Opportunities and Challenges of Ad-based Measurements from the Edge of the Network

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Motivation

- Quality of Experience perceived by end-users
  - ISP's network design
  - Regulatory policies

  measurements from the edge of the network

- Discovered network neutrality infringements
  - DNS manipulation
  - HTTP header injection

Edge-driven measurement techniques

▪ Balance between ISP-coverage, user scale and accuracy

|	RIPE Atlas	Archipelago	Netalyzr	Luminati
Number of sessions*	✅ 9.3K	❌ 181	✅ 2.2M*	✅ 1.3M*
Targeting	❌	❌	❌	❌
Time	❌ 6 yrs	❌ 10 yrs	❌ 6 yrs	✅ 5 days
ISP-coverage	✅ 3.3K	❌ 146	✅ 14.5K	✅ 14.7K
Measurement capabilities	✅	✅	✅	❌

AdTag

- Ad-based measurements

- Why?
  - Leverage the nature of ad networks
  - Large ISP-coverage – short period of time
  - **Targeting capabilities of ad networks**

- What?
  - Architecture
  - Technical aspects
  - Deployability – browser support
  - Cost
  - Ethical aspects
  - Targeting capabilities

Architecture

Targets

Geolocation
Devices
Operating Systems

DSP

Ad
Exchange

Test and
control
server
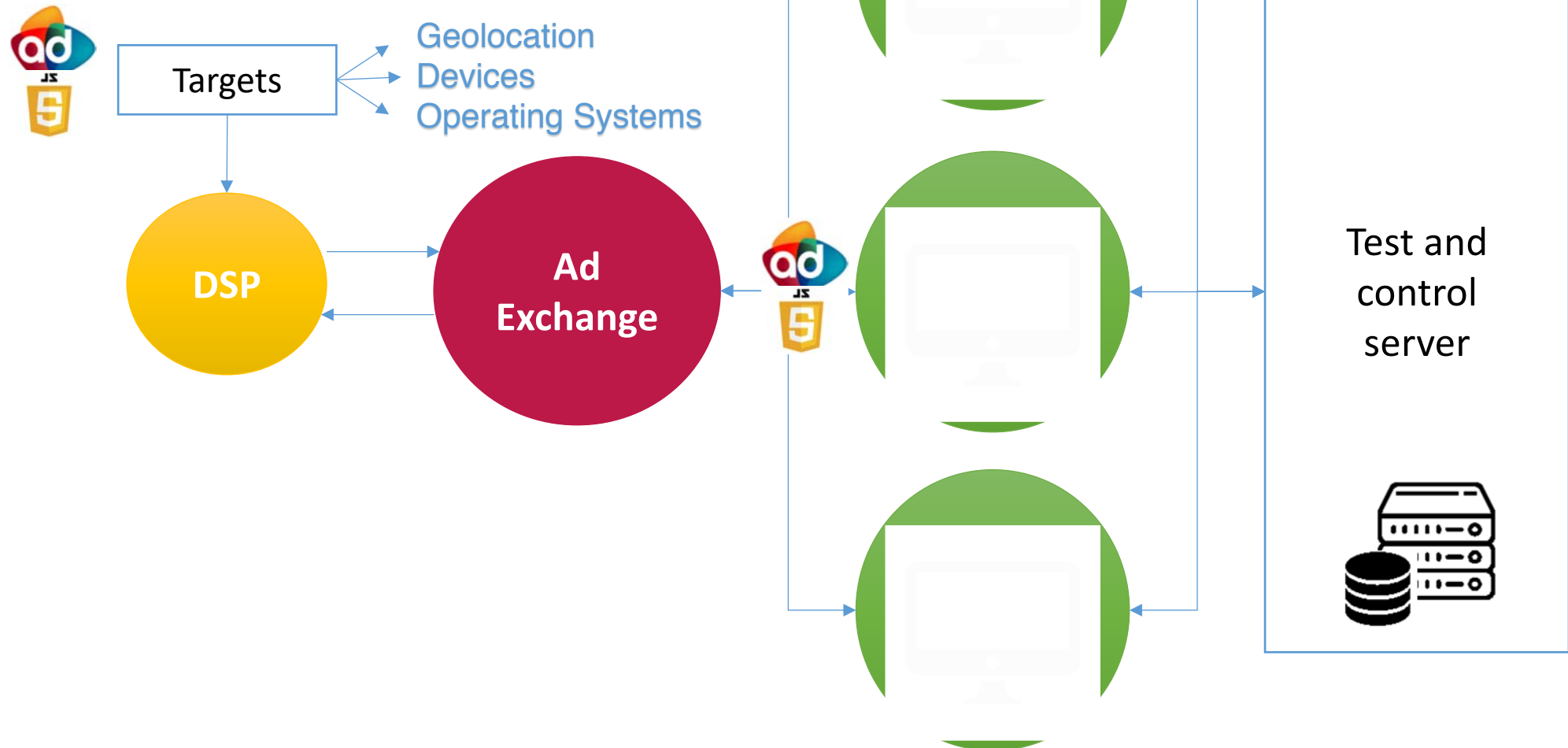
Technical aspects

- AdTag leverages HTML5-based ads

- Execute JavaScript-based active network measurements

- Limited by browsers libraries:

  - **XMLHttpRequest** – TCP / HTTP requests

  - **WebSocket** – TCP channel

  - **WebRTC** – UDP channel

Deployability

- In Ad Networks, DSPs, Ad Exchanges …

- Specifically, we run real campaigns in a DSP
  - Access to multiple vendors
  - Settings - targeting:
    - Geographical location
    - Browser brand
    - Device type
    - Operating System

Cost

- Maximize number of impressions

- Minimum CPM (Cost Per Mille) $ 0.10

1M measurements → $ 100 budget

LOW COST!

Ethical aspects

- Not user consent possible

- Do Not Track header

<div style="border: 2px solid navy; padding: 1em;">

GUIDELINES

- ☐ Do not use excessive amount of data.
- ☐ Do not collect any PII.
- ☐ Do not execute test which may compromise security.
- ☐ Do not perform experiments with user's personal integrity at risk.
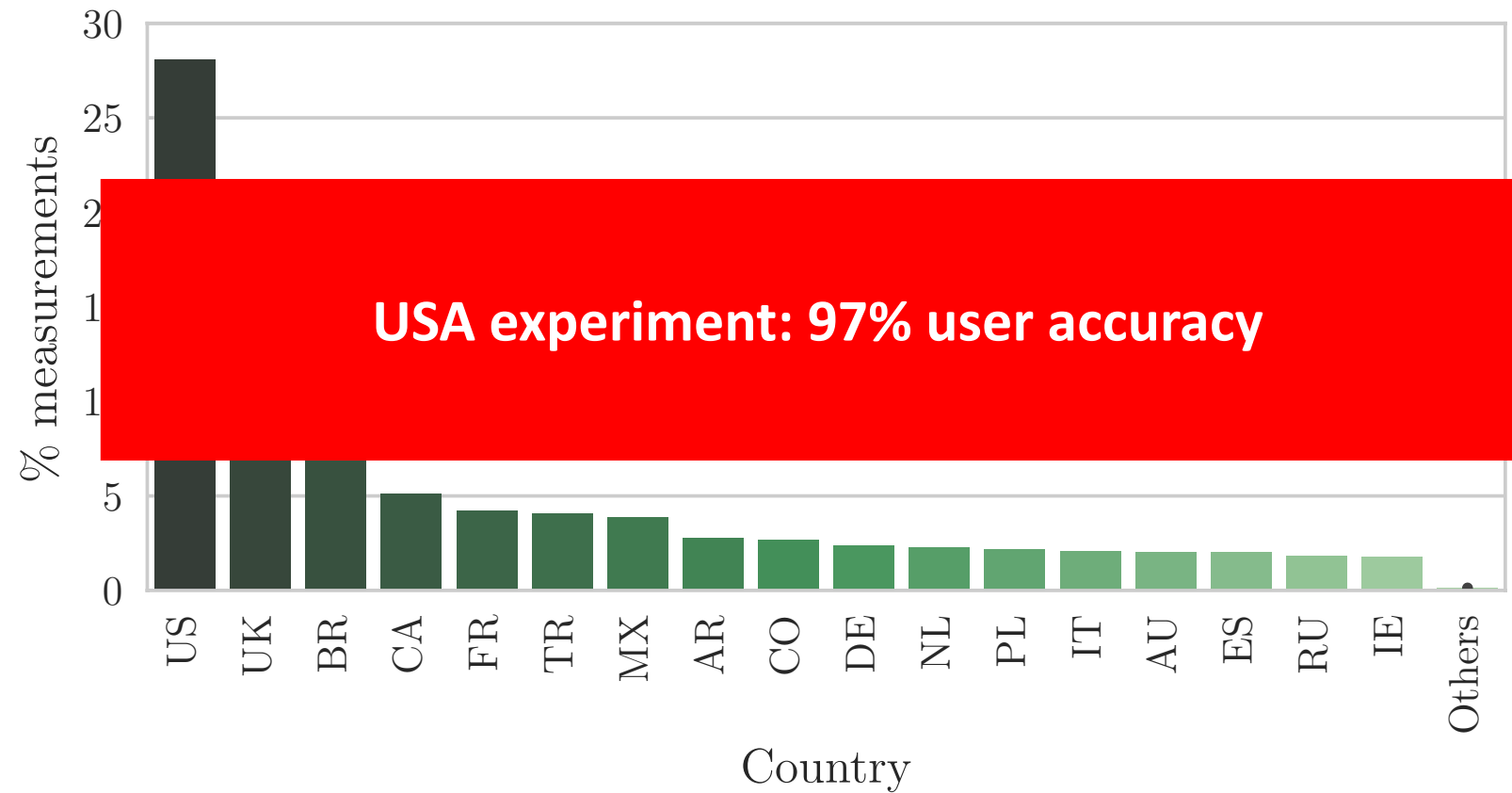
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AdTag evaluation

- Execution window

- Targeting accuracy

- Browser support

Execution window

- Time active in the browser

- Limited time

	Percentiles		
	25th		
Mobile	7.8s	**Largest time on desktop devices**	
Desktop	14.3s		
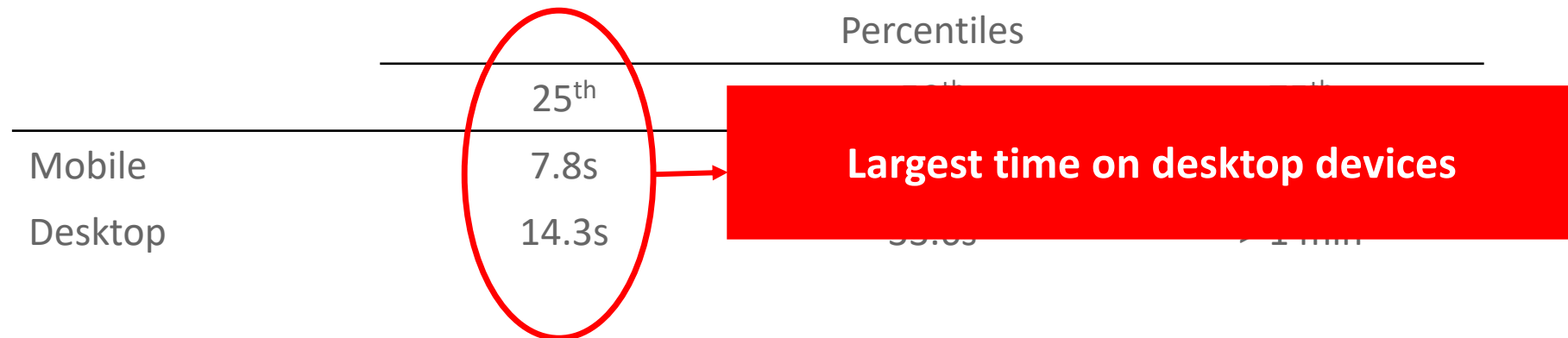
Targeting ISPs and Locations

USA experiment: 97% user accuracy

Browser support

	total	WebRTC	WebSocket
Chrome	34.5 %	97 %	97 %
Mobile Safari	21.7 %	n/a	14.3 %
Chrome Mobile	19.8 %	56 %	56 %
Firefox	5.4 %	88 %	88 %
Safari	4.6		

Less support in mobile browsers
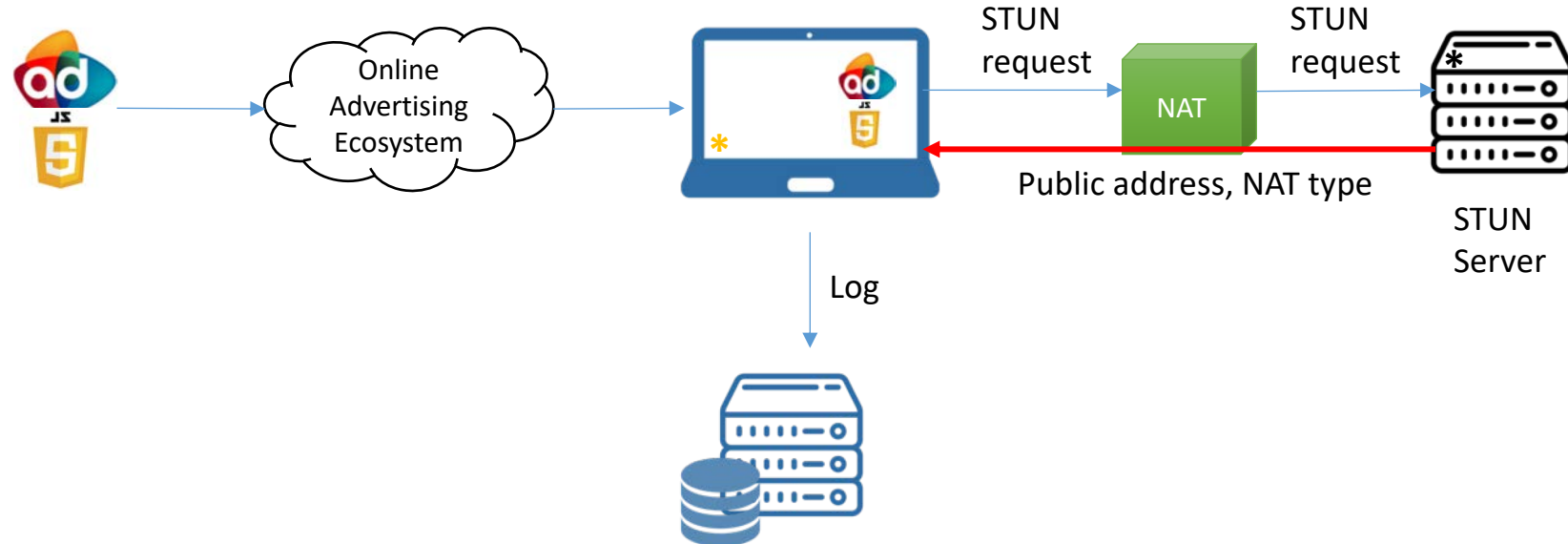
Use cases

Use cases: Middleboxes

▪ Detecting middleboxes and traffic manipulation (XHR and WebSocket)
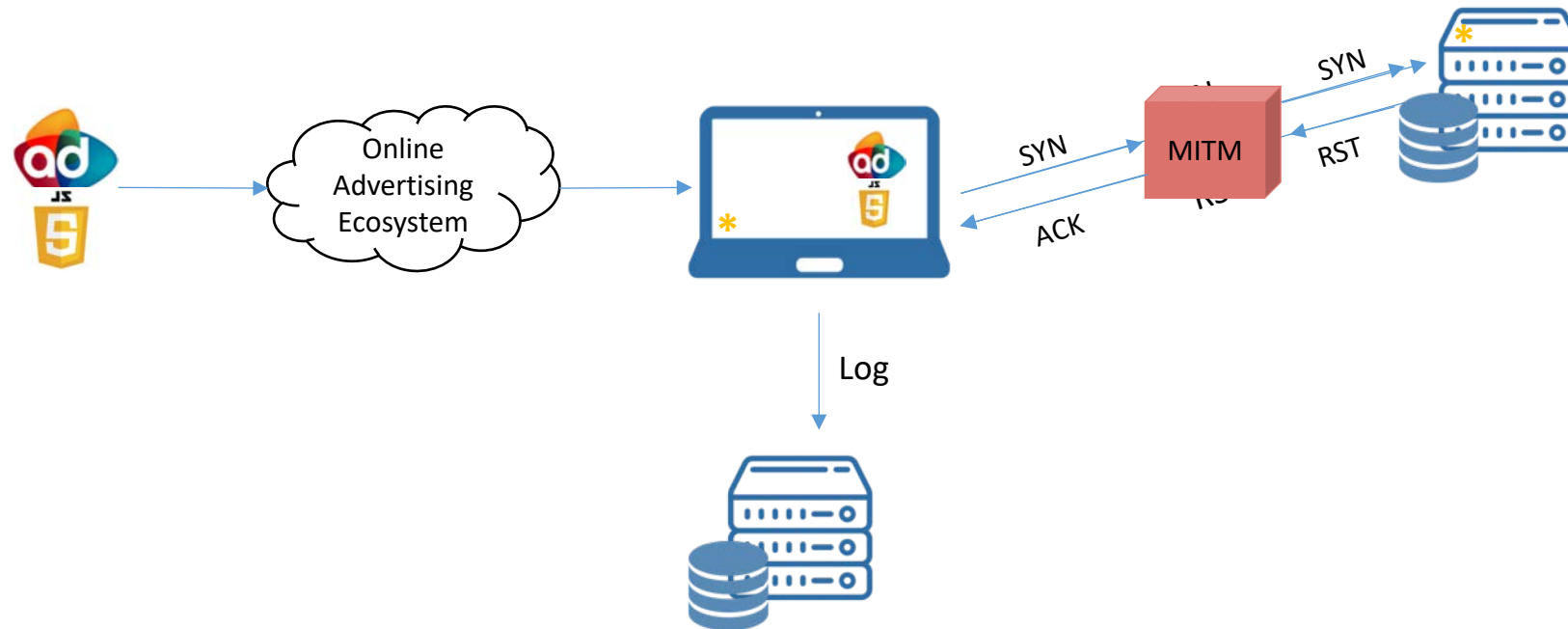
Use cases: NAT

▪ NAT detection and characterization (WebRTC and WebSocket)

Use cases

- Detecting middleboxes and traffic manipulation (XHR and WebSocket)

- NAT detection and characterization (WebRTC and WebSocket)

- **CDN performance (XHR and WebSocket)**

- **IP classification (WebRTC and WebSocket)**

Summarizing ...

	RIPE Atlas	Archipelago	Netalyzr	Luminati	**AdTag**
Number of sessions	✅	❌	✅	✅	✅
Targeting	❌	❌	❌	❌	✅
Time	❌	❌	❌	✅	✅
ISP-coverage	✅	❌	✅	✅	✅
Measurement capabilities	✅	✅	✅	❌	❌

Thank you

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■ Research project: **fdvt.org**

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