

Image compression:

On-demand systems seeking minimal latency.

Graduation work

Optimisation techniques for mobile

- Graphics Textures
- Software Loading time
- Files Compression

Web pages

Not everything is an app

Environments change

Web pages are universal

- Chrome OS
- iPhone

On-demand Systems

- Web pages
- Games
- Adverts
- Chats
- Etc.

Timing not known

Resources not known

Request > Response

Image compression

- Important
- Large
- Ubiquitous

Long loading times

Visual delays

Analysis

- | | |
|---------------|------------------------------------|
| 1. Request | Lag |
| 2. Response | Network latency |
| 3. Download | Network bandwidth
Resource size |
| 4. Processing | Decompression time |
| 5. Ready | Buffer update time |

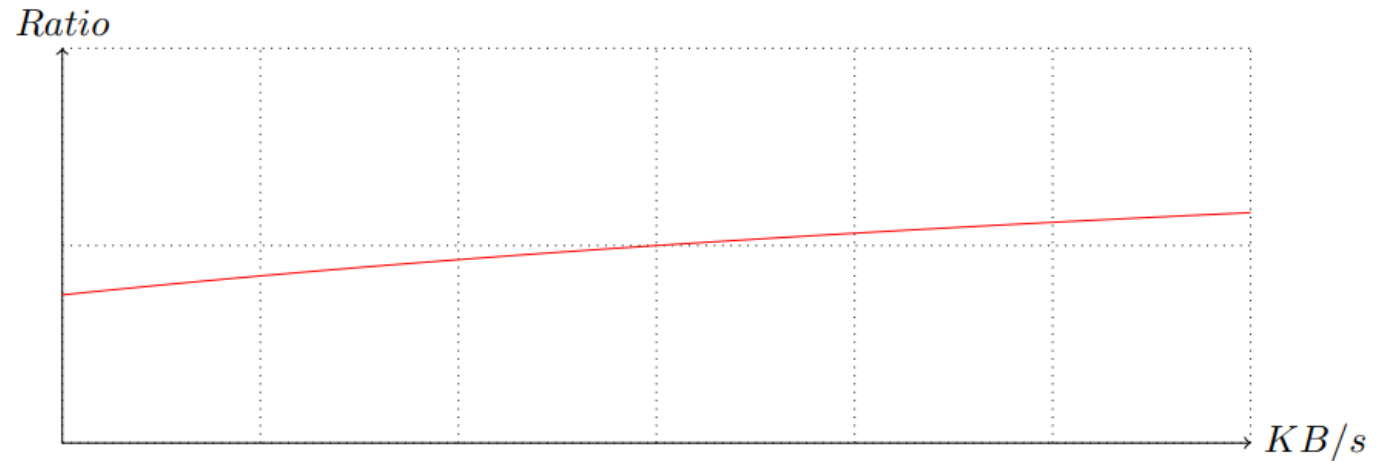
Analysis Network

- Network speed
- File size

$$T = (size * ratio) / speed + latency$$

Analysis Network

- Comparing two functions



$$speed < size * (ratio1 - ratio2) / (latency2 - latency1)$$

Analysis

Decompression

- Time complexity
- Initialisation
- Error

$$latency = O(size) * factor * (1 \pm error) + base$$

Benchmark

Source	• Size
	• Time
Archive	• Size
	• Time
Soucre	

Benchmark

Executables Reference implementation

Constraint Single threaded

Environment RAM disk

Script PowerShell

Formats

Web formats

Jpeg Not lossless

PNG Lossless

WebP "Format for the Web"
(Google. 2012)

Jpeg XL Recent JPEG format

AVIF Free HEVC (AV1) codec

Formats

General formats

(Deflate) LZ77 .png .gif .zip ...

Gzip .gz

LZMA .xz .7z

bzip2 .bz

PPMd .7z

Formats

Niche formats

Flic	Alexander Rhatushnyak
Qlic	(Rhatushnyak. 2010)
Qic	

Kvick	DCGC
EMMA	(MSU Media Group. 2020)

Benchmark

7	Quick test	~5 minutes
500	Decent test	~7 hours
16000	Thorough test	~? Days

Benchmark

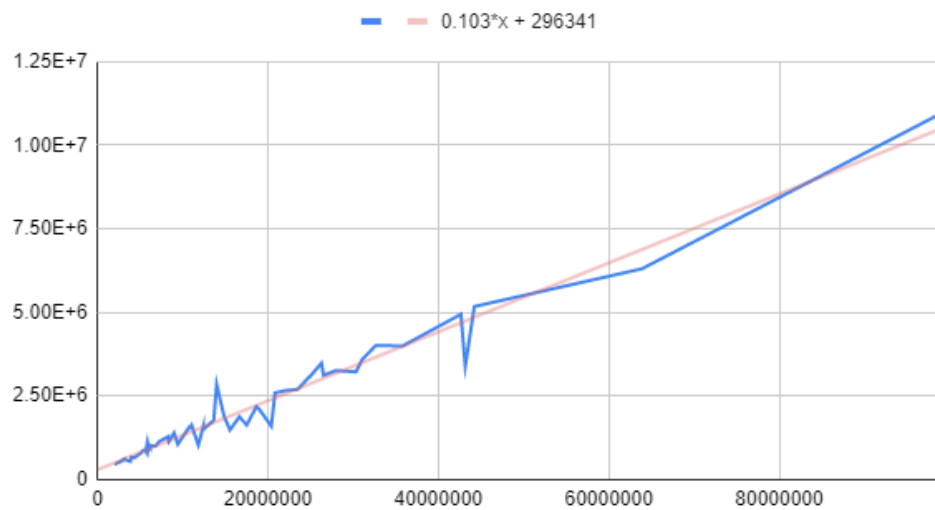
Complexity

Source file size

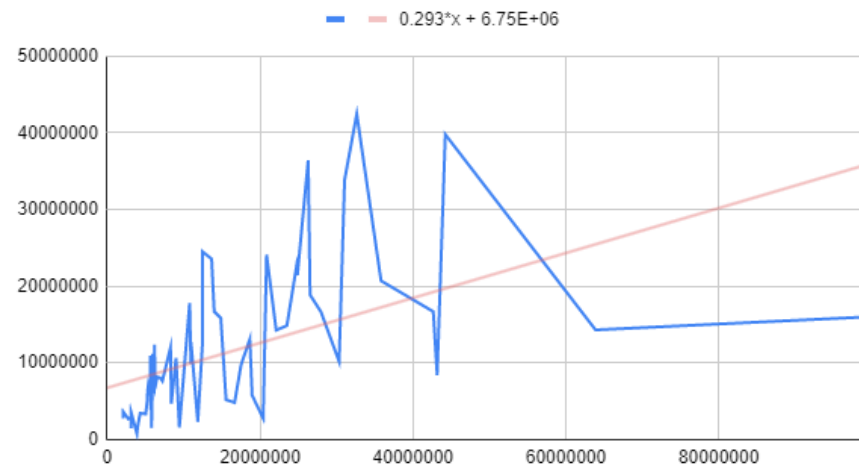
Decompression time

$$latency = O(size) * factor * (1 \pm error) + base$$

PNG



PPMD



Variable network

All formats

The graph illustrates the performance of various image and video compression formats relative to raw data transfer as network speed increases. The x-axis represents network speed in KB/s on a logarithmic scale, and the y-axis represents the percentage of time spent on raw download. Formats like FLIC, JXL, and AVIF show a significant increase in the ratio as network speed increases, indicating they become less efficient compared to raw data at high speeds. Conversely, formats like DEFLATE and GZIP maintain a relatively low and stable ratio across the range of network speeds.

Network speed (KB/s)	FLIC	WEBP	WP2	QLIC2	QLIC	QIC	JXL	BZIP2	PPMD	AVIF	PNG	LZMA2	GZIP	DEFLATE
1	35	35	30	45	35	35	35	45	30	35	35	35	30	45
10	35	35	30	45	35	35	35	45	30	35	35	35	30	45
100	35	35	30	45	35	35	35	45	30	35	35	35	30	45
1000	40	35	55	45	35	35	40	45	30	35	40	35	30	45
10000	85	45	100	50	40	40	60	55	40	45	55	45	35	45

Variable size

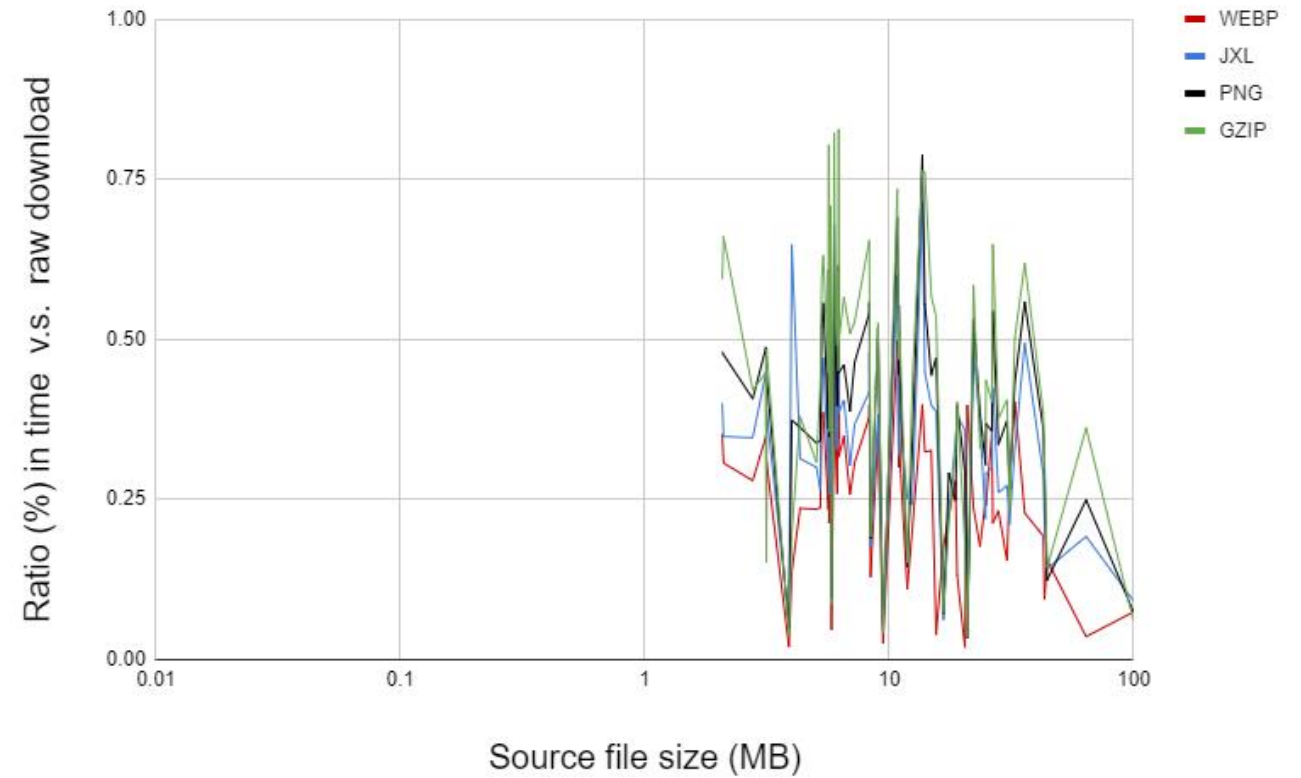
All formats

The graph plots the 'Ratio (%) in time v.s. raw download' on the y-axis (0 to 100) against 'Source file size (MB)' on the x-axis (logarithmic scale from 0.01 to 100). The legend identifies the following codecs: FLIC (blue), WEBP (red), WP2 (yellow), QLIC2 (green), QLIC (orange), QIC (teal), JXL (light blue), BZIP2 (pink), PPMD (gold), AVIF (light blue), PNG (black), LZMA2 (cyan), GZIP (dark green), and DEFLATE (light pink). The curves show that for small files, the ratio is high (near 100%), indicating poor compression efficiency. As the file size increases, the ratio decreases, indicating better compression. For large files (above 10 MB), the ratio stabilizes, with most codecs achieving a ratio between 25% and 50%. PNG and DEFLATE generally show the highest ratios for large files, while WP2 and PPMD show the lowest.

Real data

Real data

Network speed: 650 KB/s

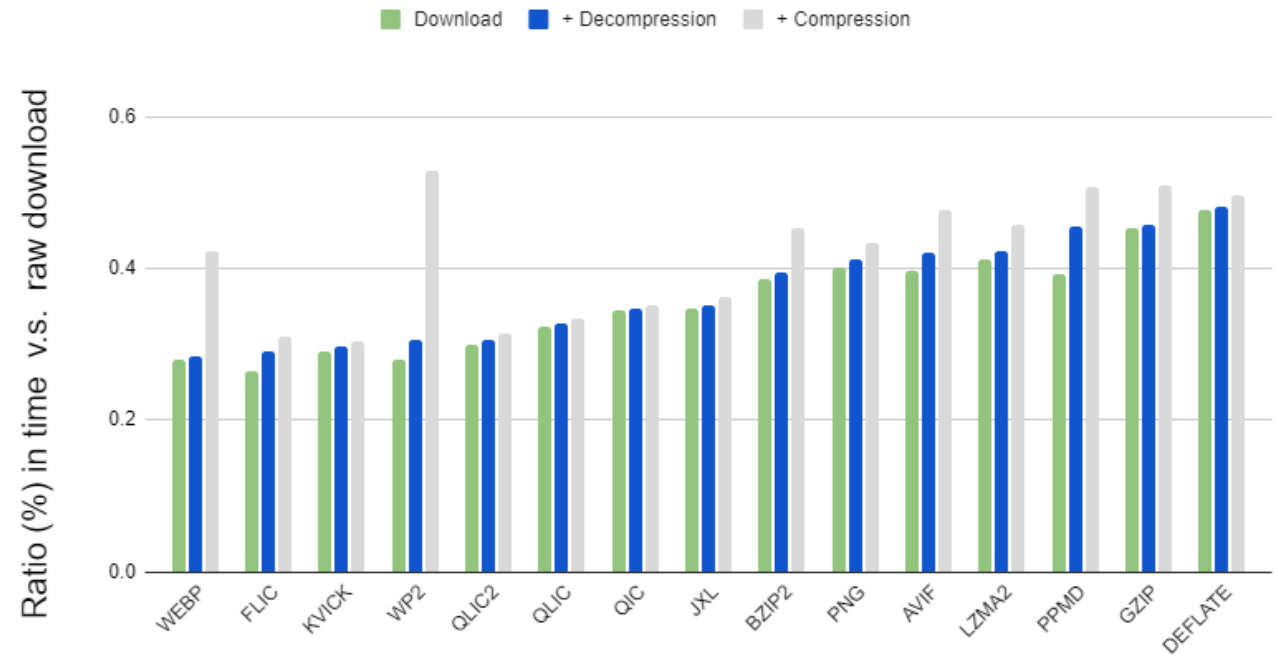


Ranking

Combined average

All formats

Network speed: 650 kb/s

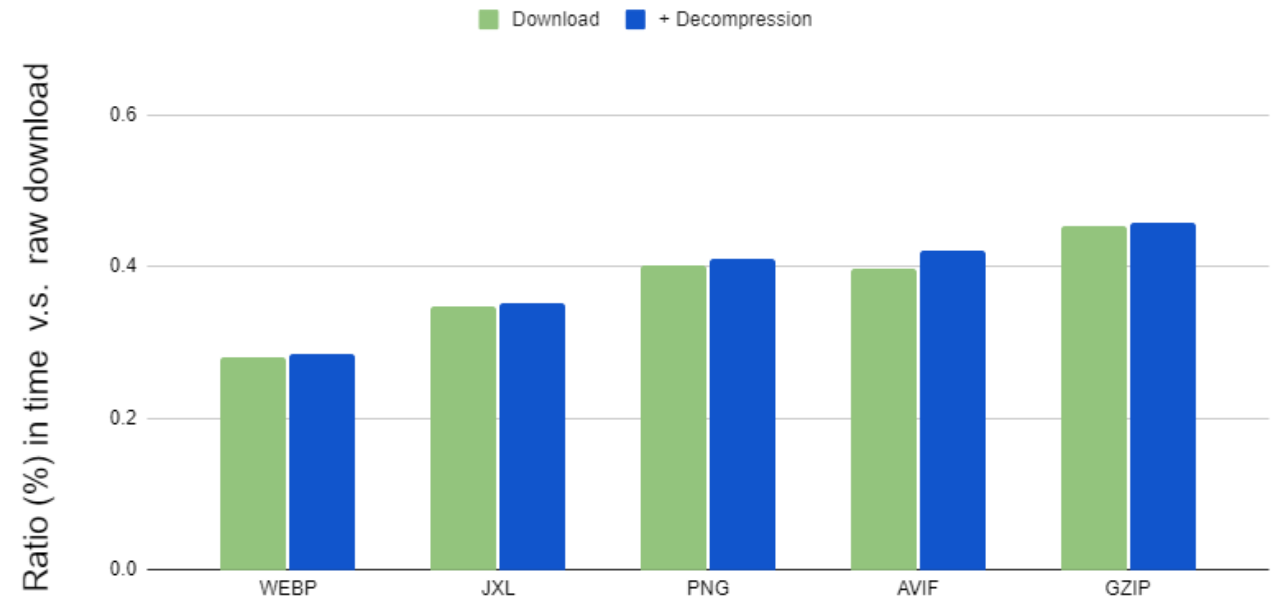


Ranking

Combined average

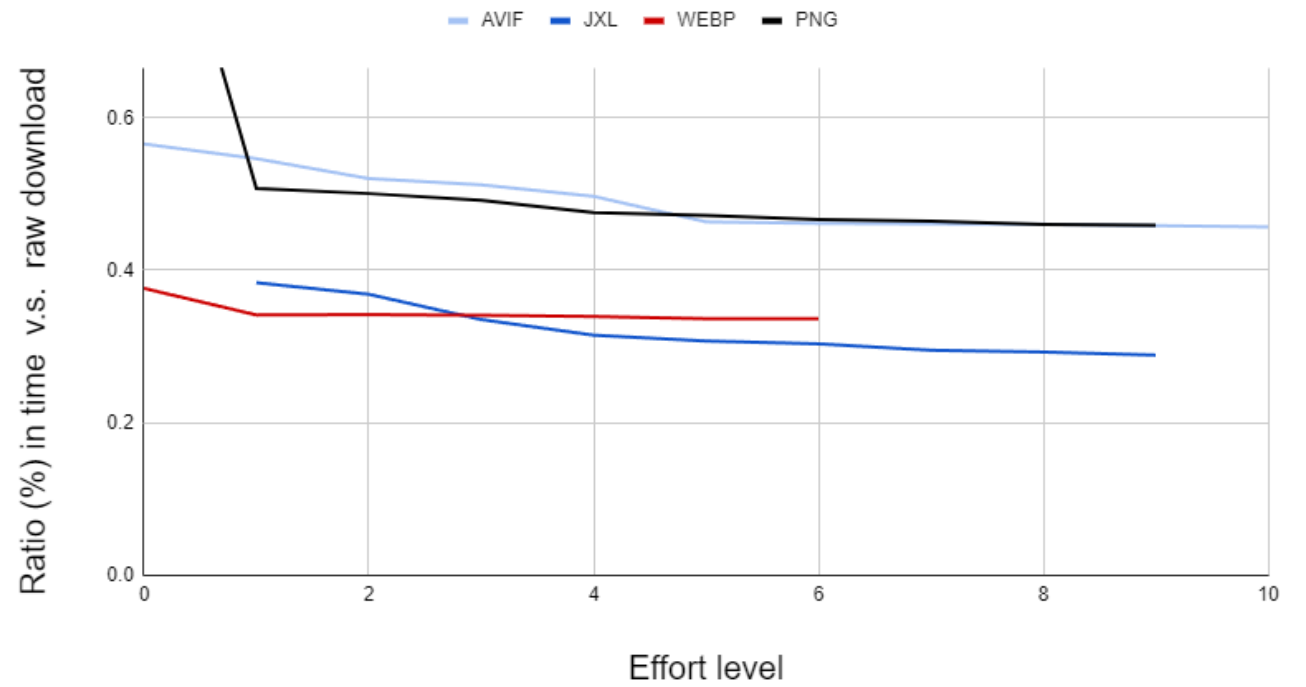
Web formats

Network speed: 650 KB/s



Effort

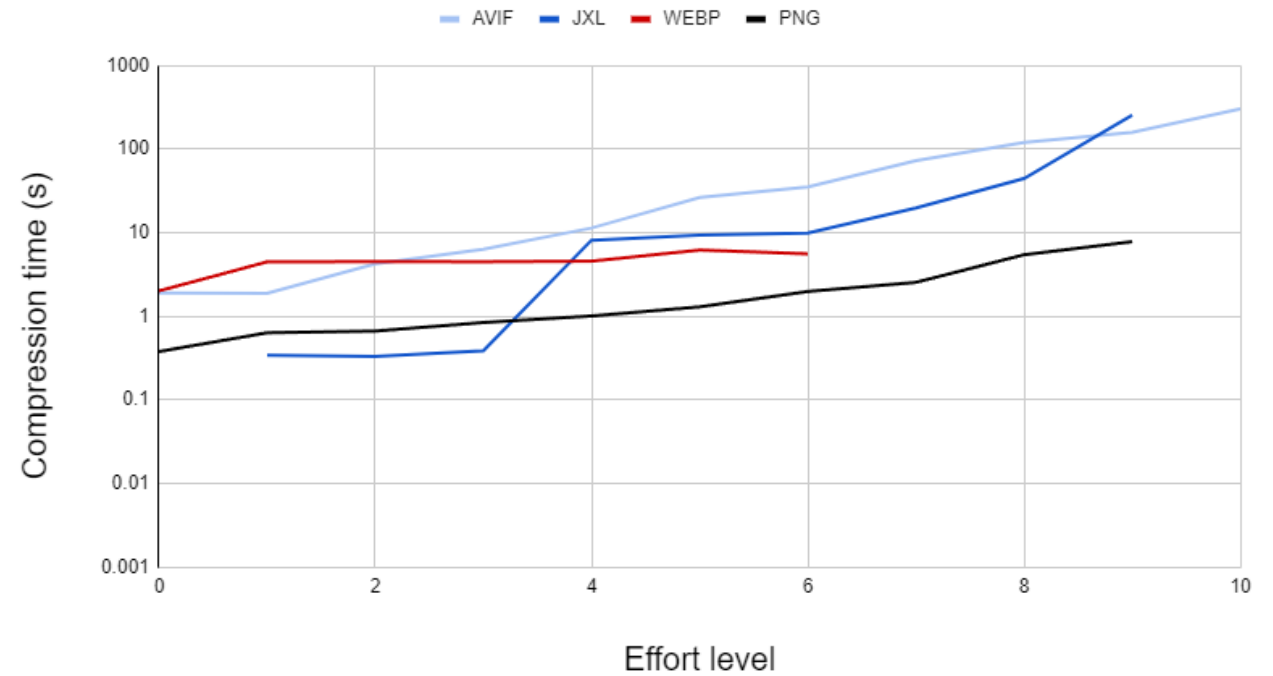
Effort: Download + Decompression



Effort

Compression time

Effort: Compression

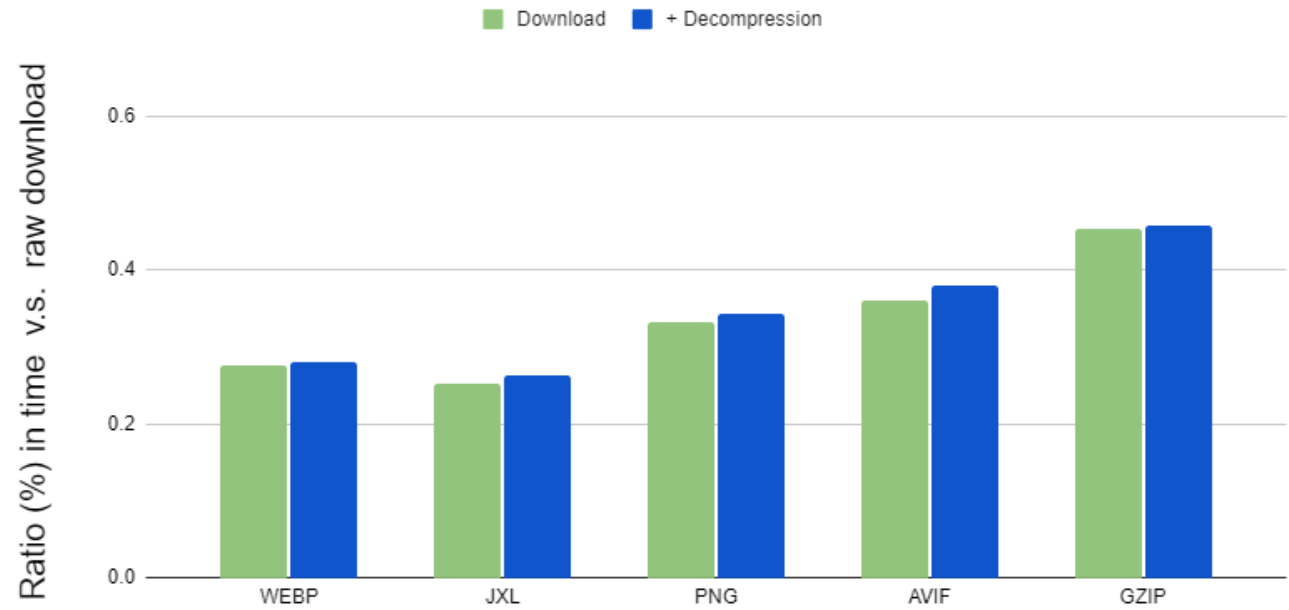


Effort

Web formats

Network speed: 650 KB/s

+ Effort gain



Conclusion

- Jpeg XL Best (absolute)
- WebP Best (browser support)
- Flic Honourable mention

Questions ?