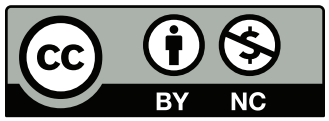
Lawful Hacking:

Using Existing Vulnerabilities for Wiretapping on the Internet

Steven M. Bellovin

https://www.cs.columbia.edu/~smb

Join work with Matt Blaze, Sandy Clark, Susan Landau



A Note on Translation

- This talk was prepared with reference to American law
- I've added a few specific references to British law—but I'm not even a lawyer in the US, let alone here
- I do not know if the proposed "enhancement" is a risk here, too—but given RIPA and general political trends, I suspect that it is

Once, Wiretapping Was Easy

Steven M. Bellovin

- The phone system was simple
- Tapping was simple
- Very little technology was needed

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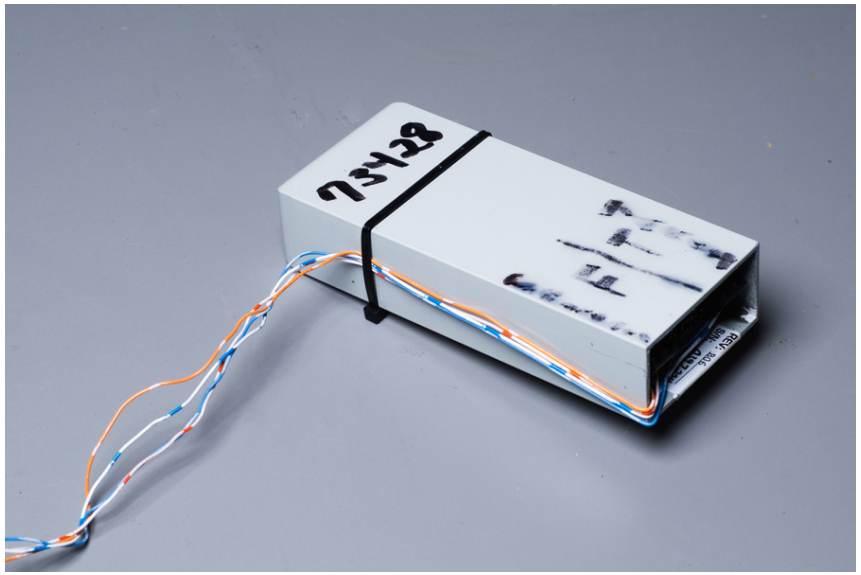
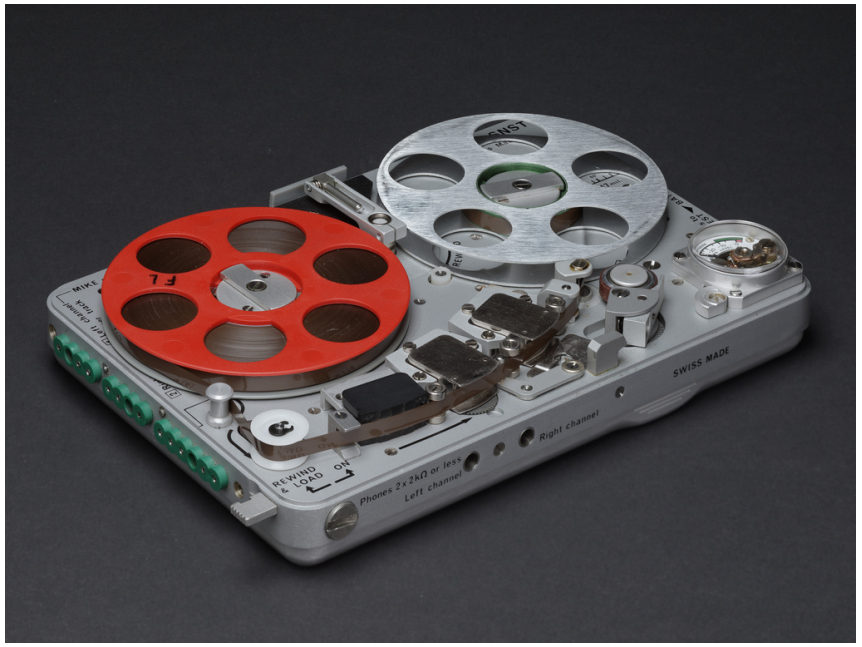
`https://en.wikipedia.org/wiki/File:Alligator_clips_444.jpg`

The Modern Incarnation Isn't Much Harder





A Harbinger of Change

https://en.wikipedia.org/wiki/File:WE1500D10buttonDSCN0217.JPG

- Signaling could now be done after the call was set up
- Eventually, this gave rise to redialing services
- The original number dialed might not be the actual number of interest

Enter CALEA

- By 1992, the FBI saw problems coming
- They knew there were technologies they couldn't tap with simple tools
- They knew there were more changes coming
- They got Congress to pass CALEA: the Communications Assistance to Law Enforcement Act (1994)

https://en.wikipedia.org/wiki/File:Mobile_phone_evolution.jpg

CALEA

- All phone switches were required to have a standardized wiretap interface
- The technology was irrelevant; the switch handled the details
- The solution was rapidly copied around the world, under the generic name “lawful intercept”
- The law was intended to apply to local phone service only
- There were problems. . .

en.wikipedia.org/wiki/File:Cisco7960G.jpg

Lawful Intercept in the UK

A similar requirement is codified in §12(1) of RIPA:

> The Secretary of State may by order provide for the imposition by him on persons who—
>
> (a) are providing public postal services or public telecommunications services, or
>
> (b) are proposing to do so,
>
> of such obligations as it appears to him reasonable to impose for the purpose of securing that it is and remains practicable for requirements to provide assistance in relation to interception warrants to be imposed and complied with.

§1(1) indicates that this already covers the Internet: "any system . . . for the purpose of facilitating the transmission of communications by any means involving the use of electrical or electro-magnetic energy."

The Athens Affair

- The lawful intercept capability is a deliberate back door
- In theory, only authorized law enforcement agencies can use the capability
- But: phone switches are *computers*, and are hackable
- In Athens, someone—just whom isn't known—hacked a mobile phone switch
- About a hundred phones belonging to high officials, up to and including the prime minister, were tapped by abusing this mechanism (`http://spectrum.ieee.org/telecom/security/the-athens-affair/0`)
- The intercepts were relayed to prepaid phones located elsewhere in Athens

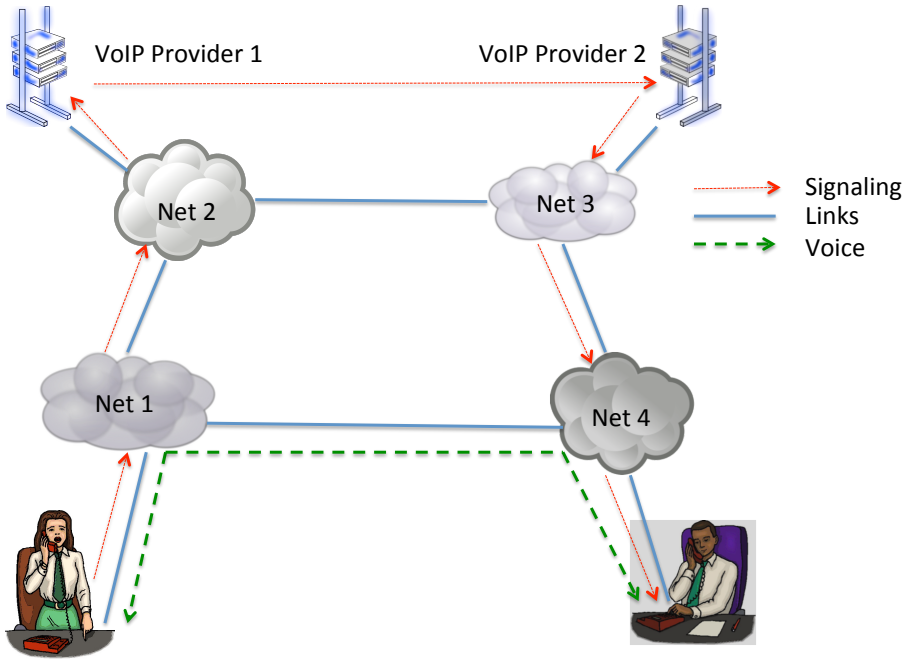
The Problem Isn't Greece

- *Every* CALEA-compliant phone switch tested by the NSA had security problems
- There was a larger (though less-publicized) abuse in Italy
- Some of the attacks on Google from China were intended to discover which users were the subject of wiretap orders
- There have been rumors that the Russian mob has hacked into CALEA interfaces in the US, to spy on law enforcement

Technology Changed Again

- Voice Over IP (VoIP) has a very different architecture than the authors of CALEA anticipated
- Skype was different still
- Many other means of communication sprung up on the Internet
- Should these be covered by CALEA? How?

VoIP Call Paths



- The signaling path is not the same as the voice path
- The "switch" may be in a different jurisdiction than the local Internet link
- Where can the CALEA tap go?

Skype is Stranger Still

- A peer-to-peer network
- There are *no* trusted phone switches
- Calls are routed through random other Skype users' computers (that's been changed of late by Microsoft)
- There is *nowhere* to place a tap interface

Other Communications Paths

- Email and IM
- Text messages in all their variants (Snapchat, anyone?)
- Voice communications in games
- Voice over IM systems
- More. . .

CALEA II

- For the last few years, the FBI has publicly advocated changes to CALEA to cover Internet services
- What they want is for *all* communications services to include a wiretap interface
- (No bill has been introduced yet, but they keep telling Congress they're "going dark")

Three Problems with CALEA-II

It won't (and can't) work:

- Attempting to make it work will drive up costs, hinder innovation, and cede the Internet service market to other countries
- How do you handle other countries' access requests?
- It creates security problems
- Other than that, it's a fine idea. . .

It Doesn't Work

- You can't put an overt back door into open source software; folks will just delete it
- End-to-end crypto defeats server-side solutions
- If run on end system clients, it may become easier for the target to notice the tap (though this can be done cleverly)
- Software can come from and/or be run in other countries

It Hinders Innovation

- CALEA-like laws are based on the implicit assumption that there is a more-or-less trusted place where you can tap all calls—which isn't true of peer-to-peer architectures
- Innovative designs may have no central servers
- Forcing small, innovative companies that are trying to ship on "Internet time" to add extra code will drive up their costs and slow down releases
- Developers in countries without such a law will thus have a competitive advantage

International Problems

- Which country should have access to a lawful intercept mechanism on a given computer?
- The US? The UK? France? India? Russia? China? The country in whose territory the target physically is?
- How do you enforce this?

It Creates Security Problems

- As noted, existing CALEA implementations are at best problematic
- This is code developed by sophisticated, skilled developers working for major phone switch vendors
- Furthermore, the problem they are trying to solve—tapping ordinary phone calls—is well-understood. It's much less obvious what it means to tap a new kind of service.
- Most developers are not security experts. Indeed, their own product-specific code will often have security problems, especially early on.

But other than all that, it's a fine idea. . .

Is There Even a Problem?

- Newer services create a vast amount of metadata
- Even Skype leaks IP addresses
- In fact, most people voluntarily carry location tracking devices, a.k.a. mobile phones
- Mobile phones are generally person-specific; law enforcement is thus more likely to cpature the conversations of interest
- Cloud services (e.g., gmail) make preservation of data a priority
- Official statistics show that previous “serious threats”, such as encryption, have not turned out to be problems
- Most criminals use off-the-shelf tools and don’t do a particularly good job of covering their tracks

☞ Late-breaking news: look at the take-down of the Silk Road

Lawful Hacking

- Suppose there is a problem. What should law enforcement do?
- Proposal: Hack the endpoints
- Plant whatever wiretap software is needed on the target's machine
- Avoid all crypto issues: capture conversation before encryption or after decryption
- Perhaps install taps in the microphone or audio device drivers
- Or simply send out a very few packets with the session keys, encrypted with the FBI's public key

Huh? Hacking? By Law Enforcement?

- Is this legal?
- Can it be done?
- Will it lead to more security holes in our software?

Legality

- Lawful hacking is done today, under court order. In other words, it is probably permissible even without new laws.
- We do suggest a new statute, along the lines of the wiretap statute (referred to the in the US as “Title III”), to specify the conditions under which this can be done.

☞ The current wiretap law places many restrictions on when taps can be done, because they’re so invasive. The same should be done, by statute, for lawful hacking.

Feasbility

- Today's computer systems are quite buggy—better than years ago, but still insecure
- Example: despite all of the effort Microsoft has put into software security—and they've put in a tremendous amount—there are critical patches released virtually every month
- There is a thriving market in "0-days": holes for which no patches exist because the vendor doesn't know about them
- Most of the customers are intelligence agencies; this won't add much volume.
- The FBI already has a lab (DCAC: Domestic Communications Assistance Center) that develops such technology

The Market

- There's a big market for vulnerabilities
- Many companies, some legit and some less so, sell them
- Some sell to all buyers; others sell only to "certain" governments

0-Days Found: March–July 2012

Month	*Vul-Labs*	*Microsoft V.R.*	*Vupen*	*Bugtraq*	*ZDI*
March	9	1	41	11	13
April	37	2	38	6	20
May	31	1	39	2	0
June	32	2	25	5	39
July	15	2	6	17	14

Will this Hurt Security?

- The bugs already exist; finding them doesn't create the problem, it merely exploits it
- We advocate a mandatory reporting requirement: if law enforcement finds or buys an vulnerability, it must report it immediately to the vendor
- This will lead to a patch, so it will *help* overall security
- Studies show that bugs remain unpatched on most users' computers for a very long time. There is thus plenty of time to use the vulnerability

☞ Most of the actual wiretap code is vulnerability-independent, and won't have to be rewritten after a given hole is patched

Why Mandatory Reporting?

- The requirement would apply to both purchased and locally developed vulnerabilities
- We feel that this is an ethical issue that should be instantiated in the law
- Otherwise, this scheme might lead to an overall increase in crime

How To Do It

- Scan the target and/or target net
- ☞ Must allow for NATs, multiple devices, etc.
- Figure out OS and software used, versions, etc.
- Select a vulnerability; build a tapping package
- Install it: drive-by download, infected attachment, hacking the target from the outside, maybe even a black bag job

Non-Proliferation

- It's important to keep the exploits from being reused, especially if they use 0-day holes
- Obfuscate the code
- Strongly tie the tapping package to the target machine
- Use DRM techniques—maybe even the OS's built-in DRM schemes—to do this
- In some situations, erase the vulnerability part as soon as the code is installed; maybe even download the tapping part anew each reboot so that it's never stored on disk
- You know, standard virus and malware techniques. . .

The Full Picture

- Law enforcement (and private sector?) labs find holes and develop exploit tools
- New holes are reported to the vendor
- When need arises:
  - Get a scanning warrant
  - Figure out the target's OS, applications, etc.
  - Get a hacking warrant
  - Plant the wiretap code

National Security Wiretaps

- This talk was about law enforcement, not national security
- Intelligence agencies have a somewhat different problem: many of their targets don't follow domestic law
- That said, they'll take advantage of whatever they can
- That includes both laws and vulnerabilities
- A public discussion on the wisdom of formalizing use of vulnerabilities by law enforcement might include the national security sector, too

Why This Helps

- It does not introduce new security holes
- It works without regard to national boundaries
- The mandatory reporting element will improve security
- The new law will regularize and regulate the hacking that already takes place
- The country will have a debate about the difficult issues raised by lawful hacking, e.g., how to limit the search as required by the Fourth Amendment

Further Reading

- Steven M. Bellovin, Matt Blaze, Sandy Clark, and Susan Landau. Going bright: Wiretapping without weakening communications infrastructure. *IEEE Security & Privacy*, 11(1):62-72, January-February 2013. https://www.cs.columbia.edu/~smb/papers/GoingBright.pdf
- Steven M. Bellovin, Matt Blaze, Sandy Clark, and Susan Landau. "Lawful hacking: Using existing vulnerabilities for wiretapping on the Internet." *Northwestern Journal of Technology and Intellectual Property*, 2014. To appear. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2312107 (draft)
- "CALEA II: Risks of Wiretap Modifications to Endpoints," May 17, 2013. https://www.cdt.org/files/pdfs/CALEAII-techreport.pdf
- "Eavesdropping on Internet Communications," editorial board, *New York Times*, May 20, 2013, https://www.nytimes.com/2013/05/20/opinion/eavesdropping-on-internet-communications.html