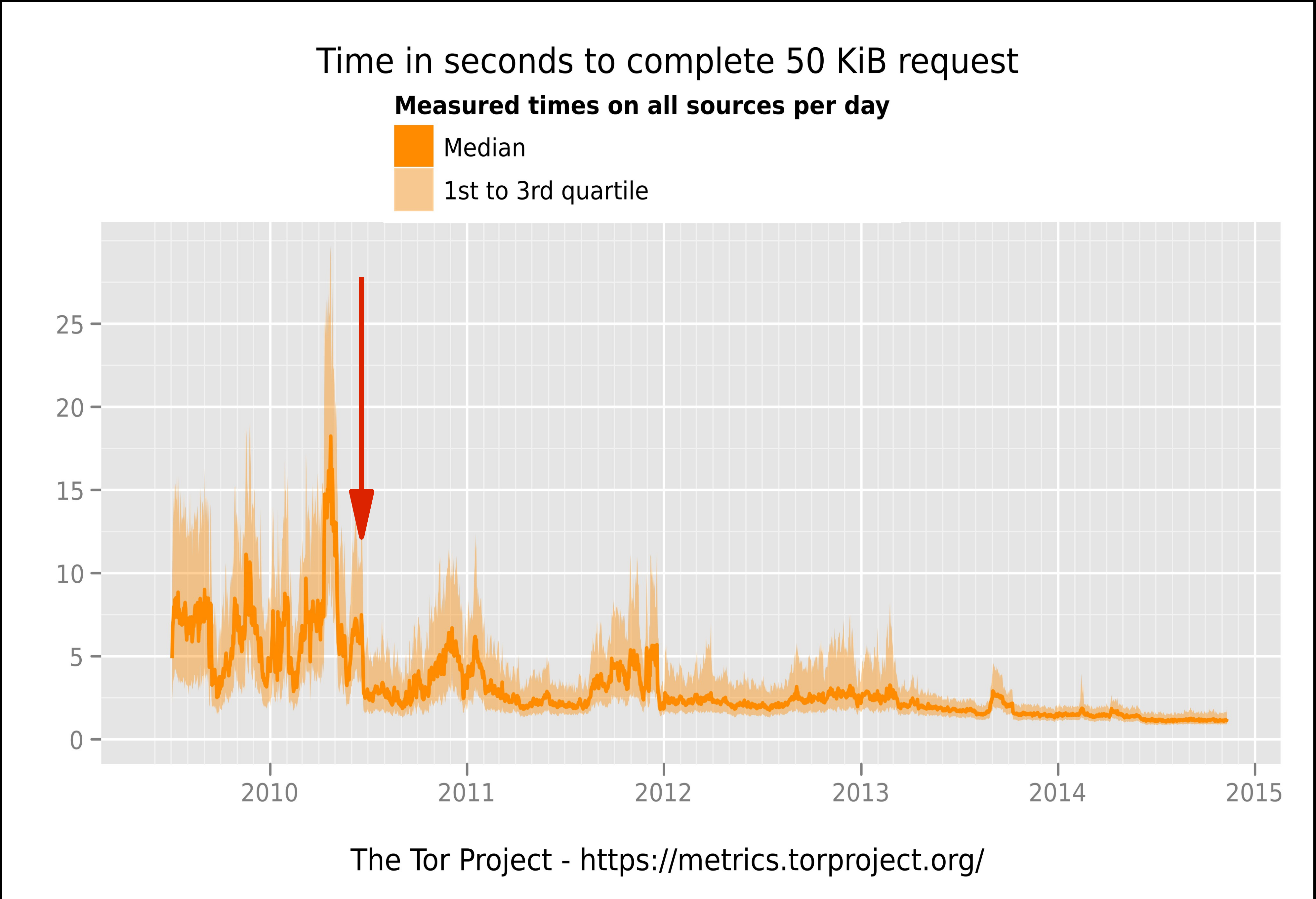
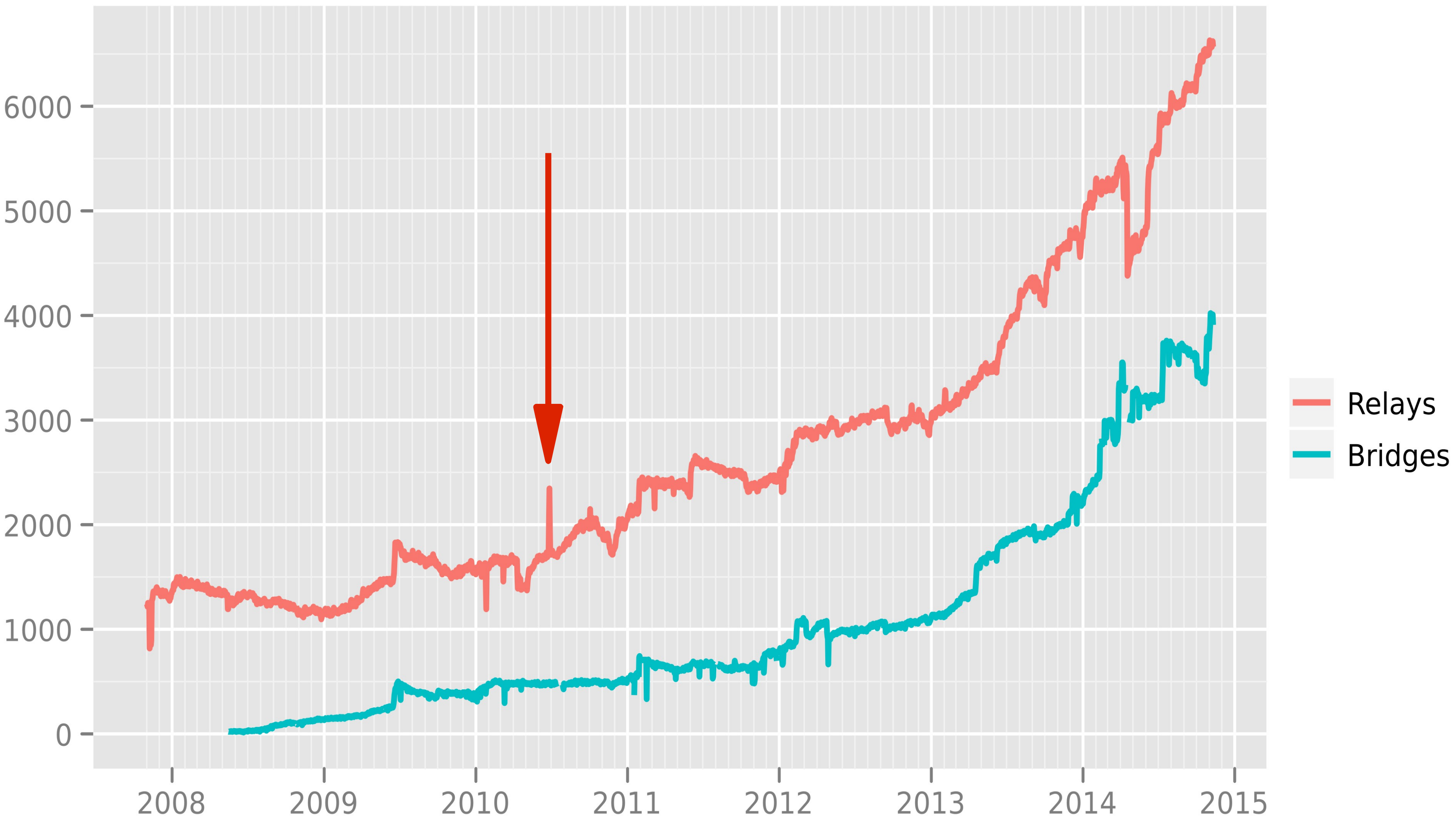
The Tor Project, Inc.

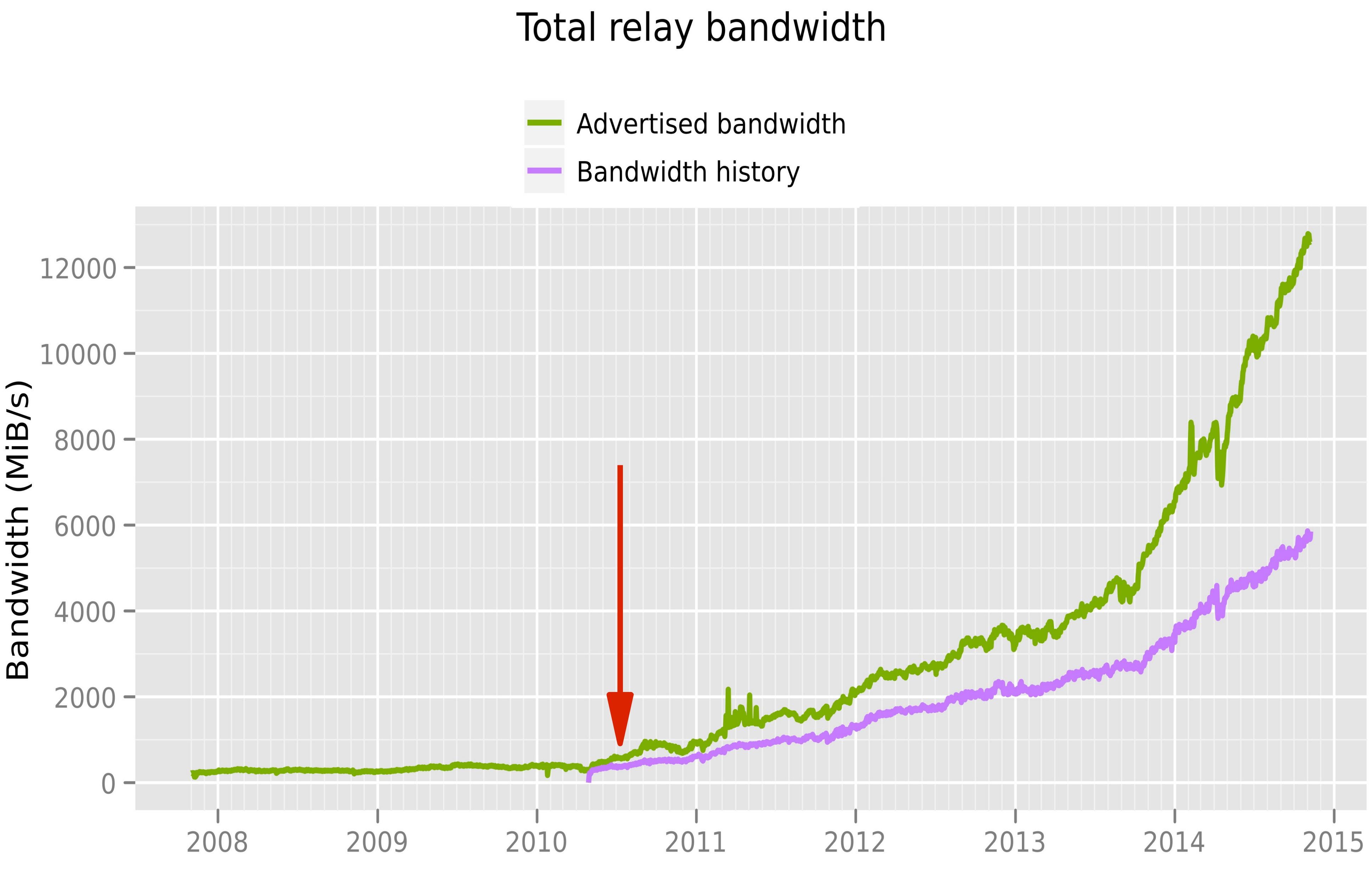
Our mission is to be the global resource for technology, advocacy, research and education in the ongoing pursuit of freedom of speech, privacy rights online, and censorship circumvention.


Time in seconds to complete 50 KiB request
Measured times on all sources per day
Median
1st to 3rd quartile
25
20
15
10
5
0
2010
2011
2012
2013
2014
2015
The Tor Project - https://metrics.torproject.org/

Number of relays



The Tor Project - https://metrics.torproject.org/



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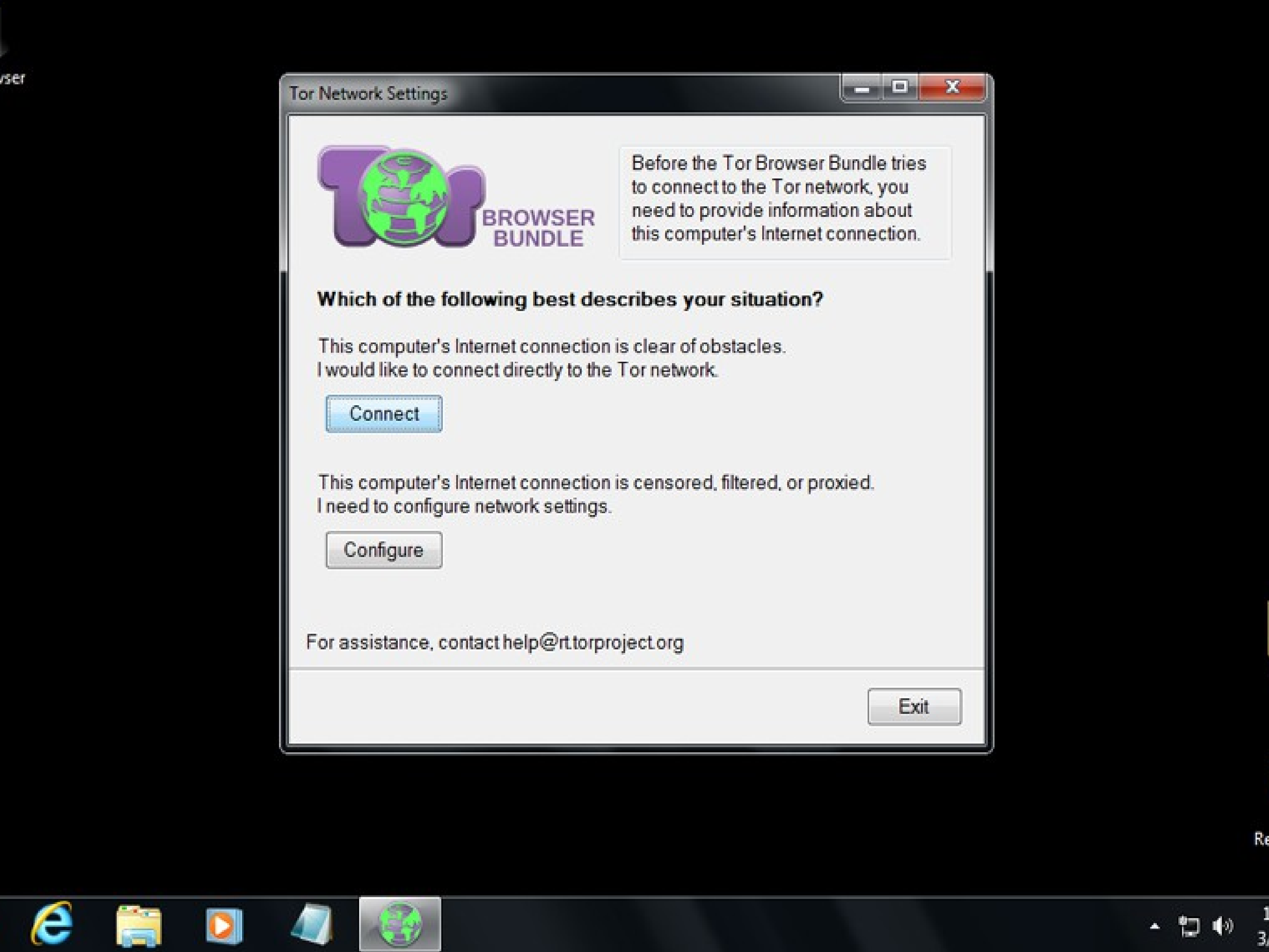
When we wrote the SAFER proposal

- Iran ran default-config Smartfilter
- China had blocked public Tor relays; vanilla bridges worked great there
- China did stateless regexp on TCP payload
- Tor was blending with SSL, because “who would block SSL”
- Before Tunisia, Egypt, Libya, Syria, ...



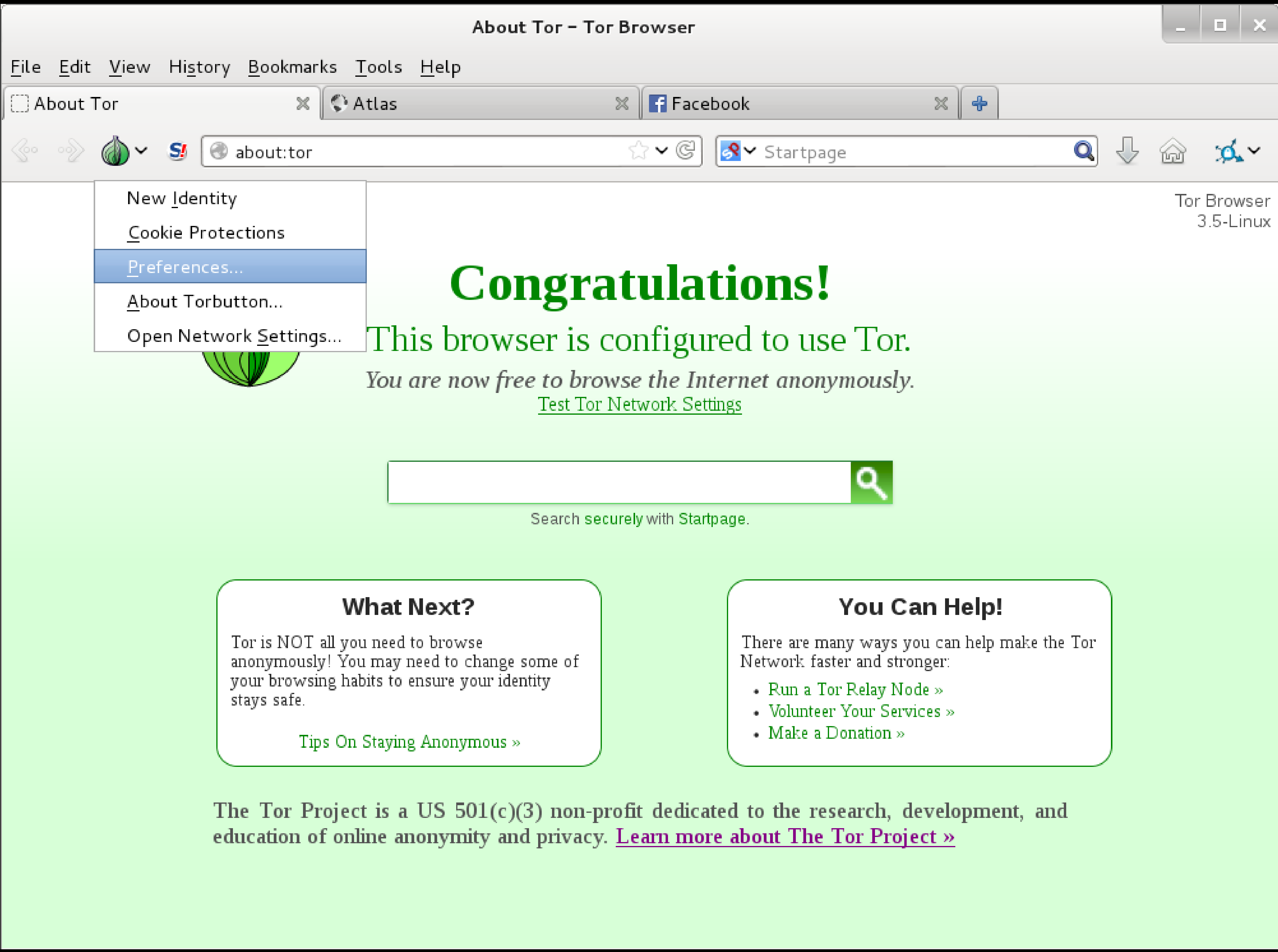
Before the Tor Browser Bundle tries to connect to the Tor network, you need to provide information about this computer's Internet connection.

Which of the following best describes your situation?

This computer's Internet connection is clear of obstacles.
I would like to connect directly to the Tor network.

This computer's Internet connection is censored, filtered, or proxied.
I need to configure network settings.

For assistance, contact help@rt.torproject.org



Congratulations!

This browser is configured to use Tor.

You are now free to browse the Internet anonymously.

Test Tor Network Settings

Search securely with Startpage.

What Next?

Tor is NOT all you need to browse anonymously! You may need to change some of your browsing habits to ensure your identity stays safe.

Tips On Staying Anonymous »

You Can Help!

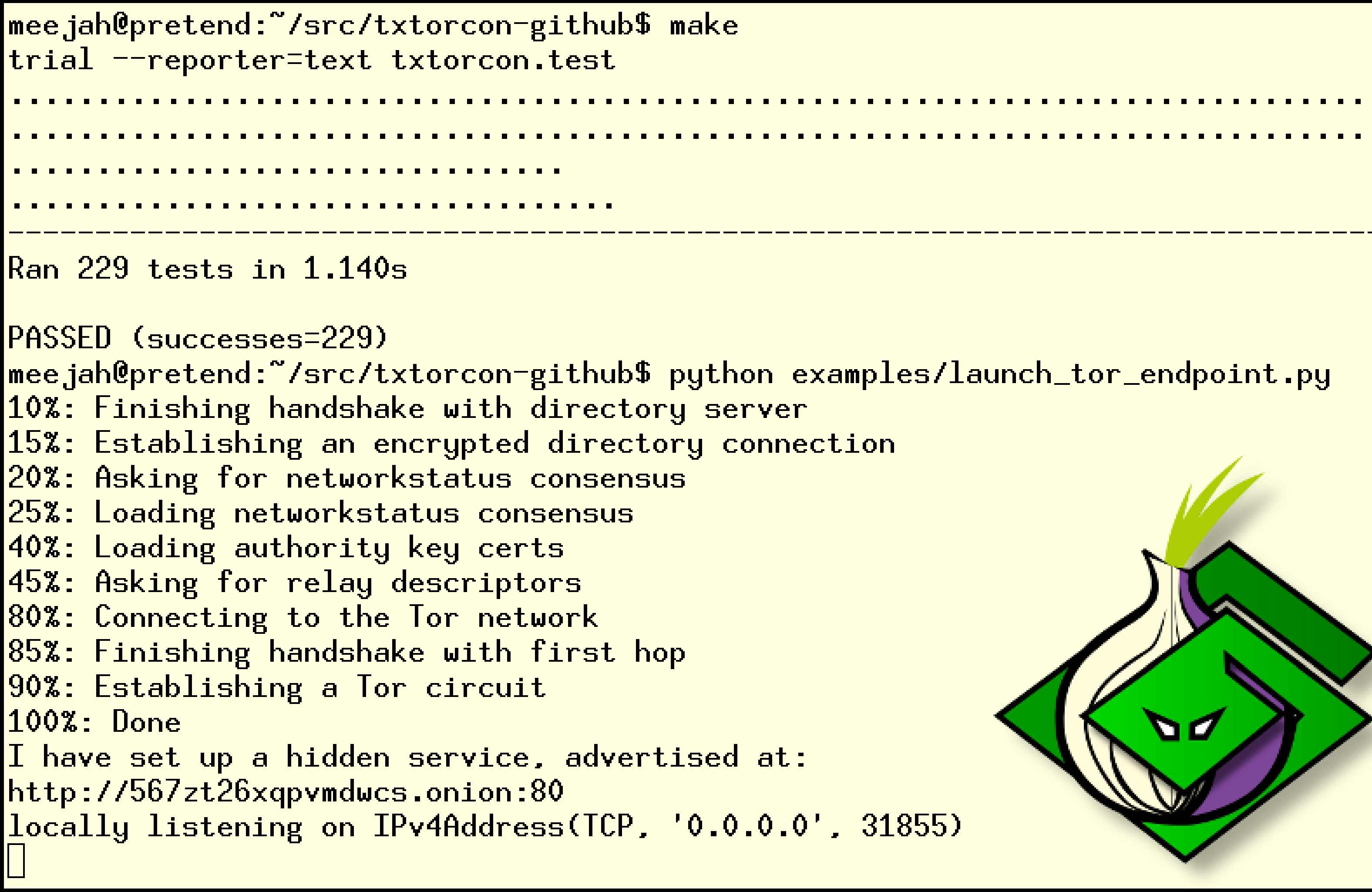
There are many ways you can help make the Tor Network faster and stronger:

- Run a Tor Relay Node »
- Volunteer Your Services »
- Make a Donation »

The Tor Project is a US 501(c)(3) non-profit dedicated to the research, development, and education of online anonymity and privacy. Learn more about The Tor Project »

Tor Controller Interface

- **stem**
- pytorctl
- jtorctl
- **txtorcon**

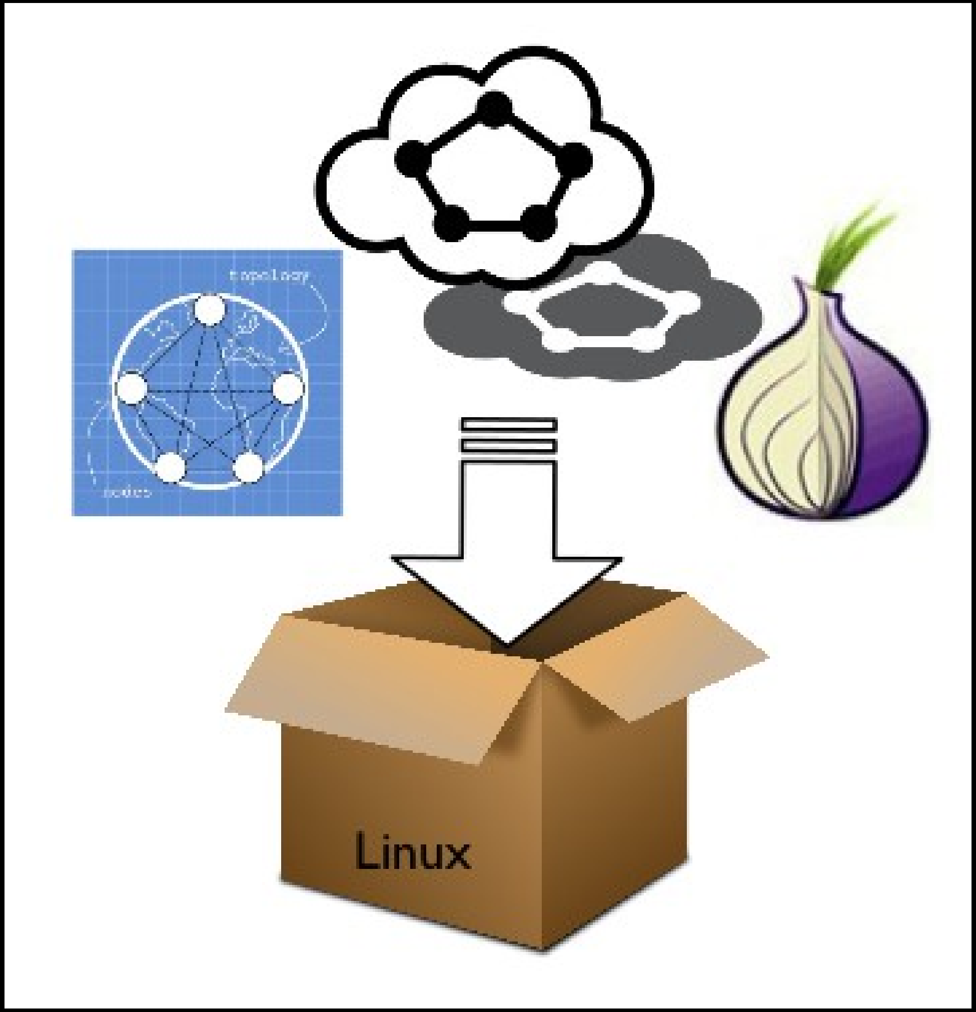


```
meejah@pretend:~/src/txtorcon-github$ make
trial --reporter=text txtorcon.test
........................................................................................
........................................................................................
................................
...................................
----------------------------------------------------------------------------------------
Ran 229 tests in 1.140s

PASSED (successes=229)
meejah@pretend:~/src/txtorcon-github$ python examples/launch_tor_endpoint.py
10%: Finishing handshake with directory server
15%: Establishing an encrypted directory connection
20%: Asking for networkstatus consensus
25%: Loading networkstatus consensus
40%: Loading authority key certs
45%: Asking for relay descriptors
80%: Connecting to the Tor network
85%: Finishing handshake with first hop
90%: Establishing a Tor circuit
100%: Done
I have set up a hidden service, advertised at:
http://567zt26xqpvmdwcs.onion:80
locally listening on IPv4Address(TCP, '0.0.0.0', 31855)
```

Tor network simulators

- **Shadow**
- ExperimenTor
- **Chutney**
- Puppetor

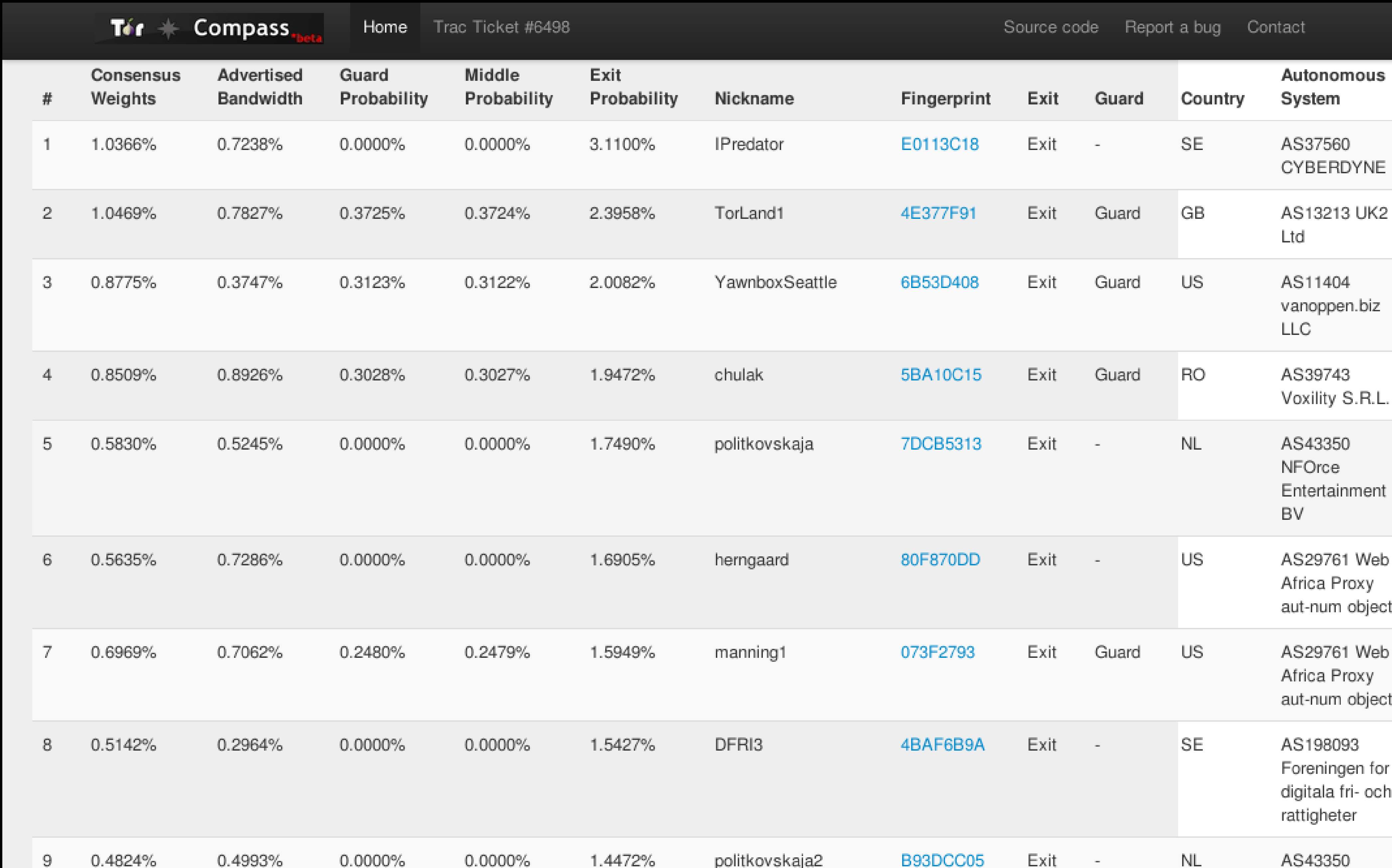


Relay descriptor archives

The relay descriptor archives contain all documents that the directory authorities make available about the network of relays. T
include network statuses, server (relay) descriptors, and extra-info descriptors. The data formats are described here.

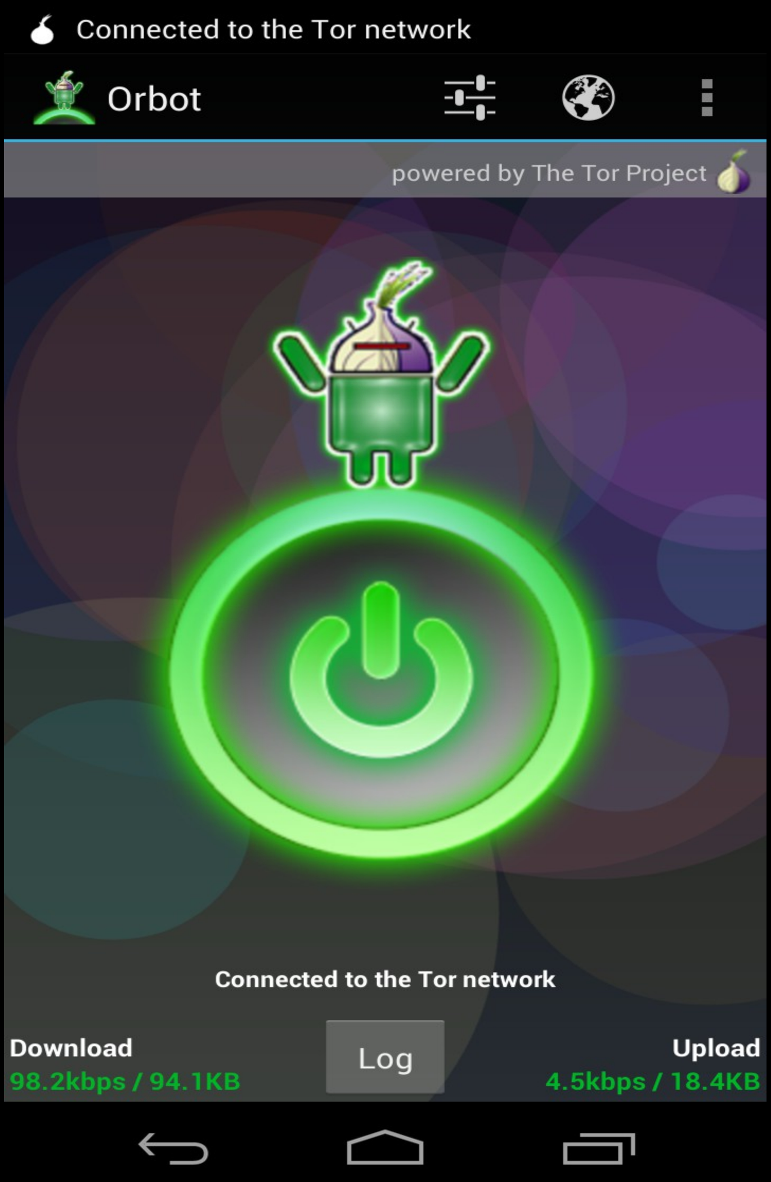
May 2013		server descriptors	extra-infos	v3 votes	v
April 2013		server descriptors	extra-infos	v3 votes	v
March 2013		server descriptors	extra-infos	v3 votes	v
February 2013		server descriptors	extra-infos	v3 votes	v
January 2013		server descriptors	extra-infos	v3 votes	v
December 2012		server descriptors	extra-infos	v3 votes	v
November 2012		server descriptors	extra-infos	v3 votes	v
October 2012		server descriptors	extra-infos	v3 votes	v
September 2012		server descriptors	extra-infos	v3 votes	v
August 2012		server descriptors	extra-infos	v3 votes	v
July 2012		server descriptors	extra-infos	v3 votes	v
June 2012		server descriptors	extra-infos	v3 votes	v
May 2012		server descriptors	extra-infos	v3 votes	v
April 2012		server descriptors	extra-infos	v3 votes	v
March 2012	v2 statuses	server descriptors	extra-infos	v3 votes	v
February 2012	v2 statuses	server descriptors	extra-infos	v3 votes	v
January 2012	v2 statuses	server descriptors	extra-infos	v3 votes	v
December 2011	v2 statuses	server descriptors	extra-infos	v3 votes	v
November 2011	v2 statuses	server descriptors	extra-infos	v3 votes	v
October 2011	v2 statuses	server descriptors	extra-infos	v3 votes	v
September 2011	v2 statuses	server descriptors	extra-infos	v3 votes	v
August 2011	v2 statuses	server descriptors	extra-infos	v3 votes	

compass.torproject.org



#	Consensus Weights	Advertised Bandwidth	Guard Probability	Middle Probability	Exit Probability	Nickname	Fingerprint	Exit	Guard	Country	Autonomous System
1	1.0366%	0.7238%	0.0000%	0.0000%	3.1100%	IPredator	E0113C18	Exit	-	SE	AS37560 CYBERDYNE
2	1.0469%	0.7827%	0.3725%	0.3724%	2.3958%	TorLand1	4E377F91	Exit	Guard	GB	AS13213 UK2 Ltd
3	0.8775%	0.3747%	0.3123%	0.3122%	2.0082%	YawnboxSeattle	6B53D408	Exit	Guard	US	AS11404 vanoppen.biz LLC
4	0.8509%	0.8926%	0.3028%	0.3027%	1.9472%	chulak	5BA10C15	Exit	Guard	RO	AS39743 Voxility S.R.L.
5	0.5830%	0.5245%	0.0000%	0.0000%	1.7490%	politkovskaja	7DCB5313	Exit	-	NL	AS43350 NFOrce Entertainment BV
6	0.5635%	0.7286%	0.0000%	0.0000%	1.6905%	herngaard	80F870DD	Exit	-	US	AS29761 Web Africa Proxy aut-num object
7	0.6969%	0.7062%	0.2480%	0.2479%	1.5949%	manning1	073F2793	Exit	Guard	US	AS29761 Web Africa Proxy aut-num object
8	0.5142%	0.2964%	0.0000%	0.0000%	1.5427%	DFRI3	4BAF6B9A	Exit	-	SE	AS198093 Foreningen for digitala fri- och rattigheter
9	0.4824%	0.4993%	0.0000%	0.0000%	1.4472%	politkovskaja2	B93DCC05	Exit	-	NL	AS43350

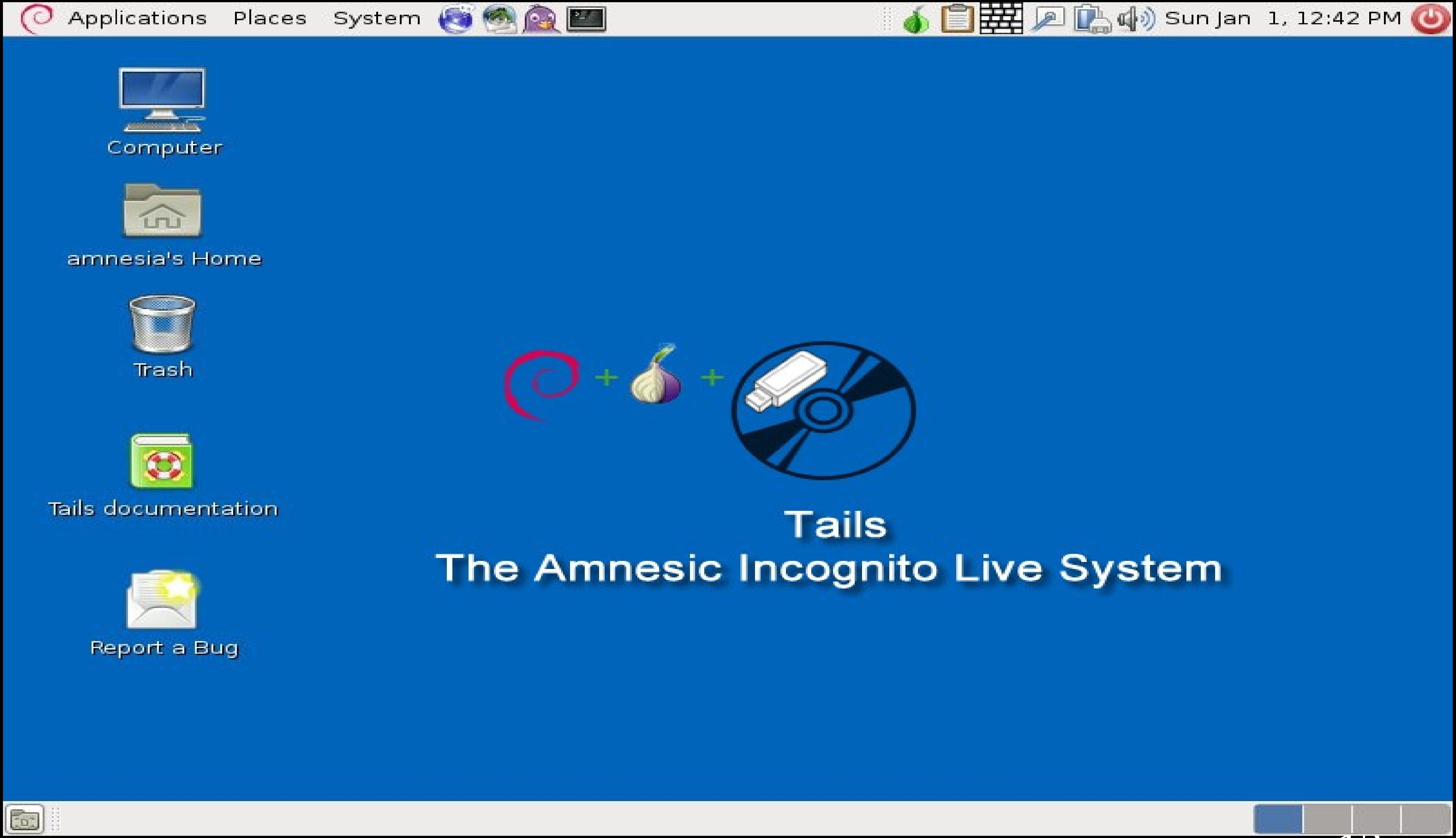
Orbot



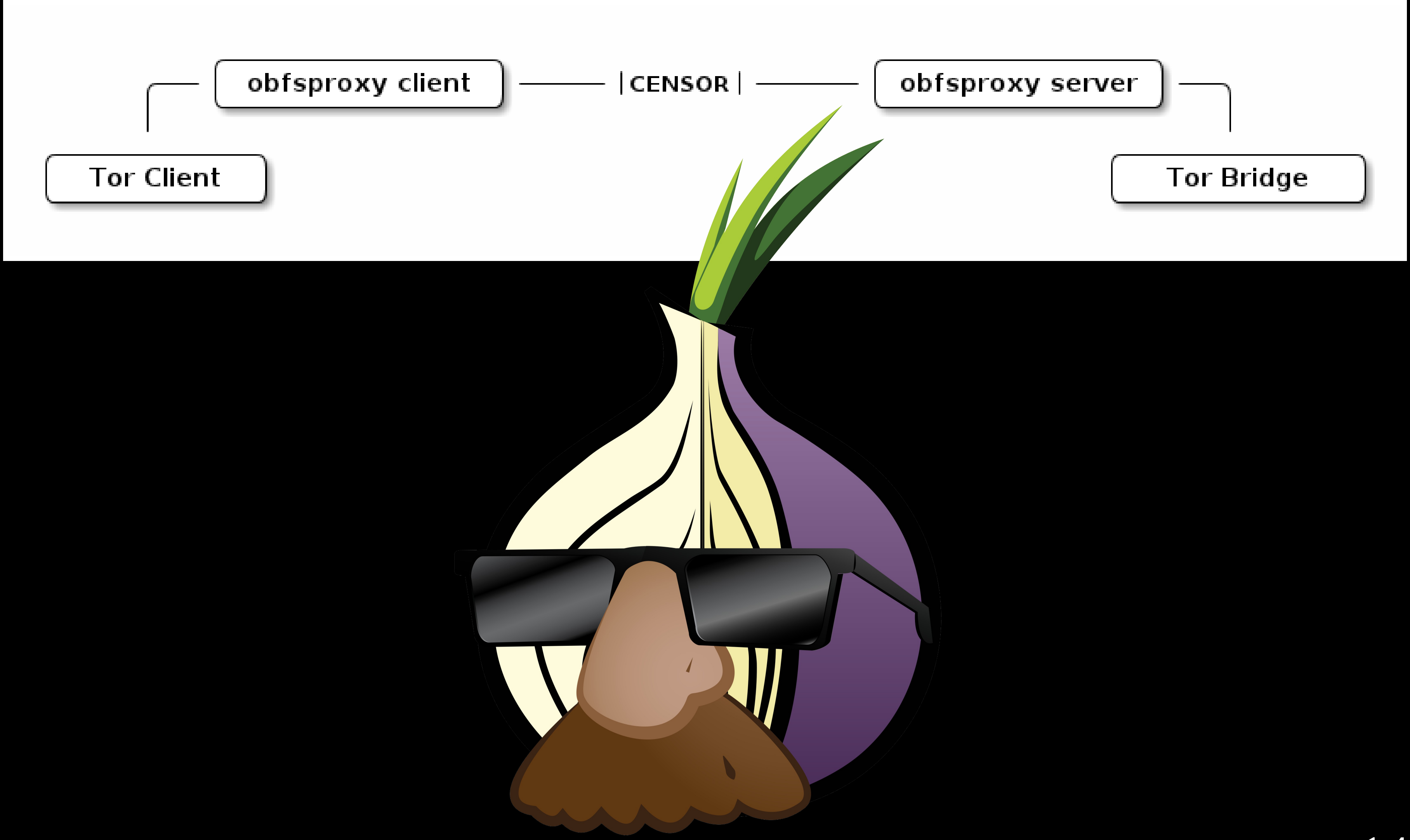
Connected to the Tor network

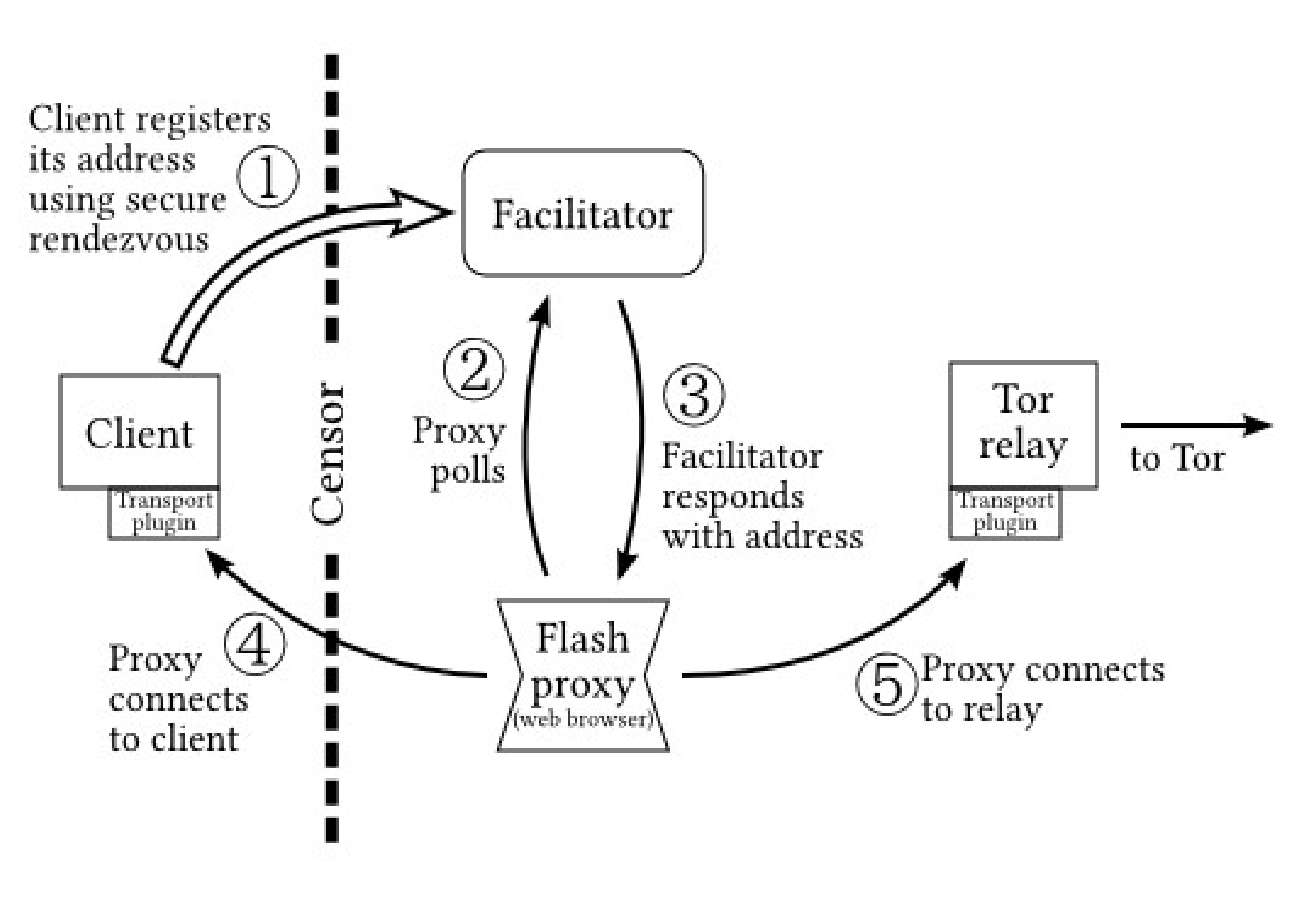
Connected to the Tor network

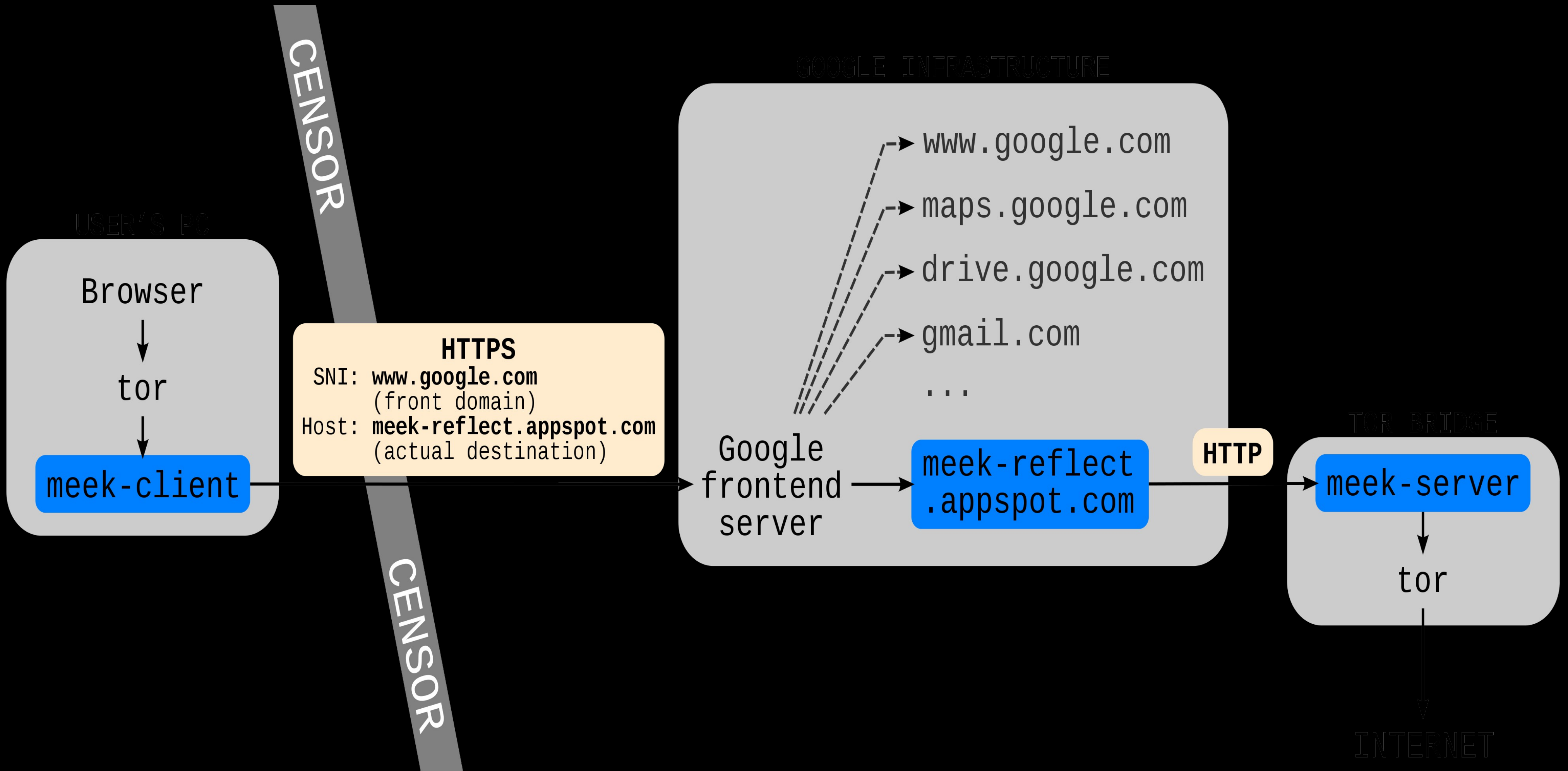
Tails LiveCD



Pluggable transports




Client registers its address using secure rendezvous
1
Facilitator
Censor
2
Proxy polls
3
Facilitator responds with address
Client
Transport plugin
Tor relay
Transport plugin
to Tor
Flash proxy
(web browser)
4
Proxy connects to client
5
Proxy connects to relay



HTTPS
SNI: **www.google.com**
(front domain)
Host: **meek-reflect.appspot.com**
(actual destination)

Attack #1: Address enumeration

- Break into bridge authority
- Solve challenges from BridgeDB
- Vulnerable: everything that uses a standard Bridge line
- Immune: meek, flashproxy

Attack #2: Active probing

- Vulnerable: obfs2, obfs3, fte, flashproxy (pointless?)
- Immune: obfs4, ScrambleSuit

Attack #3: Broad DPI

- Accepts high collateral damage
- E.g. blocking flows based on packet entropy
- Vulnerable: obfs2, obfs3, obfs4, ScrambleSuit
- Immune: meek, flashproxy, fte (?), StegoTorus

Attack #4: Protocol DPI

- Attacks to determine the protocol that's in use
- Vulnerable: obfs2, flashproxy (?)
- Immune: obfs3, obfs4, ScrambleSuit, meek, fte, StegoTorus

Attack #5: Parrot DPI

- Attacks to distinguish the apparent protocol from the underlying one
- Vulnerable: fte, SkypeMorph

Attack #6: Protocol whitelisting

- Only allow known protocols through. Includes Iran's aggressive throttling of unknown protocols.
- Vulnerable: obfs2, obfs3, obfs4, ScrambleSuit
- Immune: depends on whitelist config

Attack #7: Cut long connections

- Terminate/throttle non-whitelisted protocols after 60s
- Vulnerable: obfs2, obfs3, obfs4, ScrambleSuit, fte
- Immune: meek, StegoTorus, flashproxy (?)

Attack #8: Flow fingerprinting

- Determine underlying protocol by e.g. timing, data transfer size, etc
- Vulnerable: obfs2, obfs3, meek, fte(?), flashproxy
- Mitigated: ScrambleSuit, obfs4
- Immune: StegoTorus (?)

Tie-in to surveillance

- Flashproxy as a savior vs Global surveillance?

Measurement Lab / Adversary Lab

- We need a set of benchmarks (“Iran 2011”) to test against – real attacks that we want to know how a given design fares against
- Background traffic issue
- Assessment needs to describe attributes, not conclusions. “China can't block this” vs “An adversary who does X would choose not to block this”

Big open questions (1)

- Resisting address enumeration attacks

Big open questions (2)

- What protocols/services will remain open?

OONI:
Measuring interference in the wild

- Measuring censorship of destinations and protocols
- But just as importantly, preemptively tracking which protocols work where

Big open questions (3)

- Who should be the exit relays?
- (For Tor, for uProxy, etc)

Big open questions (4)

- Realism of parrot attacks?
- FTE should be resistant, but in practice is incredibly vulnerable

Big open questions (5)

- Centralization of bridge operation?
- Or of blending services

Big open questions (6)

- What do we do when protocol whitelist + tls mitm?
- What other plausible censorship scenarios is our toolkit unprepared for?