IDR Workgroup
Internet-Draft
Intended status: Standards Track
Expires: 12 November 2022

A. Retana
Y. Qu
Futurewei Technologies, Inc.
J. Tantsura
Microsoft
11 May 2022

Use of Streams in BGP over QUIC
draft-retana-idr-bgp-quic-stream-02

Abstract

This document specifies the use of QUIC Streams to support multiple BGP sessions over one connection in order to achieve high resiliency.

Status of This Memo

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

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at https://datatracker.ietf.org/drafts/current/.

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."

This Internet-Draft will expire on 12 November 2022.

Table of Contents

1. Introduction

The Border Gateway Protocol (BGP) [RFC4271] uses TCP as its transport protocol. BGP establishes peer relationships between routers using a TCP session on port 179. TCP also provides reliable packet communication.

Multiprotocol Extensions for BGP-4 (MP-BGP) [RFC4760] allow BGP to carry information for multiple Network Layer protocols. However, only a single TCP connection can reach the Established state between a pair of peers [RFC4271].

As pointed out by [I-D.ietf-idr-bgp-multisession], there are some disadvantages of using a single BGP session:

> A common criticism of BGP is the fact that most malformed messages cause the session to be terminated. While this behavior is necessary for protocol correctness, one may observe that the protocol machinery of a given implementation may only be defective with respect to a given AFI/SAFI. Thus, it would be desirable to

allow the session related to that family to be terminated while leaving other AFI/SAFI unaffected. As BGP is commonly deployed, this is not possible.

A second criticism of BGP is that it is difficult or in some cases impossible to manage control plane resource contention when BGP is used to support diverse services over a single session. In contrast, if a single BGP session carries only information for a single service (or related set of services) it may be easier to manage such contention.

QUIC [RFC9000] is a UDP-based multiplexed and secure transport protocol. QUIC can provide low latency and encrypted transport with resilient connections. [I-D.chen-idr-bgp-over-quic] specifies the procedure to use BGP over QUIC. Complementary to it, this document specifies a mechanism to support multiple BGP sessions using QUIC streams.

Each BGP session operates independently. Thus, an error on one session has no impact on any other session. The Network Layer protocol(s) negotiated in the BGP OPEN message distinguish the sessions.

1.1. Requirements Language

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.

2. Multiple BGP Sessions

2.1. Multiple QUIC Streams

QUIC [RFC9000] is a UDP-based secure transport protocol that provides connection-oriented and stateful interaction between a client and server. It integrates TLS and allows the exchange of application data as soon as possible.

In QUIC, application protocols exchange information via streams, and multiple streams can be multiplexed onto an underlying connection. Each stream is a separate unidirectional or bidirectional channel of "order stream of bytes." Moreover, each stream has flow control which limits bytes sent on a stream, together with flow control of the connection.

2.2. Multiple BGP Sessions Using QUIC Streams

BGP over QUIC [I-D.chen-idr-bgp-over-quic] proposes different options to map streams. This document specifies a complementary and backward compatible mechanism to establish multiple BGP sessions using QUIC streams. An implementation can assign one or more Network Layer protocols to a BGP session.

A QUIC stream is created by sending a BGP OPEN message, and each stream MUST be bidirectional as described in Section 2.1 of [RFC9000]. In addition, the corresponding stream MUST end (clean termination) as described in Section 2.4 of [RFC9000] when a BGP session is terminated.

Section 5 describes the Connection Collision Detection procedure to be used with streams. Each BGP session operates independently, which means critical conditions (such as a malformed message) in one session won't affect others.

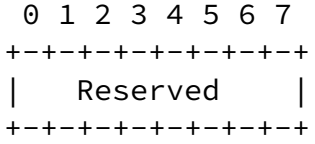
3. MultiStream Capability

The MultiStream Capability (MSC) is defined to indicate that a BGP speaker supports multiple sessions as specified in this document. The capability [RFC5492] is defined as follows:

Capability code (1 octet): TBD1

Capability length (1 octet): 1

Capability value (1 octet): flag field reserved.



Flags: bitfield - MUST be set to zero and ignored by the receiver.

The MSC only applies when using BGP over QUIC [I-D.chen-idr-bgp-over-quic]. It MUST be included in all OPEN messages. It MUST be ignored otherwise.

This specification applies only if both peers advertise the MSC during the establishment of the "initial session." Otherwise, the processes specified in [I-D.chen-idr-bgp-over-quic] MUST be followed. In particular, if a peer that advertises the MSC doesn't receive an OPEN message with the MSC from its peer, it SHOULD NOT terminate the session.

Using the MSC allows peers to establish multiple BGP sessions, one per QUIC stream. Each new BGP session is established using a separate OPEN message [RFC4271] and MUST include the MSC. If both peers exchange the MSC in the "initial session," they MUST include it when establishing other sessions. Otherwise, the new session MUST be terminated, and the Error Subcode MUST be set to MultiStream Conflict (TBD2), defined in Section 4.

Once a BGP session is established, it follows the procedures specified in [RFC4271].

4. Error Handling

OPEN message error handling is defined in section 6.2 of [RFC4271]. This document introduces the following OPEN Message Error subcodes:

TBD2 - MultiSession Conflict - Used if the MSC is exchanged by both peers in the "initial session" but is not present when establishing a new session.

TBD3 - Session Capability Mismatch - Used if a BGP speaker terminates a session in the case where it sends an OPEN message with the MSC but receives an OPEN message without it.

TBD4 - Network Layer Protocol Mismatch - Used if a BGP session has already been established for a signaled Network Layer Protocol, either individually or as part of a set.

Section 3 recommends not terminating a session when only one peer supports the MSC. If such a BGP speaker does terminate the session, the Error Subcode MUST be set to Session Capability Mismatch (TBD3).

Any individual BGP session can be terminated as specified in [RFC4486]. If multiple sessions are to be terminated, then the procedure MUST be followed for each one.

5. BGP Session Establishment and Collision Avoidance

Before creating a new session, a BGP speaker should check that no session exists for the same Network Layer protocol(s). If a session already exists, the BGP speaker SHOULD NOT attempt to create a new one.

If a pair of BGP speakers try to establish a BGP session with each other simultaneously, then two parallel sessions will be formed. In the case of BGP over QUIC, the IP addresses of the connection cannot be used to resolve collisions when using multiple streams.

To avoid connection collisions, a session is identified by the My Autonomous System and BGP Identifier fields pair in the OPEN message. In this context, a connection collision is the attempt to open a BGP

session for which the set of Network Layer protocols is the same. One of the connections MUST be closed.

The connection collision is resolved using the extension specified in [RFC6286]. In other words, the session with the higher-valued BGP Identifier is preserved [RFC4271]. If the BGP Identifiers are identical, then the session with the larger ASN is preserved [RFC6286].

Upon receiving an OPEN message, the local system MUST examine all of its sessions in the OpenConfirm state. A BGP speaker MAY also examine sessions in an OpenSent state if it knows the BGP Identifier of the peer by means outside of the protocol. If among these sessions, there is one to a remote BGP speaker whose BGP Identifier and ASN pair equals the one in the OPEN message, and this session collides with the connection over which the OPEN message is received, then the local system performs the following collision resolution procedure:

1) The BGP Identifier of the local system is compared to the BGP Identifier of the remote system (as specified in the OPEN message). Comparing BGP Identifiers is done by converting them to host byte order and treating them as 4-octet unsigned integers.

2) If the value of the local BGP Identifier is less than the remote one, the local system closes the BGP connection that already exists (the one that is already in the OpenConfirm state) and accepts the BGP connection initiated by the remote system.

2a) Otherwise, the local system closes the newly created BGP connection (the one associated with the recently received OPEN message) and continues to use the existing one (the one that is already in the OpenConfirm state).

3) If the BGP Identifiers of the peers involved in the connection collision are identical, then the session initiated by the BGP speaker with the larger AS number is preserved.

Unless allowed via configuration, a connection collision with an existing BGP session in the Established state causes the closing of the newly created session.

Closing the BGP session (that results from the collision resolution procedure) is accomplished by sending the NOTIFICATION message with the Error Code Cease, Subcode Connection Collision Resolution (7) [RFC4486].

The remainder of the process is as specified in [RFC4271].

6. Modifications to FSM

The modifications to BGP FSM is described in section 4.4 of [I-D.chen-idr-bgp-over-quic]. For simplicity and security reason, it is suggested that 1-RTT is used.

This specification does not modify BGP FSM, but the collision handling procedure should be replaced with the procedure described in this document.

7. Operational Considerations

7.1. Backward Compatibility

A BGP speaker that doesn't understand the MSC will ignore it [RFC5492]. Section 3 recommends not terminating a session when only one peer supports the MSC. Instead, the operation will continue as specified in [I-D.chen-idr-bgp-over-quic].

7.2. Session Prioritization

One of the drawbacks of a single BGP session is that control plane messages for all supported Network Layer protocols use the same connection, which may cause resource contention.

QUIC [RFC9000] does not provide a mechanism for exchanging

prioritization information. Instead, it recommends that implementations provide ways for an application to indicate the relative priority of streams, in this case, mapped to BGP sessions. An operator should prioritize BGP sessions (streams) that carry critical control plane information if the functionality is available. The definition of this functionality and the determination of the importance of a BGP session are both outside the scope of this document.

An example implementation is to have four priority (0-3) defined, and smaller number means higher priority. Each AFI/SAFI should be assigned a default priority and optional configuration to modify the default value. For example, IPv4 and IPv6 unicast AFI/SAFI (1/1 and 2/1) may have priority of 1, while BGP-LS (16388/71 and 16388/72) may have a priority of 3, and BGP FlowSpec (1/133 and 1/134) may have a priority of 4.

7.3. Other Considerations

A configuration command SHOULD be implemented to allow grouping of some AFI/SAFIs into one session.

8. Security Considerations

This document specifies how to establish multiple BGP sessions over a single QUIC connection. The general operation of BGP is not changed, nor is its security model. The security considerations of [I-D.chen-idr-bgp-over-quic] apply. Also, the non-TCP-related considerations of [RFC4271], [RFC4272], and [RFC7454] apply to the specification in this document.

By separating the control plane traffic over multiple sessions, the effect of a session-based vulnerability is reduced; only a single session is affected and not the whole connection. The result is increased resiliency.

On the other hand, a high number of BGP sessions may result in higher resource utilization and the risk of depletion. Also, more sessions may imply additional configuration and operational complexity. However, this risk is mitigated by the fact that BGP sessions typically require explicit configuration by the operator.

9. IANA Considerations

IANA is asked to assign a new Capability Code for the MultiStream Capability (Section 3) as follows:

Value	Description	Reference	Change Controller
TBD1	MultiStream Capability	[This Document]	IETF

Table 1: MultiStream Capability

IANA is asked to assign three values from the OPEN Message Error subcodes registry as follows:

Value	Name	Reference
TBD2	MultiSession Conflicty	[This Document]
TBD3	Session Capability Mismatch	[This Document]
TBD4	Network Layer Protocol Mismatch	[This Document]

Table 2

10. Acknowledgement

This document references the text and procedures defined in [I-D.ietf-idr-bgp-multisession], and we are grateful for their contributions.

The authors would like to thank xx for review and comments.

11. References

11.1. Normative References

[I-D.chen-idr-bgp-over-quic]
Chen, S., Zhang, Y., Wang, H., and Z. Li, "BGP Over QUIC", Work in Progress, Internet-Draft, draft-chen-idr-bgp-over-quic-00, 3 June 2021, <https://www.ietf.org/archive/id/draft-chen-idr-bgp-over-quic-00.txt>.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC4271] Rekhter, Y., Ed., Li, T., Ed., and S. Hares, Ed., "A Border Gateway Protocol 4 (BGP-4)", RFC 4271, DOI 10.17487/RFC4271, January 2006, <https://www.rfc-editor.org/info/rfc4271>.

[RFC4486] Chen, E. and V. Gillet, "Subcodes for BGP Cease Notification Message", RFC 4486, DOI 10.17487/RFC4486, April 2006, <https://www.rfc-editor.org/info/rfc4486>.

[RFC5492] Scudder, J. and R. Chandra, "Capabilities Advertisement with BGP-4", RFC 5492, DOI 10.17487/RFC5492, February 2009, <https://www.rfc-editor.org/info/rfc5492>.

[RFC6286] Chen, E. and J. Yuan, "Autonomous-System-Wide Unique BGP Identifier for BGP-4", RFC 6286, DOI 10.17487/RFC6286, June 2011, <https://www.rfc-editor.org/info/rfc6286>.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, DOI 10.17487/RFC8174, May 2017, <https://www.rfc-editor.org/info/rfc8174>.

[RFC9000] Iyengar, J., Ed. and M. Thomson, Ed., "QUIC: A UDP-Based Multiplexed and Secure Transport", RFC 9000, DOI 10.17487/RFC9000, May 2021, <https://www.rfc-editor.org/info/rfc9000>.

11.2. Informative References

[I-D.ietf-idr-bgp-multisession] Scudder, J., Appanna, C., and I. Varlashkin, "Multisession BGP", Work in Progress, Internet-Draft, draft-ietf-idr-bgp-multisession-07, 13 September 2012, <http://www.ietf.org/internet-drafts/draft-ietf-idr-bgp-multisession-07.txt>.

[RFC4272] Murphy, S., "BGP Security Vulnerabilities Analysis", RFC 4272, DOI 10.17487/RFC4272, January 2006, <https://www.rfc-editor.org/info/rfc4272>.

[RFC4760] Bates, T., Chandra, R., Katz, D., and Y. Rekhter, "Multiprotocol Extensions for BGP-4", RFC 4760, DOI 10.17487/RFC4760, January 2007, <https://www.rfc-editor.org/info/rfc4760>.

[RFC7454] Durand, J., Pepelnjak, I., and G. Doering, "BGP Operations and Security", BCP 194, RFC 7454, DOI 10.17487/RFC7454, February 2015, <https://www.rfc-editor.org/info/rfc7454>.

Authors' Addresses

Alvaro Retana
Futurewei Technologies, Inc.
2330 Central Expressway
Santa Clara, CA 95050
United States of America
Email: aretana@futurewei.com

Yingzhen Qu
Futurewei Technologies, Inc.
2330 Central Expressway
Santa Clara, CA 95050
United States of America
Email: yingzhen.qu@futurewei.com

Jeff Tantsura
Microsoft
United States of America
Email: jefftant.ietf@gmail.com