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Common Threats

COM-402: Information Security and Privacy

(slide credits: Philipp Jovanovic, Linus Gasser, Kirill Nikitin)

Outline

- Overview of threats to IT-systems
- Cyber attack lifecycle
  - Commodity threats
  - Hacktivism
  - Advanced Persistent Threat
- Classes of non-physical threats
  - Social engineering
  - Software vulnerabilities
  - Side-channel attacks
  - Distributed Denial of Service
  - Malicious Software (Malware)

Threats

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- Definition (ISO27005):

  “A potential cause of an incident, that may result in harm of systems and organization.”

- Definition (NIST FIPS 200):

  *“Any **circumstance** or event with the potential to **adversely impact** organizational **operations** (including mission, functions, image, or reputation), organizational **assets**, or **individuals** through an information system **via unauthorized access, destruction, disclosure, modification of information, and/or denial of service**.*

  Also, the potential for a threat-source to successfully exploit a particular information system vulnerability.”

Overview of Threats to IT-Systems

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Physical:

- Environmental
  - Fire, water, pollution
  - Earthquakes
  - Volcanic eruptions
  - Cosmic radiation
  - War, riots
- Loss of essential service
  - Electrical power
  - Air conditioning
  - Telecommunication
- Technical failures

Non-physical:

- Social engineering
- Software vulnerabilities
- Side-channel attacks
- Distributed Denial of Service
- Malicious Software (Malware)

> This lecture focuses on the non-physical security threats

Exploits

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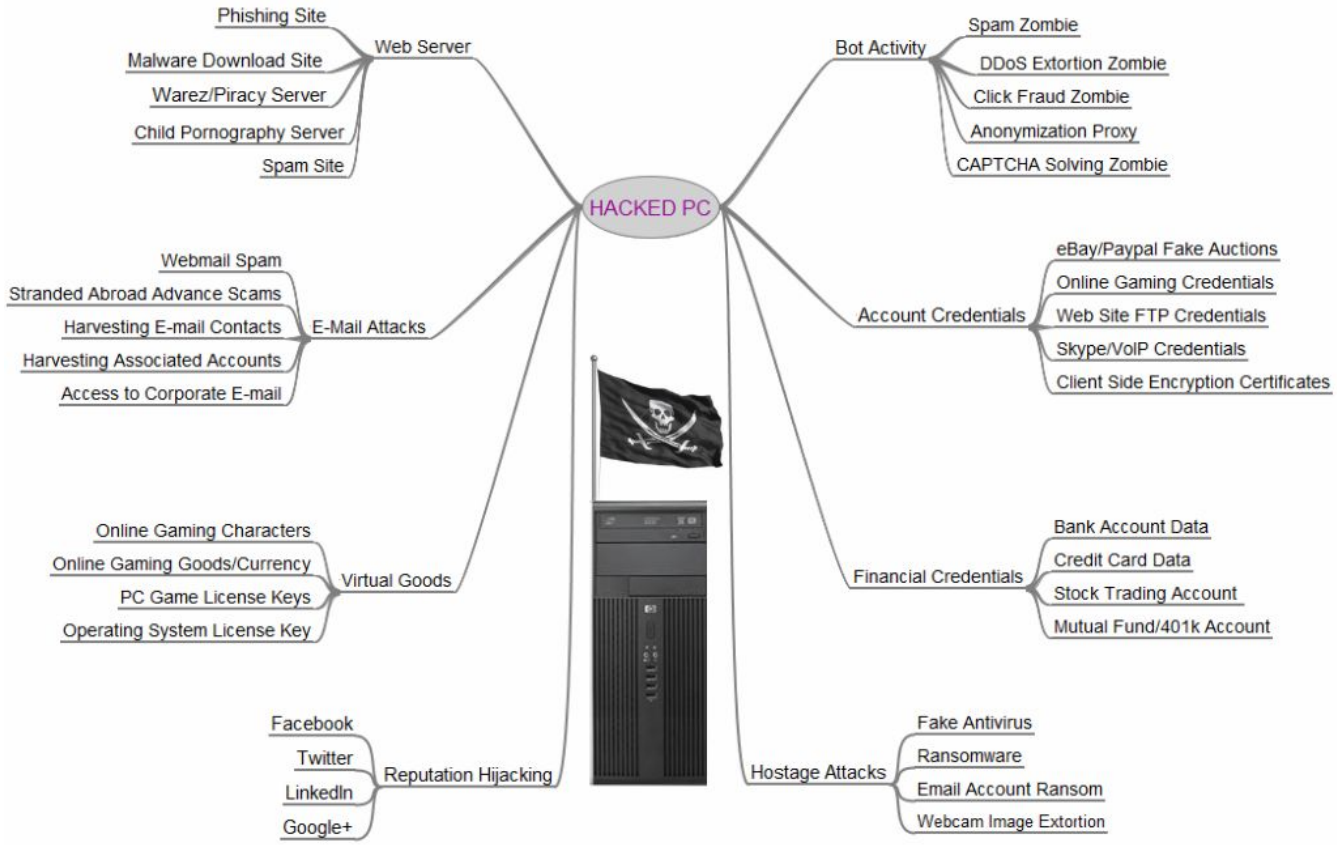
- From Wikipedia:

  An exploit (from the English verb to exploit, meaning "using something to one's own advantage") is a piece of software, [...] that takes advantage of a bug or vulnerability [...] gaining control of a computer system, [...] or a denial-of-service (DoS or related DDoS) attack.
- Can be used by malware to gain control of a system
- Exploiting vulnerabilities of
  - Humans - social engineering
    - Phishing (broad) or spear phishing (targeted): trick user into clicking/activating malware
    - Physical-world: e.g., call helpdesk and impersonate internal authority figure
  - Software bugs
    - Known exploits: cheap/ubiquitous in underground economy, target unpatched devices
    - 0-day exploits: expensive ($500K bounty for iOS), often hoarded or used sparingly
  - System attacks
    - Distributed Denial of Service (DDoS)
    - Side-channel attacks

The Value of a Hacked PC



Source: KrebsOnSecurity

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Cyber Attacks Lifecycle I

Depending on the attack type some or all of the following steps are involved:

1. Preparation
   - Define target, from broad (everyone) to focused (individual)
   - Find and organize accomplices
   - Build and/or acquire tools
   - Research target (infrastructure & people)
   - Prepare “watering holes” (traps)
2. Gain Access
   - Deployment (social engineering, exploits, etc.)
   - Initial intrusion
   - Privilege escalation
3. Maintain Access
   - Strengthen foothold (install rootkits, etc.)
   - Setup stealthy access methods
   - Internal reconnaissance
   - Expand access (lateral movement)

Source: Wikipedia

Cyber Attacks Lifecycle II

Depending on the attack type some or all of these steps are involved:

4. Complete Mission
   - Exfiltrate data
   - Damage target
   - Use target as starting point for other attacks
     - Spam
     - Distributed Denial of Service
     - Click fraud
     - …
5. Cover Tracks
   - Delete log files
   - Modify logging applications
   - Memory-only persistence

Source: Wikipedia

Commodity Threats

Source: Wikipedia

Commodity Threats

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- Non-targeted (“shotgun” approach)
- Usually non-stealthy and fully automated
- Goal is often short-term financial gains
- Often considered low risk to attackers
- Increasingly a starting point for more sophisticated attacks

Forms:

- Computer worms
- Malicious ads
- Malware-infected spam
- ...

Example: London Stock Exchange

Sunday, 27 February 2011

London Stock Exchange hit by malware

The London Stock Exchange website exposed some visitors to drive-by malware attacks today. Merely viewing the homepage at **www.londonstockexchange.com** (without clicking on anything) caused my Windows computer to be compromised by malware. This malware was apparently delivered through third-party advertisements which appeared on the site.

The malware was a classic spoof antivirus program which used a software vulnerability to download and install native executable code. The spoof program appeared in the system tray and prevented other processes such as Task Manager being run, falsely claiming that they were infected with a virus. The malware then tried to extort payment to fix the artificial problem it had created. It also replaced the wallpaper image with the following message:

Source: High Severity

Hacktivism

Source: Wikipedia

Hacktivism

Controversial term with several meanings such as:

- Politically motivated hacking
- Variant of (anarchic) civil disobedience

Forms:

- Software (e.g., PGP)
- Website mirroring to circumvent censorship
- Website defacement (e.g., various Anonymous / Lulzsec incidents)
- Anonymous blogging
- Distributed Denial of Service
- ...

“Hacktivism” Example – Sony Pictures

ENTERTAINMENT | SONY

Hackers shut down Sony Pictures' computers and are blackmailing the studio

by Russell Brandom | @russellbrandom | Nov 24, 2014, 4:28pm EST

SHARE TWEET LINKEDIN

Source: The Verge

- Nov. 2014: “Guardians of Peace” (GOP) leak confidential data of Sony Pictures
- Dec. 2014:
  - GOP demand that Sony cancels release of *The Interview*, a comedy movie on a plot to assassinate North Korean leader Kim Jong-un
  - FBI attributes attack to North Korea
  - Former employees sue Sony over leak
- Dec. 2015: Sony pays ~$8 Million in settlement of the lawsuit

Estimated costs for Sony: $35+ million

Advanced Persistent Threats

Source: Wikipedia

Advanced Persistent Threats (APTs)

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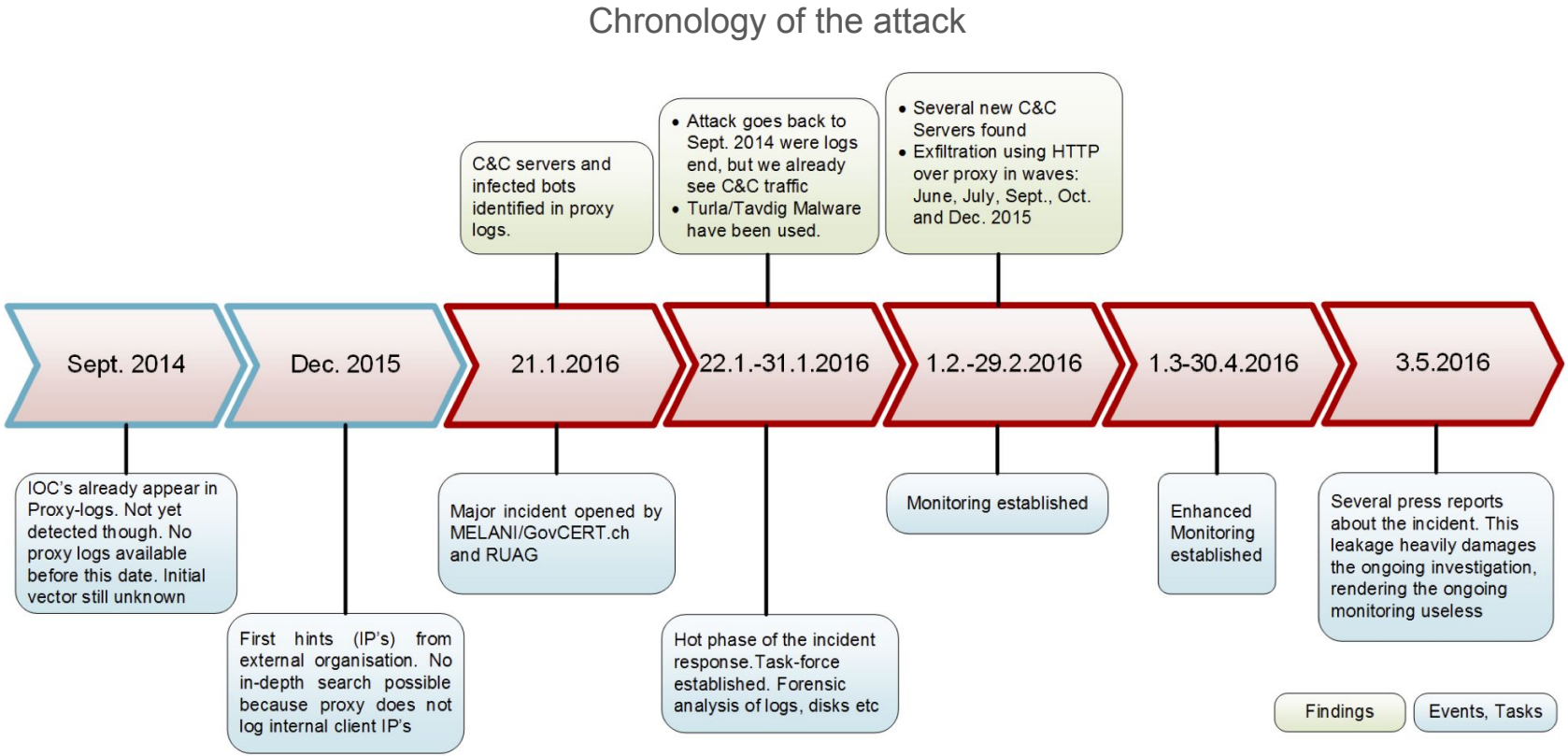
- Advanced:
  - Targeted multi-step attacks
  - Utilize full spectrum of available intrusion techniques
  - Often use specialized tools
  - Combine multiple attack vectors (90%+ attacks start with spear phishing)
- Persistent:
  - “Low-and-slow” approach
  - Prioritize long-term over short-term goals (e.g., immediate financial gain)
  - Continuous monitoring and interaction (avg attack duration: 1 year; known max: 5 years)
- Threat:
  - Human-coordinated attack
  - Attackers are skilled, motivated, and well-funded; have a clear goal (e.g., industry espionage)
  - No “fire-and-forget” approach as core component (e.g., fully-automated malware)

APT Example – RUAG



Source: MELANI

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  - Social engineering
  - Software vulnerabilities
  - Side-channel attacks
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Overview of non-physical threats

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- **Social engineering**
- Software vulnerabilities
- Distributed Denial of Service
- Side-channels
- Malicious Software (Malware)

Social Engineering

- Psychological manipulation of people tricking them into taking actions that benefit the attacker (e.g., reveal confidential information)
- Often among the first steps in a cyber attack
- Forms:
  - (Spear) Phishing
  - Coercion
  - Watering holes
  - Baiting
  - …

Social Engineering

KIM ZETTER SECURITY 10.19.15 6:14 PM

TEEN WHO HACKED CIA DIRECTOR'S EMAIL TELLS HOW HE DID IT

CIA director John Brennan. CHRIS MAGDALONI/AP

A HACKER WHO claims to have broken into the AOL account of CIA Director John Brennan says he obtained access by posing as a Verizon worker to trick another employee into revealing the spy chief's personal information.

Source: Wired

Credit: Thinkstock

Ubiquiti Networks Inc., the San Jose based manufactured of networking high-performance networking technology for service providers and enterprises, announced in its fourth quarter fiscal results that it was the victim of an email business fraud incident resulting in the loss of $39.1 million dollars.

Source: CSOonline

Spoofed communications from executives at the victim firm in a bid to initiate unauthorized wire transfers

Social Engineering

Source: Elie Burszstein's blog

Users Really Do Plug in USB Drives They Find

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Alec Mori† Elie Bursztein◇ Michael Bailey†
† University of Illinois, Urbana Champaign ‡ University of Michigan ◇ Google, Inc.
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***Abstract*—We investigate the anecdotal belief that end users will pick up and plug in USB flash drives they find by completing a controlled experiment in which we drop 297 flash drives on a large university campus. We find that the attack is effective with an estimated success rate of 45–98% and expeditious with the first drive connected in less than six minutes. We analyze the types of drives users connected and survey those users to understand their motivation and security profile. We find that a drive's appearance does not increase attack success. Instead, users connect the drive with the altruistic intention of finding the owner. These individuals are not technically incompetent, but are rather typical community members who appear to take more recreational risks than their peers. We conclude with lessons learned and discussion on how social engineering attacks—while less technical—continue to be an effective attack vector that our community has yet to successfully address.**

median time to connection of 6.9 hours and the first connection occurring within six minutes from when the drive was dropped. Contrary to popular belief, the appearance of a drive does not increase the likelihood that someone will connect it to their computer. Instead, users connect all types of drives unless there are other means of locating the owner—suggesting that participants are altruistically motivated. However, while users initially connect the drive with altruistic intentions, nearly half are overcome with curiosity and open intriguing files—such as vacation photos—before trying to find the drive's owner.

To better understand users' motivations and rationale, we offered participants the opportunity to complete a short survey when they opened any of the files and read about the study. In this survey, we ask users why they connected the drive, the

Attacks pros & cons

Attack vector	Mostly used by	Complexity & Cost	Reliability	Stealth	Cross OS
Social engineering	Academics Our study!	★	★	★	★★★
HID Spoofing Human Interface Device	White Hat Corporate espionage	★★	★★★	★★	★★
0-day	Government High-end corp espionage	★★★★	★★★★	★★★★	★

Source: BH USA 2016

Description of non-physical threats

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- Social engineering
- **Software vulnerabilities**
- Distributed Denial of Service
- Side-channels
- Malicious Software (Malware)

Software vulnerabilities

- Software *always* has errors
- Many software bugs are exploitable
  - e.g., buffer overrun -> overwrite variables
- Some errors are easy to fix (or prevent)
  - e.g., range checking in typesafe languages
- Other errors need a big, expensive, invasive changes or system redesign
  - change of protocol, new file format, authorization changes
- 0-day vulnerabilities are new errors, that are not yet known or fixed in the software
  - But even “old” vulnerabilities still useful (Android phones, embedded/IoT firmware)

Software Vulnerabilities

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- Buffer / heap / stack overflows
  - Overwriting memory locations adjacent to a buffer
- Unvalidated input, including SQL injections
  - Unvalidated input causing unexpected behaviour of software
- Race conditions
  - Changes to the order of several events cause a change in behaviour
- Insecure file operations
  - Incorrect assumptions about ownership, location or attributes of a file
- Side-channel leakage
  - Unprotected implementation leading to a leakage of secret information via side channels, *e.g.*, time, power, sound…
- Weaknesses in the implementation of access control
  - Authentication and authorization flaws

Software Vulnerabilities

Source: TripWire

- The algorithm for re-assembling IKE payloads fragmented with the Cisco fragmentation protocol contained a flaw that allowed a heap buffer to be overflowed with attacker-controlled data.
- Attackers could use this vulnerability to execute arbitrary code on affected devices.

Source: Computer Weekly

Source: The Code Curmudgeon

Software Vulnerabilities

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- OWASP Top 10 - 10 Most Critical Web Application Security Risks

A1 – Injection	Injection flaws, such as SQL, OS, and LDAP injection occur when untrusted data is sent to an interpreter as part of a command or query. The attacker's hostile data can trick the interpreter into executing unintended commands or accessing data without proper authorization.
A2 – Broken Authentication and Session Management	Application functions related to authentication and session management are often not implemented correctly, allowing attackers to compromise passwords, keys, or session tokens, or to exploit other implementation flaws to assume other users' identities.
A3 – Cross-Site Scripting (XSS)	XSS flaws occur whenever an application takes untrusted data and sends it to a web browser without proper validation or escaping. XSS allows attackers to execute scripts in the victim's browser which can hijack user sessions, deface web sites, or redirect the user to malicious sites.
A4 – Insecure Direct Object References	A direct object reference occurs when a developer exposes a reference to an internal implementation object, such as a file, directory, or database key. Without an access control check or other protection, attackers can manipulate these references to access unauthorized data.
A5 – Security Misconfiguration	Good security requires having a secure configuration defined and deployed for the application, frameworks, application server, web server, database server, and platform. Secure settings should be defined, implemented, and maintained, as defaults are often insecure. Additionally, software should be kept up to date.
A6 – Sensitive Data Exposure	Many web applications do not properly protect sensitive data, such as credit cards, tax IDs, and authentication credentials. Attackers may steal or modify such weakly protected data to conduct credit card fraud, identity theft, or other crimes. Sensitive data deserves extra protection such as encryption at rest or in transit, as well as special precautions when exchanged with the browser.
A7 – Missing Function Level Access Control	Most web applications verify function level access rights before making that functionality visible in the UI. However, applications need to perform the same access control checks on the server when each function is accessed. If requests are not verified, attackers will be able to forge requests in order to access functionality without proper authorization.
A8 - Cross-Site Request Forgery (CSRF)	A CSRF attack forces a logged-on victim's browser to send a forged HTTP request, including the victim's session cookie and any other automatically included authentication information, to a vulnerable web application. This allows the attacker to force the victim's browser to generate requests the vulnerable application thinks are legitimate requests from the victim.
A9 - Using Components with Known Vulnerabilities	Components, such as libraries, frameworks, and other software modules, almost always run with full privileges. If a vulnerable component is exploited, such an attack can facilitate serious data loss or server takeover. Applications using components with known vulnerabilities may undermine application defenses and enable a range of possible attacks and impacts.
A10 – Unvalidated Redirects and Forwards	Web applications frequently redirect and forward users to other pages and websites, and use untrusted data to determine the destination pages. Without proper validation, attackers can redirect victims to phishing or malware sites, or use forwards to access unauthorized pages.

Source: OWASP

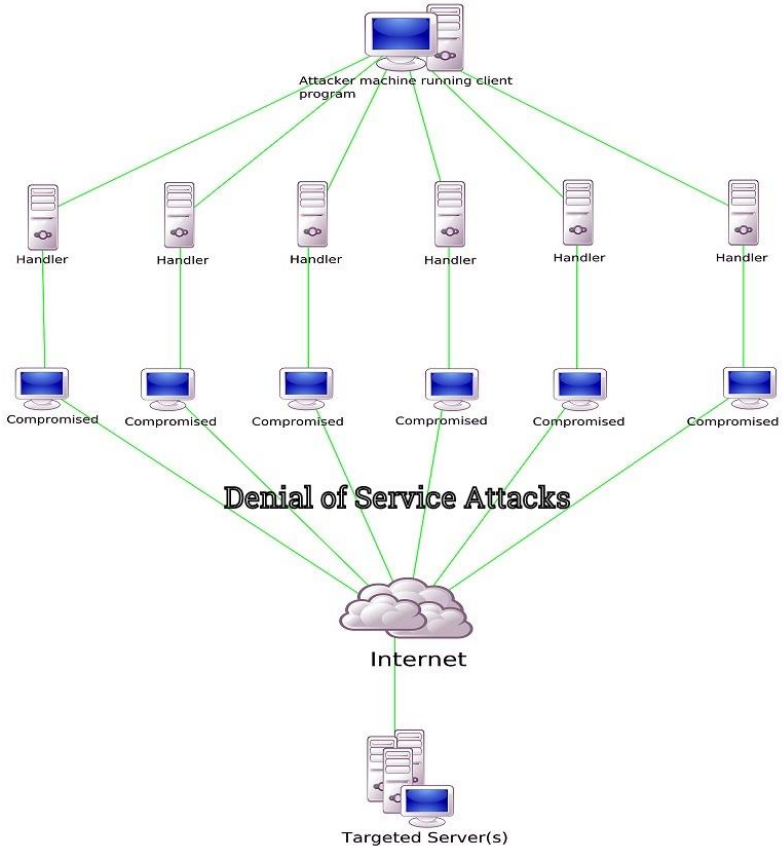
Description of non-physical threats

- Social engineering
- Software vulnerabilities
- **Distributed Denial of Service**
- Side-channels
- Malicious Software (Malware)

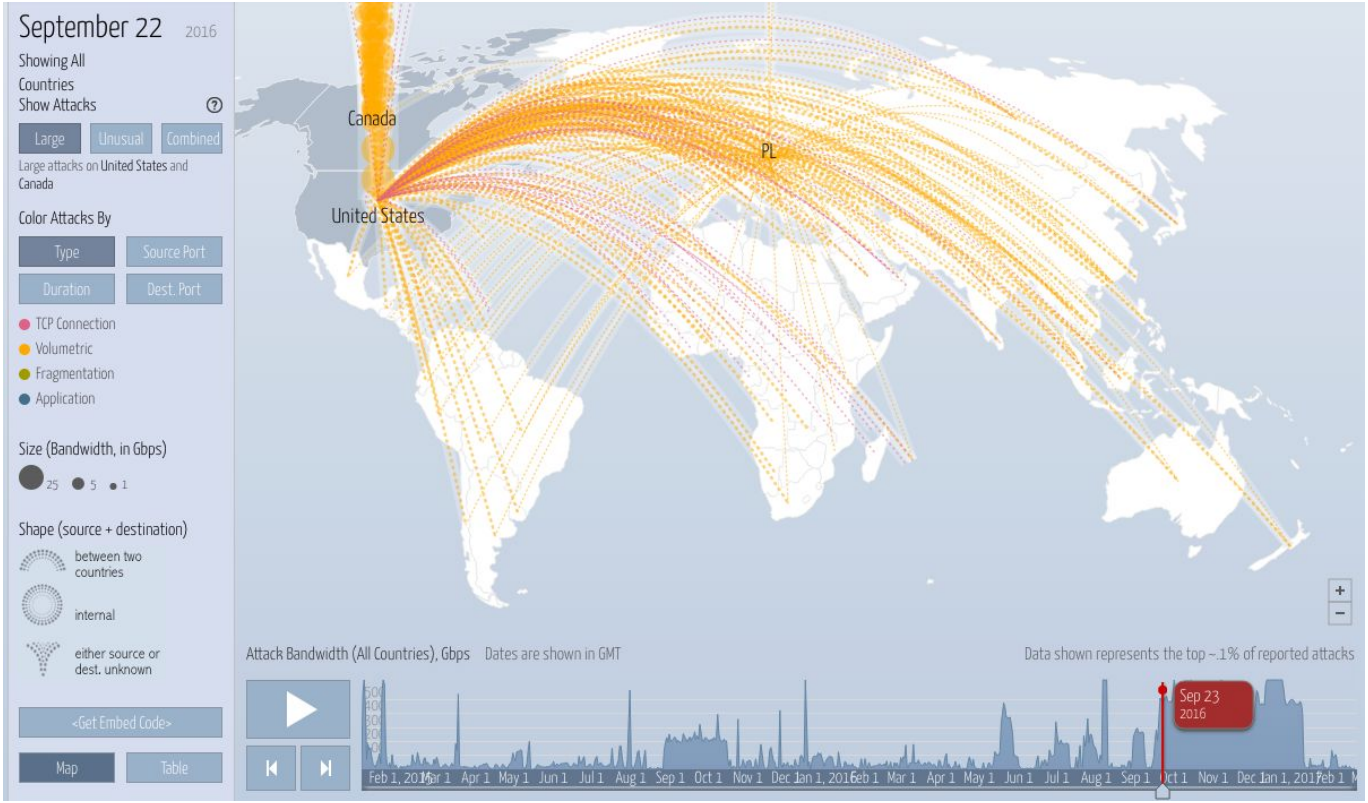
Distributed Denial of Service - (D)DoS

- Make a machine or network resource unavailable to its intended users by temporarily or indefinitely disrupting services of an Internet-connected host
- Typically accomplished by flooding the target with valid but superfluous requests attempting to overload the system and prevent some or all legitimate requests from being fulfilled

Distributed Denial-of-Service



DDoS Live



Source: [Digital Attack Map]

Mirai – The 150’000 IoT-Camera Botnet

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- 2016-09-20: KrebsOnSecurity (KOS) DDoS’ed
  - Record breaking traffic: 620 Gbps (previous record: 363 Gbps)
  - Akamai had to drop DoS protection for KOS
  - Later: KOS protected by Google’s Project Shield
- 2016-09-22: OVH hit by 1 Tbps (!) traffic
- 2016-10-21: DynDNS targeted
  - Massive Internet outage
  - Affects many large companies (Amazon, GitHub, Netflix, NYT, Spotify, Twitter, WIRED, …)
- 2016-11-04: Liberia knocked offline
- 2016-11-30: 900k German Telekom routers knocked offline by new version of Mirai
- To-be-continued …

How-To Botnet in 2017

Source: Shodan.io

Description of non-physical threats

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Side-channel Attacks

- Attacks that extract secret information based on physical or temporal properties of an implementation
- Targets usually cryptographic software/hardware
- Forms:
  - Cache behaviour analysis
  - Timing analysis
  - Power analysis
  - Electromagnetic analysis
  - Acoustic analysis
  - Error inducing (Rowhammer)
  - …

Timing Attacks

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Remote Timing Attacks are Practical

(2003)

David Brumley
Stanford University
dbrumley@cs.stanford.edu

Dan Boneh
Stanford University
dabo@cs.stanford.edu

Abstract

Timing attacks are usually used to attack weak computing devices such as smartcards. We show that timing attacks apply to general software systems. Specifically, we devise a timing attack against OpenSSL. Our experiments show that we can extract private keys from an OpenSSL-based web server running on a machine in the local network. Our results demonstrate that timing attacks against network servers are practical and therefore security systems should defend against them.

The attacking machine and the server were in different buildings with three routers and multiple switches between them. With this setup we were able to extract the SSL private key from common SSL applications such as a web server (Apache+mod_SSL) and a SSL-tunnel.

Interprocess. We successfully mounted the attack between two processes running on the same machine. A hosting center that hosts two domains on the same machine might give management access to the admins of each domain. Since both domain are hosted on the same machine, one admin could use the attack to extract the secret key belonging to the other domain.

Remote Timing Attacks Are Still Practical*

(2011)

Billy Bob Brumley and Nicola Tuveri

Aalto University School of Science, Finland
{bbrumley,ntuveri}@tcs.hut.fi

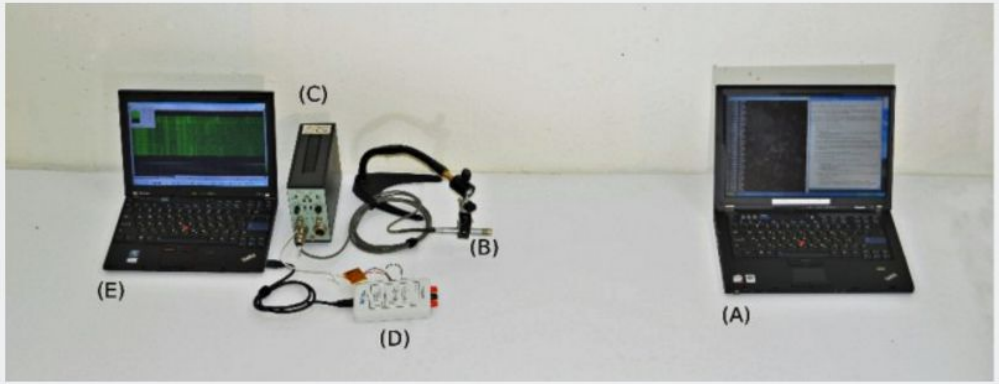
Abstract. For over two decades, timing attacks have been an active area of research within applied cryptography. These attacks exploit cryptosystem or protocol implementations that do not run in constant time. When implementing an elliptic curve cryptosystem with a goal to provide side-channel resistance, the scalar multiplication routine is a critical component. In such instances, one attractive method often suggested in the literature is Montgomery's ladder that performs a fixed sequence of curve and field operations. This paper describes a timing attack vulnerability in OpenSSL's ladder implementation for curves over binary fields. We use this vulnerability to steal the private key of a TLS server where the server authenticates with ECDSA signatures. Using the timing of the exchanged messages, the messages themselves, and the signatures, we mount a lattice attack that recovers the private key. Finally, we describe and implement an effective countermeasure.

Acoustic Cryptanalysis

New attack steals e-mail decryption keys by capturing computer sounds

Scientists use smartphone to extract secret key of nearby PC running PGP app.

DAN GOODIN - 12/19/2013, 12:25 AM



Enlarge / In this photograph, (A) is a Lenovo ThinkPad T61 target, (B) is a Brüel&Kjær 4190 microphone capsule mounted on a Brüel&Kjær 2669 preamplifier held by a flexible arm, (C) is a Brüel&Kjær 5935 microphone power supply and amplifier, (D) is a National Instruments MyDAQ device with a 10 kHz RC low-pass filter cascaded with a 150 kHz RC high-pass filter on its A2D input, and (E) is a laptop computer performing the attack. Full key extraction is possible in this configuration, from a distance of 1 meter.

Source: Ars Technica

Side-Channel Attacks: Rowhammer

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Rowhammer.js: A Remote Software-Induced Fault Attack in JavaScript

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***Abstract*—As DRAM has been scaling to increase in density, the cells are less isolated from each other. Recent studies have found that repeated accesses to DRAM rows can cause random bit flips in an adjacent row, resulting in the so called *Rowhammer bug*. This bug has already been exploited to gain root privileges and to evade a sandbox, showing the severity of faulting single bits for security. However, these exploits are written in native code and use special instructions to flush data from the cache.**

In this paper we present Rowhammer.js, a JavaScript-based implementation of the Rowhammer attack. Our attack uses an eviction strategy found by a generic algorithm that improves the eviction rate compared to existing eviction strategies from 95.2% to 99.99%. Rowhammer.js is the first remote software-induced hardware-fault attack. In contrast to other fault attacks it does not require physical access to the machine, or the execution of native code or access to special instructions. As JavaScript-based fault attacks can be performed on millions of users stealthily and simultaneously, we propose countermeasures that can be implemented immediately.

to any architecture, programming language and runtime environment that allows producing an efficient stream of memory access instructions. The main challenges to perform this attack are finding an optimal eviction strategy as replacement for the flush instruction and retrieving sufficient information on the physical addresses of data structures in JavaScript to find address pairs efficiently.

We describe an algorithm to find an optimal eviction strategy for an unknown cache replacement policy. Existing eviction strategies either focus on the pseudo-LRU cache replacement policy as implemented in Sandy Bridge [6], [7]. On Haswell and Ivy Bridge CPUs these eviction strategies show a significantly lower eviction rate. While the LRU eviction strategy achieves an eviction rate of 95.2% on our Haswell test machine, our optimal eviction strategy improves the eviction rate to 99.99%. Furthermore, our eviction strategy is more efficient in terms of additional memory accesses and time consumption. Both are crucial to successfully exploit the

Rowhammer.js Is the Most Ingenious Hack I've Ever Seen

ALIX JEAN-PHARUNS
Jul 30 2015, 2:30pm

This JavaScript exploit lets your browser mess with computer memory in a way that shouldn't be possible.

Source: Motherboard

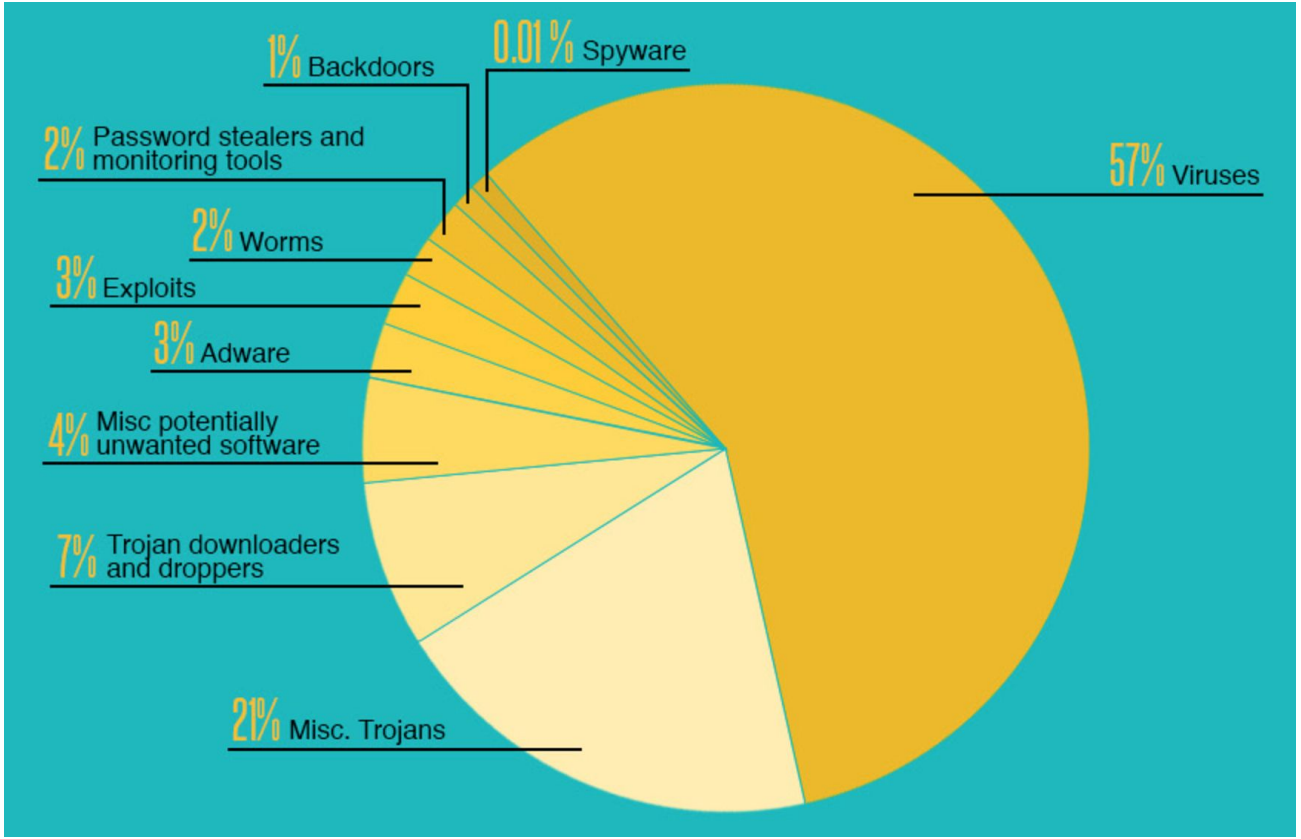
Description of non-physical threats

- Social engineering
- Software vulnerabilities
- Distributed Denial of Service
- Side-channels
- **Malicious Software (Malware)**

Malicious Software (Malware)

- Malware refers to software programs designed to damage or do other unwanted actions on a computer system.
- These actions can be visible or be hidden, depending on the purpose of the malware.

Types of Malicious Software Affecting Us



Source: ITProPortal

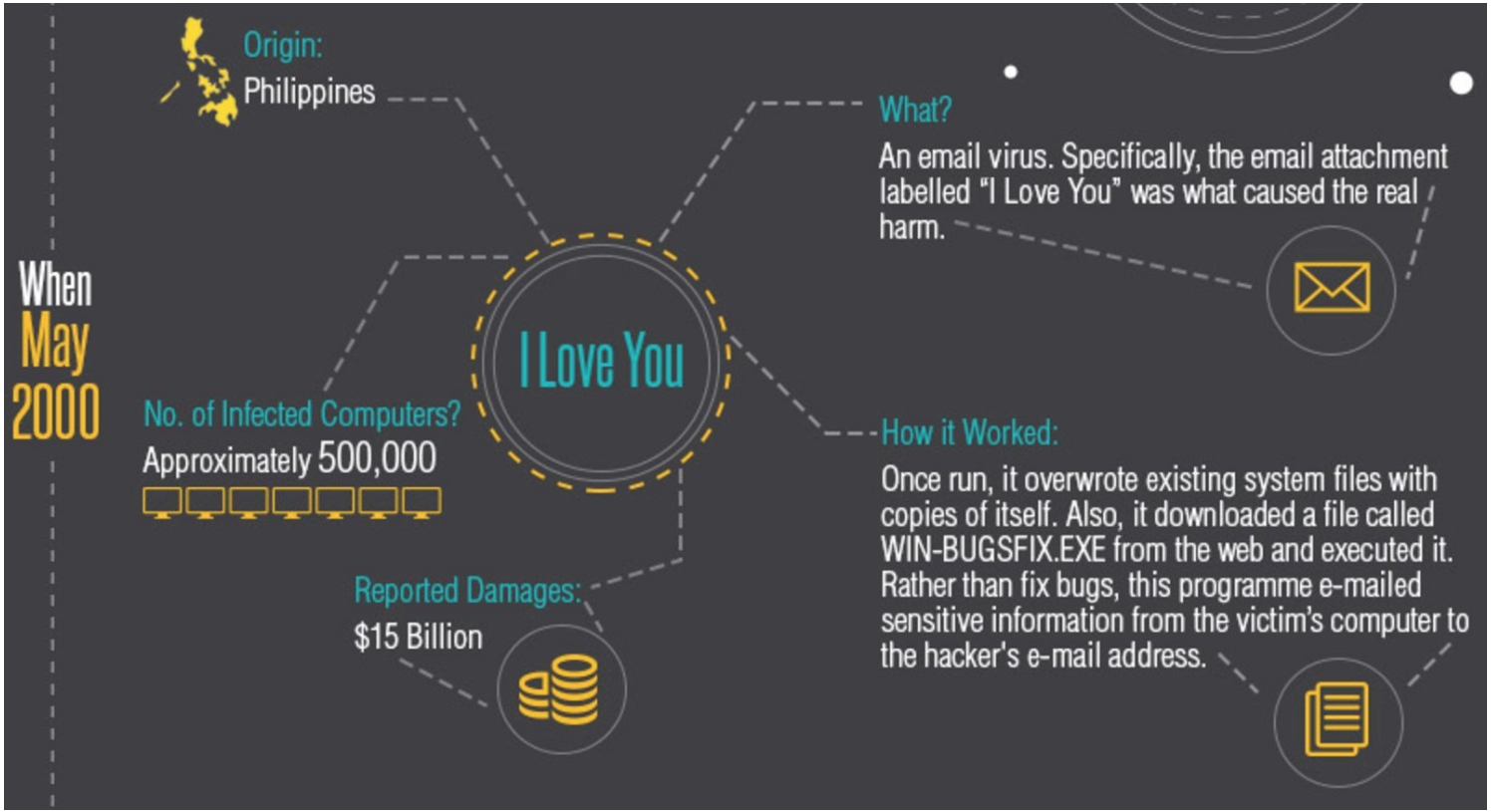
Description of non-physical threats

- Social engineering
- Software vulnerabilities
- Distributed Denial of Service
- Side-channels
- Malicious Software (Malware)
  - **Viruses**
  - Worms
  - Trojans
  - Rootkit
  - Ransomware
  - Backdoors
  - Nation-state malware

Viruses

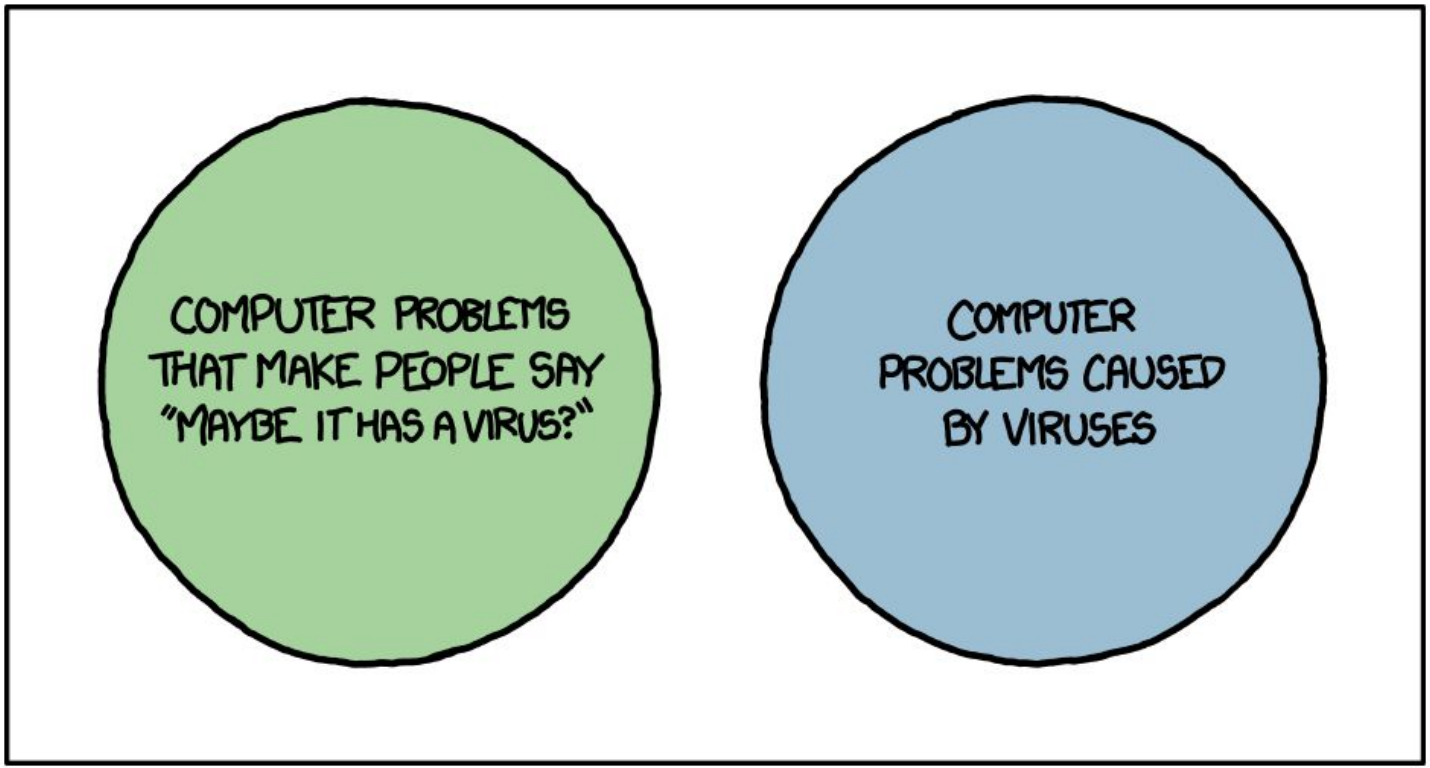
- Hidden inside programs / files
- Produces copies of itself which are inserted into other programs / files
- Passive spreading: Requires user actions for distribution to other systems

ILOVEYOU



Source: ITProPortal

Virus Venn Diagram



Source: xkcd

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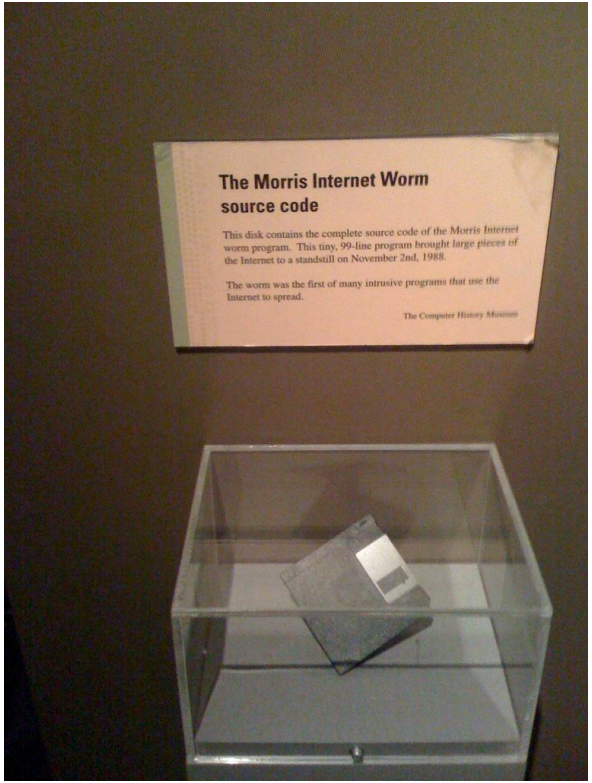
  - Viruses
  - **Worms**
  - Trojans
  - Rootkit
  - Ransomware
  - Backdoors
  - Nation-state malware

Worms

- Standalone malware
- Active spreading:
  - Transmits itself over the network
  - Exploits software vulnerabilities

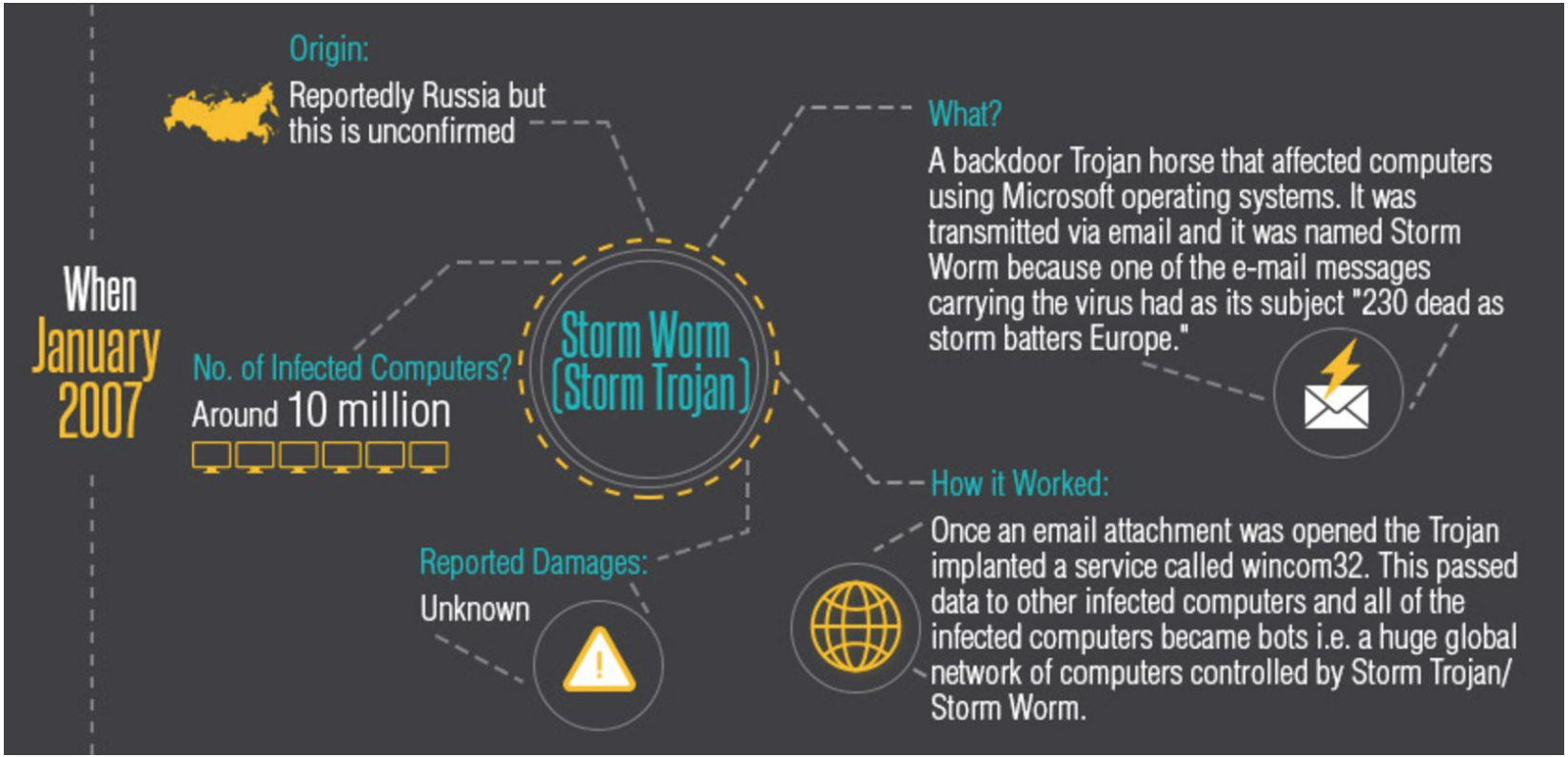
Morris Worm

- Created by Robert Tappan Morris at Cornell University in 1988
- One of the first Internet worms
- Intended goal: Map the existing Internet
  - Accidental side-effect: Computers could be infected multiple times, slowing them down until eventually becoming unusable
- Infected more than 6000 University, military and research center computers
- Exploited vulnerabilities in sendmail, finger and rsh/exec and weak passwords



Source: Wikipedia

Storm Worm



Source: ITProPortal

Conficker

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Worm Infects Millions of Computers Worldwide

By JOHN MARKOFF JAN. 22, 2009

A new digital plague has hit the Internet, infecting millions of personal and business computers in what seems to be the first step of a multistage attack. The world's leading computer security experts do not yet know who programmed the infection, or what the next stage will be.

In recent weeks a worm, a malicious software program, has swept through corporate, educational and public computer networks around the world. Known as Conficker or Downadup, it is spread by a recently discovered Microsoft Windows vulnerability, by guessing network passwords and by hand-carried consumer gadgets like USB keys.

Experts say it is the worst infection since the Slammer worm exploded through the Internet in January 2003, and it may have infected as many as nine million personal computers around the world.

Source: New York Times

Description of non-physical threats

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

- Social engineering
- Software vulnerabilities
- Distributed Denial of Service
- Side-channels
- Malicious Software (Malware)
  - Viruses
  - Worms
  - **Trojans**
  - Rootkit
  - Ransomware
  - Backdoors
  - Nation-state malware

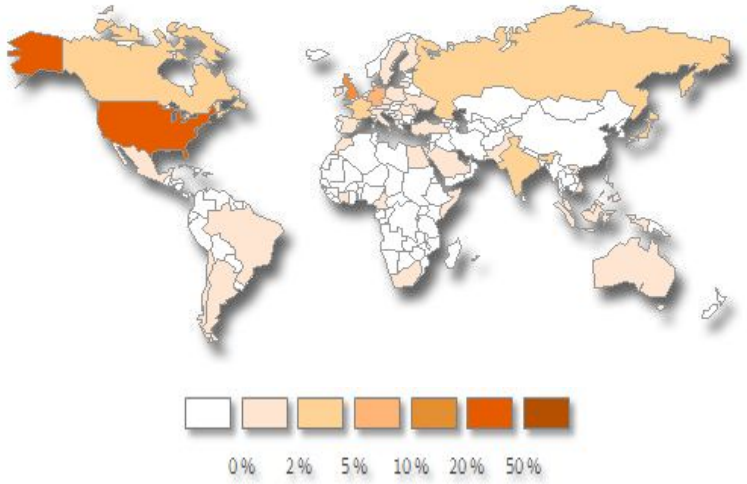
Trojans

- Disguises itself as a useful program tricking victims into installing it
- Often combined with social engineering
- Does usually not propagate itself
- Usually has remote access capabilities

ZeuS

- High-tech Trojan used to create Botnets
- Sold as a kit for $3000 - $4000
- Offers several for-pay extensions, e.g., Jabber ($500) or VNC ($10’000)
- Employs advanced stealth techniques to avoid AV
- Encrypted peer-to-peer communication
- Features hardware-based licensing system
- Spread by
  - Drive-by-downloads
  - Phishing
- Application purpose:
  - Banking fraud (keylogging, form stealing)
  - Spread ransomware (CryptoLocker)
- Infected > 3.6 million PCs in the US by 2009

Geographical Distribution



Source: Symantec

Fileless Malware

- Trades persistence for stealth:
  - Does not store files on disk
  - Does not survive reboots (often not a problem because computers are rarely rebooted nowadays)
  - Undetectable by AV scanners
- Usage scenarios:
  - Load other malware (e.g., rootkits, ransomware)
  - Perform click-fraud
  - Send spam
  - …

LILY HAY NEWMAN SECURITY 02.09.17 7:22 PM

SAY HELLO TO THE SUPER-STEALTHY MALWARE THAT'S GOING MAINSTREAM

Source: Wired

Registry Malware

- Advanced fileless malware
- Achieves stealthiness **and** persistence
- Infects Windows registry
- Undetectable by AV scanners

Symantec Official Blog

+1
1 Votes

Poweliks click-fraud malware goes fileless in attempt to prevent removal

Prolific click-fraud bot, Trojan.Poweliks, resides only in the Windows registry and uses several tricks to make it difficult to evict.

By: Kevin Gossett SYMANTEC EMPLOYEE

Created 09 Jun 2015 | 0 Comments | : 简体中文, 繁體中文, 日本語

0 454

Source: Symantec

Trojan.Poweliks first grabbed people's attention in 2014 when it evolved into a registry-based threat. As a registry-based threat, Poweliks does not exist as a file on the compromised computer and instead resides only in the Windows registry. While fileless threats that reside in memory-only have been seen before, Poweliks stands out from this crowd because of a persistence mechanism that allows it to remain on the compromised computer even after a restart.

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Rootkits

- Advanced malware concealing itself to avoid detection
- Enables continued privileged access
- There are types for user / kernel mode, hypervisors, firmware, and hardware
- Removal usually (very) difficult

Firmware Rootkits – The Attacker's Holy Grail

Source: Wired

- Most powerful and sophisticated technique
- Hard to develop and deploy
- Survives reboots, system updates and reinstallations
- Has hidden storage to keep valuable data:
  - Exfiltrated files
  - Full-disk encryption keys / passwords
- Almost impossible to detect / remove:
  - Undetectable by AV scanners
  - Manually checking for altered firmware is difficult and requires expert knowledge
  - Replacing the infected device is often the only "solution" to get rid of the malware

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Ransomware

- Malware that locks your computer until victim has paid a ransom (usually in Bitcoin)
- Newer versions (starting with CryptoLocker in 2013) encrypt data using public-key cryptography

Ransomware

Source: Wired

For example: In 2014 CryptoLocker extorted about $23 million from victims (according to an estimation by Symantec)

Ransomware – More of the Same

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- CryptoDefense:
  - Enforced payments over Tor
  - Handed out Tor installation guides to victims
- CryptoWall:
  - Also encrypts your external drives (i.e., backups)
  - Has an affiliate program giving criminals a cut of the profit if they help spread the word
- CTB-Locker:
  - CTB: Curve-Tor-Bitcoin
  - Uses Elliptic curve cryptography
  - Command servers on Tor
  - Payments via Bitcoin
  - Has an affiliates program as well
- Soon: Ransomware using Zcash?

LILY HAY NEWMAN SECURITY 12.13.16 7:00 AM

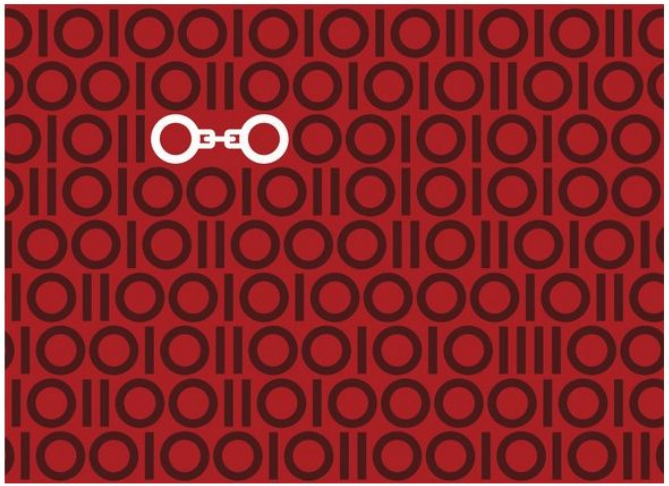
DEVIOUS RANSOMWARE FREES YOU IF YOU INFECT TWO OTHER PEOPLE

Source: Wired

Ransomware – No One is Spared

LILY HAY NEWMAN SECURITY 02.01.17 7:00 AM

RANSOMWARE TURNS TO BIG TARGETS—WITH EVEN BIGGER FALLOUT



Source: Wired

Source: Talk by Jeremiah Grossman at RSAConf'17

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Definition of a backdoor by Zdziarski:

“A backdoor is a component of a security boundary mechanism, in which the component is active on a computer system without consent of the computer’s owner, performs functions that subvert purposes disclosed to the computer’s owner, and is under the control of an undisclosed actor.“

Backdoors

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How to test whether a technology fulfils the definition:

- **Intent:** “Does the mechanism behave in a way that subverts purposes as disclosed to the computer owner?”
- **Consent:** “Is the mechanism, or are subcomponents of the mechanism, active on a computer without the consent of the computer’s owner?”
- **Access:** “Is the mechanism under the control of an undisclosed actor?”

Clipper Chip

The idea is to give the Government means to override other people's codes, according to a concept called "key escrow." Employing normal cryptography, two parties can communicate in total privacy, with both of them using a digital "key" to encrypt and decipher the conversation or message. A potential eavesdropper has no key and therefore cannot understand the conversation or read the data transmission. But with Clipper, an additional key -- created at the time the equipment is manufactured -- is held by the Government in escrow. With a court-approved wiretap, an agency like the F.B.I. could listen in. By adding Clipper chips to telephones, we could have a system that assures communications will be private -- from everybody but the Government.

Source: The New York Times

- The Clipper chip satisfies the three requirements **Intent**, **Consent**, and **Access** of Zdziarski's backdoor definition
- Discussion on key escrow is more relevant than ever, see, e.g., Apple vs. FBI in 2016

Dual-EC DRBG

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Dual EC: A Standardized Back Door

Daniel J. Bernstein[1,2], Tanja Lange[1], and Ruben Niederhagen[1]

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University of Illinois at Chicago
Chicago, IL 60607–7045, USA
djb@cr.yp.to

Abstract. Dual EC is an algorithm to compute pseudorandom numbers starting from some random input. Dual EC was standardized by NIST, ANSI, and ISO among other algorithms to generate pseudorandom numbers. For a long time this algorithm was considered suspicious – the entity designing the algorithm could have easily chosen the parameters in such a way that it can predict all outputs – and on top of that it is much slower than the alternatives and the numbers it provides are more biased, i.e., not random.

The Snowden revelations, and in particular reports on Project Bullrun and the SIGINT Enabling Project, have indicated that Dual EC was part of a systematic effort by NSA to subvert standards.

This paper traces the history of Dual EC including some suspicious changes to the standard, explains how the back door works in real-life applications, and explores the standardization and patent ecosystem in which the standardized back door stayed under the radar.

Source: projectbullrun.org

US & WORLD | NATIONAL SECURITY

NSA paid $10 million to put its backdoor in RSA encryption, according to Reuters report

by Russell Brandom | @russellbrandom | Dec 20, 2013, 4:54pm EST

Source: The Verge

On the Practical Exploitability of Dual EC in TLS Implementations

Stephen Checkoway[1], Matthew Fredrikson[2], Ruben Niederhagen[3], Adam Everspaugh[2], Matthew Green[1], Tanja Lange[3], Thomas Ristenpart[2], Daniel J. Bernstein[3,4], Jake Maskiewicz[5], and Hovav Shacham[5]

[1] *Johns Hopkins University*, [2] *University of Wisconsin*, [3] *Technische Universiteit Eindhoven*, [4] *University of Illinois at Chicago*, [5] *UC San Diego*

Abstract

This paper analyzes the actual cost of attacking TLS implementations that use NIST's Dual EC pseudorandom number generator, assuming that the attacker generated the constants used in Dual EC. It has been known for several years that an attacker generating these constants and seeing a long enough stretch of Dual EC output bits can predict all future outputs; but TLS does not naturally provide a long enough stretch of output bits, and the cost of an attack turns out to depend heavily on choices made in implementing the RNG and on choices made in implementing other parts of TLS.

Specifically, this paper investigates OpenSSL-FIPS, Windows' SChannel, and the C/C++ and Java versions of the RSA BSAFE library. This paper shows that Dual EC exploitability is fragile, and in particular is stopped by an outright bug in the certified Dual EC implementation in OpenSSL. On the other hand, this paper also shows that Dual EC exploitability benefits from a modification made to the Dual EC standard in 2007; from several attack optimizations introduced here; and from various proposed TLS extensions, one of which is implemented in BSAFE, though disabled in the version we obtained and studied. The paper's attacks are implemented; benchmarked; tested against libraries modified to use new Dual EC constants; and verified to successfully recover TLS plaintext.

The documents also make specific reference to a set of pseudorandom number generator (PRNG) algorithms adopted as part of the National Institute of Standards and Technology (NIST) Special Publication 800-90 [21] in 2006, and also standardized as part of ISO 18031 [15]. These standards include an algorithm called the Dual Elliptic Curve Deterministic Random Bit Generator (Dual EC). As a result of these revelations, NIST reopened the public comment period for SP 800-90.

Known weaknesses in Dual EC. Long before 2013, Dual EC had been identified by the security community as biased [8, 27], extremely slow, and backdoorable.

SP 800-90 had already noted that "elliptic curve arithmetic" makes Dual EC generate "pseudorandom bits more slowly than the other DRBG mechanisms in this Recommendation" [21, p. 177] but had claimed that the Dual EC design "allows for certain performance-enhancing possibilities." In fact, Dual EC with all known optimizations is two orders of magnitude slower than the other PRNGs, because it uses scalar multiplications on an elliptic curve where the other PRNGs use a hash function or cipher call.

The back door is a less obvious issue, first brought to public attention by Shumow and Ferguson [28] in 2007. What Shumow and Ferguson showed was that an attacker specifying Dual EC, and inspecting some Dual EC output bits from an unknown seed, had the power to predict all

Source: dualec.org

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  - Backdoors
  - **Nation-state malware**

Nation-state Malware

- Highly advanced malware
- Used for targeted attacks
  (often espionage, but sometimes physical)
- For infection commonly uses a combination of
  - Social engineering
  - Zero-day exploits
  - Other advanced attack vectors
    (e.g., hash function collision attacks)

Air-Gap Bridging Malware

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

ANDY GREENBERG SECURITY 02.22.17 7:00 AM

MALWARE LETS A DRONE STEAL DATA BY WATCHING A COMPUTER'S BLINKING LED

Source: Wired

Attack outline:

- Plant malware on air-gapped system (e.g., by paying insider to plug in an infected SD card / USB drive)
- Malware encodes data into signal using blinking LEDs
- Position drone with a high-res camera in front of a window to pick up the signal and exfiltrate data (at up to 4000 bps)

Stuxnet

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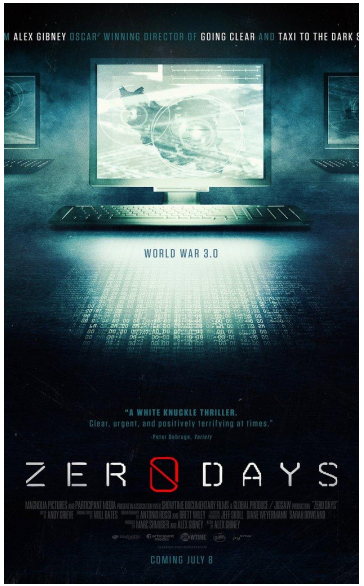
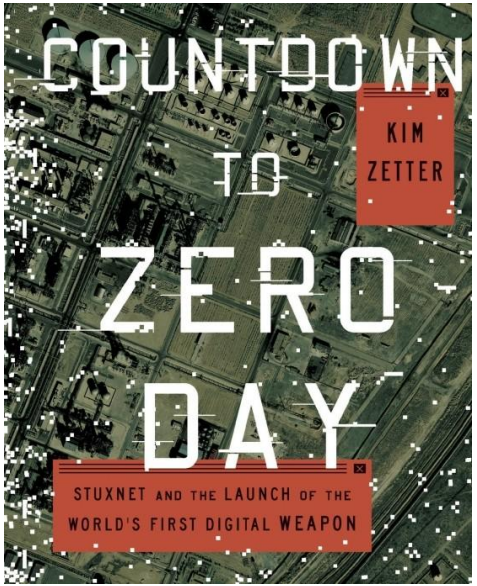
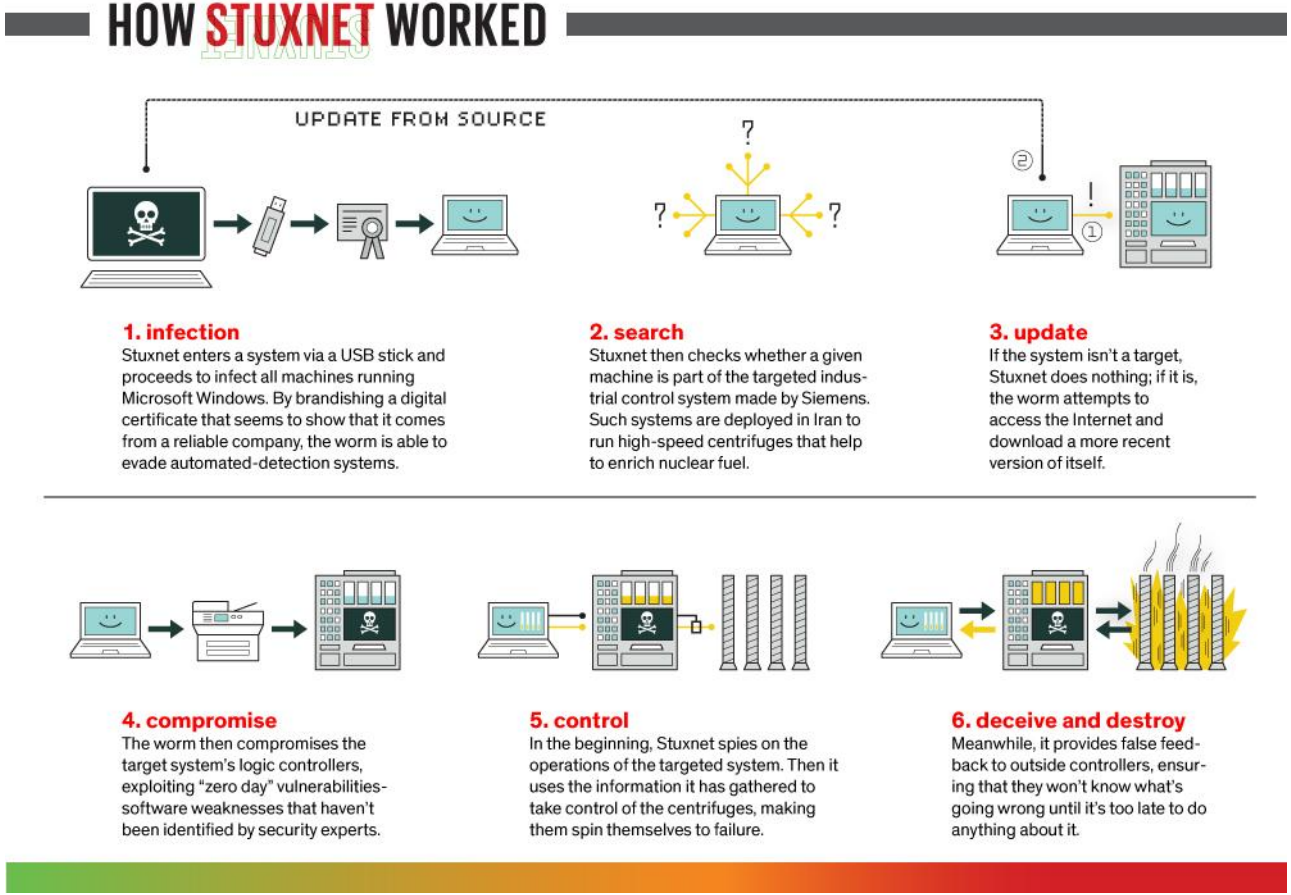
- Highly advanced malware
- Used for **targeted sabotage** of Iran's nuclear program
- Supposedly developed by an American-Israeli team
- Exploited four zero-day exploits in Microsoft Windows
- Accidentally spread beyond its intended target due to a programming error





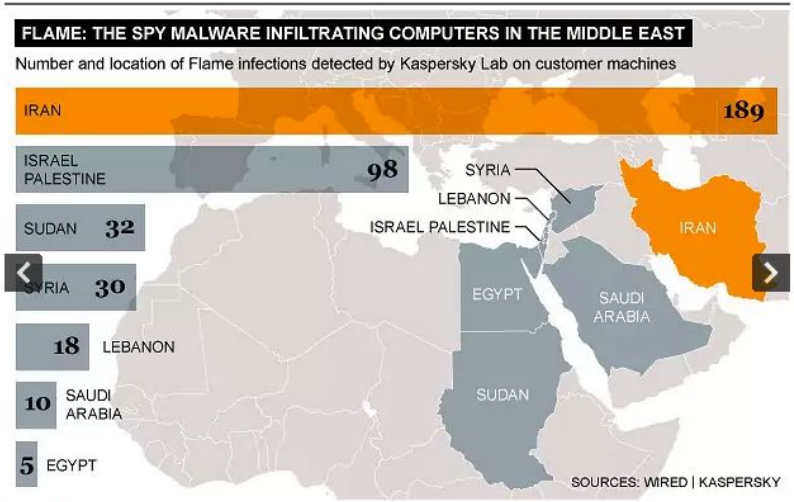
Stuxnet



Source: IEEE Spectrum

Flame

- Highly advanced self-modifying malware
- Used for **targeted espionage** (mostly in the Middle East)
- Uncommonly large: 20MB
- Supported 5 different encryption methods
- Contained an entire SQLite database (!)
- Used two exploits previously known from Stuxnet
- Signed by a fraudulent Microsoft certificate (created by an MD5 collision)



Source: The Telegraph

Soon: Flame 2 - The Revenge (http://shattered.io/)?


OUR DEVICES ARE NOW 100% SECURE.
I TURNED THEM ALL OFF.
HOW DID YOU DO THAT?
© D.Fletcher for CloudTweaks.com

Conclusion

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FÉDÉRALE DE LAUSANNE

- Random attacks mostly use viruses, phishing, commodity malware
  - More concerned by the number of infections
  - Don’t care who is infected
- Targeted attacks use social engineering, spear phishing, specialty malware
  - Social engineering to place malware at strategic places
  - DDoS to silence service / institution / person
- Different attack vectors often require different defenses