The Tor Project

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.

What is Tor?

Online anonymity 1) open source software, 2) network, 3) protocol

Community of researchers, developers, users, and relay operators

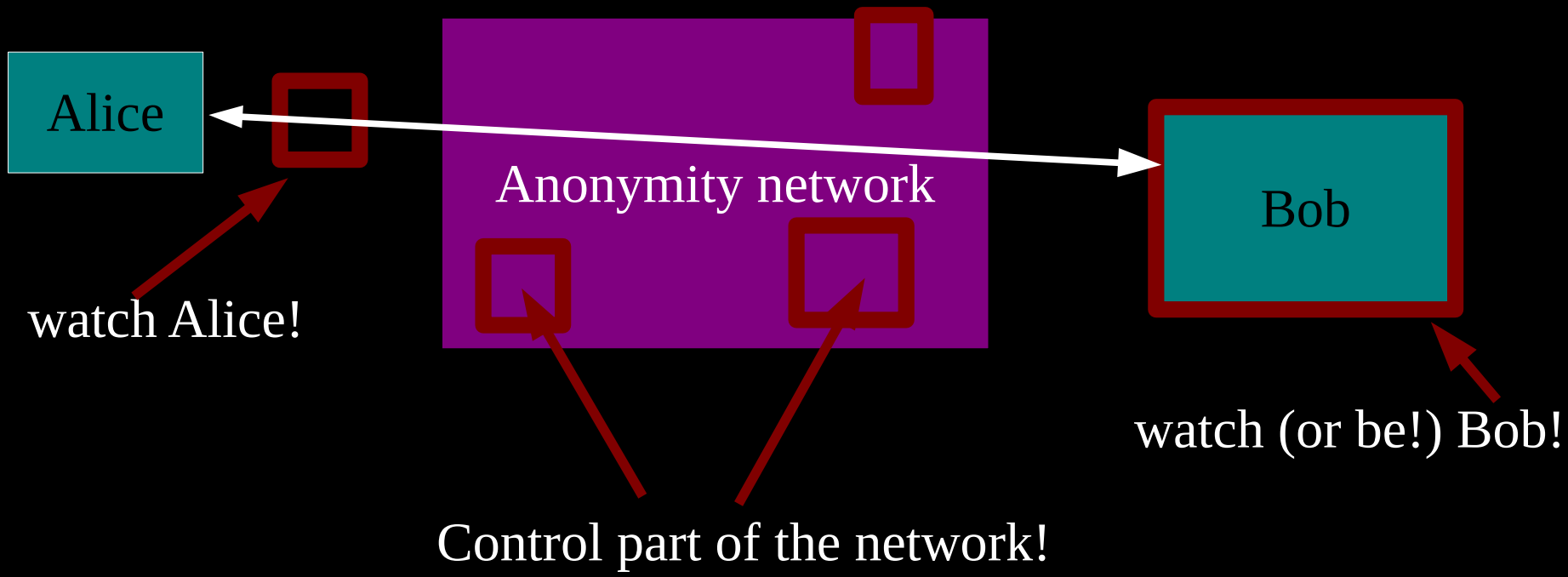
Funding from US DoD, Electronic Frontier Foundation, Voice of America, Google, NLnet, Human Rights Watch, NSF, US State Dept, SIDA, Knight Foundation, ...

The Tor Project, Inc.

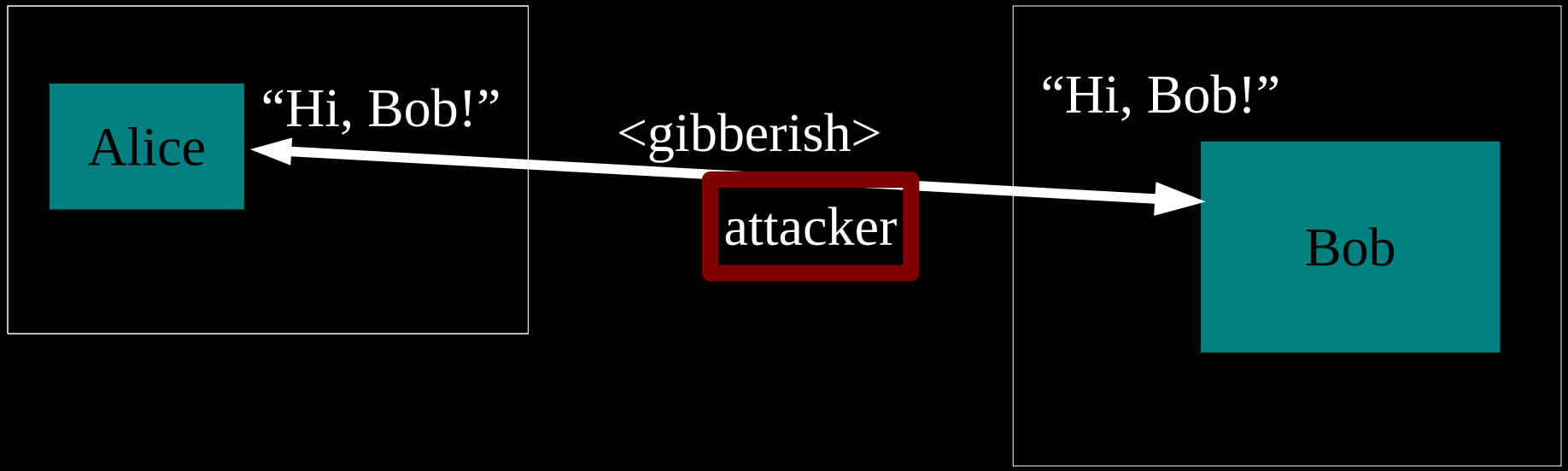
501(c)(3) non-profit organization dedicated to the research and development of tools for online anonymity and privacy


Estimated 1,000,000+
daily Tor users

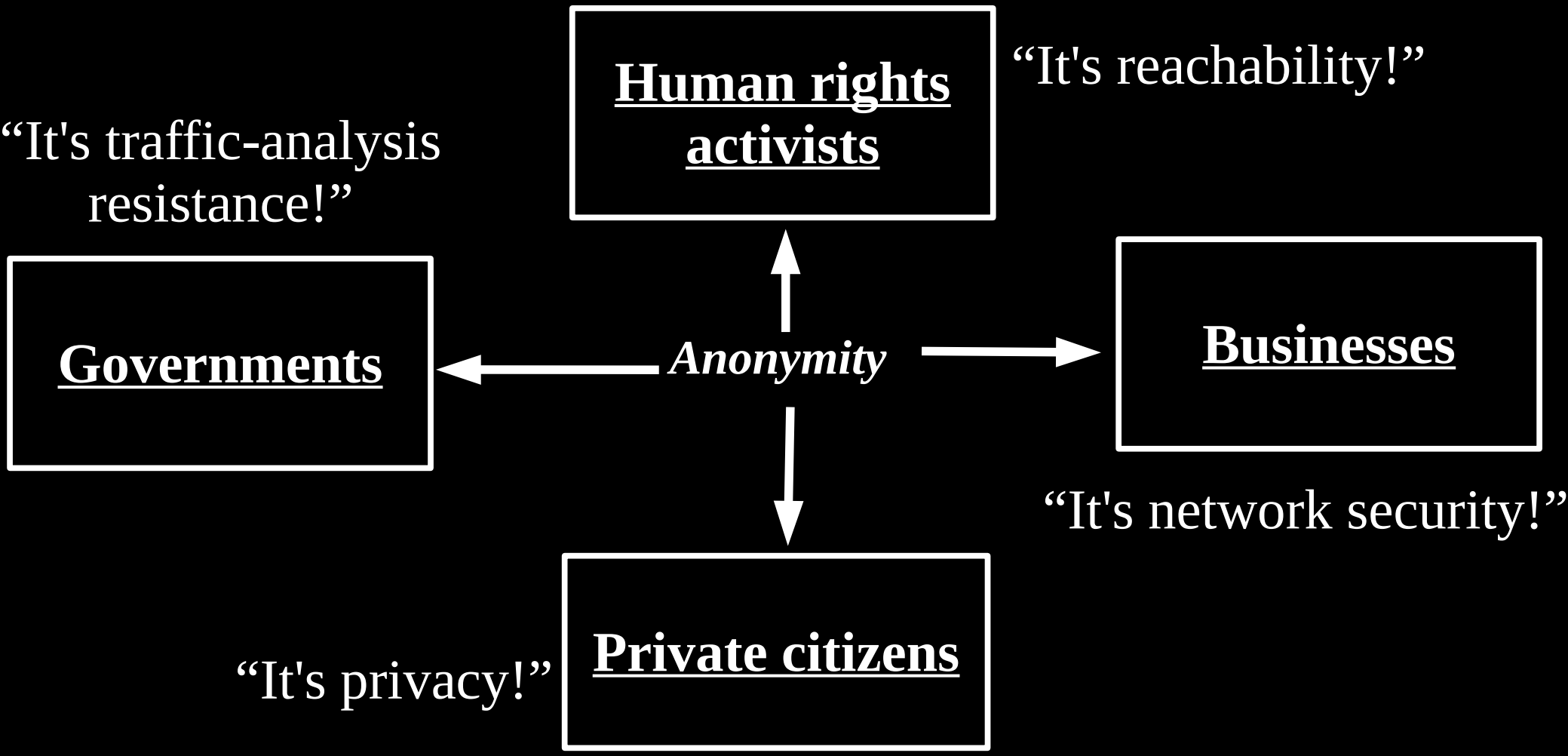
Threat model: what can the attacker do?



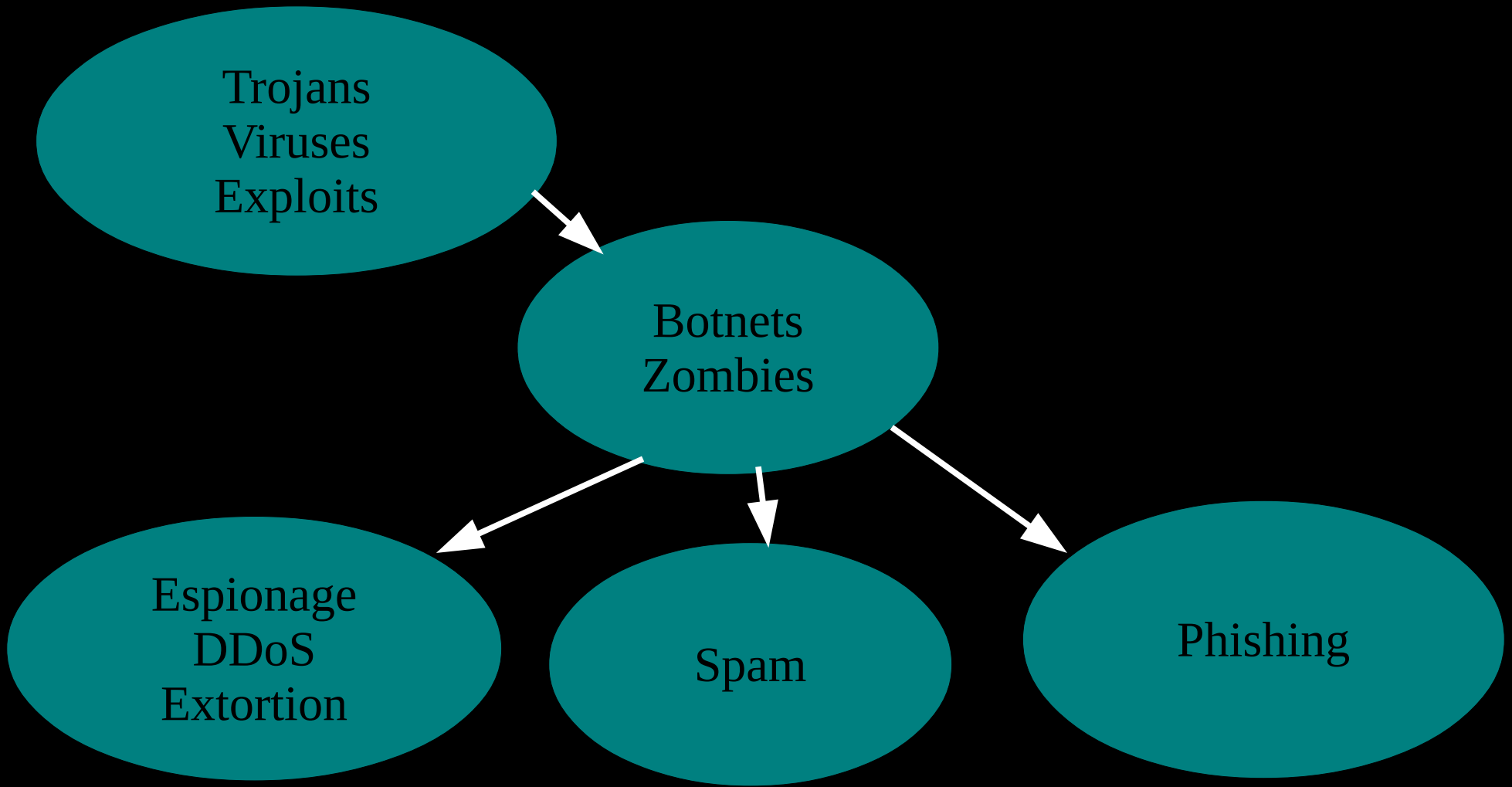
Anonymity isn't encryption: Encryption just protects contents.



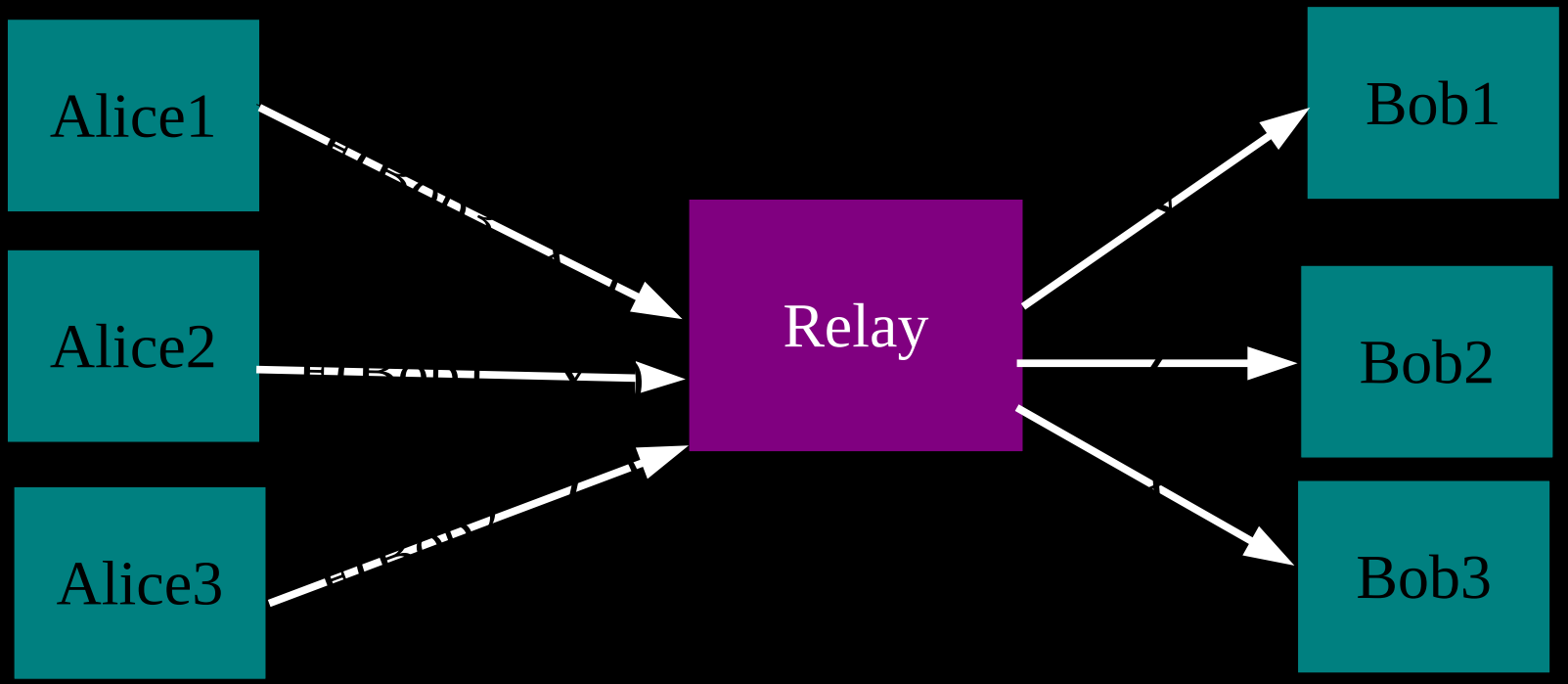
Anonymity serves different interests for different user groups.



Current situation: Bad people on the Internet are doing fine

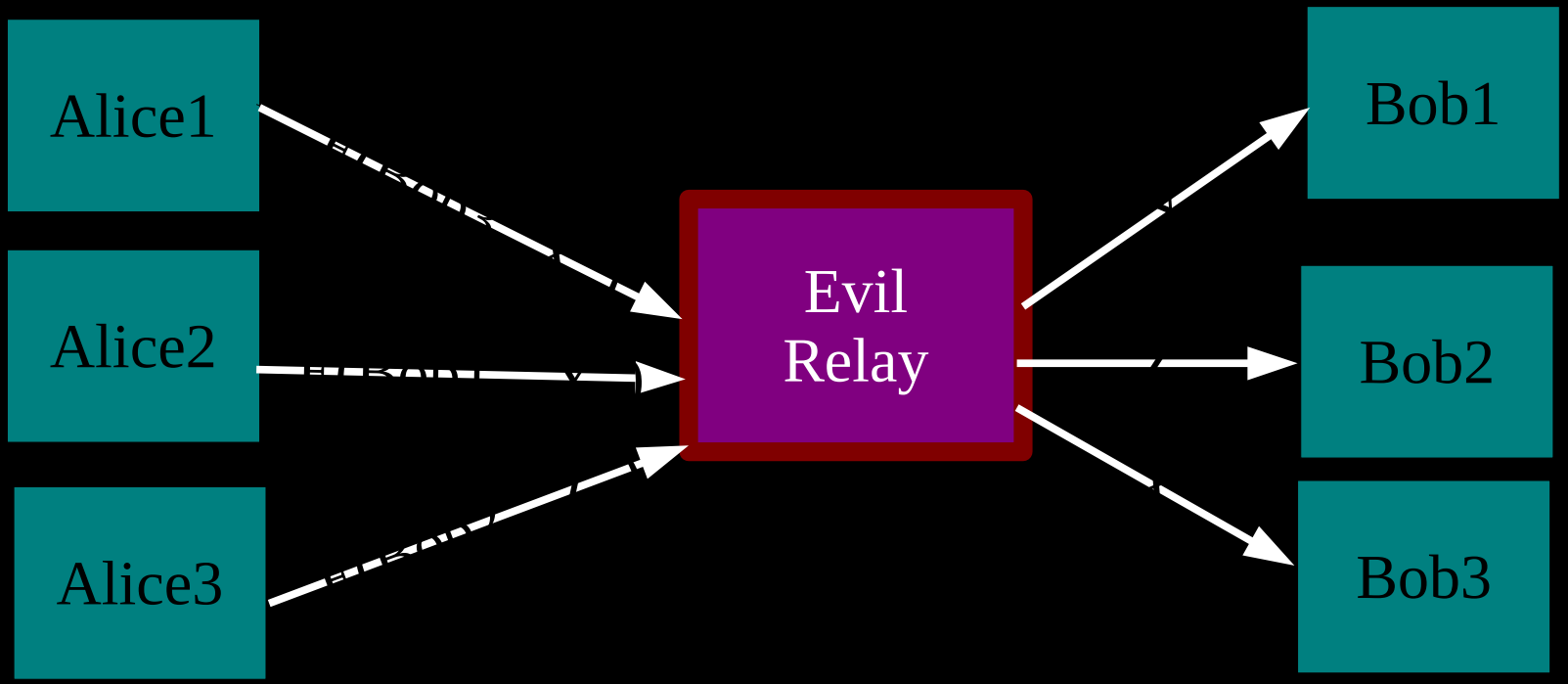


The simplest designs use a single relay to hide connections.

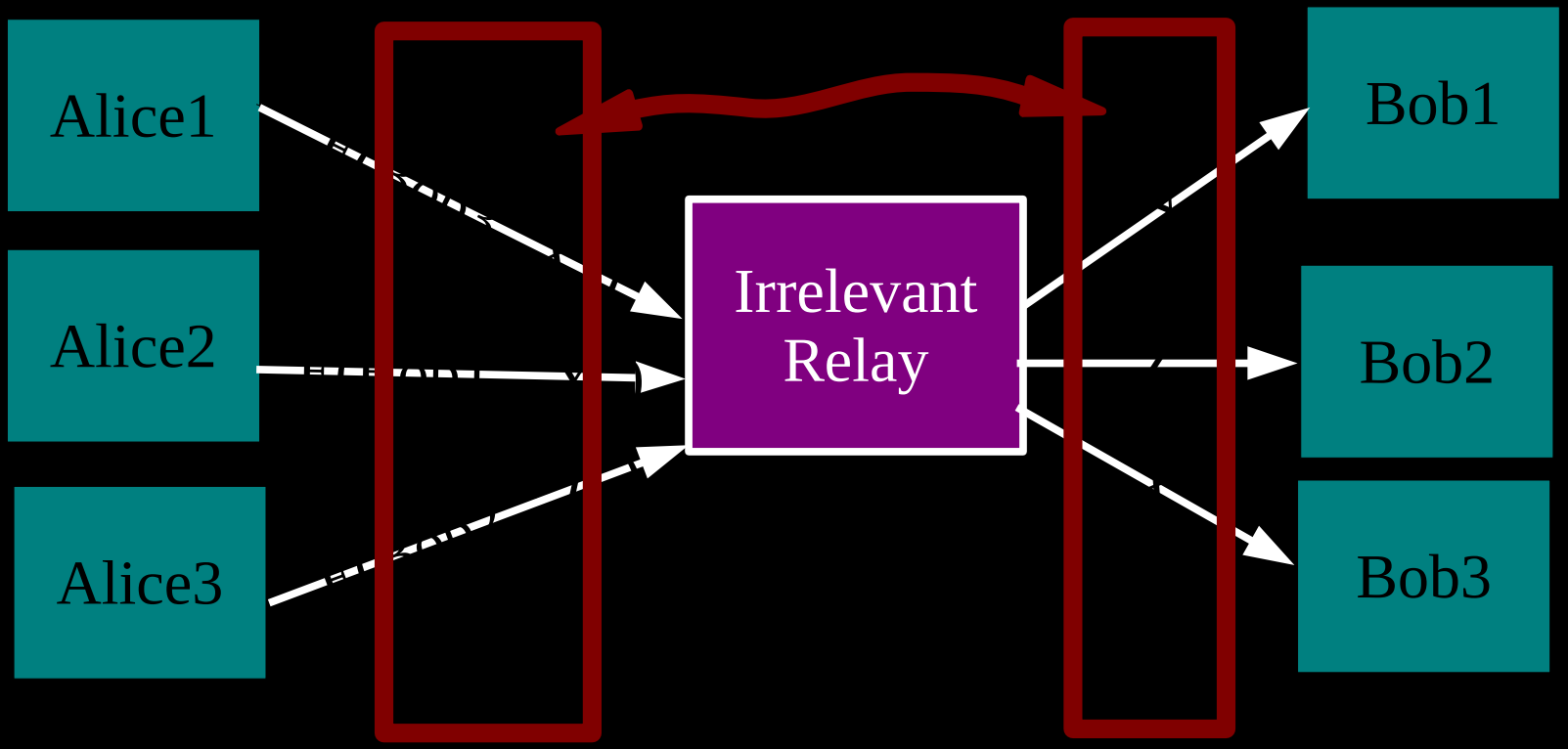


(example: some commercial proxy providers)

But a single relay (or eavesdropper!) is a single point of failure.

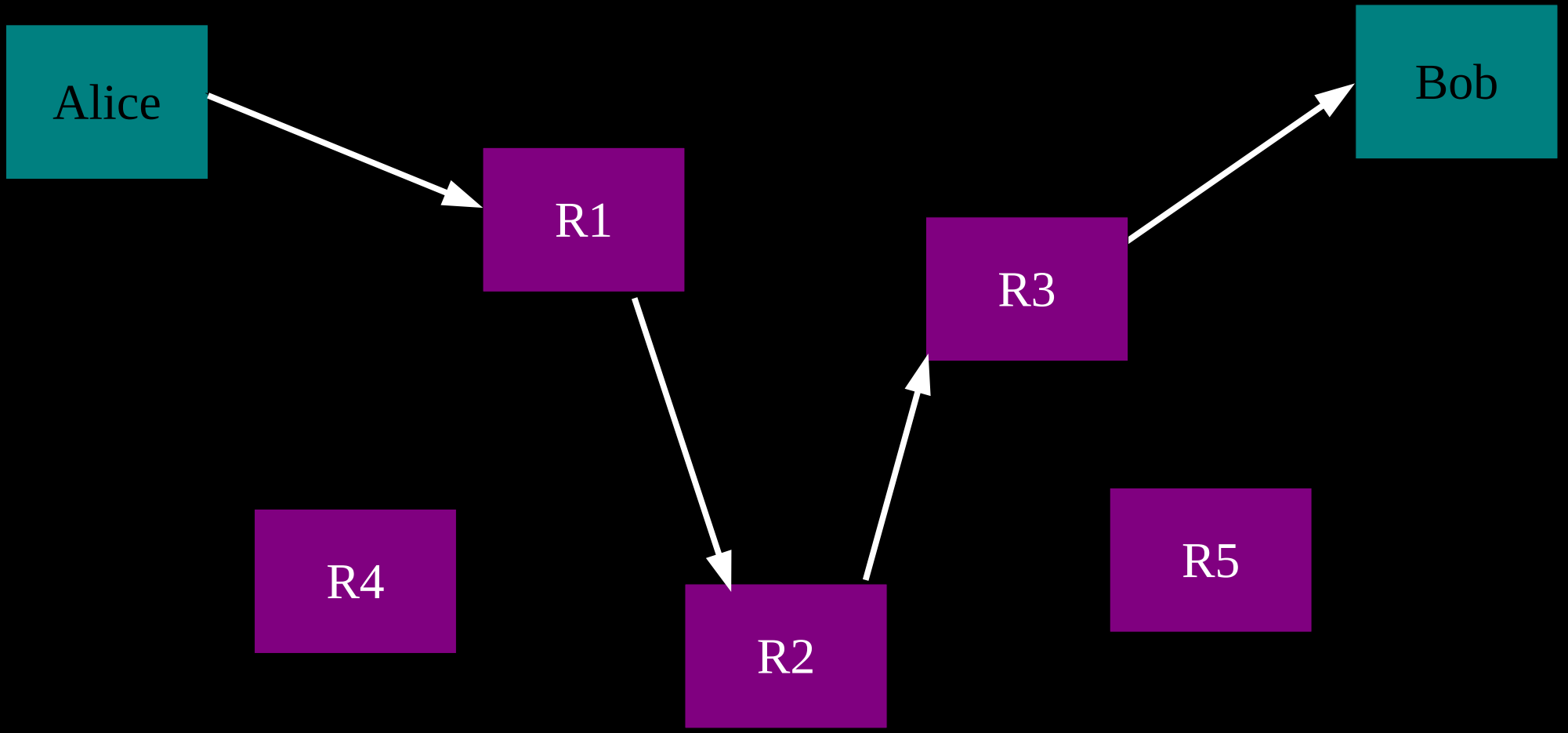


... or a single point of bypass.

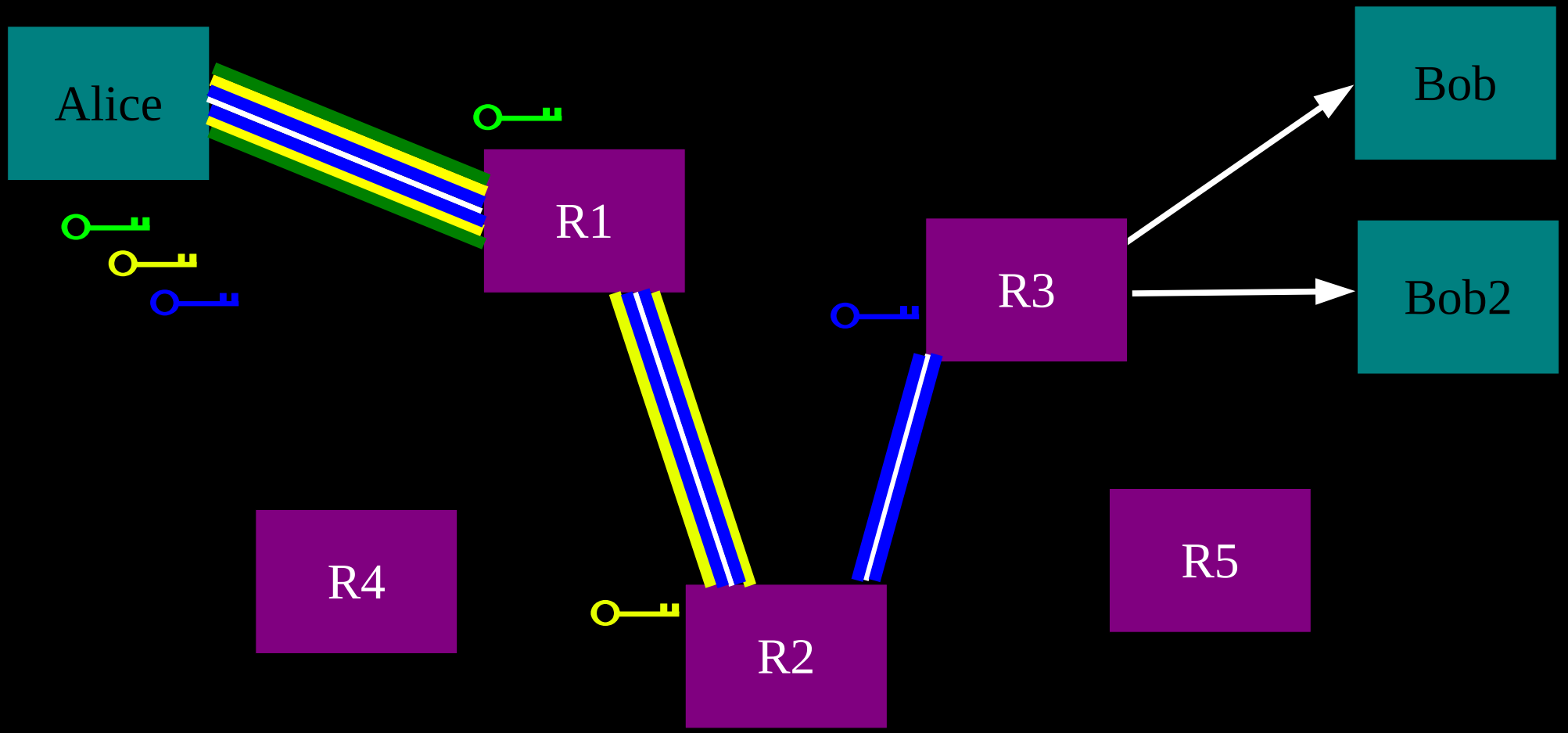


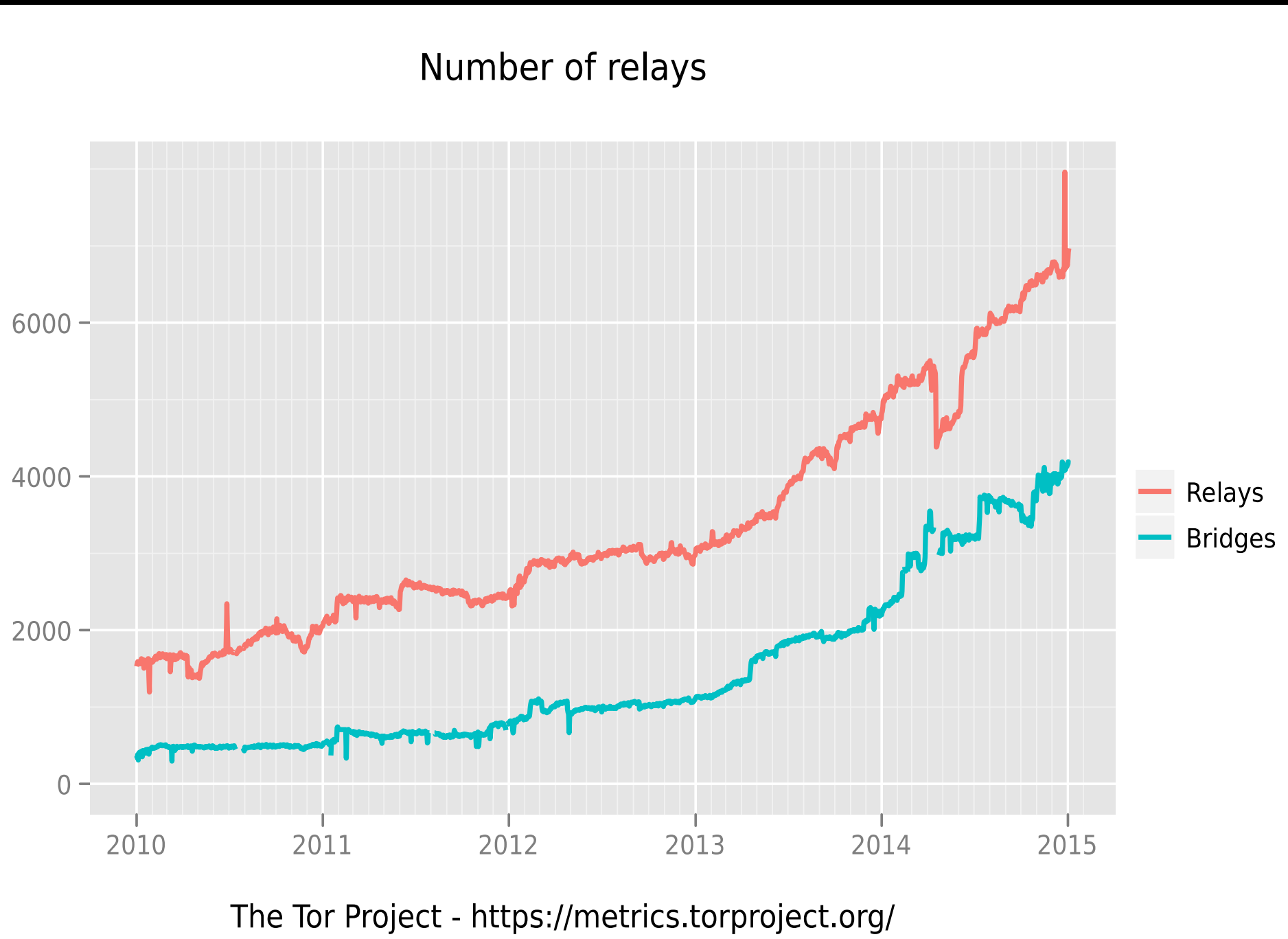
Timing analysis bridges all connections through relay ⇒ An attractive fat target

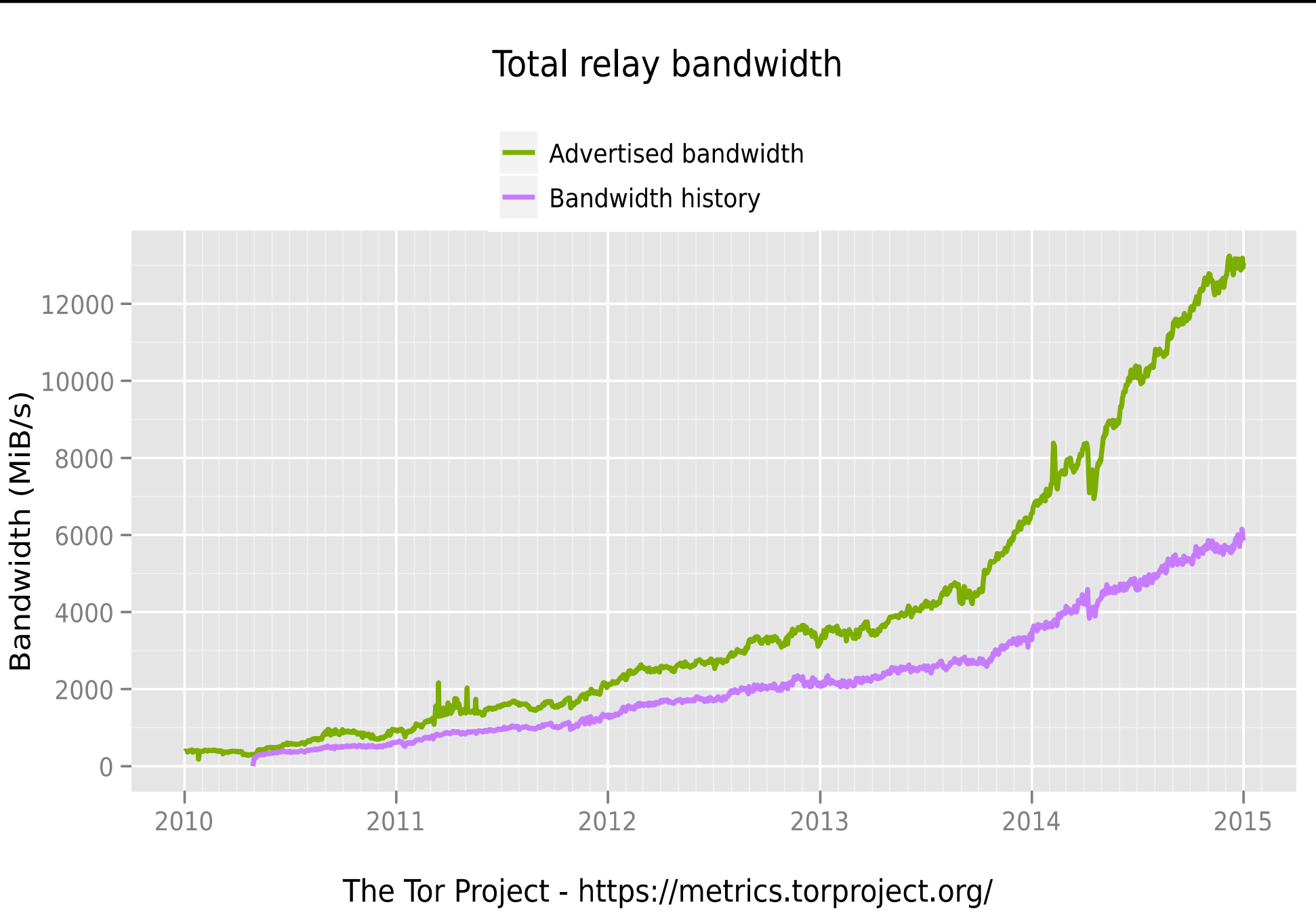
So, add multiple relays so that no single one can betray Alice.



Alice makes a session key with R1 ...And then tunnels to R2...and to R3




Number of relays
6000
4000
2000
0
2010
2011
2012
2013
2014
2015
Relays
Bridges
The Tor Project - https://metrics.torproject.org/

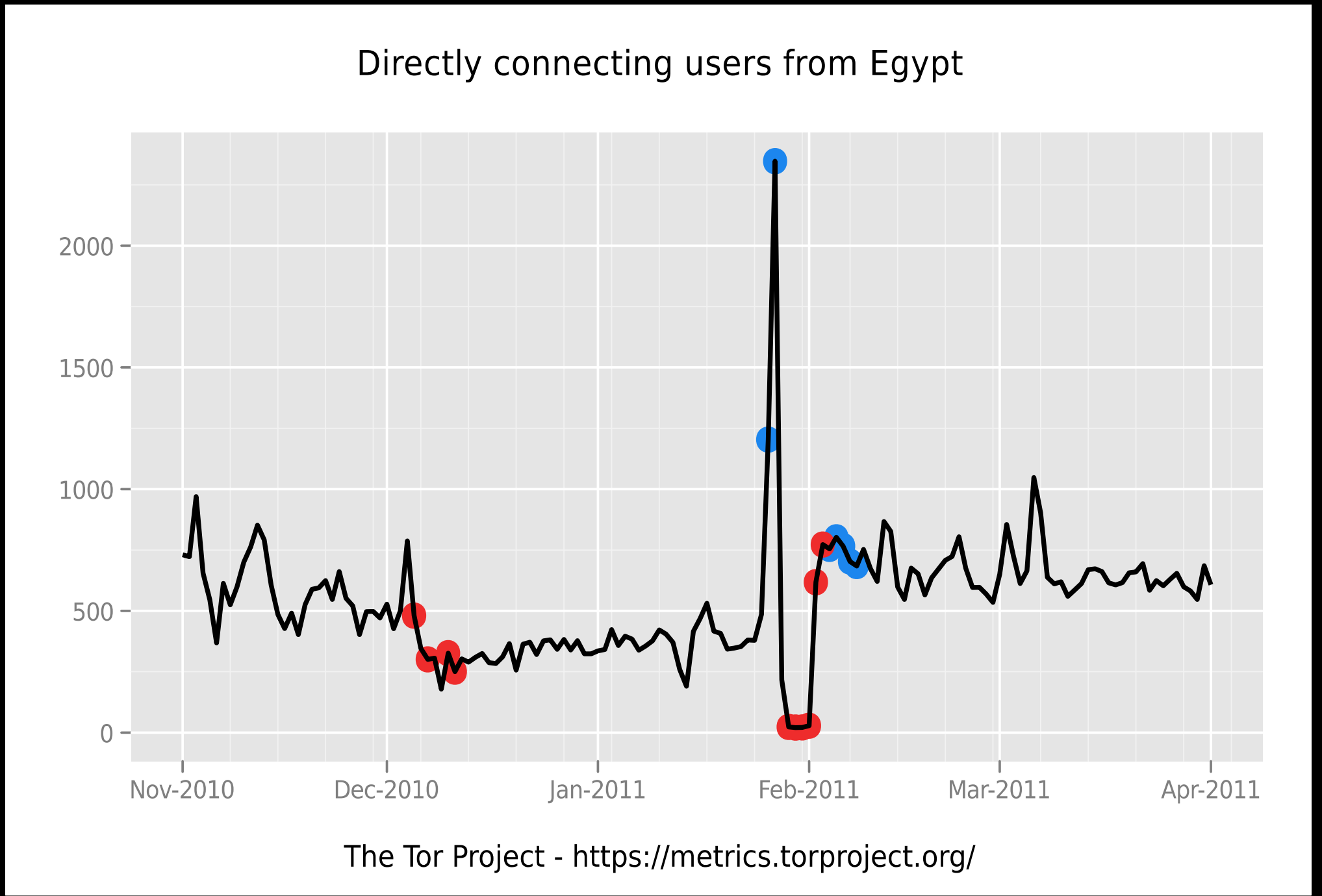

Total relay bandwidth
Advertised bandwidth
Bandwidth history
Bandwidth (MiB/s)
12000
10000
8000
6000
4000
2000
0
2010
2011
2012
2013
2014
2015
The Tor Project - https://metrics.torproject.org/

Tor's safety comes from diversity

- #1: Diversity of relays. The more relays we have and the more diverse they are, the fewer attackers are in a position to do traffic confirmation. (Research problem: measuring diversity over time)
- #2: Diversity of users and reasons to use it. 50000 users in Iran means almost all of them are normal citizens.

Tor's anonymity comes from...

- The first 1,000 relays (location diversity)
- The first 100,000 users (user diversity)
- The last 1,000,000 users (end-to-end correlation resistance)


Directly connecting users from Egypt
2000
1500
1000
500
0
Nov-2010
Dec-2010
Jan-2011
Feb-2011
Mar-2011
Apr-2011
The Tor Project - https://metrics.torproject.org/

Attackers can block users from connecting to the Tor network

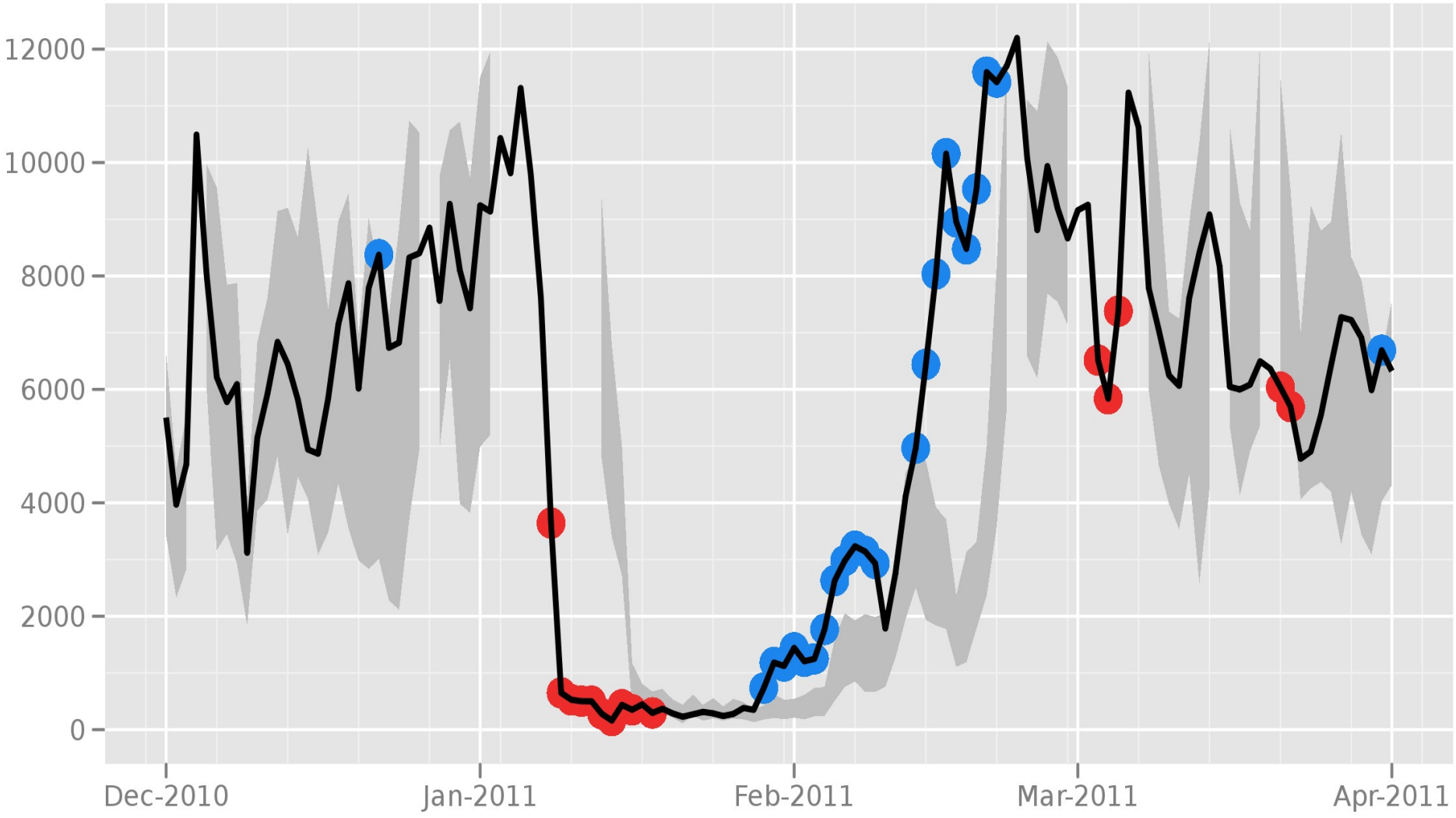
1) By blocking the directory authorities

2) By blocking all the relay IP addresses in the directory, or the addresses of other Tor services

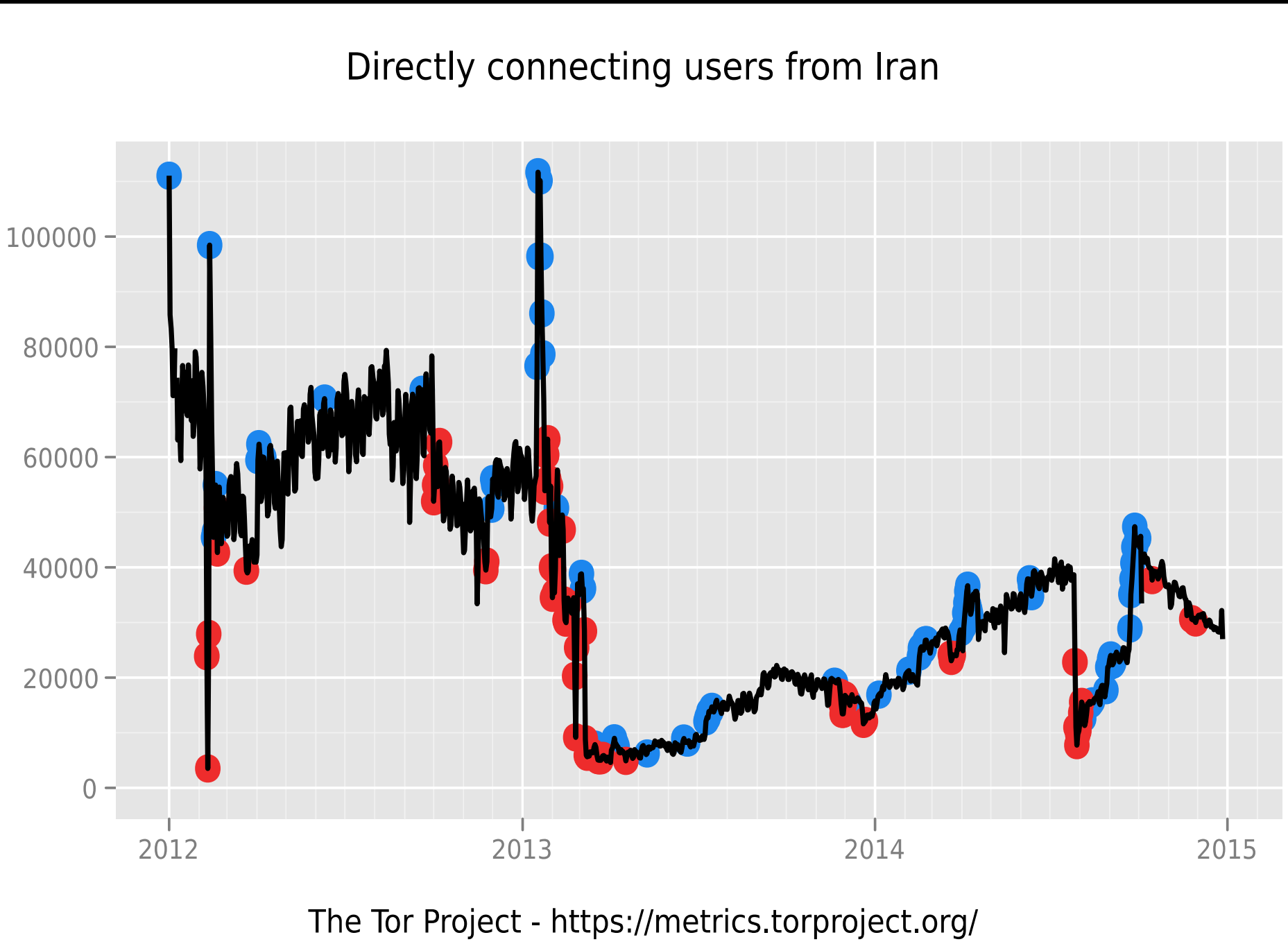
3) By filtering based on Tor's network fingerprint

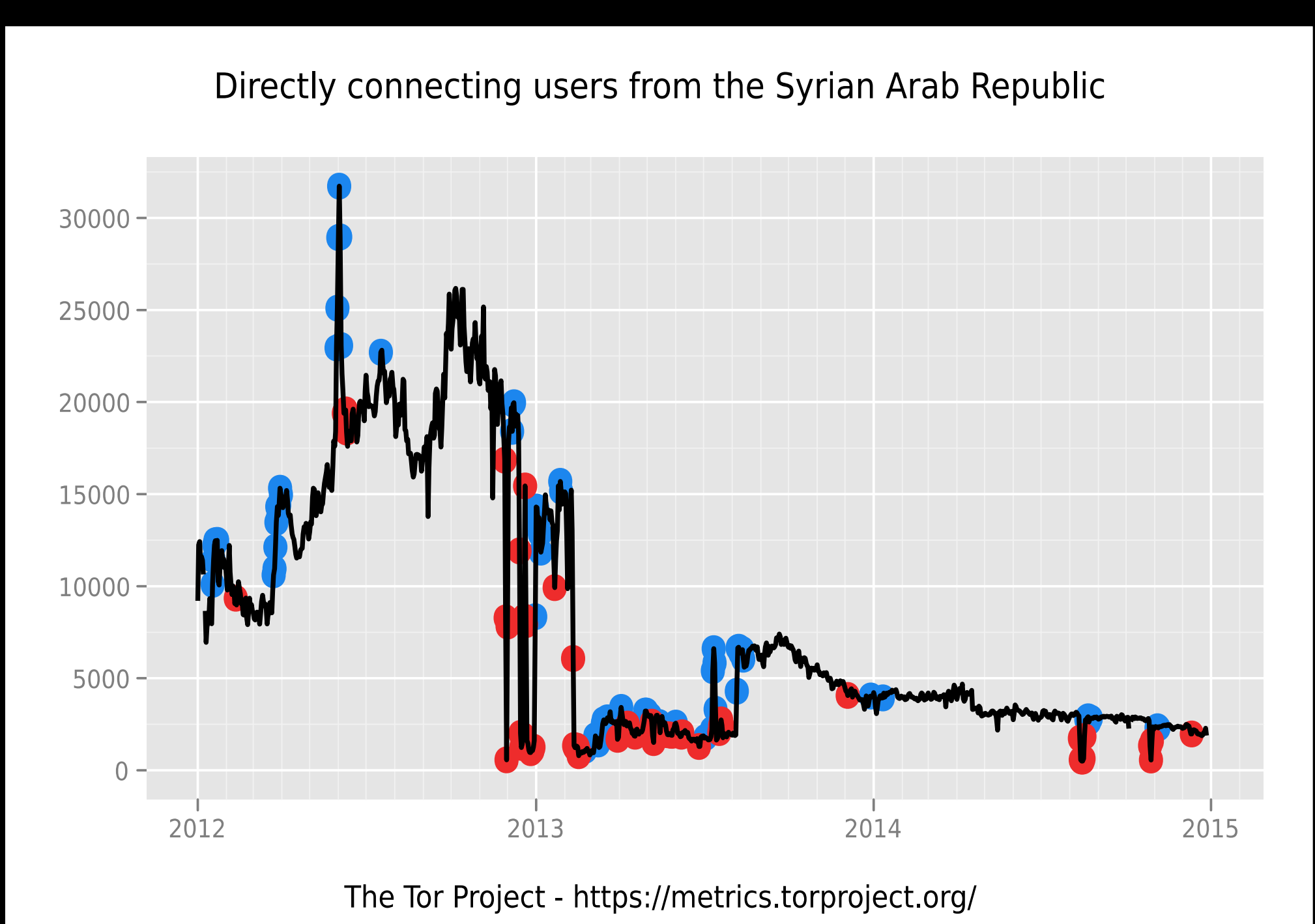
4) By preventing users from finding the Tor software (usually by blocking website)

Directly connecting users from the Islamic Republic of Iran

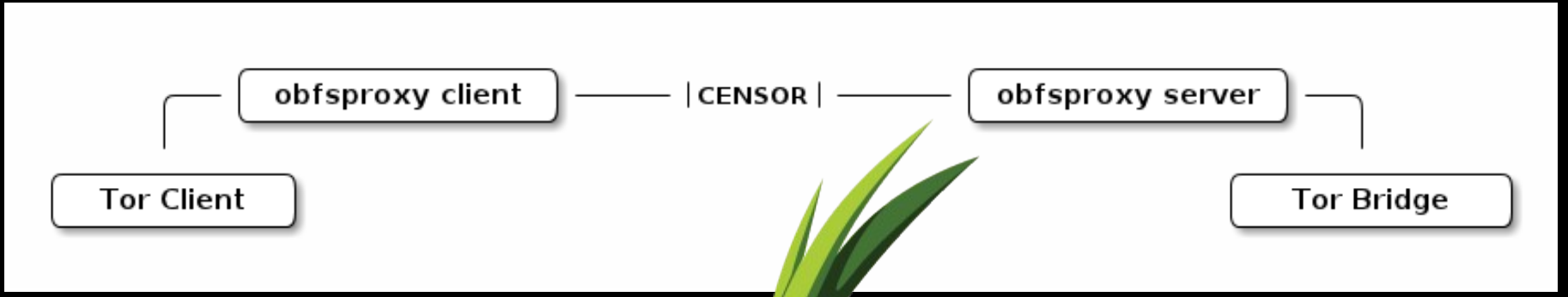


The Tor Project - https://metrics.torproject.org/


Directly connecting users from Iran
100000
80000
60000
40000
20000
0
2012
2013
2014
2015
The Tor Project - https://metrics.torproject.org/


Directly connecting users from the Syrian Arab Republic
30000
25000
20000
15000
10000
5000
0
2012
2013
2014
2015
The Tor Project - https://metrics.torproject.org/

Pluggable transports



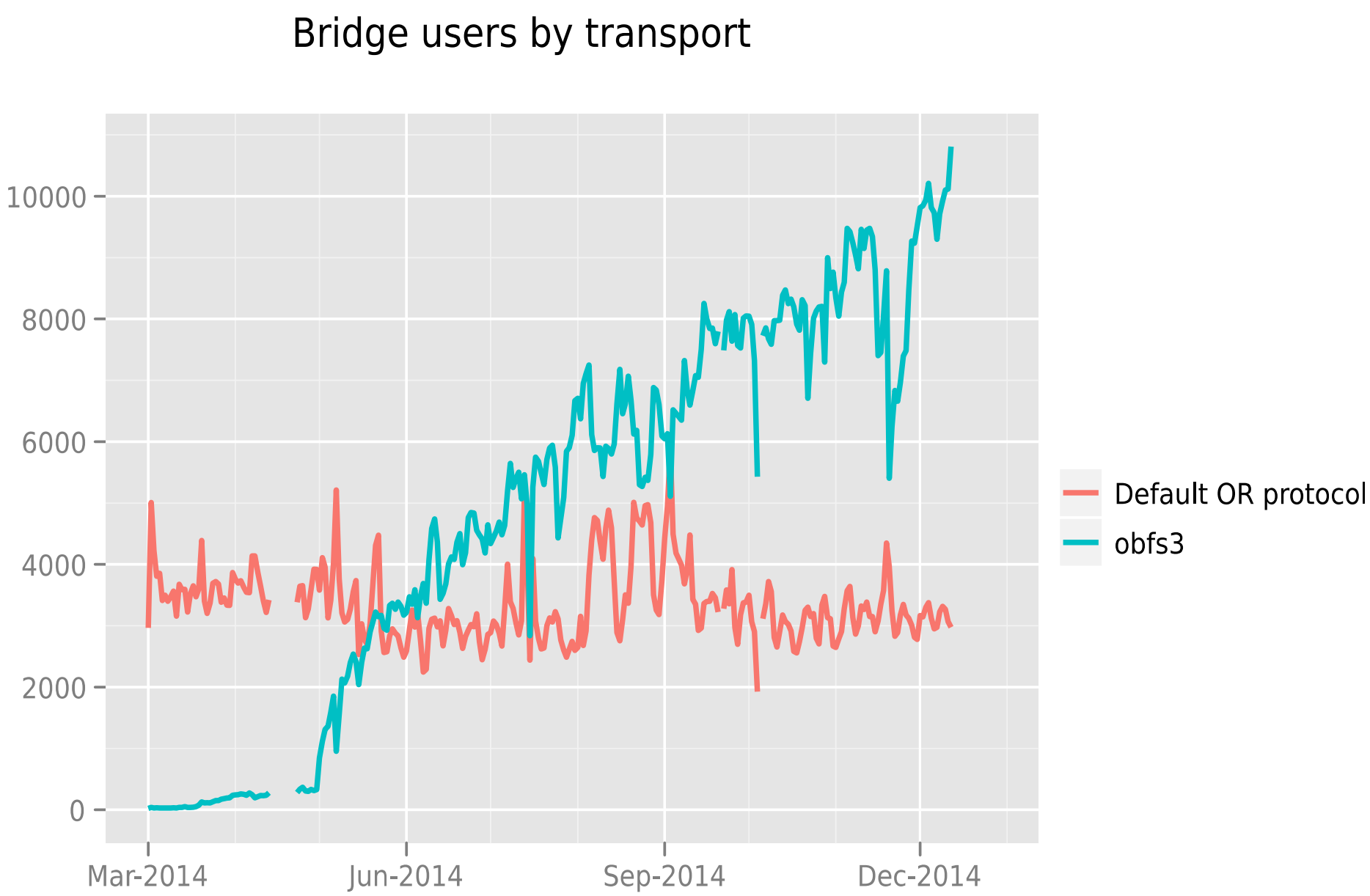
Two paradigms

- “Look like nothing”
- “Look like something they expect”

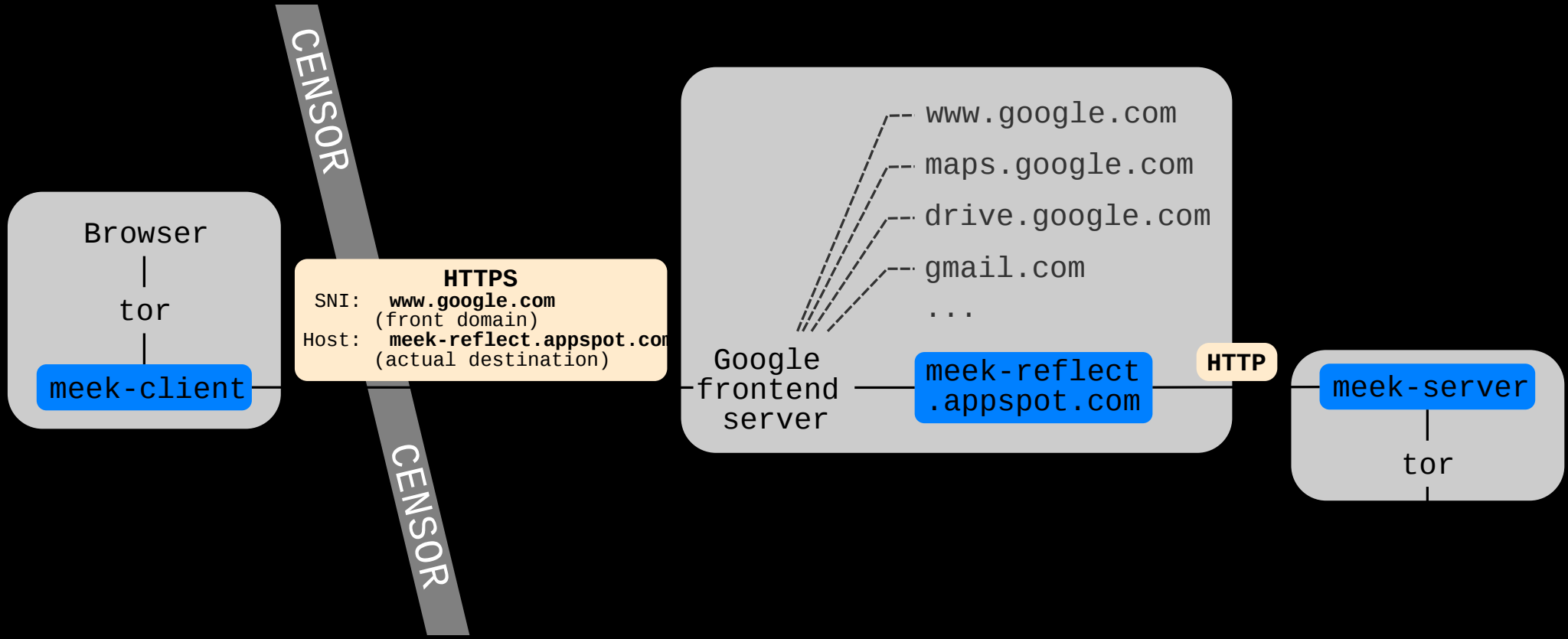
- Active probing: what should your service look like if the client doesn't auth right?
- “Be not there” vs “Be innocent service”

Pluggable transports

- Flashproxy (Stanford), websocket
- FTEProxy (Portland St), http via regex
- Stegotorus (SRI/CMU), http
- Skypemorph (Waterloo), Skype video
- uProxy (Google/UW), webrtc
- Lantern (BNS), social network based
- ScrambleSuit (Karlstad), obfs-based
- Telex (Michigan/Waterloo), traffic divert



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


Browser
tor
meek-client
CENSOR
HTTPS
SNI: www.google.com
(front domain)
Host: meek-reflect.appspot.com
(actual destination)
CENSOR
www.google.com
maps.google.com
drive.google.com
gmail.com
...
Google
frontend
server
meek-reflect
.appspot.com
HTTP
meek-server
tor


I Support Online Rights
ELECTRONIC FRONTIER FOUNDATION EFF.ORG

“Still the King of high secure, low latency Internet Anonymity”

Contenders for the throne:

- None

NSA targets the privacy-conscious

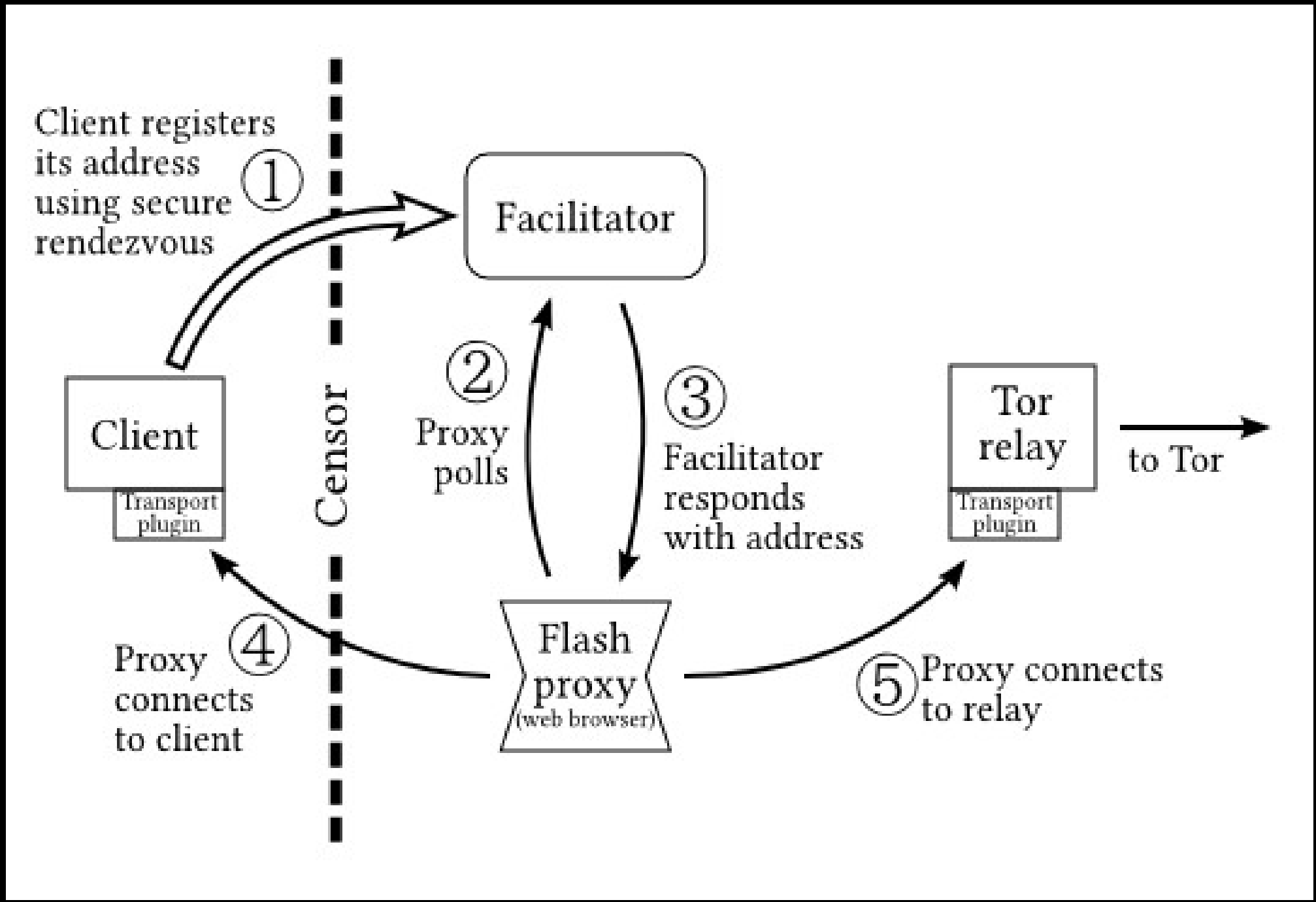
von J. Appelbaum, A. Gibson, J. Goetz, V. Kabisch, L. Kampf, L. Ryge

One of NSA's German targets is 212.212.245.170. The string of numbers is an IP address assigned to Sebastian Hahn, a computer science student at the University of Erlangen. Hahn operates the server out of a grey high-security building a few kilometers from where he lives. Hahn, 28 years old and sporting a red beard, volunteers for the Tor Project in his free time. He is especially trusted by the Tor community, as his server is not just a node, it is a so-called Directory Authority. There are nine of these worldwide, and they are central to the Tor Network, as they contain an index of all Tor nodes. A user's traffic is automatically directed to one of the directory authorities to download the newest list of Tor relays generated each hour.

Hahn's predecessor named the server Gabelmoo, or Fork Man, the nickname of a local statue of Poseidon. After a look at the NSA source code, Hahn quickly

Pervasive surveillance

- Design changes to improve robustness
- Internet is more centralized than we'd like
- Defending against end-to-end correlation attacks is a good idea in theory
- Surveillance (DPI) and censorship (DPI) more related than we realized


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