Anonymity & Censorship-free Communication

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Who needs anonymity?

- Military personnel
- Law enforcement
- Bloggers
- Activists and whistle-blowers
- Ordinary people
BBC Horizon
Encryption doesn’t work

TLS, PGP, S/MIME only hide what is being said

- Alice uploaded a gigabyte to CNN 6 hours before footage of human rights abuses were aired
- Bob, who just joined our criminal organization sent an encrypted email to the FBI a week before our boss got arrested
- Charlie keeps browsing our website of illegal material, maybe we should give him fake data?
Remailers


- Simply stripped headers off emails sent via remailer
- Allowed replies to be sent
- Easy to use, but single point of compromise
- Shut down following compromise by CoS

Type-1 (Cypherpunk)

- Mix decrypts messages
- Uses PGP
- CAST5 & ElGamal

Mixmaster (1998–)

- Layered encryption
- Batching and re-ordering
- Based on Chaum Mix (1981)
- 3DES & RSA (PKCS #1 v1.5)

Mixminion (2002–)

- Fixed many problems
- Introduced replies
- AES, SHA-1, RSA OPEAP
- LIONESS wide-block cipher to resist tagging
penet.fi (1993-1996)

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messages

A

For D

K_{pub}

Mix

K_{priv}

B

For C

K_{pub}

D

C

Jamal
CAST5 & ElGamal

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There is no one security criterion for anonymity.

Quantifying and Measuring Anonymity, Murdoch
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Quantifying and Measuring Anonymity, Murdoch
Number of users \approx 0

The Web

Fixed many problems
Introduced replies
AES, SHA-1, RSA OEAP
LIONESS wide-block cipher to resist tagging
The Web

Web browsing is hard to secure

- Requires low latency
- High variability
- Low tolerance to padding

Equivalent systems

Open proxies ≈ penet.fi
VPN (IPSEC) ≈ Type-0
MixMinion ≈ Tor
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Open proxies ≈ penet.fi
VPN (IPSEC) ≈ Type-0
MixMinion ≈ Tor
Link encryption
- Confidentiality and integrity
- Weak resistance to traffic analysis
- Cryptography (not so useful now)
- TLS configured in similar way to web browser and client (RSA-1024
  authenticating EC DH P-256 & AES)
- Server to client authenticated
- (client to server uses custom auth)

Circuit encryption
- Cannot explain ciphertext so as to hide
  path length without padding
- AES CTR, with no MAC (possible?)
- Keys negotiated using IITM algorithm
- One-way authenticated Diffie
  Hellman (possibly)
- Curve25519 elliptic curves
- Cells contain Circuit ID
Link encryption

- Confidentiality and integrity
- Weak resistance to traffic analysis
- Covertness (not so useful now)
- TLS configured in similar way to web browser and client (RSA-1024 authenticating ECDH P-256 & AES)
- Server to client authenticated
- (client to server uses custom auth)
Link encryption
- Confidentiality and Integrity
- Weak resistance to traffic analysis
- Sender-recipient stealth (not so useful now)
- TLS configured in similar way to web browser and client (RSA-1024
  authenticating EC DH P-256 & AES)
- Two-way client authentication
- [Client to server uses custom auth]

Circuit encryption
- Cannot expand ciphertext so as to hide
  path length without padding
- AES CTR, with no MAC (possible)
- Keys negotiated using SSH algorithm
- One-way authenticated Diffie
- Elliptic (secp)
- Curve25519 elliptic curves
- Cells contain Circuit ID
Circuit encryption

- Cannot expand ciphertext so as to hide path length without padding
- AES CTR, with no MAC (malleable)
- Keys negotiated using nTor algorithm
  - One-way authenticated Diffie Hellman (approx.)
  - Curve25519 elliptic curves
- Cells contain Circuit ID
E2E encryption

- E2E MAC verified by exit node
- When MAC is verified to end of the path has been reached
- Some bits set to zero to optimise the check
- Payload contains command, Stream ID and data
Directory crypto

- List of nodes and their public keys maintained by 8 directory authorities
- Consensus algorithm to create agreed set and together signed with RSA-2048
- Each node signs descriptor with RSA-1024
- Will be moving to ED25519 to replace RSA-1024 and 2048
Node selection for security and performance

Metrics for Security and Performance in Low-Latency Anonymity Systems, Murdoch and Watson
The Web

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Equivalent systems

Open proxies ≈ penet.fi
VPN (IPSEC) ≈ Type-0
MixMinion ≈ Tor
Censorship resistance
Recurring, directly connecting Chinese Tor users (past 180 days)
Get Bridges!

BridgeDB can provide bridges with several types of Pluggable Transports, which can help obfuscate your connections to the Tor Network, making it more difficult for anyone watching your internet traffic to determine that you are using Tor.

Some bridges with IPv6 addresses are also available, though some Pluggable Transports aren’t IPv6 compatible.

Additionally, BridgeDB has plenty of plain-ol’-vanilla bridges — without any Pluggable Transports — which maybe doesn’t sound as cool, but they can still help to circumvent internet censorship in many cases.

Just give me bridges!
Chinese Tor users via bridges (past 180 days)
Fingerprinting and developing blocking rules

Abuse

Unreal Tournament 2004 lends incontestable proof to John Gabriel's Greater Internet Fuckwad Theory.

Normal Person + Anonymity + Audience = Total Fuckwad

3.67% of the most popular 1,000 websites block Tor


Connections before complaint remain anonymous

\[ t_0 \quad \times \quad t_1 \quad t_2 \quad t_3 \]

Future connections from the same user are linkable, and the user is blocked

\[ t_4 \quad t_5 \]

Server complains about ticket \( t_1 \) and recieves linking token for misbehaving user

Nymble
Unreal Tournament 2004 lends incontrovertible proof to John Gabriel's Greater Internet Fuckwad Theory.

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Shitcock
3.67% of the most popular 1,000 websites block Tor


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Connections before complaint remain anonymous

\[ t_0 \rightarrow t_1 \rightarrow t_2 \rightarrow t_3 \]

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\[ t_4 \rightarrow t_5 \]

Server complains about ticket \( t_1 \) and receives linking token for misbehaving user

Nymble
Sustainability

Incentives

- Many users are unable to pay (tragedy of the commons)
- Giving better performance to users who contribute could reduce anonymity
- If money is changing hands, volunteers may give up
Financial Review

Tor's fiscal 2012 marked another year of financial improvement and stability. The Tor Project has seen steady revenue growth since its inception. Since meeting the revenue milestones of $1,253,241 in 2009, $1,574,119 in 2010 and $1,681,101 in 2011, Tor has reached new heights in 2012 with over $2 million in revenue (unaudited). Fiscal 2012 results also provided a new financial achievement, for the first time since inception: The Tor Project Inc. had net operating income. Tor's revenue growth was driven by diversity in funding sources which include U.S. government federal funding, Knight Foundation, SRI International, Google, the Swedish International Development Cooperative Agency, and private donations, among others.

Fiscal responsibility is important to the Tor Project Inc. In order to maintain financial stability, Tor maintains cash reserves sufficient to maintain operations for a minimum of 90 days. Tor is proud to report that, since 2009, over 80% of its revenue has been directed towards spending on programs.

As plans for 2013 commence, Tor will continue to improve and expand revenues to expand research and development efforts.

The accounts and financial statements of the Tor Project are maintained in accordance with generally accepted principles in the United States. Our audits are performed in accordance with government auditing standards and in accordance with OMB A133 which requires a higher level of assurance with respect to compliance and internal controls. Tor is proud to report that in both fiscal 2010 and 2011, we obtained an unmodified audit opinion and had no compliance or internal control findings.

To view Tor's audited financial reports visit www.torproject.org/about/financials.
stability. The Tor Project reported $1,681,101 in 2011, and in revenue (unaudited) for the first
2011 Expenses

- Program Services: 86%
- Management and General: 11%
- Fundraising: 4%
Tor's fiscal 2012 marked another milestone of $1,250,000. Fiscal 2012 revenue growth time since income.

### 2011 Income
- Contributions: 4%
- U.S. Government based income: 60%
- Foundation and Other Grants: 18%
- Donated Services: 18%
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Juice Media Rap News
September 2012
THIS IS WHAT A Tor SUPPORTER LOOKS LIKE

DAN ELLSBERG AND PATRICIA MARK ELLSBERG, PRIVACY ACTIVISTS

#SUPPORTTor
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