octets)         |
+-----+
| ...                      |
+-----+
| Prefix (variable)        |
+-----+
```

The usage of the extended NLRI encodings is specified in the Operation section.

4. ADD-PATH Capability

The ADD-PATH Capability is a new BGP capability [[RFC5492](#)]. The Capability Code for this capability is specified in the IANA Considerations section of this document. The Capability Length field of this capability is variable. The Capability Value field consists of one or more of the following tuples:

```
+-----+
| Address Family Identifier (2 octets) |
+-----+
| Subsequent Address Family Identifier (1 octet) |
+-----+
| Send/Receive (1 octet)              |
+-----+
```

The meaning and use of the fields are as follows:

Address Family Identifier (AFI):

This field is the same as the one used in [[RFC4760](#)].

Subsequent Address Family Identifier (SAFI):

This field is the same as the one used in [[RFC4760](#)].

Send/Receive:

This field indicates whether the sender is (a) willing to

receive multiple paths from its peer (value 1), (b) would like to send multiple paths to its peer (value 2), or (c) both (value 3) for the <AFI, SAFI>.

5. Operation

The Path Identifier specified in the previous section can be used to advertise multiple paths for the same address prefix without subsequent advertisements replacing the previous ones. Apart from the fact that this is now possible, the route advertisement rules of [[RFC4271](#)] are not changed. In particular, a new advertisement for a given address prefix and a given path identifier replaces a previous advertisement for the given address prefix and the given path identifier.

A BGP speaker that is willing to receive multiple paths from its peer, or would like to send multiple paths to its peer, SHOULD advertise the ADD-PATH Capability to the peer using BGP Capabilities advertisement [[RFC5492](#)].

A BGP speaker MUST follow the existing procedures in generating an UPDATE message for a particular <AFI, SAFI> to a peer unless the BGP speaker advertises the ADD-PATH Capability to the peer indicating its desire to send multiple paths for the <AFI, SAFI>, and also receives the ADD-PATH Capability from the peer indicating its willingness to receive multiple paths for the <AFI, SAFI>, in which case the speaker MUST generate a route update for the <AFI, SAFI> based on the combination of the address prefix and the Path Identifier, and use the extended NLRI encodings specified in this document. The peer SHALL act accordingly in processing an UPDATE message related to a particular <AFI, SAFI>.

As the Path Identifiers are locally assigned, and may or may not be persistent across a control plane restart of a BGP speaker, an implementation SHOULD take special care so that the underlying forwarding plane of a "Receiving Speaker" as described in [[RFC4724](#)] is not affected during the graceful restart of a BGP session.

6. Applications

The BGP extension specified in this document can be used by a BGP speaker to advertise multiple paths in certain applications. The availability of the additional paths can help reduce or eliminate persistent route oscillations [[RFC3345](#)]. It can also help with optimal routing and routing convergence in a network. The applications are detailed in separate documents.

7. Deployment Considerations

The extension proposed in this document provides a mechanism for a BGP speaker to advertise multiple paths over a BGP session. Care needs to be taken in its deployment to ensure consistent routing and forwarding in a network, the details of which will be described in separate application documents.

8. IANA Considerations

IANA has assigned capability number 69 for the ADD-PATH Capability described in this document. This registration is in the BGP Capability Codes registry.

9. Security Considerations

This document introduces no new security concerns to BGP or other specifications referenced in this document.

10. Acknowledgments

We would like to thank David Cook and Naiming Shen for their contributions to the design and development of the extension.

Many people have made valuable comments and suggestions, including Rex Fernando, Eugene Kim, Danny McPherson, Dave Meyer, Pradosh Mohapatra, Keyur Patel, Robert Raszuk, Eric Rosen, Srihari Sangli, Dan Tappan, and Mark Turner.

11. References

11.1. Normative References

[RFC4271] Rekhter, Y., T. Li, and S. Hares, "A Border Gateway Protocol 4 (BGP-4)," [RFC 4271](#), January 2006.

[RFC5492] Scudder, J. and R. Chandra, "Capabilities Advertisement with BGP-4", [RFC 5492](#), February 2009.

[RFC4760] Bates, T., Chandra, R., Rekhter, Y., and D. Katz, "Multiprotocol Extensions for BGP-4", [RFC 4760](#), January 2007.

[RFC3107] Rekhter, R. and E. Rosen, "Carrying Label Information in BGP-4," [RFC 3107](#), May 2001.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels," [RFC 2119](#), [BCP 14](#), March 1997.

[RFC4724] Sangli, S., E. Chen, R. Fernando, J. Scudder, and Y. Rekhter, "Graceful Restart Mechanism for BGP", [RFC 4724](#), January 2007.

11.2. Informative References

[RFC3345] McPherson, D., V. Gill, D. Walton, and A. Retana, "Border Gateway Protocol (BGP) Persistent Route Oscillation Condition", [RFC 3345](#), August 2002.

12. Authors' Addresses

Daniel Walton
Cisco Systems, Inc.
7025 Kit Creek Rd.
Research Triangle Park, NC 27709

Email: dwalton@cisco.com

Alvaro Retana
Hewlett-Packard Co.
2610 Wycliff Road
Raleigh, NC 27607

Email: alvaro.retana@hp.com

Enke Chen
Cisco Systems, Inc.
170 W. Tasman Dr.
San Jose, CA 95134

Email: enkechen@cisco.com

John Scudder
Juniper Networks

Email: jgs@juniper.net