

Auditing net neutrality violations globally

-or-

What happened when Apple said no

DAVID CHOFFNES



Northeastern University
College of Computer and Information Science



Problem statement

Problem statement



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EFF Confirms: T-Mobile's Binge On Optimization is Just Throttling, Applies Indiscriminately to All Video

TECHNICAL ANALYSIS BY JEREMY GILLULA | JANUARY 4, 2016

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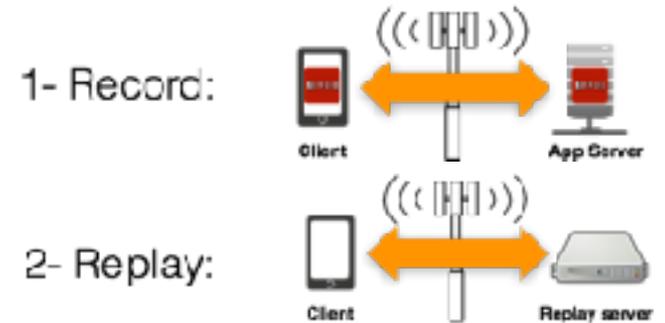
Key measurement questions/challenges:

- Which **apps** are affected?
- How do you obtain **strong confidence** that an ISP is violating net neutrality?
- How do you obtain **ground truth**?
- Can we **crowdsource** measurements of net neutrality violations?

Addressing challenges: TL;DR

Which apps are affected?

- We don't know a priori
- **Record and replay** real app traffic



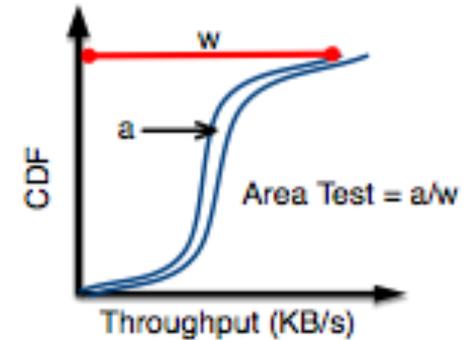
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Ground truth

- Bought a DPI middlebox off eBay
- Found **matching rules** surprisingly brittle

Header	Example Value	Example Application
URI	site.js[...]- nbc sports-com	NBC Sports
Host	Host: www. spotify .com	Spotify
User-Agent	User-Agent: Pandora 5.0{...}	Pandora
Content-Type	Content-Type: video/ quicktime	QuickTime

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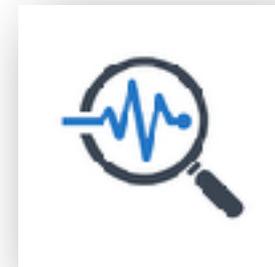
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Can we crowdsource?

- Yes! **Wehe** requires no special permissions
- Works on Wifi/cell via Android/iOS apps

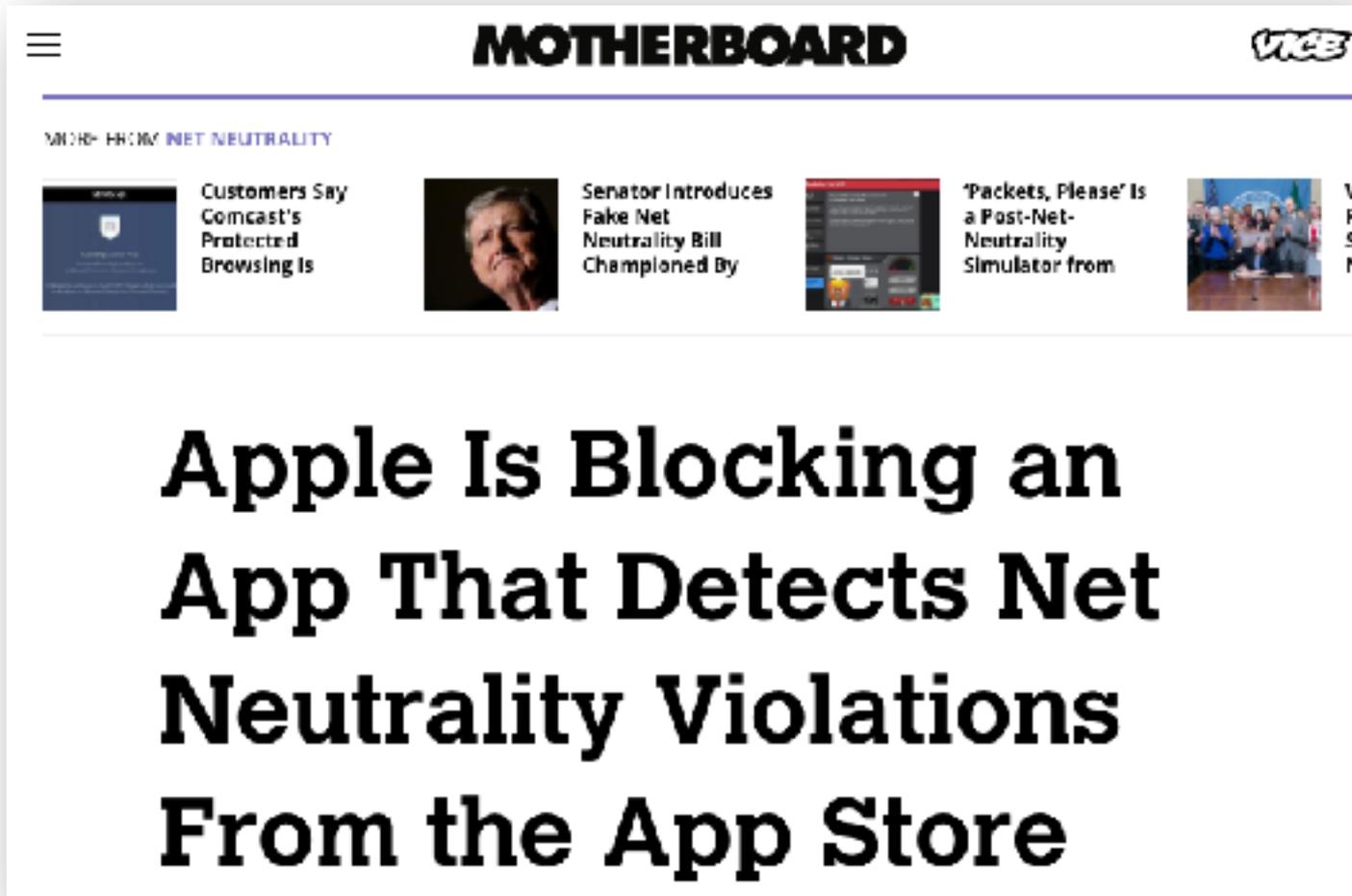


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The image shows a screenshot of a Motherboard article. At the top, the 'MOTHERBOARD' logo is centered, with a 'VICE' logo in the top right corner. Below the logo, there is a navigation menu with a hamburger icon on the left and a 'NET NEUTRALITY' link. The main content area features a large, bold headline: 'Apple Is Blocking an App That Detects Net Neutrality Violations From the App Store'. Above the headline, there are four smaller article teasers, each with a thumbnail image and a title: 1. 'Customers Say Comcast's Protected Browsing Is...' with a blue shield icon; 2. 'Senator Introduces Fake Net Neutrality Bill Championed By...' with a portrait of a man; 3. ''Packets, Please' Is a Post-Net-Neutrality Simulator from...' with a screenshot of a game; 4. A partially visible title 'W P S N' with a group photo thumbnail.

Apple Is Blocking an App That Detects Net Neutrality Violations From the App Store

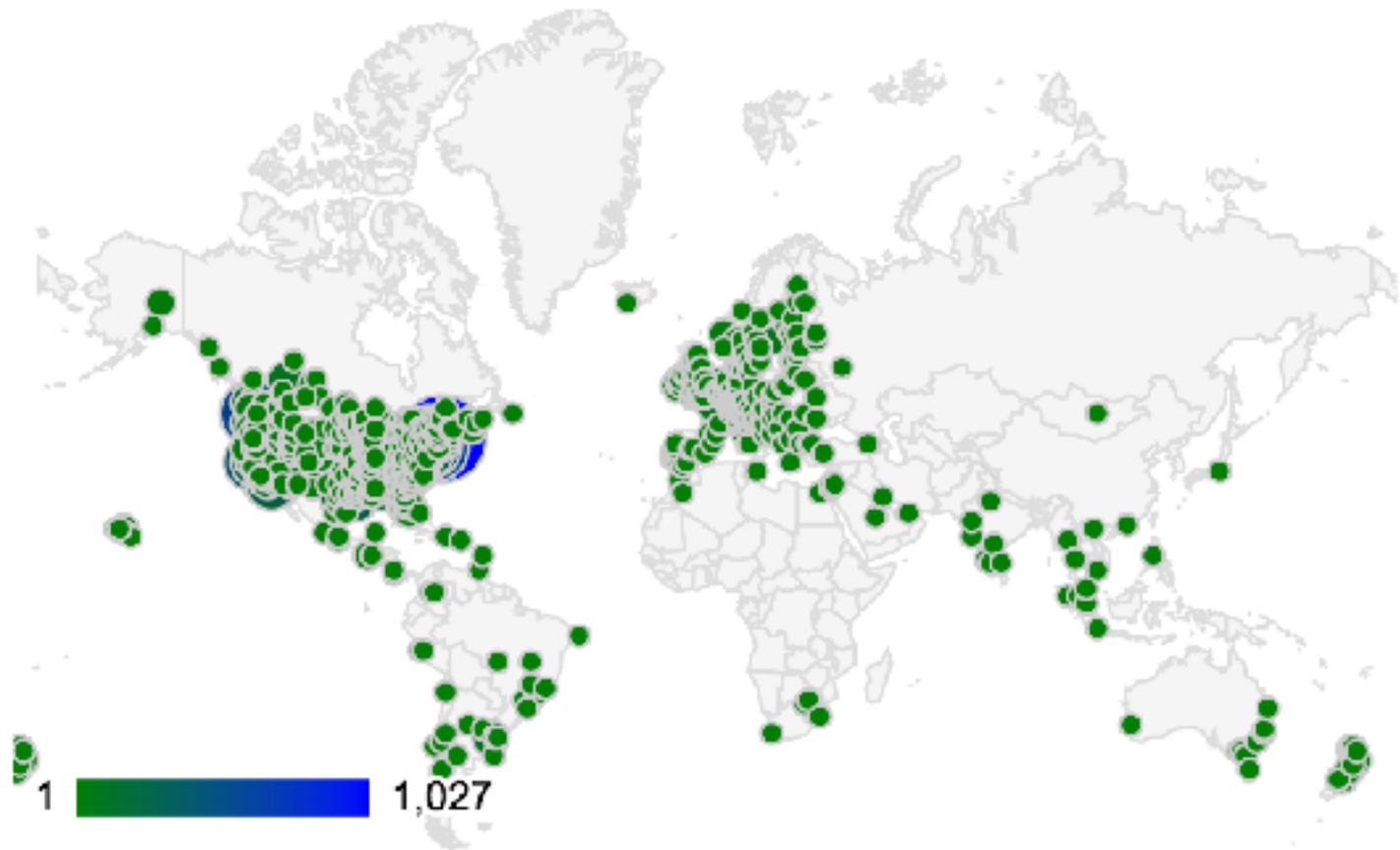
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A screenshot of a web browser displaying the Reddit homepage. The browser's address bar shows "Secure | https://www.reddit.com". The page features the Reddit logo, navigation tabs (hot, new, rising, controversial, top, gilded, wiki), and a search bar. A banner at the top reads "Welcome to Reddit. Come for the cats, stay for the empathy." Below this, there are two main posts. The first post, titled "Apple Is Blocking an App That Detects Net Neutrality Violations From the App Store: Apple told a university professor his app 'has no direct benefits to the user.'", is highlighted with a purple border. The second post is titled "Two teenage boys were rescued by a brand new lifesaving drone in Australia while lifeguards were still training to use it." On the right side of the page, there are buttons for "Submit a new link" and "Submit a new text post", along with a "daily reddit gold goal" progress bar.

Neutrality violations From the App Store

Apple says no



Some of our findings

116,000 tests and growing (~2k per day)

Countries	ISPs
US	Verizon Wireless, MetroPCS, HOME, T-Mobile, cricket, CSpire, Boost Mobile, AT&T, iWireless
UK	O2, giffgaff
UAE	Blocking Skype

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Apps	
YouTube (10)	T-Mobile, Verizon Wireless, MetroPCS, AT&T, HOME, O2 - UK, cricket, CSpire, giffgaff, Boost Mobile
Netflix (6)	T-Mobile, Verizon Wireless, MetroPCS, O2 - UK, AT&T, Boost Mobile
Amazon Prime Video (5)	Verizon Wireless, MetroPCS, HOME, ,T-Mobile, MetroPCS
NBCSports (4)	T-Mobile, MetroPCS, AT&T, iWireless

Wehe for public policy



Currently working w/ ARCEP (equivalent of FCC in France)

- **Strong** net neutrality laws
- Contract to provide **auditing** using Wehe

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Our goal: improve **transparency**, serve as a **model** for other jurisdictions

ARCEP contract

Deliver a tool to monitor net neutrality in France

- Translate to French language
- Provide fully functional apps
 - Along with infrastructure to support them
 - Using M-Lab, EC2, will add more providers
 - Regular updates to include latest traffic samples from relevant apps
- Reverse engineering of DPI rules
- Interface to submit complaints directly to ARCEP from the app

Operational challenges

False positives

- We run multiple tests back-to-back to reduce probability
- Issues with incomplete tests
- Support interface to show what others have seen

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False negatives

- Sometimes cellular bandwidth is terrible
- If less than throttled rate, there is no differentiation applied
- Needs a way to automatically infer throttling rate

Operational challenges (2)

User perception

- “What if I don’t have a Netflix account?”
- “Wow, AT&T is slowing my video by 10x!”
- “Wait, I can turn off throttling?”
- “How do I test my fixed-line connection?”

User requests

- Please add app X
- Please provide Windows support
- Please provide the source code (soon!)

The screenshot shows a mobile application interface titled "Selected Applications" with a back arrow on the left and a checkmark on the right. The interface displays a list of four applications, each with a unique icon, size, time, and differentiation status. The first application has a blue 'S' icon, a size of 8.7 MB (x2), a time of 20 s (x2), and a status of "No differentiation". The second application has a red YouTube icon, a size of 10.7 MB (x2), a time of 4.1 s (x2), a status of "Differentiation detected", and throughput values of 1.63 Mb/s for YouTube and 10.54 Mb/s for Non-YouTube. The third application has an orange Amazon icon, a size of 8.2 MB (x2), a time of 3 s (x2), and a status of "No differentiation". The fourth application has a colorful icon, a size of 12.5 MB (x2), a time of 0.2 s (x2), and a status of "1/2 Running the Sender process". A blue play button is visible in the bottom right corner of the fourth application's card. At the bottom of the screen, there is an orange bar with the text "6 applications selected" and "149 MB".

Application Icon	Size	Time	Differentiation Status	Throughput
S (Blue)	8.7 MB (x2)	20 s (x2)	No differentiation	-
YouTube (Red)	10.7 MB (x2)	4.1 s (x2)	Differentiation detected	YouTube Throughput: 1.63 Mb/s Non-YouTube Throughput: 10.54 Mb/s
Amazon (Orange)	8.2 MB (x2)	3 s (x2)	No differentiation	-
Colorful (Multi)	12.5 MB (x2)	0.2 s (x2)	1/2 Running the Sender process	-

MA State Legislature

Testified at MA State Senate Hearing

- Described much of what I covered at TPRC this year
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 - Who measures?
 - How to define the grades?
 - How to avoid subversion?

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- What if we gave ISPs “grades” for neutrality?
 - Who measures?
 - How to define the grades?
 - How to avoid subversion?
- Other carrots/sticks discussed
 - Relationship between ISPs and various jurisdictions is complicated
 - No silver bullet here

Going forward

Continue to improve our tests

Engage with more jurisdictions

Tackle some thorny measurement/policy questions

Be vigilant

<https://dd.meddle.mobi>