Introduction to The Tor Ecosystem:

Privacy, Anonymity, and Anti-censorship

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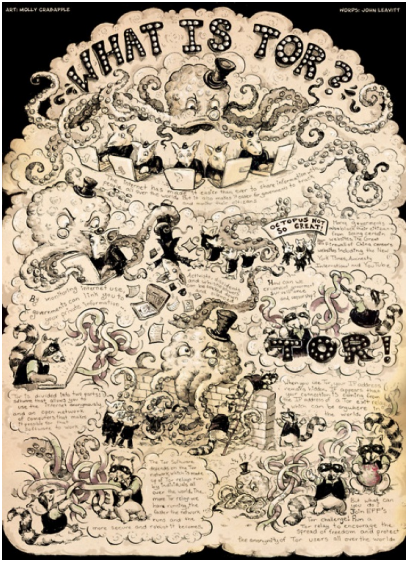
October 7, 2025

About Me

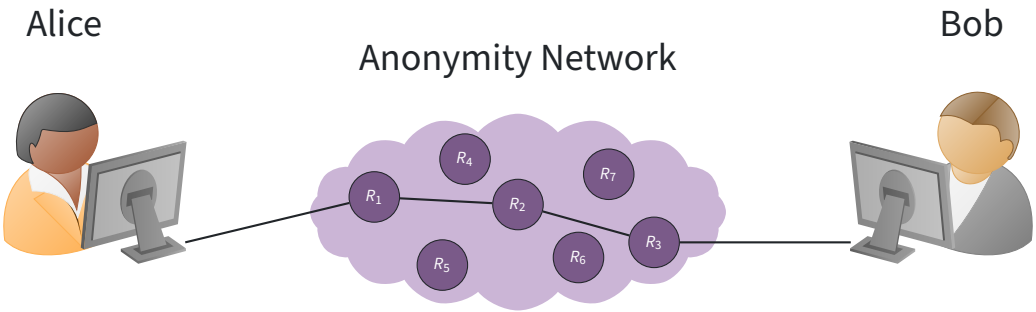
- Core Developer at The Tor Project since early 2017. Team Lead of the Network Team since late 2019.
- Free Software developer since 2006.
- Worked with distributed systems in the Erlang programming language, WebKit-based mobile browsers, embedded development, and software development consulting.

What is Tor?

- Online anonymity, and censorship circumvention.
  - Free software.
  - Open network.
- Community of researchers, developers, users, and relay operators.
- U.S. 501(c)(3) non-profit organization.

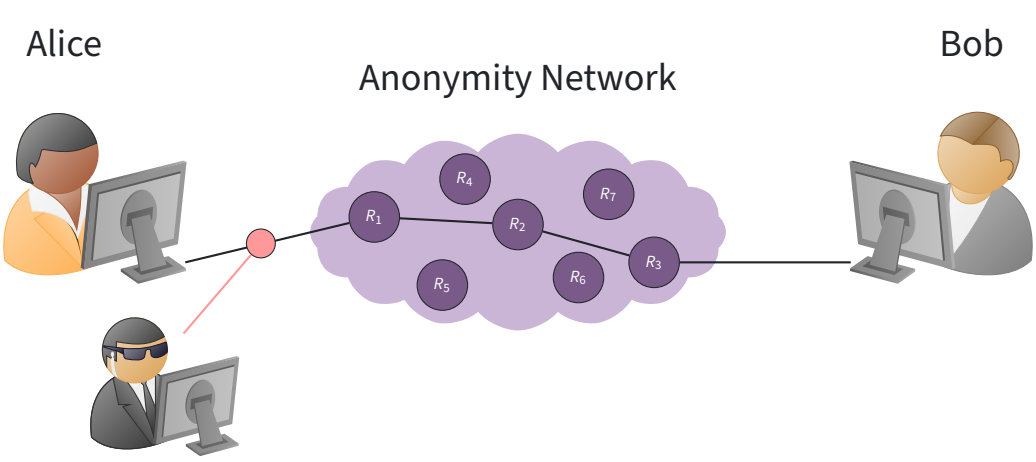


Threat Model



What can the attacker do?

Threat Model



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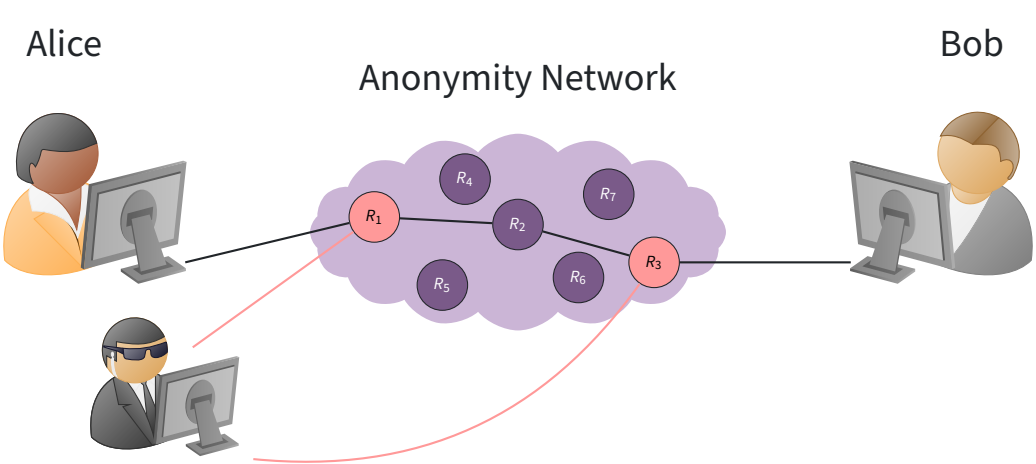

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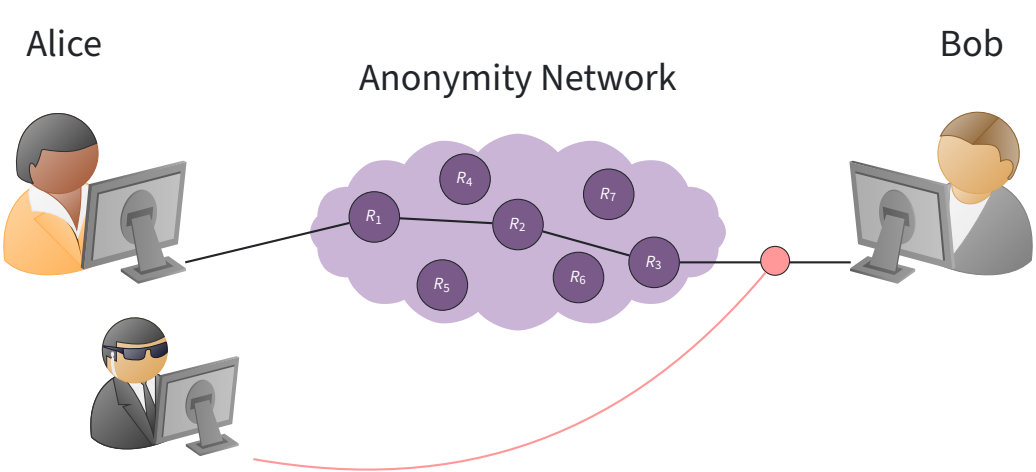

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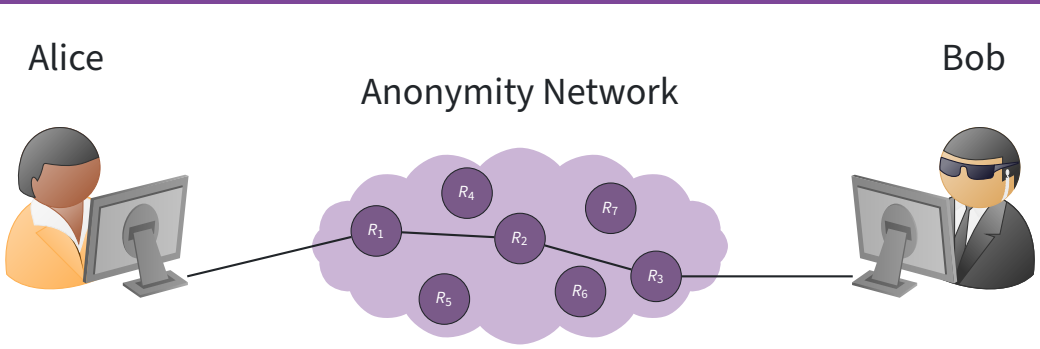
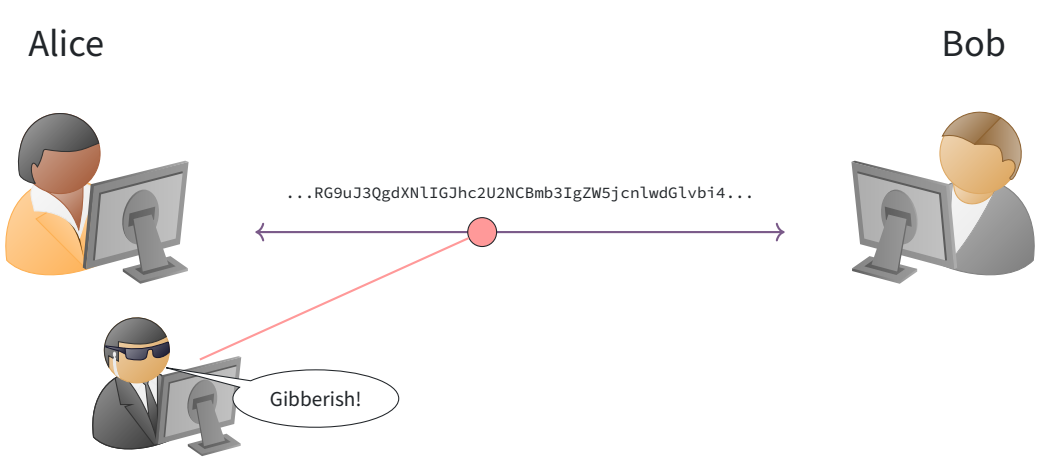


Anonymity isn't Encryption



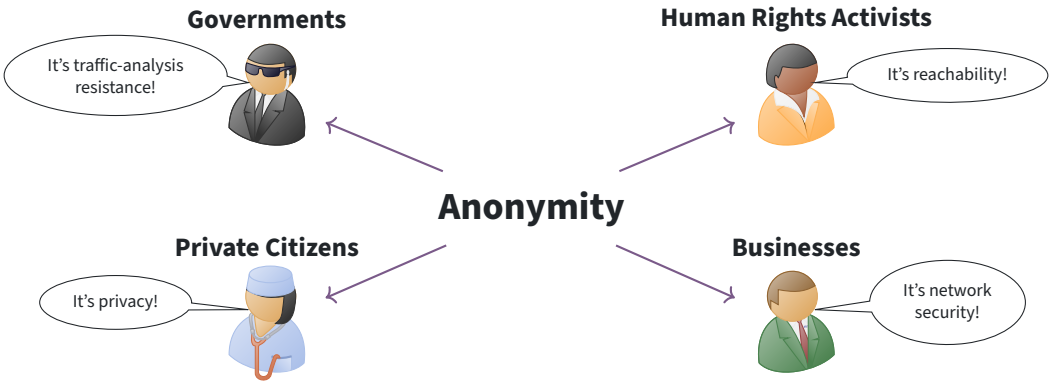
Encryption just protects contents.

Metadata

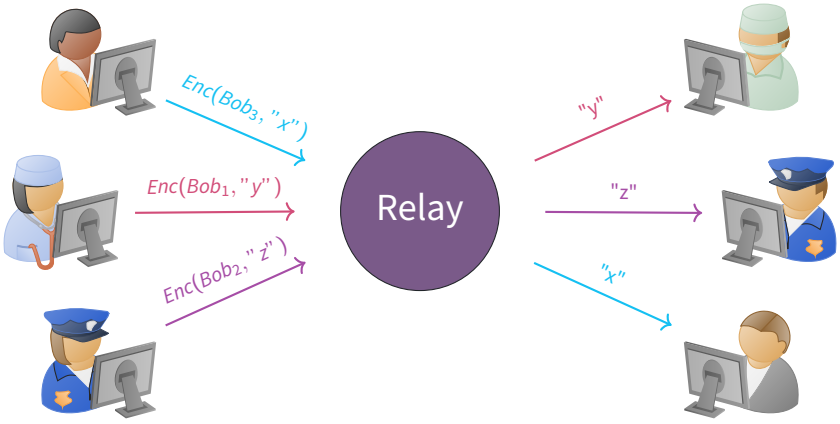
"We Kill People Based on Metadata."

—Michael Hayden, former director of the NSA.

Different Purposes of Anonymity

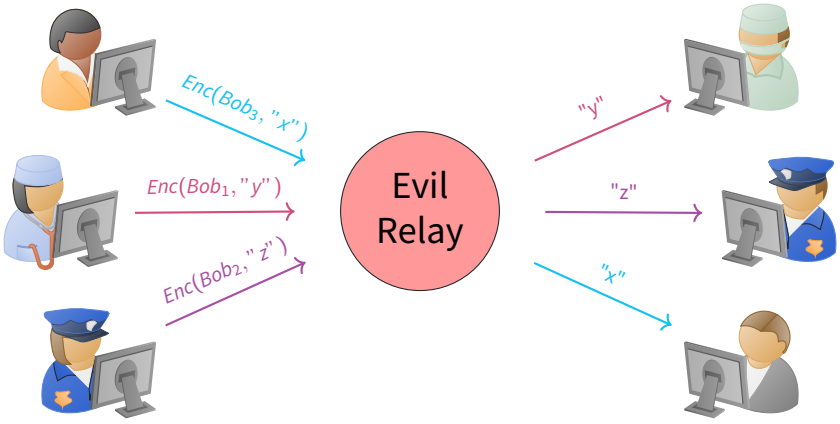


A Simple Design



Equivalent to some commercial proxy providers.

A Simple Design



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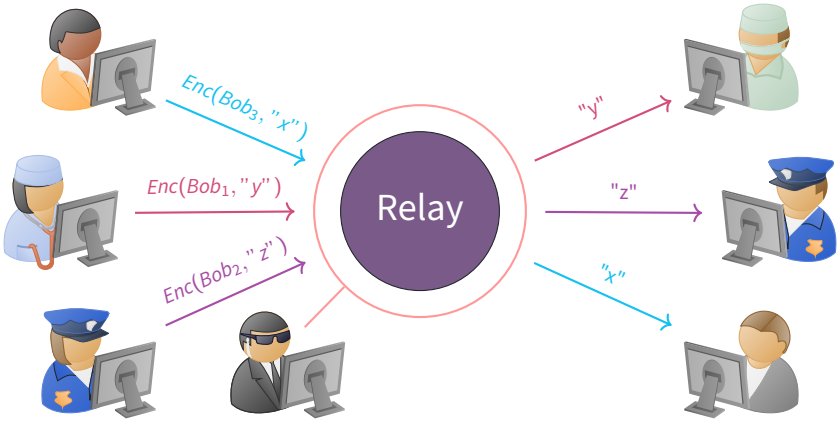
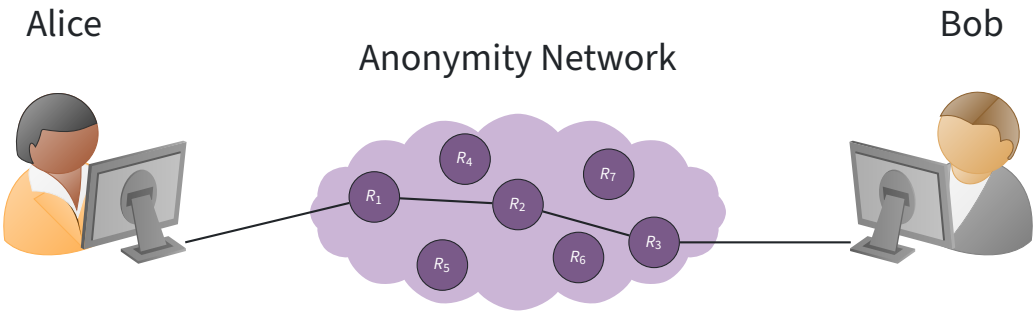


Timing analysis bridges all connections going through the relay.

The Tor Design



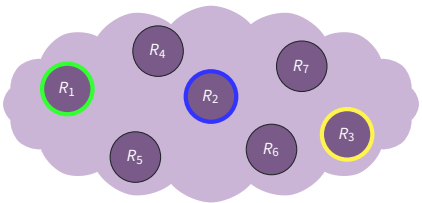
Add multiple relays so that no single relay can betray Alice.

The Tor Design

Alice

Anonymity Network

Bob



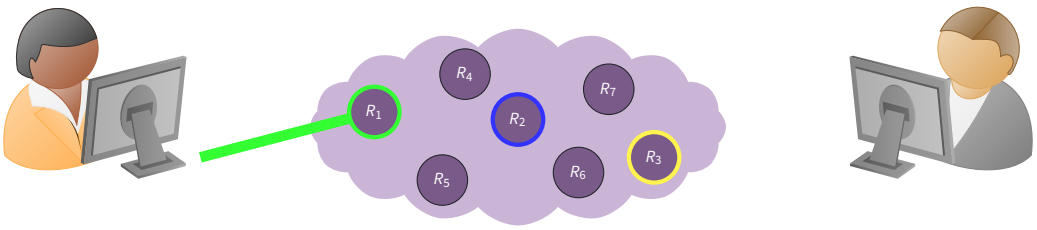
Alice picks a path through the network: R_1, R_2, and R_3 before finally reaching Bob.

The Tor Design

Alice

Anonymity Network

Bob



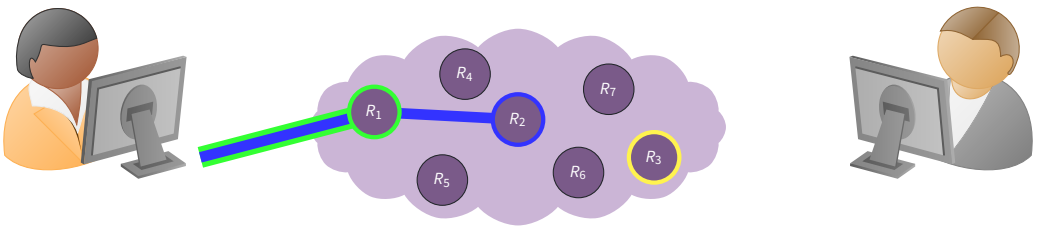
Alice makes a session key with R_1.

The Tor Design

Alice

Anonymity Network

Bob



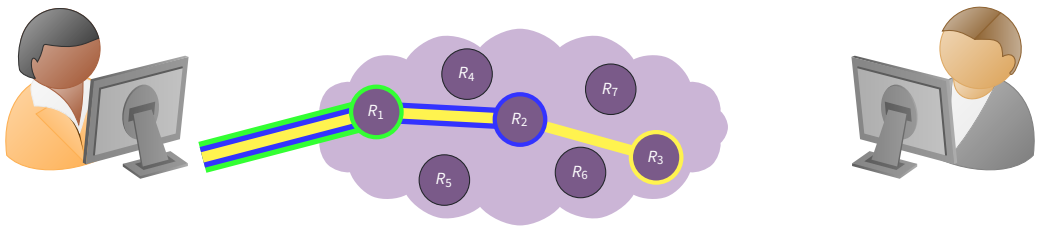
Alice asks R_1 to extend to R_2.

The Tor Design

Alice

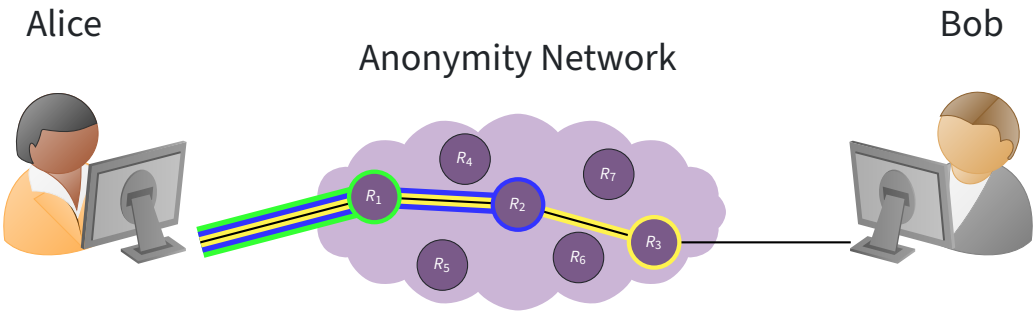
Anonymity Network

Bob



Alice asks R_2 to extend to R_3.

The Tor Design



Alice finally asks R_3 to connect to Bob.

The Tor Network

- An open network – everybody can join!
- Between 6000 and 8000 relay nodes.
- Kindly hosted by various individuals, companies, and non-profit organisations.
- 9 Directory Authority nodes and 1 Bridge Authority node.

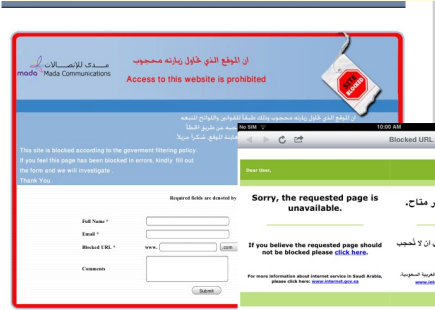
I live in Iran and I have been using Tor for censorship circumvention. During political unrest while the government tightens grip on other censorship circumvention alternatives, **Tor with obfuscation plugins remains the only solution.**

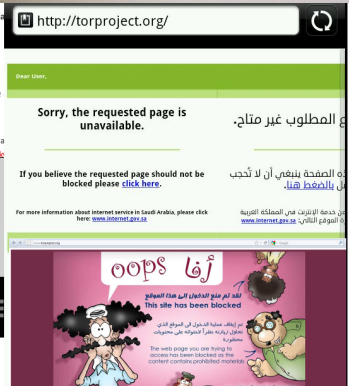
Tor changed my personal life in many ways. **It made it possible to access information on Youtube, Twitter, Blogger and countless other sites.** I am grateful of Tor project, people working on it as well as people running Tor nodes.

—Anonymous Tor User.

Access Denied

our request was denied because of its content categorization: "Computers/Internet;Proxy Avoida





Du var på vej ind på en ulovlig hjemmeside

Vi vil meget gerne hjælpe dig med at finde den film eller serie, du søger.

Søg med FilmFinder →

Hvis du er på udkig efter musik, bøger eller møbler

Gå til SHARE WITH CARE →

SHARE WITH CARE

Hjemmesiden er blevet blokeret, fordi den er dømt ulovlig ved en dansk domstol. Brug Share With Care til at finde det, du leder efter, lovligt. På den måde passer du både på dig selv og på kulturen. **Læs mere om Share With Care**

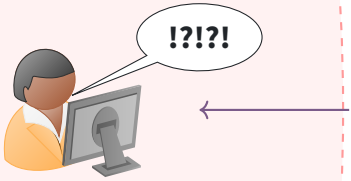
Kulturministeriet · RettighedsAlliancen · TI Tele Industrien · DI Digital

Introduction to Censorship

Censored Region

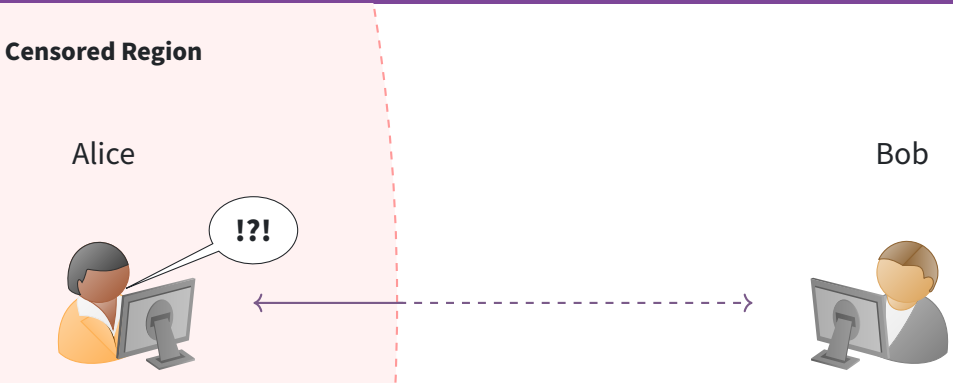
Alice

Bob



Alice is unable to reach Bob.

Introduction to Censorship



Alice can reach Bob, but their connection is throttled.

Introduction to Censorship

Censored Region

Alice

Bob

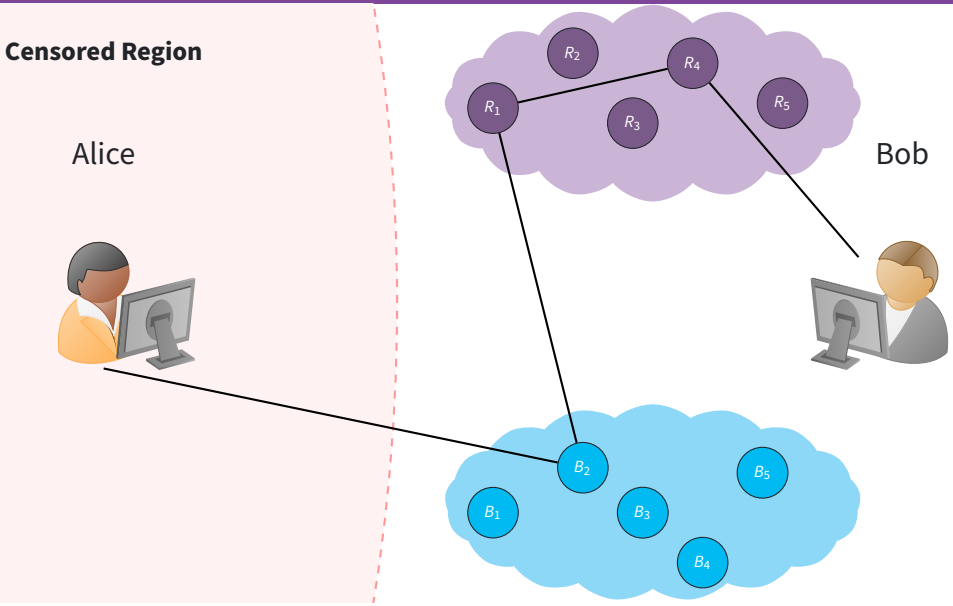
Alice can reach Bob because the censor thinks Bob is fine.

Anti-censorship Strategies

1. Censors will apply censorship to **all** relays in the network and effectively block access to the Tor network.
2. Censors will apply censorship to **known** bridges.

Solution: We make it difficult to find and block bridges and we make it difficult to learn if a given connection is between a Tor user and an entry-point into the Tor network.

Bridges



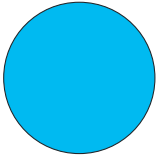
Bridges

Censored Region

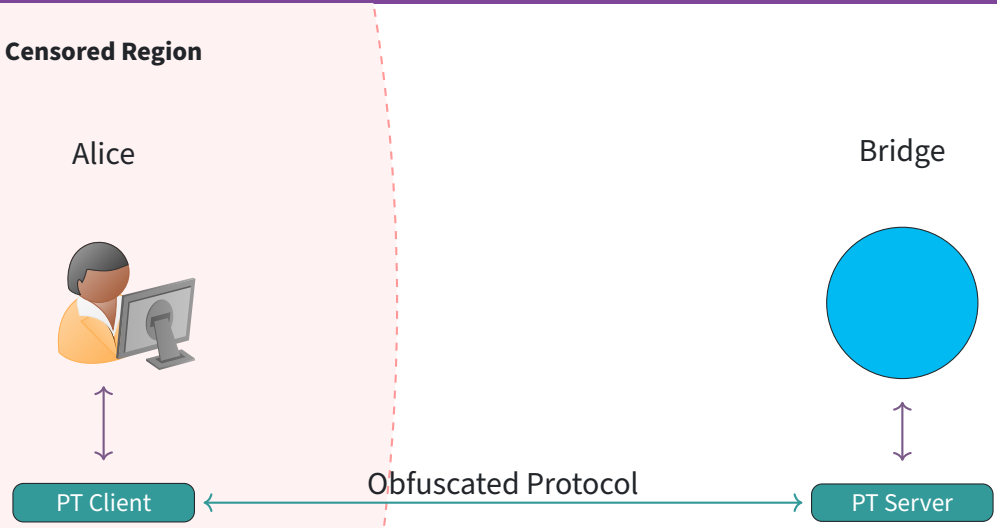
Alice

Tor Protocol

Bridge



Bridges and Pluggable Transports



Pluggable Transports

- Allows people to easily build, experiment, and deploy their own obfuscation technology without having to modify the Tor source code itself.
- The specification for Pluggable Transports is open and allows other vendors to implement support for PTs in their own products.
- Allows people to experiment with different transports for Tor that might not be doing any anti-censorship related obfuscation.

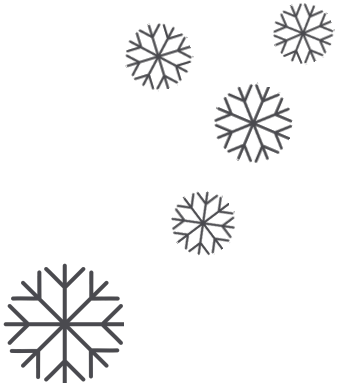
Snowflake

Censored Region

Alice

Snowflake PT Client

Snowflake Broker



Bridge

Snowflake PT Server

Snowflake

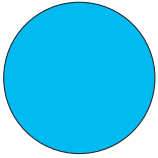
Censored Region

Alice

Snowflake PT Client

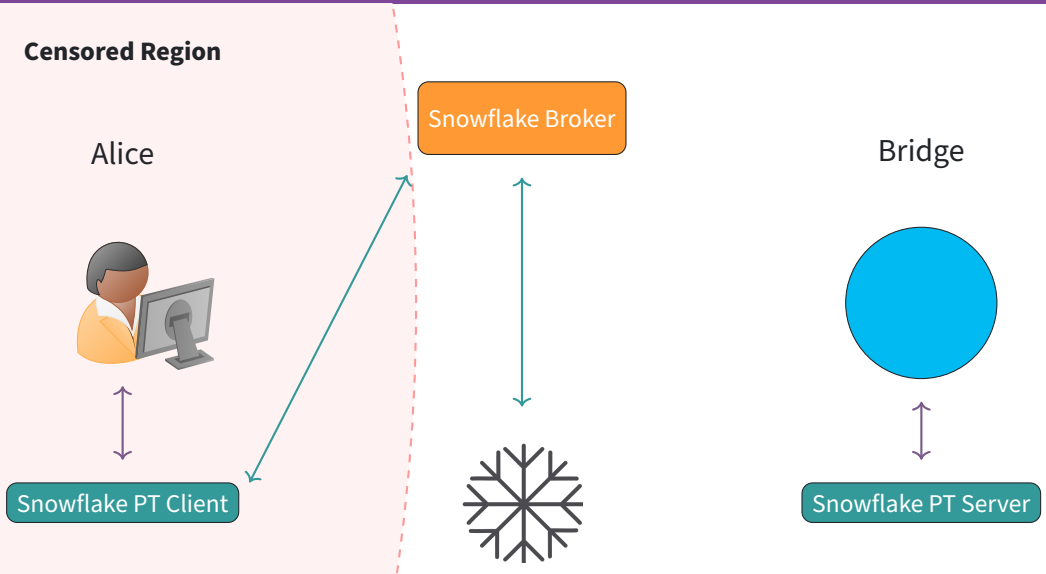
Snowflake Broker

Bridge



Snowflake PT Server

Snowflake


Censored Region
Alice
Snowflake Broker
Bridge
Snowflake PT Client
Snowflake PT Server

Snowflake

Censored Region

Alice

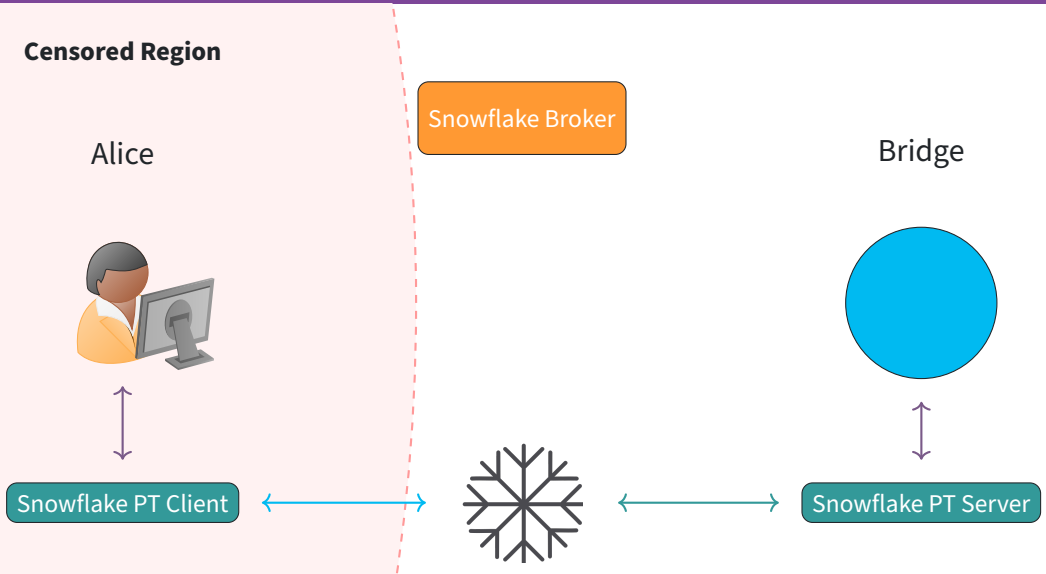
Snowflake PT Client

Snowflake Broker

Bridge

Snowflake PT Server

Snowflake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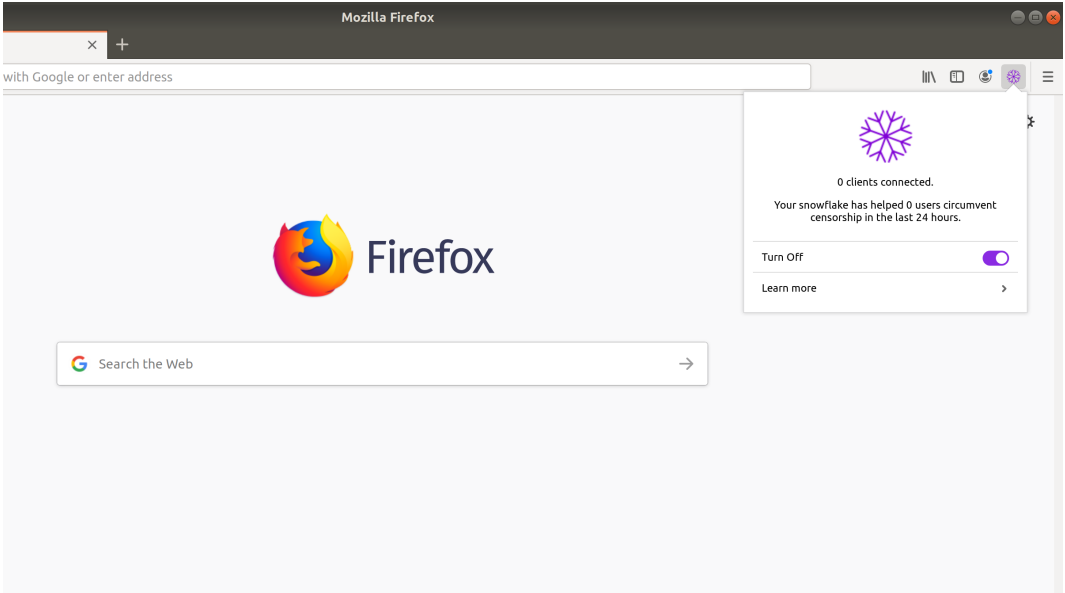
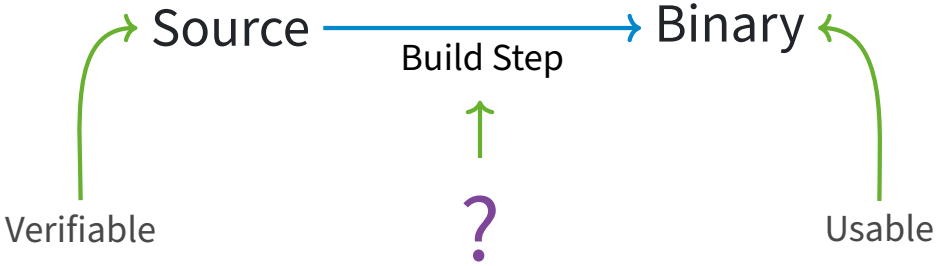
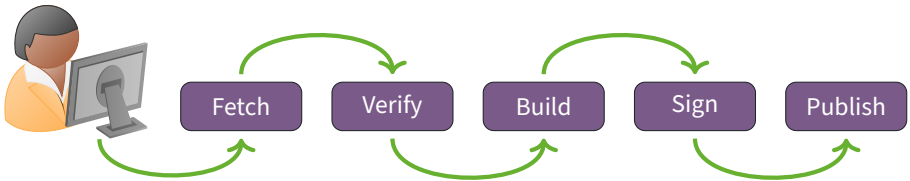

Mozilla Firefox
with Google or enter address
0 clients connected.
Your snowflake has helped 0 users circumvent censorship in the last 24 hours.
Turn Off
Learn more
Firefox
Search the Web

Reproducible Builds

Reproducible Builds



Build Process



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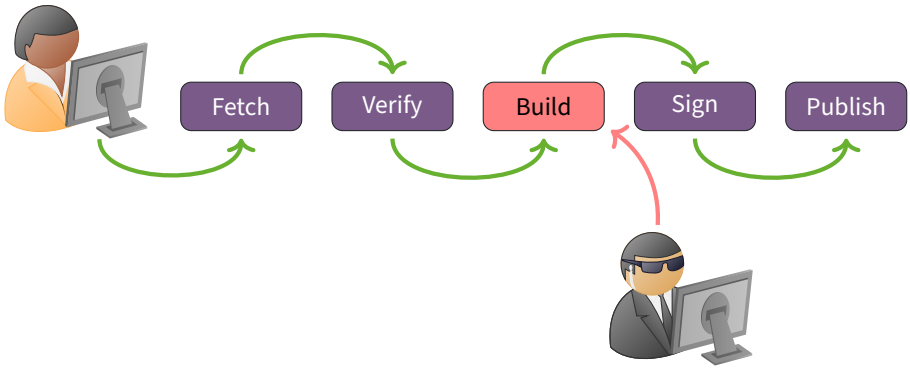

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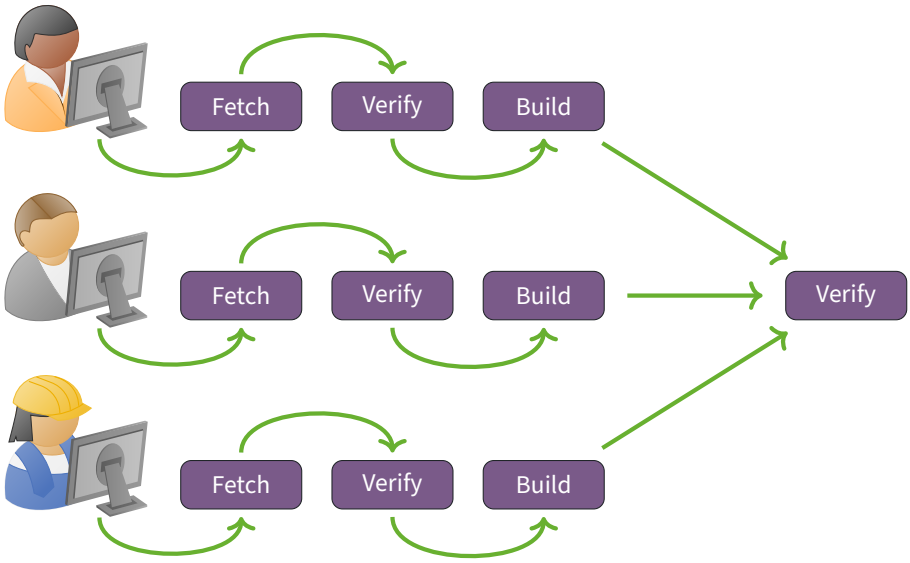
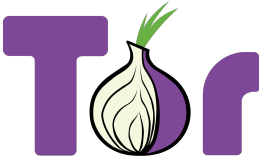


Reproducible Builds



Reproducible Builds Problems

Common problems includes:

- Timestamps as part of the build process.
- Usernames.
- Locale settings.
- Host settings (such as hostname and IP).

Tor is not foolproof

- Browser metadata fingerprinting.
- Browser exploits.
- Traffic analysis.
- Operational security mistakes.

How can you help?

- Find, and maybe fix, bugs in Arti.
- Run a Tor relay or a bridge!
- Teach others about Tor and privacy in general.
- Work on some of the many open research projects.

Questions?

ahf@torproject.org

- ahf @ Funding the Commons Discord

OpenPGP:
`1C1B C007 A9F6 07AA 8152`
`C040 BEA7 B180 B149 1921`

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@ahf.me

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