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## **A Sequence Number Extension for HTTP Datagrams**

### **Abstract**

This document defines a sequence number extension to HTTP datagrams used to carry proxied UDP payload or IP datagrams. This extension is useful when HTTP datagrams are transported on top of a multipath protocol that does not ensure in-order delivery as it allows a masque endpoint to implement reordering logic specific to its needs.

### **About This Document**

This note is to be removed before publishing as an RFC.

Status information for this document may be found at <https://datatracker.ietf.org/doc/draft-ihlar-masque-datagram-numbers/>.

Discussion of this document takes place on the WG Working Group mailing list (<mailto:masque@ietf.org>), which is archived at <https://mailarchive.ietf.org/arch/browse/masque/>. Subscribe at <https://www.ietf.org/mailman/listinfo/masque/>.

Source for this draft and an issue tracker can be found at <https://github.com/ihlar/draft-ihlar-masque-datagram-numbers>.

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### 1. Introduction

This document defines a sequence number extension to HTTP datagrams [RFC9297]. Sequence numbers at the HTTP datagram layer allows a receiving endpoint to implement arbitrary reordering logic, which can be useful when proxied datagrams are sent over multiple paths simultaneously, such as when using the multipath QUIC extension [MPQUIC]. The extension applies to HTTP datagrams when they are used with the extended CONNECT method and the protocols are either connect-ip [CONNECT-IP] or connect-udp [RFC9298].

### 2. 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.

### 3. Sequence Number Datagram Extension

The Sequence Number datagram extension prepends sequence numbers to HTTP datagrams. Datagram sequence numbers are unsigned integers initiated to 0 and are incremented by 1 for every transmitted HTTP datagram, except for when the integer overflows and is reset to 0. The extension can be used with the HTTP CONNECT method when the :protocol pseudo header is equal to "connect-udp" or "connect-ip". Use of the sequence number extension is determined per request, and the scope of a datagram sequence is limited to a single request stream. Datagrams with different quarter stream IDs have distinct sequence number spaces.

#### 3.1. Registration

Endpoints indicate support for Sequence Number Datagram type by including the boolean-valued Item Structured Field "DG-Sequence: ?1" in the HTTP Request and Response headers (See [Section 3.3.6](#) of [\[RFC8941\]](#) for information about the boolean format.).

A datagram sequence is registered by sending a REGISTER\_SEQUENCE\_CONTEXT capsule. An endpoint **MAY** send multiple REGISTER\_SEQUENCE\_CONTEXT capsules in order to support multiple payload formats.

```
REGISTER_SEQUENCE_CONTEXT Capsule {  
  Type (i) = REGISTER_SEQUENCE_CONTEXT,  
  Length (i),  
  Context ID (i),  
  Payload Context ID (i),  
  [Representation (8)]  
}
```

The capsule has the following fields:

Context ID: Identifies a sequence number context. The value **MUST** be unique within the scope of a request stream.

Payload Context ID: Identifies the type of payload that follows a sequence number. The value **MUST** be equal to a previously registered Context ID.

Representation: The size in bits of the unsigned interger used to encode the sequence number, the value **MUST** be one of the following: 8, 16, 32 or 64. This field **MUST** be present in the first REGISTER\_SEQUENCE\_CONTEXT capsule sent on a request stream and it **MAY** be omitted in subsequent capsules.

### 3.2. Datagram Format

A Sequence Number Datagram has the following format:

```
Sequence Number Datagram {  
  Context ID (i),  
  Sequence Number (8..64),  
  Payload (..)  
}
```

Context ID: This value indicates that the datagram contains a sequence number and the format of the data that follows the sequence number.

Sequence Number: Unsigned integer of size specified in registration, indicates the transmission order of the datagram.

Payload: Datagram payload.

### 4. Security Considerations

Although the usage of the sequence number is not defined by this specification, there is an underlying assumption that the sequence numbers are assigned in transmission order of HTTP datagram sent in the context of this HTTP request. Any attacker that can break that assumption will thus impact any node that uses the sequence number. By altering the sequence number in HTTP datagrams, an attacker can impact how much data a receiver is buffering for the following purposes:

- \*Resource exhaustion attack by maximizing the amount of data buffered in each HTTP request context
- \*Introducing reordering, jitter and additional delay in the path properties for these datagram
- \*Cause the sequence number using node to drop some HTTP Datagrams by causing them to be so far reordered that some policy in the receiving node drops the datagram.

A malicious endpoint is more likely to mount a resource exhaustion attack, while HTTP intermediaries could be used by an third party attacker to impact the HTTP datagram flow between a source and a destination.

A user that buffers datagrams based on sequence numbers should ensure that they have protection against resource exhaustion attacks by limiting the size of their buffers.

## 5. IANA Considerations

### 5.1. Capsule types

This document adds following entries to the "HTTP Capsule Types" registry:

Capsule Type	Value	Specification
REGISTER_SEQUENCE_CONTEXT	TBD	(This document)

Table 1

### 5.2. HTTP headers

This document adds following entry to the "Hypertext Transfer Protocol (HTTP) Field Name Registry":

Field Name	Template	Status	Reference	Comments
DG-Sequence		permanent	(This document)	

Table 2

## 6. References

### 6.1. Normative References

[CONNECT-IP] Pauly, T., Schinazi, D., Chernyakhovsky, A., Kühlewind, M., and M. Westerlund, "Proxying IP in HTTP", Work in Progress, Internet-Draft, draft-ietf-masque-connect-ip-08, 1 March 2023, <<https://datatracker.ietf.org/doc/html/draft-ietf-masque-connect-ip-08>>.

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## 6.2. Informative References

[MPQUIC] Liu, Y., Ma, Y., De Coninck, Q., Bonaventure, O., Huitema, C., and M. Kühlewind, "Multipath Extension for QUIC", Work in Progress, Internet-Draft, draft-ietf-quic-multipath-03, 24 October 2022, <<https://datatracker.ietf.org/doc/html/draft-ietf-quic-multipath-03>>.

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