

Internet Engineering Task Force (IETF)  
Request for Comments: 7313  
Updates: 2918  
Category: Standards Track  
ISSN: 2070-1721

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July 2014

## Enhanced Route Refresh Capability for BGP-4

### Abstract

In this document, we enhance the existing BGP route refresh mechanisms to provide for the demarcation of the beginning and the ending of a route refresh. The enhancement can be used to facilitate correction of BGP Routing Information Base (RIB) inconsistencies in a non-disruptive manner. This document updates RFC 2918.

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This is an Internet Standards Track document.

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## 1. Introduction

It is sometimes necessary to perform routing consistency validations such as checking for possible missing route withdrawals between BGP speakers [RFC4271]. Currently, such validations typically involve offline, manual operations that can be tedious and time-consuming.

In this document, we enhance the existing BGP route refresh mechanisms [RFC2918] to provide for the demarcation of the beginning and the ending of a route refresh (which refers to the complete re-advertisement of the Adj-RIB-Out to a peer, subject to routing policies). The enhancement can be used to facilitate online, non-disruptive consistency validation of BGP routing updates.

This document updates [RFC2918] by redefining a field in the ROUTE-REFRESH message that was previously designated as Reserved.

## 2. 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 [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. Protocol Extensions

The BGP protocol extensions introduced in this document include the definition of a new BGP capability, named "Enhanced Route Refresh Capability", and the specification of the message subtypes for the ROUTE-REFRESH message.

### 3.1. Enhanced Route Refresh Capability

The "Enhanced Route Refresh Capability" is a new BGP capability [RFC5492]. IANA has assigned a Capability Code of 70 for this capability. The Capability Length field of this capability is zero.

By advertising this capability to a peer, a BGP speaker conveys to the peer that the speaker supports the message subtypes for the ROUTE-REFRESH message and the related procedures described in this document.

### 3.2. Subtypes for ROUTE-REFRESH Message

The "Reserved" field of the ROUTE-REFRESH message specified in [RFC2918] is redefined as the "Message Subtype" with the following values:

- 0 - Normal route refresh request [RFC2918]  
with/without Outbound Route Filtering (ORF) [RFC5291]
- 1 - Demarcation of the beginning of a route refresh  
(BoRR) operation
- 2 - Demarcation of the ending of a route refresh  
(EoRR) operation
- 255 - Reserved

The remaining values of the message subtypes are reserved for future use; see Section 6 ("IANA Considerations"). The use of the new message subtypes is described in Section 4 ("Operation").

## 4. Operation

A BGP speaker that supports the message subtypes for the ROUTE-REFRESH message and the related procedures SHOULD advertise the "Enhanced Route Refresh Capability".

The following procedures are applicable only if a BGP speaker has received the "Enhanced Route Refresh Capability" from a peer.

Before the speaker starts a route refresh that is either initiated locally, or in response to a "normal route refresh request" from the peer, the speaker MUST send a BoRR message. After the speaker completes the re-advertisement of the entire Adj-RIB-Out to the peer, it MUST send an EoRR message.

Conceptually, the "entire Adj-RIB-Out" for a peer in this section refers to all the route entries in the "Adj-RIB-Out" for the peer at the start of the route refresh operation. These route entries comprise both the reachability as well as unreachability information.

When a route entry in the "Adj-RIB-Out" changes, only the modified route entry needs to be advertised.

In processing a ROUTE-REFRESH message from a peer, the BGP speaker MUST examine the "message subtype" field of the message and take the appropriate actions. The message processing rules for ROUTE-REFRESH message with subtype of 0 are described in [RFC2918] and [RFC5291]. A BGP speaker can receive a BoRR message from a peer at any time, either as a result of a peer responding to a ROUTE-REFRESH message, or as a result of a peer unilaterally initiating a route refresh. When a BGP speaker receives a BoRR message from a peer, it MUST mark all the routes with the given Address Family Identifier and Subsequent Address Family Identifier, <AFI, SAFI> [RFC2918], from that peer as stale. As it receives routes from its peer's subsequent Adj-RIB-Out re-advertisement, these replace any corresponding stale routes. When a BGP speaker receives an EoRR message from a peer, it MUST immediately remove any routes from the peer that are still marked as stale for that <AFI, SAFI>. Such purged routes MAY be logged for future analysis. A BGP speaker MAY ignore any EoRR message received without a prior receipt of an associated BoRR message. Such messages MAY be logged for future analysis.

An implementation MAY impose a locally configurable upper bound on how long it would retain any stale routes. Once the upper bound is reached, the implementation MAY remove any routes from the peer that are still marked as stale for that <AFI, SAFI> without waiting for an EoRR message.

The following procedures are specified in order to simplify the interaction with the BGP Graceful Restart [RFC4724]. In particular, these procedures ensure that End-of-RIB (EoR) defined in Graceful Restart and EoRR as defined in this specification are kept separate, thereby avoiding any premature cleanup of stale routes. For a BGP speaker that supports the BGP Graceful Restart, it MUST NOT send a BoRR for an <AFI, SAFI> to a neighbor before it sends the EoR for the <AFI, SAFI> to the neighbor. A BGP speaker that has received the Graceful Restart Capability from its neighbor MUST ignore any BoRRs for an <AFI, SAFI> from the neighbor before the speaker receives the EoR for the given <AFI, SAFI> from the neighbor. The BGP speaker SHOULD log an error of the condition for further analysis.

## 5. Error Handling

This document defines a new NOTIFICATION error code:

Error Code	Name
7	ROUTE-REFRESH Message Error

The following error subcode is defined as well:

Subcode	Name
1	Invalid Message Length

The error handling specified in this section is applicable only when a BGP speaker has received the "Enhanced Route Refresh Capability" from a peer.

If the length, excluding the fixed-size message header, of the received ROUTE-REFRESH message with Message Subtype 1 and 2 is not 4, then the BGP speaker MUST send a NOTIFICATION message with the Error Code of "ROUTE-REFRESH Message Error" and the subcode of "Invalid Message Length". The Data field of the NOTIFICATION message MUST contain the complete ROUTE-REFRESH message.

When the BGP speaker receives a ROUTE-REFRESH message with a "Message Subtype" field other than 0, 1, or 2, it MUST ignore the received ROUTE-REFRESH message. It SHOULD log an error for further analysis.

## 6. IANA Considerations

This document defines the Enhanced Route Refresh Capability for BGP. In the "Capability Codes" registry, IANA has assigned it value 70, referencing this document.

This document also defines two new subcodes for the Route Refresh message. They have been registered with the IANA in a new registry as follows:

Under "Border Gateway Protocol (BGP) Parameters":  
 Registry: "BGP Route Refresh Subcodes"  
 Reference: [RFC7313]  
 Registration Procedure(s): Values 0-127 Standards Action,  
 values 128-254 First Come First Served

Value	Code	Reference
0	Route-Refresh	[RFC2918], [RFC5291]
1	BoRR	[RFC7313]
2	EoRR	[RFC7313]
3-254	Unassigned	
255	Reserved	[RFC7313]

In addition, this document defines a NOTIFICATION error code and an error subcode related to the ROUTE-REFRESH message. IANA has changed the name of the "BGP Error Codes" to "BGP Error (Notification) Codes" and added this document as a reference. IANA has allocated a new error code from that registry with the name "ROUTE-REFRESH Message Error", referencing this document.

IANA has created a new registry for the error subcodes as follows:

Under "Border Gateway Protocol (BGP) Parameters",  
 under "BGP Error Subcodes":  
 Registry: "BGP ROUTE-REFRESH Message Error subcodes"  
 Reference: [RFC7313]  
 Registration Procedure(s): Values 0-127 Standards Action,  
 values 128-255 First Come First Served

Value	Name	Reference
0	Reserved	[RFC7313]
1	Invalid Message Length	[RFC7313]
2-255	Unassigned	

## 7. Security Considerations

Security considerations are given in [RFC4272] , but they do not cover Route-Refresh and many other BGP extensions. This document does not significantly change the underlying security issues regarding Route-Refresh, although improved error handling may aid operational security.

## 8. Acknowledgements

The authors would like to thank Pedro Marques, Pradosh Mohapatra, Robert Raszuk, Pranav Mehta, Shyam Sethuram, Bruno Decraene, Martin Djernaes, Jeff Haas, Ilya Varlashkin, Rob Shakir, Paul Jakma, Jie Dong, Qing Zeng, Albert Tian, Jakob Heitz, and Chris Hall for their review and comments. The authors would like to thank John Scudder for the review and contribution to this document.

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