HTTP
Internet-Draft
Updates: ietf-httpbis-client-hints (if approved)
Intended status: Experimental
Expires: January 14, 2021

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July 13, 2020

Client Hint Reliability
draft-davidben-http-client-hint-reliability-00

Abstract

This document defines the Critical-CH HTTP response header, and the ACCEPT_CH HTTP/2 frame to allow HTTP servers to reliably specify their Client Hint preferences, with minimal performance overhead.

Status of This Memo

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

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This Internet-Draft will expire on January 14, 2021.

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1. Introduction

[I-D.ietf-httpbis-client-hints] defines a response header, Accept-CH, for servers to advertise a set of request headers used for proactive content negotiation. This allows clients to send request headers only when used, improving their performance overhead as well as reducing passive fingerprinting surface.

However, on the first HTTP request to a server, the client will not have received the Accept-CH header and may not take the server preferences into account. More generally, the server's configuration may have changed since the most recent HTTP request to the server. This document defines a pair of mechanisms to resolve this:

1. an HTTP response header, Critical-CH, for the server to instruct the client to retry the request

2. an alternate delivery mechanism for Accept-CH in HTTP/2 [RFC7540], which can avoid the performance hit of a retry in most cases

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.

This document uses the Augmented Backus-Naur Form (ABNF) notation of [RFC5234].

3. The Critical-CH Response Header Field

When a client requests a resource based on a missing or outdated Accept-CH value, it may not send a desired request header field. Neither client nor server has enough information to reliably and efficiently recover from this situation. The server can observe that the header is missing, but the client may not have supported the header, or may have chosen not to send it. Triggering a new request in these cases would risk an infinite loop or an unnecessary round-trip.

Conversely, the client can observe that a request header appears in the Accept-CH (Section 3.1 of [I-D.ietf-httpbis-client-hints]) and Vary (Section 7.1.4 of [RFC7231]) response header fields. However, retrying based on this information would waste resources if the resource only used the Client Hint as an optional optimization.

This document introduces critical Client Hints. These are the Client Hints which meaningfully change the resulting resource. For example, a server may use the Device-Memory Client Hint [DEVICE-MEMORY] to select simple and complex variants of a resource to different clients. Such a resource should be fetched consistently across page loads to avoid jarring user-visible switches.

The server specifies critical Client Hints with the Critical-CH response header field. It is a Structured Header [I-D.ietf-httpbis-header-structure] whose value MUST be an sf-list (Section 3.1 of [I-D.ietf-httpbis-header-structure]) whose members are tokens (Section 3.3.4 of [I-D.ietf-httpbis-header-structure]). Its ABNF is:

```
Critical-CH = sf-list
```

For example:

```
Critical-CH: Sec-CH-Example, Sec-CH-Example-2
```

Each token listed in the Critical-CH header SHOULD additionally be present in the Accept-CH and Vary response headers.

When a user agent receives an HTTP response containing a Critical-CH header, it first processes the Accept-CH header as described in Section 3.1 of [I-D.ietf-httpbis-client-hints]. It then performs the following steps:

1. If the request did not use a safe method (Section 4.2.1 of [RFC7231]), ignore the Critical-CH header and continue processing the response as usual.

2. If the response was already the result of a retry, ignore the Critical-CH header and continue processing the response as usual.

3. Determine the Client Hints that would have been sent given the updated Accept-CH value, incorporating the user agent's local policy and user preferences. See also Section 2.1 of [I-D.ietf-httpbis-client-hints].

4. Compare this result to the Client Hints which were sent. If any Client Hint listed in the Critical-CH header was not previously sent and would now have been sent, retry the request with the new preferences. Otherwise, continue processing the response as usual.

Note this procedure does not cause the user agent to send Client Hints it would not otherwise send.

3.1. Example

For example, if the user agent loads https://example.com with no knowledge of the server's Accept-CH preferences, it may send the following response:

```
GET / HTTP/1.1
Host: example.com

HTTP/1.1 200 OK
Content-Type: text/html
Accept-CH: Sec-CH-Example, Sec-CH-Example-2
Vary: Sec-CH-Example
Critical-CH: Sec-CH-Example
```

In this example, the server, across the whole origin, uses both Sec-CH-Example and Sec-CH-Example-2 Client Hints. However, this resource only uses Sec-CH-Example, which it considers critical.

The user agent now processes the Accept-CH header and determines it would have sent both headers. Sec-CH-Example is listed in Critical-CH, so the user agent retries the request, and receives a more specific response.

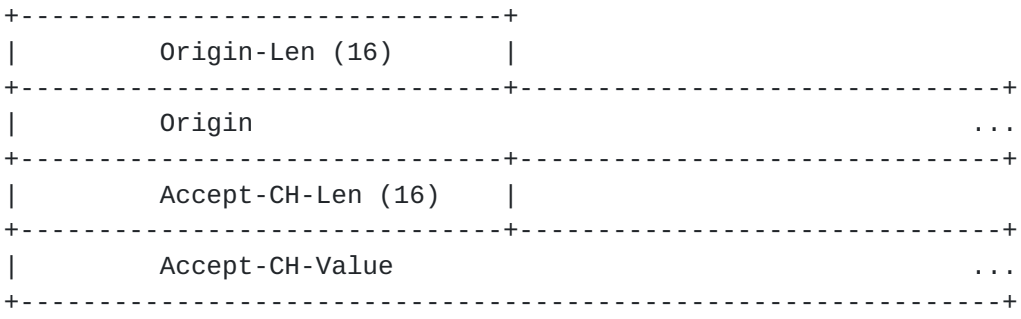
```
GET / HTTP/1.1
Host: example.com
Sec-CH-Example: 1
Sec-CH-Example-2: 2

HTTP/1.1 200 OK
Content-Type: text/html
Accept-CH: Sec-CH-Example, Sec-CH-Example-2
Vary: Sec-CH-Example
Critical-CH: Sec-CH-Example
```

4. The ACCEPT_CH HTTP/2 Frame

While Critical-CH header provides reliability, it requires a retry on some requests. This document additionally introduces the ACCEPT_CH HTTP/2 frame as an optimization so the server's Client Hint preferences are usually available before the client's first request.

[[TODO: Alternatively, is it time to revive draft-bishop-httpbis-extended-settings?]]

The ACCEPT_CH frame type is TBD (decimal TBD) and contains one or more entries, each consisting of a pair of length-delimited strings:



The fields are defined as follows:

Origin-Len: An unsigned, 16-bit integer indicating the length, in octets, of the Origin field.

Origin: A sequence of characters containing the ASCII serialization of an origin (Section 6.2 of [RFC6454]) that the sender is providing an Accept-CH value for.

Accept-CH-Len: An unsigned, 16-bit integer indicating the length, in octets, of the Accept-CH-Value field.

Accept-CH-Value: A sequence of characters containing the Accept-CH value for the corresponding origin. This value MUST satisfy the

Accept-CH ABNF defined in Section 3.1 of [I-D.ietf-httpbis-client-hints].

HTTP/2 Servers which request Client Hints SHOULD send an ACCEPT_CH frame as early as possible. Connections using TLS [RFC8446] which negotiate the Application Layer Protocol Settings (ALPS) [I-D.vvv-tls-alps] extension SHOULD include the ACCEPT_CH frame in the ALPS value as described in [I-D.vvv-httpbis-alps]. This ensures the information is available to the client when it makes the first request.

Clients MUST NOT send ACCEPT_CH frames. Servers which receive an ACCEPT_CH frame MUST respond with a connection error (Section 5.4.1 of [RFC7540]) of type PROTOCOL_ERROR.

ACCEPT_CH frames always apply to a single connection, never a single stream. The identifier in the ACCEPT_CH frame MUST be zero. The flags field of an ACCEPT_CH field is unused and MUST be zero. If a client receives an ACCEPT_CH frame whose stream identifier or flags field is non-zero, it MUST respond with a connection error of type PROTOCOL_ERROR.

4.1. Client Behavior

The client remembers the most recently received ACCEPT_CH frame for each connection. When it receives a new ACCEPT_CH frame, either in application data or ALPS, it overwrites this value. As this is an optimization, the client MAY bound the size and ignore or forget entries to reduce resource usage.

When the client makes an HTTP request to a particular origin over an HTTP/2 connection, it looks up the origin in the remembered ACCEPT_CH, if any. If it finds a match, it treats the union of that value and any saved Accept-CH response header as the server's Client Hint preferences. It then proceeds as in Section 2.1 of [I-D.ietf-httpbis-client-hints].

Clients MUST NOT process Client Hint preferences in ACCEPT_CH frames corresponding to origins for which the connection is not authoritative. Note the procedure above implicitly satisfies this by deferring processing to after the connection has been chosen for a corresponding request. Unauthoritative origins and other unmatched entries are ignored.

[[TODO: Some variations on this behavior we could choose instead:

- Do new ACCEPT_CH frames override the whole set or implement some kind of update? Overriding the whole set seems simplest and most consistent with an EXTENDED_SETTINGS variant.

- Should the client reject the ACCEPT_CH frame if there are unexpected origins in there? Deferring avoids needing to worry about this, and ignoring the unused ones may interact better with secondary certs.

- Should ACCEPT_CH frames be deferred or just written to the cache when received? Deferred simplifies reasoning about bad origins, predictive connections, etc., but means interactions between ACCEPT_CH and Accept-CH are more complex (see below).

- How should ACCEPT_CH and Accept-CH interact? The document currently proposes unioning them, which is easy. Accept-CH first would work, but unnecessarily ignore newer connection-level ACCEPT_CHs. ACCEPT_CH would not; a stale connection-level preference would get stuck. Whichever is received earlier would also work, but requires tracking timestamps if deferred (see above).]]

4.2. Interaction with Critical-CH

The ACCEPT_CH frame avoids a round-trip, so relying on it over Critical-CH would be preferable. However, this is not always possible:

- The server may be running older software without support for ACCEPT_CH or ALPS.

- The server's Accept-CH preferences may change while clients have existing connections open. In this case, the connection-level settings may be out of date. While the server could send a new ACCEPT_CH frame, the frame may not arrive in time for the client's next request. Moreover, if the HTTP serving frontend is an intermediary like a CDN, it may not be proactively notified of origin server changes.

- HTTP/2 allows connection reuse across multiple origins (Section 9.1.1 of [RFC7540]). Some origins may not be listed in the ACCEPT_CH frame, particularly if the server used a wildcard X.509 certificate.

Thus this document defines both mechanisms. Critical-CH provides reliable Client Hint delivery, while the ACCEPT_CH frame avoids the retry in most cases.

5. Security Considerations

Request header fields may expose sensitive information about the user's environment. Section 4.1 of [I-D.ietf-httpbis-client-hints] discusses some of these considerations. The document augments the capabilities of Client Hints, but does not change these considerations. The procedure described in Section 3 does not result in the user agent sending request headers it otherwise would not have.

The ACCEPT_CH frame does introduce a new way for HTTP/2 connections to make assertions about origins they are not authoritative for, but the procedure in Section 4.1 defers processing until after the client has decided to use the connection for a particular request (Section 9.1.1 of [RFC7540]).

6. IANA Considerations

This specification adds an entry to the "HTTP/2 Frame Type" registry with the following parameters:

- Frame Type: ACCEPT_CH
- Code: TBD
- Allowed in ALPS: Yes
- Reference: [[this document]]

[[TODO: As of writing, the HTTP/2 Frame Type registry does not include an Allowed in ALPS column. [I-D.vvv-httpbis-alps], as of writing, will add it. This document should be updated as that design evolves.]]

7. References

7.1. Normative References

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7.2. Informative References

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Acknowledgments

This document has benefited from contributions and suggestions from Ilya Grigorik, Nick Harper, Aaron Tagliaboschi, Victor Vasiliev, Yoav Weiss, and others.

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