Analyzing The Adoption of QUIC From a Mobile Development Perspective

In Workshop on Evolution, Performance, and Interoperability of QUIC (EPIQ ‘20)

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1. CONTEXT AND MOTIVATION
Google introduced QUIC in 2013
QUIC has been adopted by the IETF since 2016
QUIC outperforms TCP/TLS in unstable wireless networks [1]

CONTEXT AND MOTIVATION

• 2017-2018: QUIC accounted for 7-9% of total traffic volume [2, 3]

• Today: more companies started adopting QUIC
  o Facebook (IETF QUIC)
  o Uber Technologies Inc. (gQUIC)

Profile QUIC traffic from network measurements taken by mobile end-user devices
Profile QUIC traffic from network measurements taken by mobile end-user devices

- **Measurements in user-space**
  - Allows to identify applications using QUIC

- **Mobile devices**
  - Performance of QUIC can be of particular interest for wireless networks

- **Wireless networks**
  - By 2022, 71% of total IP traffic is expected to be wireless (51% WiFi and 20% Mobile)
2. NETWORK MEASUREMENT METHODOLOGY
NETWORK MEASUREMENT METHODOLOGY

• Android framework to take network flow measurements

• PePa methodology
  1. Periodic behavior
  2. Passive behavior
1. Periodic Behavior

- Obtain an overall of the user’s network traffic without overloading the device
- Monitor user’s traffic for 1-min every 15-min
2. Passive Behavior

- Use Android VpnService to implement a local VPN server
- Gains packet-level access without requiring root privileges
NETWORK MEASUREMENTS

- Information from each monitored network flow

<table>
<thead>
<tr>
<th>dst_ip</th>
<th>dst_port</th>
<th>protocol</th>
<th>start_time</th>
<th>end_time</th>
<th>tx_bytes</th>
<th>rx_bytes</th>
<th>connection_type</th>
<th>package_name</th>
</tr>
</thead>
<tbody>
<tr>
<td>157.240.204.60</td>
<td>443</td>
<td>tcp</td>
<td>03/26/2020 02:35:18.25</td>
<td>03/26/2020 02:35:37.81</td>
<td>839</td>
<td>1371</td>
<td>WiFi</td>
<td>com.whatsapp</td>
</tr>
<tr>
<td>64.233.186.95</td>
<td>443</td>
<td>udp</td>
<td>03/24/2020 13:13:28.45</td>
<td>03/24/2020 13:15:22.89</td>
<td>2961</td>
<td>4327</td>
<td>Mobile</td>
<td>com.google.android.youtube</td>
</tr>
</tbody>
</table>
COLLECTED DATASET
February to April 2020

~160 REAL USERS

~175,000 EXECUTIONS OF THE 1-MIN MEASUREMENT SYSTEM

~1,850,000 INTERNET TRAFFIC FLOWS

831 DIFFERENT ANDROID APPLICATIONS

~35,000 DIFFERENT IP ADDRESSES
Further insights into the collected network flows:

**Identify web flows**

- **HTTP/HTTPS**
  - Nmap tool to check each <IP : PORT> from the dataset

- **QUIC**
  - Connect using HTTP over TCP connections
  - Alternative service (HTTP header)
  - LiteSpeed QUIC (LSQUIC) library
DATA PROCESSING

For each IP address running a web service (HTTP, HTTPS or QUIC):

• Establish an HTTPS connection to analyze the SSL certificate
  o Obtain server’s common name and organization

• This method was successful for 82% of these IP addresses
  o Particularly, it was successful for all IP addresses running QUIC
3. DATA ANALYSIS
23.05% of network traffic from Android devices.

26.16% WiFi traffic
10.56% Mobile data traffic
ANDROID APPS USING QUIC

2020
173 ANDROID APPS

2018
32 ANDROID APPS
ANDROID APPS USING QUIC

2020
173 ANDROID APPS

2018
32 ANDROID APPS

: APPS DEVELOPED BY GOOGLE
ANDROID APPS USING QUIC

2020
173 ANDROID APPS

2018
32 ANDROID APPS

: APPS DEVELOPED BY GOOGLE
ANDROID APPS USING QUIC

2020
173 ANDROID APPS

: APPS DEVELOPED BY GOOGLE
- YouTube
- Google Chrome
- Google Photos
- Maps

: APPS NOT DEVELOPED BY GOOGLE
- Facebook
- Instagram
- Snapchat
- Uber
Google LLC  Facebook, Inc.

Snap, Inc.  Uber Technologies, Inc.

ORGANIZATIONS SERVING QUIC
ORGANIZATIONS SERVING QUIC
QUIC TRAFFIC
Between Android applications and organizations

- Other Apps (144): 80% of their QUIC connections were resolved to:
  - *g.doubleclick.net
  - dns.google
  - *google.com
  - *googlevideo.com
  - *google-analytics.com

- Embedded Google SDKs, e.g., Google Analytics SDK or Google Mobile Ads SDK
4. CONCLUSIONS
# Conclusions

<table>
<thead>
<tr>
<th>Profile the adoption of QUIC</th>
<th>Crowdsourced mobile traffic data</th>
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</thead>
<tbody>
<tr>
<td>More Android apps using QUIC</td>
<td>More companies adopting QUIC</td>
</tr>
<tr>
<td>Future work: temporal analysis to track the evolution of QUIC</td>
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