

moz://a

Firefox Quantum

Performance in Firefox

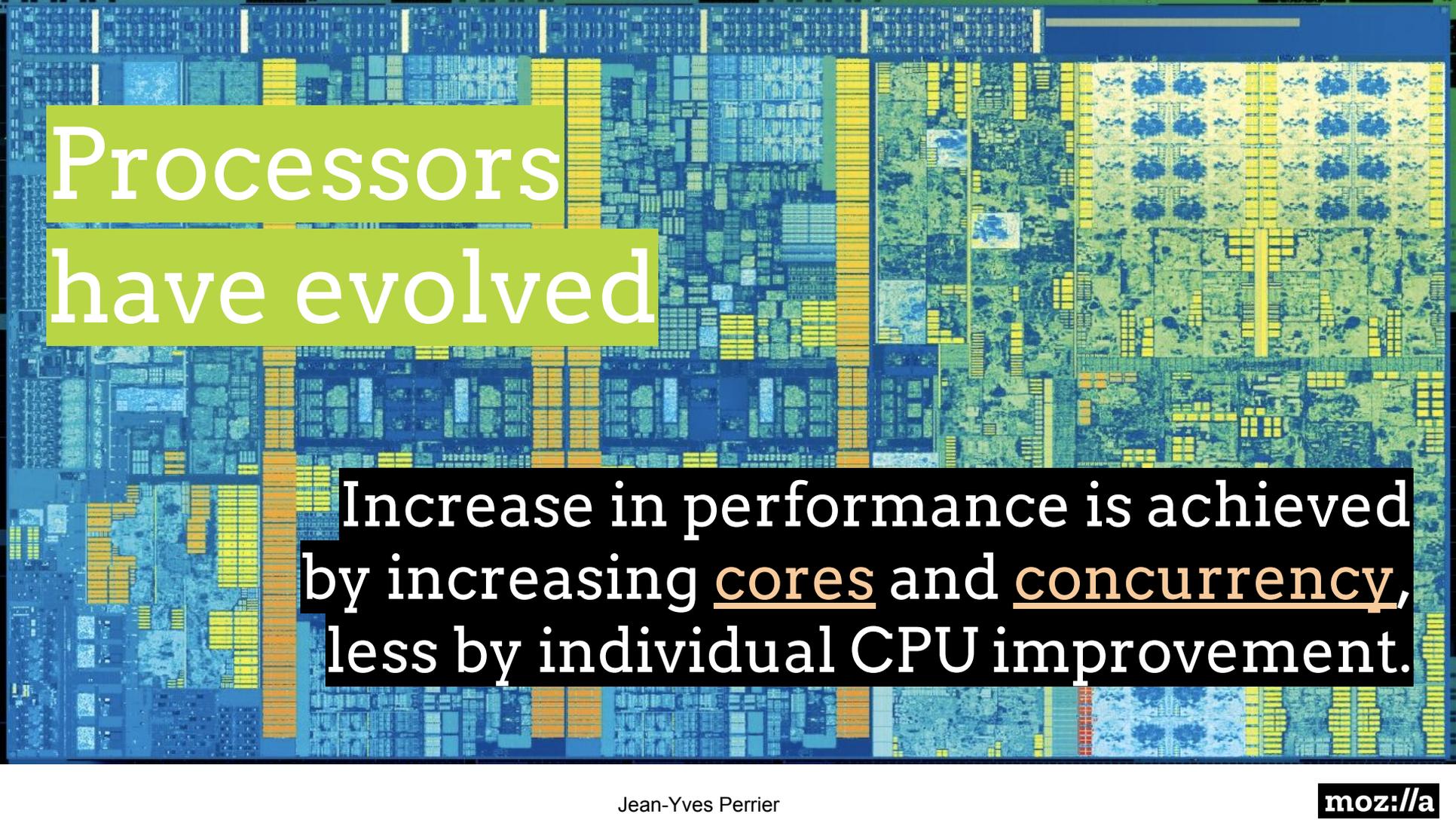
Jean-Yves Perrier
2018-02-03



Jean-Yves Perrier

I am part of Developer Outreach

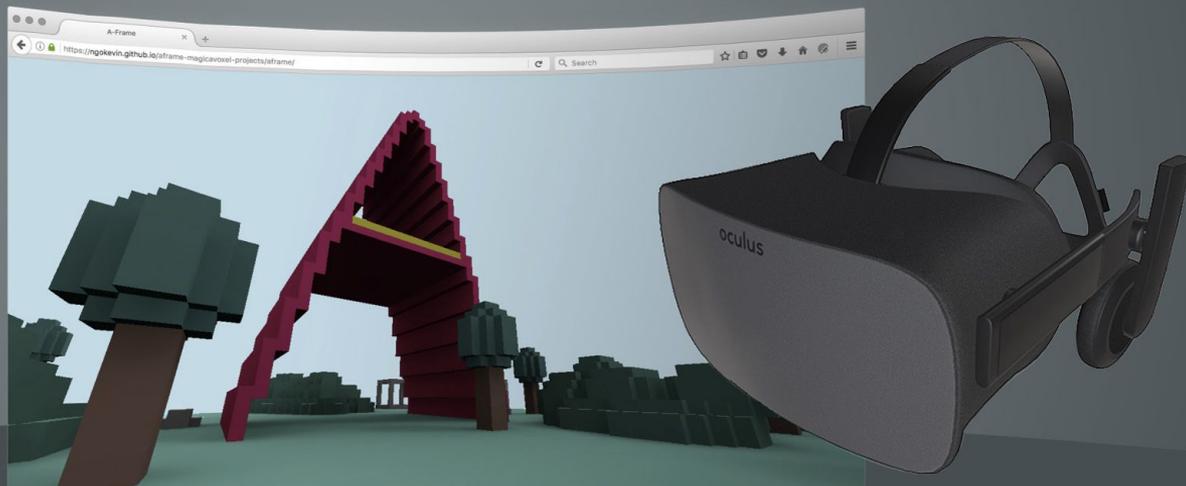
Twitter: [@teoli2003](https://twitter.com/teoli2003)



Processors have evolved

Increase in performance is achieved by increasing cores and concurrency, less by individual CPU improvement.

Expectations changed



In the 2000s we wanted pages with images;
today we want 60 fps **virtual reality**
with **HD videos**.

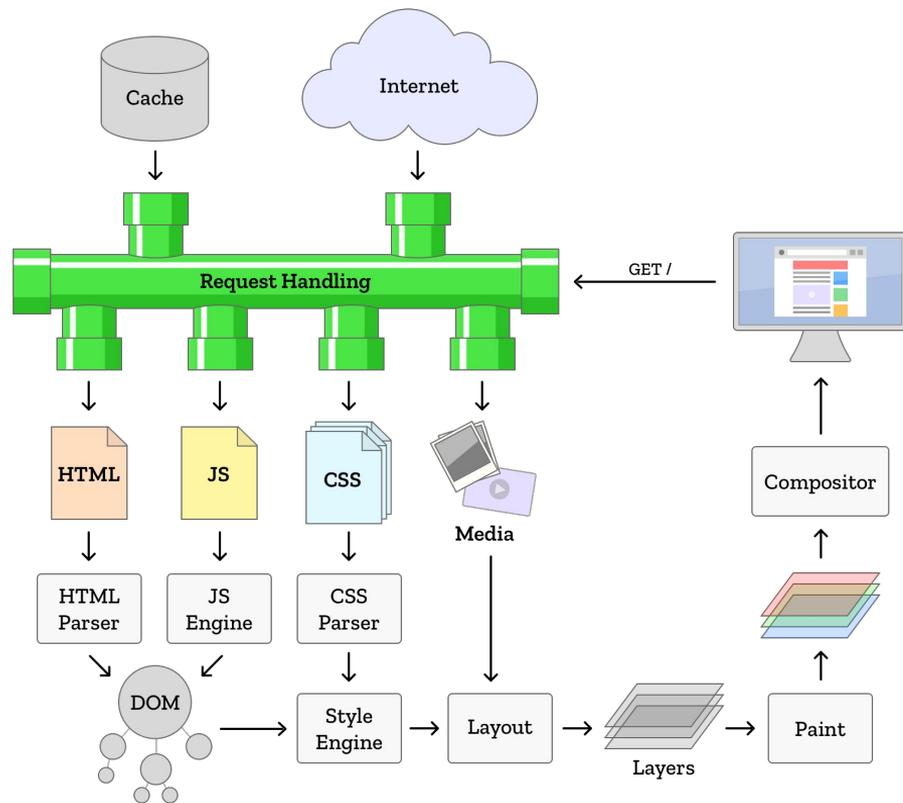
Mark 3



Mark 57



The rendering engine



Drawing by Potch



Our testbed: Servo

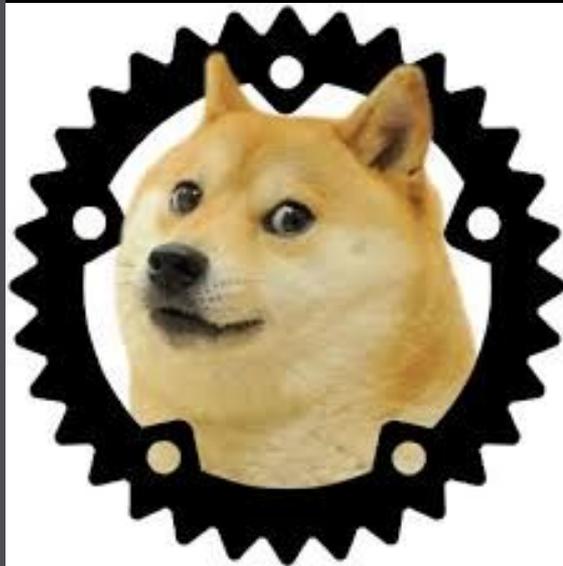
An experimental engine:

Written in Rust

Massive parallelism

No significant UI

Break the Web



Project Quantum



Problems to solve:

Stability

Old theme

UI jank

Integration of improvements from Servo

Project Quantum



Quantum Composer

Quantum CSS (Stylo)

Quantum Flow / Quantum DOM

Photon

Quantum Renderer (WebRender)

Quantum Compositor



GPU does composition well: offload to GPU

On Windows, lots of **crashes** caused by graphic drivers

Idea: isolate the compositor in its own process

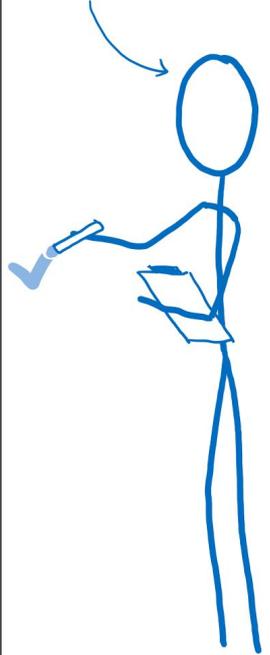
Improve: stability

Released: Firefox 53, April 19th, 2017

Quantum CSS (Stylo)



match selectors



sort declarations
by specificity

origin	selector	property	value	specificity
author	.message p	color	white	0,1,0,1
author	p	color	blue	0,0,0,1
user-agent	p	margin-top	1em	0,0,0,1
user-agent	p	margin-bottom	1em	0,0,0,1

compute property values

COMPUTED STYLES

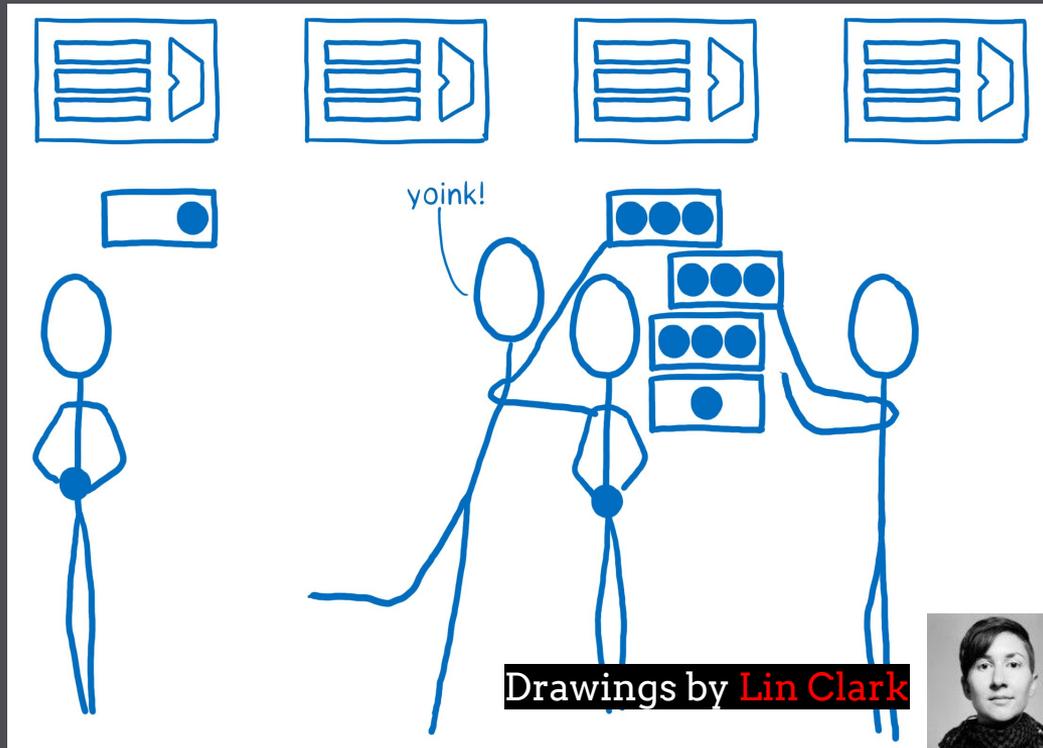
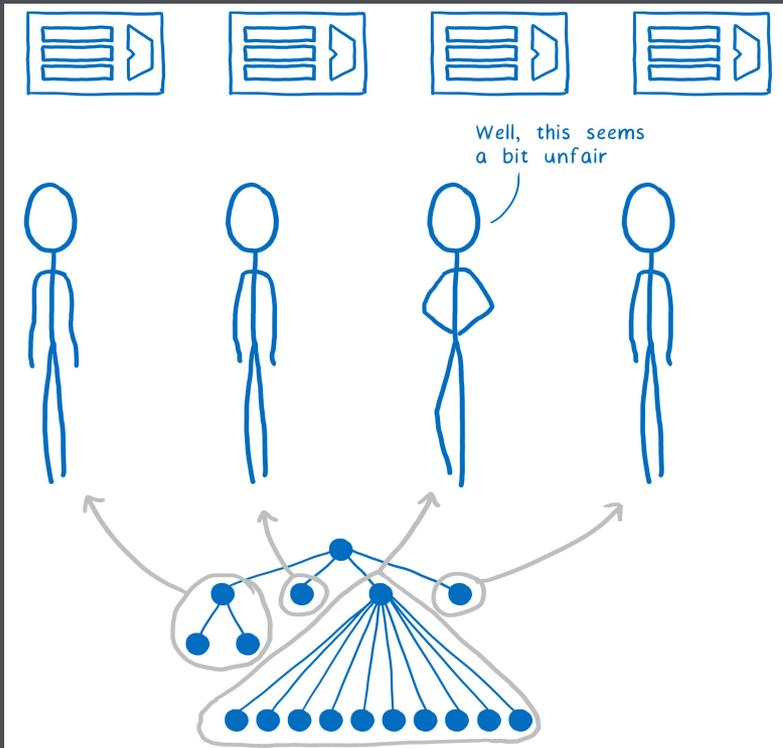
PLEASE PRINT CLEARLY IN BLACK INK

COLOR style struct #213	MARGIN style struct #57
FONT style struct #24	PADDING

Drawing by **Lin Clark**



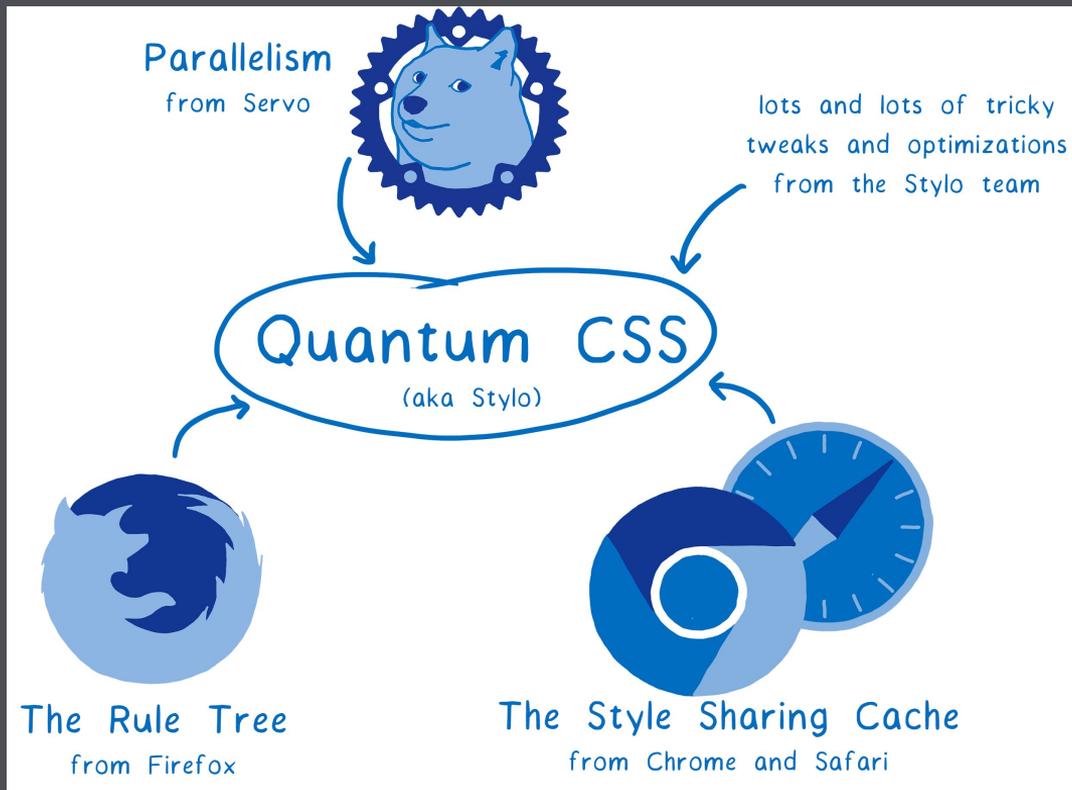
Quantum CSS (Stylo)



Drawings by **Lin Clark**



Quantum CSS (Stylo)



Style Sharing Cache

Same ids, classes, ... ?

Same inline styles ?

Same parents ?

Same "oddities",
like `:first-child()`?

Drawing by [Lin Clark](#)



Quantum CSS (Stylo)



First technology transfer from Servo

Embarrassingly parallel problem

Works best for complex pages.



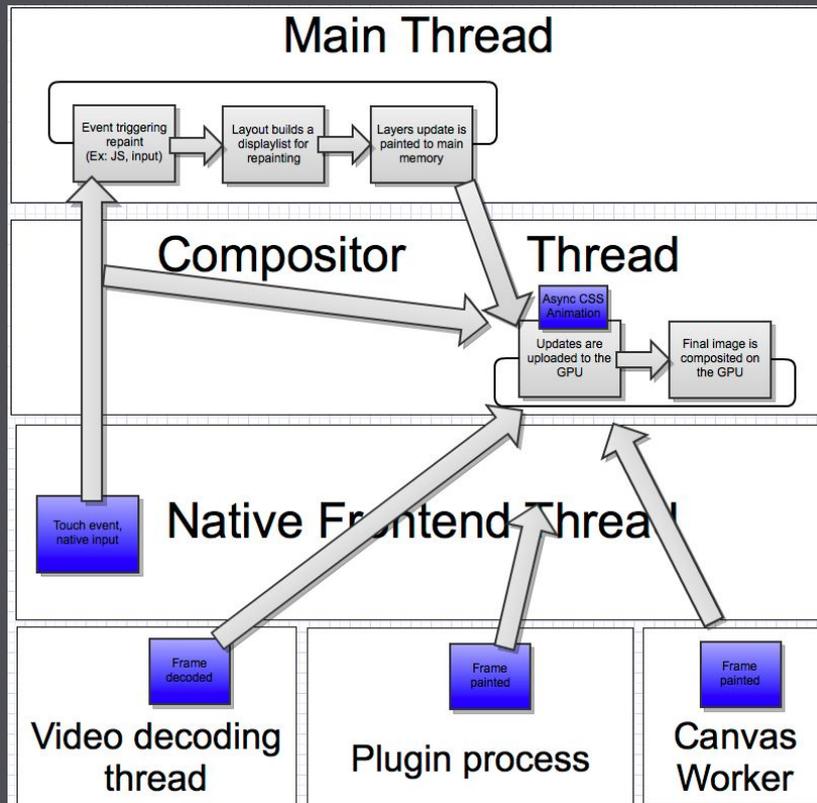
More info:

<https://hacks.mozilla.org/2017/08/inside-a-super-fast-css-engine-quantum-css-aka-stylo/>
by the amazing **Lin Clark** who did the great drawings.

Improve: performance

Desktop: in Firefox 57, November 14th, 2017

The Main Thread Challenge



Quantum Flow



Approach performance in Firefox as a **system**

Measure all the things!
then triage, prioritize and (re)-measure

Goal: Fight **jank**

Hundreds of improvements
“Death by a million cuts”



Read Ehsan Akhgari blog posts:

<https://ehsanakhgari.org/blog/2017-09-15/quantum-flow-engineering-newsletter-24>

Improve: overall performance

Release: Bits by bits (Firefox 57), November 14th, 2017

QFlow: Better scrolling



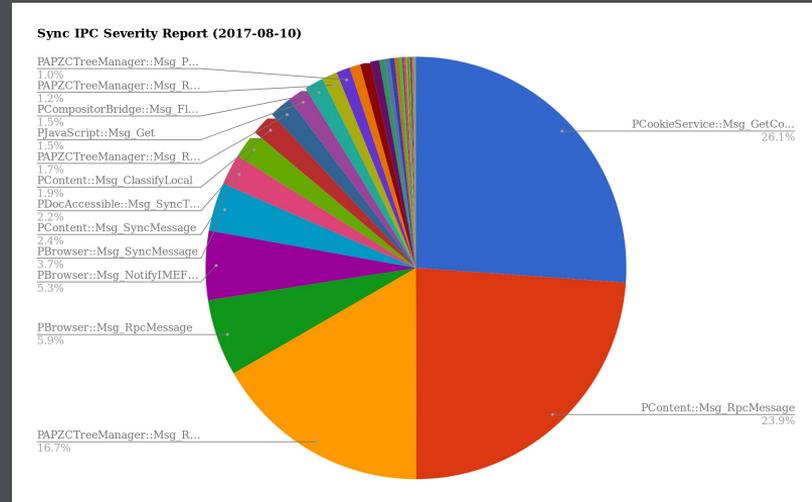
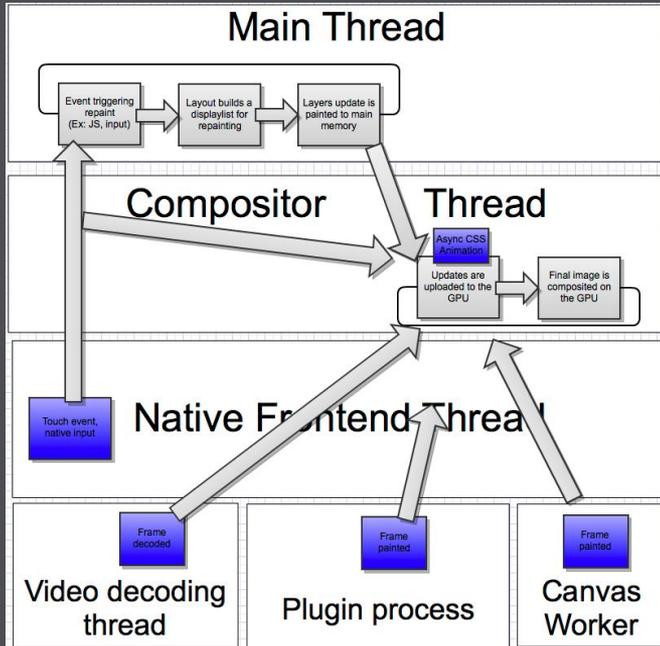
Never pause it, the user gets confused

Checkerboard: When no data ready, display a default pattern.

Same overall performance, but **user feeling** completely different.

This was standard for mobile (touch interface),
but we now use it for all input type, even on desktop.

QFlow: No sync IPC

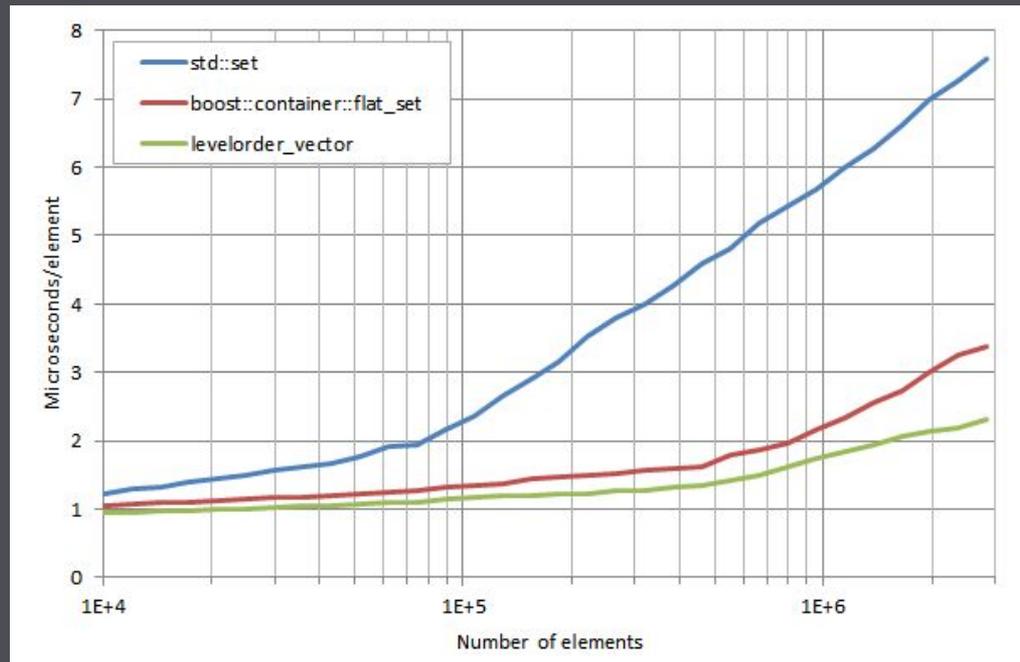


Annoying offenders: XUL extensions, plugins, cookies.

QFlow: Locality



E.g.
cache-friendly
binary tree search



QFlow: Controlling GC



Garbage collection is critical to memory control,
but if it is too long, it creates **jank**.

Evolution over the years; now it is:

generational, to prioritize area likely to be released

more **incremental**, to control how long it runs.

QFlow: No timers



Advantage:

Delay execution: it allows to improve start-up times, or specific operation performance.

Disadvantage:

Fire at a given time, that may not be the *right* time.

Solution

```
Window.requestIdleCallback()
```

Hint: also works for Web Content!

Photon



Refresh the Firefox front end to be the user facing component of Quantum

Visual Re-Design

How it looks

Motion

How it feels

Perceived Performance

How it feels

Structure

How it works / Where things live

Content

How we talk to users

Improve: user experience

In Firefox 57, November 14th, 2017

Mark 3



Mark 57



Mark 3

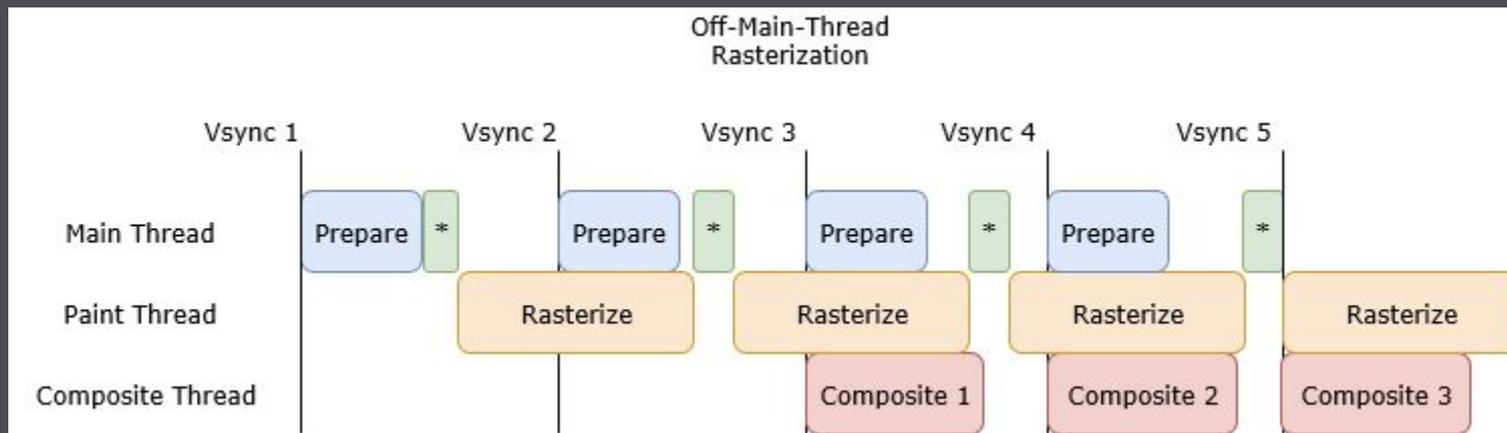


Firefox Quantum





Off Main Thread Painting



More details in this blog post by David Anderson:

<https://mozillagfx.wordpress.com/2017/12/05/off-main-thread-painting/>

Improve: performance

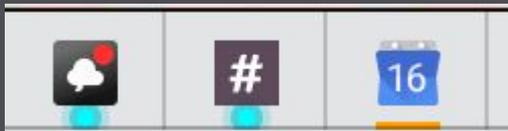
In Firefox 58, January 23rd, 2018

Background Tabs



Pause them or throttle them!

Not always possible, they may do something useful:



Be **defensive**, and experiment.

Details on MDN:

https://developer.mozilla.org/en-US/docs/Web/API/Page_Visibility_API#Policies_in_place_to_aid_background_page_performance

Improve: performance

In Firefox 58, January 23rd, 2018

More to come



- Long tail of improvements (especially Quantum flow, sync IPC fight)
- Quantum Render
- Specific process for Web Extensions
- Stricter JS budget

Firefox Quantum is a new foundation to build upon.

It isn't the end, it is a new beginning.



Firefox Quantum

Thank you!

Help by:
Installing Firefox Nightly
Reporting problems.
Spreading the word.

Stay informed:
Follow @FirefoxNightly

Firefox Quantum 58

released on Nov 14th

