Discovering WebSocket over HTTP/2 and HTTP/3

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Recap

- Bootstrapping WebSockets with
  - HTTP/2 - RFC 8441
  - HTTP/3 - RFC 9220
- WebSocket per request stream, converted via `extended` CONNECT

```
:method = CONNECT
:protocol = websocket
:scheme = https
:path = /chat
:authority = server.example.com
sec-websocket-protocol = chat, superchat
sec-websocket-extensions = permessage-deflate
sec-websocket-version = 13
origin = http://www.example.com
```
We extended CONNECT semantics and flowers bloomed

```
SETTINGS_ENABLE_CONNECT_PROTOCOL=1
  Once a client knows, it can send extended CONNECT
  Sending extended CONNECT at any other time == malformed request

:protocol pseudo-header
  Value is an [HTTP Upgrade Token](#)
  Registered: websocket, connect-udp
  WIP: webtransport, connect-ip, … connect-tcp
```
The setting makes client implementation difficult

A client probably discovers a WebSocket resource with the scheme wss://

SETTINGS_ENABLE_CONNECT_PROTOCOL is a strong signal that extended CONNECT is supported but a weak signal that WebSockets are supported

A client has to make several gambles when determining what connection to pick to open a WebSocket.

- New H1.1 conn + Upgrade: websocket probably will work
- New H2 or H3 conn => wait for SETTING
  - Send a request that might fail because :protocol is not supported
- Existing H2 or H3 => will already have SETTING
  - Send extended CONNECT that might fail because :protocol is not supported
So what’re the perceived problems?

From past WG mailing list discussion, these are views are not shared by all:

- Availability of a resource at an authority is not tightly linked to the HTTP version features available when connecting to the authority.
- Latency risks from guessing wrong adds friction to uptake of “X over HTTP/Y”
- Dispatching requests based on state can be opaque and a bit non-deterministic
- More extended CONNECT on the way e.g., WebTransport
  - Supporting different protocols requires SETTINGS_ENABLE_CONNECT_PROTOCOL
  - But setting doesn’t indicate list of supported protocols
  - Server operator may have reasons to support a protocol on a subset of HTTP versions
Fix, mitigate, avoid, or ignore?

1. Better advertisement could provide **stronger hints**, reducing risks:
   - 2 proposals, see next slides
2. Better semantic HTTP feature discovery could provide **stronger hints**:
   - E.g. OPTIONS for HTTP-version-specific features?
3. Better response status or error codes could provide better **failover hints**
   - currently defined but unsuitable(?):
     421, 426, HTTP_1_1_REQUIRED, H3_VERSION_FALLBACK
4. Require deployments to support “all the things” to avoid client (user) pain?
5. Live with status quo, do nothing, etc.
**Current Problem with just extended CONNECT knowledge**

When there is an existing H2 or H3 connection and client discovers a WebSocket resource with the scheme `wss://`

<table>
<thead>
<tr>
<th>Server Supports WebSocket over HTTP/2</th>
<th>Client Sends a WebSockets Request by Extended CONNECT Using the Existing Connection</th>
<th>Client Creates New HTTP/1.1 Connection and Does Upgrade</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>supports</strong></td>
<td>WebSockets over HTTP/2 Connection Successfully Created :) 😊😊😊</td>
<td>WebSockets Creation Connected (Requires Unnecessary RTTs to Create New HTTP/1.1 Connection) :( 😯 😯 😯</td>
</tr>
<tr>
<td><strong>does not support</strong></td>
<td>WebSockets over HTTP/2 Connection Fails :( 😯 😯 😯</td>
<td>WebSockets Creation Connected :) 😊😊😊</td>
</tr>
</tbody>
</table>

The client does not know if the server supports WebSockets over the current connection, so it cannot make the right choice.
Proposal 1: SETTINGS_ENABLE_WEBSOCKETS

Create a SETTINGS_ENABLE_WEBSOCKET parameter
draft-momoka-httpbis-settings-enable-websockets

WebTransport has a SETTINGS_ENABLE_WEBTRANSPORT parameter. How about we do the same for WebSockets over H2 or H3?

server supports WebSockets over H2 or H3:
SETTINGS_ENABLE_WEBSOCKETS = 1

server does not support WebSockets over H2 or H3:
SETTINGS_ENABLE_WEBSOCKETS = 0
Proposal 1: SETTINGS_ENABLE_WEBSOCKETS

The Client behavior:

<table>
<thead>
<tr>
<th>settings parameter is not sent from server (current behavior)</th>
<th>There is an existing H2 or H3 connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>SETTINGS_ENABLE_WEBSOCKETS = 0</td>
<td>Behavior may vary by implementation.</td>
</tr>
<tr>
<td>SETTINGS_ENABLE_WEBSOCKETS = 1</td>
<td>New HTTP/1.1 connection + Upgrade</td>
</tr>
<tr>
<td></td>
<td>Use current connection for WebSockets over H2 or H3</td>
</tr>
</tbody>
</table>
Proposal 2: Advertising WebSocket support in HTTPS RR

Discover the WebSockets support before creating a connection

Extending HTTPS RR:
- Already use for discovering alpn, etc.

draft-damjanovic-websockets-https-rr-01
Proposal 2: Advertising WebSocket support in HTTPS RR

e.example.net IN HTTPS 1 . alpn=h2,h3 wss=h2,h3

- New "wss" SvcParamKey
- the SvcParamValue: a list of alpn-ids that support the WebSocket Protocol
- The alpn-ids must be present in the "alpn" key as well
Proposal 2: Advertising WebSocket support in HTTPS RR

- The Client behavior:
  - the "wss" key is present - strong indication of support, the client can attempt WebSockets over HTTP/2 or HTTP/3
  - the "wss" key is not present - the client should use WebSockets over HTTP/1.1
  - the "wss" key - no indication of the support for WebSockets over HTTP/1.1
Conclusion

This topic has been rumbling along for ~2 years

Let's determine if there is consensus to address it with fixes

...and is so, let’s quickly align on what fixes

... two complimentary proposals on the table

- draft-momoka-httplibs-settings-enable-websockets
- draft-damjanovic-websockets-https-rr-01