HTTP / 2

HTTP 2는 어떻게 차이점을 두었을까?

By IMHOJEONG

1편과 이어집니다!

왜? 라는 질문에서 깊이를 얻을 수 있습니다!

HTTP 2 알아보기 전에...

TCP  HTTP

TCP, HTTP와 같은 기술들에 대한 기본 지식 필요!

Browser Rendering 과정 중에...

HTTP 2

Core Concept

HTTP methods

Status Codes

URI

header fields

+

Only Change

1. format
2. transport

why HTTP 2 is appear?

HTTP/1.x

Concurrency

TCP HandShake

TCP HandShake

Latency

TCP HandShake

....

needs Multi Connection

why HTTP 2 is appear?

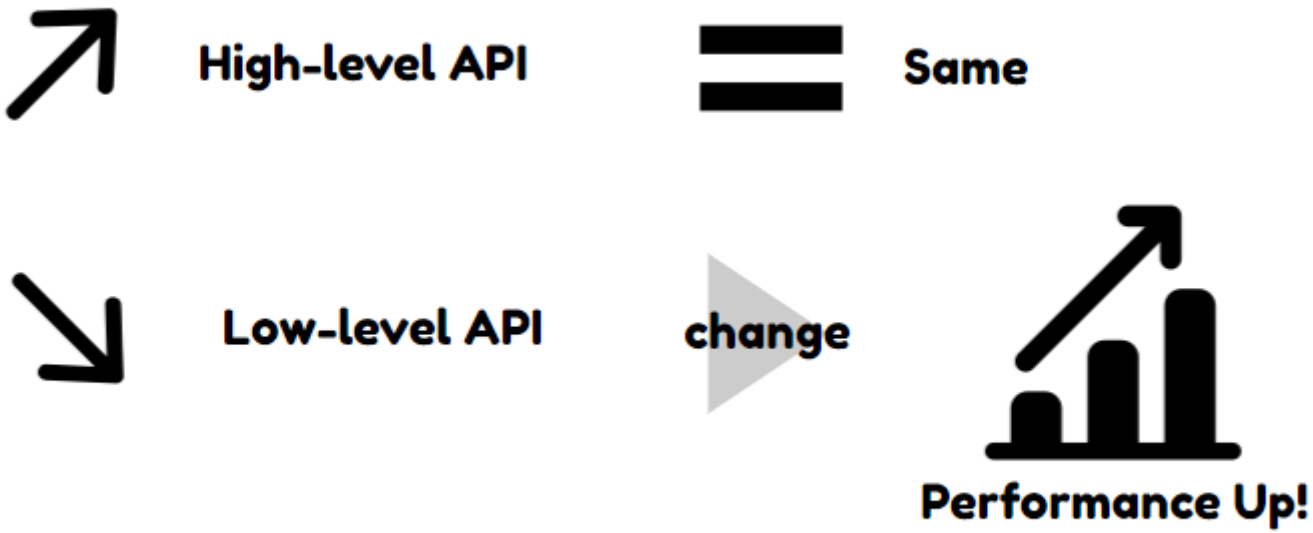
HTTP/1.x

no HTTP Header Compression

Unnecessary Traffic

no Resource Priority

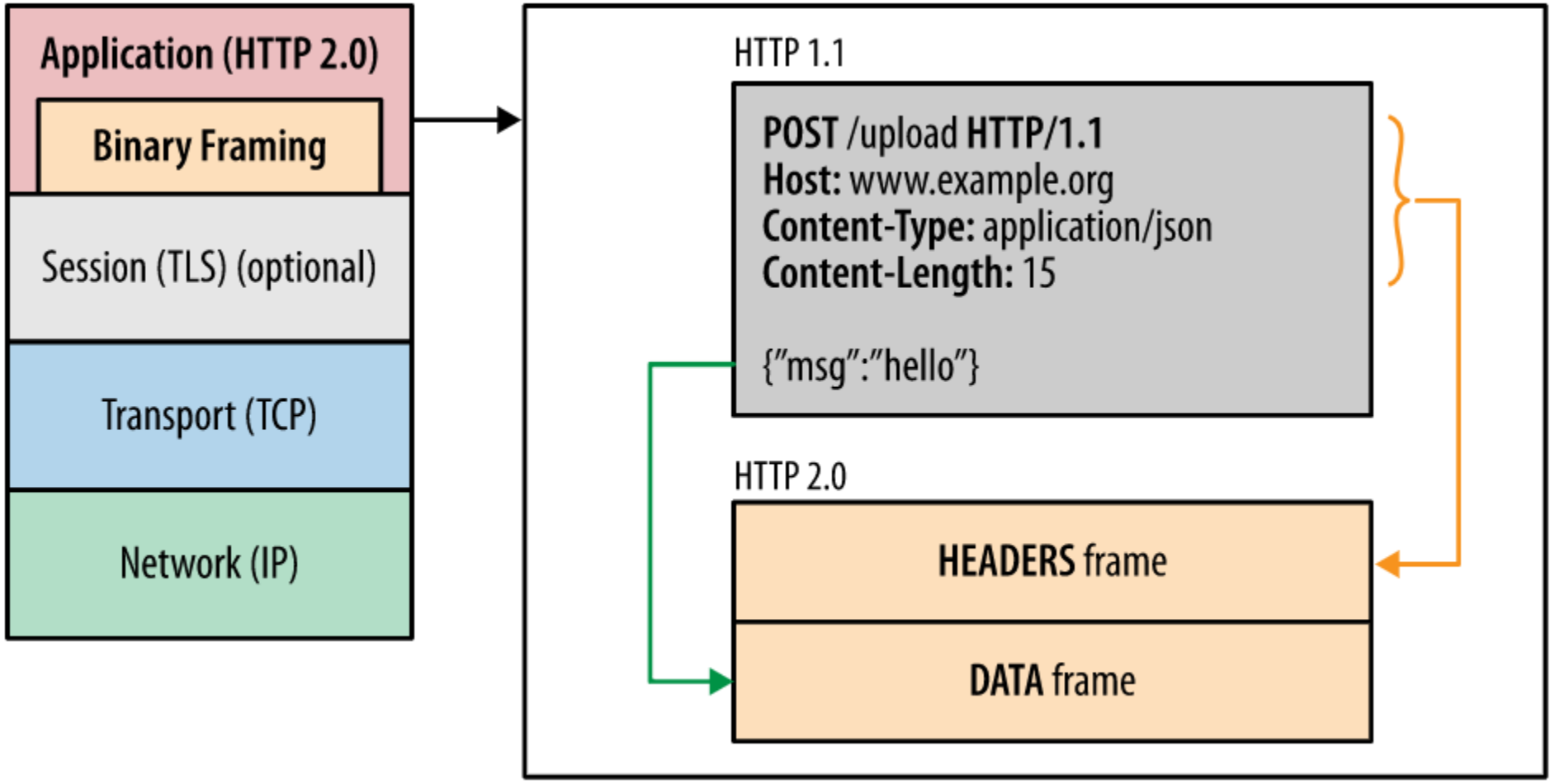
HTTP/2 is HTTP/1 expansion



Binary Framing

Binary Frame

Binary Framing layer



Binary Framing layer

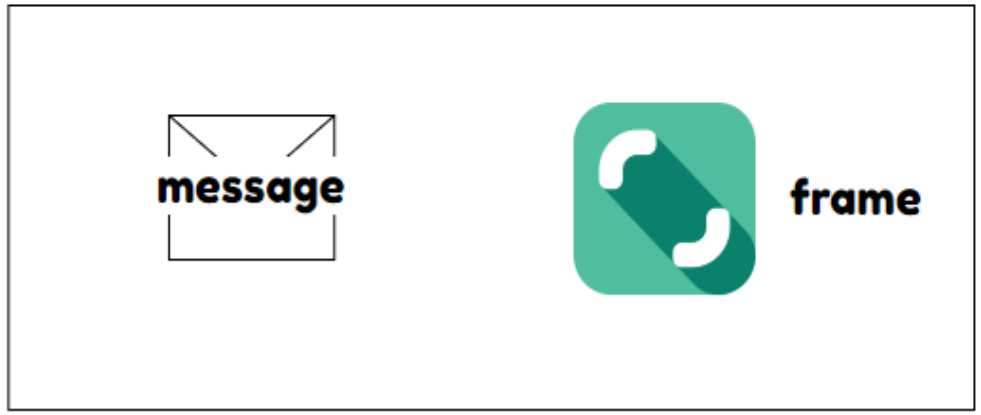
HTTP/1.x

newline delimited plaintext

vs

HTTP/2.0

Encoded by binary format



Verbs, Methods, Headers

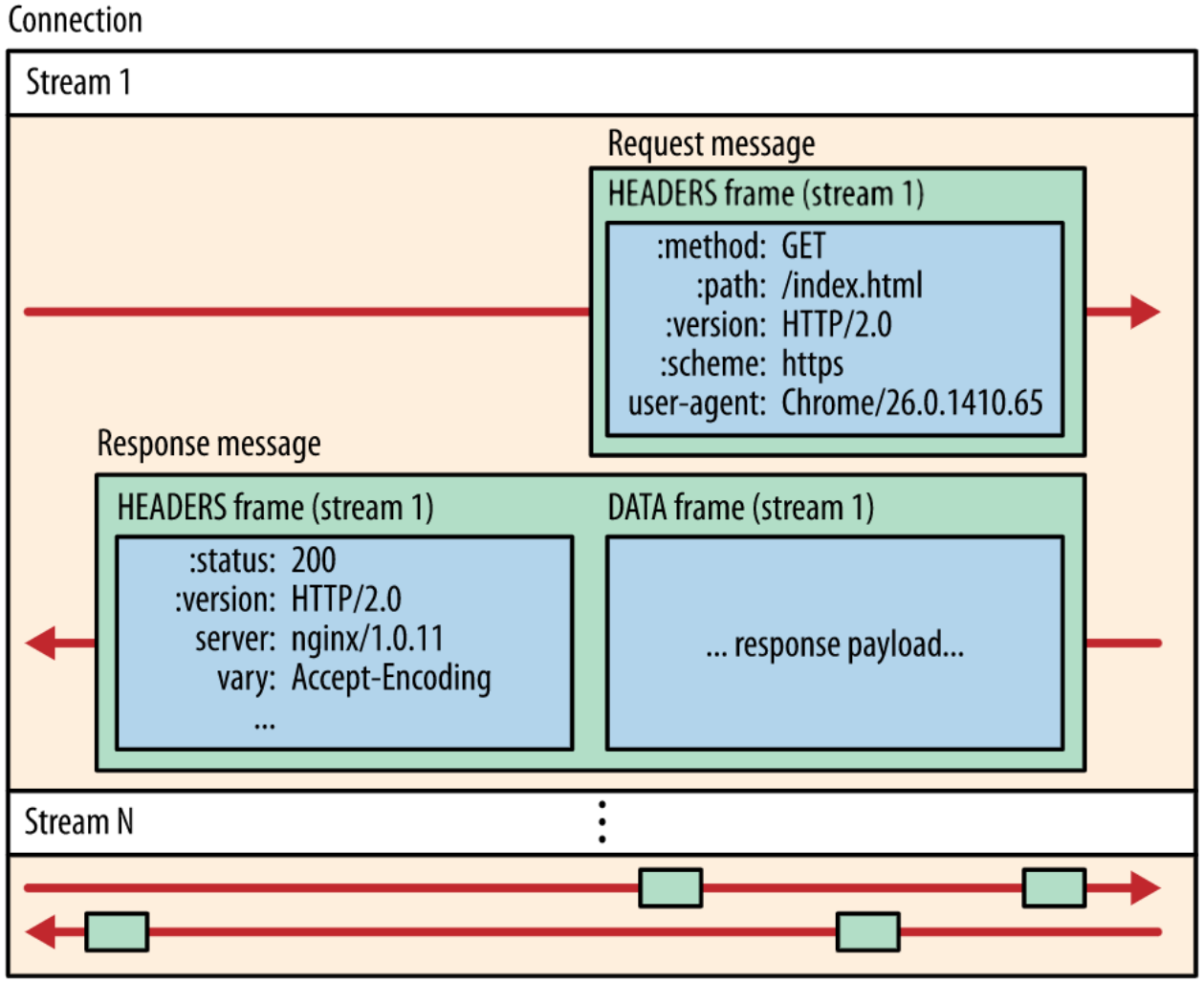
UnAffected

Binary Framing layer

new Binary Framing Mechanism

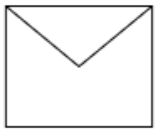
Stream, Message, Frame

Stream, Message, Frame



Stream

bidirectional flow of bytes



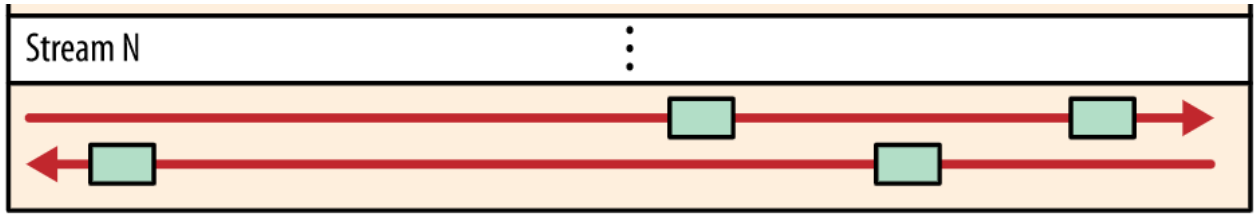
message

complete sequence of frames

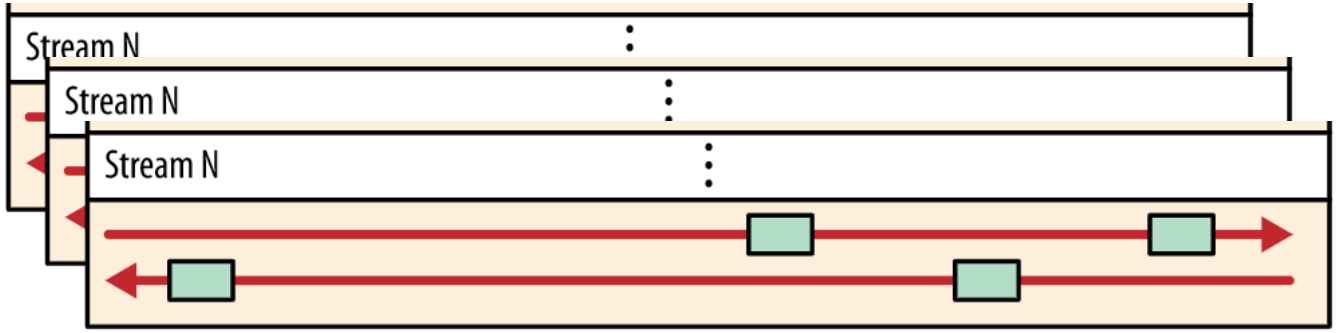
frame

the smallest unit of communication

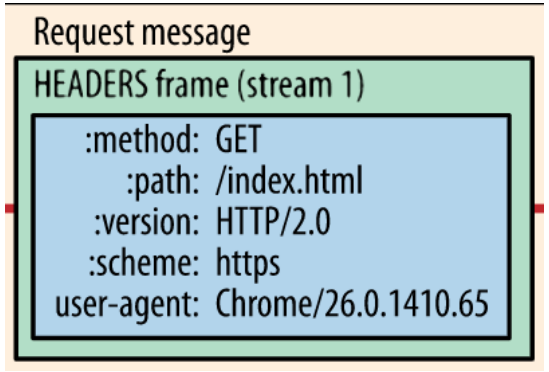
Stream, Message, Frame



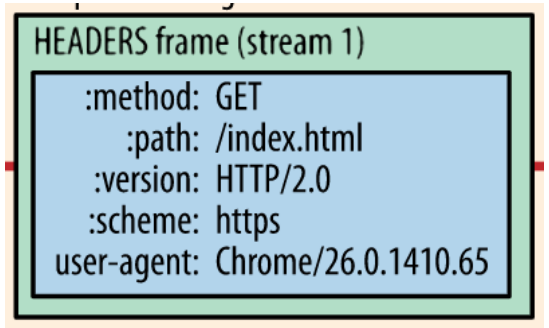
Single TCP Connection
(any number of Streams)



unique identifier,
Optional Priority Information
(any number of Streams)

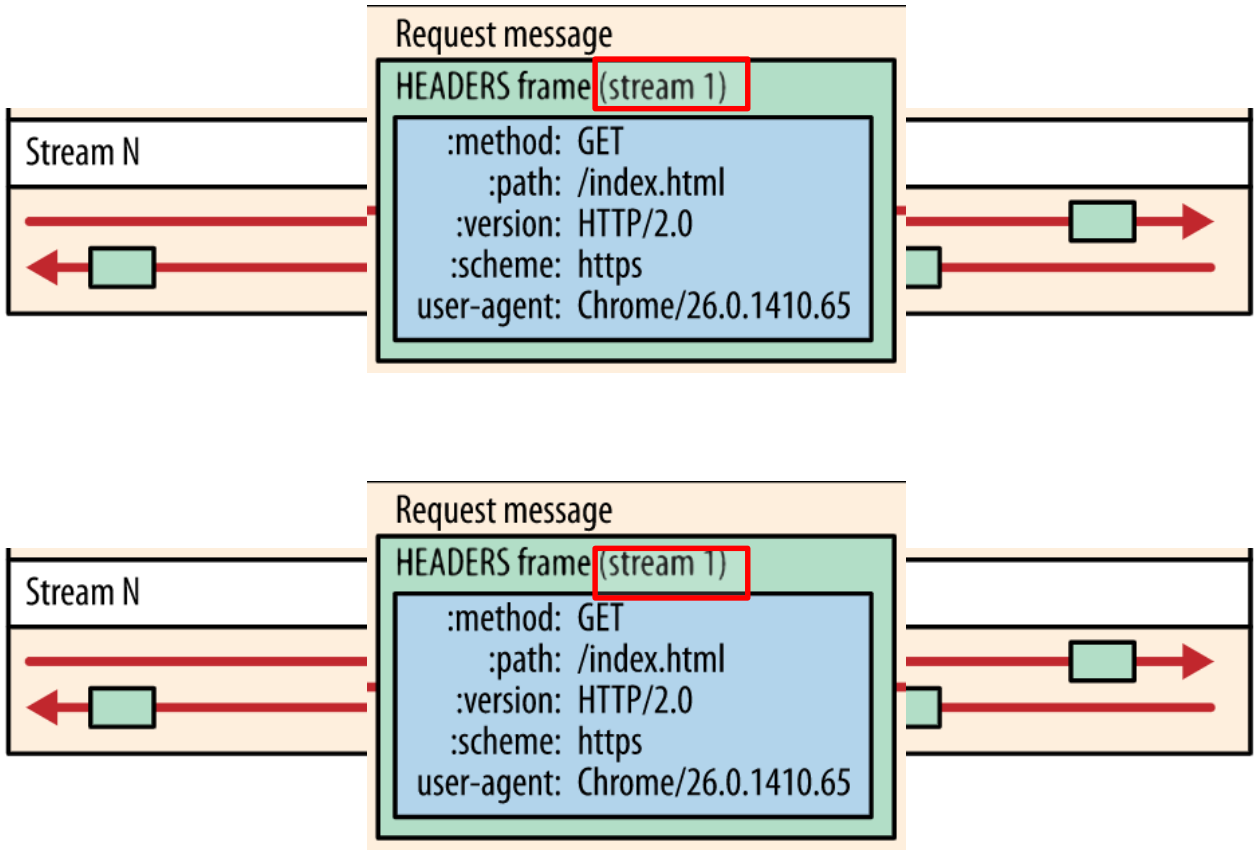


logical HTTP message
(one or more frames)

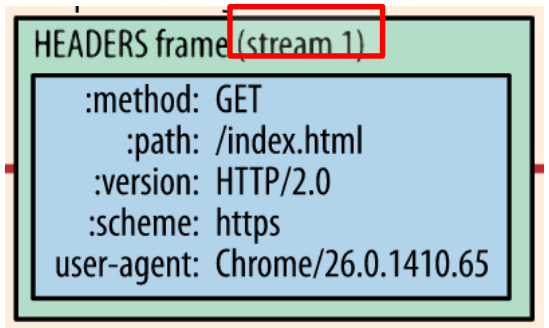


Frames from
different streams
may be interleaved

Stream, Message, Frame



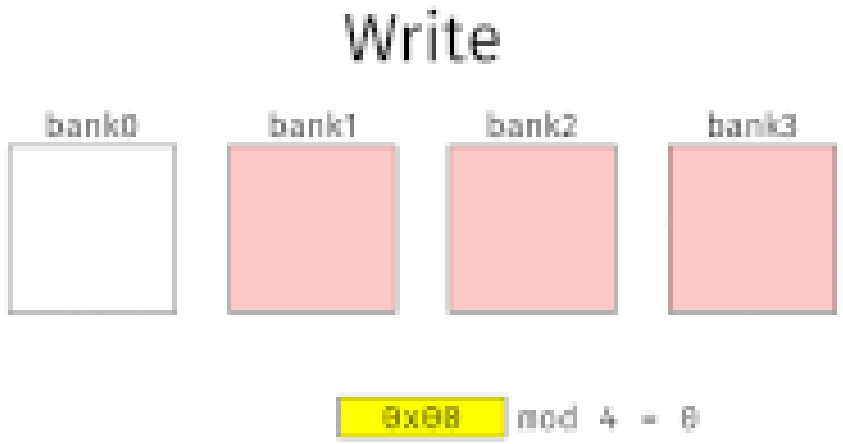
logical HTTP message (one or more frames)



reassembled (the embedded stream identifier (in the header of each frame)

interleaving

Memory Interleaving



Memory efficiency

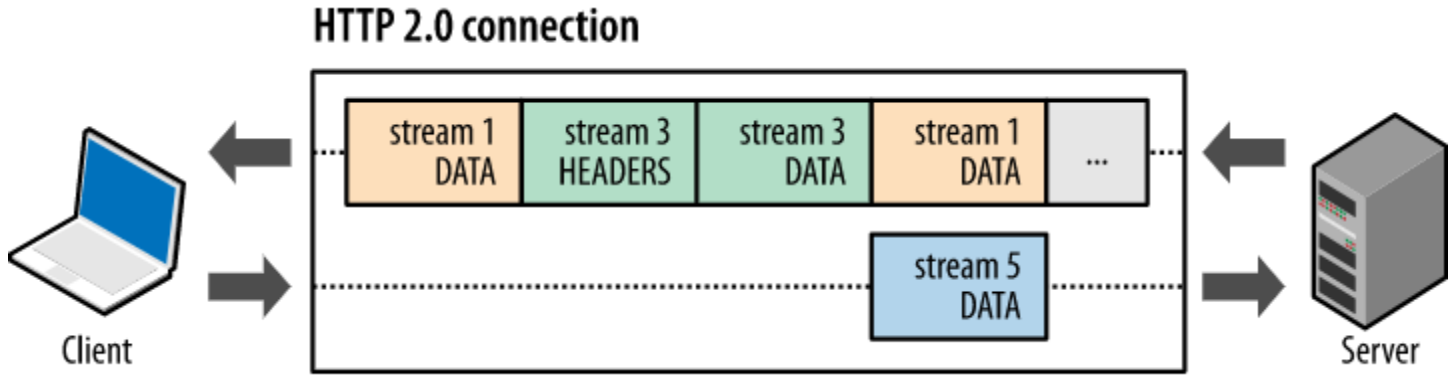
+ DMA

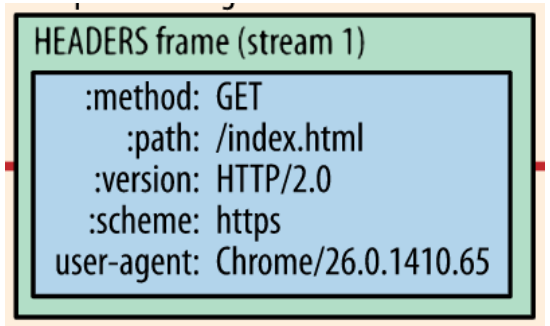
Request and response Multiplexing

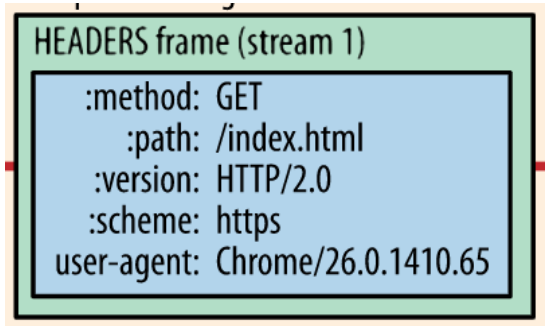
By Binary Framing layer

request or response multiplexing

HTTP/1.1 => Head Of Line & TCP not efficient use

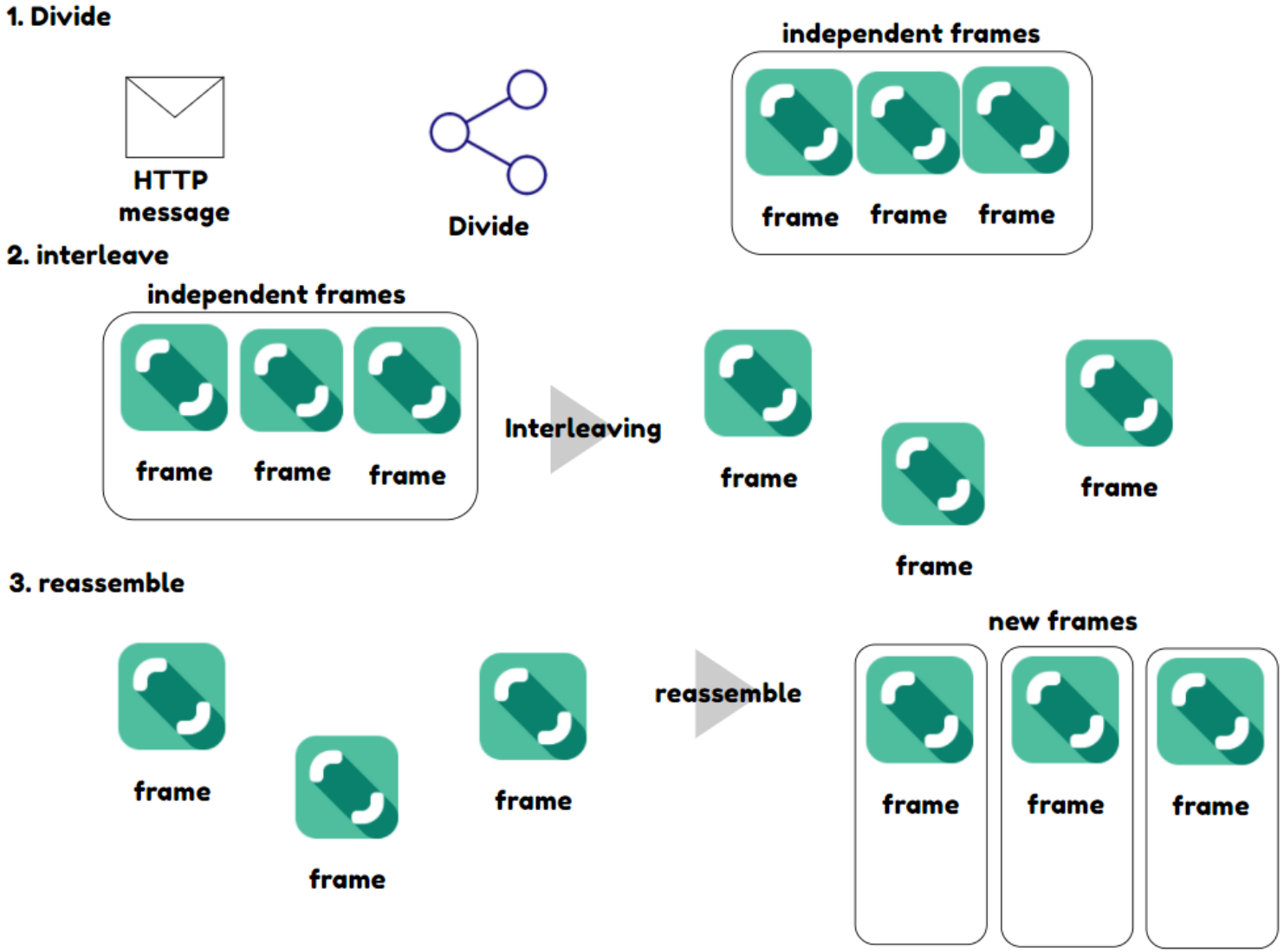






request or response multiplexing

! very important



interleaving

1. Interleaving

   Requests, Responses

2. Single Connection

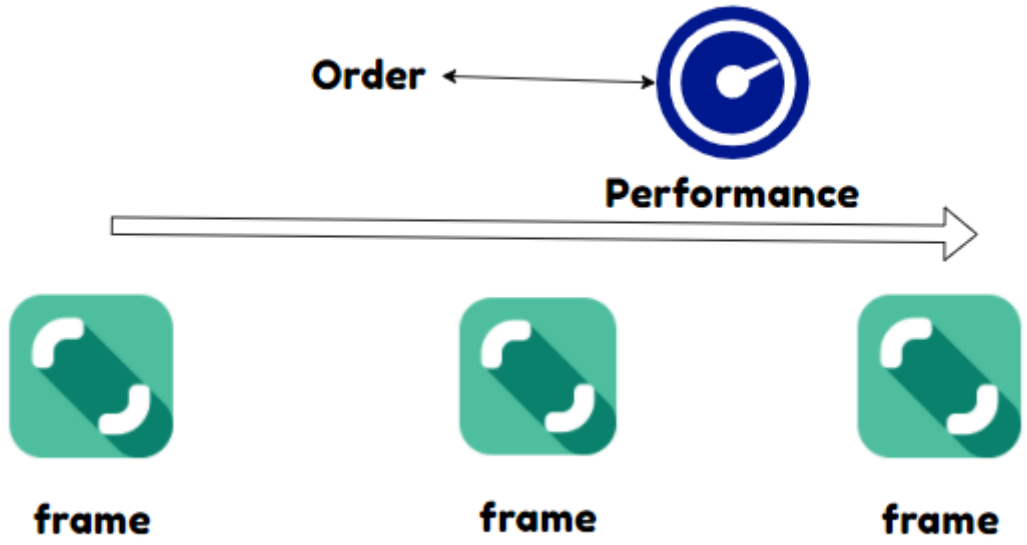
3. HTTP/1.x workarounds

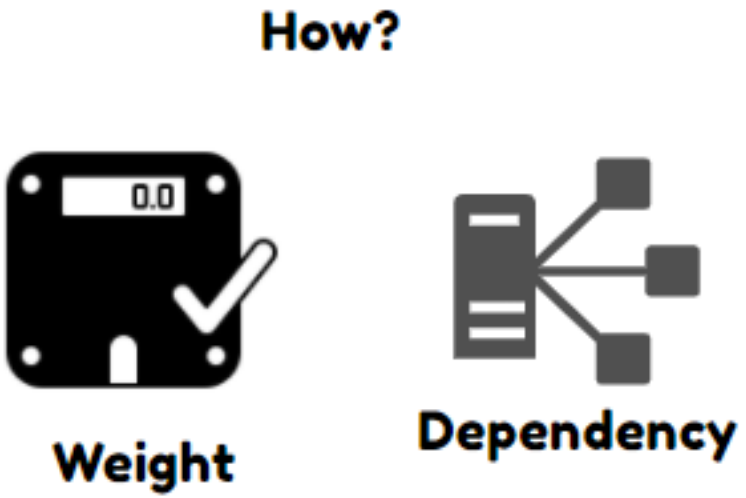
   

4. page load

Stream Priority





order of delivery ∝ Performance

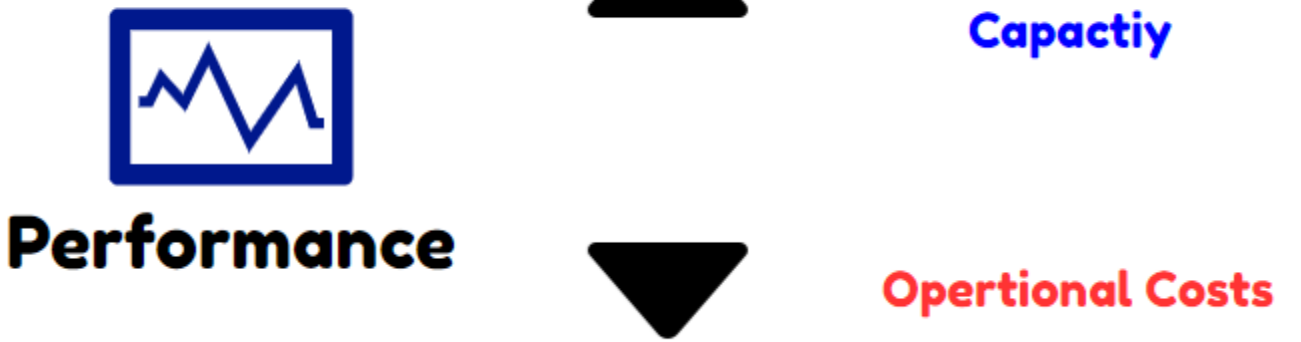
Stream Priority

How implement?

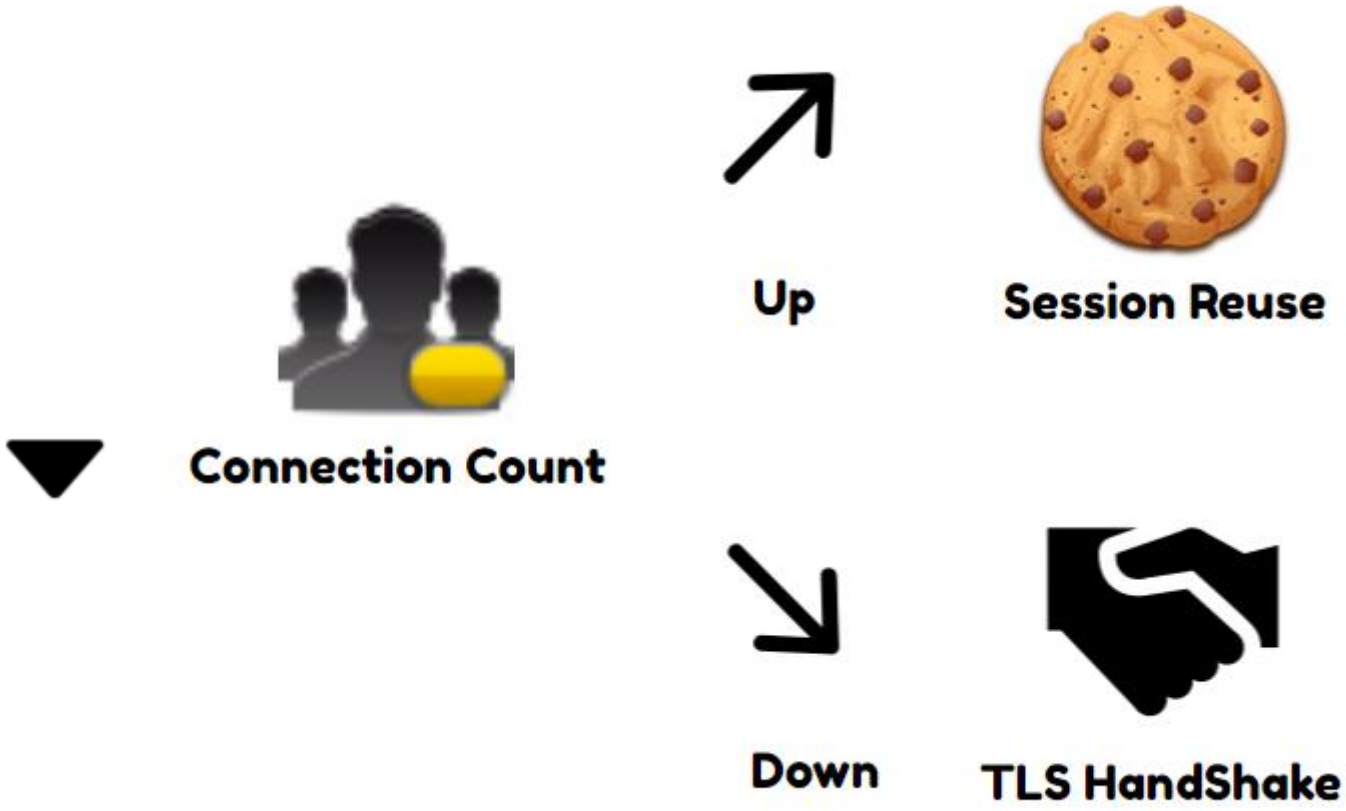
One connection per origin

One Connection

one connection per origin



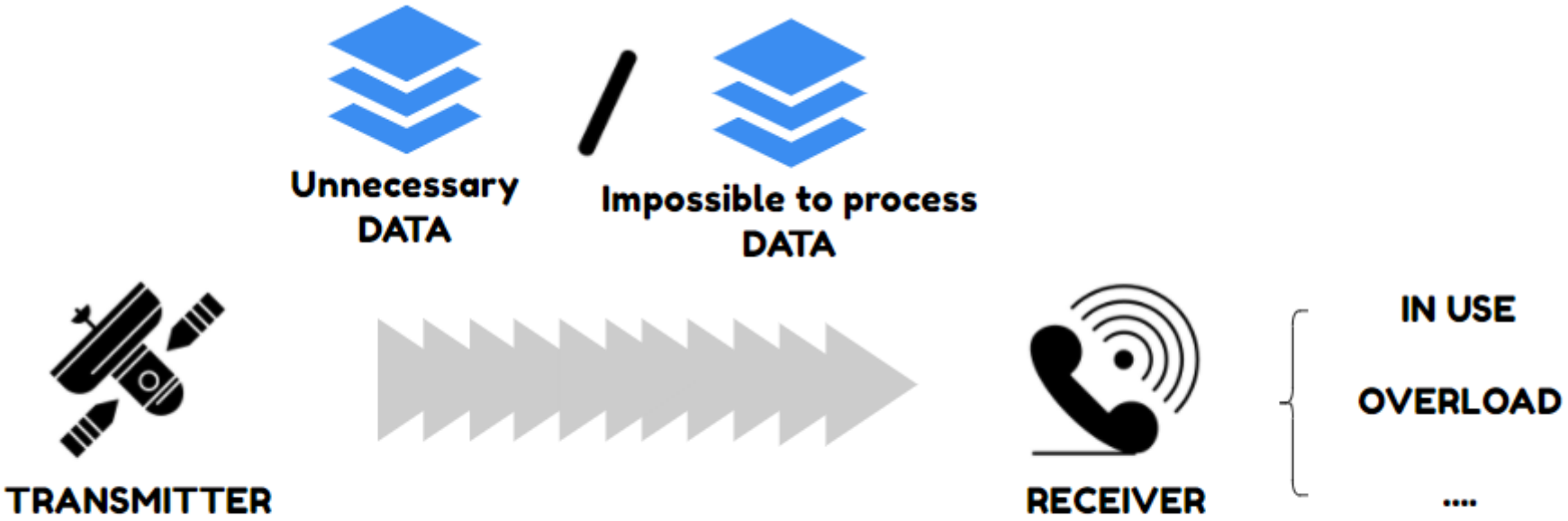
one connection per origin



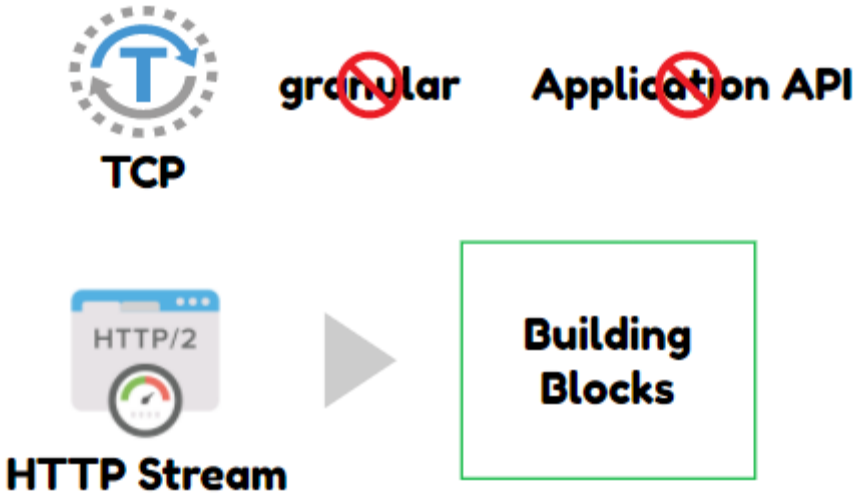
Flow Control

mechanism to prevent the sender from Overwhelming the receiver

why use Flow Control?



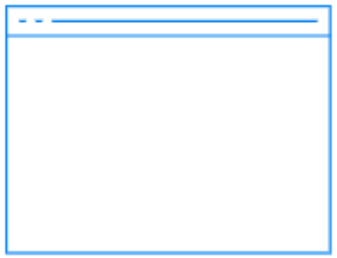
TCP vs HTTP/2 Stream



Flow Control

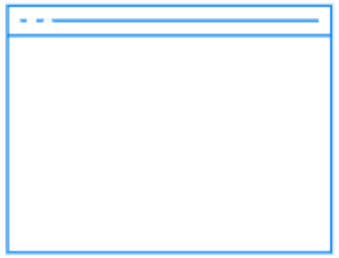
① Directional

② Choose Window Size



DATA

— Window Size



WINDOW_UPDATE

+ Window Size

not Disabled

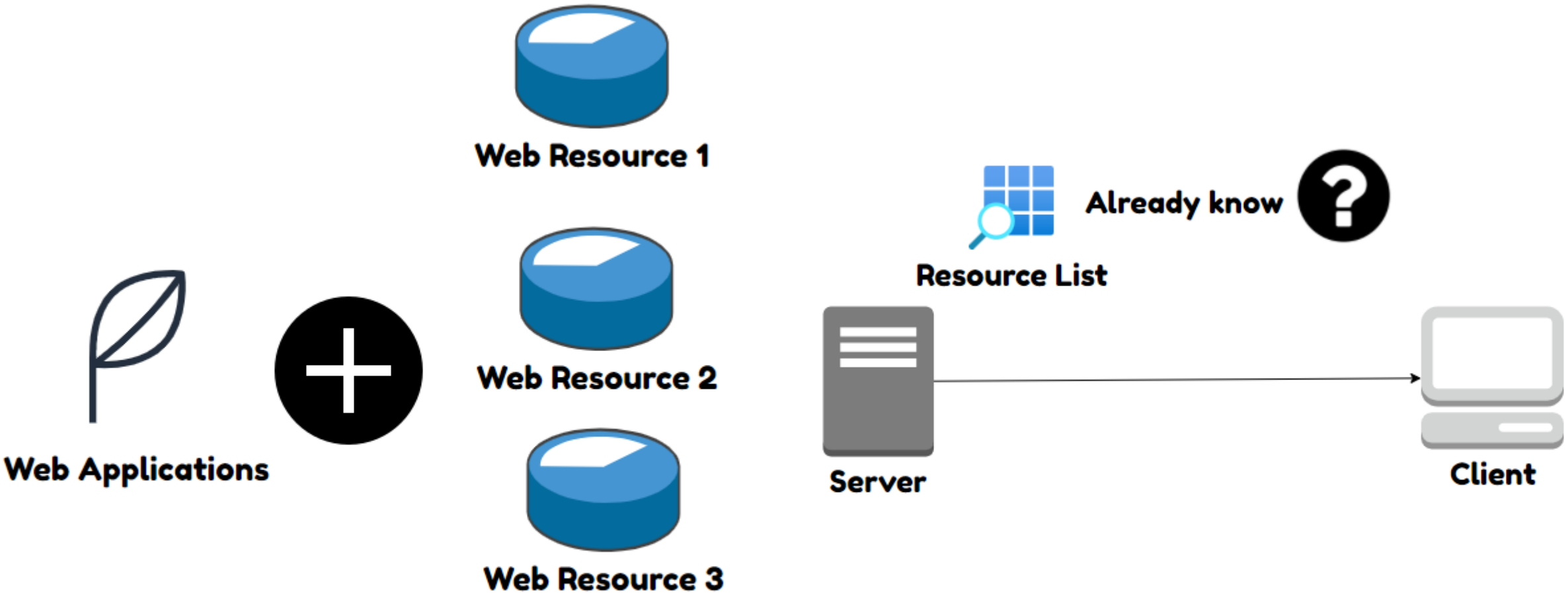
Server Push

the ability of the server to send multiple responses for a single client request

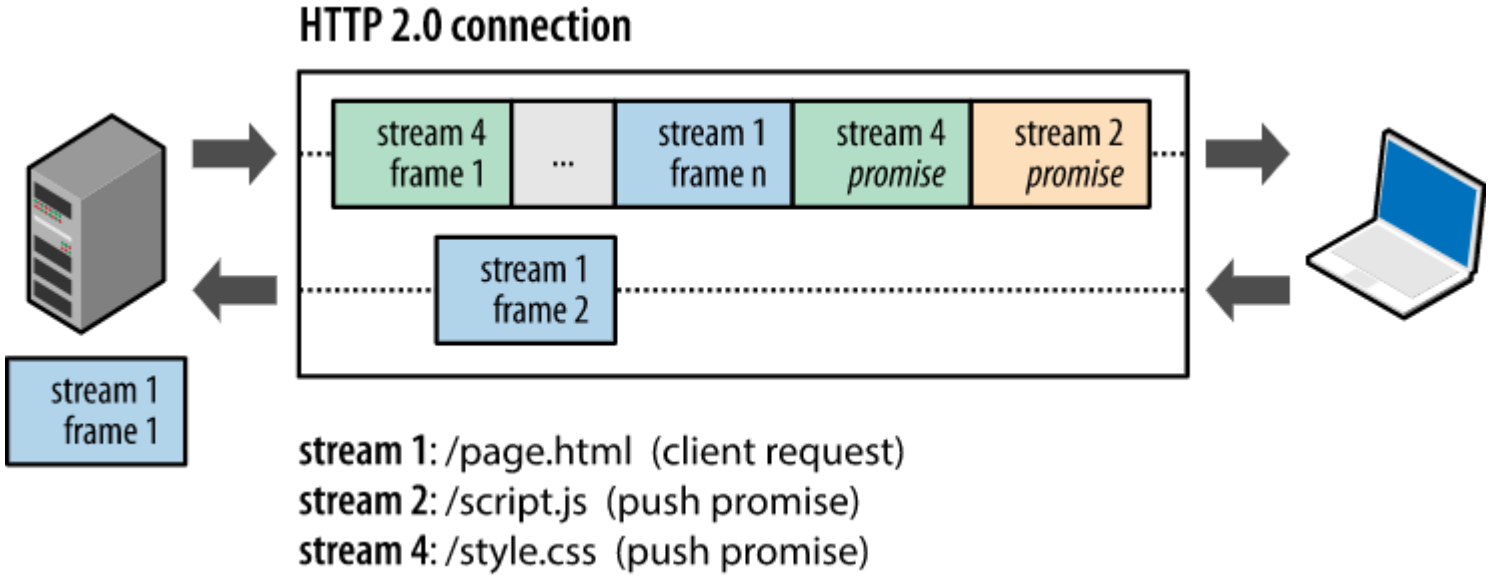
Why Header Compression needs?

if Server already know?

Why Server Push needs?



Server Push 개요



example

```
<img src="
          AAAAACH5BAAAAAAALAAAAAABAAEAAAICTAEAOw=="
     alt="1x1 transparent (GIF) pixel" />
```

How implement?

Push resources advantages

Cached by the client

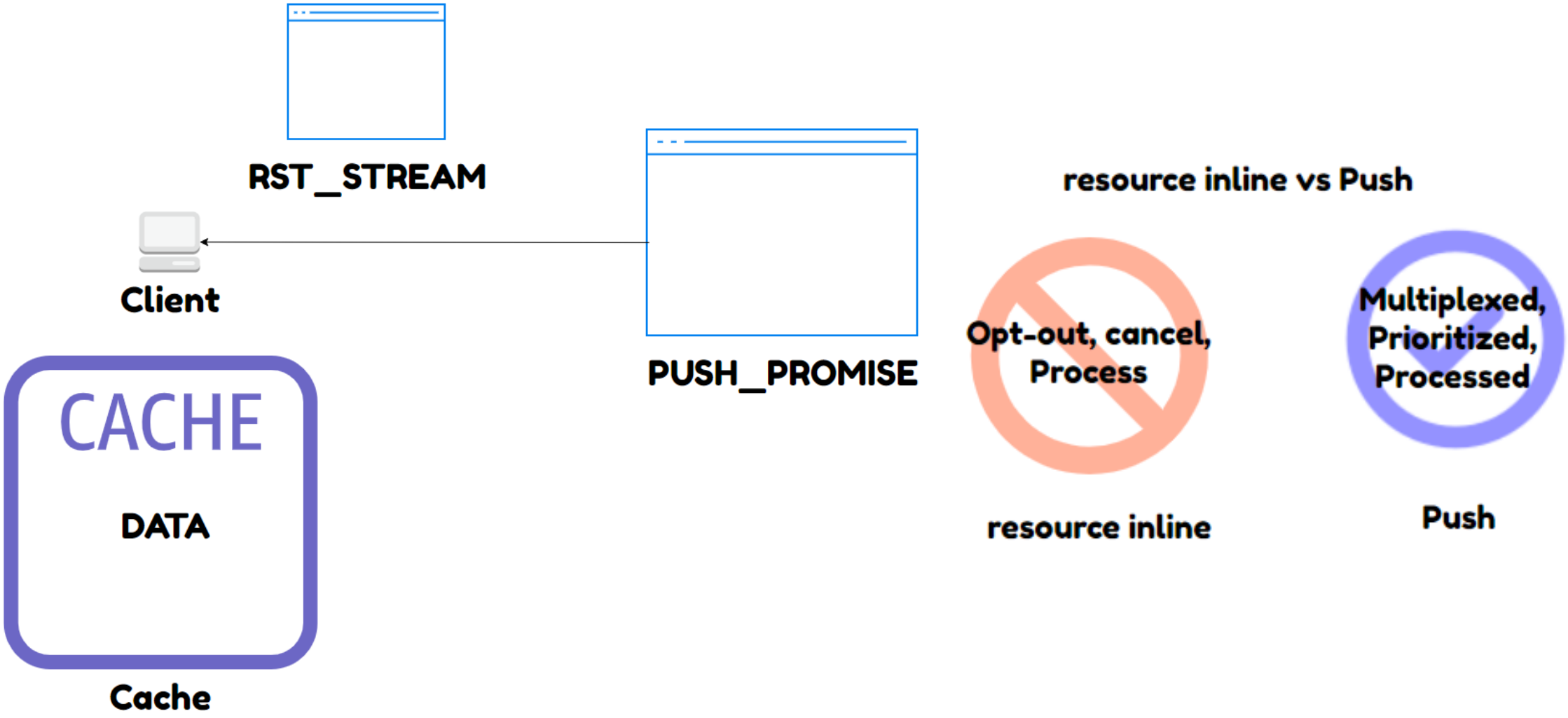
Reused across different pages

Multiplexed alongside other resources

Prioritized by the server

Declined by the client

Server Push – 'PUSH_PROMISE'



Header Compression

HPACK compression format

Why Header Compression needs?

HTTP 1.1

HTTP/1.x

500 Bytes ~ 800 Bytes / ~~KB with Cookie

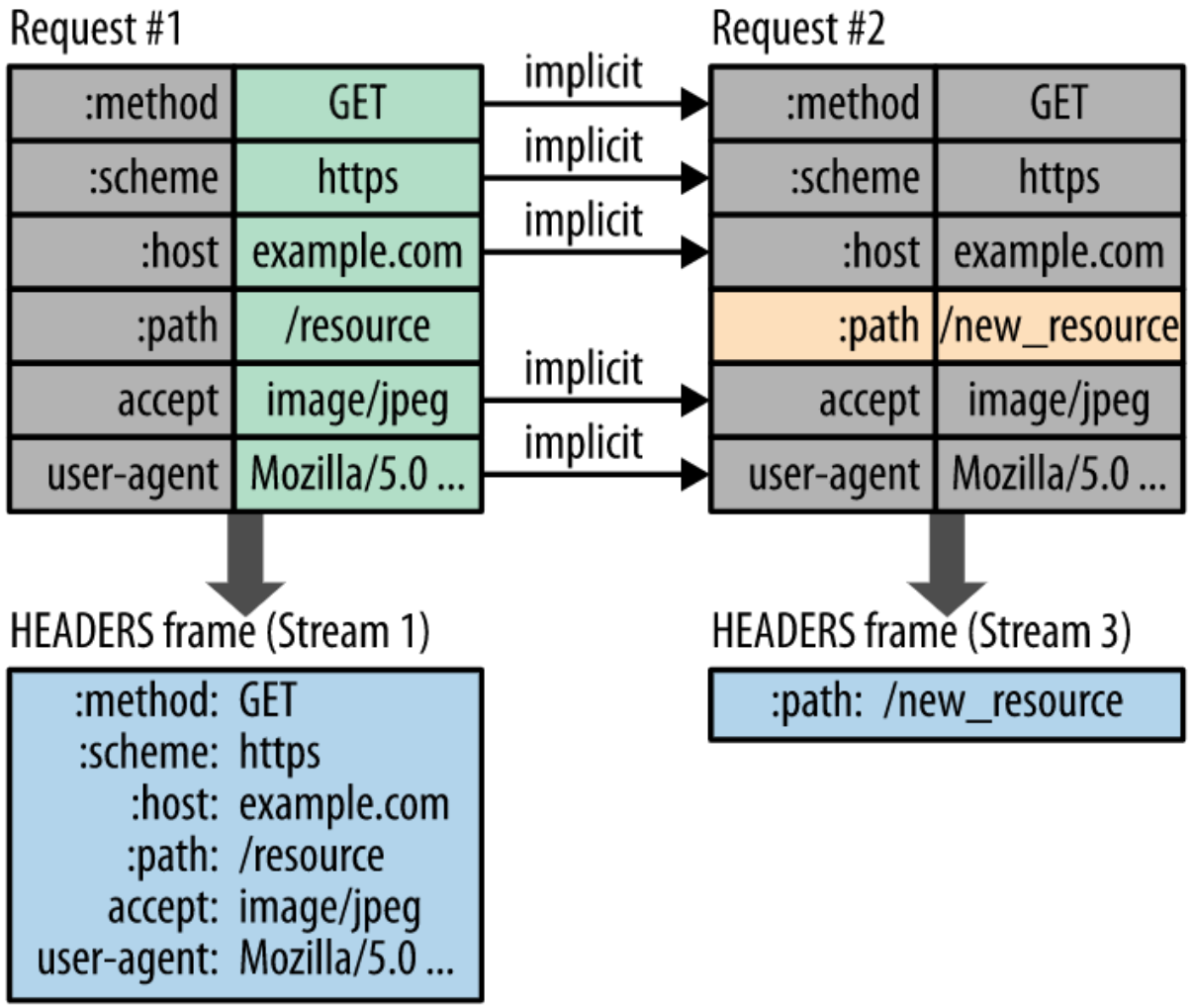
HPACK compression

① static Huffman code

Transfer Size

② Indexed Value

look up, reconstruct



Let's Play

Test HTTP2 with WireShark

Run!

1. Run Wireshark

2. curl --http2 -v nghttp2.org/robots.txt nghttp2.org/humans.txt

http2

No.	Time	Source	Destination	Protocol	Length	Info
1188	56.147751	139.162.123.134	192.168.0.19	HTTP2	158	HTTP/1.1 101 Switching Protocols , SETTINGS[0]
1189	56.148565	192.168.0.19	139.162.123.134	HTTP2	78	Magic
1190	56.148681	192.168.0.19	139.162.123.134	HTTP2	81	SETTINGS[0]
1191	56.148739	192.168.0.19	139.162.123.134	HTTP2	63	SETTINGS[0]
1192	56.148821	192.168.0.19	139.162.123.134	HTTP2	67	WINDOW_UPDATE[0]
1195	56.151103	139.162.123.134	192.168.0.19	HTTP2	371	HEADERS[1]: 200 OK, DATA[1] (text/plain)
1200	56.159177	192.168.0.19	139.162.123.134	HTTP2	103	HEADERS[3]: GET /humans.txt
1209	56.188490	139.162.123.134	192.168.0.19	HTTP2	63	SETTINGS[0]
1211	56.202851	139.162.123.134	192.168.0.19	HTTP2	121	HEADERS[3]: 404 Not Found, DATA[3] (text/plain)

h2	h2c
HTTP/2 uses TLS	HTTP/2 is run over cleartext TCP

```
> Frame 1189: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface \Device\NPF_{A9EC19D7-68CA-4EBE-A65A-95A34BA8520B}, id 0
> Ethernet II, Src: IntelCor_c0:98:83 (34:2e:b7:c0:98:83), Dst: EFMNetwo_60:92:57 (70:5d:cc:60:92:57)
> Internet Protocol Version 4, Src: 192.168.0.19, Dst: 139.162.123.134
> Transmission Control Protocol, Src Port: 57490, Dst Port: 80, Seq: 179, Ack: 105, Len: 24
> HyperText Transfer Protocol 2
```

HTTP 1.1 101 Switching Protocols

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	10.9.0.2	139.162.123.134	HTTP	244	GET /robots.txt HTTP/1.1
2	0.600079	139.162.123.134	10.9.0.2	HTTP2	164	HTTP/1.1 101 Switching Protocol
3	0.600465	10.9.0.2	139.162.123.134	HTTP2	90	Magic
4	0.600541	10.9.0.2	139.162.123.134	HTTP2	93	SETTINGS[0]
5	0.600575	10.9.0.2	139.162.123.134	HTTP2	75	SETTINGS[0]
6	0.600596	139.162.123.134	10.9.0.2	HTTP2	342	HEADERS[1]: 200 OK, DATA[1] (te
7	0.600603	10.9.0.2	139.162.123.134	HTTP2	79	WINDOW_UPDATE[0]
8	0.601307	10.9.0.2	139.162.123.134	HTTP2	115	HEADERS[3]: GET /humans.txt
9	0.912304	139.162.123.134	10.9.0.2	HTTP2	75	SETTINGS[0]
10	0.916413	139.162.123.134	10.9.0.2	HTTP2	156	HEADERS[3]: 404 Not Found, DATA

```
Frame 1: 244 bytes on wire (1952 bits), 244 bytes captured (1952 bits)
Ethernet II, Src: 92:76:39:be:c1:81 (92:76:39:be:c1:81), Dst: 8a:7d:40:9e:52:1b (8a:7d:40:9e:52:1b)
Internet Protocol Version 4, Src: 10.9.0.2, Dst: 139.162.123.134
Transmission Control Protocol, Src Port: 58038, Dst Port: 80, Seq: 1, Ack: 1, Len: 178
Hypertext Transfer Protocol
  GET /robots.txt HTTP/1.1\r\n
  Host: nghttp2.org\r\n
  User-Agent: curl/7.61.0\r\n
  Accept: */*\r\n
  Connection: Upgrade, HTTP2-Settings\r\n
  Upgrade: h2c\r\n
  HTTP2-Settings: AAMAAABkAARAAAAAAAIAAAAA\r\n
    Settings - Max concurrent streams : 100
    Settings - Initial Windows size : 1073741824
    Settings - Enable PUSH : 0
  \r\n
  [Full request URI: http://nghttp2.org/robots.txt]
  [HTTP request 1/1]
  [Response in frame: 2]
```

Client

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	10.9.0.2	139.162.123.134	HTTP	244	GET /robots.txt HTTP/1.1
2	0.600079	139.162.123.134	10.9.0.2	HTTP2	164	HTTP/1.1 101 Switching Protocols , SETTINGS[0]
3	0.600465	10.9.0.2	139.162.123.134	HTTP2	90	Magic
4	0.600541	10.9.0.2	139.162.123.134	HTTP2	93	SETTINGS[0]
5	0.600575	10.9.0.2	139.162.123.134	HTTP2	75	SETTINGS[0]
6	0.600596	139.162.123.134	10.9.0.2	HTTP2	342	HEADERS[1]: 200 OK, DATA[1] (text/plain)
7	0.600603	10.9.0.2	139.162.123.134	HTTP2	79	WINDOW_UPDATE[0]
8	0.601307	10.9.0.2	139.162.123.134	HTTP2	115	HEADERS[3]: GET /humans.txt
9	0.912304	139.162.123.134	10.9.0.2	HTTP2	75	SETTINGS[0]
10	0.916413	139.162.123.134	10.9.0.2	HTTP2	156	HEADERS[3]: 404 Not Found, DATA[3] (text/plain)

```
Frame 2: 164 bytes on wire (1312 bits), 164 bytes captured (1312 bits)
Ethernet II, Src: 8a:7d:40:9e:52:1b (8a:7d:40:9e:52:1b), Dst: 92:76:39:be:c1:81 (92:76:39:be:c1:81)
Internet Protocol Version 4, Src: 139.162.123.134, Dst: 10.9.0.2
Transmission Control Protocol, Src Port: 80, Dst Port: 58038, Seq: 1, Ack: 179, Len: 98
Hypertext Transfer Protocol
  HTTP/1.1 101 Switching Protocols\r\n
  Connection: Upgrade\r\n
  Upgrade: h2c\r\n
  \r\n
  [HTTP response 1/1]
  [Time since request: 0.600079000 seconds]
  [Request in frame: 1]
  [Request URI: http://nghttp2.org/robots.txt]
HyperText Transfer Protocol 2
  Stream: SETTINGS, Stream ID: 0, Length 18
    Length: 18
    Type: SETTINGS (4)
    Flags: 0x00
      0000 000. = Unused: 0x00
      .... ...0 = ACK: False
    0... .... .... .... .... .... .... .... = Reserved: 0x0
    .000 0000 0000 0000 0000 0000 0000 0000 = Stream Identifier: 0
    Settings - Max concurrent streams : 100
    Settings - Initial Windows size : 1048576
    Settings - Header table size : 8192
```

Server

HTTP 1.1 101 Switching Protocols

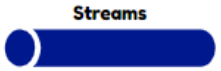
HTTP2-Settings Header

Max Concurrent Streams	100
Initial Windows size	1073741824(1GB)
Enable PUSH	0

HTTP2-Settings Header

Max Concurrent Streams	100
Initial Windows size	1048576(1MB)
Header table size	8192

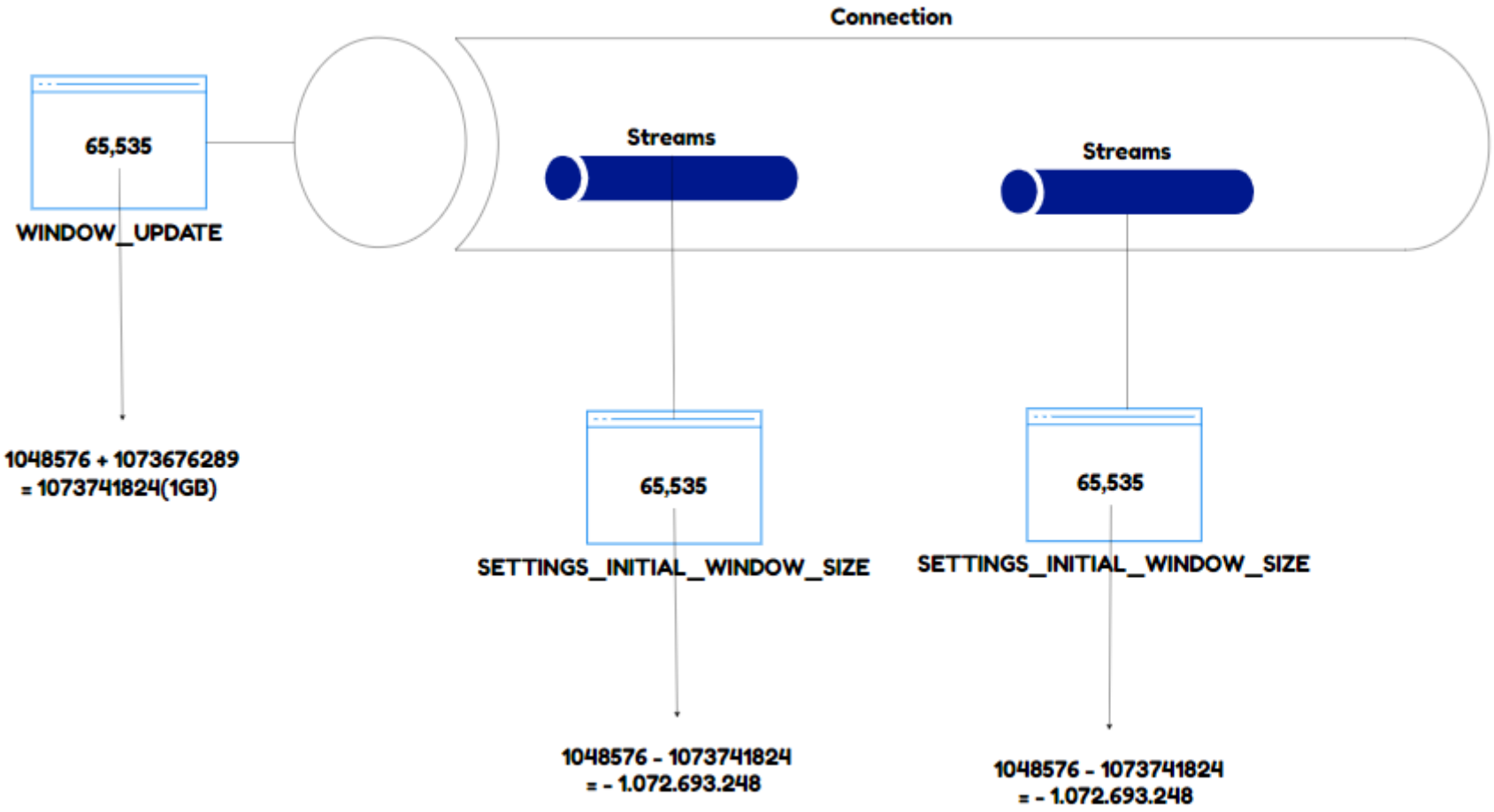
Default



HTTP2-Settings Header

$2^{16}-1 = 65535$

HTTP 1.1 101 Switching Protocols



Connection Preface

3	0.600465	10.9.0.2	139.162.123.134	HTTP2	90 Magic
4	0.600541	10.9.0.2	139.162.123.134	HTTP2	93 SETTINGS[0]
5	0.600575	10.9.0.2	139.162.123.134	HTTP2	75 SETTINGS[0]
6	0.600596	139.162.123.134	10.9.0.2	HTTP2	342 HEADERS[1]: 200 OK, DATA[1]
7	0.600603	10.9.0.2	139.162.123.134	HTTP2	79 WINDOW_UPDATE[0]
8	0.601307	10.9.0.2	139.162.123.134	HTTP2	115 HEADERS[3]: GET /humans.txt
9	0.912304	139.162.123.134	10.9.0.2	HTTP2	75 SETTINGS[0]
10	0.916413	139.162.123.134	10.9.0.2	HTTP2	156 HEADERS[3]: 404 Not Found,

```
> Frame 3: 90 bytes on wire (720 bits), 90 bytes captured (720 bits)
> Ethernet II, Src: 92:76:39:be:c1:81 (92:76:39:be:c1:81), Dst: 8a:7d:40:9e:52:1b (8a:7d:40:9e:52:1b)
> Internet Protocol Version 4, Src: 10.9.0.2, Dst: 139.162.123.134
> Transmission Control Protocol, Src Port: 58038, Dst Port: 80, Seq: 179, Ack: 99, Len: 24
v HyperText Transfer Protocol 2
  v Stream: Magic
      Magic: PRI * HTTP/2.0\r\n\r\nSM\r\n\r\n
```

```
0000  8a 7d 40 9e 52 1b 92 76  39 be c1 81 08 00 45 00   ·}@·R··v 9·····E·
0010  00 4c 8c 72 40 00 40 06  9d 06 0a 09 00 02 8b a2   ·L·r@·@· ········
0020  7b 86 e2 b6 00 50 a3 6a  32 3e a4 31 16 8b 80 18   {····P·j 2>·1····
0030  00 e5 11 72 00 00 01 01  08 0a 44 e5 61 c5 d4 bc   ···r···· ··D·a···
0040  f2 56 50 52 49 20 2a 20  48 54 54 50 2f 32 2e 30   ·VPRI *  HTTP/2.0
0050  0d 0a 0d 0a 53 4d 0d 0a  0d 0a                     ····SM·· ··
```

Magic = 8 X 24

a sequence of 24 octets

Setting FRAME

.....

Connection Preface

3	0.600465	10.9.0.2	139.162.123.134	HTTP2	90 Magic
4	0.600541	10.9.0.2	139.162.123.134	HTTP2	93 SETTINGS[0]
5	0.600575	10.9.0.2	139.162.123.134	HTTP2	75 SETTINGS[0]
6	0.600596	139.162.123.134	10.9.0.2	HTTP2	342 HEADERS[1]: 200 OK, DATA[1]
7	0.600603	10.9.0.2	139.162.123.134	HTTP2	79 WINDOW_UPDATE[0]
8	0.601307	10.9.0.2	139.162.123.134	HTTP2	115 HEADERS[3]: GET /humans.txt
9	0.912304	139.162.123.134	10.9.0.2	HTTP2	75 SETTINGS[0]
10	0.916413	139.162.123.134	10.9.0.2	HTTP2	156 HEADERS[3]: 404 Not Found,

```
> Frame 3: 90 bytes on wire (720 bits), 90 bytes captured (720 bits)
> Ethernet II, Src: 92:76:39:be:c1:81 (92:76:39:be:c1:81), Dst: 8a:7d:40:9e:52:1b (8a:7d:40:9e:52:1b)
> Internet Protocol Version 4, Src: 10.9.0.2, Dst: 139.162.123.134
> Transmission Control Protocol, Src Port: 58038, Dst Port: 80, Seq: 179, Ack: 99, Len: 24
v HyperText Transfer Protocol 2
  v Stream: Magic
      Magic: PRI * HTTP/2.0\r\n\r\nSM\r\n\r\n
```

```
0000  8a 7d 40 9e 52 1b 92 76  39 be c1 81 08 00 45 00   ·}@·R··v 9·····E·
0010  00 4c 8c 72 40 00 40 06  9d 06 0a 09 00 02 8b a2   ·L·r@·@· ········
0020  7b 86 e2 b6 00 50 a3 6a  32 3e a4 31 16 8b 80 18   {····P·j 2>·1····
0030  00 e5 11 72 00 00 01 01  08 0a 44 e5 61 c5 d4 bc   ···r···· ··D·a···
0040  f2 56 50 52 49 20 2a 20  48 54 54 50 2f 32 2e 30   ·VPRI *  HTTP/2.0
0050  0d 0a 0d 0a 53 4d 0d 0a  0d 0a                     ····SM·· ··
```

Connection Preface

```
 4 0.600541    10.9.0.2          139.162.123.134   HTTP2     93 SETTINGS[0]
 5 0.600575    10.9.0.2          139.162.123.134   HTTP2     75 SETTINGS[0]
 6 0.600596    139.162.123.134   10.9.0.2          HTTP2    342 HEADERS[1]: 200 OK, DA
 7 0.600603    10.9.0.2          139.162.123.134   HTTP2     79 WINDOW_UPDATE[0]
 8 0.601307    10.9.0.2          139.162.123.134   HTTP2    115 HEADERS[3]: GET /human
 9 0.912304    139.162.123.134   10.9.0.2          HTTP2     75 SETTINGS[0]
10 0.916413    139.162.123.134   10.9.0.2          HTTP2    156 HEADERS[3]: 404 Not Fo
```

```
> Ethernet II, Src: 92:76:39:be:c1:81 (92:76:39:be:c1:81), Dst: 8a:7d:40:9e:52:1b (8a:7d:40:9e:52
> Internet Protocol Version 4, Src: 10.9.0.2, Dst: 139.162.123.134
> Transmission Control Protocol, Src Port: 58038, Dst Port: 80, Seq: 203, Ack: 99, Len: 27
v HyperText Transfer Protocol 2
  v Stream: SETTINGS, Stream ID: 0, Length 18
      Length: 18
      Type: SETTINGS (4)
    v Flags: 0x00
        0000 000. = Unused: 0x00
        .... ...0 = ACK: False
      0... .... .... .... .... .... .... .... = Reserved: 0x0
      .000 0000 0000 0000 0000 0000 0000 0000 = Stream Identifier: 0
    > Settings - Max concurrent streams : 100
    > Settings - Initial Windows size : 1073741824
    > Settings - Enable PUSH : 0
```

```
0000  8a 7d 40 9e 52 1b 92 76  39 be c1 81 08 00 45 00   ·}@·R··v 9·····E·
0010  00 4f 8c 73 40 00 40 06  9d 02 0a 09 00 02 8b a2   ·O·s@·@· ········
0020  7b 86 e2 b6 00 50 a3 6a  32 56 a4 31 16 8b 80 18   {····P·j 2V·1····
0030  00 e5 11 75 00 00 01 01  08 0a 44 e5 61 c5 d4 bc   ···u···· ··D·a···
0040  f2 56 00 00 12 04 00 00  00 00 00 00 03 00 00 00   ·V······ ········
0050  64 00 04 40 00 00 00 00  02 00 00 00 00            d··@···· ·····
```

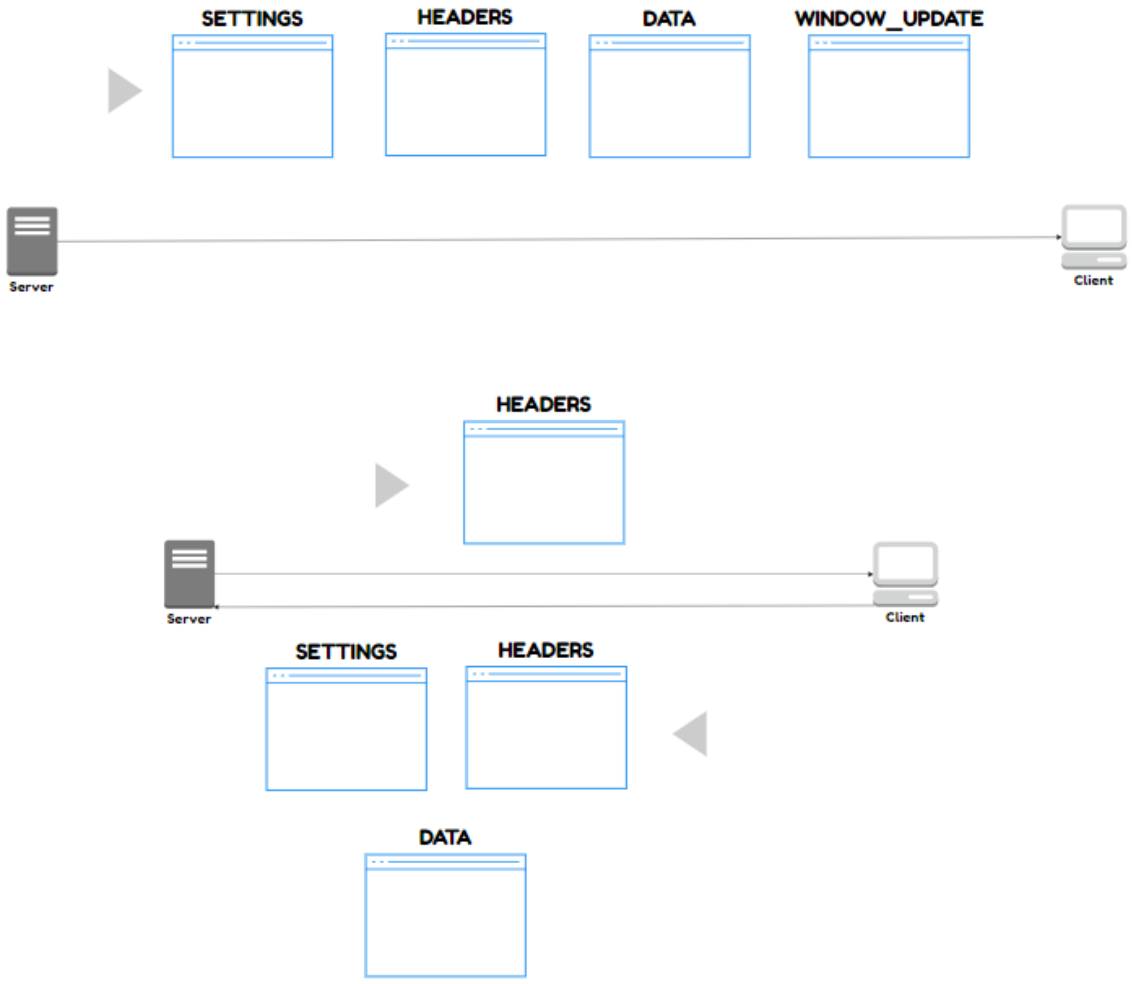
Connection Preface

```
  4 0.600541      10.9.0.2          139.162.123.134   HTTP2      93 SETTINGS[0]
  5 0.600575      10.9.0.2          139.162.123.134   HTTP2      75 SETTINGS[0]
  6 0.600596      139.162.123.134   10.9.0.2          HTTP2     342 HEADERS[1]: 200 OK, DATA
  7 0.600603      10.9.0.2          139.162.123.134   HTTP2      79 WINDOW_UPDATE[0]
  8 0.601307      10.9.0.2          139.162.123.134   HTTP2     115 HEADERS[3]: GET /humans.
  9 0.912304      139.162.123.134   10.9.0.2          HTTP2      75 SETTINGS[0]
  … 0.916413      139.162.123.134   10.9.0.2          HTTP2     156 HEADERS[3]: 404 Not Four
```

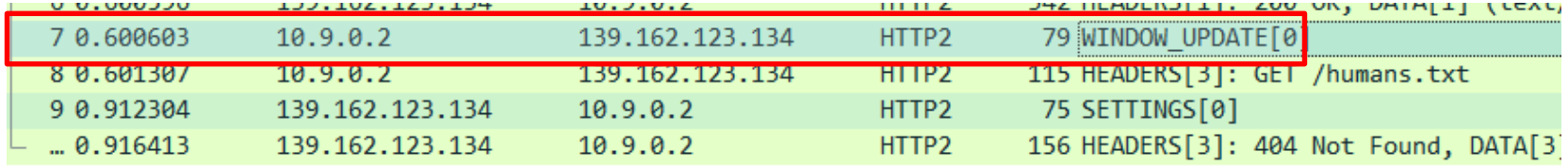
```
> Frame 5: 75 bytes on wire (600 bits), 75 bytes captured (600 bits)
> Ethernet II, Src: 92:76:39:be:c1:81 (92:76:39:be:c1:81), Dst: 8a:7d:40:9e:52:1b (8a:7d:40:9e:52:1
> Internet Protocol Version 4, Src: 10.9.0.2, Dst: 139.162.123.134
> Transmission Control Protocol, Src Port: 58038, Dst Port: 80, Seq: 230, Ack: 99, Len: 9
v HyperText Transfer Protocol 2
  v Stream: SETTINGS, Stream ID: 0, Length 0
      Length: 0
      Type: SETTINGS (4)
    v Flags: 0x01, ACK
        0000 000. = Unused: 0x00
        .... ...1 = ACK: True
      0... .... .... .... .... .... .... .... = Reserved: 0x0
      .000 0000 0000 0000 0000 0000 0000 0000 = Stream Identifier: 0
```

```
0000  8a 7d 40 9e 52 1b 92 76  39 be c1 81 08 00 45 00   ·}@·R··v 9·····E·
0010  00 3d 8c 74 40 00 40 06  9d 13 0a 09 00 02 8b a2   ·=·t@·@· ········
0020  7b 86 e2 b6 00 50 a3 6a  32 71 a4 31 16 8b 80 18   {····P·j 2q·1····
0030  00 e5 11 63 00 00 01 01  08 0a 44 e5 61 c5 d4 bc   ···c···· ··D·a···
0040  f2 56 00 00 00 04 01 00  00 00 00                 ·V····· ···
```

SETTINGS, HEADERS, DATA, WINDOW_UPDATE



WINDOW_UPDATE

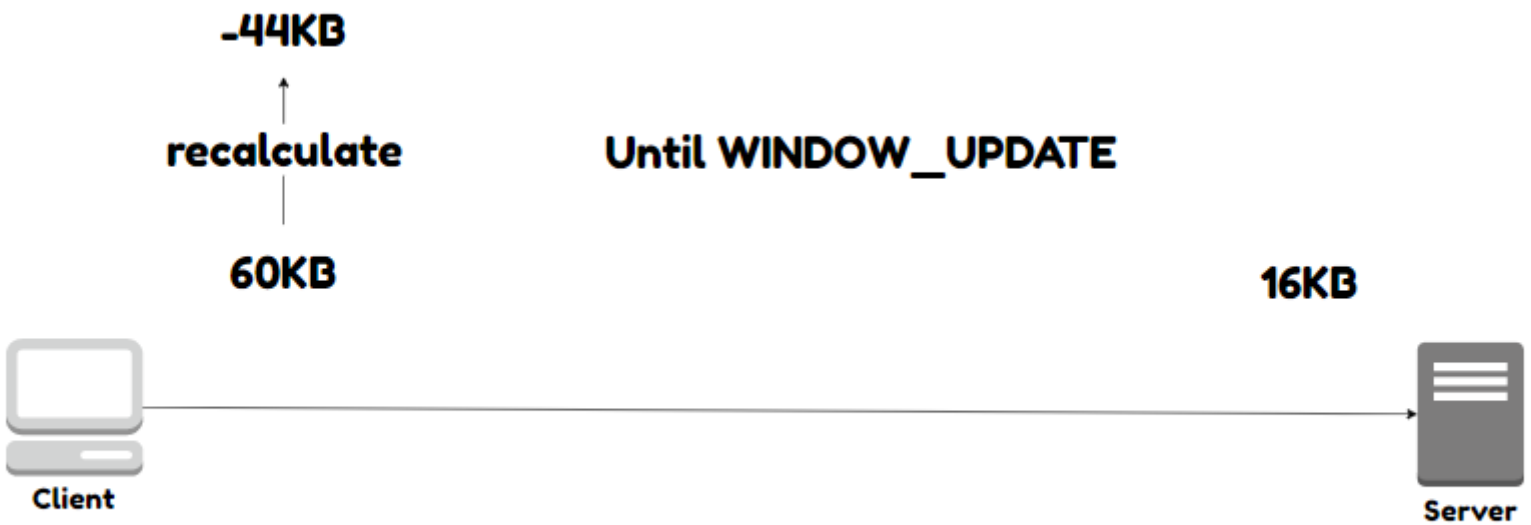



```
> Frame 7: 79 bytes on wire (632 bits), 79 bytes captured (632 bits)
> Ethernet II, Src: 92:76:39:be:c1:81 (92:76:39:be:c1:81), Dst: 8a:7d:40:9e:52:1b (8a:7d:40:9e:52:1b)
> Internet Protocol Version 4, Src: 10.9.0.2, Dst: 139.162.123.134
> Transmission Control Protocol, Src Port: 58038, Dst Port: 80, Seq: 239, Ack: 99, Len: 13
v HyperText Transfer Protocol 2
  v Stream: WINDOW_UPDATE, Stream ID: 0, Length 4
      Length: 4
      Type: WINDOW_UPDATE (8)
    > Flags: 0x00
      0... .... .... .... .... .... .... .... = Reserved: 0x0
      .000 0000 0000 0000 0000 0000 0000 0000 = Stream Identifier: 0
      0... .... .... .... .... .... .... .... = Reserved: 0x0
      .011 1111 1111 1111 0000 0000 0000 0001 = Window Size Increment: 1073676289
```

```
0000  8a 7d 40 9e 52 1b 92 76  39 be c1 81 08 00 45 00   ·}@·R··v 9·····E·
0010  00 41 8c 75 40 00 40 06  9d 0e 0a 09 00 02 8b a2   ·A·u@·@· ········
0020  7b 86 e2 b6 00 50 a3 6a  32 7a a4 31 16 8b 80 18   {····P·j 2z·1····
0030  00 e5 11 67 00 00 01 01  08 0a 44 e5 61 c5 d4 bc   ···g···· ··D·a···
0040  f2 56 00 00 04 08 00 00  00 00 00 3f ff 00 01      ·V····· ···?···
```

WINDOW_UPDATE

Individual Stream vs Entire Connection => Hop By Hop



HEADERS Frame

6	0.600596	139.162.123.134	10.9.0.2	HTTP2	342 HEADERS[1]: 200 OK, DATA[1] (text/plain)
7	0.600603	10.9.0.2	139.162.123.134	HTTP2	79 WINDOW_UPDATE[0]
8	0.601307	10.9.0.2	139.162.123.134	HTTP2	115 HEADERS[3]: GET /humans.txt
9	0.912304	139.162.123.134	10.9.0.2	HTTP2	75 SETTINGS[0]
…	0.916413	139.162.123.134	10.9.0.2	HTTP2	156 HEADERS[3]: 404 Not Found, DATA[3] (text/plain)

```
> Frame 6: 342 bytes on wire (2736 bits), 342 bytes captured (2736 bits)
> Ethernet II, Src: 8a:7d:40:9e:52:1b (8a:7d:40:9e:52:1b), Dst: 92:76:39:be:c1:81 (92:76:39:be:c1:81)
> Internet Protocol Version 4, Src: 139.162.123.134, Dst: 10.9.0.2
> Transmission Control Protocol, Src Port: 80, Dst Port: 58038, Seq: 99, Ack: 179, Len: 276
v HyperText Transfer Protocol 2
  > Stream: HEADERS, Stream ID: 1, Length 196, 200 OK
  > Stream: DATA, Stream ID: 1, Length 62
  v Line-based text data: text/plain (4 lines)
      User-agent: *\n
      Disallow: \n
      \n
      Sitemap: //nghttp2.org/sitemap.xml \n
```

참고

HTTP/2(https://developers.google.com/web/fundamentals/performance/http2)

Hello HTTP/2, Goodbye SPDY(https://blog.chromium.org/2015/02/hello-http2-goodbye-spdy.html)

https://developer.mozilla.org/ko/docs/Web/HTTP/Status/101

https://datatracker.ietf.org/doc/html/rfc7540#section-3.5

https://httpwg.org/specs/rfc7540.html

https://ko.wikipedia.org/wiki/%EB%A9%94%EB%AA%A8%EB%A6%AC_%EC%9D%B8%ED%84%B0%EB%A6%AC%EB%B9%99

https://hpbn.co/http2/#server-push

Thank You!

39ghwjd@naver.com
IMHOJEONG@github.com