Cabinet Office

Matt Hobbs

Head of Frontend, Lead Developer

Government Digital Service

@TheRealNooshu

I work at the Government Digital Service

Bringing HTTP/2 to GOV.UK

Who are GDS?

Boards
Trello
angusmontgomery
Welcome to GDS (Step 1: make a copy of this board and use that)
Public
Show Menu
Simple essentials
READ ME - using this board
Get set up with the basics
Get your ID pass
Understand where you fit in
Tour of the office
Things you have to read
Read the social media guidance
Read the Civil Service Code
Read the guidance about giving presentations and speaking at external events
0/4
Read the Design Principles
Read "Revolution not evolution"
Other stuff
Attend the "Welcome to GDS" talk
Find out about the People Board
Find out about diversity at GDS
Start your training - mandatory courses at Civil Service Learning
What to do
MacBook Air

GOV.UK
Tell us what you think of GOV.UK
Take the 3 minute survey
Welcome to GOV.UK
The best place to find government services and information
Simpler, clearer, faster
Search GOV.UK
Business and self-employed
Tools and guidance for businesses
Citizenship and living in the UK
Voting, community participation, life in the UK, international projects
Crime, justice and the law
Legal processes, courts and the police
Lasting Power of Attorney
Education and learning
Includes student loans, admissions and apprenticeships
Employing people
Includes pay, contracts and hiring
Environment and countryside
Includes flooding, recycling and wildlife
Money and tax
MacBook Pro

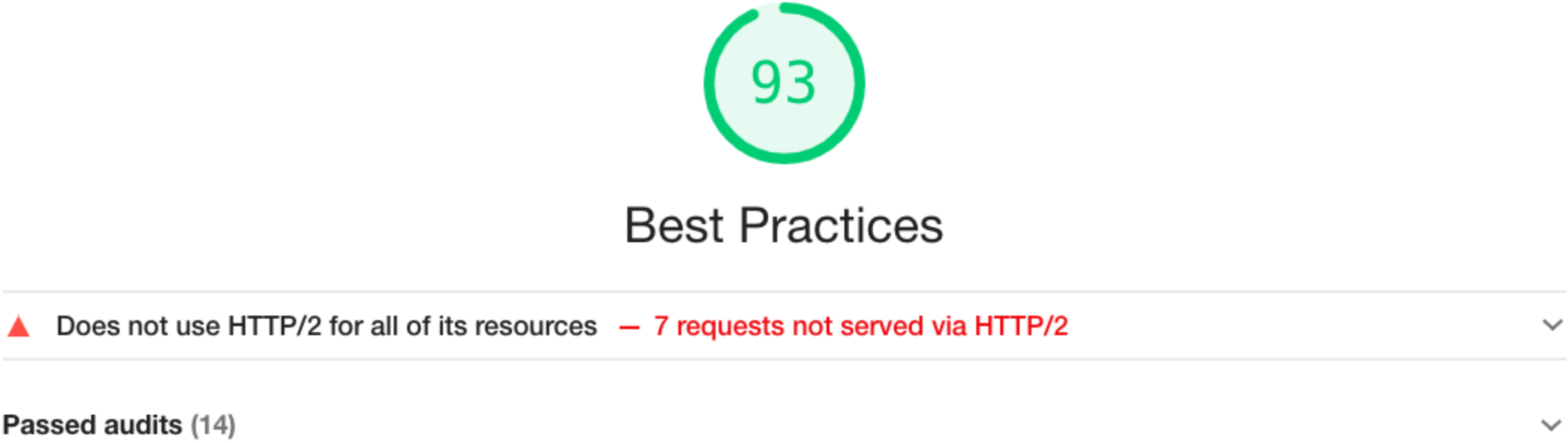
GOV.UK

What is HTTP/2?

- HPACK header compression
- Multiplexing streams
- Prioritisation
- Server push†

†: May or may not be an improvement, but it’s in the specifications

Why enable it?

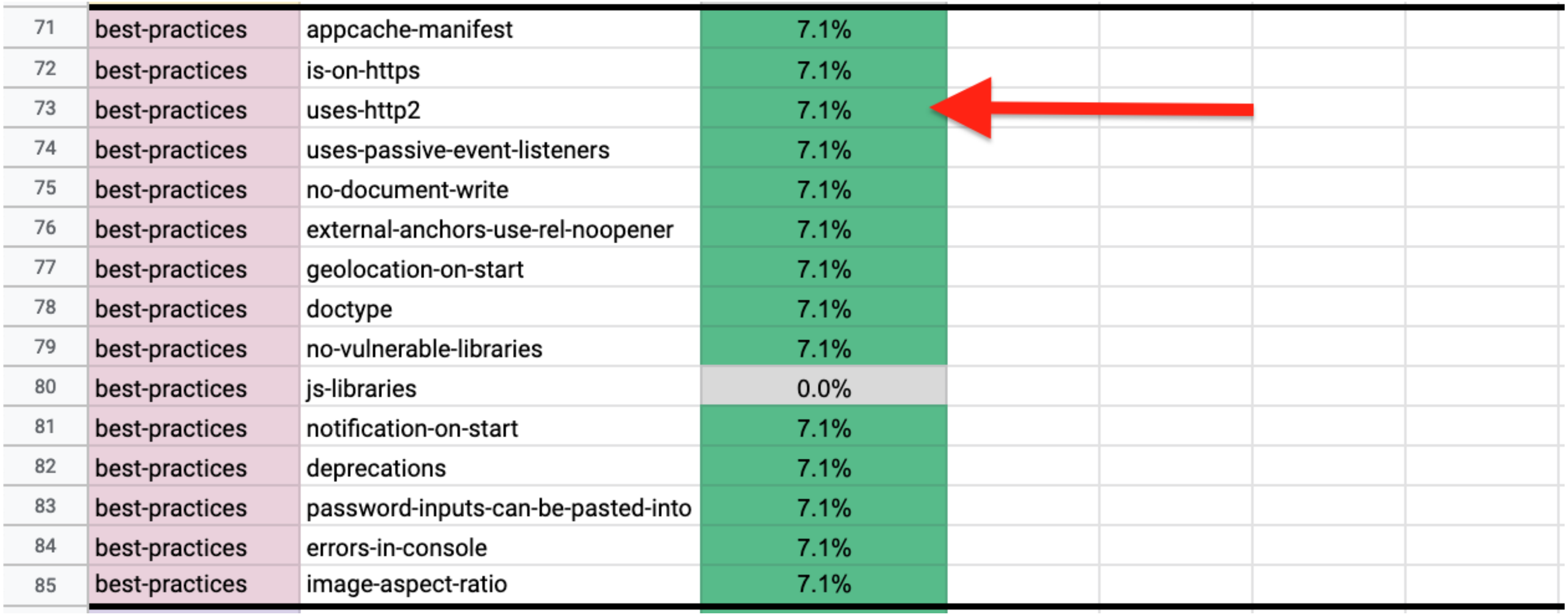


93

Best Practices

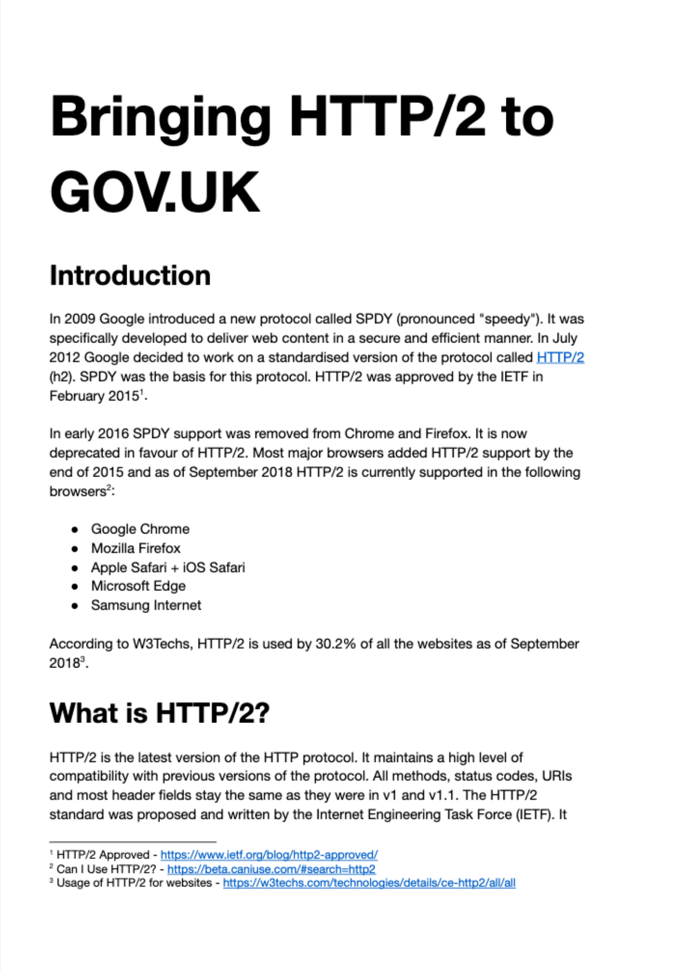
▲ Does not use HTTP/2 for all of its resources — 7 requests not served via HTTP/2

Passed audits (14)



71	best-practices	appcache-manifest	7.1%
72	best-practices	is-on-https	7.1%
73	best-practices	uses-http2	7.1%
74	best-practices	uses-passive-event-listeners	7.1%
75	best-practices	no-document-write	7.1%
76	best-practices	external-anchors-use-rel-noopener	7.1%
77	best-practices	geolocation-on-start	7.1%
78	best-practices	doctype	7.1%
79	best-practices	no-vulnerable-libraries	7.1%
80	best-practices	js-libraries	0.0%
81	best-practices	notification-on-start	7.1%
82	best-practices	deprecations	7.1%
83	best-practices	password-inputs-can-be-pasted-into	7.1%
84	best-practices	errors-in-console	7.1%
85	best-practices	image-aspect-ratio	7.1%

10 page report on HTTP/2



Bringing HTTP/2 to GOV.UK

Introduction

In 2009 Google introduced a new protocol called SPDY (pronounced "speedy"). It was specifically developed to deliver web content in a secure and efficient manner. In July 2012 Google decided to work on a standardised version of the protocol called HTTP/2 (h2). SPDY was the basis for this protocol. HTTP/2 was approved by the IETF in February 2015[1].

In early 2016 SPDY support was removed from Chrome and Firefox. It is now deprecated in favour of HTTP/2. Most major browsers added HTTP/2 support by the end of 2015 and as of September 2018 HTTP/2 is currently supported in the following browsers[2]:

- Google Chrome
- Mozilla Firefox
- Apple Safari + iOS Safari
- Microsoft Edge
- Samsung Internet

According to W3Techs, HTTP/2 is used by 30.2% of all the websites as of September 2018[3].

What is HTTP/2?

HTTP/2 is the latest version of the HTTP protocol. It maintains a high level of compatibility with previous versions of the protocol. All methods, status codes, URIs and most header fields stay the same as they were in v1 and v1.1. The HTTP/2 standard was proposed and written by the Internet Engineering Task Force (IETF). It

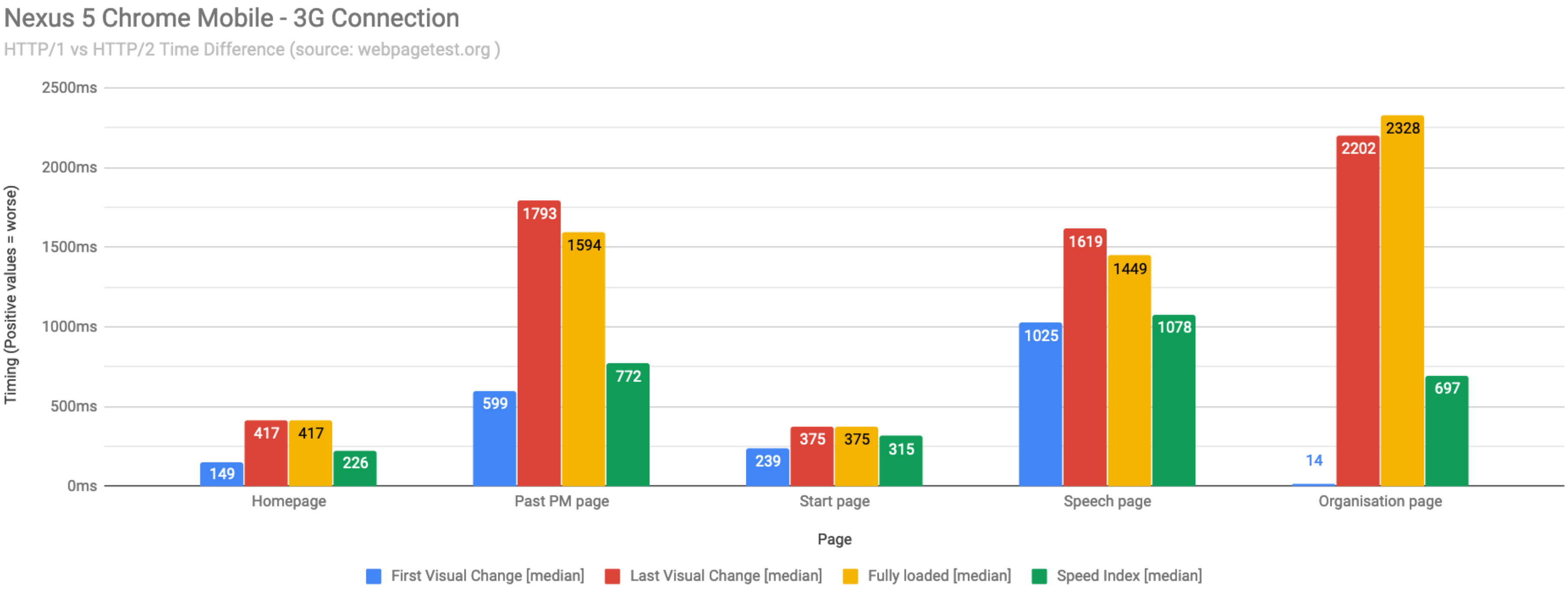
[1] HTTP/2 Approved - https://www.ietf.org/blog/http2-approved/
[2] Can I Use HTTP/2? - https://beta.caniuse.com/#search=http2
[3] Usage of HTTP/2 for websites - https://w3techs.com/technologies/details/ce-http2/all/all

On examining all the evidence I cannot see any downsides to enabling this protocol on our Fastly CDN layer.

Matt Hobbs - 8th October 2018

Initial trial

- 5 page types selected, different content / templates
- Tested on:
    - Chrome Desktop - Native (Sitespeed.io)
    - Chrome Mobile - 3G & 3G slow (Sitespeed.io)
    - Firefox Desktop - Native (Sitespeed.io)
    - Firefox Mobile - 3G & 3G slow (Sitespeed.io)
    - Nexus 5 - Chrome - 3G (WebPageTest)
    - iPhone 5C - 4G (WebPageTest)
    - Nexus 5X - 3G Fast (Lighthouse)

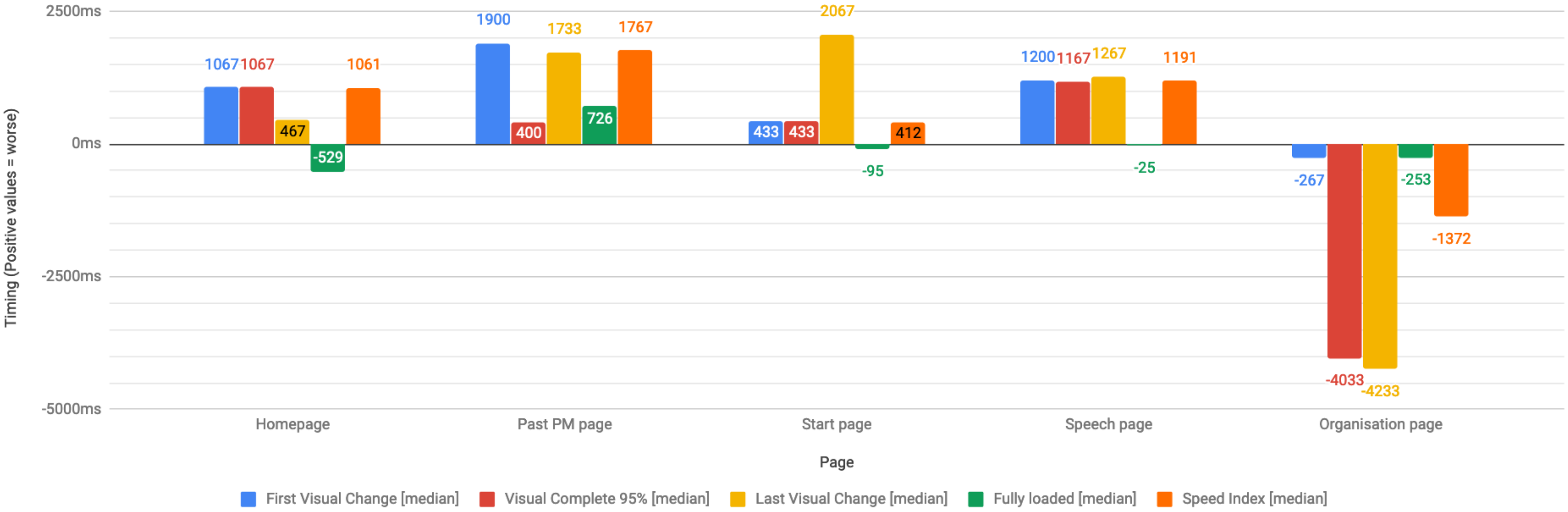


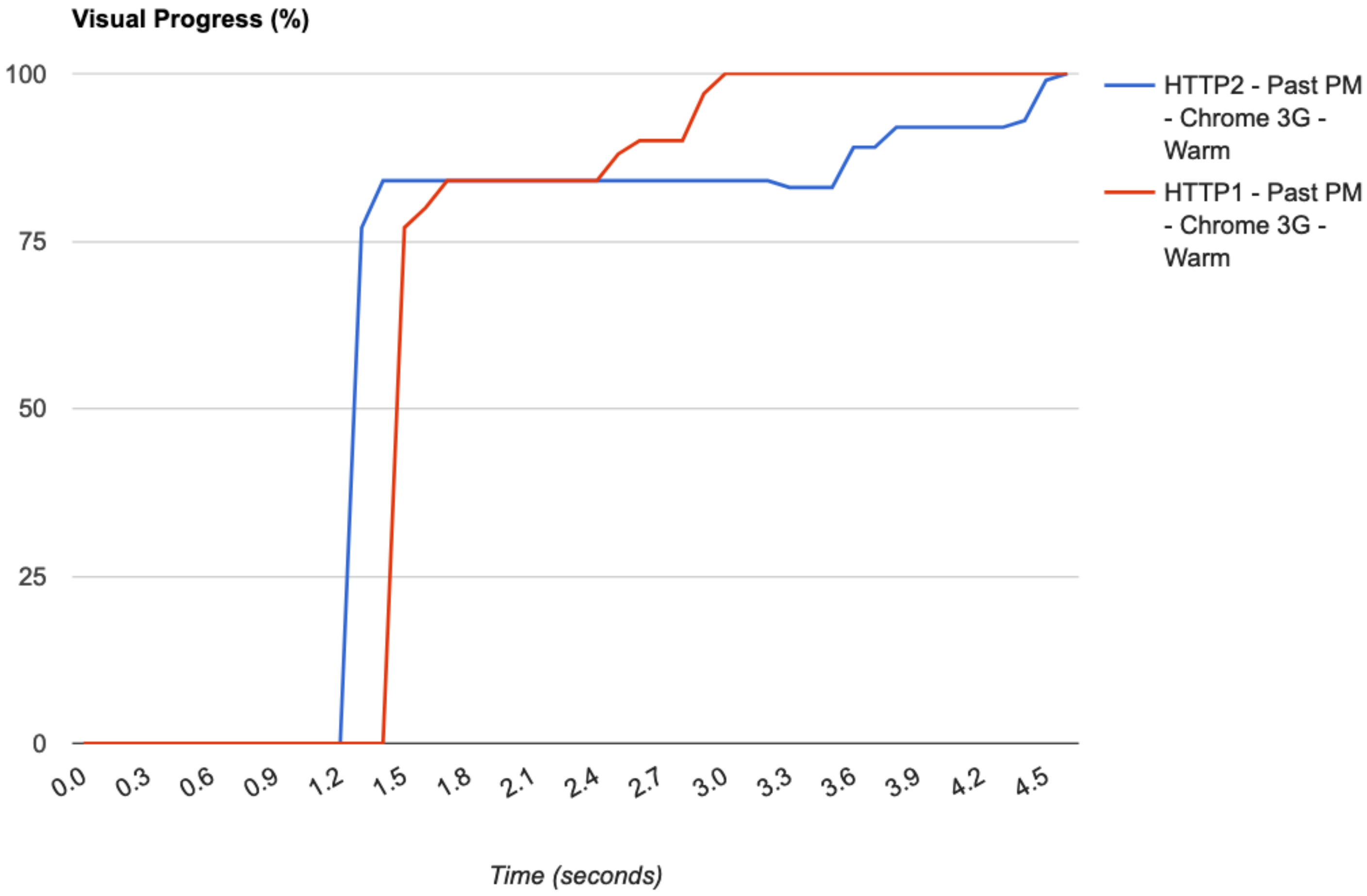
Nexus 5 Chrome Mobile - 3G Connection

HTTP/1 vs HTTP/2 Time Difference (source: webpagetest.org)

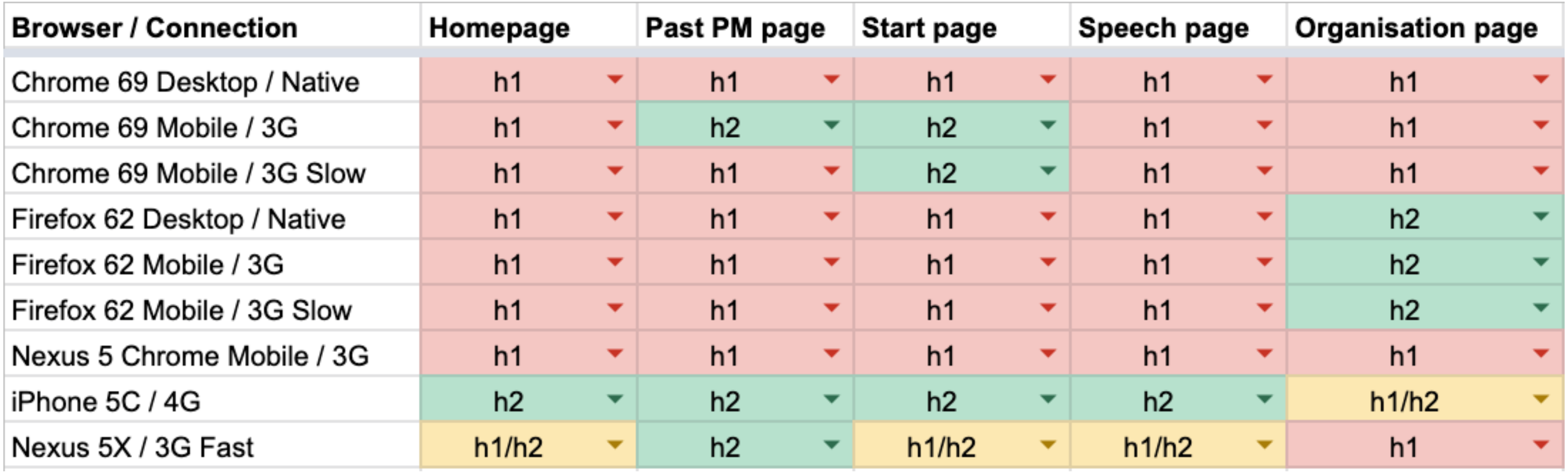
Firefox 62 Mobile - 3G Connection

HTTP/1 vs HTTP/2 Time Difference (source: Sitespeed.io)



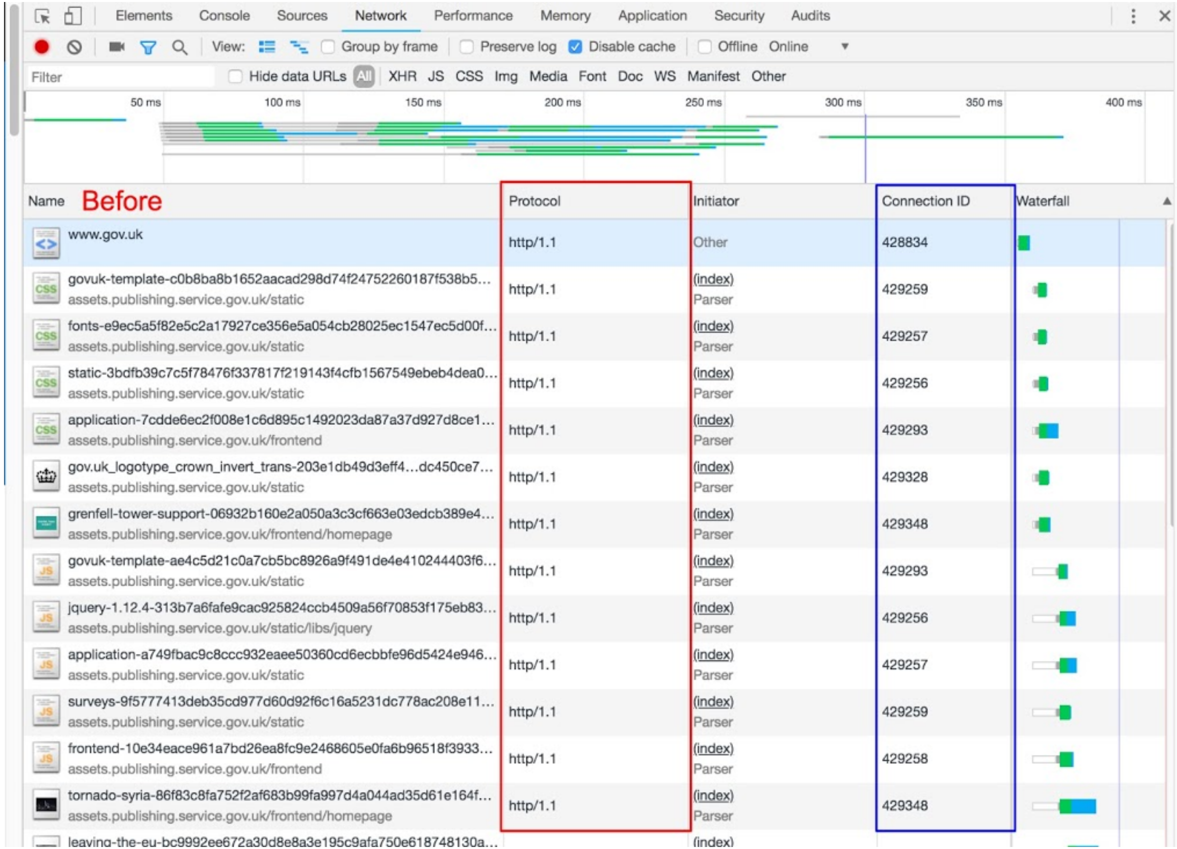

Visual Progress (%)
100
75
50
25
0
0.0
0.3
0.6
0.9
1.2
1.5
1.8
2.1
2.4
2.7
3.0
3.3
3.6
3.9
4.2
4.5
Time (seconds)
HTTP2 - Past PM - Chrome 3G - Warm
HTTP1 - Past PM - Chrome 3G - Warm

HTTP/2 - Initial trial



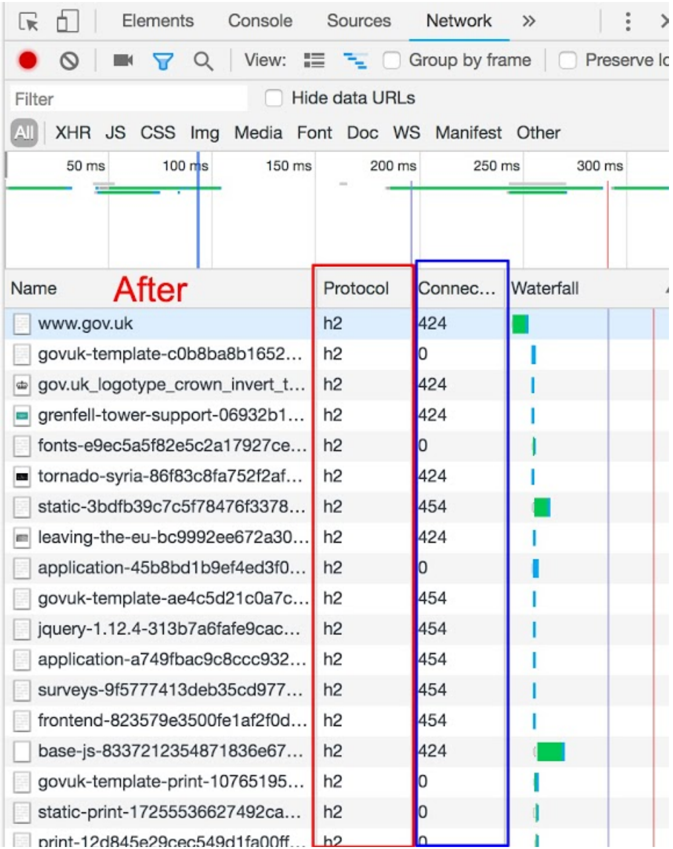
Browser / Connection	Homepage	Past PM page	Start page	Speech page	Organisation page
Chrome 69 Desktop / Native	h1	h1	h1	h1	h1
Chrome 69 Mobile / 3G	h1	h2	h2	h1	h1
Chrome 69 Mobile / 3G Slow	h1	h1	h2	h1	h1
Firefox 62 Desktop / Native	h1	h1	h1	h1	h2
Firefox 62 Mobile / 3G	h1	h1	h1	h1	h2
Firefox 62 Mobile / 3G Slow	h1	h1	h1	h1	h2
Nexus 5 Chrome Mobile / 3G	h1	h1	h1	h1	h1
iPhone 5C / 4G	h2	h2	h2	h2	h1/h2
Nexus 5X / 3G Fast	h1/h2	h2	h1/h2	h1/h2	h1

Investigation



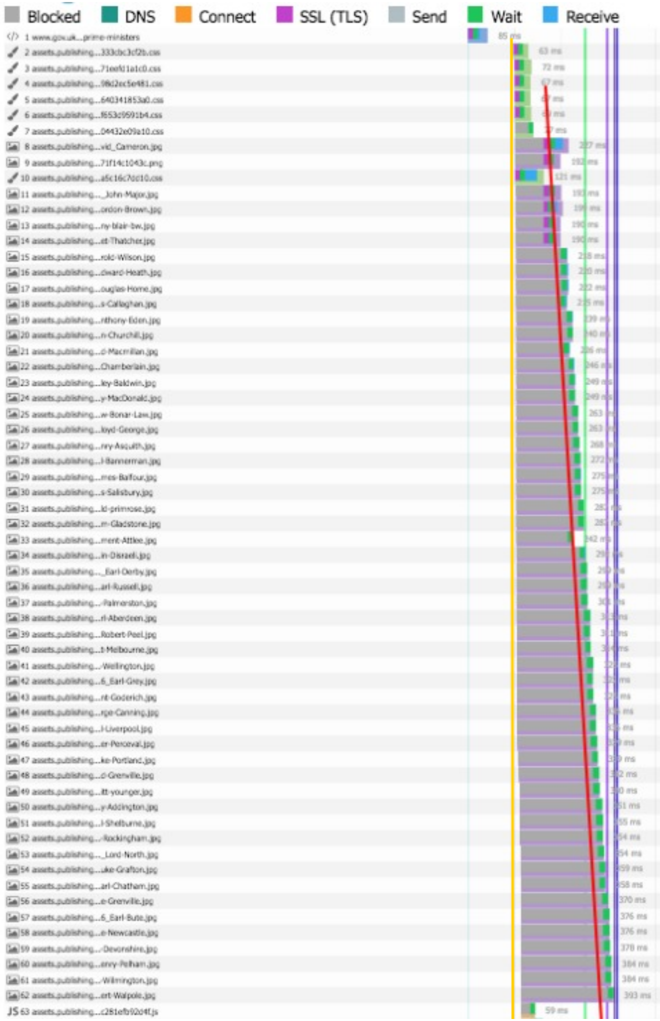
Before

Name	Protocol	Initiator	Connection ID	Waterfall
www.gov.uk	http/1.1	Other	428834	
govuk-template-c0b8ba8b1652aacad298d74f24752260187f538b5… assets.publishing.service.gov.uk/static	http/1.1	(index) Parser	429259	
fonts-e9ec5a5f82e5c2a17927ce356e5a054cb28025ec1547ec5d00f… assets.publishing.service.gov.uk/static	http/1.1	(index) Parser	429257	
static-3bdfb39c7c5f78476f337817f219143f4cfb1567549ebeb4dea0… assets.publishing.service.gov.uk/static	http/1.1	(index) Parser	429256	
application-7cdde6ec2f008e1c6d895c1492023da87a37d927d8ce1… assets.publishing.service.gov.uk/frontend	http/1.1	(index) Parser	429293	
gov.uk_logotype_crown_invert_trans-203e1db49d3eff4…dc450ce7… assets.publishing.service.gov.uk/static	http/1.1	(index) Parser	429328	
grenfell-tower-support-06932b160e2a050a3c3cf663e03edcb389e4… assets.publishing.service.gov.uk/frontend/homepage	http/1.1	(index) Parser	429348	
govuk-template-ae4c5d21c0a7cb5bc8926a9f491de4e410244403f6… assets.publishing.service.gov.uk/static	http/1.1	(index) Parser	429293	
jquery-1.12.4-313b7a6fafe9cac925824ccb4509a56f70853f175eb83… assets.publishing.service.gov.uk/static/libs/jquery	http/1.1	(index) Parser	429256	
application-a749fbac9c8ccc932eaee50360cd6ecbbfe96d5424e946… assets.publishing.service.gov.uk/static	http/1.1	(index) Parser	429257	
surveys-9f5777413deb35cd977d60d92f6c16a5231dc778ac208e11… assets.publishing.service.gov.uk/static	http/1.1	(index) Parser	429259	
frontend-10e34eace961a7bd26ea8fc9e2468605e0fa6b96518f3933… assets.publishing.service.gov.uk/frontend	http/1.1	(index) Parser	429258	
tornado-syria-86f83c8fa752f2af683b99fa997d4a044ad35d61e164f… assets.publishing.service.gov.uk/frontend/homepage	http/1.1	(index) Parser	429348	
leaving-the-eu-bc9992ee672a30d8e8a3e195c9afa750e618748130a…		(index)		



After

Name	Protocol	Connec…	Waterfall
www.gov.uk	h2	424	
govuk-template-c0b8ba8b1652…	h2	0	
gov.uk_logotype_crown_invert_t…	h2	424	
grenfell-tower-support-06932b1…	h2	424	
fonts-e9ec5a5f82e5c2a17927ce…	h2	0	
tornado-syria-86f83c8fa752f2af…	h2	424	
static-3bdfb39c7c5f78476f3378…	h2	454	
leaving-the-eu-bc9992ee672a30…	h2	424	
application-45b8bd1b9ef4ed3f0…	h2	0	
govuk-template-ae4c5d21c0a7c…	h2	454	
jquery-1.12.4-313b7a6fafe9cac…	h2	454	
application-a749fbac9c8ccc932…	h2	454	
surveys-9f5777413deb35cd977…	h2	454	
frontend-823579e3500fe1af2f0d…	h2	454	
base-js-833721235487183 6e67…	h2	424	
govuk-template-print-10765195…	h2	0	
static-print-17255536627492ca…	h2	0	
print-12d845e29cec549d1fa00ff…	h2	0	



```
Blocked  DNS  Connect  SSL (TLS)  Send  Wait  Receive
</> 1 www.gov.uk...prime-ministers           85 ms
    2 assets.publishing...333cbc3cf2b.css     63 ms
    3 assets.publishing...71eefd1a1c0.css     72 ms
    4 assets.publishing...98d2ec5e481.css     67 ms
    5 assets.publishing...640341853a0.css     [illegible] ms
    6 assets.publishing...f653d9591b4.css     [illegible] ms
    7 assets.publishing...04432e09a10.css     [illegible] ms
    8 assets.publishing...vid_Cameron.jpg     2[illegible]7 ms
    9 assets.publishing...71f14c1043c.png     192 ms
   10 assets.publishing...a5c16c7dd10.css     121 ms
   11 assets.publishing..._John-Major.jpg     193 ms
   12 assets.publishing...ordon-Brown.jpg     19[illegible] ms
   13 assets.publishing...ny-blair-bw.jpg     190 ms
   14 assets.publishing...et-Thatcher.jpg     190 ms
   15 assets.publishing...rold-Wilson.jpg     218 ms
   16 assets.publishing...dward-Heath.jpg     220 ms
   17 assets.publishing...ouglas-Home.jpg     222 ms
   18 assets.publishing...s-Callaghan.jpg     2[illegible]5 ms
   19 assets.publishing...nthony-Eden.jpg     239 ms
   20 assets.publishing...n-Churchill.jpg     240 ms
   21 assets.publishing...d-Macmillan.jpg     226 ms
   22 assets.publishing...Chamberlain.jpg     246 ms
   23 assets.publishing...ley-Baldwin.jpg     249 ms
   24 assets.publishing...y-MacDonald.jpg     249 ms
   25 assets.publishing...w-Bonar-Law.jpg     263 ms
   26 assets.publishing...loyd-George.jpg     263 ms
   27 assets.publishing...nry-Asquith.jpg     268 ms
   28 assets.publishing...l-Bannerman.jpg     272 ms
   29 assets.publishing...mes-Balfour.jpg     275 ms
   30 assets.publishing...s-Salisbury.jpg     275 ms
   31 assets.publishing...ld-primrose.jpg     282 ms
   32 assets.publishing...m-Gladstone.jpg     282 ms
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   36 assets.publishing...arl-Russell.jpg     29[illegible] ms
   37 assets.publishing...-Palmerston.jpg     30[illegible] ms
   38 assets.publishing...rl-Aberdeen.jpg     3[illegible] ms
   39 assets.publishing...Robert-Peel.jpg     3[illegible] ms
   40 assets.publishing...t-Melbourne.jpg     3[illegible] ms
   41 assets.publishing...-Wellington.jpg     [illegible] ms
   42 assets.publishing...6_Earl-Grey.jpg     [illegible] ms
   43 assets.publishing...nt-Goderich.jpg     [illegible] ms
   44 assets.publishing...rge-Canning.jpg     [illegible] ms
   45 assets.publishing...l-Liverpool.jpg     [illegible] ms
   46 assets.publishing...er-Perceval.jpg     3[illegible]9 ms
   47 assets.publishing...ke-Portland.jpg     3[illegible]9 ms
   48 assets.publishing...d-Grenville.jpg     3[illegible]2 ms
   49 assets.publishing...itt-younger.jpg     3[illegible]0 ms
   50 assets.publishing...y-Addington.jpg     351 ms
   51 assets.publishing...l-Shelburne.jpg     355 ms
   52 assets.publishing...-Rockingham.jpg     354 ms
   53 assets.publishing..._Lord-North.jpg     354 ms
   54 assets.publishing...uke-Grafton.jpg     359 ms
   55 assets.publishing...arl-Chatham.jpg     358 ms
   56 assets.publishing...e-Grenville.jpg     370 ms
   57 assets.publishing...6_Earl-Bute.jpg     376 ms
   58 assets.publishing...e-Newcastle.jpg     376 ms
   59 assets.publishing...-Devonshire.jpg     378 ms
   60 assets.publishing...enry-Pelham.jpg     384 ms
   61 assets.publishing...-Wilmington.jpg     384 ms
   62 assets.publishing...ert-Walpole.jpg     393 ms
JS 63 assets.publishing...c281efb92d4f.js     59 ms
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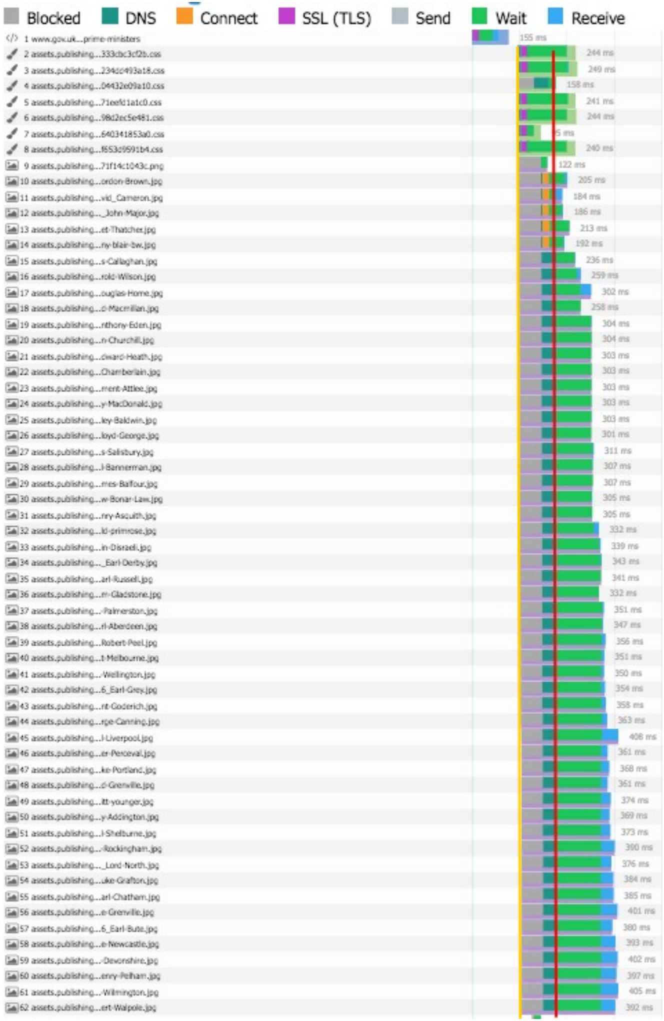

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Blocked  DNS  Connect  SSL (TLS)  Send  Wait  Receive
</> 1 www.gov.uk...prime-ministers           155 ms
    2 assets.publishing...333cbc3cf2b.css     244 ms
    3 assets.publishing...234dd493a18.css     249 ms
    4 assets.publishing...04432e09a10.css     158 ms
    5 assets.publishing...71eefd1a1c0.css     241 ms
    6 assets.publishing...98d2ec5e481.css     244 ms
    7 assets.publishing...640341853a0.css     [illegible]5 ms
    8 assets.publishing...f653d9591b4.css     240 ms
    9 assets.publishing...71f14c1043c.png     122 ms
   10 assets.publishing...ordon-Brown.jpg     205 ms
   11 assets.publishing...vid_Cameron.jpg     184 ms
   12 assets.publishing..._John-Major.jpg     186 ms
   13 assets.publishing...et-Thatcher.jpg     213 ms
   14 assets.publishing...ny-blair-bw.jpg     192 ms
   15 assets.publishing...s-Callaghan.jpg     236 ms
   16 assets.publishing...rold-Wilson.jpg     259 ms
   17 assets.publishing...ouglas-Home.jpg     302 ms
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   25 assets.publishing...ley-Baldwin.jpg     303 ms
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   33 assets.publishing...in-Disraeli.jpg     339 ms
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   45 assets.publishing...l-Liverpool.jpg     408 ms
   46 assets.publishing...er-Perceval.jpg     361 ms
   47 assets.publishing...ke-Portland.jpg     368 ms
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   49 assets.publishing...itt-younger.jpg     374 ms
   50 assets.publishing...y-Addington.jpg     369 ms
   51 assets.publishing...l-Shelburne.jpg     373 ms
   52 assets.publishing...-Rockingham.jpg     390 ms
   53 assets.publishing..._Lord-North.jpg     376 ms
   54 assets.publishing...uke-Grafton.jpg     384 ms
   55 assets.publishing...arl-Chatham.jpg     385 ms
   56 assets.publishing...e-Grenville.jpg     401 ms
   57 assets.publishing...6_Earl-Bute.jpg     380 ms
   58 assets.publishing...e-Newcastle.jpg     393 ms
   59 assets.publishing...-Devonshire.jpg     402 ms
   60 assets.publishing...enry-Pelham.jpg     397 ms
   61 assets.publishing...-Wilmington.jpg     405 ms
   62 assets.publishing...ert-Walpole.jpg     392 ms
```
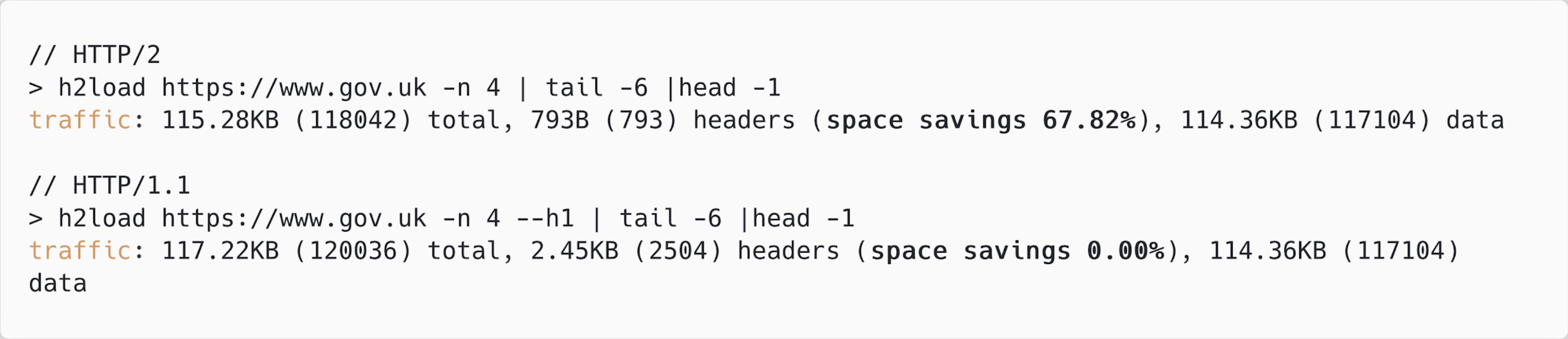
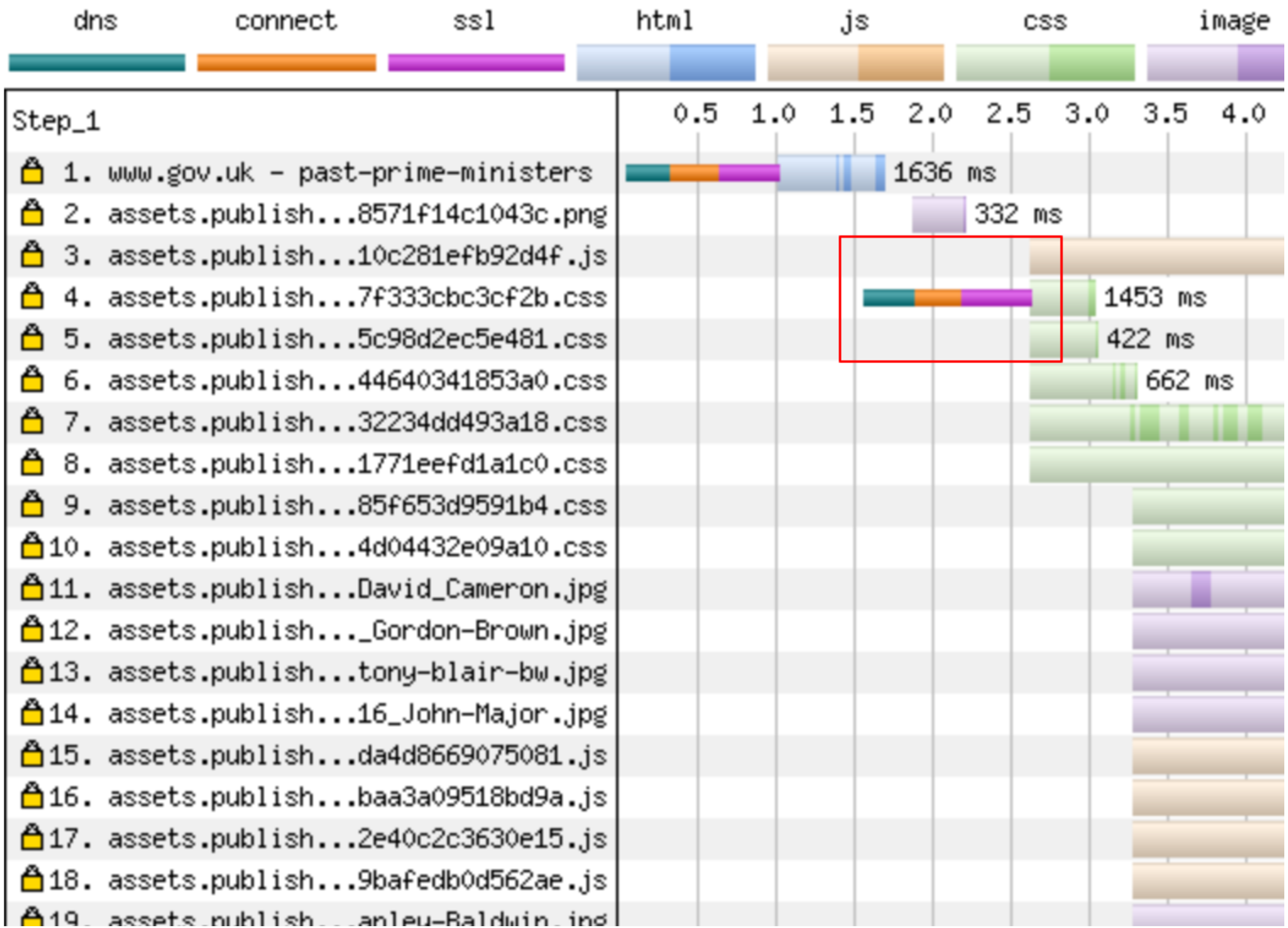



```
// HTTP/2
> h2load https://www.gov.uk -n 4 | tail -6 |head -1
traffic: 115.28KB (118042) total, 793B (793) headers (space savings 67.82%), 114.36KB (117104) data

// HTTP/1.1
> h2load https://www.gov.uk -n 4 --h1 | tail -6 |head -1
traffic: 117.22KB (120036) total, 2.45KB (2504) headers (space savings 0.00%), 114.36KB (117104)
data
```

Issue

Domain Sharding

- ‘www.gov.uk’
  - Used for HTML only
- ‘assets.publishing.service.gov.uk’
  - Used for all other assets



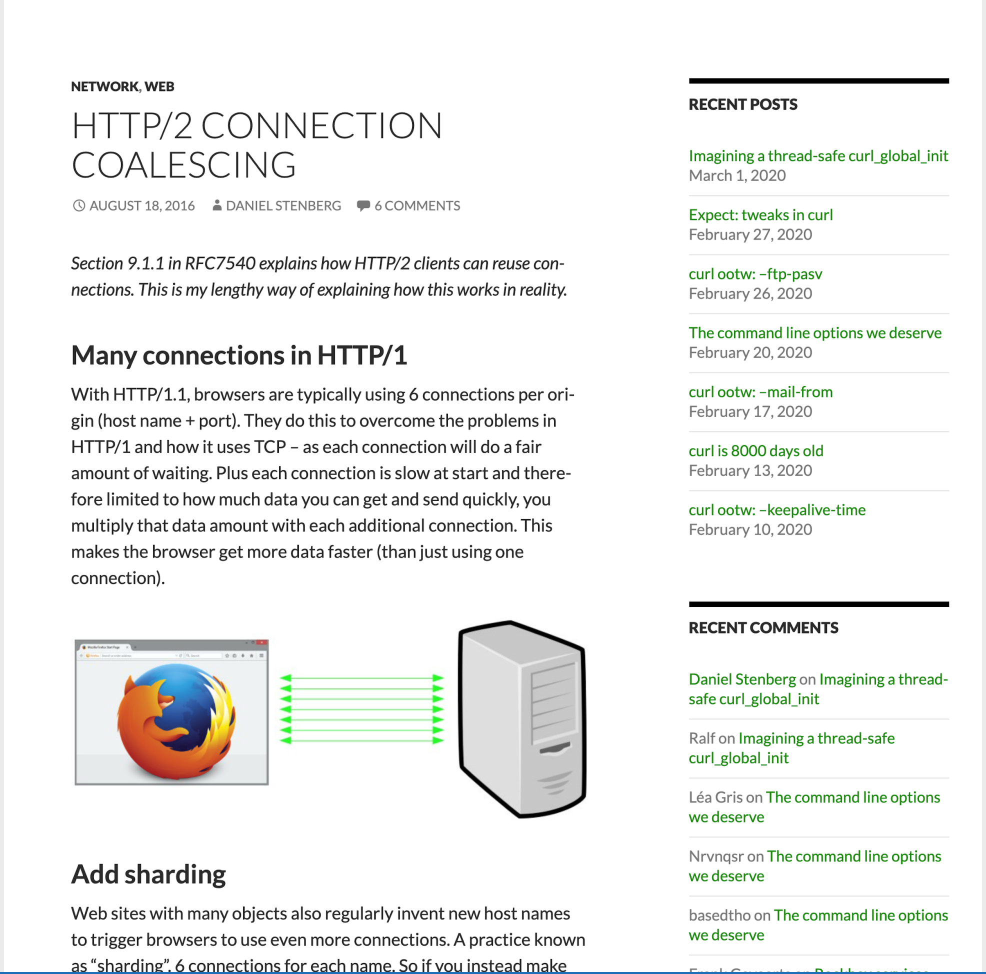
Step_1

1. www.gov.uk - past-prime-ministers
2. assets.publish...8571f14c1043c.png
3. assets.publish...10c281efb92d4f.js
4. assets.publish...7f333cbc3cf2b.css
5. assets.publish...5c98d2ec5e481.css
6. assets.publish...44640341853a0.css
7. assets.publish...32234dd493a18.css
8. assets.publish...1771eefd1a1c0.css
9. assets.publish...85f653d9591b4.css
10. assets.publish...4d04432e09a10.css
11. assets.publish...David_Cameron.jpg
12. assets.publish..._Gordon-Brown.jpg
13. assets.publish...tony-blair-bw.jpg
14. assets.publish...16_John-Major.jpg
15. assets.publish...da4d8669075081.js
16. assets.publish...baa3a09518bd9a.js
17. assets.publish...2e40c2c3630e15.js
18. assets.publish...9bafedb0d562ae.js
19. assets.publish...anley-Baldwin.jpg

Possible solutions

```
Link: <https://assets.publishing.service.gov.uk>; rel=preconnect; crossorigin
```

HTTP/2 connection coalescing



NETWORK, WEB

HTTP/2 CONNECTION COALESCING

AUGUST 18, 2016 DANIEL STENBERG 6 COMMENTS

Section 9.1.1 in RFC7540 explains how HTTP/2 clients can reuse connections. This is my lengthy way of explaining how this works in reality.

Many connections in HTTP/1

With HTTP/1.1, browsers are typically using 6 connections per origin (host name + port). They do this to overcome the problems in HTTP/1 and how it uses TCP – as each connection will do a fair amount of waiting. Plus each connection is slow at start and therefore limited to how much data you can get and send quickly, you multiply that data amount with each additional connection. This makes the browser get more data faster (than just using one connection).

Add sharding

Web sites with many objects also regularly invent new host names to trigger browsers to use even more connections. A practice known as "sharding". 6 connections for each name. So if you instead make

RECENT POSTS

Imagining a thread-safe curl_global_init
March 1, 2020

Expect: tweaks in curl
February 27, 2020

curl ootw: –ftp-pasv
February 26, 2020

The command line options we deserve
February 20, 2020

curl ootw: –mail-from
February 17, 2020

curl is 8000 days old
February 13, 2020

curl ootw: –keepalive-time
February 10, 2020

RECENT COMMENTS

Daniel Stenberg on Imagining a thread-safe curl_global_init

Ralf on Imagining a thread-safe curl_global_init

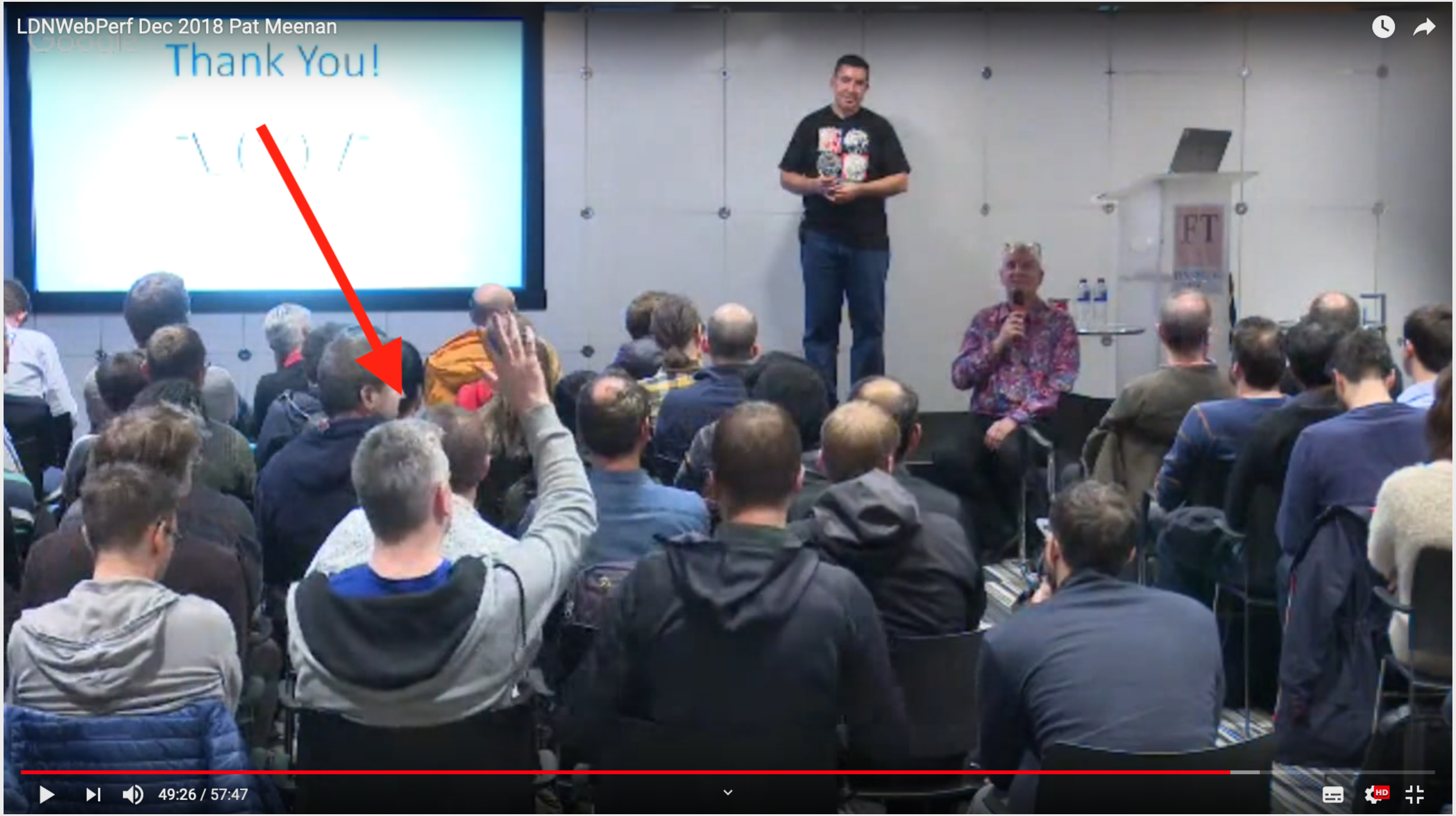
Léa Gris on The command line options we deserve

Nrvnqsr on The command line options we deserve

basedtho on The command line options we deserve

~~Domain Sharding~~

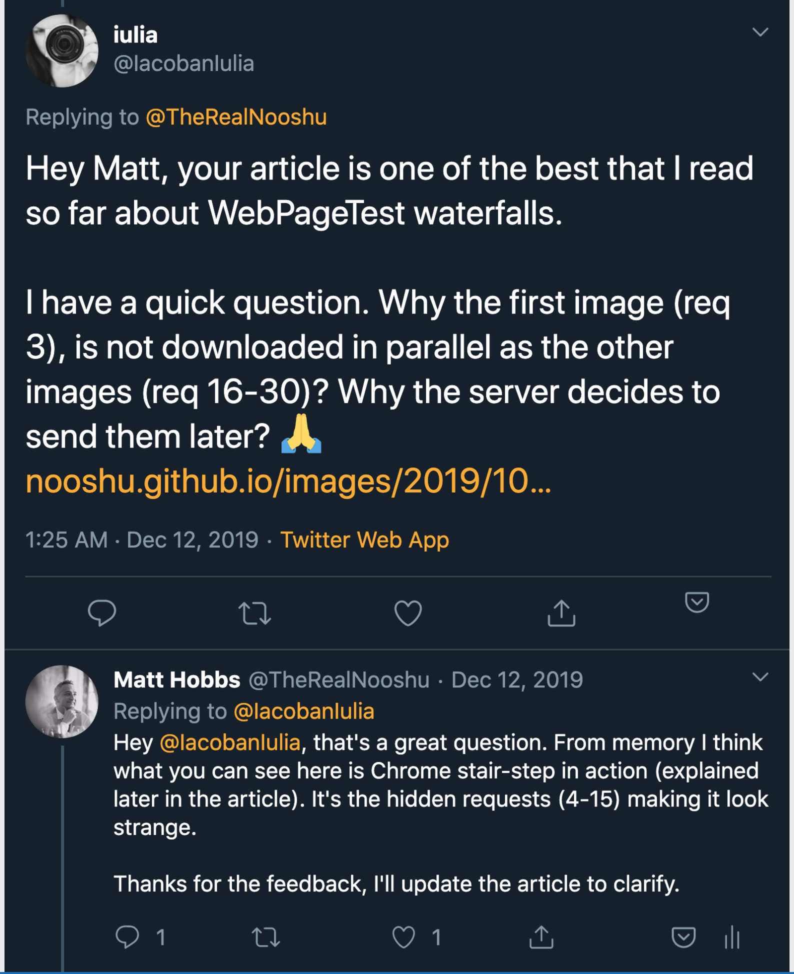
- ‘www.gov.uk’
  - Used for HTML, CSS, JavaScript, and images
- ~~‘assets.publishing.service.gov.uk’~~
  - ~~Used for all other assets~~


LDNWebPerf Dec 2018 Pat Meenan
Thank You!
¯_(ツ)_/¯
FT
49:26 / 57:47
HD

~~HTTP/2~~ → HTTP/1.1

12

The rogue image



iulia
@IacobanIulia

Replying to @TheRealNooshu

Hey Matt, your article is one of the best that I read so far about WebPageTest waterfalls.

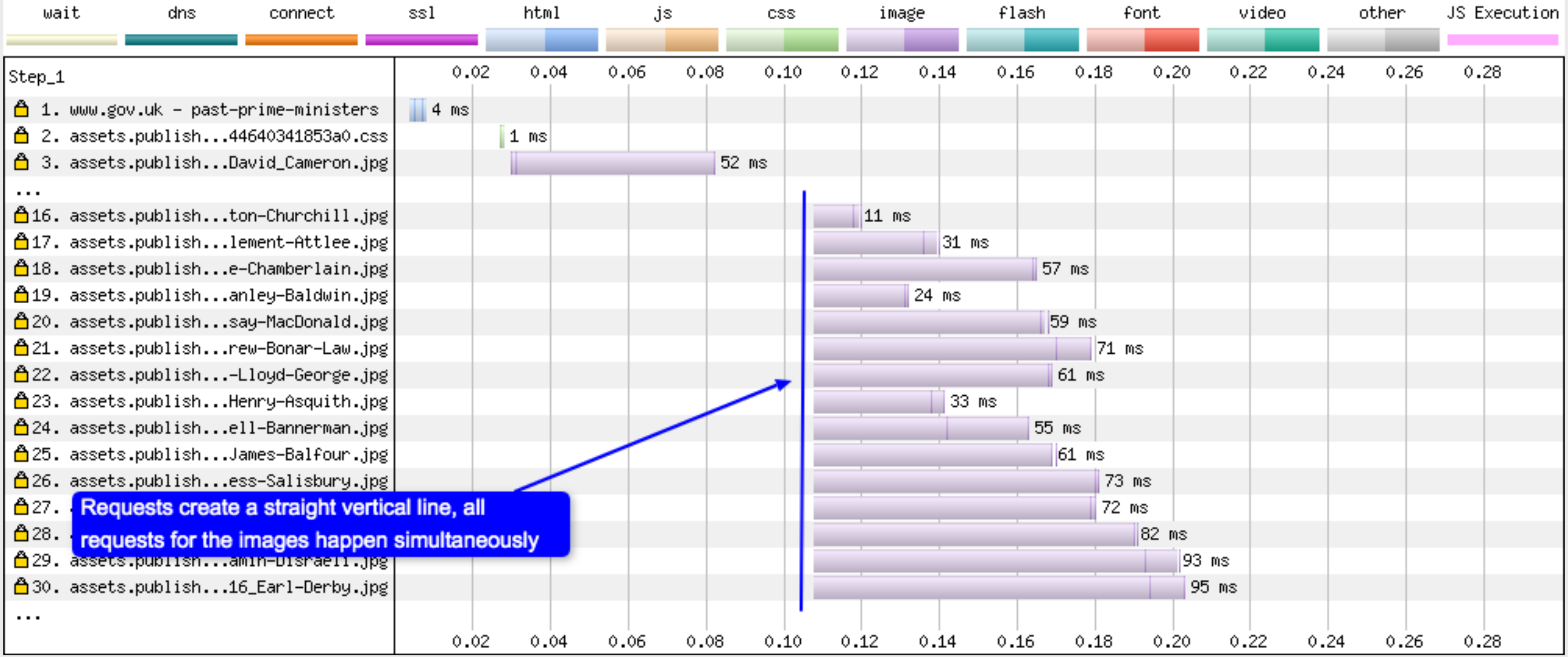
I have a quick question. Why the first image (req 3), is not downloaded in parallel as the other images (req 16-30)? Why the server decides to send them later? 🙏 nooshu.github.io/images/2019/10…

1:25 AM · Dec 12, 2019 · Twitter Web App

Matt Hobbs @TheRealNooshu · Dec 12, 2019
Replying to @IacobanIulia

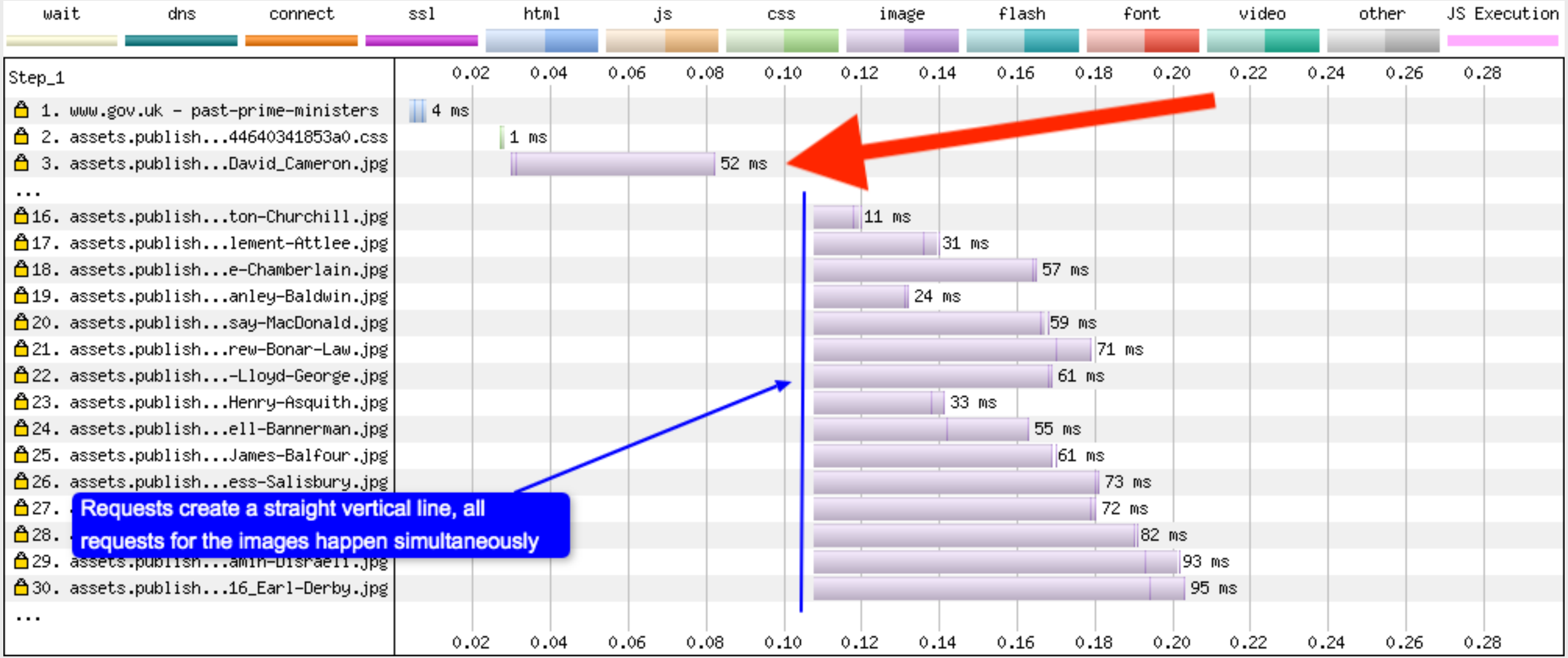
Hey @IacobanIulia, that's a great question. From memory I think what you can see here is Chrome stair-step in action (explained later in the article). It's the hidden requests (4-15) making it look strange.

Thanks for the feedback, I'll update the article to clarify.



```
Step_1
 1. www.gov.uk - past-prime-ministers    4 ms
 2. assets.publish...44640341853a0.css    1 ms
 3. assets.publish...David_Cameron.jpg    52 ms
...
16. assets.publish...ton-Churchill.jpg    11 ms
17. assets.publish...lement-Attlee.jpg    31 ms
18. assets.publish...e-Chamberlain.jpg    57 ms
19. assets.publish...anley-Baldwin.jpg    24 ms
20. assets.publish...say-MacDonald.jpg    59 ms
21. assets.publish...rew-Bonar-Law.jpg    71 ms
22. assets.publish...-Lloyd-George.jpg    61 ms
23. assets.publish...Henry-Asquith.jpg    33 ms
24. assets.publish...ell-Bannerman.jpg    55 ms
25. assets.publish...James-Balfour.jpg    61 ms
26. assets.publish...ess-Salisbury.jpg    73 ms
27.                                       72 ms
28.                                       82 ms
29. assets.publish...amin-Disraeli.jpg    93 ms
30. assets.publish...16_Earl-Derby.jpg    95 ms
...
```

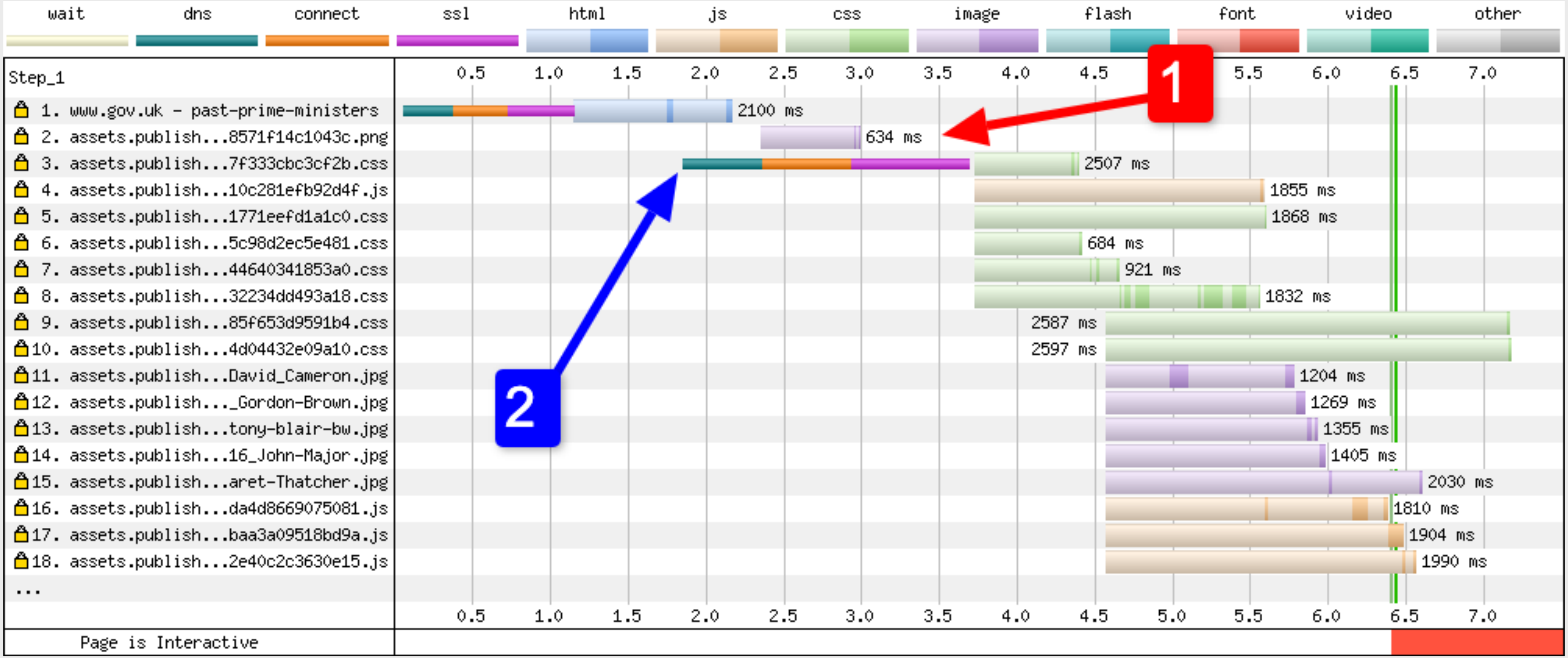
Requests create a straight vertical line, all requests for the images happen simultaneously



Step_1

1. www.gov.uk - past-prime-ministers	4 ms
2. assets.publish...44640341853a0.css	1 ms
3. assets.publish...David_Cameron.jpg	52 ms
...	
16. assets.publish...ton-Churchill.jpg	11 ms
17. assets.publish...lement-Attlee.jpg	31 ms
18. assets.publish...e-Chamberlain.jpg	57 ms
19. assets.publish...anley-Baldwin.jpg	24 ms
20. assets.publish...say-MacDonald.jpg	59 ms
21. assets.publish...rew-Bonar-Law.jpg	71 ms
22. assets.publish...-Lloyd-George.jpg	61 ms
23. assets.publish...Henry-Asquith.jpg	33 ms
24. assets.publish...ell-Bannerman.jpg	55 ms
25. assets.publish...James-Balfour.jpg	61 ms
26. assets.publish...ess-Salisbury.jpg	73 ms
27.	72 ms
28.	82 ms
29. assets.publish...amin-Disraeli.jpg	93 ms
30. assets.publish...16_Earl-Derby.jpg	95 ms
...	

Requests create a straight vertical line, all requests for the images happen simultaneously

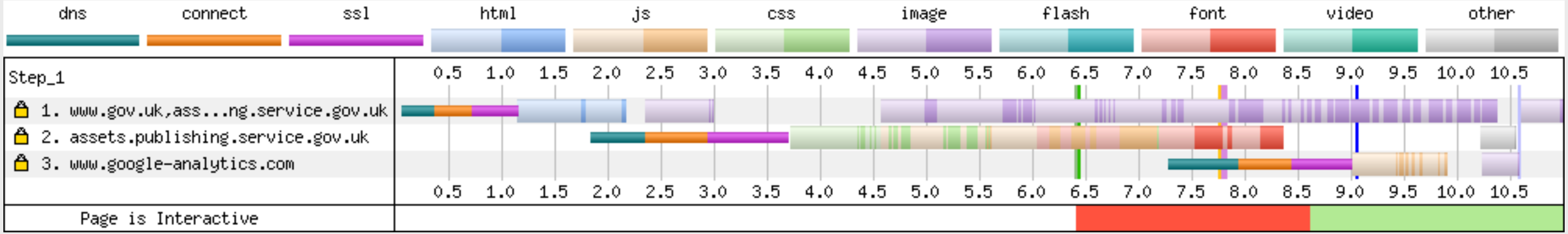


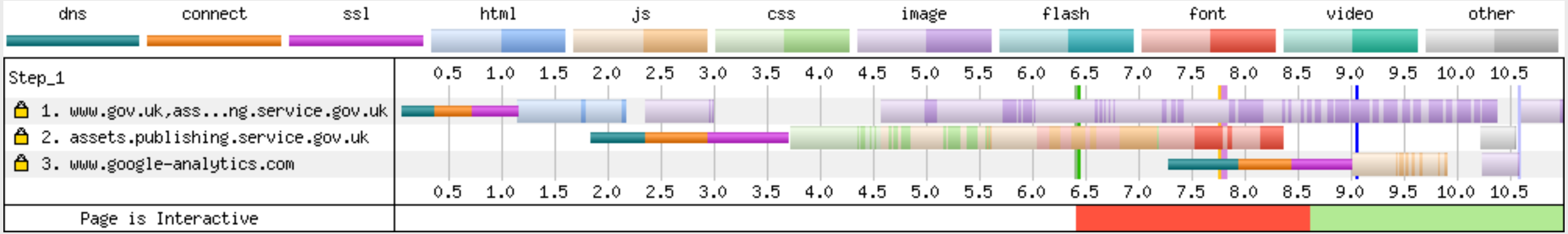
Step_1

1. www.gov.uk - past-prime-ministers 2100 ms
2. assets.publish...8571f14c1043c.png 634 ms
3. assets.publish...7f333cbc3cf2b.css 2507 ms
4. assets.publish...10c281efb92d4f.js 1855 ms
5. assets.publish...1771eefd1a1c0.css 1868 ms
6. assets.publish...5c98d2ec5e481.css 684 ms
7. assets.publish...44640341853a0.css 921 ms
8. assets.publish...32234dd493a18.css 1832 ms
9. assets.publish...85f653d9591b4.css 2587 ms
10. assets.publish...4d04432e09a10.css 2597 ms
11. assets.publish...David_Cameron.jpg 1204 ms
12. assets.publish..._Gordon-Brown.jpg 1269 ms
13. assets.publish...tony-blair-bw.jpg 1355 ms
14. assets.publish...16_John-Major.jpg 1405 ms
15. assets.publish...aret-Thatcher.jpg 2030 ms
16. assets.publish...da4d8669075081.js 1810 ms
17. assets.publish...baa3a09518bd9a.js 1904 ms
18. assets.publish...2e40c2c3630e15.js 1990 ms

...

Page is Interactive

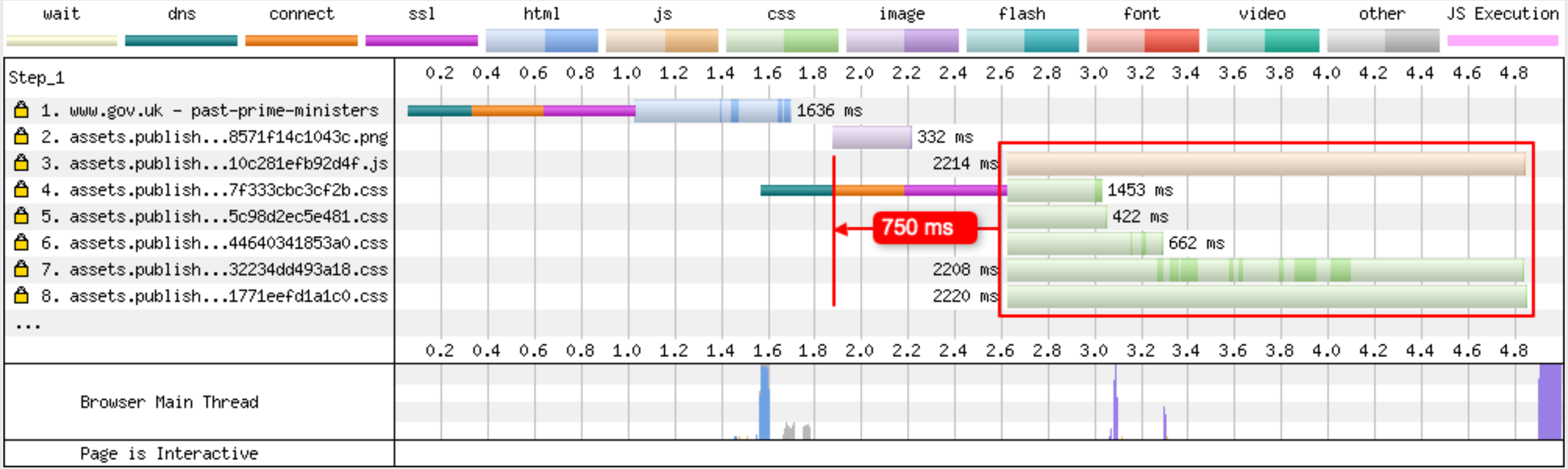

dns
connect
ssl
html
js
css
image
flash
font
video
other
Step_1
1. www.gov.uk,ass...ng.service.gov.uk
2. assets.publishing.service.gov.uk
3. www.google-analytics.com
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
Page is Interactive


dns
connect
ssl
html
js
css
image
flash
font
video
other
Step_1
1. www.gov.uk,ass...ng.service.gov.uk
2. assets.publishing.service.gov.uk
3. www.google-analytics.com
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5
Page is Interactive

Subresource Integrity (SRI)

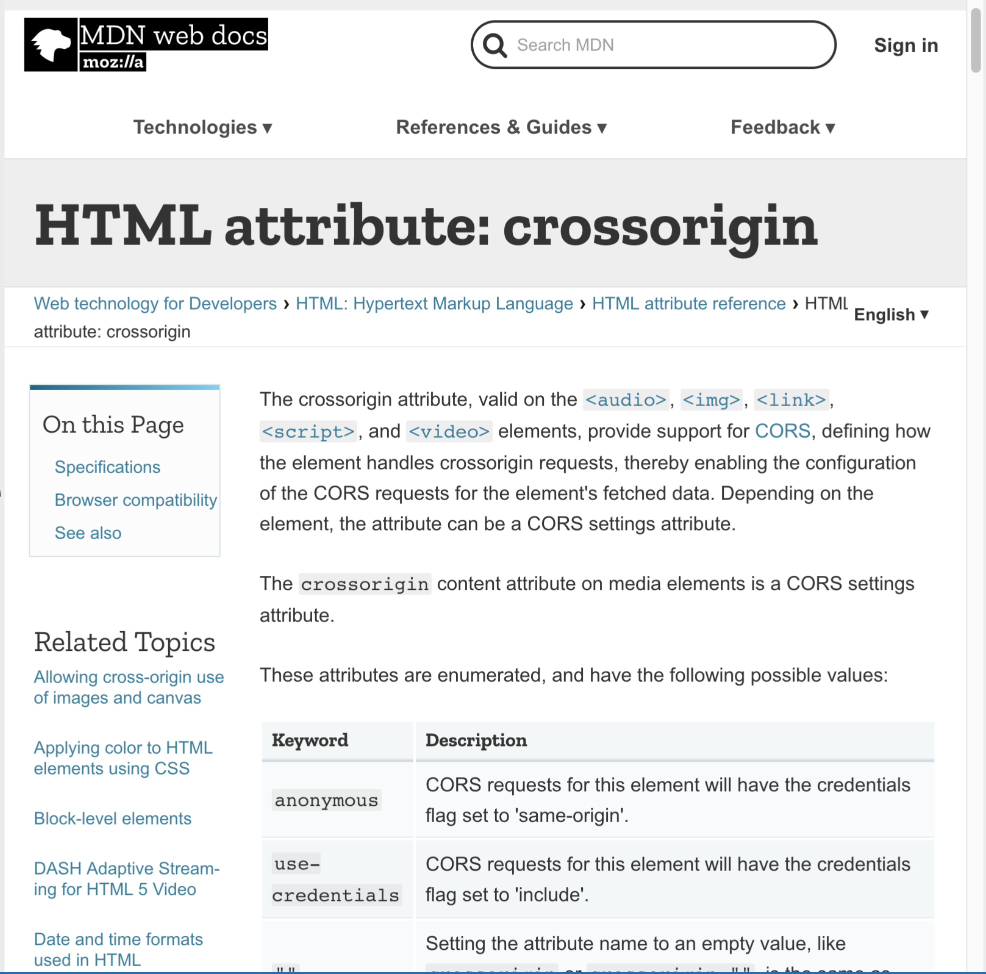
```html
<script src="https://assets.publishing.service.gov.uk/static/libs/jquery/jquery-1.12.4.js"
crossorigin="anonymous" integrity="sha256-xzHCDimVxXawUJ0713b3q2Sma5U2OjtfrphkKZ7llO0="></script>
```

```
<script src="https://assets.publishing.service.gov.uk/static/libs/jquery/jquery-1.12.4.js"
crossorigin="anonymous" integrity="sha256-xzHCDimVxXawUJ0713b3q2Sma5U2OjtfrphkKZ7llO0="></script>
```


wait
dns
connect
ssl
html
js
css
image
flash
font
video
other
JS Execution
Step_1
0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 2.8 3.0 3.2 3.4 3.6 3.8 4.0 4.2 4.4 4.6 4.8
1. www.gov.uk - past-prime-ministers
1636 ms
2. assets.publish...8571f14c1043c.png
332 ms
3. assets.publish...10c281efb92d4f.js
2214 ms
4. assets.publish...7f333cbc3cf2b.css
1453 ms
5. assets.publish...5c98d2ec5e481.css
422 ms
6. assets.publish...44640341853a0.css
662 ms
7. assets.publish...32234dd493a18.css
2208 ms
8. assets.publish...1771eefd1a1c0.css
2220 ms
...
Browser Main Thread
Page is Interactive

750 ms

Change `anonymous` to `use credentials`?



HTML attribute: crossorigin

Web technology for Developers › HTML: Hypertext Markup Language › HTML attribute reference › HTML attribute: crossorigin

Related Topics

- Allowing cross-origin use of images and canvas
- Applying color to HTML elements using CSS
- Block-level elements
- DASH Adaptive Streaming for HTML 5 Video
- Date and time formats used in HTML

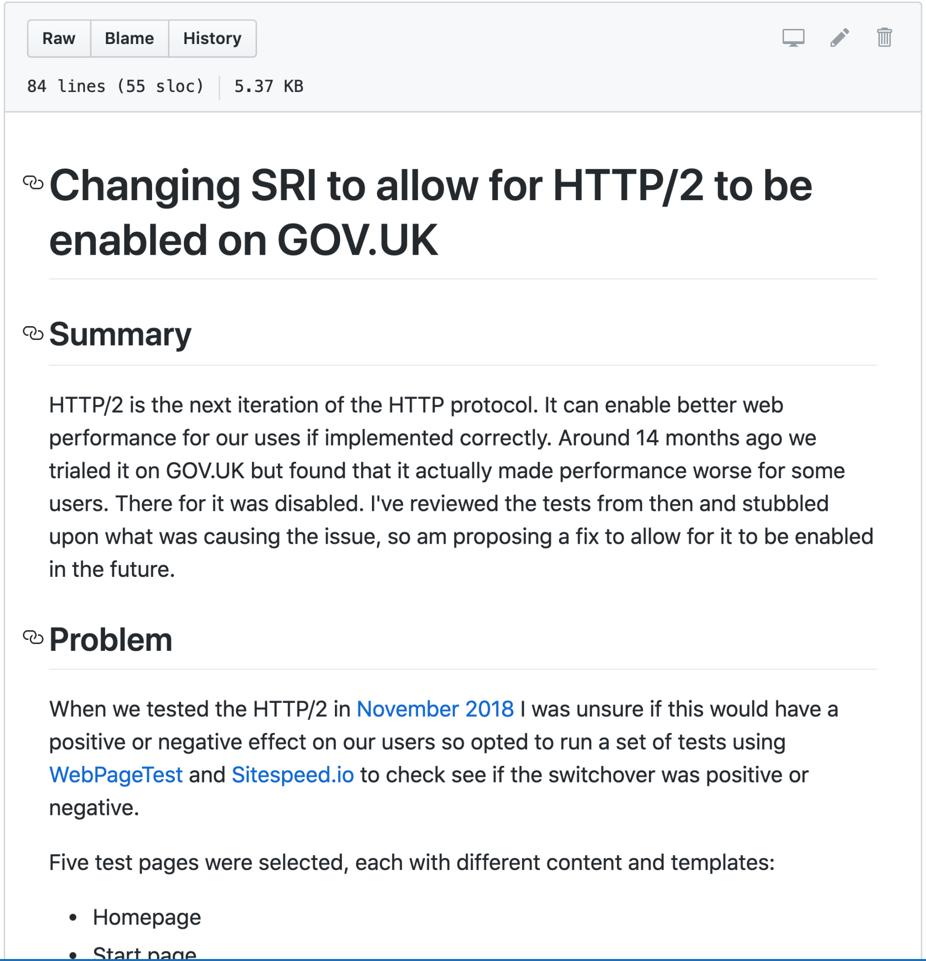
The crossorigin attribute, valid on the `<audio>`, `<img>`, `<link>`, `<script>`, and `<video>` elements, provide support for CORS, defining how the element handles crossorigin requests, thereby enabling the configuration of the CORS requests for the element's fetched data. Depending on the element, the attribute can be a CORS settings attribute.

The `crossorigin` content attribute on media elements is a CORS settings attribute.

These attributes are enumerated, and have the following possible values:

Keyword	Description
`anonymous`	CORS requests for this element will have the credentials flag set to 'same-origin'.
`use-credentials`	CORS requests for this element will have the credentials flag set to 'include'.
`""`	Setting the attribute name to an empty value, like

RFC-114



84 lines (55 sloc) | 5.37 KB

Changing SRI to allow for HTTP/2 to be enabled on GOV.UK

Summary

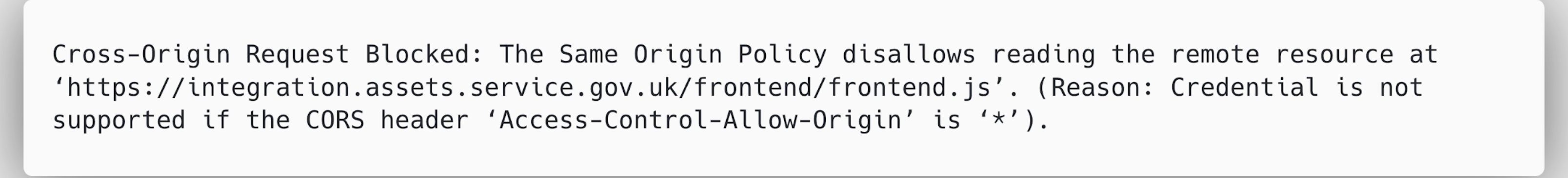
HTTP/2 is the next iteration of the HTTP protocol. It can enable better web performance for our uses if implemented correctly. Around 14 months ago we trialed it on GOV.UK but found that it actually made performance worse for some users. There for it was disabled. I've reviewed the tests from then and stubbled upon what was causing the issue, so am proposing a fix to allow for it to be enabled in the future.

Problem

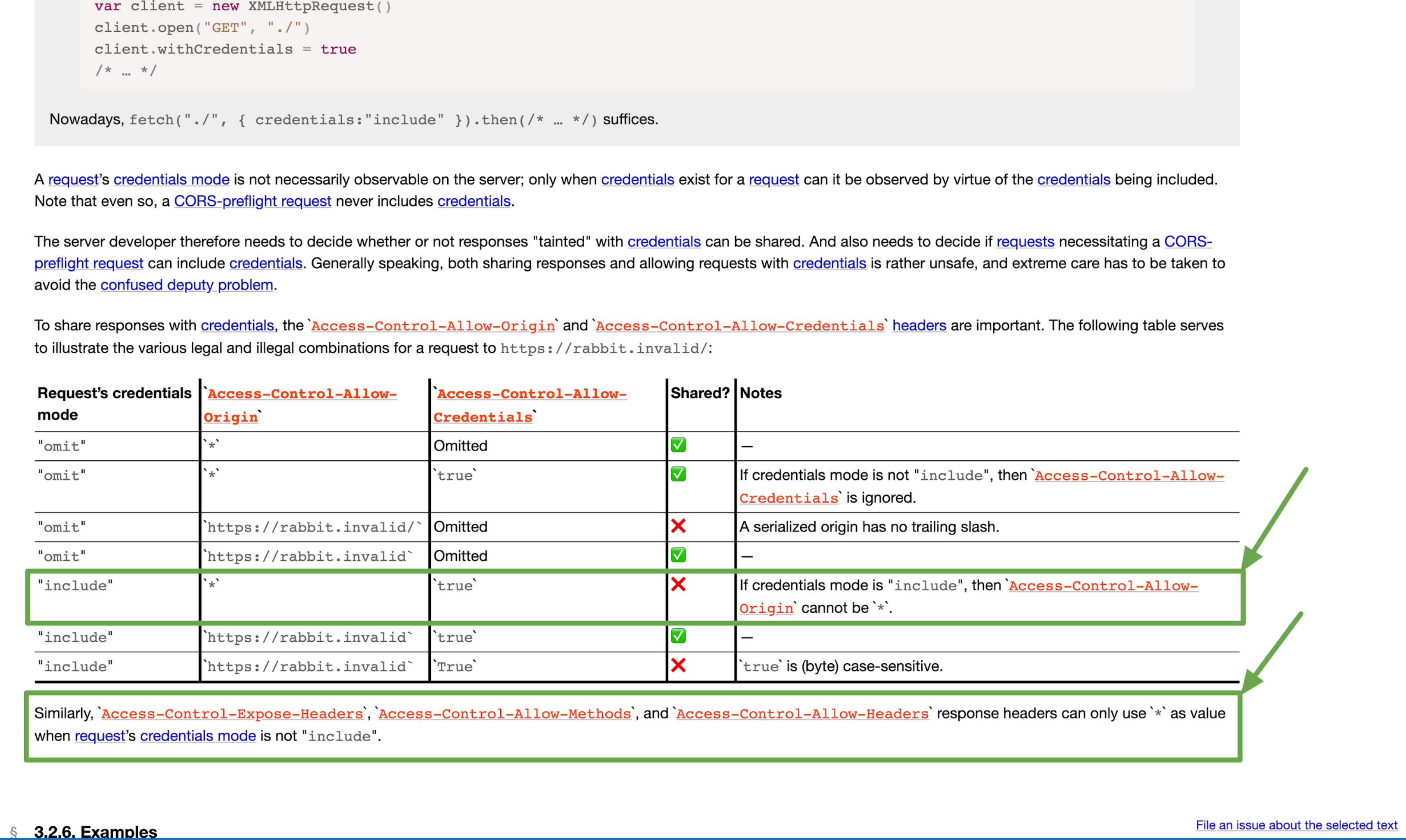
When we tested the HTTP/2 in November 2018 I was unsure if this would have a positive or negative effect on our users so opted to run a set of tests using WebPageTest and Sitespeed.io to check see if the switchover was positive or negative.

Five test pages were selected, each with different content and templates:

- Homepage
- Start page



```
Cross-Origin Request Blocked: The Same Origin Policy disallows reading the remote resource at
‘https://integration.assets.service.gov.uk/frontend/frontend.js’. (Reason: Credential is not
supported if the CORS header ‘Access-Control-Allow-Origin’ is ‘*’).
```



```
var client = new XMLHttpRequest()
client.open("GET", "./")
client.withCredentials = true
/* … */
```

Nowadays, `fetch("./", { credentials:"include" }).then(/* … */)` suffices.

A request's credentials mode is not necessarily observable on the server; only when credentials exist for a request can it be observed by virtue of the credentials being included. Note that even so, a CORS-preflight request never includes credentials.

The server developer therefore needs to decide whether or not responses "tainted" with credentials can be shared. And also needs to decide if requests necessitating a CORS-preflight request can include credentials. Generally speaking, both sharing responses and allowing requests with credentials is rather unsafe, and extreme care has to be taken to avoid the confused deputy problem.

To share responses with credentials, the `Access-Control-Allow-Origin` and `Access-Control-Allow-Credentials` headers are important. The following table serves to illustrate the various legal and illegal combinations for a request to `https://rabbit.invalid/`:

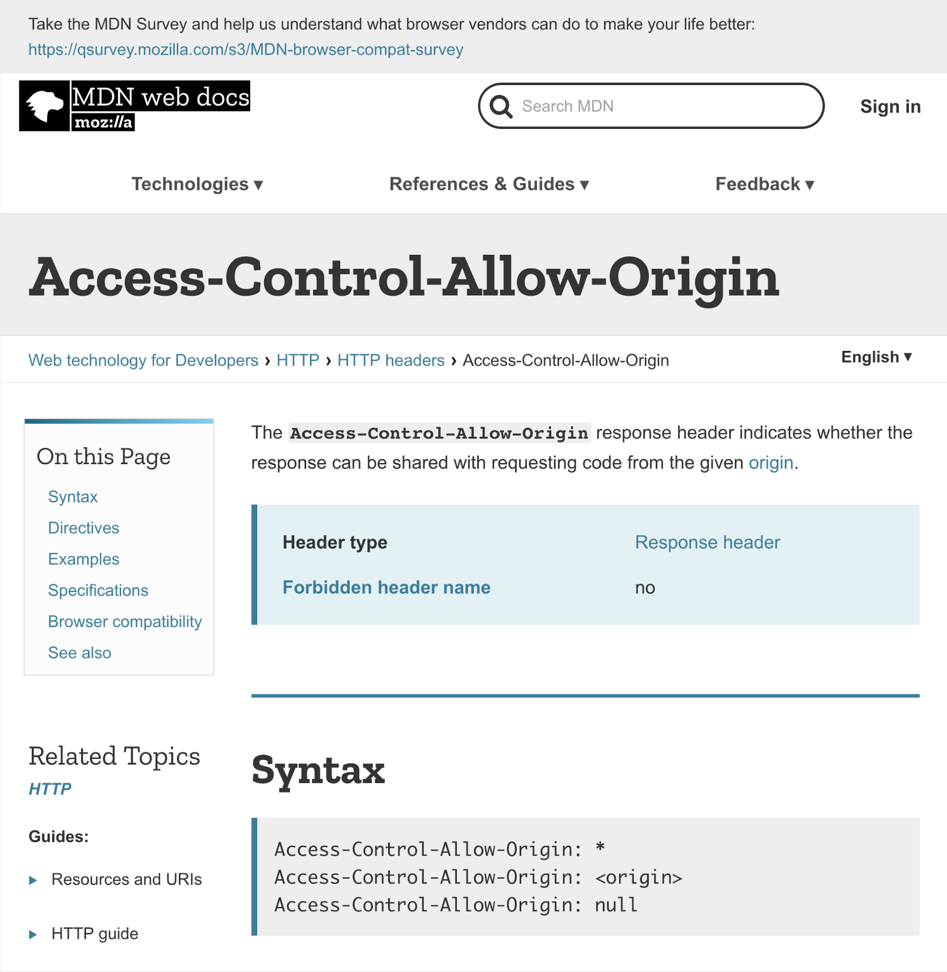
Request's credentials mode	`Access-Control-Allow-Origin`	`Access-Control-Allow-Credentials`	Shared?	Notes
"omit"	`*`	Omitted	✅	—
"omit"	`*`	`true`	✅	If credentials mode is not "include", then `Access-Control-Allow-Credentials` is ignored.
"omit"	`https://rabbit.invalid/`	Omitted	❌	A serialized origin has no trailing slash.
"omit"	`https://rabbit.invalid`	Omitted	✅	—
"include"	`*`	`true`	❌	If credentials mode is "include", then `Access-Control-Allow-Origin` cannot be `*`.
"include"	`https://rabbit.invalid`	`true`	✅	—
"include"	`https://rabbit.invalid`	`True`	❌	`true` is (byte) case-sensitive.

Similarly, `Access-Control-Expose-Headers`, `Access-Control-Allow-Methods`, and `Access-Control-Allow-Headers` response headers can only use `*` as value when request's credentials mode is not "include".

§ 3.2.6. Examples

File an issue about the selected text

Access-Control-Allow-Origin and web fonts



Take the MDN Survey and help us understand what browser vendors can do to make your life better: https://qsurvey.mozilla.com/s3/MDN-browser-compat-survey

Access-Control-Allow-Origin

Web technology for Developers › HTTP › HTTP headers › Access-Control-Allow-Origin

On this Page

- Syntax
- Directives
- Examples
- Specifications
- Browser compatibility
- See also

The `Access-Control-Allow-Origin` response header indicates whether the response can be shared with requesting code from the given origin.

Header type	Response header
Forbidden header name	no

Related Topics

HTTP

Guides:

- Resources and URIs
- HTTP guide

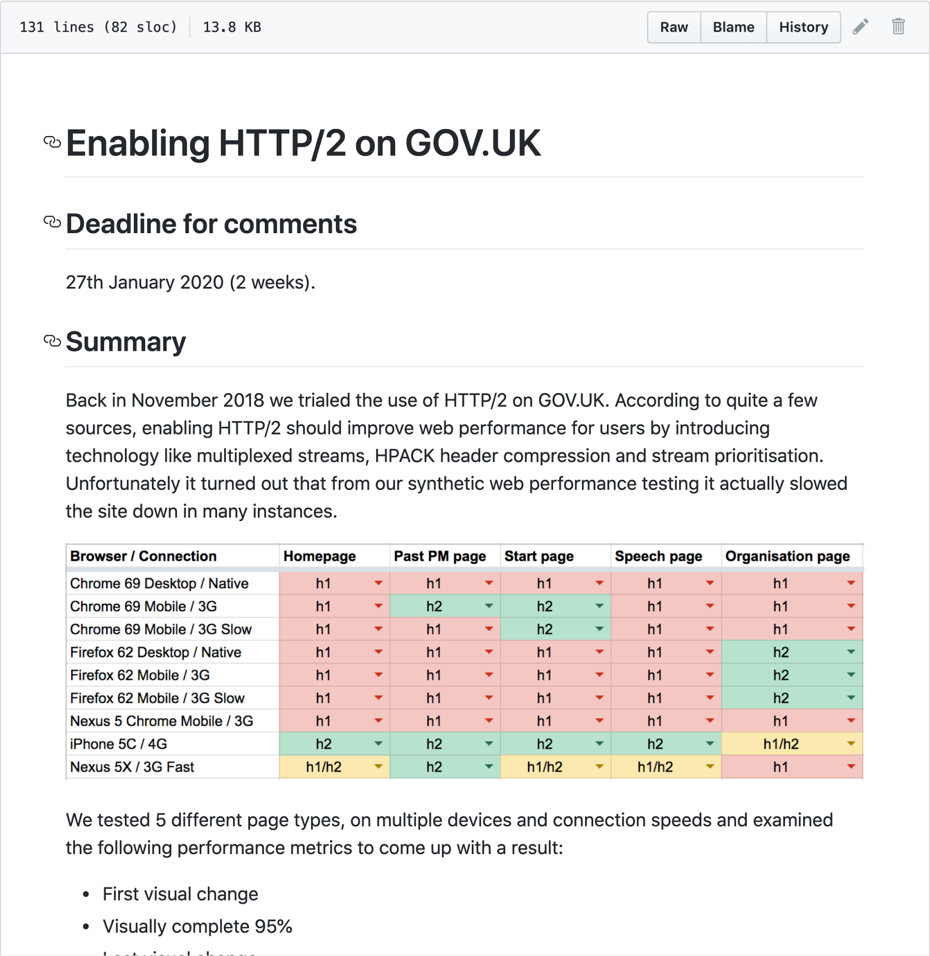
Syntax

```
Access-Control-Allow-Origin: *
Access-Control-Allow-Origin: <origin>
Access-Control-Allow-Origin: null
```

- Access-Control-Allow-Origin: *
- crossorigin="use-credentials"

~~Subresource Integrity (SRI)~~

RFC-115



Enabling HTTP/2 on GOV.UK

Deadline for comments

27th January 2020 (2 weeks).

Summary

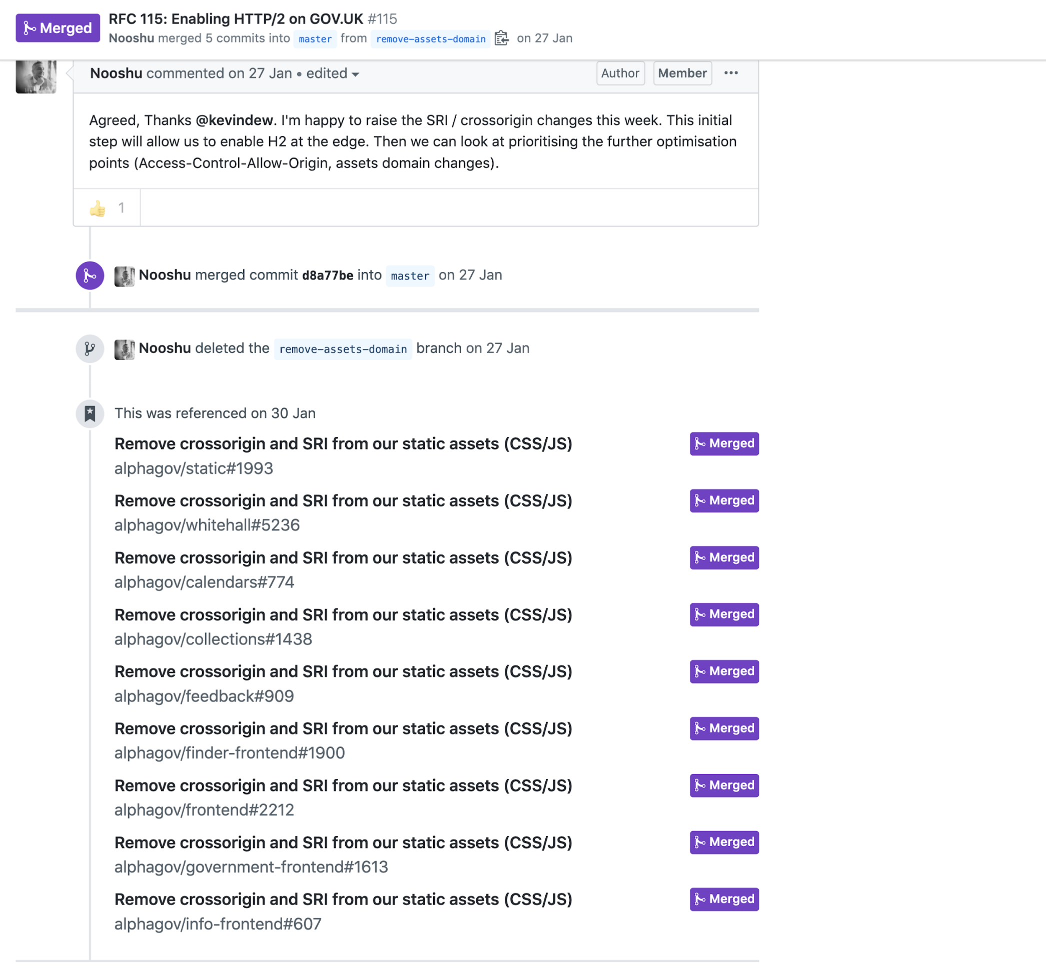
Back in November 2018 we trialed the use of HTTP/2 on GOV.UK. According to quite a few sources, enabling HTTP/2 should improve web performance for users by introducing technology like multiplexed streams, HPACK header compression and stream prioritisation. Unfortunately it turned out that from our synthetic web performance testing it actually slowed the site down in many instances.

Browser / Connection	Homepage	Past PM page	Start page	Speech page	Organisation page
Chrome 69 Desktop / Native	h1	h1	h1	h1	h1
Chrome 69 Mobile / 3G	h1	h2	h2	h1	h1
Chrome 69 Mobile / 3G Slow	h1	h1	h2	h1	h1
Firefox 62 Desktop / Native	h1	h1	h1	h1	h2
Firefox 62 Mobile / 3G	h1	h1	h1	h1	h2
Firefox 62 Mobile / 3G Slow	h1	h1	h1	h1	h2
Nexus 5 Chrome Mobile / 3G	h1	h1	h1	h1	h1
iPhone 5C / 4G	h2	h2	h2	h2	h1/h2
Nexus 5X / 3G Fast	h1/h2	h2	h1/h2	h1/h2	h1

We tested 5 different page types, on multiple devices and connection speeds and examined the following performance metrics to come up with a result:

- First visual change
- Visually complete 95%
- Last visual change

Nine small PR’s



Merged **RFC 115: Enabling HTTP/2 on GOV.UK** #115

Nooshu merged 5 commits into `master` from `remove-assets-domain` on 27 Jan

Nooshu commented on 27 Jan • edited ▾ Author Member ···

Agreed, Thanks **@kevindew**. I'm happy to raise the SRI / crossorigin changes this week. This initial step will allow us to enable H2 at the edge. Then we can look at prioritising the further optimisation points (Access-Control-Allow-Origin, assets domain changes).

👍 1

Nooshu merged commit **d8a77be** into `master` on 27 Jan

Nooshu deleted the `remove-assets-domain` branch on 27 Jan

This was referenced on 30 Jan

Remove crossorigin and SRI from our static assets (CSS/JS) Merged
alphagov/static#1993

Remove crossorigin and SRI from our static assets (CSS/JS) Merged
alphagov/whitehall#5236

Remove crossorigin and SRI from our static assets (CSS/JS) Merged
alphagov/calendars#774

Remove crossorigin and SRI from our static assets (CSS/JS) Merged
alphagov/collections#1438

Remove crossorigin and SRI from our static assets (CSS/JS) Merged
alphagov/feedback#909

Remove crossorigin and SRI from our static assets (CSS/JS) Merged
alphagov/finder-frontend#1900

Remove crossorigin and SRI from our static assets (CSS/JS) Merged
alphagov/frontend#2212

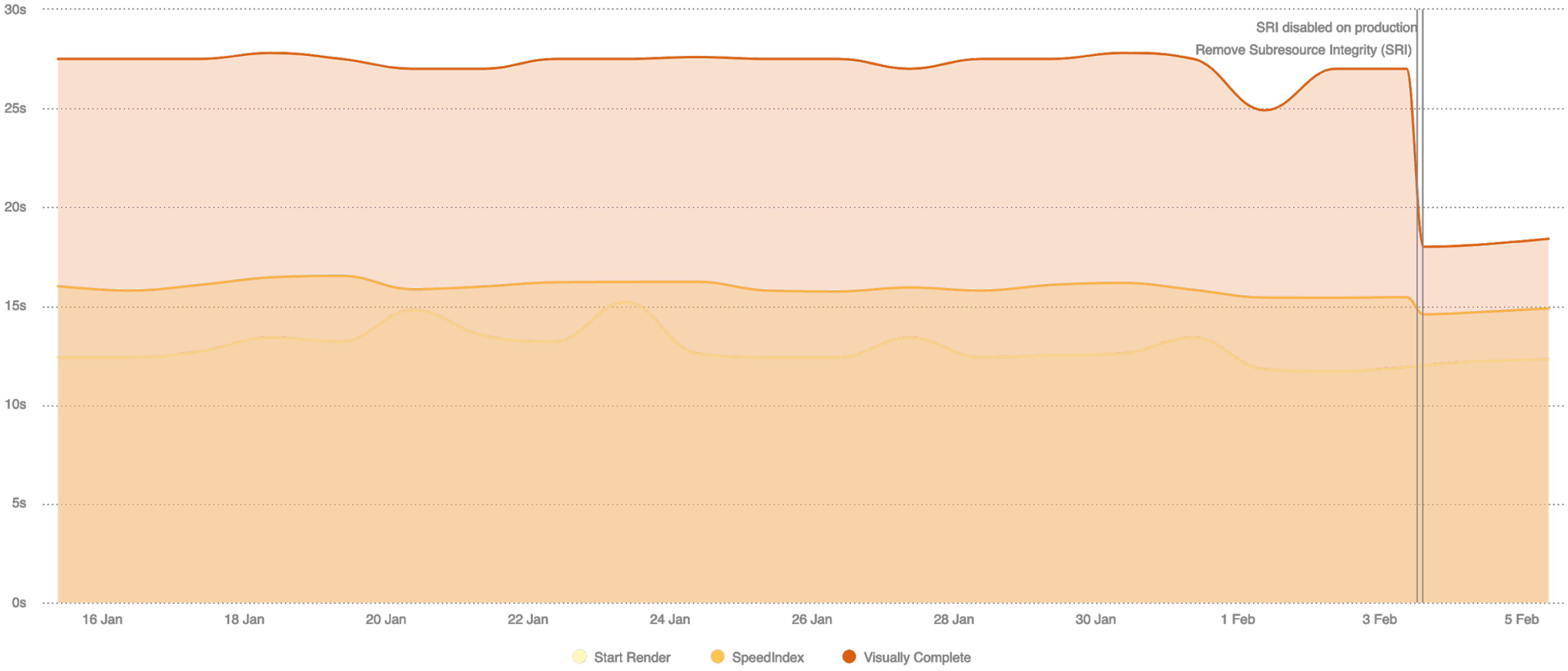
Remove crossorigin and SRI from our static assets (CSS/JS) Merged
alphagov/government-frontend#1613

Remove crossorigin and SRI from our static assets (CSS/JS) Merged
alphagov/info-frontend#607

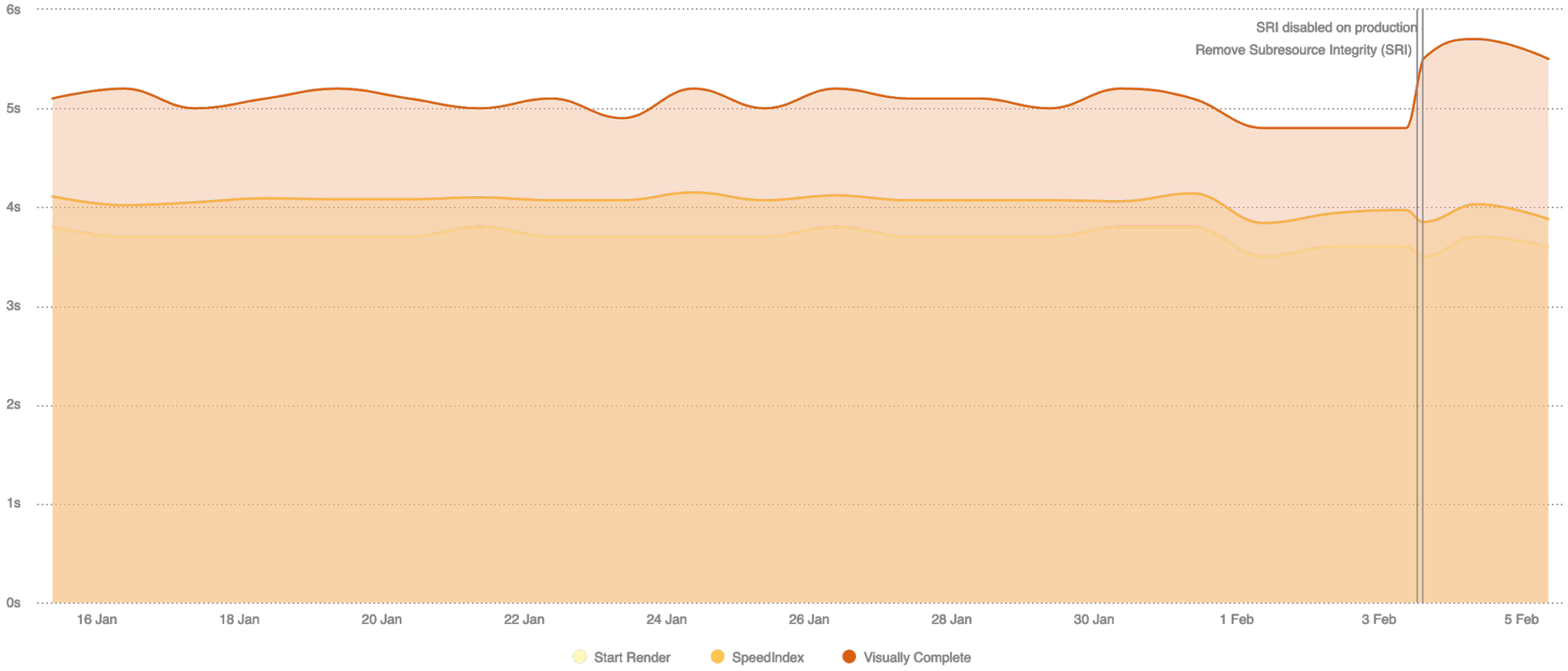
Results

HTTP/1.1 (SRI) to HTTP/1.1 (no-SRI)

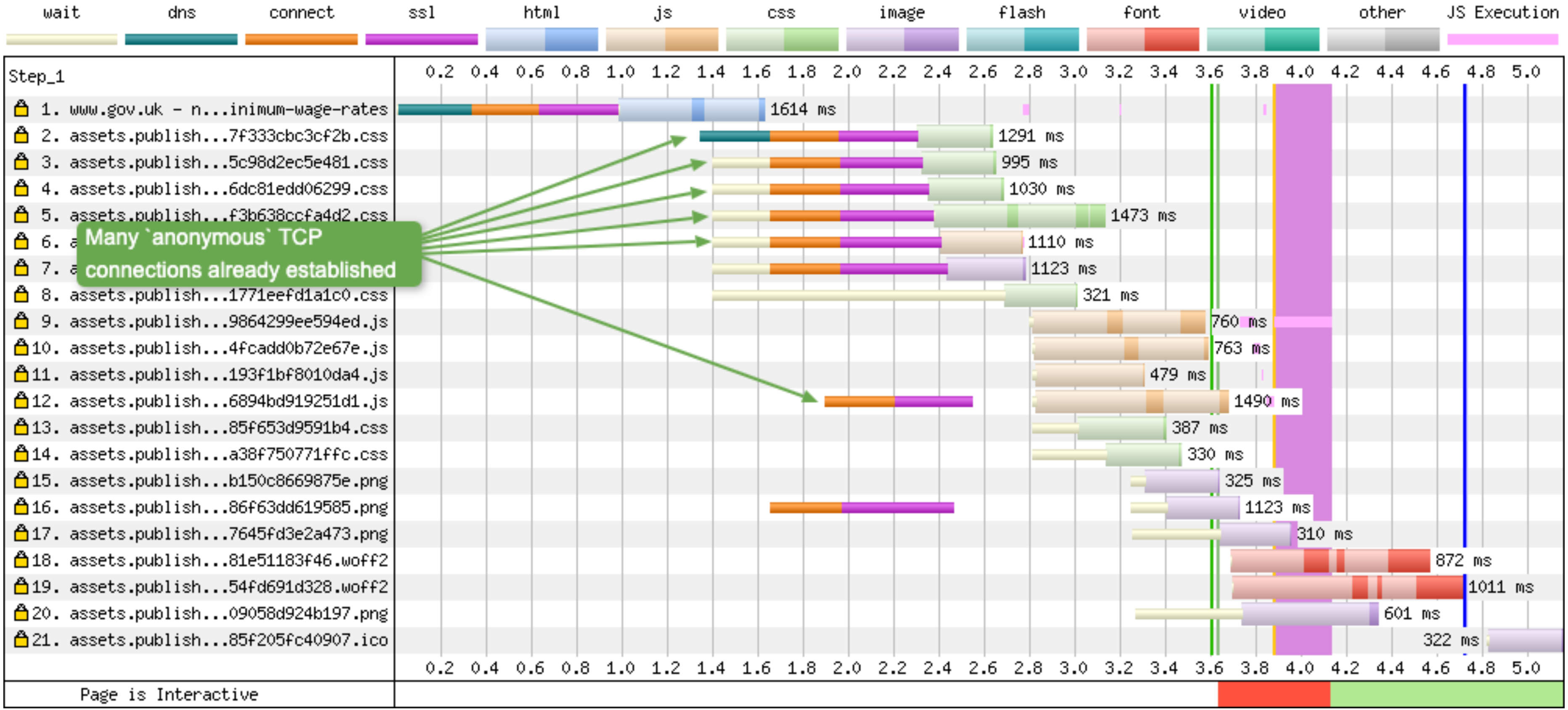
Homepage - slow mobile (Samsung S3, 2G)



Answers page - medium mobile (Samsung S4, 3G)



HTTP/1.1 with SRI



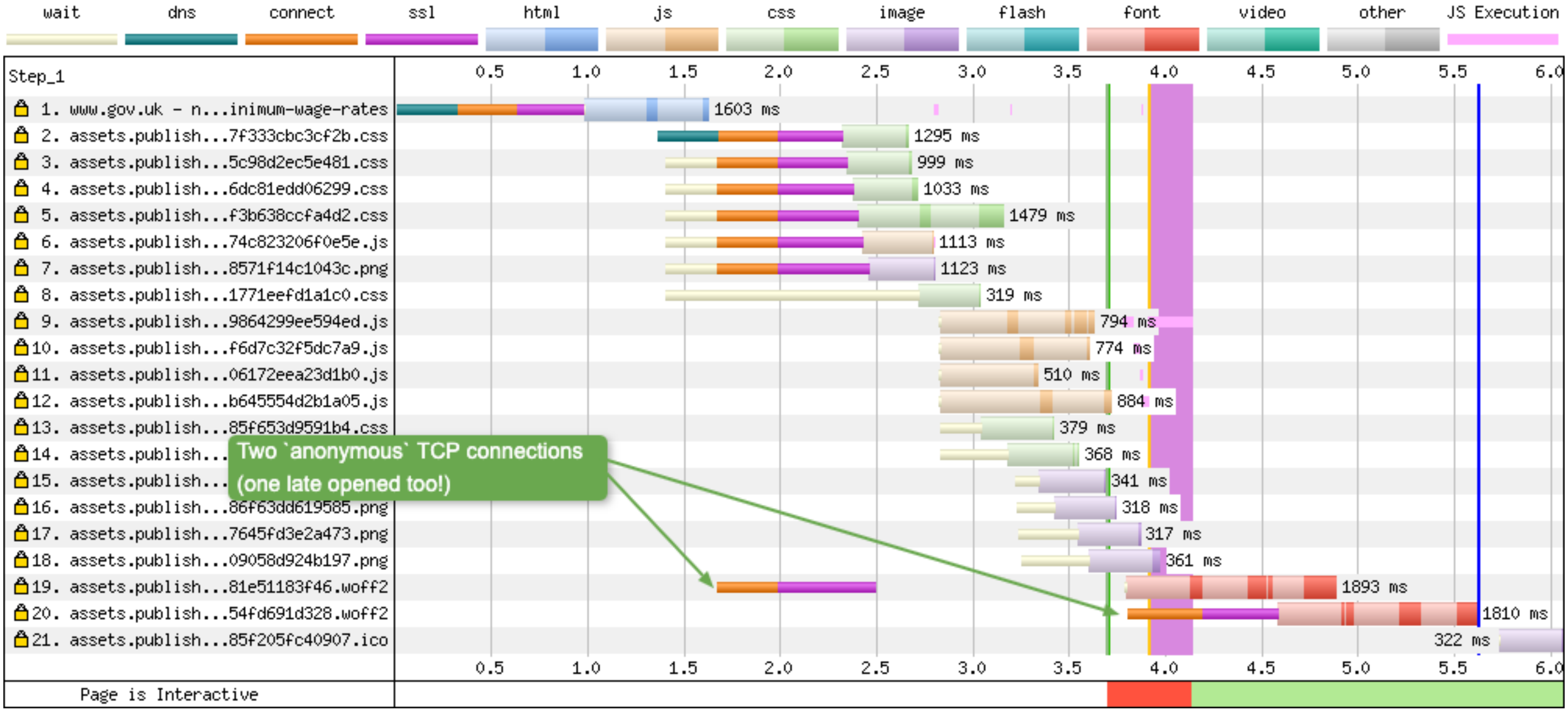
Step_1

1. www.gov.uk - n...inimum-wage-rates 1614 ms
2. assets.publish...7f333cbc3cf2b.css 1291 ms
3. assets.publish...5c98d2ec5e481.css 995 ms
4. assets.publish...6dc81edd06299.css 1030 ms
5. assets.publish...f3b638ccfa4d2.css 1473 ms
6. a 1110 ms
7. a 1123 ms
8. assets.publish...1771eefd1a1c0.css 321 ms
9. assets.publish...9864299ee594ed.js 760 ms
10. assets.publish...4fcadd0b72e67e.js 763 ms
11. assets.publish...193f1bf8010da4.js 479 ms
12. assets.publish...6894bd919251d1.js 1490 ms
13. assets.publish...85f653d9591b4.css 387 ms
14. assets.publish...a38f750771ffc.css 330 ms
15. assets.publish...b150c8669875e.png 325 ms
16. assets.publish...86f63dd619585.png 1123 ms
17. assets.publish...7645fd3e2a473.png 310 ms
18. assets.publish...81e51183f46.woff2 872 ms
19. assets.publish...54fd691d328.woff2 1011 ms
20. assets.publish...09058d924b197.png 601 ms
21. assets.publish...85f205fc40907.ico 322 ms

Page is Interactive

Many `anonymous` TCP connections already established

HTTP/1.1 without SRI

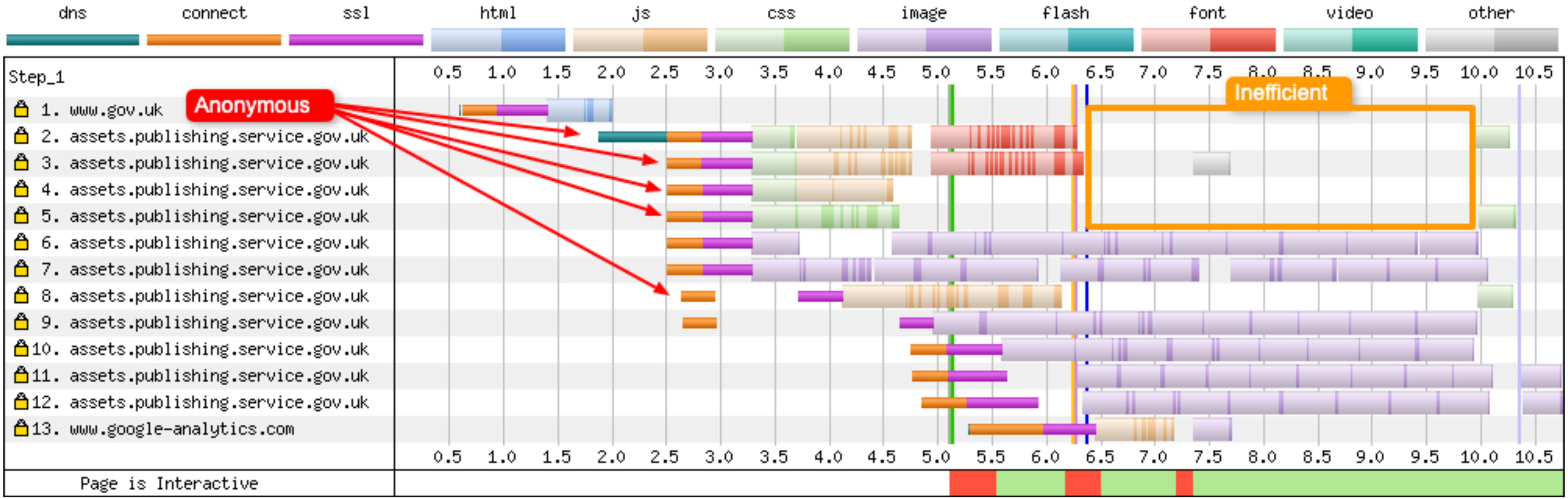


1. www.gov.uk - n...inimum-wage-rates 1603 ms
2. assets.publish...7f333cbc3cf2b.css 1295 ms
3. assets.publish...5c98d2ec5e481.css 999 ms
4. assets.publish...6dc81edd06299.css 1033 ms
5. assets.publish...f3b638ccfa4d2.css 1479 ms
6. assets.publish...74c823206f0e5e.js 1113 ms
7. assets.publish...8571f14c1043c.png 1123 ms
8. assets.publish...1771eefd1a1c0.css 319 ms
9. assets.publish...9864299ee594ed.js 794 ms
10. assets.publish...f6d7c32f5dc7a9.js 774 ms
11. assets.publish...06172eea23d1b0.js 510 ms
12. assets.publish...b645554d2b1a05.js 884 ms
13. assets.publish...85f653d9591b4.css 379 ms
14. assets.publish... 368 ms
15. assets.publish... 341 ms
16. assets.publish...86f63dd619585.png 318 ms
17. assets.publish...7645fd3e2a473.png 317 ms
18. assets.publish...09058d924b197.png 361 ms
19. assets.publish...81e51183f46.woff2 1893 ms
20. assets.publish...54fd691d328.woff2 1810 ms
21. assets.publish...85f205fc40907.ico 322 ms

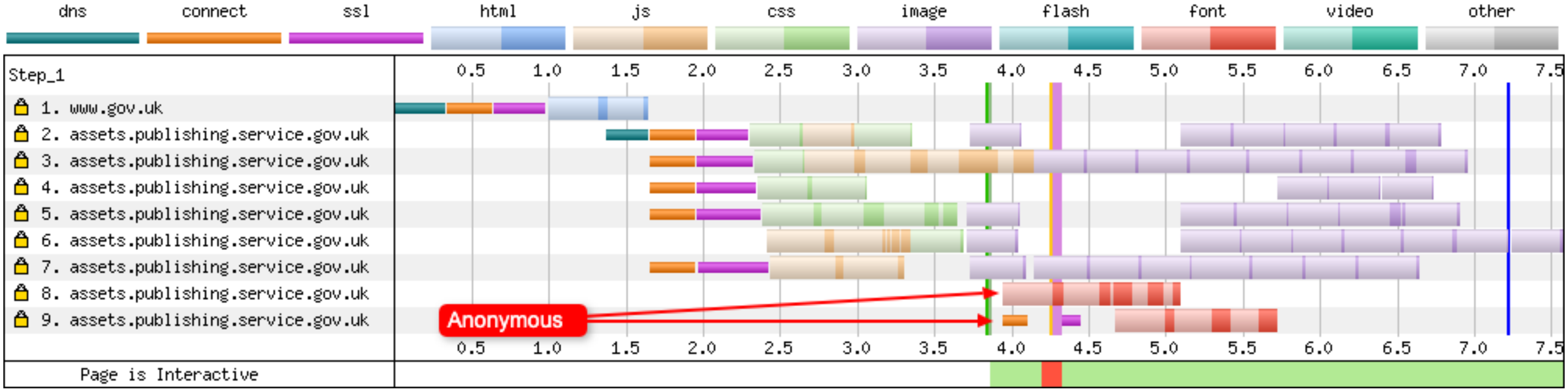
Page is Interactive

Two `anonymous` TCP connections (one late opened too!)

HTTP/1.1 with SRI

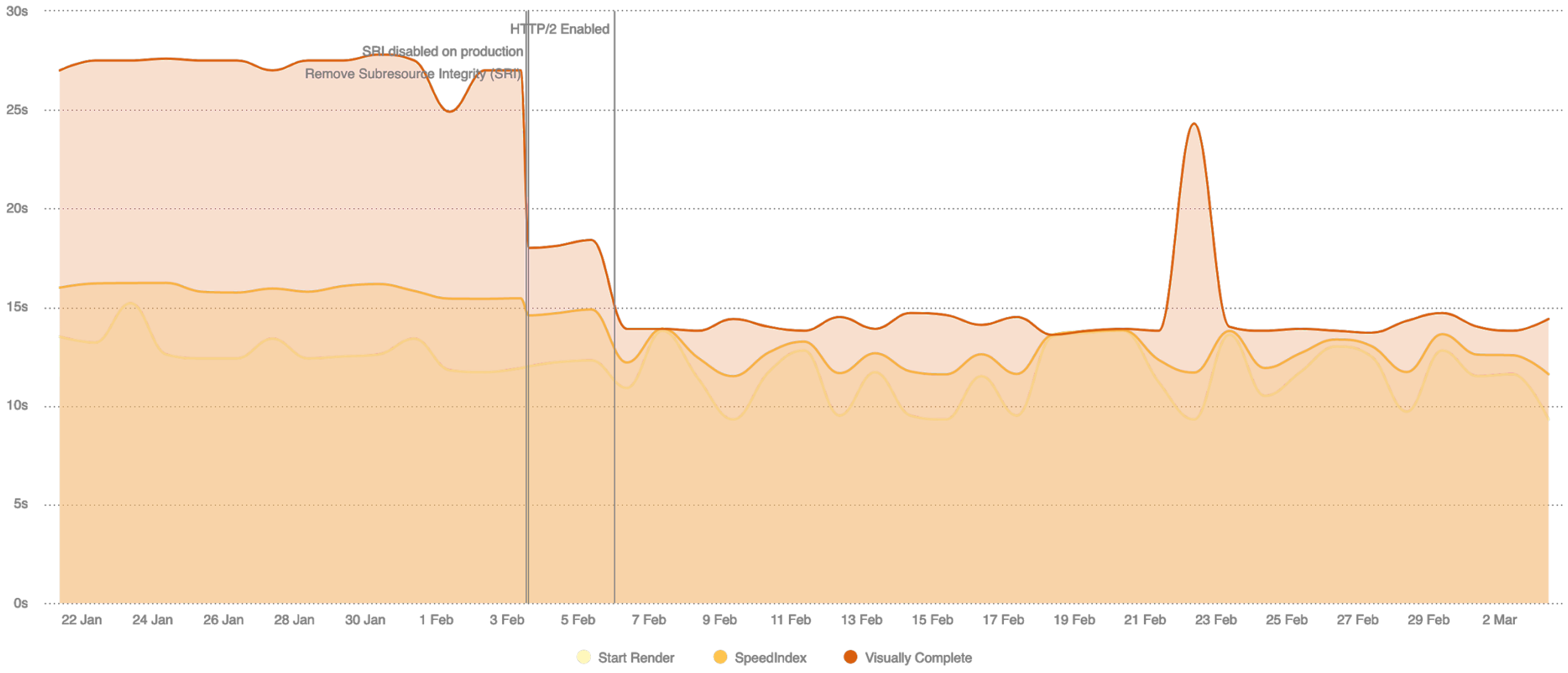


HTTP/1.1 without SRI

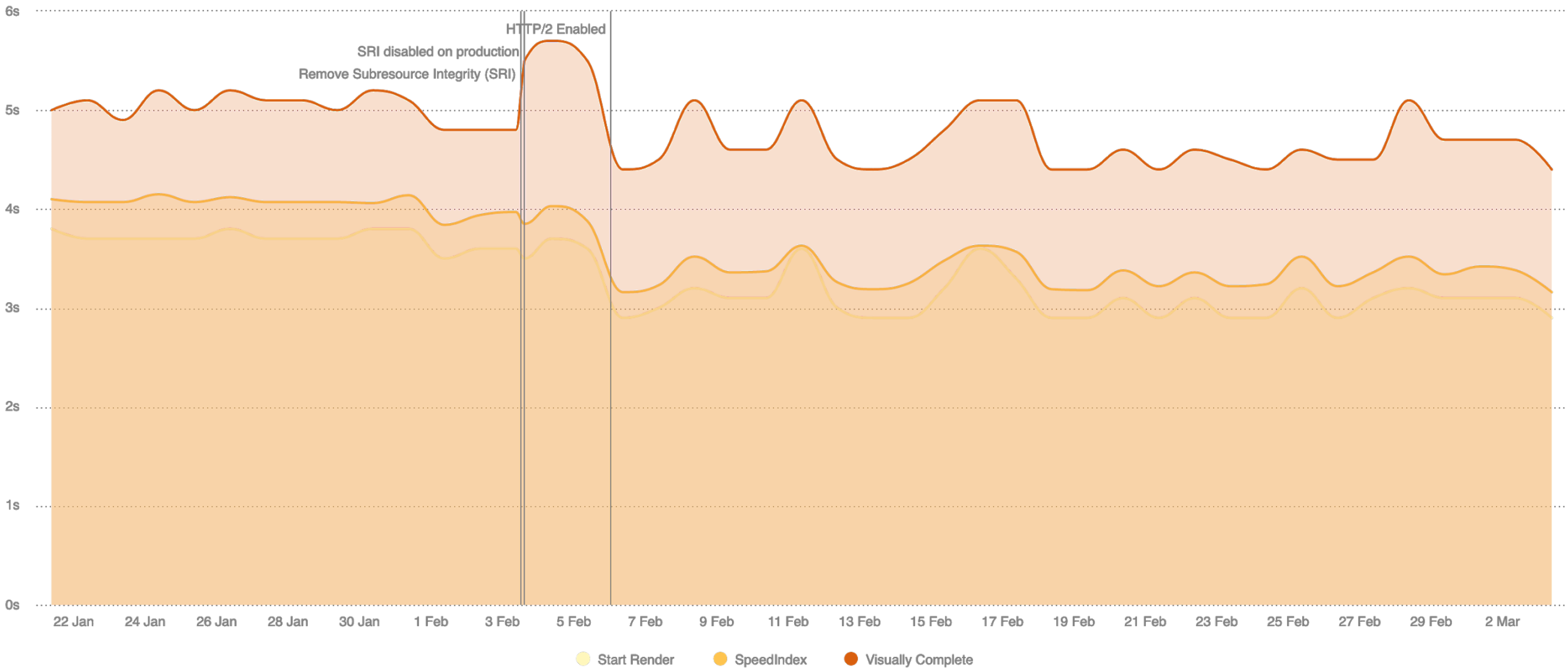


HTTP/1.1 (no-SRI) to HTTP/2

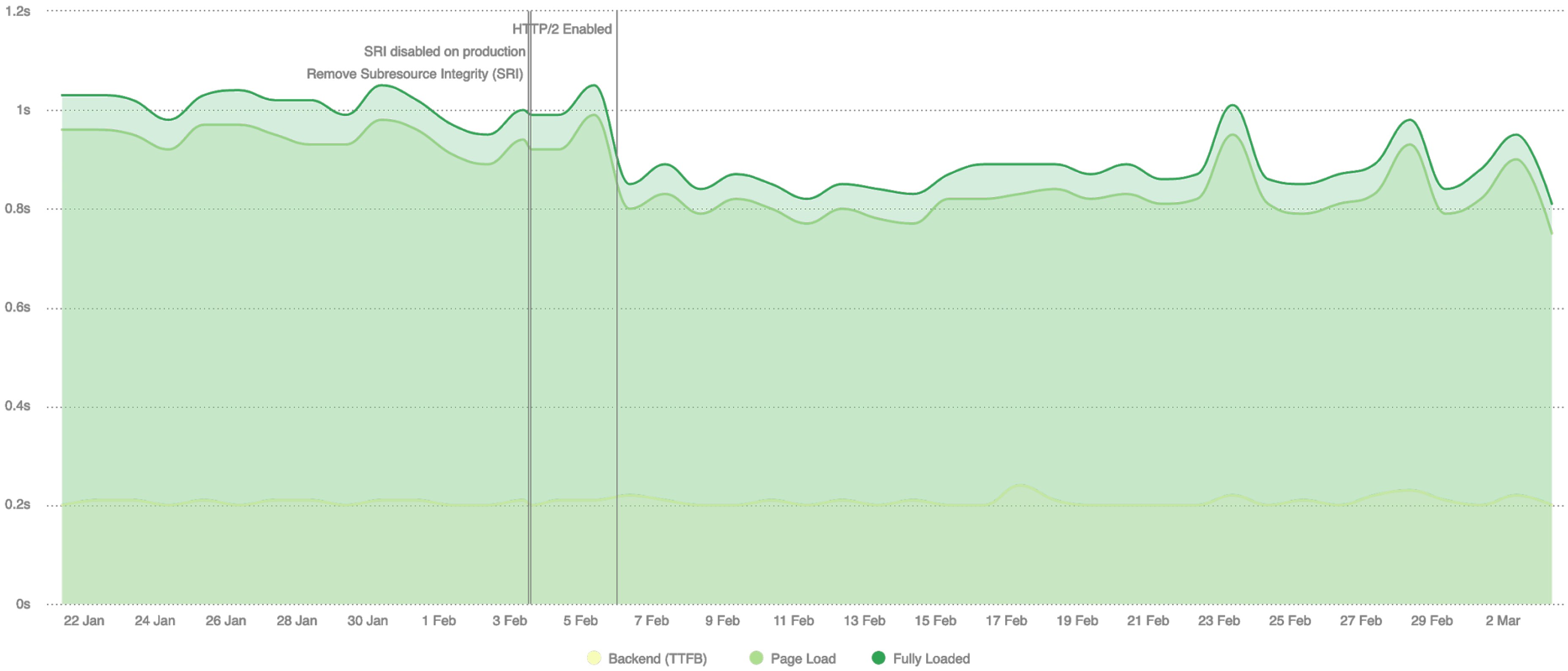
Homepage - slow mobile (Samsung S3, 2G)



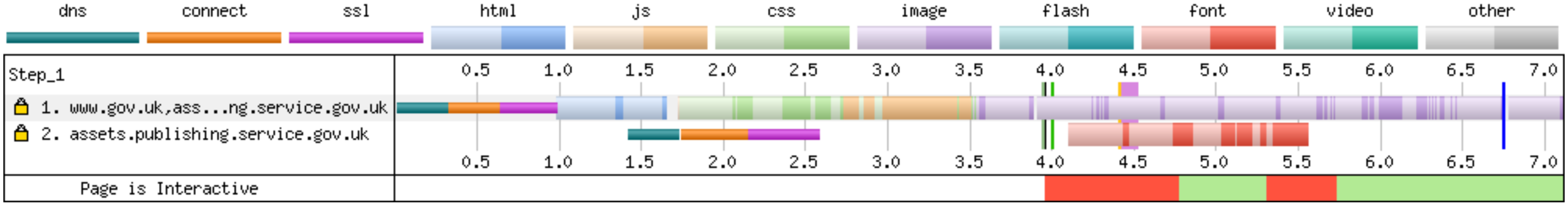
Answers page - medium mobile (Samsung S4, 3G)



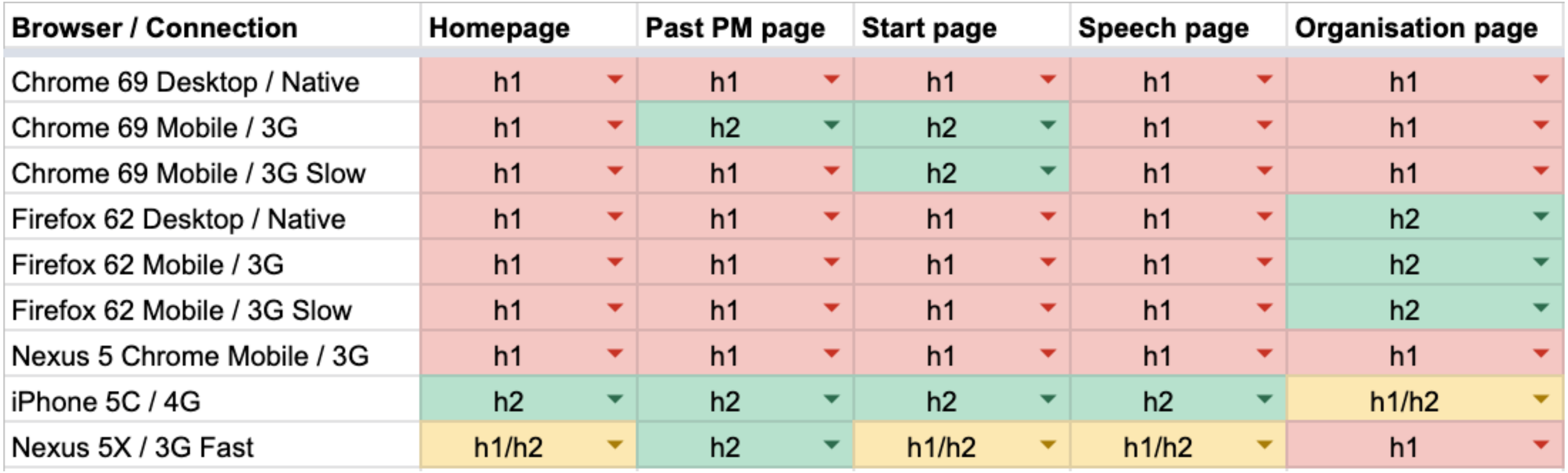
Start page - Chrome - Cable



HTTP/2

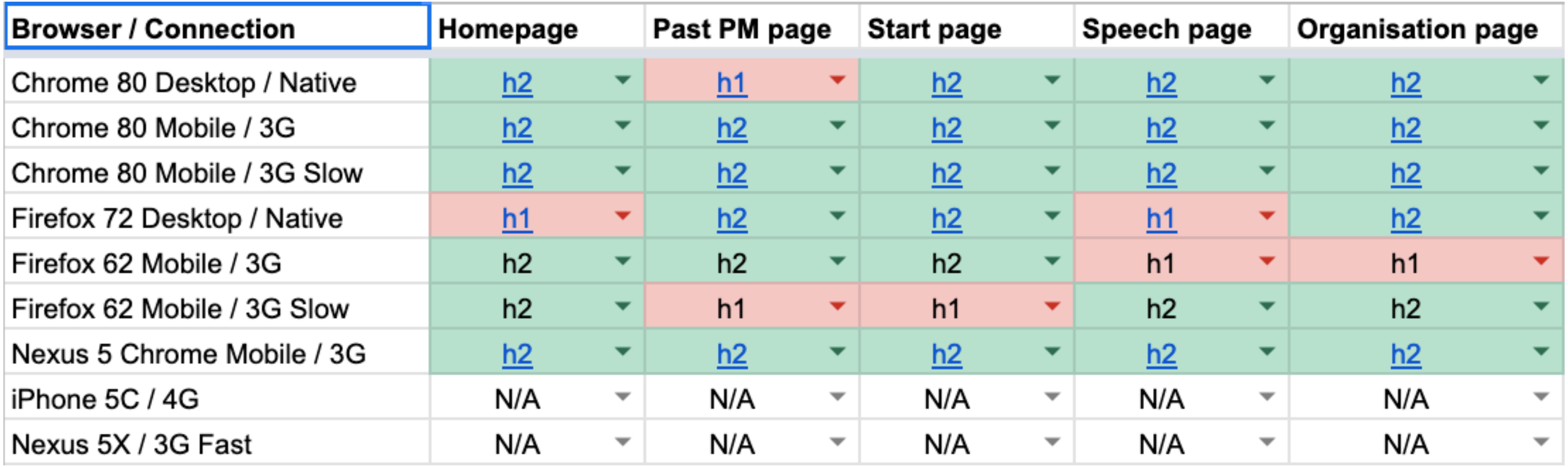

dns
connect
ssl
html
js
css
image
flash
font
video
other
Step_1
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
1. www.gov.uk,ass...ng.service.gov.uk
2. assets.publishing.service.gov.uk
Page is Interactive

HTTP/1.1 with SRI enabled



Browser / Connection	Homepage	Past PM page	Start page	Speech page	Organisation page
Chrome 69 Desktop / Native	h1	h1	h1	h1	h1
Chrome 69 Mobile / 3G	h1	h2	h2	h1	h1
Chrome 69 Mobile / 3G Slow	h1	h1	h2	h1	h1
Firefox 62 Desktop / Native	h1	h1	h1	h1	h2
Firefox 62 Mobile / 3G	h1	h1	h1	h1	h2
Firefox 62 Mobile / 3G Slow	h1	h1	h1	h1	h2
Nexus 5 Chrome Mobile / 3G	h1	h1	h1	h1	h1
iPhone 5C / 4G	h2	h2	h2	h2	h1/h2
Nexus 5X / 3G Fast	h1/h2	h2	h1/h2	h1/h2	h1

HTTP/1.1 with SRI enabled

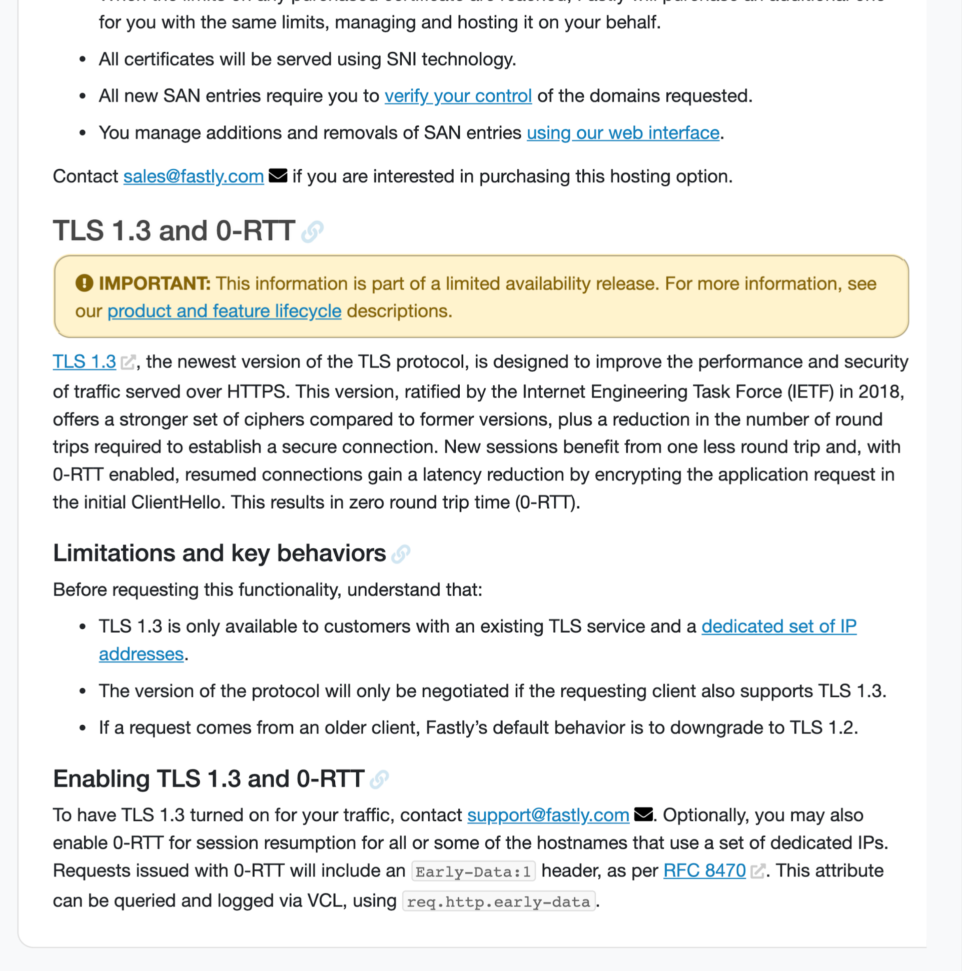


Browser / Connection	Homepage	Past PM page	Start page	Speech page	Organisation page
Chrome 80 Desktop / Native	h2	h1	h2	h2	h2
Chrome 80 Mobile / 3G	h2	h2	h2	h2	h2
Chrome 80 Mobile / 3G Slow	h2	h2	h2	h2	h2
Firefox 72 Desktop / Native	h1	h2	h2	h1	h2
Firefox 62 Mobile / 3G	h2	h2	h2	h1	h1
Firefox 62 Mobile / 3G Slow	h2	h1	h1	h2	h2
Nexus 5 Chrome Mobile / 3G	h2	h2	h2	h2	h2
iPhone 5C / 4G	N/A	N/A	N/A	N/A	N/A
Nexus 5X / 3G Fast	N/A	N/A	N/A	N/A	N/A

What’s next for GOV.UK?

- Access-Control-Allow-Origin: *
- Remove assets domain (for static assets)

TLSv1.3 (+ 0-RTT?)



When the limits on any purchased certificate are reached, Fastly will purchase an additional one for you with the same limits, managing and hosting it on your behalf.

- All certificates will be served using SNI technology.
- All new SAN entries require you to verify your control of the domains requested.
- You manage additions and removals of SAN entries using our web interface.

Contact sales@fastly.com ✉ if you are interested in purchasing this hosting option.

TLS 1.3 and 0-RTT

IMPORTANT: This information is part of a limited availability release. For more information, see our product and feature lifecycle descriptions.

TLS 1.3, the newest version of the TLS protocol, is designed to improve the performance and security of traffic served over HTTPS. This version, ratified by the Internet Engineering Task Force (IETF) in 2018, offers a stronger set of ciphers compared to former versions, plus a reduction in the number of round trips required to establish a secure connection. New sessions benefit from one less round trip and, with 0-RTT enabled, resumed connections gain a latency reduction by encrypting the application request in the initial ClientHello. This results in zero round trip time (0-RTT).

Limitations and key behaviors

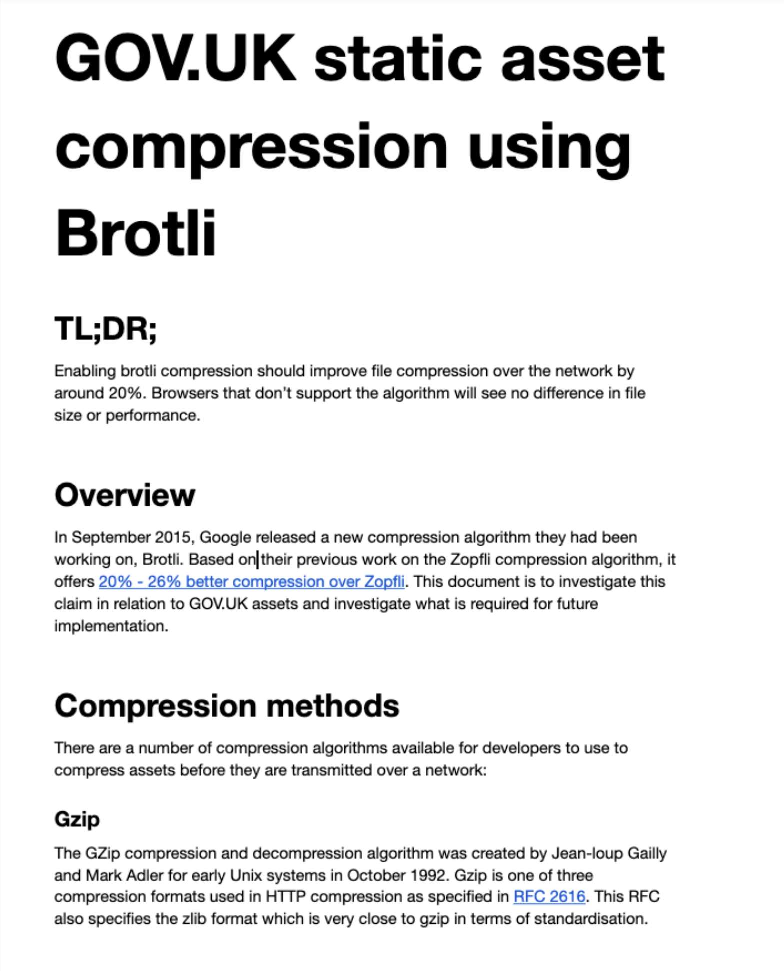
Before requesting this functionality, understand that:

- TLS 1.3 is only available to customers with an existing TLS service and a dedicated set of IP addresses.
- The version of the protocol will only be negotiated if the requesting client also supports TLS 1.3.
- If a request comes from an older client, Fastly's default behavior is to downgrade to TLS 1.2.

Enabling TLS 1.3 and 0-RTT

To have TLS 1.3 turned on for your traffic, contact support@fastly.com ✉. Optionally, you may also enable 0-RTT for session resumption for all or some of the hostnames that use a set of dedicated IPs. Requests issued with 0-RTT will include an `Early-Data:1` header, as per RFC 8470. This attribute can be queried and logged via VCL, using `req.http.early-data`.

Brotli compression



GOV.UK static asset compression using Brotli

TL;DR;

Enabling brotli compression should improve file compression over the network by around 20%. Browsers that don't support the algorithm will see no difference in file size or performance.

Overview

In September 2015, Google released a new compression algorithm they had been working on, Brotli. Based on their previous work on the Zopfli compression algorithm, it offers 20% - 26% better compression over Zopfli. This document is to investigate this claim in relation to GOV.UK assets and investigate what is required for future implementation.

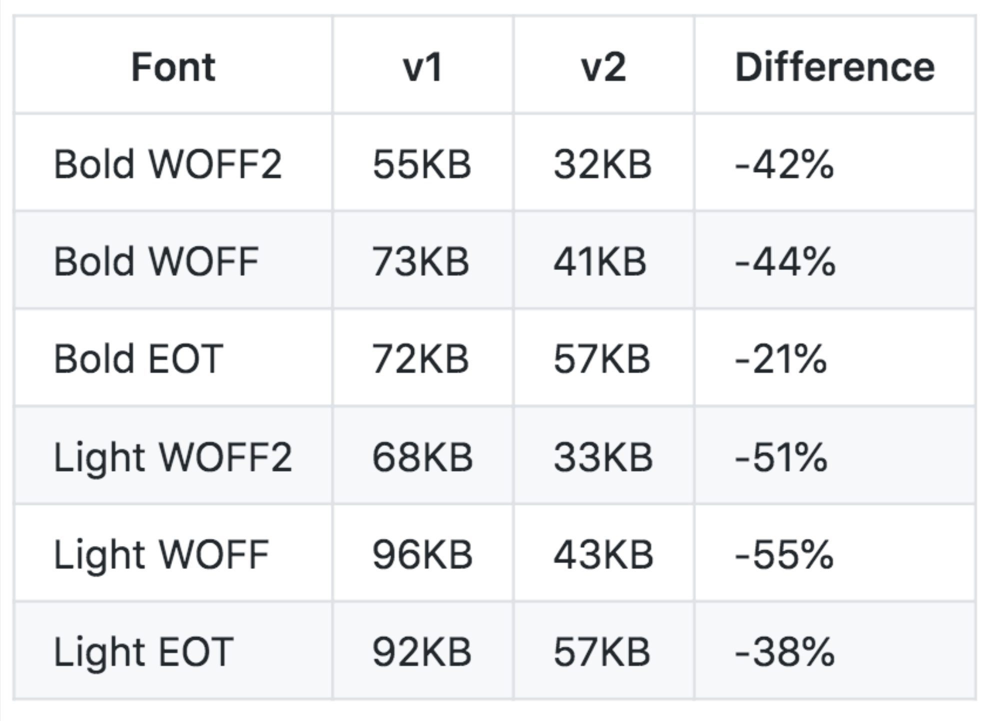
Compression methods

There are a number of compression algorithms available for developers to use to compress assets before they are transmitted over a network:

Gzip

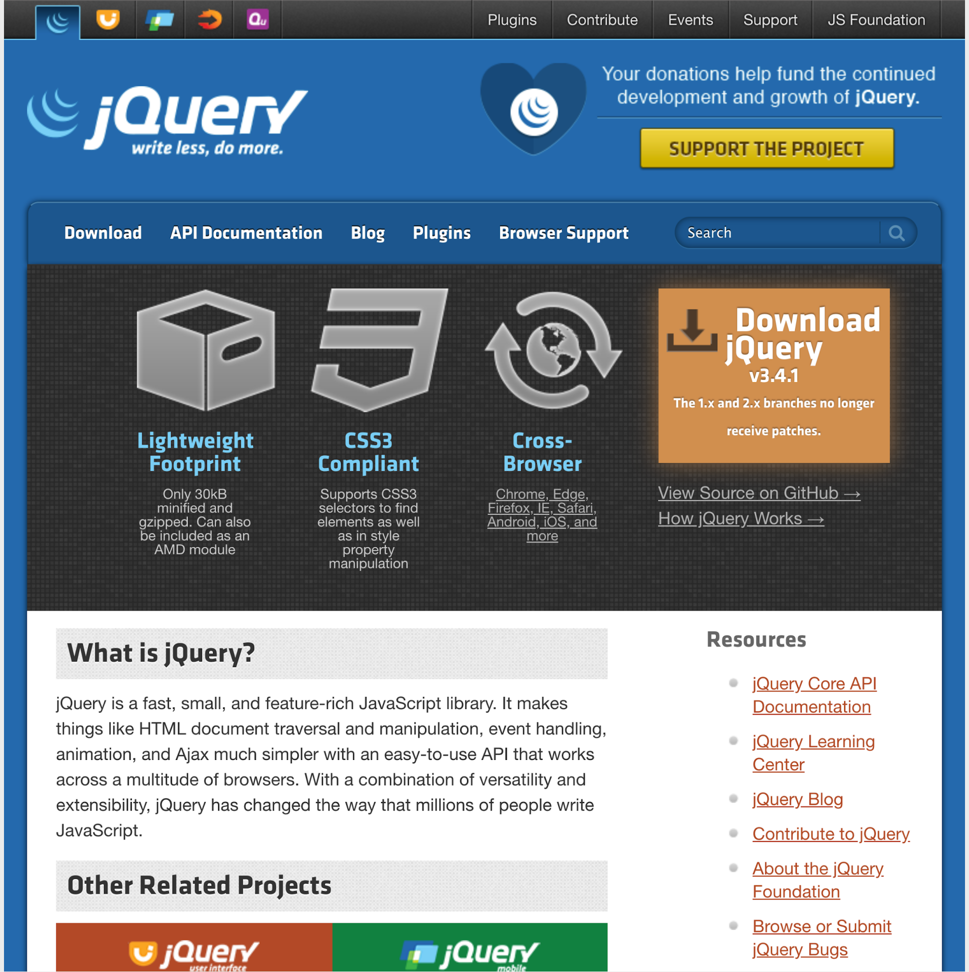
The GZip compression and decompression algorithm was created by Jean-loup Gailly and Mark Adler for early Unix systems in October 1992. Gzip is one of three compression formats used in HTTP compression as specified in RFC 2616. This RFC also specifies the zlib format which is very close to gzip in terms of standardisation.

New webfont



Font	v1	v2	Difference
Bold WOFF2	55KB	32KB	-42%
Bold WOFF	73KB	41KB	-44%
Bold EOT	72KB	57KB	-21%
Light WOFF2	68KB	33KB	-51%
Light WOFF	96KB	43KB	-55%
Light EOT	92KB	57KB	-38%

JS improvements



Your donations help fund the continued development and growth of **jQuery**.

Lightweight Footprint

Only 30kB minified and gzipped. Can also be included as an AMD module

CSS3 Compliant

Supports CSS3 selectors to find elements as well as in style property manipulation

Cross-Browser

Chrome, Edge, Firefox, IE, Safari, Android, iOS, and more

The 1.x and 2.x branches no longer receive patches.

View Source on GitHub →

How jQuery Works →

What is jQuery?

jQuery is a fast, small, and feature-rich JavaScript library. It makes things like HTML document traversal and manipulation, event handling, animation, and Ajax much simpler with an easy-to-use API that works across a multitude of browsers. With a combination of versatility and extensibility, jQuery has changed the way that millions of people write JavaScript.

Other Related Projects

Resources

- jQuery Core API Documentation
- jQuery Learning Center
- jQuery Blog
- Contribute to jQuery
- About the jQuery Foundation
- Browse or Submit jQuery Bugs

Summary

Cabinet Office

Thanks for listening!

Matt Hobbs

Twitter: @TheRealNooshu