Tor: a quick overview

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The Tor Project
https://torproject.org/

What is Tor?

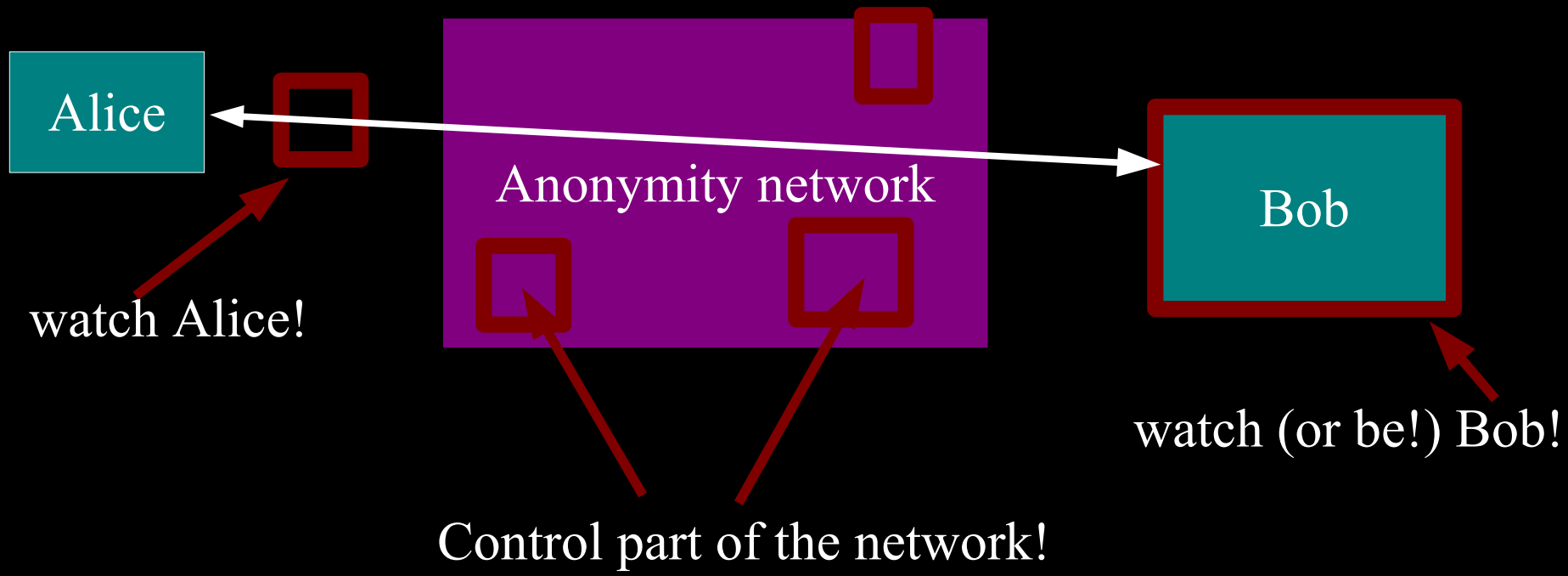
- Online anonymity software and network
- Open source, freely available
- Community of researchers, developers, users, and relay operators

The Tor Project, Inc.

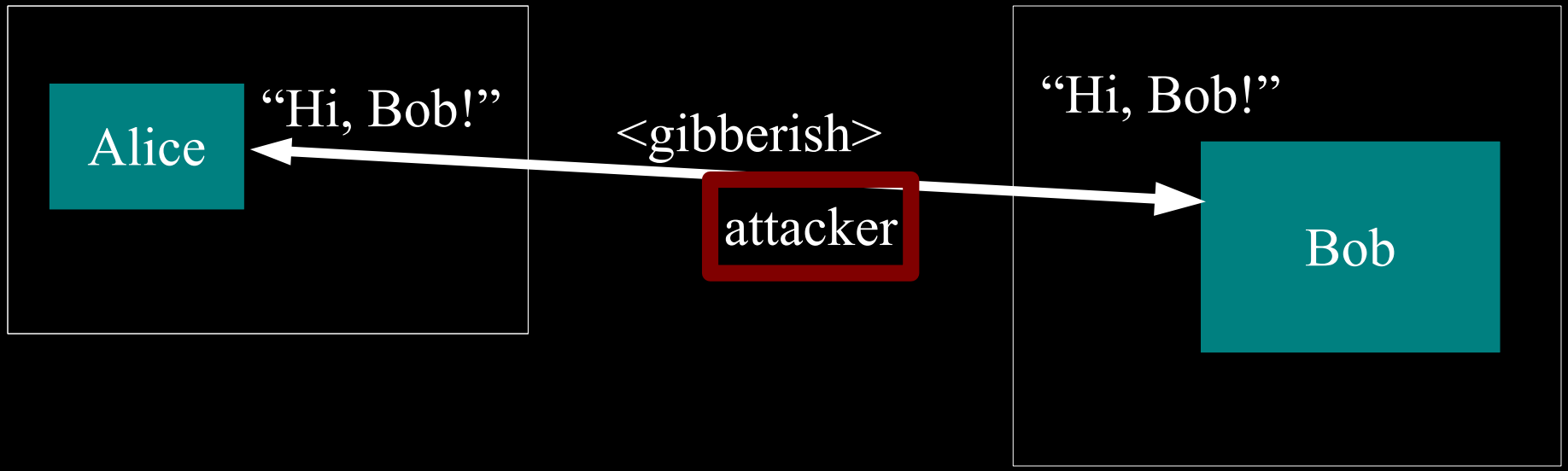
- 501(c)(3) non-profit organization dedicated to the research and development of tools for online anonymity and privacy


Estimated 300,000
daily Tor users

Threat model: what can the attacker do?



Anonymity isn't cryptography: Cryptography just protects contents.



Anonymity isn't just wishful thinking...

“You can't prove it was me!”

“Promise you won't look!”

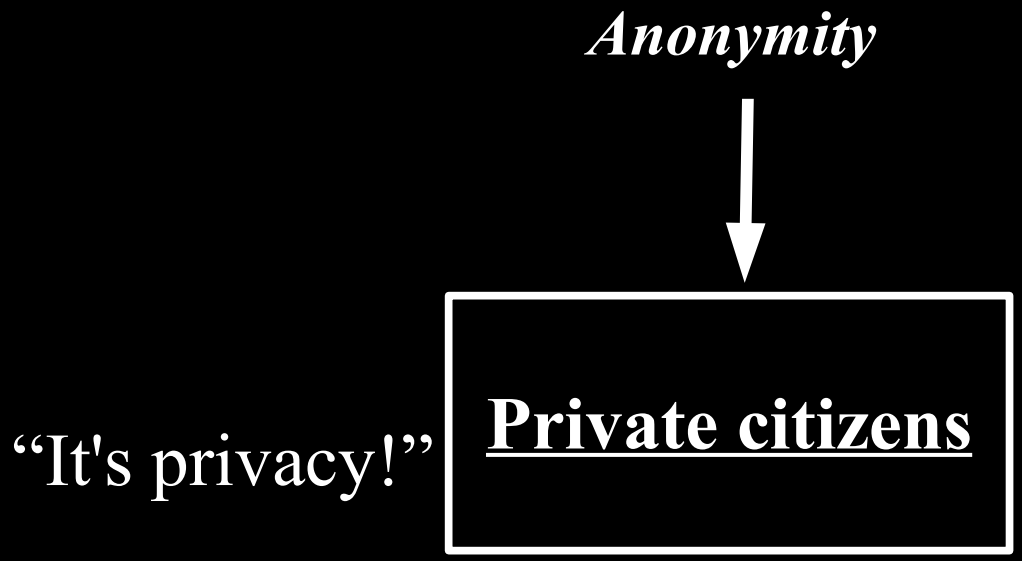
“Promise you won't remember!”

“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.



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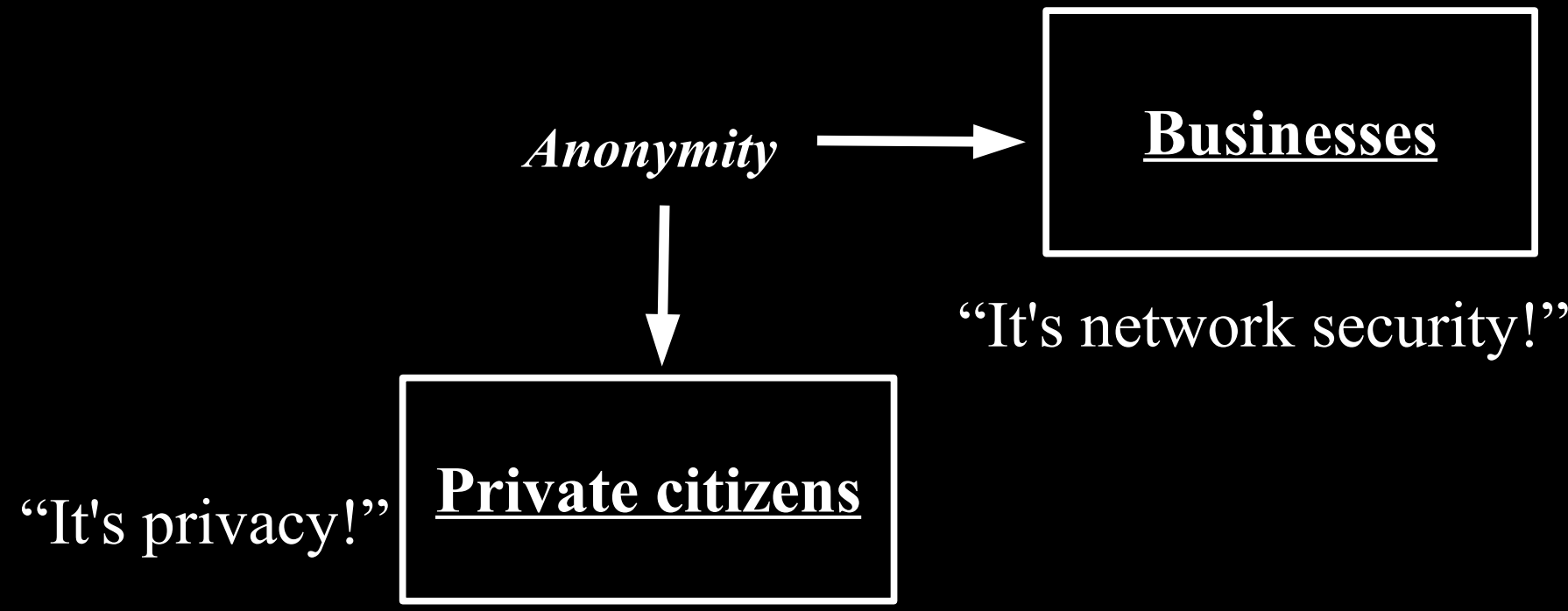

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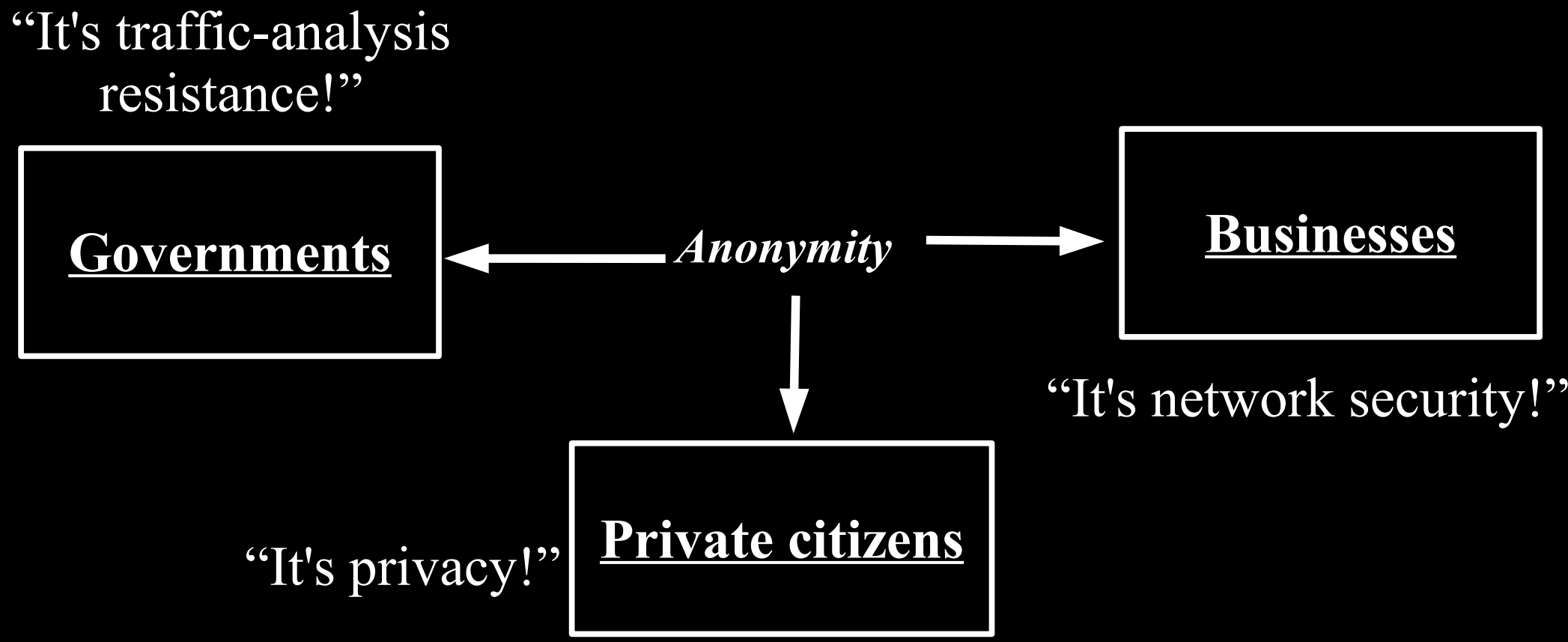

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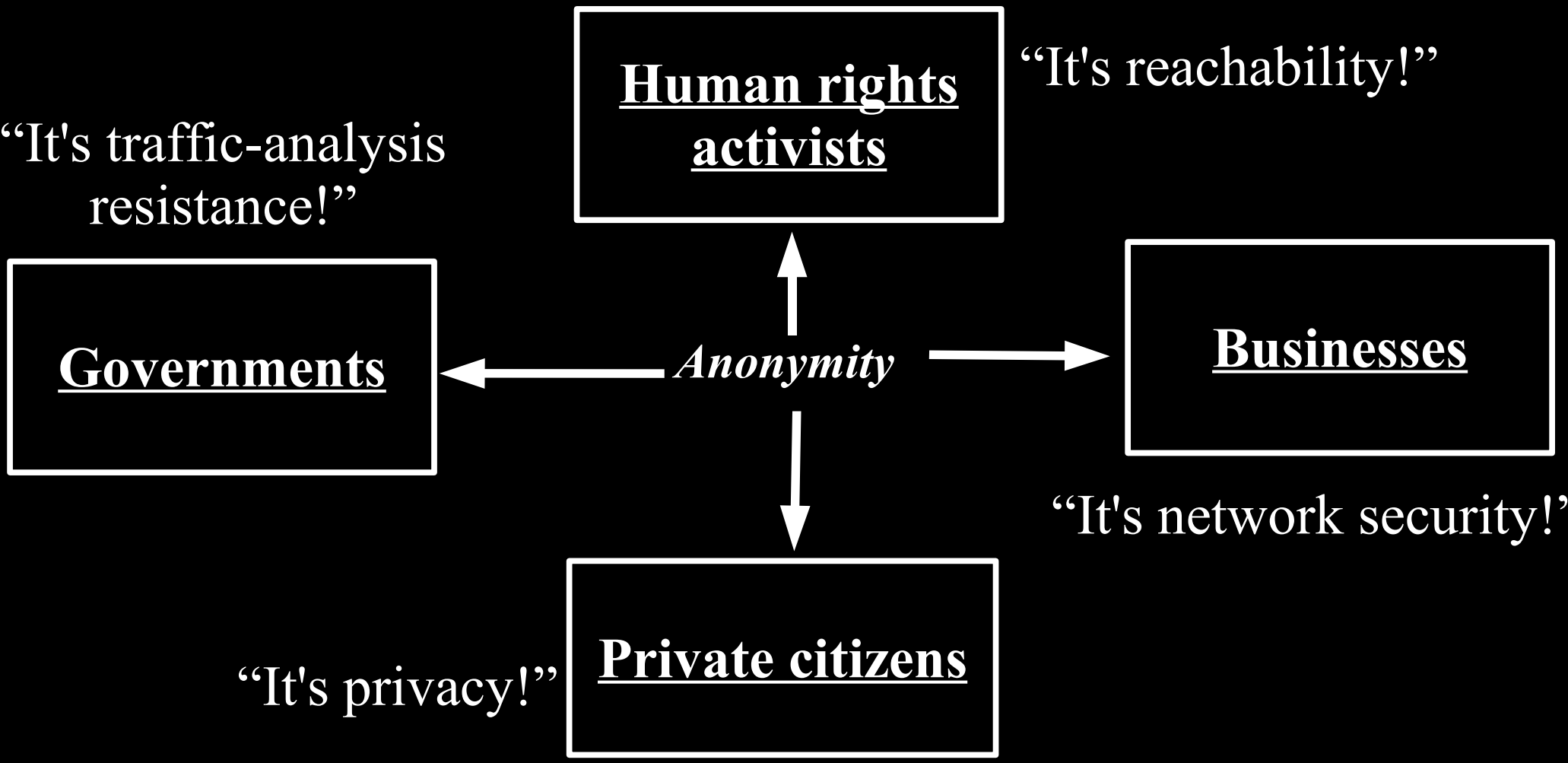
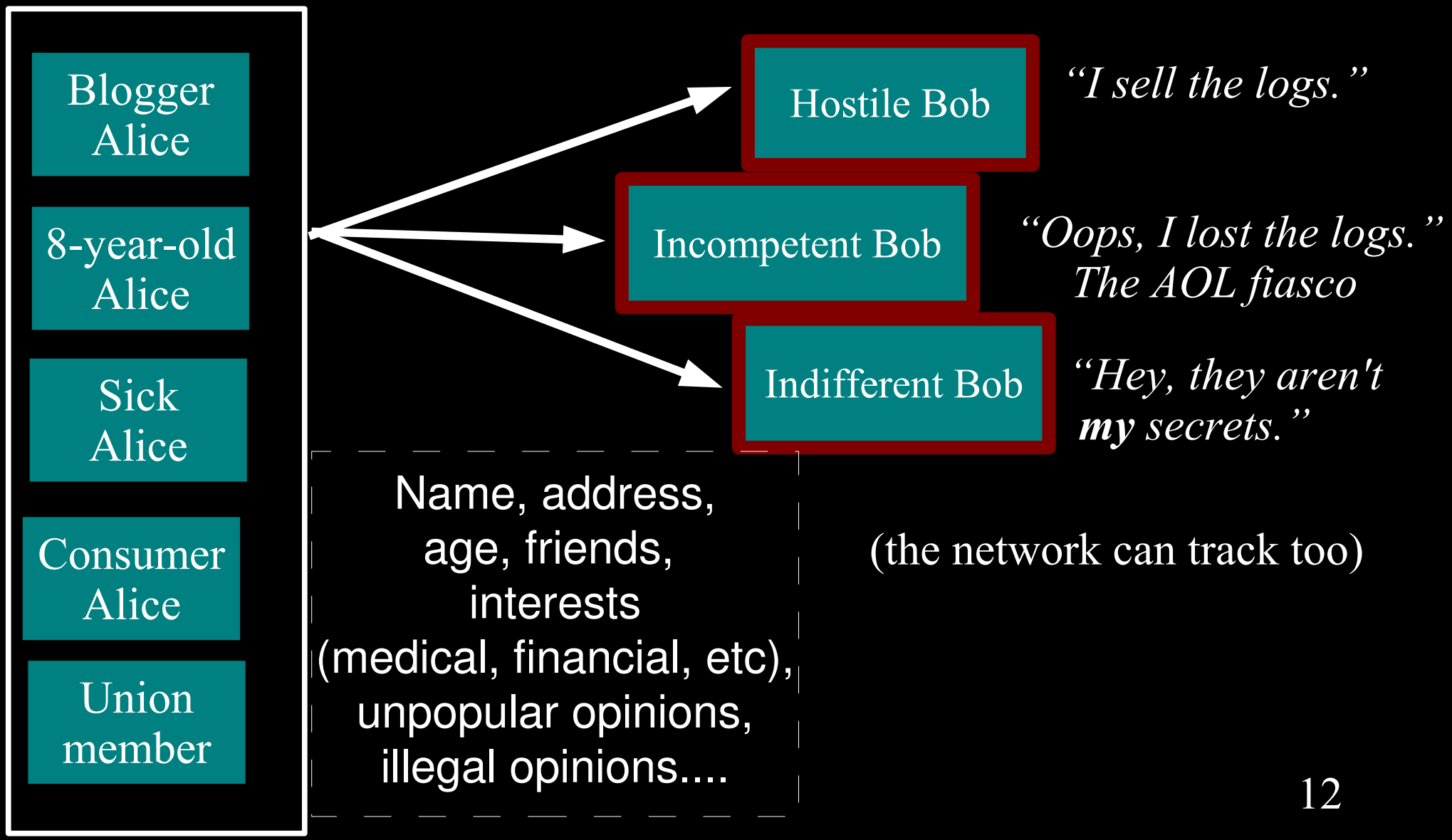
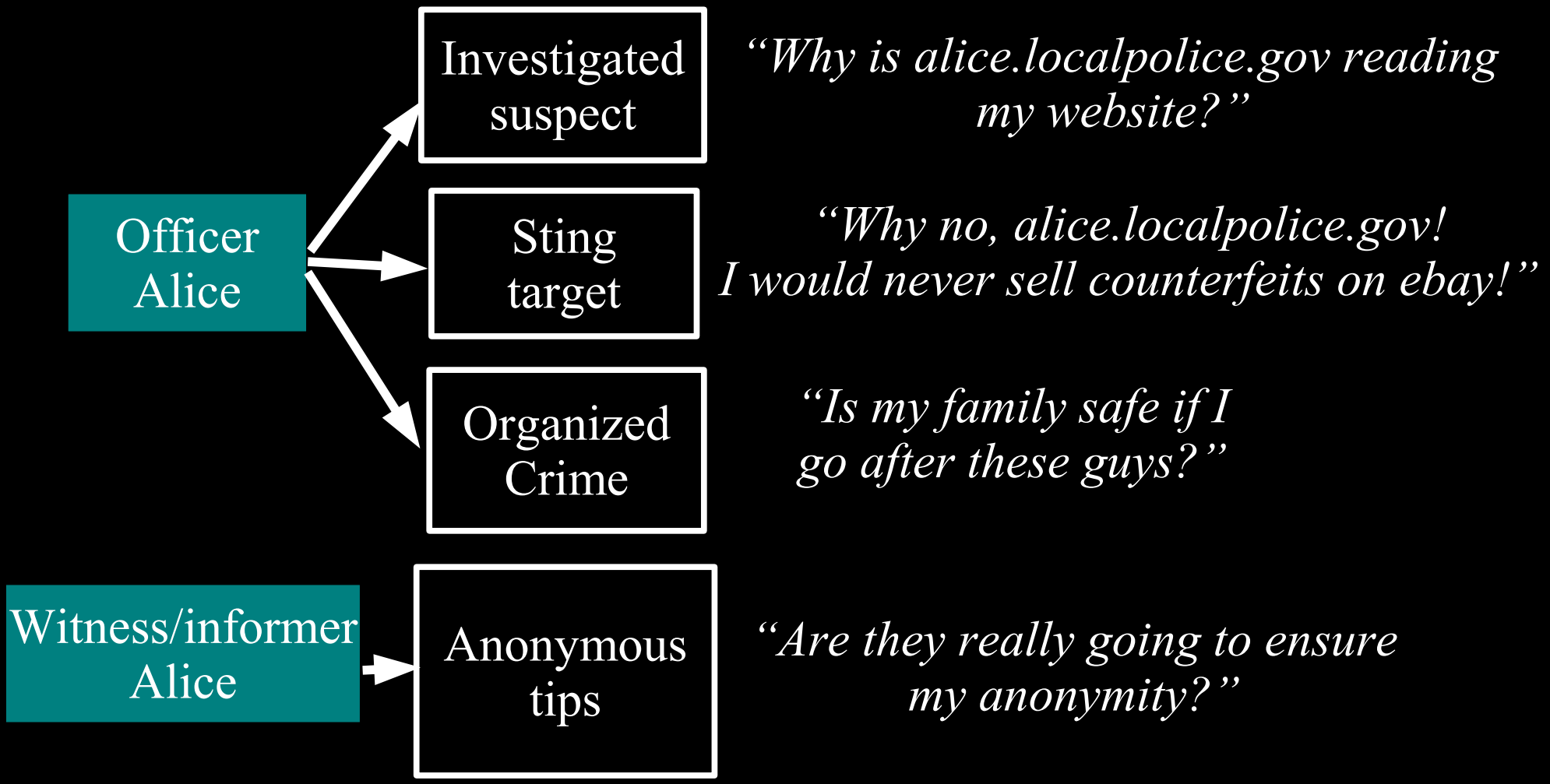


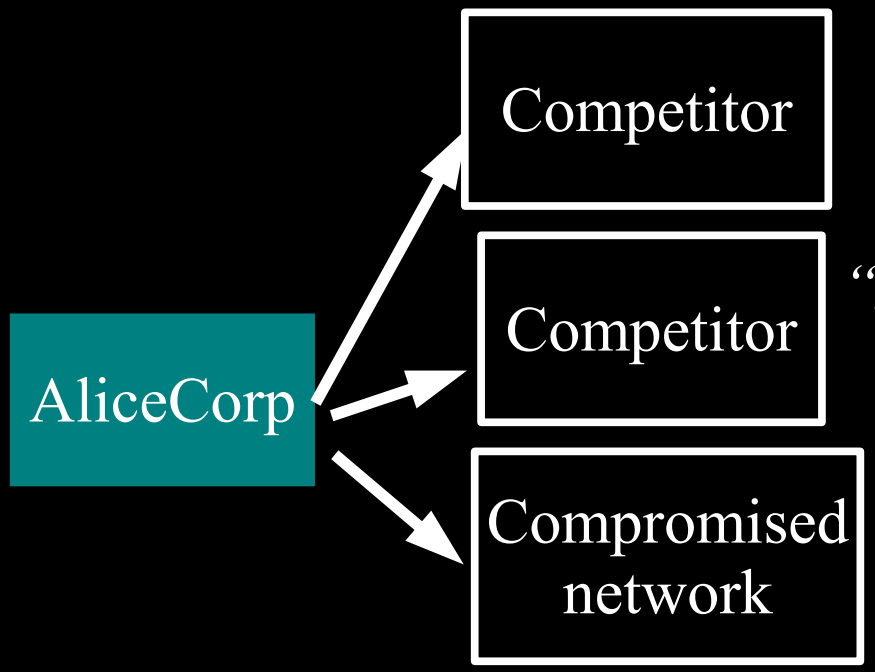
Regular citizens don't want to be watched and tracked.



Law enforcement needs anonymity to get the job done.



Businesses need to protect trade secrets ... and their customers

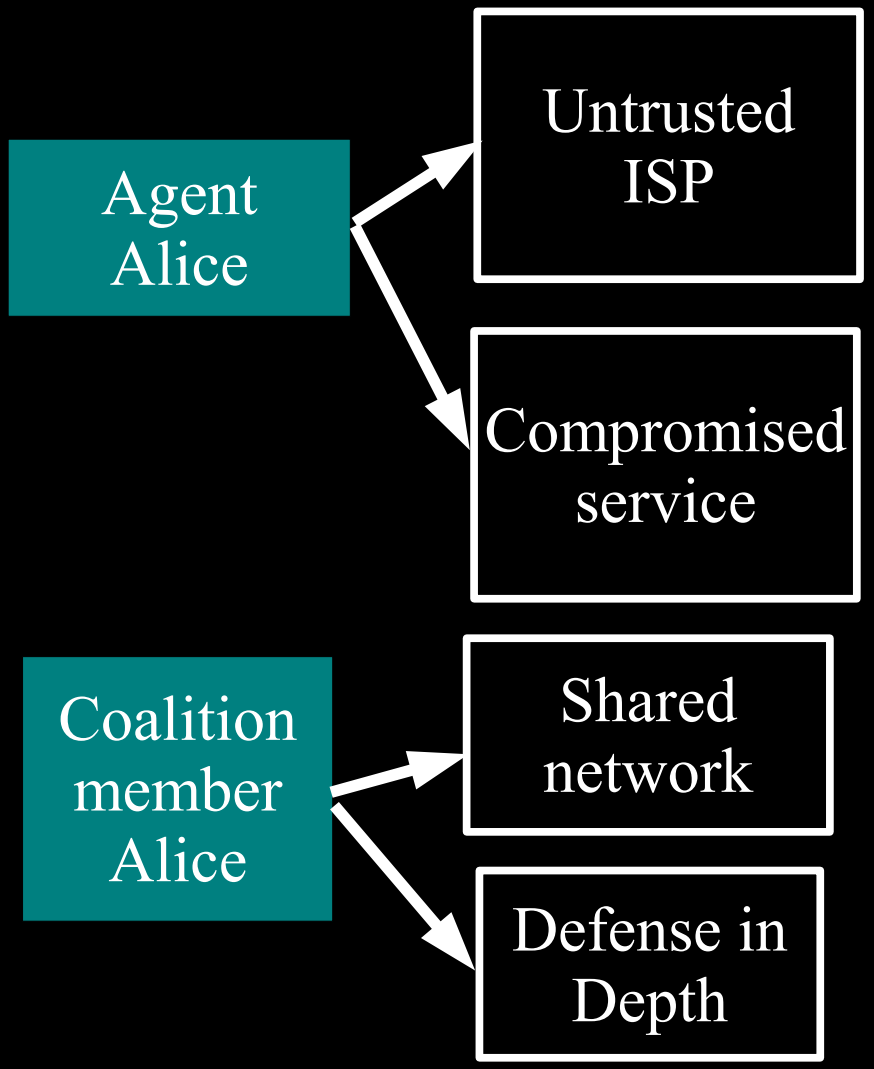


"Oh, your employees are reading our patents/jobs page/product sheets?"

"Hey, it's Alice! Give her the 'Alice' version!"

"Wanna buy a list of Alice's suppliers? What about her customers? What about her engineering department's favorite search terms?"

Governments need anonymity for their security



"What will you bid for a list of Baghdad IP addresses that get email from .gov?"

"Somebody in that hotel room just checked his Navy.mil mail!"

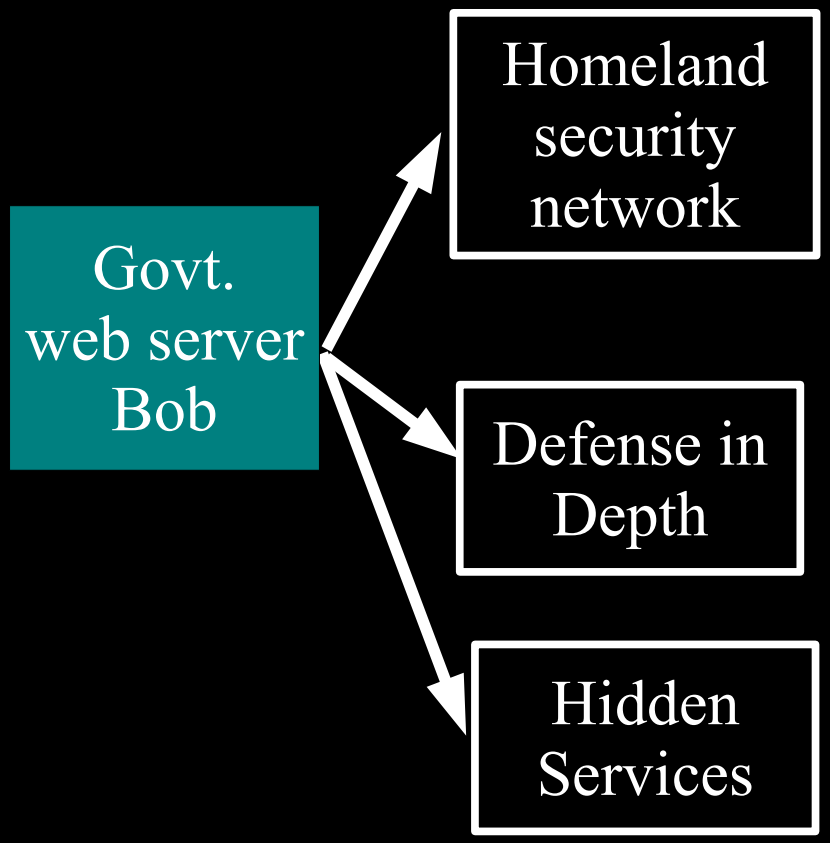
"*What* does *FBI Google for?*"

"Do I really want to reveal my internal network topology?"

"Do I want all my partners to know extent/pattern of my comms with other partners?

"What about insiders?"

Governments need anonymity for their security



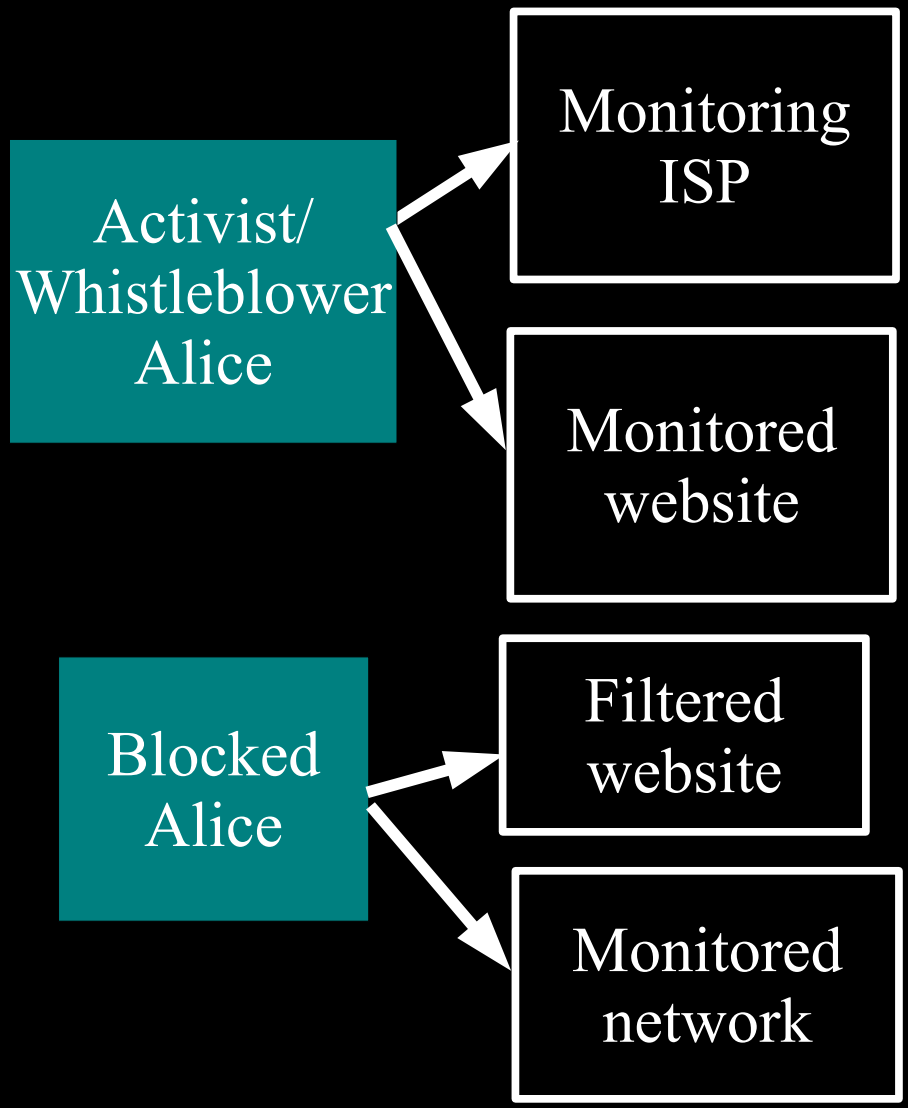
"How can I securely and quickly exchange vital info with every sheriff's dept and Hazmat transporter without bringing them into my secure network?

"Do I want every SIPRNET node to know where all the traffic on it is headed?"

"Can I hide where my MLS chat server/my automated regrader is?"

Can my servers resist DDoS and physical attack even by authorized users?"

Journalists and activists need Tor for their personal safety

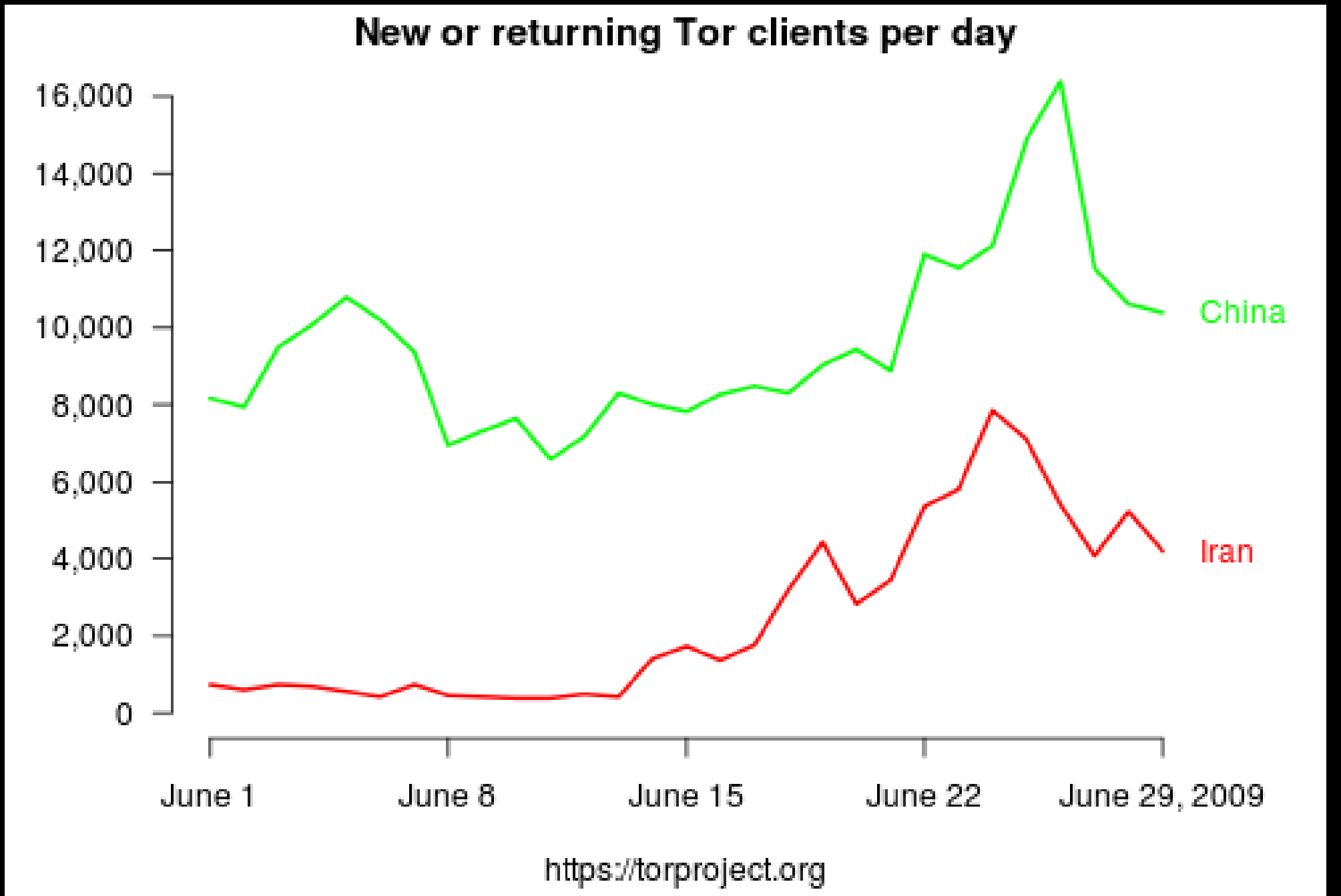


"Did you just post to that website?"

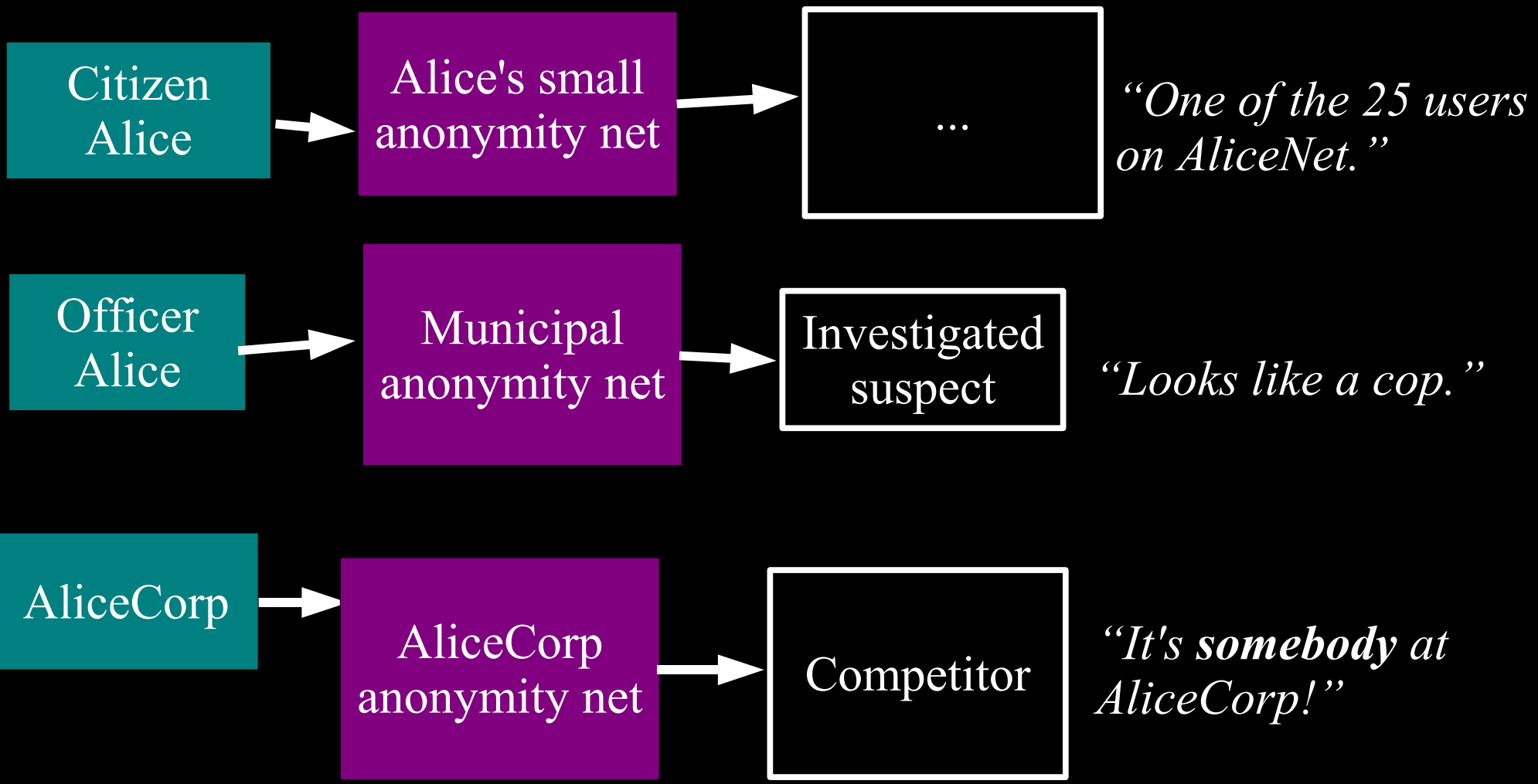
"Where are the bloggers connecting from?"
"I run livejournal and track my users"
"Of course I tell China about my users"

"What does the Global Voices website say today?"
"I want to tell people what's going on in my country"

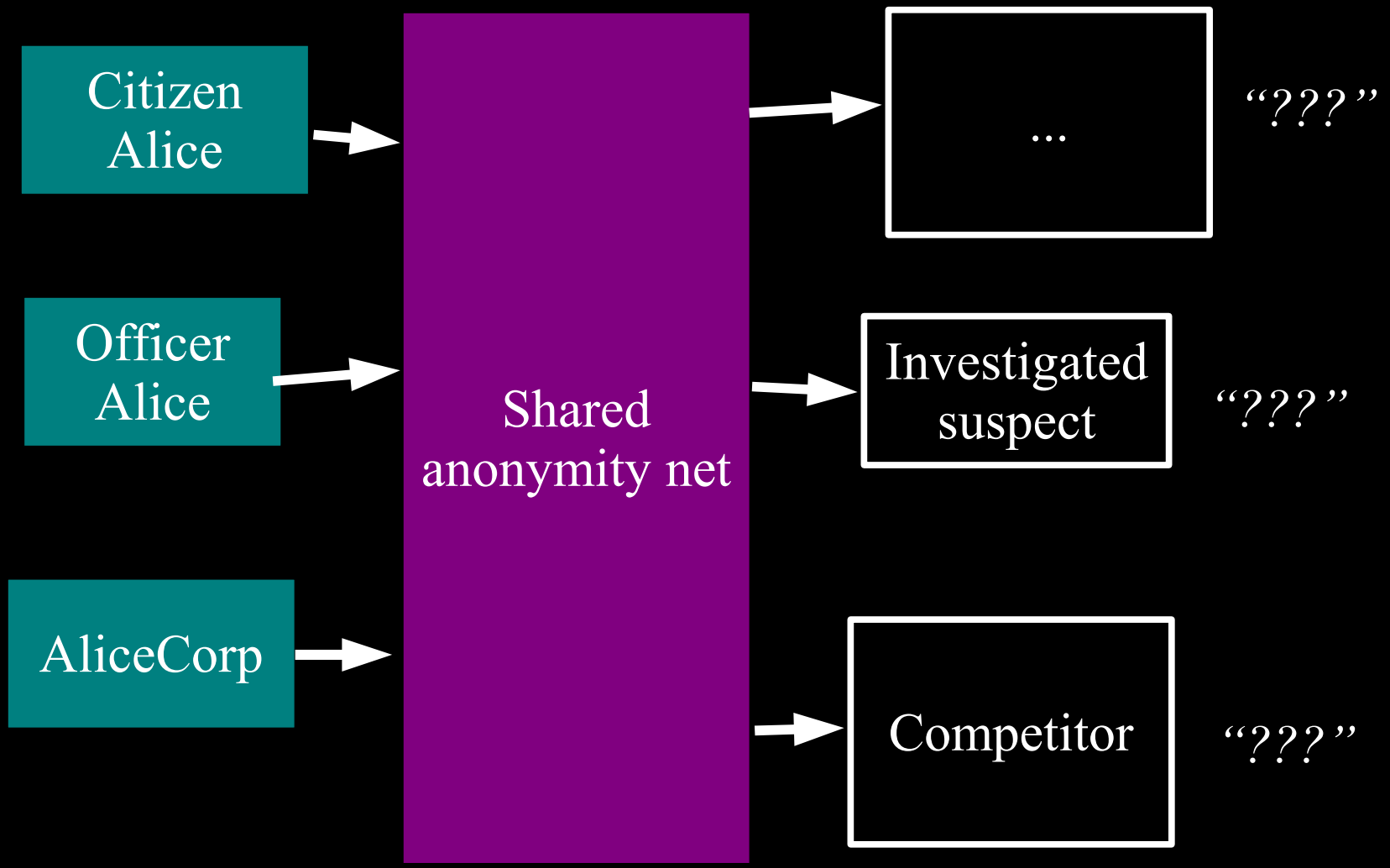
"I think they're watching. I'm not even going to try."


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

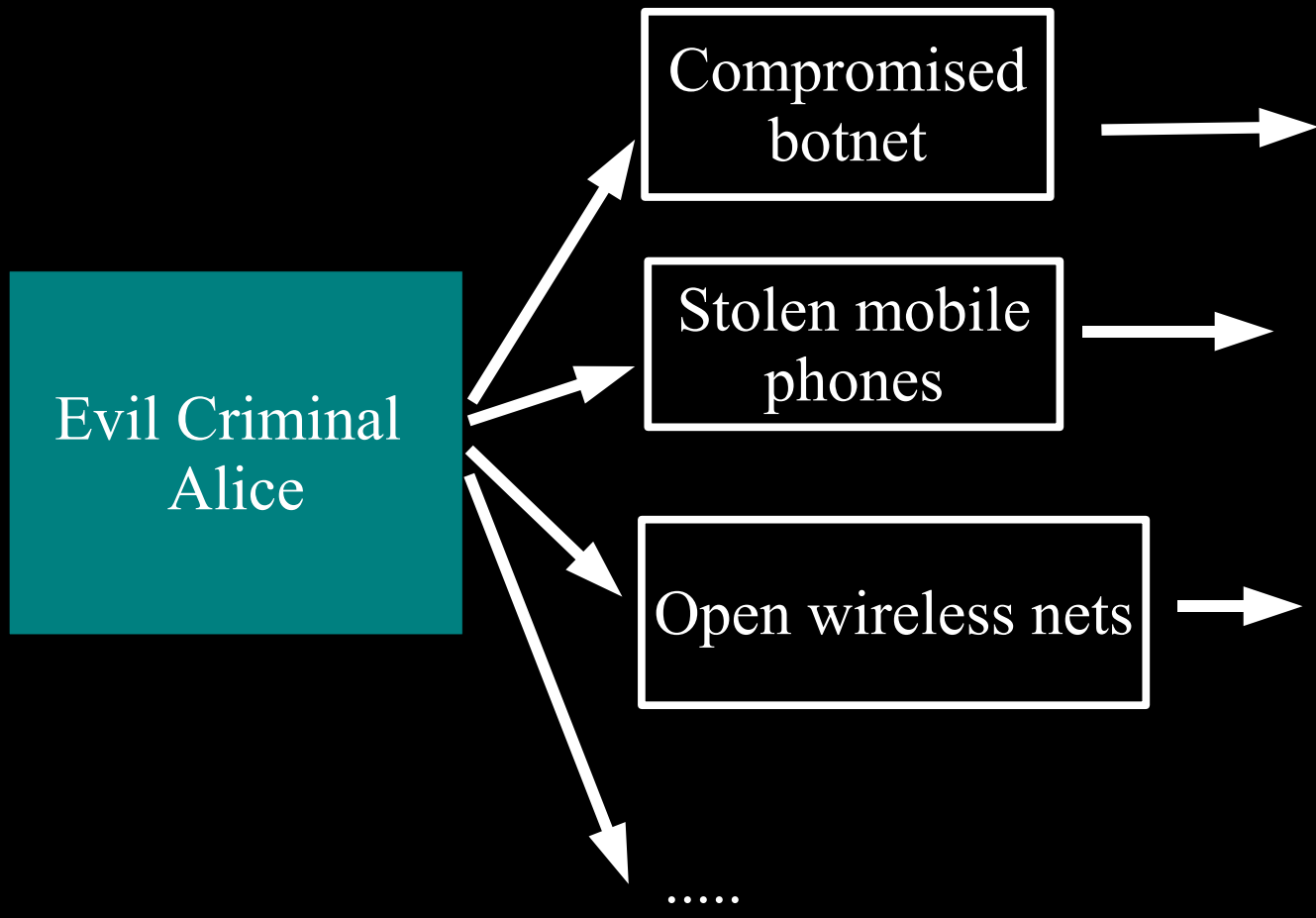
You can't get anonymity on your own: private solutions are ineffective...



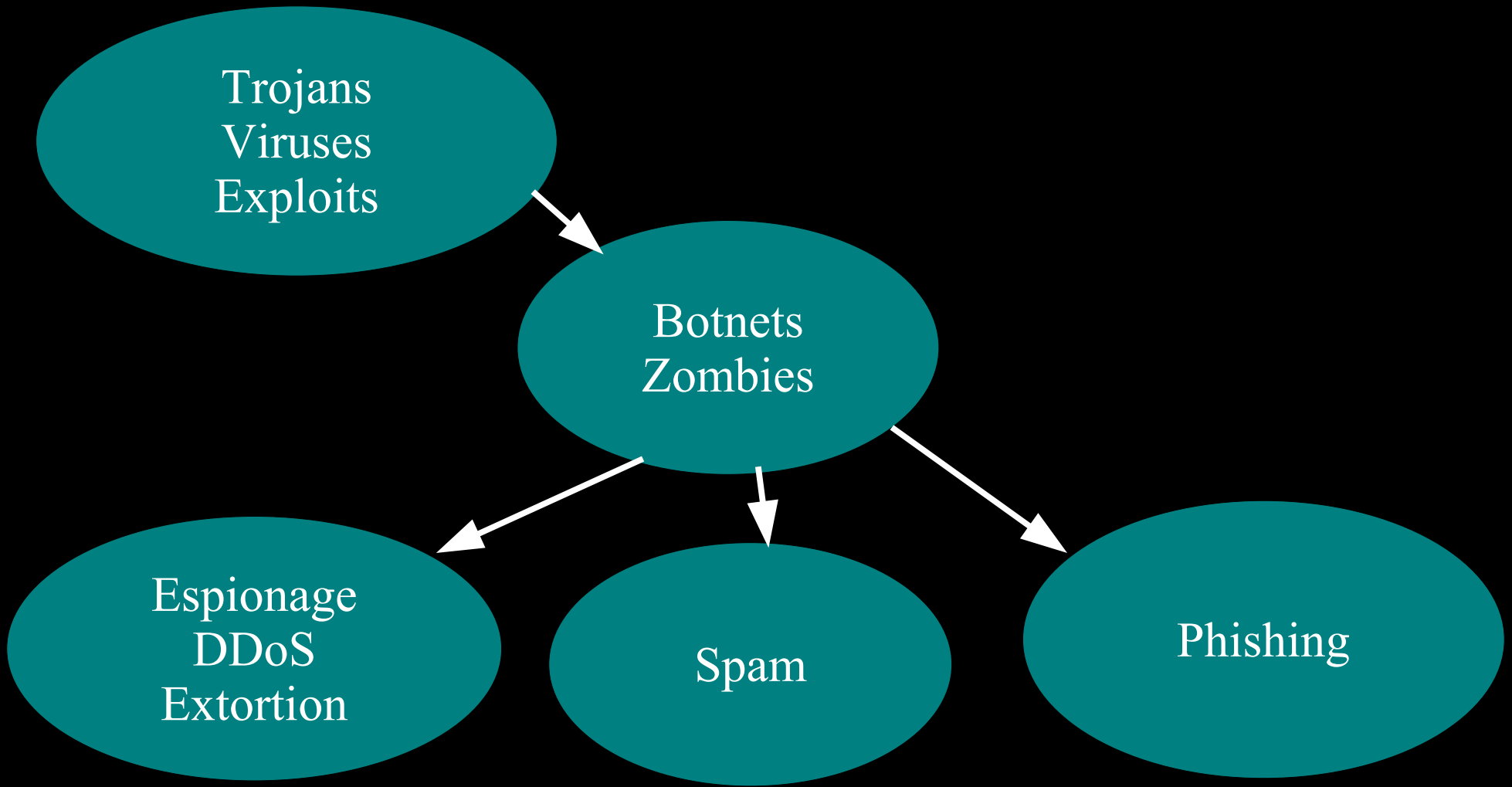
... so, anonymity loves company!



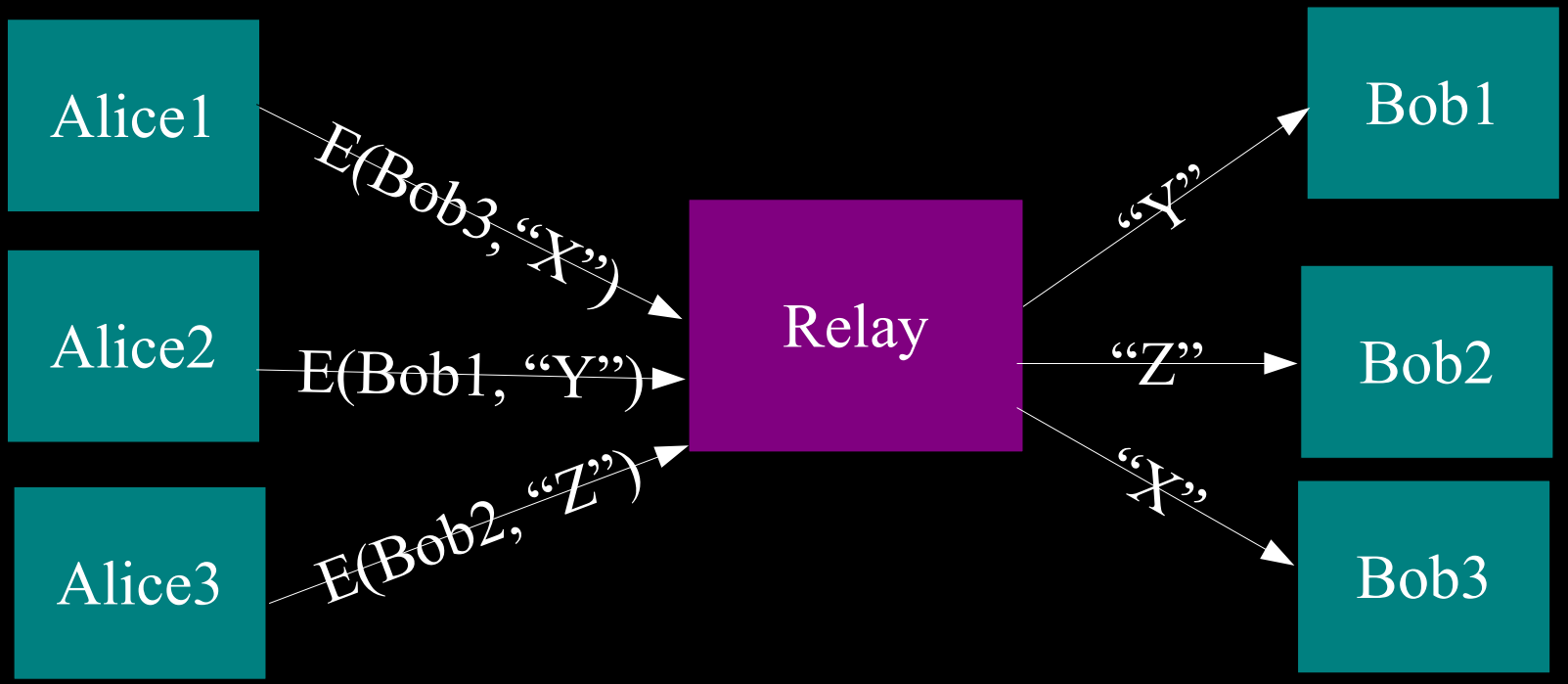
Yes, bad people need anonymity too. But they are *already* doing well.



Current situation: Bad people on the Internet are doing fine

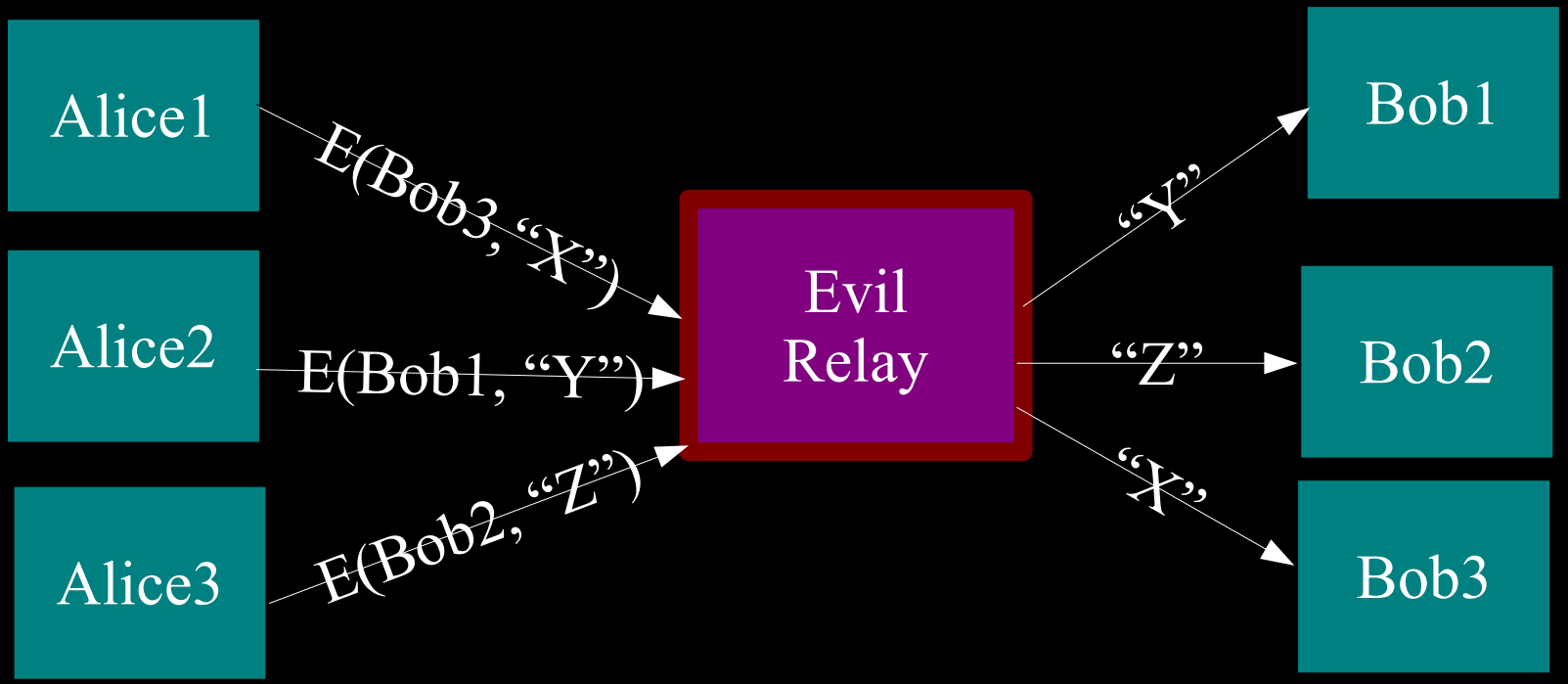


The simplest designs use a single relay to hide connections.

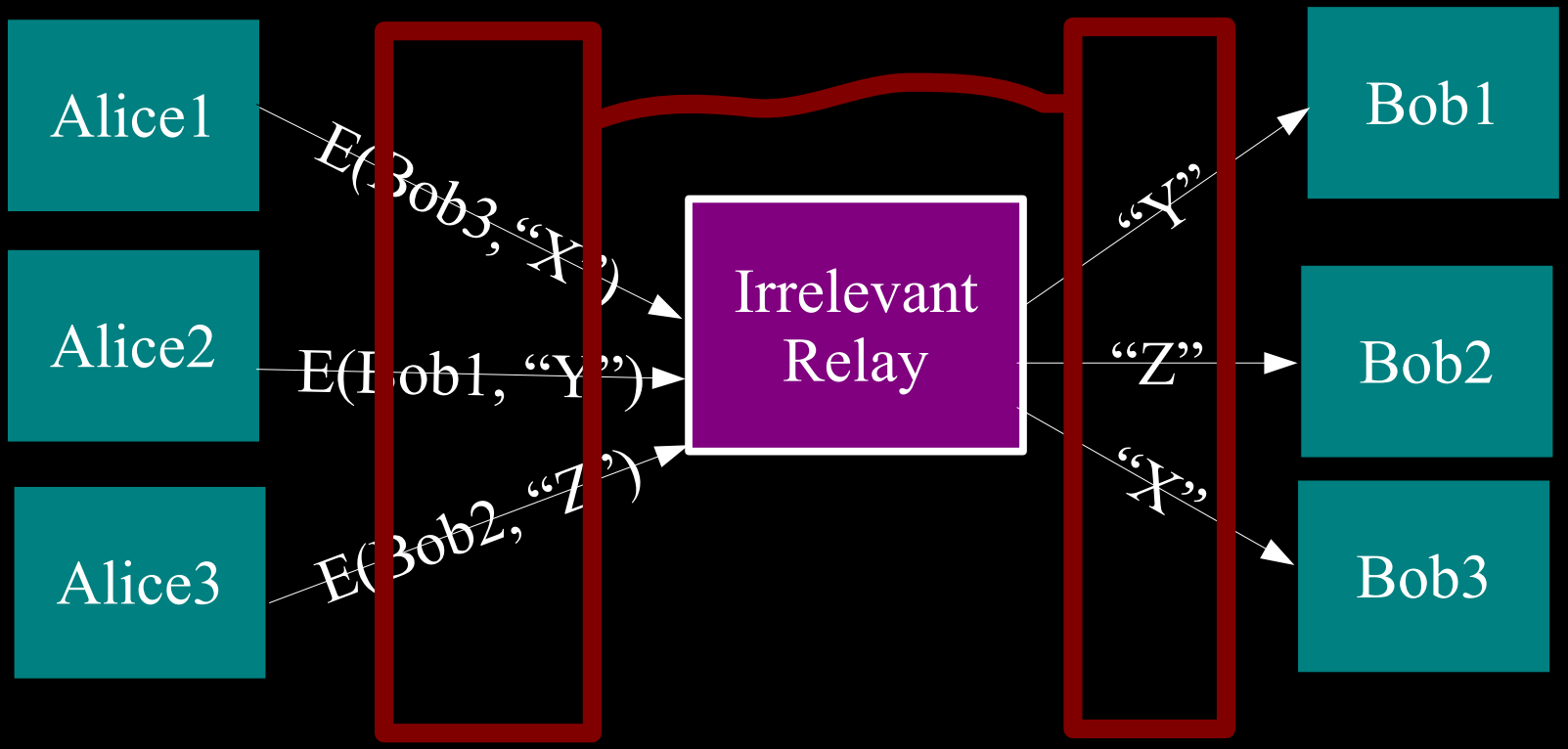


(example: some commercial proxy providers)

One relay is a single point of failure.

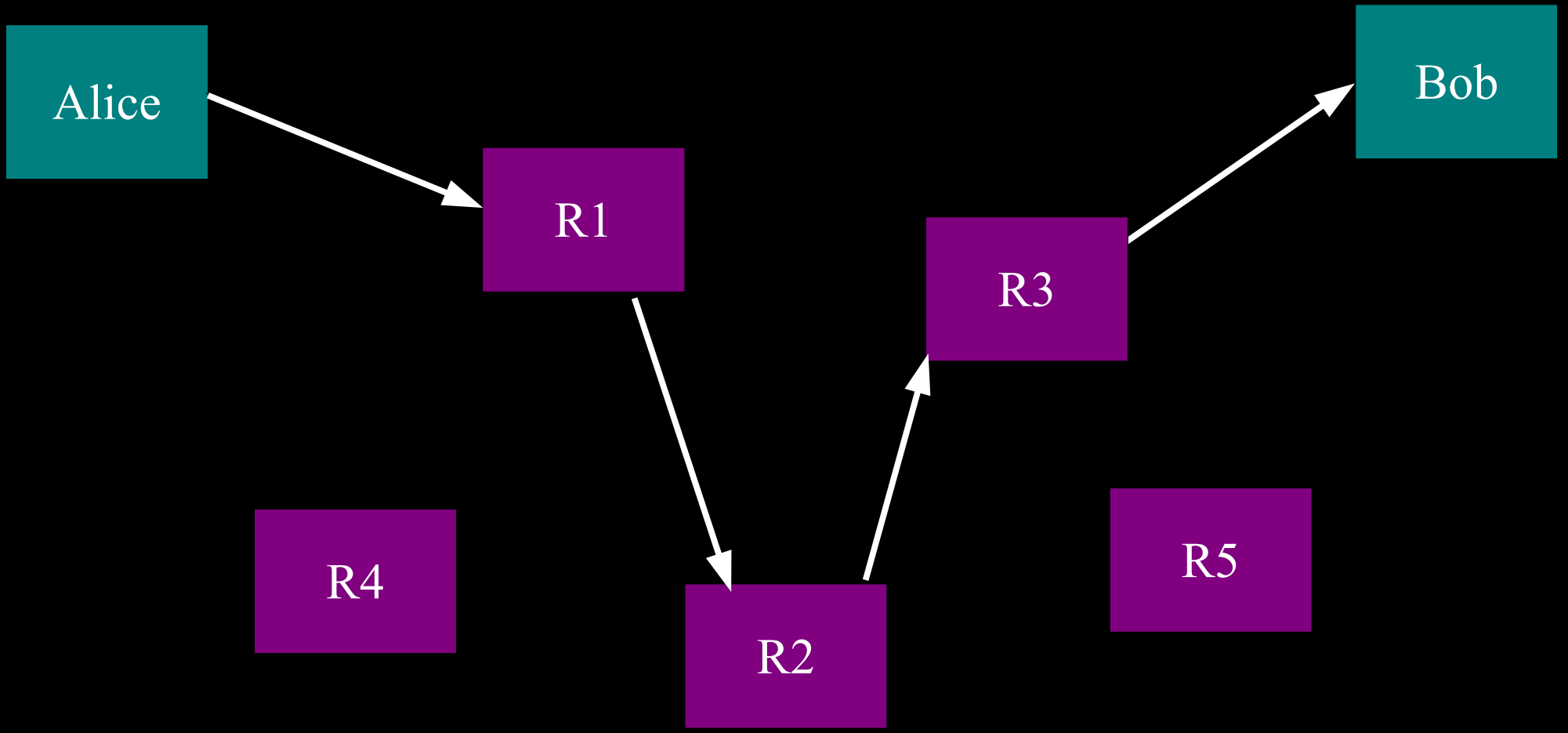


... or a single point of bypass.

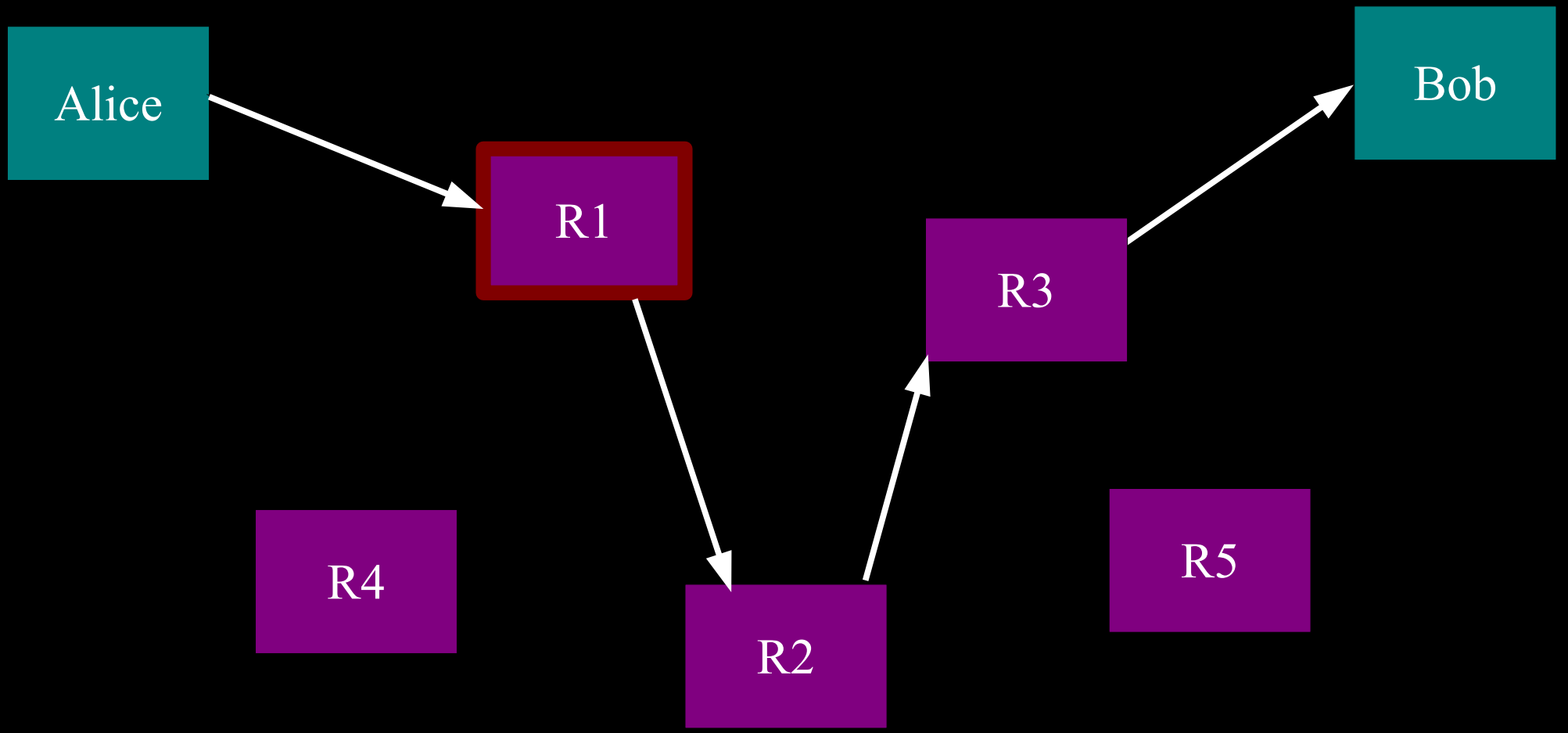


Timing analysis bridges all connections through relay ⇒ An attractive fat target

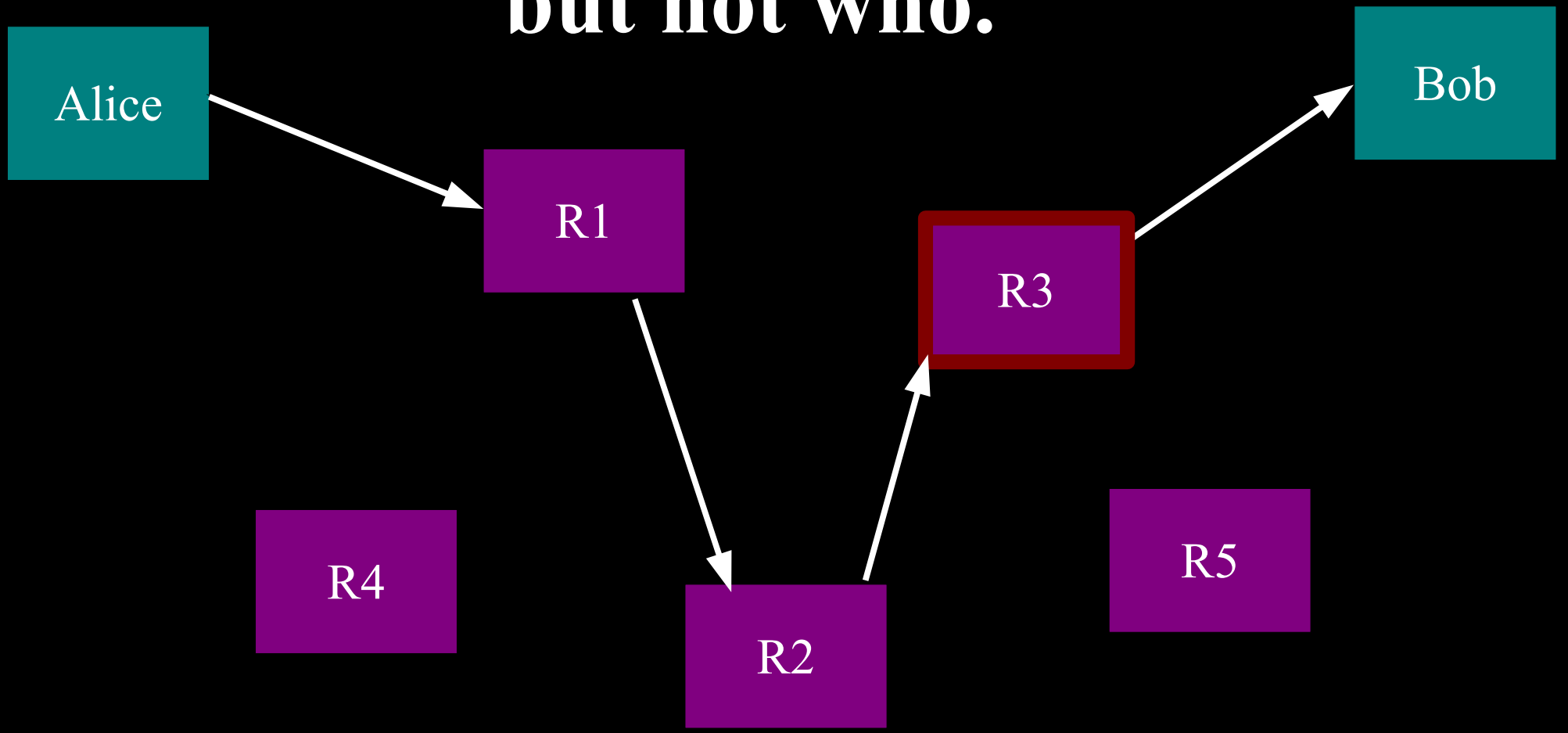
So, add multiple relays so that no single one can betray Alice.



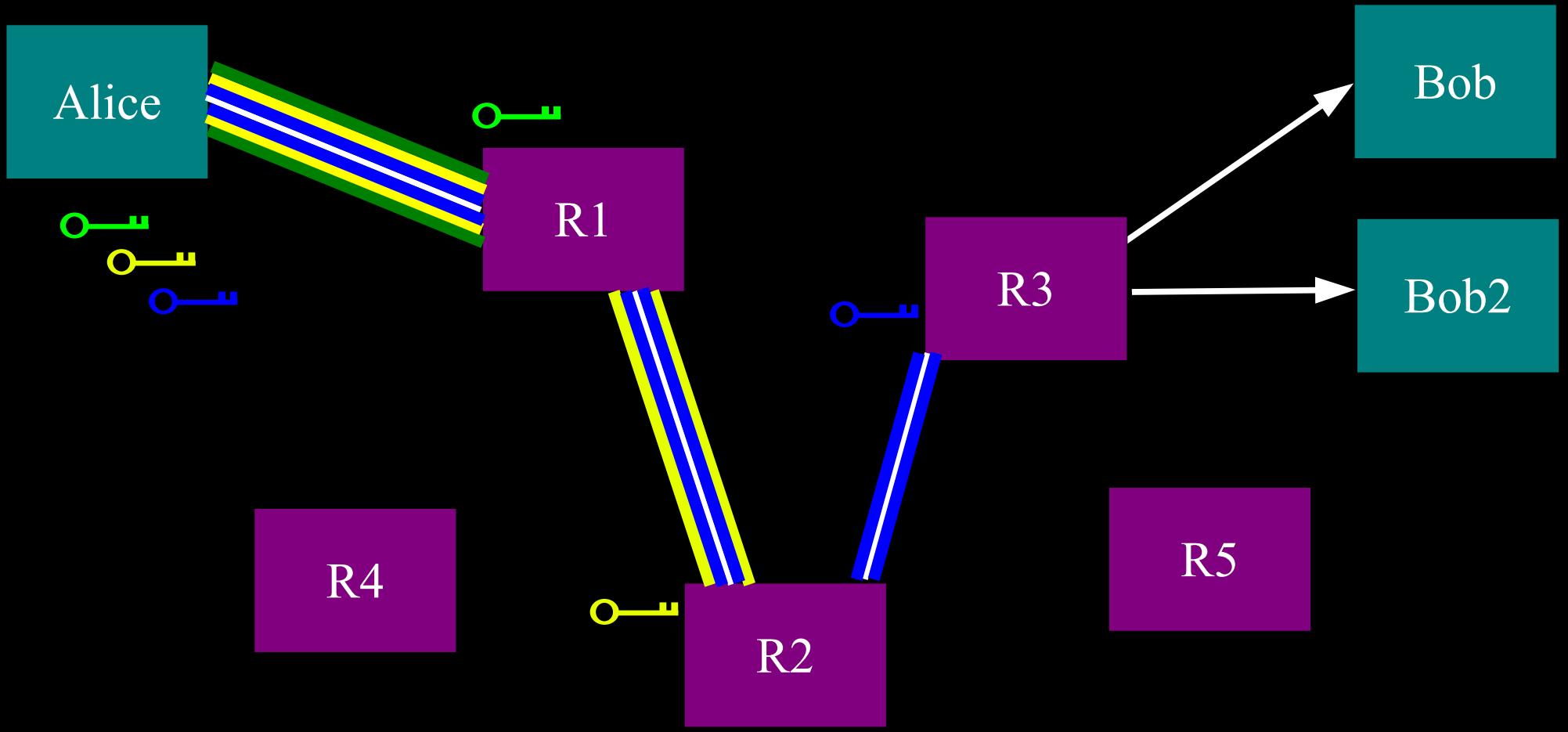
A corrupt first hop can tell that Alice is talking, but not to whom.



A corrupt final hop can tell that somebody is talking to Bob, but not who.



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



Snooping on Exit Relays

- Lots of press in 2007 about people watching traffic coming out of Tor.
- If you want end-to-end encryption (like https), then you need to get it separately.
- Tor hides your location; it doesn't magically encrypt all traffic on the Internet.
- Though Tor *does* protect from your local network.

Javascript, cookies, history, etc

- Javascript refresh attack
- Cookies, History, browser window size, user-agent, language, http auth, ...
- Mike Perry's Torbutton extension for Firefox fixes many of these, but not all

Flash is dangerous too

- Some apps are bad at obeying their proxy settings.
- Adobe PDF plugin. Flash. Other plugins. Extensions. Especially Windows stuff: did you know that Microsoft Word is a network app?

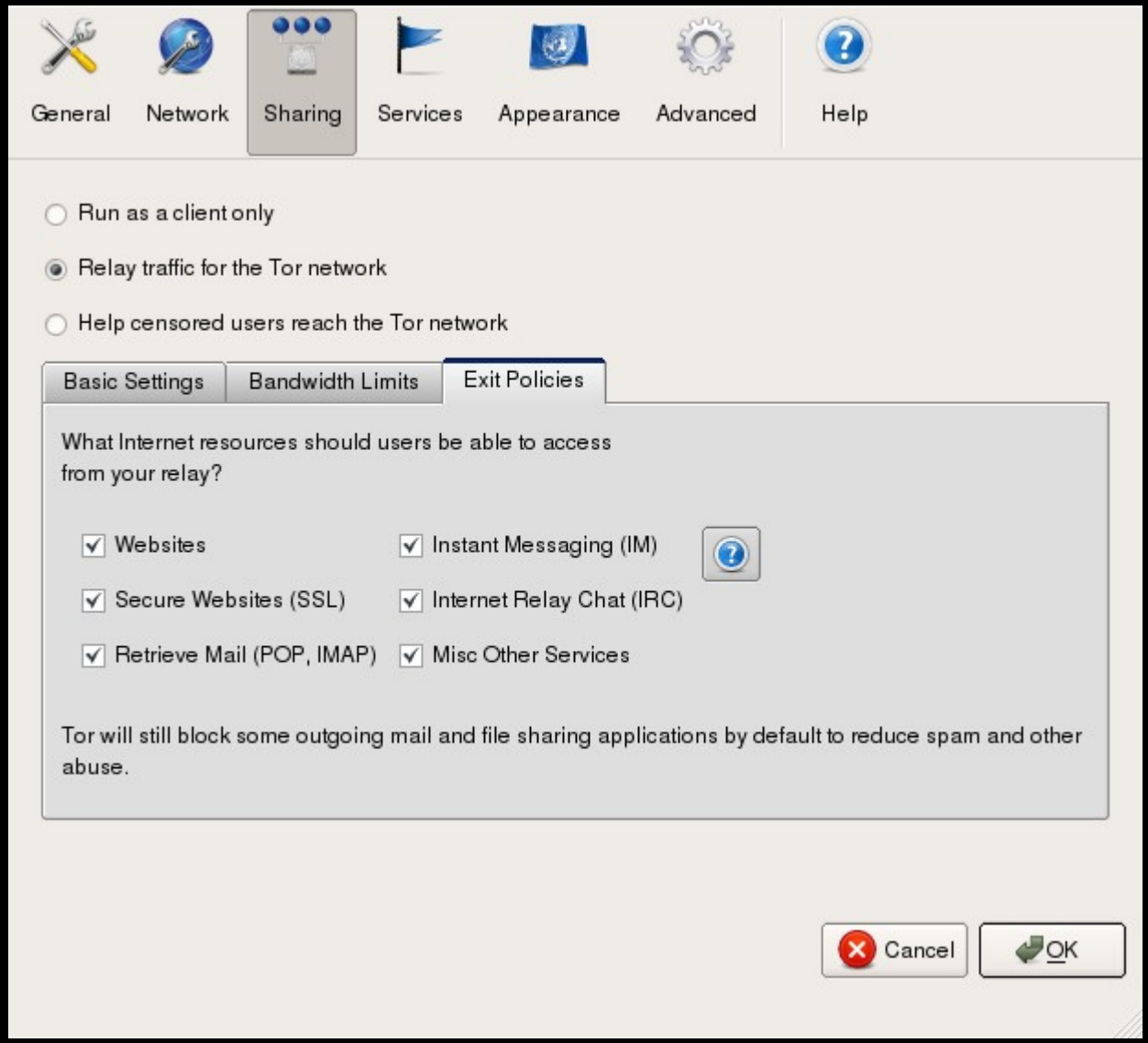
Choose how to install it

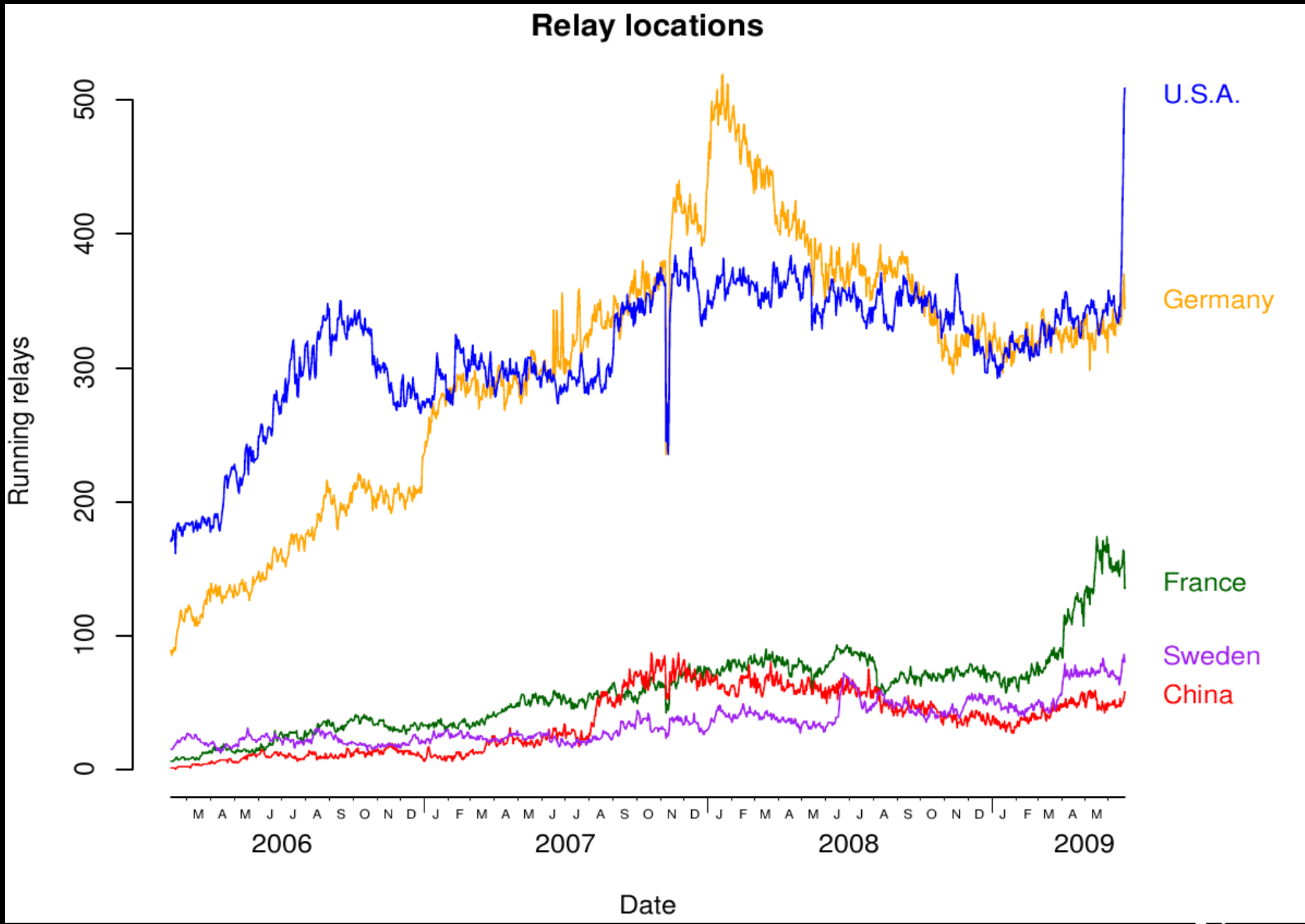
- Tor Browser Bundle: standalone Windows exe with Tor, Vidalia, Firefox, Torbutton, Polipo, e.g. for USB stick
- Vidalia bundle: Windows/OSX installer
- Tor VM: Transparent proxy for Windows
- “Net installer” via our secure updater
- Incognito Linux LiveCD

Usability for relay operators is key.

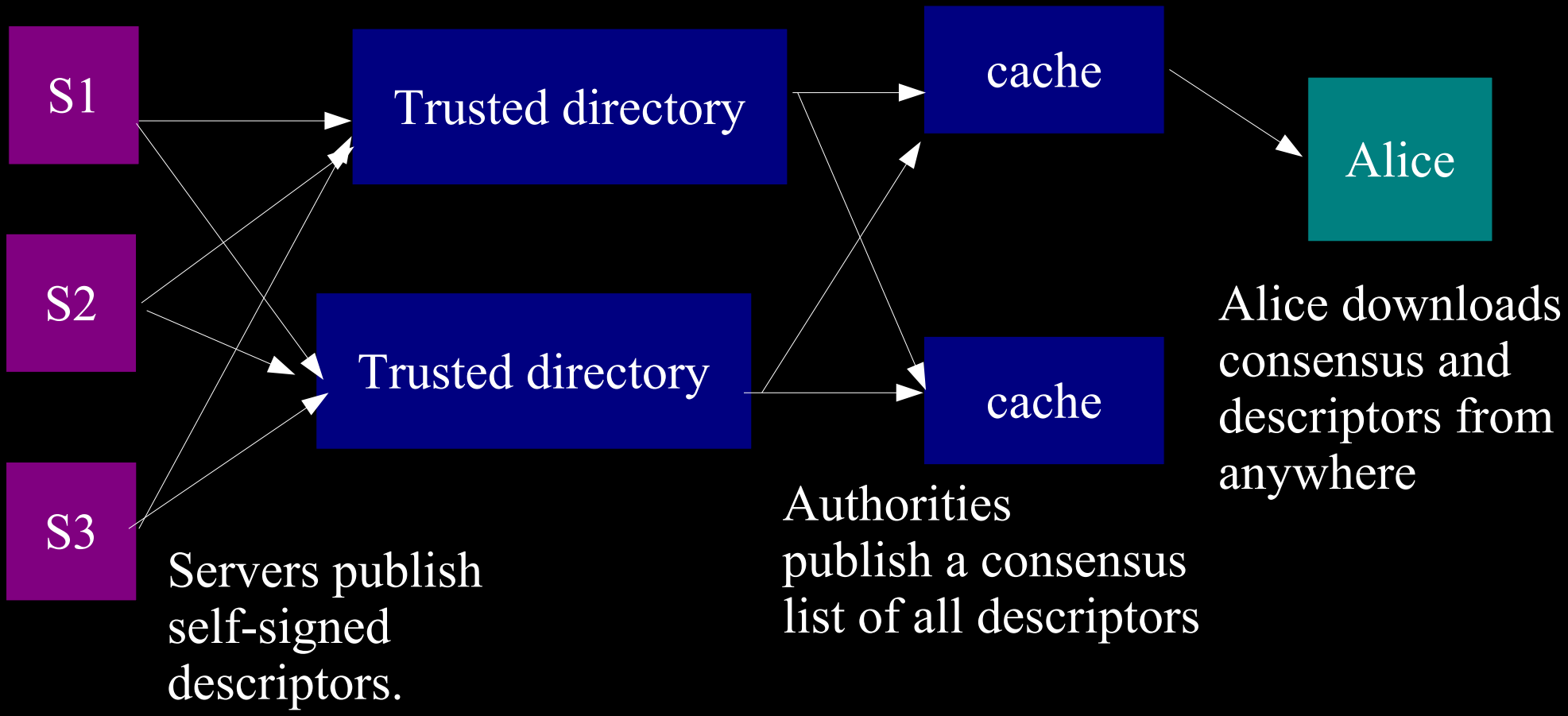
- Rate limiting: shouldn't eat too much bandwidth
- Exit policies: not everyone is willing to emit arbitrary traffic.

```
allow 18.0.0.0/8:*
    allow *:22
    allow *:80
    reject *:*
```

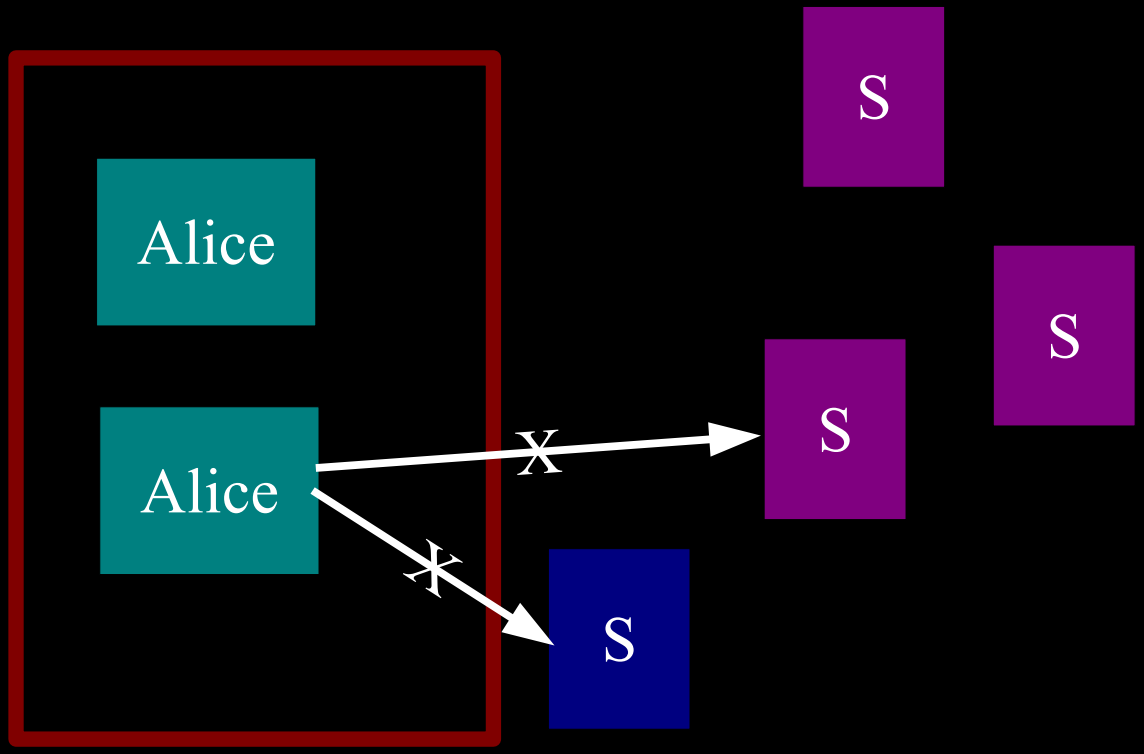

General
Network
Sharing
Services
Appearance
Advanced
Help
Run as a client only
Relay traffic for the Tor network
Help censored users reach the Tor network
Basic Settings
Bandwidth Limits
Exit Policies
What Internet resources should users be able to access from your relay?
Websites
Instant Messaging (IM)
Secure Websites (SSL)
Internet Relay Chat (IRC)
Retrieve Mail (POP, IMAP)
Misc Other Services
Tor will still block some outgoing mail and file sharing applications by default to reduce spam and other abuse.
Cancel
OK

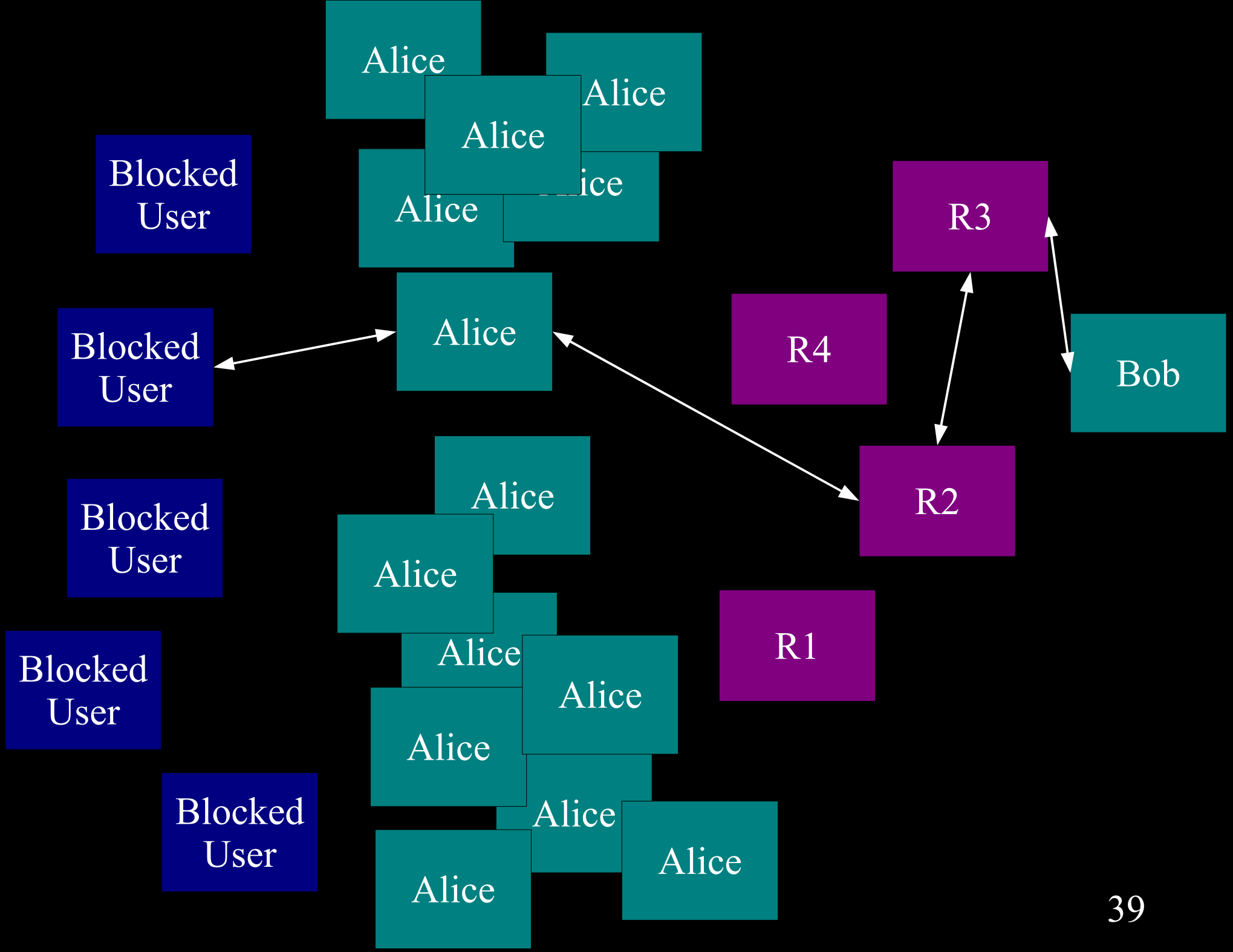

Relay locations
Running relays
0
100
200
300
400
500
U.S.A.
Germany
France
Sweden
China
M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M
2006
2007
2008
2009
Date

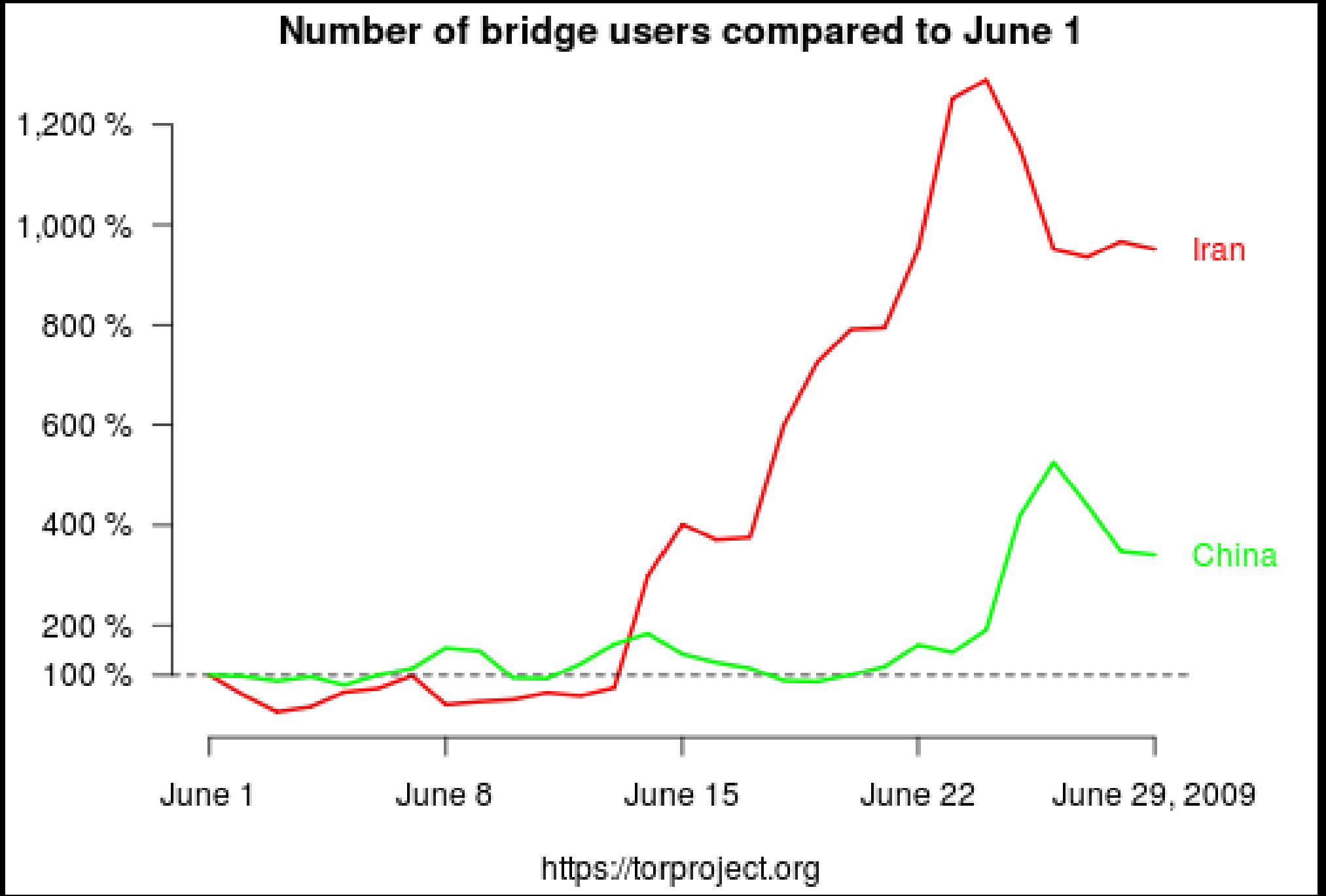
The basic Tor design uses a simple centralized directory protocol.



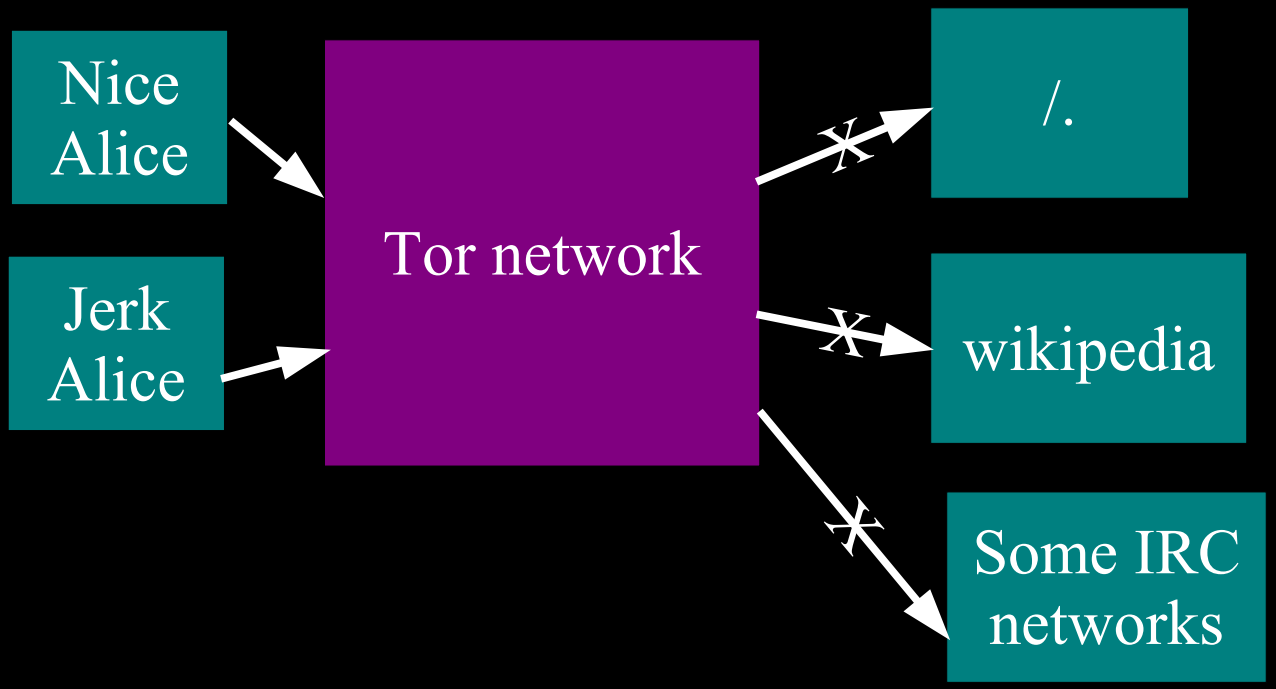
Governments and other firewalls can just block the whole Tor network.




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


Number of bridge users compared to June 1
1,200 %
1,000 %
800 %
600 %
400 %
200 %
100 %
Iran
China
June 1
June 8
June 15
June 22
June 29, 2009
https://torproject.org

Problem: Abusive users get the whole network blocked.



Minimize scope of blocking?

Some abuses we've seen

- Ransom note via Hotmail
- Spam via Google Groups
- IRC jerks → DDoS on Tor relay
- Somebody downloads a Vin Diesel movie
- Wikipedia, Slashdot block posts

Tor is 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
- Assume the users can fetch a genuine copy of Tor: from a friend, via PGP signatures, etc.

Community

- Many tools make a big splash in the press
  - Censors need to feel in control; publicity removes the appearance of control
- Increase community diversity
  - Strong social network
- Funding
  - Donations, grants, contracts

3-Year Development Roadmap

- Improve Performance
- Client Safety
- Ease of Use and Understanding
- Core Research & Development

https://torproject.org/press/ for details

Lessons?

- 1) Bad people don't need Tor. They're doing fine.
- 2) Honest people need more security/privacy/anonymity.
- 3) Law enforcement can benefit from it too.
- 4) Tor is not unbreakable.

Suggestions: Run a Tor node

- General Caveat: All advice is that of a theory guy with a PhD in Philosophical Logic

That said...

- Run a Tor node (preferably on a firewall)
  - enclave communications to/from Tor protected
  - CAVEAT: An adversary that watches everything on your internet connection and the other end will see who communicates with that Tor node

Suggestion: Know your network

- Most exit nodes run by people who want to defend: democracy, privacy, consumers, crime victims, dissidents, bloggers, etc.
  - most do this on principle: at varying risk to themselves and their property
  - please be aware of impact on volunteer operators of watching/interacting with bad guys over Tor network
  - please be aware of Tor (and open relays and botnets) if only identifier you have to investigate is a network address
  - Talk to me or Tor Project whenever you can

Suggestions: Know your adversary

- Destination adversary: lock down applications, etc. https://www.torproject.org/download.html/#Warning
- Exit node adversary: same advice, also worry about pseudonymous profiles.
  - DON'T assume passwords over otherwise unencrypted links are safe because they went through Tor first.
- Local/temporary adversary: you are probably OK just using (properly configured) Tor
  - CAVEAT: You might have other adversaries watching you even if they are not your immediate concern

Suggestions: Know your adversary

- Well-funded tech-savvy adversary: Be patient, onion routing is not there yet.
  - Using Tor is usually better than not using Tor or using anything else I know of.
  - Nothing to prevent someone from running a nontrivial percentage of Tor nodes and watching the traffic over them and/or watching internet connections.
  - Currently working on research to work trust into the model and design of Tor.