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WebRTC Testing: State of the Art

ICSOFT 2017

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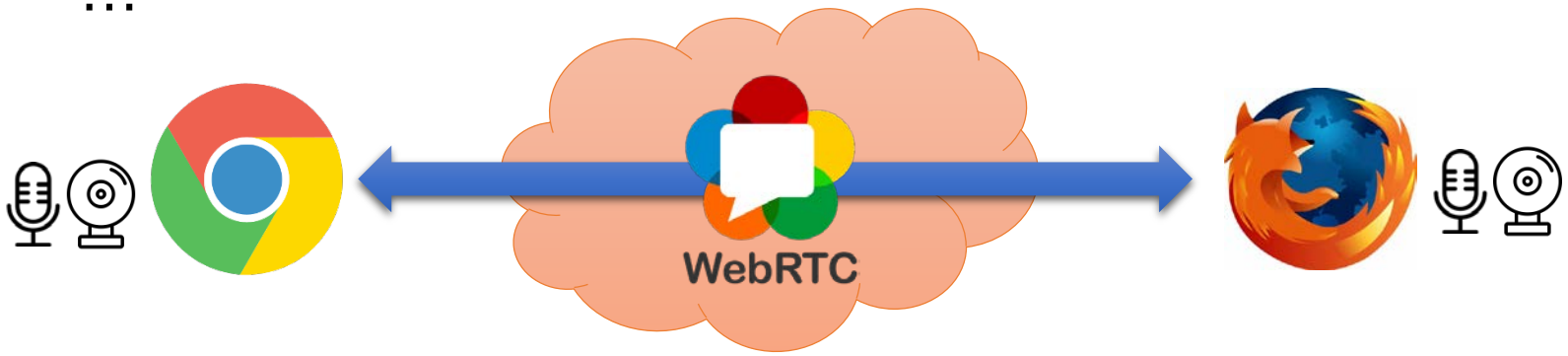
ICSOFT | 26th July 2017 | Madrid

Table of contents

1. Introduction

- **WebRTC** is the set umbrella term for a number of novel technologies having the ambition of bringing high-quality *Real Time Communications* to the Web
  - W3C (JavaScript APIs): *getUserMedia*, *PeerConnection*, *DataChannels*
  - IETF (protocol stack): ICE, SDP, TURN, STUN, DTLS, …



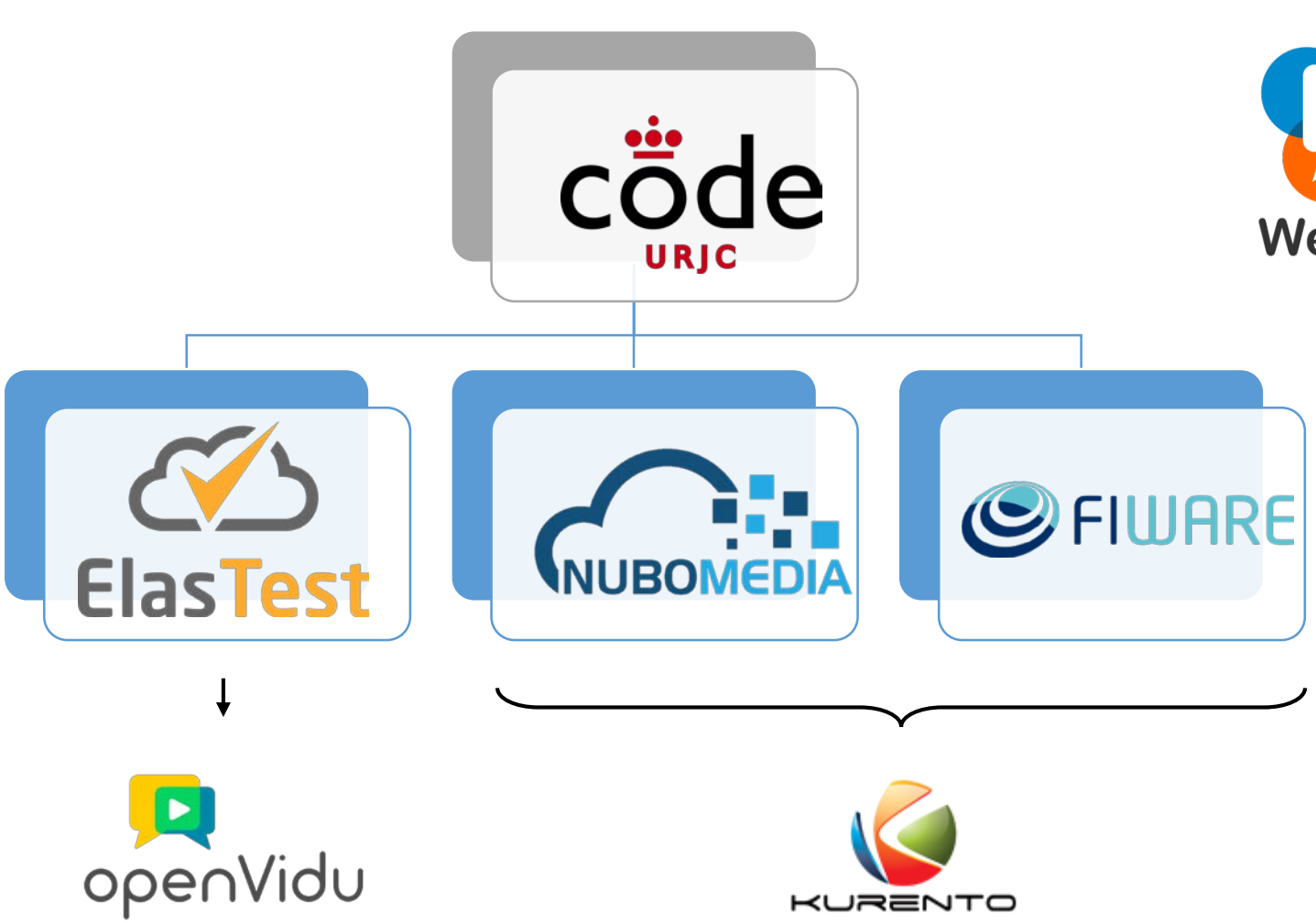
1. Introduction

- Strong rate of growth of WebRTC since its inception 2011
  - IP video traffic will be 82 percent of all consumer Internet traffic by 2020 (Cisco Index, 2016)
  - 7 billion devices compliant WebRTC by 2020 (Sal and Rebbeck, 2014)
- It is imperative to have a strategy in place in order to assess WebRTC
- Nevertheless, testing WebRTC based application in a consistently automated fashion is a challenging problem

1. Introduction

- Objective: survey the state of the art of testing for WebRTC-based applications
- This survey aggregates 3 different sources of information:
  1. **Scientific papers** and articles in peer-reviewed journals, magazine, and international conferences
  2. Public available **WebRTC testing tools**, both commercial and open source
  3. Contributions available in the so-called "***grey literature***" (technical reports, white papers, newsletters, blogs, etc.)

2. Background



3. Scientific and academic research

- Search engines used:
  1. Google Scholar
     http://scholar.google.com/
  2. CiteSeerx
     http://citeseerx.ist.psu.edu/
  3. Microsoft Academic Research
     http://academic.research.microsoft.com/
  4. ScienceDirect
     http://www.sciencedirect.com/

3. Scientific and academic research

- Results:

Title	Keywords	Reference
On-Demand WebRTC Tunneling in Restricted Networks	Black-box testing, QoS, networking	(Sandholm et al., 2013)
WebRTC quality assessment: Dangers of black-box testin	Black-box testing, QoS, objective QoE	(Cinar and Melvin, 2014)
The impact of mobile device factors on QoE for multi-party video conferencing via WebRTC	Subjective QoE	(Vucic and Skorin-Kapov, 2015)
WebRTCbench: a benchmark for performance assessment of WebRTC implementations	Performance testing, framework, open source	(Taheri et al., 2015)

3. Scientific and academic research

- Results:

Title	Keywords	Reference
Jattack: a WebRTC load testing tool	Load testing, QoS, framework	(Amirante et al., 2016)
Performance comparison of a WebRTC server on Docker versus virtual machine	Load testing, QoS	(Spoiala et al., 2016)
Testing Framework for WebRTC Services	Black-box testing, QoE, QoS, framework, open source	(García et al., 2016a)
Analysis of Video Quality and End-to-End Latency in WebRTC	Load testing, QoS, objective QoE, framework, open source	(García et al., 2016b)
WebRTC Testing: Challenges and Practical Solutions	Load testing, QoS, objective QoE, framework, networking	(García et al., 2017)

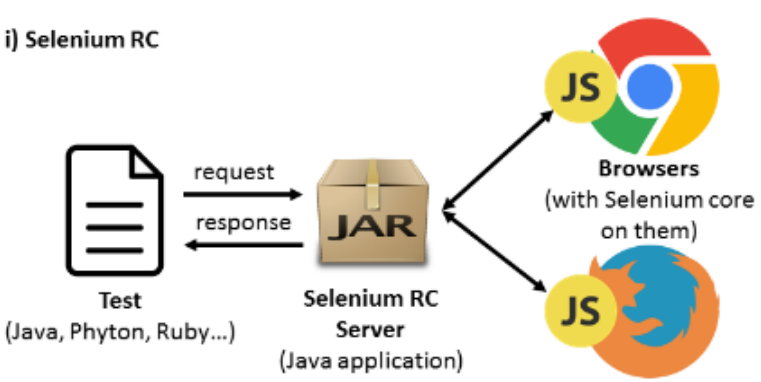
3. Scientific and academic research

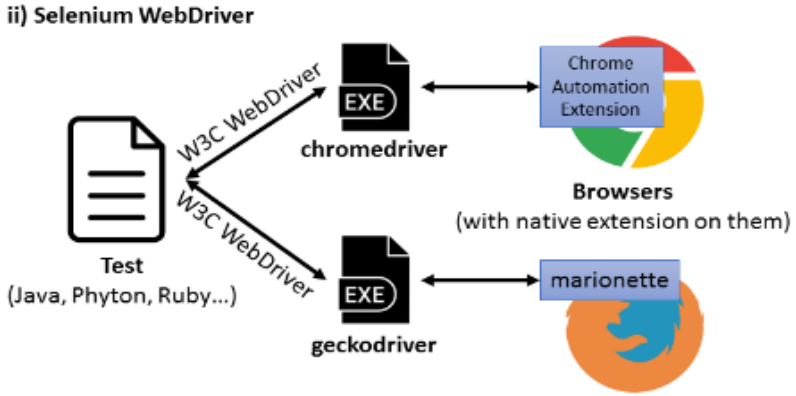
- Findings/conclusions:
  - Each contribution is focused in an specific domain (load testing, black-box, QoS, networking, …)
  - Implementation not always available
  - Fully integrated solution not available
  - Quality of Experience (QoE) is a promising research line applied to WebRTC

4. Tools

1. Selenium

- Open source testing framework which allows to control real browsers using different programming languages





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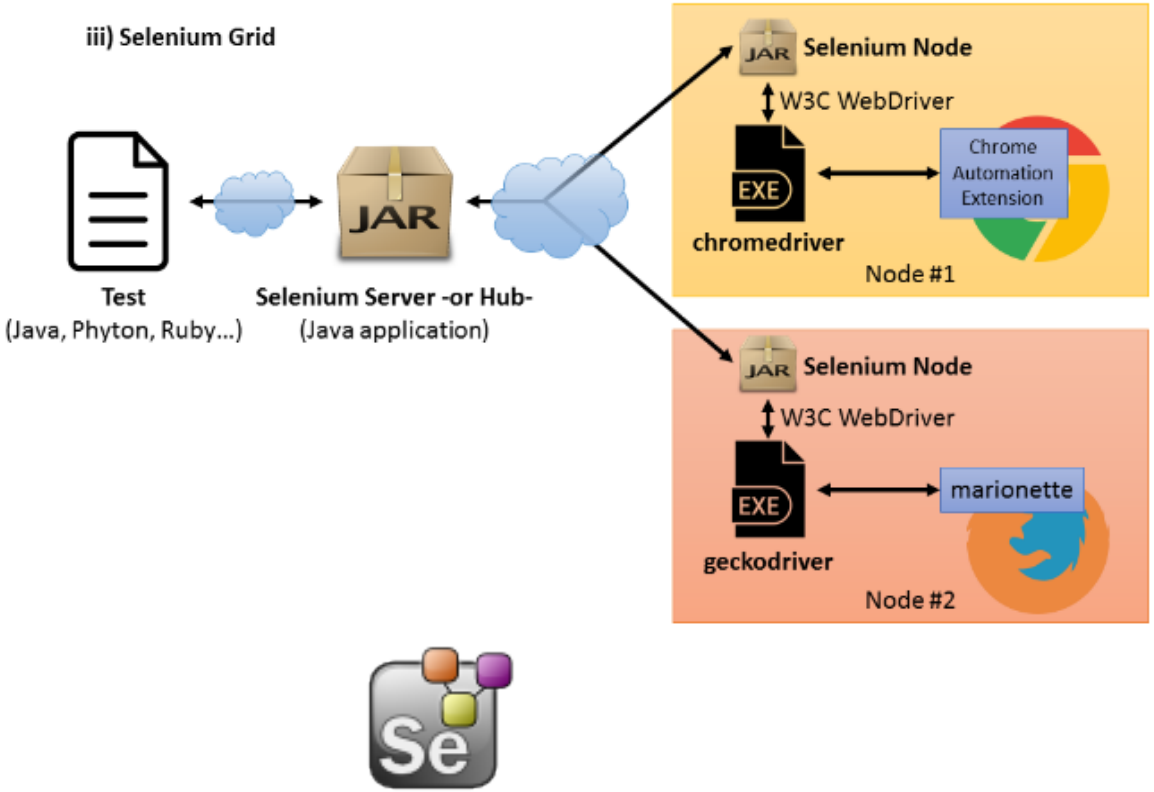
4. Tools

1. Selenium



Cloud providers

BrowserStack

4. Tools

2. TestRTC

- Commercial integrated platform aimed to test, monitor and analyze WebRTC-based communications
  - Use of real browsers
  - JavaScript API (built on the top of Nightwatch.js)
  - Network awareness
  - WebRTC tests at scale
  - Monitor Key Performance Indicators (KPIs) such as channel types, bitrate, timing, packet loss, and jitter
  - WebRTC-internals analyzer
  - Live preview of the remote browser
  - …

4. Tools

- Findings/conclusions:
  - In the open source arena, Selenium is a must-know tool to carry out automated testing of WebRTC-based application, but:
    - Specific capabilities for WebRTC are not available
    - Usually, QA teams builds its own testing frameworks on the top of Selenium (WebDriver/Grid)
  - In the commercial arena, TestRTC offers an integrated powerful solution for testing WebRTC-based applications
    - Convenient for companies and large projects
    - You need to pay for it, so it is difficult to assume for open source or small project

5. Grey literature

- Sources:
  1. Google Testing Blog
     https://testing.googleblog.com/
  2. Google Test Automation Conference (GTAC)
     https://developers.google.com/google-test-automation-conference/
  3. WebRTC Conference
     https://webrtc-conference.com/
  4. BlogGeek.me
     https://bloggeek.me/
  5. WebRtcHacks.com
     https://webrtchacks.com/

5. Grey literature

- Results

Title	Keywords	Reference
WebRTC Audio Quality Testing	Black-box testing, objective QoE	(Höglund, 2013a)
Automated Video Quality Measurements	Black-box testing, objective QoE	(Höglund, 2013b)
Chrome-Firefox WebRTC Interop Test	Interoperability testing	(Höglund, 2014)
Audio Testing - Automatic Gain Control	Black-box testing	(Höglund, 2015)
The WebRTC Troubleshooter: test.webrtc.org	Black-box testing, QoS	(Pascual, 2015)
Overcoming the Challenges in Testing WebRTC Services	Testing methodology	(Levent-levi, 2015)
Quality Assurance for WebRTC Services	Testing methodology	(Levent-levi, 2016)

5. Grey literature

- Findings/conclusions:
  - Spread contributions (tools, methodologies, …)
  - Quite interesting to follow the right people to be in touch with the latest trends

6. Conclusions and future work

- WebRTC is a set of technologies aimed to provide real time media capabilities to web applications
  - WebRTC applications are more and more demanded
  - They involve complex, distributed and heterogeneous network topologies (testing is not trivial)
- In the light of results, we conclude there are significant effort in the field of WebRTC testing
- There is room for improvement in several aspects, such as QoE and integrated open source solutions

6. Conclusions and future work

- Future work: ElasTest (H2020 project)
  - The objective of ElasTest is to provide a flexible open source testing platform aimed to simplify the end-to-end testing processes for different types of applications (among them, WebRTC-based applications)

ElasTest

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Thank you

QA

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