

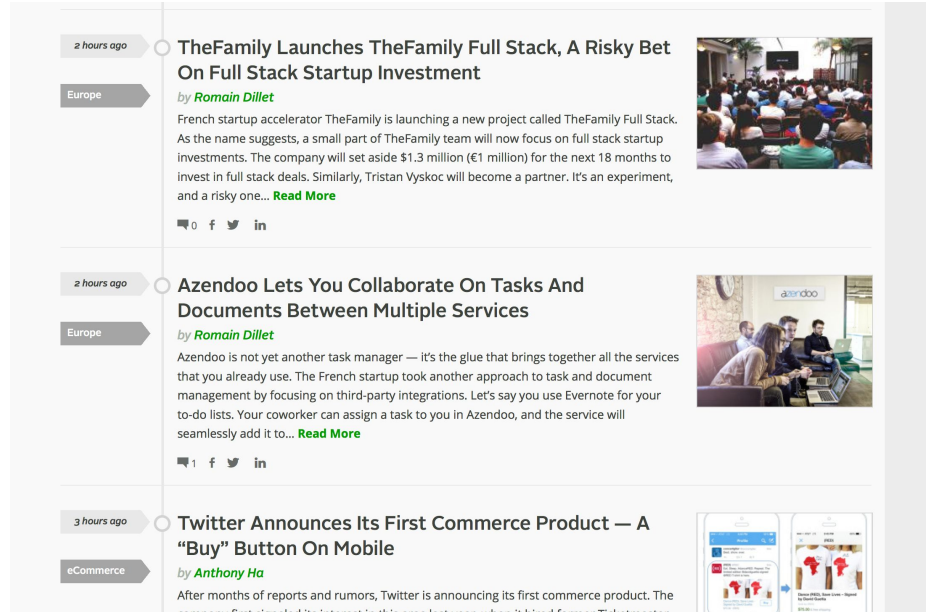
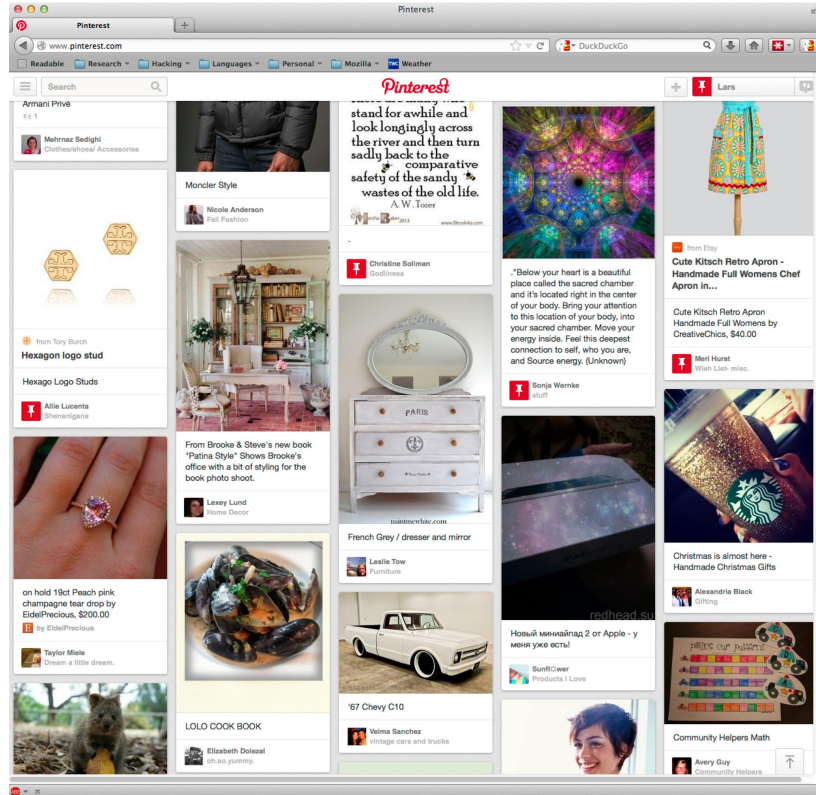
# *SERVO: TODAY & TOMORROW*

Jack Moffitt // Mozilla Research // September 26, 2016

# Goal

Create a new browser engine making a generational leap in  
*performance and robustness.*

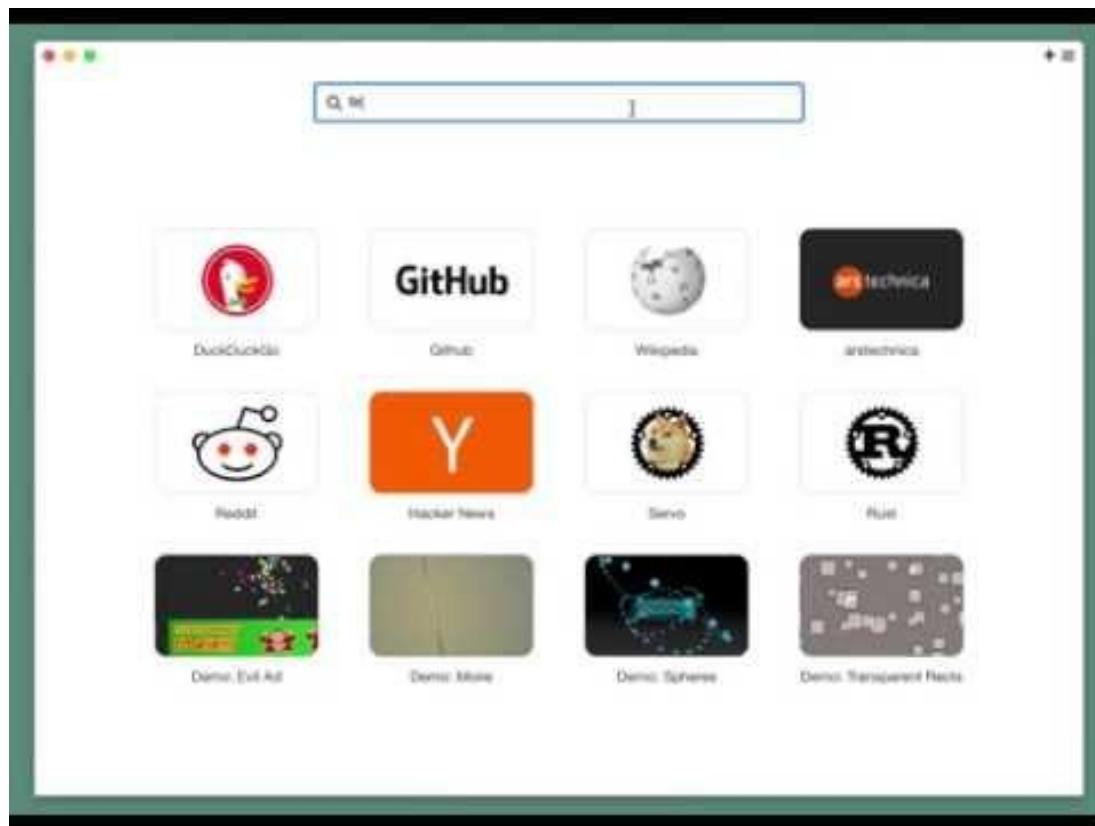
# Performance Through Parallelism



## *Robustness From Rust*

- WebAudio implementation in Firefox had 34 security critical bugs
- All were array out of bounds or use after free errors
- All would have been prevented by the Rust compiler

*Servo Nightly - [download.servo.org](https://download.servo.org)*



## Servo Nightly Reception

*“It's definitely slower to actually load pages — I'm guessing that there are still a lot of network optimizations that more mature codebases have accrued that Servo hasn't yet — **but holy cow are pages buttery smooth** once they do load (and even while they're loading, which is unusual). **Comparing Chrome and Servo in terms of UI jank felt pretty shocking**, in Servo's favor. Kudos, it looks like Rust and WebRender have paid off.” - [reissbaker](#)*

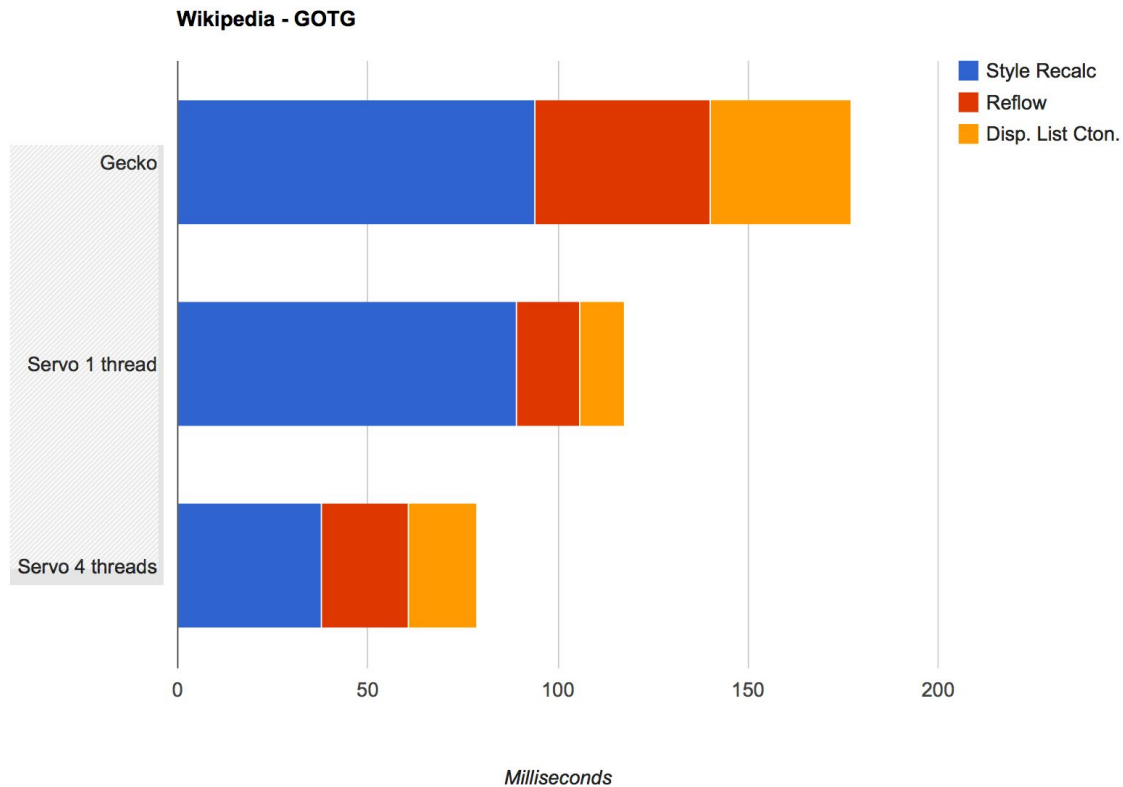
# *The Branches*

- Parallel layout
- Parallel styling
- WebRender
- Constellation

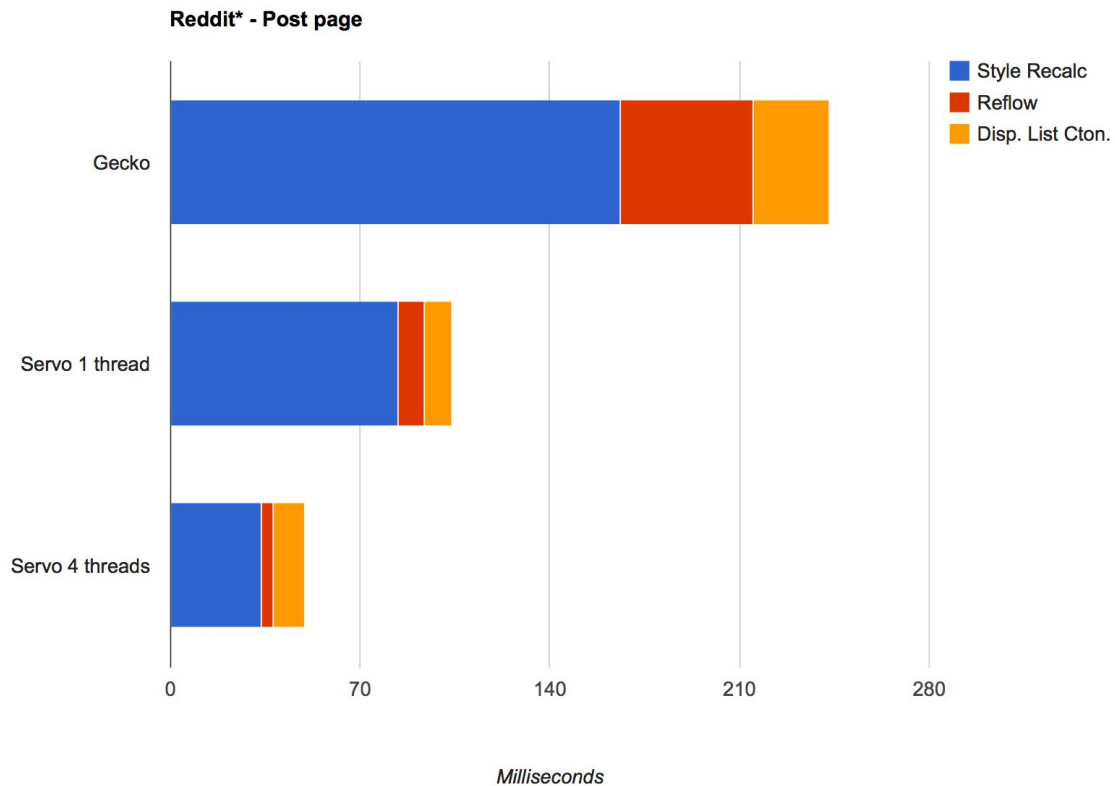
# *PARALLEL STYLE & LAYOUT*



# Servo vs. Gecko



# Servo vs. Gecko



## *Power Performance*

- Running cores at a lower voltage reduces performance by 30% but power usage by 40%
- Servo can make up this performance loss through parallelism, achieving the same performance with 40% less power

# Stylo

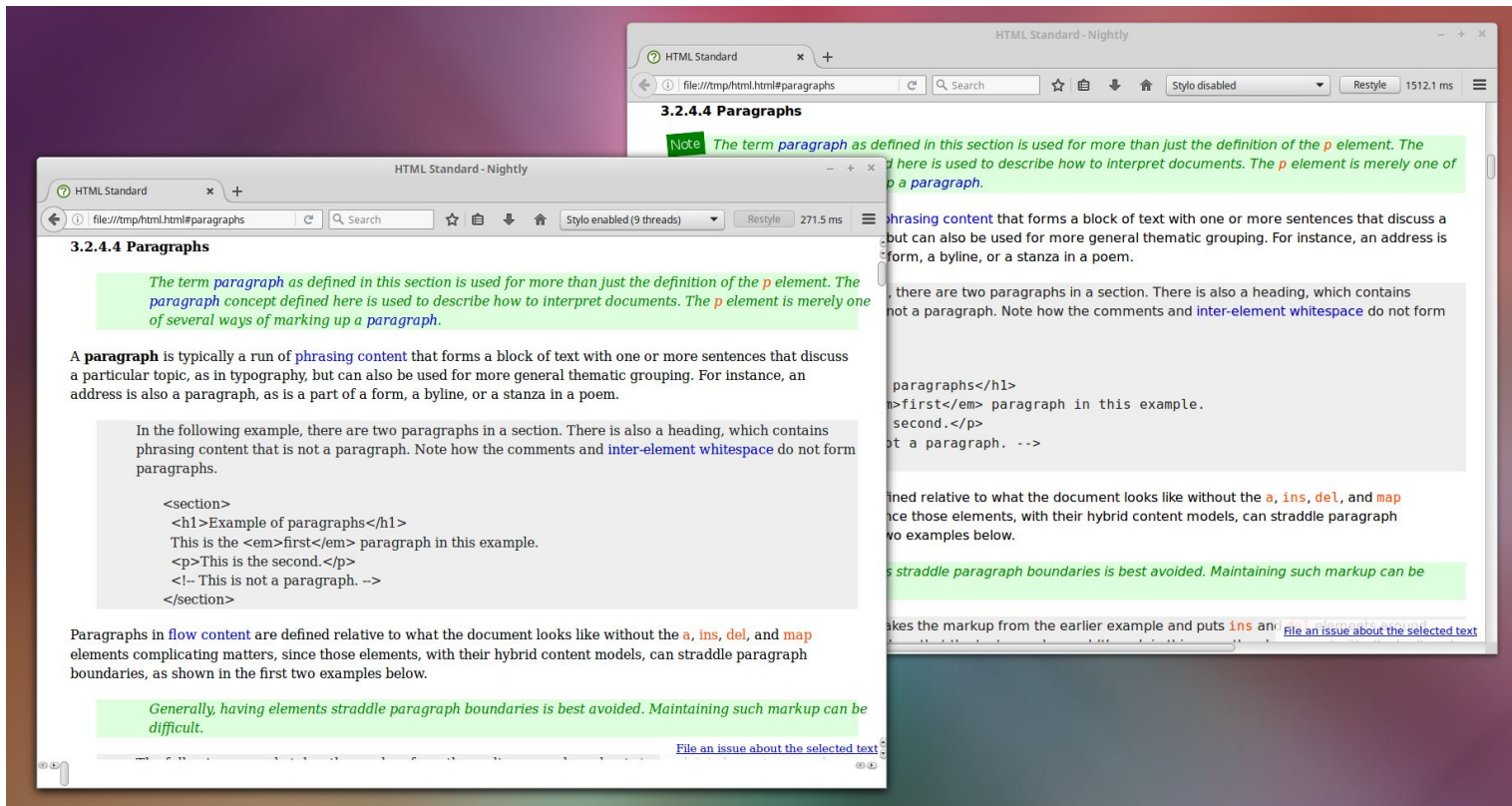
- Goal: Replace the CSS styling system in Gecko with the parallel version from Servo
- Initial experiments showed same performance gain when used in Gecko
- Telemetry shows ~95% of Firefox users will get at least 2x speedup, and ~50% will get at least 4x.
- First major uplift of Servo technology into Firefox

# Stylo on Wikipedia

The image shows a screenshot of the Wikipedia article for Barack Obama, with the Stylo extension applied. The browser window is titled "Barack Obama - Wikipedia, the free encyclopedia - Nightly". The address bar shows the URL "https://en.wikipedia.org/wiki/Barack\_Obama". The page is displayed in a dark theme. The main content area shows the article title "Barack Obama" and a summary paragraph. The summary paragraph reads: "Barack Hussein Obama II (us <sup>i</sup>/bəˈrɑːk huːˈseɪn oʊˈbɑːmə/<sup>[23]</sup>) born August 4, 1961) is an American politician serving as the 44th President of the United States. He is the first African American to hold the office, as well as the first president born outside of the continental United States. Born in Honolulu, Hawaii, Obama is a graduate of Columbia University and Harvard Law School, where he served as president of the *Harvard Law Review*. He was a community organizer in Chicago before earning his law degree. He worked as a civil rights attorney and taught constitutional law at University of Chicago Law School between 1992 and 2004. He served three terms representing the 13th District in the Illinois Senate from 1997 to 2004, and ran unsuccessfully in the Democratic primary for the United States House of Representatives in 2000 against incumbent Bobby Rush. In 2004, Obama received national attention during his campaign to represent Illinois in the United States Senate with his victory in the March Democratic Party primary, his keynote address at the Democratic National Convention in July, and his election to the Senate in November. He began his presidential campaign in 2007 and, after a close primary campaign against Hillary Rodham Clinton in 2008, he won sufficient

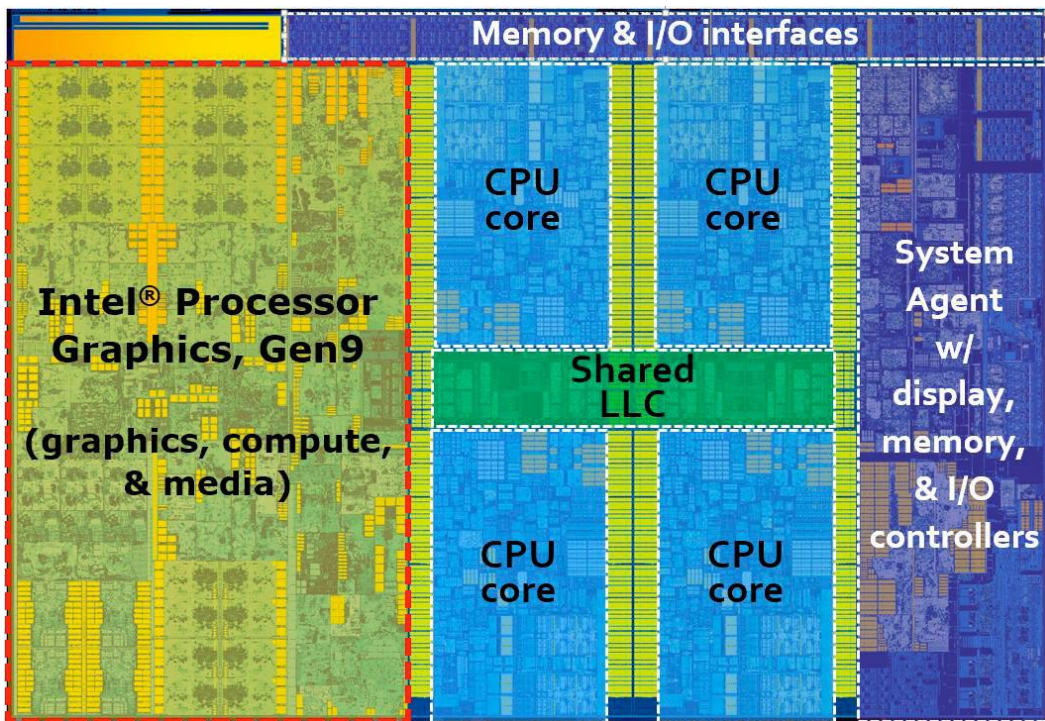
The Stylo extension is visible in the browser's address bar, showing "Stylo disabled" and "Restyle" buttons. The page is styled with a dark background and a light-colored text area. The article title "Barack Obama" is prominently displayed at the top of the main content area. Below the title, there is a summary paragraph. The page also includes a sidebar with navigation links and a list of tools. The overall layout is clean and modern, reflecting the Stylo extension's design.

# Stylo on HTML5 Spec



*WEBRENDER*

# WebRender Motivation





## *WebRender in a Nutshell*

- Hard to optimize immediate mode
- Retained mode graphics are better suited to GPUs
- Web pages are basically scene graphs, which can be sent to the GPU all at once
- Parallel CPU side preprocessing for some things (batch creation, font rasterization, border-radius, etc)

## *WebRender Progress*

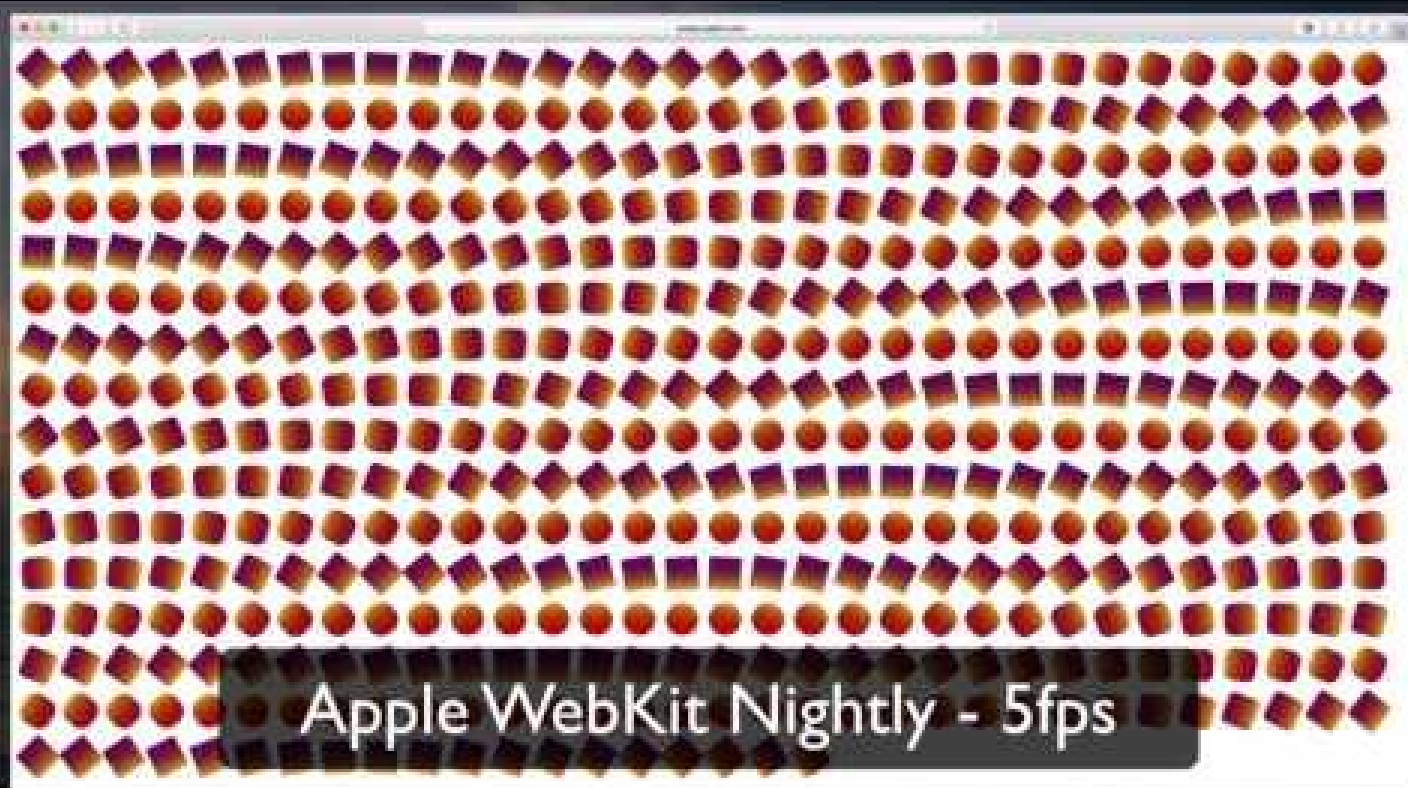
- Landed in Servo
- Optimized and fixed bugs
- Shipped in Servo nightly in June
- New design prototyped
- New design finished and landed



Firefox

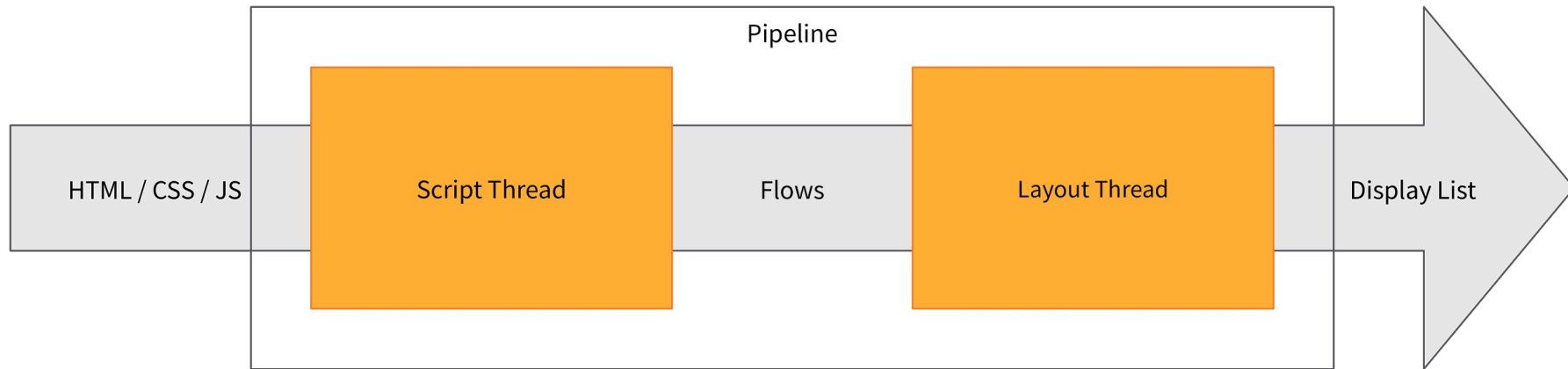


Servo

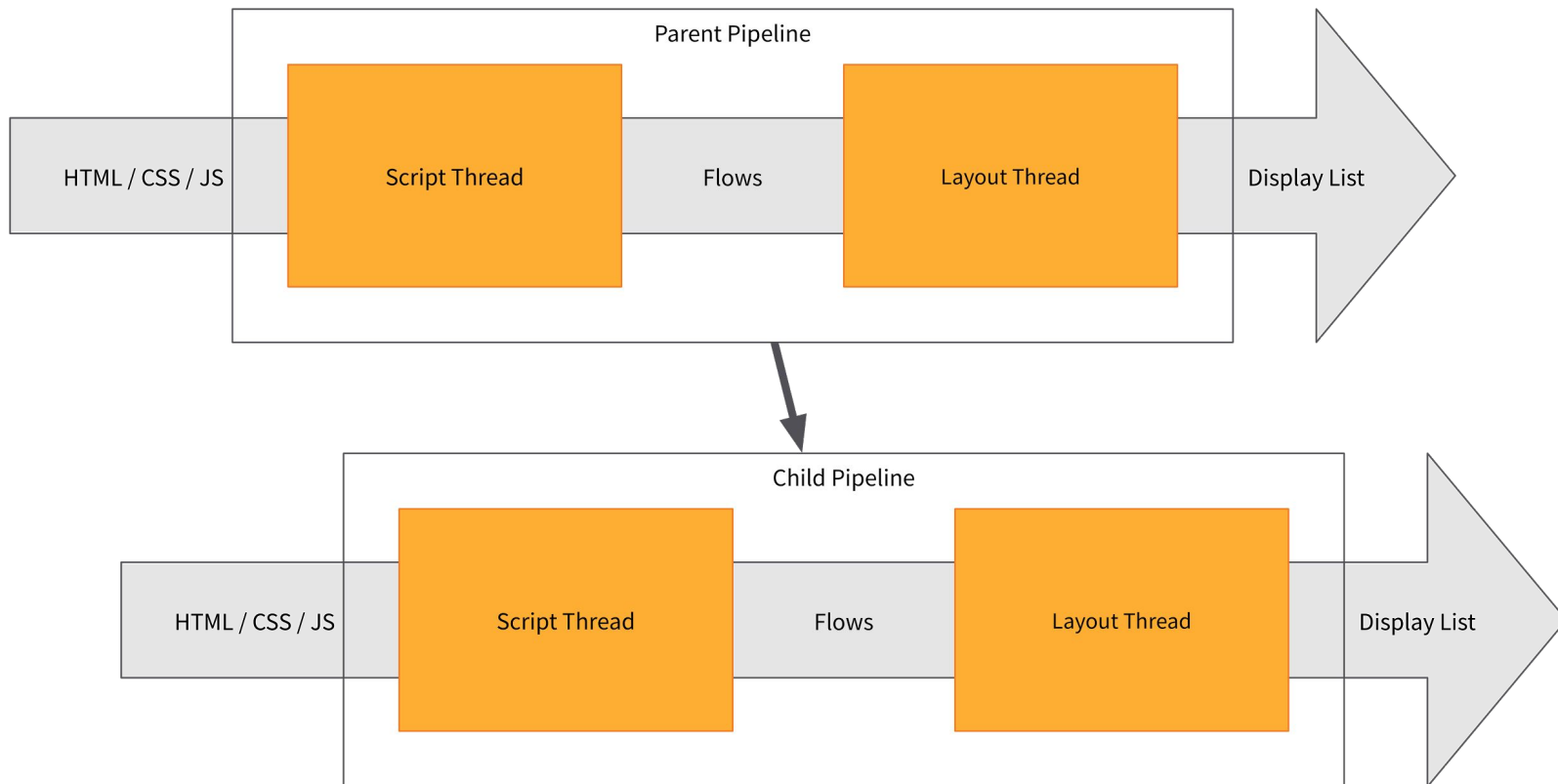


# *CONSTELLATION*

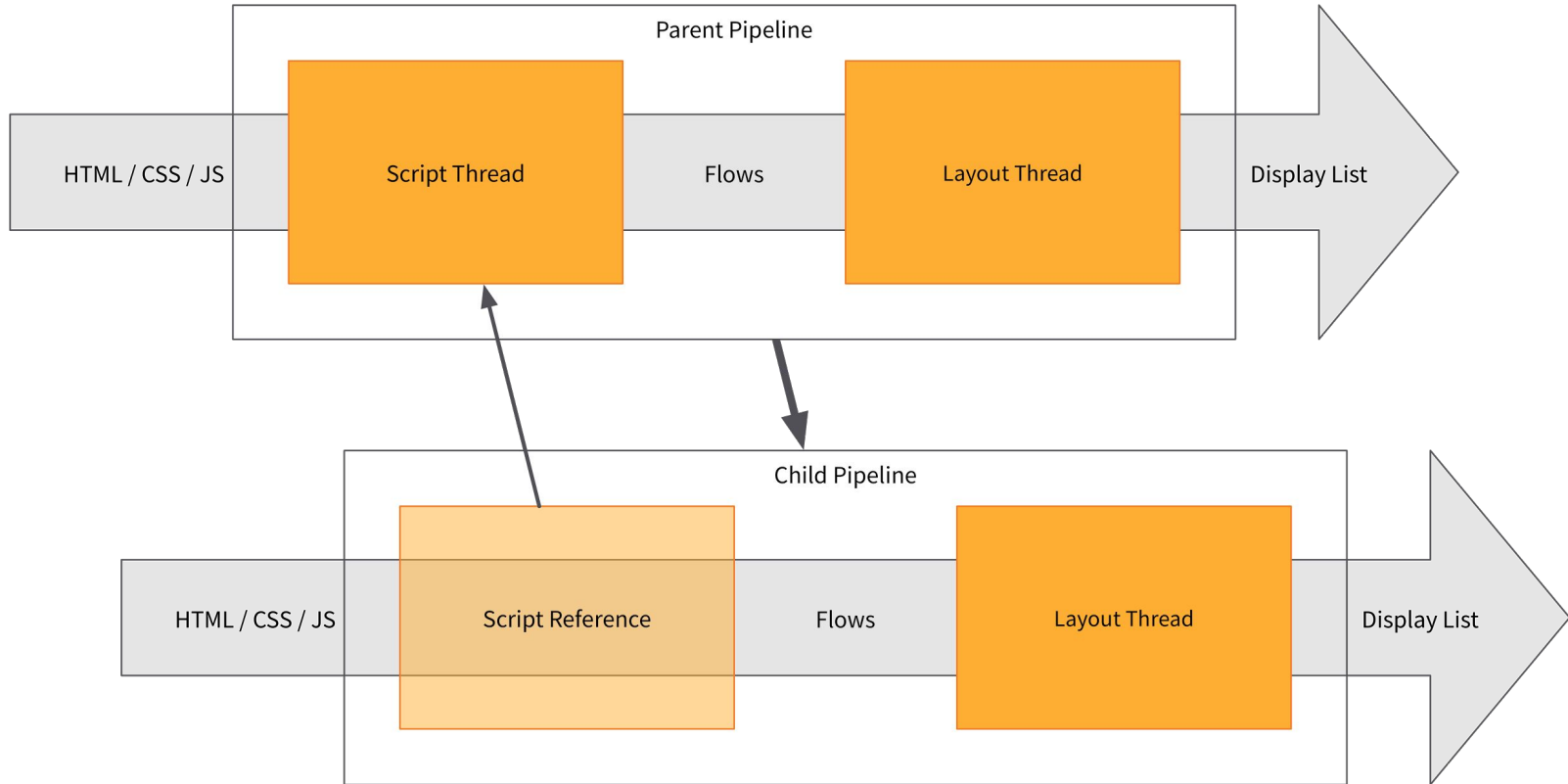
# *SINGLE PIPELINE*



# PIPELINE WITH CROSS-DOMAIN IFRAMES



# PIPELINE WITH SYNC IFRAMES

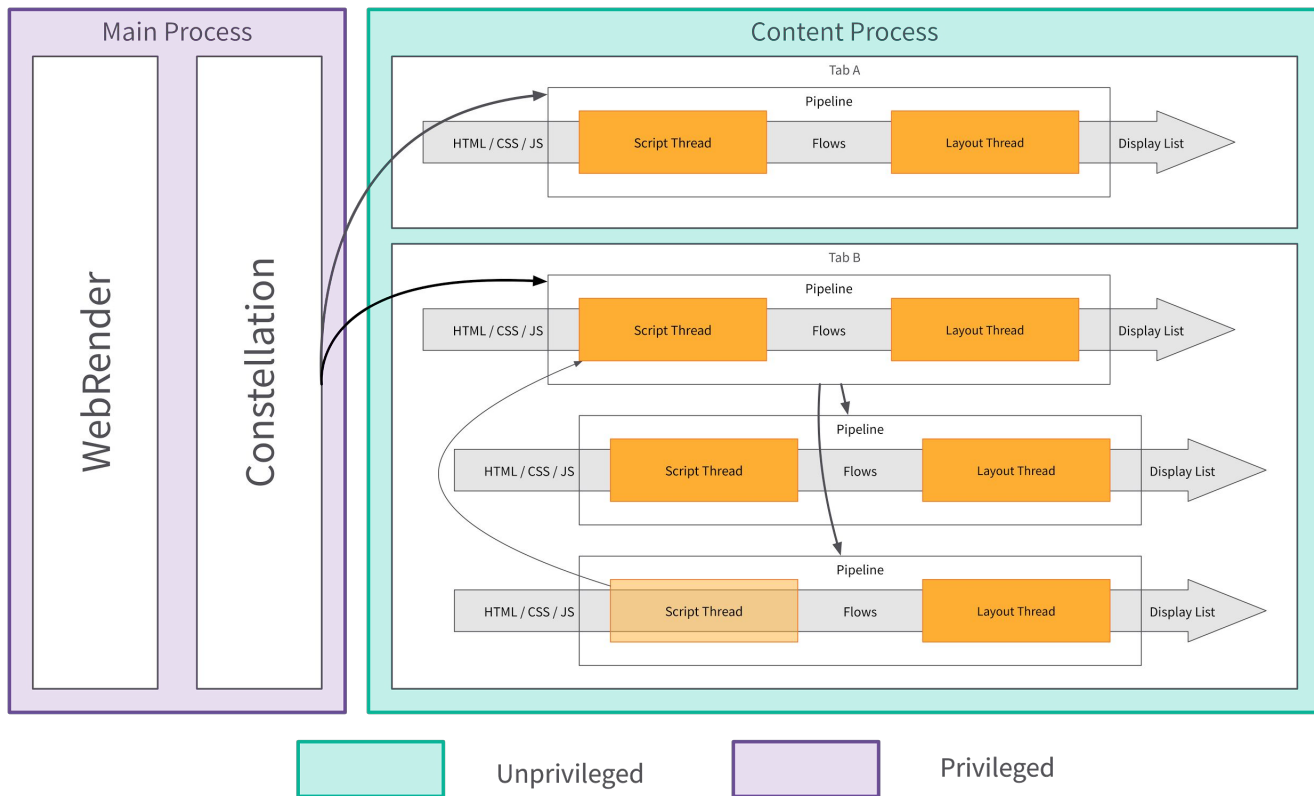




## *BENEFITS OF PIPELINES*

- iframes don't block their parent page or each other
- Layout and JavaScript don't always block each other
- Many failures can be handled independently

# MULTIPROCESS CONSTELLATION



# *The New Branches*

- Constellation
- Parallel layout
- Parallel styling
- WebRender
- **Magic DOM**
- **Parallelize MORE**

## *Magic DOM*

- Explore ways to achieve significant performance wins in JS / DOM integration
- Discussed for years, but a concrete proposal presented last year seemed fairly promising
- Fusing reflectors and DOM objects
- Self hosted JS

## *Parallelism Experiments*

- JPEG decode (GPU)
- PNG decode
- Glyph rasterization (GPU)

## *External Research Collaborations*

- Machine learning (Rohit Zambre at UC Irvine)
- Power management (Connor Imes at U. Chicago)
- Incremental computation (Kyle Headley at U. Colorado)
- WebBluetooth (Gabor Loki et al, University of Szeged)
- Software transactional memory (Alan Jeffrey)

# *QUESTIONS*