A picture is worth thousand … kilobytes

But should it?

Tamas Piros, 22nd March 2023

Fresh Body 🏃

Fit Mind 🧠

Let’s exercise! 🏋️

Thank you for the standing ovation!

👏🙏🏻

99.9%

Pages generate at least one request for an image resource

https://almanac.httparchive.org/en/2022/media

199 billion

Image requests were handled by an Image CDN *per month*

https://cloudinary-marketing-res.cloudinary.com/image/upload/sovm22-state-of-visual-media-report-2022.pdf

2.7 million

Image requests were delivered to Sony BRAVIA TVs *per month*

https://cloudinary-marketing-res.cloudinary.com/image/upload/sovm22-state-of-visual-media-report-2022.pdf

50%

Of the brain is involved in visual processing

https://www.rochester.edu/pr/Review/V74N4/0402_brainscience.html#:~:text=%E2%80%9CMore%20than%2050%20percent%20of,brain%20as%20a%20whole%20works.%E2%80%9D

“The image element turned 25 in 2020…it both ***engages*** users with delight and ***enrages*** developers”

Henri Helvetica, 2021

How it started (1995)

5.10. Image: IMG

The <IMG> element refers to an image or icon via a hyperlink (see 7.3, "Simultaneous Presentation of Image Resources").

HTML user agents may process the value of the ALT attribute as an alternative to processing the image resource indicated by the SRC attribute.

NOTE - Some HTML user agents can process graphics linked via anchors, but not <IMG> graphics. If a graphic is essential, it should be referenced from an <A> element rather than an <IMG> element. If the graphic is not essential, then the <IMG> element is appropriate.

Attributes of the <IMG> element:

How it started (1995)

```
ALIGN
        alignment of the image with respect to the text
        baseline.

            * `TOP' specifies that the top of the image aligns
            with the tallest item on the line containing the
            image.

            * `MIDDLE' specifies that the center of the image
            aligns with the baseline of the line containing the
            image.

            * `BOTTOM' specifies that the bottom of the image
            aligns with the baseline of the line containing the
            image.

ALT
        text to use in place of the referenced image resource,
        for example due to processing constraints or user
        preference.

ISMAP
        indicates an image map (see 7.6, "Image Maps").

SRC
        specifies the URI of the image resource.

            NOTE - In practice, the media types of image
            resources are limited to a few raster graphic
            formats: typically `image/gif', `image/jpeg'. In
            particular, `text/html' resources are not
            intended to be used as image resources.
```

How it is today (2022)

```
<img
    src="zurich-w800"
    alt="Zurich, Switzerland"
    width="800"
    height="904"
    srcset="zurich-w400.jpg 400w,
      zurich-w800.jpg 800w"
    sizes="(max-width: 600px) 400px, 800px"
    loading="lazy"
    decoding="async"
    style="
      background-size: cover;
      background-image: url([svg]);
    "
  />
```

“Adding images to a website is easy!”

Said no-one, ever.

Image optimisation is easy but getting it right is difficult

Format? Content? Devices?
Responsive? Delivery? Decode?

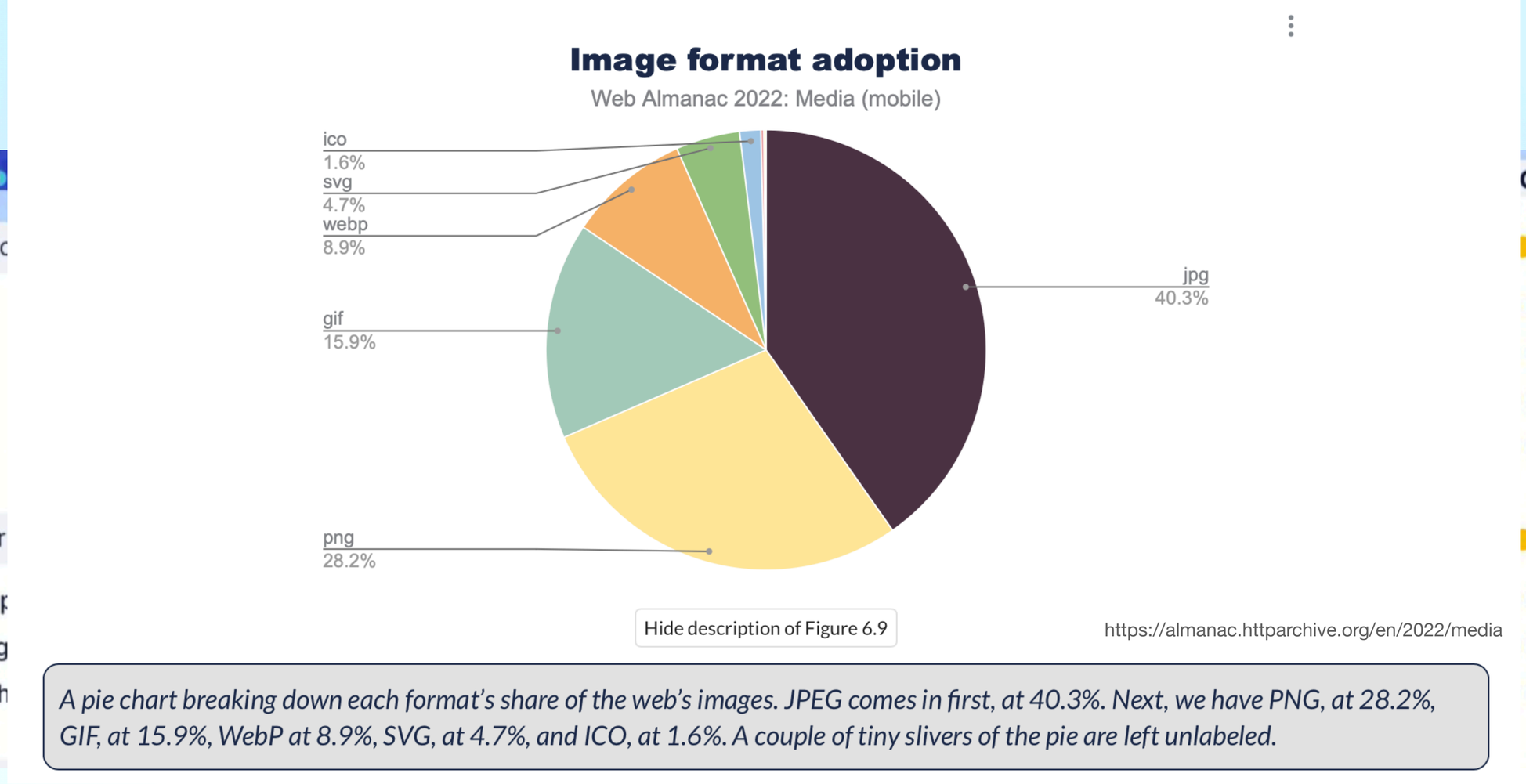
Available tooling

- Various **online tools** (Squoosh.app)
- Various **desktop clients** (ImageOptim)
- Various **libraries** (npm: sharp, jimp)
- **Image CDNs**

Key concepts

- Image formats
- User device (art direction, device pixel ratio, viewport)
- Core Web Vitals (LCP, FID, CLS)
- Responsive images
- Placeholders and loading techniques

Image Formats



Hide description of Figure 6.9

https://almanac.httparchive.org/en/2022/media

A pie chart breaking down each format's share of the web's images. JPEG comes in first, at 40.3%. Next, we have PNG, at 28.2%, GIF, at 15.9%, WebP at 8.9%, SVG, at 4.7%, and ICO, at 1.6%. A couple of tiny slivers of the pie are left unlabeled.

https://res.cloudinary.com/cloudinary-marketing/image/upload/Web_Assets/blog/Battle-of-the-Codecs_fnl.png

Fidelity is about visually preserving the original image


Low-Fidelity AVIF


High-Fidelity JPEG

The Xerox Incident

110.000	54,60
125.000	60,00
140.000	65,40
155.000	70,80
170.000	76,20

110.000	54,80
125.000	60,00
140.000	85,40
155.000	70,80
170.000	76,20

Sure sure, but what does this all mean?

BagsForSale: e-commerce shop

(☝🏽 I made that up)

Low-fidelity, high-appeal: Lower bandwidth, sharp images that load faster

Great browser experience, better sales and profit

Low-fidelity could fail to preserve original colour, or fine details about the fabric of the product

Unhappy customers, returns, complaints.

Improve

Core Web Vitals

on a media heavy site

First Input Delay

- The goal is to create a good load responsiveness
- Avoid network conflict amongst competing resources
- Avoid large network requests that block requests to other resources

Cumulative Layout Shift

- Set image dimensions (width, height) to avoid content shift
- Use the appropriate CSS properties (aspect-ratio) to “block” space for images

Largest Contentful Paint

- Optimise TTFB (time to first byte)
- Optimise resource load delay
- Optimise resource load time
- Reduce element render delay

Reduce TTFB

- **Measures the time between the request for a resource and the first received byte**
- Deliver the initial HTML page as quickly as possible
  - Reduce page redirects
  - Reconnect to origins
  - Use HTTP/2 or HTTP/3 (QUIC)
  - Utilise predictive prefetching (Guess.js)
  - Generate static HTML at build time vs Server-Side Rendering

Resource Load Delay

- **Δ between TTFB and the browser loading the LCP resource candidate**
- Load the LCP resource as soon as possible
  - General rule of thumb: LCP resource should start loading at the same time as the first resource for a page
  - Set the appropriate priority (aid the browser's preload scanner)

Resource Load Time

- **The actual time it takes to load the LCP resource**
- Reduce the time spent transferring the bytes of the resource over the network
  - Create a smaller more optimised resource
  - Image optimisations - load via image CDN*
  - (As a sitenote fonts also impact the resource load time, when the LCP is text)

Load Images via CDN*

- * Having a resource on the same origin vs a CDN would actually be beneficial, however on the fly / CDN level optimisation has potentially more benefits

Element Render Delay

- **Δ between when the LCP resource finishes loading and the element is fully rendered**
- Render LCP element straight after it has been loaded
  - LCP should not be loaded via JavaScript nor lazy-loaded
  - Inline critical styles, reduce stylesheet size
  - Defer non-critical CSS and JavaScript

LCP value: 4725.8

LCP element: <img class="active w-100" src="img/1.jpeg"> https://serene-genie-90e41b.netlify.app/img/1.jpeg

(index)	LCP sub-part	Time (ms)	% of LCP
0	'Time to first byte'	7	'0.1%'
1	'Resource load delay'	281.2000000011176	'6%'
2	'Resource load time'	4307.5999999996275	'91.2%'
3	'Element render delay'	129.99999999925512	'2.8%'

▶ Array(4)

LCP value: 146.399 perf.

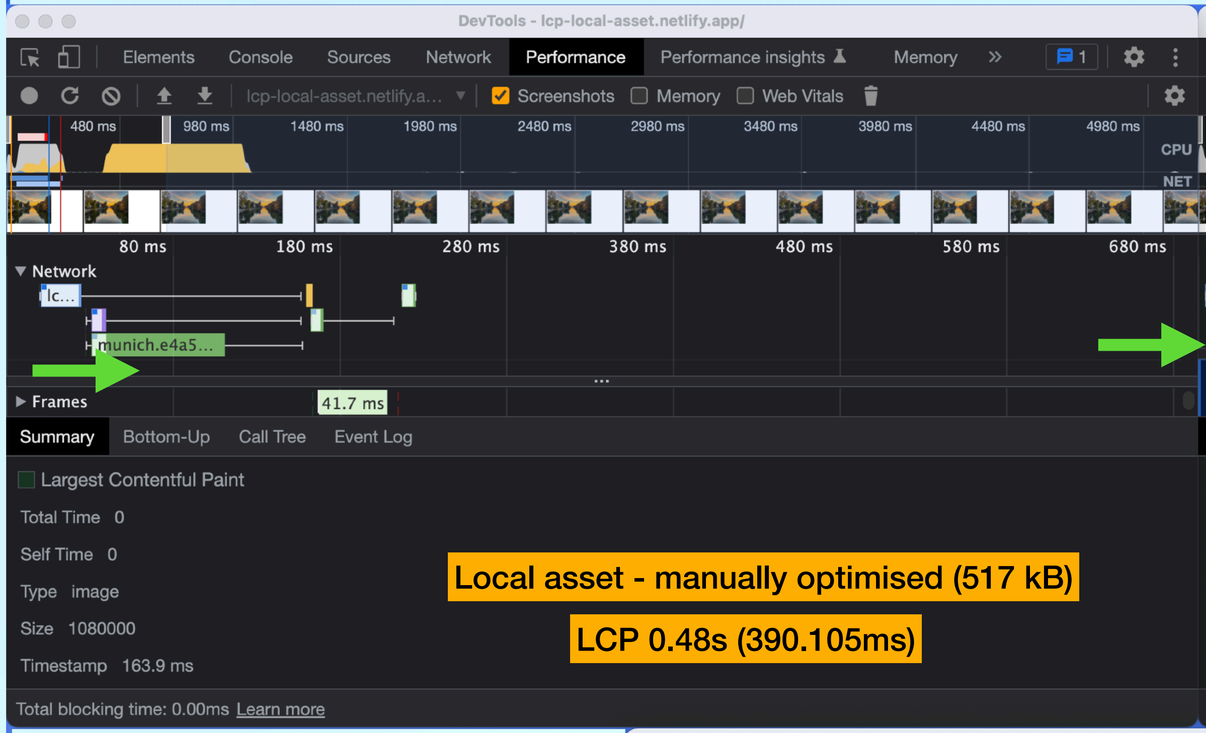
LCP element: perf.

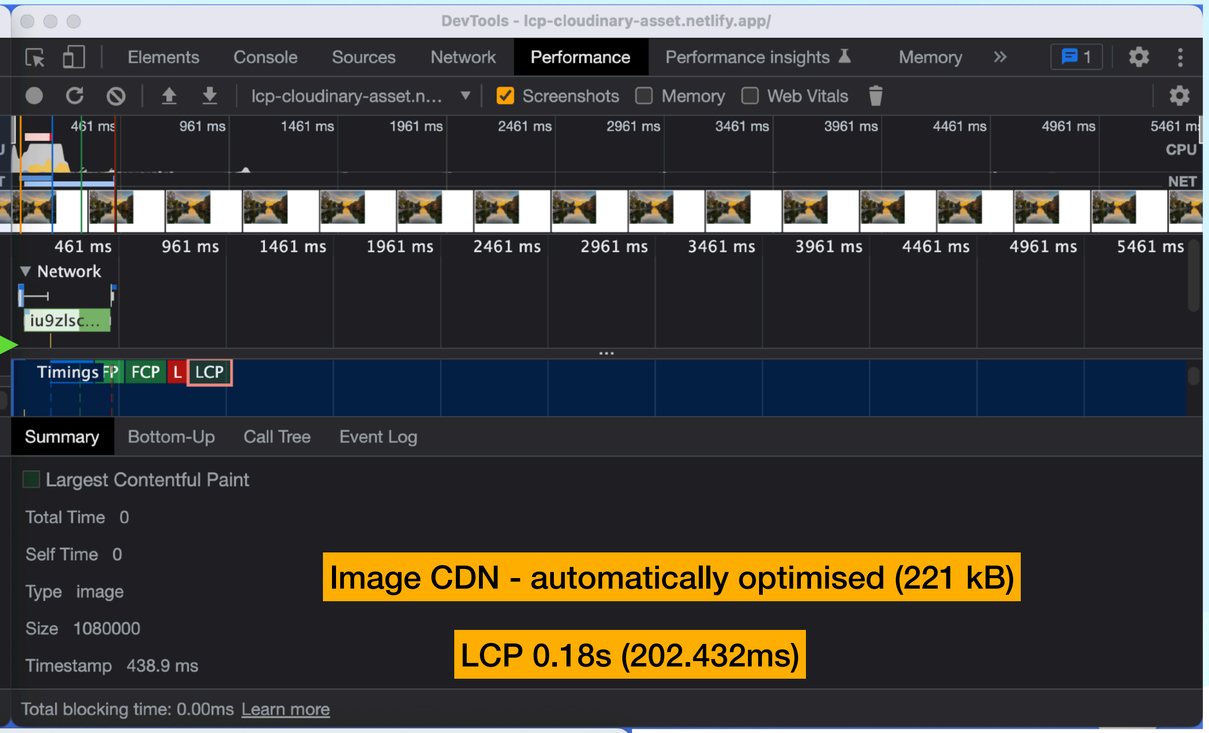
<img class="active w-100" src="https://res.cloudinary.com/tamas-demo/image/upload/w_776,f_auto,q_auto/lcp/1">
s://res.cloudinary.com/tamas-demo/image/upload/w_776,f_auto,q_auto/lcp/1

perf.

(index)	LCP sub-part	Time (ms)	% of LCP
0	'Time to first byte'	8.199999999254942	'5.6%'
1	'Resource load delay'	8.599999999627471	'5.9%'
2	'Resource load time'	20.59999999962747	'14.1%'
3	'Element render delay'	108.99900000149012	'74.5%'

▶ Array(4)


DevTools - lcp-local-asset.netlify.app/
Elements
Console
Sources
Network
Performance
Performance insights
Memory
lcp-local-asset.netlify.a...
Screenshots
Memory
Web Vitals
Network
munich.e4a5...
Frames
41.7 ms
Summary
Bottom-Up
Call Tree
Event Log
Largest Contentful Paint
Total Time 0
Self Time 0
Type image
Size 1080000
Timestamp 163.9 ms
Total blocking time: 0.00ms Learn more
Local asset - manually optimised (517 kB)
LCP 0.48s (390.105ms)


DevTools - lcp-cloudinary-asset.netlify.app/
Elements
Console
Sources
Network
Performance
Performance insights
Memory
lcp-cloudinary-asset.n...
Screenshots
Memory
Web Vitals
Network
iu9zlsc...
Timings
FP
FCP
L
LCP
Summary
Bottom-Up
Call Tree
Event Log
Largest Contentful Paint
Total Time 0
Self Time 0
Type image
Size 1080000
Timestamp 438.9 ms
Total blocking time: 0.00ms Learn more
Image CDN - automatically optimised (221 kB)
LCP 0.18s (202.432ms)

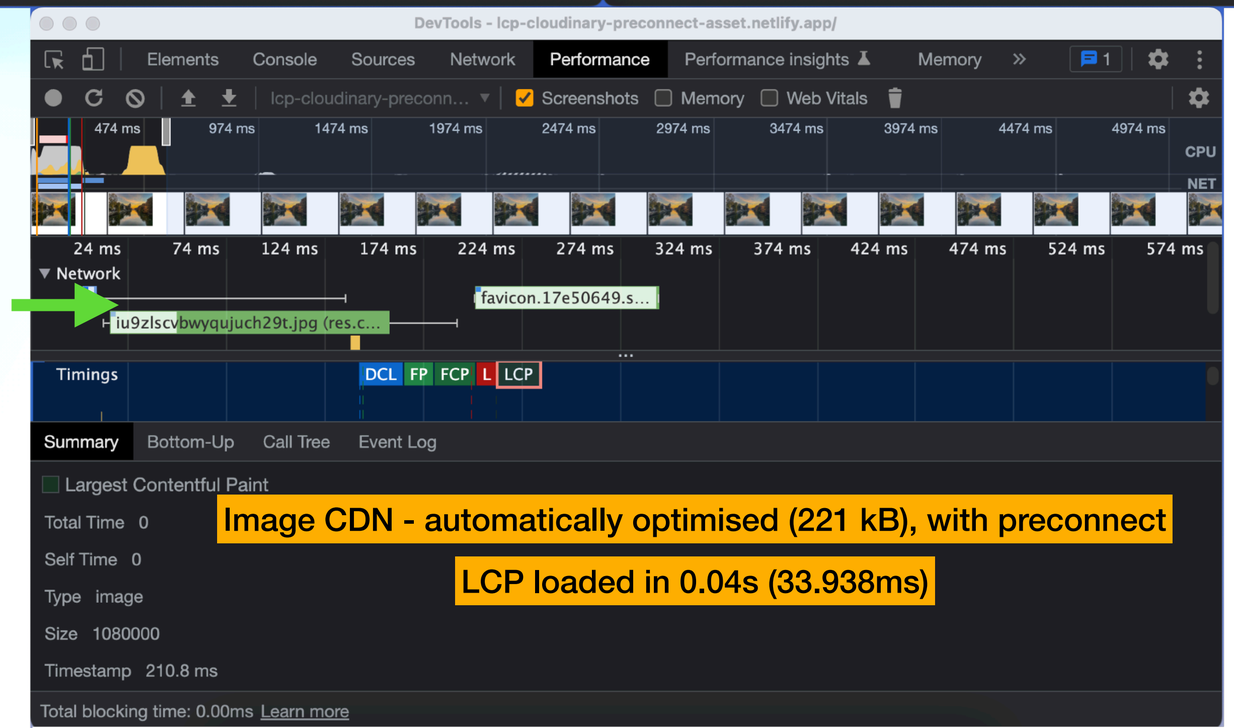

DevTools - lcp-cloudinary-preconnect-asset.netlify.app/
Elements
Console
Sources
Network
Performance
Performance insights
Memory
lcp-cloudinary-preconn...
Screenshots
Memory
Web Vitals
Network
favicon.17e50649.s...
iu9zlscvbwyqujuch29t.jpg (res.c...
Timings
DCL
FP
FCP
L
LCP
Summary
Bottom-Up
Call Tree
Event Log
Largest Contentful Paint
Total Time 0
Self Time 0
Type image
Size 1080000
Timestamp 210.8 ms
Total blocking time: 0.00ms Learn more
Image CDN - automatically optimised (221 kB), with preconnect
LCP loaded in 0.04s (33.938ms)

Image Optimisation Checklist

- Run **a performance report** - check for image related audits (serve images in next-gen formats, properly size images, efficiently encode images, preload LCP image, etc…) (Lighthouse, PageSpeed Insights, WebpageTest)
- Use the new **Performance Insights** panel (beta) in DevTools to further analyse LCP
- **Optimise image resources** - remember, bulk optimisation is a good start, but not perfect
- Generate **different versions for different browsers**
- **Cache image resources** at the CDN level, if possible for faster delivery
- **Lazy-load** images (but not LCP)
- Use **low quality image placeholders** (LQIP) to provide instant visuals

DIAGNOSTICS

- ▲ Largest Contentful Paint image was lazily loaded
- ▲ Image elements do not have explicit `width` and `height`

● Serve images in next-gen formats — Potential savings of 93 KiB

Image formats like WebP and AVIF often provide better compression than PNG or JPEG, which means faster downloads and less data consumption. Learn more.

	URL	Resource Size	Potential Savings
	`img` /zurich.jpg (localhost)	563.5 KiB	92.8 KiB

▲ Largest Contentful Paint
7.51s

▼ LCP Element

Element	img.active.w-100
Width	776px
Height	582px

▼ Slowed down by

Type	Render blocking request
Resource	https://cdn.jsdelivr.net/npm/bootstrap@5.2.0-beta1/dist/css/bootstrap.css
How to fix	Inline critical styles required for the first paint in an inline <style> block. See web.dev.

Type	Render blocking request
Resource	https://serene-genie-90e41b.netlify.app/styles/styles.css
How to fix	Inline critical styles required for the first paint in an inline <style> block. See web.dev.

Type	Long task
Function	insertBefore ()
How to fix	Optimize how you load this third party script to avoid impacting your page load. Learn more

▼ Critical path for LCP resource

https://serene-genie-90e41b.netlify.app/img/1.jpeg 6,159.422ms

▼ Timings breakdown

Total	7.498s
Time to first byte	361.464ms
Resource load delay	845.031ms
Resource load time	6.16s
Element render delay	131.475ms

Learn more on LCP timings

Yikes!

Can you do ***all of this at once***?

```
<img
  src="https://res.cloudinary.com/tamas-demo/image/upload/f_auto,q_auto,w_800/zurich"
  alt="Zurich, Switzerland"
  width="800"
  height="904"
  srcset="
    https://res.cloudinary.com/tamas-demo/image/upload/f_auto,q_auto,w_400/zurich 400w,
    https://res.cloudinary.com/tamas-demo/image/upload/f_auto,q_auto,w_800/zurich 800w
  "
  sizes="(max-width: 600px) 400px, 800px"
  loading="lazy"
  decoding="async"
  style="
    background-size: cover;
    background-image: url(https://res.cloudinary.com/tamas-demo/image/upload/e_vectorize:colors:2:detail:0.2,w_400/zurich.svg);
  "
/>
```

```html
<picture>
  <source
    media="(max-width: 600px)"
    srcset="
      https://res.cloudinary.com/tamas-demo/image/upload/f_auto,q_auto,w_400/zurich
    "
    width="400"
    height="452"
  />
  <img
    src="https://res.cloudinary.com/tamas-demo/image/upload/f_auto,q_auto,w_800/zurich"
    width="800"
    height="904"
    loading="lazy"
    decoding="async"
    style="
      background-size: cover;
      background-image: url(https://res.cloudinary.com/tamas-demo/image/upload/e_vectorize:colors:2:detail:0.2,w_400/zurich.svg);
    "
  />
</picture>
```

https://res.cloudinary.com → Default Cloudinary shared CDN distribution

/tamas-demo → Cloudinary account name

/image/upload → Asset delivery type

/f_auto,q_auto → Automatic format and quality selection

/w_400 → Set the width to 400px

/zurich → Name of asset served

https://res.cloudinary.com
/tamas-demo
/image/upload
/e_vectorize:colors:2:detail:0.2
/w_400
/zurich.svg

Vectorise effect (2 colours, level of detail)

Same asset, but delivered as SVG

Document

localhost:8080

node ct.css DemoLinks Imported

DevTools - localhost:8080/

Elements Console Sources Network Performance 14

Preserve log Disable cache Fast 3G

Filter Invert Hide data URLs

All Fetch/XHR JS CSS Img Media Font Doc WS Wasm Manifest Other Has blocked cookies

Blocked Requests 3rd-party requests

Use large request rows Group by frame

Show overview Capture screenshots

20 ms 40 ms 60 ms 80 ms 100 ms

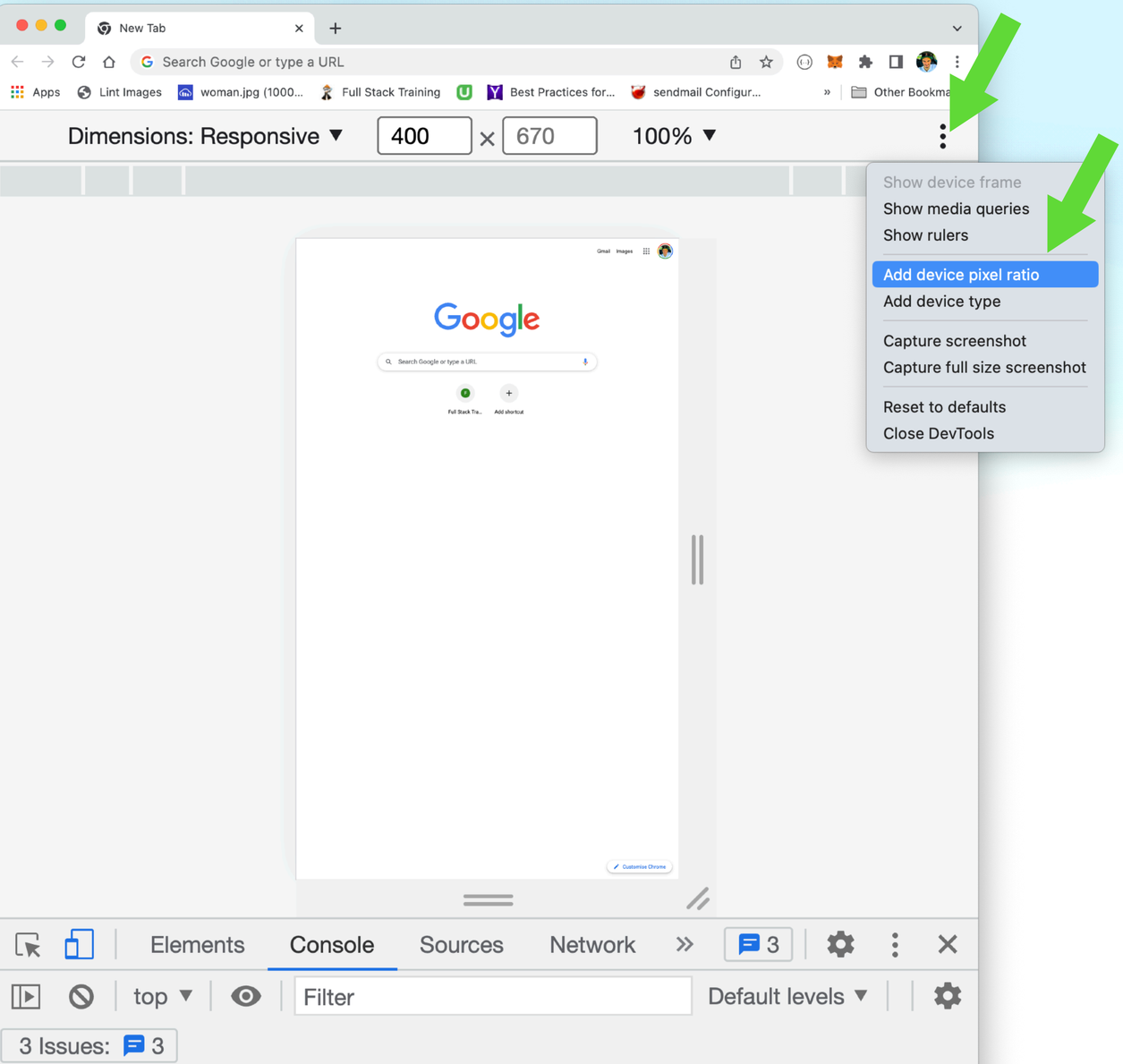
Recording network activity…

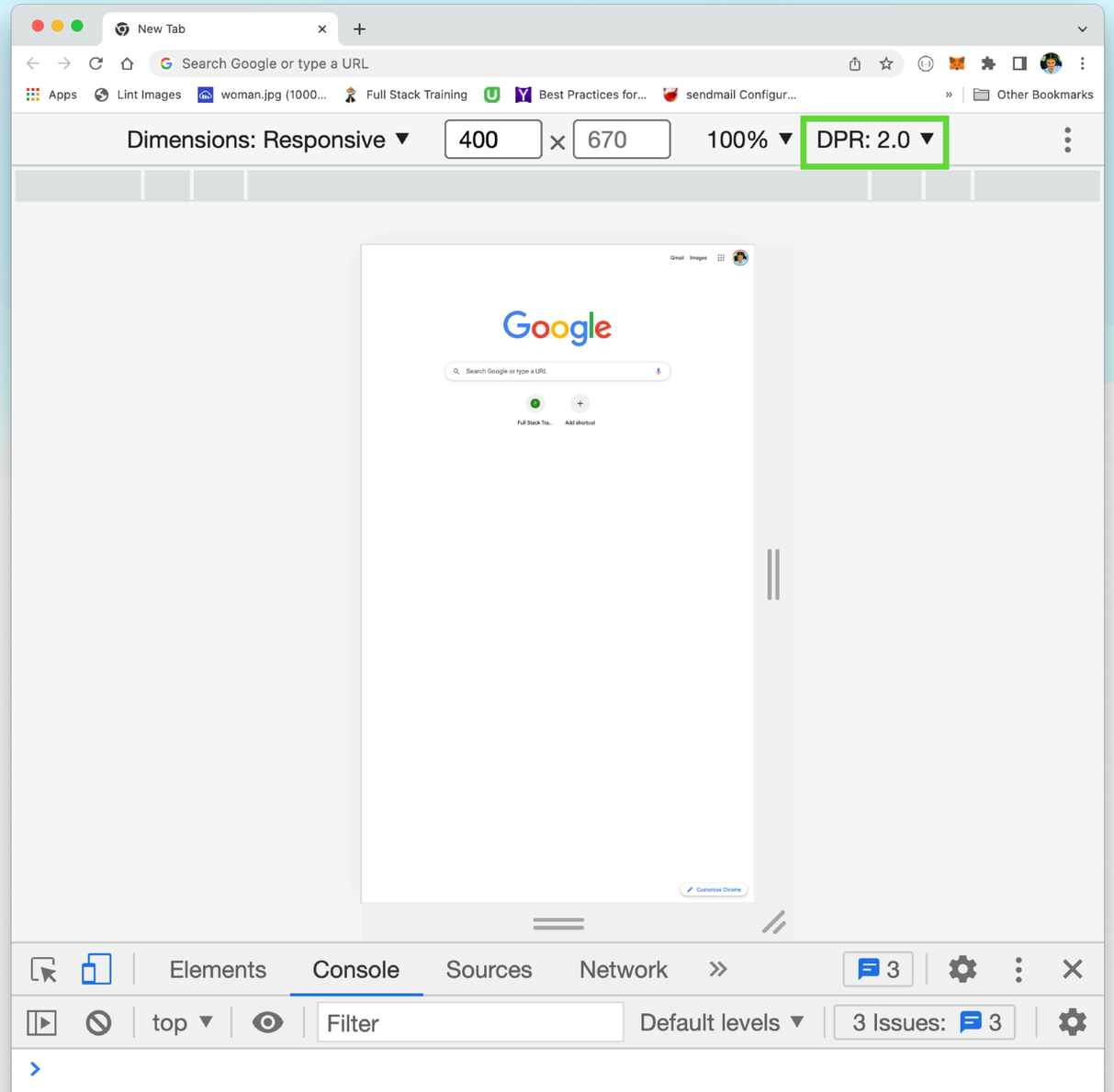
Perform a request or hit ⌘ R to record the reload.

Learn more

```html
<picture>
  <source srcset="zurich.avif" type="image/avif">
  <source srcset="zurich.webp" type="image/webp">
  <img src="zurich.jpg" alt="Zurich, Switzerland"
    width="400" height="400" loading="lazy" decoding="async">
</picture>
```

Pro tip


New Tab
Search Google or type a URL
Apps
Lint Images
woman.jpg (1000...
Full Stack Training
Best Practices for...
sendmail Configur...
Other Bookma
Dimensions: Responsive
400
670
100%
Show device frame
Show media queries
Show rulers
Add device pixel ratio
Add device type
Capture screenshot
Capture full size screenshot
Reset to defaults
Close DevTools
Google
Elements
Console
Sources
Network
3
top
Filter
Default levels
3 Issues: 3


New Tab
Search Google or type a URL
Apps
Lint Images
woman.jpg (1000...
Full Stack Training
Best Practices for...
sendmail Configur...
Other Bookmarks
Dimensions: Responsive
400
670
100%
DPR: 2.0
Google
Elements
Console
Sources
Network
3
top
Filter
Default levels
3 Issues: 3

```
`<link fetchpriority="high" rel="preload"
    href="zurich.jpeg" as="image" />`
```

Format? Content? Devices?
Responsive? Delivery? Decode?

Using Cloudinary

- Optimise image resources: `**q_auto**`
- Generate different versions for difference browsers: `**f_auto**`
- Cache image resources at the CDN level: Cloudinary is a **multi-tenant CDN**
- Lazy-load images: use `**lazy**` attribute
- Use low quality image placeholders (LQIP) to provide instant visuals: `**e_vectorize**` or `**e_blur:1000,q_1,e_grayscale**`

Demo

node ct.css DemoLinks Imported

EN JA ZH

COLLECTIONS BRAND MANUFACTURE PRESS RETAILERS & CONTACT

GPHG
OFFICIAL NOMINATION

NOVELTIES

img.w-full.align-top 189.6 × 253.31

Elements Console Sources Network

```
<div id="contentWra
  <div class="relat
  <div class="bg-wh
    <div class="con
      <div class="b
        <h2 class="
        t">Noveltie
        <ul class="
        x] pb-[60px
          <li class
          <li class
          <li class
            <div cla
              <a hre
                eel-blu
                <img src="
                alt="  class="w-full align-top"> == $0
              </a>
              <h2 class="mt-2 | sm:mt-4 font-bold text-sm uppercase">…</h2>
            </div>
          </li>
          <li class="w-1/2 sm:w-1/3 lg:w-auto mb-10 | md:mb-0">…</li>
          <li class="w-1/2 sm:w-1/3 lg:w-auto mb-10 | md:mb-0">…</li>
```

Rendered size: 190 × 253 px
Rendered aspect ratio: 190:253
Intrinsic size: 1250 × 1670 px
Intrinsic aspect ratio: 125:167
File size: 2.0 MB
Current source:

... -language-en div#mainWrapper div#app.main-content main#main.row div#contentWrapper ...

Styles Computed Layout Event Listeners DOM Breakpoints Properties Accessibility

Filter :hov .cls

```
element.style {
}
.align-top {                                   frontend.scss:163
  vertical-align: top;
}
.w-full {                                      frontend.scss:163
  width: 100%;
}
img, video {                                   frontend.scss:18
  height: auto;
  max-width: 100%;
}
audio, canvas, embed, iframe, img, object, svg, video {   frontend.scss:18
  display: block;
  vertical-align: middle;
}
```

Resources

- **State of Visual Media (2022)**: https://cloudinary-marketing-res.cloudinary.com/image/upload/sovm22-state-of-visual-media-report-2022.pdf
- **State of Media (Web Almanac 2022)**: https://almanac.httparchive.org/en/2022/media
- **web.dev**: https://web.dev/fast/#optimize-your-images
- **Get started with Cloudinary**: https://cloudinary.com/documentation/cloudinary_get_started
- **Go all in**: https://cloudinary.com/blog/author/jon_sneyers

🇸🇬 Thank you 🇸🇬

tpiros.dev