Tor: a quick overview

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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

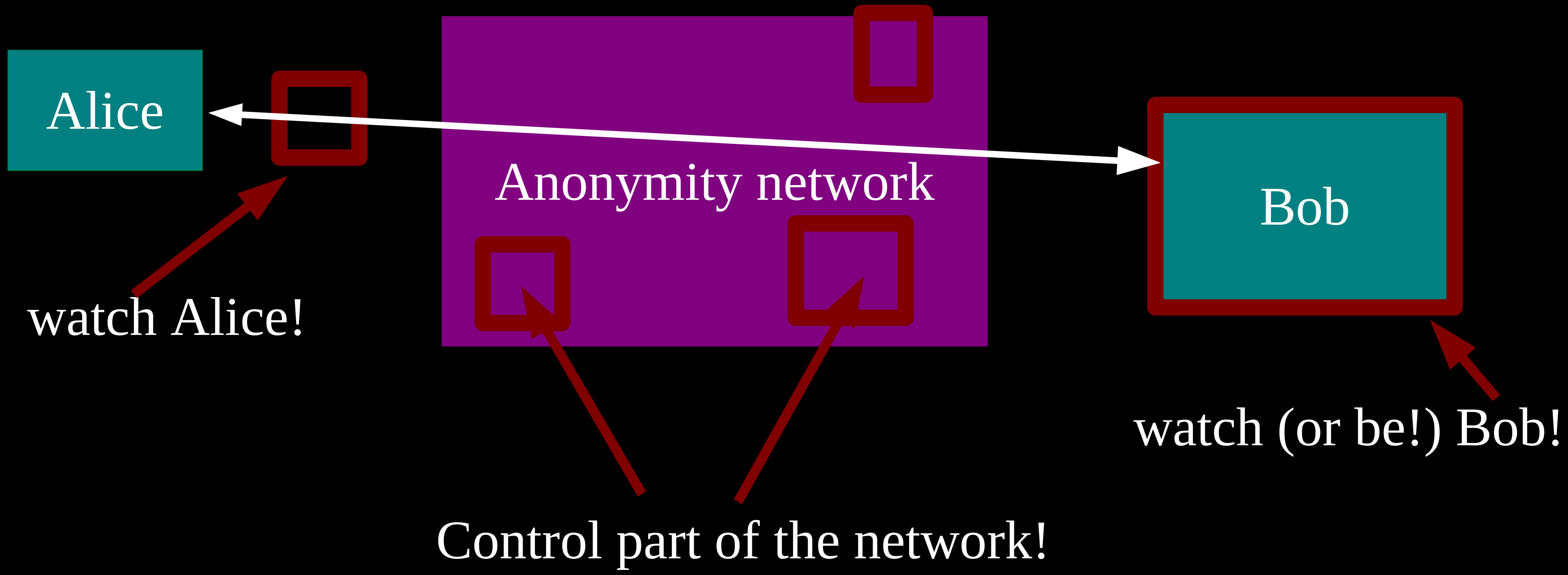
Funding from US DoD, Electronic Frontier Foundation, Voice of America, Google, NLnet, Human Rights Watch, NSF, US State Dept, SIDA, Knight Foundation, ...

The Tor Project, Inc.

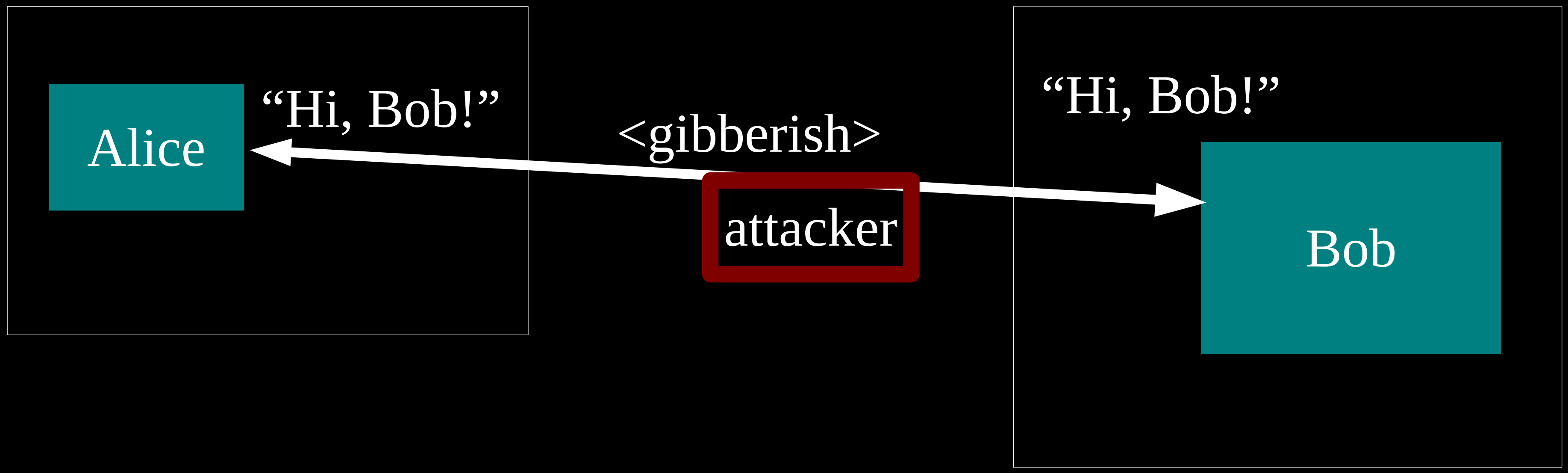
501(c)(3) non-profit organization dedicated to the research and development of tools for online anonymity and privacy

Estimated 500,000?
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!”

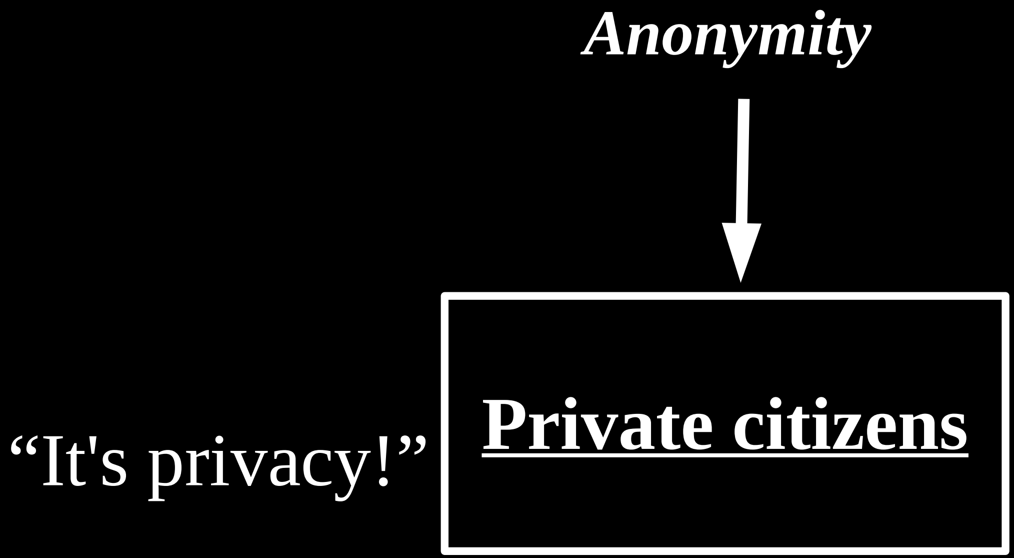
“Promise you won't remember!”

“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.

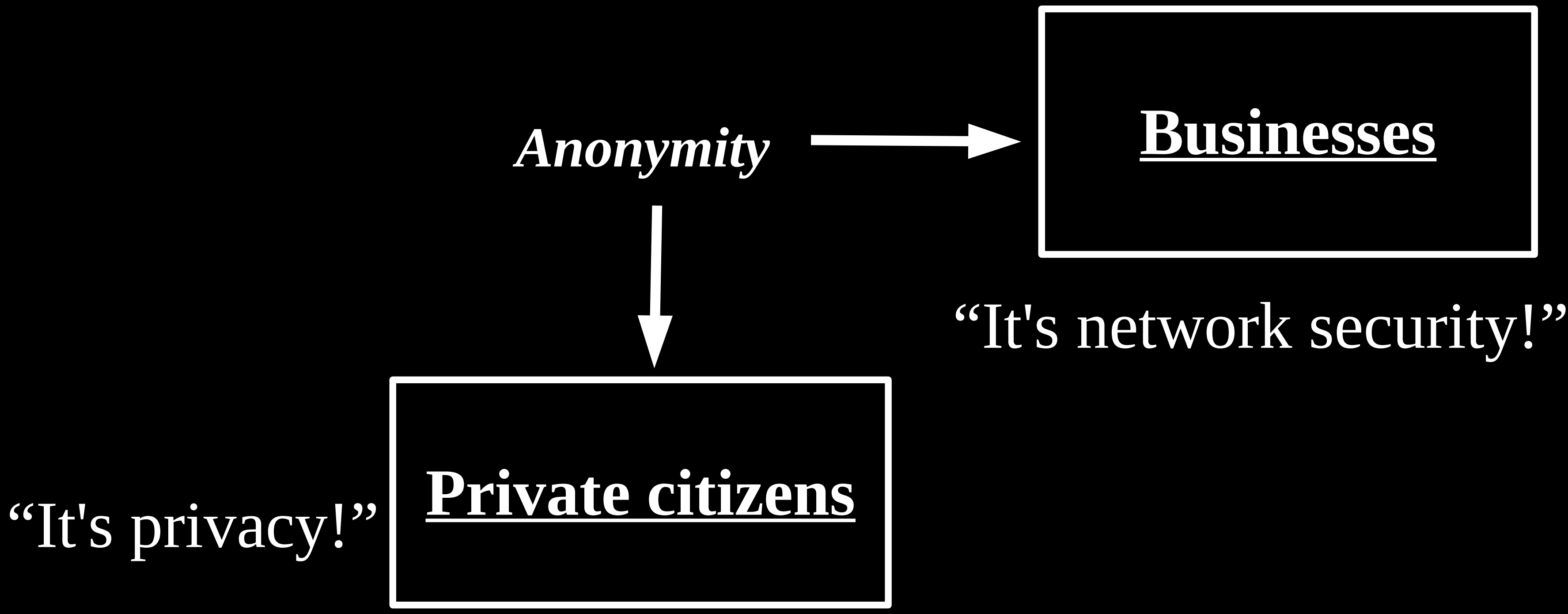


Anonymity

“It's privacy!”

Private citizens

Anonymity serves different interests for different user groups.



Anonymity

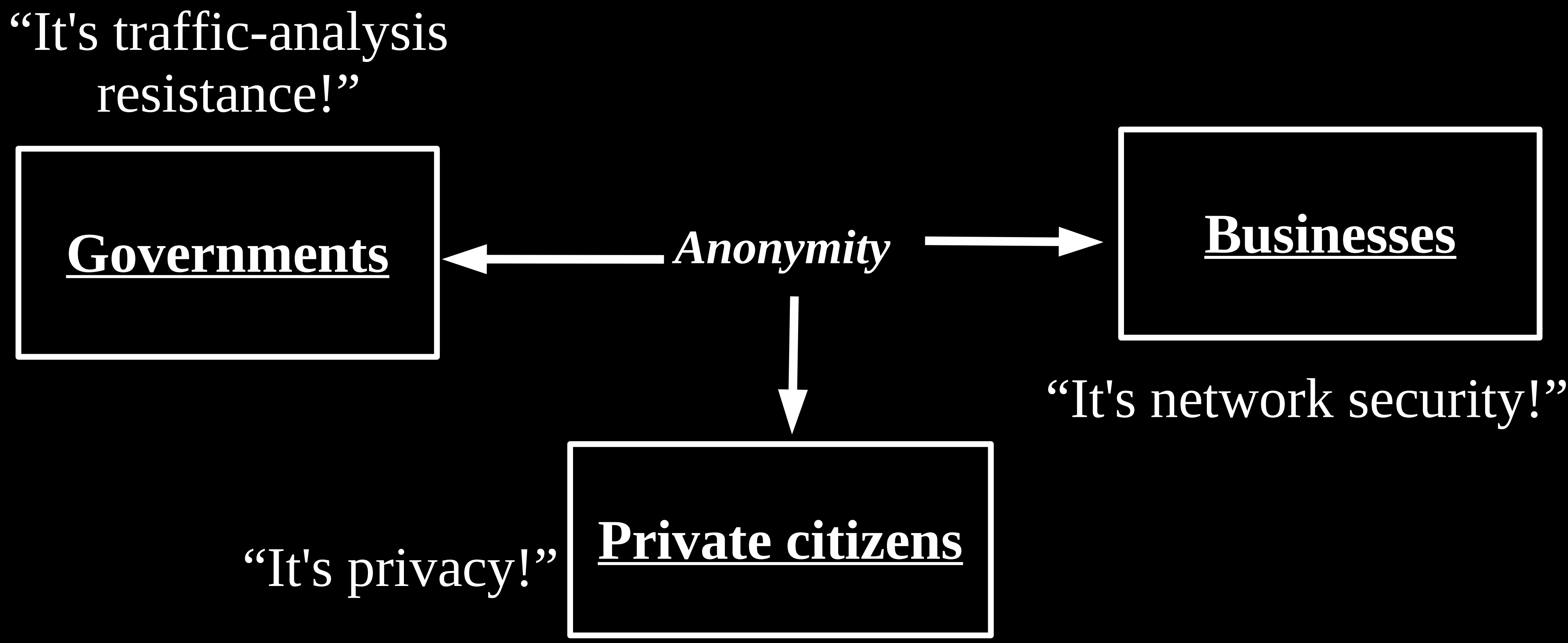
Businesses

“It's network security!”

Private citizens

“It's privacy!”

Anonymity serves different interests for different user groups.



“It's traffic-analysis resistance!”

Governments

Anonymity

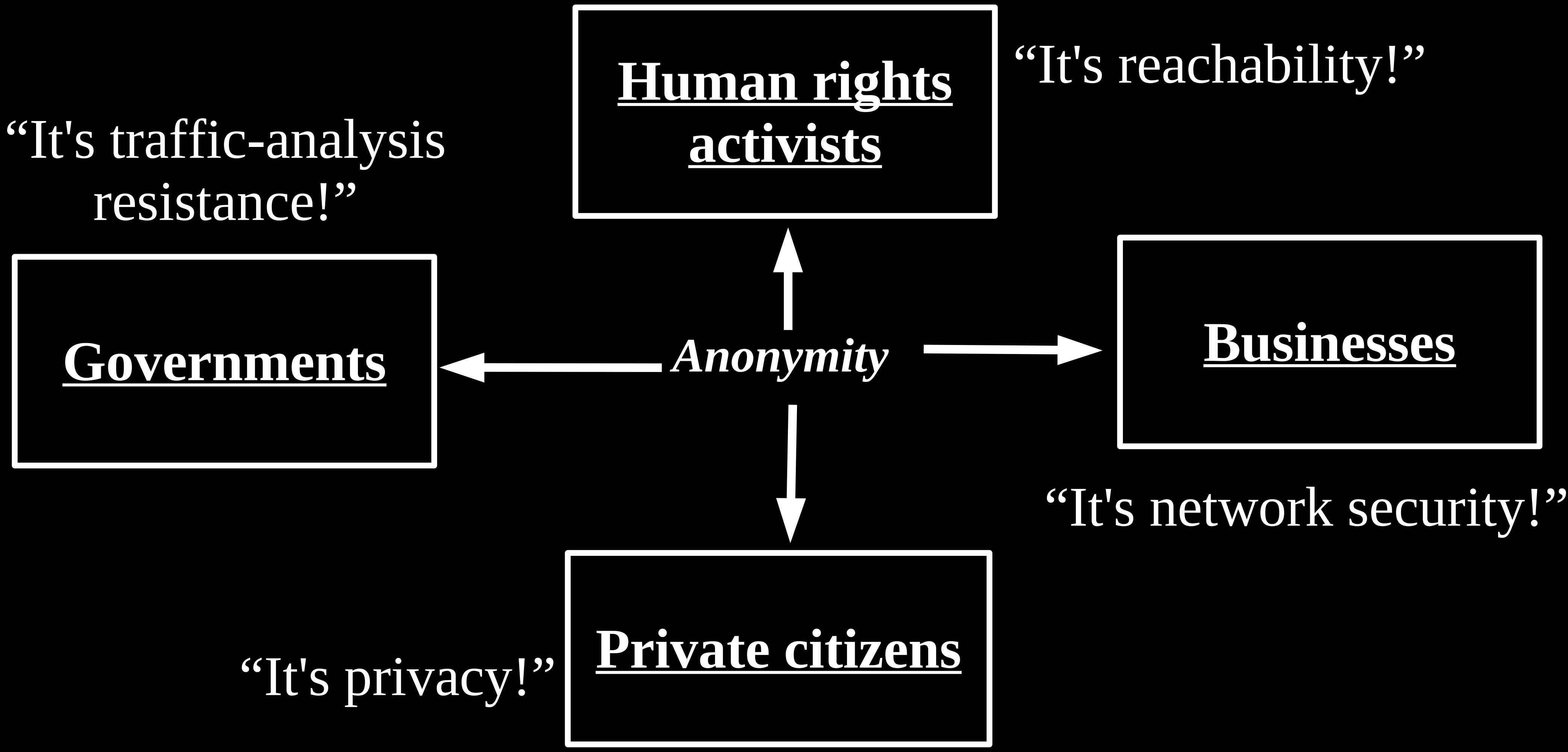
Businesses

“It's network security!”

“It's privacy!”

Private citizens

Anonymity serves different interests for different user groups.



Human rights activists

“It's reachability!”

“It's traffic-analysis resistance!”

Governments

Anonymity

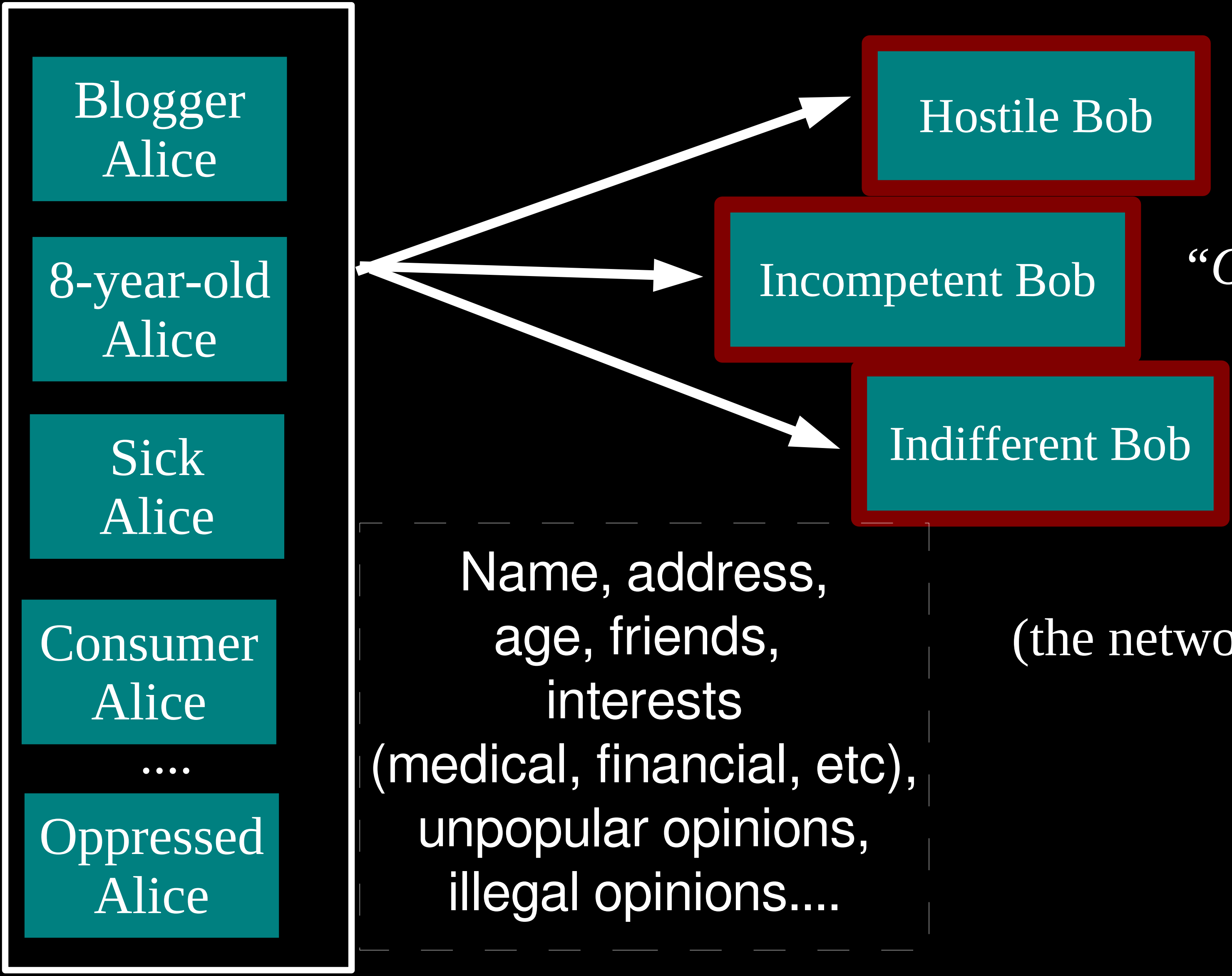
Businesses

“It's network security!”

Private citizens

“It's privacy!”

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



Blogger Alice

8-year-old Alice

Sick Alice

Consumer Alice

....

Oppressed Alice

Hostile Bob

"I sell the logs."

Incompetent Bob

"Oops, I lost the logs."
The AOL fiasco

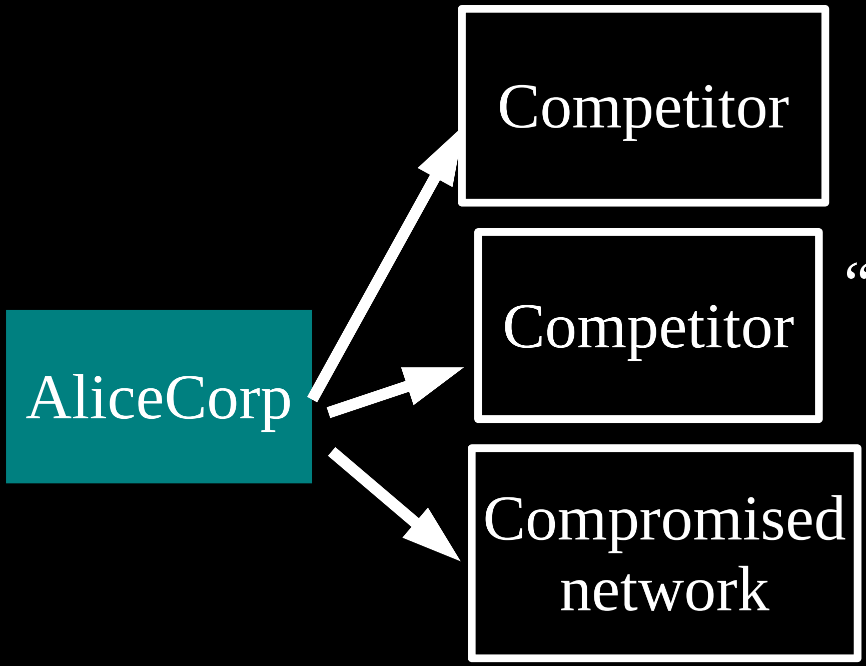
Indifferent Bob

*"Hey, they aren't **my** secrets."*

Name, address,
age, friends,
interests
(medical, financial, etc),
unpopular opinions,
illegal opinions....

(the network can track too)

Businesses need to keep trade secrets.



AliceCorp

Competitor

Competitor

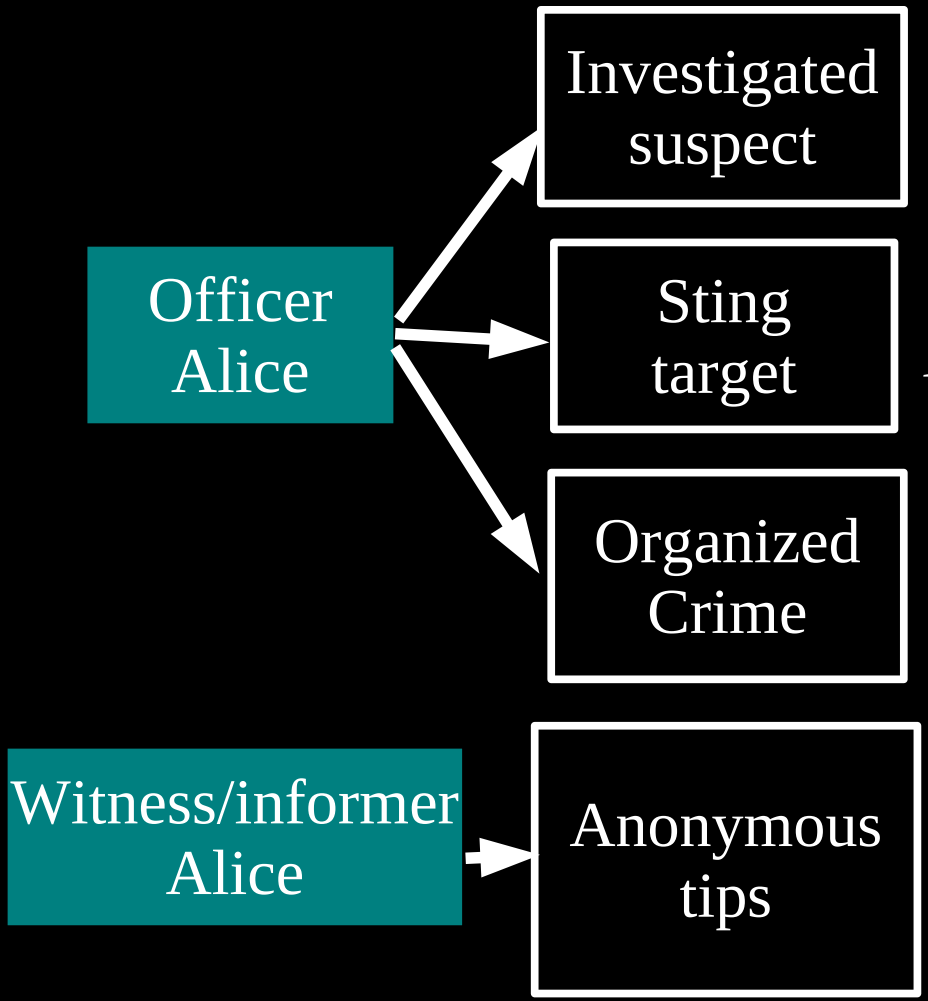
Compromised network

"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?"

Law enforcement needs anonymity to get the job done.



Officer Alice

Investigated suspect

Sting target

Organized Crime

Witness/informer Alice

Anonymous tips

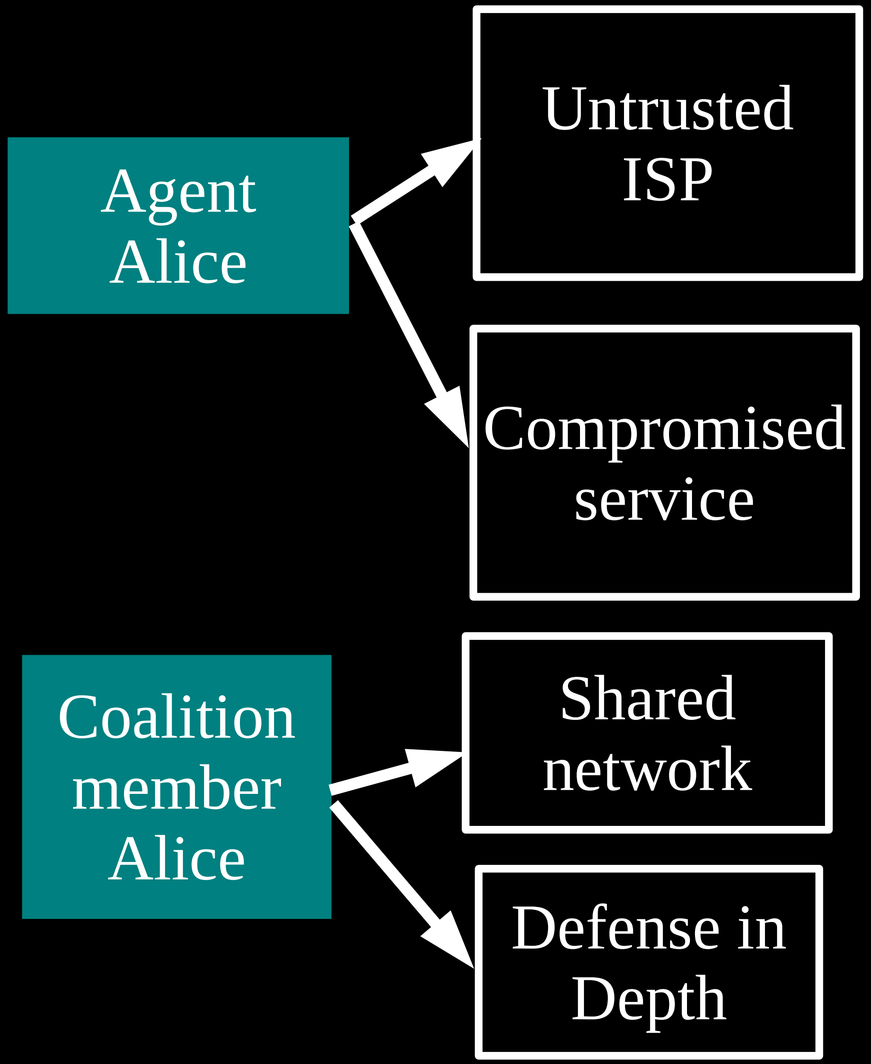
“Why is alice.localpolice.gov reading my website?”

“Why no, alice.localpolice.gov! I would never sell counterfeits on ebay!”

“Is my family safe if I go after these guys?”

“Are they really going to ensure my anonymity?”

Governments need anonymity for their security



Agent Alice

Untrusted ISP

Compromised service

Coalition member Alice

Shared network

Defense in Depth

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

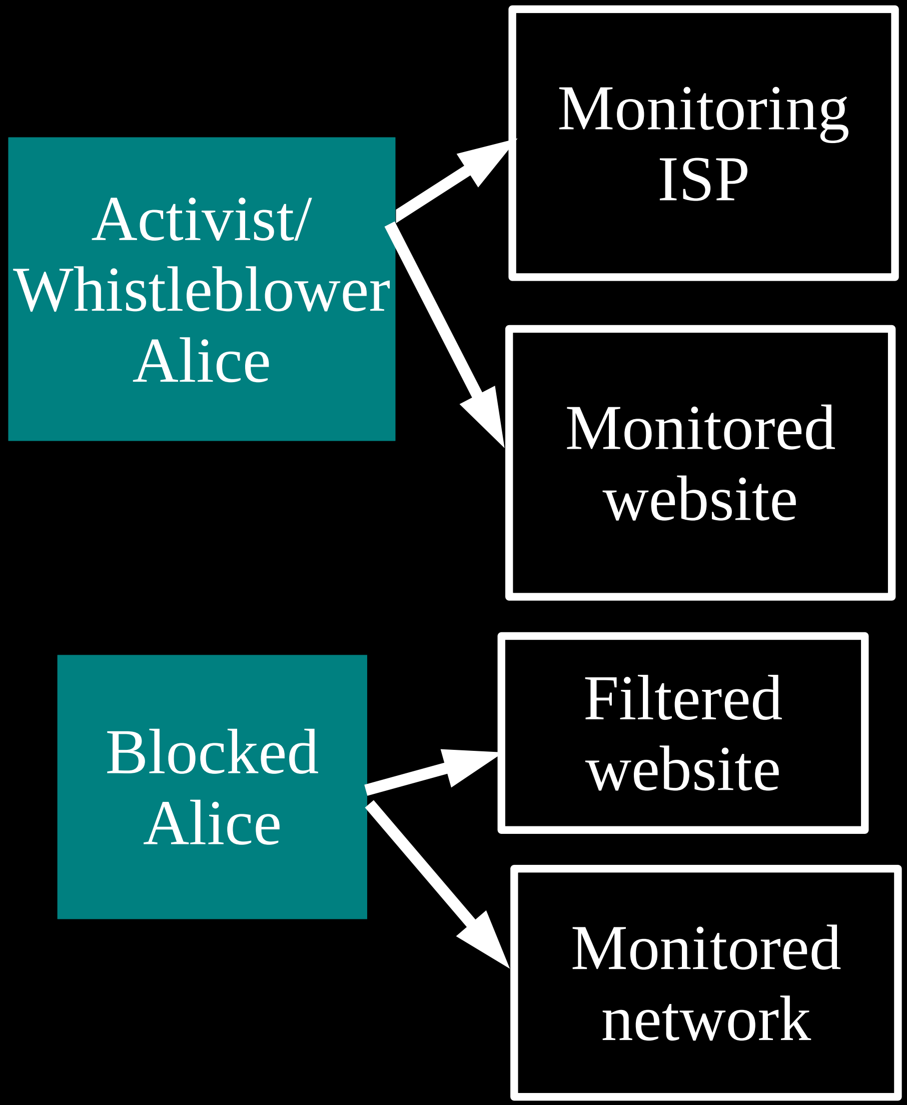
“Somebody in that hotel room just checked his Navy.mil mail!”

“What **does** *FBI Google for?”*

“Do I really want to reveal my internal network topology?”

“What about insiders?”

Journalists and activists need Tor for their personal safety



Activist/ Whistleblower Alice

Monitoring ISP

“Did you just post to that website?”

Monitored website

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

Blocked Alice

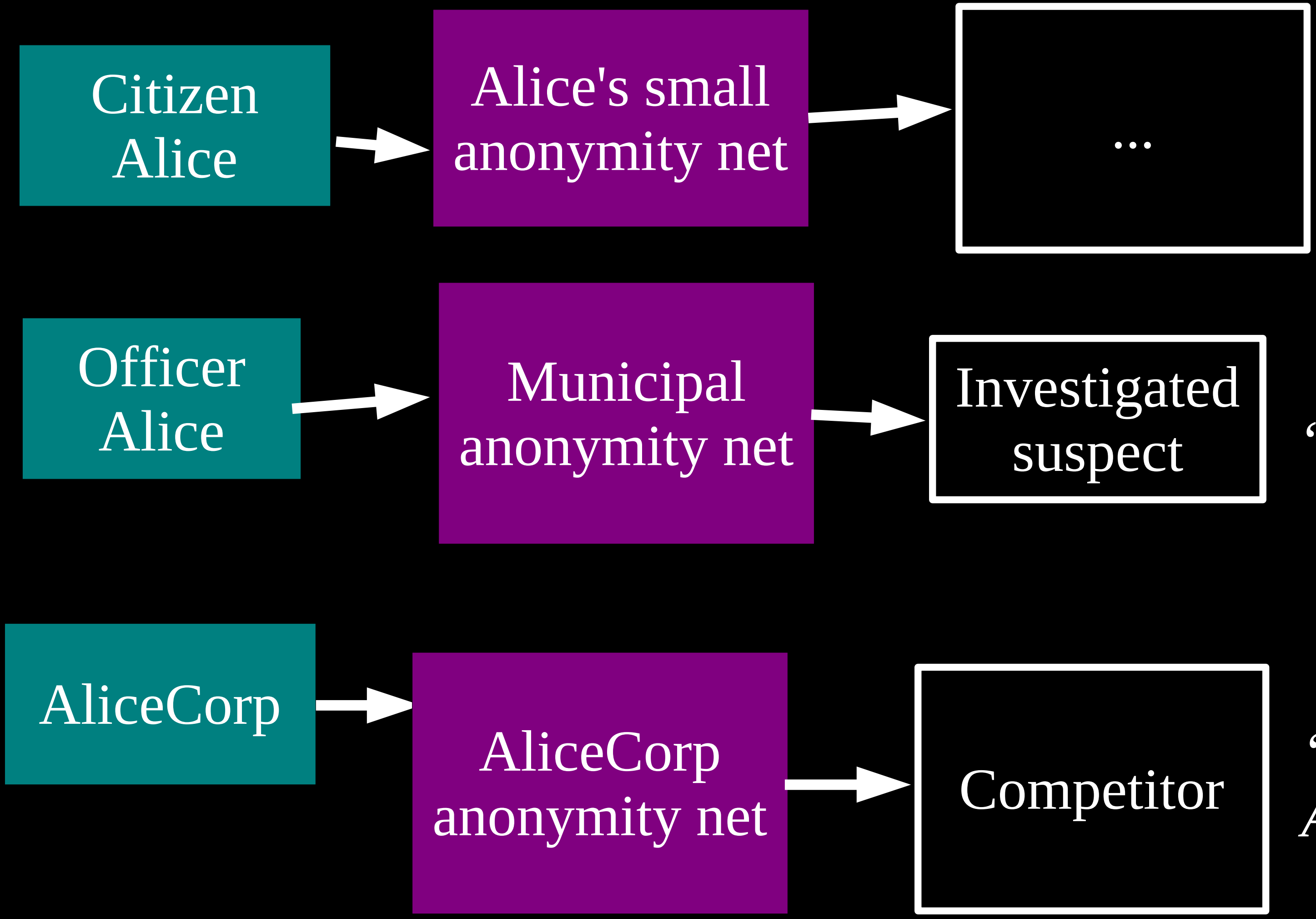
Filtered website

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

Monitored network

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

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



Citizen Alice

Alice's small anonymity net

...

“One of the 25 users on AliceNet.”

Officer Alice

Municipal anonymity net

Investigated suspect

“Looks like a cop.”

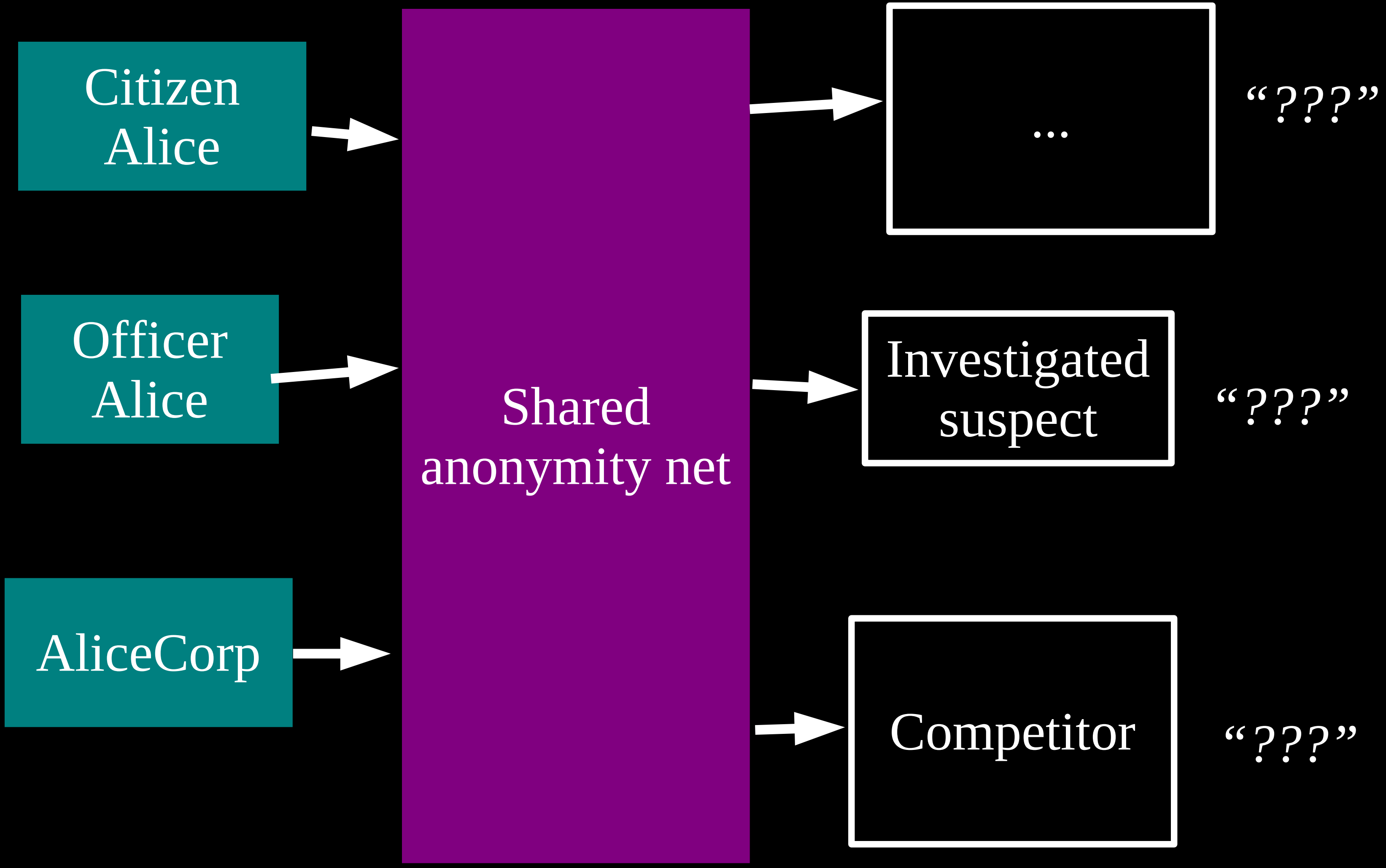
AliceCorp

AliceCorp anonymity net

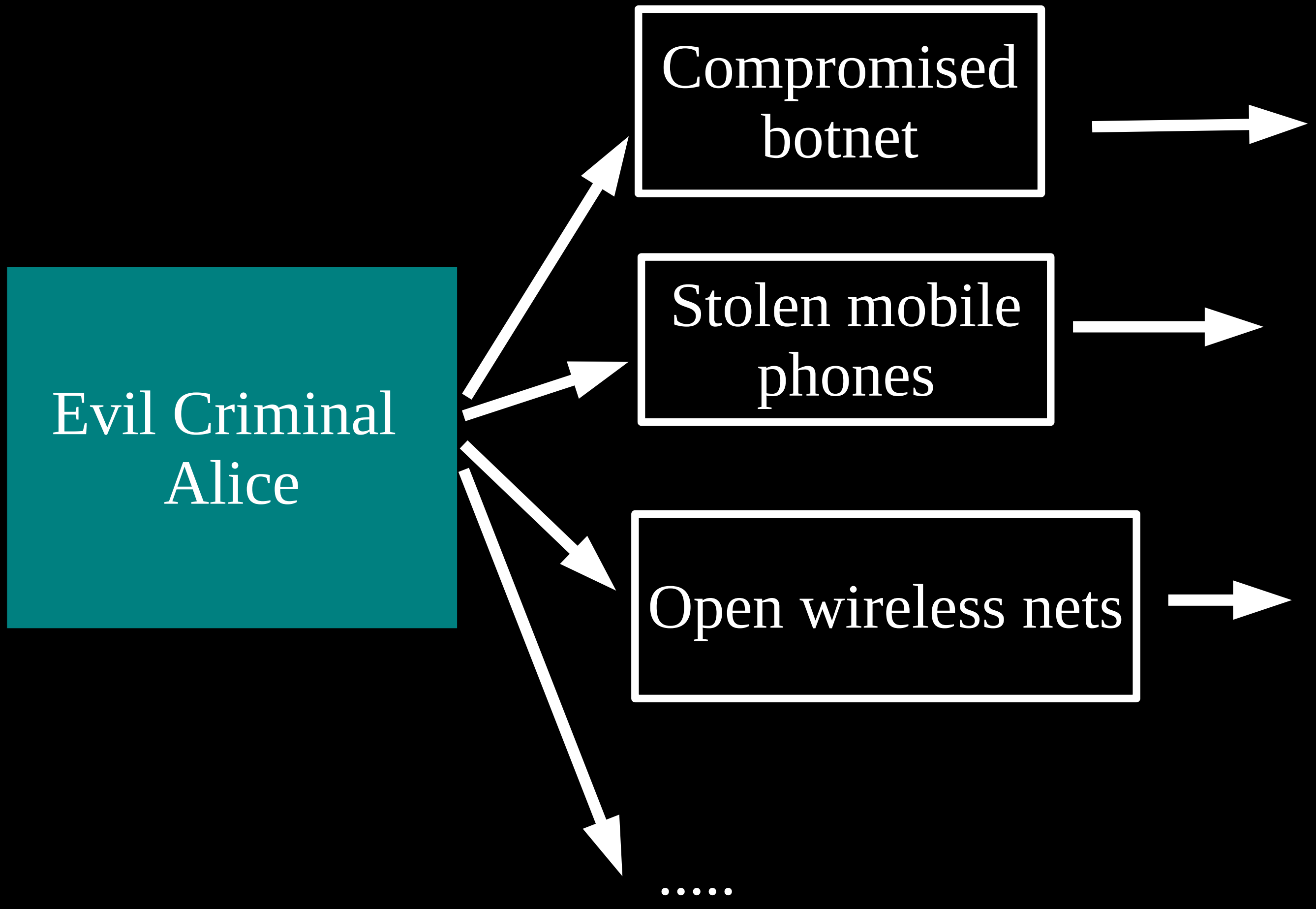
Competitor

*“It's **somebody** at AliceCorp!”*

... so, anonymity loves company!



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



Evil Criminal Alice

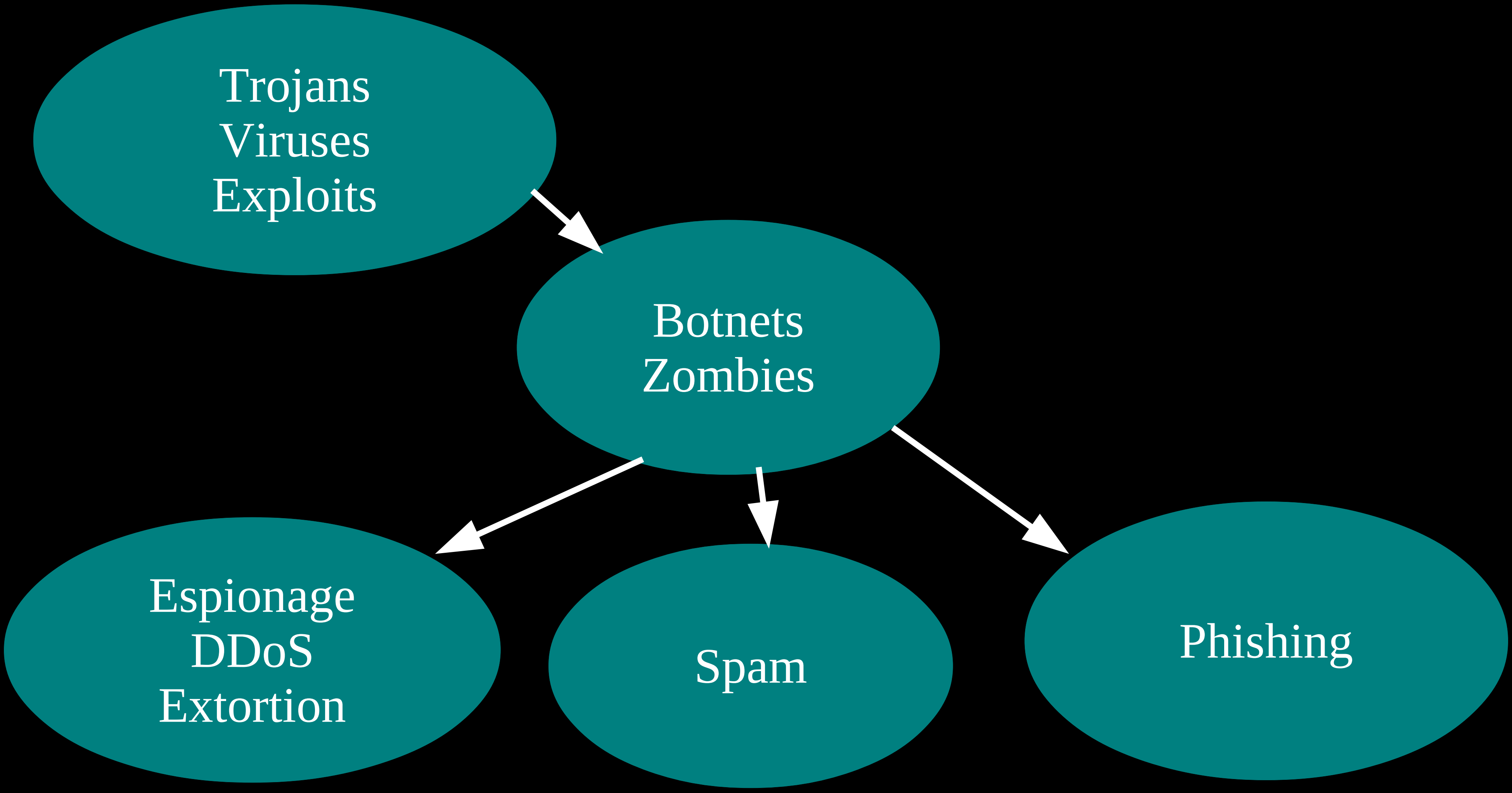
Compromised botnet

Stolen mobile phones

Open wireless nets

.....

Current situation: Bad people on the Internet are doing fine



Trojans
Viruses
Exploits

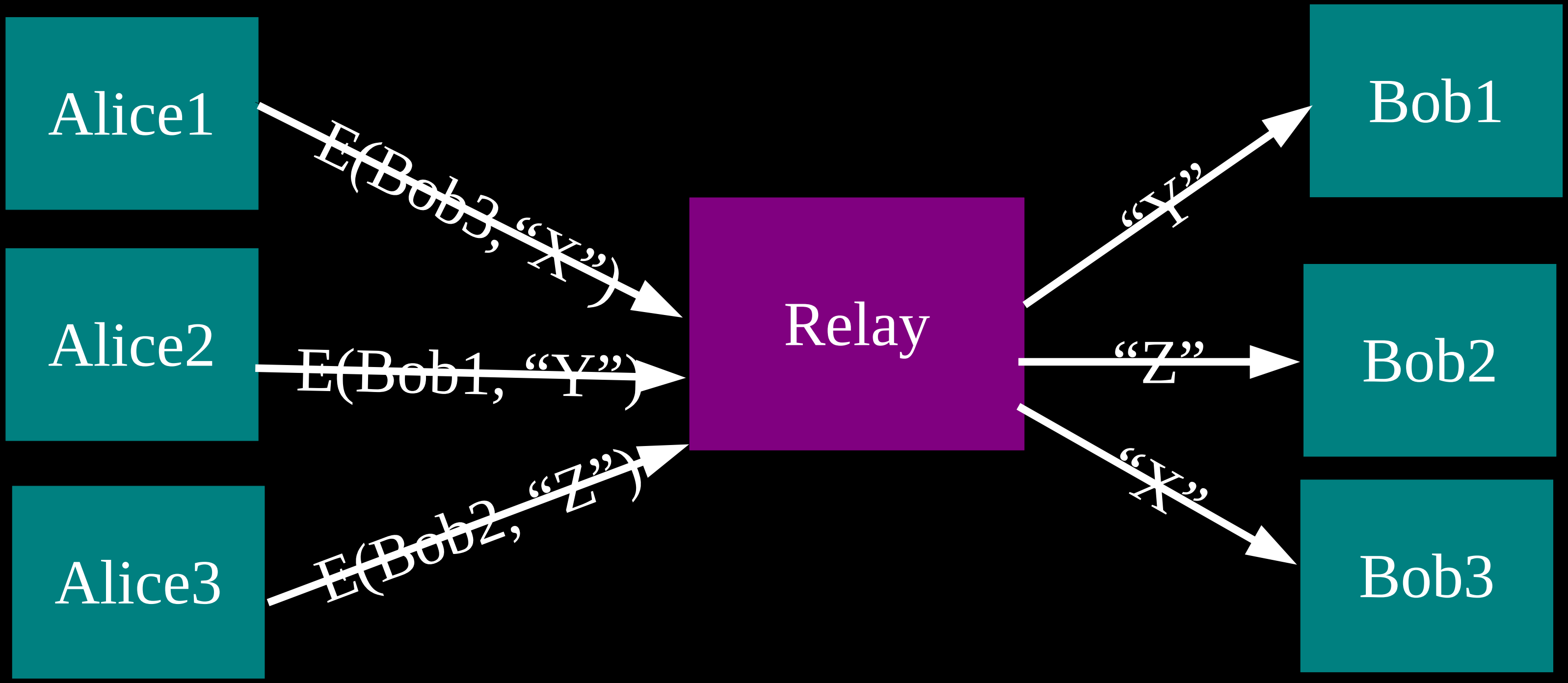
Botnets
Zombies

Espionage
DDoS
Extortion

Spam

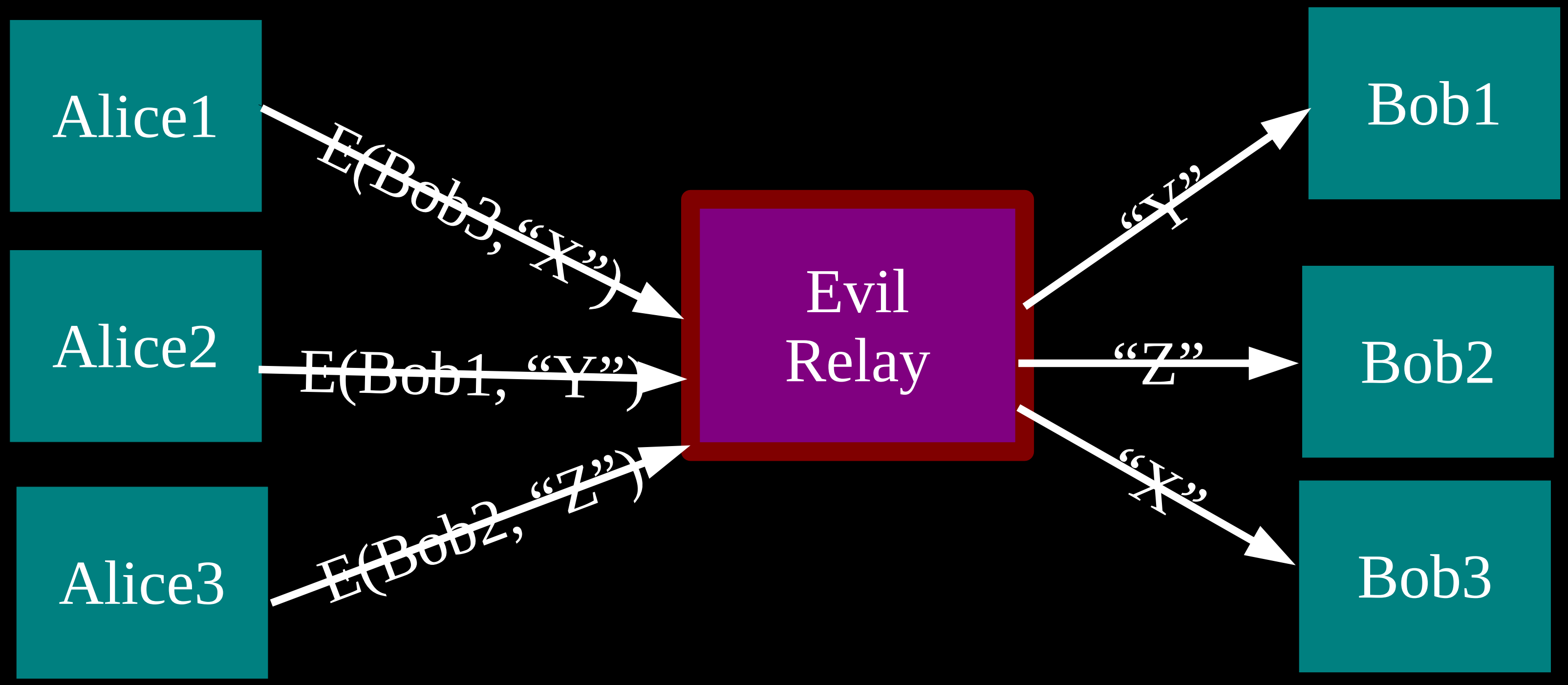
Phishing

The simplest designs use a single relay to hide connections.

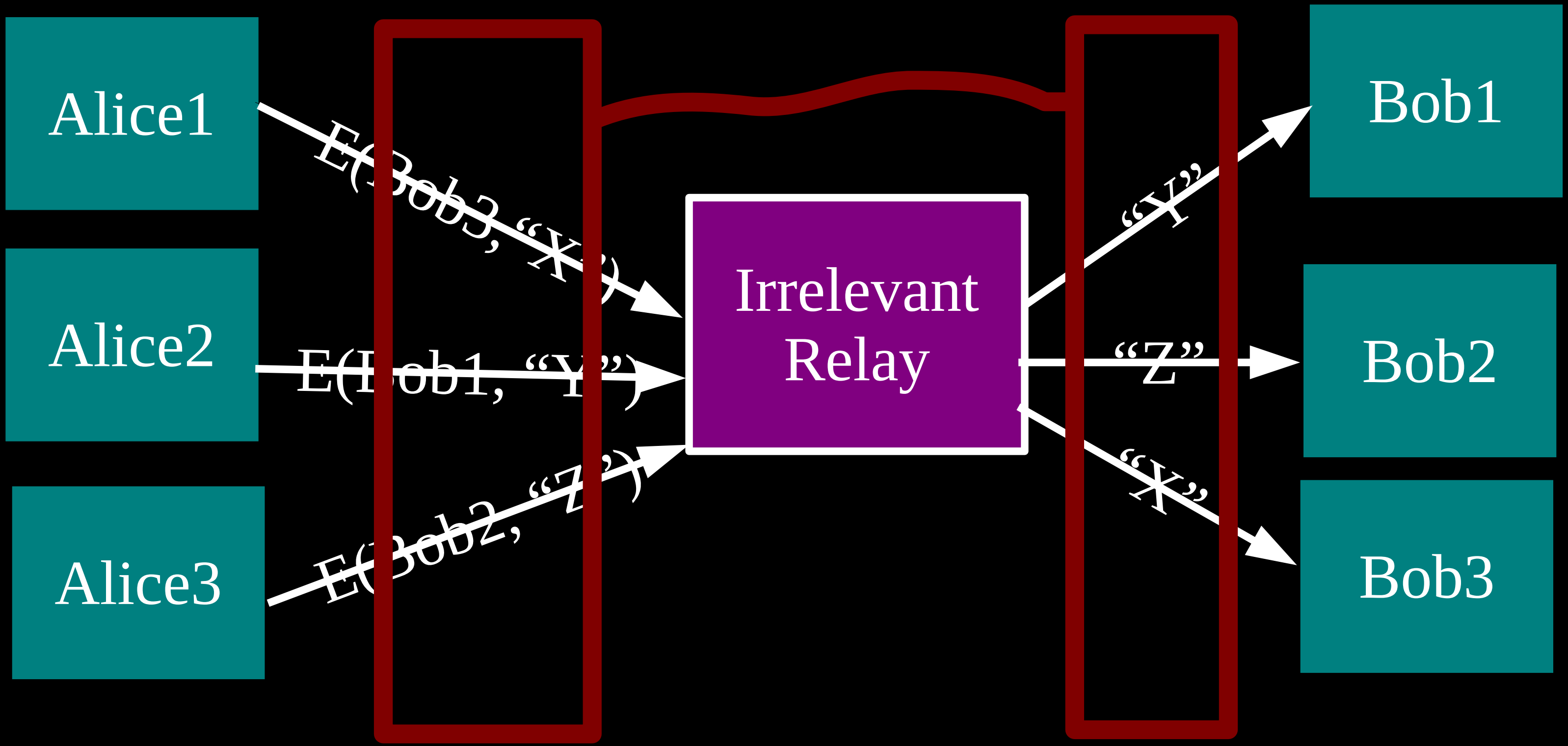


(example: some commercial proxy providers)

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

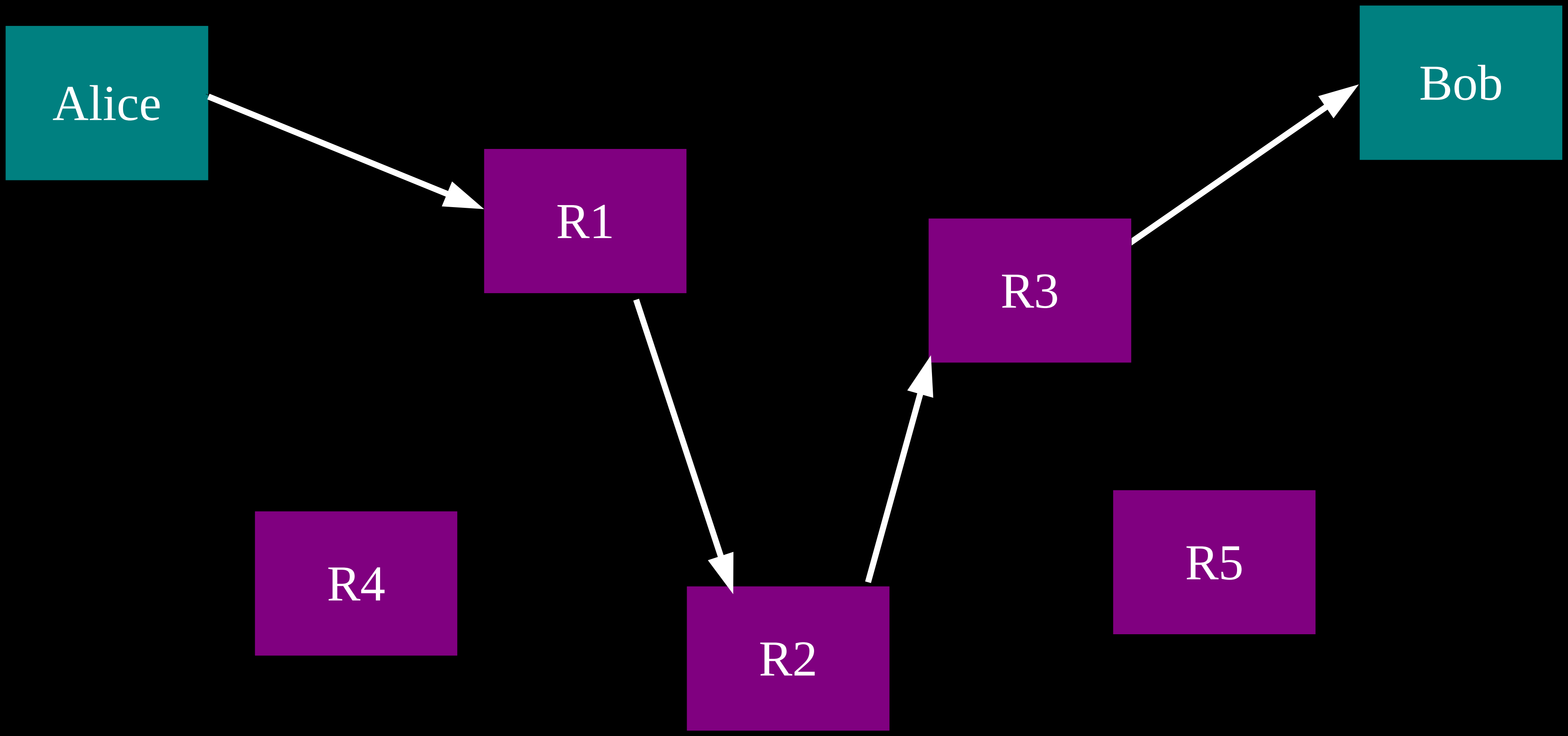


... or a single point of bypass.

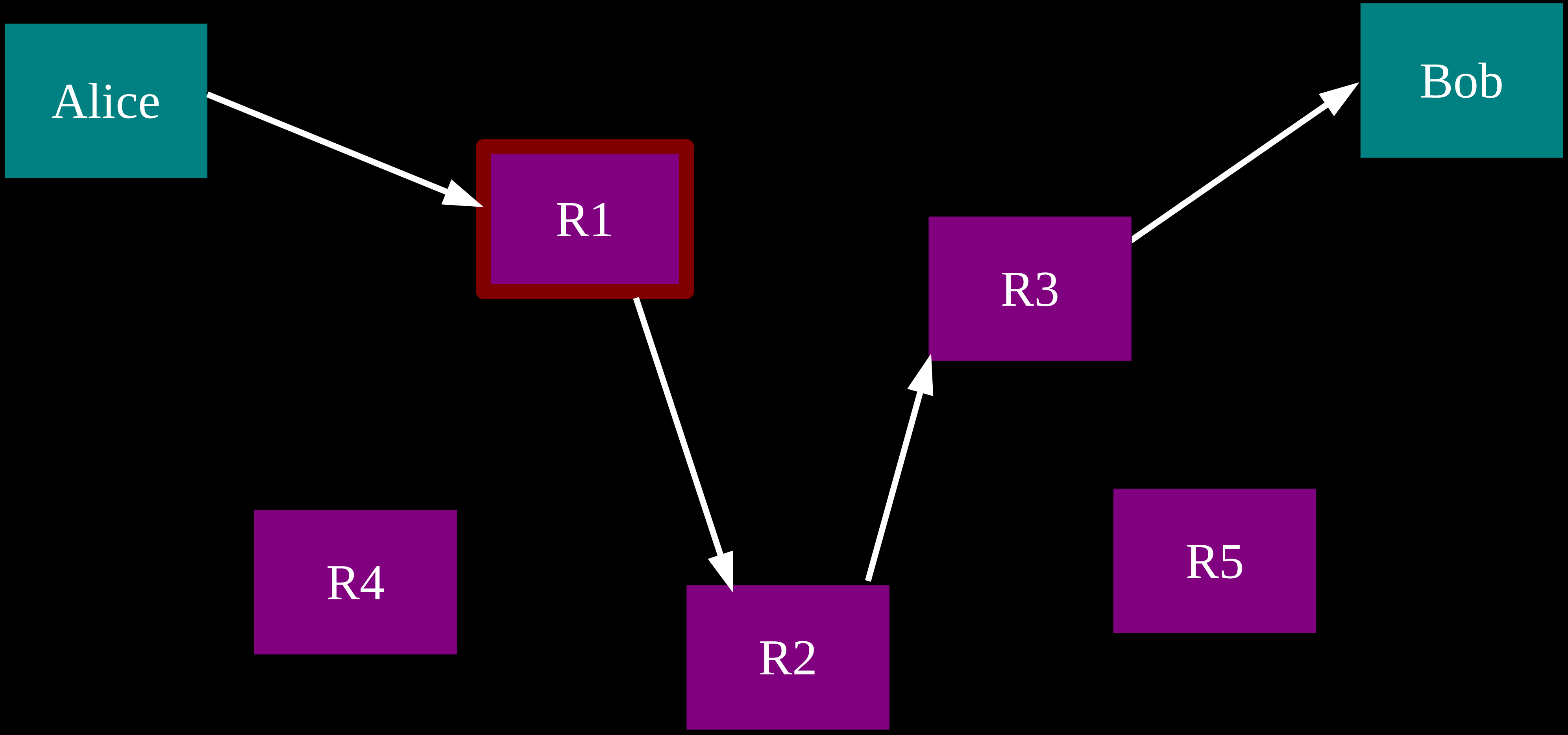


Timing analysis bridges all connections through relay ⇒ An attractive fat target

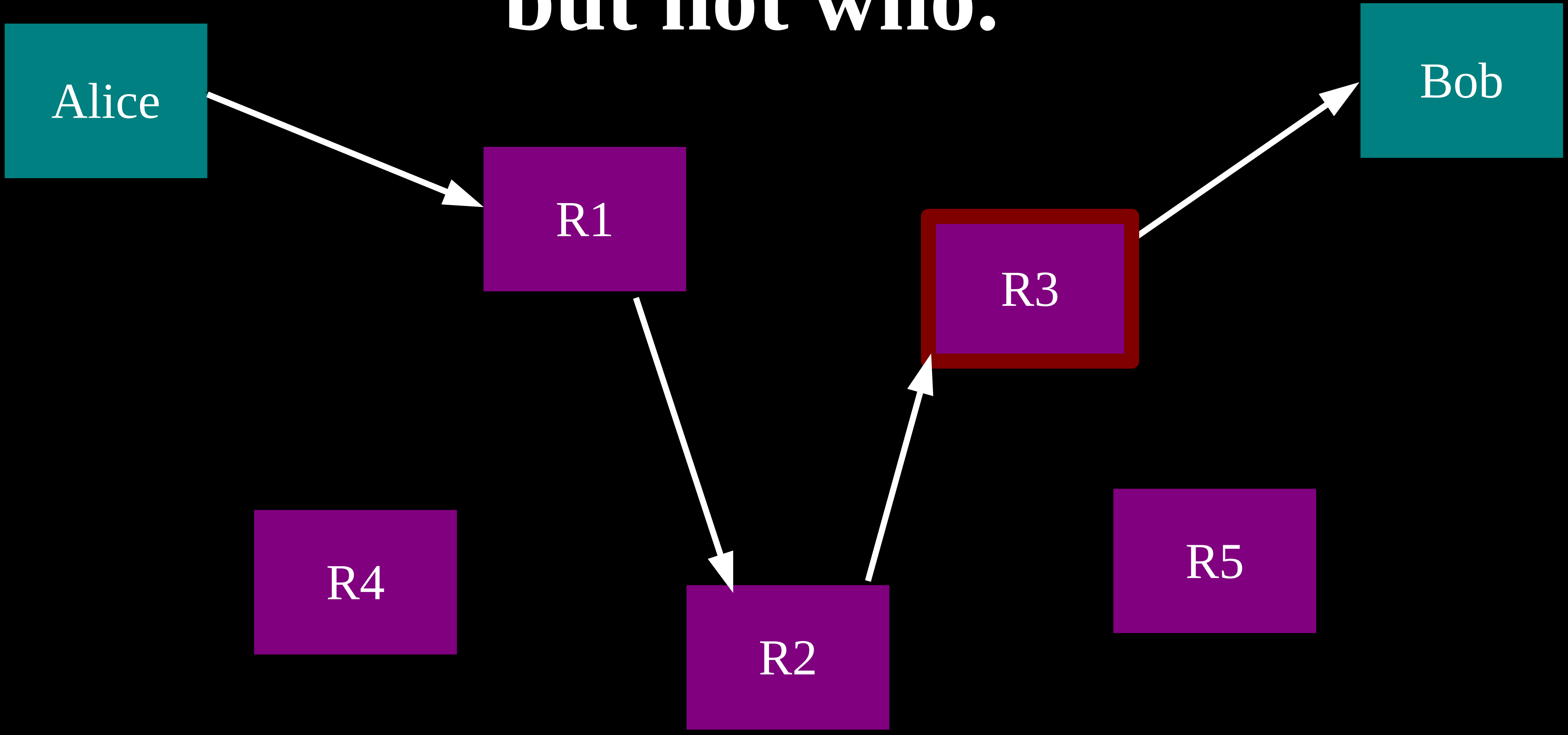
So, add multiple relays so that no single one can betray Alice.



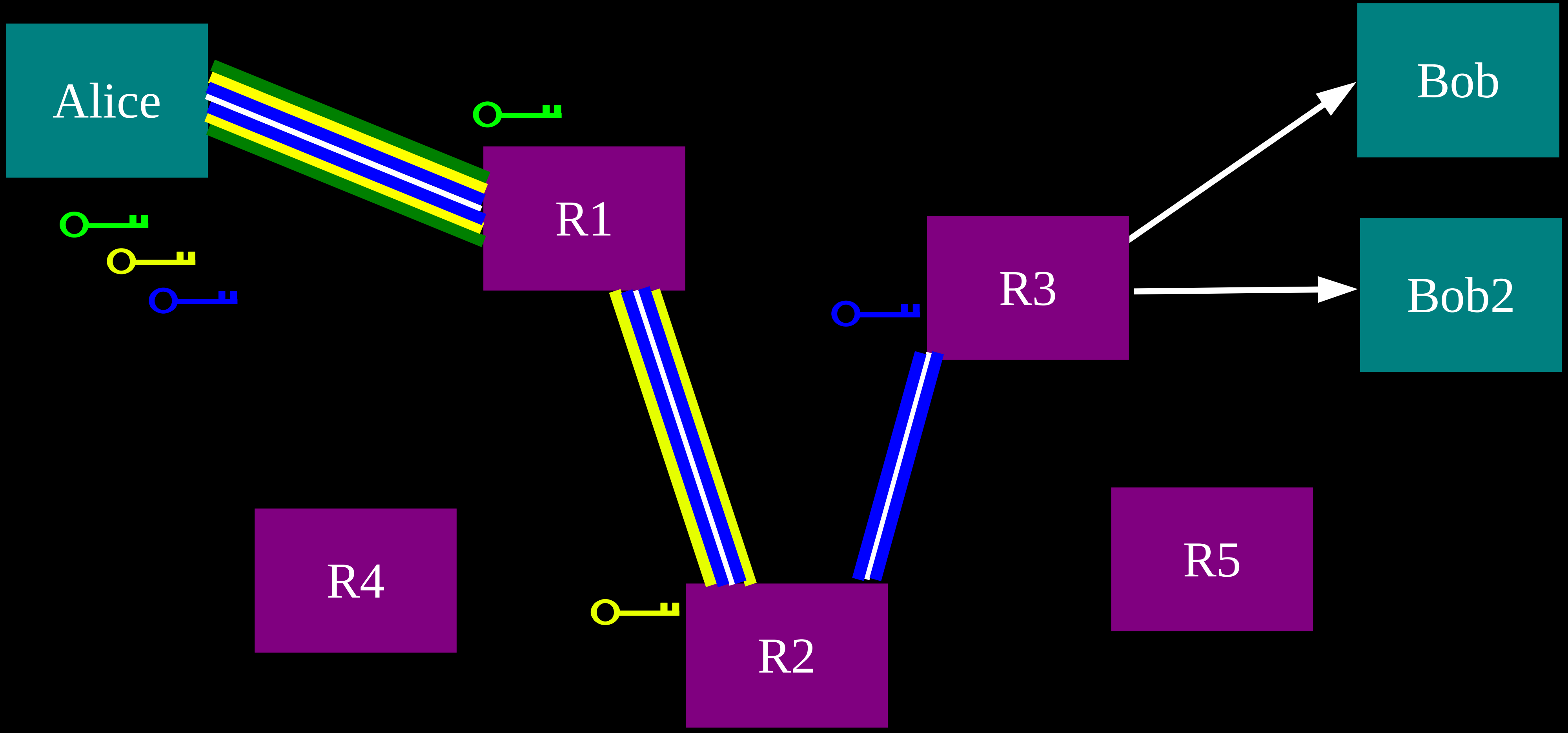
A corrupt first hop can tell that Alice is talking, but not to whom.

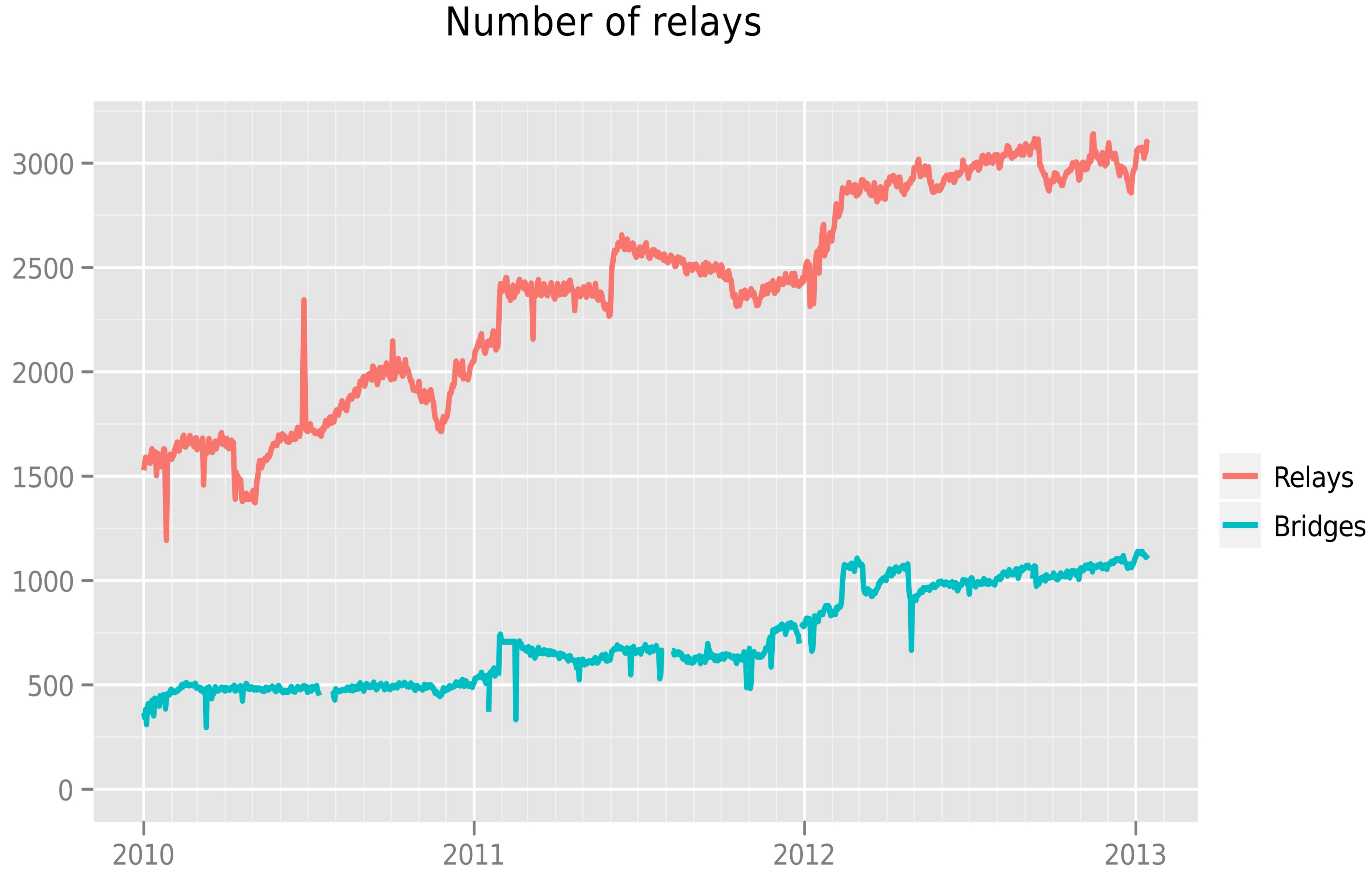


A corrupt final hop can tell that somebody is talking to Bob, but not who.



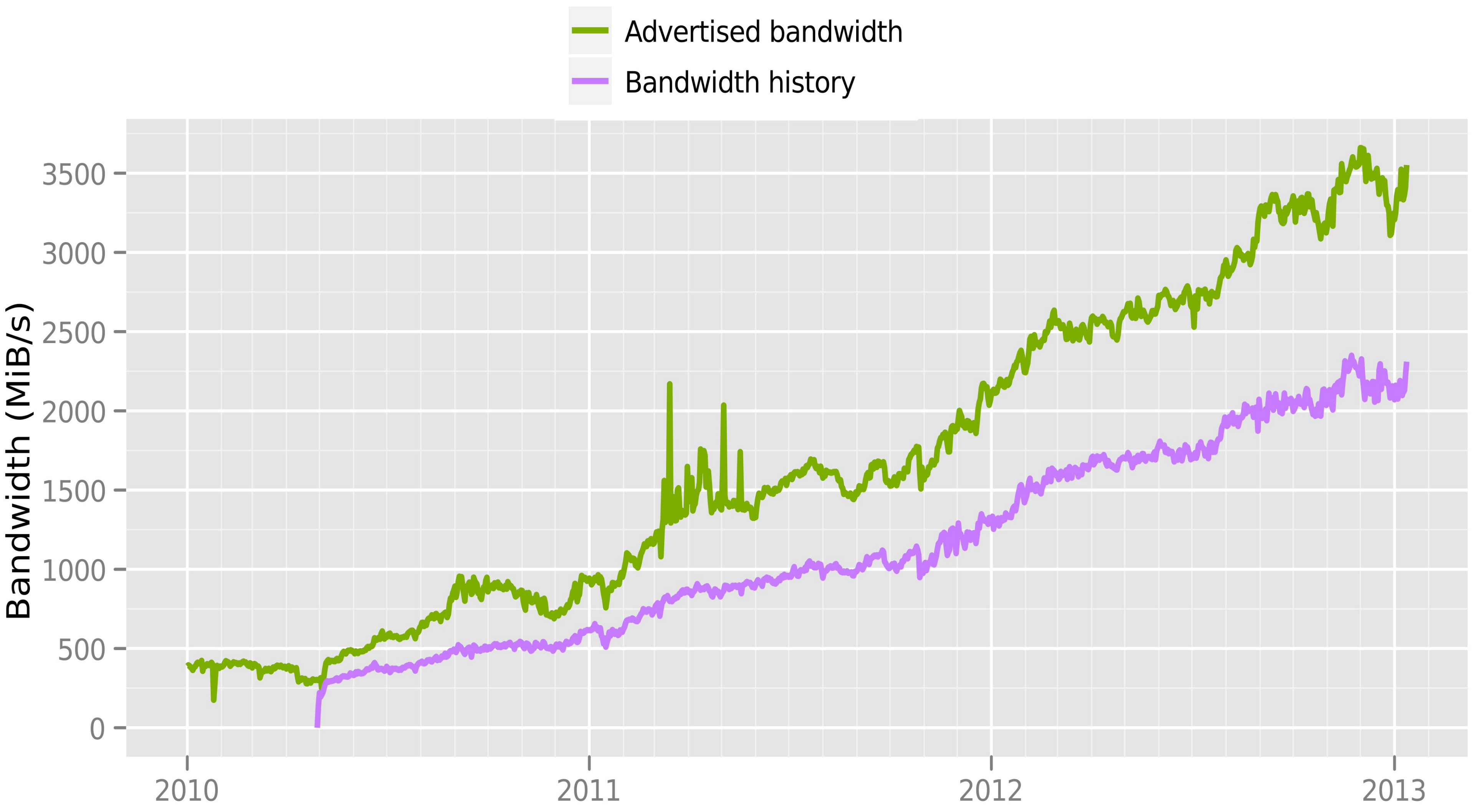
Alice makes a session key with R1 ...And then tunnels to R2...and to R3





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

Total relay bandwidth



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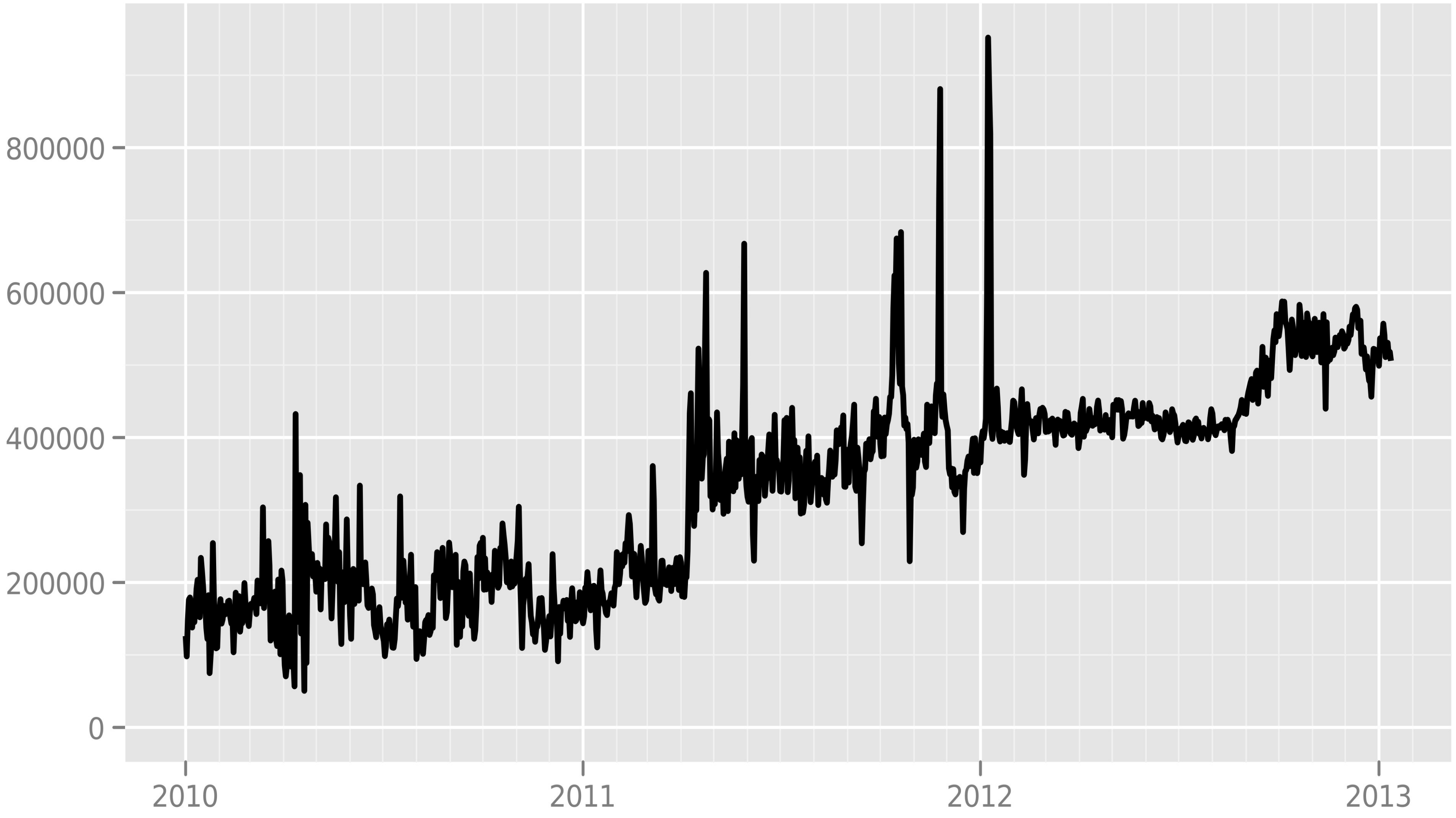
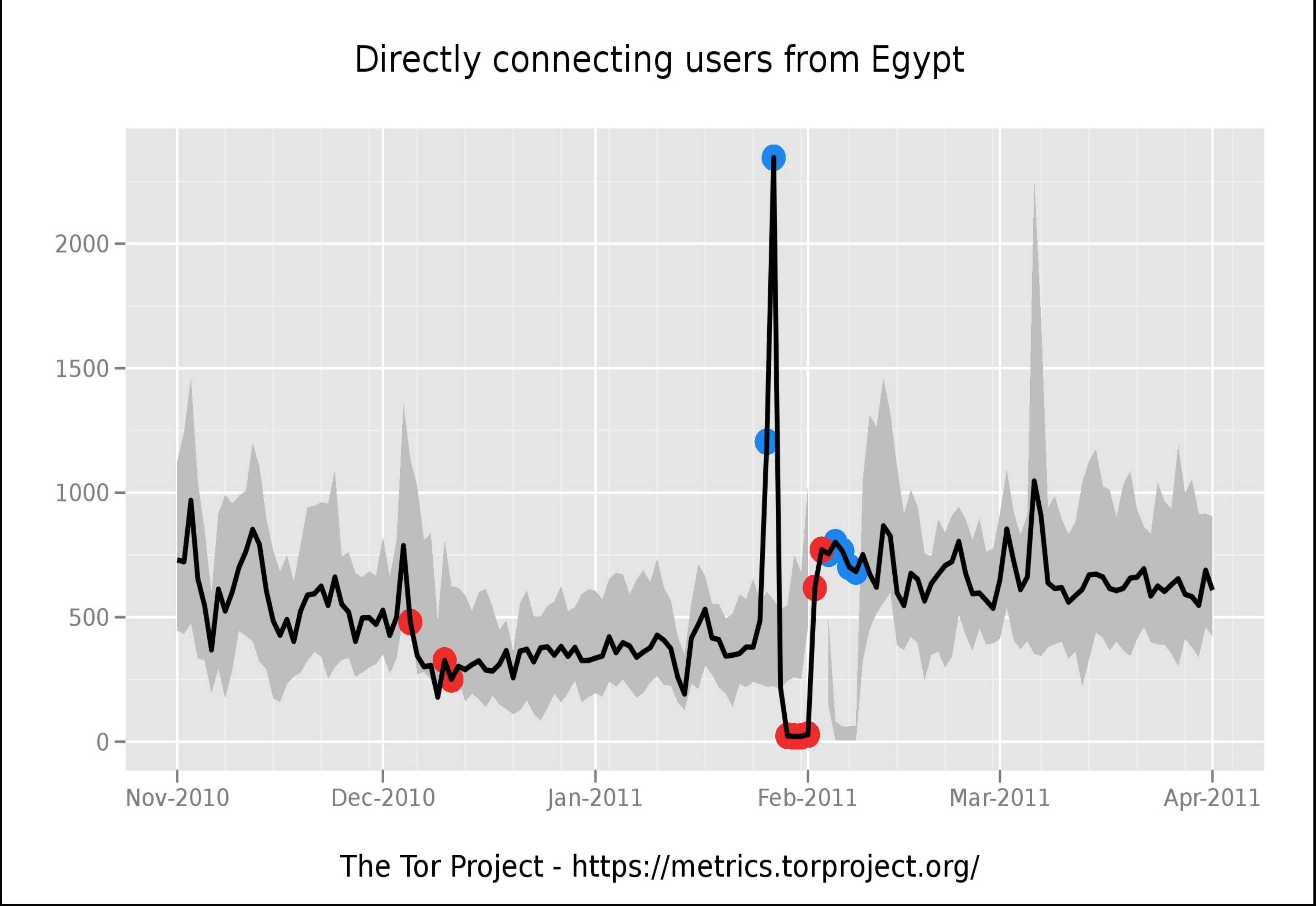
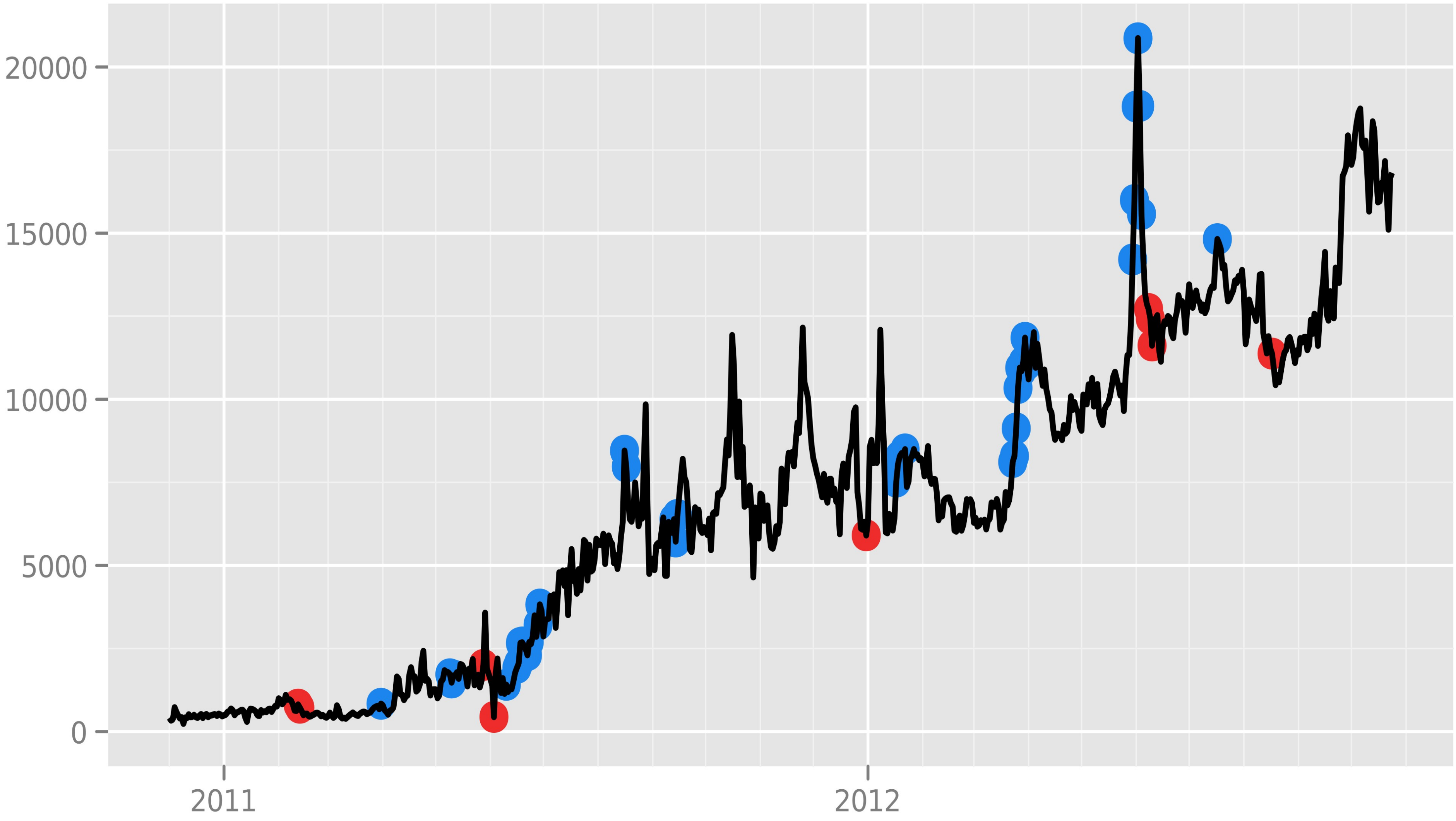
Directly connecting users from all countries



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


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/

Directly connecting users from the Syrian Arab Republic



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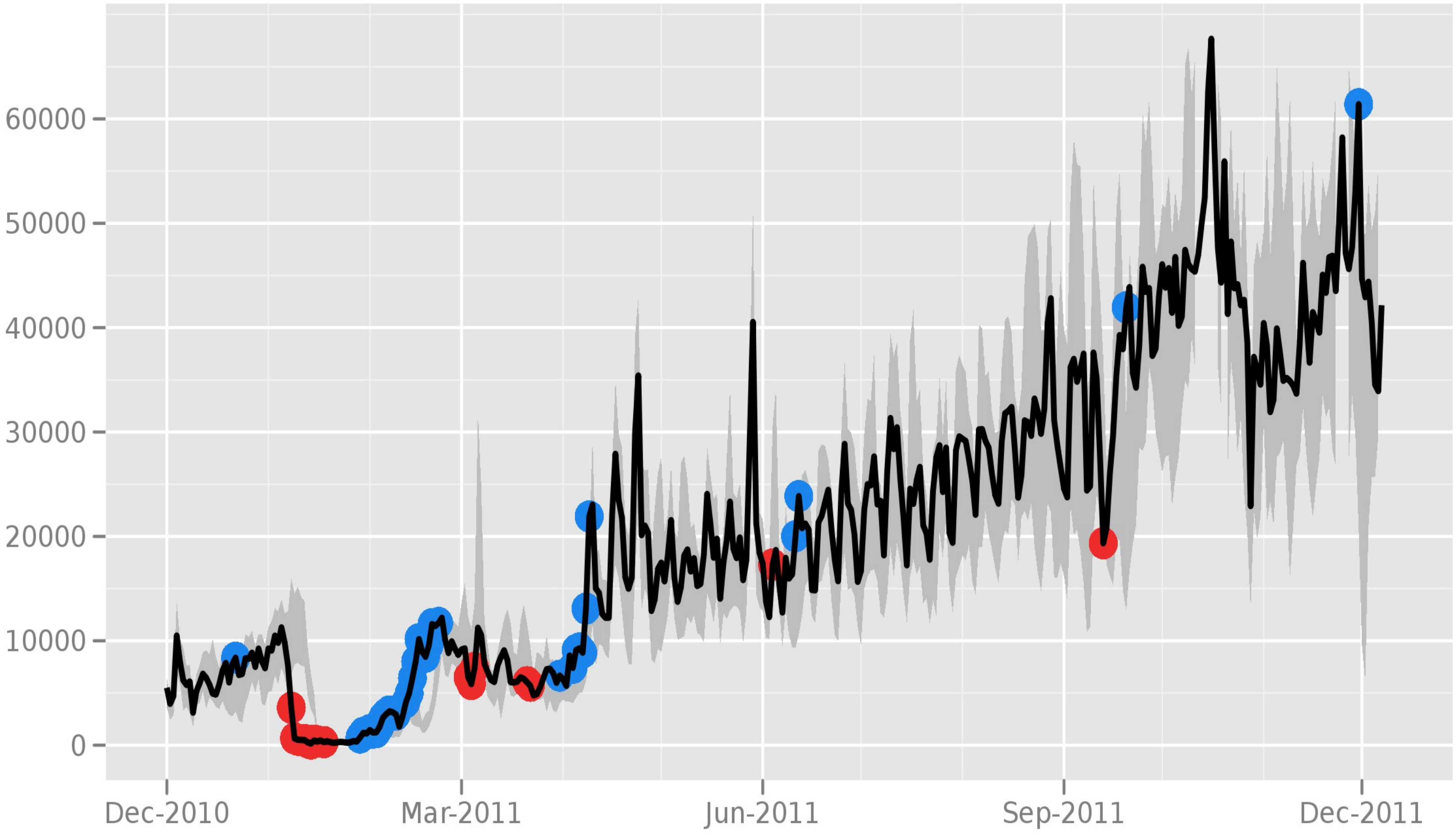
Directly connecting users from the Islamic Republic of Iran



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

What we spend our time on

Performance and scalability

Maintaining the whole software ecosystem

Blocking-resistance (circumvention)

Basic research on anonymity

Reusability and modularity

Advocacy, education, and trainings around the world

Metrics, data, and analysis

Javascript, cookies, history, etc

Javascript refresh attack

Cookies, History, browser window size, user-agent, language, http auth, ...

Our Torbutton Firefox extension tackles many of these

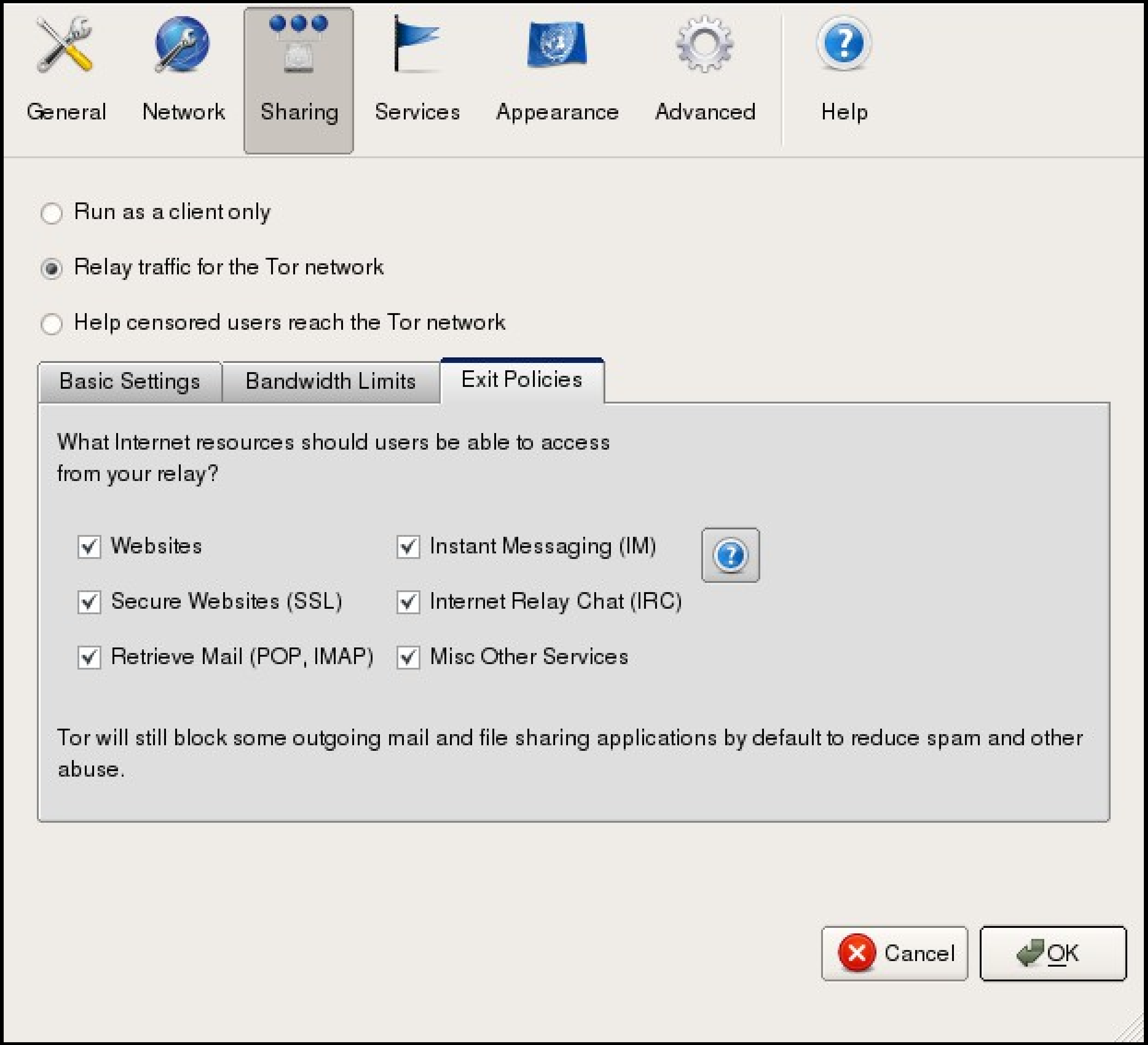
Flash is dangerous too

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, e.g. for USB stick
- Tails Linux LiveCD



○ Run as a client only

● Relay traffic for the Tor network

○ Help censored users reach the Tor network

What Internet resources should users be able to access from your relay?

☑ Websites

☑ Secure Websites (SSL)

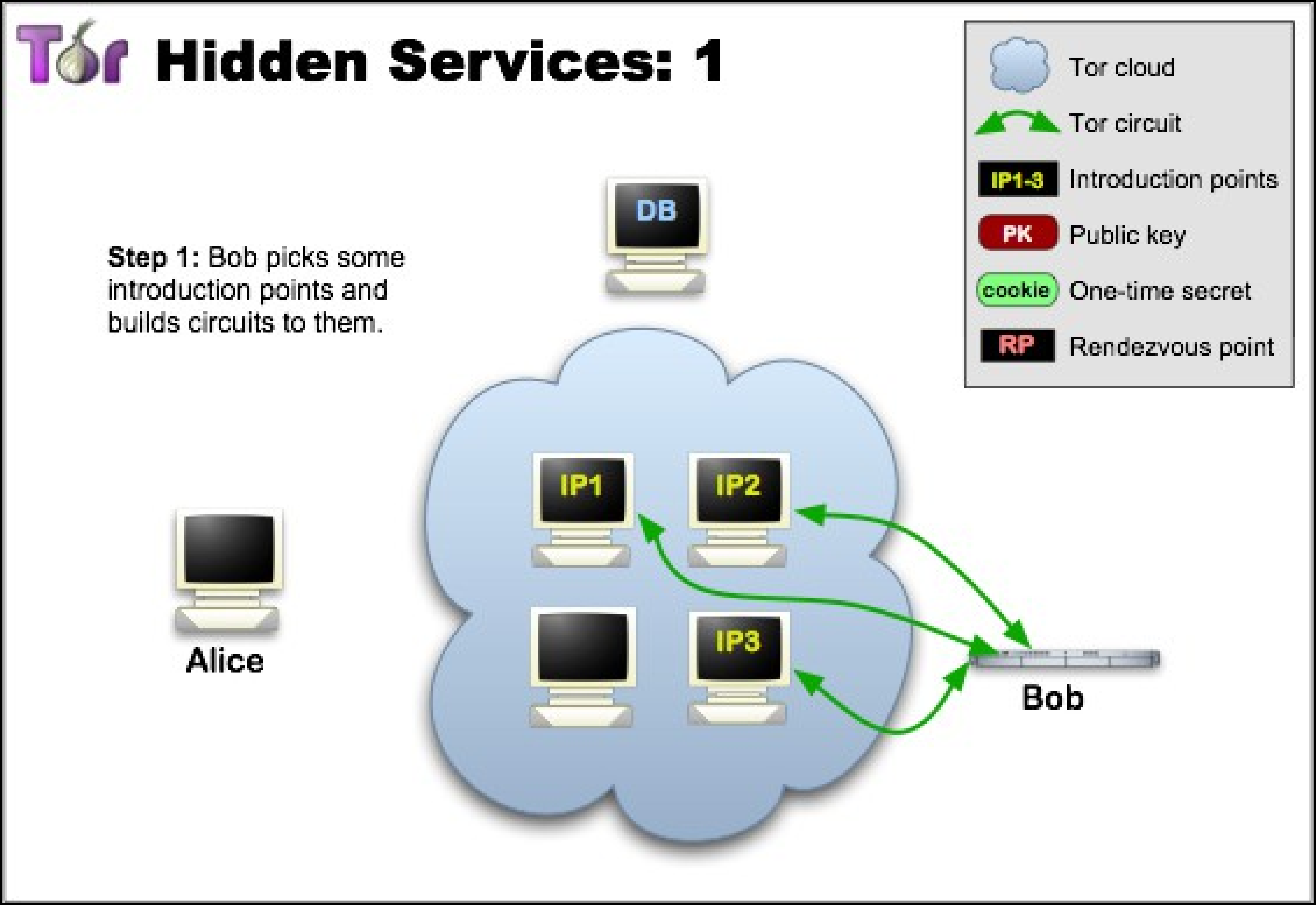
☑ Retrieve Mail (POP, IMAP)

☑ Instant Messaging (IM)

☑ Internet Relay Chat (IRC)

☑ Misc Other Services

Tor will still block some outgoing mail and file sharing applications by default to reduce spam and other abuse.

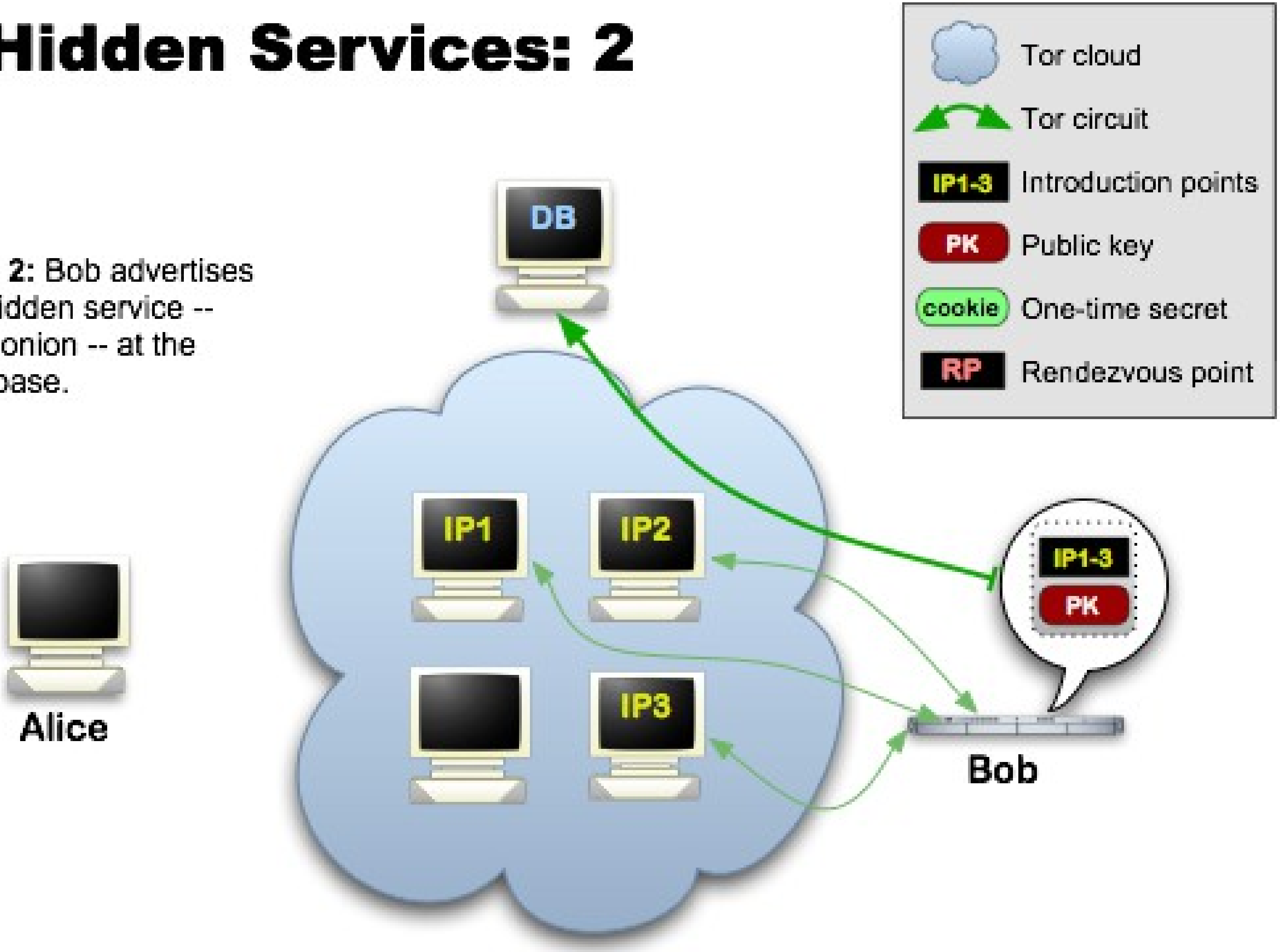


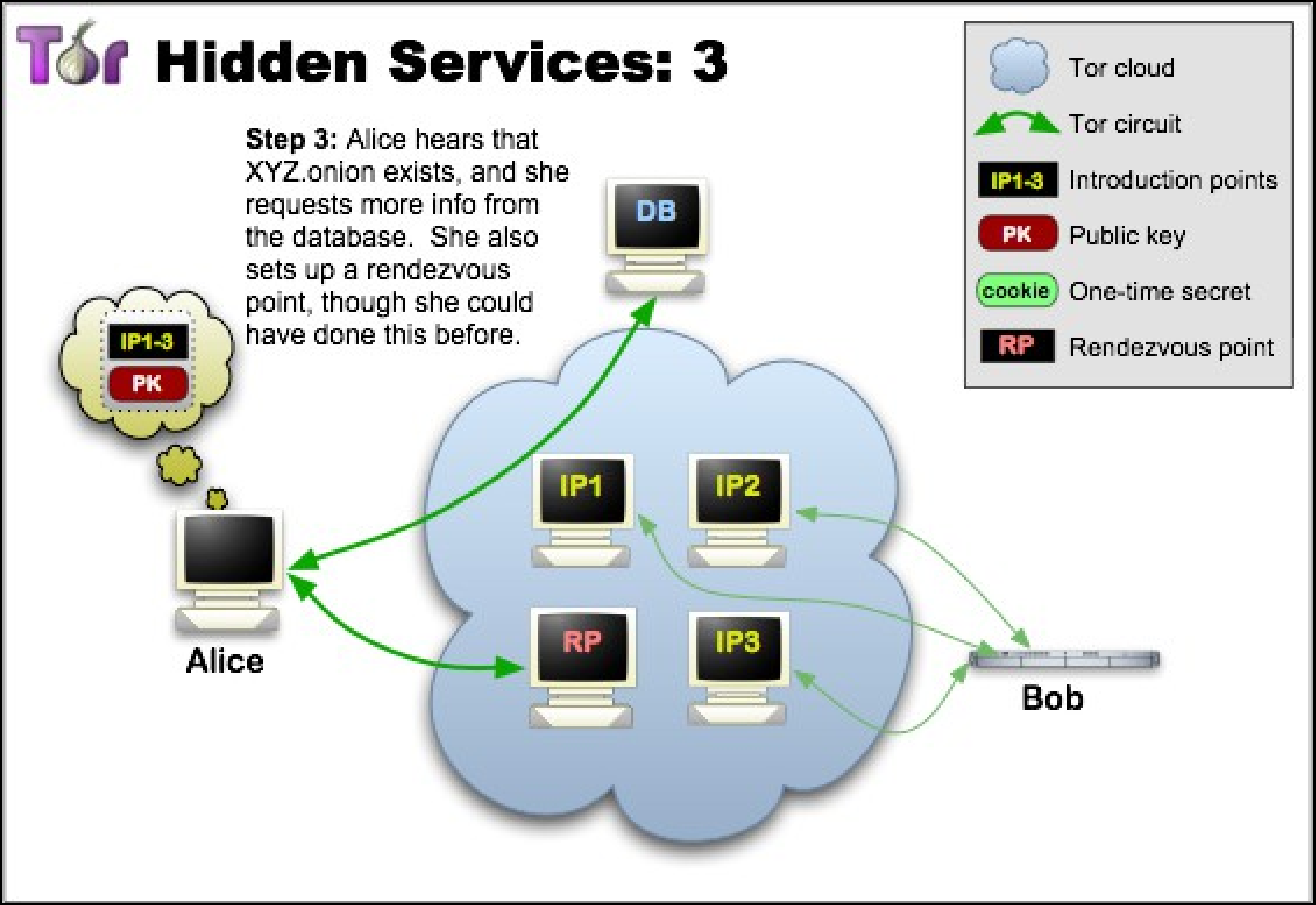
Tor Hidden Services: 1

Step 1: Bob picks some introduction points and builds circuits to them.

Tor Hidden Services: 2

Step 2: Bob advertises his hidden service -- XYZ.onion -- at the database.

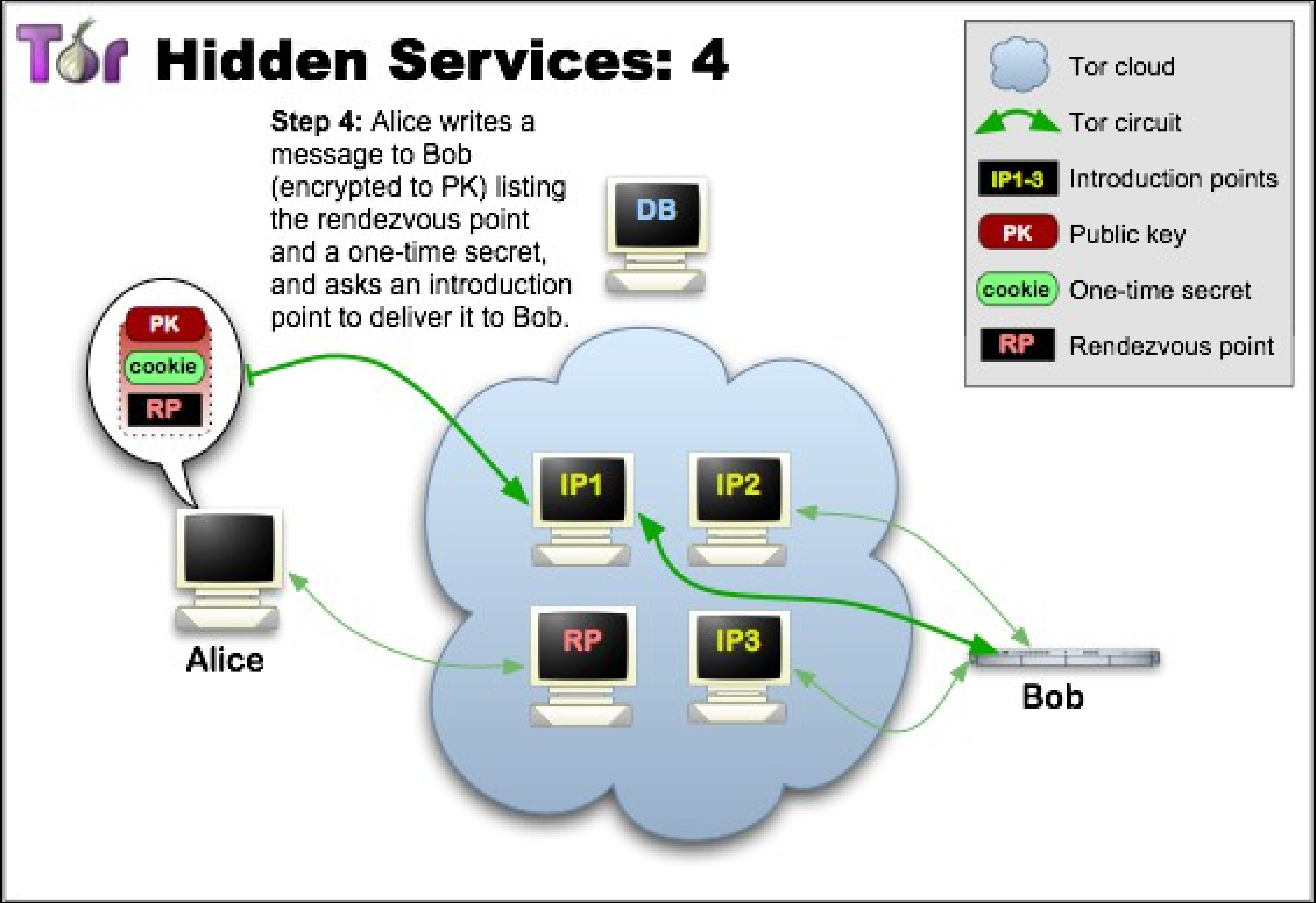




Tor Hidden Services: 3

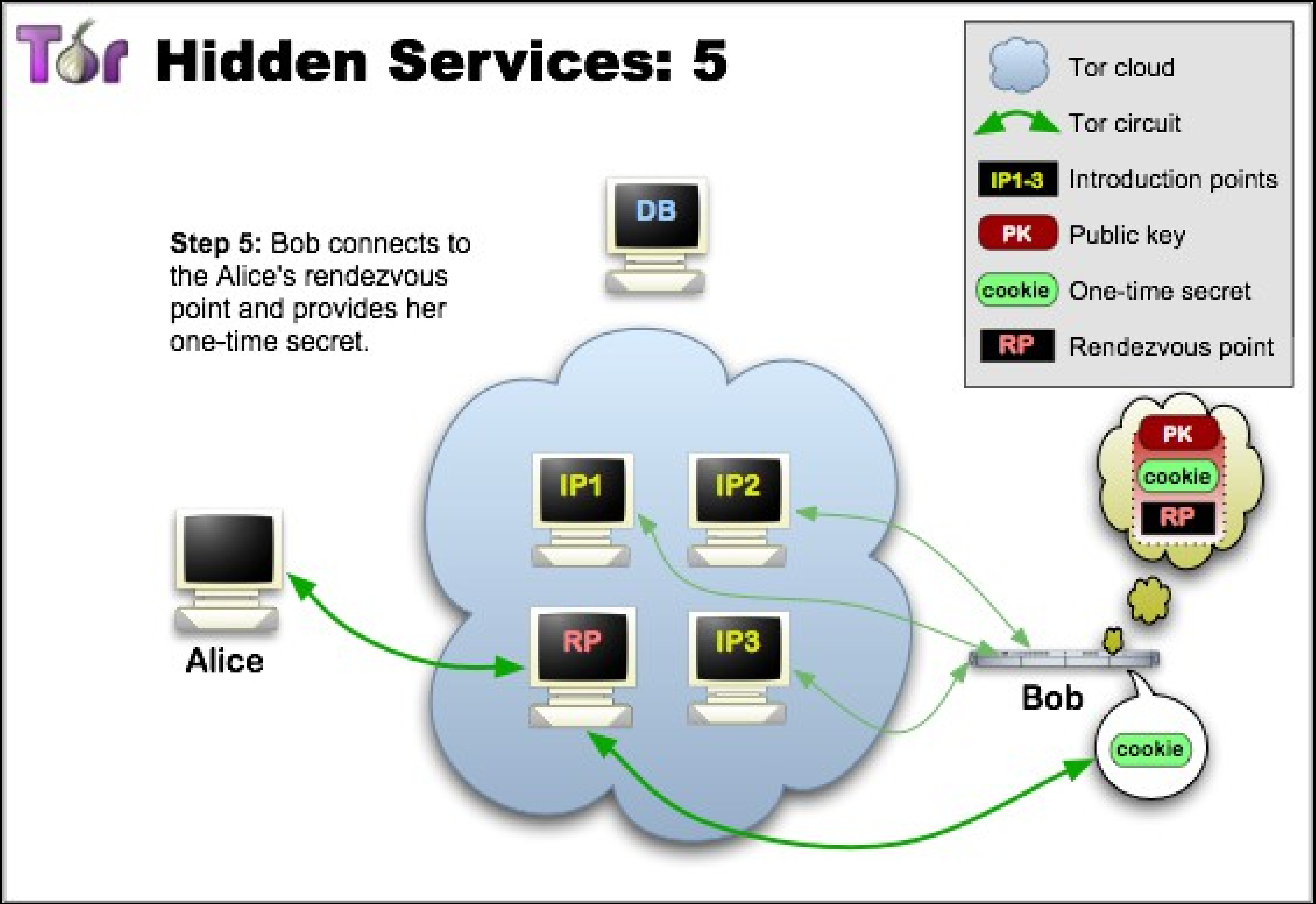
Step 3: Alice hears that XYZ.onion exists, and she requests more info from the database. She also sets up a rendezvous point, though she could have done this before.

☁	Tor cloud
⤻	Tor circuit
IP1-3	Introduction points
PK	Public key
cookie	One-time secret
RP	Rendezvous point



Tor Hidden Services: 4

Step 4: Alice writes a message to Bob (encrypted to PK) listing the rendezvous point and a one-time secret, and asks an introduction point to deliver it to Bob.



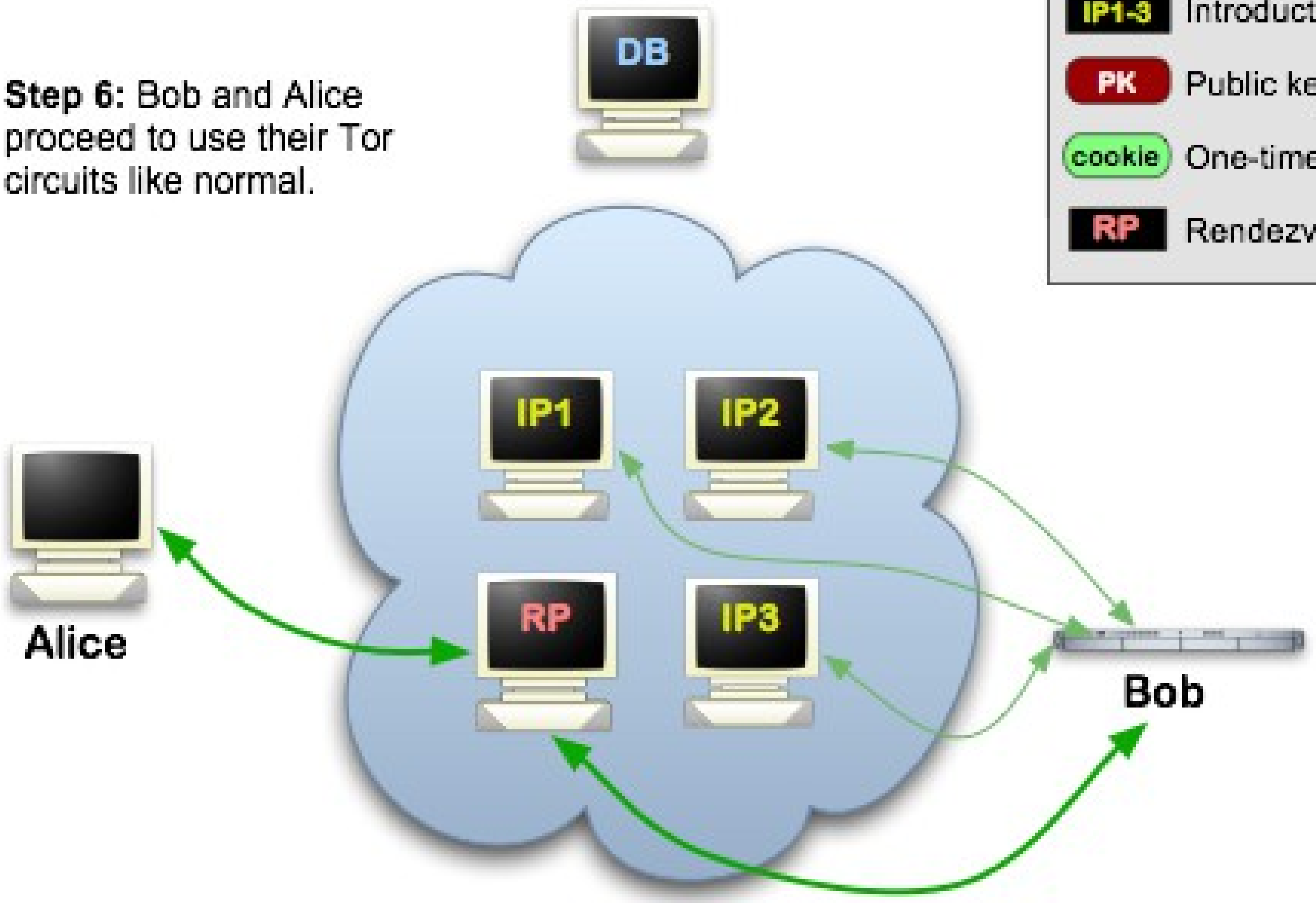
Tor Hidden Services: 5

Step 5: Bob connects to the Alice's rendezvous point and provides her one-time secret.

Hidden Services: 6

☁	Tor cloud
↔	Tor circuit
IP1-3	Introduction points
PK	Public key
cookie	One-time secret
RP	Rendezvous point

Step 6: Bob and Alice proceed to use their Tor circuits like normal.



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.

Advocacy and education

- Unending stream of people (e.g. in DC) who make critical policy decisions without much technical background
- Worse, there's a high churn rate
- Need to teach policy-makers, business leaders, law enforcement, journalists, ...
- Data retention? Internet driver's license?

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FREEDOM?
Tor
TorProject.org

Lessons?

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