

# CSE 127: Introduction to Security

## Lecture 18: Privacy and Anonymity / Policy and Ethics

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UCSD

Spring 2022

Some material from Deian Stefan and Nadia Heninger

# Lecture outline

- Foundations of privacy
- Privacy-enhancing technologies
  - PGP and modern encrypted messaging
  - Tor and anonymous communication
  - Privacy-respecting browsers (Tor, Firefox)
- Ethical principles
- Laws relevant to security research and practice

# What is privacy and why do we care?

Various definitions of privacy:

- Secrecy
- Anonymity
- Solitude

Human rights and values:

- Human dignity
- Mental health
- Intimacy/relationships

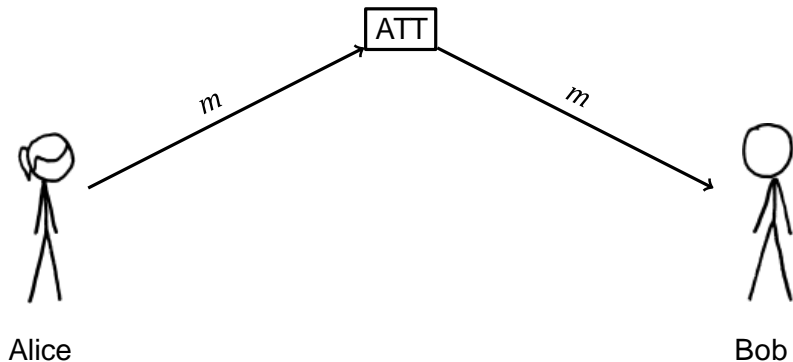
Political and democratic values:

- Liberty of action
- Moral autonomy

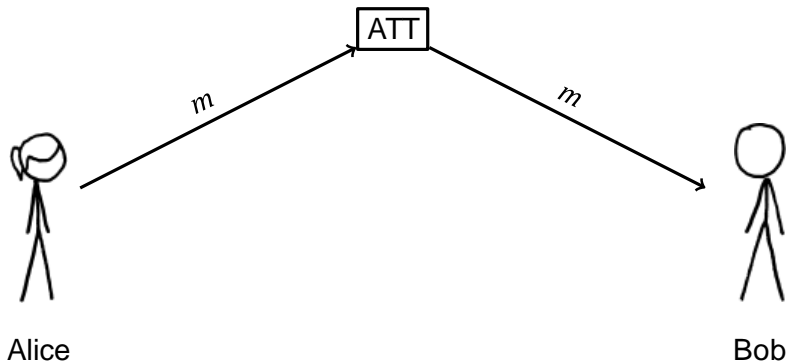
# The “crypto wars”: privacy vs. wiretapping

- Crypto wars 1.0
  - Late 1970s,
  - US government threatened legal sanctions on researchers who published papers about cryptography.
  - Threats to retroactively classify cryptography research.
- Crypto wars 2.0
  - 1990s
  - Main issues: Export control and key escrow
  - Several legal challenges
- Crypto wars 3.0
  - Now
  - Snowden
  - Apple v. FBI
  - ...?
  - Calls for “balance”

# Why is anonymous communication hard?

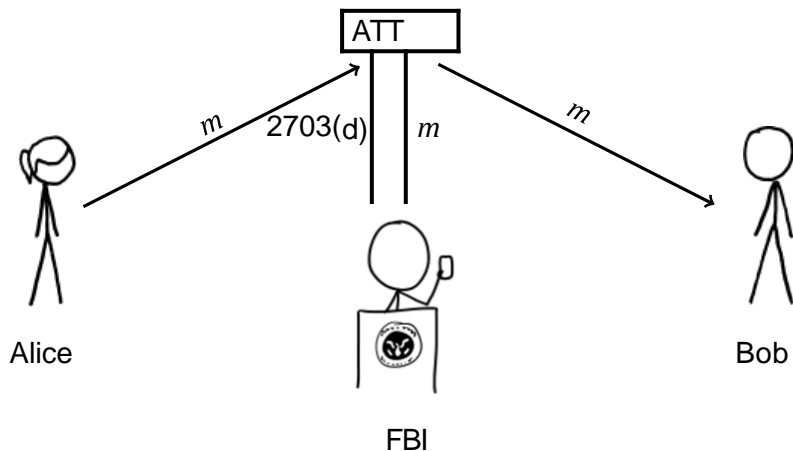


## Why is anonymous communication hard?



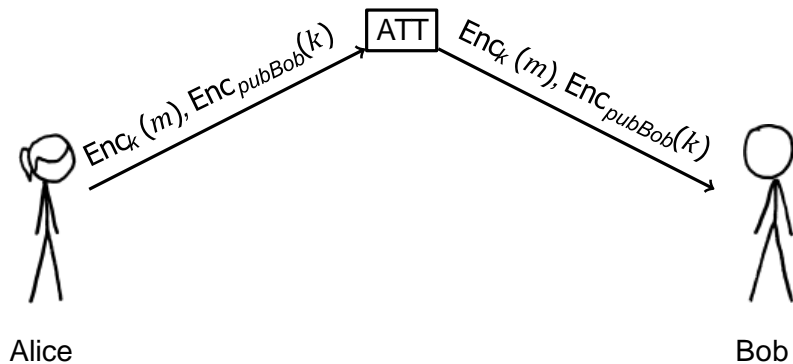
Communications/network service providers (ISPs, Google, Facebook, etc.) can generally see all traffic or communications they handle.

# Why is anonymous communication hard?



Under the Stored Communications Act (1986), the US government can compel service providers to turn over customer communications. Only requires a subpoena for “storage” or communications held longer than 180 days.

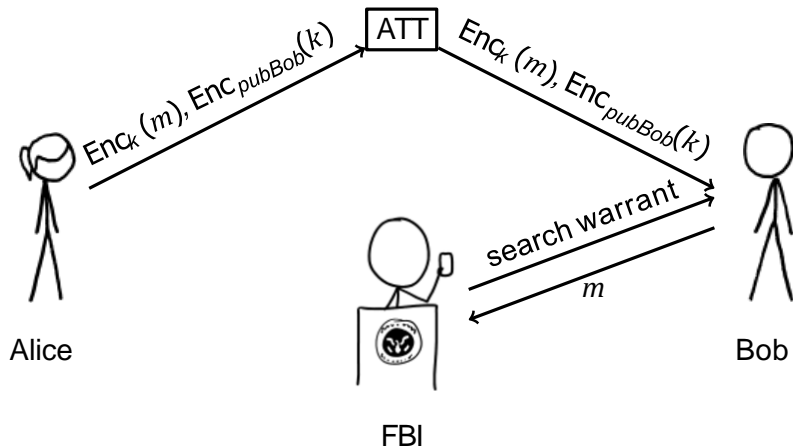
## End-to-end encryption and service providers



If a message is end-to-end encrypted, the service provider may not have the plaintext.



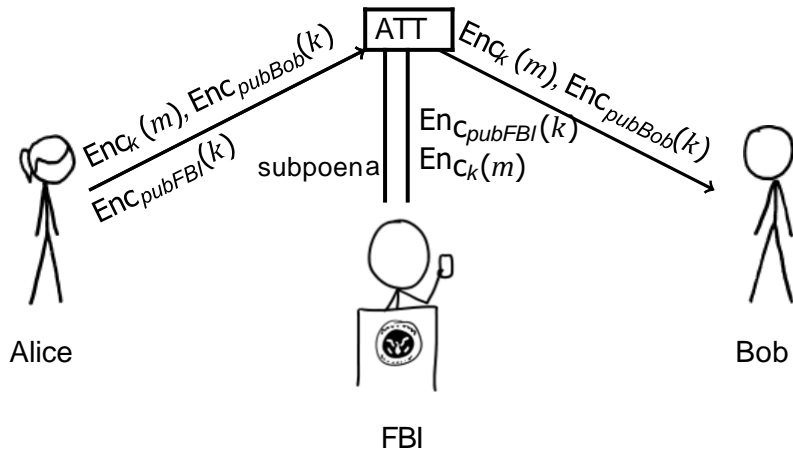
# End-to-end encryption and service providers



Law enforcement can always serve the customer with a search warrant for the decrypted communications.

# End-to-end encryption and service providers

“Key escrow” or “backdoored encryption”



The US government has been asking service providers to design ways to overcome encryption for decades. Most reasonable proposals work something like this.

# Pretty Good Privacy (PGP)

- Written by Phil Zimmermann in 1991
  - Response to US Senate bill requiring crypto backdoors (didn't pass)
- Public key email encryption “for the masses”
  - Signatures, public key encryption, or sign+encrypt
- Key management
  - Public key servers
  - Web of trust: users sign other users' keys
- Grand jury investigated Zimmermann 1993–1996
  - No indictment issued, but was a subject for violating export controls
- Fundamental insight: Knowledge about cryptography is public. In theory, citizens can circumvent government-mandated key escrow by implementing cryptography themselves.

# PGP in the modern era

- PGP was built before modern cryptographic protocol design was properly understood.
- Numerous vulnerabilities
- GnuPGP and libgcrypt open source and quite widely used
- Usability issues: most experts unable to use PGP properly
  - “Why Johnny Can’t Encrypt: A Usability Evaluation of PGP 5.0” by Whitten and Tygar
  - “Why Johnny Still, Still Can’t Encrypt: Evaluating the Usability of a Modern PGP Client” by Ruoti et al.

# HOW TO USE PGP TO VERIFY THAT AN EMAIL IS AUTHENTIC:

LOOK FOR THIS  
TEXT AT THE TOP.



IF IT'S THERE, THE EMAIL IS PROBABLY FINE.

<https://xkcd.com/1181/>

“If you want to be extra safe, check that there’s a big block of jumbled characters at the bottom.”

# Message Encryption since PGP

- For messaging, Signal, WhatsApp, or iMessage offer modern end-to-end encryption.
- Modern protocols typically:
  - Use Diffie-Hellman to negotiate ephemeral keys
  - Use long-term authentication keys with out-of-band fingerprint verification
  - Offer “forward secrecy”:
    - In theory, protects against key compromise at time  $t$  revealing plaintext of previous messages
    - If sender or recipient store plaintext, this is more likely point of compromise
  - Offer “deniability”:
    - Message recipient can verify message integrity without a third party being able to “cryptographically prove” that sender sent the message.
    - Cryptographically interesting, but likely legally irrelevant.

# Crypto Wars 2.0

In the current debates about government-mandated weakening of cryptography, there are two scenarios of interest:

- Message encryption.
  - This is what we've talked about so far in lecture.
- Storage encryption.
  - For example, unlocking iPhones.
  - This is what the Apple v. FBI case was about.

In Apple v. FBI, the question was whether the government could compel Apple to break their own encryption mechanism with the All Writs Act. The government backed down and reportedly used a specialty consulting firm to unlock the phone.

# Anonymity

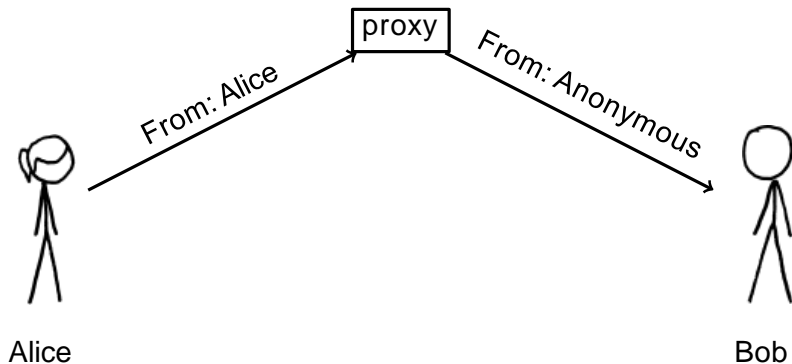
Michael Hayden, former NSA director: "We kill people based on metadata."

- Long history of anonymous communication in US democracy
- e.g. Revolutionary war anonymous political pamphlets

**Technical question:** Is anonymous communication still feasible on the internet?



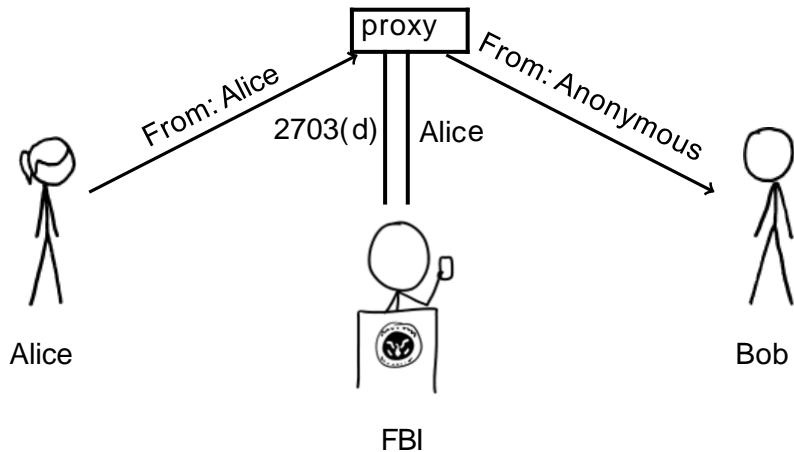
## “Anonymity” via tunneling or proxies



A proxy can rewrite metadata. Examples:

- Early “anonymous remailers” forwarded email.
- VPN services allow users to tunnel traffic

## “Anonymity” via tunneling or proxies



One-hop proxies have a single point of failure, must see both sides of communication.

# Tor: Anonymous communication for TCP sessions

Desired properties:

- Network attacker watching client traffic can't see destination.
- Destination server does not see client IP address.
- Network nodes can't link client and server.
- Fast enough to support TCP streams and network applications.

Current state: A nonprofit organization, active academic research, deployed around the world.

Not perfect, but a building block.



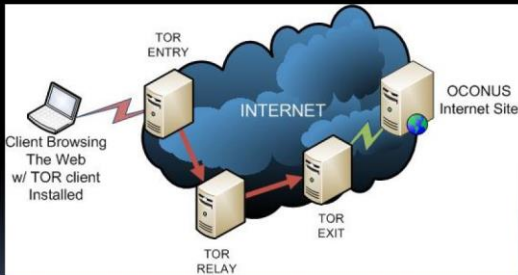
## (U) What is TOR?



- (U) “The Onion Router”
- (U) Enables anonymous internet activity
  - General privacy
  - Non-attribution
  - Circumvention of nation state internet policies
- (U) Hundreds of thousands of users
  - Dissidents (Iran, China, etc)
  - (S//SI//REL) **Terrorists!**
  - (S//SI//REL) Other targets too!

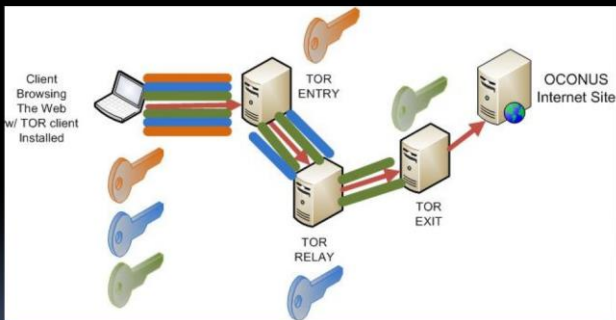


# (U) What is TOR?





# (U) What is TOR?



# Tor also allows “anonymous” servers

Shop by category:

- Cannabis(203)
- Ecstasy(35)
- Psychedelics(127)
- Opioids(39)
- Stimulants(68)
- Dissociatives(9)
- Other(197)
- Benzos(43)

1 hit of LSD (blotter) **\$0.58**

1/8 oz high quality cannabis **\$2.05**

1 g pure MDMA (white) **\$1.28**

**Step-by-step:**

1. Get **anonymous money**
2. Buy something here
3. Enjoy it when it arrives!

Vacation mode. Important info for **sellers**...

**recent feedback:**

seller	rating	feedback	
<a href="#">1UP of Canada(97)</a>	4 of 5	amazing weed. the only reason this is not a 5 is because the package was so tightly double vacuum sealed that the product was flattened, which I know is necessary for security but it still decreases quality	<a href="#">item</a>
<a href="#">CaliforniaSunrise</a>	5 of 5	Fast shipping. Nice packaging. I haven't tried the chocolate yet, but it looks tasty! Smooth transaction.	<a href="#">item</a>
<a href="#">Rook</a>	5 of 5	all good! thanks so much!	<a href="#">item</a>
<a href="#">illy</a>	5 of 5	Very friendly. Fast Shipping. Great packaging.	<a href="#">item</a>
<a href="#">somatik</a>	5 of 5	Order arrived quickly and as described. Thanks!	<a href="#">item</a>
<a href="#">gamely54</a>	5 of 5	No issue at all, I officially recommend this seller. Now go forth and purchase from him!	<a href="#">item</a>
<a href="#">mellowyellow</a>	5 of 5	Item arrived quickly and as described, good communication. This guy's legit.	<a href="#">item</a>
<a href="#">dirtysouf(100)</a>	5 of 5	looks good	<a href="#">item</a>

vice.com

In practice, prominent “hidden services” deanonymized through real-world metadata, browser 0days, misconfigured servers.

# Anonymity on the web

- Companies like Google, Facebook, Twitter, Microsoft, Amazon, Target, Walmart, . . . make a lot of money from tracking users.
- For some of these companies you are the product. So tracking you is their business.
- How do websites track users?
  - Third-party cookies: recall that cookies for trackme.com are sent with any request to trackme.com, even if you're on cnn.com.
  - Tracking content: Sites include tracking code into URLs (e.g., advertisements, videos, marketing emails, etc.)
  - Fingerprinting: sites profile your browser, extensions, OS, hardware, screen resolution, fonts you have installed, etc.



# What can you do about this?

- Can't really avoid these platforms (e.g., Facebook profiles you even if you don't have an account).
- Use a browser that cares about your privacy (e.g., Firefox, The Tor Browser, Brave, Safari)
- Use privacy-enhancing browser extensions

# Privacy-enhanced browsing (Firefox)

**Standard** ▼






Balanced for protection and performance. Pages will load normally.


**Strict** ▼


Stronger protection, but may cause some sites or content to break.

**Custom**

Choose which trackers and scripts to block.

-  **Cookies** All third-party cookies (may cause websites to break) ▼
-  **Tracking cookies** Cross-site and social media trackers
-  **Cryptominers** Cookies from unvisited websites
-  **Fingerprinters** All third-party cookies (may cause websites to break)
-  **Cryptominers** All cookies (will cause websites to break)

 You will need to reload your tabs to apply these changes.

 [Reload All Tabs](#)

 **Heads up!**

Blocking trackers could impact the functionality of some sites. Reload a page with trackers to load all content. [Learn how](#)

Send websites a "Do Not Track" signal that you don't want to be tracked [Learn more](#)

- Always
- Only when Firefox is set to block known trackers

# Privacy-enhanced browsing (Tor)

## Security

### Security Level

Disable certain web features that can be used to attack your security and anonymity.

[Learn more](#)

**Standard**

All Tor Browser and website features are enabled.

**Safer**

Disables website features that are often dangerous, causing some sites to lose functionality.

JavaScript is disabled on non-HTTPS sites.

Some fonts and math symbols are disabled.

Audio and video (HTML5 media), and WebGL are click-to-play.

**Safest**

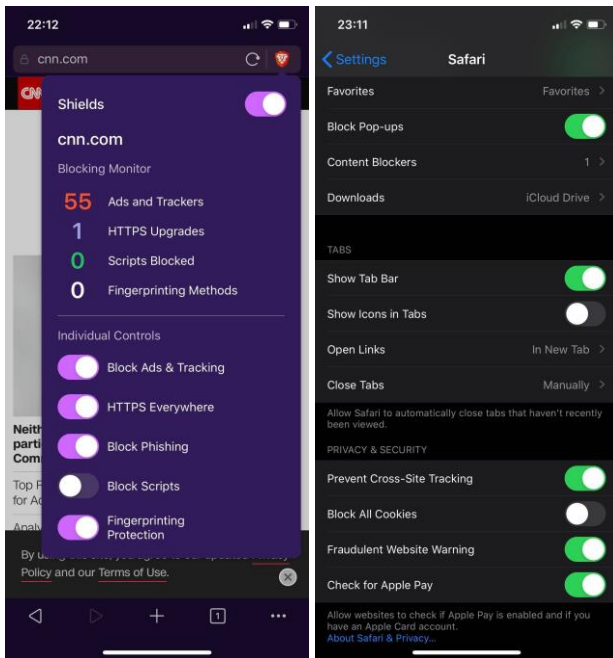
Only allows website features required for static sites and basic services. These changes affect images, media, and scripts.

JavaScript is disabled by default on all sites.

Some fonts, icons, math symbols, and images are disabled.

Audio and video (HTML5 media), and WebGL are click-to-play.

# Privacy-enhanced browsing (Brave & Safari)



# Privacy-enchanting extensions

- Privacy Badger blocks trackers; uBlock Origin blocks ads; many others

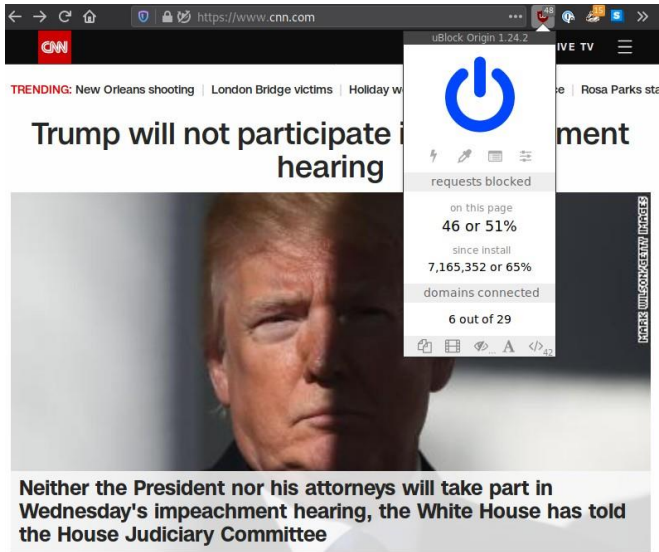
The screenshot shows a browser window with the URL <https://www.cnn.com>. The page content includes the CNN logo, a trending topic "New Orleans shooting | London", and a headline "Trump will not". A Privacy Badger extension popup is open, displaying the EFF logo and the text: "Privacy Badger detected 15 potential trackers on this page. You shouldn't need to adjust the sliders unless something is broken." Below this text are three icons: a red circle with a slash, a yellow circle with a red 'x', and a green checkmark. A list of detected trackers is shown with sliders indicating their status:

Tracker	Status
ib.adnxs.com	Blocked (Red)
c.amazon-adsystem.com	Blocked (Red)
bat.bing.com	Blocked (Red)
cdnjs.cloudflare.com	Allowed (Yellow)
dpm.demdex.net	Blocked (Red)

At the bottom of the popup are three buttons: "Disable Privacy Badger for This Site", "Did Privacy Badger break this site? Let us know!", and "Donate to EFF". The version number "version 2019.11.18" is visible at the bottom left of the popup. The background article text includes "Neither the President" and "Wednesday's impeachment hearing, the White House has told the House Judiciary Committee".

# Privacy-enhancing extensions

- Privacy Badger blocks trackers; uBlock Origin blocks ads; many others



The image shows a screenshot of a web browser displaying a CNN article. The article's headline is "Trump will not participate in impeachment hearing". Below the headline is a large photograph of Donald Trump. At the bottom of the article, a text box reads: "Neither the President nor his attorneys will take part in Wednesday's impeachment hearing, the White House has told the House Judiciary Committee".

Overlaid on the right side of the browser window is the uBlock Origin extension interface. The interface shows a blue power button icon and the following statistics:

- requests blocked
- on this page: 46 or 51%
- since install: 7,165,352 or 65%
- domains connected: 6 out of 29

The browser's address bar shows the URL "https://www.cnn.com". The uBlock Origin extension version is 1.24.2. The browser's taskbar at the bottom shows various icons, including the Windows logo, a search icon, and several application icons.

# Lecture outline

- Foundations of privacy
- Privacy-enhancing technologies
  - PGP and modern encrypted messaging
  - Tor and anonymous communication
  - Privacy-respecting browsers (Tor, Firefox, Brave)
- Ethical principles ✓
- Laws relevant to security research and practice

# Overarching principles/lessons

- Ethics: Try to be a good person. Be thoughtful about your actions and their effects on yourself and others.
- Legal issues: Don't violate laws.
- If lawyers or law enforcement are involved, you have already lost. It doesn't matter if you could in theory win the case in the end.



# Legal/ethical principle: Property rights

Respect other people's property.

**Example:** Hacking your own password.

- On your own machine: Probably ok. (Possible exception: DMCA.)
- On someone else's machine: Get permission or else it's probably not ok. (Might be CFAA violation under Terms of Service interpretation.)

# Computer Fraud and Abuse Act (CFAA)

18 U.S. CODE §1030 - FRAUD AND RELATED ACTIVITY IN CONNECTION WITH COMPUTERS

Whoever intentionally accesses a computer without authorization or exceeds authorized access, and thereby obtains information from any protected computer...

The punishment for an offense...

- a fine under this title or imprisonment for not more than one year, or both...,
- a fine under this title or imprisonment for not more than 5 years, or both... if—
  - (i) the offense was committed for purposes of commercial advantage or private financial gain;
  - (ii) the offense was committed in furtherance of any criminal or tortious act...; or
  - (iii) the value of the information obtained exceeds \$5,000

## Remember Aaron Swartz's CFAA case

- Scraped JStor from MIT's network and evaded numerous blocking attempts.
- Prosecuted for violating the Terms of Service of JStor even though JStor did not want to prosecute.
- Property owners: MIT, JStor, article authors
- Swartz had already been investigated for scraping public court records



<https://docs.jstor.org/>

# Ethical Principle: Minimizing harm

Ethical research involves trying to minimize harm.

## **Example:** SYN scanning

- Scanning public hosts is legal, but generates many complaints.
- Depends on intended use: Used by attackers to find vulnerable hosts, used by researchers to measure networks.
- Doing research on open networks means understanding and following best practices:
  - Publicly identifying the purpose of the research
  - Providing an opt-out mechanism
  - Not launching attacks
  - Avoiding overwhelming your or others' networks or crashing hosts
  - Etc.

# Ethical principle: Minimizing harm

## Example: Botherding

<https://www.bbc.com/news/technology-49127569>

- Botherding is taking over a botnet
- Is this ethical or not?
  - Interfering with a legal botnet is definitely illegal.
  - Marcus Hutchins was celebrated for activating a "kill switch" in WannaCry malware that halted infections.
  - Is taking over a botnet for research purposes ethical? It is pursuing illegal activity to study illegal activity.

## Your Botnet is My Botnet: Analysis of a Botnet Takeover

Brett Stone-Gross, Marco Cova, Lorenzo Cavallaro, Bob Gilbert, Martin Szydowski, Richard Kemmerer, Christopher Kruegel, and Giovanni Vigna

University of California, Santa Barbara

[bstone,marco,sullivan,rgilbert,msz,kemm,chris,vigna]@cs.ucsb.edu

### ABSTRACT

Botnets, networks of malware-infected machines that are controlled by an adversary, are the root cause of a large number of security problems on the Internet. A particularly sophisticated and insidious type of bot is Torpig, a malware program that is designed to

One approach to study botnets is to perform *passive analysis* of secondary effects that are caused by the activity of compromised machines. For example, researchers have collected spam mails that were likely sent by bots [47]. Through this, they were able to make indirect observations about the sizes and activities of different spam botnets. Similar measurements focused on DNS queries [34, 35]

# Digital Millennium Copyright Act (DMCA)

## 17 U.S. Code § 1201 - Circumvention of copyright protection systems

Current through Pub. L. [113-86](#), except [113-79](#). (See [Public Laws for the current Congress](#).)

US Code

Notes

Updates

(a) Violations Regarding Circumvention of Technological Measures.—

(1)

(A) No person shall circumvent a technological measure that effectively controls access to a work protected under this title. The prohibition contained in the preceding sentence shall take effect at the end of the 2-year period beginning on the date of the enactment of this chapter.

# DMCA cases

- 2010 US v. Crippen, rare criminal DMCA prosecution of Xbox modder
- 2002 Bunnie Huang Xbox key extraction
  - MIT did not support his work, AI Lab published his work and reached an agreement with Microsoft

## % Hacking the Xbox\_

### A Brief History of the Book

"Hacking the Xbox" was originally a work commissioned by the respected technical publisher Wiley & Sons. Shortly after completing the final chapters, Wiley & Sons notified the author that publishing of the book had been cancelled, due to their concerns regarding the Digital Millennium Copyrights Act (DMCA). This happened despite the author taking special care not to include any Microsoft-copyrighted material or materials that could be directly applied to copyright circumvention.

Furthermore, on the second day of book pre-sales, the original e-commerce provider Americart elected to decline offering cart services due to concerns over the DMCA:

Now for the bad news. We are going to have to decline to offer you cart service for selling hacker materials, which is our right to do so per the Americart Merchant Service agreement. It's too risky for us to be involved in, especially in light of the fact that now I know about it. \$15 per month doesn't pay for us to take the risk of being named in a DMCA suit. From what I understand, Microsoft is pretty aggressive on such matters. It is nothing personal on our part.

# DMCA Exemptions

Every three years, the Library of Congress considers exemptions to the DMCA.

- 2010: Phone jailbreaking
- 2016: Security research

Accordingly, based on the Register's recommendation, the Librarian adopts the following exemption:

**(i) Computer programs, where the circumvention is undertaken on a lawfully acquired device or machine on which the computer program operates solely for the purpose of good-faith security research and does not violate any applicable law, including without limitation the Computer Fraud and Abuse Act of 1986, as amended and codified in title 18, United States Code; and provided, however, that, except as to voting machines, such circumvention is initiated no earlier than 12 months after the effective date of this regulation, and the device or machine is one of the following:**

(2) Permissible acts of encryption research.— Notwithstanding the provisions of subsection (a)(1)(A), it is not a violation of that subsection for a person to circumvent a technological measure as applied to a copy, phonorecord, performance, or display of a published work in the course of an act of good faith encryption research if—

(A) the person lawfully obtained the encrypted copy, phonorecord, performance, or display of the published work;

(B) such act is necessary to conduct such encryption research;

(C) the person made a good faith effort to obtain authorization before the circumvention; and

(D) such act does not constitute infringement under this title or a violation of applicable law other than this section, including section 1030 of title 18 and those provisions of title 18 amended by the Computer Fraud and Abuse Act of 1986.



# Personal and Privacy Rights

## Principle: Informed consent

- Human subjects research should go through ethical review
  - At a university, this is done by IRB
  - Some companies now have review processes
- Human subjects research includes any collection of Personally Identifiable Information

# Judge Confirms Government Paid CMU Scientists to Hack Tor Users for FBI

📅 February 25, 2016 👤 Swati Khandelwal



Everything is now crystal clear:

The security researchers from Carnegie Mellon University (CMU) were hired by the federal officials to discover a technique that could help the FBI [Unmask Tor users](#) and [Reveal their IP addresses](#) as part of a criminal investigation.

Yes, a federal judge in Washington has recently confirmed that the computer scientists at CMU's Software Engineering Institute (SEI) were indeed behind a hack of the TOR project in 2014, according to court documents [\[PDF\]](#) filed Tuesday.

In November 2015, The Hacker News reported that Tor Project Director *Roger Dingledine* accused the Federal Bureau of Investigation (FBI) of paying the CMU, at least, [\\$1 Million for providing information](#) that led to the criminal suspects identification on the [Dark Web](#).

After this news had broken, the [FBI denied the claims](#), saying *"The allegation that we paid [CMU] \$1 Million to hack into TOR is inaccurate."*

# Informed consent

**Example:** Jason Fortuny posted fake sex ad on Craigslist as a woman in 2006

- Received hundreds of replies, posted them all online
- Unethical? Yes.
- Illegal? Unclear.
  - Encyclopedia Dramatica received DMCA takedown notice.
  - Sued in Illinois by anonymous victim, default \$75k judgement

# Legal foundations of privacy

In US, 14th amendment: “nor shall any state deprive any person of life, liberty, or property without due process of law”

Interpreted as right to privacy by 20th century supreme court:

- Legality of contraception
- Roe v. Wade

Recent administration trying to FUBAR

# Wiretapping

## 18 U.S. Code § 2511 - Interception and disclosure of wire, oral, or electronic communications prohibited

Current through Pub. L. [113-296](#), except [113-287](#), [113-291](#), [113-295](#). (See [Public Laws for the current Congress.](#))

US Code

Notes

[prev](#) | [next](#)

- (1) Except as otherwise specifically provided in this chapter any person who—
- (a) intentionally intercepts, endeavors to intercept, or procures any other person to intercept or endeavor to intercept, any wire, oral, or electronic communication;
  - (b) intentionally uses, endeavors to use, or procures any other person to use or endeavor to use any electronic, mechanical, or other device to intercept any oral communication when—
    - (i) such device is affixed to, or otherwise transmits a signal through, a wire, cable, or other like connection used in wire communication; or
    - (ii) such device transmits communications by radio, or interferes with the transmission of such communication; or
    - (iii) such person knows, or has reason to know, that such device or any component thereof has been sent through the mail or transported in interstate or foreign commerce; or
    - (iv) such use or endeavor to use (A) takes place on the premises of any business or other commercial establishment the operations of which affect interstate or foreign commerce; or (B) obtains or is for the purpose of obtaining information relating to the operations of any business or other commercial establishment the operations of which affect interstate or foreign commerce; or

California is a “two-party consent” state. All parties in a conversation must consent for it to be recorded.

# Snowden leaked FISA order for all Verizon Business customer information in 2013

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IN RE APPLICATION OF THE  
FEDERAL BUREAU OF INVESTIGATION  
FOR AN ORDER REQUIRING THE  
PRODUCTION OF TANGIBLE THINGS  
FROM VERIZON BUSINESS NETWORK SERVICES,  
INC. ON BEHALF OF MCI COMMUNICATION  
SERVICES, INC. D/B/A VERIZON  
BUSINESS SERVICES.

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Docket Number: BR

13 - 8 0

## SECONDARY ORDER

This Court having found that the Application of the Federal Bureau of Investigation (FBI) for an Order requiring the production of tangible things from **Verizon Business Network Services, Inc. on behalf of MCI Communication Services Inc., d/b/a Verizon Business Services (individually and collectively "Verizon")** satisfies the requirements of 50 U.S.C. § 1861,

IT IS HEREBY ORDERED that, the Custodian of Records shall produce to the National Security Agency (NSA) upon service of this Order, and continue production

**TOP SECRET//SI//NOFORN**

Derived from: Pleadings in the above-captioned docket  
Declassify on: 12 April 2038

on an ongoing daily basis thereafter for the duration of this Order, unless otherwise ordered by the Court, an electronic copy of the following tangible things: all call detail records or "telephony metadata" created by Verizon for communications (i) between the United States and abroad; or (ii) wholly within the United States, including local telephone calls. This Order does not require Verizon to produce telephony metadata for communications wholly originating and terminating in foreign countries.

Telephony metadata includes comprehensive communications routing information, including but not limited to session identifying information (*e.g.*, originating and terminating telephone number, International Mobile Subscriber Identity (IMSI) number, International Mobile station Equipment Identity (IMEI) number, etc.), trunk identifier, telephone calling card numbers, and time and duration of call. Telephony metadata does not include the substantive content of any communication, as defined by 18 U.S.C. § 2510(8), or the name, address, or financial information of a subscriber or customer.

IT IS FURTHER ORDERED that no person shall disclose to any other person that the FBI or NSA has sought or obtained tangible things under this Order, other than to: (a) those persons to whom disclosure is necessary to comply with such Order; (b) an attorney to obtain legal advice or assistance with respect to the production of things in

Updated FISA orders have continued to be approved.

(Reuters) - Security industry pioneer RSA adopted not just one but two encryption [tools](#) developed by the U.S. National Security Agency, greatly increasing the spy agency's ability to eavesdrop on some Internet communications, according to a team of academic researchers.

Reuters reported in December that the NSA had paid RSA \$10 million to make a now-discredited cryptography system the default in [software](#) used by a wide range of Internet and computer security programs. The system, called Dual Elliptic Curve, was a random number generator, but it had a deliberate flaw - or "back door" - that allowed the NSA to crack the encryption.

A group of professors from Johns Hopkins, the University of Wisconsin, the University of Illinois and elsewhere now say they have discovered that a second NSA tool exacerbated the RSA software's vulnerability.

The professors found that the tool, known as the "Extended Random" extension for secure websites, could help crack a version of RSA's Dual Elliptic Curve [software](#) tens of thousands of times faster, according to an advance copy of their research shared with Reuters.

While Extended Random was not widely adopted, the new research sheds light on how the NSA extended the reach of its surveillance under cover of advising companies on protection.

# Law Enforcement Access Policy

Policy/ethics question: Is it preferable to have law enforcement/intelligence:

- Stockpile software vulnerabilities, write targeted malware, and hack into targets when desired
- Mandate encryption backdoors or otherwise enable mass surveillance



# The FBI's Firefox Exploit

By [Nicholas Weaver](#) Thursday, April 7, 2016, 8:43 AM



Lawfare contributors are having an [interesting debate](#) (with dinners and drinks on the line) about whether and why the FBI might reveal the details of the exploit used to unlock the San Bernardino iPhone. My guess is that the FBI will inadvertently release so many details in aiding local law enforcement that the question becomes moot: we will at least learn whether the exploit uses the USB connection or attacks through the cellular "baseband," as well as whether the exploit works on current versions or has already been patched by Apple.

But another fight over vulnerability disclosure is far more interesting and getting far less attention. The FBI is apparently hoarding a Tor Browser exploit which it used to target visitors of the "Playpen" child porn site. I've previously discussed [how the FBI wrote the warrant to hack over a thousand targets](#). Now the FBI is [fighting defense efforts to examine the exploit itself](#) despite an order [requiring the FBI to reveal the exploit to the defense](#).

The Tor Browser is simply Firefox running in a hardened mode. While many Firefox exploits will not work against the Tor browser—particularly those relying on Flash—the converse is not necessarily true. To the contrary, any Tor browser exploit is almost certainly a Firefox exploit too.

# Unintended Consequences of Law Enforcement Access

- 2004 Greek wiretapping scandal
  - Greek politicians wiretapped through law enforcement access system present on phone network
- 2010 China Google hack
  - Came in through law enforcement access portal

<https://www.theguardian.com/business/2006/feb/07/newmedia.media>

[https://www.washingtonpost.com/world/national-security/chinese-hackers-who-breached-google-gained-access-to-sensitive-data-us-officials-say/2013/05/20/51330428-be34-11e2-89c9-3be8095fe767\\_story.html](https://www.washingtonpost.com/world/national-security/chinese-hackers-who-breached-google-gained-access-to-sensitive-data-us-officials-say/2013/05/20/51330428-be34-11e2-89c9-3be8095fe767_story.html)

# Disclosure options for security flaws

- Report to vendor only
- Report to vendor and receive bug bounty
- Report to vendor, wait for fix, report to public (“responsible disclosure”)
- Report in full to public immediately (“full disclosure”)
- Tell no one
- Sell vulnerability to middleman and don’t report to vendor

# The process of reporting vulnerabilities

- Some vendors have sensible reporting process
  - E.g., Firefox and Chrome teams respond and react quickly, easy to work with on fixing bugs, etc.
- Some vendors less so
  - E.g., Send email through an intermediary, receive ACK, no real conversation.
  - E.g., Send email, poke individual folks for replies, no replies. Give up.
- Some vendors are playing catch up
- Some vendors are the worst: they will try to gag/sue you

# Bug bounty programs

- Many vendors have bug bounty programs: \$\$ for bugs
  - Mozilla and Google will even run your checkers and pay you if the checkers find real bugs
- Our students made  $\approx$ \$3K per bug!

	High-quality report with functional exploit	High-quality report	Baseline
Sandbox escape / Memory corruption in a non-sandboxed process	\$30,000	\$20,000	\$5,000 - \$15,000
Universal Cross Site Scripting	\$20,000	\$15,000	\$2,000 - \$10,000
Renderer RCE / memory corruption in a sandboxed process	\$10,000	\$7,500	\$2,000 - \$5,000
Security UI Spoofing	\$7,500	N/A [1]	\$500 - \$3,000
User information disclosure	\$5,000 - \$20,000	N/A [1]	\$500 - \$2,000
Web Platform Privilege Escalation	\$5,000	\$3,000	\$500 - \$1,000
Exploitation Mitigation Bypass	\$5,000	\$3,000	\$500 - \$1,000
Chrome OS	<a href="#">See below</a>		
Chrome Fuzzer Bonus	\$1,000		
Chrome Patch Bonus	\$500 - \$2,000		

# Policy questions around security research

- Should exploit sales be legal?
  - Code as speech principle says yes
  - Is publishing exploits ethical?
- How about mixed-use tools?
  - Privacy tools like Tor or encrypted messengers used by criminals, normal people, activists
  - Random darknet shopper art piece?

Have a great end of the  
quarter!

Good luck on the final!