Building a Browser for Automotive: Alternatives, Challenges and Recommendations

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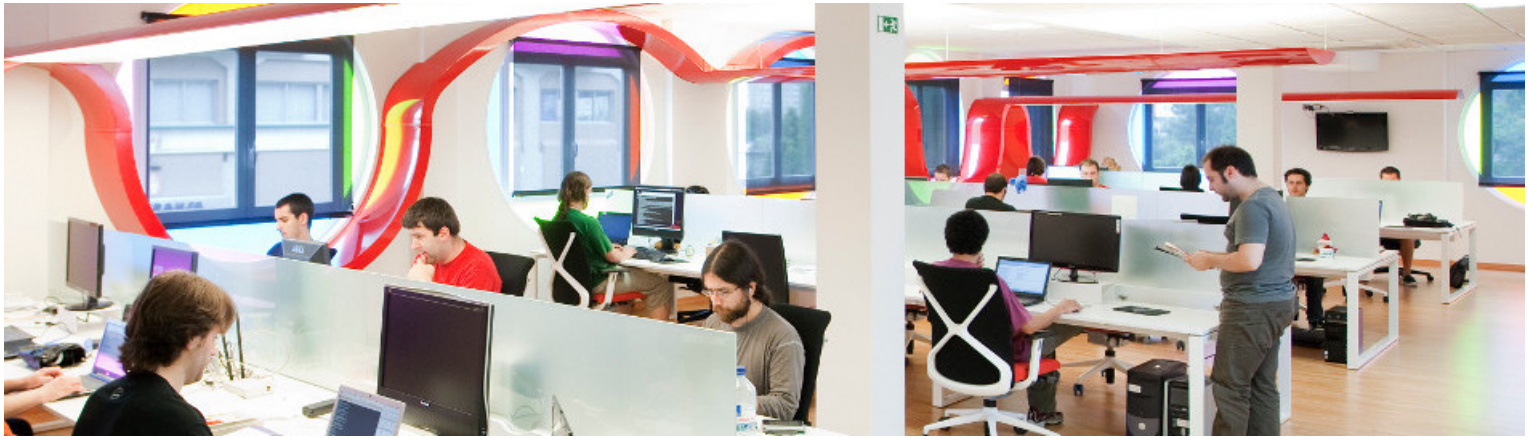
Myself, Igalia and Webkit/Chromium



- Co-founder of Igalia
- Open source consultancy founded in 2001
- Igalia is Top 5 contributor to upstream WebKit/Chromium
- Working with many industry actors: automotive, tablets, phones, smart tv, set-top boxes, IVI and home automation

Outline

1. A browser for automotive: requirements and alternatives
2. WebKit and Chromium, a historical perspective
3. Selecting between WebKit and Chromium based alternatives

PART 1
A browser for automotive: requirements and alternatives

Requirements

- Different User Experiences
  - UI modifications (flexibility)
  - New ways of interacting: accessibility support
- Support of specific standards (mostly communication and interfaces)
- Portability: support of specific hardware boards (performance optimization)
- Functionality and completeness can be less demanding in some cases (for now)
- Provide both browser as an application and as a runtime

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Available alternatives

- Option 1) Licensing a proprietary solution: might bring a reduced time-to-market but involves a cost per unit and lack of flexibility
- Option 2) Deriving a new browser from the main open source browser technologies:
  - Firefox (Gecko)
  - Chromium
  - WebKit (Safari and others)
- Mozilla removed support in their engine for third party browser developers, so the two available choices are Chromium and WebKit (with various options for each of them)

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Understanding the main alternatives

- When creating a new open source browser for automotive, a decission between Chromium and WebKit will need to be made
- Chromium and Webkit share a lot of history, design and code
- Learning how WebKit was created, and how Chromium emerged and derived from WebKit, improves the understanding of the pros and cons of each solution
- We will make a detailed historical review of both projects

PART 2
WebKit and Chromium, a historical perspective

PART 2.1: 2004-2013
WebKit, the first 9 years

The WebKit project

- **Web rendering engine** (*HTML*, *JavaScript*, *CSS*...)
- The engine is the product
- Started as a fork of KHTML and KJS in 2001
- *Open Source* since 2005
- Among other things, it's **useful for**:
  - Web browsers
  - Using web technologies for UI development

WebKit features

- HTML and XML support
- JavaScript support (ECMAScript 5.1)
- CSS 2.1, CSS 3 support
- SVG support
- Support for Plugins (NPAPI, WebKit Plugins)
- HTML5 support: multimedia, 3D graphics, advanced CSS animations and transformations, drag'n'drop, offline & local storage, connectivity...
- Accessibility support
- Q&A infrastructure: review process, continuous integration,
- Passing ACID3 with 100/100 tests since March 2008

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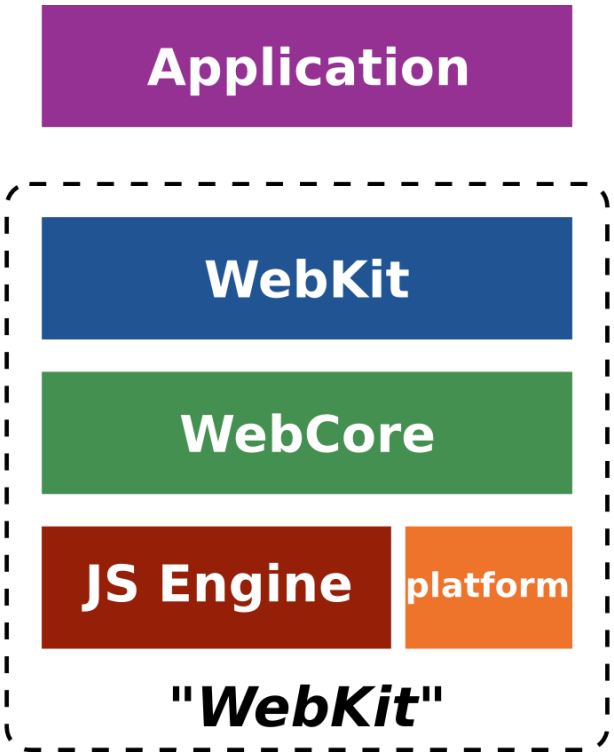
WebKit Architecture

From a simplified point of view, WebKit is structured this way:



- **WebKit**: thin layer to link against from the applications
- **WebCore**: rendering, layout, network access, multimedia, accessibility support...
- **JS Engine**: the JavaScript engine. JavaScriptCore by default.
- **platform**: platform-specific *hooks* to implement generic algorithms

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What is a WebKit port?

iOS

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How many WebKit ports are there?

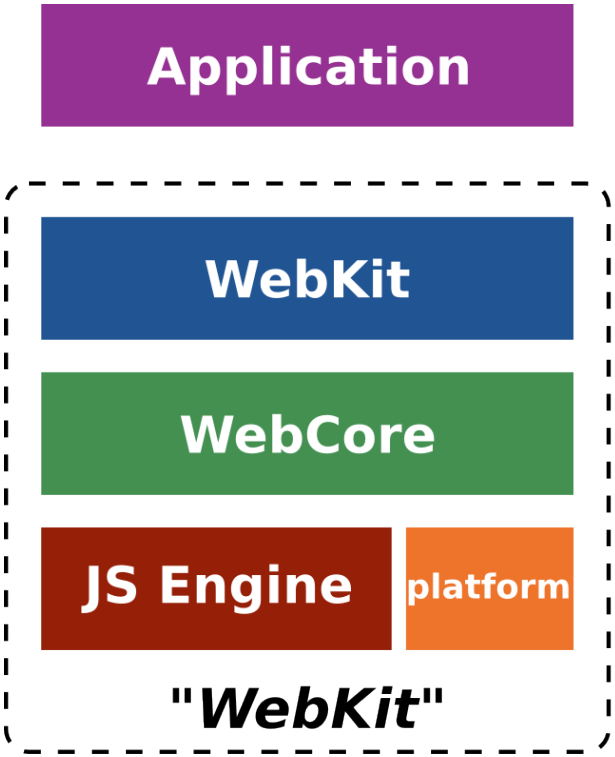
WebKit is available for different platforms:

- Main upstream ports in 2012/2013:
  - Mac OS X, iOS
  - GTK+ based platforms (GNOME)
  - Qt based platforms (KDE)
  - Enlightenment Foundation Libraries (EFL, Tizen)
  - Google Chromium / Chrome
  - WebKitNIX
- Other ports: wxWidgets, Brew MP, Symbian devices (S60), Win32, BlackBerry, Adobe Integrated Runtime (Adobe AIR)

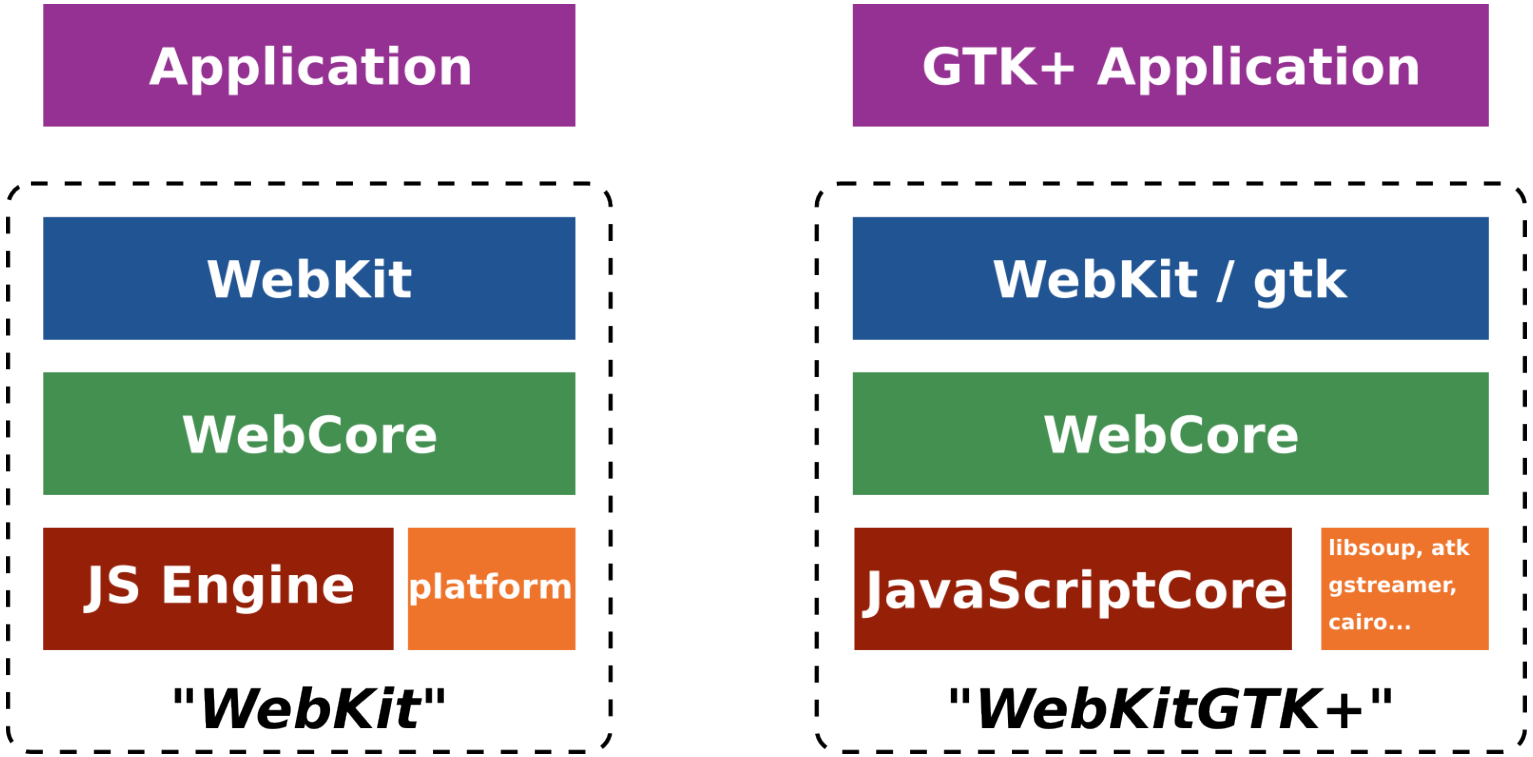
Some WebKit based browsers in 2013

- Amazon Kindle
- Arora
- BOLT browser
- Epiphany browser
- Google Chrome
- iCab (version >= 4)
- Iris Browser
- Konqueror
- Midori
- Nintendo 3DS
- OWB
- OmniWeb
- PS3 web browser
- RockMelt
- Safari
- SRWare Iron
- Shiira
- Sputnik for MorphOS
- Stainless
- Steel for Android
- TeaShark
- Uzbl
- Web Browser for S60 (Nokia)
- WebOS Browser

Architecture of a WebKit port



Architecture of a WebKit port



How do we use a WebKit port?

- **The WebView *widget***:
  A platform-specific widget that renders web content.

  It's the **main component** and it's useful for:
  - Loading URIs or data buffers pointing to HTML content
  - Go fullscreen, text/text+image zooming...
  - Navigate back and forward through history...

- **Events handling**:
  Allows embedders to get notified when something important happens or when some input is needed.

  Some examples of these events:
  - Getting notified when a load finished or failed
  - Asking permission for navigating to an URI
  - Requesting authorization for something..

A minibrowser written in Python

```
#!/usr/bin/env python
# -*- coding: utf-8 -*-

import gtk
import webkit

def entry_activated_cb(entry, embed):
    embed.load_uri(entry.get_text())

# Widgets and signals
window = gtk.Window()
window.set_default_size(800, 600)
window.set_title("Mini browser written in Python")
embed = webkit.WebView(); # WebKit embed
entry = gtk.Entry()
entry.connect('activate', entry_activated_cb, embed)
scroller = gtk.ScrolledWindow()
scroller.add(embed)

# Pack everything up and show
vbox = gtk.VBox(False, 5)
vbox.pack_start(entry, False, False)
vbox.pack_start(scroller)
window.add(vbox)
window.show_all()

# Load a default URI and run
embed.load_uri("http://www.webkit.org")
gtk.main()
```

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A minibrowser written in Python

What is WebKit2?

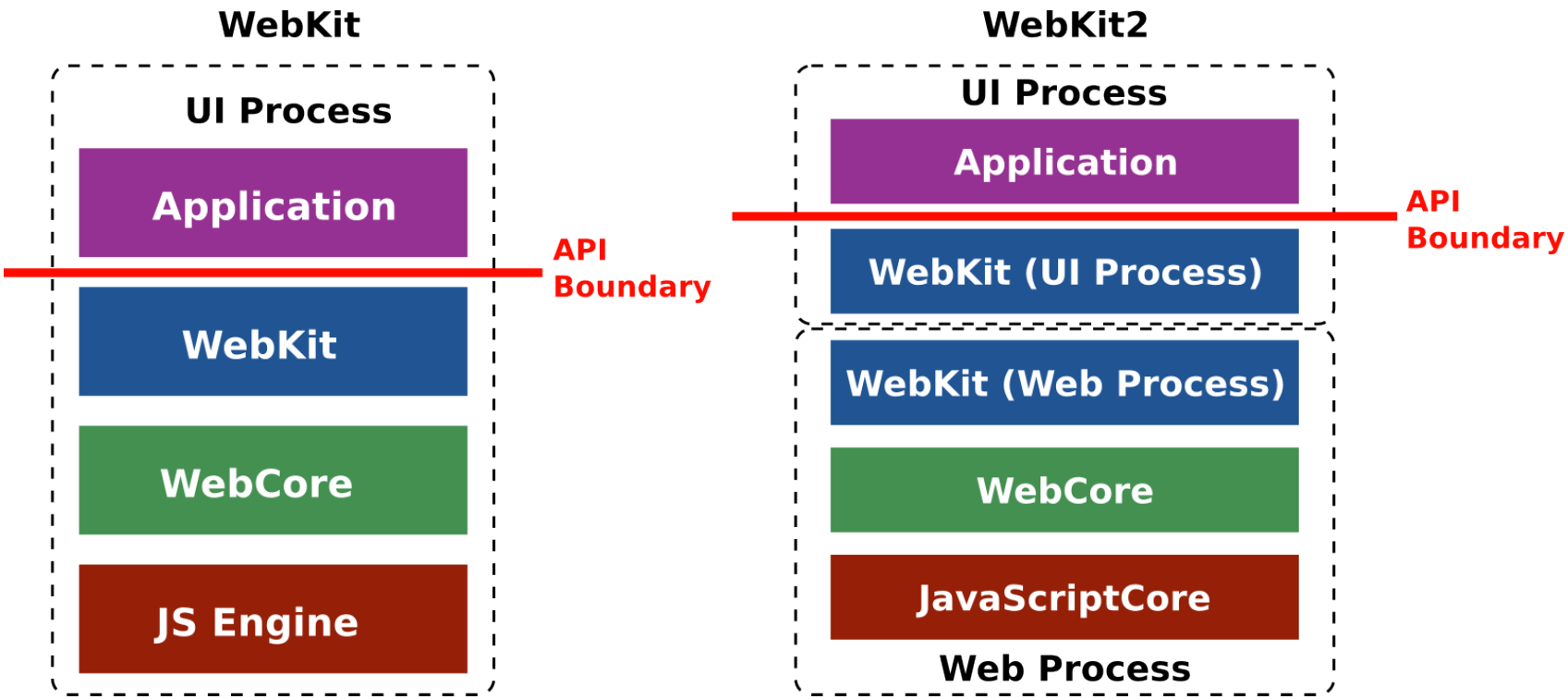
- New API layer designed to support a split process model (First release by Apple on April 8th, 2010[1]).
- Different to Chromium's multi-process implementation

  It's bundled in the framework (reusable)

- Different processes take care of different tasks:
  - **UI process**: the WebView *widget*, application UI
  - **Web process**: loading, parsing, rendering, layout...
  - **Plugin process**: each plugin type in a process
- It comes with Inter-Process Communication (IPC) mechanisms to communicate those processes bundled-in

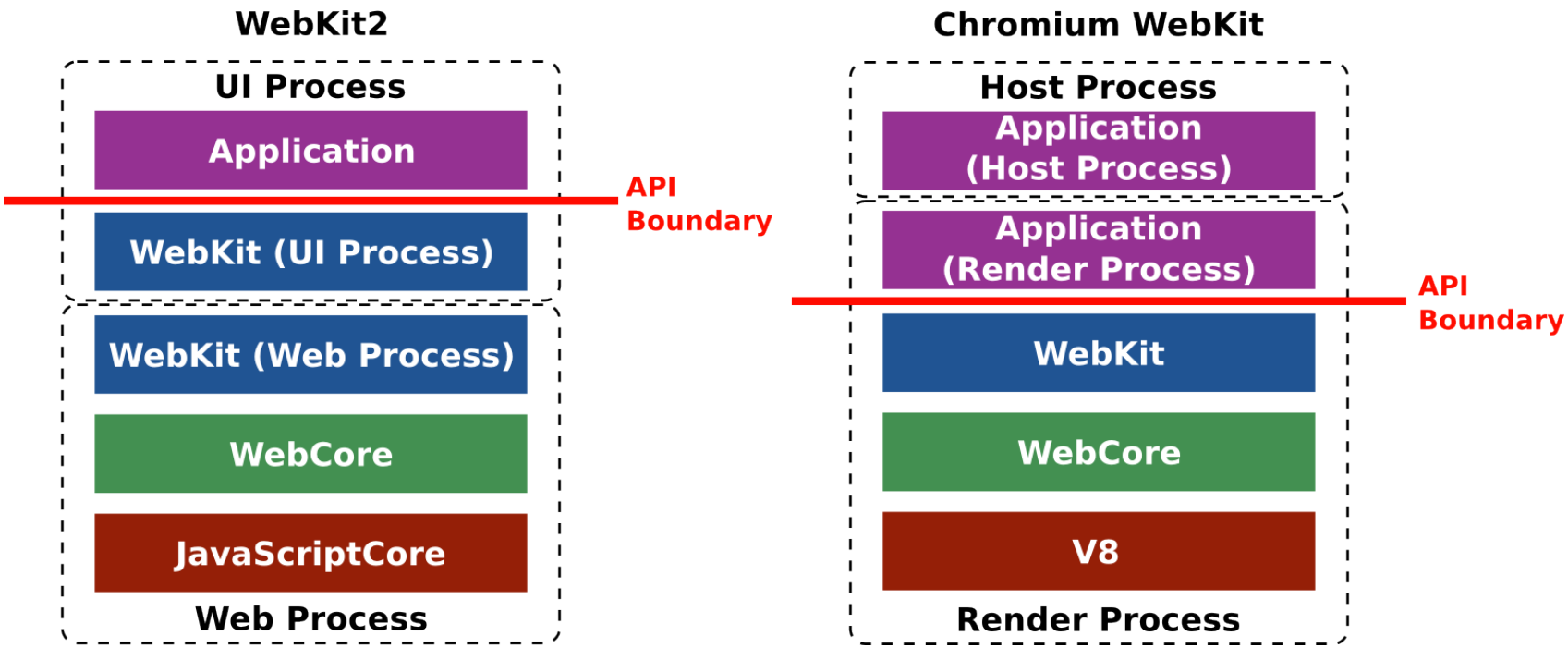
`http://trac.webkit.org/wiki/WebKit2`

WebKit VS WebKit2



Advantages: isolation, security, performance, stability.

WebKit2 VS Chromium

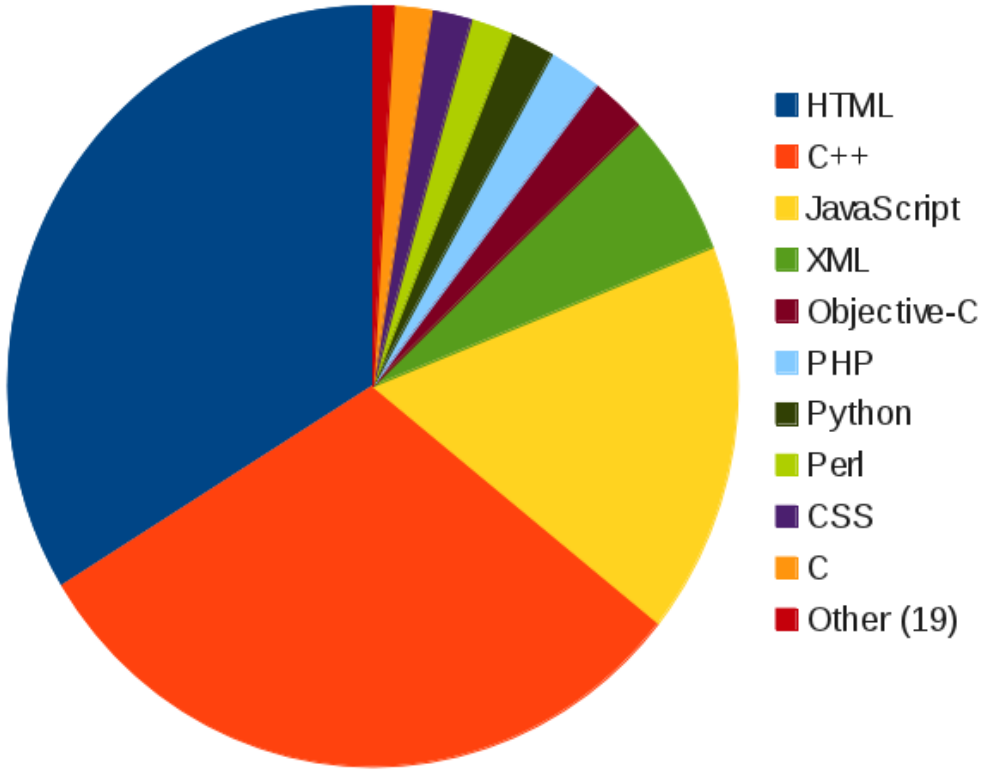


Chromium first released in late 2008.

The Source Code in numbers

According to Ohloh on May 17th, **lines of code per language**, without considering blank lines nor comments:

Language	LoC	%
HTML	1,955,561	32.4 %
C++	1,308,667	27.5 %
JavaScript	962,086	20.8 %
Objective-C	175,669	3.4 %
XML	158,555	2.5 %
C	121,951	3.0 %
PHP	100,345	2.3 %
CSS	93,247	1.6 %
Python	78,348	1.9 %
Perl	76,491	1.7 %
OpenGL Shad	52,234	1.8 %
Other (16)	50,000	1.1 %
Total	4,132,955	



`https://www.ohloh.net/p/WebKit/analyses/latest/language_summary`

Just considering C++, Objective-C and C >1.6M LoC!

Licenses: BSD 3-clause and LGPL

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The WebKit Project in numbers

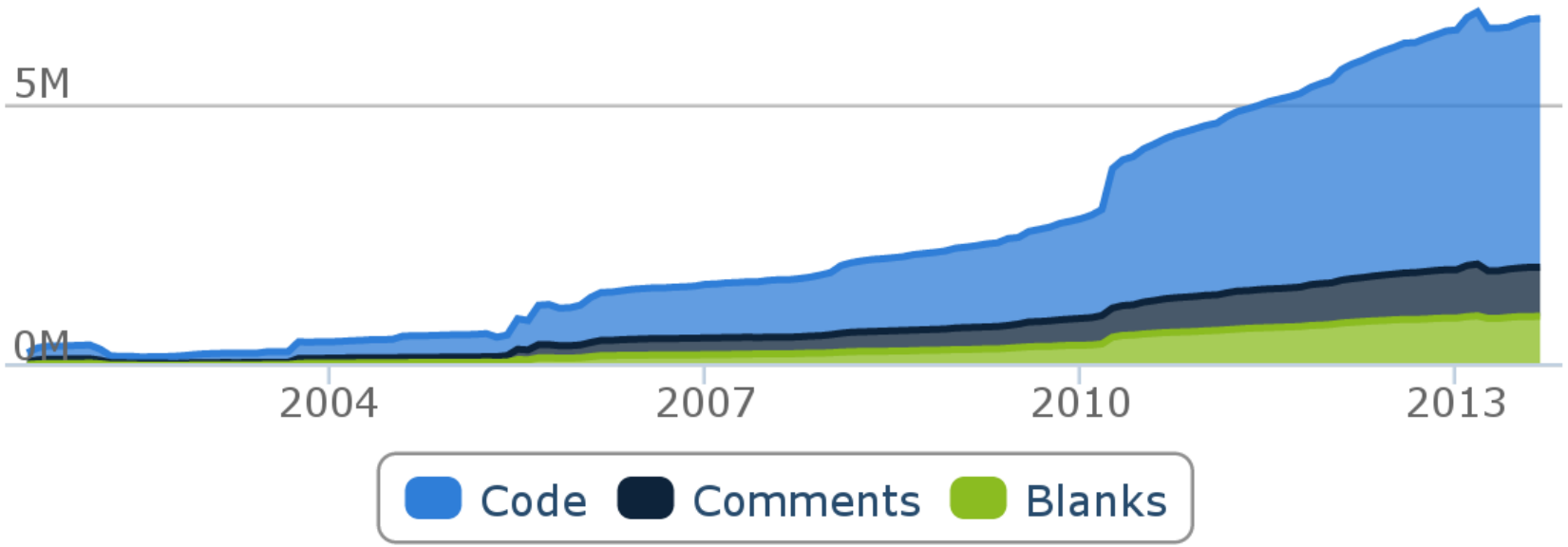
Commits per month till 2013:

The WebKit Project in numbers

Contributors per month::

The WebKit Project in numbers

Evolution in the number of lines of code



Activity of Companies by 2013

- Based on Bitergia's report[2]
- Based on reviewed commits
- "Gardening" commits filtered out
- From the beginning of the project till beginning of 2013

[2] http://blog.bitergia.com/2013/02/06/report-on-the-activity-of-companies-in-the-webkit-project/

Activity of Companies by 2013

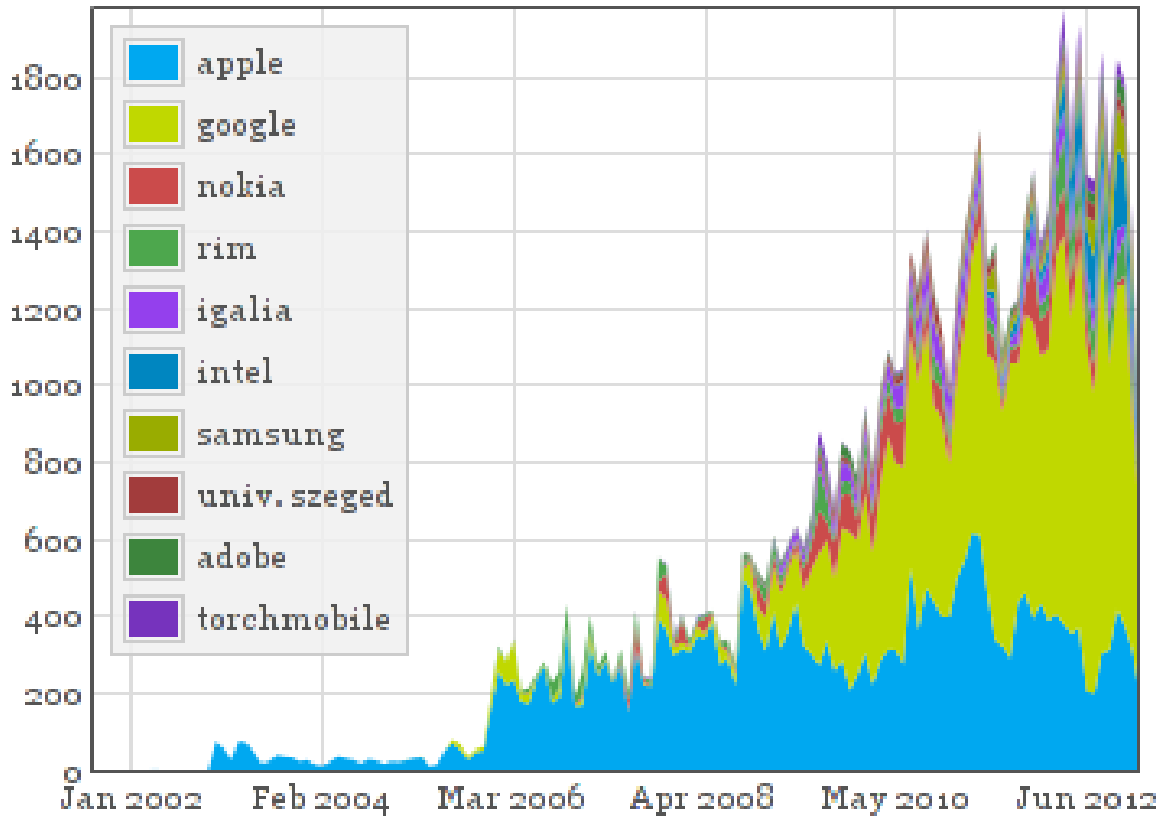


Figura : Commits per company (monthly)

Activity of Companies by 2013

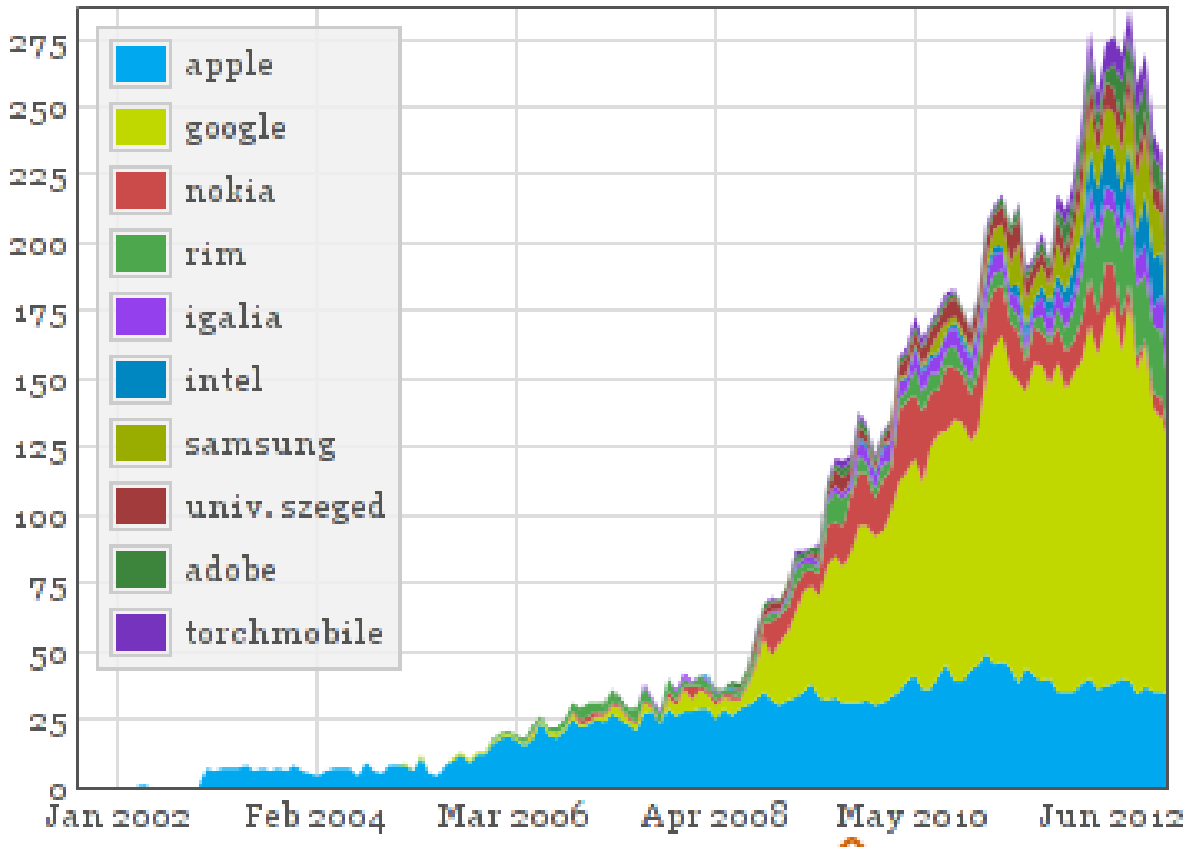
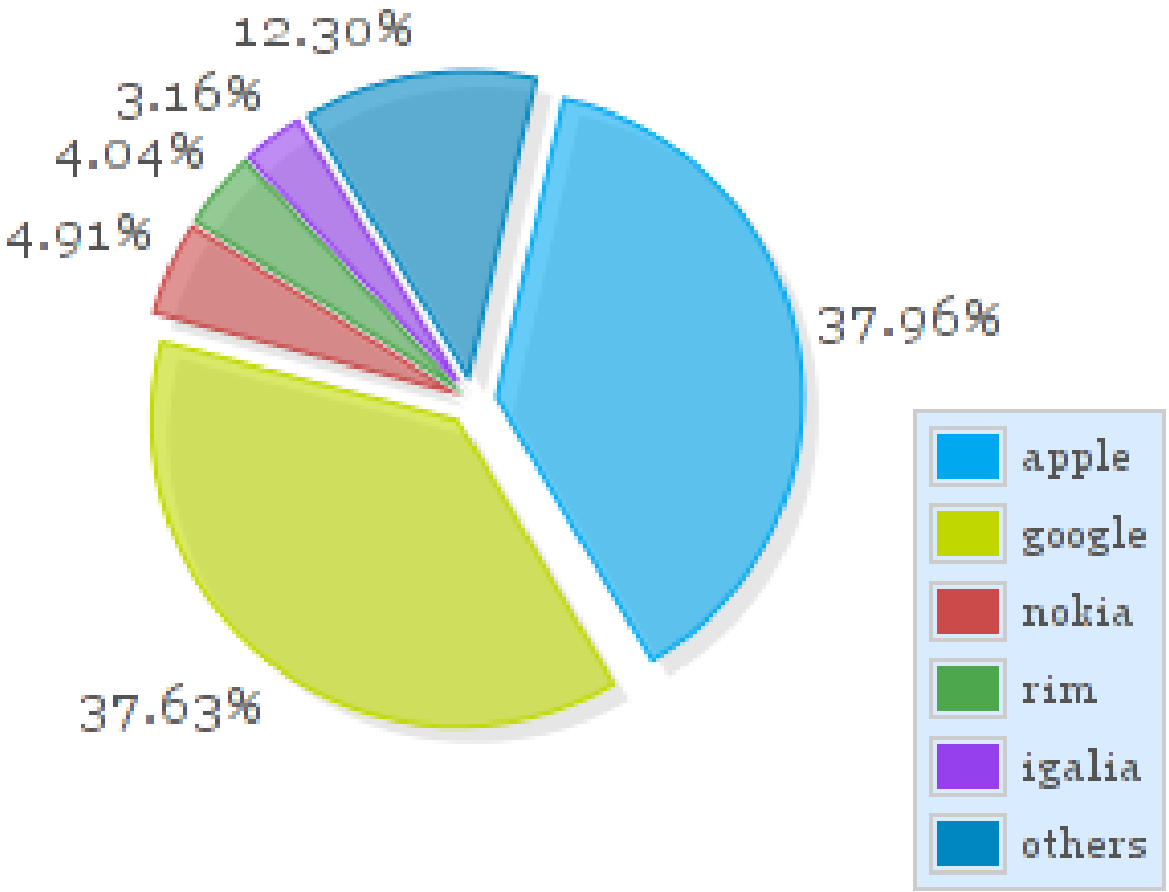


Figura : Active authors per company (monthly)

Activity of Companies by 2013



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Activity of Companies by 2013

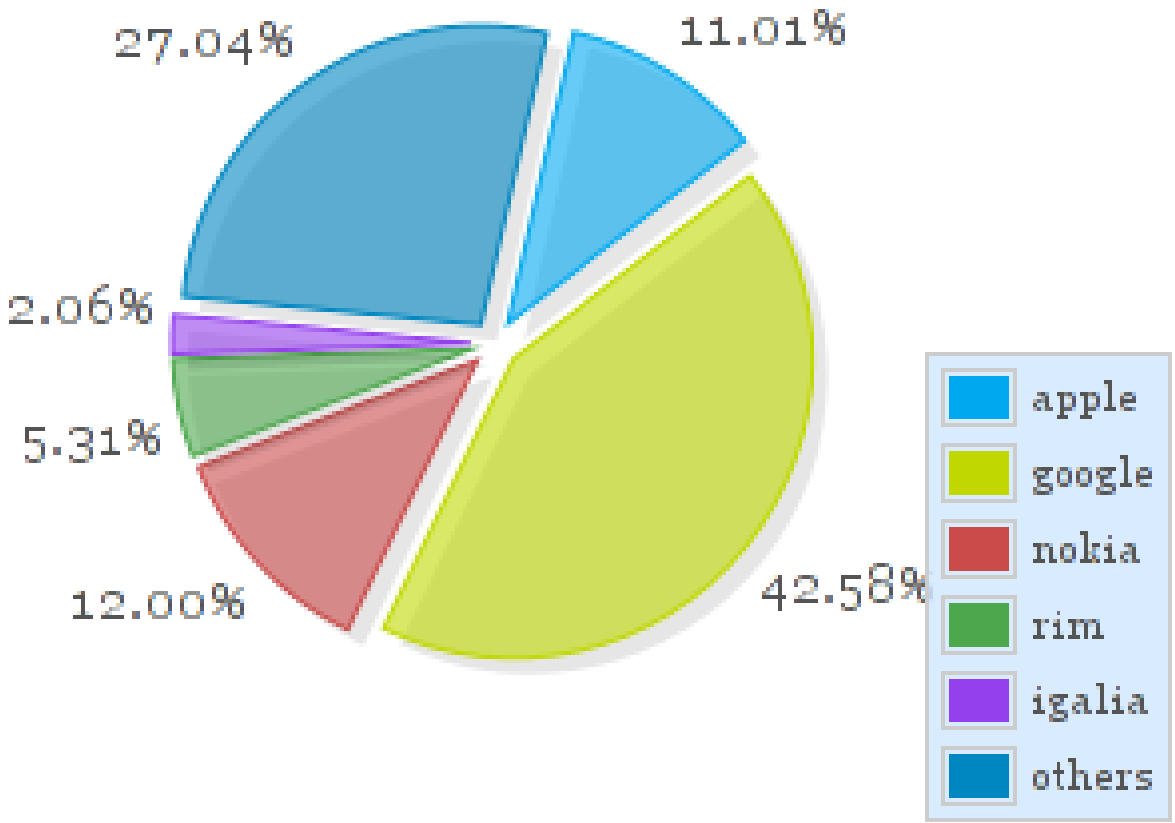


Figura : Active authors per company

Part 2.2

The creation of Blink (April 2013)

Google's Departure. Blink

- Google announced on April 3rd that they would be forking WebKit and creating Blink
- Motivations according to Google:
  - They were not using WebKit2 anyway
  - Easier to do ambitious architectural changes after the fork
  - Simplification of the codebase in Blink
- Tension between Apple and Google before the fork
  - Architectural decisions: NetworkProcess
  - Code governance: Owners need to approve some core changes
- Big shock within the WebKit community

Differences between WebKit and Blink

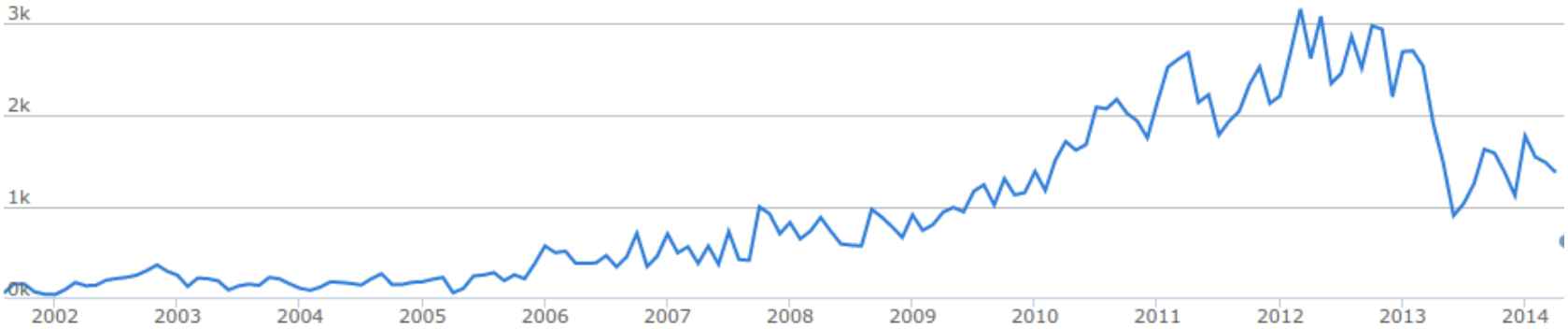
- Removes the concept of 'port' as it was defined in WebKit (deep platform integration): Skia, V8 and other libraries cannot be replaced
- Still possible to use Blink in other platforms, but now integration happens at Content level
- Only the rendering engine. Multi-process architecture is still in Chromium
- WebKit has committers, reviewers and owners (control some core areas). Blink only committers and owners (similar to WebKit reviewers)
- Peer review process a bit more relaxed in Blink
- Many architecture changes

Early consequences of Blink for WebKit

- Google was the main contributor by # of commits. Apple's position now more dominant
- Opera joined WebKit then moved to Blink. Other companies and communities started migrating (Tizen and Qt)
- Several WebCore modules left orphan. Other hackers assuming WebCore modules maintainership
- WebKit developers porting patches from/to Blink
- Many hacks to accomodate Chromium removed. Engines quickly starting to diverge at faster pace

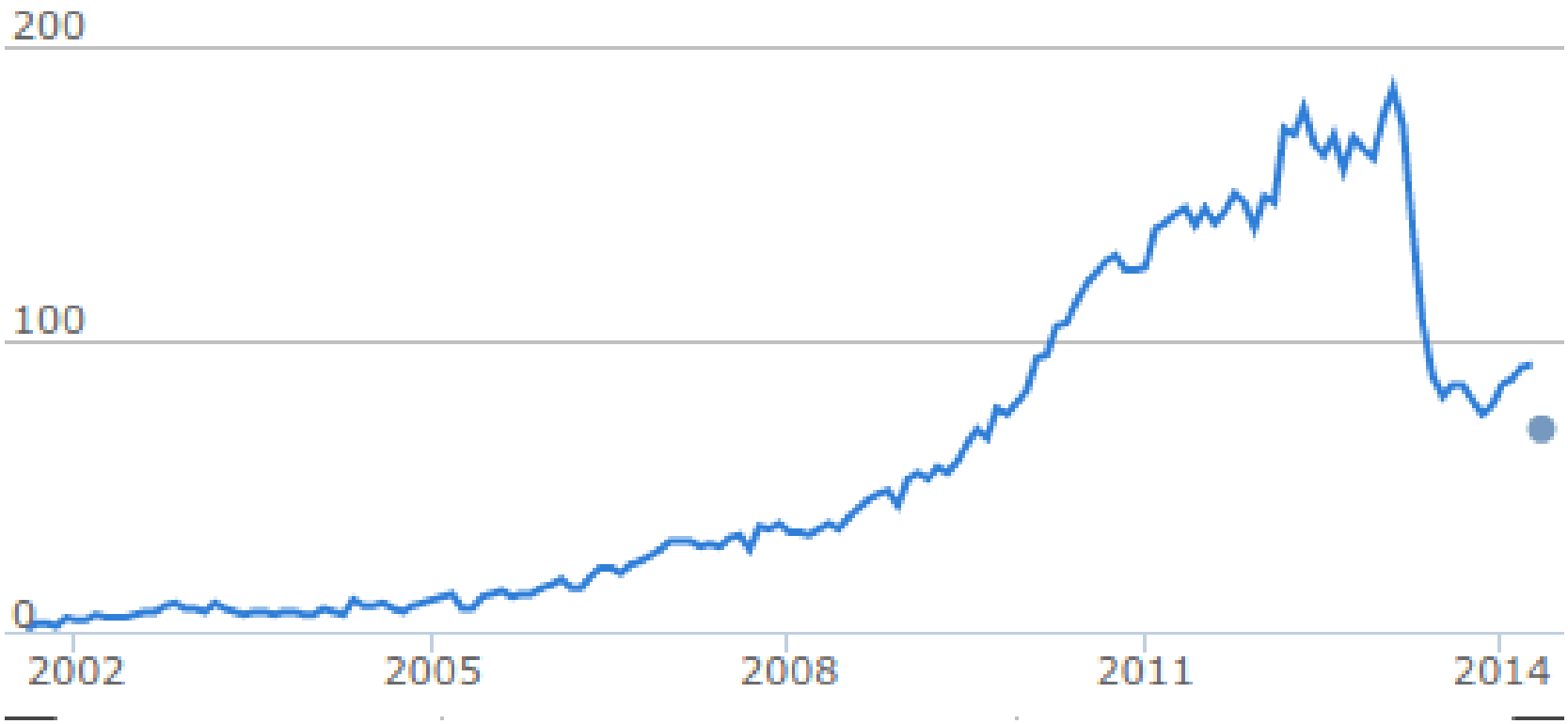
Impact of Blink in numbers

Commits per month in WebKit, including last months:



Impact of Blink in numbers

Contributors per month in WebKit, including first year of Blink:

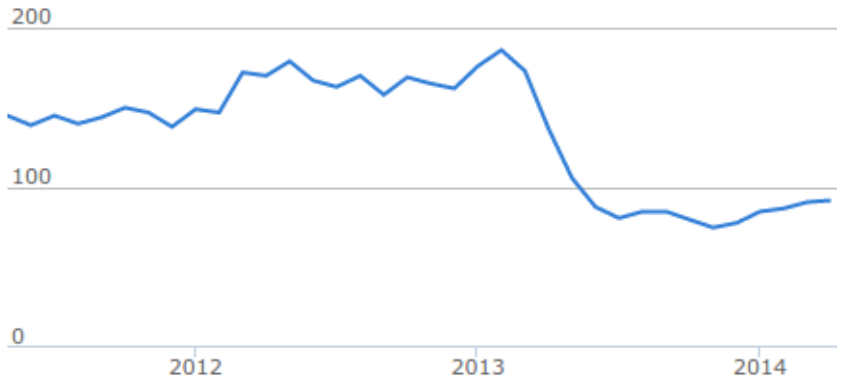


Impact of Blink in numbers

Contributors per month in 2013-2014:

Blink:

WebKit:



Impact of Blink in numbers

Commits per month in 2013-2014, Blink::

Commits per month in 2013-2014, WebKit::

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Webkit and Chromium in 2015

- Less shared energy because of the split, but both projects very active and alive
- There is a recent trend towards more users for Blink and Chromium, but still quite a lot of open questions and challenges
- Both provide good building blocks for creating a browser for automotive

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PART 3
Selecting the best alternative

Alternatives today

- In WebKit you need to select (or create) a port, in Chromium you need to define how to derive from upstream
- WebKit:
  - WebKitGTK+
  - WebKit for wayland
  - WebkitEFL and QtWebkit still in some (mostly) legacy projects
- Chromium:
  - Chromium directly
  - QtWebEngine
  - Crosswalk
  - Cromium Embedded Framework (CEF)

Webkit vs Chromium: pros and cons

- WebKit:
  - Pro: memory footprint is smaller
  - Pro: ports are upstream, easy to integrate core changes
  - Pro: very flexible architecture, easy to plug components
  - Con: less companies contributing (Apple very relevant)
  - Con: less innovation lately in some areas of the codebase
- Chromium:
  - Pro: more innovation happening in some areas, Google driving it with a lot of developers
  - Pro: trend of more and more companies using the technology and testing it
  - Con: no concept of ports, alternatives are not upstream
  - Con: difficult to contribute to some core areas (Google)
  - Con: versions of Chromium diverting a lot from Chrome

WebKitGTK+ and WebKit for Wayland

- Pure open source projects, easy to influence their upstream development
- Reliable and well-known release process and quality maintenance procedures, strong API and ABI compatibility
- Possibility of modifying the whole stack, avoiding a big delta (e.g. gstreamer vs other media frameworks)
- Developed by a relatively small team (compared to Google's Chromium)
- Less widely tested in heterogeneous hardware platforms
- Webkit for wayland brings an interesting alternative to WebKitGTK+ for some use cases, but still not a mature project

Chromium directly

- All the features in the browser and flexibility to use them at the cost of increased maintenance complexity
- Browsing operations implemented interfacing Chromium's Content API. Browser services like history, bookmarks or incognito should be interfaced directly through internal (unstable) APIs
- High risk of ending with a big delta compared to upstream Chromium (which moves very fast)
- Changing the UI requires patching the UI code (no toolkit available)
- Chromium is officially supported on Intel-based Windows, Mac OS X and Linux with X11. Building on top of ARM devices is possible but less directly supported

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Crosswalk

- Crosswalk is an HTML application runtime based on Chromium. It is available for Android as an embeddable webview container and for Tizen as the system-wide application runtime
- Crosswalk usage as a webview for Android difficult to port as it is mostly implemented in Java. Crosswalk reuses and adapts the multiprocess model of Chromium to its needs
- Crosswalk is intended to run applications and not web pages. Building a browser on top requires creating a quite big delta with upstream
- Still a quite new project (created in 2013). Not a big community outside Intel and Tizen
- No backwards compatibility in the new versions

QtWebEngine

- Evolution of the Qt webkit port, but using Chromium
- It was undergoing heavy development until very recently
- Some small open source browsers use it but not focused on being used for browsers, just for embedding small HTML5 parts in Qt 5 applications
- Potential issues with LGPLv3 license for some users. Alternative of paying a license for Qt

Chromium Embedded Framework

- Stable API for development of applications with embedded browsers
- All browser abstractions are preserved, and the multiprocess architecture of Chromium is preserved and properly interfaced
- A browser based on CEF would be an independent application that would incorporate CEF as a library and use its API
- Browser features from layers above the Content API are not present in CEF (history, bookmarks or incognito)
- Officially supported only on Intel-based Windows, Mac OS X and Linux with X11
- Created in 2009. Still mostly a one person project

Conclusions

- There are various alternatives both on WebKit and Chromium to create a derived browser for Automotive
- Different companies and projects are using different solutions. There is none that seems to be good at everything
- The choice largely depends on the weight of the different goals to be achieved with that project and its specific hardware and software needs
- In any case, and independently from the choice, 3 keys for success:
  - Long term analysis of hardware and software requirements
  - Respecting community and open source dynamics (minimum delta, as much upstream as possible)
  - Right team and project scope definition

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Thank you!

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