Tor:
Anonymous Communications for the Dept of Defense...and you.

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The Free Haven Project

http://tor.eff.org/

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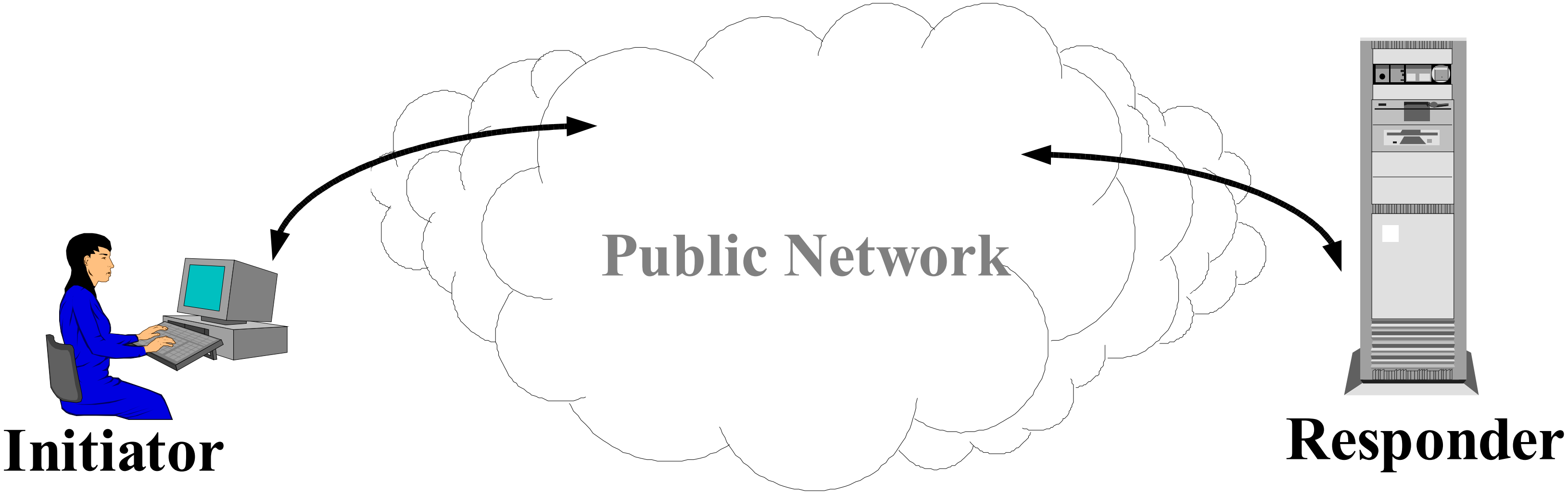
Talk Outline

- Motivation: Why anonymous communication?
  - Myth 1: This is only for privacy nuts.
  - Myth 2: This stuff enables criminals.
- Tor design overview
- Hidden servers and rendezvous points
- Policy issues raised
- Open technical issues and hard problems

Public Networks are Vulnerable to Traffic Analysis

- In a Public Network (Internet):
- Packet (message) headers identify recipients
- Packet routes can be tracked



Encryption does *not* hide routing information.

Who Needs Anonymity?

- Journalists, Dissidents, Whistleblowers (indymedia, victimpower)
- Censorship resistant publishers/readers (libraries)
- Socially sensitive communicants: (Diabetes people, grouphug)
  - Chat rooms and web forums for abuse survivors, people with illnesses
- Law Enforcement: (In-q-tel, Nye Kripos)
  - Anonymous tips or crime reporting
  - Surveillance and honeypots (sting operations)
- Corporations: (Google, Wal-Mart, ...)
  - Who's talking to the company lawyers? Are your employees looking at monster.com?
  - Competitive analysis
- Governments (hiding procurement patterns, web requests...)

Anonymity Loves Company

- You can't be anonymous by yourself
  - *Can* have confidentiality by yourself

- A network that protects only DoD network users won't hide that connections from that network are from Defense Dept.

- You must carry traffic for others to protect yourself

- But those others don't want to trust their traffic to just one entity either. Network needs *distributed trust*.

- Security depends on diversity and dispersal of network.

Who Needs Anonymity?

- And yes criminals

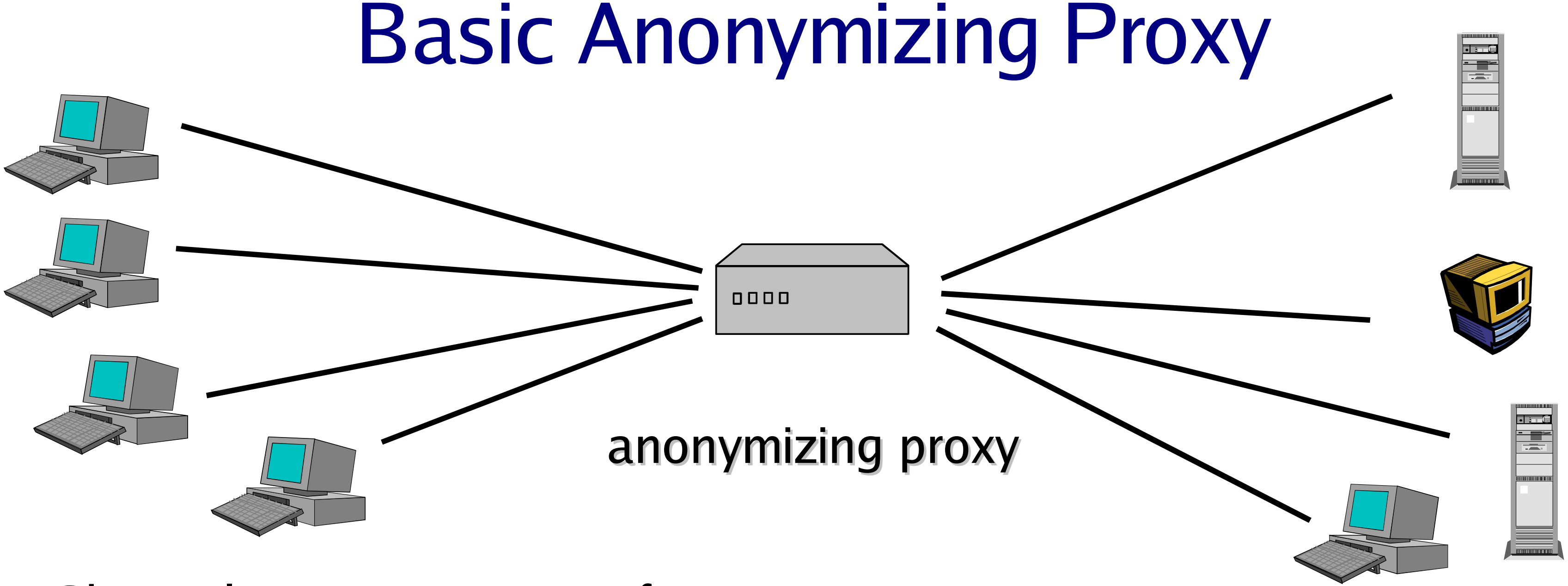
Who Needs Anonymity?

- And yes criminals

But they already have it.
We need to protect everyone else.

Focus of Tor is anonymity of the communication pipe, not what goes through it

Basic Anonymizing Proxy



- Channels appear to come from proxy, not true originator
- Appropriate for Web connections, etc.:
  SSL, TLS, SSH (lower cost symmetric encryption)
- Examples: The Anonymizer
- Advantages: Simple, Focuses lots of traffic for more anonymity
- Main Disadvantage: Single point of failure, compromise, attack

Tor

Tor

The Onion Routing

Tor

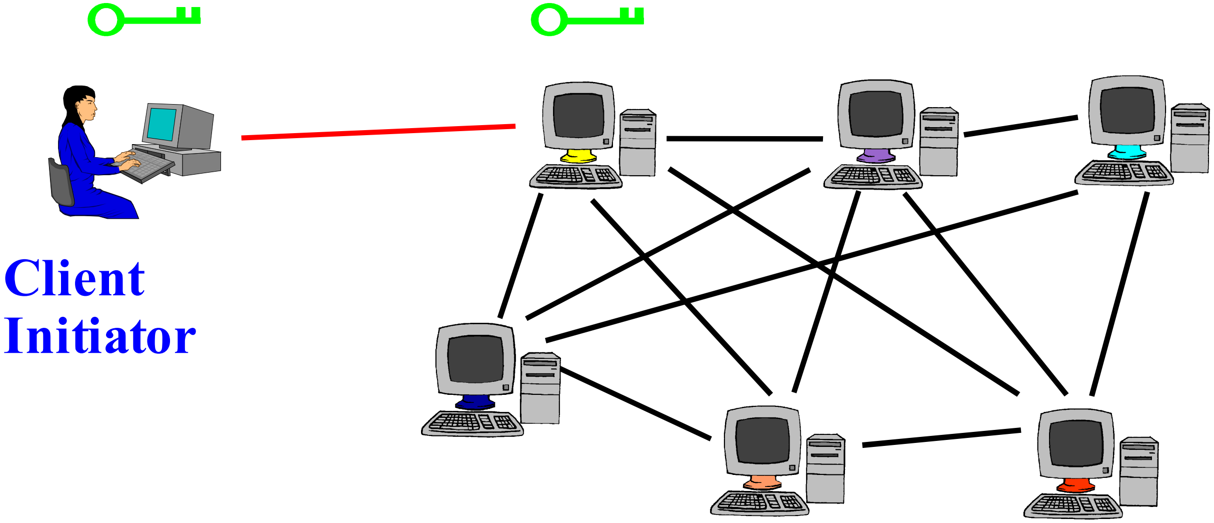
Tor's Onion Routing

Numbers and Performance

- Running since October 2003
- 150 nodes on five continents (North America, South America, Europe, Asia, Australia)
- Twenty thousand+ (?) users
- Nodes process 1-90 GB / day application cells
- Network has never been down

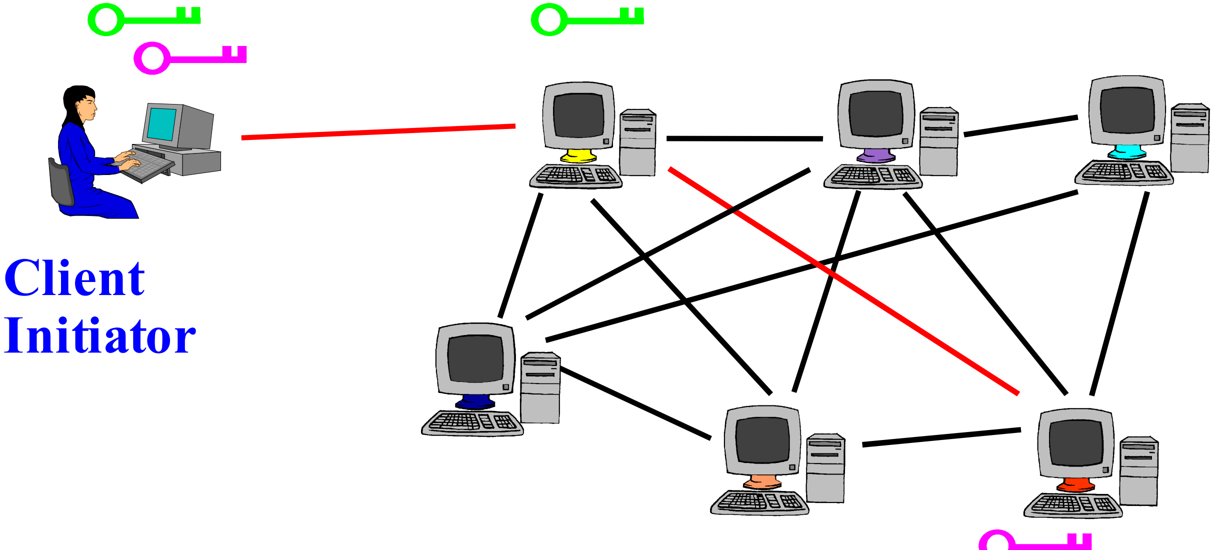
Tor Circuit Setup

- Client Proxy establishes session key + circuit w/ Onion Router 1



Tor Circuit Setup

- Client Proxy establishes session key + circuit w/ Onion Router 1
- Proxy tunnels through that circuit to extend to Onion Router 2



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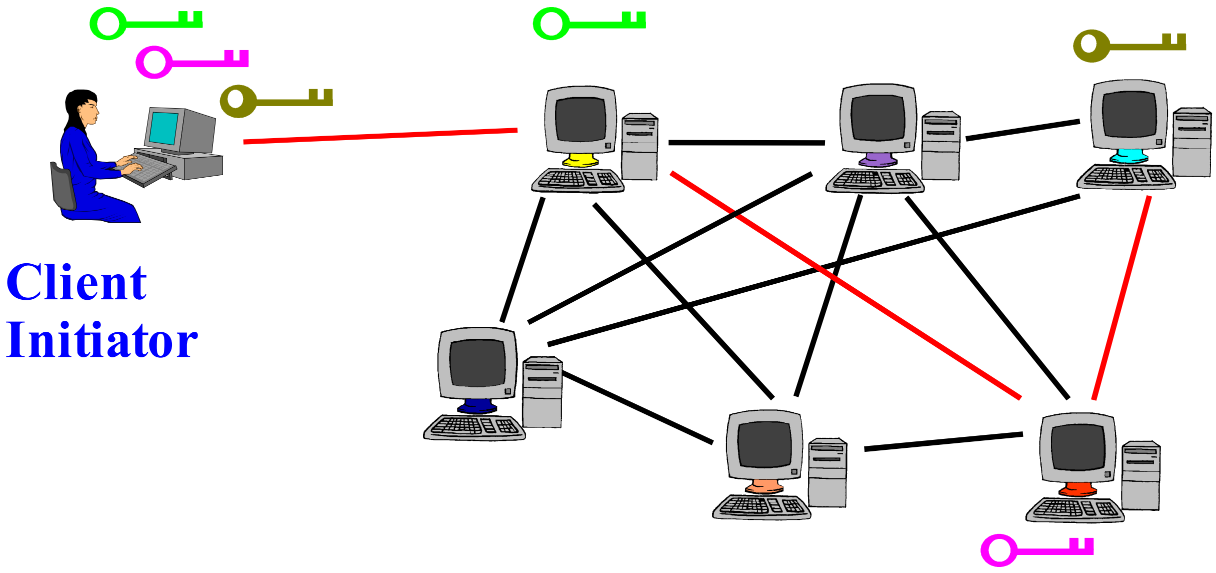

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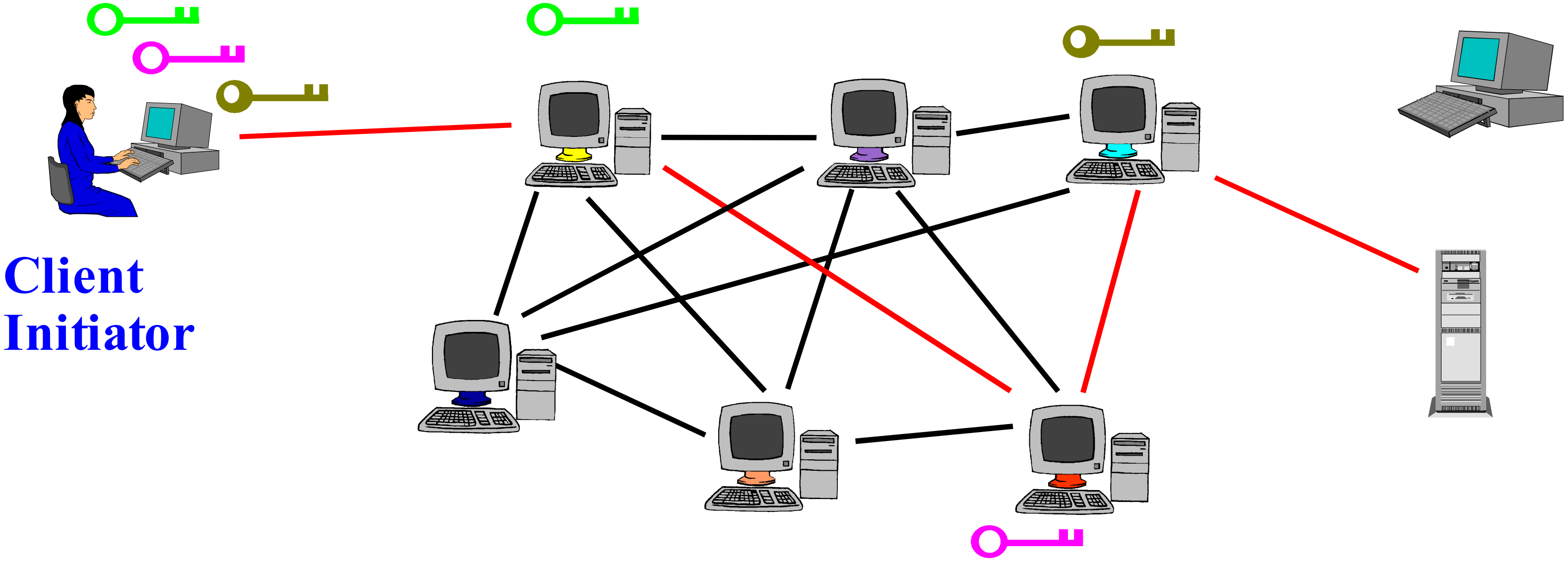

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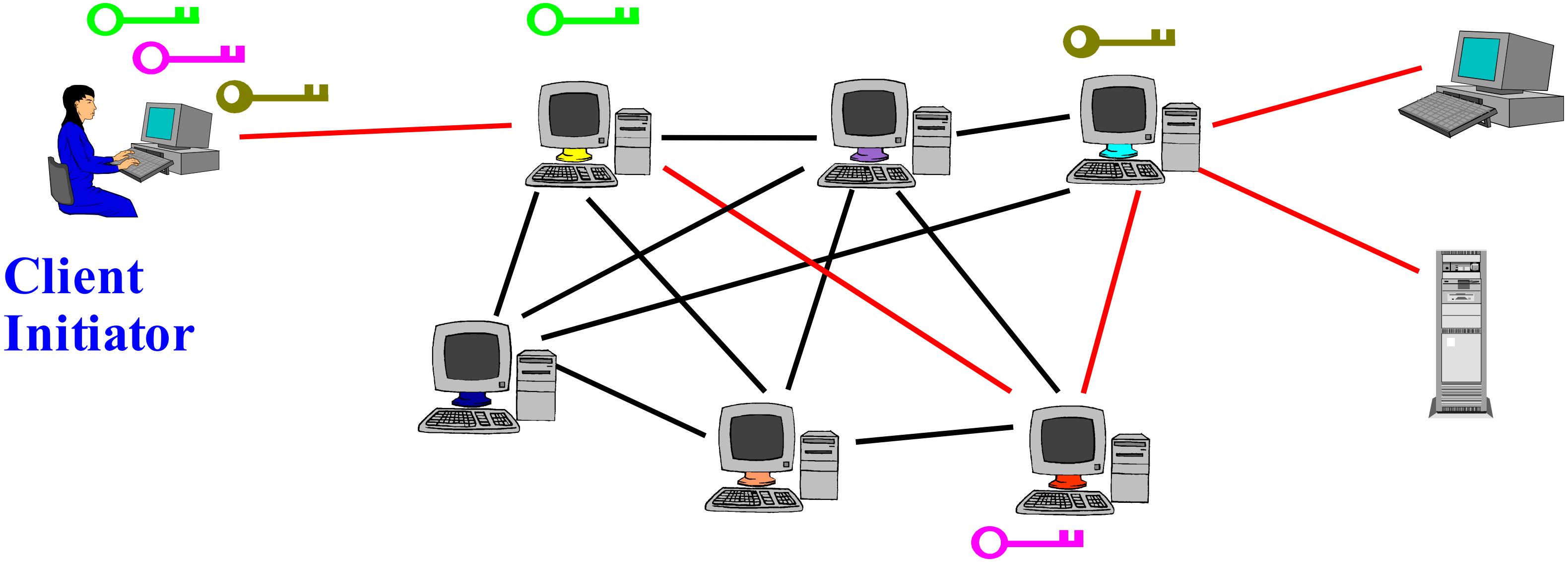

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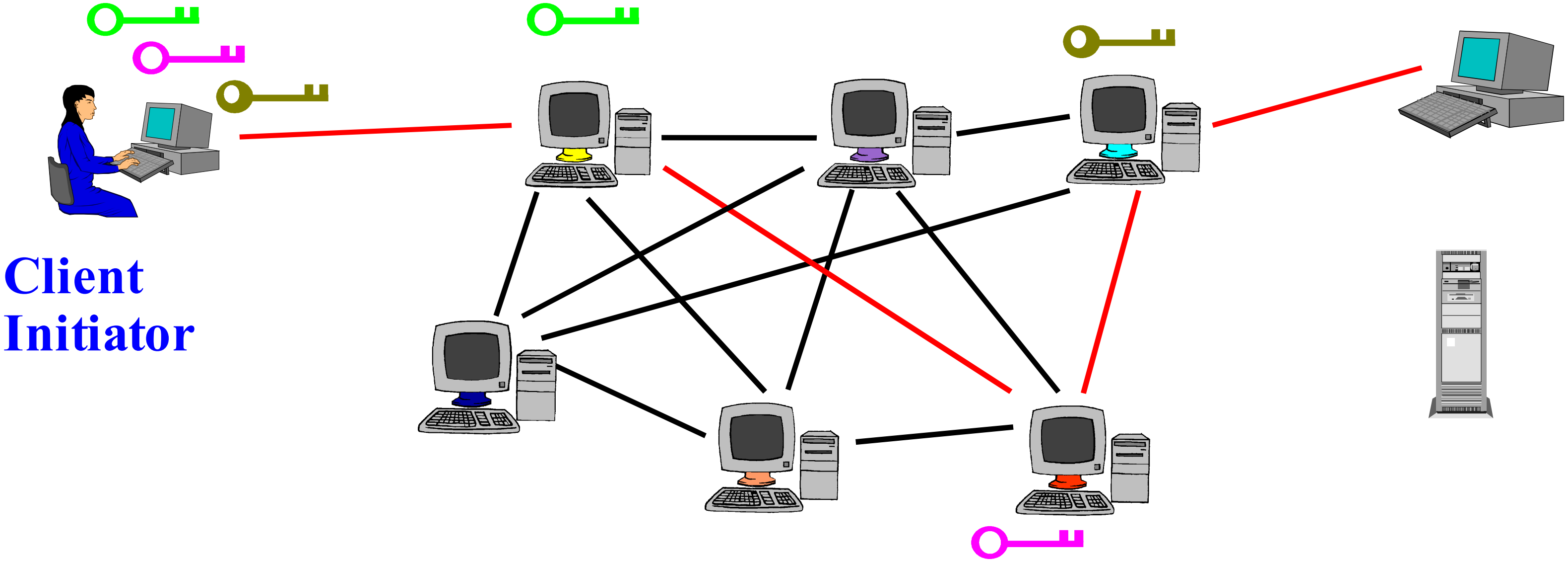


Where do I go to connect to the network?

- Directory Servers
  - Maintain list of which onion routers are up, their locations, current keys, exit policies, etc.
  - Directory server keys ship with the code
  - Control which nodes can join network
    - Important to guard against Sybil attack and related problems
  - These directories are cached and served by other servers, to reduce bottlenecks
  - Need to decentralize, get humans out of the loop, without letting the botnets sign up 100,000 nodes.

Some Tor Properties

- Simple modular design, restricted ambitions.
  - ~30K lines of C code
  - Even servers run in user space, no need to be root
  - Flexible exit policies, each node chooses what applications/destinations can emerge from it
  - Server usability is key to adoption. Without a network, we are nothing.

Some Tor Properties

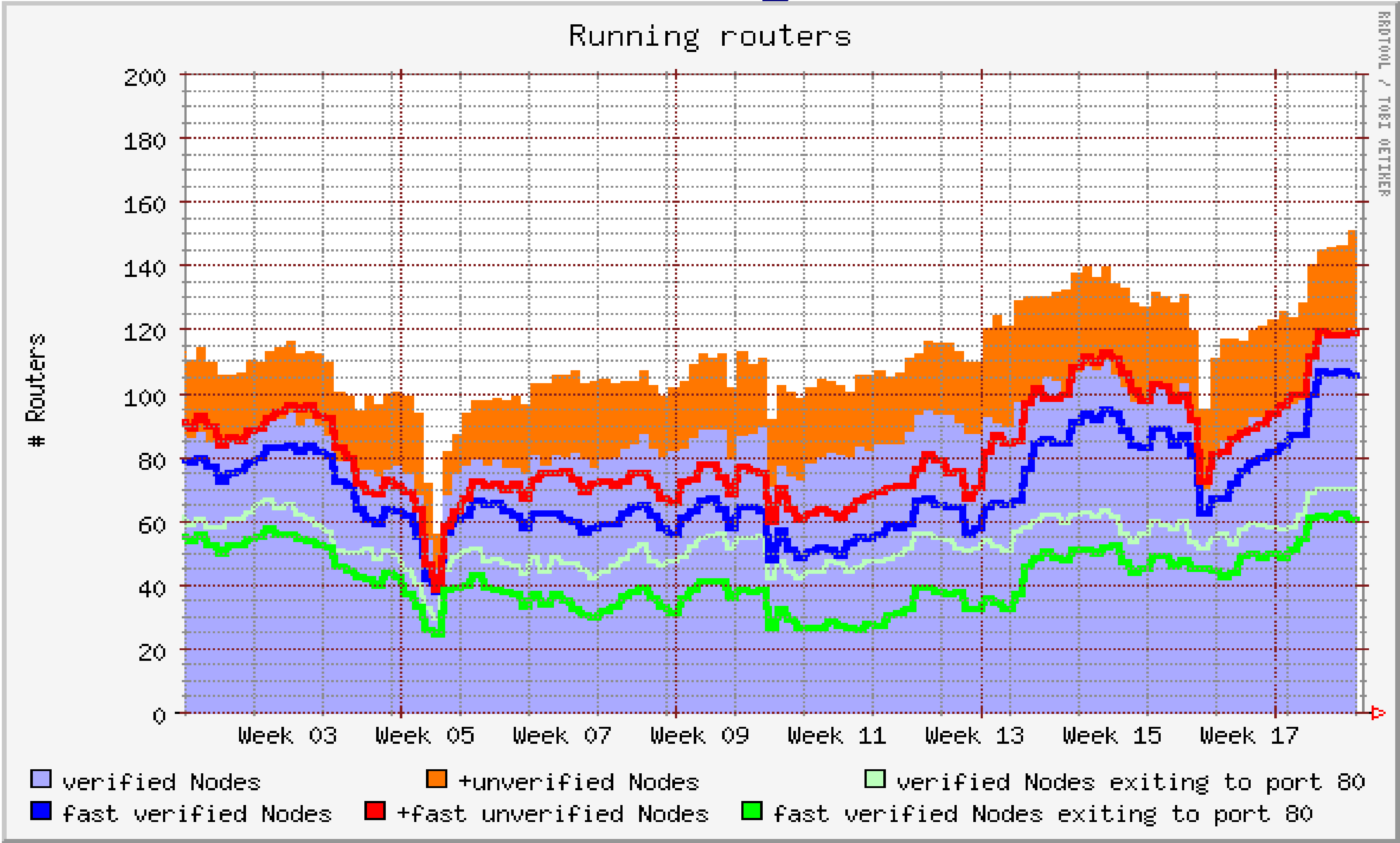
- Lots of supported platforms:

    Linux, BSD, MacOS X, Solaris, Windows, ...

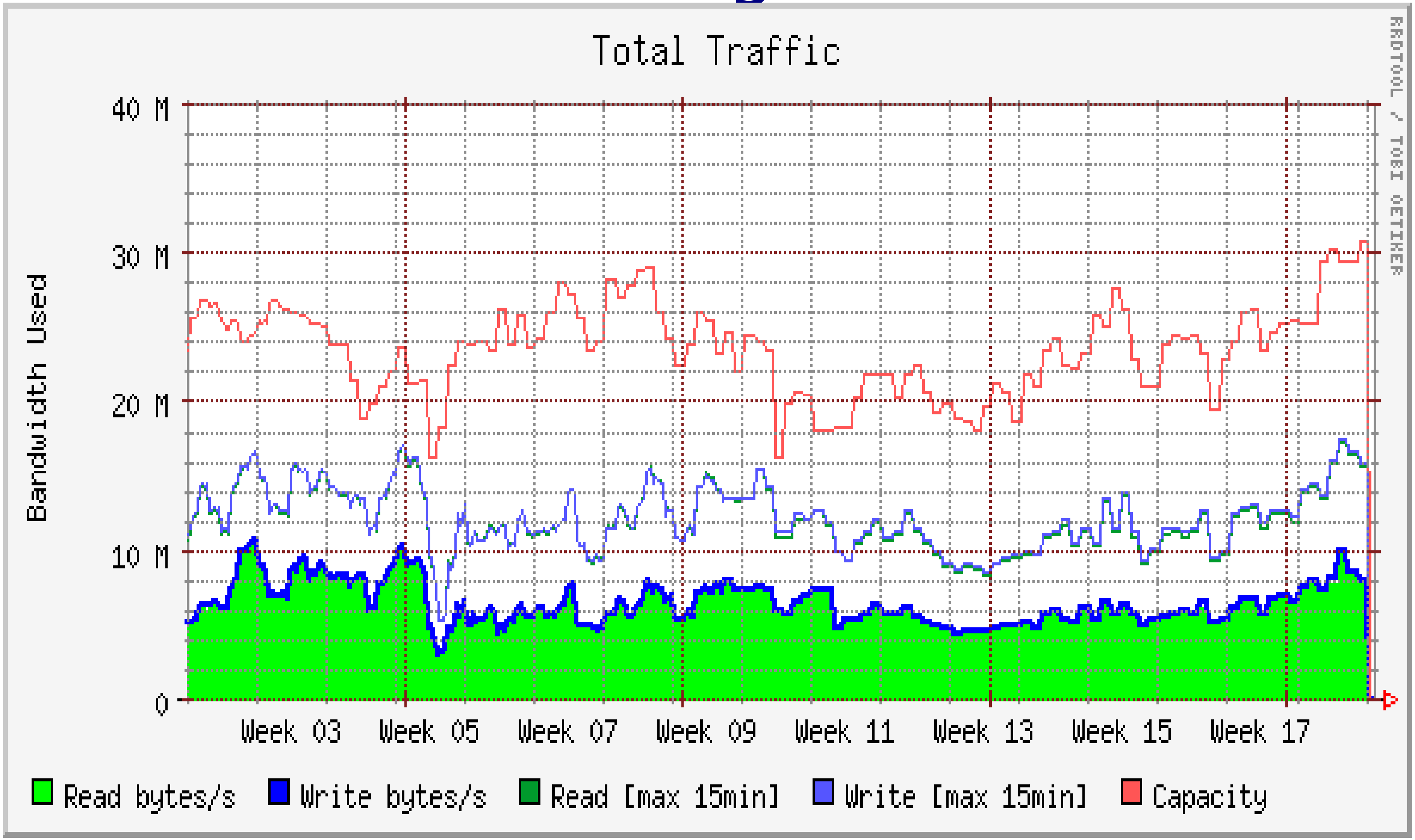
Tor servers on xbox, linksys wireless routers.

- Deployment paradigm:
  - Volunteer server operators
  - No payments, not proprietary
  - Moving to a P2P incentives model

Number of running Tor servers



Total traffic through Tor network



Location Hidden Servers

- Alice can connect to Bob's server without knowing where it is or possibly who he is
- Can provide servers that
  - Are accessible from anywhere
  - Resist censorship
  - Require minimal redundancy for resilience in denial of service (DoS) attack
  - Can survive to provide selected service even during full blown distributed DoS attack
  - Resistant to physical attack (you can't find them)
- How is this possible?

Firewalls

- Hidden services (and Tor itself) can be used from inside a firewall. If you can get out, you can get in.
- Nye Kripos firewall during demo.
- “You're breaking my security policy!”

Get the Code, Run a Node!
(or just surf the web anonymously)

- Current code freely available (3-clause BSD license)
- Comes with a specification – the JAP team in Dresden implemented a compatible Tor client in Java
- (The AES bug.)
- (JAP and backdoors.)
- Design paper, system spec, code, see the list of current nodes, etc.
- http://tor.eff.org/

Tradeoffs

- Low-latency (Tor) vs. high-latency (Mixminion)
- Padding vs. no padding (mixing, traffic shaping)
- UI vs. no UI (Contest!)
- Incentives to run servers / allow exits
- Enclave-level onion routers / proxies / helper nodes
- China?
- P2P network vs. static network

Policy issues

- Spam / spam blacklists
- Google groups
- Wikipedia
- Internet Relay Chat (IRC)
- DMCA (MPAA) Harvard / Berkman
- Hotmail (FBI)

Please help out

- Run a server.
- Publicize. Tell your friends.
- Report bugs!
- UI contest.
- Packaging, documentation, translation, ...
- Help out EFF.