

# Towards a Censorship Analyser for Tor

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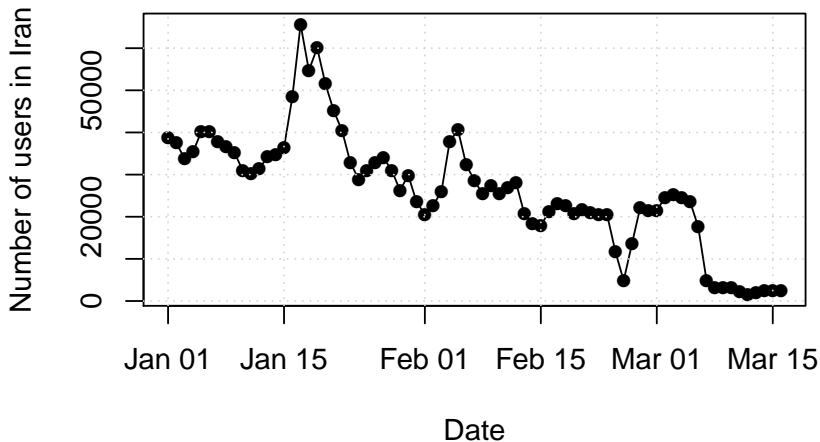
*The Tor Project & Karlstad University*

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# Tor and censorship

- ▶ Some countries, corporate firewalls, captive portals and ISPs block Tor.
- ▶ Blocks become known through users and dropping usage statistics.
- ▶ Incidents are then analysed to either modify Tor or motivate new censorship-resistant protocol (see obfsproxy et al.).

## Example: pre-election censorship in Iran



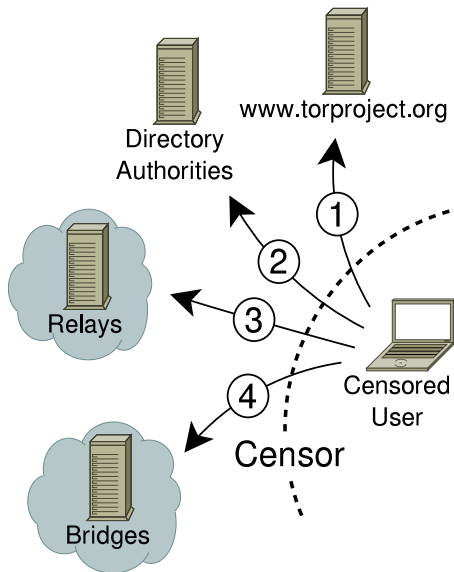
# Motivation for this paper

- ▶ Analysis of censorship incidents not always straightforward.
- ▶ Two typical analysis scenarios
  - ▶ Obtain shell inside censoring network and debug Tor handshake.
  - ▶ Obtain network trace of Tor bootstrapping and study it.
- ▶ Problems
  - ▶ No shells.
  - ▶ No network traces.
  - ▶ Dependence on technical volunteers.

# Our approach to the problem

- ▶ How about (unskilled) **users** do the censorship analysis for us?
- ▶ Provide a small **tool** which automatically gathers analysis-relevant data.
- ▶ Comes with novel **technical** and **ethical** challenges.
- ▶ Important: respect user's **privacy** and **security**.

# What our analyser does

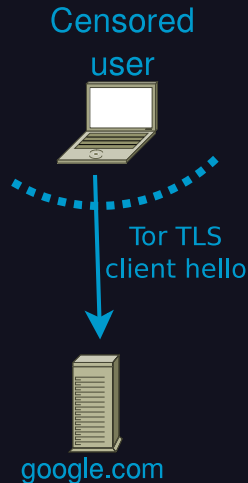


# Analysis steps (1/3)

- ▶ Create a network trace of analysis
  - ▶ Should be optional.
  - ▶ Must only cover analysis.
- ▶ Obfuscate tests
  - ▶ Randomise order of executed tests.
  - ▶ Use random sleep periods between tests.
- ▶ Probe the website
  - ▶ Try to download the index page.
  - ▶ Resolve [www.torproject.org](http://www.torproject.org) and check A records.
  - ▶ Experiment with TLS SNI and perhaps HTTP Host header.

## Analysis steps (2/3)

- ▶ Probe the directory authorities
  - ▶ Authorities are a popular choke point.
  - ▶ Try to download the consensus.
  - ▶ If it fails, ping and traceroute the authorities.
- ▶ Test relay reachability
  - ▶ Connect to relay found in consensus.
  - ▶ Step through TLS handshake.
  - ▶ Send Tor-specific TLS client hello to unrelated machine.
- ▶ Test bridge reachability
  - ▶ Bridges are relays not listed in the consensus.
  - ▶ See if pluggable transport protocols work.





# Analysis steps (3/3)

## ▶ Gather debug information

- ▶ What ISP does the user have?
- ▶ What is the autonomous system number?
- ▶ Is the user behind a captive portal?
- ▶ Is all traffic routed through an HTTP proxy?

## ▶ Anonymising reports

- ▶ Network traces, IP addresses, ASNs, whois and traceroutes can be discarded.
- ▶ However, anonymous submission is hard → Tor unavailable.

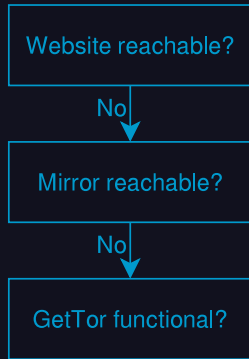
# Think about the users

- ▶ Analyser must be as **easy to use** as possible.
- ▶ Provide **user-friendly** output with little jargon.
- ▶ Cover our analyser's tracks and **delete reports** after submission.
- ▶ **Informed consent**: analyser should inform users about analysis steps and make it easy to abort process.



# Create usage diversity

- ▶ Based on analysis results, we can recommend **further steps**.
- ▶ Therefore, our tool's only purpose is no longer to **assist in censorship circumvention**.
- ▶ Usage diversity should make having a copy of our tool **less suspicious**.



# Report submission

- ▶ We end up with a text file containing YAML-like data.
- ▶ Report could be submitted using [email](#) or [instant messaging](#).
- ▶ Hard-coded OpenPGP public key could be used to [encrypt report](#).
- ▶ Report [content](#) can be anonymised but report [submission](#) hard to do anonymously.

# No need to reinvent the software wheel!

- ▶ **OONI** is a modular framework for censorship analysis and network interference (see FOCI'12 paper): <https://ooni.torproject.org>.
- ▶ We implement our analyser as several **OONI tests**.
- ▶ Finally, bundle OONI with our tests to a click-and-go executable.



```
class TestTorDNSEntries( DNSTest ):
    a_records = [ "38.229.72.14", "38.229.72.16",
                  "86.59.30.40",  "93.95.227.222" ]
    domains = [ "www.torproject.org",
                "bridges.torproject.org" ]

    def test_domains( self ):

        def getResult( result, domain ):

            self.report["a_records"] = result

            if set(result).intersection(self.a_records) ==
               set(self.a_records):
                print "Host_names_resolved_as_expected."
            else:
                print "WARNING: unexpected_resolved_host_names!"

        for domain in self.domains:
            d = self.performALookup(domain, ("8.8.8.8", 53))
            d.addCallback(getResult, domain)
            return d
```

# Discussion

- ▶ Our analyser is **not unobservable!**
- ▶ Users with very strong threat models should **not** use the analyser.
- ▶ Additional desirable features
  - ▶ **Grammatical inference** algorithm to uncover DPI fingerprints.
  - ▶ **Identify/cluster** exact model of DPI hardware if possible.

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