Image compression:

On-demand systems seeking minimal latency.

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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

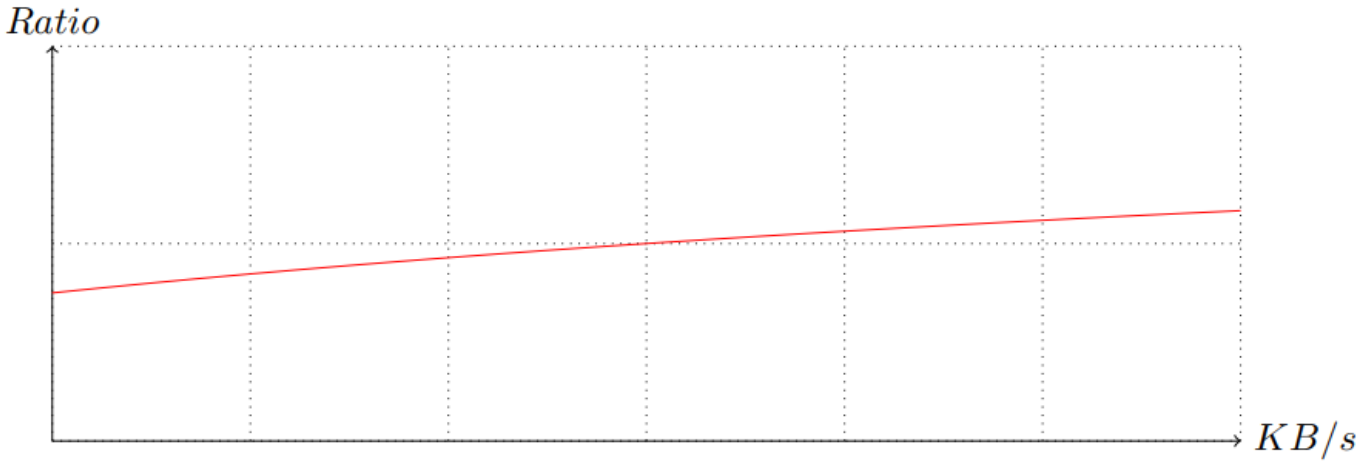
Analysis
Network

- 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
|
Archive
|
Soucre

- Size
- Time
- Size
- Time

Benchmark

Executables	Reference implementation
Contraint	Single threaded
Environment	RAM disk
Script	PowerShell

Derived values

- Exact data

Compression ratio

- Variable data

Download time

- Theoretical data

Complexity approximation

Assumptions

- Complexity

Hard to measure correctly

➢ O(n)

- Theoretical model

Based on complexity

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

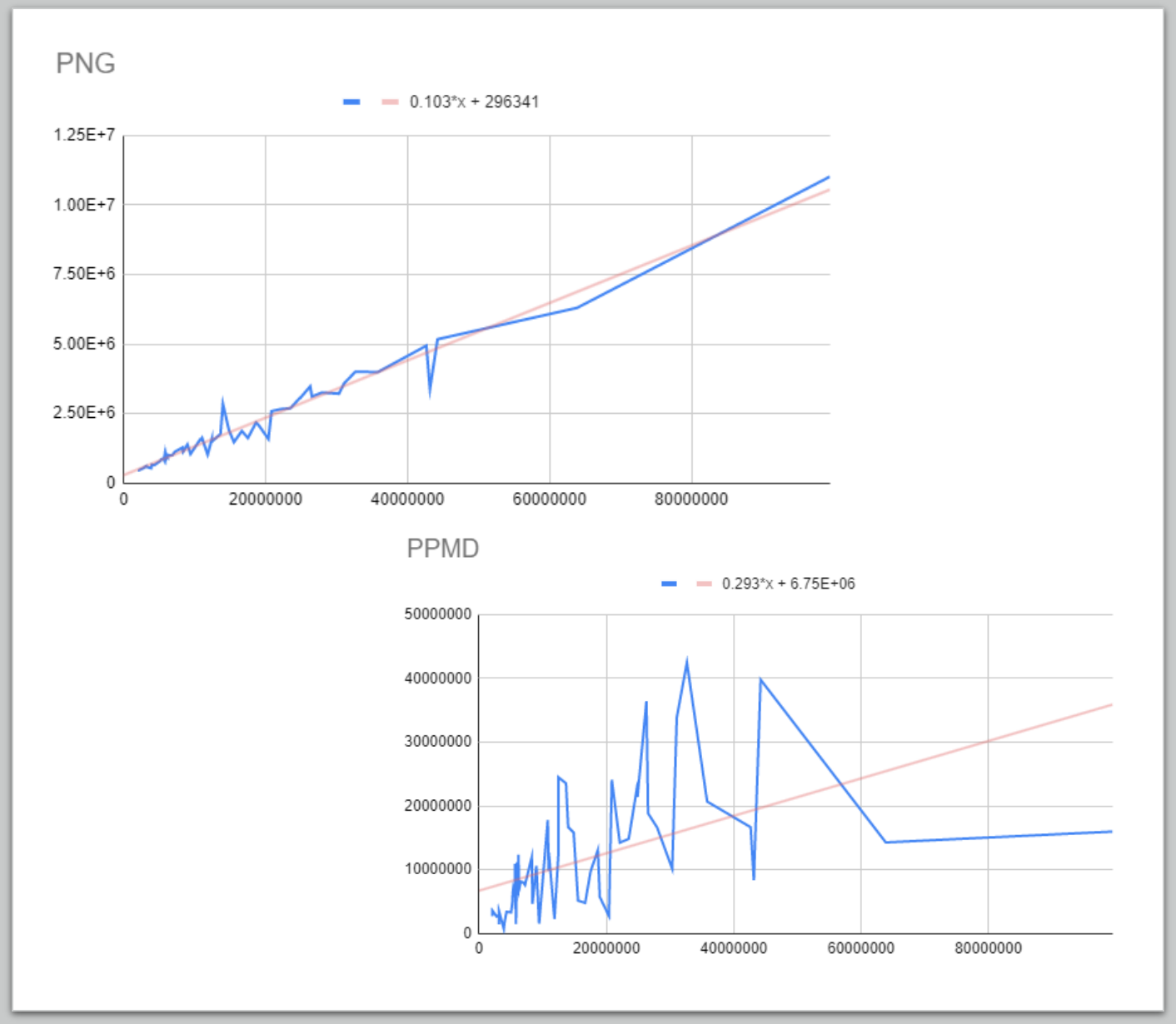
Benchmark

Complexity

Source file size

Decompression time

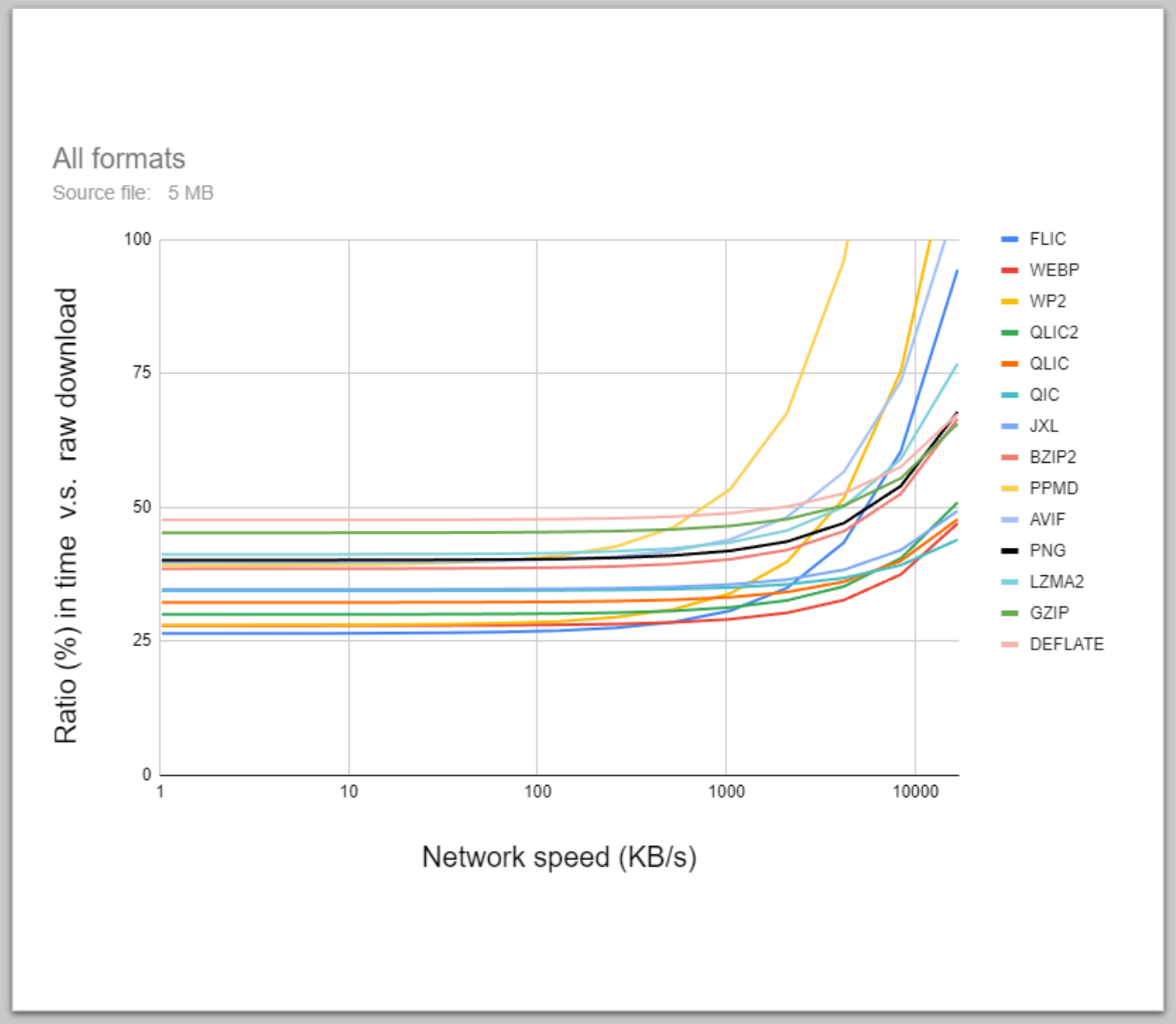
$$latency = O(size) * factor * (1 \pm error) + base$$



Model

Variable network

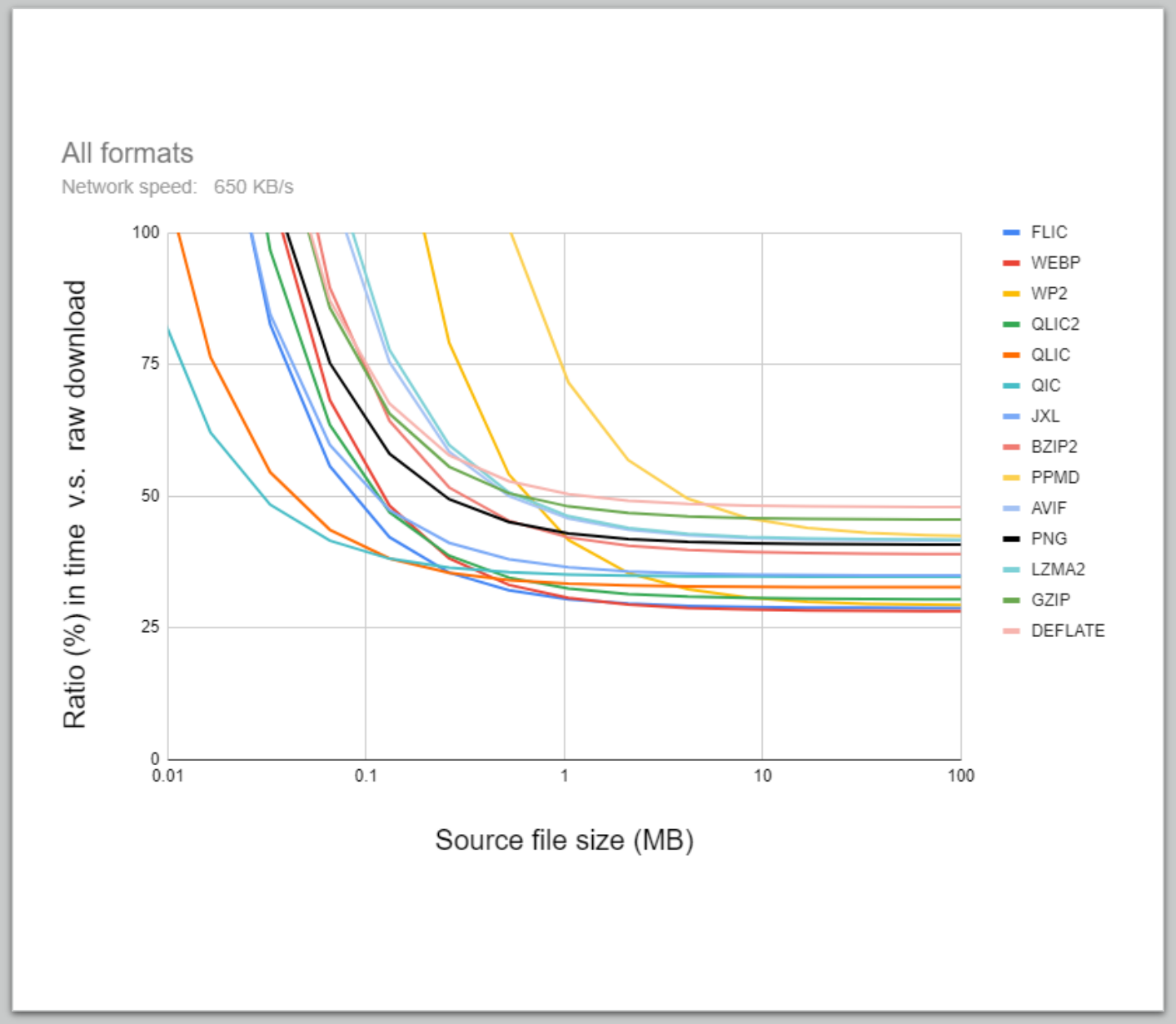
$$T = (size_0 * ratio)/speed + size_0 * factor + base$$



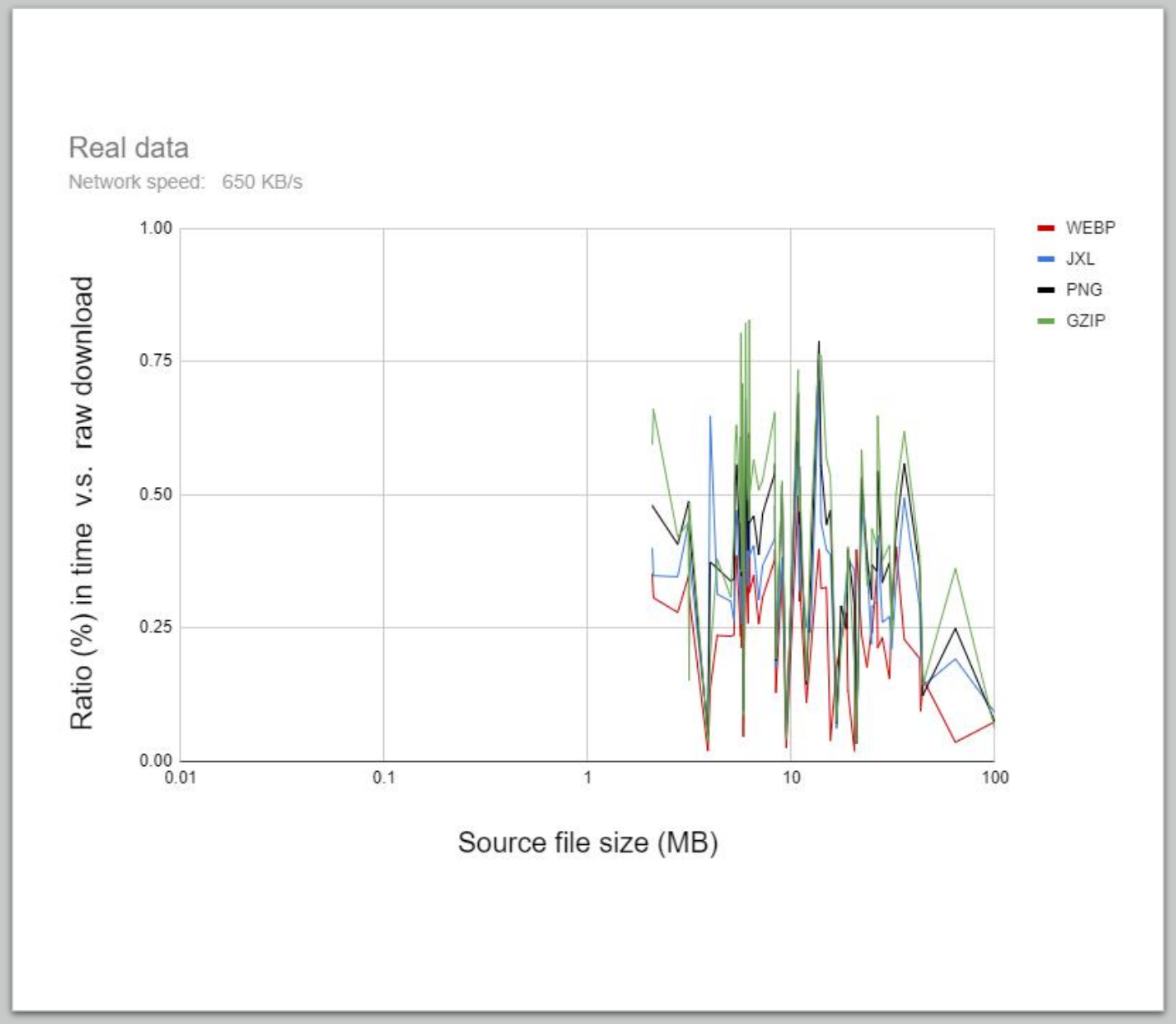
Model

Variable size

$$T = (size_0 * ratio)/speed + size_0 * factor + base$$

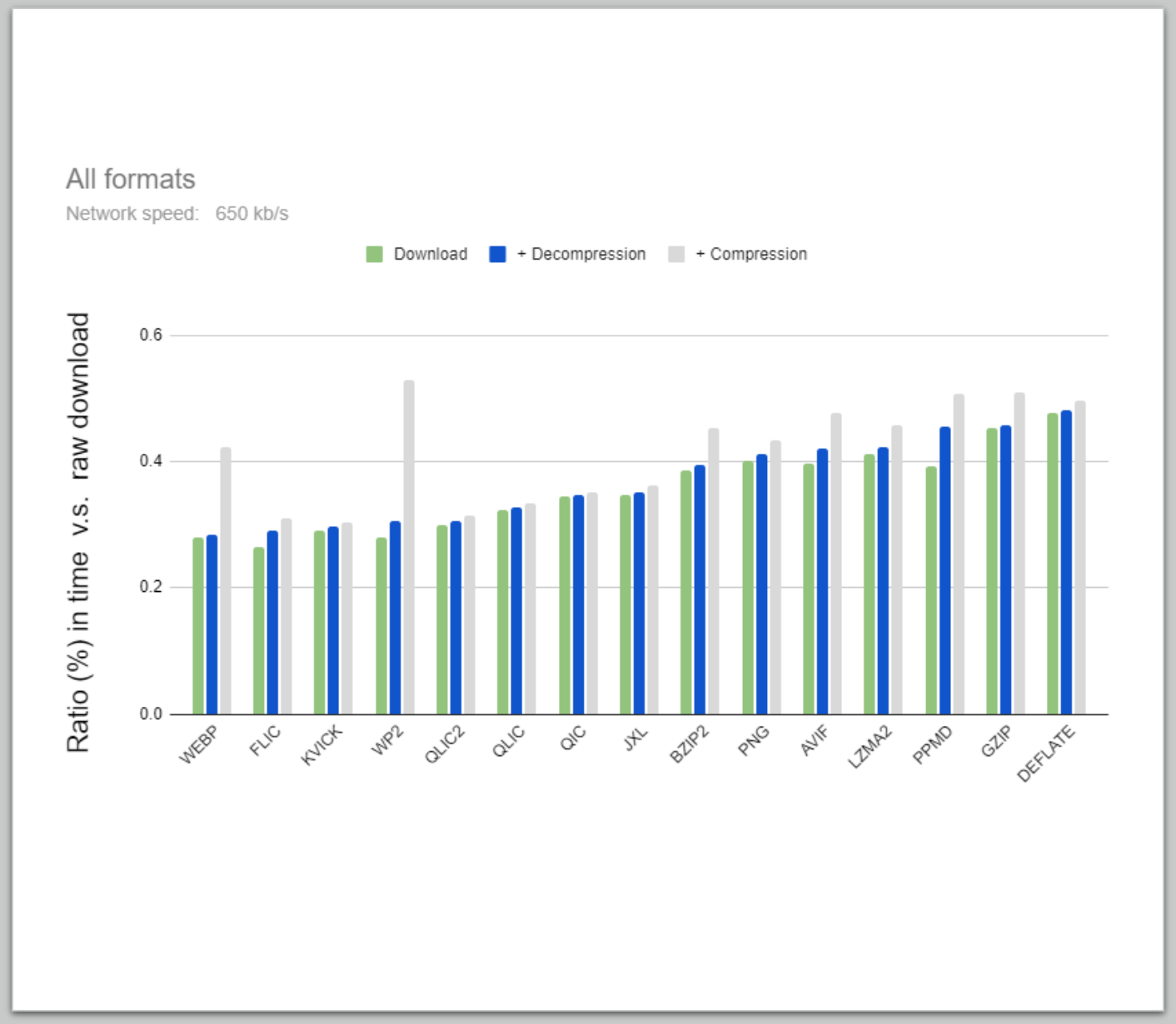


Real data


Real data
Network speed: 650 KB/s
Ratio (%) in time v.s. raw download
1.00
0.75
0.50
0.25
0.00
0.01
0.1
1
10
100
Source file size (MB)
WEBP
JXL
PNG
GZIP

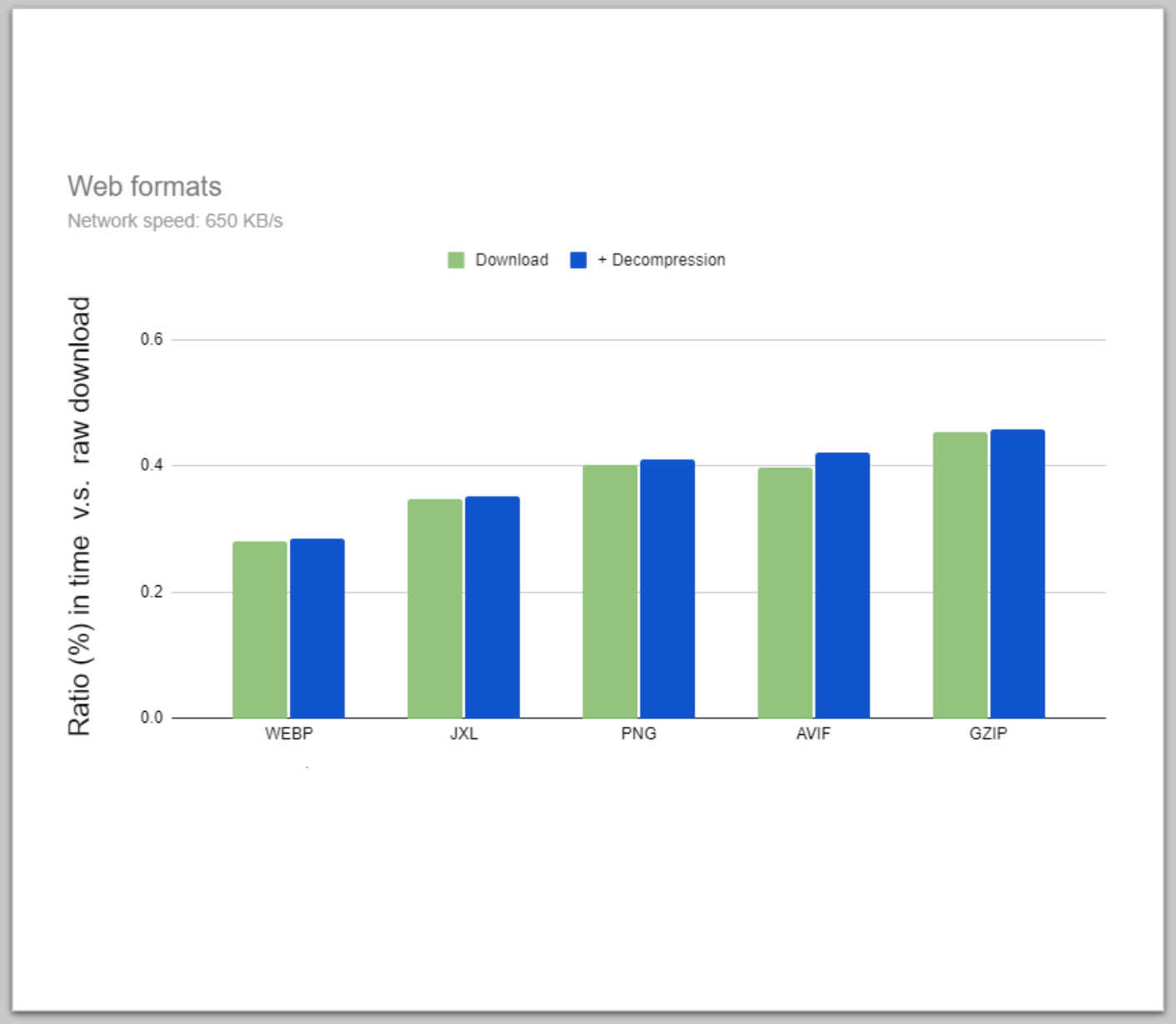
Ranking

Combined average

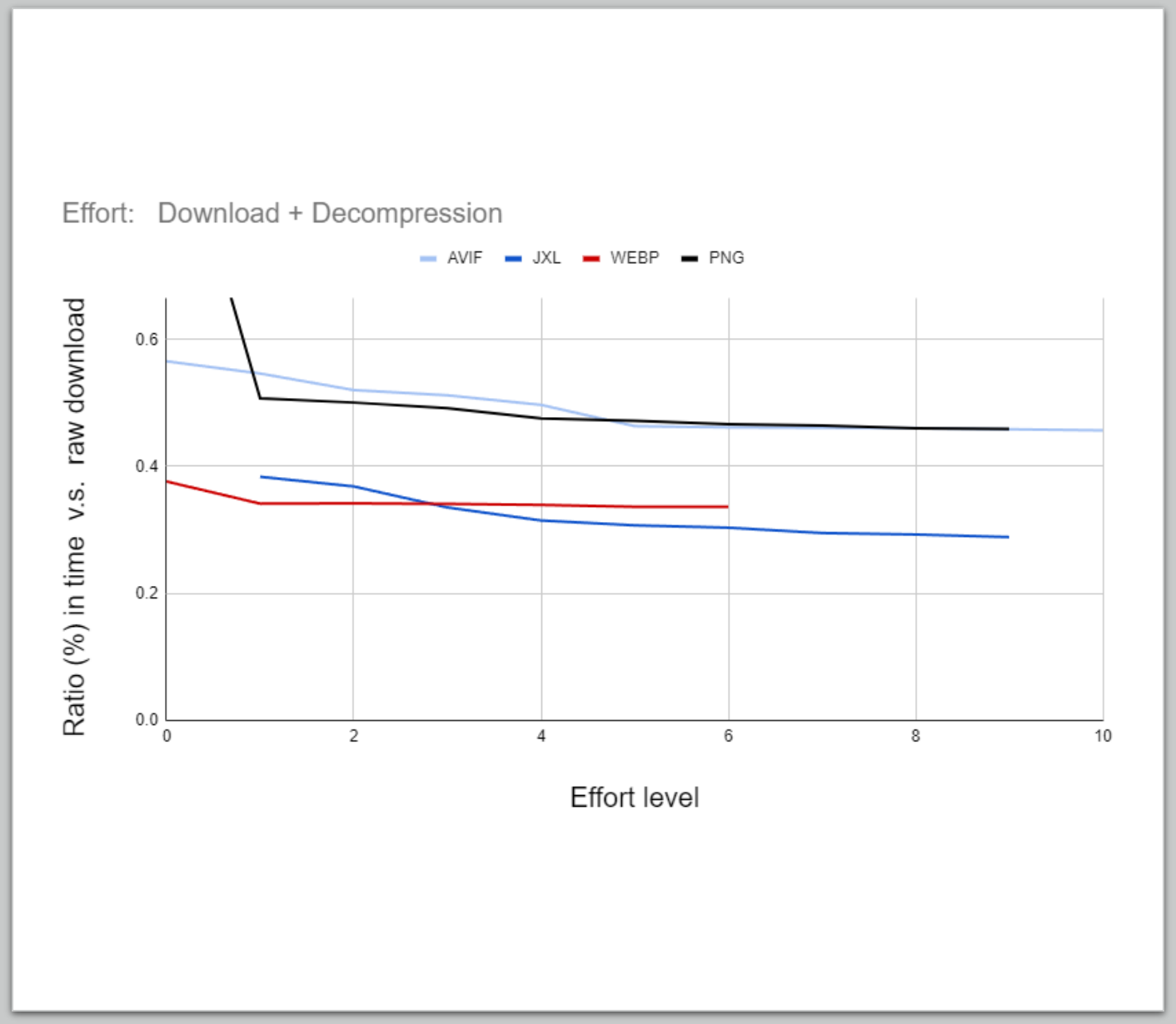


Ranking

Combined average

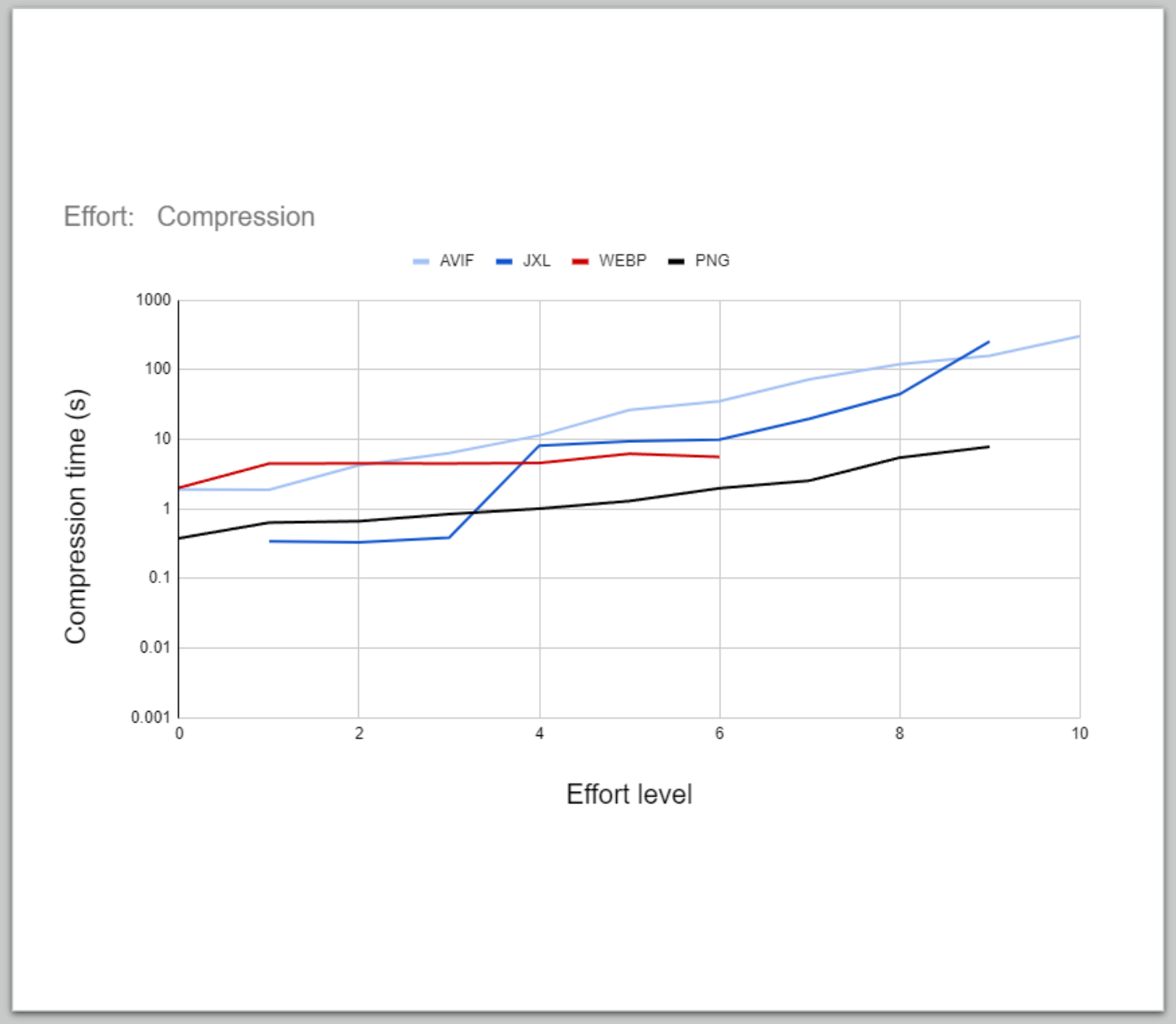


Effort

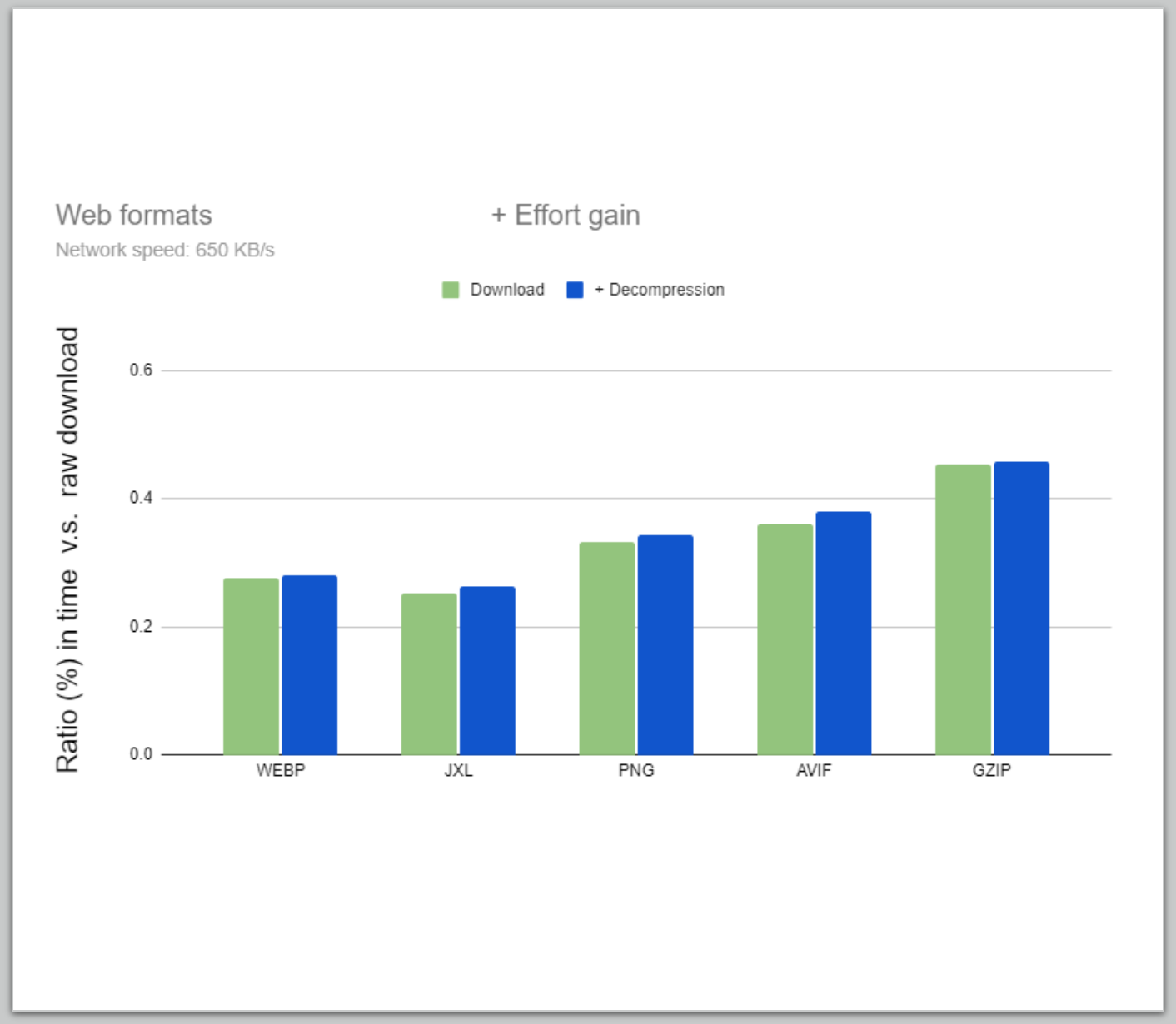

Effort: Download + Decompression
AVIF
JXL
WEBP
PNG
Ratio (%) in time v.s. raw download
0.6
0.4
0.2
0.0
0
2
4
6
8
10
Effort level

Effort

Compression time



Effort


Web formats
+ Effort gain
Network speed: 650 KB/s
Download
+ Decompression
Ratio (%) in time v.s. raw download
0.6
0.4
0.2
0.0
WEBP
JXL
PNG
AVIF
GZIP

Conclusion

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

Questions ?