Towards a Censorship Analyser for Tor

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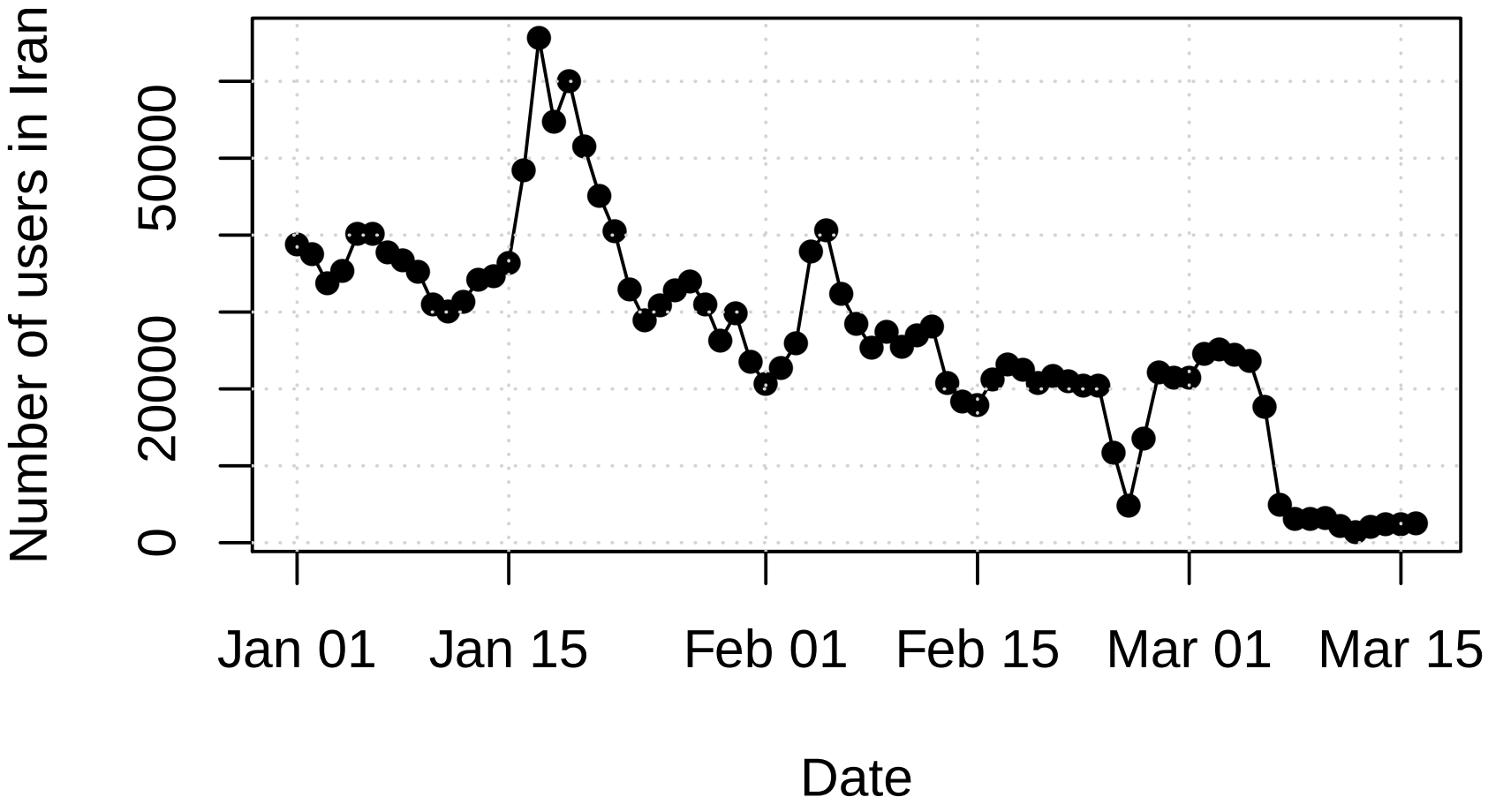
Tor and censorship

- 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



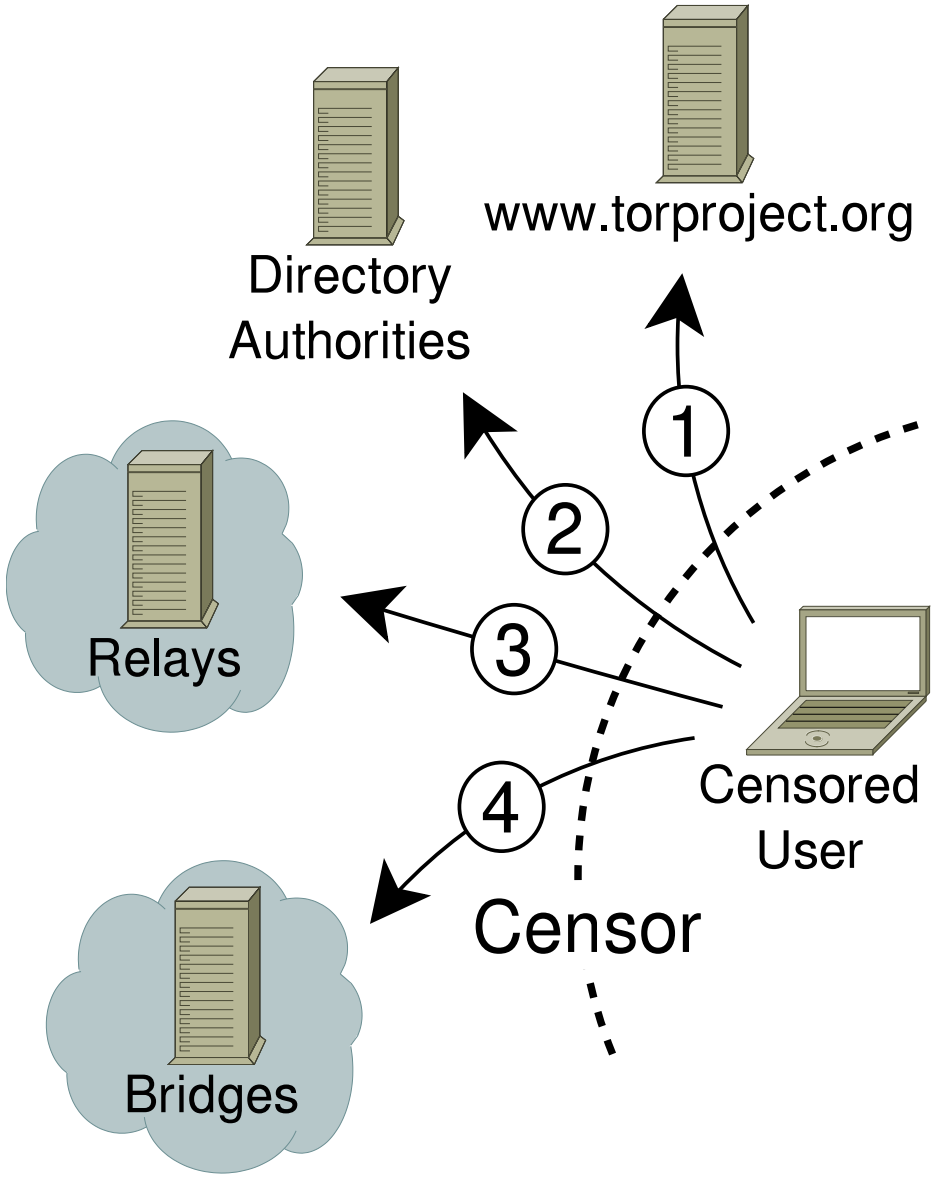
Motivation for this paper

- 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 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)

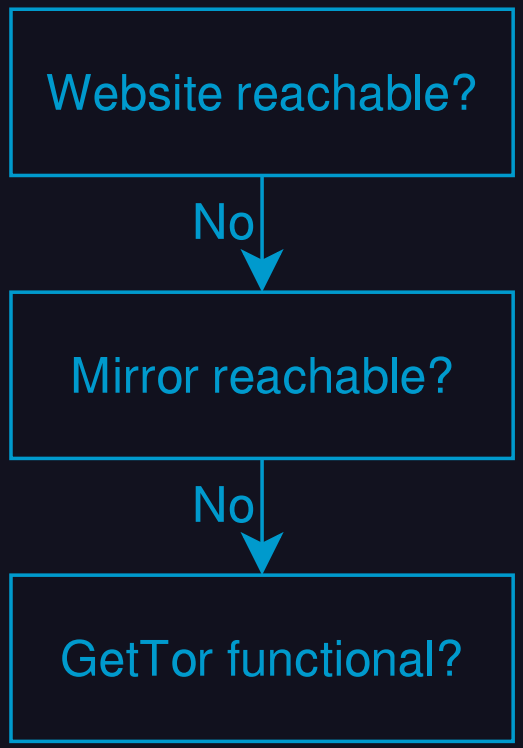
- Gather debug information
  - What ISP does the user have?
  - What is the autonomous system number?
  - Is the user behind a captive portal?
  - Is all traffic routed through an HTTP proxy?
- Anonymising reports
  - Network traces, IP addresses, ASNs, whois and traceroutes can be discarded.
  - However, anonymous submission is hard $\rightarrow$ 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 gotResult( 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(gotResult, 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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