Quark : Browser with Formally Verified Kernel

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Security Bugs in Browser Code

Lots of Browser Features

JIT for JavaScript, HTML5, WebGL, etc, …

Lots of Security Policies

Same Origin Policies (JS,Cookie,XHR), Browser extensions

Lead to Security Bugs

938 Vulnerabilities in IE,Firefox,Chrome (2009–2011)

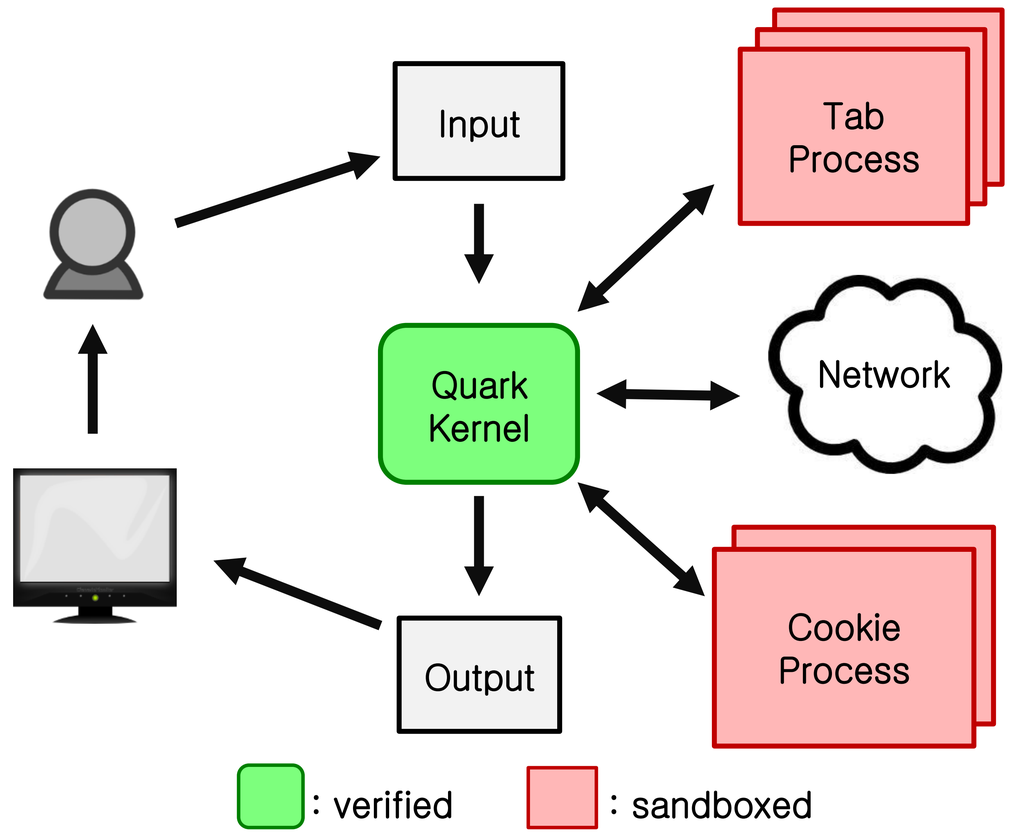
Kernel-based Browser

Chrome's Architecture (Kernel / Renderer)

Kernel ← IPC → Sandboxed Renderer

Q: What if the kernel is buggy?

Quark Architecture



Kernel Ensures Security

Small kernel enables us to apply formal verification

Formal Verification

Security Policies

Tab isolation

Cookie same domain policy

Address-bar correctness

Security Policies (142 LOC)

Safe system call sequences

↑ *Proved to satisfy*

Trace Spec (268 LOC)

All system call sequences that the code can generate

↑ *Proved to satisfy*

Kernel Code (859 LOC)

Message handling / access control for resources

Internal book-keeping / Written in Coq, Ocaml

Evaluation

Verification Efforts

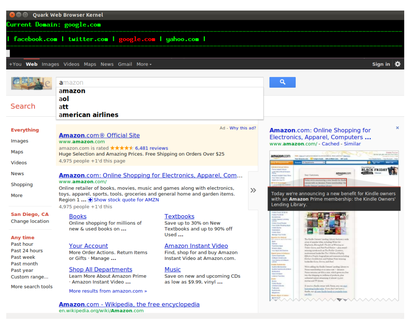
Staged proofs make it easier

Prototype first, prove later

Overall 6 man months to build / verify

Performance

20% overhead for page loading with optimizations for reducing IPC messages



Usability

Usable on major sites like Gmail,Maps,Amazon, …

Project Site : http://goto.ucsd.edu/quark/