



Rolldown: Chunking in the wild

Jacob Groß – @kurtextrem – 9th October 2025

<https://kurtextrem.de>

Who am I?

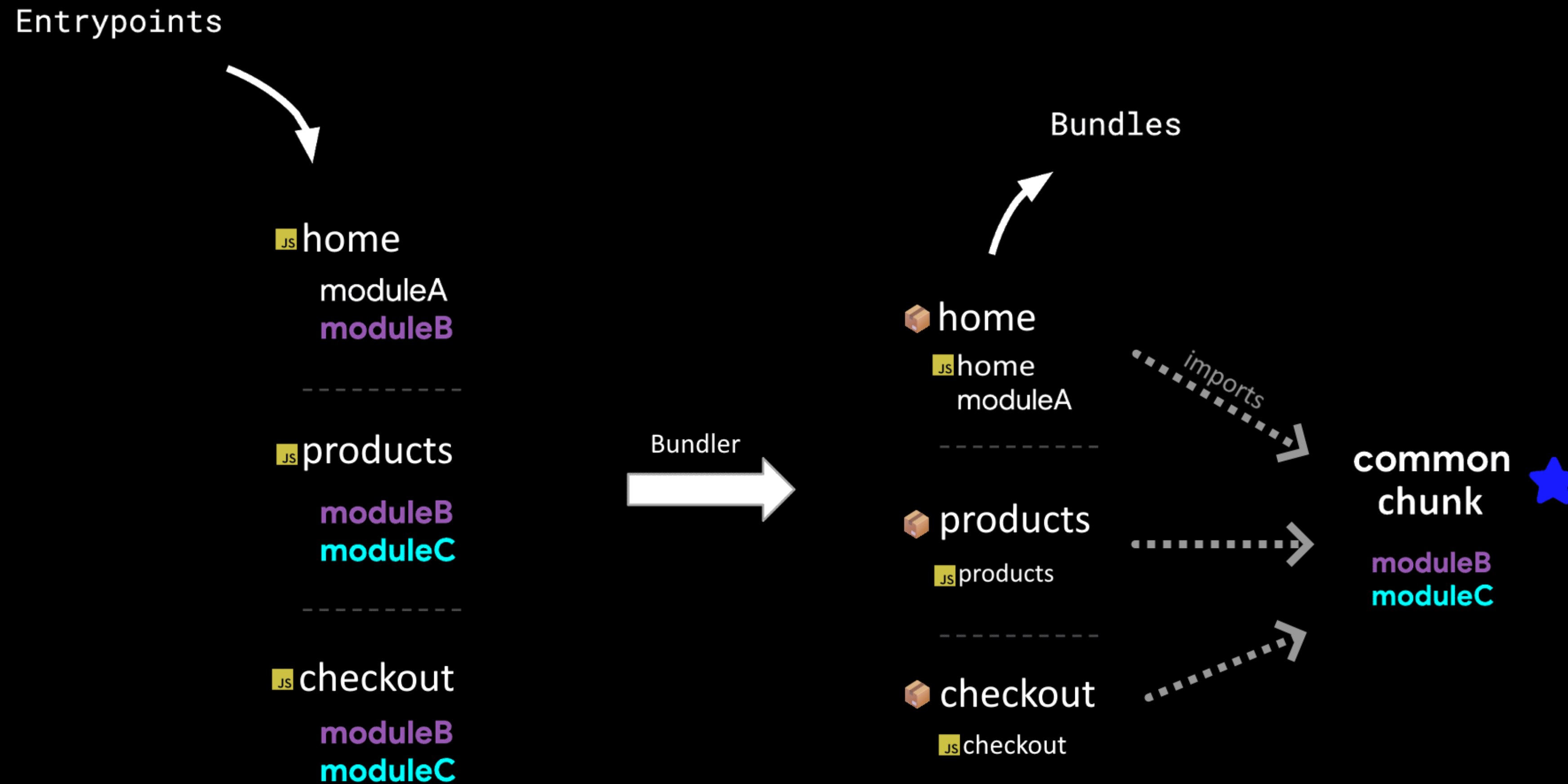
 Senior Performance Engineer @ Framer

 I work on Core Web Vitals & performance related topics

 Participant in the W3C WebPerf Working Group – come chat w/ me about perf topics :)

 **Framer** is a website builder and design tool, where you can design any website for any scale, setup complex animations, user interactions, ... and have it published in seconds.

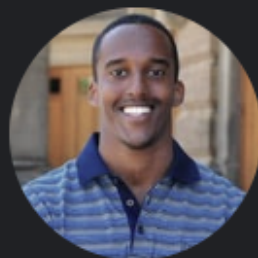
What are “chunks”?



How many chunks are optimal?

Improved Next.js and Gatsby page load performance with granular chunking

A newer webpack chunking strategy in Next.js and Gatsby minimizes duplicate code to improve page load performance.



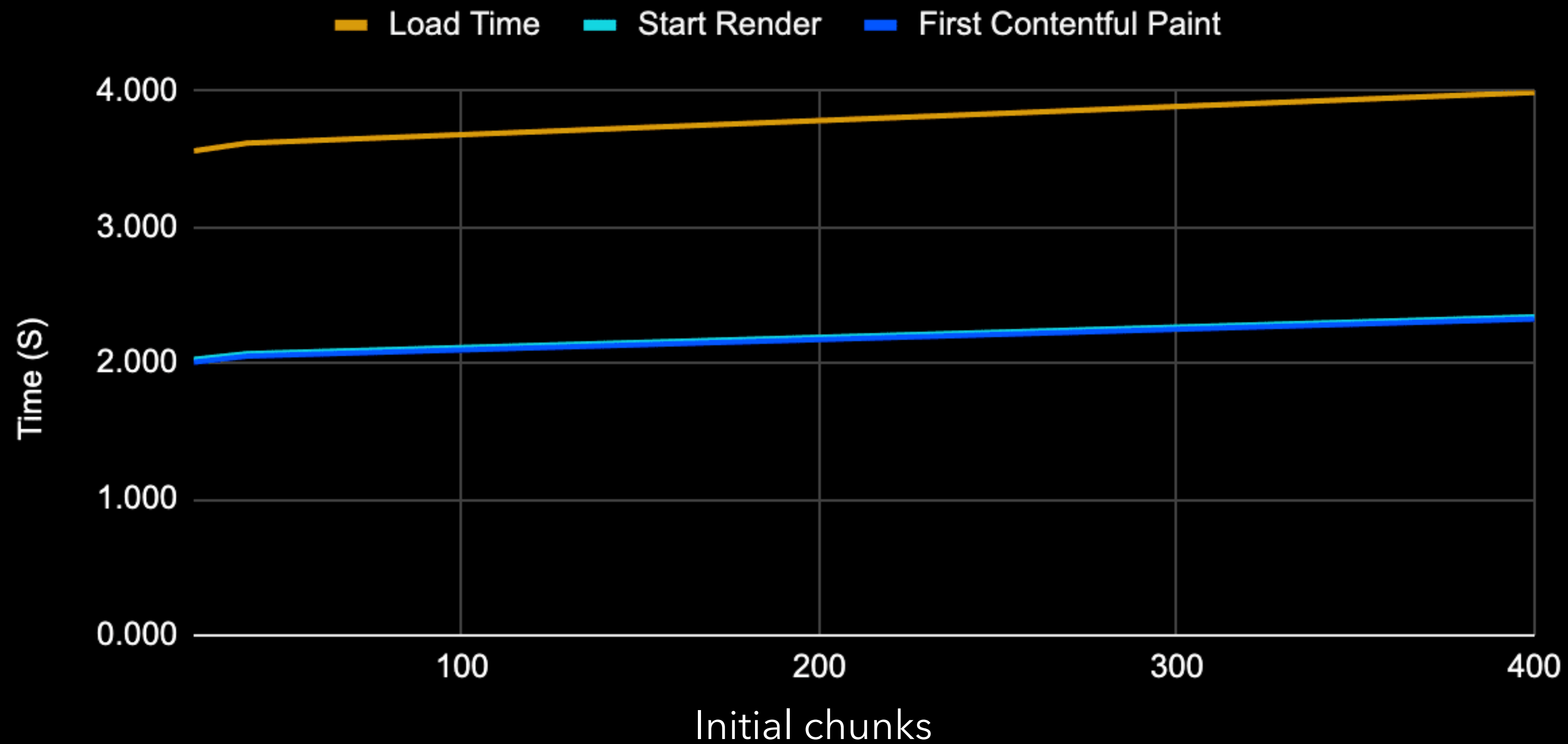
Houssein Djirdeh



Chrome is [collaborating](#) with tooling and frameworks in the JavaScript open-source ecosystem. A number of newer optimizations were recently added to improve the loading performance of [Next.js](#) and [Gatsby](#). This article covers an improved granular chunking strategy that is now shipped by default in both frameworks.

How many chunks are optimal?

Average of three runs on Zeit.co



20-25

“Initial chunks struck the right balance between loading performance and caching efficiency”

This talk isn't meant to bash on esbuild.

esbuild served us great. We were (one of?) the first users of esbuild in production.

It's stable & incredibly fast – Evan Wallace started the race of fast bundlers.

But: It lacks some options – a void for other bundlers to fill.

Too many small chunks

feat(splitting): support minChunkSize option #3302

Open

evanw:main

← ArrayZoneYour:feat/add_min_chunk_size_support



Conversation 6

Commits 1

Checks 0

Files changed 12



ArrayZoneYour on Aug 9, 2023

Contributor ...



fix [#2901](#), [#2419](#), related to [#207](#)

When there are many entry points, it is easy to generate some small chunks.

This MR try to land minChunkSize options to control the chunk size by source content size



31



DzmVasileusky (Dzmitry) on Aug 18

...



+1

We have [276 initial chunks and most of them are < 1kb unzipped.](#) This is crazy, server waiting time is growing with each next chunk from 100ms to 500-900ms for the last one.



Not so strict import order

Incorrect import order with code splitting and multiple entry points

Open



iamakulov (Ivan Akulov) opened on Sep 20, 2020 · edited by iamakulov

Edits



For the workaround, see [#399 \(comment\)](#).

Consider the following code:

```
// entry1.js
import './init-dep-1.js';
import './run-dep.js';

// entry2.js
import './init-dep-2.js';
import './run-dep.js';

// init-dep-1.js
global.foo = {
  log: () => console.log("foo.log() (from entry 1) called"),
};

// init-dep-2.js
global.foo = {
  log: () => console.log("foo.log() (from entry 2) called"),
};

// run-dep.js
global.foo.log();
```

When you bundle this code with `esbuild --bundle --outdir=build --format=esm --splitting --platform=node --out-extension:.js=.mjs ./entry1.js ./entry2.js`, ESBuild discovers that `run-dep.js` is a module shared between both entry points. Because code splitting is enabled, ESBuild moves it into a separate chunk:

```
// build/entry1.js
import './chunk.P2RPFHF3.js';

global.foo = {
  log: () => console.log("foo.log() (from entry 1) called")
};
```

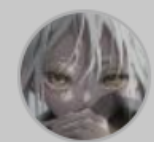
However, by doing so, ESBuild puts `run-dep.js` above the `init-dep-1.js` or `init-dep-2.js` code. This changes the import

Stale PRs

feat: reuse slots when minifying identifiers #2614

 Closed [evanw:main](#) ← [unbyte:feat/enclosed](#)  

 Conversation 6  Commits 1  Checks 0  Files changed 6



unbyte on Oct 17, 2022 · edited

Currently, esbuild cannot reuse slots from those symbols from the outer scope that are not used in the current scope.

This PR implements slots reusing and helps reduce the final size of our large project.

Artifact	Original size	Gzip size	
react v17.0.2 (Source)	72.13 · kB	19.40 · kB	
Minifier	Minified size	Minzipped size	Time
SWC	 -68% 22.89 · kB	 -58% 8.18 · kB	 22 · ms
terser	-68% 23.14 · kB	-57% 8.32 · kB	7x 153 · ms
esbuild-optimized	-67% 23.63 · kB	-56% 8.51 · kB	1x 22 · ms
esbuild	-67% 23.70 · kB	-56% 8.53 · kB	1x 22 · ms

Alipay *internally* forked esbuild

Fork it?

Unbundle everything?





Why bundle in 2025

Why bundle?

HTTP/2+ does not solve the need for bundling.

Effects of splitting one file into multiple ones:

Network overhead: ↑ roundtrips, ↓ compression, HTTP header overhead



Harry Roberts
@csswizardry



As a rule, RTT (α) stays constant while download time (x) is proportional to filesize. Therefore, splitting one large bundle into 16 smaller ones goes from $1\alpha + x$ to $16\alpha + 16(0.0625x)$. Expect things to probably get a little slower.



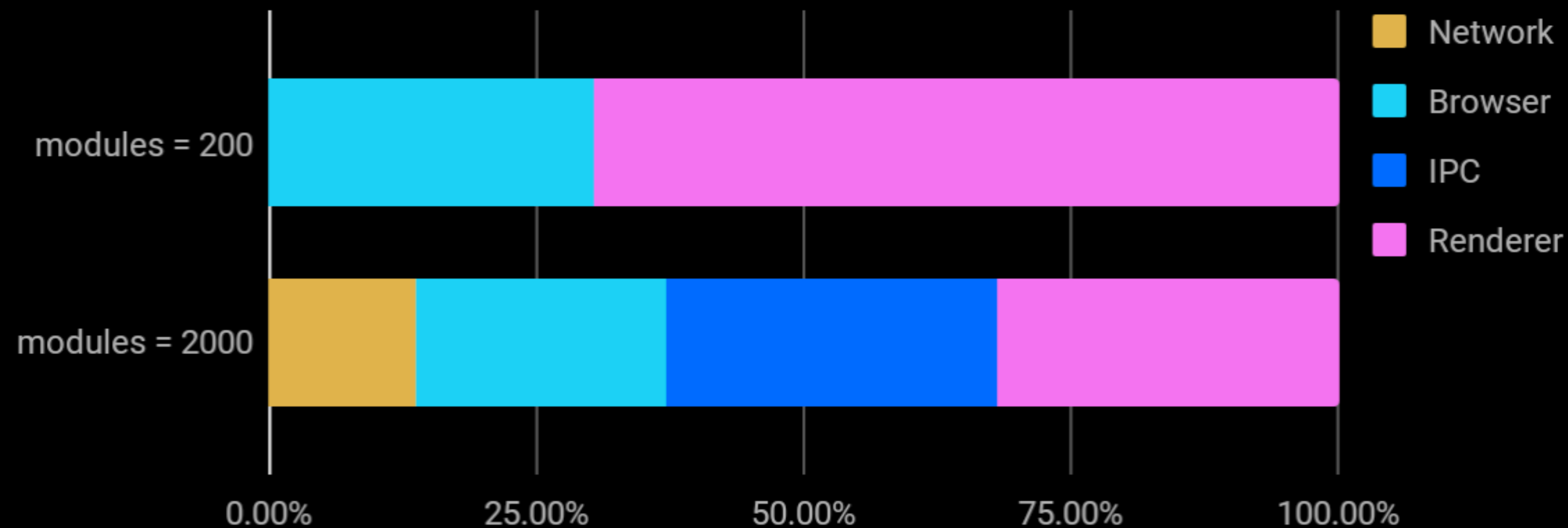
Yoav Weiss
@yoavweiss



HTTP/2+ doesn't enable us to extend a compression window beyond a single resource. What that means in practice is that the compression ratio of a lot of small files is significantly worse than the compression ratio of fewer, larger files.

Renderer & IPC cost

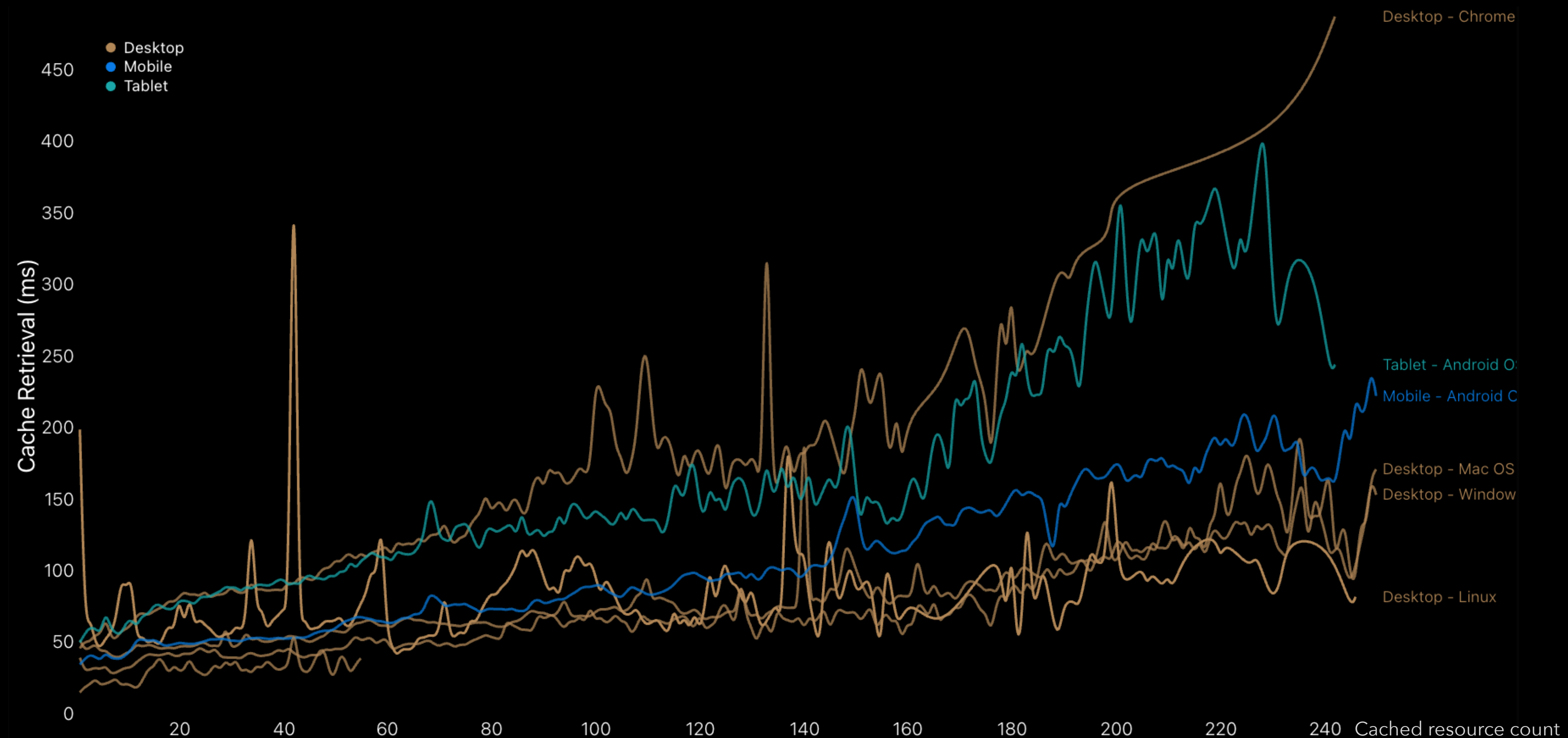
Modules have a cost in both Blink, V8 and the communication between.



“Loading time increases proportionally to the # of requests, not by the total size of responses, regardless of whether they come from cache or not. For example:

Loading 10_000 1kB files is **10x slower than a single 10MB load.**”

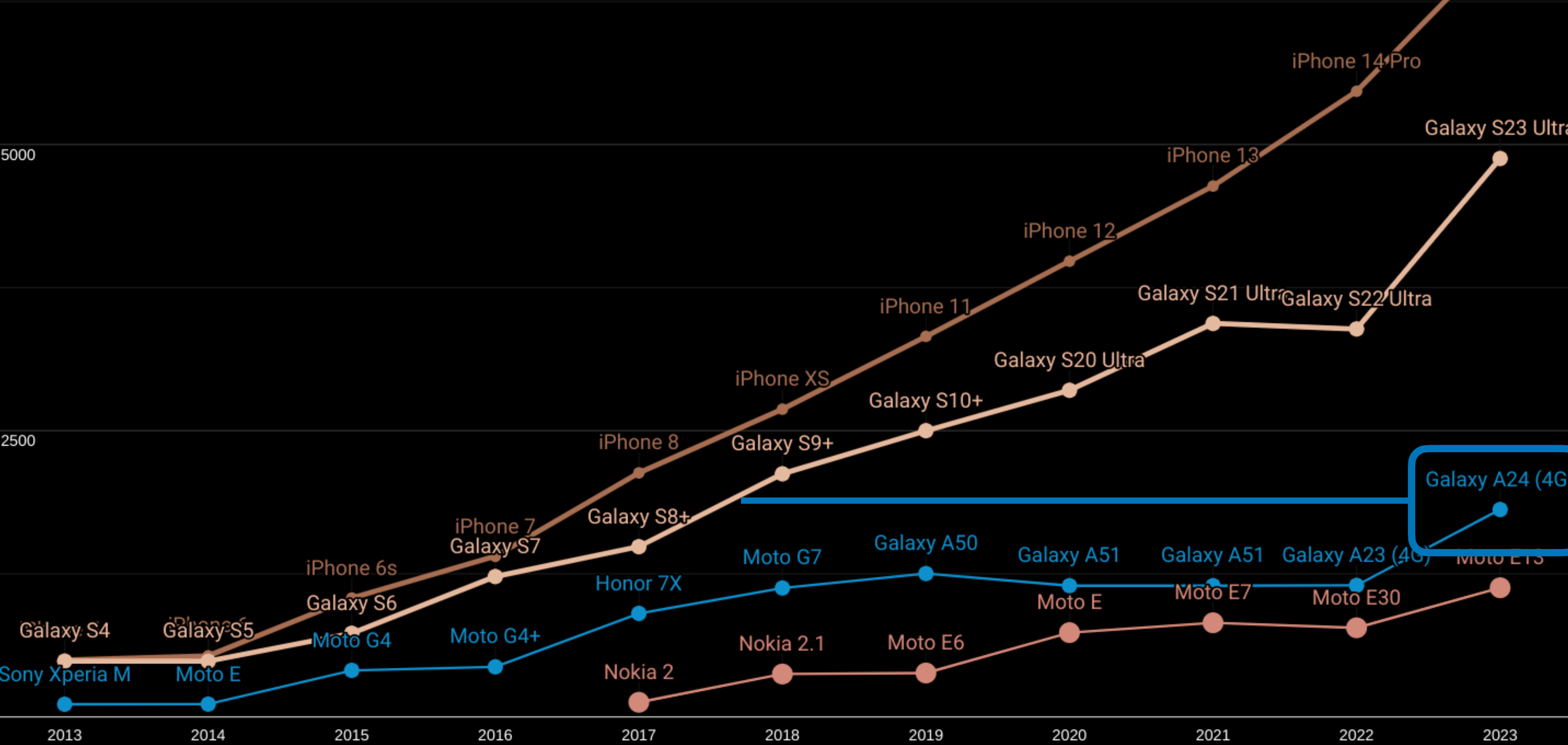
Renderer & IPC cost



Chrome OS average cache retrieval **doubles from** $\pm 50\text{ms}$ with **5 cached** resources up **to** $\pm 100\text{ms}$ with **25 resources**.

Geekbench 5 Multi-Core Scores

● iOS Multi-Core ● Android Multi-Core ● Budget Android Multi-Core ● Low-End Multi-Core



Think about all users

Concurrency limits

HTTP/2+ servers only accept **N concurrent streams**. After, they kinda behave like HTTP/1.

Table 6.1 Concurrent stream limits on popular HTTP/2 server-side implementations

Software	Type	Default concurrent streams
Apache HTTPD (v2.4.35)	Web server	100 ^a
nginx (v1.14.0)	Web server	128 ^b
H2O (2.3.0)	Web server	100 ^c
IIS (v10)	Web server	100
Jetty (9.4.12)	Web and Java servlet container	128 ^d
Apache Tomcat (9.0)	Web and Java servlet container	200 ^e
Node (10.11.0)	JavaScript runtime environment	100 ^f
Akamai	CDN	100
Amazon CloudFront and S3	CDN	128
Cloudflare	CDN	128
MaxCDN	CDN	128

Table 6.2 Concurrent stream limits on popular HTTP/2 web browsers

Software	Default concurrent streams
Chrome (v69)	1000
Firefox (v62)	Not set (uses HTTP/2 default of unlimited)
Safari (v12)	1000
Opera (v56)	1000
Edge (v17)	1024
Internet Explorer 11	1024

You should bundle.

HTTP/2+ does not solve the need for bundling.

Splitting one file into multiple ones creates more overhead:

1. **Network overhead:** ↑ roundtrips, ↓ compression, HTTP header overhead
2. **Renderer & IPC cost:** More isn't free.
3. **Concurrency limits** of HTTP/2+ servers & browsers

This leads to **worse UX & Core Web Vitals** – especially on slower devices & networks.

REWRITE EVERYTHING TO RUST!



Ambitious bundler goals

Our 3 must-have requirements:

- 1. Granular control over chunks** – to counter too-small-modules.
- 2. Strict module execution order** – to isolate user code in our case.
- 3. Equally or faster than esbuild** – regressing perf isn't an option.

A bundler journey

There are other good bundlers out there:

 **Parcel**: Surprisingly fast and capable. Slower than esbuild.

 **Rspack**: Similar API to Webpack. In my tests in 2024, slower than Parcel.

 **Farm-Fe**: Unique chunking algo. Slower than Rspack.

 **Turbopack**: Tied to Next.js.



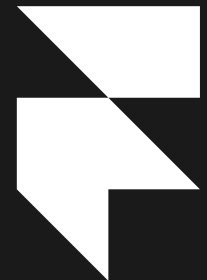
Back in May 2024, we knew Rolldown was coming, but it was early.

We've seen how fast Oxc is. We heard Rolldown is *fast*.

Rolldown at Framer

from research to product

After talking in August 2024, we figured a cooperation would shape Framer's future of bundling and I could help shape Rolldown's API.

void(0) ×  **Framer**

What happened in 1 year?

- Designing & implementing the chunking API
- Minification support
- Fix rare minification errors
- Handle legal comments during minification
- Fix crashes
- Hashing woes
- Top-level await support
- CJS in ESM
- Nasty chunking algorithm things (Yunfei can tell you a story)
- Performance & memory improvements (bundle 300 MB JS?)
- Test Rolldown for Framer sites with 1 route and with 10_000s of routes

Esbuild vs Rolldown

(from my POV)

- ✓ Similar API (with unique Rolldown additions)
- ✓ JS plugin support (we use it to create virtual modules)
- ✓ JS minification
- ✗ No CSS minification yet!

Minifier performance

Artifact	Original size	Gzip size	
typescript v4.9.5 (Source)	10.95 MB	1.88 MB	
Minifier	Minified size	Minzipped size	Time
1. oxc-minify	-70% 3.34 MB	🏆 -55% 855.08 KB	5x 607 ms
2. @tdewolff/minify	-69% 3.35 MB	-54% 875.82 KB	2x 255 ms
3. @swc/core	🏆 -70% 3.31 MB	-54% 859.05 KB	13x 1,487 ms
4. esbuild	-68% 3.49 MB	-51% 915.59 KB	4x 485 ms
5. bun	-68% 3.54 MB	-51% 923.27 KB	2x 293 ms
6. uglify-js (no compress)	-68% 3.54 MB	-53% 876.54 KB	34x 3,784 ms
7. terser (no compress)	-68% 3.53 MB	-53% 878.64 KB	43x 4,687 ms

Esbuild vs Rolldown

Memory usage when bundling 300 MB JS w/ 500 MB sourcemaps:

- 🔄 Rolldown: **>10 GB**
- ➡ esbuild: **9.2 GB**

Improvements are coming! (And I hope no one else has 300 MB of JS somewhere)

Bundling at Framer

- Customers can write custom JS code, most commonly React components → our biggest sites have ± 300 MB of JS (across all pages)
- We use SSG for faster page loads & crawl-ability (no SSR → no LLM!) 🤖
- Rolldown bundles both client and server code
 - 🪶 **Deps needed for SSR shouldn't end up in the client bundle**
 - 🔒 **Strict execution order matters** – our runtime code shouldn't fail if there is an error in user code

Bundling at Framer

-  Every route has its own entry-point
→ **Lazy loaded** in the browser (& preloaded using heuristics)
-  Every route might have its own dependencies
→ **They shouldn't be loaded on every other route**

Non trivial: **How do you split the code optimally?**

Good rules for bundling

Google research to the rescue:

A. **Used by some chunks and below 20 kb**

→ "common" chunks

B. **Used on all pages**

→ "shared" chunks

C. **Big library > 160kb**

→ "library" chunks

Start simple

```
groups: [  
  {  
    name: "react",  
    // include react/react-dom/scheduler, but not the server chunk  
    test: /[\\V]npm:(react|react-dom|scheduler)@(?![\\d.]+Vserver\\.browser\\.js)/,  
    priority: 1000,  
  },  
  { name: "motion", test: /^motion|framer-motion/, },  
  { name: "framer", test: /^framer/, },  
  {  
    name: "shared-lib",  
    minShareCount: routesLength,  
  },  
  routesLength >= 40 ? {  
    name: "shared",  
    minShareCount: Math.floor(routesLength / 2),  
  } : undefined,  
].filter(group => group !== undefined),
```

←←← Update independently

← Used by all routes

← More likely to hit 20-25 chunks

Advanced Options in Rolldown

Goal: Simple, yet powerful options similar to webpack.

A. **minSize** → don't create the group unless $> N$ bytes

B. **maxSize** → split the group when $> N$ bytes

C. **minShareCount**

→ create only if N entrypoints reference it

D. **min/maxModuleSize**

→ min or max size of modules that are bundled into the group

How Framer loads JS

```
<body>  
  <div id="main"><!-- react root --></div>  
  ...  
  <link rel="modulepreload" href="chunk1.mjs">  
  <link rel="modulepreload" href="chunk2.mjs">  
  <script type="module" src="main.mjs" async></script>  
</body>
```

Using **HTTP/3**
from our CDN

Browser preload scanner starts downloading the chunks before executing "main"



Analyze your chunks

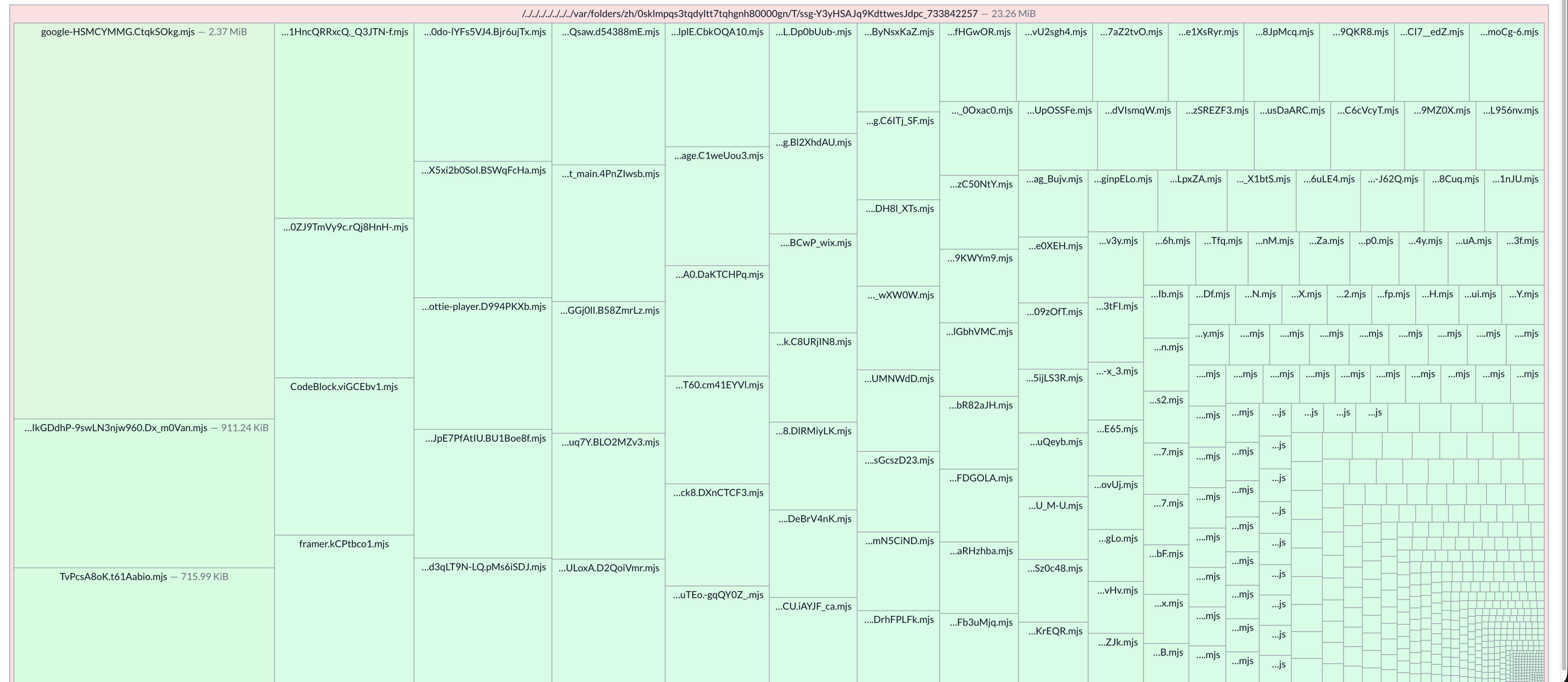
Analyzing bundles

- *Spoiler: Bundle analysis will be part of Vite Devtools, stay tuned for Anthony's talk*
- For pure Rolldown users, currently there are two plugins:
 -  Sonda
 - Rollup-plugin-visualizer
-  DevTools is a viable option too

Build treemap

Treemap representation of the build, showing all assets and their sizes.

🔍 Filter items (prefix with - to exclude) Uncompressed 🔍 Type



Build treemap

Treemap representation of the build, showing all assets and their sizes.

Q codemirror

Filter by Type

[./.././.././.././var/folders/zh/OskImpqs3tqdyLtt7tqhgnh80000gn/T/ssg-Y3yHSAJq9KdttwesJdpc_733842257](#) — 915.38 KiB

codemirror_language.C1weUou3.mjs — 290.67 KiB

codemirror_lang_html.DusDaARC.mjs – 123.53 KiB

codemirror_lang_php.BFI6uLE4.mjs — 93.32 KiB

...emirror_lang_python.C8ZyQ3K7.mjs — 54.00 KiB

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...irror_lang_markdown.Cf1bFZfp.mjs
```

codemirror_lang_java.CjilkXkY.mjs

```
...or_lang_sql.CYJZysdG.mjs
```

...plete.HsVOr9Ce.mjs

```
...mode_perl.M9mdhUJc.mjs
```

...inx.npPyUQZn.mjs

...M-4x.mjs

...by.B_yogwkX.mjs

...xGM0rLY.mjs

```
...y_modes_mode_clike.B1962Hjf.mjs
```

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[illegible]

...tySml.mjs

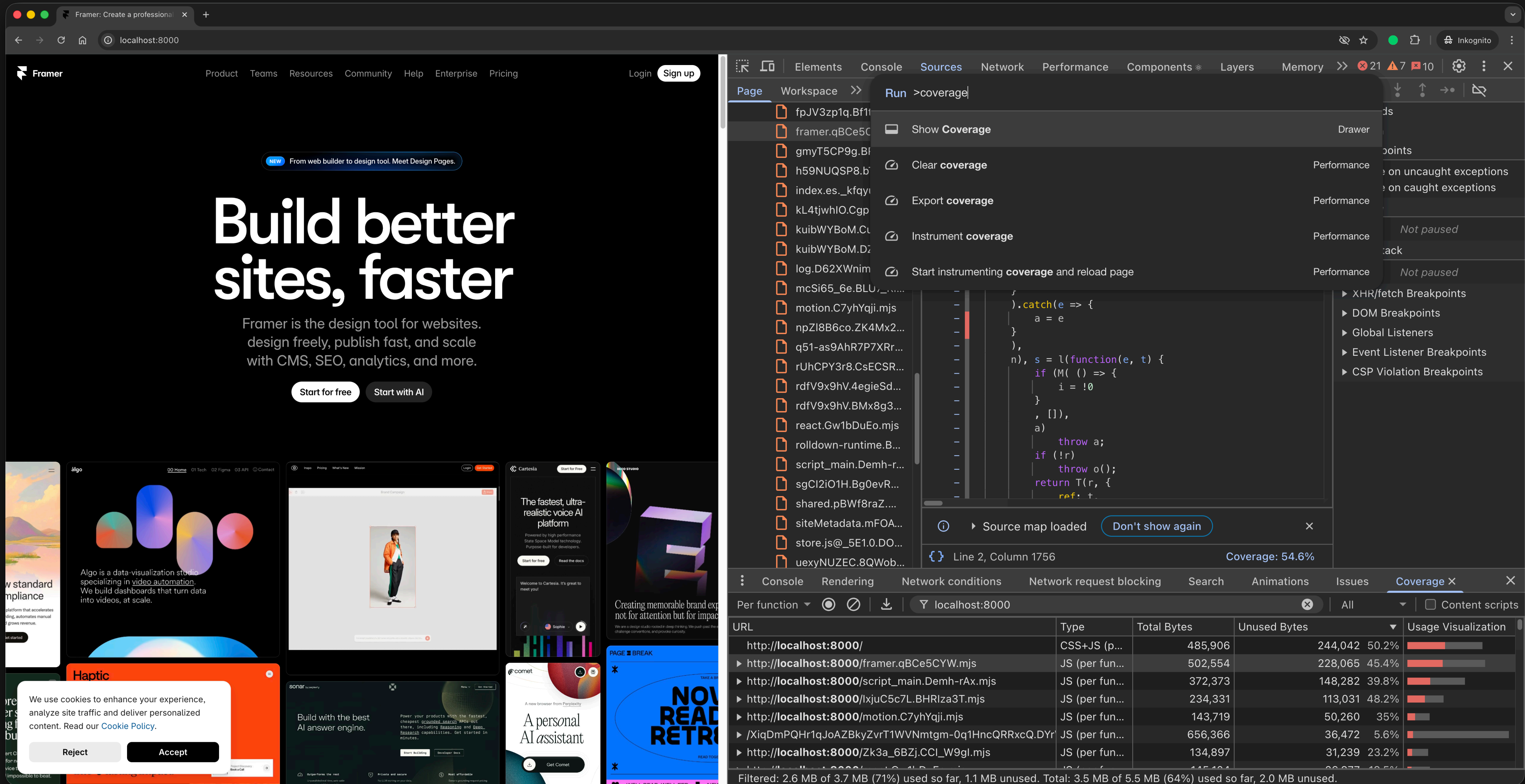
[illegible]

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...CWw.mjs

...R.mjs

....mjs	
---------	--



Analyzing bundles

Follow discussions about emitting an esbuild-like metafile in [#6425](#).

Once we have that, you can use:

- [hawkeye](#), [bundle-buddy](#), [esbuild-analyzer](#), [Bundle Size Analyzer](#)
- [@rnx-kit/esbuild-bundle-analyzer](#)
...which unlocks support for [microsoft/webpack-bundle-compare](#) &  [Rsdoctor](#)

```
experimental: {  
  attachDebugInfo: "full",  
},
```


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localhost:8000

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RejectAccept

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ElementsConsoleSourcesNetworkPerformanceComponentsLayersMemory

script_main.Demh-rAx.mjsframer.qBCe5CYW.mjs

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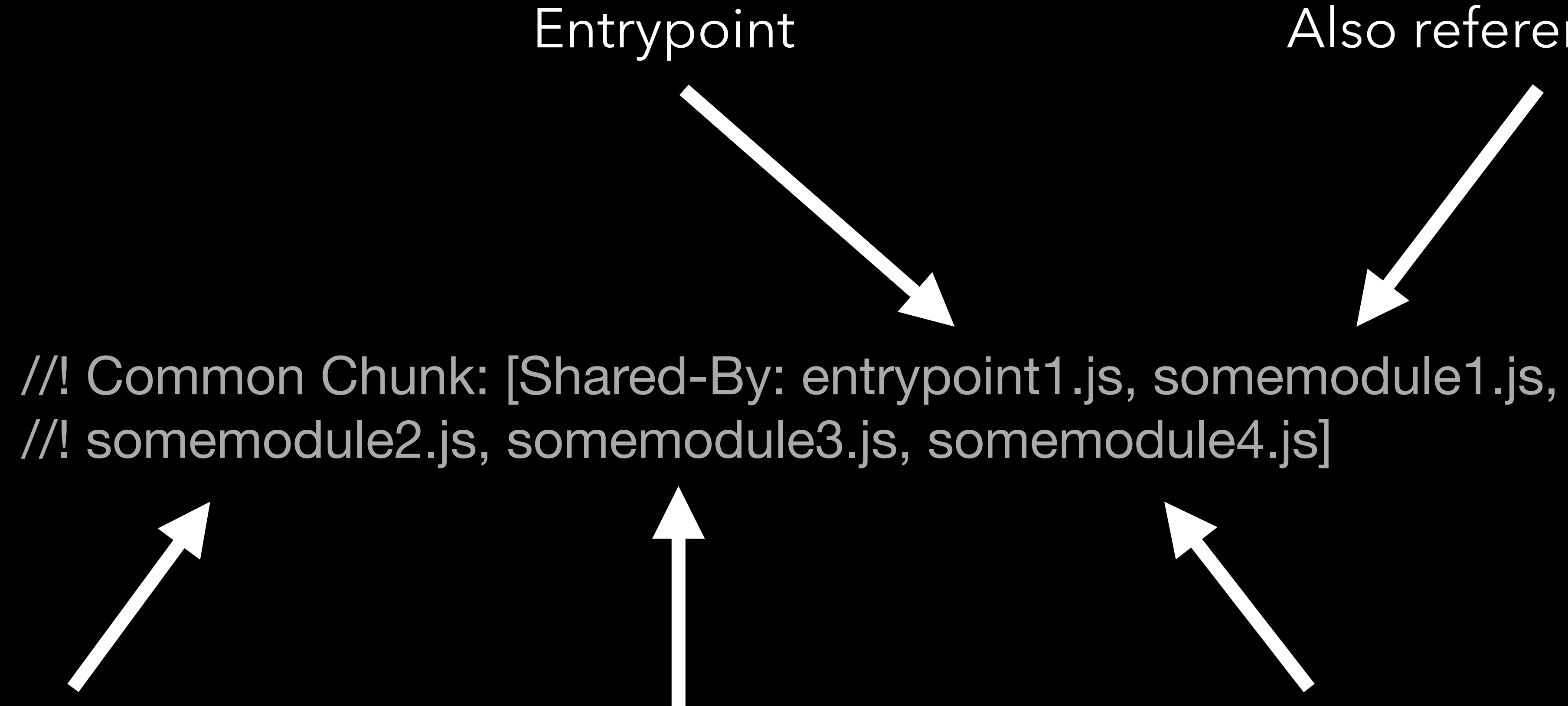
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Entrypoint

Also referenced by



```
graph TD; A[Entrypoint] --> C[Common Chunk]; B[Also referenced by] --> C; D1[ ] --> C; D2[ ] --> C; D3[ ] --> C;
```

//! Common Chunk: [Shared-By: entrypoint1.js, somemodule1.js,
//! somemodule2.js, somemodule3.js, somemodule4.js]

To get rid of this chunk → make sure it's not imported by those modules



Results

Improvements to chunks

p25	20 → 14
p75	67 → 22
p90	80 → 30
p99	95 → 54

36%

Median drop in download size in both un- and compressed JS

4%

Avg. improvement to LCP¹ for websites with 1-2MB of JS

¹ LCP adjusted to TTFB

41%

Avg. improvement to LCP¹ for websites with 2MB+ of JS.

¹ LCP adjusted to TTFB

11%

Faster LCP¹ at p90 across all Framer sites.
❤️ for slow devices & slow networks

¹ LCP adjusted to TTFB

A fast, stable and capable bundler is a win-win for everyone.
For us, our customers & their visitors, the Vite community, the web.



Thank you!

Questions?

@kurtextrem on X, LinkedIn, BlueSky

<https://kurtextrem.de>