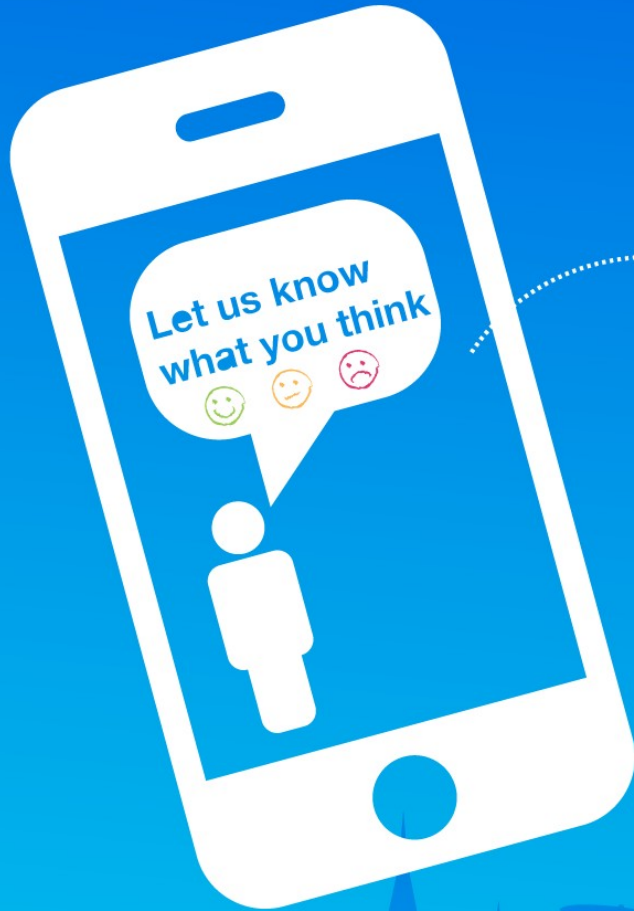


HTTP/2

Daniel Stenberg, Mozilla
@bagder





**Click 'engage'
to rate sessions
and ask questions**

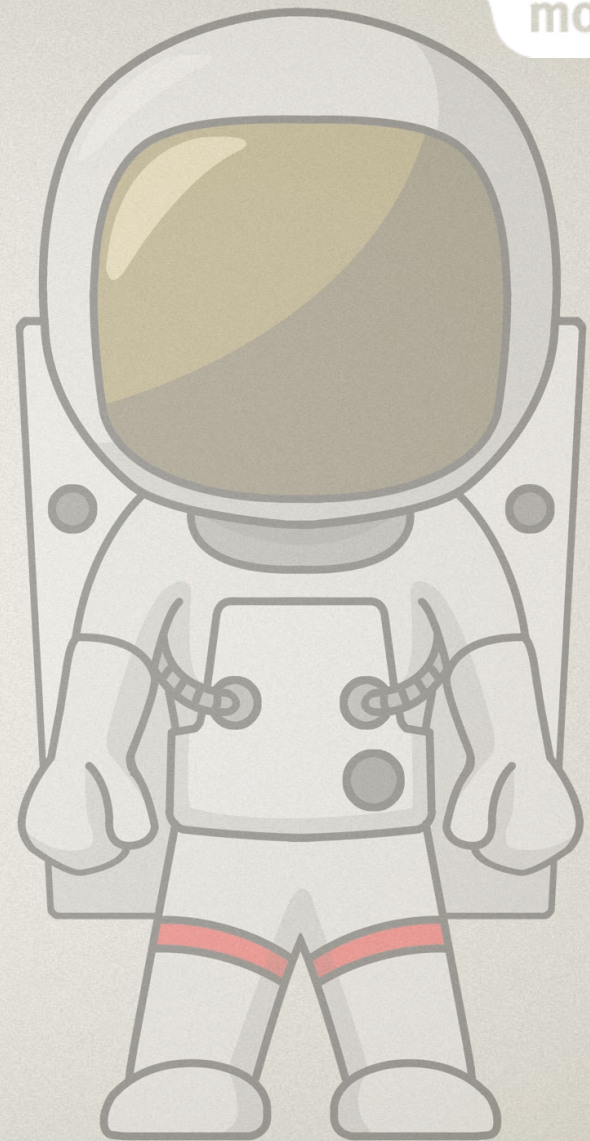


HTTP Today

HTTP/2 basics

Status

Future



Daniel Stenberg

mozilla



BAGDER

mozilla

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Twitter: @bagder

Web: daniel.haxx.se

Blog: daniel.haxx.se/blog

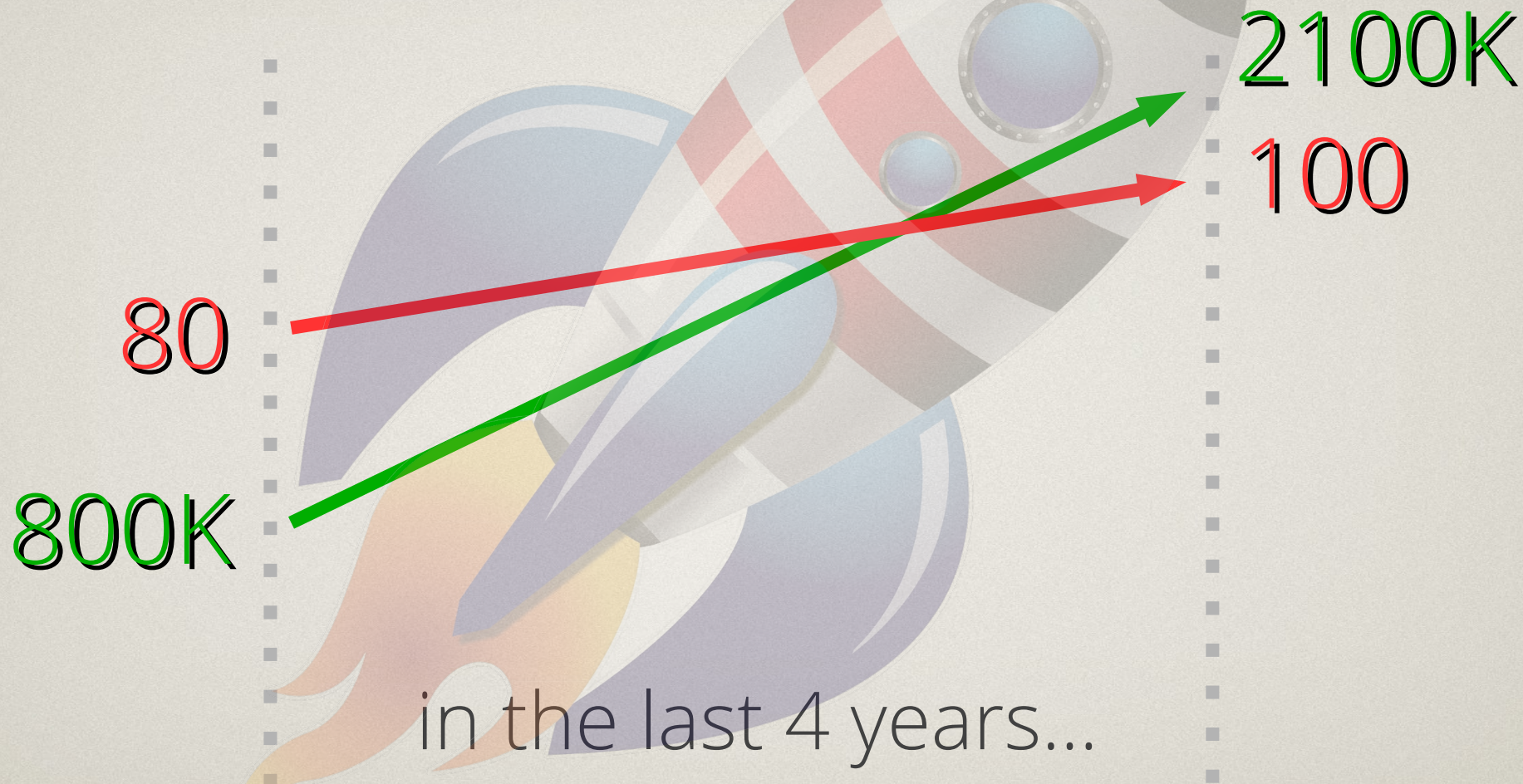
A historical black and white photograph of a busy city street, likely from the late 19th or early 20th century. A steam locomotive is pulling a train of freight cars down the street, emitting a large plume of white smoke. The street is filled with horse-drawn carriages, some carrying multiple passengers, and several pedestrians. The buildings lining the street are multi-story brick structures with many windows. The overall scene depicts a bustling urban environment from a past era.

Internet Today

HTTP for everything

The web has changed
significantly since 1996

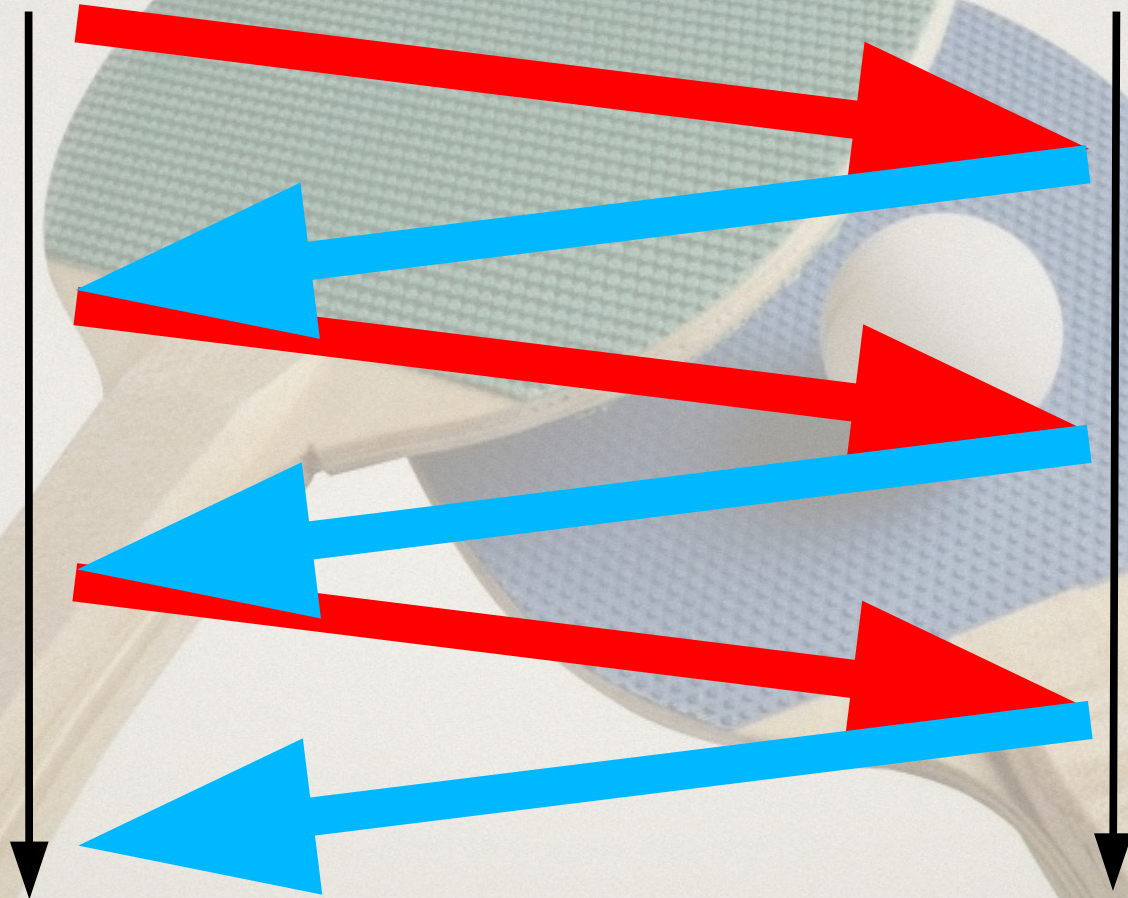
Request and payload growth



connections per page



Roundtrip Bonanza



Latency adds up

Page load
time

4,000 ms

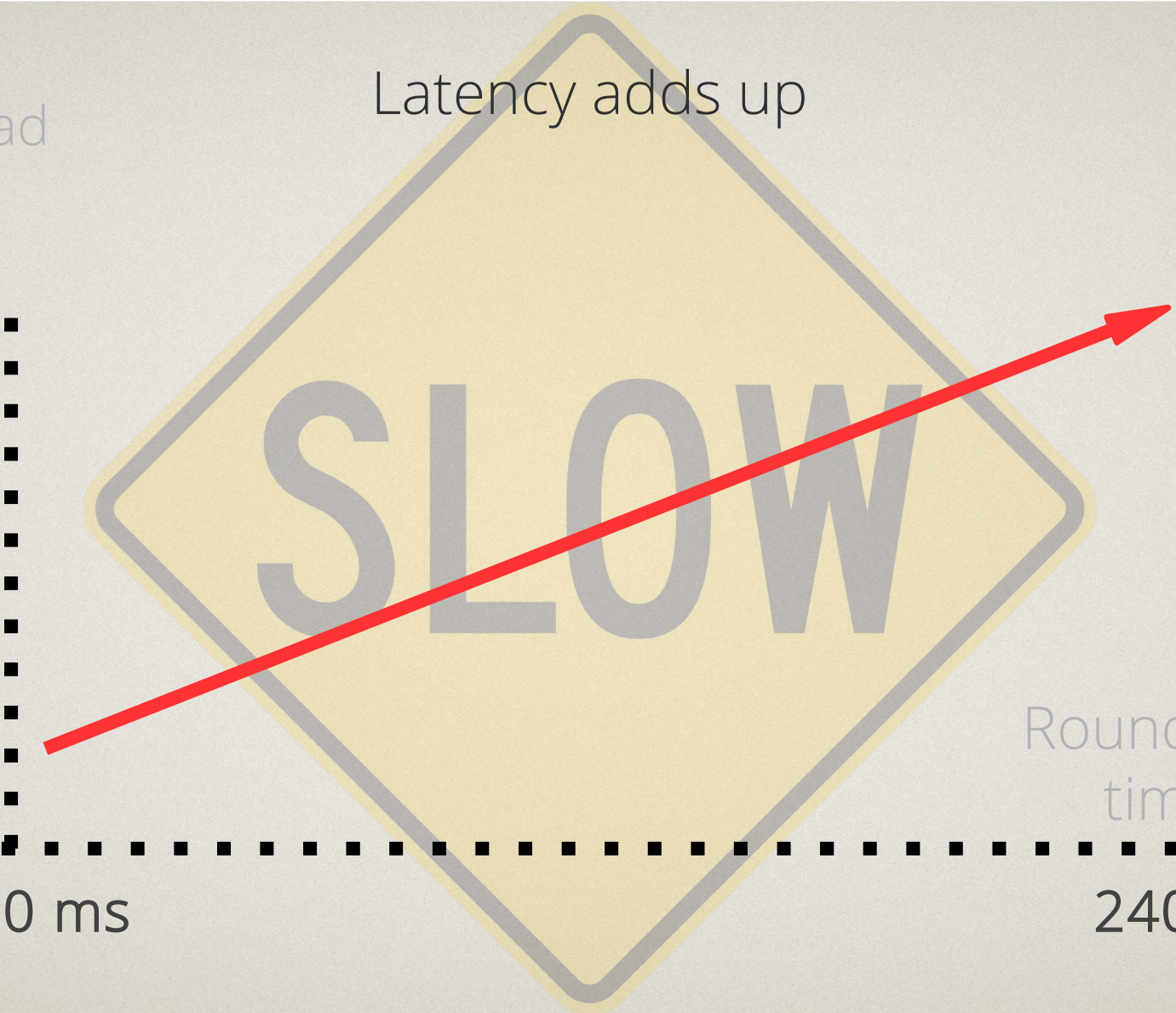
750 ms

0 ms

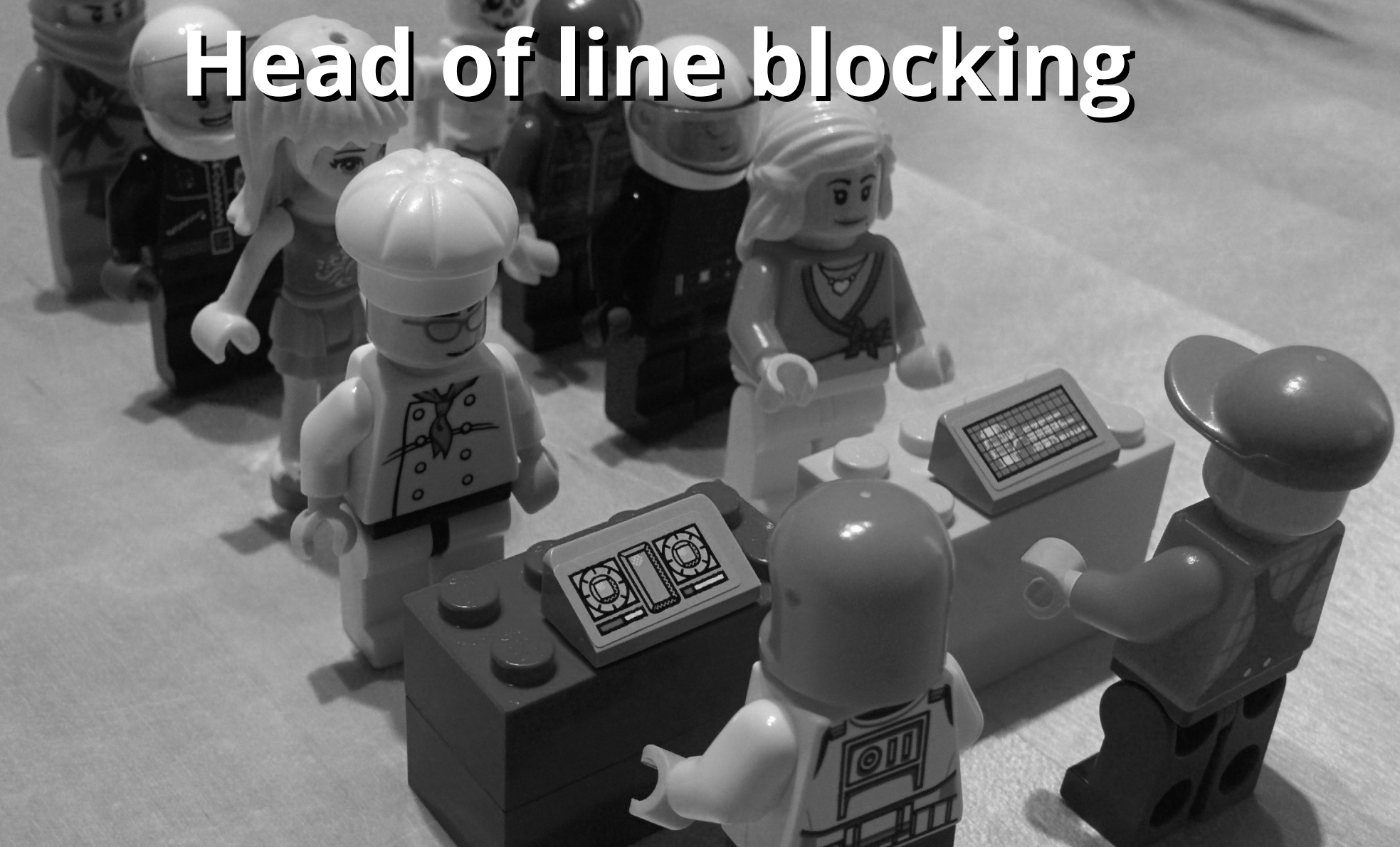
Round trip
time

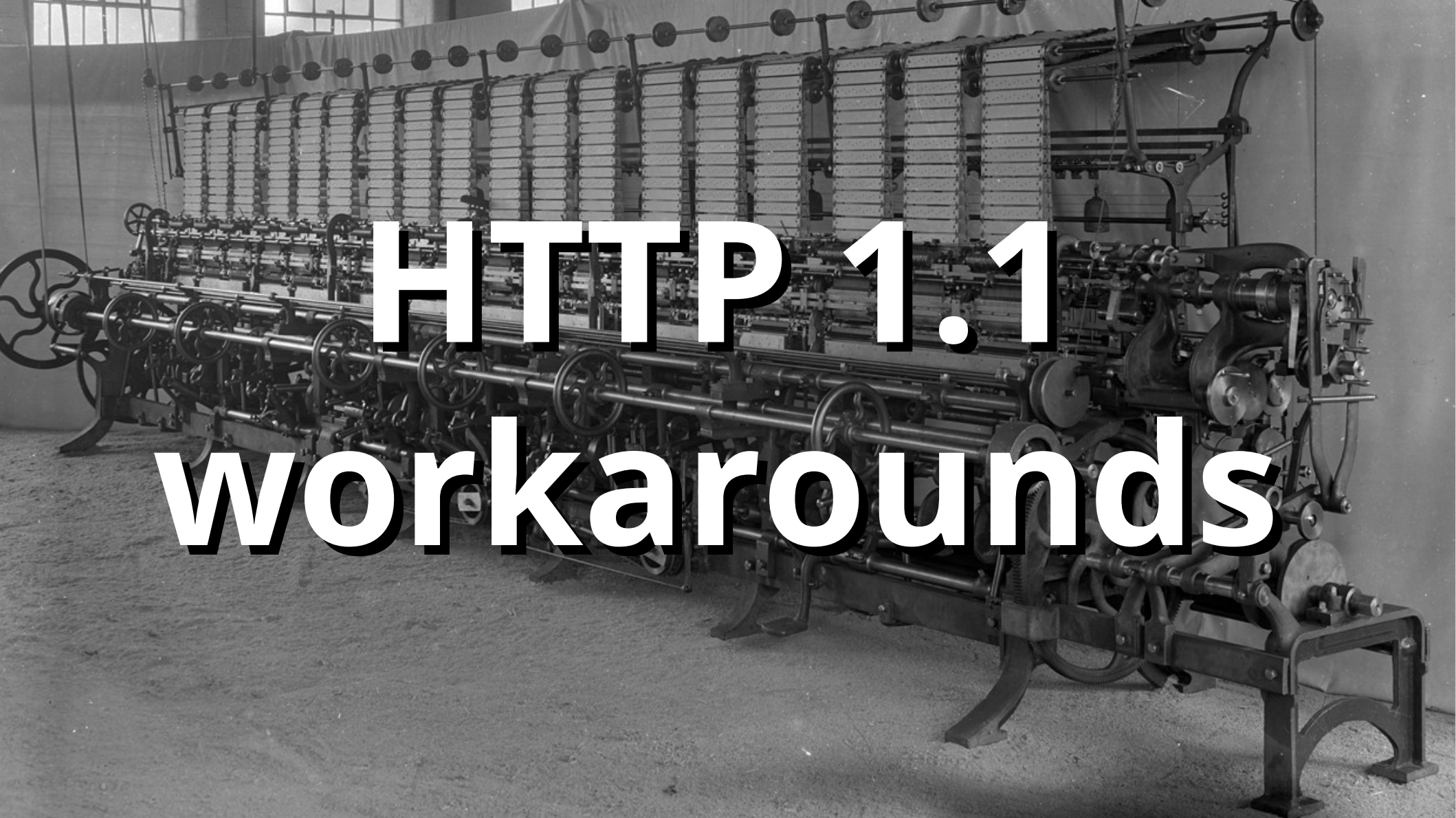
240 ms

Mike Belshe



Head of line blocking





HTTP 1.1 workarounds



Sprinting

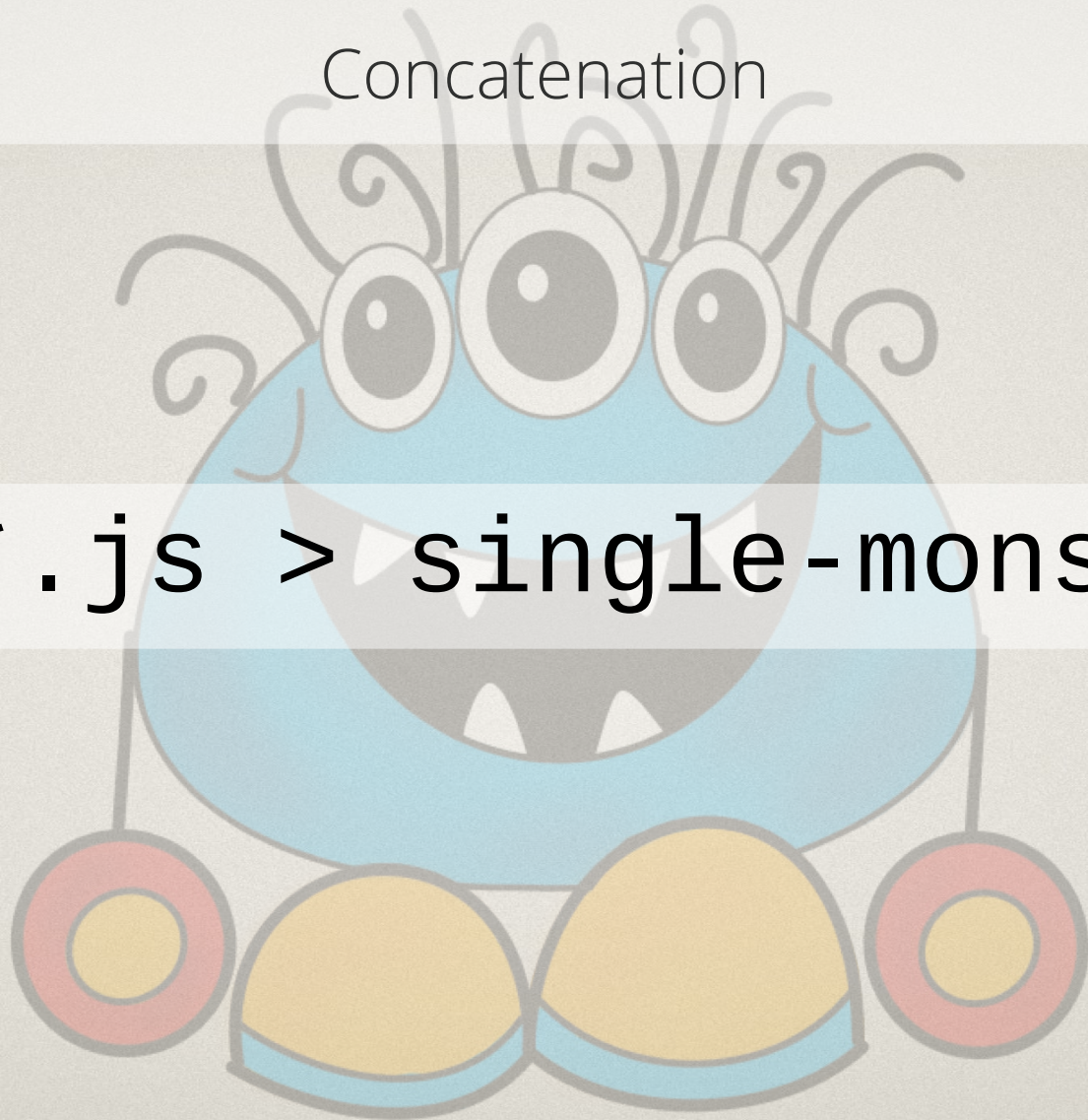
Inlining

```
.icon1 {  
  background: url(data:image/png;base64,<data>) no-repeat;  
}
```

```
.icon2 {  
  background: url(data:image/png;base64,<data>) no-repeat;  
}
```


Concatenation

```
$ cat *.js > single-monster.js
```



200 GET	174.jpg	w.cdn-expressen.se	jpeg	8.14 KB	→ 103 ms
200 GET	174.jpg	y.cdn-expressen.se	jpeg	4.19 KB	→ 172 ms
200 GET	174.jpg	z.cdn-expressen.se	jpeg	4.48 KB	→ 223 ms
200 GET	174.jpg	x.cdn-expressen.se	jpeg	4.58 KB	→ 173 ms
200 GET	174.jpg	w.cdn-expressen.se	jpeg	35.18 KB	→ 56 ms
200 GET	174.jpg	y.cdn-expressen.se	jpeg	12.97 KB	→ 165 ms
200 GET	174.jpg	z.cdn-expressen.se	jpeg	4.83 KB	→ 56 ms
200 GET	174.jpg	x.cdn-expressen.se	jpeg	9.54 KB	→ 228 ms
200 GET	174.jpg	w.cdn-expressen.se	jpeg	182.50 KB	→ 285 ms
200 GET	174.jpg	y.cdn-expressen.se	jpeg	5.66 KB	→ 104 ms
200 GET	174.jpg	z.cdn-expressen.se	jpeg	12.24 KB	→ 287 ms
200 GET	174.jpg	x.cdn-expressen.se	jpeg	6.85 KB	→ 225 ms
200 GET	174.jpg	w.cdn-expressen.se	jpeg	7.50 KB	→ 173 ms
200 GET	174.jpg	y.cdn-expressen.se	gif	2.85 KB	→ 227 ms
200 GET	174.jpg	z.cdn-expressen.se	jpeg	50.87 KB	→ 188 ms
200 GET	174.jpg	x.cdn-expressen.se	jpeg	6.65 KB	→ 55 ms
200 GET	174.jpg	w.cdn-expressen.se	jpeg	6.09 KB	→ 196 ms
200 GET	540.jpg	z.cdn-expressen.se	jpeg	16.14 KB	→ 67 ms
200 GET	540.jpg	w.cdn-expressen.se	jpeg	19.89 KB	→ 112 ms
200 GET	174.jpg	z.cdn-expressen.se	jpeg	5.03 KB	→ 55 ms
200 GET	540.jpg	w.cdn-expressen.se	jpeg	21.27 KB	→ 108 ms
200 GET	540.jpg	x.cdn-expressen.se	jpeg	5.43 KB	→ 237 ms
200 GET	174.jpg	y.cdn-expressen.se	jpeg	6.08 KB	→ 169 ms
200 GET	174.jpg	w.cdn-expressen.se	jpeg	5.62 KB	→ 105 ms
200 GET	540.jpg	x.cdn-expressen.se	jpeg	20.32 KB	→ 241 ms
200 GET	174.jpg	z.cdn-expressen.se	jpeg	6.66 KB	→ 55 ms
200 GET	540.jpg	x.cdn-expressen.se	jpeg	11.13 KB	→ 237 ms
200 GET	265.jpg	w.cdn-expressen.se	jpeg	5.20 KB	→ 111 ms
200 GET	265.jpg	x.cdn-expressen.se	jpeg	6.93 KB	→ 288 ms
200 GET	265.jpg	x.cdn-expressen.se	jpeg	12.09 KB	→ 249 ms
200 GET	265.jpg	z.cdn-expressen.se	jpeg	5.92 KB	→ 167 ms
200 GET	original.jpg	y.cdn-expressen.se	jpeg	64.28 KB	→ 192 ms
200 GET	original.jpg	w.cdn-expressen.se	jpeg	21.88 KB	→ 106 ms
200 GET	540.jpg	w.cdn-expressen.se	jpeg	18.77 KB	→ 112 ms
200 GET	128.jpg	z.cdn-expressen.se	jpeg	3.34 KB	→ 55 ms
200 GET	265.jpg	x.cdn-expressen.se	jpeg	13.00 KB	→ 245 ms
200 GET	265.jpg	y.cdn-expressen.se	jpeg	9.19 KB	→ 194 ms
200 GET	540.jpg	w.cdn-expressen.se	jpeg	13.13 KB	→ 108 ms
200 GET	174.jpg	y.cdn-expressen.se	jpeg	5.66 KB	→ 197 ms
200 GET	174.jpg	z.cdn-expressen.se	jpeg	5.56 KB	→ 55 ms
200 GET	174.jpg	w.cdn-expressen.se	jpeg	5.07 KB	→ 111 ms
200 GET	174.jpg	z.cdn-expressen.se	jpeg	6.16 KB	→ 59 ms
200 GET	174.jpg	y.cdn-expressen.se	jpeg	6.57 KB	→ 210 ms
200 GET	174.jpg	y.cdn-expressen.se	jpeg	4.58 KB	→ 12 ms
200 GET	265.jpg	y.cdn-expressen.se	jpeg	11.49 KB	→ 173 ms

Sharding





RFC 7540

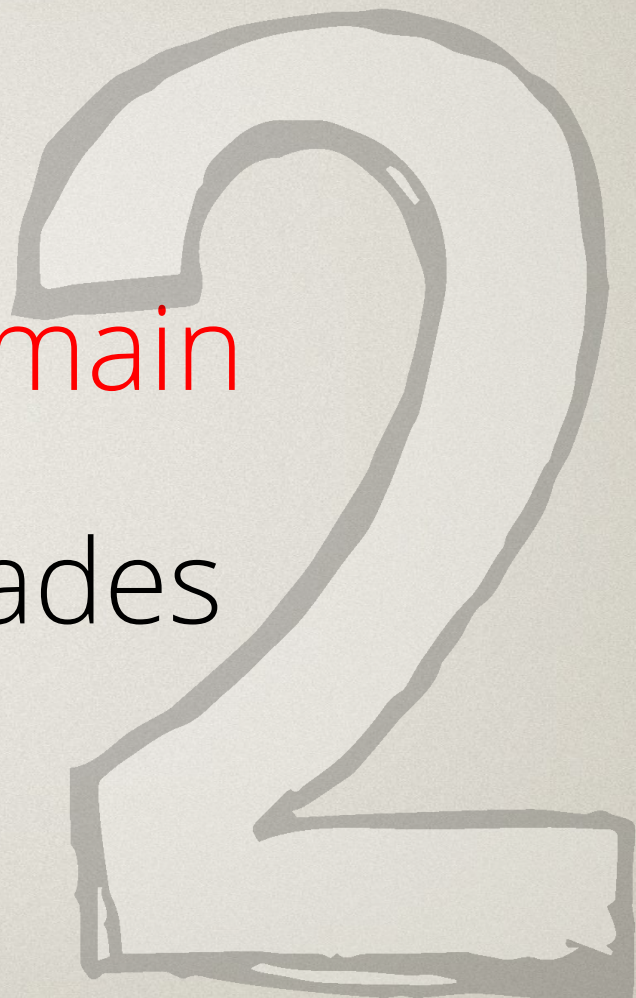
Just a new framing layer

maintains HTTP paradigms

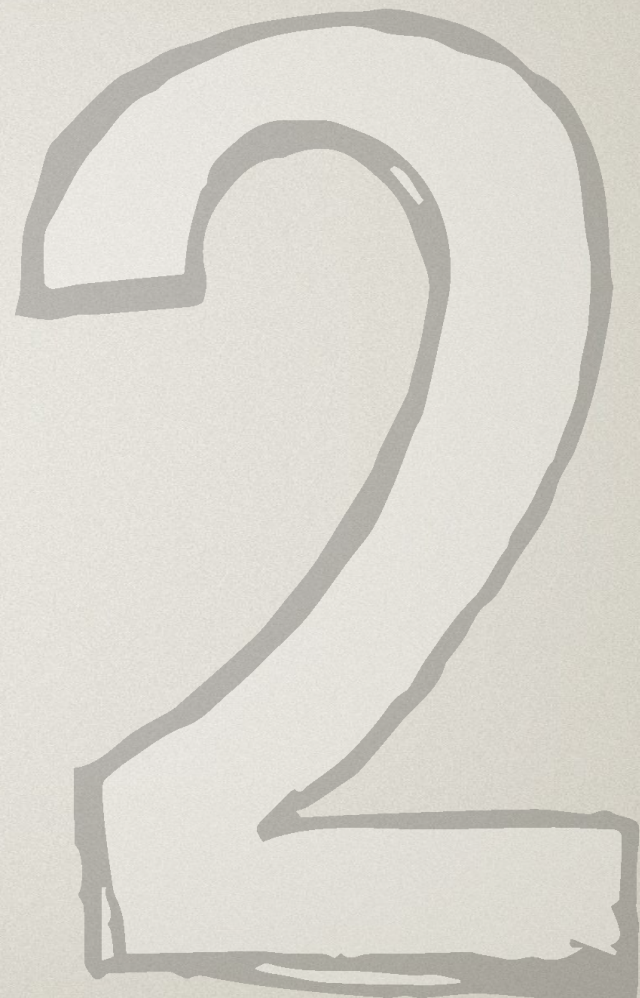
http:// and https:// URLs remain

HTTP/1.1 will linger for decades

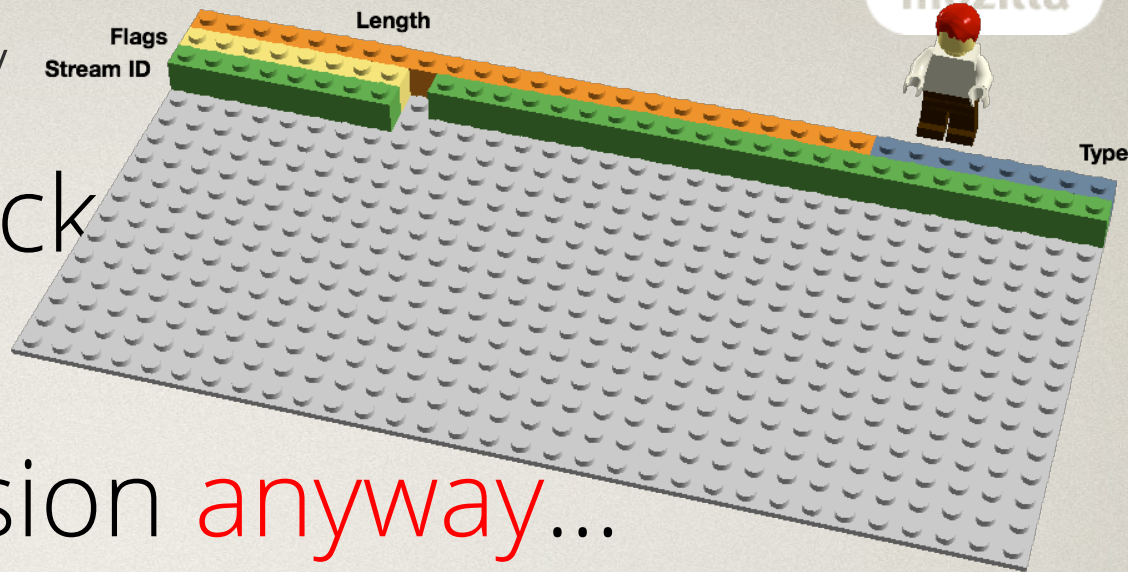
Proxies to convert 1:1



Conservative in what you accept
less optional parts
no minor version!



Binary



No more telnet trick

Easier framing

TLS and compression anyway...

Wireshark inspector

frame types, like HEADERS and
DATA

Multiplexed (1/2)

Multiple **streams** over a single physical connection

Max number of parallel streams **set by peer**



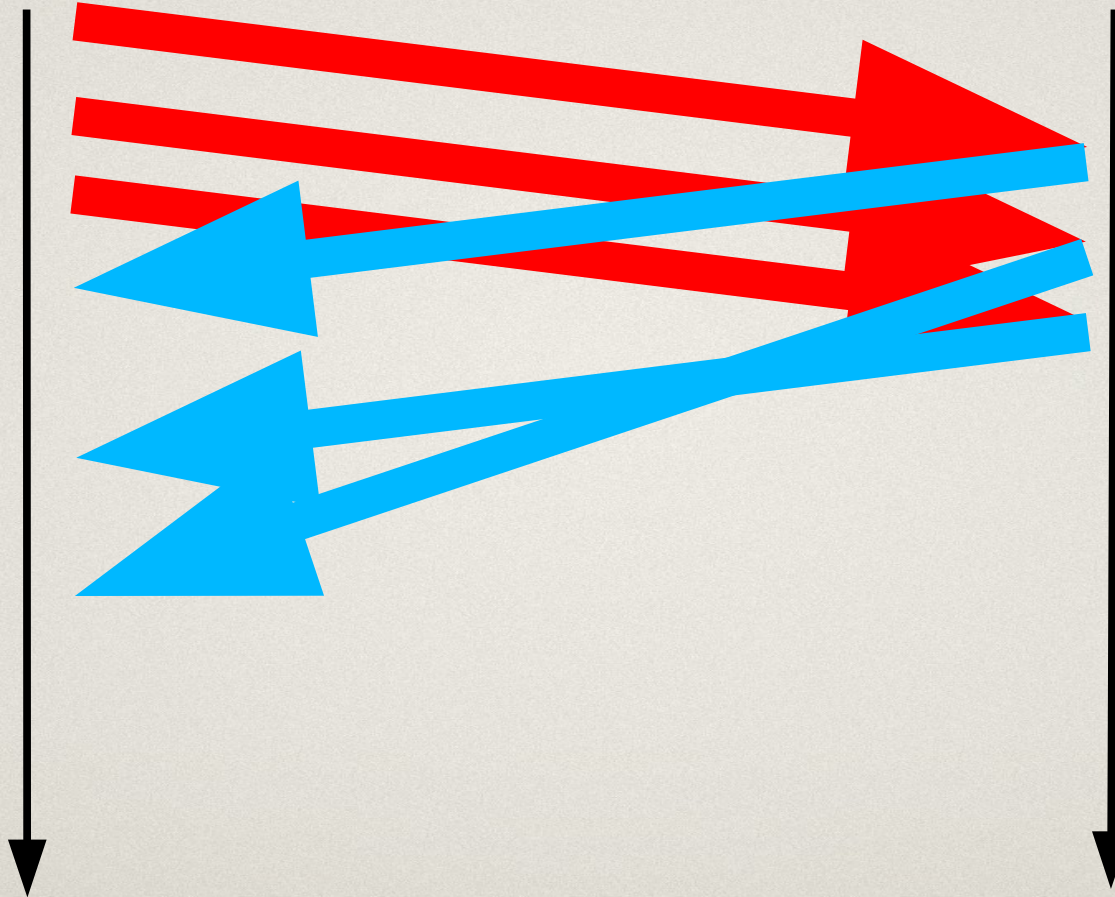
Multiplexed (2/2)





One TCP connection

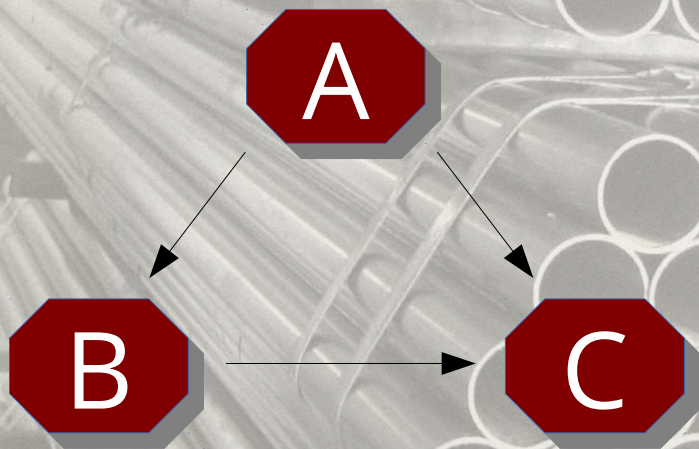
Better utilization of bandwidth



Streams

Dynamic priority

Dependencies



Flow control



Header compression

headers are **big** and **repetitive**

1.1 **has no** header compression

HPACK

TEKTON 5"

Server push



Give me HTML please!

Here's HTML for you

Here's CSS for you



Stricter TLS

TLS version 1.2+ only

Stricter cipher suite requirements

No compression

No renegotiations

HTTP/2 is not

Mandatory TLS
Changing HTTP headers

How will HTTP/2 affect users?

Faster page loads

More responsive loading

More HTTPS



How will HTTP/2 affect web development?

Most things are unaffected

HTTP/1 work-arounds *hurt* HTTP/2 perf

Need to do *separate* tweaks

Optimal HTTP/2 usage will *need some time*

Implementations

Akamai Ghost, Apache Traffic Server, http4s-blaze, Chromium, Chicken Scheme hpack lib, cl-http2-protocol, curl and libcurl, Deuterium, Ericsson MSP, F5, H2O, Haskell http2 lib, http-2, http2, hyper, hyper, Jetty, LiteSpeed Enterprise, Lucid, Microsoft, mod_h2, Mozilla Firefox, Netty, nghttp2, NGINX, node-http2, OkHttp, OpenLiteSpeed, Protocol::HTTP2, Brocade SteelApp Traffic Manager, Sasazka, second-transfer, Test GFE, Trusterd, Twitter, Undertow, Warp, Wireshark

<https://github.com/http2/http2-spec/wiki/Implementations>

browsers



Will HTTP/2 get widely deployed?

YES

Will HTTP/2 get widely deployed?

“Look at IPv6”

All major browsers

Many sites already did SPDY

Apache, nginx and more

HTTP/2 – October 2015

Browsers only over HTTPS

Firefox: **14%** HTTP/2

30% of HTTPS is HTTP/2

HTTP/2 is used **15 times more** than HTTP/1.0

Google servers: **18%** HTTP/2

HTTP/2 in **70%** of browsers in use right now

IPv6: 9% today, almost **20 years** after first RFC



Future

HTTP/2 lays the foundation for the future
Time to drop legacy HTTP “mistakes”?
HTTP/3 might happen faster
QUIC

Final recap

Binary and multiplexed
Primarily over TLS
Users won't see a "2"
It's already here

*What Every Web Developer Should Know About
Networking and Browser Performance*



High Performance

Browser Networking

O'REILLY®

Ilya Grigorik

Thank you!

http2 explained

Daniel Stenberg



Please

**Remember to
rate this session**

Thank you!

