

# Lightning-Fast Web Performance

Scott Jehl, WebPageTest Team

---



# Course Agenda

1. Introduction
2. Why Performance Matters
3. Metrics! How do we define fast?
4. **Identifying Performance Problems**
5. Making Things Faster
6. Wrapping Up

# Identifying Problems

# Test. Optimize. Repeat!

Instantly test your site's speed, usability, and resilience in real **browsers, devices, and locations** around the world.

Webpage Performance Test Result

View: Performance Summary

Performance Summary

Here's how this site performed in this test. **Please note:** Supported metrics will vary based on the browser being tested. Also, the way a site performs in some conditions may not predict how well it will perform in others, so we encourage testing in a variety of browsers, devices, & locations.

Summarized Metrics

First Byte	Start Render	FCP	Speed Index	LCP	CLS	TBT	Total Bytes
.221s	.500s	.368s	.580s	1.384s	0.031	≥.000s	486KB

VISUAL PAGE LOADING PROCESS (EXPLORE)

Start a **Site Performance** ▾ Test!

Enter a website URL...

Simple Configuration 3 test runs from recommended location and browser presets

MOBILE 4G Virginia, USA

DESKTOP Cable Virginia, USA

Include Repeat View  
(Loads the page, closes the browser and then loads the page again)

Start Test →



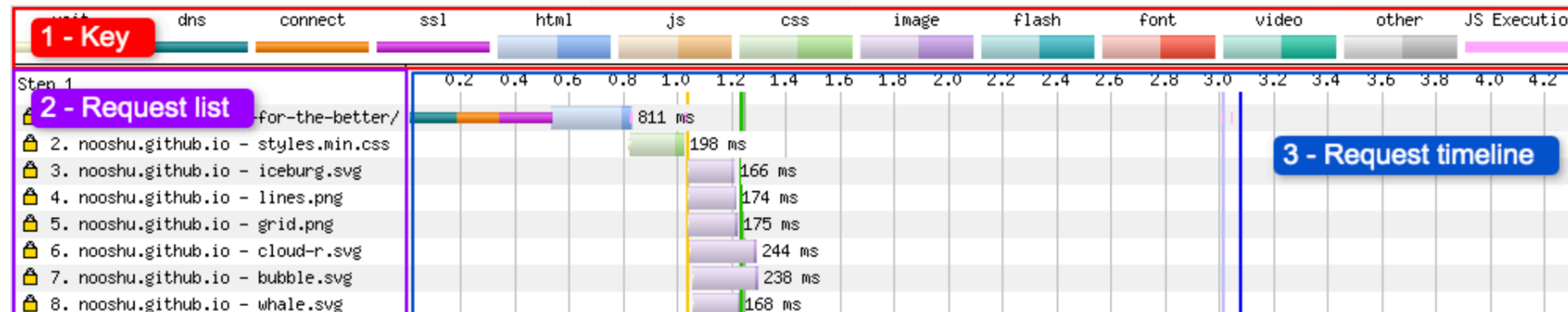
## # How to read a Web Page Test waterfall chart

Published: Oct 2, 2019 Tagged: [webperf](#), [ramblings](#). Read time: 20 mins

So I often find myself looking at [WebPageTest](#) (WPT) waterfall charts, but as I seem to have the [memory of a chimpanzee](#) (not a goldfish, that's a myth) I tend to forget some of the details and what they all mean. So I decided to pull together many bits of information into a single blog post I can then refer to at a later date. If you find it useful, or think I've forgotten anything, please [let me know](#).

### # Basic Layout

Here's the basic layout of the waterfall chart user interface:



Analyze

Enter a valid URL

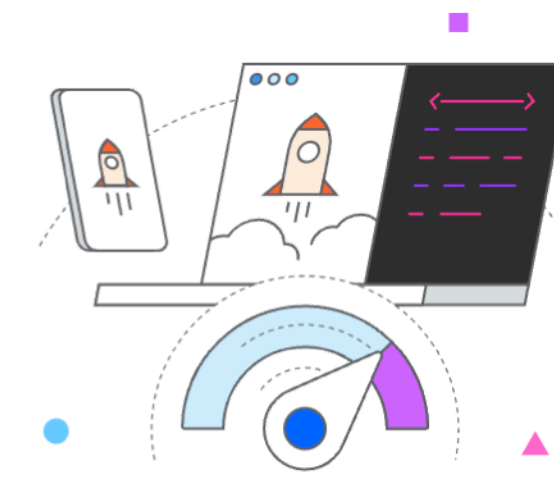
## Make your web pages fast on all devices

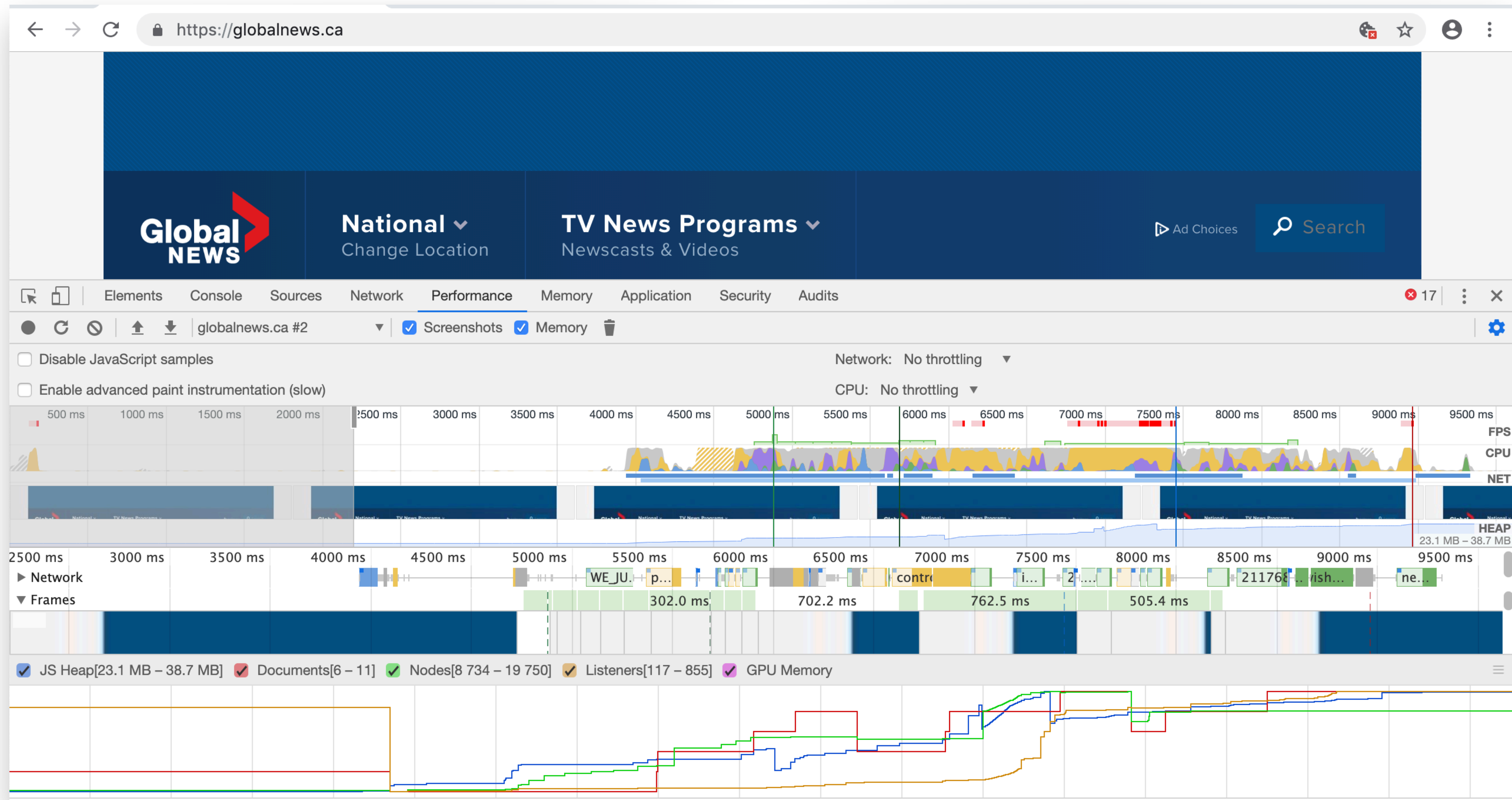
CHECK OUT

[What's new](#)

[Documentation](#)

[Learn about Web Performance](#)





<https://developers.google.com/web/tools/chrome-devtools>

The image shows a split-screen view. On the left is the WebPageTest website interface, and on the right is the Lighthouse report configuration panel.

**WebPageTest Interface (Left):**

- Logo: WebPageTest by catchpoint
- Header: Welcome to **WebPageTest** **Pro**
- Text: **Are you ready to go!** Enjoy premium locations, bulk test priority, our API, & No-Code Experiments!
- Form: Start a **Site Performance** **Test!**
- Input: Enter a website URL...
- Section: **Example Configuration** 3 test runs from recommended location and browser presets
- Options: **MOBILE** (Chrome, 4G, Virginia, USA), **Include Repeat View** (Loads the page, closes the browser and then loads the page again)

**Lighthouse Report Configuration Panel (Right):**

- Tab: Lighthouse
- Header: Generate a Lighthouse report
- Mode: **Navigation (Default)** (selected), Timespan, Snapshot
- Device: **Mobile** (selected), Desktop
- Categories:  Performance,  Accessibility,  Best practices,  SEO,  Progressive Web App
- Plugins:  Publisher Ads
- Warning: **⚠ There may be stored data affecting loading performance in this location. Use an incognito window to prevent those resources from affecting your score.**





# App & Browser Testing Made Easy

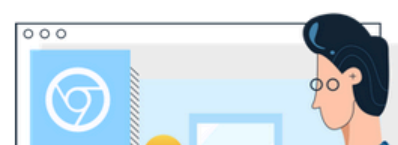
Give your users a seamless experience by testing on 2000+ real devices and browsers. Don't compromise with emulators and simulators.

Get started free

## Test your websites

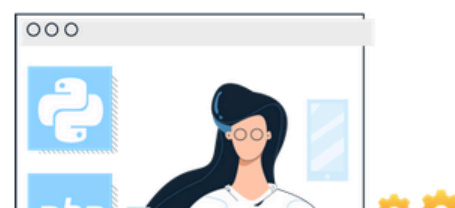
### LIVE

Interactive cross browser testing



### AUTOMATE

Instant Selenium testing



## Test your mobile apps

### APP LIVE

Interactive mobile app testing



### APP AUTOMATE

Automated mobile app testing





Inspect with Chrome Developer x +

Chrome | chrome://inspect/#devices

## DevTools

- Devices
- Pages
- Extensions
- Apps
- Shared workers

## Devices

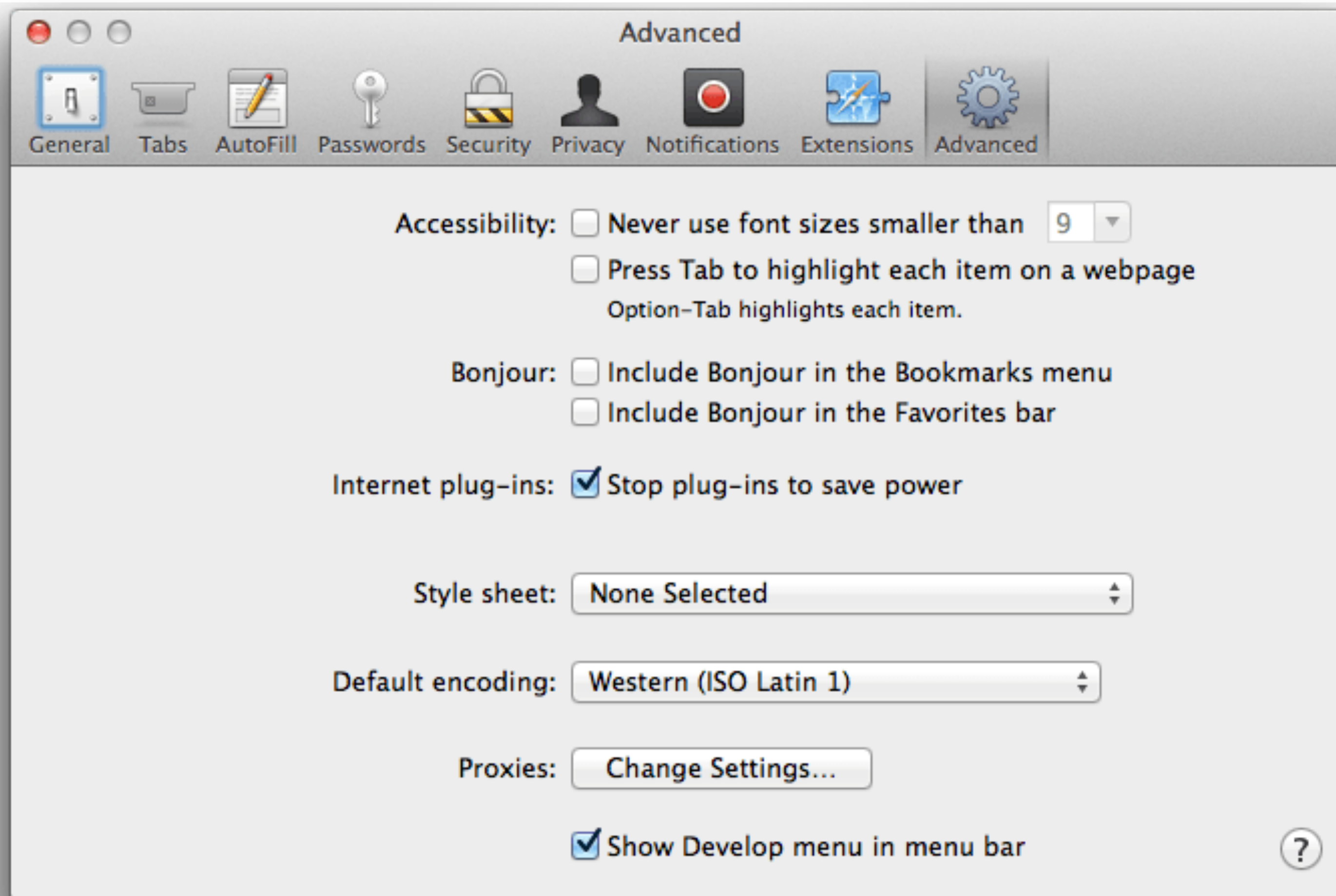
- Discover USB devices Port forwarding...
- Discover network targets Configure...

[Open dedicated DevTools for Node](#)

---

## Remote Target #LOCALHOST





# Can I use webp ? [Settings](#)

18 results found

Caniuse (15)  MDN (3)

## # WebP image format - OTHER

Image format (based on the VP8 video format) that supports lossy and lossless compression, as well as animation and alpha transparency. WebP generally has better compression than JPEG, PNG and GIF and is designed to supersede them. [AVIF](#) and [JPEG XL](#) are designed to supersede WebP.

Usage % of all users Global 93.95% + 3% = 96.96%

Current aligned Usage relative Date relative Filtered All

Chrome	Edge*	Safari	Firefox	Opera	IE	Chrome for Android	Safari on iOS*	Samsung Internet	Opera Mini*	Opera Mobile*	UC Browser for Android	Android Browser*	Firefox for Android	QQ Browser	Baidu Browser	KaiOS Browser
4-8				10.1												
<sup>1</sup> 9-22				<sup>1</sup> 11.5								2.1-3				
<sup>2</sup> 23-31	12-17	3.1-13.1	2-64	<sup>2</sup> 12.1-18			3.2-13.7					<sup>1</sup> 4-4.1				
32-103	18-102	<sup>3</sup> 14-15.5	65-102	19-88	6-10		14-15.4	4-16.0		12-12.1		4.2-4.4.4				
104	103	<sup>3</sup> 15.6	103	89	11	103	15.5	17.0	all	64	12.12	103	101	10.4	7.12	2.5
105-107		16.0-TP	104-105	90			16.0									



# What Does My Site Cost?

Find out how much it costs for someone to use your site on mobile networks around the world.

<http://www.wired.com/2015/03/our-new-site/> weighs 11.27MB. Here's what that costs around the globe.

Want to make things better? Check out the [full results and recommendations at WebPageTest.org](#).

Cost in USD

**Cost in USD, PPP**

Cost as % of GNI, PPP

Postpaid

Prepaid

## Cost in USD, PPP (POSTPAID DATA)

This is the cost of the site based on data from the [ITU](#) and [World Bank](#). The cost of data is standardized based on the [PPP](#) factor. Prices were collected from the operator with the largest marketshare in the country, using the least expensive plan with a (minimum) data allowance of 500 MB over (a minimum of) 30 days. Prices include taxes. Because these numbers are based on the least expensive plan, they are **best case scenarios**.

Country	Cost (in USD, PPP)
Vanuatu	\$4.06
This exceeds the \$1.25 per day poverty level.	
Switzerland	\$0.15
This exceeds the \$1.25 per day poverty level.	

<http://whatdoesmysitecost.com>

# Goals & Budgets

# Your site vs competitor 1



You display meaningful content (FMP)  
**0.3 seconds slower**

You visually complete (VC)  
**2.4 seconds faster**

you

FIRST PAINT (FP) **2.3s**  
FIRST CONTENT (FCP) **2.6s**  
FIRST MEANINGFUL (FMP) **3.0s**  
VISUALLY COMPLETE (VC) **3.7s**



FIRST PAINT (FP) **2.3s**  
FIRST CONTENT + MEANINGFUL (FCP + FMP) **2.6s**

VISUALLY COMPLETE (VC) **6.1s**

Comp 1



---

# WPO stats



*Case studies and experiments demonstrating the impact of web performance optimization (WPO) on user experience and business metrics.*



53% of visits to mobile sites are abandoned after 3 seconds according to research from Google's DoubleClick.

SHARE ON TWITTER

#abandonment

#2016

Subscribe

Follow along using the magic of [RSS](#).

---

# Mobile Perf Goals

PSI Score of 100 to maximize SEO potential

Optimization

Good

100 / 100

Shift First Paint (FP) and Content Paint (FCP) to sub-2.0 seconds.



Speed up First Meaningful Paint (FMP) by 700ms to 2.3 seconds. This beats by 300ms (2.6s now)

Visually Complete (VC) by 300ms to 3.4 seconds. This widens your lead over to almost 3 seconds.

JANUARY 28, 2013

# Setting a performance budget

# [performance performance budget](#)

Jason Grigsby [once quipped](#) that “We’ve remade the Internet in our image....obese.” He was right, of course. Average page weight and number of connections has been increasing at a rather alarming rate.

This is why I’ve been so happy to see the recent rash of posts discussing performance as a fundamental component of design. [The latest comes from Mr. Brad Frost](#). He makes the case that performance is not just something developers need to worry about, but that it is an “essential *design* feature.”

One of the things he suggests doing is mentioning performance in project documents.

*Statements of work, project proposals and design briefs should explicitly and repeatedly call out performance as a primary goal. “The goal of this project is to create a stunning,*





8 January, 2020

# Performance Budgets, Pragmatically

## Table of Contents

One of the key tools that performance engineers have at their disposal is the Performance Budget: it helps us—or, more importantly, our clients—ensure that any performance-focused work is monitored and maintained after we've gone.

By establishing an acceptable threshold, be that based on RUM data, bundle analysis, image weight, milestone timings, or any other suitable metric, we can be sure that new or unrelated bodies of work do not have a detrimental impact on the performance of our site.

The difficulty, however, lies in actually defining those thresholds. This post is for anyone who has struggled with the question, *'But what should our budgets actually be?!'*

## Targets vs. Safeguards

Hi there, I'm Harry. I am an **award-winning Consultant Front-end Architect, designer, developer, writer and speaker** from the UK. I **write, tweet, speak** and **share code** about authoring and scaling CSS for big websites. You can **hire me**.

[Follow @csswizardry](#)

I am currently **accepting new projects** for Q1–2 2020

Projects





Having a pre-defined 'budget' is a clear, tangible way to frame decisions about what can and can't be included, and at a suitably early stage in the project.

Mark Perkins



<https://clearleft.com/posts/responsive-design-on-a-budget>

# What if a change breaks the budget?

- Optimize an existing feature or asset on the page.
- Remove an existing feature or asset from the page.
- Don't add the new feature or asset.

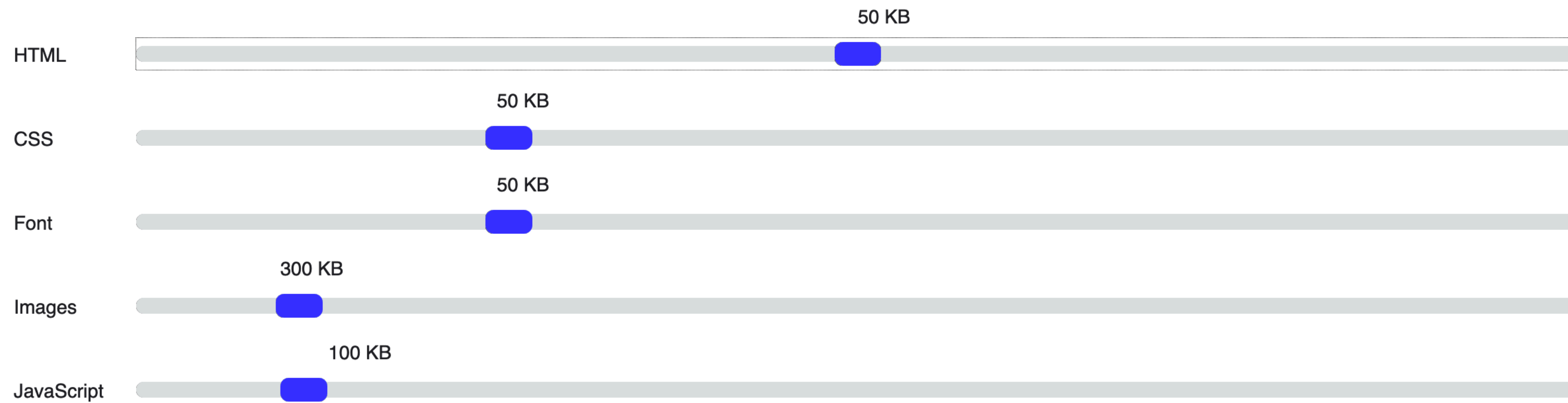
# Performance Budget Calculator

**4.5s** Estimated Time to Interactive

*Median TTI for similar mobile sites.*

**3.4 - 5.6s** Time to Interactive Range

*25th - 75th percentile TTI for similar mobile sites.*



\* Measurements represent *transferred* file size.

[Download budget.json](#)

A budget.json file can be used with the [Lighthouse](#) CLI to set performance budgets.





# The HTTP Archive Tracks How the Web is Built.

We periodically crawl the top sites on the web and record detailed information about fetched resources, used web platform APIs and features, and execution traces of each page. We then crunch and analyze this data to identify trends — [learn more](#) about our methodology.

[View Reports](#)





# **Codifying,** Monitoring



### Some checks were not successful

1 failing and 2 successful checks

[Hide all checks](#)



**Lighthouse** — Failed. Required scores: performance:96,pwa:100.

[Details](#)



**continuous-integration/travis-ci/pr** — The Travis CI build passed

[Details](#)



**continuous-integration/travis-ci/push** — The Travis CI build passed

[Details](#)



### This branch has no conflicts with the base branch

Merging can be performed automatically.

Merge pull request



You can also [open this in GitHub Desktop](#) or view [command line instructions](#).



<https://github.com/ebidel/lighthouse-ci>

Search or jump to...

Pull requests Issues Marketplace Explore



GoogleChrome / lighthouse-ci

Used by 104

Watch 41

Star 2.8k

Fork 164

Code

Issues 36

Pull requests 1

Actions

Projects 0

Wiki

Security 0

Insights

Automate running Lighthouse for every commit, viewing the changes, and preventing regressions

712 commits

5 branches

0 packages

34 releases

29 contributors

Apache-2.0

Branch: master

New pull request

Create new file

Upload files

Find file

Clone or download



patrickhulce chore(ci): upgrade to lighthouseci.js

Latest commit 03eb7aa 11 hours ago

<a href="#">.dependabot</a>	chore: add dependabot configuration file (#185)	4 months ago
<a href="#">.github</a>	misc: add semantic-pull-request validation (#177)	4 months ago
<a href="#">docs</a>	docs: add basic architecture doc	7 days ago
<a href="#">packages</a>	chore(ci): upgrade to lighthouseci.js	8 hours ago
<a href="#">scripts</a>	fix(server): handle missing metric values in dashboard graphs	8 hours ago
<a href="#">types</a>	fix(server): statistics now use median instead of average	8 hours ago
<a href="#">.browserslistrc</a>	refactor: split package into cli and utils	9 months ago



https://github.com/ebidel/lighthouse-ci

[Print Section](#) [Configuration](#)[Configuration Languages](#)[Configuration Types](#)[Entry and Context](#)[Mode](#)[Output](#)[Module](#)[Resolve](#)[Optimization](#)[Plugins](#)[DevServer](#)[Devtool](#)[Target](#)[Watch and WatchOptions](#)[Externals](#)[Performance](#)

# Performance

These options allows you to control how webpack notifies you of assets and entry points that exceed a specific file limit. This feature was inspired by the idea of [webpack Performance Budgets](#).

## performance

object

Configure how performance hints are shown. For example if you have an asset that is over 250kb, webpack will emit a warning notifying you of this.

## performance.hints

```
string = 'warning': 'error' | 'warning' boolean: false
```

Turns hints on/off. In addition, tells webpack to throw either an error or a warning when hints are found.

Given an asset is created that is over 250kb:





<https://speedcurve.com/>



Changes

Status

Improve

Favorites

LUX

Synthetic

Login

## STATUS



Below is the status of all of your performance budgets. [Learn how to manage your performance budgets](#)

CSS Size | Guardian | Each Label | AVG

**83KB** / 50KB

Start Render on homepage

**3.01s** / 3s

JS on homepage

**1260KB** / 1000KB

Chrome speedindex for each region

**2.25s** / 1.5s

First CPU Idle, Time To Interactive | Guardian | Home | AVG

**10.37s** / 11s

Guardian JS on Homepage

**948KB** / 1600KB

JS Size on mobile

**970KB** / 900KB

Guardian JS Size Desktop vs Mobile

**959KB** / 1000KB

Guardian JS Size for each URL

JS SIZE FOR EACH SITE



<https://speedcurve.com/>



**FILTERS** | **BUDGET**

Budget Metric: JS Size

Budget Threshold (KB): 170

Budget Rate of Change (%): 10

Send alerts for this budget (notification settings)

Only alert when the budget is crossed: 3 times





**JS Size is over by 55%**

The budget on JS (Syn), US West Coast, Chrome has crossed over the threshold of 170 KB by 55% and is now 264 KB.

SpeedCurve's performance budget alerts inform me when I've exceeded my JavaScript size budget.



<https://speedcurve.com/>



**Test Location**

**Browser**

**Advanced Settings** ▼

**Test Settings** | **Advanced** | **Chrome** | **Auth** | **Script** | **Block** | **SPOF** | **Custom**

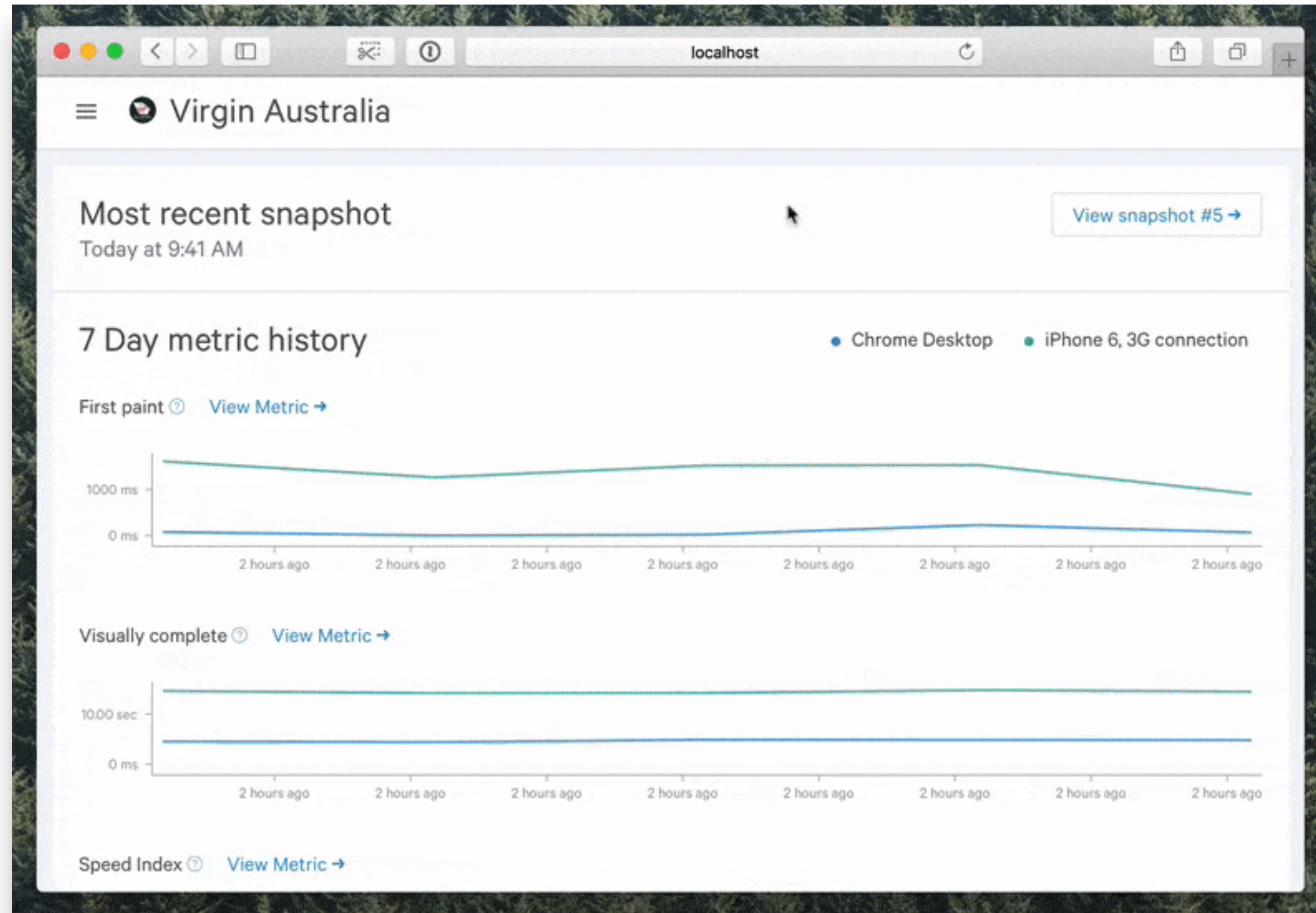
**Block Requests Containing...**  
Space separated list

dynamicyield





<https://calibreapp.com/>

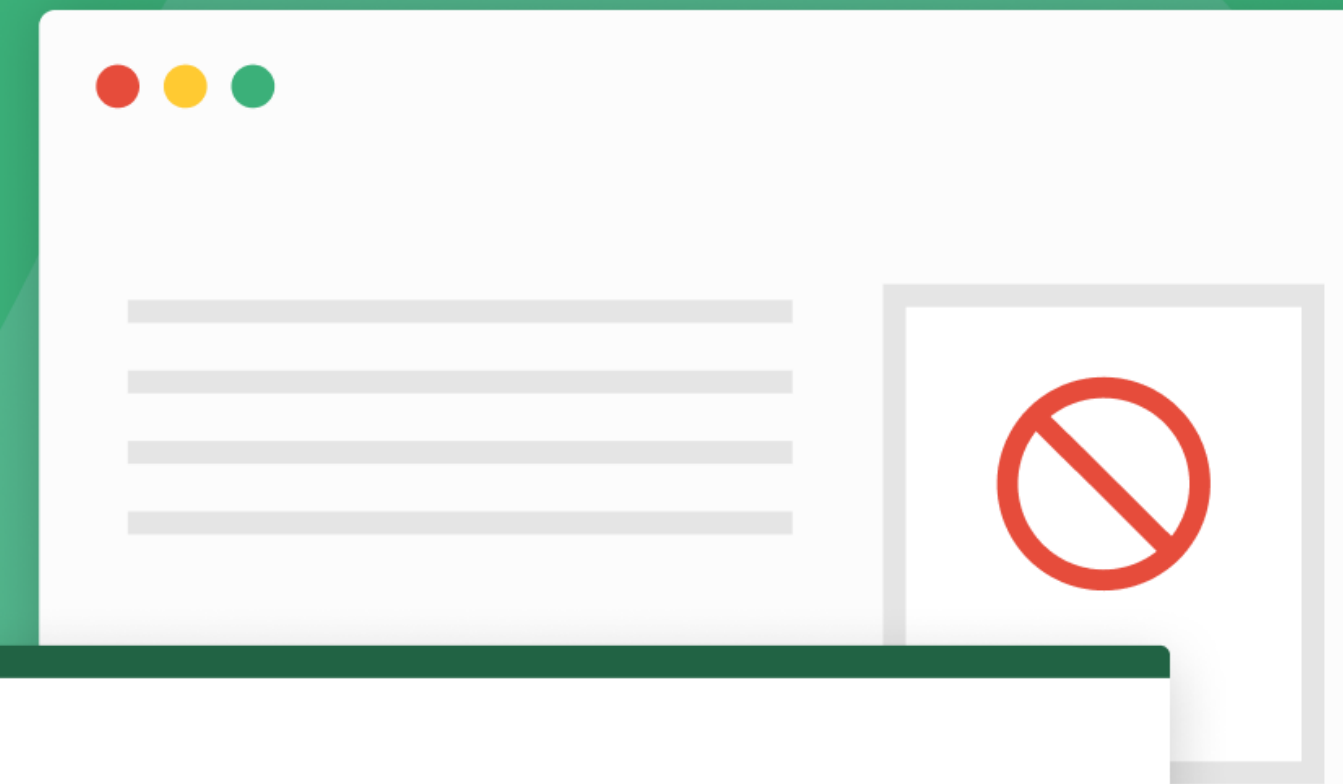


<https://calibreapp.com/docs/metrics/budgets>

# Adblocking NEW

Test your site with or without ads and third-party scripts.

- ✓ Effortlessly compare performance
- ✓ No code changes required



## Test Profile

 London, United Kingdom

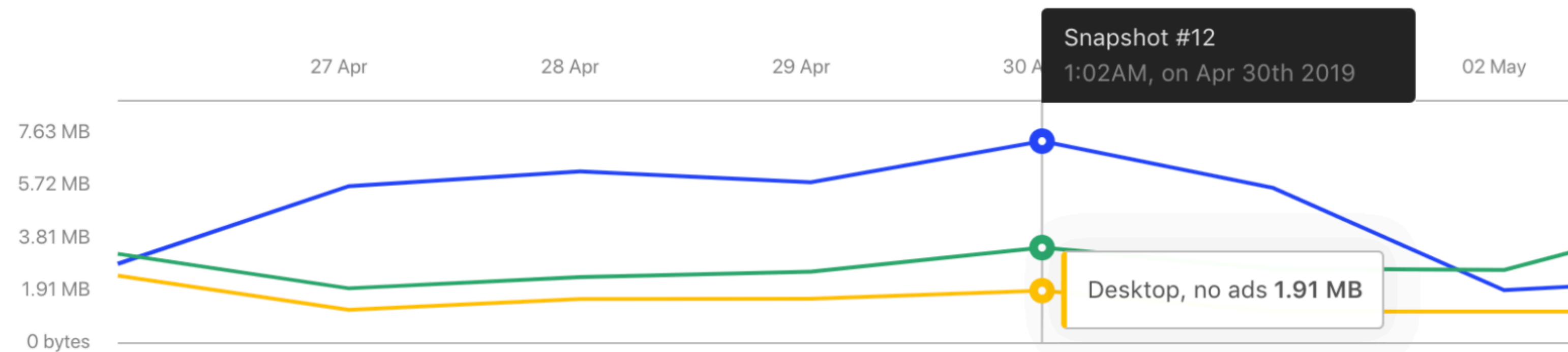
Use Ad Blocker



# Ad blocking in action

After Calibre has tested your site, stats will be shown alongside existing Test Profiles:

Total Page transferred [View Metric →](#)



# Lightning-Fast Web Performance

Scott Jehl, WebPageTest Team

---



# Taking it further!

- Audit some sites you've worked on. (Or any site!)
- Check it in Webpage Test, PSI, Dev Tools
- Identify 3 most critical performance problems