How governments have tried to block Tor

Roger Dingledine

The Tor Project
https://torproject.org/

What is Tor?

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

Community of researchers, developers, users, and relay operators

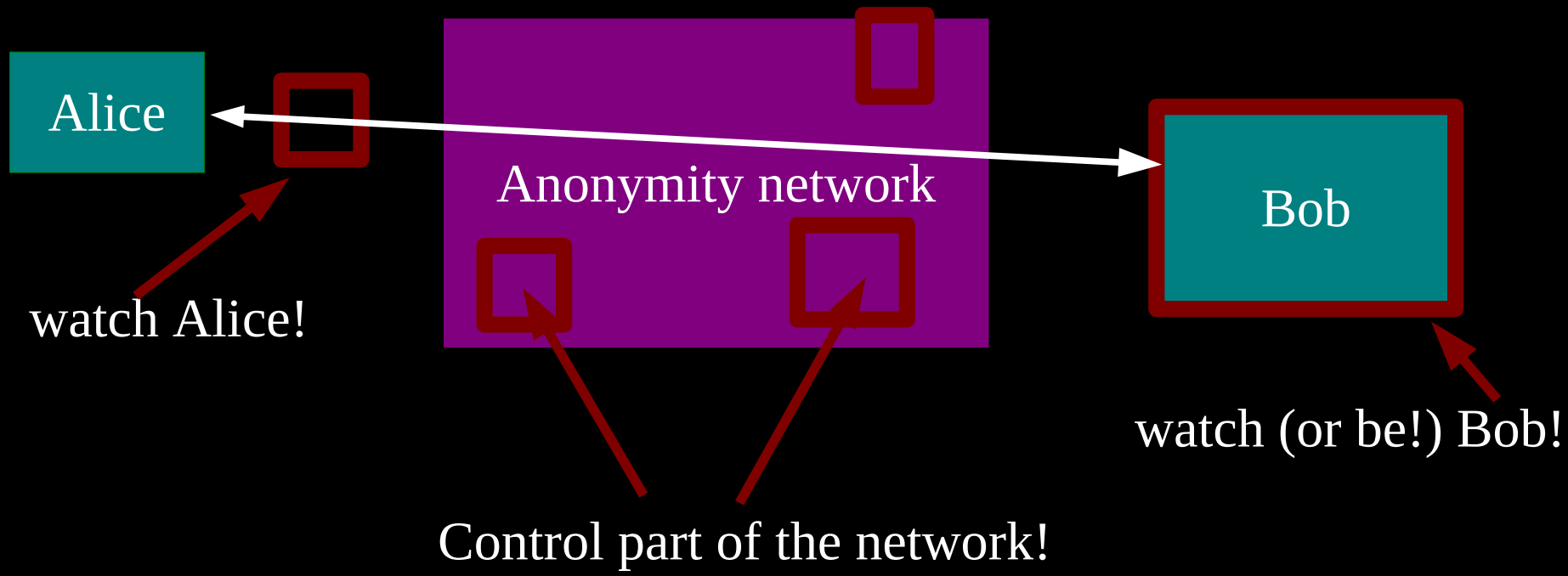
Funding from US DoD, Electronic Frontier Foundation, Voice of America, Google, NLnet, Human Rights Watch, NSF, US State Dept, SIDA, ...

The Tor Project, Inc.

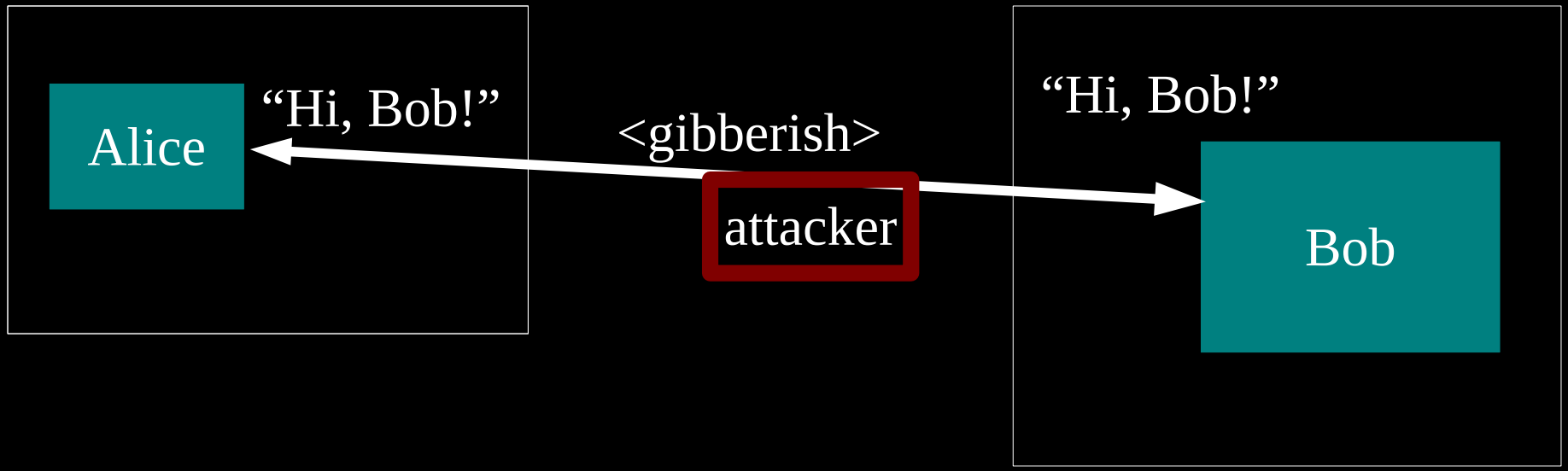
U.S. 501(c)(3) non-profit organization dedicated to the research and development of tools for online anonymity and privacy


Estimated ~400,000?
daily Tor users

Threat model: what can the attacker do?



Anonymity isn't encryption: Encryption just protects contents.



Anonymity isn't just wishful thinking...

“You can't prove it was me!”

“Promise you won't look!”

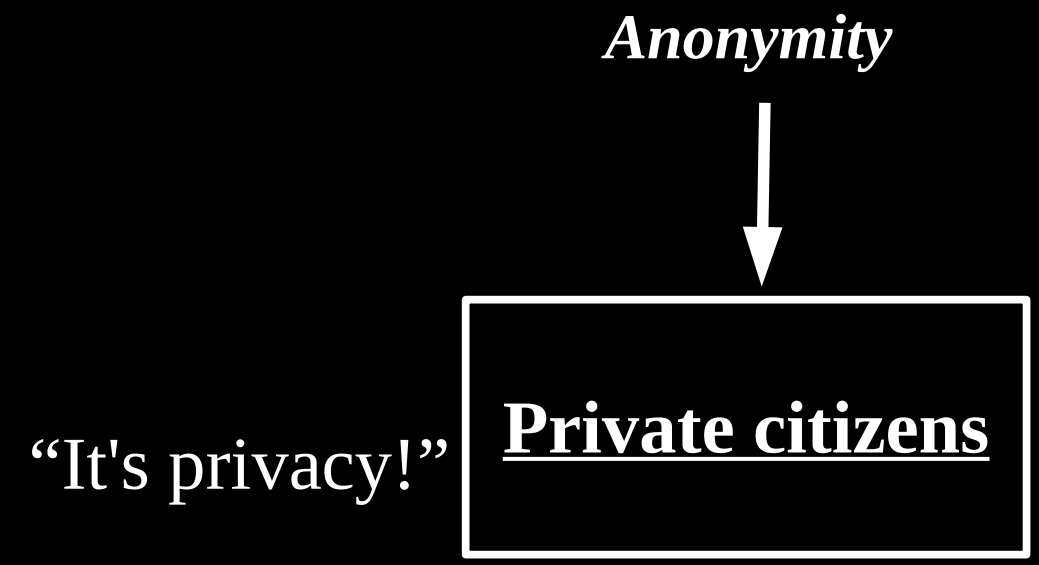
“Promise you won't remember!”

“Promise you won't tell!”

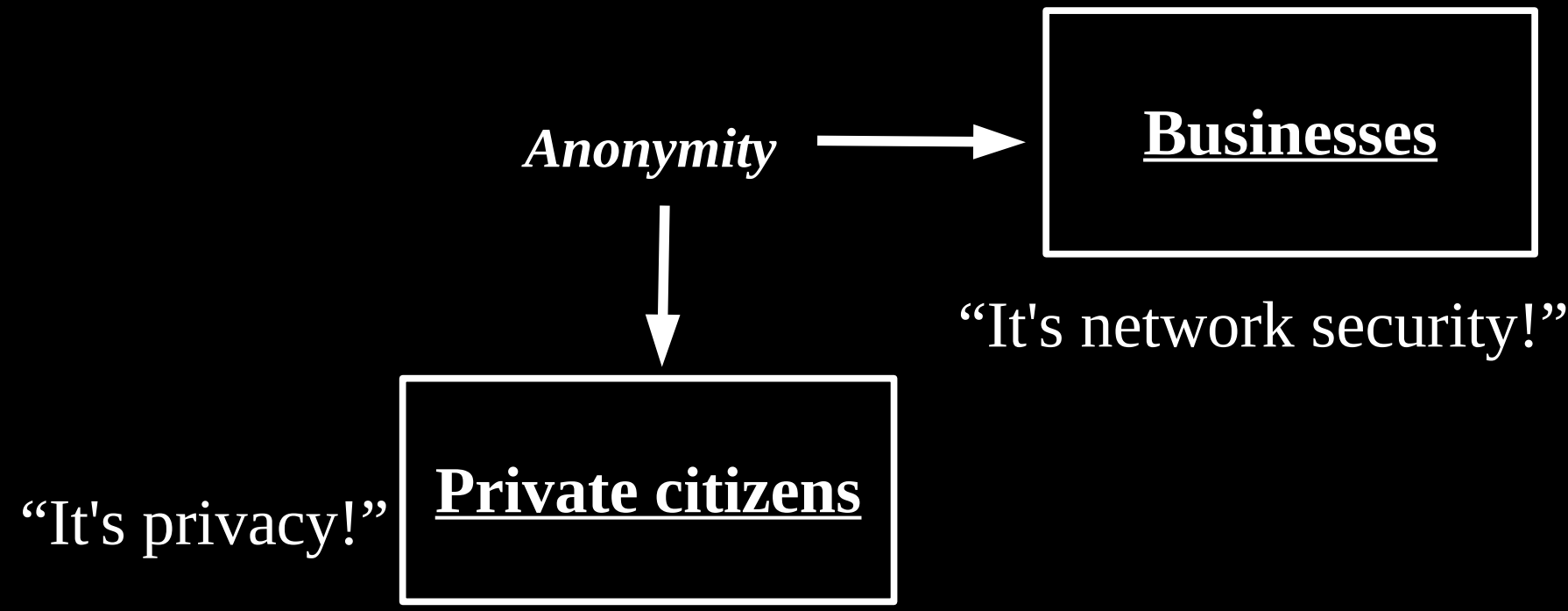
“I didn't write my name on it!”

“Isn't the Internet already anonymous?”

Anonymity serves different interests for different user groups.



Anonymity serves different interests for different user groups.



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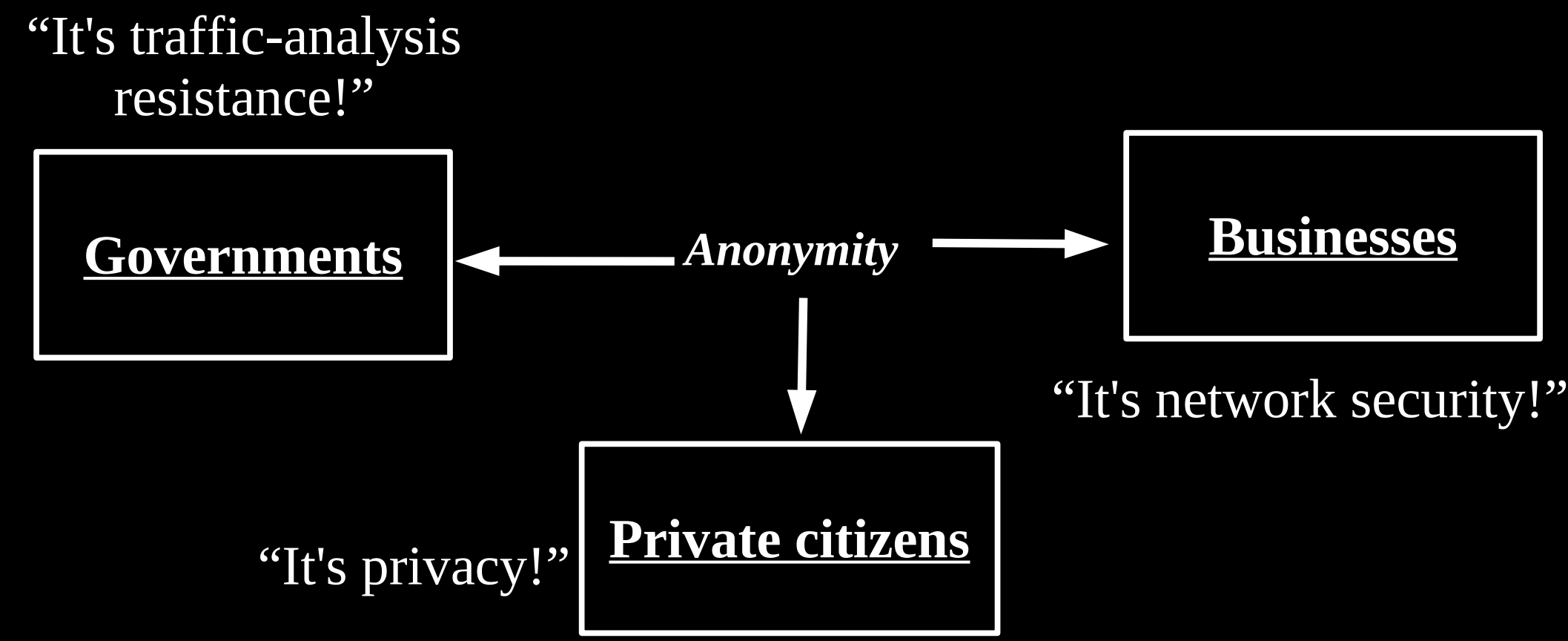

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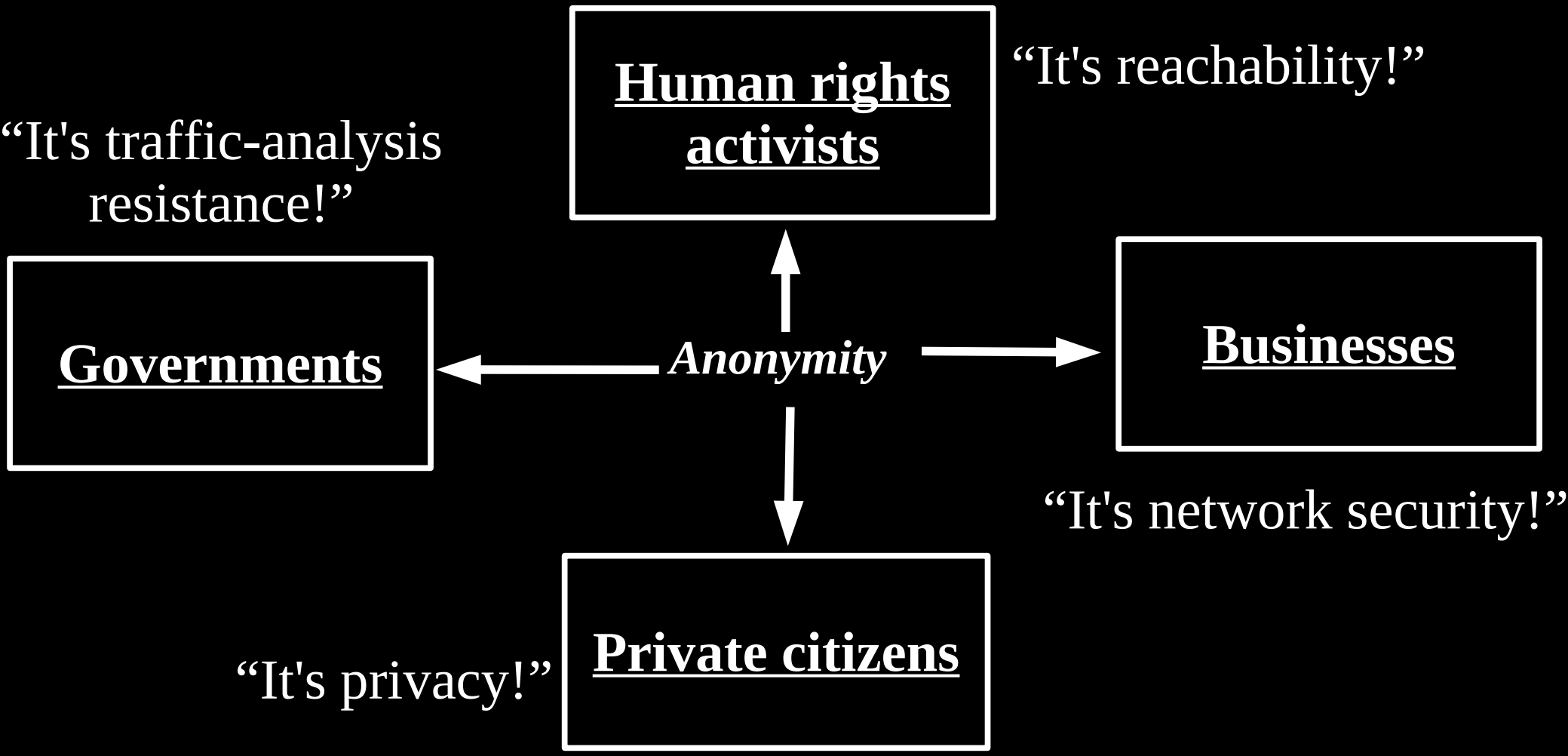
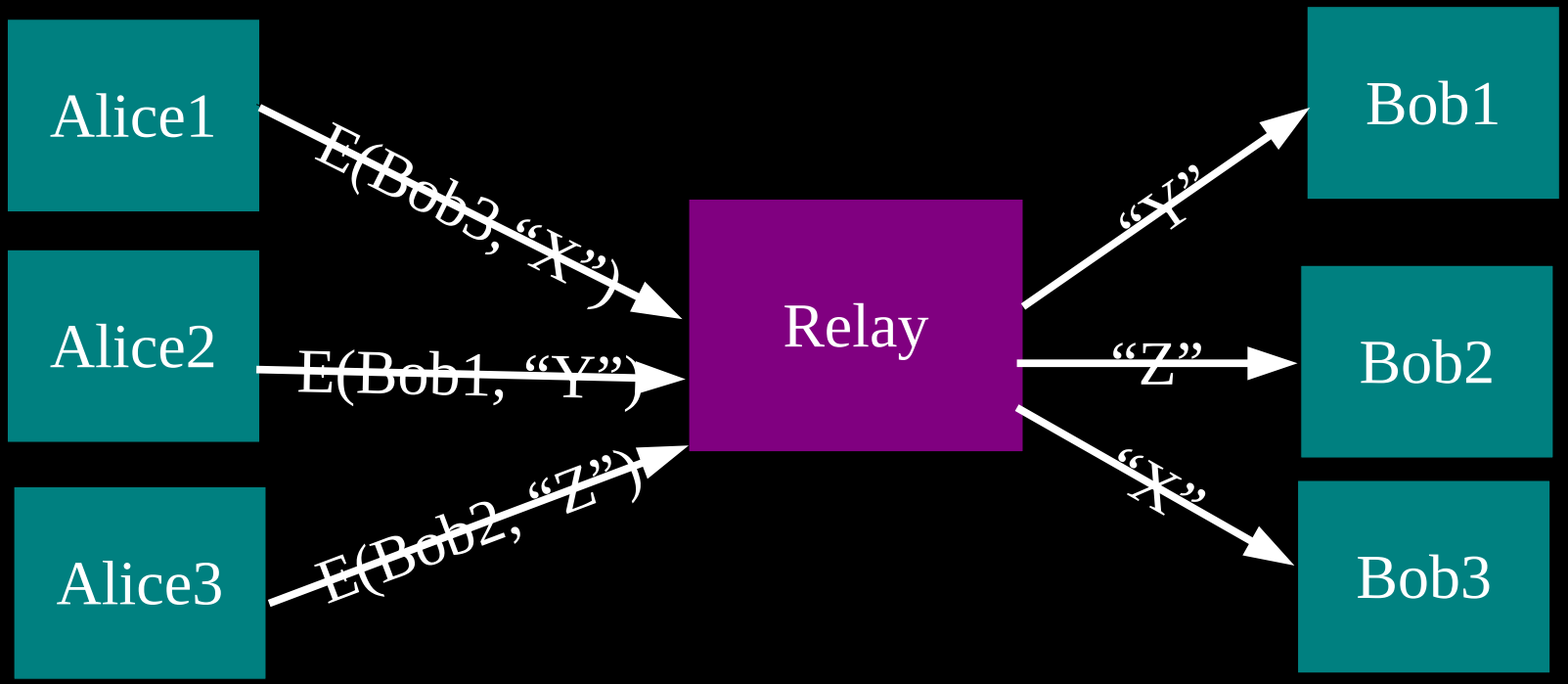
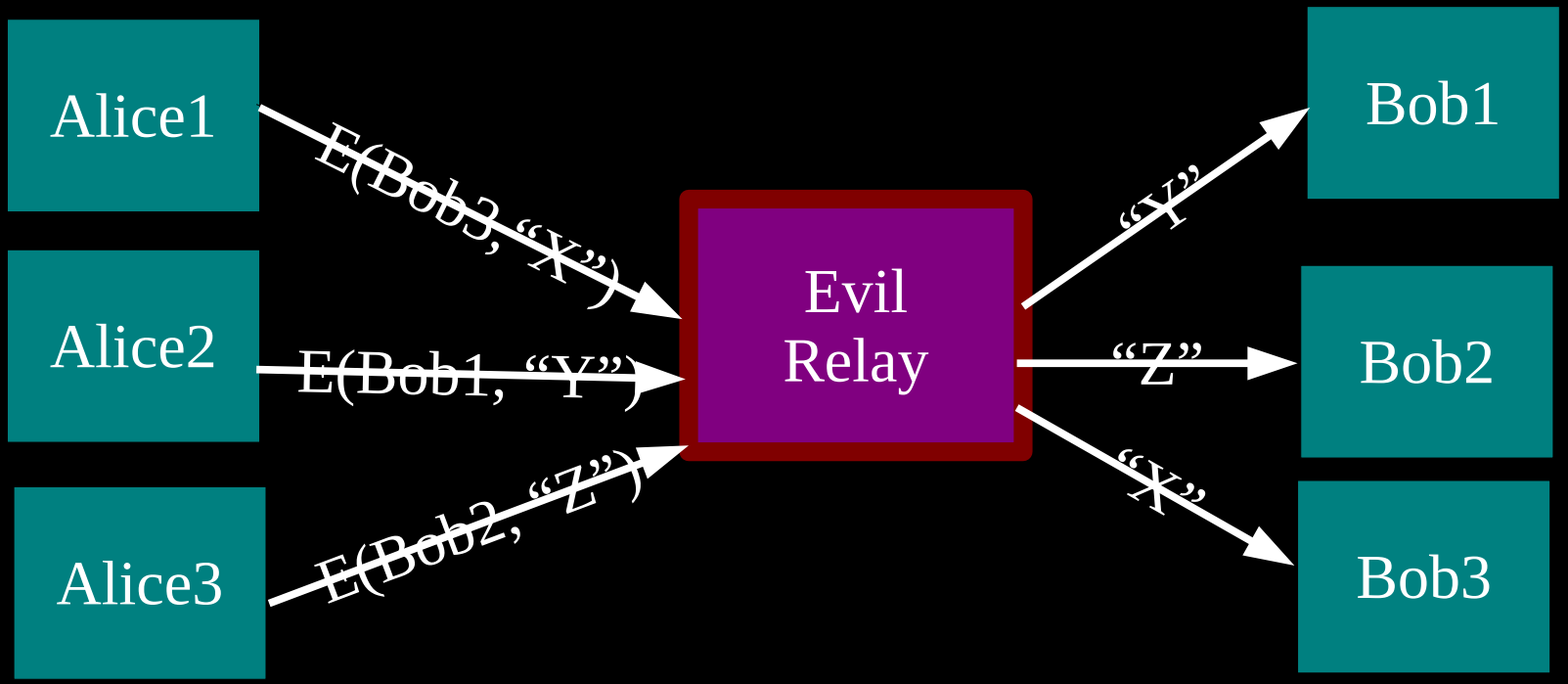


The simplest designs use a single relay to hide connections.

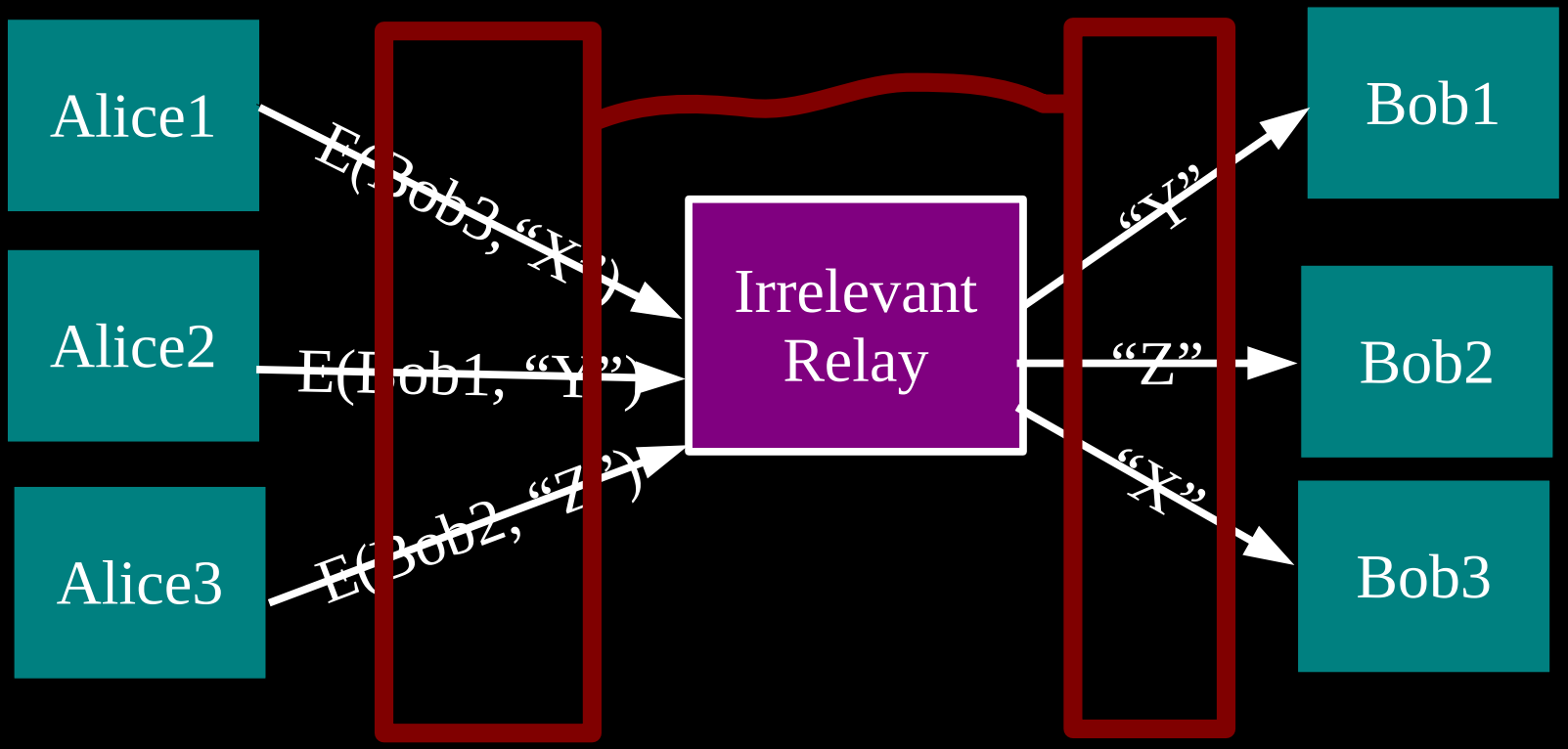


(example: some commercial proxy providers)

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

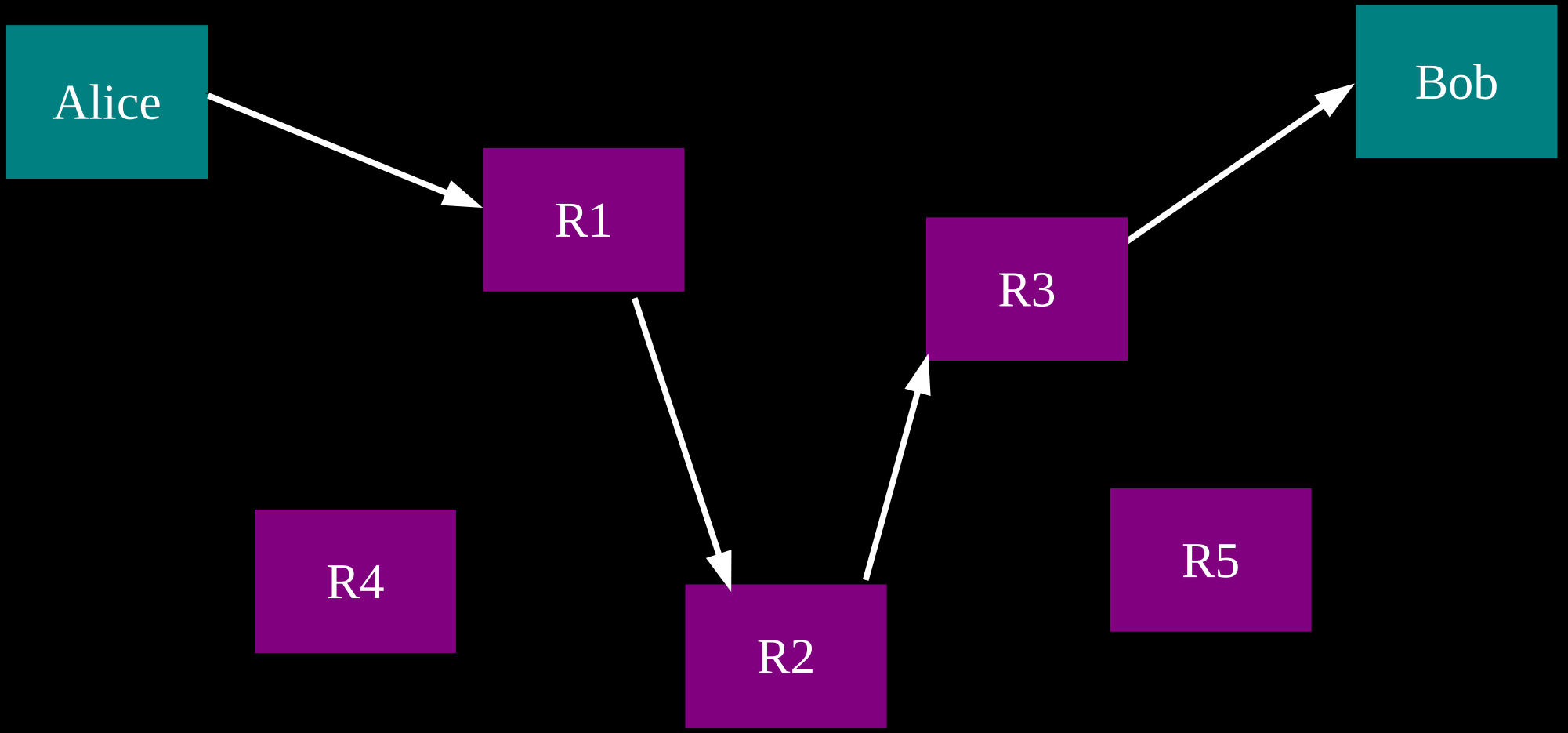


... or a single point of bypass.

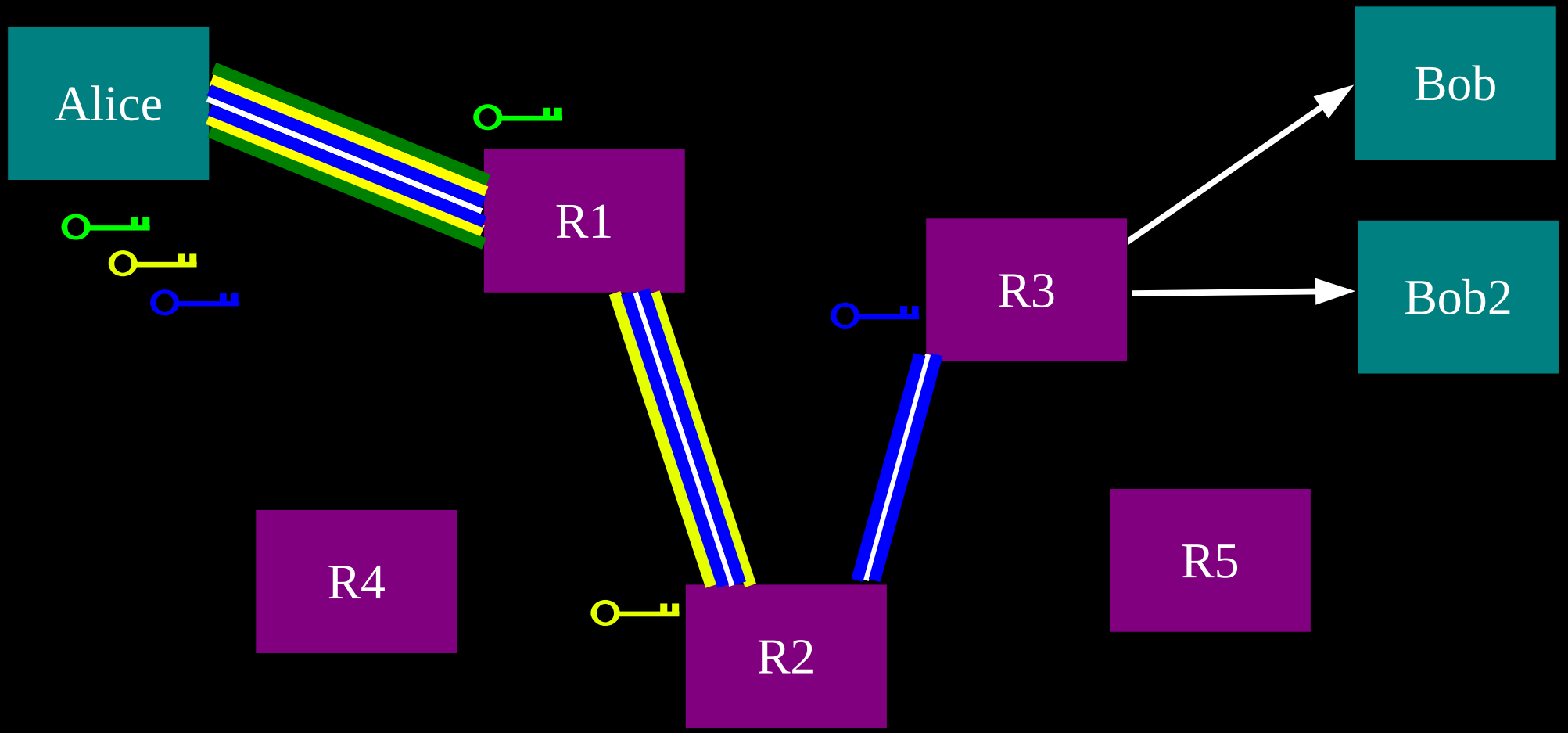


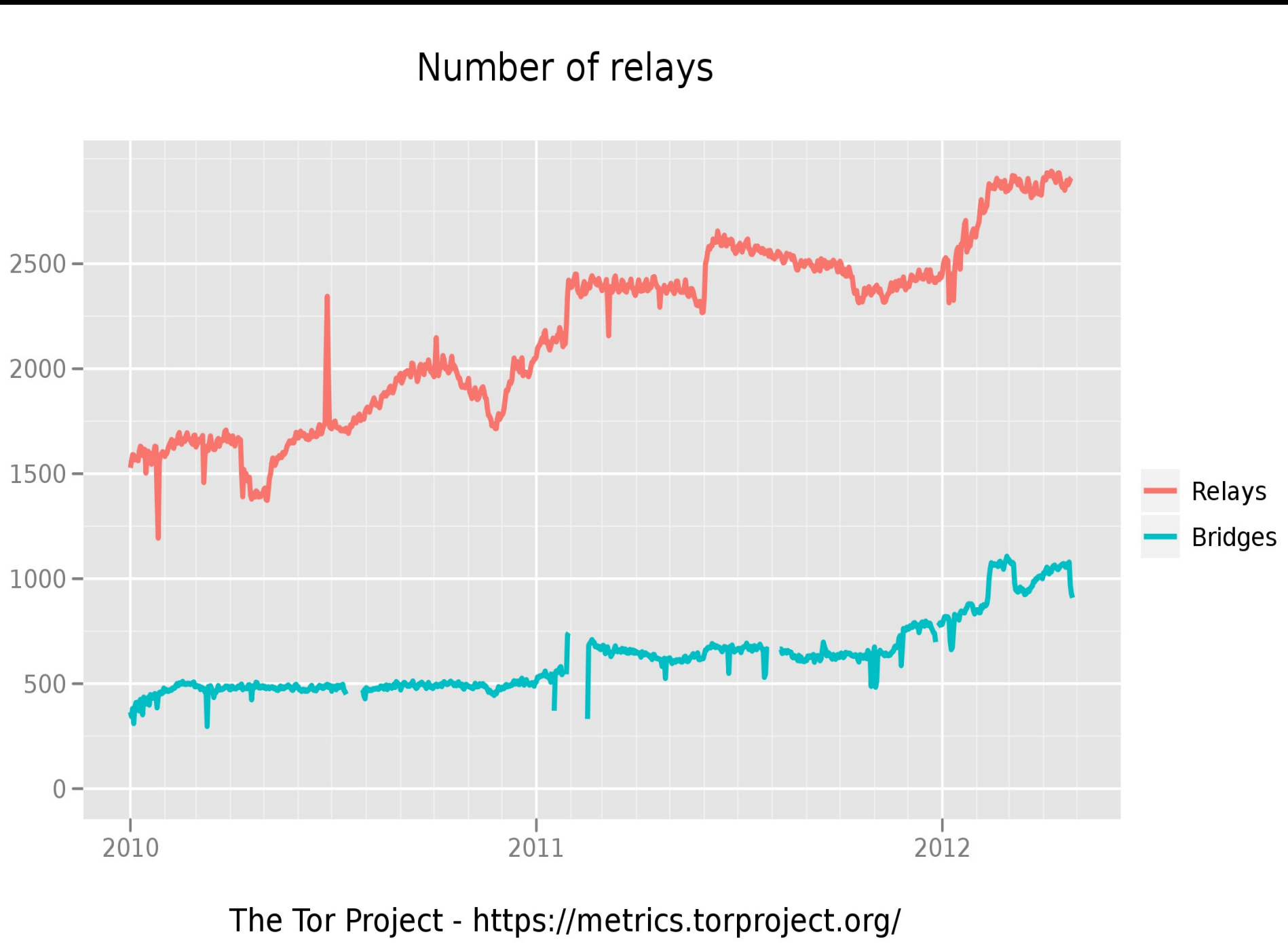
Timing analysis bridges all connections through relay ⇒ An attractive fat target

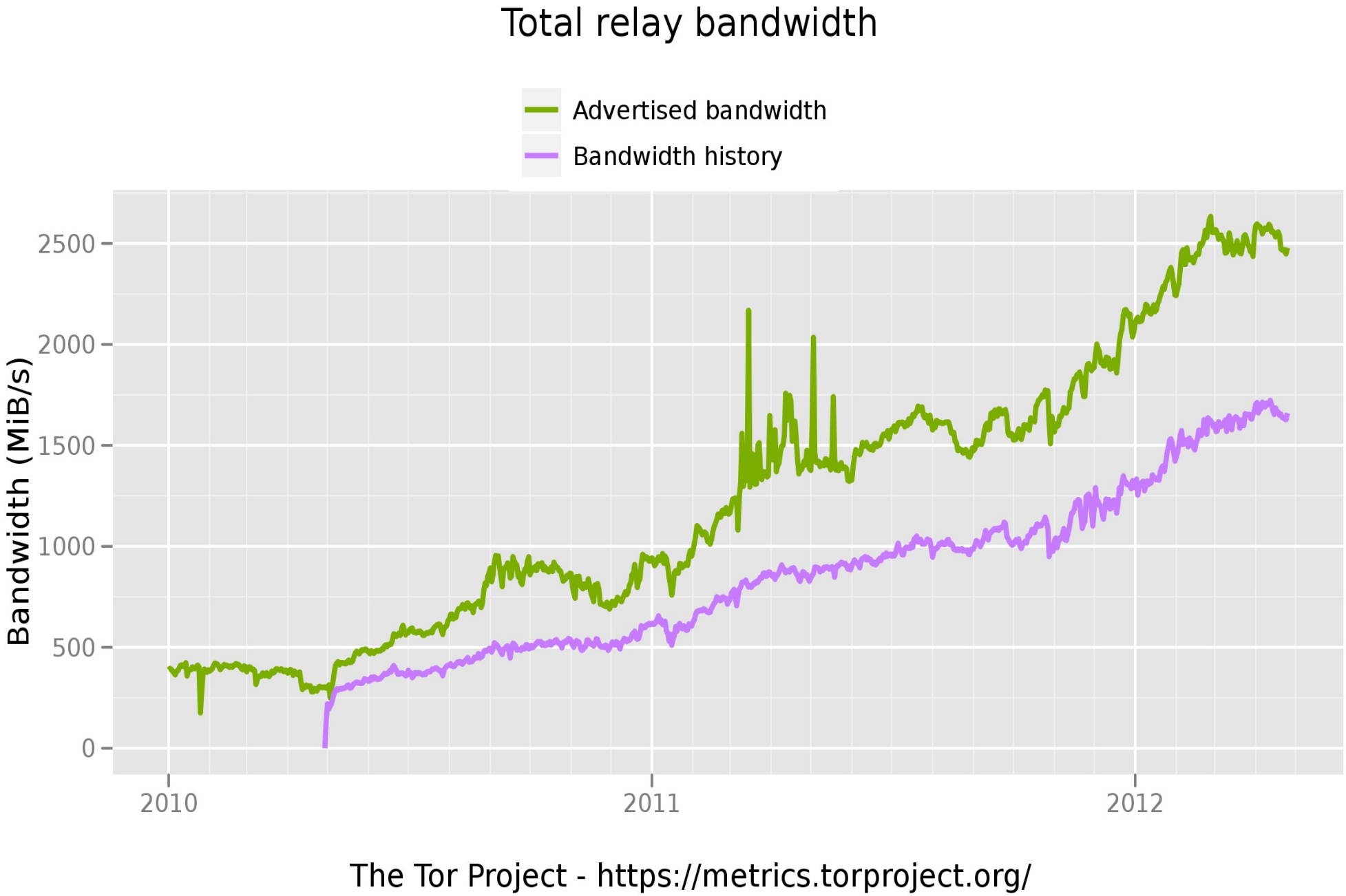
So, add multiple relays so that no single one can betray Alice.



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




Number of relays
2500
2000
1500
1000
500
0
2010
2011
2012
Relays
Bridges
The Tor Project - https://metrics.torproject.org/


Total relay bandwidth
Advertised bandwidth
Bandwidth history
Bandwidth (MiB/s)
2500
2000
1500
1000
500
0
2010
2011
2012
The Tor Project - https://metrics.torproject.org/

Tor's code released (2002)

- Tor's code released in 2002
- Tor's design paper published in 2004
- The clock starts ticking...

Thailand (April 2006)

- DNS filtering of our website
- Only by ISPs that participated in the Cyber Clean program of the Ministry of Information and Communication Technology
- Redirected to block page
  - http://www.mict.go.th/ci/block.html

Smartfilter/Websense (2006)

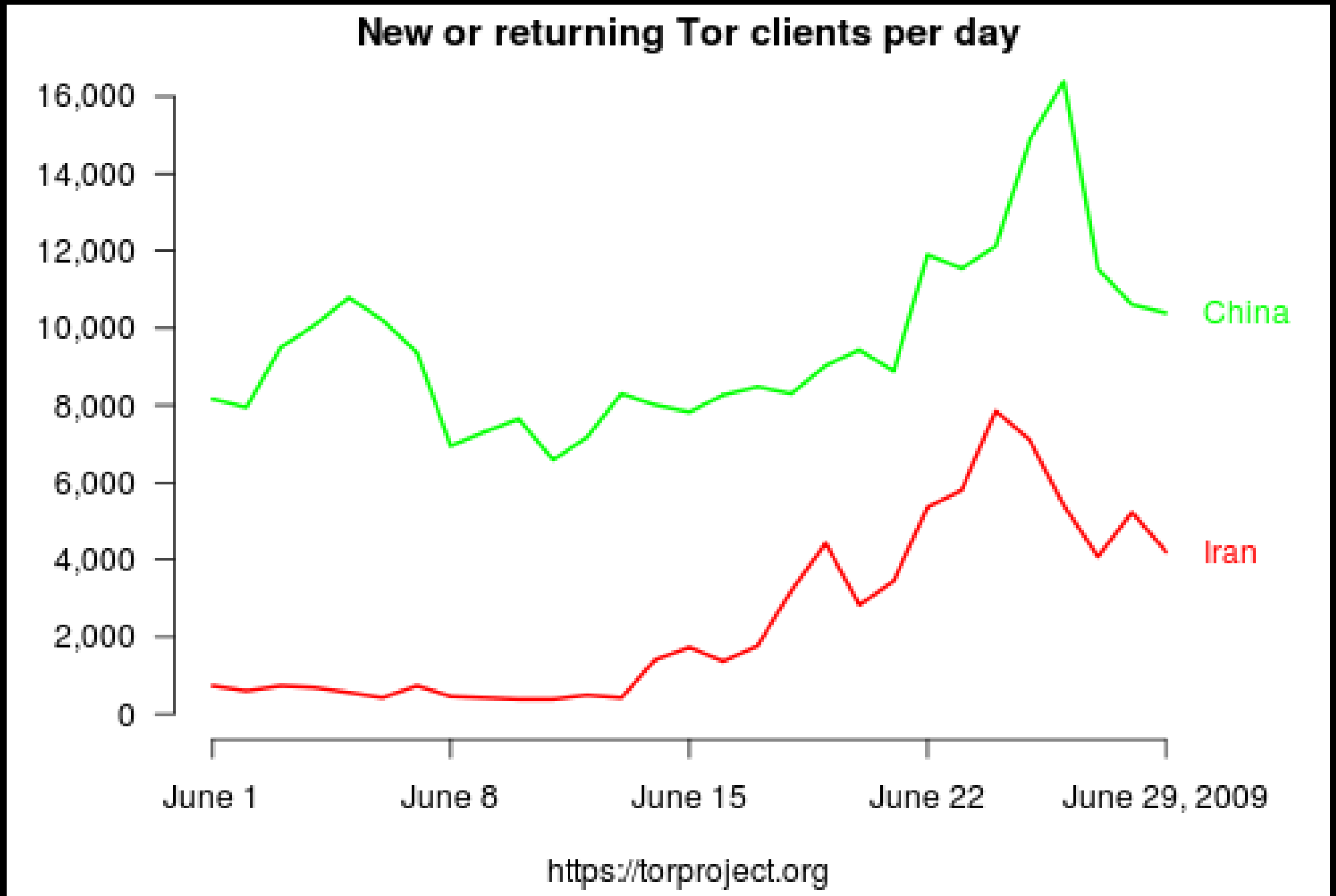
- Tor used TLS for its encrypted connection, and HTTP for fetching directory info.
- Smartfilter just cut all HTTP GET requests for “/tor/...”
  - That is not much of an arms race...
- Websense, Cisco, etc advertised this way of blocking Tor, even when it was obsolete.

Iran/Saudi Arabia/etc (2007)

- Picked up these Smartfilter/Websense rules by pulling an update
- The fix was to tunnel directory fetches inside the encrypted connection
  - When Iran kicked out Smartfilter in early 2009, Tor's old (non-TLS) directory fetches worked again!

Iran throttles SSL (June 2009)

- We made Tor's TLS handshake look like Firefox+Apache.
- So when Iran freaked out and throttled SSL bandwidth by DPI in summer 2009, they got Tor for free


New or returning Tor clients per day
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
China
Iran
June 1
June 8
June 15
June 22
June 29, 2009
https://torproject.org

Tunisia (summer 2009)

- As of the summer of 2009, Tunisia used Smartfilter to filter every port but 80 and 443
- And if they didn't like you, they *would* block 443 just for **you**
- You could use a Tor bridge on port 80, but couldn't bootstrap into the main network
- So we set up a Tor directory authority doing TLS on port 80

China (September 2009)

- China grabbed the list of public relays and blocked them
- They also enumerated one of the three bridge buckets (the ones available via https://bridges.torproject.org/)
- But they missed the other bridge buckets.

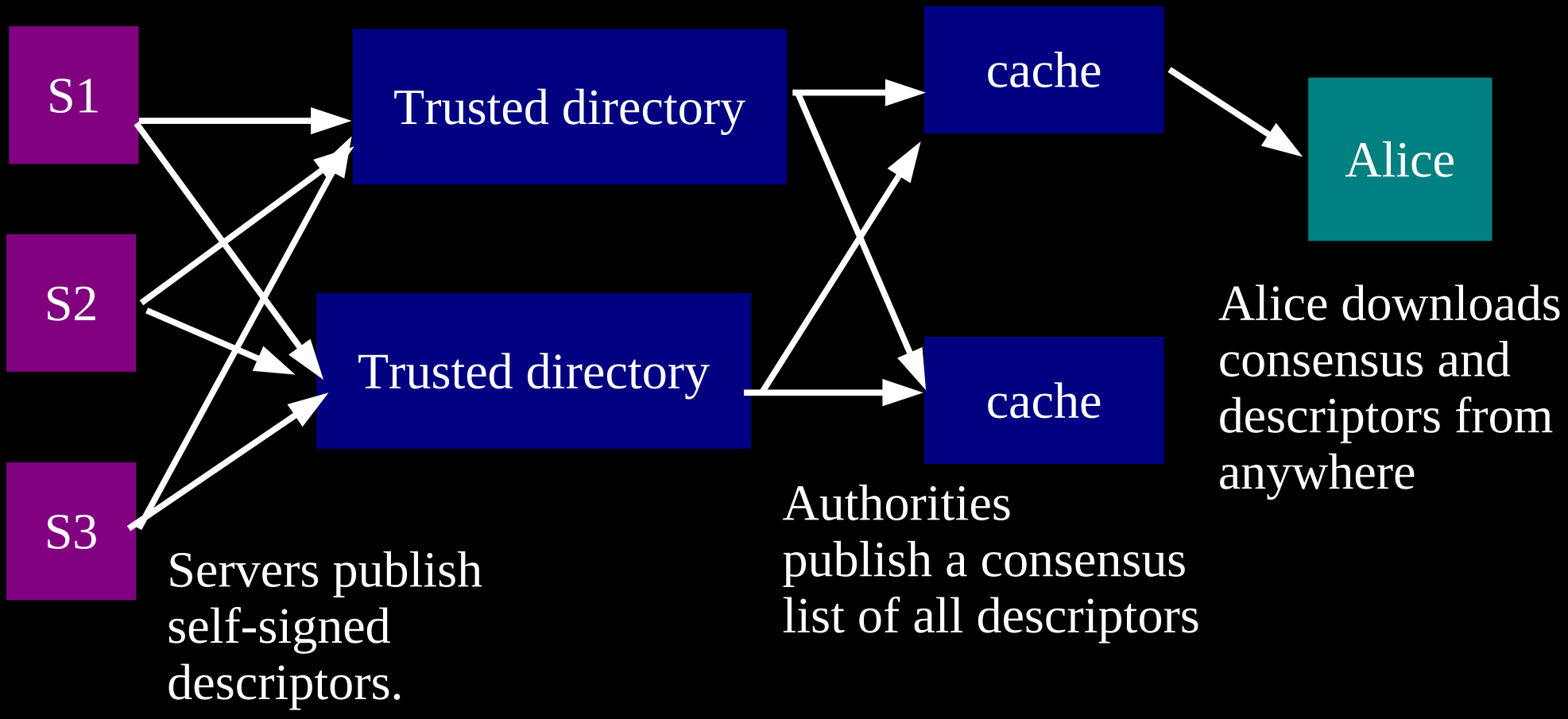
Relay versus Discovery

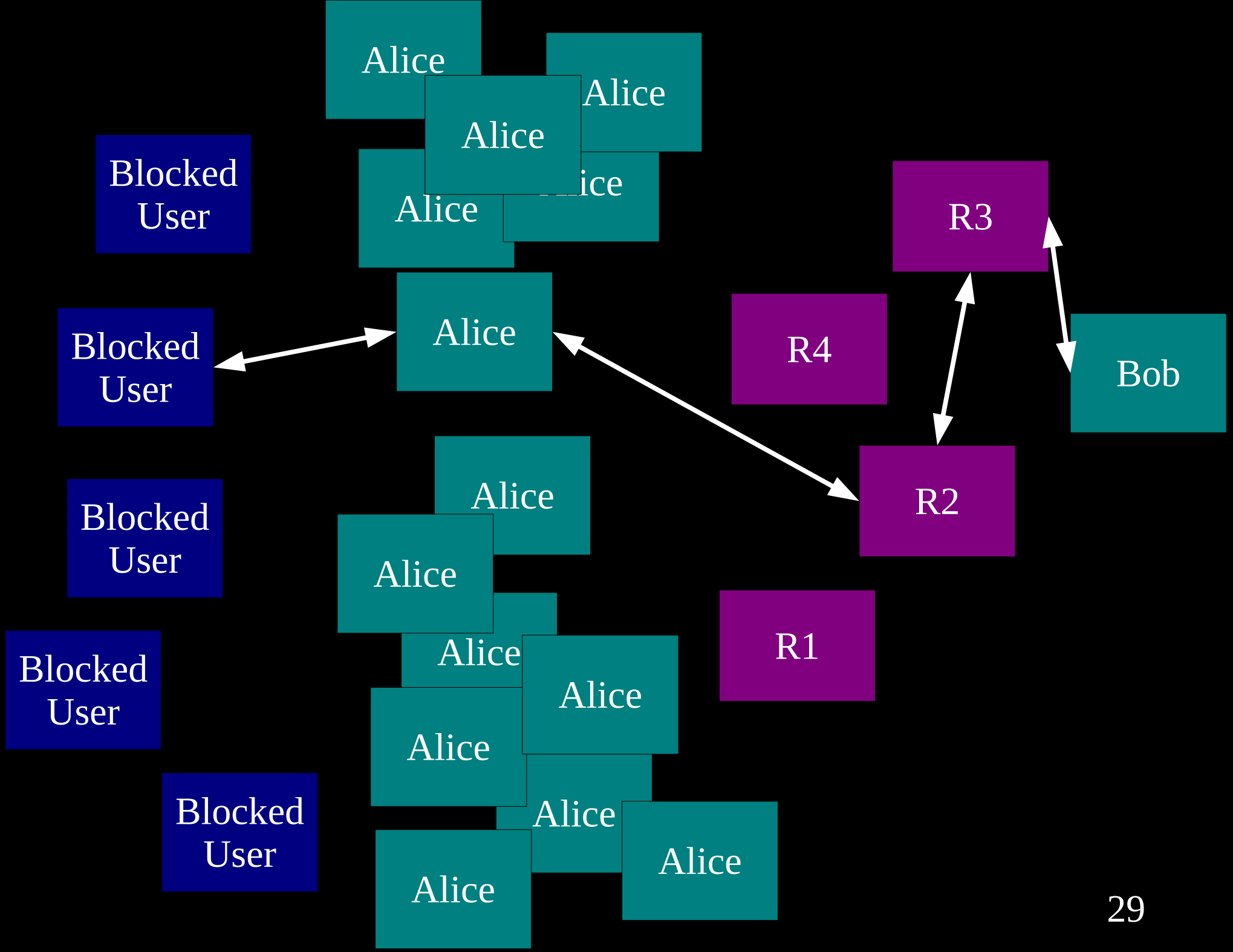
There are two pieces to all these “proxying” schemes:

a **relay** component: building circuits, sending traffic over them, getting the crypto right

a **discovery** component: learning what relays are available

The basic Tor design uses a simple centralized directory protocol.




Alice
Alice
Alice
Alice
Alice
Blocked User
Blocked User
Blocked User
Blocked User
Blocked User
Alice
Alice
Alice
Alice
Alice
Alice
Alice
R3
R4
R2
R1
Bob

How do you find a bridge?

1) **https://bridges.torproject.org/** will tell you a few based on time and your IP address

2) Mail bridges@torproject.org from a gmail address and we'll send you a few

3) I mail some to a friend in Shanghai who distributes them via his social network

4) You can set up your own private bridge and tell your target users directly

Attackers can block users from connecting to the Tor network

1) By blocking the directory authorities

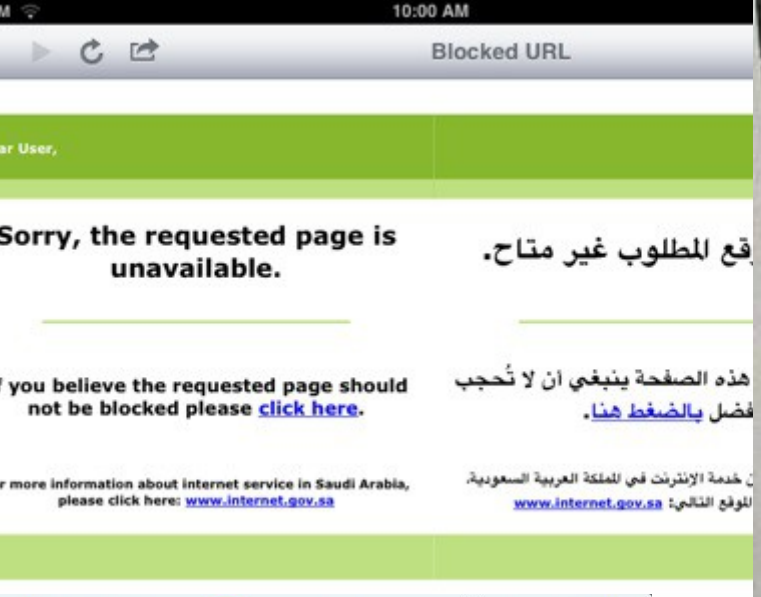
2) By blocking all the relay IP addresses in the directory, or the addresses of other Tor services

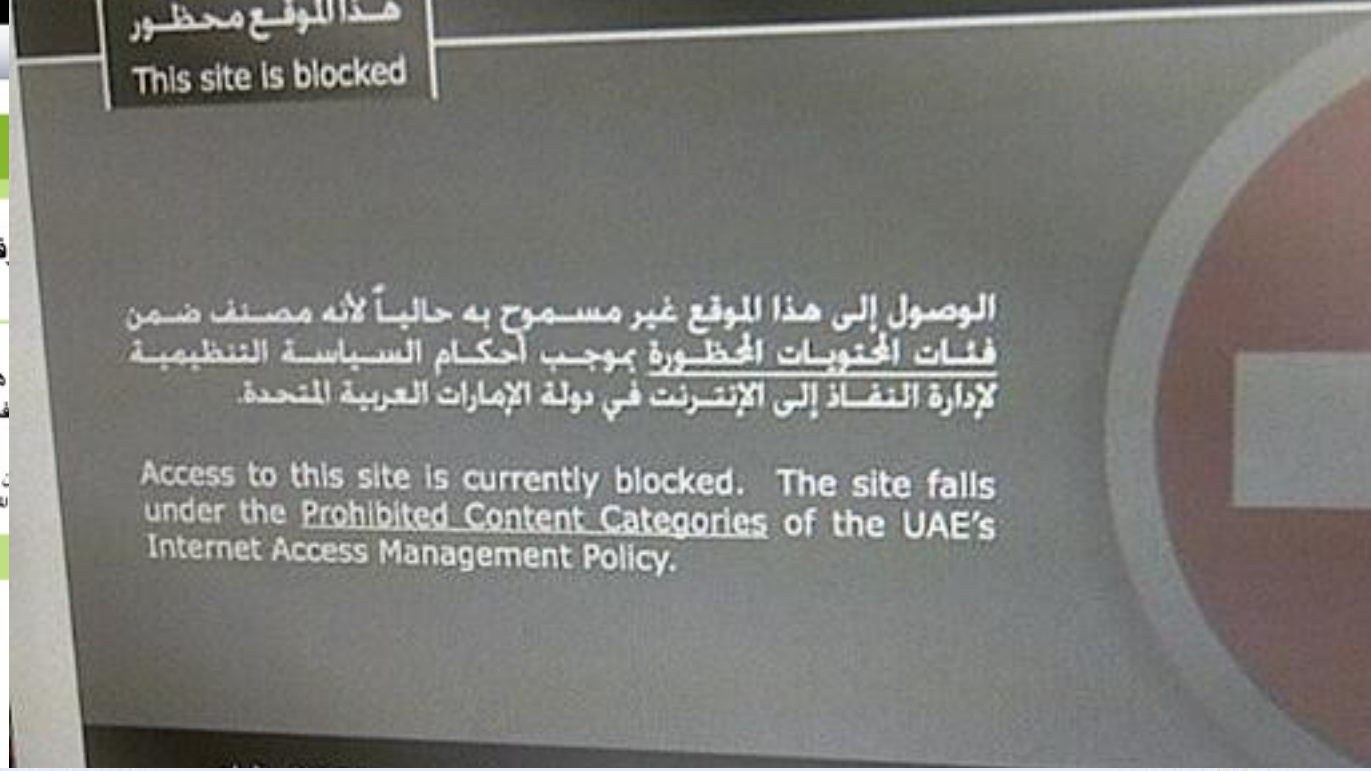
3) By filtering based on Tor's network fingerprint

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

Your request was denied because of its conte

ء على اللوائح والقوانين
مع unblock.kw@kw.zain

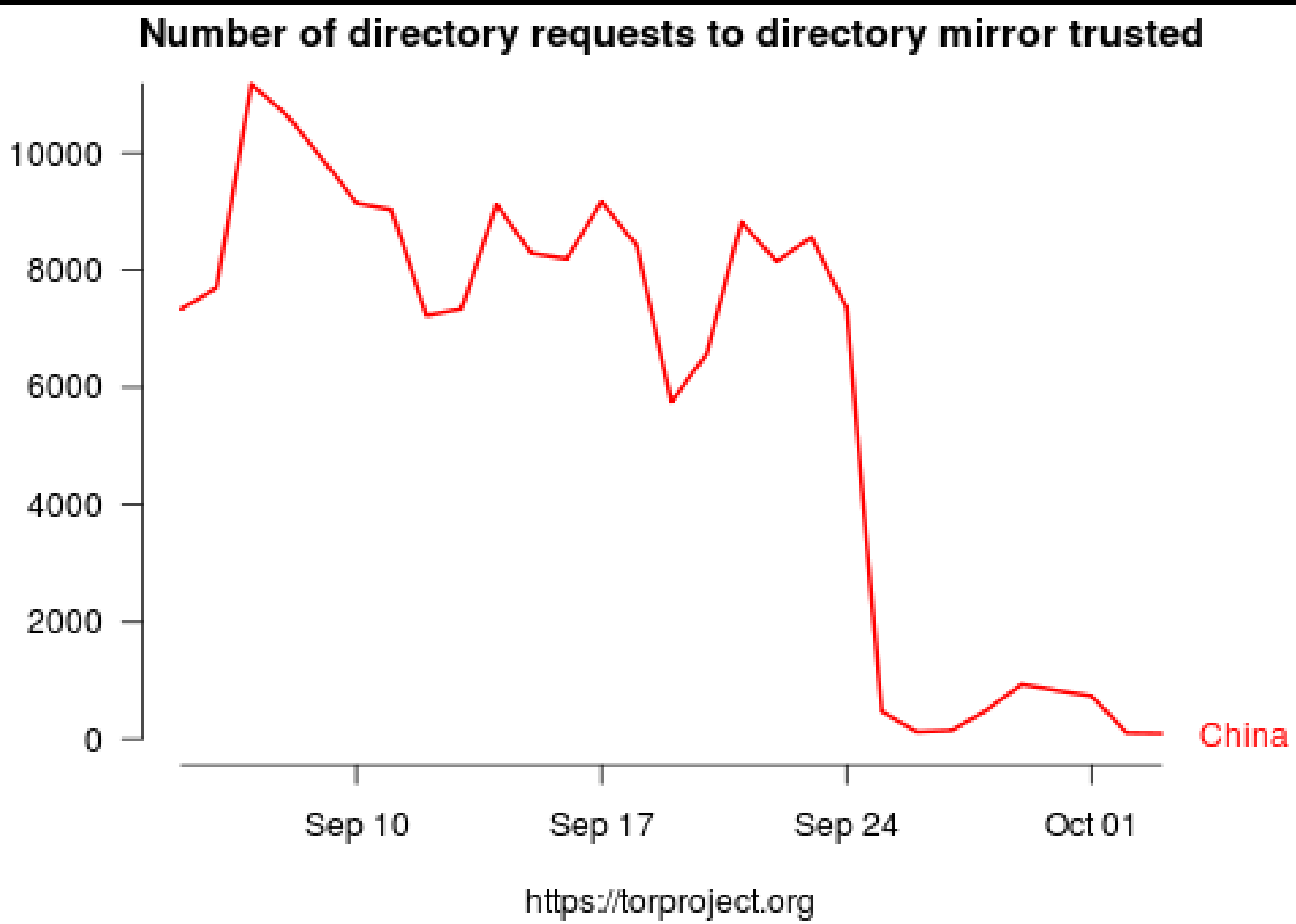

10:00 AM
Blocked URL
ar User,
Sorry, the requested page is unavailable.
قع المطلوب غير متاح.
you believe the requested page should not be blocked please click here.
هذه الصفحة ينبغي أن لا تُحجب
فضل بالضغط هنا.
r more information about internet service in Saudi Arabia, please click here: www.internet.gov.sa
www.internet.gov.sa

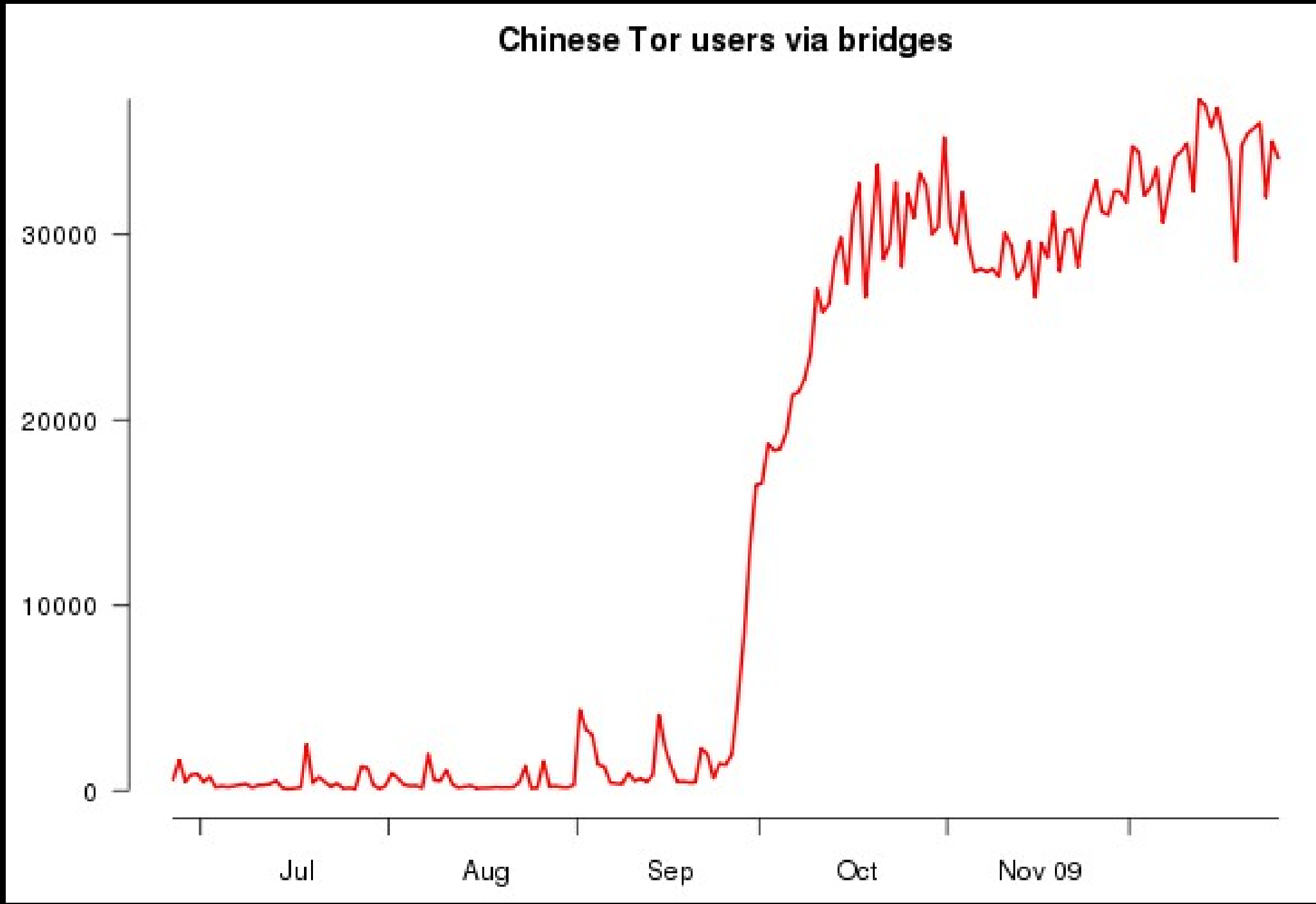

This site is blocked
الوصول إلى هذا الموقع غير مسموح به حالياً لأنه مصنف ضمن فئات المحتويات المحظورة بموجب أحكام السياسة التنظيمية لإدارة النفاذ إلى الإنترنت في دولة الإمارات العربية المتحدة.
Access to this site is currently blocked. The site falls under the Prohibited Content Categories of the UAE's Internet Access Management Policy.


KT WATA...
٩:٢١ ص
87%
Tweet
Blocked by Mada Com...


مـــدى للإتصـــالات
mada Mada Communications
ان الموقع الذي تحاول زيارته محجوب
Access to this website is prohibited
This site is blocked according to the goverment filtering policy.
If you feel this page has been blocked in errors, kindly fill out the form and we will investigate.
Thank You.
Required fields are denoted by (*)
Full Name *
الإسم
Email *
العنوان البريدي
Blocked URL *
www.
.com
اسم المخالف
Comments
استفسارك
Submit

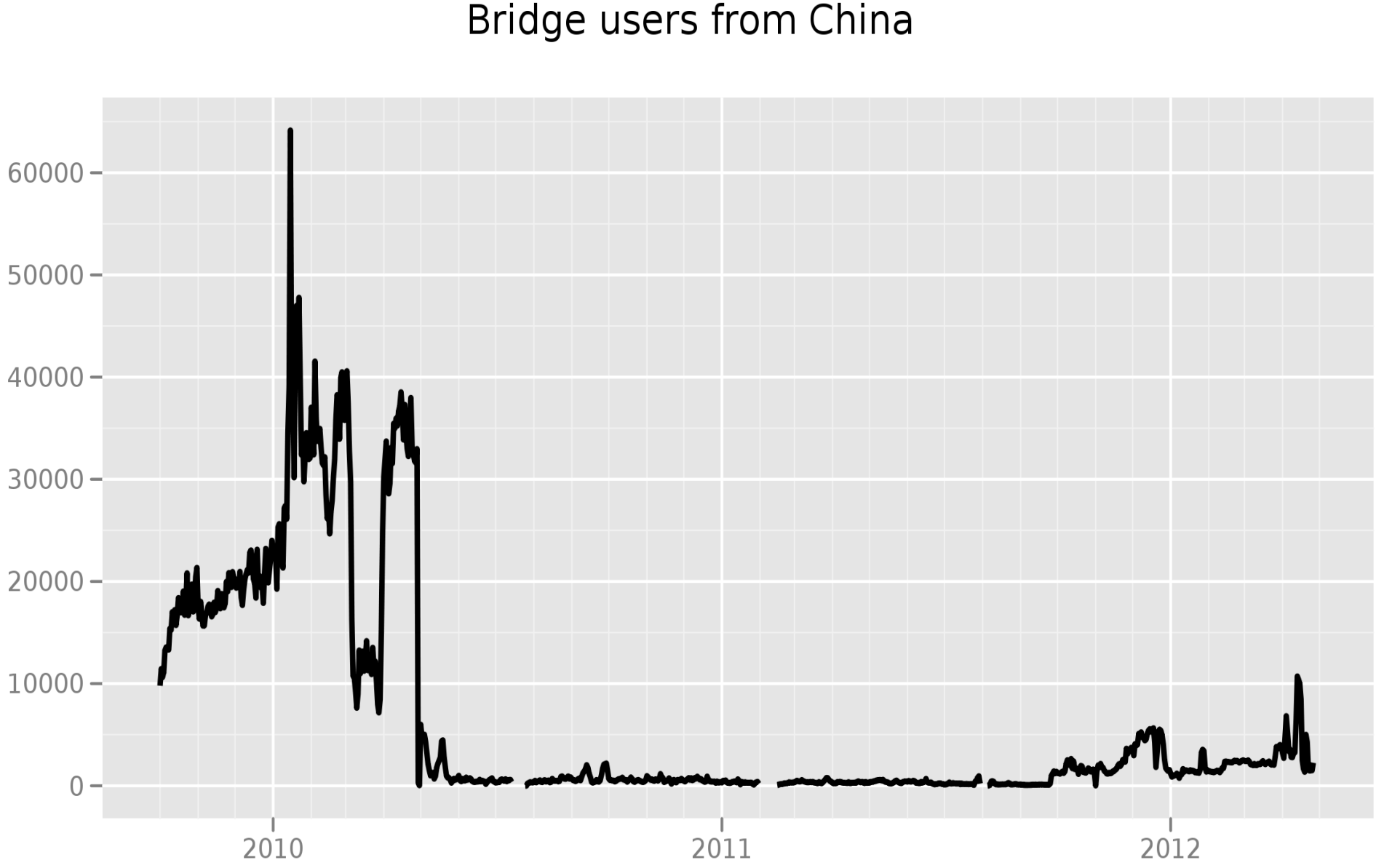

أفا oops
لقد تم منع الدخول إلى هذا الموقع
This site has been blocked
تم إيقاف عملية الدخول الى الموقع الذي تحاول زيارته نظراً لاحتوائه على محتويات محظورة
The web page you are trying to access has been blocked as the content contains prohibited materials
إذا كنت ترى أن هناك خطأ في ذلك - يرجى إرسال رسالة بريد إلكتروني إلى helpdesp.qa
If you feel this is an error then please send


Number of directory requests to directory mirror trusted
10000
8000
6000
4000
2000
0
Sep 10
Sep 17
Sep 24
Oct 01
China
https://torproject.org


Chinese Tor users via bridges
30000
20000
10000
0
Jul
Aug
Sep
Oct
Nov 09

China (March 2010)

- China enumerated the second of our three bridge buckets (the ones available at bridges@torproject.org via Gmail)
- We were down to the social network distribution strategy, and the private bridges

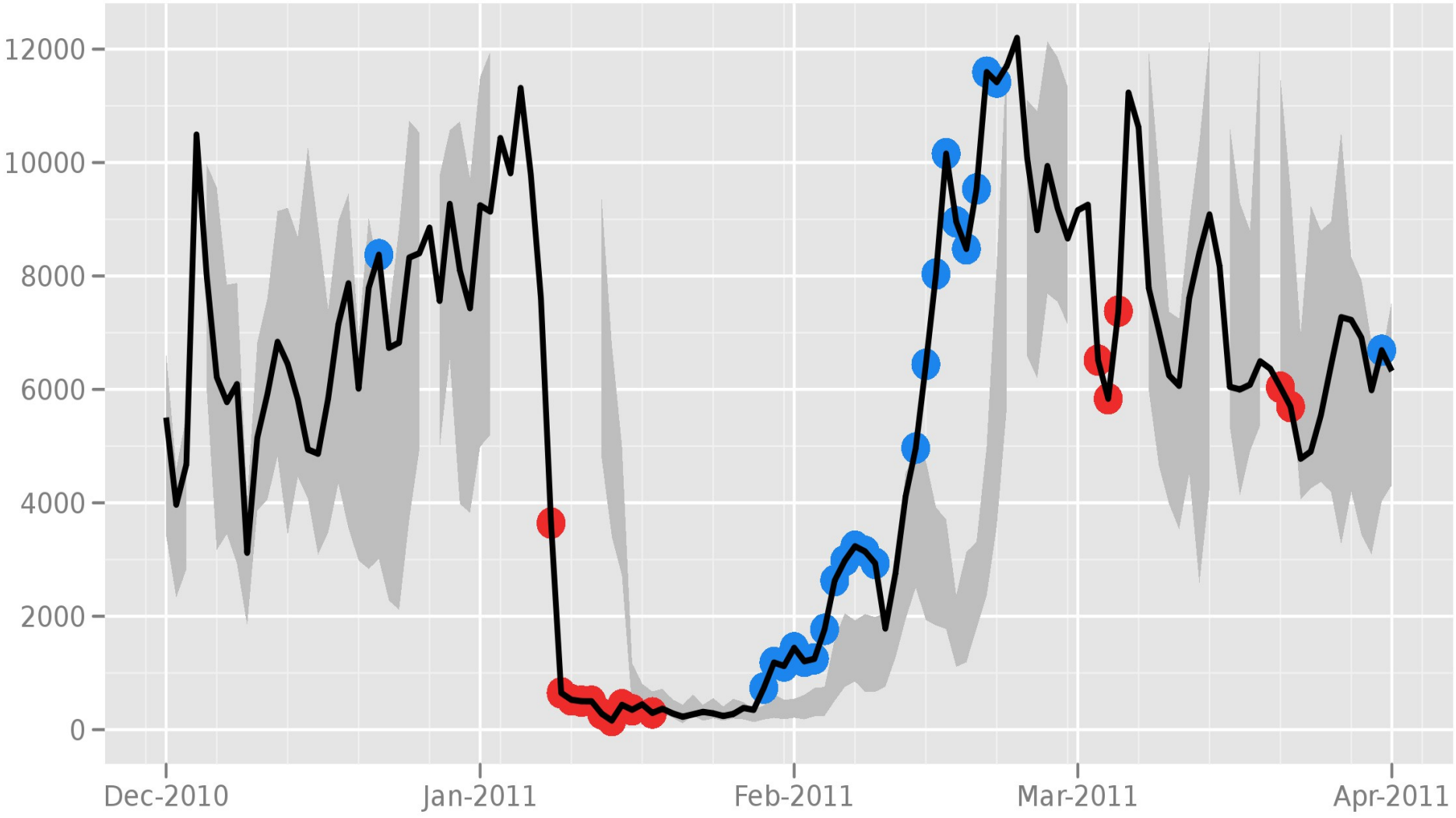


The Tor Project - https://metrics.torproject.org/

Iran (January 2011)

- Iran blocked Tor by DPI for SSL and filtering our Diffie-Hellman parameter.
- The prime p recommended by the DNSSEC RFC is part of a banned class of numbers
- Socks proxy worked fine the whole time (the DPI didn't pick it up)
- DH p is a server-side parameter, so the relays and bridges had to upgrade, but not the clients

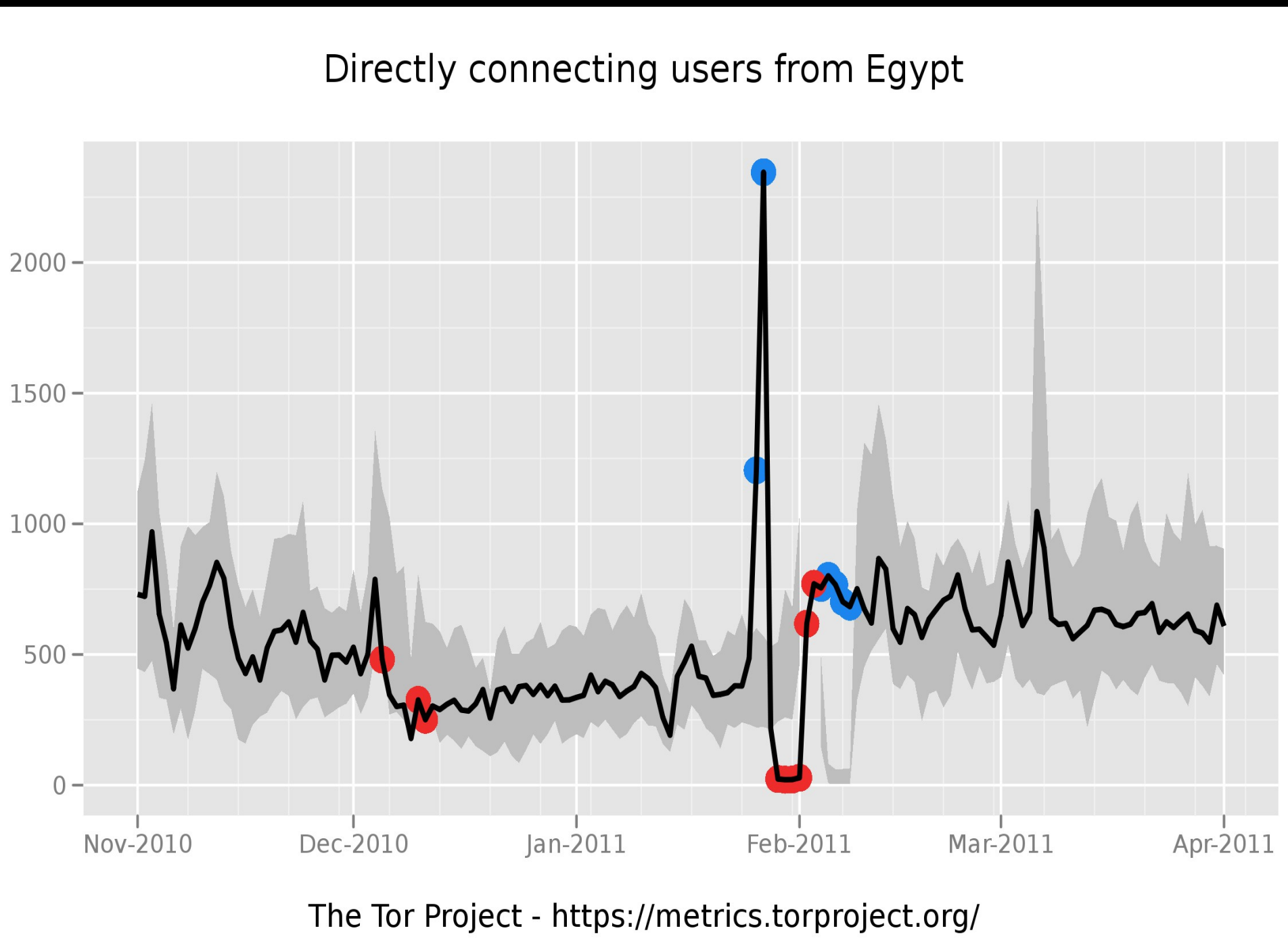
Directly connecting users from the Islamic Republic of Iran



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

Egypt (January 2011)

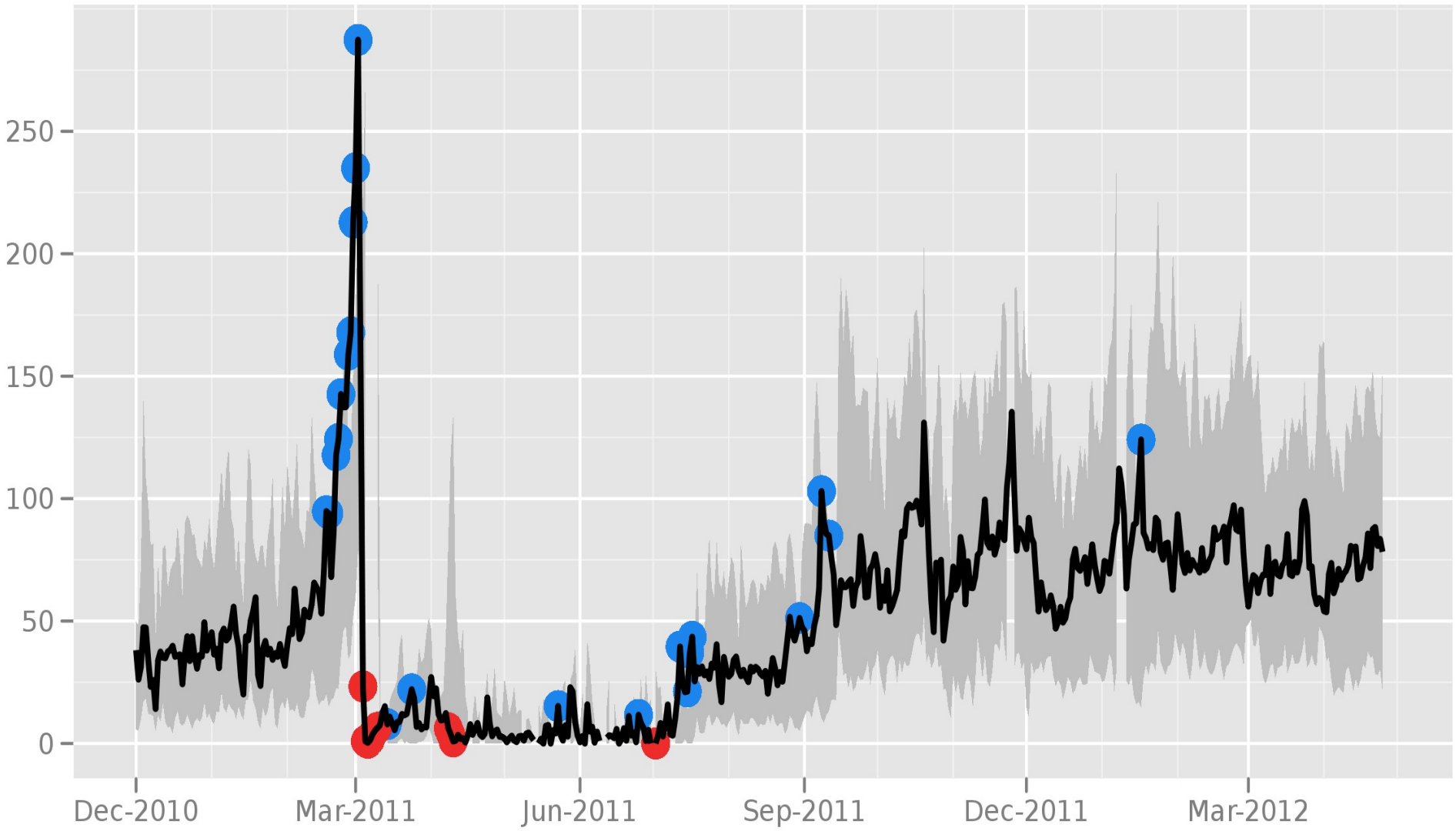
- Egypt selected and targeted sites for blocking
    - Twitter was not entirely blocked but the attempt was good enough
- When Egypt unplugged its Internet, no more Tor either.


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/

Libya (March-July 2011)

- Libya might as well have unplugged its Internet.
- But they did it through throttling, so nobody cared.

Directly connecting users from Libya

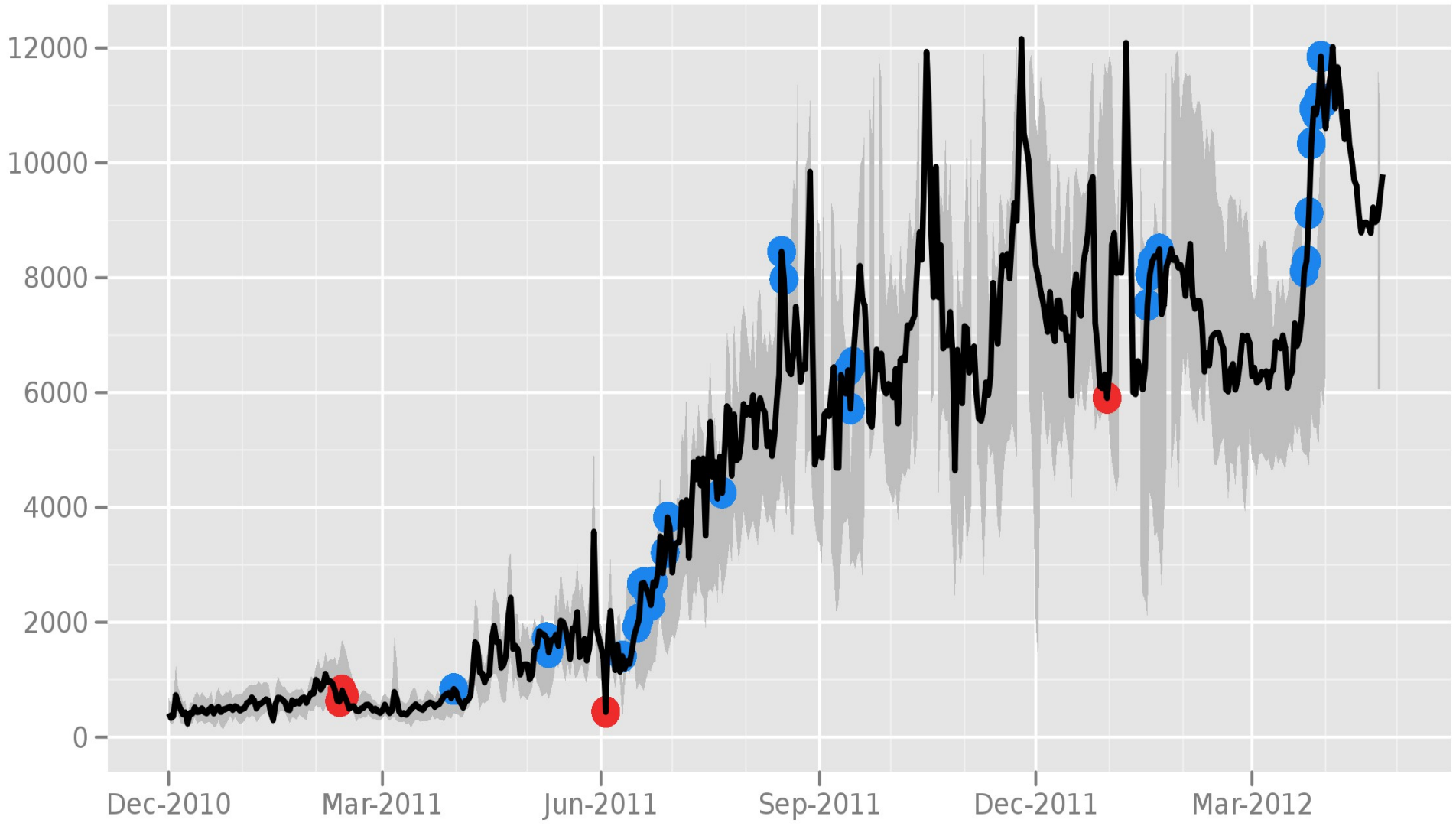


The Tor Project - https://metrics.torproject.org/

Syria (June 2011)

- One ISP briefly DPIed for Tor's TLS renegotiation and killed the connections.
- A week later, that ISP went offline. When it came back, no more Tor filters.
- Who was testing what?

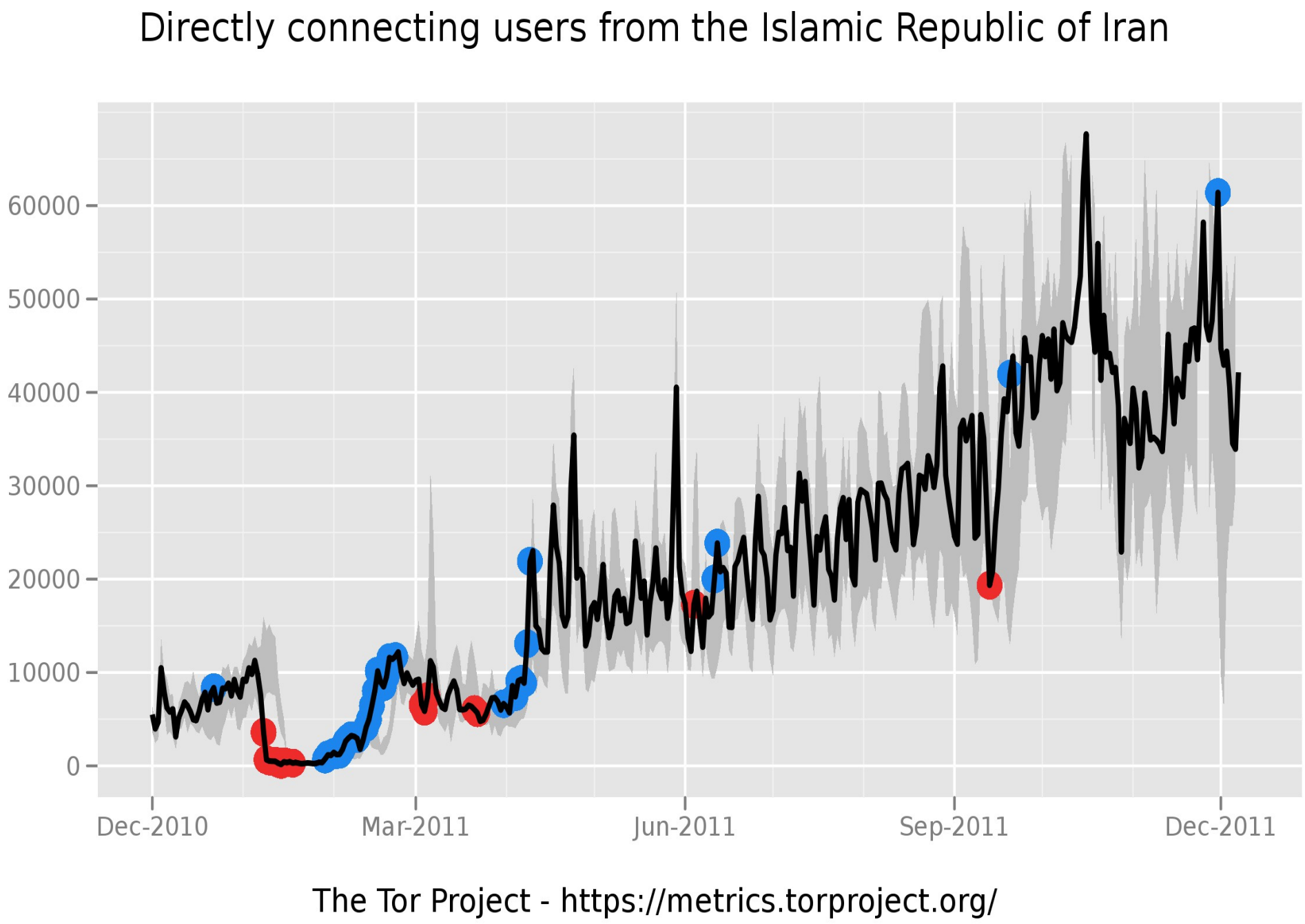
Directly connecting users from the Syrian Arab Republic

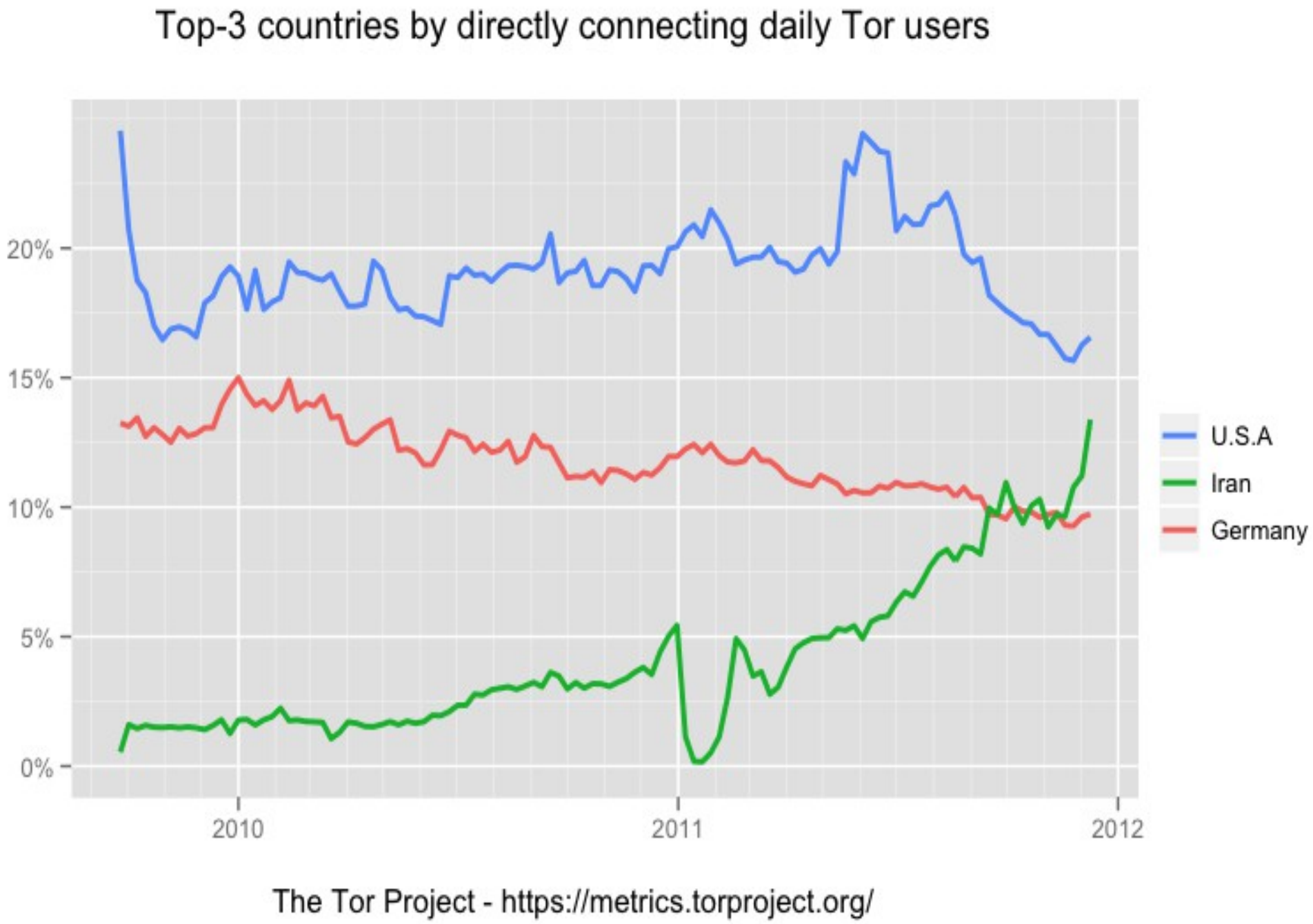


The Tor Project - https://metrics.torproject.org/

Iran (September 2011)

- This time, DPI for SSL and look at our TLS certificate lifetime.
- (Tor rotated its TLS certificates every 2 hours, because key rotation is good, right?)
- Now our certificates last for a year
- These are all low-hanging fruit. How do we want the arms race to go?


Directly connecting users from the Islamic Republic of Iran
60000
50000
40000
30000
20000
10000
0
Dec-2010
Mar-2011
Jun-2011
Sep-2011
Dec-2011
The Tor Project - https://metrics.torproject.org/

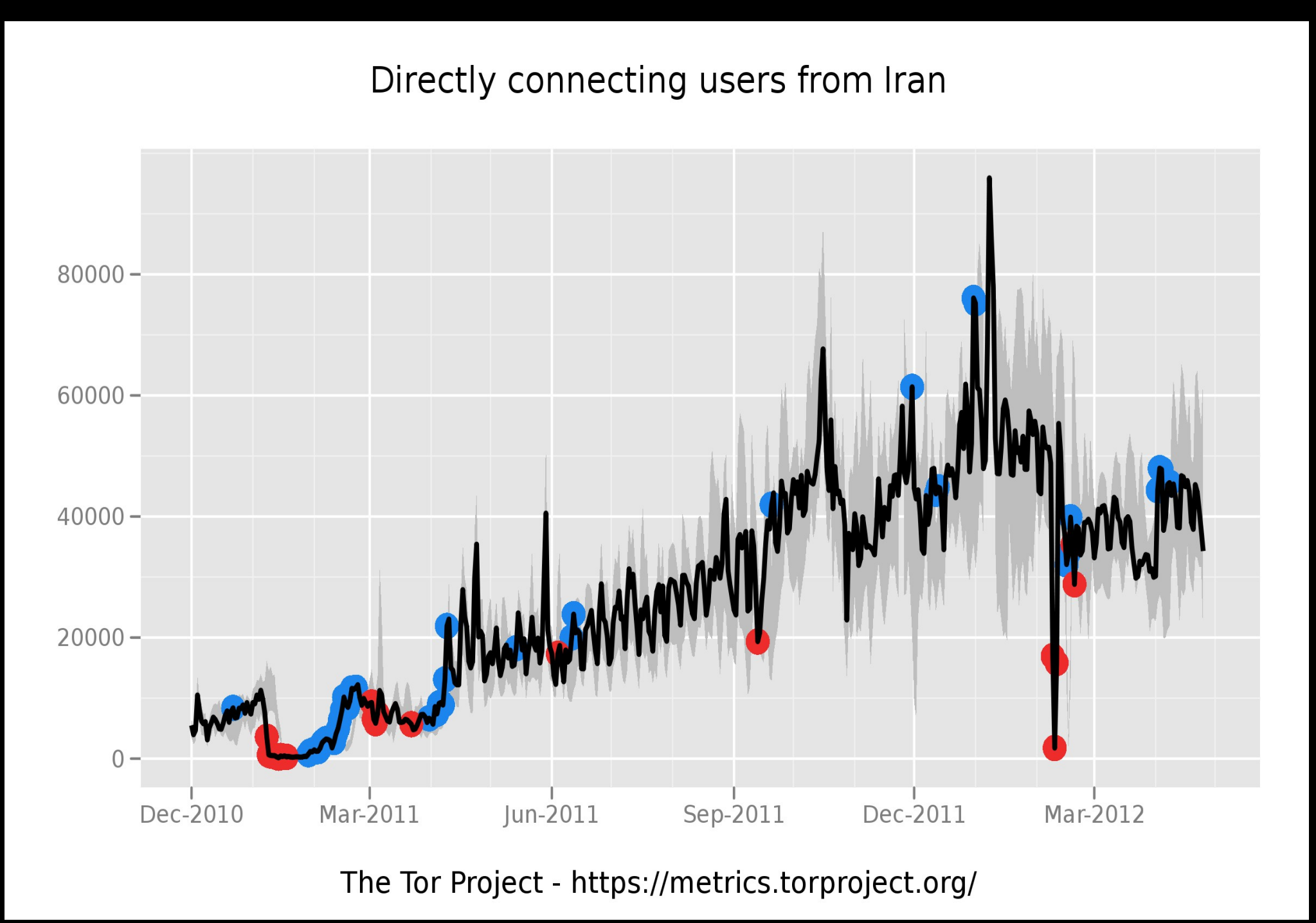

Top-3 countries by directly connecting daily Tor users
20%
15%
10%
5%
0%
2010
2011
2012
U.S.A
Iran
Germany
The Tor Project - https://metrics.torproject.org/

China (October 2011)

- China DPIs for SSL + Tor's ciphersuites, does active follow-up probing that talks the Tor protocol!
- Two avenues to solving it:
    - Change ciphersuite to blend in better
    - Scanning-resistance

Iran (February 2012)

- DPI for all SSL flows and cut them
- No more gmail, facebook, etc etc
- Pluggable transports
    - Obfsproxy
    - SkypeMorph
    - StegoTorus
- Need “obfuscation” metrics?


Directly connecting users from Iran
80000
60000
40000
20000
0
Dec-2010
Mar-2011
Jun-2011
Sep-2011
Dec-2011
Mar-2012
The Tor Project - https://metrics.torproject.org/

What we're up against

Govt firewalls used to be stateless. Now they're buying fancier hardware.

Burma vs Iran vs China

New filtering techniques spread by commercial (American) companies :(

Tor's safety comes from diversity

- #1: Diversity of relays. The more relays we have and the more diverse they, 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.

Only a piece of the puzzle

Assume the users aren't attacked by their hardware and software

No spyware installed, no cameras watching their screens, etc

Users can fetch a genuine copy of Tor?

BridgeDB needs a feedback cycle

- Measure how much use each bridge sees
- Measure bridge blocking
- Then adapt bridge distribution to favor efficient distribution channels
- (Need to invent new distribution channels)


I CAN HAZ
FREEDOM?
TorProject.org

Next steps

Technical solutions won't solve the whole censorship problem. After all, firewalls are *socially* very successful in these countries.

But a strong technical solution is still a critical puzzle piece.

You should run a relay! Non-exit relays are easy and safe to set up.