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Using QUIC Datagrams with HTTP/3

Abstract

The QUIC DATAGRAM extension provides application protocols running over QUIC with a mechanism to send unreliable data while leveraging the security and congestion-control properties of QUIC. However, QUIC DATAGRAM frames do not provide a means to demultiplex application contexts. This document defines how to use QUIC DATAGRAM frames when the application protocol running over QUIC is HTTP/3 by adding an identifier at the start of the frame payload.

Discussion of this work is encouraged to happen on the QUIC IETF mailing list (quic@ietf.org) or on the GitHub repository which contains the draft: <https://github.com/DavidSchinazi/draft-h3-datagram>.

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1. Introduction

The QUIC DATAGRAM extension [[DGRAM](#)] provides application protocols running over QUIC [[QUIC](#)] with a mechanism to send unreliable data while leveraging the security and congestion-control properties of QUIC. However, QUIC DATAGRAM frames do not provide a means to demultiplex application contexts. This document defines how to use QUIC DATAGRAM frames when the application protocol running over QUIC is HTTP/3 [[H3](#)] by adding an identifier at the start of the frame payload.

This design mimics the use of Stream Types in HTTP/3, which provide a demultiplexing identifier at the start of each unidirectional stream.

Discussion of this work is encouraged to happen on the QUIC IETF mailing list (quic@ietf.org) or on the GitHub repository which contains the draft: <https://github.com/DavidSchinazi/draft-h3-datagram>.

1.1. Conventions and Definitions

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. HTTP/3 DATAGRAM Frame Format

When used with HTTP/3, the Datagram Data field of QUIC DATAGRAM frames uses the following format:

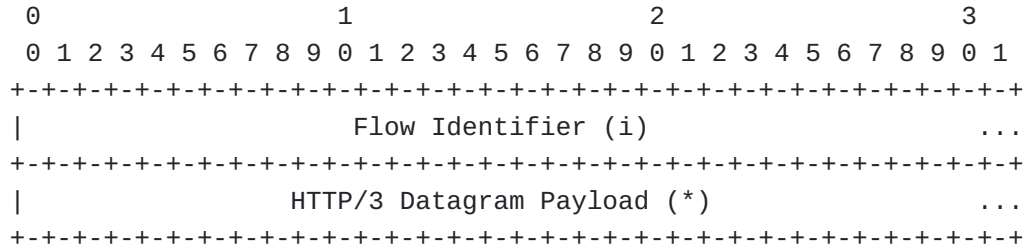


Figure 1: HTTP/3 DATAGRAM Frame Format

Flow Identifier: A variable-length integer indicating the Flow Identifier of the datagram (see [Section 2.1](#)).

HTTP/3 Datagram Payload: The payload of the datagram, whose semantics are defined by individual applications.

2.1. Flow Identifiers

Flow identifiers represent bidirectional flows of datagrams within a single QUIC connection. These are conceptually similar to streams in the sense that they allow multiplexing of application data. Of course flows lack any of the ordering or reliability guarantees of streams.

Beyond this, a sender SHOULD ensure that DATAGRAM frames within a single flow are transmitted in order relative to one another. If multiple DATAGRAM frames can be packed into a single QUIC packet, the sender SHOULD group them by flow identifier to promote fate-sharing within a specific flow and improve the ability to process batches of datagram messages efficiently on the receiver.

3. Flow Identifier Allocation

Implementations of HTTP/3 that support the DATAGRAM extension MUST provide a flow identifier allocation service. That service will allow applications co-located with HTTP/3 to request a unique flow identifier that they can subsequently use for their own purposes. The HTTP/3 implementation will then parse the flow identifier of incoming DATAGRAM frames and use it to deliver the frame to the appropriate application.

Even flow identifiers are client-initiated, while odd flow identifiers are server-initiated. This means that an HTTP/3 client implementation of the flow identifier allocation service MUST only

provide even identifiers, while a server implementation MUST only provide odd identifiers. Note that, once allocated, any flow identifier can be used by both client and server - only allocation carries separate namespaces to avoid requiring synchronization.

4. The H3_DATAGRAM HTTP/3 SETTINGS Parameter

Implementations of HTTP/3 that support this mechanism can indicate that to their peer by sending the H3_DATAGRAM SETTINGS parameter with a value of 1. The value of the H3_DATAGRAM SETTINGS parameter MUST be either 0 or 1. A value of 0 indicates that this mechanism is not supported. An endpoint that receives the H3_DATAGRAM SETTINGS parameter with a value that is neither 0 or 1 MUST terminate the connection with error H3_SETTINGS_ERROR.

And endpoint that sends the H3_DATAGRAM SETTINGS parameter with a value of 1 MUST send the max_datagram_frame_size QUIC Transport Parameter [DGRAM]. An endpoint that receives the H3_DATAGRAM SETTINGS parameter with a value of 1 on a QUIC connection that did not also receive the max_datagram_frame_size QUIC Transport Parameter MUST terminate the connection with error H3_SETTINGS_ERROR.

When clients use 0-RTT, they MAY store the value of the server's H3_DATAGRAM SETTINGS parameter. Doing so allows the client to use HTTP/3 datagrams in 0-RTT packets. When servers decide to accept 0-RTT data, they MUST send a H3_DATAGRAM SETTINGS parameter greater or equal to the value they sent to the client in the connection where they sent them the NewSessionTicket message. If a client stores the value of the H3_DATAGRAM SETTINGS parameter with their 0-RTT state, they MUST validate that the new value of the H3_DATAGRAM SETTINGS parameter sent by the server in the handshake is greater or equal to the stored value; if not, the client MUST terminate the connection with error H3_SETTINGS_ERROR.

5. Security Considerations

This document currently does not have additional security considerations beyond those defined in [QUIC] and [DGRAM].

6. IANA Considerations

This document will request IANA to register the following entry in the "HTTP/3 Settings" registry:

Setting Name	Value	Specification	Default
H3_DATAGRAM	0x276	This Document	0

7. Normative References

- [DGRAM] Pauly, T., Kinnear, E., and D. Schinazi, "An Unreliable Datagram Extension to QUIC", Work in Progress, Internet-Draft, draft-ietf-quic-datagram-01, 24 August 2020, <<http://www.ietf.org/internet-drafts/draft-ietf-quic-datagram-01.txt>>.
- [H3] Bishop, M., "Hypertext Transfer Protocol Version 3 (HTTP/3)", Work in Progress, Internet-Draft, draft-ietf-quic-http-31, 24 September 2020, <<http://www.ietf.org/internet-drafts/draft-ietf-quic-http-31.txt>>.
- [QUIC] Iyengar, J. and M. Thomson, "QUIC: A UDP-Based Multiplexed and Secure Transport", Work in Progress, Internet-Draft, draft-ietf-quic-transport-31, 24 September 2020, <<http://www.ietf.org/internet-drafts/draft-ietf-quic-transport-31.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>>.
- [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>>.

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