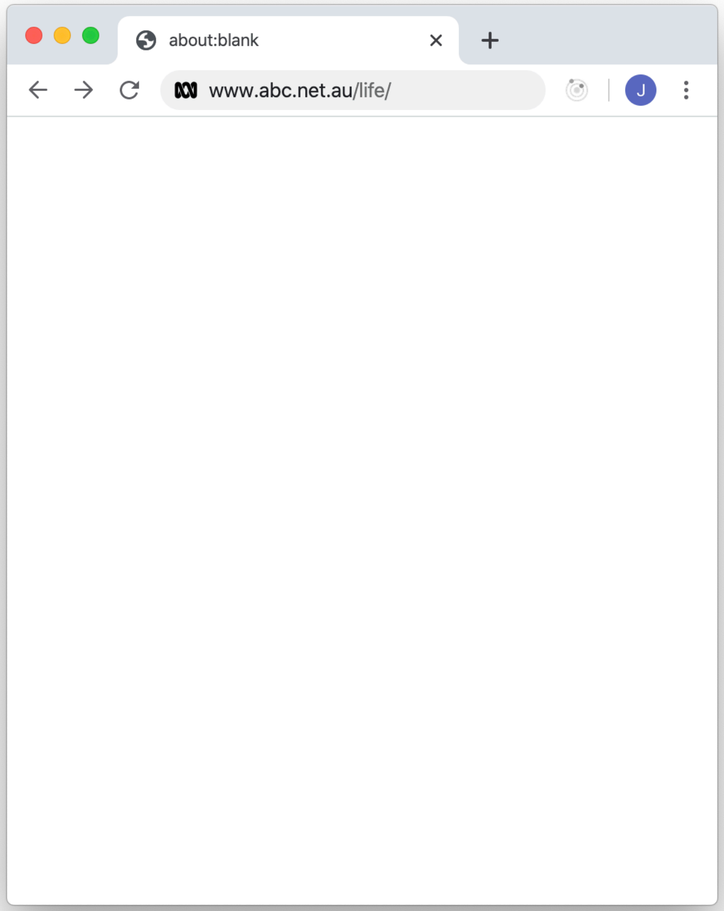
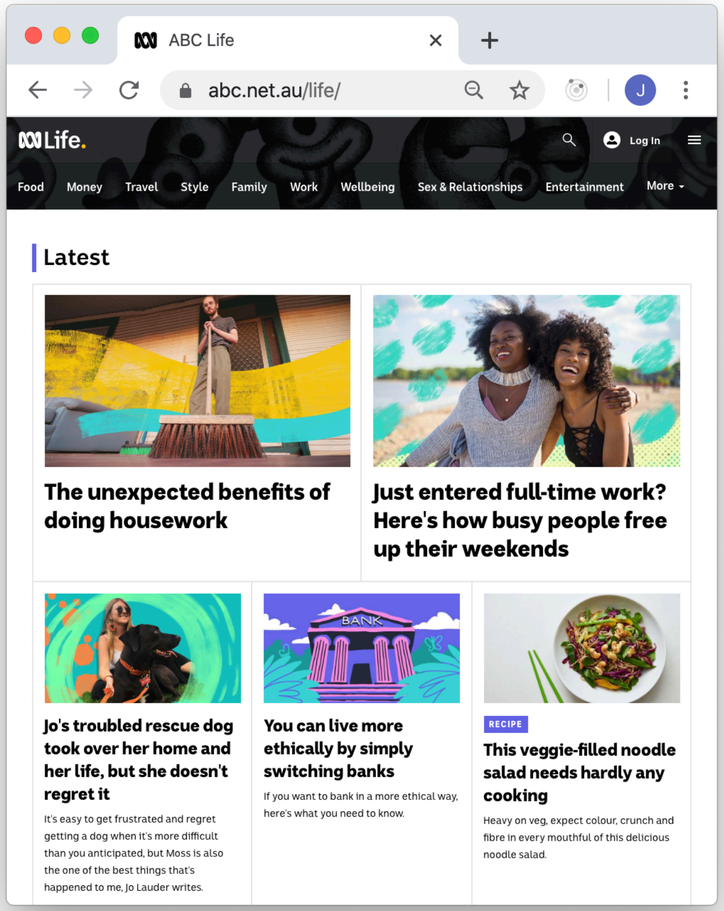
THE FIRST TWO SECONDS

FASTER PAGE LOADS FOR REACT

@joshduck



Stuff happens



React is just JavaScript

Browsers have twenty years of
optimisations for rendering and JS

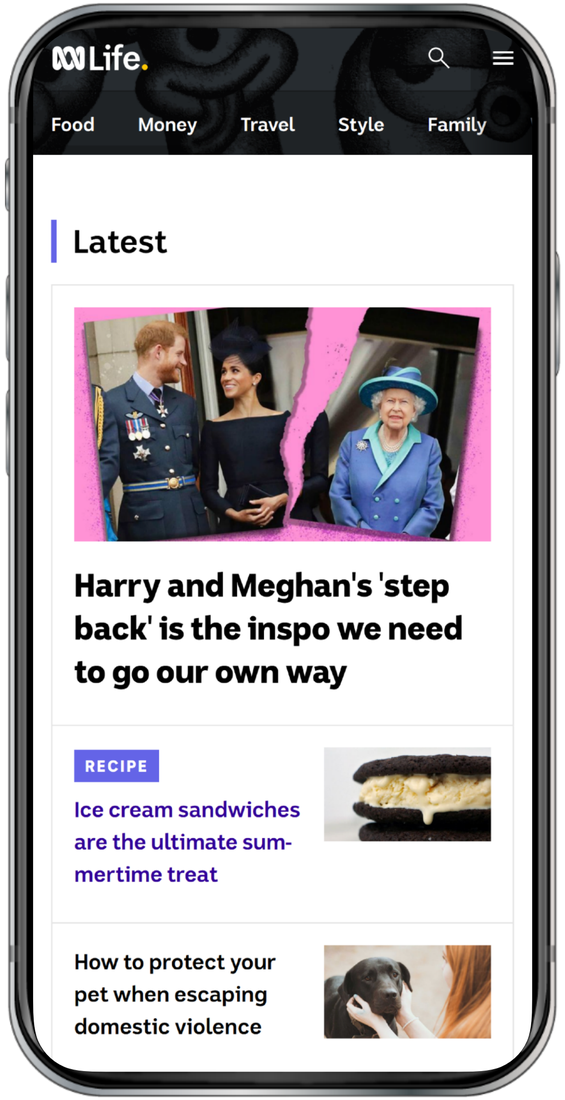
Josh Duck
@joshduck

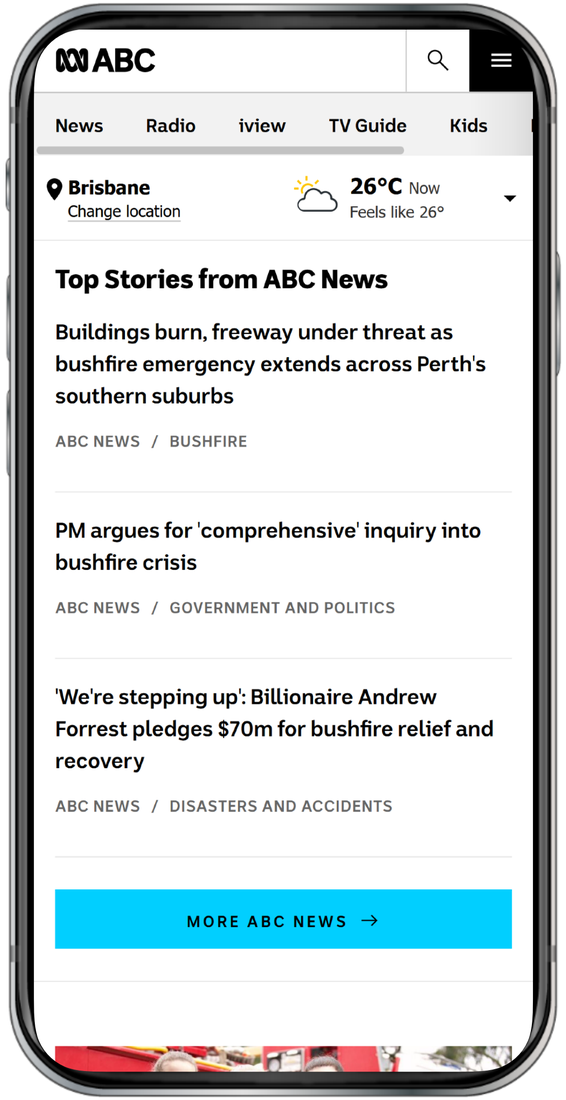
Engineering manager at:

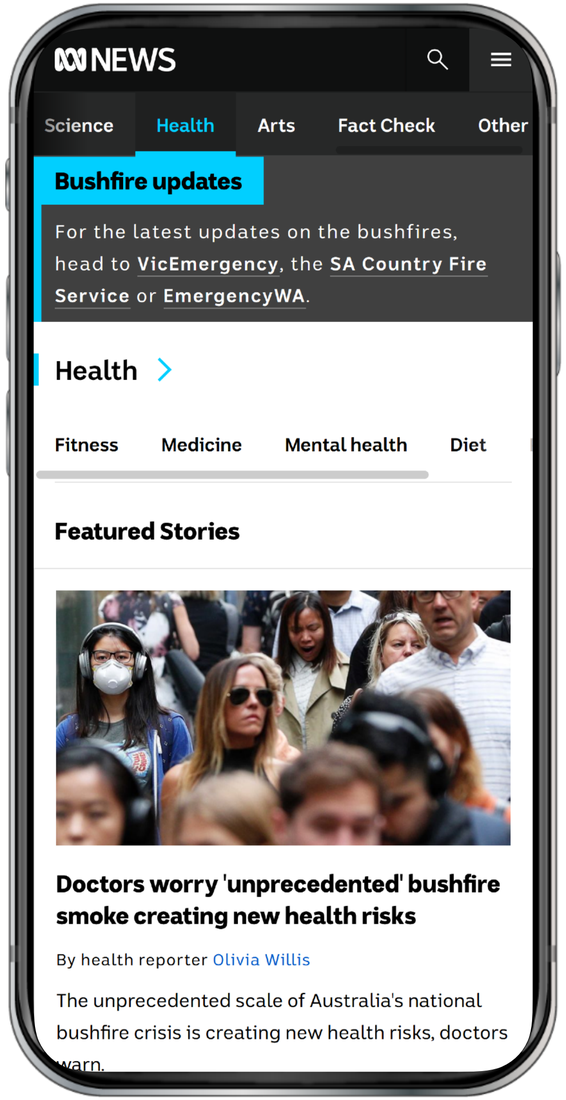
clipchamp

ABC

facebook


ABC Life.
Food
Money
Travel
Style
Family
Latest
Harry and Meghan's 'step back' is the inspo we need to go our own way
RECIPE
Ice cream sandwiches are the ultimate sum-mertime treat
How to protect your pet when escaping domestic violence


ABC
News
Radio
iview
TV Guide
Kids
Brisbane
Change location
26°C Now
Feels like 26°
Top Stories from ABC News
Buildings burn, freeway under threat as bushfire emergency extends across Perth's southern suburbs
ABC NEWS / BUSHFIRE
PM argues for 'comprehensive' inquiry into bushfire crisis
ABC NEWS / GOVERNMENT AND POLITICS
'We're stepping up': Billionaire Andrew Forrest pledges $70m for bushfire relief and recovery
ABC NEWS / DISASTERS AND ACCIDENTS
MORE ABC NEWS


ABC NEWS
Science
Health
Arts
Fact Check
Other
Bushfire updates
For the latest updates on the bushfires, head to VicEmergency, the SA Country Fire Service or EmergencyWA.
Health
Fitness
Medicine
Mental health
Diet
Featured Stories
Doctors worry 'unprecedented' bushfire smoke creating new health risks
By health reporter Olivia Willis
The unprecedented scale of Australia's national bushfire crisis is creating new health risks, doctors warn.

Today
we'll cover

Key metrics, and our guiding model

Our key architectural decisions

Fixing performance bottlenecks

Our take-aways from the journey

LET’S START AT THE VERY BEGINNING

Defining the architecture

Server Side Rendering

Components are rendered to markup on the server

+

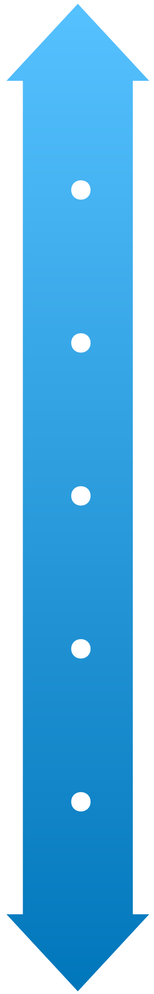
Data Hydration

Initial data is included in the HTML payload (fetch-then-render)

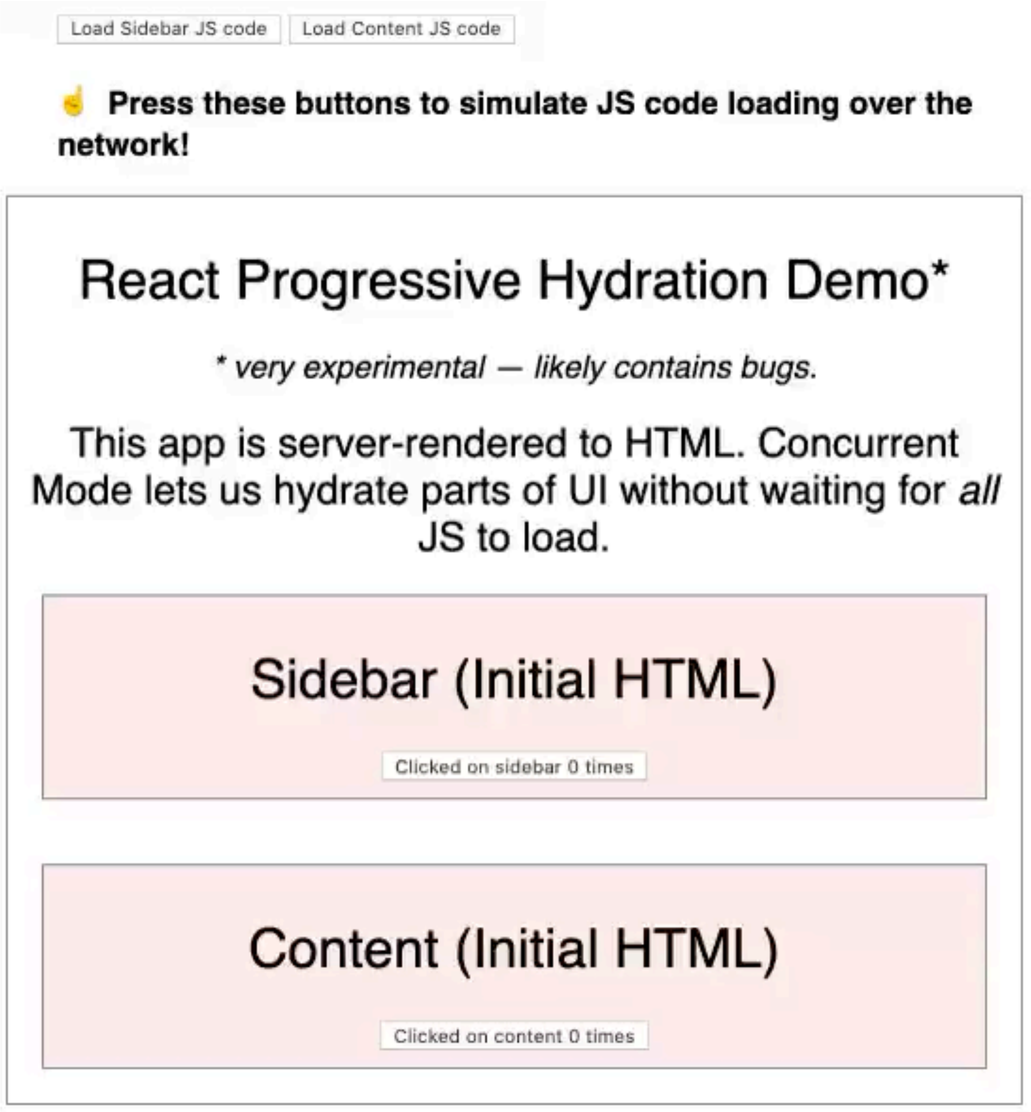
- Client rendering (like create-react-app)
- **Server render with client hydration (like Next.js)**
- Server render with progressive hydration
- Server render with partial hydration
- Server render with no client JS

- Client rendering (like create-react-app)
- Server render with client hydration (like Next.js)
- Server render with progressive hydration
- Server render with partial hydration
- **Server render with no client JS**


JS
JS
JS
JS
JS
JS
JS
JS
JS
JS
HTML
5



- Client rendering (like create-react-app)
- Server render with client hydration (like Next.js)
- **Server render with progressive hydration**
- Server render with partial hydration
- Server render with no client JS



https://twitter.com/dan_abramov/status/1200111677833973760

Server render
with CDN and caching

- Static site generation (like Gatsby)
- **Server rendering with CDN/caching**
- Server rendering per request (like Express)

CSS media queries

(Yes, really)

Our architecture

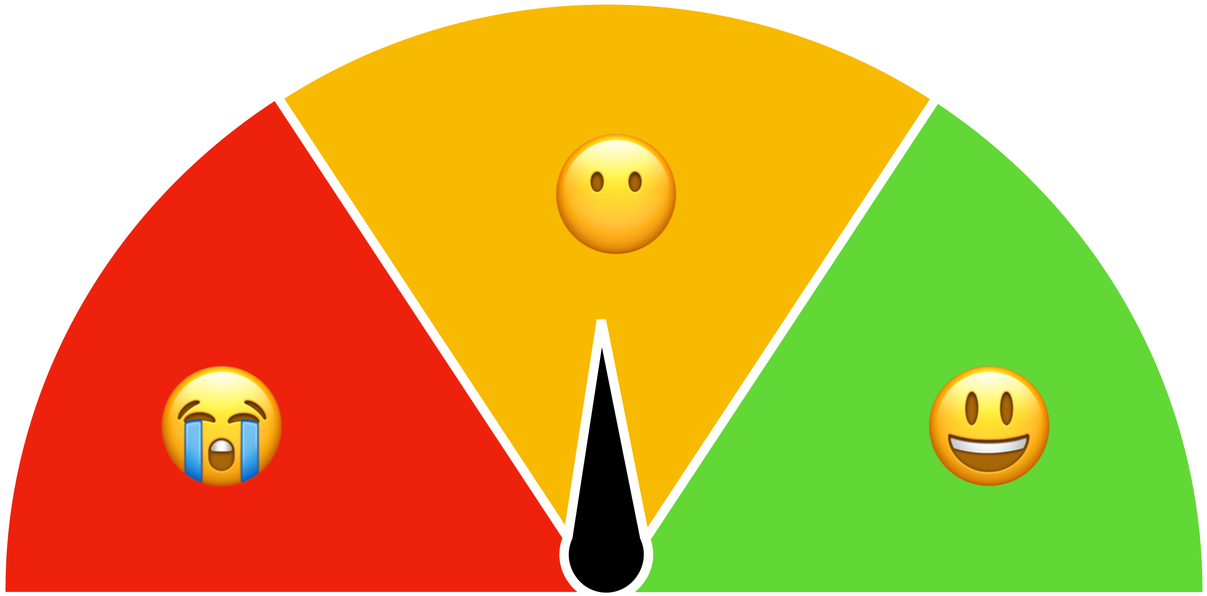
Server side rendering

Client hydration

Caching via CDN

CSS media queries

Our performance was…



Performance matters

Better user experience

Better conversions

Better SEO

Google punishes slow sites

> The “Speed Update,” as we’re calling it, will only affect pages that deliver the slowest experience to users and will only affect a small percentage of queries. It applies the same standard to all pages, regardless of the technology used to build the page. The intent of the search query is still a very strong signal, so a slow page may still rank highly if it has great, relevant content.

https://webmasters.googleblog.com/2018/01/using-page-speed-in-mobile-search.html

Get started

A. Developer in Intellectually Dishonest

Jan 22 · 8 min read

We made our pages faster and increased revenue

We completely redesigned the site and checkout too, but that part of the story won't get us an awesome like count

Read more...

1.2K

4 responses

Really?

Response time in man-computer conversational transactions

by ROBERT B. MILLER

International Business Machines Corporation
Poughkeepsie, New York

Fall Joint Computer Conference, 1968

INTRODUCTION AND MAJOR CONCEPTS

The literature concerning man-computer transactions abounds in controversy about the limits of "system response time" to a user's command or inquiry at a terminal. Two major semantic issues prohibit resolving this controversy. One issue centers around the question of "Response time to what?" The implication is that different human purposes and actions will have different acceptable or useful response times.

This paper attempts a rather ex
and definition of different classes
and purpose at terminals of variou
be shown that "two-second respon
versal requirement.

The second semantic question is
or requirement?" In the present discussion, the reader is asked to accept the following definition: "A need or requirement is some demonstrably better alternative in a set of competing known alternatives that enable a human purpose or action to be implemented." This definition intentionally

Operating needs and psychological needs

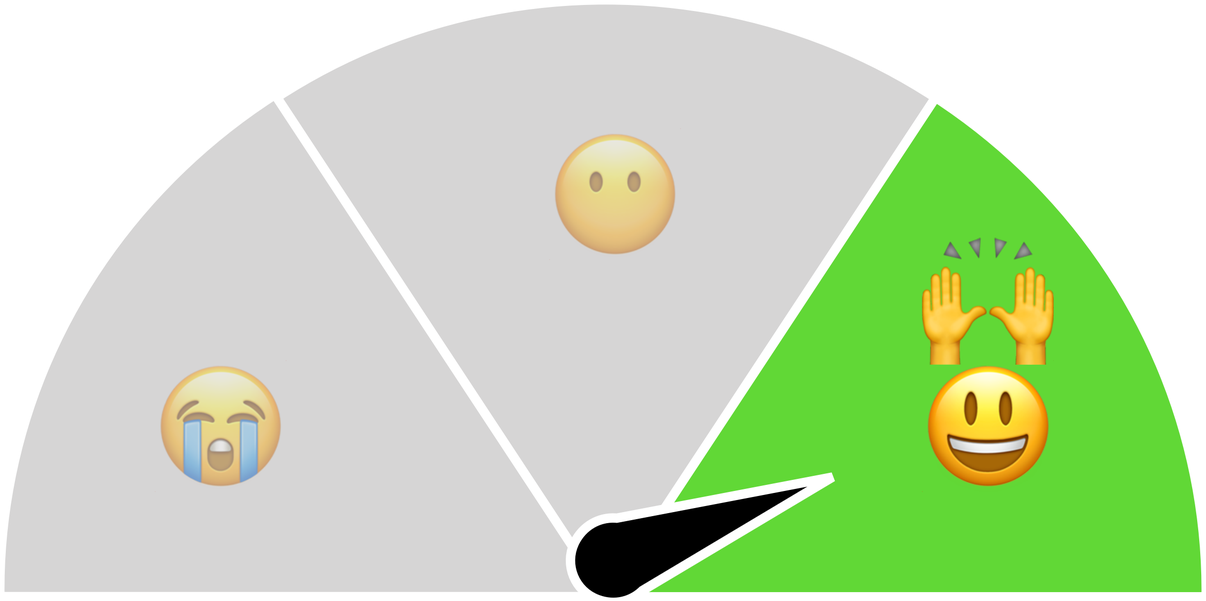
An example of an operating need is that unless a given airplane's velocity exceeds its stall speed, the airplane will fall to earth. Velocity above stall speed is an undebatable operating need. In a superficially different context, it is a "fact" (let's assume we know the numbers) that when airline customers make reservations over a telephone, any delays in completing transactions above five min-

> That is why the tasks which humans can and will perform with machine communications will seriously change their character if response delays are greater than two seconds, with some possible

into the problems of operating needs except to mention when they may be more significant than a psychological need. The following topics address psychological needs.

Response to expectancies

What we wanted



The right architecture and right technical solutions alone won't make you fast


📦🚀 Blazing fast, simple and co
Blazing fast and accurate glob
A blazing fast js bundle
📦🚀 Blazing fast, zero config
🌊 Blazing fast 1kb search library
🚀⚡ Blazing fast blog
A blazing fast library for viewin
A blazing fast React alterna
🌱 A blazing-fast Single Pag
[DEPRECATED] Blazing fast tile base

Performance comes from measuring and improving and iterating

HOW CAN WE BE FAST?

Learning what to measure

Lighthouse performance

Performance

Metrics

First Contentful Paint	2.2 s	First Meaningful Paint	2.2 s
Speed Index	2.4 s	First CPU Idle	8.8 s
Time to Interactive	10.5 s	Max Potential First Input Delay	1,320 ms

Standard point-in-time metrics

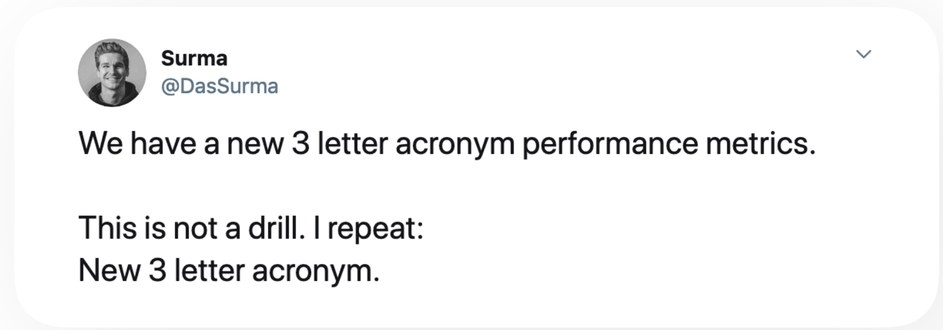
First Byte

FCP — First Contentful Paint
Any DOM paint

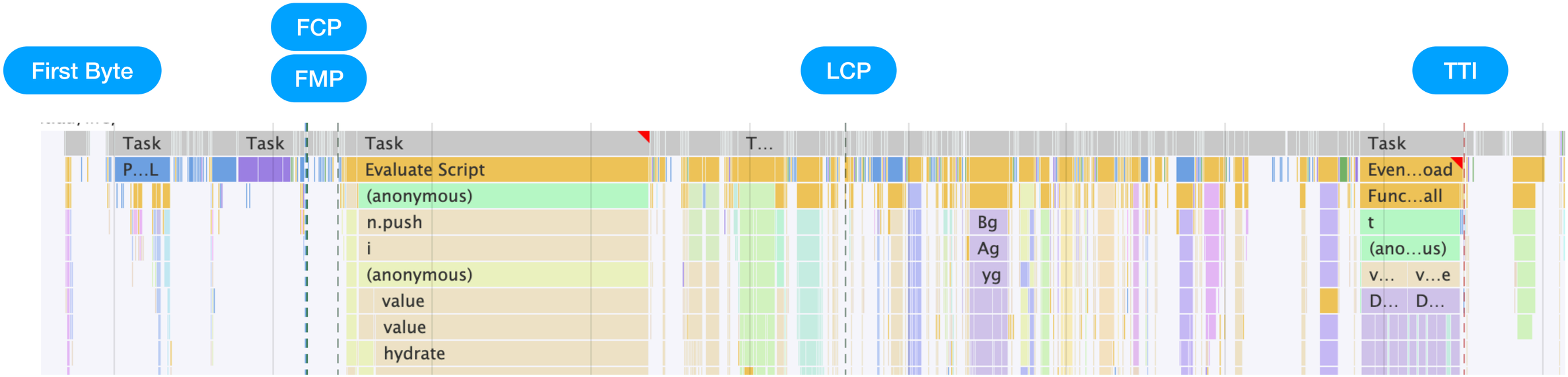
FMP — First Meaningful Paint
User defined hero element

LCP — Largest Contentful Paint
Largest node was rendered

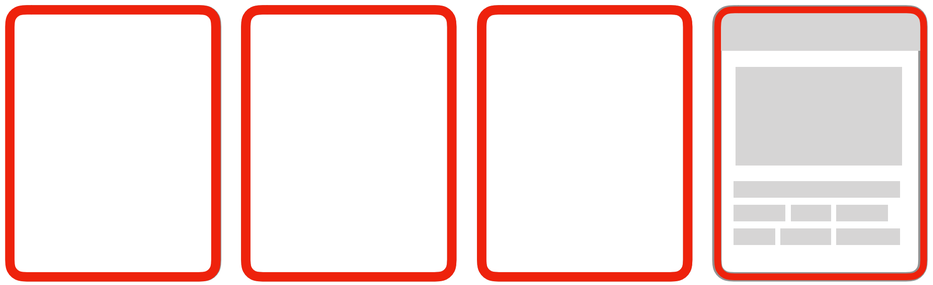
TTI — Time to Interactive
Large JS chunks have finished

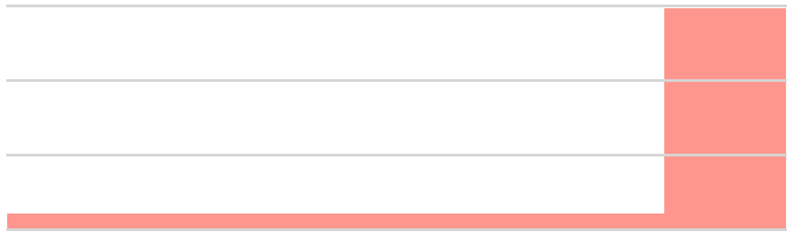


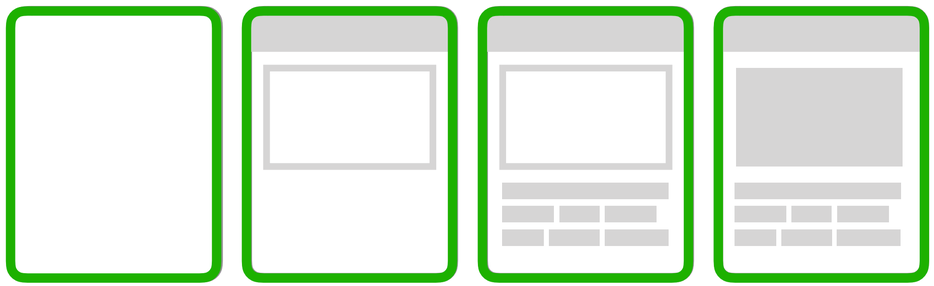
Standard point-in-time metrics

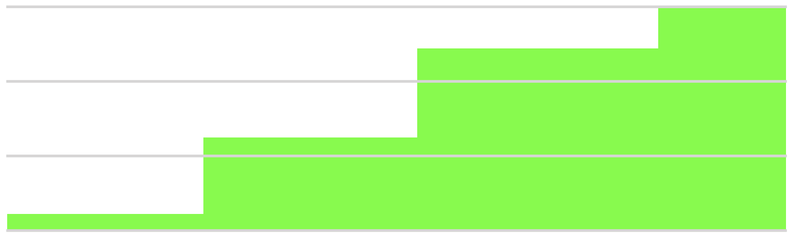


Speed index score

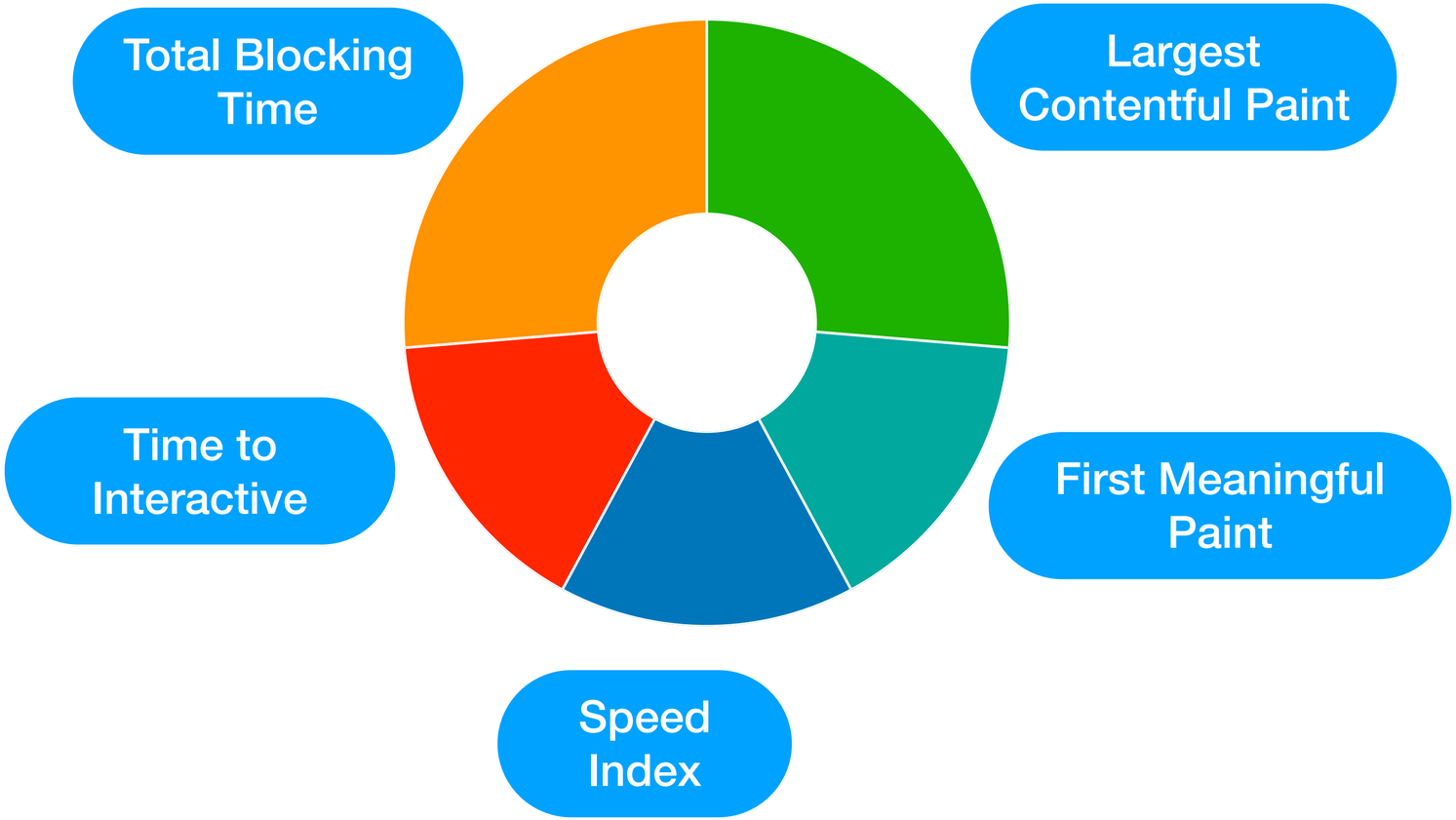






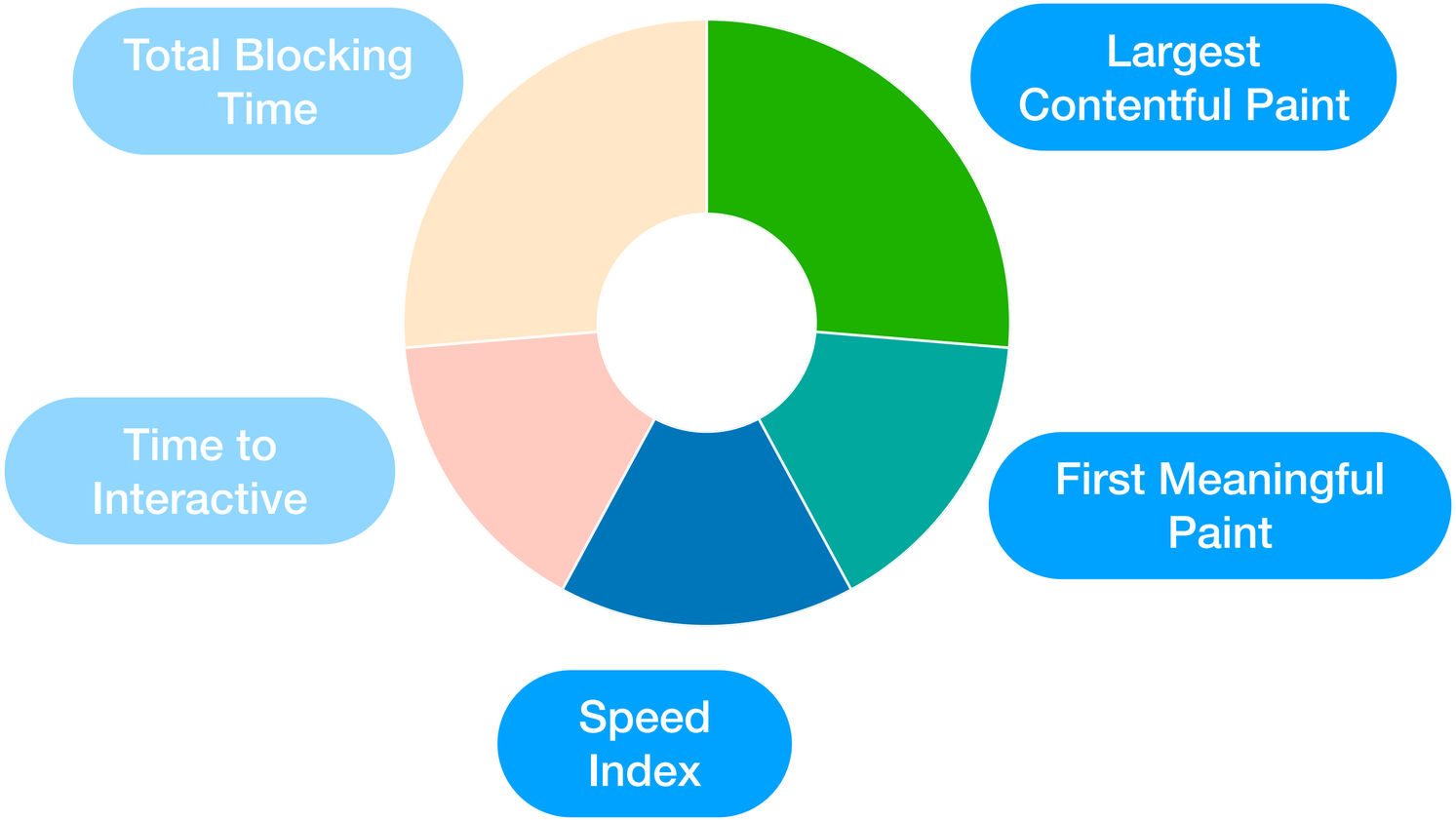


Lighthouse performance



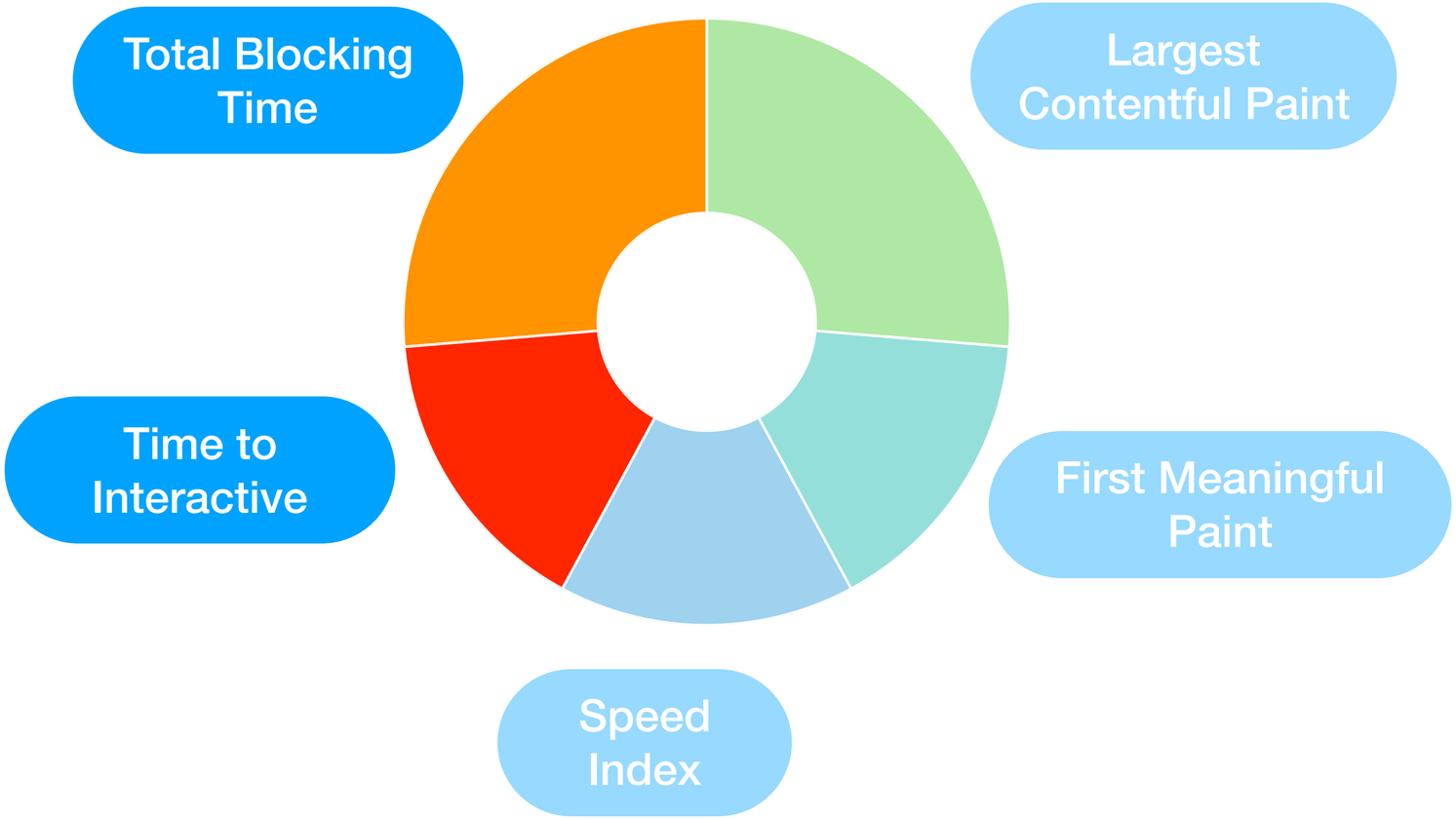
https://web.dev/performance-scoring/

Lighthouse performance



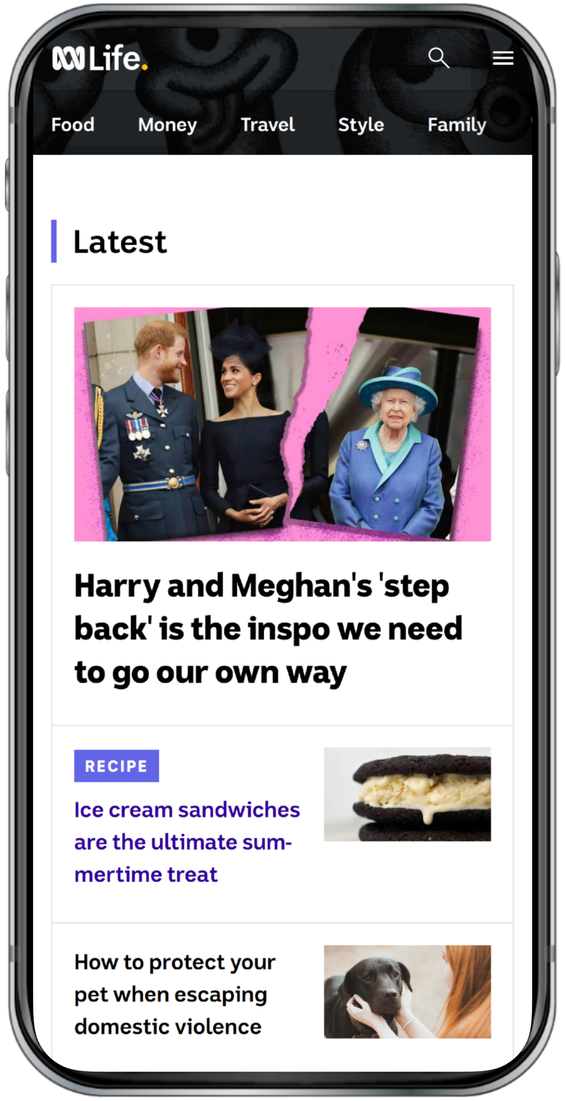
https://web.dev/performance-scoring/

Lighthouse performance



https://web.dev/performance-scoring/

Choose metrics that
fit your needs


ABC Life.
Food
Money
Travel
Style
Family
Latest
Harry and Meghan's 'step back' is the inspo we need to go our own way
RECIPE
Ice cream sandwiches are the ultimate sum-mertime treat
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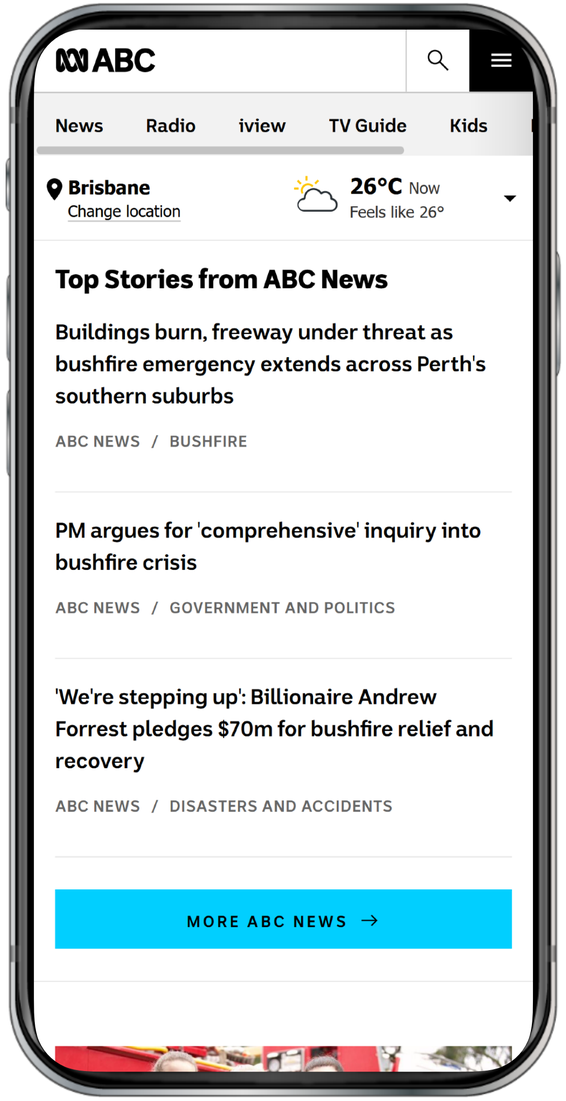
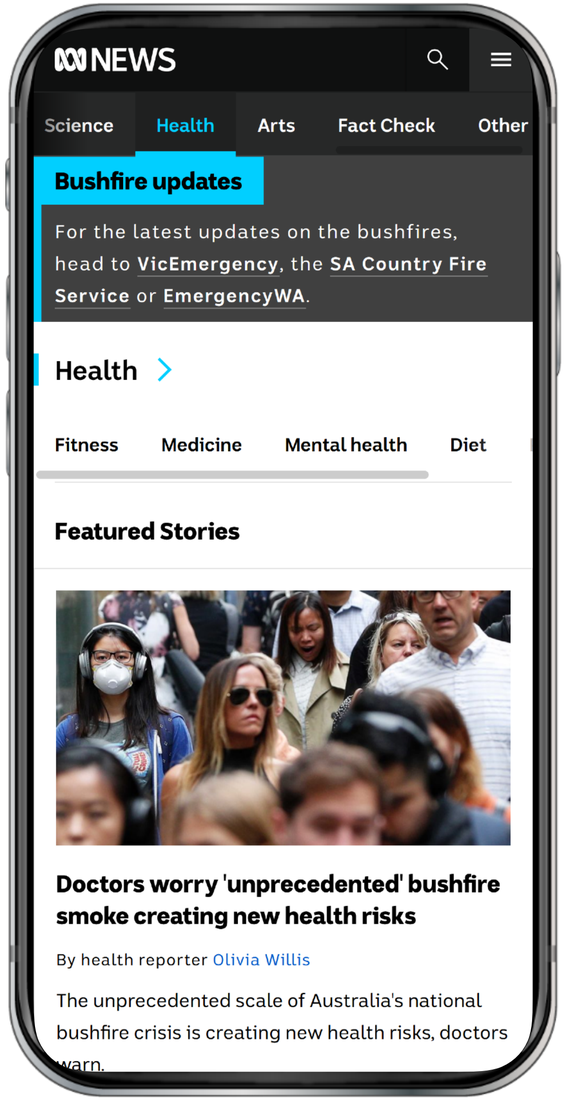

ABC
News
Radio
iview
TV Guide
Kids
Brisbane
Change location
26°C Now
Feels like 26°
Top Stories from ABC News
Buildings burn, freeway under threat as bushfire emergency extends across Perth's southern suburbs
ABC NEWS / BUSHFIRE
PM argues for 'comprehensive' inquiry into bushfire crisis
ABC NEWS / GOVERNMENT AND POLITICS
'We're stepping up': Billionaire Andrew Forrest pledges $70m for bushfire relief and recovery
ABC NEWS / DISASTERS AND ACCIDENTS
MORE ABC NEWS →


ABC NEWS
Science
Health
Arts
Fact Check
Other
Bushfire updates
For the latest updates on the bushfires, head to VicEmergency, the SA Country Fire Service or EmergencyWA.
Health
Fitness
Medicine
Mental health
Diet
Featured Stories
Doctors worry 'unprecedented' bushfire smoke creating new health risks
By health reporter Olivia Willis
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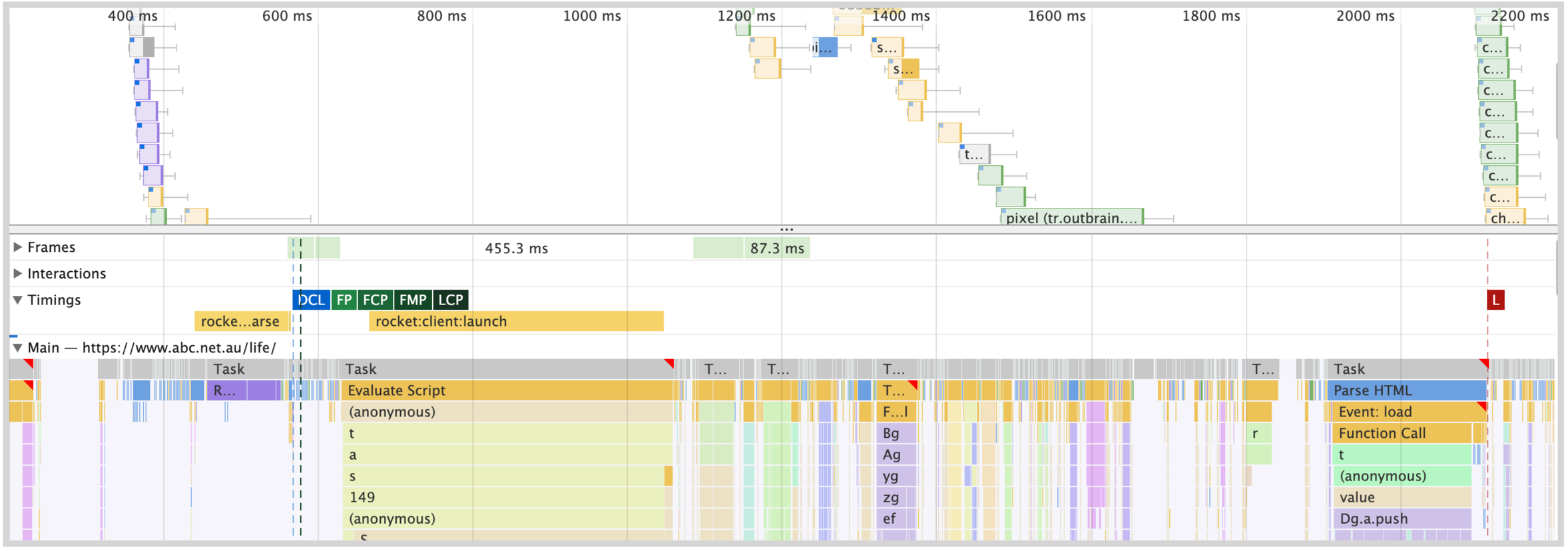


Not React (mostly) | **React** | **Not React** (mostly)

Our page load model

Phase 1

Styling complete

Layout complete

Images visible

Not interactive

Phase 2

Phase 3

Our page load model

Phase 1

Styling complete

Layout complete

Images visible

Not interactive

Phase 2

React hydration

Page is interactive

Phase 3

Our page load model

Phase 1

Styling complete

Layout complete

Images visible

Not interactive

Phase 2

React hydration

Page is interactive

Phase 3

Non-critical JS

Analytics

Ads

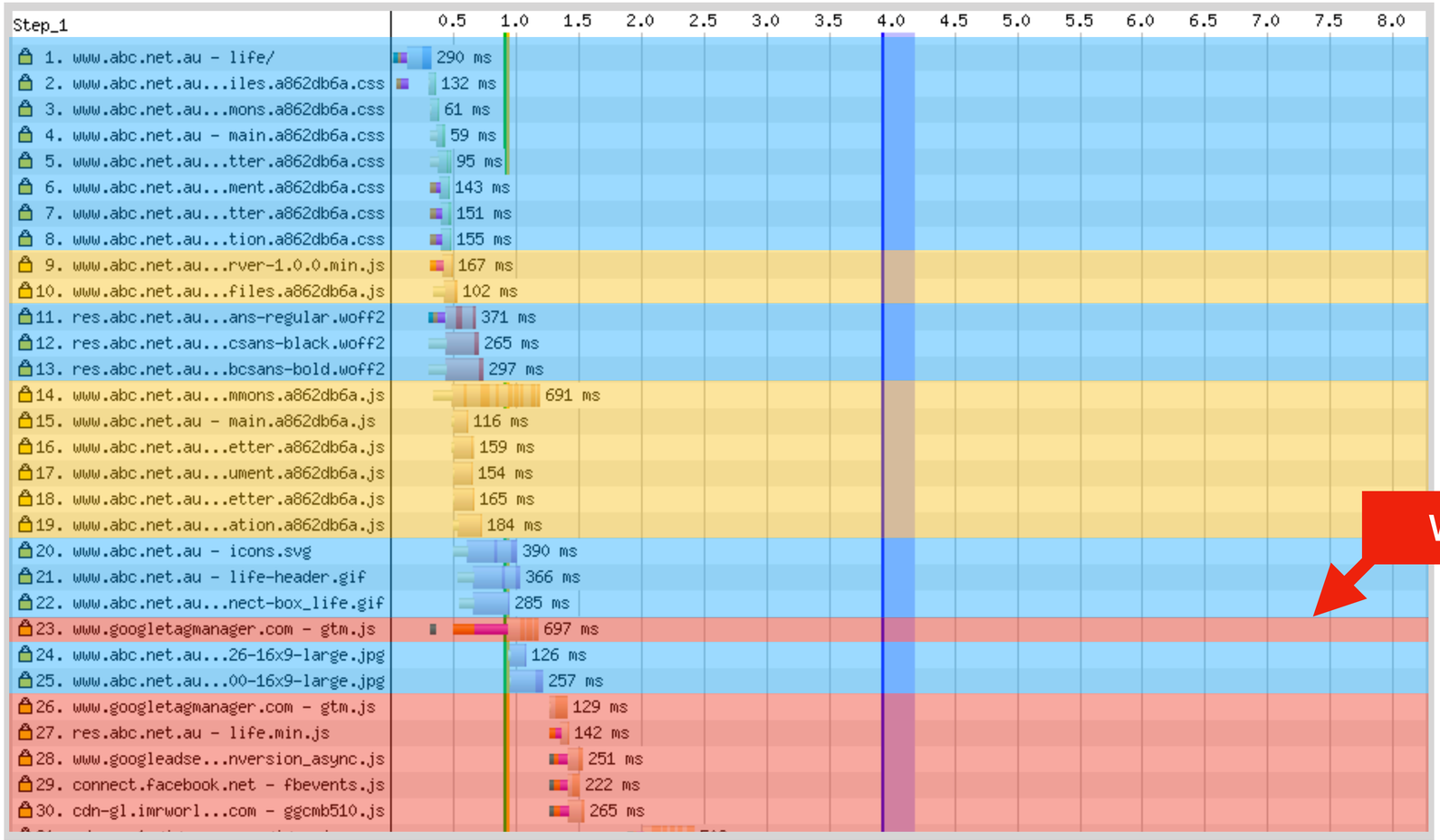
Understanding what's happening

Understanding what's happening

Phase 1

Phase 2

Phase 3



Whoops!


Lighthouse
Score

MEASURE AND IMPROVE

Improving performance

Phase 1

Styling complete

Layout complete

Images visible

Not interactive

Phase 2

React hydration

Page is interactive

Phase 3

Non-critical JS

Analytics

Ads

Fix our cache headers

Font swapping

Font swapping

First Meaningful Paint

4.0 sec → 2.2 sec

Lighthouse with synthetic network and CPU throttling.

Preloading resources

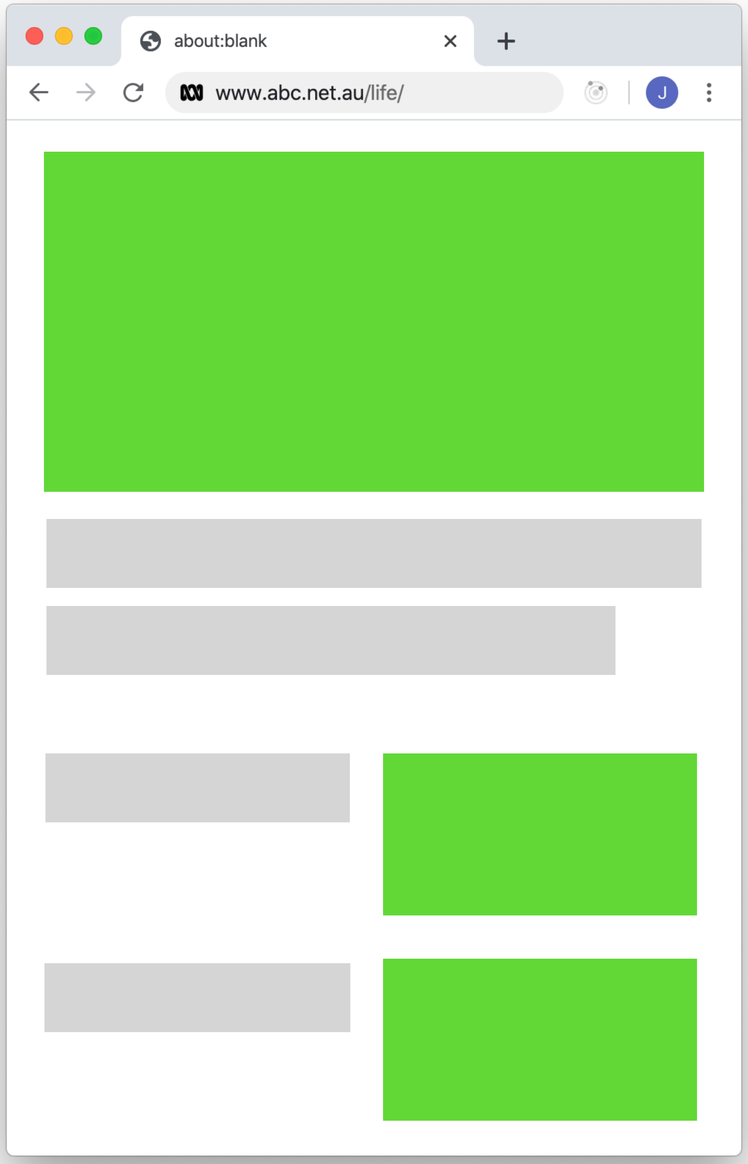
Preloading resources

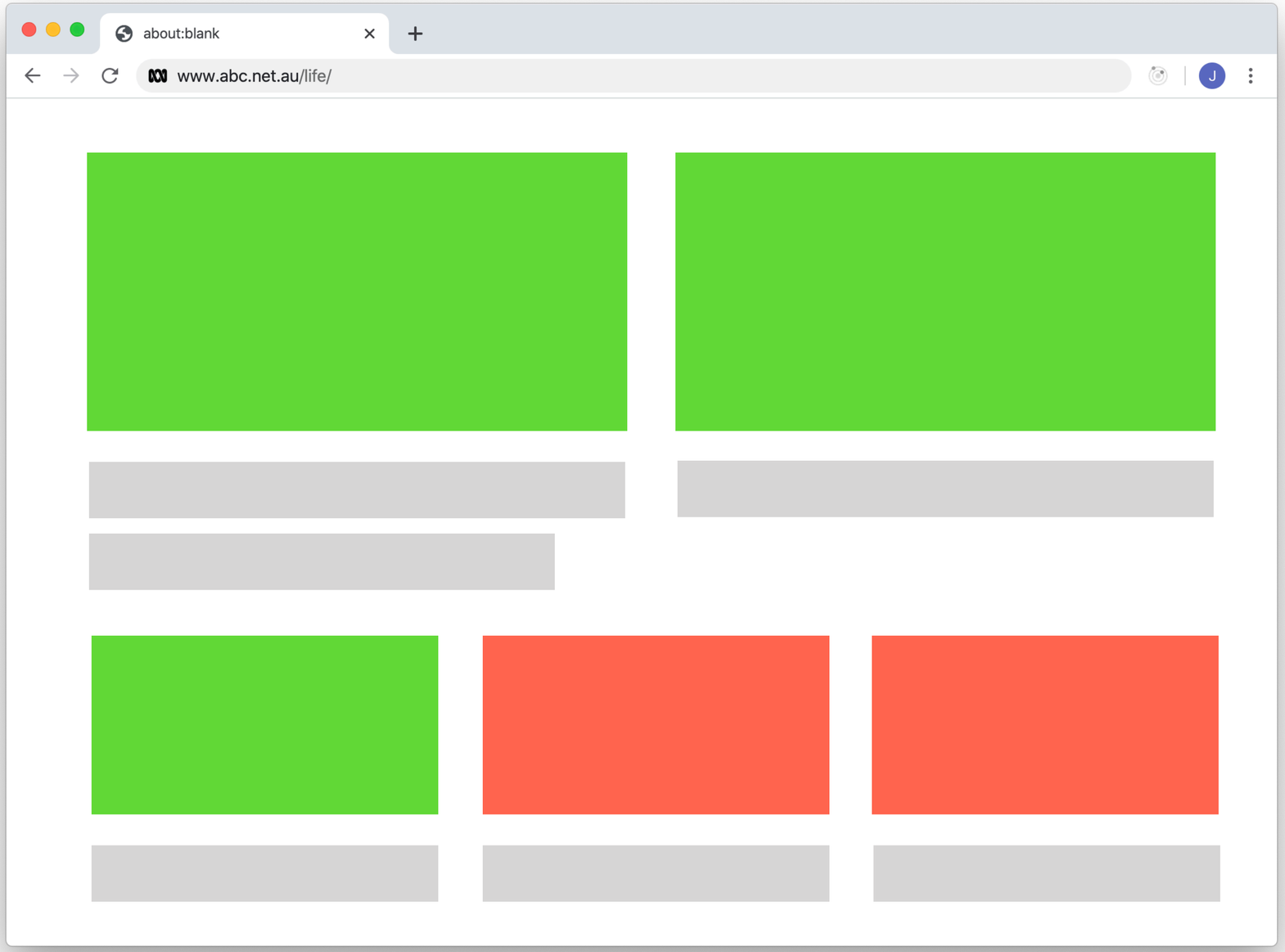
```
<link rel="preload" href="/abc-regular.woff2" as="font" type="font/woff2" />
<link rel="preload" href="/abc-bold.woff2" as="font" type="font/woff2" />
<link rel="preload" href=“/abc-black.woff2" as="font" type="font/woff2" />
```

Lazy loading images

Intersection observer

```
function Image(props) {
    const ref = React.createRef();
    const visible = useIntersectionObserver(ref);

    return (
      <img
        ref={ref}
        src={visible ? props.src : undefined}
      />
    );
}
```

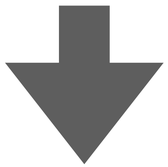

about:blank
www.abc.net.au/life/
J


about:blank
www.abc.net.au/life/
J

Bootstrapping images

```
<script data-react-helmet="true" type="text/javascript" nonce src="/core/assets/abc-
polyfill-observer-1.0.0.min.js"></script>
▼<script data-react-helmet="true" type="text/javascript">
  !function(){var t;t=function(){for(var t=document.querySelectorAll("img"),e=
  [],n=0;n<t.length;n++){var
  a=t[n],o=window.scrollY||window.pageYOffset||0;a.parentElement&&a.parentElement.getB
  oundingClientRect().top<window.innerHeight+o&&e.push(a)}for(n=0;n<e.length;n++)
  (a=e[n]).hasAttribute("data-nojs")&&a.removeAttribute("data-
  nojs");for(n=0;n<e.length;n++){var r=
  (a=e[n]).dataset.src,s=a.dataset.srcset,d=a.dataset.sizes;r&&(a.src=r),d&&s&&
  (a.srcset=s,a.sizes=d)}},"loading"!==document.readyState?
  t():document.addEventListener("DOMContentLoaded",t)}();
</script>
```

First Image



44%

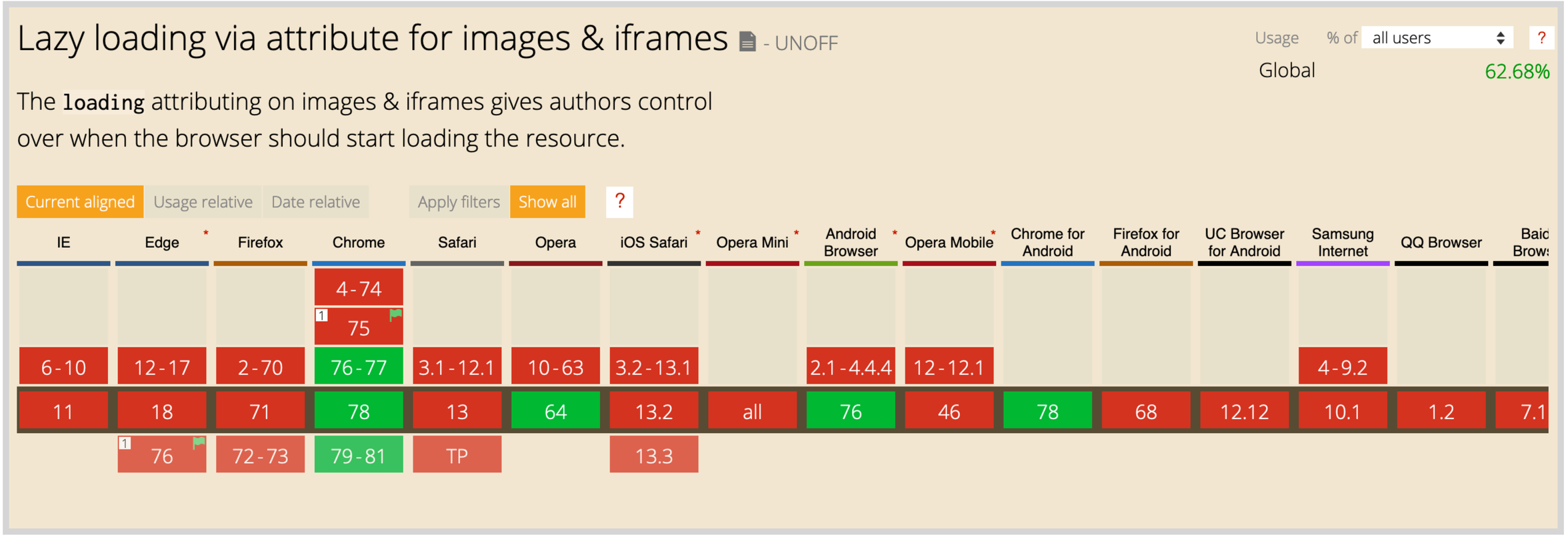
7.8 sec → 4.3 sec

Lighthouse with simulated 4x CPU slowdown and 3G network

Native support…?

```
<img src="image.jpg" loading="lazy" alt="..." />
```

Native support…?



Phase 1

Styling complete

Layout complete

Images visible

Not interactive

Phase 2

React hydration

Page is interactive

Phase 3

Non-critical JS

Analytics

Ads

No module hack for polyfills

```
<script src="/polyfill.min.js" nomodule></script>
```

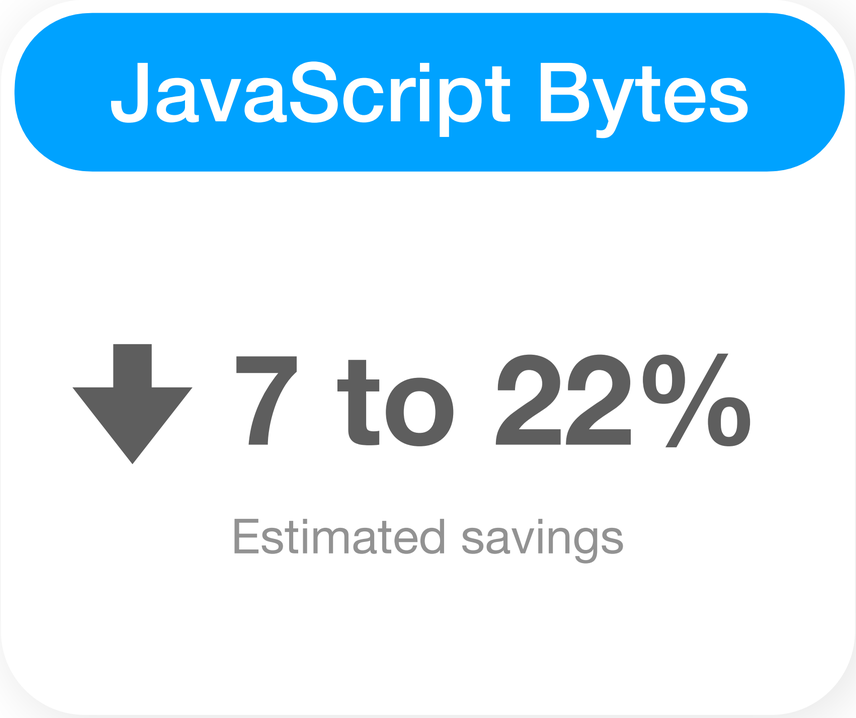
No module hack

First Contentful Paint

1.8s → 1.4s
-20kb gzipped

Lighthouse with 4x CPU slowdown

Avoid transpiling for modern browsers



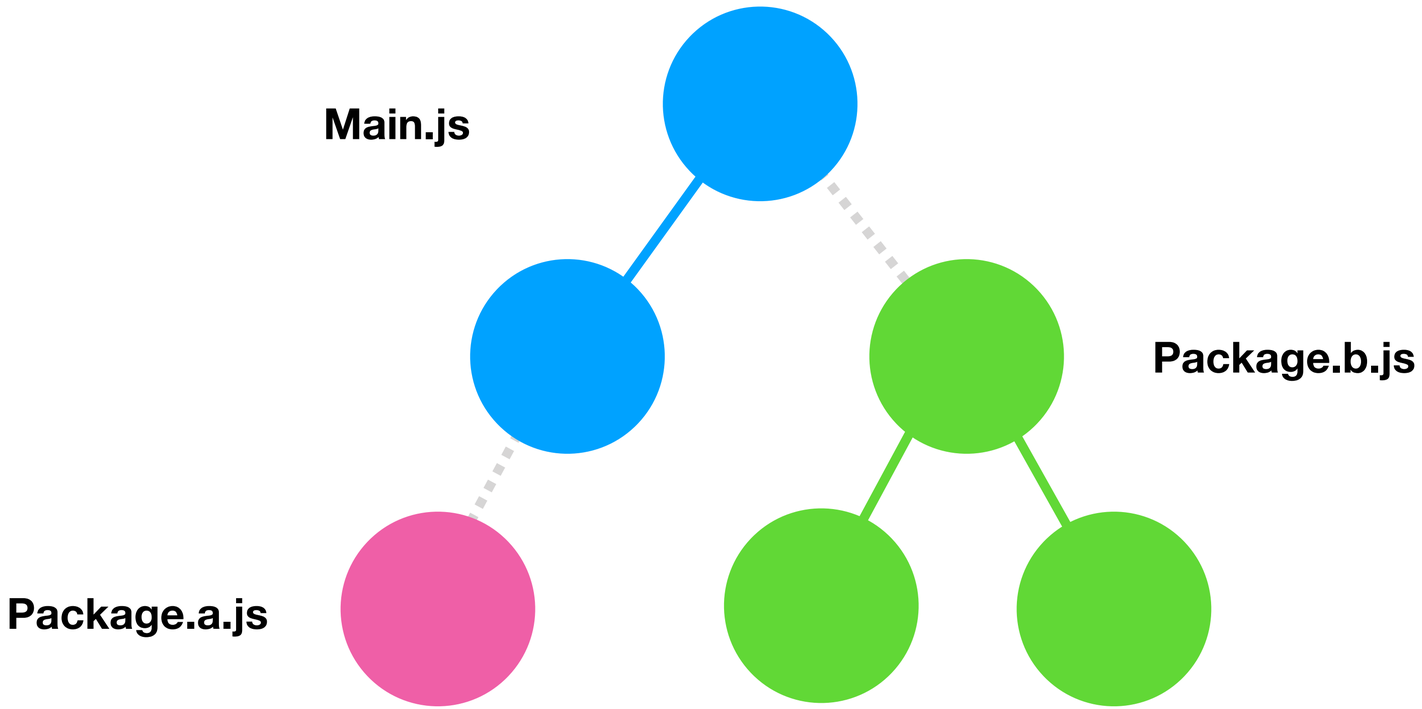
Advancing the web framework ecosystem (Chrome Dev Summit 2019)
https://www.youtube.com/watch?v=QDljY2I1Pfw

Dynamic imports and bundle splitting

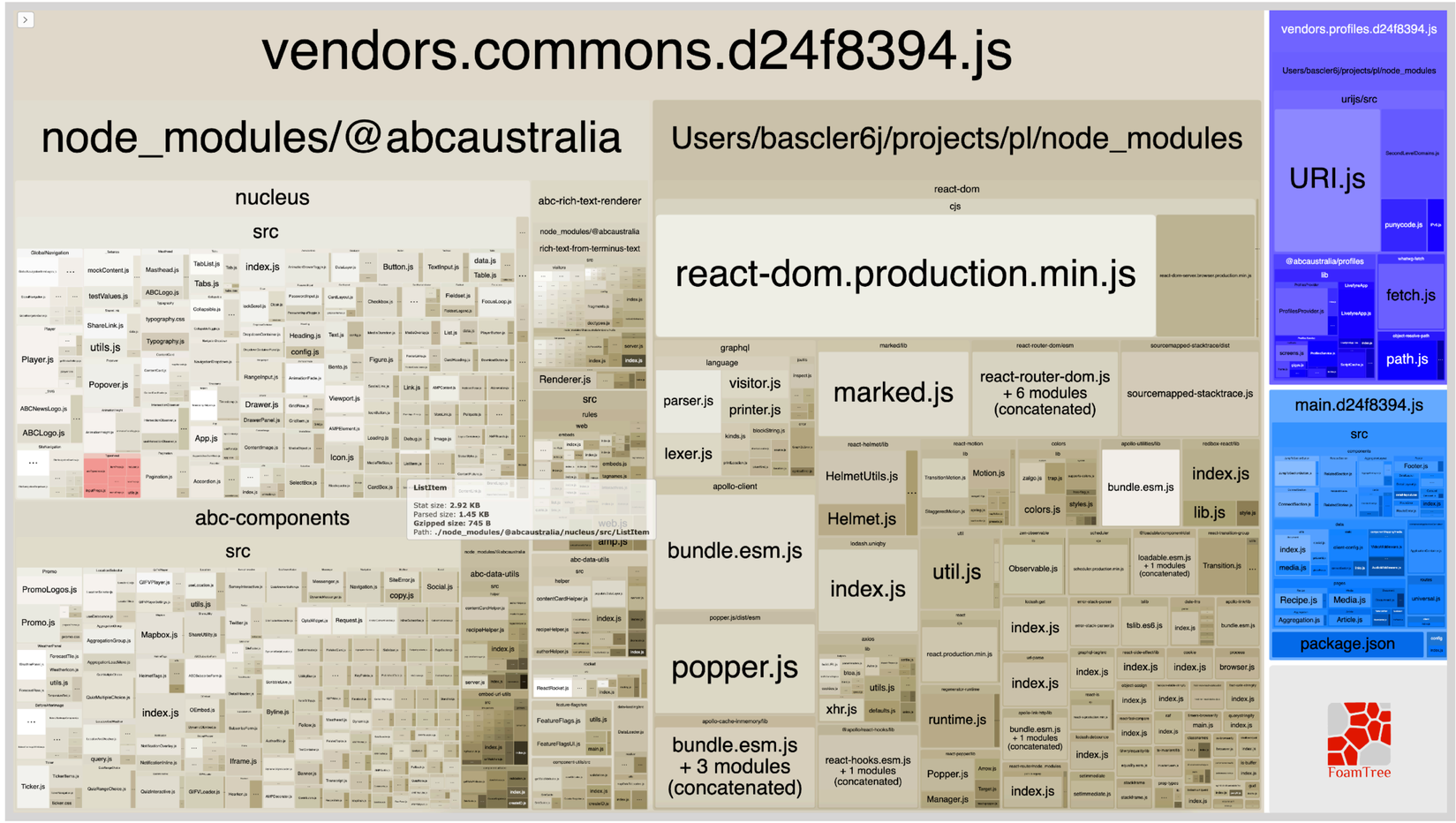
Dynamic imports

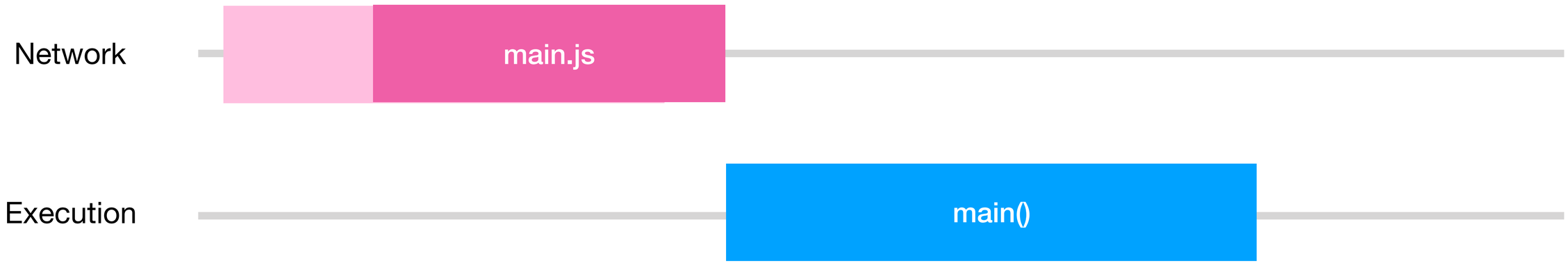
```
// Before
import sum from './sum';
console.log(sum(1, 2));

// After
import('./sum').then(sum => {
   console.log(sum(1, 2));
});
```

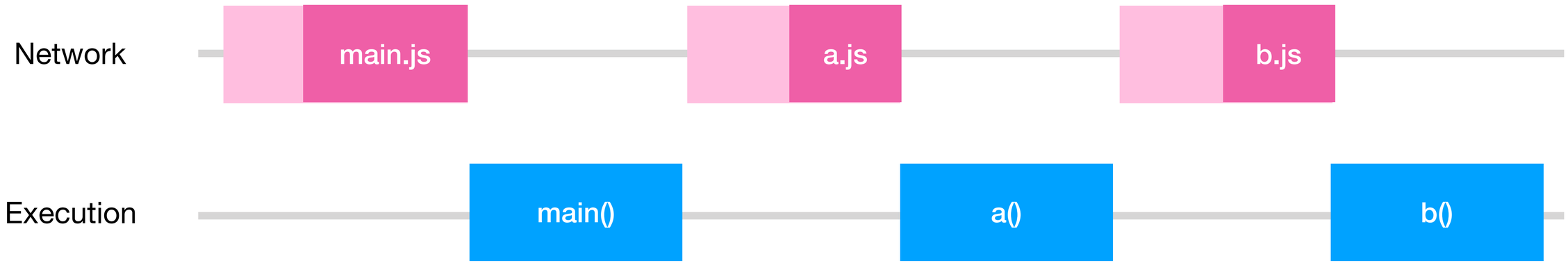
Dynamic imports

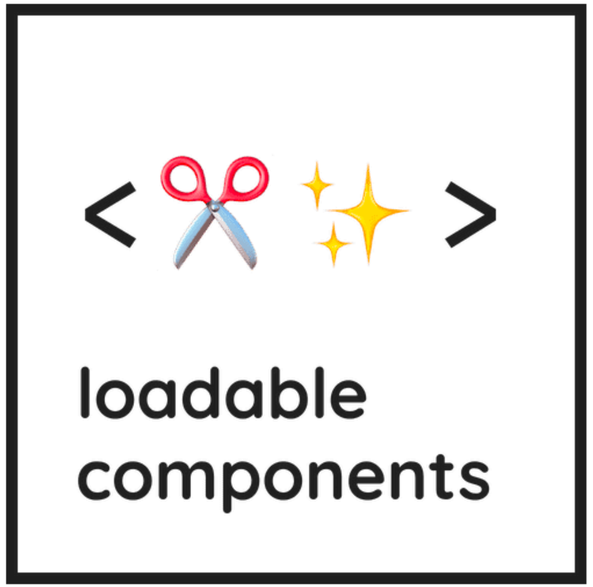


Webpack analyse



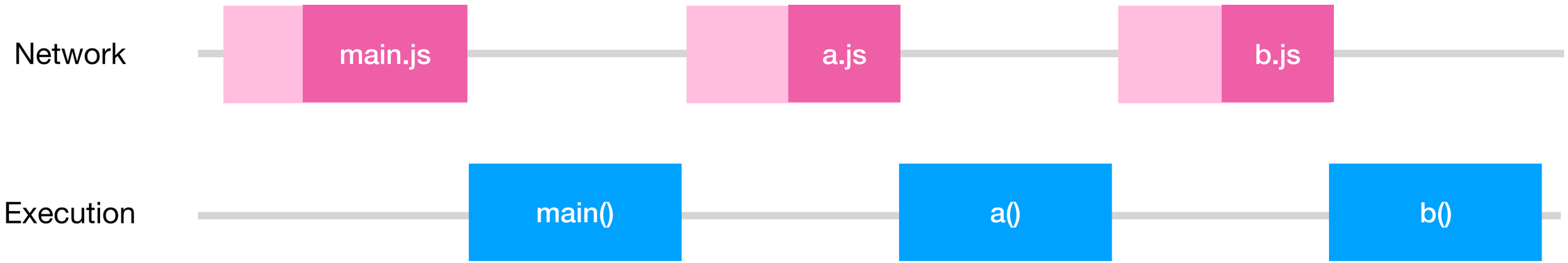

Network
main.js
Execution
main()

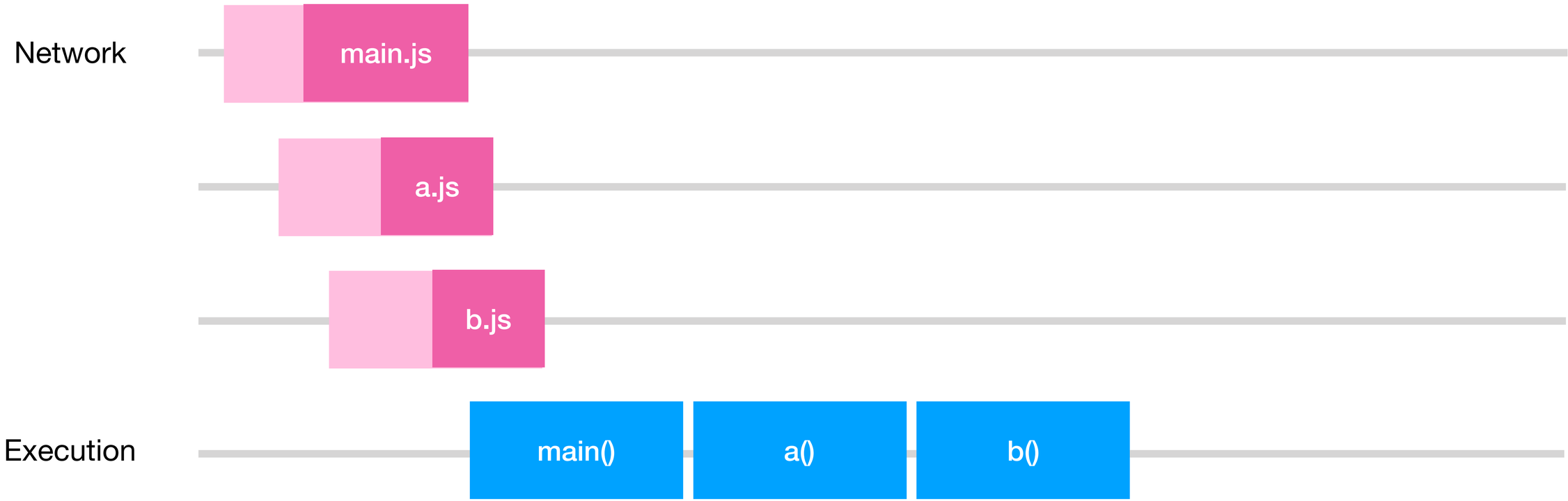

Network
main.js
a.js
b.js
Execution
main()
a()
b()



1. Make dynamic `import()` work on server render

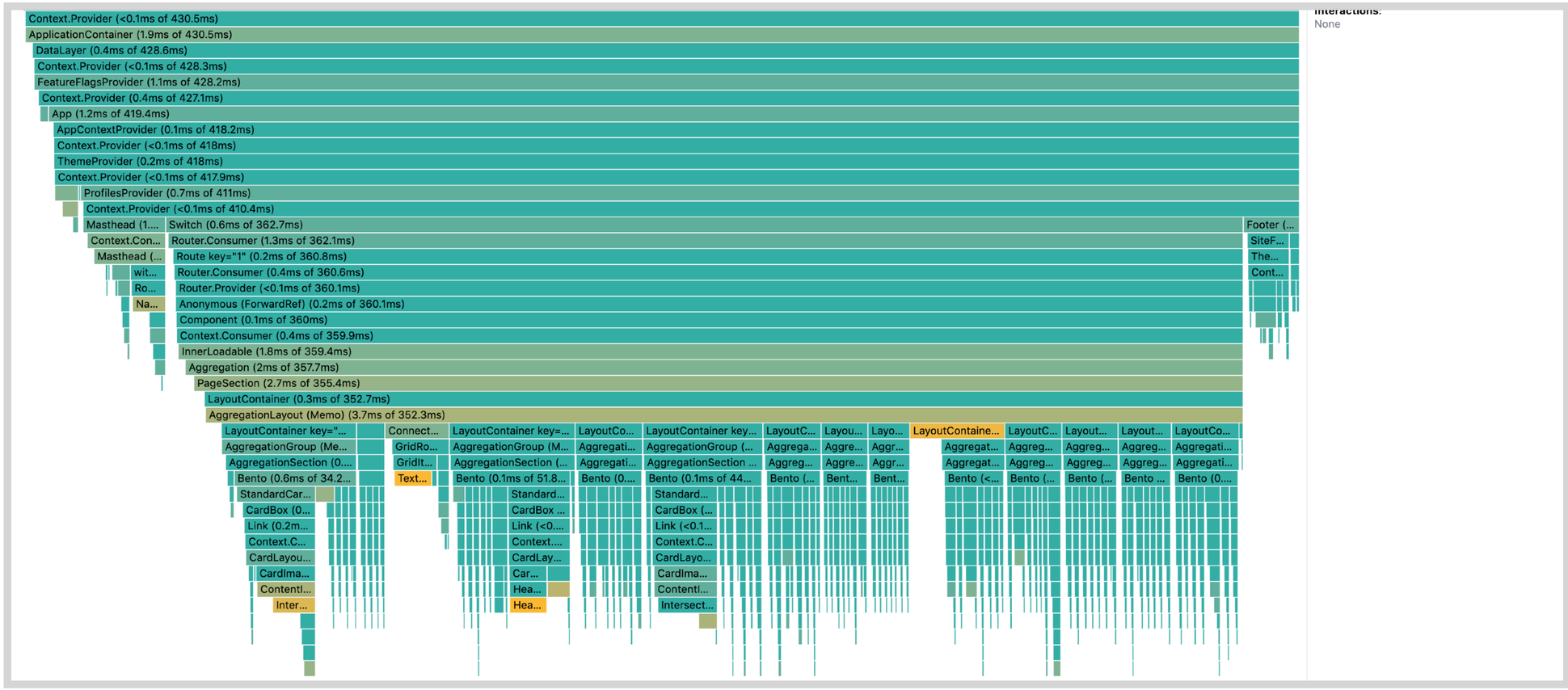
2. Generate a list of packages to preload on the client


Network
main.js
a.js
b.js
Execution
main()
a()
b()


Network
main.js
a.js
b.js
Execution
main()
a()
b()

React Profiling

React profiling



Phase 1

Styling complete

Layout complete

Images visible

Not interactive

Phase 2

React hydration

Page is interactive

Phase 3

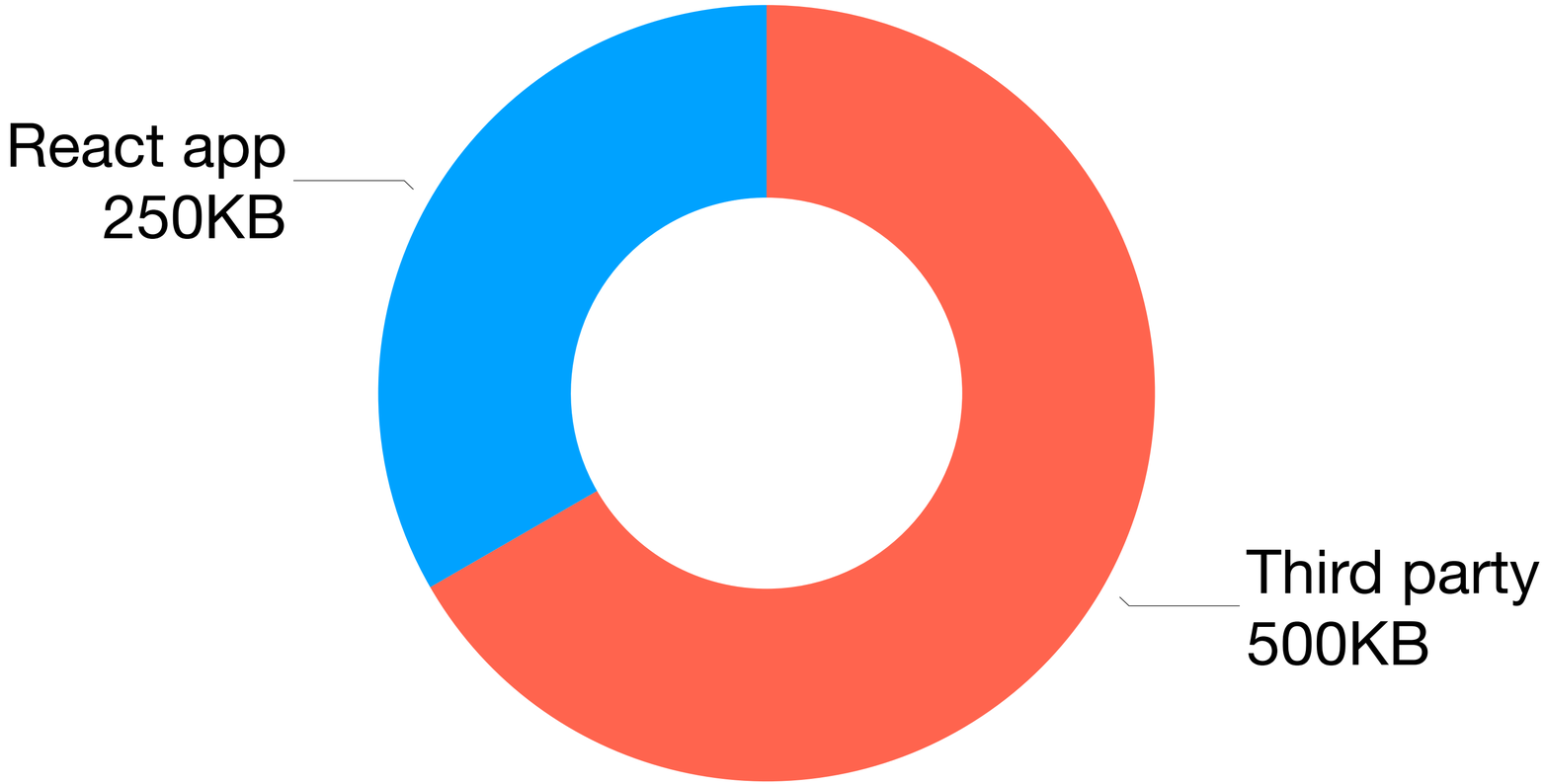
Non-critical JS

Analytics

Ads


Harry Roberts
@csswizardry
This is your website. This is your website on tag managers.
This is your website…
…this is your website on tag managers.

JS breakdown



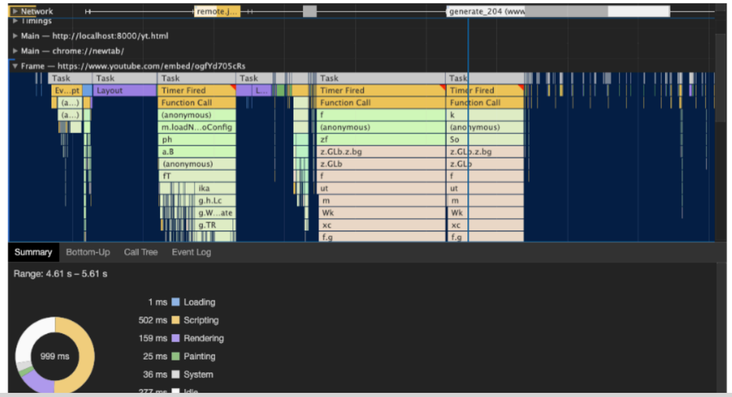
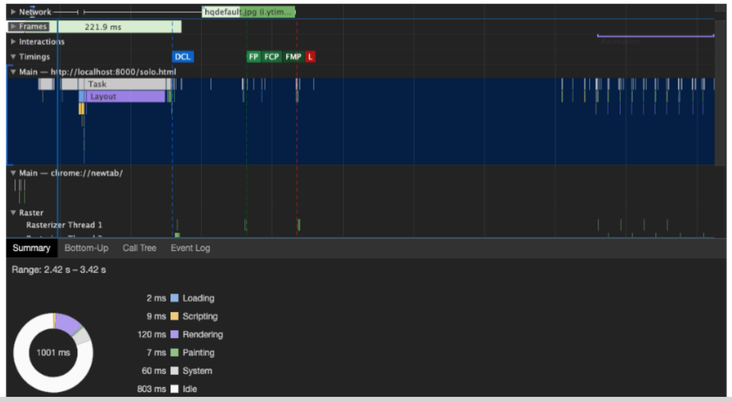
Lite YouTube Embed

Lite YouTube Embed

> Renders faster than a sneeze.

Provide videos with a supercharged focus on visual performance. This custom element renders just like the real thing but approximately 224X faster.

Comparison

Normal `<iframe>` YouTube embed	`lite-youtube`
	

Lighthouse third party report

Third-Party Usage — 9 Third-Parties Found

Third-party code can significantly impact load performance. Limit the number of redundant third-party providers and try to load third-party code after your page has primarily finished loading. Learn more.

Third-Party	Size	Main Thread Time
Google Tag Manager	72 KB	697 ms
Gigya	105 KB	467 ms
Google/Doubleclick Ads	13 KB	540 ms
Nielsen NetRatings SiteCensus	82 KB	409 ms
Facebook	142 KB	181 ms
Chartbeat	32 KB	132 ms
Google Analytics	18 KB	112 ms

Scorecard

First Contentful Paint

⬇54%

MotoG4 4.3 sec → 2.0 sec

⬇30%

Desktop 0.56 sec → 0.39 sec

Lighthouse emulated MotoG4 on 3G, and Chrome without throttling

Scorecard

Visually Complete

⬇25%

MotoG4 16.7 sec → 12.6 sec

⬇32%

Desktop 1.7 sec → 1.2 sec

Lighthouse emulated MotoG4 on 3G, and Chrome without throttling

Scorecard

Parse and Compile

⬇37%

MotoG4 6.4 sec → 4.0 sec

⬇42%

Desktop 1.2 sec → 0.7 sec

Scorecard

Blocking Execution

⬇45%

MotoG4 4.9 sec → 2.7 sec

⬇55%

Desktop 0.79 sec → 0.36 sec

Lighthouse emulated MotoG4 on 3G, and Chrome without throttling

What did we learn?

Lighthouse audit is not a silver bullet

Opportunities — These suggestions can help your page load faster. They don't directly affect the Performance score.

Opportunity	Estimated Savings
Defer offscreen images	2.25 s
Eliminate render-blocking resources	1.11 s
Avoid multiple page redirects	0.78 s
Preconnect to required origins	0.31 s

Diagnostics — More information about the performance of your application. These numbers don't directly affect the Performance score.

- Serve static assets with an efficient cache policy — 93 resources found
- Avoid an excessive DOM size — 2,477 elements
- Minimize main-thread work — 5.6 s

Phase 1

Styling complete

Layout complete

Images visible

Not interactive

Phase 2

React hydration

Page is interactive

Phase 3

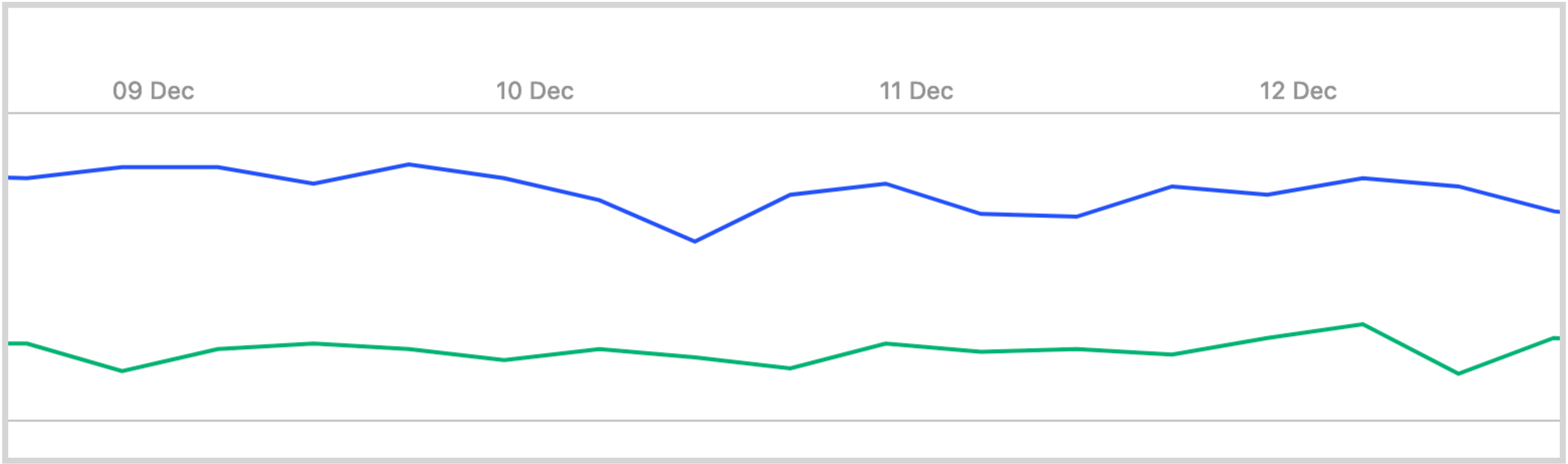
Non-critical JS

Analytics

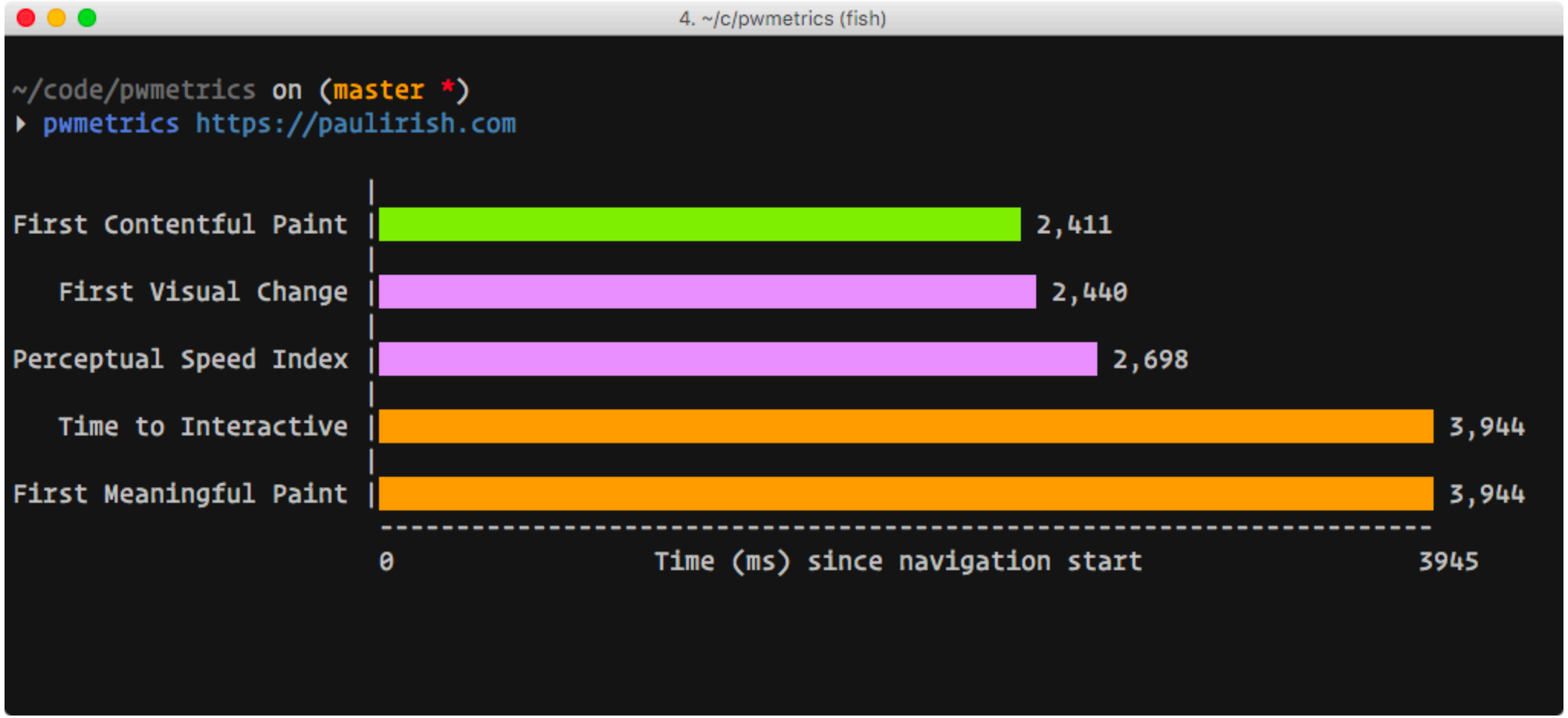
Ads

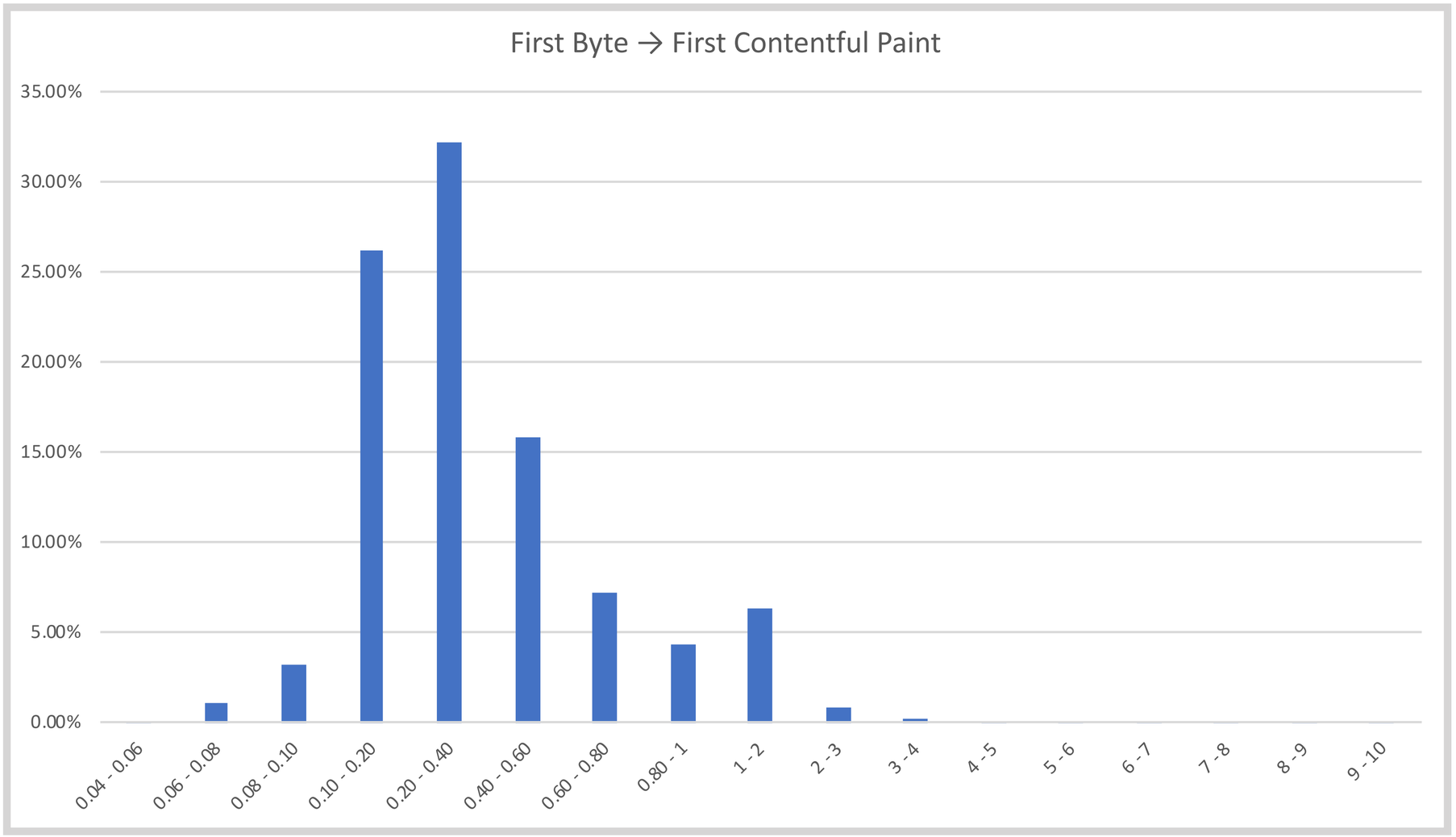
Measuring impact of changes is hard

Lighthouse is super noisy



PWMetrics


4. ~/c/pwmetrics (fish)
~/code/pwmetrics on (master *)
▸ pwmetrics https://paulirish.com
First Contentful Paint
2,411
First Visual Change
2,440
Perceptual Speed Index
2,698
Time to Interactive
3,944
First Meaningful Paint
3,944
0
Time (ms) since navigation start
3945


First Byte → First Contentful Paint
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
0.04 - 0.06
0.06 - 0.08
0.08 - 0.10
0.10 - 0.20
0.20 - 0.40
0.40 - 0.60
0.60 - 0.80
0.80 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10

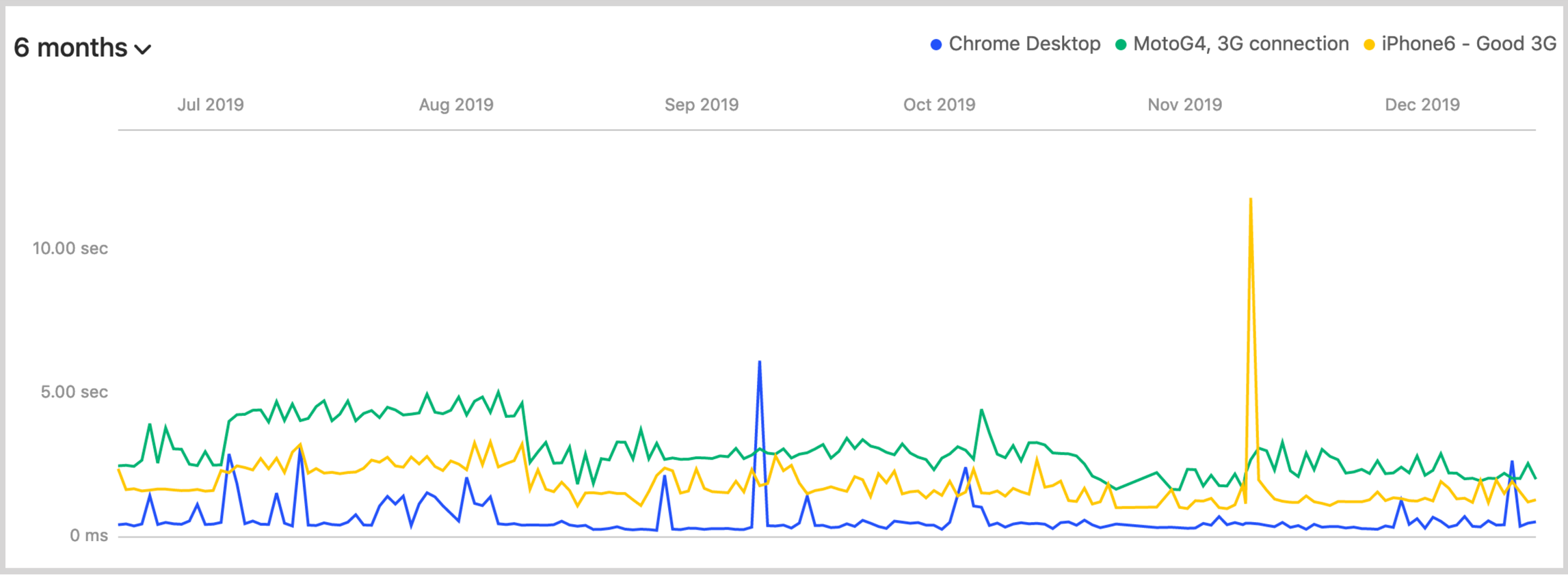
Performance API

```
// Introspection
performance.getEntriesByType("mark");
performance.getEntriesByType("resource");

entry.transferSize;
entry.startTime;
entry.duration;

// Reporting
performance.mark("render-start");
```

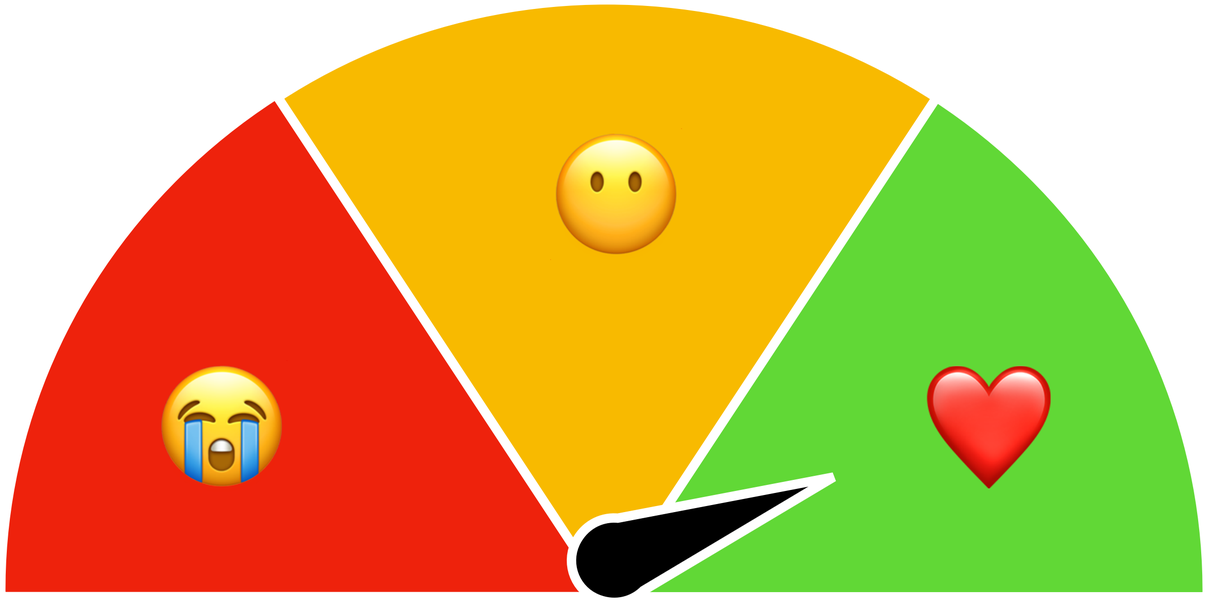
Record your wins and losses

I always forget this

Calibre


6 months
Chrome Desktop
MotoG4, 3G connection
iPhone6 - Good 3G
Jul 2019
Aug 2019
Sep 2019
Oct 2019
Nov 2019
Dec 2019
10.00 sec
5.00 sec
0 ms

React complements the platform



THE FIRST TWO SECONDS

FASTER PAGE LOADS FOR REACT

joshduck.com or @joshduck for slides.