How Igalia is Driving Innovation in Embedded Systems with Open Source Technologies

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About us

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About Igalia

- Highly specialized **Open Source consultancy** founded in 2001
- **Worker-owned, employee-run, flat structure** (140+ igalians)
- Top contributors to Chromium, WebKit and Gecko
- **Active contributor to other OSS projects**
  - V8, SpiderMonkey, JSC, LLVM, Node.js, GStreamer, Mesa, Linux Kernel...
- **Members of several working groups:**
  - W3C, WHATWG, WPT, TC39, OpenJS, Test262, Khronos...
Embedded devices

- **Web UIs** are used for a wide range of different use cases
- **GStreamer** often used for multimedia (e.g. HW-accel, MSE, EME)
- **Wayland and DRM/KMS** widely used in embedded devices
- Good **graphics drivers** crucial to optimal performance
- **Linux** as the most widely used OS in embedded devices
- **Virtual** and **Augmented** reality
Igalia and embedded devices

- Smart TVs, set-top-boxes and video game consoles
- Smart home appliances and home automation devices
- Hi-Fi audio systems and video editing devices
- In-vehicle and in-flight infotainment systems
- Navigational and GPS-based instrumentation
- Virtual and Augmented reality headsets
- Digital signage
Web Rendering Engines
WPE WebKit
WPE WebKit

- **WebKit**: OSS Web rendering engine for desktop & embedded
- **WPE**: WebKit port for embedded devices
  - Focus on flexibility, security and performance on lower-powered devices
  - Great for **HW-based acceleration** and specific integration requirements
  - Widely used for multimedia (i.e. MSE, EME, WebRTC, WebAudio...)
  - Also useful for other use cases e.g. server-side, headless Web rendering...

https://wpewebkit.org/
Igalia and WebKit

- **Second committer to WebKit project** after Apple
  - 15+ years of contributions. 22 reviewers, 44 committers
- **Lead developers** of the two only Linux-based **WebKit ports**
  - WebKitGTK and WPE (started from scratch in 2014)
- **Implementation of Web standards** and **JavaScript features**
- **GStreamer-based multimedia stack** in WebKitGTK and WPE
- **Accessibility support** on Linux
- **Other**: 32-bit systems, performance, bugfixing, QA...
Igalia, WPE WebKit and embedded

- Development and maintenance of WPE for RDK set-top-boxes
- New HW-accelerated SVG engine in WebKit
- Integration of WPE's GStreamer backends with DRM systems
- Custom WPE backends for specific Hardware
- Experiments about supporting WPE on Android devices
- Maintenance of downstream forks for customers
Chromium
Chromium

- Standalone **Open Source Web browser** (not just the engine)
- Available for **different platforms**, desktop & mobile
  - Windows, Mac OS, Linux, Android and iOS
- Used as the **base of several browsers** and **apps**:
  - e.g. Chrome & ChromeOS, Edge, Opera, Samsung Browser, CEF, Electron...
- Also used on **embedded devices** for certain use cases
  - e.g. Automotive Grade Linux (AGL)

https://chromium.org/
Igalia and Chromium

- Second committer to Chromium project after Google
  - 10+ years of contributions. 14 owners, 25 committers
- Lead developers of native Wayland support
- Implementation of Web standards and JavaScript features
- Accessibility support
- Other: performance, bugfixing, refactoring, code health...
Igalia, Chromium and embedded

- Ported Chromium to specific hardware platforms
- Deployment of Chromium-based Web runtimes (e.g. WebOS)
- Active members of the Automotive Grade Linux project
- Maintenance of downstream forks for customers
Servo

- Independent, modular, embeddable Web rendering engine
- Focus on speed, security, API for embedders and cross-platform support (currently on Windows, Mac, Linux)
- Written in Rust: memory safety, concurrency

https://servo.org/
Igalia and Servo

- **R&D effort started in 2012** (Mozilla Research)
  - Initial participation from **Igalia from 2014 to 2020**.
- **Servo moved** from Mozilla Research to the **LF in 2020**
  - Original mission remained unchanged
- **Igalia took over Servo maintenance in 2023**
- **2023 roadmap**: upgrade main dependencies, CSS2 conformance, embeddable Web engine experiments, Android
Igalia, Servo and embedded

- Embedded devices that need a **small, fast and secure Web view**
- Simple embedded Web applications (**controlled environment**)  
- **Advanced Web features** like WebGL, WebGPU, WebXR...
- **Use cases**: kiosk mode applications, UI frameworks...
Multimedia & Graphics
GStreamer

- **Reference framework** for Linux-based multimedia
- **Flexible architecture design** i.e. pipelines & plugins
- Multiple **use cases**: media players, Web browsers, video editors, transcoders, streaming services, server-side rendering...
Igalia and GStreamer

- **Top consultancy company** with GStreamer in Web engines
  - Second contributor to GStreamer in the past 5 years
- **15+ years** of contributions to GStreamer. 9 contributors
  - Strong experience in multimedia in embedded devices
- Lead development of **GStreamer-based back-ends** of WebKit:
  - Video playback, WebAudio, WebRTC, adaptive streaming, MSE, EME...
- **GStreamer-VA, Vulkan elements**: HW-accelerated plugins
  - Video encoding, decoding, post-processing and rendering plugins
- **GStreamer Editing Services, Pitivi**: API for nonlinear video editing, OpenTimelineIO-compatible video editor
Igalia, GStreamer and embedded

- **New GStreamer features** developed upstream (core & plugins)
  - Enable key features crucial for the embedded industry
- **GStreamer-based back-ends** in different Web rendering engines
  - Direct impact in millions of embedded devices (e.g. set-top-boxes)
- **Improving performance** by providing **HW acceleration solutions**
  - Key for constrained and lower-powered devices
- **Integration with different multimedia libraries**
  - Adapt and develop GStreamer pipelines tailored to specific HW
Mesa 3D
Mesa

- **Mesa**:  
  - Open Source implementation (library) of OpenGL and Vulkan  
  - Includes graphics drivers for different GPU vendors

- **OpenGL and Vulkan**:  
  - Cross-platform APIs to expose GPU HW to application programmers  
  - Developed by the Khronos group
Igalia and Mesa

- **9+ years** of contributions to the Mesa project
- **Development and maintenance of Mesa drivers** for OpenGL and Vulkan aimed at different GPU hardware platforms
- **Conformance Tests Suites (CTS):** OpenGL and Vulkan
  - Work to expand API coverage to become conformant with different versions
Igalia, Mesa and embedded

- **OpenGL & Vulkan drivers development** for different GPUs
  - e.g. Raspberry Pi, Qualcomm Adreno, Vivante
- Developed a **Vulkan driver for Raspberry Pi 4**
  - Started on January 2020, Vulkan 1.2 conformant
- **HW-accelerated encoding/decoding support**
  - Optimization of graphics pipelines
- **Integration** with the underlying **graphical systems**
  - e.g. Wayland, DRM/KMS
Operating systems
Operating systems

- **The Linux Kernel**:  
  - Low-level abstraction layers  
  - Exposes I/O devices  
  - Processes & memory management, filesystems, CPU schedulers, drivers...  
  - *Most common kernel used in embedded devices*

- Other components:  
  - Windowing systems, drivers, desktop integration, i18n/l10n, sandboxing...
Igalia and Linux-based OS's

- **10+ years** in the lower layers of the kernel
- **20+ years** of experience as Debian developers
  - Maintenance of the **RISC-V** Debian port
- **Maintainers of the VKMS** (virtual display i.e. for headless use)
- **Contributors to Linux kernel** drivers for different GPUs:
  - VideoCore (vc4, c3d), AMD (amdgpu), Vivante (etnaviv)
- **Other**: distros customization, power management, file systems (btrfs), kdump/kexec, udisks, futex2, flatpak, graphical toolkits...
Igalia, Linux and embedded

- **Build systems, tools and frameworks**: Yocto, Buildroot...
- **Linux device drivers**: networking, graphics...
- **Creation** of Linux distributions and/or filesystems
- Adaptation aimed at **specific hardware requirements**
- **Porting software** to custom embedded OS's
Virtual & Augmented Reality
Wolvic

- **Open Source Web browser** for **Virtual Reality**
  - Supports immersive experiences
- **Started by Mozilla** as Firefox Reality in 2018, currently being **developed and maintained** by Igalia since 2022
- **Available** in several **app stores from VR devices**:
  - Huawei app gallery, Meta Quest app store, Pico XR app store
- **Support for a growing range of devices**:
  - Meta Quest2 and Meta Quest Pro, Huawei VR Glasses, Pico4 and Pico4E, Qualcomm Snapdragon Spaces...

https://wolvic.com
Vision of embedded devices and technologies
Open Source

- Embedded systems are attached to Open Source
- High impact projects are basic assets in the embedding industry
- Major organizations are contributing upstream to these projects
Web Platform

- **Web engines are extremely relevant** for embedded devices
  - They are **not just for Web browsers**
  - **Web-based UIs** are getting more popular
- **The Web is an openly developed platform**
  - Under **continuous evolution**
  - Alternatives can bring **diversity to the Web platform ecosystem**
Highly specialized expertise

- **Embedded devices** have a different set of requirements and needs
- Development of **new features** targeted for embedded systems
- **Performance optimizations** across all the layers of the stack
Wrap up

- **Explosion** of interconnected smart devices
- **Lower-powered and constrained devices**
- **Reduce carbon footprint**, focus on extending life of devices

*Tension* between **product features**, **hardware capabilities** and **power consumption**
(i.e. "more with less")
Thanks