Post-Snowden Cryptography or who holds your keys?

Bart Preneel
COSIC KU Leuven and iMinds, Belgium
Bart.Preneel(at)esat.kuleuven.be

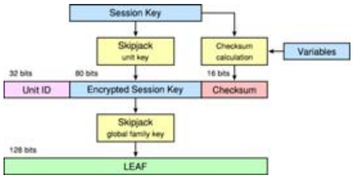
February 2014

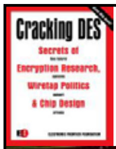
Crypto Wars History 101

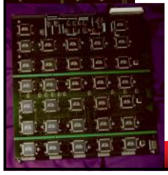
- hardware export (and import) controls
  - weak or very weak encryption in mobile phones (A5/1 and A5/2)
- research: attempts to suppress
  - US in late 1970s; examples: RSA, Davida
  - EU around 1988; example: RIPE
- software export controls (1987-1993)
  - mostly restricted to 40-bit keys (RC4/DES = IBM CDMF)
  - even hooks/APIs disallowed
  - avoid: using print books (e.g. PGP)

Crypto Wars History 101

- 1993: AT&T secure telephones with triple-DES
- US response: key escrow, e.g. Clipper Chip
- if key escrow, can export 56-bit DES







Cracking DES (56-bit key)

controversy in 1977: $20-200 million

M. Wiener's design (1993):
$1 million machine: 3 hours
(today < 1 second)

EFF Deep Crack (July 1998)
250,000 $ machine: 50 hours…

DES was withdrawn by NIST in 2004

Wassenaar Arrangement

(1995-present)

the first global multilateral arrangement on export controls for conventional weapons and sensitive **dual-use goods and technologies**

signed in 1995, operational Sept. 1996

33 members now expanded to 41

relaxed in 1998:

- symmetric key: 56 bits, public key: 512 RSA/112 ECC
- mass market: 64 bits (but…)

no cryptanalytic hardware

personal use exemption

Wassenaar Arrangement

Sept. 2000: announcement about lifting some restrictions

Oct. 2000: Rijndael selected as AES

Dec. 2000: 64-bit limit relaxed for mass market software and hardware

details: http://www.cryptolaw.org/

Legal intercept

- Overlooked for GSM
- Has been added to various communication systems
  - VOIP
  - 3G/LTE

7

Digital Millennium Copyright Act (1998)

- goal: implement the World Intellectual Property Organization Copyright Treaty and Performances and Phonograms Treaty (and for other purposes)
- cryptanalytic research may not be allowed
  - example: Dmitry Sklyarov

8

National Security Agency

cryptologic intelligence agency of the USA DoD

- collection and analysis of foreign communications and foreign signals intelligence
- protecting government communications and information systems

9

National Security Agency

cryptologic intelligence agency of the USA DoD

- collection and analysis of foreign communications and foreign signals intelligence

mission from cold war, repurposed after 9/11

collect it all, know it all, exploit it al (or: in God we trust, all others we monitor)

- even air to ground link from laptop to ground in air planes and chat in second life

aided by Moore’s law and ubiquitous internet

redundancy:

- 3 different ways to get to Gmail user data: 3 different corporate partners and 3 different legal authorities

hide capabilities by being selective with the truth

collaboration with other organizations

- inside US: FBI, CIA, DEA, DHS
- outside US: UKUSA (Five Eyes) and many other nations (BE, CH, DE, DK, ES, FR, IL, IT, NL, NO,. SE)

10

National Security Agency

cryptologic intelligence agency of the USA DoD

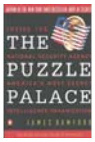
- collection and analysis of foreign communications and foreign signals intelligence

Modus operandi

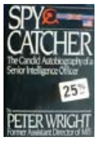
- Spontaneous cooperation of companies
- Bribery
- Threats
- Security letters
- Exchange of information with others

11

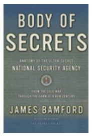
Information about NSA/GCHQ



1982



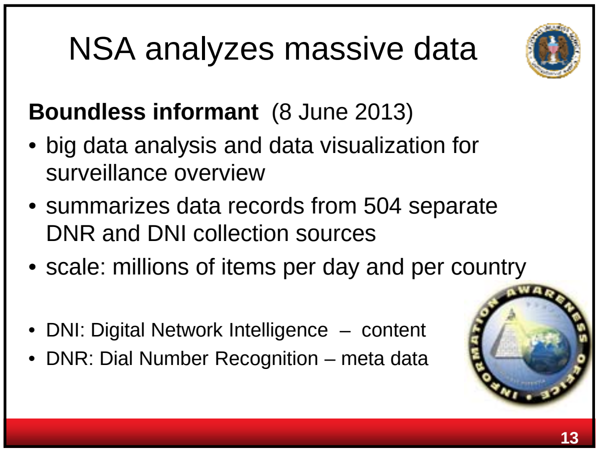
1987



2002

2010

12



NSA analyzes massive data

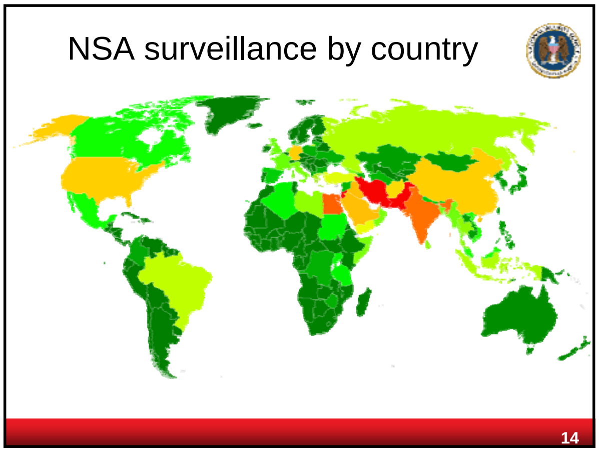
Boundless informant (8 June 2013)

- big data analysis and data visualization for surveillance overview
- summarizes data records from 504 separate DNR and DNI collection sources
- scale: millions of items per day and per country

- DNI: Digital Network Intelligence – content
- DNR: Dial Number Recognition – meta data

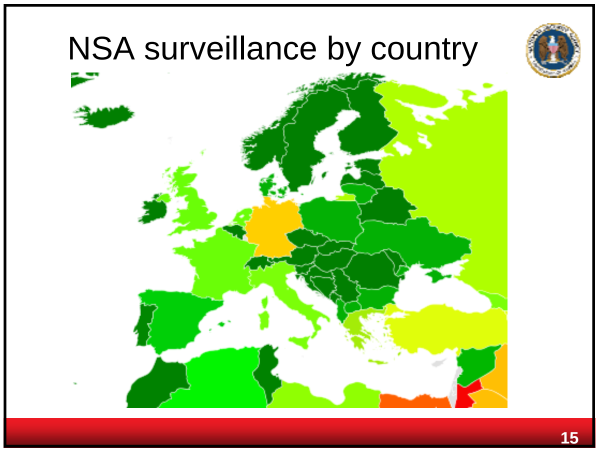
INFORMATION AWARENESS OFFICE

13



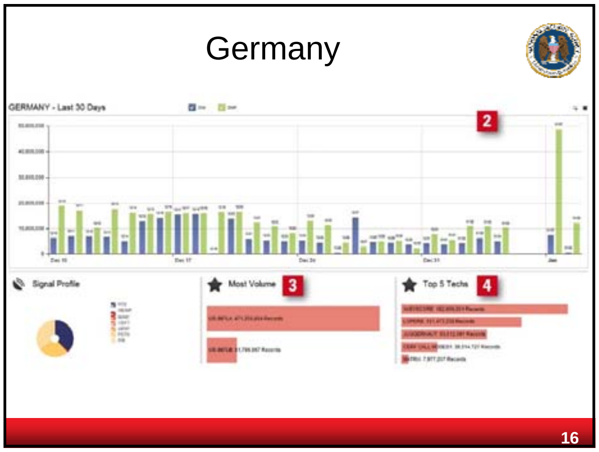
NSA surveillance by country

14



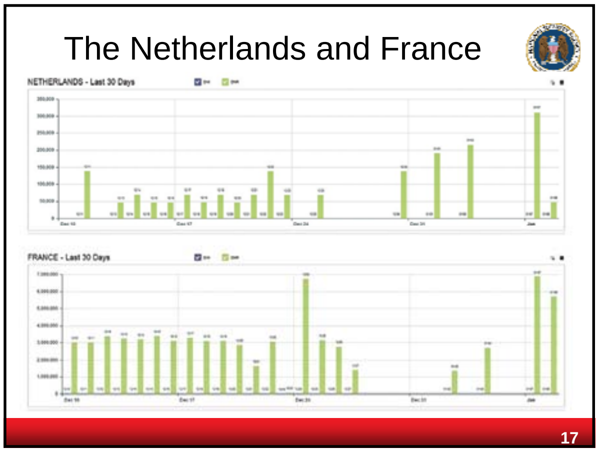
NSA surveillance by country

15



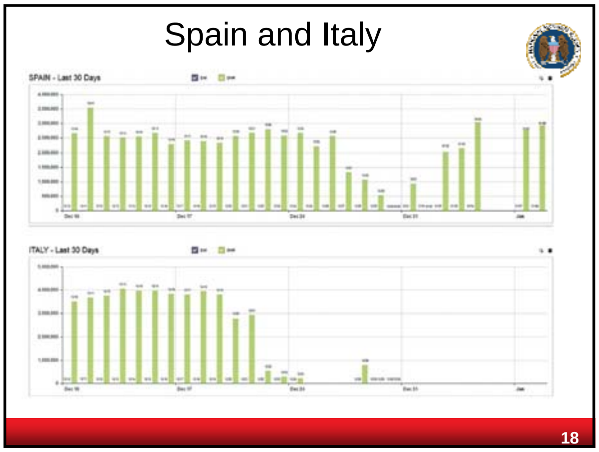
Germany

16



The Netherlands and France

17



Spain and Italy

18

NSA analyzes massive data

Xkeyscore (July 2013):
700 servers at approximately 150 sites

- *F6 (Special Collection Service)* – CIA/NSA clandestine operations including espionage on foreign diplomats and leaders
- *FORNSAT* (foreign satellite collection): intercepts from satellites
- *SSO (Special Source Operations)* – cooperation with telcos
- *Overhead:* US spy planes, drones and satellites
- *TAO (Tailored Access Operations)* – hacking and cyberwarfare
- *FISA* – approved by the Foreign Intelligence Surveillance Court
- *Third party* – foreign partners of the NSA such as the (signals) intelligence agencies of other nations
- Also Windows error reporting

19

NSA foils much internet encryption

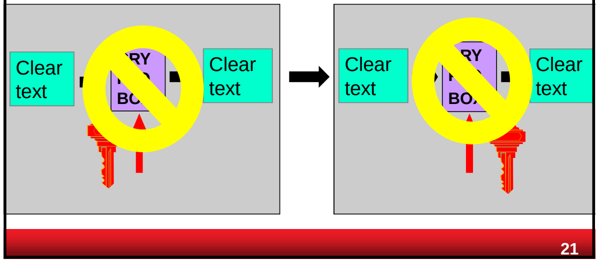
NYT 6 September 2013

The National Security Agency is winning its long-running secret war on **encryption**, using supercomputers, technical trickery, court orders and behind-the-scenes persuasion to undermine the major tools protecting the privacy of everyday communications in the Internet age

20

Rule #1 of cryptanalysis: search for plaintext [B. Morris]

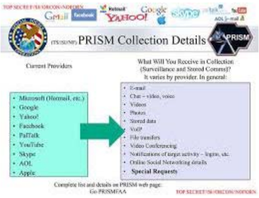
Alice **Eve/NSA** **Bob**



21

Where do you find plaintext?

1. PRISM (server)



TOP SECRET//SI//ORCON//NOFORN

(TS//SI//NF) PRISM Collection Details

Current Providers

- Microsoft (Hotmail, etc.)
- Google
- Yahoo!
- Facebook
- PalTalk
- YouTube
- Skype
- AOL
- Apple

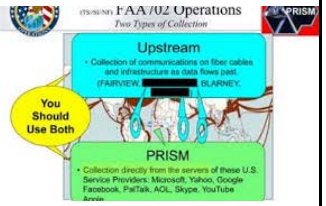
What Will You Receive in Collection (Surveillance and Stored Comms)?
It varies by provider. In general:

- E-mail
- Chat – video, voice
- Videos
- Photos
- Stored data
- VoIP
- File transfers
- Video Conferencing
- Notifications of target activity – logins, etc.
- Online Social Networking details
- **Special Requests**

Complete list and details on PRISM web page:
Go PRISMFAA

TOP SECRET//SI//ORCON//NOFORN

2. Upstream (fiber)



(TS//SI//NF) FAA702 Operations
Two Types of Collection

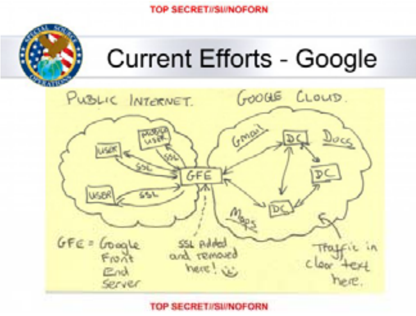
Upstream
- Collection of communications on fiber cables and infrastructure as data flows past. (FAIRVIEW, [redacted], BLARNEY, [redacted]

You Should Use Both

PRISM
- Collection directly from the servers of these U.S. Service Providers: Microsoft, Yahoo, Google Facebook, PalTalk, AOL, Skype, YouTube Apple.

Tempora

22



TOP SECRET//SI//NOFORN

Current Efforts - Google

GFE = Google Front End Server

SSL Added and removed here! ☺

Traffic in clear text here.

TOP SECRET//SI//NOFORN

Muscular (GCHQ) help from Level 3 (LITTLE)

Jan 9 2013: In the preceding 30 days, field collectors had processed and sent back 181,280,466 new records — including "metadata," which would indicate who sent or received e-mails and when, as well as content such as text, audio and video (from Yahoo! and Google)

23

Is upstream surprising?

- 7 April 2006
- whistleblower Marc Klein, ex-AT&T Technician reports about NSA room 641A at 611 Folsom Street in San Francisco
- includes splitter + data mining

24

Upstream (continued)

- What if you want the upstream in other countries?
  - Echelon (European Parliament 2001)
    - submarines (underwater cables)
    - satellites
    - fiber
  - reroute traffic– who ever believed that internet routing was secure?
  - hack the telcos (Belgacom?)

Upstream (continued)

With help of foreign agencies?

- in 1 day: 444,743 e-mail address books from Yahoo, 105,068 from Hotmail, 82,857 from Facebook, 33,697 from Gmail and 22,881 from unspecified other providers
  - 250 M email addresses per year

- 500,000 buddy lists and inboxes per day
  - 180 M per year

3. Traffic data (meta data) (DNR)

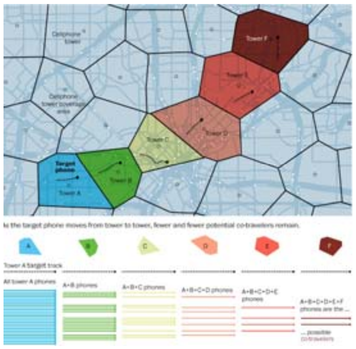
- traffic data is not plaintext itself, but it is very informative
  - it may contain URLs of websites
  - it allows to map networks
  - location information reveals social relations

6 June 2013: NSA collecting phone records of millions of Verizon customers daily

EU: data retention directive (2006/24/EC)

3. Traffic data (DNR) – phone location

- NSA collects about 5B records a day on cell phone location
- Co-traveler



Cellphone tower
Cellphone tower coverage area
Tower F
Tower E
Tower D
Tower C
Target phone
Tower B
Tower A
As the target phone moves from tower to tower, fewer and fewer potential co-travelers remain.
A
B
C
D
E
F
Tower A target track
All tower A phones
A+B phones
A+B+C phones
A+B+C+D phones
A+B+C+D+E phones
A+B+C+D+E+F phones are the ...
... possible co-travelers

3. Traffic data (DNR) - defense

- TOR: tool for anonymous browsing and services

- not designed to resist global attacker
- NSA's attempts
  - denial of service
  - compromise end systems e.g. via bug in browser package (EgotisticalGiraffe)
  - meet-in-the middle via web site impersonations (Quantum)

- according to leaked documents from 2006: "We will never be able to de-anonymize all Tor users all the time" but "with manual analysis we can de-anonymize a very small fraction of Tor users"

http://www.washingtonpost.com/blogs/the-switch/wp/2013/10/04/everything-you-need-to-know-about-the-nsa-and-tor-in-one-faq/

4. Client systems

- hack the client devices
  - use unpatched weaknesses (disclosed by vendors?)
  - anyone remembers _NSAKEY from 1999?
- get plaintext

- it is well known that any mobile phone can be converted into a remote microphone

4. Client systems: TAO

- Targeted Access Operations
  - many technologies
  - large number on bridging air gaps
  - number of targets is limited by cost/effort
- Examples:
  - use radio interfaces and radar activation
  - supply chain interception

4. Client systems: TAO (2)

ANDYGRAM: A telephone tripwire that mimics a cellphone tower.

ANGRYNEIGHBOR: taps your PS/2 or USB keyboard and transmits to the radio antenna station.

COTTONMOUTH: A modified USB plug for intercepting communications, installing trojans etc.

WATERWITCH: A handheld "finishing tool" for finding the exact location of nearby handsets.

SURLYSPAWN: Monitors keystrokes when a target computer isn't connected to the Internet.

FOXACID: A system for installing spyware with a "quantum insert" that infects spyware at the packet level.

IRONCHEF: Infects networks by installing itself in a computer's input-output BIOS.

JETPLOW: A firmware implant that provides a permanent backdoor through a Cisco firewall.

4. Client systems: TAO (3)

HEADWATER: Does the same for China's Huawai routers.

RAGEMASTER: Taps the line between a desktop computer's video card and its monitor.

HOWLERMONKEY: A radio transceiver for extracting data from systems or making them remote-controllable.

- 50 units fetches $200,000 USD

MONKEYCALENDAR: Attack software that sends a mobile phone's location by covert text message.

DIETYBOUNCE: Installs a secret payload in a Dell computer by reflashing the motherboard BIOS when the machine is turned on.

NIGHTSTAND: A mobile system for wirelessly installing exploits of Microsoft Windows from up to eight miles away.

SOMBERKNAVE: A Windows XP implant to connect computers to NSA headquarters, from where they can be remotely controlled.

4. Client systems: TAO (4)

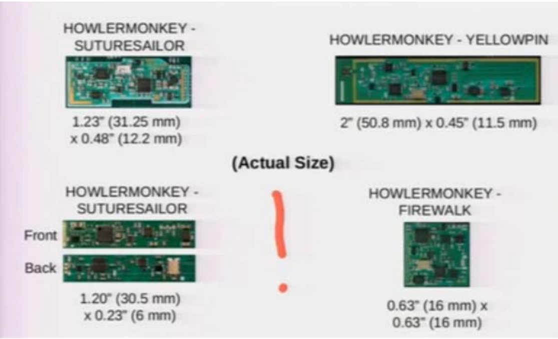
ANGRYMONK: Inserts itself into the firmware of hard drives made by Western Digital, Seagate, Maxtor and Samsung.

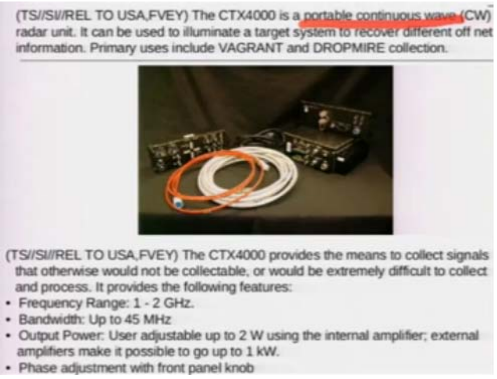
SWAP: Reflashes the BIOS of multiprocessor systems running Windows, Solaris, Linux or FreeBSD.

SPARROW II: A tool for detecting and mapping wireless networks via drone.

TOTEGHOSTLY: An implant that allows full remote control of Window Mobile phones.

DROPOUTJEEP: (I quote) "A software implant for the Apple iPhone that utilizes modular mission applications to provide specific SIGINT functionality. This functionality includes the ability to remotely push/pull files from the device. SMS retrieval, contact list retrieval, voicemail, geolocation, hot mic, camera capture, cell tower location, etc. Command, control and data exfiltration can occur over SMS messaging or a GPRS data connection. All communications with the implant will be covert and encrypted."

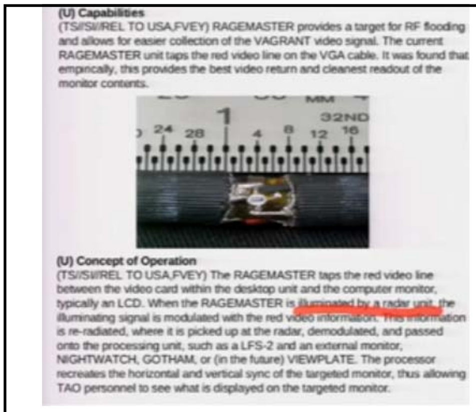

HOWLERMONKEY - SUTURESAILOR
1.23" (31.25 mm) x 0.48" (12.2 mm)
HOWLERMONKEY - YELLOWPIN
2" (50.8 mm) x 0.45" (11.5 mm)
(Actual Size)
HOWLERMONKEY - SUTURESAILOR
Front
Back
1.20" (30.5 mm) x 0.23" (6 mm)
!
HOWLERMONKEY - FIREWALK
0.63" (16 mm) x 0.63" (16 mm)



(TS//SI//REL TO USA,FVEY) The CTX4000 is a portable continuous wave (CW) radar unit. It can be used to illuminate a target system to recover different off net information. Primary uses include VAGRANT and DROPMIRE collection.

(TS//SI//REL TO USA,FVEY) The CTX4000 provides the means to collect signals that otherwise would not be collectable, or would be extremely difficult to collect and process. It provides the following features:

- Frequency Range: 1 - 2 GHz.
- Bandwidth: Up to 45 MHz
- Output Power: User adjustable up to 2 W using the internal amplifier; external amplifiers make it possible to go up to 1 kW.
- Phase adjustment with front panel knob



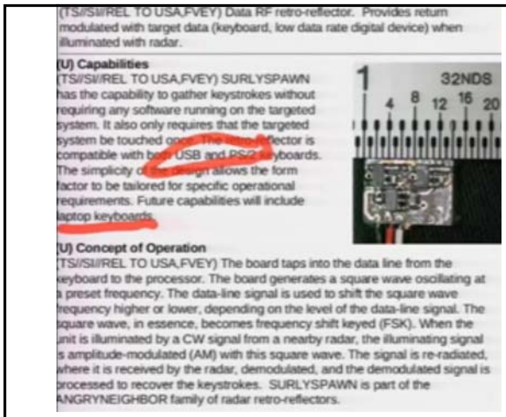
(U) Capabilities

(TS//SI//REL TO USA,FVEY) RAGEMASTER provides a target for RF flooding and allows for easier collection of the VAGRANT video signal. The current RAGEMASTER unit taps the red video line on the VGA cable. It was found that empirically, this provides the best video return and cleanest readout of the monitor contents.

MM
1
32ND
24
28
4
8
12
16

(U) Concept of Operation

(TS//SI//REL TO USA,FVEY) The RAGEMASTER taps the red video line between the video card within the desktop unit and the computer monitor, typically an LCD. When the RAGEMASTER is illuminated by a radar unit, the illuminating signal is modulated with the red video information. This information is re-radiated, where it is picked up at the radar, demodulated, and passed onto the processing unit, such as a LFS-2 and an external monitor, NIGHTWATCH, GOTHAM, or (in the future) VIEWPLATE. The processor recreates the horizontal and vertical sync of the targeted monitor, thus allowing TAO personnel to see what is displayed on the targeted monitor.



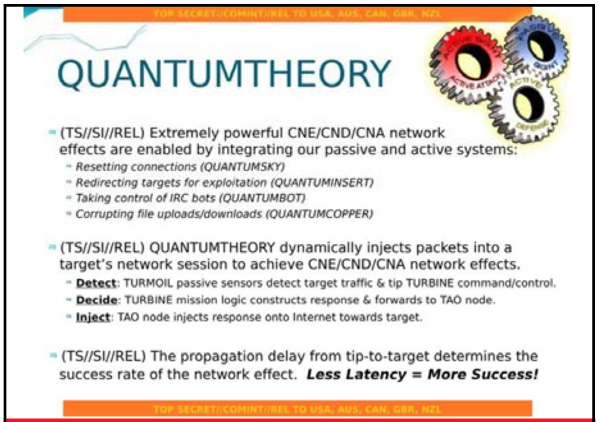
(TS//SI//REL TO USA,FVEY) Data RF retro-reflector. Provides return modulated with target data (keyboard, low data rate digital device) when illuminated with radar.

(U) Capabilities

(TS//SI//REL TO USA,FVEY) SURLYSPAWN has the capability to gather keystrokes without requiring any software running on the targeted system. It also only requires that the targeted system be touched once. The retro-reflector is compatible with both USB and PS/2 keyboards. The simplicity of the design allows the form factor to be tailored for specific operational requirements. Future capabilities will include laptop keyboards.

(U) Concept of Operation

(TS//SI//REL TO USA,FVEY) The board taps into the data line from the keyboard to the processor. The board generates a square wave oscillating at a preset frequency. The data-line signal is used to shift the square wave frequency higher or lower, depending on the level of the data-line signal. The square wave, in essence, becomes frequency shift keyed (FSK). When the unit is illuminated by a CW signal from a nearby radar, the illuminating signal is amplitude-modulated (AM) with this square wave. The signal is re-radiated, where it is received by the radar, demodulated, and the demodulated signal is processed to recover the keystrokes. SURLYSPAWN is part of the ANGRYNEIGHBOR family of radar retro-reflectors.



TOP SECRET//COMINT//REL TO USA, AUS, CAN, GBR, NZL

QUANTUMTHEORY

ACTIVE EXPLOIT
ACTIVE ATTACK
PASSIVE
SIGINT
ACTIVE
DEFENSE

- (TS//SI//REL) Extremely powerful CNE/CND/CNA network effects are enabled by integrating our passive and active systems:
  - *Resetting connections (QUANTUMSKY)*
  - *Redirecting targets for exploitation (QUANTUMINSERT)*
  - *Taking control of IRC bots (QUANTUMBOT)*
  - *Corrupting file uploads/downloads (QUANTUMCOPPER)*
- (TS//SI//REL) QUANTUMTHEORY dynamically injects packets into a target's network session to achieve CNE/CND/CNA network effects.
  - **Detect**: TURMOIL passive sensors detect target traffic & tip TURBINE command/control.
  - **Decide**: TURBINE mission logic constructs response & forwards to TAO node.
  - **Inject**: TAO node injects response onto Internet towards target.
- (TS//SI//REL) The propagation delay from tip-to-target determines the success rate of the network effect. ***Less Latency = More Success!***

TOP SECRET//COMINT//REL TO USA, AUS, CAN, GBR, NZL

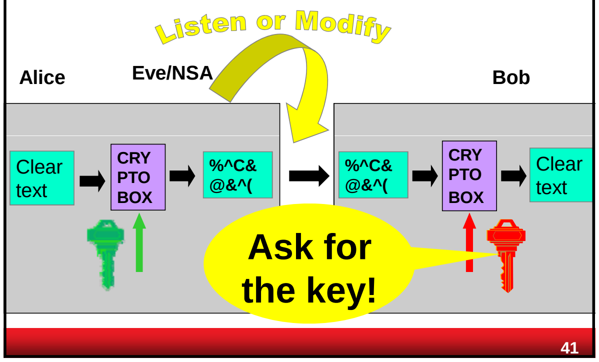
Further comments

Quantum:

- great firewall of China works in the same way
- similar methods used in Syria

[Feb.'14]: GCHQ runs DDOS attacks on chatrooms run by anonymous

If you can't get the plaintext



Asking for the key

- (alleged) examples
  - Lavabit email encryption
  - CryptoSeal Privacy VPN
  - SSL/TLS servers of large companies

> This experience has taught me one very important lesson: without congressional action or a strong judicial precedent, I would **strongly** recommend against anyone trusting their private data to a company with physical ties to the United States.
>
> Ladar Levison, Owner and Operator, Lavabit LLC

If you can't get the private key, substitute the public key

fake SSL certificates or SSL person-in-the-middle

- Flame: rogue certificate by cryptanalysis*
- Comodo, Diginotar, Turktrust
- NSA – GCHQ FLYING PIG (Google, Hotmail, Yahoo!)

* *Stevens*, Counter-cryptanalysis, *Crypto 2013*

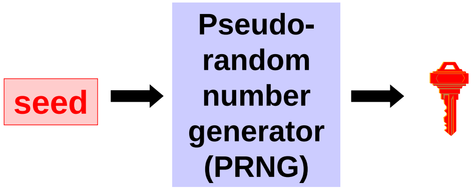
The CA Mess on the web

[Eckersley10] "An observatory for the SSLiverse"

10.8M servers start SSL handshake
4.3M use valid certificate chains
650 CA certs trustable by Windows or Firefox
1.4M unique valid leaf certs
– 300K signed by one GoDaddy cert
80 distinct keys used in multiple CA certs
several CAs sign the IP adr. 192.168.1.2 (reserved by RFC 1918)
2 leaf certs have 508-bit keys
Debian OpenSSL bug (2006-2008)
– resulted in 28K vulnerable certs
– fortunately only 530 validate
– only 73 revoked

If you can't get or replace the key

make sure that the key is generated using a random number generator with trapdoor



trapdoor allows to predict keys

Dual_EC_DRBG or Dual Elliptic Curve Deterministic Random Bit Generator

- 1 of the 4 PRNGs in NIST SP 800-90A
- draft Dec. 2005; published 2006; revised 2012
- warnings
  - Dec 05: output not perfectly random [Gjøsteen]
  - Mar 06: problem if one fails to choose P and Q at random but one chooses Q = d.P for a known d [Brown]
  - May 06: flaw [Schoenmakers-Sidorenko]
  - Aug 07: backdoor [Ferguson-Shumov]

Appendix: The security of Dual_EC_DRBG requires that the points P and Q be properly generated. To avoid using potentially weak points, the points specified in Appendix A.1 should be used.

Dual_EC_DRBG or Dual Elliptic Curve Deterministic Random Bit Generator

- 10 Sept. 2013, NYT: "internal memos leaked by a former NSA contractor suggest that the NSA generated one of the random number generators used in a 2006 NIST standard — called the Dual EC DRBG standard — which contains a **backdoor** for the NSA."
- NSA **Bullrun program:** NSA has been actively working to "Insert vulnerabilities into commercial encryption systems, IT systems, networks, and endpoint communications devices used by targets."

Dual_EC_DRBG or Dual Elliptic Curve Deterministic Random Bit Generator

- 9 Sept. 2013: NIST **"strongly recommends" against the use of dual_EC_DRBG**, as specified in the January 2012 version of SP 800-90A.
- in light of community security concerns SP 800-90A reissued as draft standard, and re-opening SP800-90B/C for public comment

Why was the slowest and least secure of the 4 PRNGs chosen as the default algorithm in BSAFE?

On 7 Feb 2001 Bleichenbacher of Bell Labs found an attack on the PRNG building block of DSA (FIPS 186). Coincidence?

More PRNG flaws

- 1996: Netscape SSL [Goldberg-Wagner]
- 2008: Debian SSL [Bello]
- 2012: wireless routers [Heninger+], PGP/SSL [Lenstra+]
- 15 Aug. 2013: Android Java and OpenSSL PRNG flaw led to theft of bitcoins

AC'13 Factoring RSA keys from certified smart cards: Coppersmith in the wild [Bernstein-Chang-Cheng-Chou-Heninger-Lange-van Someren'13] IACR ePrint Archive 2013: 599

184 keys from Taiwan Citizen Digital Certificate cards
card + OS: EAL 4+; FIPS 140-2 Level 2

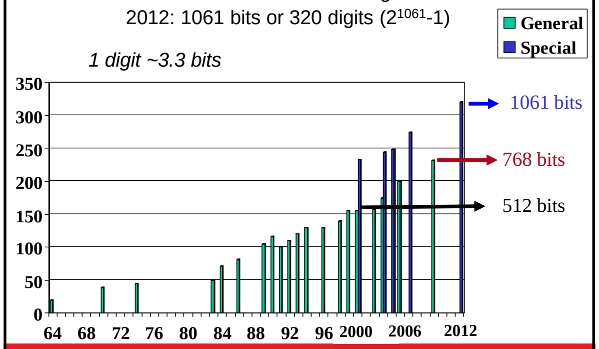
If you can't get plaintext or key: cryptanalysis

Can NSA break

- RSA-512: easily
- RSA-768: definitely
- RSA-1024: likely
- RSA-1536: perhaps
- RSA-2048: who knows

Factorisation records (RSA)

2009: 768 bits or 232 digits
2012: 1061 bits or 320 digits (2^{1061}-1)



Widely used public-key systems rely on 3 problems from algebraic number theory

Integer factorization: RSA (n = p.q)
Discrete **LOG**arithm : Diffie-Hellman, DSA: y = g^x
Elliptic Curve **D**iscrete **LOG**arithm, ECDSA: Q = x.P

RSA-1024 ~ DLOG-1024 ~ ECC-146
RSA-2048 ~ DLOG-2048 ~ ECC-206
RSA-4096 ~ DLOG-4096 ~ ECC-282

Not so likely that NSA can break some specific ECC curves proposed by NIST

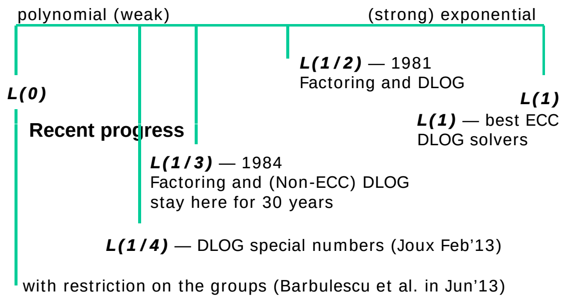
The Cryptocalypse?

2013 breakthrough for DLOG in group of special form

Math Advances Raise the Prospect of an Internet Security Crisis

Public key crypto security

$L(a)=exp((log_2 n)^a (log_2 log_2 n)^{1-a})$



L(1/2) — 1981
Factoring and DLOG

L(1) — best ECC DLOG solvers

L(1/3) — 1984
Factoring and (Non-ECC) DLOG stay here for 30 years

L(1/4) — DLOG special numbers (Joux Feb'13)

with restriction on the groups (Barbulescu et al. in Jun'13)

Special form DLOG record: 9234 bits [Granger+'13]

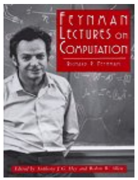
Quantum computers?

exponential parallelism

n coupled quantum bits ⇩ 2^n degrees of freedom !

Shor 1994: perfect for factoring

but: can a quantum computer be built?



55

If a large quantum computer can be built...

all schemes based on factoring (RSA) and DLOG will be insecure

same for elliptic curve cryptography

symmetric key sizes: x2

hash sizes: unchanged (for collisions)

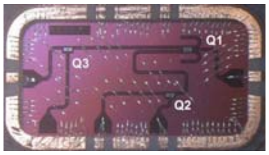
alternatives: postquantum crypto

- McEliece, NTRU,…
- so far it seems very hard to match performance of current systems while keeping the security level against conventional attacks

56

2001: 7-bit quantum computer factors 15
2007: two new 7-bit quantum computers
2012: 143 has been factored in April

2012: 10 to 15 years for a large quantum computer



Quantum Computing: An IBM Perspective

Steffen, M.; DiVincenzo, D. P.; Chow, J. M.; Theis, T. N.; Ketchen, M. B.

Quantum physics provides an intriguing basis for achieving computational power to address certain categories of mathematical problems that are completely intractable with machine computation as we know it today. We present a brief overview of the current theoretical and experimental works in the emerging field of quantum computing. The implementation of a functioning quantum computer poses tremendous scientific and technological challenges, but current rates of progress suggest that these challenges will be substantively addressed over the next ten years. We provide a sketch of a quantum computing system based on superconducting circuits, which are the current focus of our research. A realistic vision emerges concerning the form of a future scalable fault-tolerant quantum computer.

57

And what about NSA?

News in January 2014: NSA has spent 85 M$ on building a quantum computer

58

Cryptographic breakthrough? (speculation)

Indications: James Clapper referred to it when presenting the budget

1) ECC - in general or for some curves; NSA has influenced curve selection
2) general factoring/DLOG - 10 year ahead
3) RC4 – effective attack
4) AES – solve the equations?
5) Random number generation flaws

Good crypto works but NSA finds a way around it

59

COMSEC - Communication Security

Protecting data in transit: encryption

- effective when done right
- good (but complex) standards: TLS, IPsec, S/MIME
- weak legacy systems: GSM, Bluetooth
- not end-to-end: WLAN, 3G
- lack of transparency: Skype
- weak implementations: Dual EC DRBG
- weak governance and key management: DigiNotar
- insecure routing and domain name services
- backdoors likely

Limited fraction(a few %) of traffic is protected. A very small fraction of traffic is protected end-to-end with a high security level

60

COMSEC - Communication Security
meta data

hiding communicating identities

- few solutions
- largest one is TOR with a few million users
- well managed but known limitations
  - e.g. security limited if user and destination are in same country

location privacy: problematic

COMPUSEC - Computer Security

Encrypting stored data

- well established solutions for local encryption: Bitlocker, Truecrypt
- few solutions for the cloud
- infrequently used
- Achilles heel is key management

COMPUSEC - Computer Security

Complex ecosystem developed over 40 years by thousands of people that has many weaknesses

Errors at all levels leading to attacks

- foreign governments have privileged access to those weaknesses

Continuous remote **update** needed

- entity that controls updates is in charge

Current **defense technologies** (firewall, anti-virus) not very strong

- cannot resist a motivated attacker

- Not designed to resist **human factor** attacks: coercion, bribery, blackmail
- **Supply chain** of software and hardware vulnerable and hard to defend
  - backdoors are hard to detect

How to Improve the State of the Art

Human factor: education of IT people combined with security & privacy by default

Legal: strong privacy and security legislation with **technical enforcement** and substantial fines

Technology factor: research

- cryptology
- privacy enhancing technologies such as anonymous networking
- secure and open implementations in hardware and software
- community driven open audit
- rethink IT
  - **security architectures: security and privacy "by design"**
  - **key building blocks need to be rebuilt from scratch**

Economic dimension:

- standardization
  - going for gold standards, not compromises
  - open process, not driven by a single country (ideally European) or by industry only
- procurement: European backdoor-free security

Governance and architectures

Governments: want access for themselves but preclude this for others

- seems elusive with current state of the art

Industry: conflicting requirements

1. government requirements for access and backdoors
2. DRM for content and software
3. privacy of consumer

Individual: cannot manage complex tradeoffs

Need to rethink centralized architectures with massive storage of raw data

avoid single point of trust that becomes single point of failure

data minimization through infrastructure

Transparency and community review

Recommendations

Invest more in defense than in offense

Open technologies and review by open communities

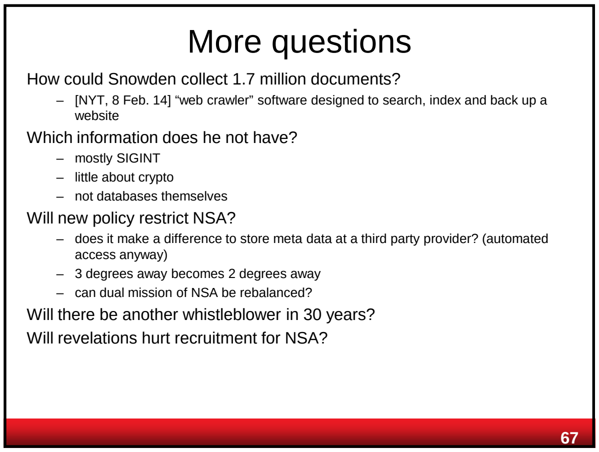
Rethink architectures

Research on improved technologies and standards

Use procurement wisely

Advertisement: draft report of EU parliament

http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-%2F%2FEP%2F%2FNONSGML%2BCOMPARL%2BPE-526.085%2B02%2BDOC%2BPDF%2BV0%2F%2FEN



More questions

How could Snowden collect 1.7 million documents?

- [NYT, 8 Feb. 14] “web crawler” software designed to search, index and back up a website

Which information does he not have?

- mostly SIGINT
- little about crypto
- not databases themselves

Will new policy restrict NSA?

- does it make a difference to store meta data at a third party provider? (automated access anyway)
- 3 degrees away becomes 2 degrees away
- can dual mission of NSA be rebalanced?

Will there be another whistleblower in 30 years?

Will revelations hurt recruitment for NSA?

The end

Thank you for
your attention