Auditing net neutrality violations globally
-or-
What happened when Apple said no

DAVID CHOFFNES
Problem statement
Problem statement
Problem statement

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

Back in November, T-Mobile announced a new service for its mobile customers called
Problem statement
Net neutrality (extreme): Treat all network traffic the same
Problem statement

Net neutrality (practical): Treat all network traffic the same, except for *reasonable network management*
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Net neutrality (practical): Treat all network traffic the same, except for *reasonable network management*

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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- Developed **new type of KS-Test** statistic
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Ground truth
- Bought a DPI middlebox off eBay
- Found **matching rules** surprisingly brittle

<table>
<thead>
<tr>
<th>Header</th>
<th>Example Value</th>
<th>Example Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>URI</td>
<td>site.js{...}-nbcspports-com</td>
<td>NBC Sports</td>
</tr>
<tr>
<td>Host</td>
<td>Host: <a href="http://www.spotify.com">www.spotify.com</a></td>
<td>Spotify</td>
</tr>
<tr>
<td>User-Agent</td>
<td>User-Agent: Pandora 5.0[...]</td>
<td>Pandora</td>
</tr>
<tr>
<td>Content-Type</td>
<td>Content-Type: video/quicktime</td>
<td>QuickTime</td>
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Can we crowdsource?
- Yes! Wehe requires no special permissions
- Works on Wifi/cell via Android/iOS apps
Apple says no
Apple says no

@apple just rejected our Wehe app (dd.meddle.mobi) for detecting net neutrality violations such as throttling video traffic. Asked why, and was told "We do not think it is appropriate." (1/n)

4:31 PM - 16 Jan 2018

635 Retweets 996 Likes
Apple says no

Apple Is Blocking an App That Detects Net Neutrality Violations From the App Store
Apple says no
Apple says no
Some of our findings

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

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<td>Verizon Wireless, MetroPCS, HOME, T-Mobile, cricket, CSpire, Boost Mobile, AT&amp;T, iWireless</td>
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<td>YouTube (10)</td>
<td>T-Mobile, Verizon Wireless, MetroPCS, AT&amp;T, HOME, O2 - UK, cricket, CSpire, giffgaff, Boost Mobile</td>
</tr>
<tr>
<td>Netflix (6)</td>
<td>T-Mobile, Verizon Wireless, MetroPCS, O2 - UK, AT&amp;T, Boost Mobile</td>
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<tr>
<td>Amazon Prime Video (5)</td>
<td>Verizon Wireless, MetroPCS, HOME, T-Mobile, MetroPCS</td>
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<td>NBCSports (4)</td>
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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!)
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  - Senators clearly engaged, had lots of questions no one else could answer
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    ■ 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