# The Discovery of a Government Malware and an Unexpected Spy Scandal

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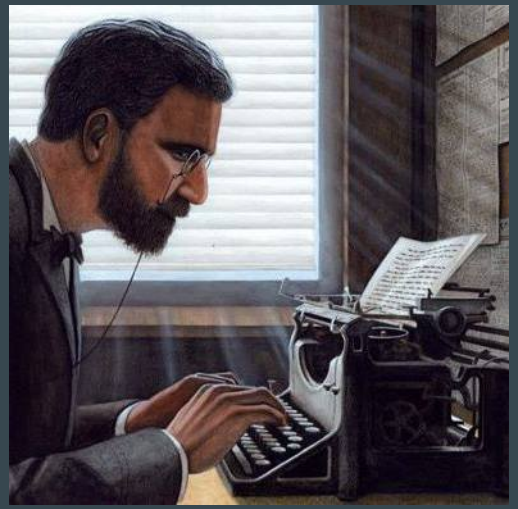
Lorenzo Franceschi-Bicchierai

Black Hat 2019

August 8, 2019

# WHOAMI



- Senior staff writer at VICE Motherboard
- Been covering infosec for 6+ years
- Chatted with Guccifer 2.0
- I secretly dream about becoming a pizza reporter.

# The Discovery of a Government Malware and an Unexpected Spy Scandal

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# Attribution Ain't That Hard

# The Discovery of a Government Malware and an Unexpected Spy Scandal

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# Even Skids Can Slip Malware on The Google Play Store

# The Discovery of a Government Malware and an Unexpected Spy Scandal

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Pizza, Spaghetti, Spyware

# GLOSSARY

-**Government malware**: malicious software that collects data from computers and cellphones for cops and spies. AKA “spyware,” “government trojan” (“Bundestrojaner,” “Trojan di Stato.”) Remote Access Trojans (RATs), implants.

-**Lawful intercept**: industry of companies that do contract work for cops and spies, making the RATs, and sometimes exploits (0days, Ndays). Example: Hacking Team, FinFisher, NSO Group, etc.

-**Sources and methods**: there are some thing I can say, and some things I cannot in order to protect my sources.

# TL;DR

— Discovery of rare Android malware called Exodus

— One of first in-depth investigation into how local law enforcement in EU (ab)uses spyware.

— Case study for collaboration between security researchers and journalists.

# TL;DR

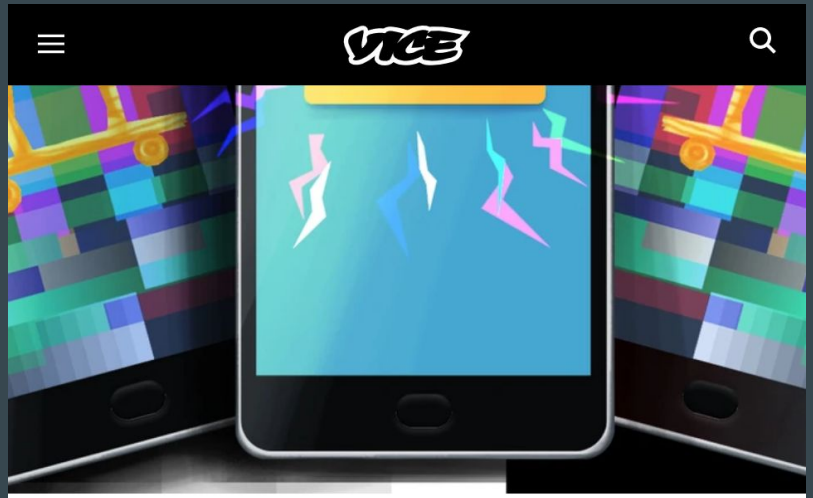
-Behind the scenes of joint investigation between journalists and security researchers.

— Reverse engineering malware

— Reporting techniques (interviews, FOIA, etc)

— Each of these feeds into the other.

# THE BIRTH OF THE EXODUS INVESTIGATION



# THE BIRTH OF THE EXODUS INVESTIGATION

-Italian cops can legally compel ISPs to send phishing text messages to install spyware on target devices.

- Bait: maintenance, service requests.

-End-to-end encryption everywhere brought us here.

- Before E2E: get warrant, the ISP gives you data
- After E2E: data is on the two ends only.

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-Security Without Borders finds suspicious apps on Google Play Store.

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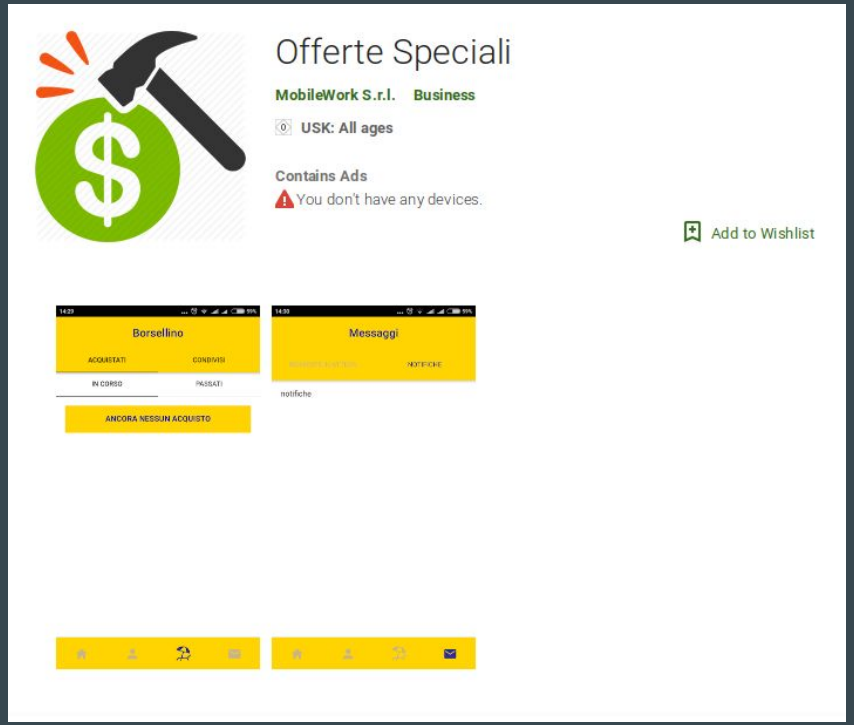

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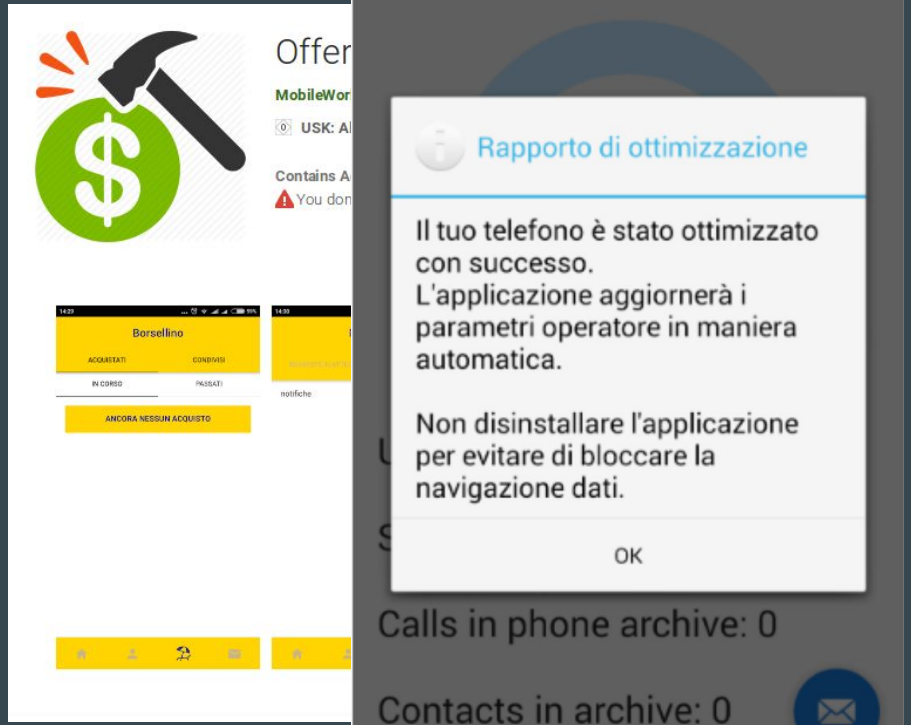

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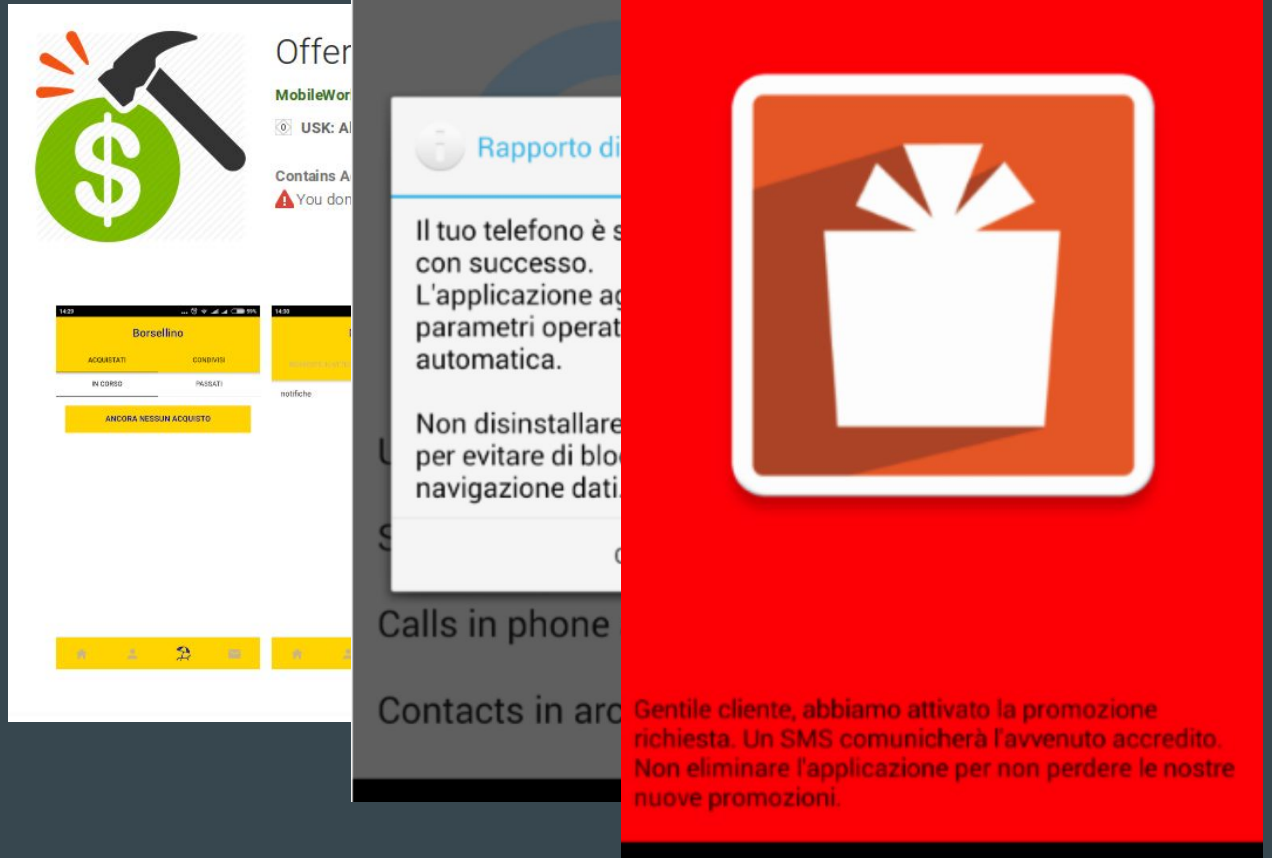
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Calls in phone
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4:13
Offerte Per Te
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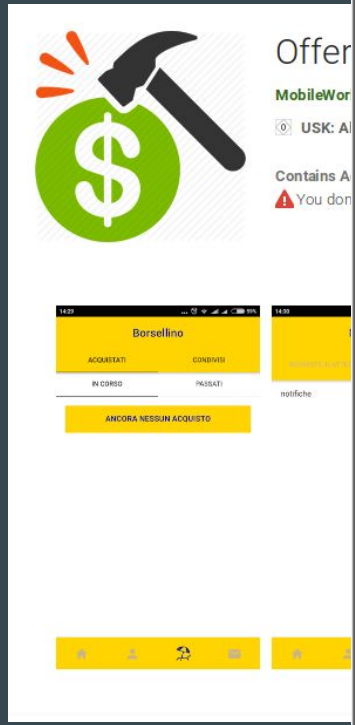
# THE BIRTH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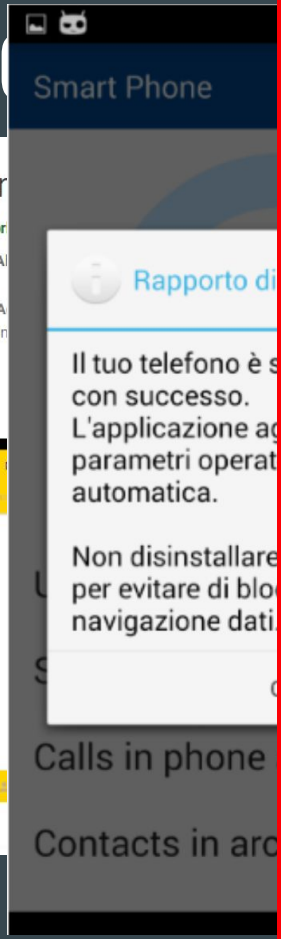
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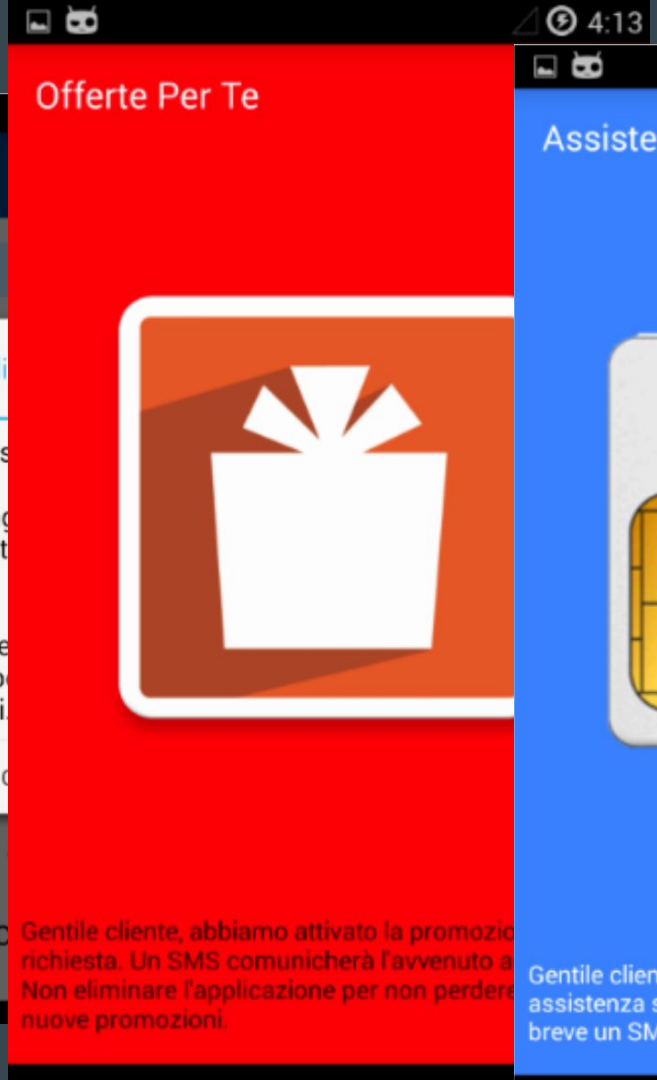
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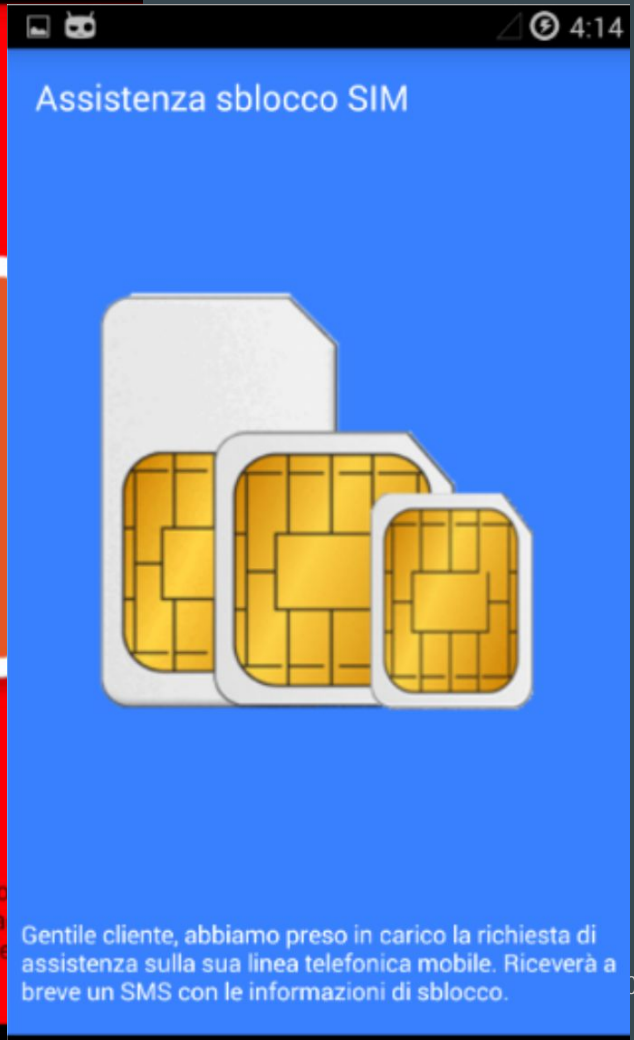

4:14
Assistenza sblocco SIM
Gentile cliente, abbiamo preso in carico la richiesta di assistenza sulla sua linea telefonica mobile. Riceverà a breve un SMS con le informazioni di sblocco.

# THE BIRTH OF THE EXODUS INVESTIGATION

Big questions:

- Are these malicious apps?
- Is this how Italian cops phish targets to get spyware on devices?
- Is it just crimeware?
- Who makes the apps?
- Who installed them?

# THE BIRTH OF THE EXODUS INVESTIGATION

The Big Question: is there even a story here?

- Malware on Google Play is not a new thing.
- We didn't have any info on victims — hard to find a narrative.

# THE BIRTH OF THE TRIO

# THE MALWARE

-25 malicious apps on Google Play Store from 2016 to 2019.

-Fewer than 1,000 victims, according to Google.

# THE MALWARE

-25 malicious apps on Google Play Store from 2016 to 2019..

-Fewer than 1,000 victims, according to Google.

-Exodus was programmed to act in two stages:

- Stage 1: dropper that collects IMEI and Phone Number. “CheckValidTarget”

  *** In tests malware was upgraded immediately to Stage 2.

- Stage 2: Malware downloads and executes payload.
  - (Spoiler: it’s a RAT)

# THE MALWARE

# THE MALWARE

- Stage 2: Malware downloads and executes payload.
  - List of apps
  - Record surrounding audio
  - Browser history
  - Call logs
  - Record phone calls
  - Take pictures
  - Facebook contact list
  - Exfil SMS, Telegram, WhatsApp, Viber, WeChat
  - Extract GPS coordinates
  - Extract WiFi password

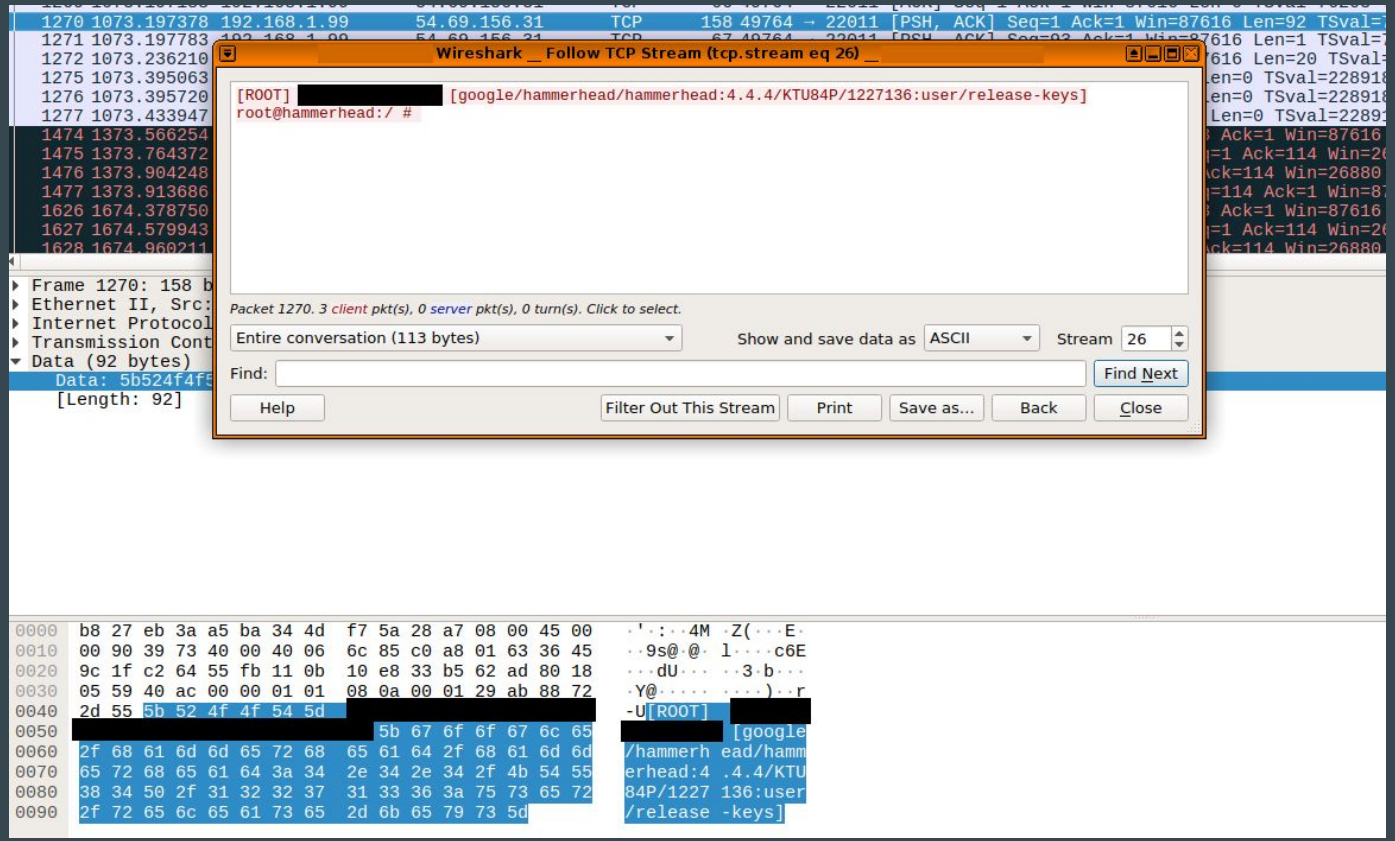
# THE MALWARE

-Problems:

- Exodus opens remote reverse shell to C&C with *no* TLS
  - MiTM
  - Spying on the spies.

# THE MALWARE

-Problems:



# THE MALWARE

-Problems:

- Anyone on the same network can get shell on infected device
  - Tampering with device
  - Removing evidence

# THE MALWARE

-Problems:

```
user@laptop:~$ nmap 192.168.1.99 -p6000-7000

Starting Nmap 7.40 ( https://nmap.org ) at 2019-02-28 17:12 CET
Nmap scan report for android-[REDACTED] (192.168.1.99)
Host is up (0.035s latency).
Not shown: 994 closed ports
PORT     STATE SERVICE
6200/tcp open  lm-x
6201/tcp open  thermo-calc
6205/tcp open  unknown
6209/tcp open  qmtps
6211/tcp open  unknown
6212/tcp open  unknown
6842/tcp open  netmo-http

Nmap done: 1 IP address (1 host up) scanned in 2.30 seconds
```

# THE MALWARE

# THE MALWARE

-Lookout discovers iOS version.

-Similar to Android but...requires user to accept enterprise certificate.

- More limited access:
  - Contacts
  - Audio Recordings
  - Photos
  - Videos
  - GPS
  - Device info

# THE VICTIMS

-No data on victims.

-No data on how apps were installed on target device. (Phishing? Physical access? 0day?)

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-Source reveals: operators infected random people as “guinea pigs”

— Court documents obtained later confirmed this.

# THE VICTIMS

-Problems:

— Putting malware on Google Play may not be legal in Italy.

— Vulnerabilities in malware (risk of MiTM) put investigations at risk.

# THE VICTIMS

“Putting something on the Play Store thinking you’re going to infect an undetermined number of people, and do trawling is something absolutely illegal.” [...]

“Opening up security holes and leaving them available to anyone is crazy and senseless, even before being illegal.”

— Police Agent

# THE ATTRIBUTION

“Attribution is hard.” — everyone in the threat intelligence industry.

# THE ATTRIBUTION

"In true Greek irony, the Cassandras of the modern age are hamstrung by their own Apollonian curse: as intelligence agencies they are blessed with the ability to see but not to publicly substantiate. The gift to attribute without being believed."

— Brian Bartholomew, Juan Andres Guerrero-Saade, "Wave your false flags! Deception tactics muddying attribution in targeted attacks," Virus Bulletin 2016

# THE ATTRIBUTION

— Maybe only NSA, FSB, state actors, should do it because “there’s no attribution without retribution.”

— Reality: It’s hard but not impossible.

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— Maybe only NSA, FSB, state actors, should do it because “there’s no attribution without retribution.”

— Reality: It’s hard but not impossible.

— It’s OK for journalists to do it—responsibly.

— Must weigh public interest

— “Whodunit” is key in journalism

# THE ATTRIBUTION

```
a("MUNDIZZA", "09081427-FE30-46B7-BFC6-50425D3F85CC", ".*", false);
this.b.info("UPLOADSERVICE Aggiunti i file mundizza. Dimensione coda upload {}",
```

# THE ATTRIBUTION

```
a("MUNDIZZA", "09081427-FE30-46B7-BFC6-50425D3F85CC", ".*", false);
this.b.info("UPLOADSERVICE Aggiunti i file mundizza. Dimensione coda upload {}",
```

```
char[] cArr = new char[]{'R', 'I', 'N', 'O', ' ', 'G', 'A', 'T', 'T', 'U', 'S', 'O'};
```

# THE ATTRIBUTION

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```
ws.my-local-weather[.]com
```

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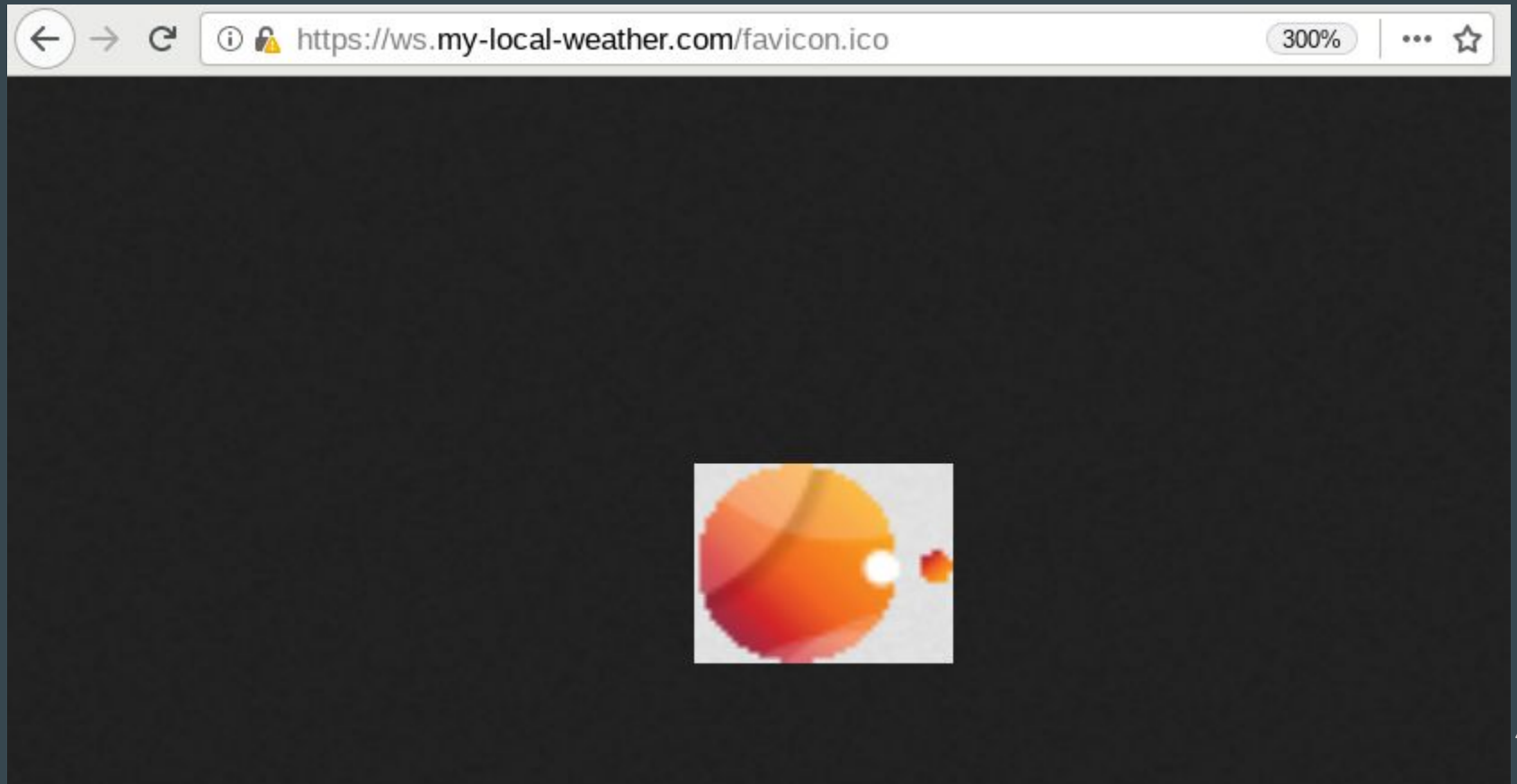
```

— Apps C&C server with self-signed TLS cert.

— Search for TLS cert fingerprint on Censys.io returned other servers.

— Many servers shared the same favicon.

# THE ATTRIBUTION



# THE ATTRIBUTION

— Searching favicon on Shodan returned 40 servers

— All servers were linked to eSurv, company based in Catanzaro, Calabria (Italy)

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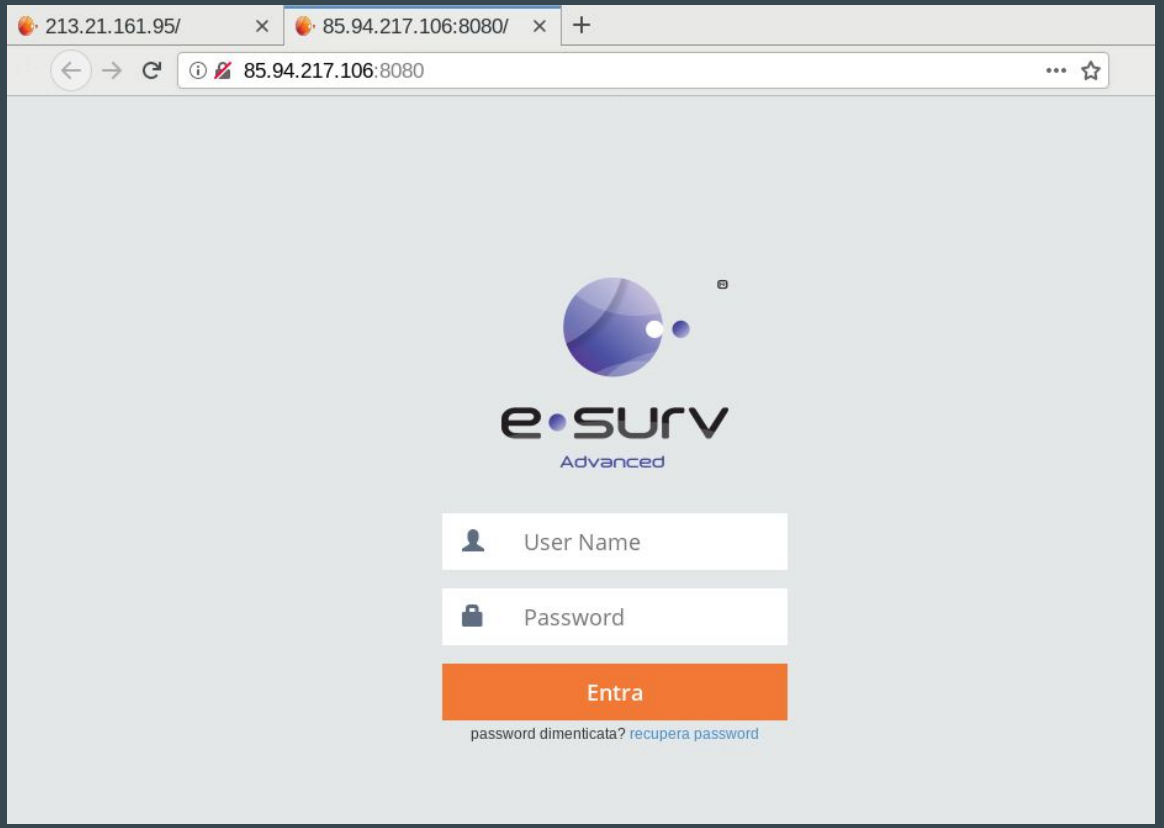

# THE ATTRIBUTION

TOTAL RESULTS

40

TOP COUNTRIES

| | |
|---|---|
| Italy | 29 |
| United States | 6 |
| France | 4 |
| Germany | 1 |

TOP SERVICES

| | |
|---|---|
| HTTP | 29 |
| HTTPS | 9 |
| HTTP (8080) | 2 |

TOP ORGANIZATIONS

| | |
|---|---|
| Telecom Italia Mobile | 6 |
| Telecom Italia Business | 4 |
| Telecom Italia | 4 |
| OVH SAS | 4 |
| Amazon.com | 4 |

**85.94.217.106**

vm4152.cloud.seeweb.it

**Seeweb Cloud Servers customers**

Added on 2019-02-14 16:49:47 GMT

Italy

Technologies:

```
HTTP/1.1 200 OK
Date: Thu, 14 Feb 2019 16:50:37 GMT
Server: Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips mod_fcgid/2.3.9 PHP/5.4.41
X-Powered-By: PHP/5.4.41
Set-Cookie: PHPSESSID=04qgcsd8f1u8jgbss77pe67ol4; path=/
Expires: Thu, 19 Nov 1981 08:52:00 GMT
Cache-Control: no-store, no-cache, must-r...
```

**194.184.36.133**

host133-36-static.184-194-b.business.telecomitalia.it

**Telecom Italia Business**

Added on 2019-02-14 18:19:30 GMT

Italy, Sandrigo

Technologies:

```
HTTP/1.1 200 OK
Date: Thu, 14 Feb 2019 18:19:29 GMT
Server: Apache/2.4.6 (CentOS) OpenSSL/1.0.1e-fips mod_fcgid/2.3.9 PHP/5.4.41
X-Powered-By: PHP/5.4.41
Set-Cookie: PHPSESSID=imme7obocer6dbjv1tvcdhqr16; path=/
Expires: Thu, 19 Nov 1981 08:52:00 GMT
Cache-Control: no-store, no-cache, must-r...
```

**eSurv - Login**

90.147.32.3

**Consortium GARR**

Added on 2019-02-14 04:31:04 GMT

Italy, Milan

Technologies:

```
HTTP/1.1 200 OK
Date: Thu, 14 Feb 2019 04:37:55 GMT
Server: Apache/2.2.22 (Ubuntu)
X-Powered-By: PHP/5.3.10-1ubuntu3.11
Set-Cookie: PHPSESSID=ll0v9o56nt4o2mfdu6i6ri24l6; path=/
Expires: Thu, 19 Nov 1981 08:52:00 GMT
Cache-Control: no-store, no-cache, must-revalidate, post-check=0, pre-check...
```

# THE ATTRIBUTION

— eSurv employee wrote in his LinkedIn:

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— Italian government document reveals eSurv had 300,000 EUR contract with “Polizia di Stato” to develop “passive and active interception system.”

# THE ATTRIBUTION

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-What we know at this point:

— eSurv makes spyware called Exodus

— eSurv has contract with the cops

— 25 eSurv apps were on Play Store

— Exodus infected less than 1,000 targets

— We still have no idea who the targets are.

# THE ATTRIBUTION

-Final questions:

— Do we name the company?

— How many details do we include? (Apps screenshots, IP addresses, etc)

— Do we alert authorities?

-**Significant risk** of putting legitimate investigations into serious crimes in danger.

# THE ATTRIBUTION

-We contact company

— They deny making malware, then ghost us.

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— No answers

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-We contact Polizia di Stato, prosecutors offices, asking for comment.

— No answers

-We contact Italian government through intermediary.

— No answers

# THE ATTRIBUTION

# THE AFTERMATH

-We **did not** expect this story to have a huge impact.

— Italy is full of malware makers

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# THE AFTERMATH

-As it turns out ... Exodus became a huge story in Italy.

— eSurv spying on “guinea pigs” made everyone a potential victim.

— Story became: “this could have happened to **you**.”

# THE AFTERMATH

-Local news reports that two prosecutor's offices in Italy had opened inquiry into eSurv weeks before.

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— Illegal wiretapping: eSurv monitored innocents with Exodus

— Employees listened to calls in eSurv's office, called them "volunteers."

— Servers in prosecutor's offices were empty, no operating system.

# THE AFTERMATH

-Italian law:

— Servers for wiretapping need to be on government premises

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-Italian law:

— Servers for wiretapping need to be on government premises

- eSurv used AWS

— Prosecutors in one office are only authorized to access their investigations' data

- Anyone using Exodus could read all investigations data

# THE AFTERMATH

— eSurv's CEO and CTO under house arrest, under criminal investigation for illegal wiretapping.

— Authorities estimate ~200 out of ~800 targets were unauthorized.

— Multiple prosecutor's offices investigating use of Exodus by police and intelligence agencies.

— Italian Data Protection Authority questions use of Government Trojans and calls for safeguards

# HOW DID WE GET HERE?

The history of Lawful Intercept industry is poorly documented

— 2010s have a lot of documented cases

- Citizen Lab investigations
- AV reports
- Leaked documents

— 2000s, 1990s are not well documented.

# HOW DID WE GET HERE?

-How old is Lawful Intercept?

— Early days (1990s, 2000s) are not very well documented, but governments were already using malware because of end-to-end encryption.

# HOW DID WE GET HERE?

— Anecdotes:

- Developer on LinkedIn says he's been working on Windows malware for 20+ years.
- 2002: off the shelf $40 RAT to investigate terrorist operation in European country.
- Uptick of government employees coming to Black Hat looking for talent and tools in mid 2000s.

# HOW DID WE GET HERE?

-Lawful Intercept history in US has some earlier data points.

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-Lawful Intercept history in US has some earlier data points.

— 1998: FBI's network surveillance system "Carnivore"

— 1999: FBI uses malware (keylogger) to steal PGP private key of mob boss.

# HOW DID WE GET HERE?


-Lawful Intercept history in US has some earlier data points.

— 2001: FBI's Magic Lantern malware

— 2003: FBI uses spyware against animal welfare group. (Operation Trail Mix)

— 2007: FBI uses "CIPAV" (Computer and Internet Protocol Address Verifier) malware to trace bomb threats to a 15-year-old

# HOW DID WE GET HERE?

-Meanwhile in Europe...

— 2003: Hacking Team is born in Italy.

— 2004: Hacking Team's first sale outside of Italy (Spain)

— 2011: WikiLeaks' Spy Files reveal existence of Hacking Team's spyware

# HOW DID WE GET HERE?

-Meanwhile in Europe...

— 2011: Egyptian activists find FinFisher documents in government building.

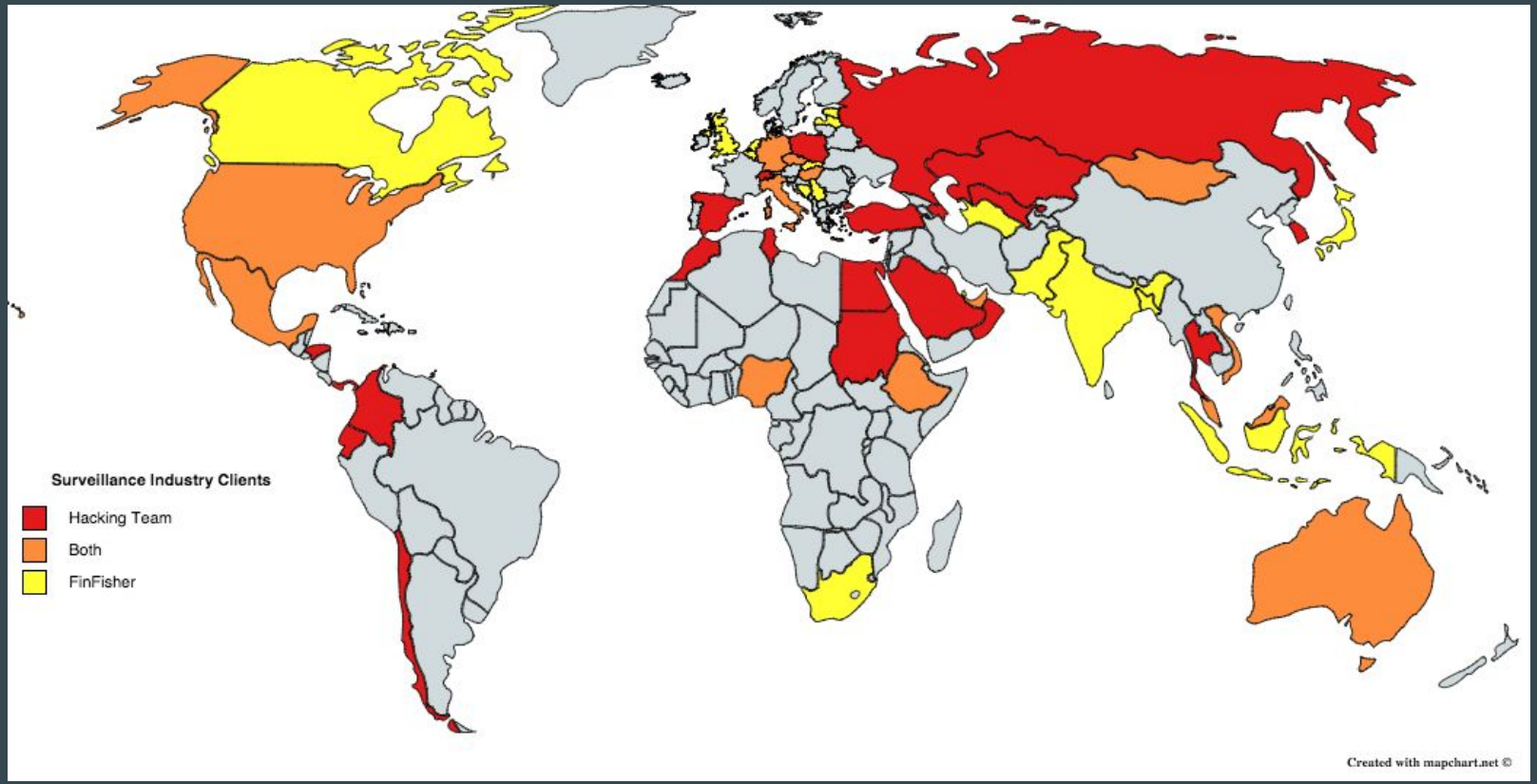
# HOW DID WE GET HERE?

-Hacking Team and FinFisher conquer the world.

— Hacking Team:  present in 41 countries before 2015 breach.

— FinFisher: present in 32 countries as of 2015.

# HOW DID WE GET HERE?



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— 60+ customers in 35 countries as of 2019

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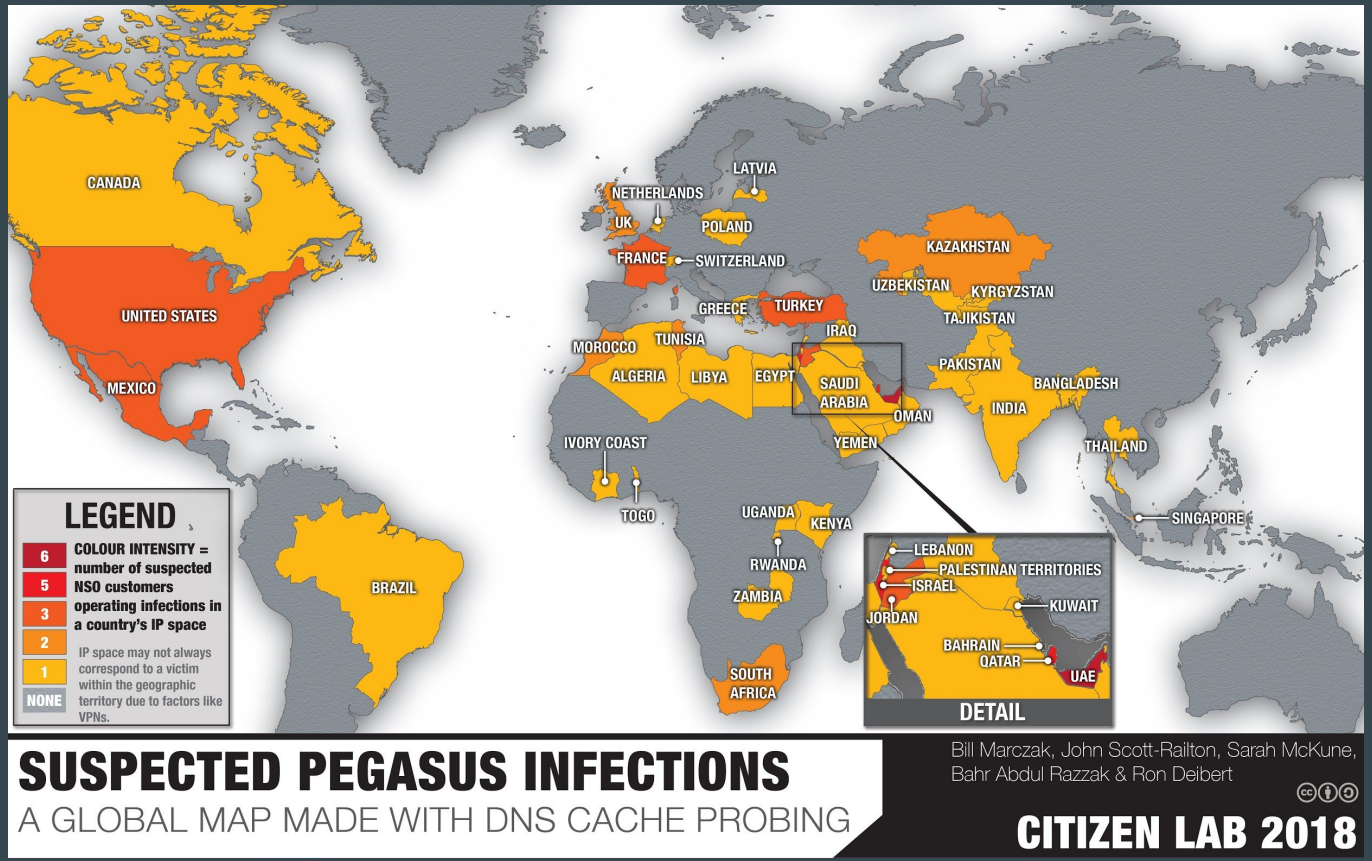

# HOW DID WE GET HERE?

-NSO Group (Israel) takes over.

— 60+ customers in 35 countries as of 2019

— $251 million revenue in 2018

# HOW DID WE GET HERE?

-The Lawful Intercept market today:

— Worth $12 billion (Moody's and S&P estimate).

— **Multiple** companies can have presence in the **same** countries (UAE, Ethiopia, Mexico...)

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-The Lawful Intercept market today:

— Worth $12 billion (Moody's and S&P estimate).

— **Multiple** companies can have presence in the **same** countries (UAE, Ethiopia, Mexico...)

- Agencies need different products depending on target (Mobile, Desktop)
- Agency buys product for defensive purposes (track and detect malware).

# HOW DID WE GET HERE?

-The Lawful Intercept market today:

— “Five Eyes” (US/UK/CA/NZ/AU) work almost exclusively with local companies.

— China: government is moving toward keeping all offensive capabilities within China.

# HOW DID WE GET HERE?

-Italy is an interesting case study in Europe.

— Authorities love wiretapping (“intercettazioni”), especially against organized crime.

— Every prosecutor’s office has a lot of freedom when buying solutions.

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-Italy is an interesting case study in Europe.

— Authorities love wiretapping (“intercettazioni”), especially against organized crime.

— Every prosecutor’s office has a lot of freedom when buying solutions.

— Result: fragmented market with a lot of small companies.

- First: network level interception (Area, RCS Lab)
- Then: malware (HT, Raxir, Negg...)

# HOW DID WE GET HERE?

-Recent data from Italy in 2017: (Ministry of Justice)

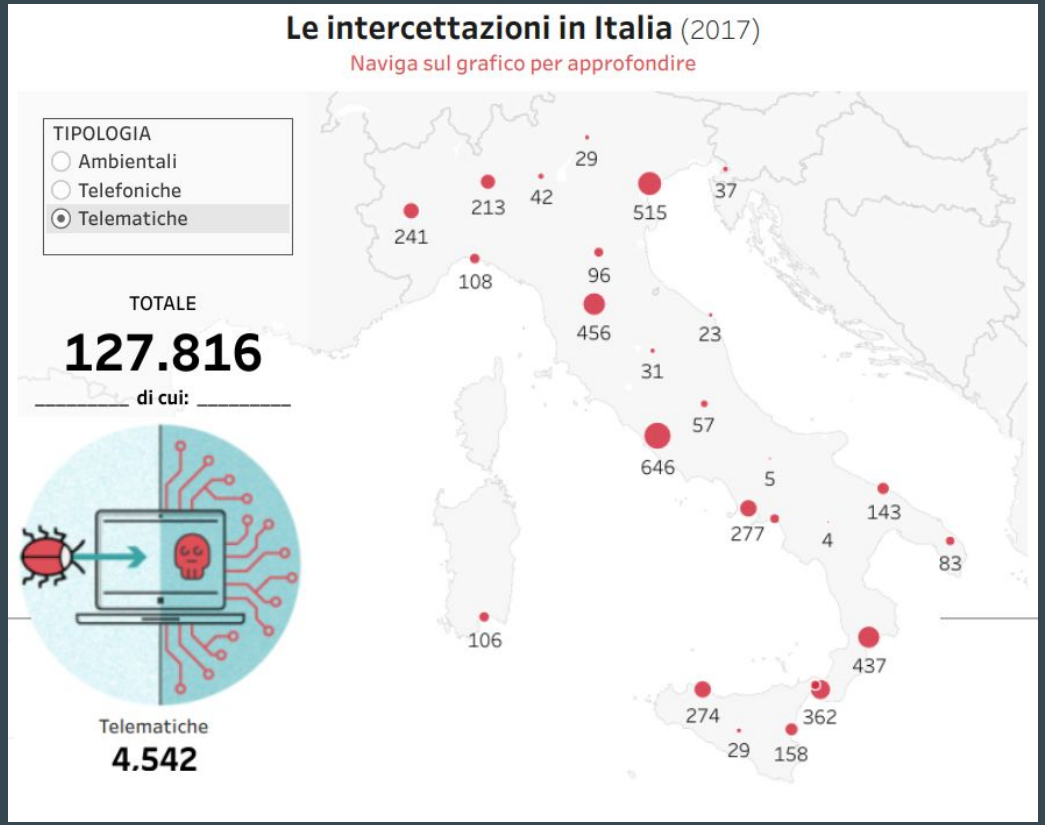
— Phone wiretaps with providers' help: 106,000

— Wiretaps through "bugs": 16,000 ("ambient" wiretaps)

— Wiretaps through malware: 4,542 ("electronic wiretaps")

— 148 licensed companies.

# HOW DID WE GET HERE?



# CONCLUSION

-Lawful Intercept industry is here to stay:

— End-to-end encryption makes old wiretapping obsolete

— Cops and spies need wiretapped data.

— Contractors (HT, FinFisher, NSO...) are offering those solutions right now.

# CONCLUSION

-Future challenges:

— Vet spyware companies and products

— Figure out who gets access to surveillance data.

# GRAZIE 💖

— Security Without Borders

— Riccardo Coluccini

— Trail of Bits

# QUESTIONS? COMMENTS? TIPS?

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