Catching Malware En Masse : DNS and IP style

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Part 1: Catching Malware DNS style

- Fastflux botnets as proxy networks

Part 2: Catching Malware IP style

- ASN graph
- Suspicious sibling ASNs
- Detecting sibling ASNs through BGP outages
- Detecting Malicious IP ranges
- Detecting Malicious subdomains under compromised domains

Part 3: Visualizing knowledge with our 3D engine

- OpenGraphiti
- Semantic Nets
- Particle Physics

Conclusion

Part 1:

Catching Malware DNS style

Background

Attackers seek to keep their operations online at all times

The Network = the hosting infrastructure is

CRUCIAL

Spam

Phishing

Malware distribution

Botnets

Fast flux botnets

Fast flux botnets serving as proxy networks

Extra evasion/protection layer for actual CnCs

Infected hosts <-> FF proxy network <-> Backend CnCs

Usages of proxy network:

-Serve malware pushed from CnCs down to infected clients (via drive-by, spam, etc.)

-Forward communication from infected clients to CnCs

e.g. Kelihos TTL 0, zbot TTL 150

Zeus Crimeware

-Control panel

-Config files (contains urls for: drop zone, extra payload, extra configs, target websites for web injects)

-Binary files

-Builder

Characteristics:

-Steals financial data: online bank account info, credit card

-Steals sensitive credentials

-Web injects

Zeus CnCs

-Compromised sites

-Bulletproof or free hosting

-Fast flux botnet

CnC domains used for 3 types of purposes:

-Serve configuration files

-Serve binary files

-Drop zones

Zbot proxy network

Fast flux domains with TTL = 150 sec sharing same infected hosts infrastructure

Detection methods:

1) Periodic batch pig job
2) IP harvesting + streaming auth DNS + filtering heuristics

Detection methods (1)

-Periodic Pig job to retrieve domains with TTL = 150 from authoritative logs

-Filter out noise domains such as spam, legitimate domains known to use TTL = 150

-Build “domain to IP” bipartite graph

-Extract largest connected component

-Identify new zbot CnC domains to block

-Add IPs from largest connected component to pool of zbot IPs

Streaming Authoritative DNS

- Tap into processed authoritative DNS stream before it's consolidated into a persistent DB
- asn, domain, 2LD, IP, NS_IP, timestamp, TTL, type
- Faster than DNSDB on Hadoop
- 100s – 1000s entries/sec (from subset of resolvers)
- Need to implement your own filters, detection heuristics

Detection methods (2)

-Start with a seed of identified zbot CnC domains

-Continuously harvest IPs and add them to pool of zbot IPs

-Check for any domain in authlogs DNS stream whose IP or NS_IP is in pool of zbot IPs

-Identify new zbot CnC domains to block

-Add new domains to seed

Zbot proxy network

-Fast flux domains riding on proxy network used as CnCs post-infection by Kuluoz

-Various Exploit kits lead to dropping of malware and infected host joins Asprox botnet

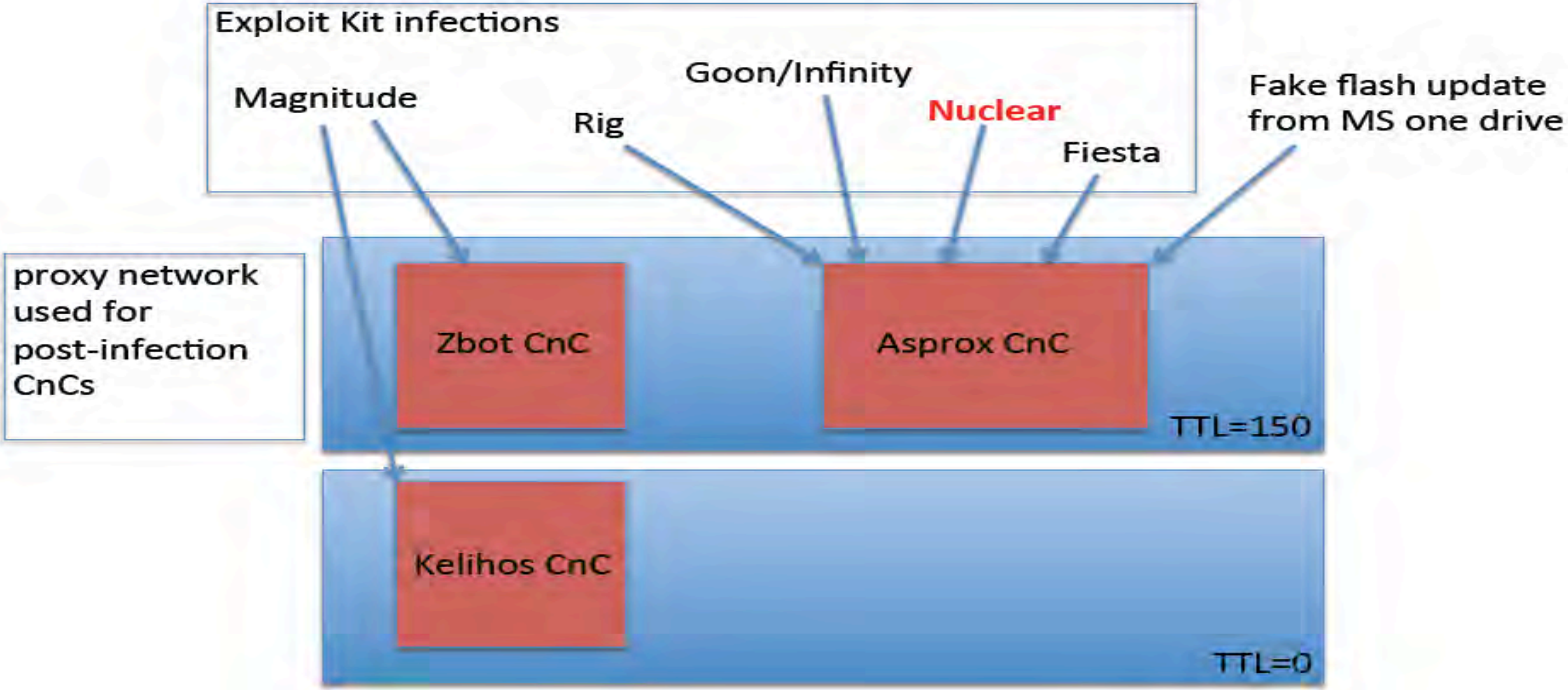
-Malware used to gain control of hosts is Kuluoz/Dofoil

Infection vectors:

-Drive-by, exploit kit

-Spam emails: embedded links leading to malware, or malware in attachment (fake Flash update)

Zbot proxy network



HTTP traffic url patterns

Monitoring HTTP traffic to CnCs using:

-Sinkhole

and

-VirusTotal

HTTP traffic url patterns

A Zeus CnC domain can serve 3 types of urls:

-Config

-Binary

-Drop zone

Example Zeus CnC observed traffic

seorubl.in, GET /forum/popap1.jpg, ConfigURL

reznormakro.su, GET /winconf/kernl.bin, ICE IX, ConfigURL

orbitmanes.ru, GET /01.exe, KINS, BinaryURL

reportonh.com, GET /pack32/sysconf.exe, BinaryURL

sytemnr.com, GET /pack32/sysconf.exe, BinaryURL

HTTP traffic url patterns

ET TROJAN W32/Asprox.ClickFraudBot CnC Beacon

GET /b/eve/0008f258b0e99d069756f425

GET /b/letr/002D63501FC3E082B1E9F290

GET /b/shoe/1480

ET TROJAN W32/Asprox.ClickFraudBot POST CnC Beacon

POST /b/opt

POST /b/req

Multiple Asprox type callbacks and binary downloads followed by click fraud

HTTP traffic url patterns

Beaconing and announcing version, make, OS

```
GET /1/?uid=01604555&ver=1.14&mk=bb3b62&os=S2000&rs=adm&c=14&rq=0
```

```
os=S2000
os=Win07
os=Win_V
os=WinXP
os=Win08
```

HTTP traffic url patterns

Other urls to get binaries and configs

azg.su, GET /coivze7aip/modules/bot.exe

tundra-tennes.com, GET /infodata/soft32.dll

tundra-tennes.com, GET /info-data/soft32.dll

bee-pass.com, GET /info/soft32.dll

quarante-ml.com, GET /nivoslider/jquery/

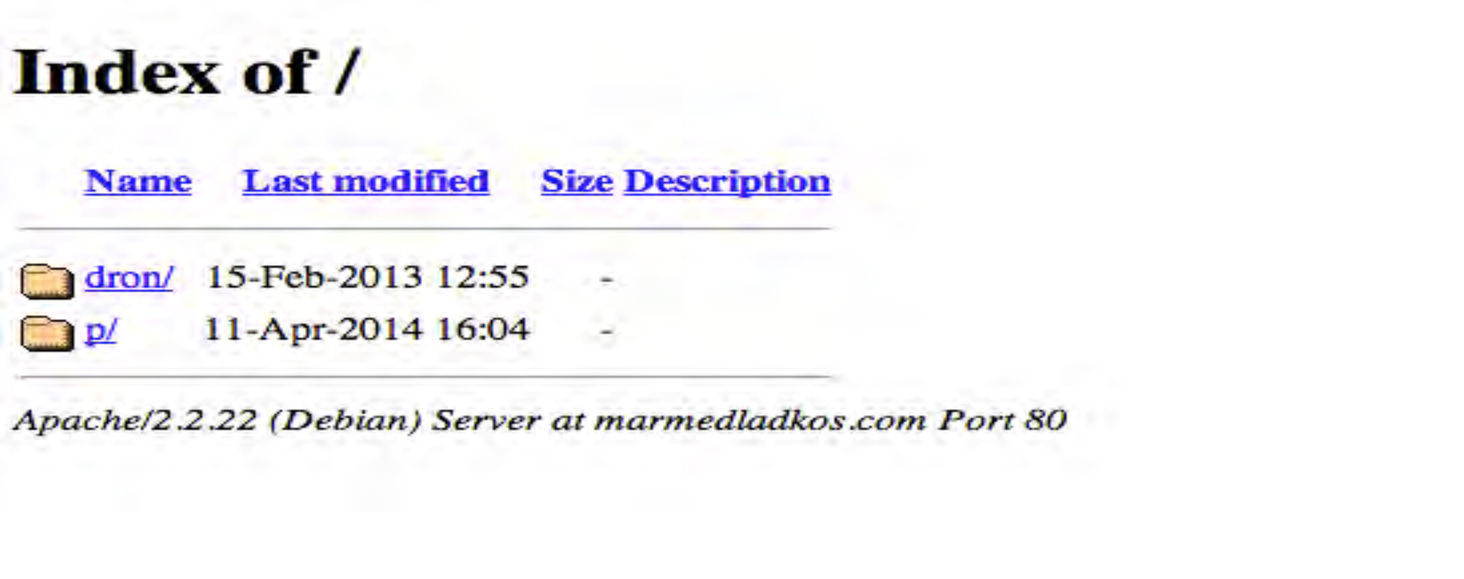
GET /nivoslider98.45/ajax/

GET /nivoslider98.45/jquery/

GET /nivoslider/ajax/

Pony panel on zbot proxy network

-marmedladkos.com



Index of /

	Name	Last modified	Size	Description
📁	dron/	15-Feb-2013 12:55	-	
📁	p/	11-Apr-2014 16:04	-	

Apache/2.2.22 (Debian) Server at marmedladkos.com Port 80

Pony panel on zbot proxy network

-Pony 1.9 leaked for Trojan Forge in late 2012

-Botnet controller via a panel, user management, logging, database, statistics

-Info stealer

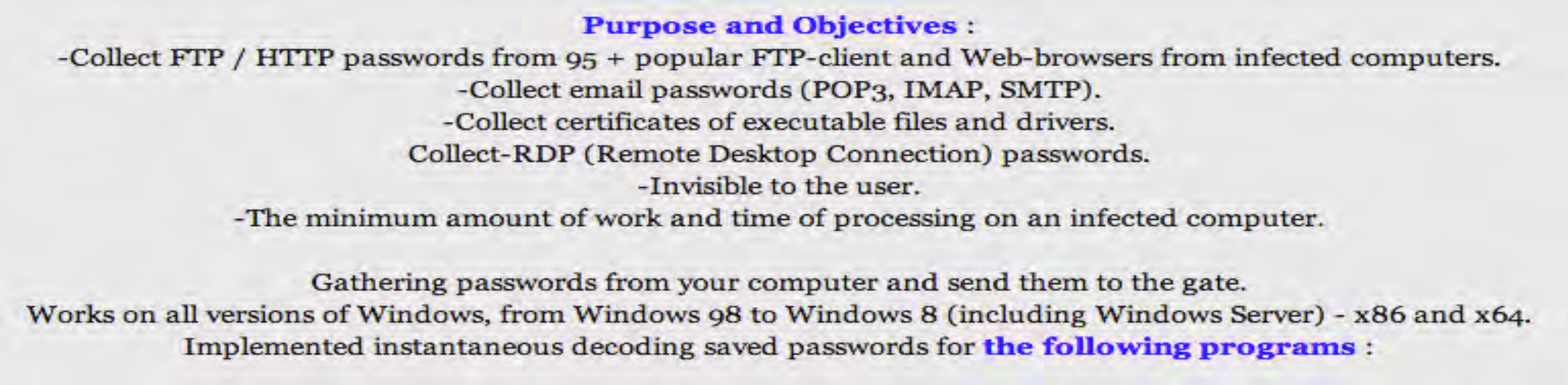
-Win32/Fareit

Payload delivered via:

-Drive-by/Exploit kit

-Attachment in spam emails

Pony panel on zbot proxy network



Purpose and Objectives :

-Collect FTP / HTTP passwords from 95 + popular FTP-client and Web-browsers from infected computers.

-Collect email passwords (POP3, IMAP, SMTP).

-Collect certificates of executable files and drivers.

Collect-RDP (Remote Desktop Connection) passwords.

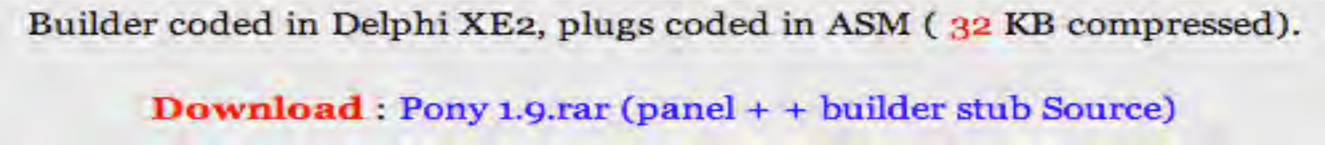
-Invisible to the user.

-The minimum amount of work and time of processing on an infected computer.

Gathering passwords from your computer and send them to the gate.

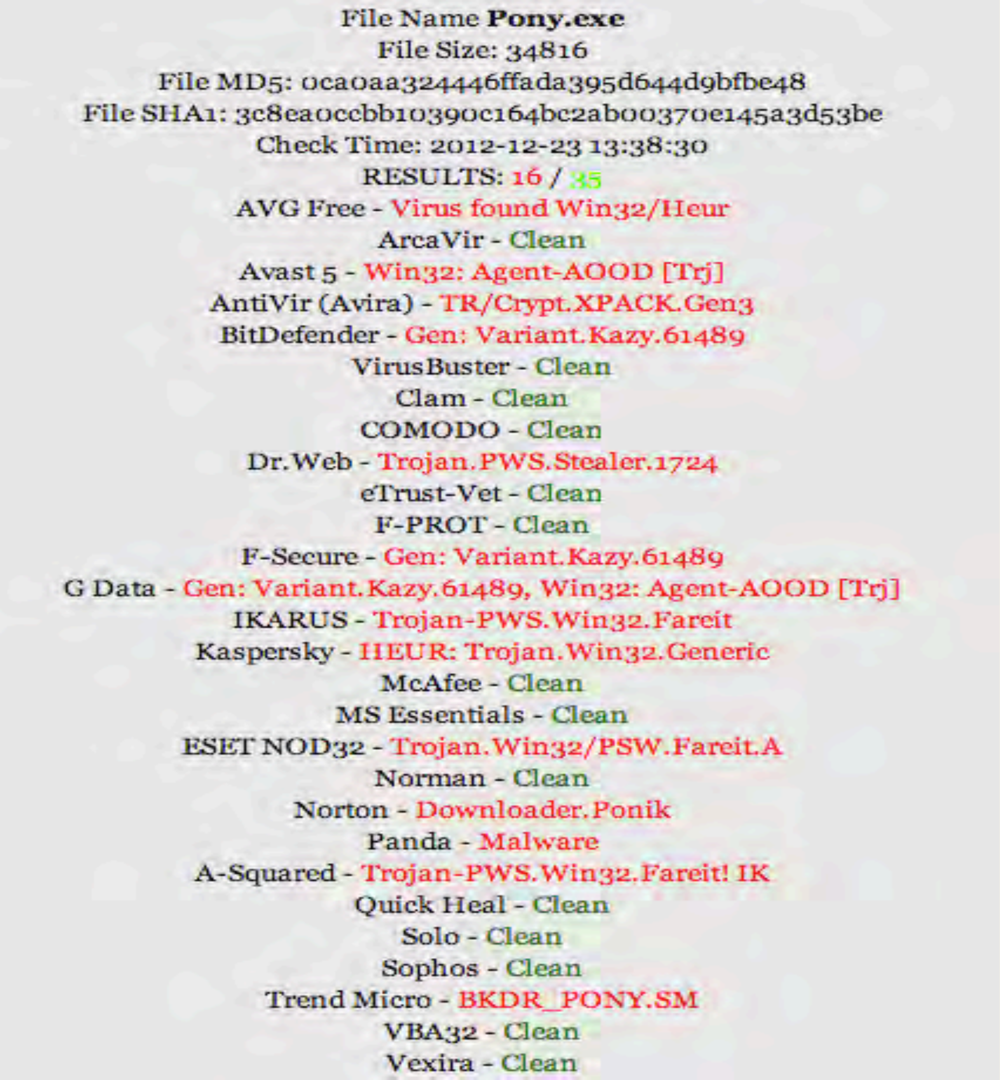
Works on all versions of Windows, from Windows 98 to Windows 8 (including Windows Server) - x86 and x64.

Implemented instantaneous decoding saved passwords for **the following programs** :



Builder coded in Delphi XE2, plugs coded in ASM (32 KB compressed).

Download : Pony 1.9.rar (panel + + builder stub Source)



File Name **Pony.exe**
File Size: 34816
File MD5: 0ca0aa324446ffada395d644d9bfbe48
File SHA1: 3c8ea0ccbb10390c164bc2ab00370e145a3d53be
Check Time: 2012-12-23 13:38:30
RESULTS: 16 / 35
AVG Free - Virus found Win32/Heur
ArcaVir - Clean
Avast 5 - Win32: Agent-AOOD [Trj]
AntiVir (Avira) - TR/Crypt.XPACK.Gen3
BitDefender - Gen: Variant.Kazy.61489
VirusBuster - Clean
Clam - Clean
COMODO - Clean
Dr.Web - Trojan.PWS.Stealer.1724
eTrust-Vet - Clean
F-PROT - Clean
F-Secure - Gen: Variant.Kazy.61489
G Data - Gen: Variant.Kazy.61489, Win32: Agent-AOOD [Trj]
IKARUS - Trojan-PWS.Win32.Fareit
Kaspersky - HEUR: Trojan.Win32.Generic
McAfee - Clean
MS Essentials - Clean
ESET NOD32 - Trojan.Win32/PSW.Fareit.A
Norman - Clean
Norton - Downloader.Ponik
Panda - Malware
A-Squared - Trojan-PWS.Win32.Fareit! IK
Quick Heal - Clean
Solo - Clean
Sophos - Clean
Trend Micro - BKDR_PONY.SM
VBA32 - Clean
Vexira - Clean

Pony panel on zbot proxy network

-p/Panel.zip — controlling php scripts

-includes/design/images/modules/* — images for each zeus plugin supported/tracked

-includes/password_modules.php — contains array with all software it tries to steal credentials for

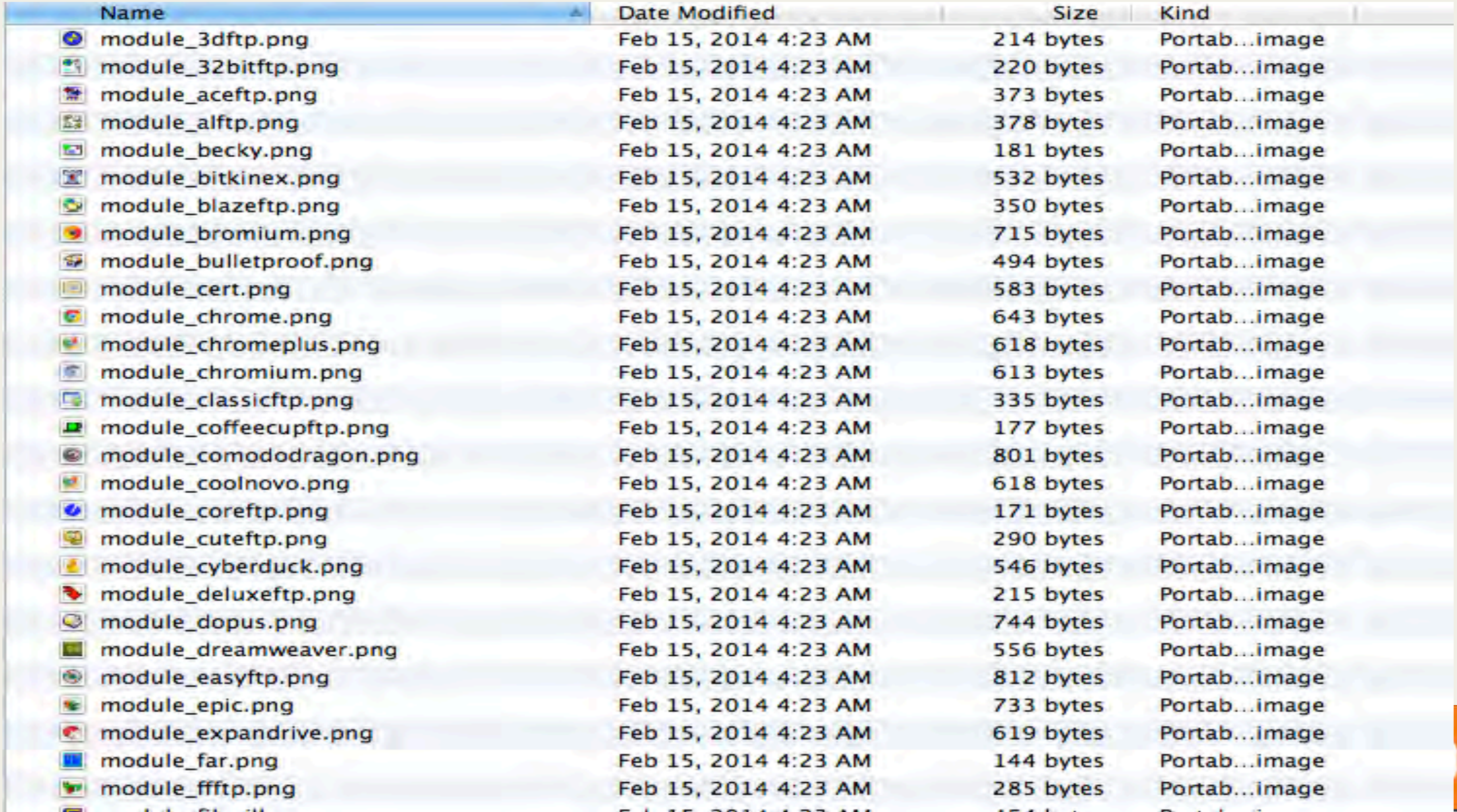
-includes/database.php — contains db schema and accessors

-character set cp1251 used everywhere

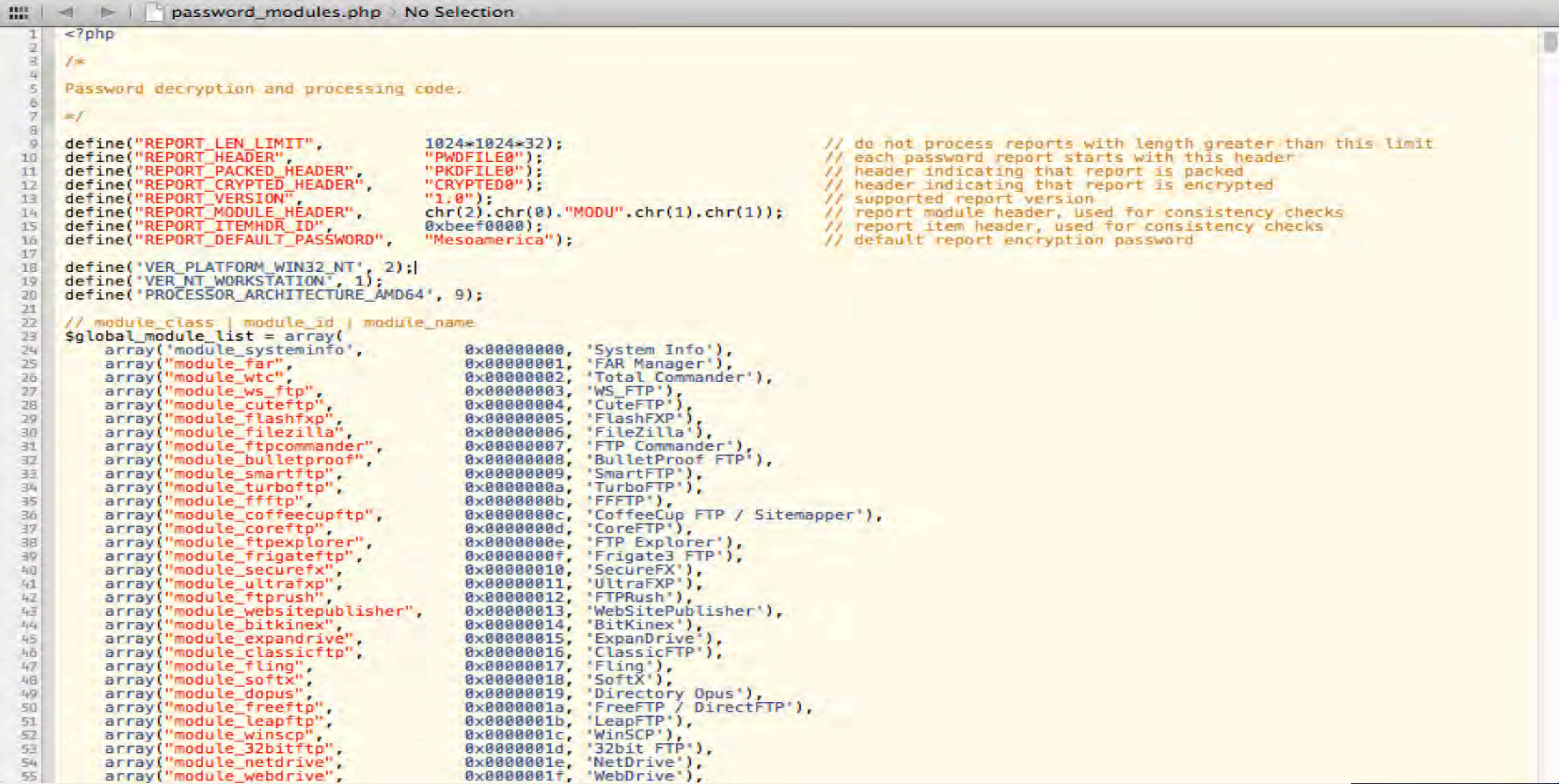
-mysql storage engine is MyISAM

-config.php date_default_timezone_set('Europe/Moscow')

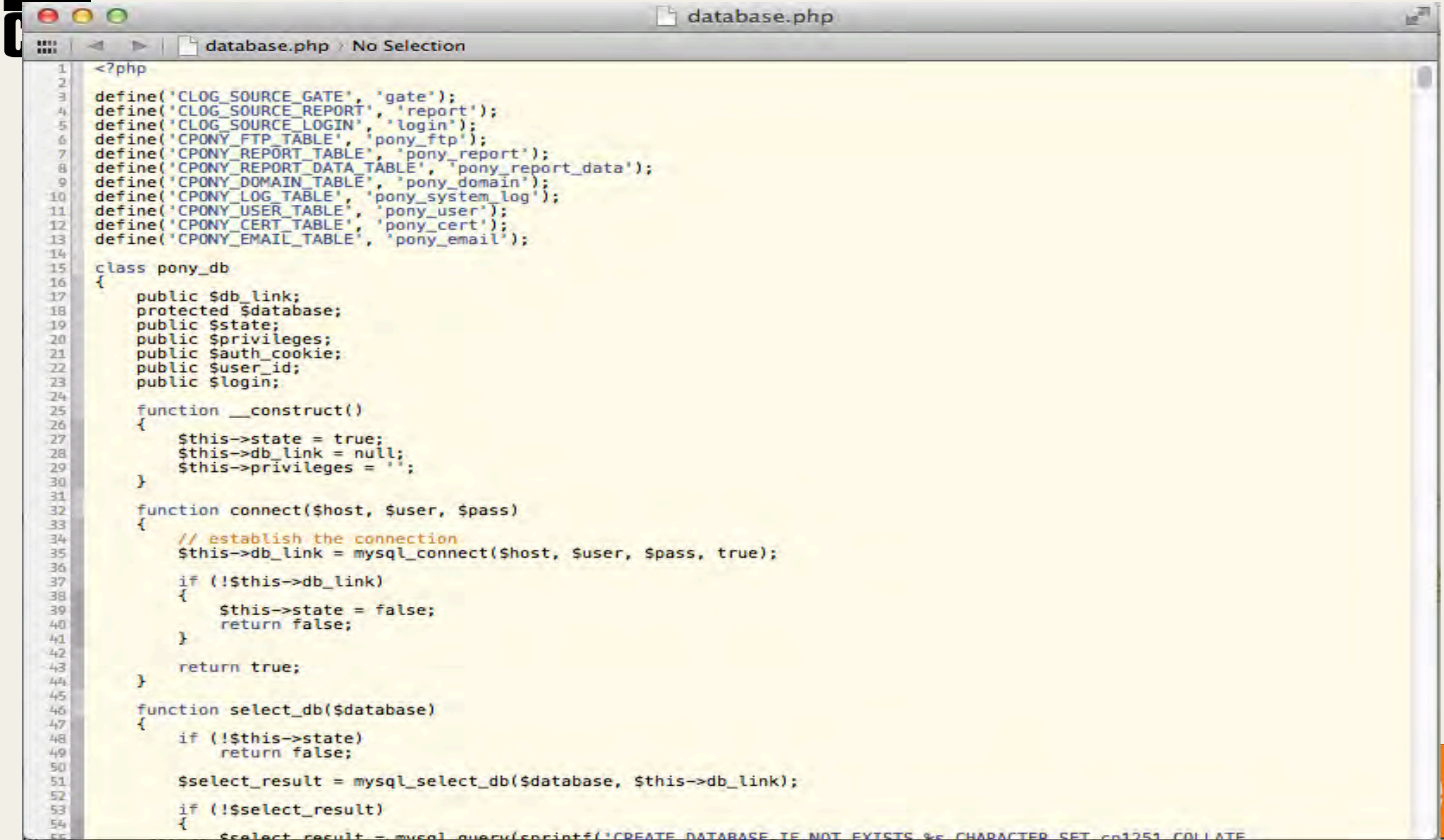
Pony panel on zbot proxy network



Name	Date Modified	Size	Kind
module_3dftp.png	Feb 15, 2014 4:23 AM	214 bytes	Portab...image
module_32bitftp.png	Feb 15, 2014 4:23 AM	220 bytes	Portab...image
module_aceftp.png	Feb 15, 2014 4:23 AM	373 bytes	Portab...image
module_alftp.png	Feb 15, 2014 4:23 AM	378 bytes	Portab...image
module_becky.png	Feb 15, 2014 4:23 AM	181 bytes	Portab...image
module_bitkinex.png	Feb 15, 2014 4:23 AM	532 bytes	Portab...image
module_blazeftp.png	Feb 15, 2014 4:23 AM	350 bytes	Portab...image
module_bromium.png	Feb 15, 2014 4:23 AM	715 bytes	Portab...image
module_bulletproof.png	Feb 15, 2014 4:23 AM	494 bytes	Portab...image
module_cert.png	Feb 15, 2014 4:23 AM	583 bytes	Portab...image
module_chrome.png	Feb 15, 2014 4:23 AM	643 bytes	Portab...image
module_chromeplus.png	Feb 15, 2014 4:23 AM	618 bytes	Portab...image
module_chromium.png	Feb 15, 2014 4:23 AM	613 bytes	Portab...image
module_classicftp.png	Feb 15, 2014 4:23 AM	335 bytes	Portab...image
module_coffeecupftp.png	Feb 15, 2014 4:23 AM	177 bytes	Portab...image
module_comododragon.png	Feb 15, 2014 4:23 AM	801 bytes	Portab...image
module_coolnovo.png	Feb 15, 2014 4:23 AM	618 bytes	Portab...image
module_coreftp.png	Feb 15, 2014 4:23 AM	171 bytes	Portab...image
module_cuteftp.png	Feb 15, 2014 4:23 AM	290 bytes	Portab...image
module_cyberduck.png	Feb 15, 2014 4:23 AM	546 bytes	Portab...image
module_deluxeftp.png	Feb 15, 2014 4:23 AM	215 bytes	Portab...image
module_dopus.png	Feb 15, 2014 4:23 AM	744 bytes	Portab...image
module_dreamweaver.png	Feb 15, 2014 4:23 AM	556 bytes	Portab...image
module_easyftp.png	Feb 15, 2014 4:23 AM	812 bytes	Portab...image
module_epic.png	Feb 15, 2014 4:23 AM	733 bytes	Portab...image
module_expandrive.png	Feb 15, 2014 4:23 AM	619 bytes	Portab...image
module_far.png	Feb 15, 2014 4:23 AM	144 bytes	Portab...image
module_ffftp.png	Feb 15, 2014 4:23 AM	285 bytes	Portab...image



```php
<?php

/*

Password decryption and processing code.

*/

define("REPORT_LEN_LIMIT",          1024*1024*32);                           // do not process reports with length greater than this limit
define("REPORT_HEADER",             "PWDFILE0");                             // each password report starts with this header
define("REPORT_PACKED_HEADER",      "PKDFILE0");                             // header indicating that report is packed
define("REPORT_CRYPTED_HEADER",     "CRYPTED0");                             // header indicating that report is encrypted
define("REPORT_VERSION",            "1.0");                                  // supported report version
define("REPORT_MODULE_HEADER",      chr(2).chr(0)."MODU".chr(1).chr(1));     // report module header, used for consistency checks
define("REPORT_ITEMHDR_ID",         0xbeef0000);                             // report item header, used for consistency checks
define("REPORT_DEFAULT_PASSWORD",   "Mesoamerica");                          // default report encryption password

define('VER_PLATFORM_WIN32_NT', 2);
define('VER_NT_WORKSTATION', 1);
define('PROCESSOR_ARCHITECTURE_AMD64', 9);

// module_class | module_id | module_name
$global_module_list = array(
    array('module_systeminfo',          0x00000000, 'System Info'),
    array("module_far",                 0x00000001, 'FAR Manager'),
    array("module_wtc",                 0x00000002, 'Total Commander'),
    array("module_ws_ftp",              0x00000003, 'WS_FTP'),
    array("module_cuteftp",             0x00000004, 'CuteFTP'),
    array("module_flashfxp",            0x00000005, 'FlashFXP'),
    array("module_filezilla",           0x00000006, 'FileZilla'),
    array("module_ftpcommander",        0x00000007, 'FTP Commander'),
    array("module_bulletproof",         0x00000008, 'BulletProof FTP'),
    array("module_smartftp",            0x00000009, 'SmartFTP'),
    array("module_turboftp",            0x0000000a, 'TurboFTP'),
    array("module_ffftp",               0x0000000b, 'FFFTP'),
    array("module_coffeecupftp",        0x0000000c, 'CoffeeCup FTP / Sitemapper'),
    array("module_coreftp",             0x0000000d, 'CoreFTP'),
    array("module_ftpexplorer",         0x0000000e, 'FTP Explorer'),
    array("module_frigateftp",          0x0000000f, 'Frigate3 FTP'),
    array("module_securefx",            0x00000010, 'SecureFX'),
    array("module_ultrafxp",            0x00000011, 'UltraFXP'),
    array("module_ftprush",             0x00000012, 'FTPRush'),
    array("module_websitepublisher",    0x00000013, 'WebSitePublisher'),
    array("module_bitkinex",            0x00000014, 'BitKinex'),
    array("module_expandrive",          0x00000015, 'ExpanDrive'),
    array("module_classicftp",          0x00000016, 'ClassicFTP'),
    array("module_fling",               0x00000017, 'Fling'),
    array("module_softx",               0x00000018, 'SoftX'),
    array("module_dopus",               0x00000019, 'Directory Opus'),
    array("module_freeftp",             0x0000001a, 'FreeFTP / DirectFTP'),
    array("module_leapftp",             0x0000001b, 'LeapFTP'),
    array("module_winscp",              0x0000001c, 'WinSCP'),
    array("module_32bitftp",            0x0000001d, '32bit FTP'),
    array("module_netdrive",            0x0000001e, 'NetDrive'),
    array("module_webdrive",            0x0000001f, 'WebDrive'),
```

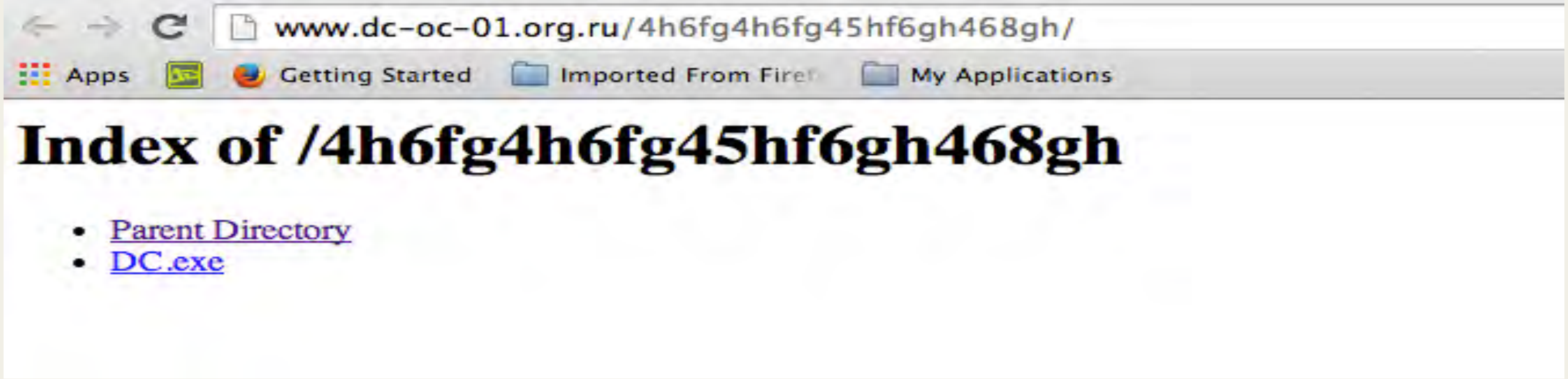


```php
<?php

define('CLOG_SOURCE_GATE', 'gate');
define('CLOG_SOURCE_REPORT', 'report');
define('CLOG_SOURCE_LOGIN', 'login');
define('CPONY_FTP_TABLE', 'pony_ftp');
define('CPONY_REPORT_TABLE', 'pony_report');
define('CPONY_REPORT_DATA_TABLE', 'pony_report_data');
define('CPONY_DOMAIN_TABLE', 'pony_domain');
define('CPONY_LOG_TABLE', 'pony_system_log');
define('CPONY_USER_TABLE', 'pony_user');
define('CPONY_CERT_TABLE', 'pony_cert');
define('CPONY_EMAIL_TABLE', 'pony_email');

class pony_db
{
    public $db_link;
    protected $database;
    public $state;
    public $privileges;
    public $auth_cookie;
    public $user_id;
    public $login;

    function __construct()
    {
        $this->state = true;
        $this->db_link = null;
        $this->privileges = '';
    }

    function connect($host, $user, $pass)
    {
        // establish the connection
        $this->db_link = mysql_connect($host, $user, $pass, true);

        if (!$this->db_link)
        {
            $this->state = false;
            return false;
        }

        return true;
    }

    function select_db($database)
    {
        if (!$this->state)
            return false;

        $select_result = mysql_select_db($database, $this->db_link);

        if (!$select_result)
        {
            $select_result = mysql_query(sprintf('CREATE DATABASE IF NOT EXISTS %s CHARACTER SET cp1251 COLLATE
```

Pony panel on zbot proxy network

-Searching for certain strings leads to several more sites with open panels with some sites hosting other malware payload

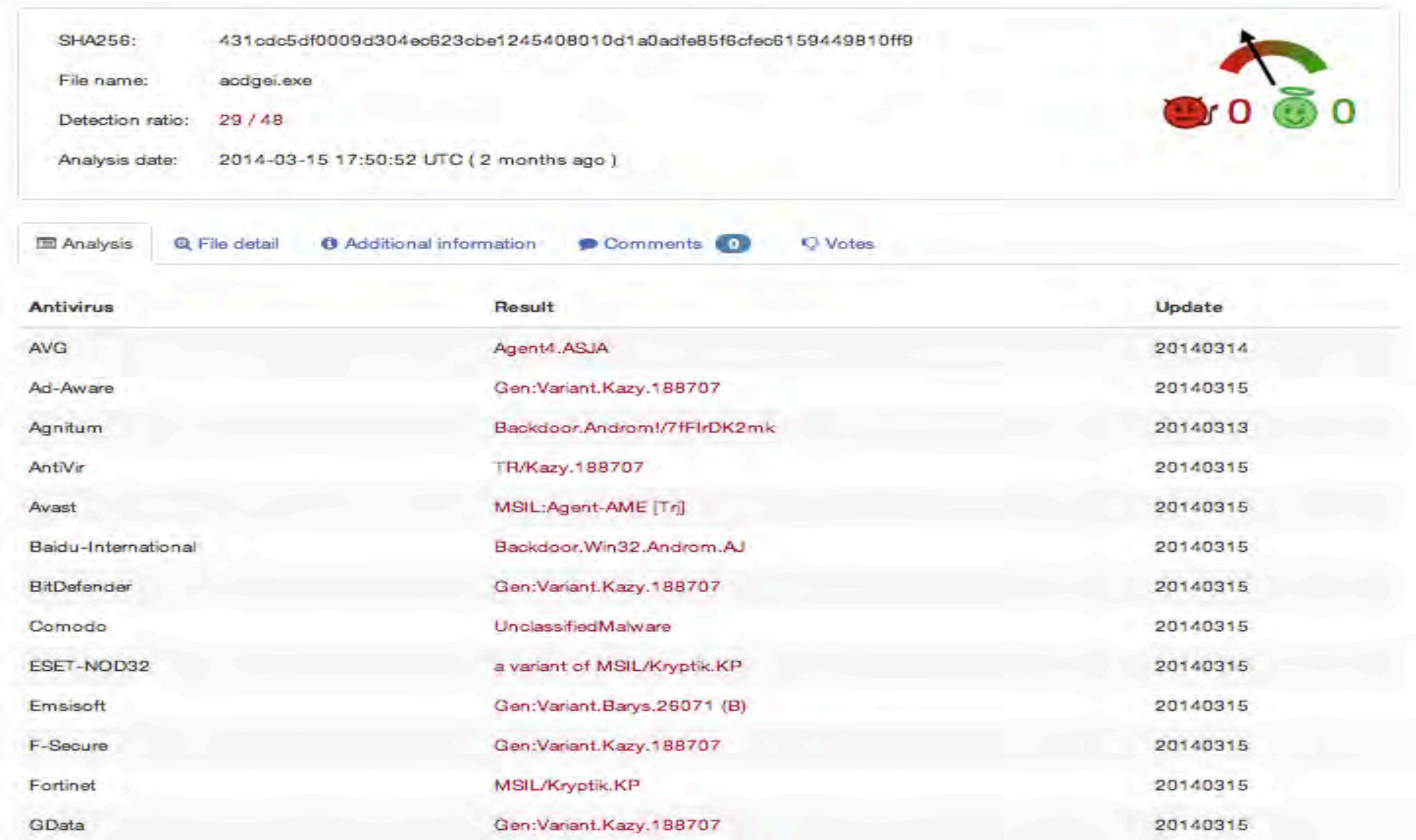
-Example:



Index of /4h6fg4h6fg45hf6gh468gh

- Parent Directory
- DC.exe

Pony panel on zbot proxy network



SHA256: 431cdc5df0009d304ec623cbe1245408010d1a0adfe85f6cfec6159449810ff9

File name: acdgei.exe

Detection ratio: 29 / 48

Analysis date: 2014-03-15 17:50:52 UTC (2 months ago)

Antivirus	Result	Update
AVG	Agent4.ASJA	20140314
Ad-Aware	Gen:Variant.Kazy.188707	20140315
Agnitum	Backdoor.Androm!/7fFIrDK2mk	20140313
AntiVir	TR/Kazy.188707	20140315
Avast	MSIL:Agent-AME [Trj]	20140315
Baidu-International	Backdoor.Win32.Androm.AJ	20140315
BitDefender	Gen:Variant.Kazy.188707	20140315
Comodo	UnclassifiedMalware	20140315
ESET-NOD32	a variant of MSIL/Kryptik.KP	20140315
Emsisoft	Gen:Variant.Barys.26071 (B)	20140315
F-Secure	Gen:Variant.Kazy.188707	20140315
Fortinet	MSIL/Kryptik.KP	20140315
GData	Gen:Variant.Kazy.188707	20140315

Pony panel on zbot proxy network

epvpcash.net16.net/Panel/temp/

hgfhgfhgfhfg.net/pony/temp/

http://pantamati.com/dream/Panel/temp/

http://pantamati.com/wall/Panel/temp/

mastermetr.ru/steal/Panel/temp/

microsoft.blg.lt/q/temp/

santeol.su/p/temp/

terra-araucania.cl/pooo/temp/

thinswares.com/panel/temp/

www.broomeron.com/pn2/temp/

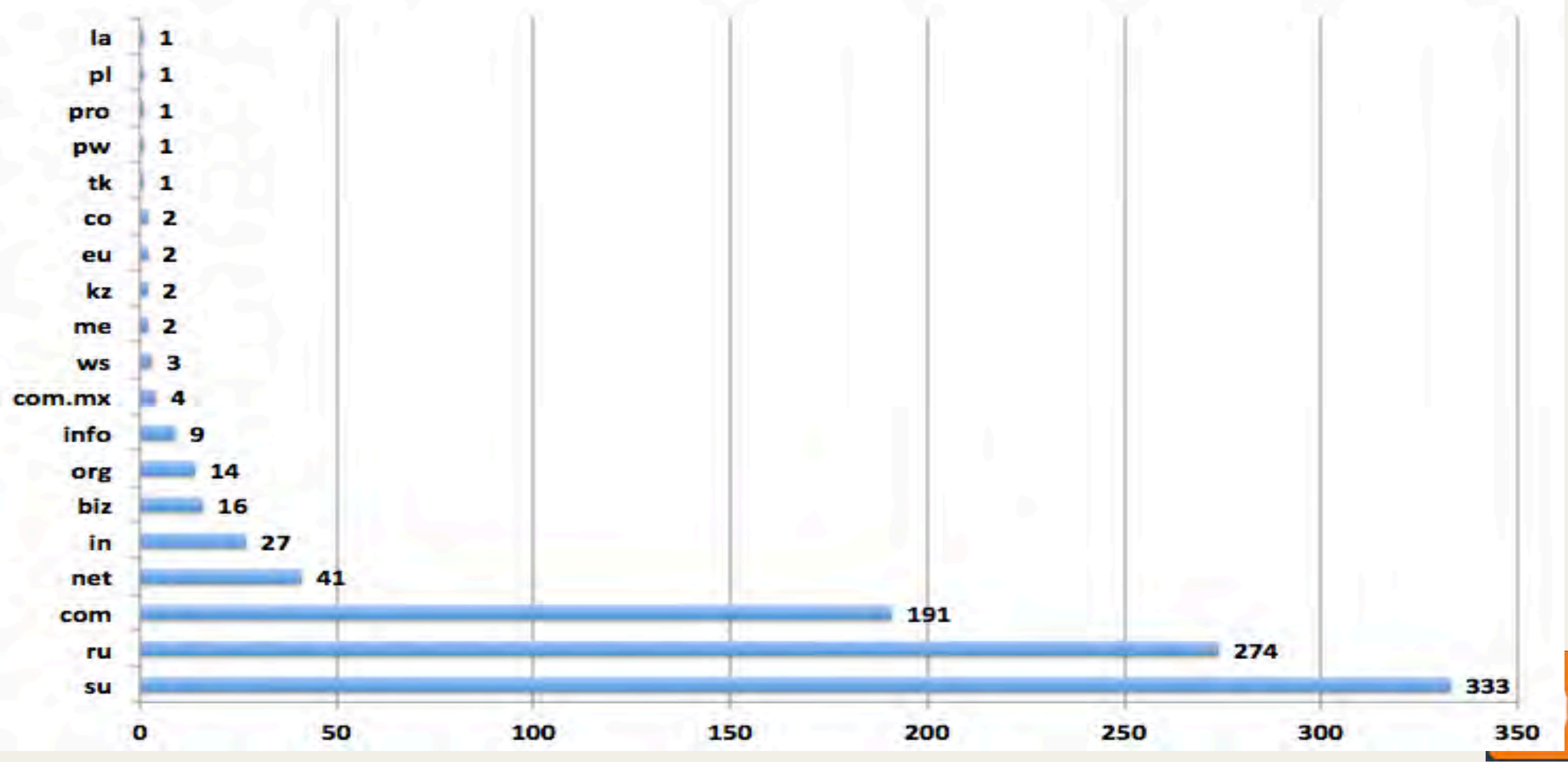
www.kimclo.com/cli/temp/

www.sumdfase2.net/adm/temp/

www.tripplem2.com/images/money/temp/

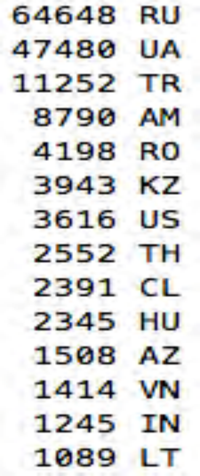
TLD distribution of CnCs

Sample of 925 zbot CnC domains

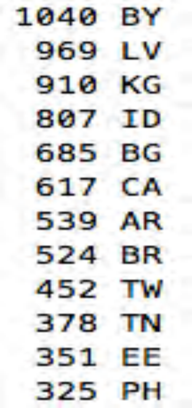


Proxy network hosts geo-distribution

Sample of 170,208 IPs of the zbot proxy network Map

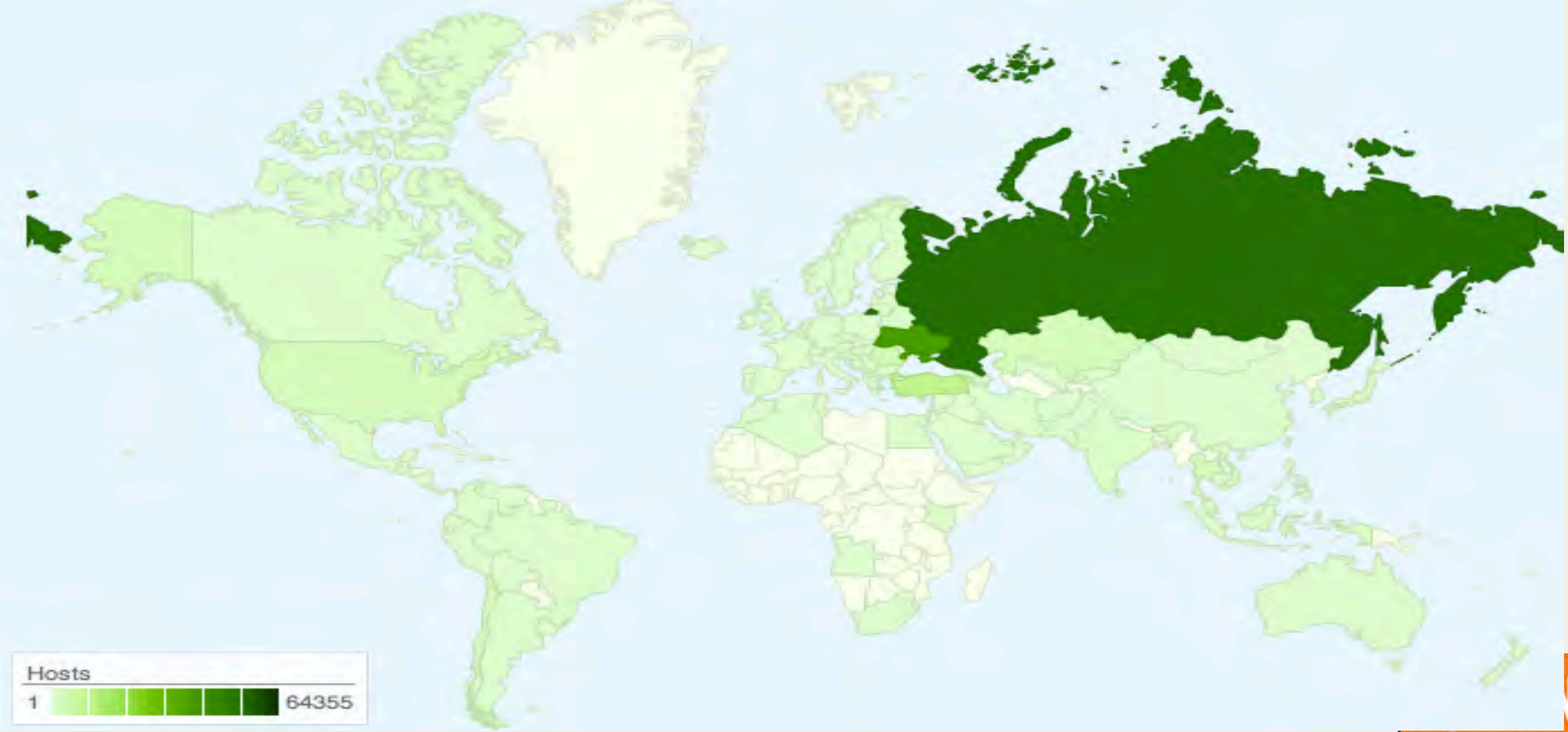


64648	RU
47480	UA
11252	TR
8790	AM
4198	RO
3943	KZ
3616	US
2552	TH
2391	CL
2345	HU
1508	AZ
1414	VN
1245	IN
1089	LT



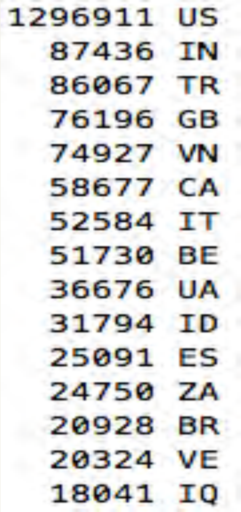
1040	BY
969	LV
910	KG
807	ID
685	BG
617	CA
539	AR
524	BR
452	TW
378	TN
351	EE
325	PH

Proxy network hosts geo-distribution

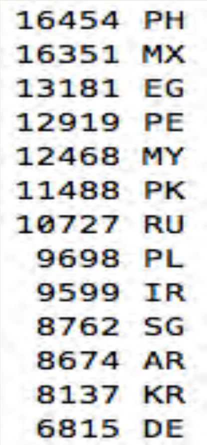


Clients phoning to CnCs

2,220,230 DNS lookups to CnCs over 24 hours Map

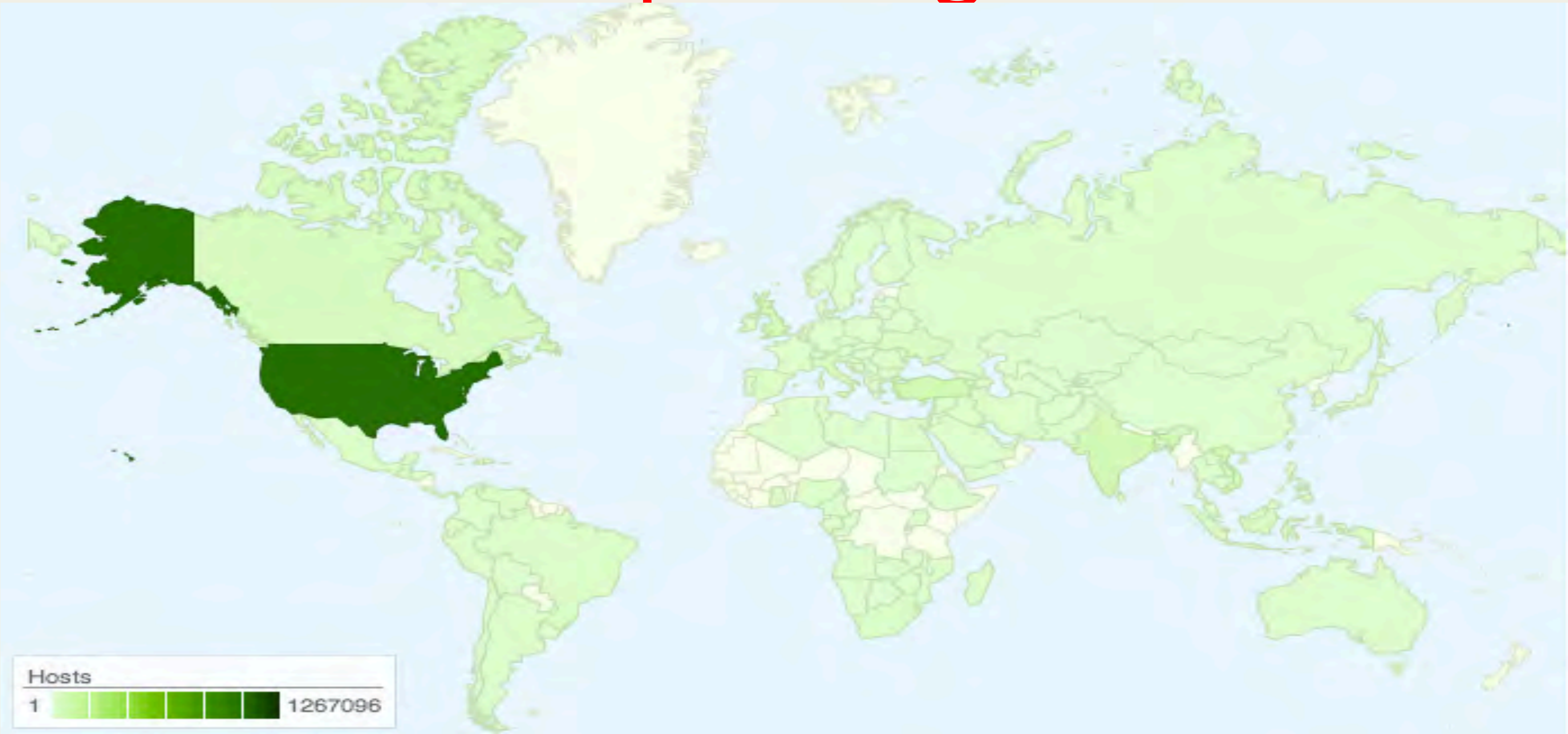


```
1296911 US
  87436 IN
  86067 TR
  76196 GB
  74927 VN
  58677 CA
  52584 IT
  51730 BE
  36676 UA
  31794 ID
  25091 ES
  24750 ZA
  20928 BR
  20324 VE
  18041 IQ
```



```
16454 PH
16351 MX
13181 EG
12919 PE
12468 MY
11488 PK
10727 RU
 9698 PL
 9599 IR
 8762 SG
 8674 AR
 8137 KR
 6815 DE
```

Clients phoning to CnCs



CnC domains and related samples

-Sample of 337 zbot CnC domains

-208 different samples (sha256 communicated with the CnCs)

Top recorded sample names:

Trojan[Spy]/Win32.Zbot

TrojanDownloader:Win32/Upatre

-Upatre is used as a downloader for Zeus GameOver

-Sent as attachment in spam emails delivered by Cutwail botnet

Part 2:

Catching Malware IP style

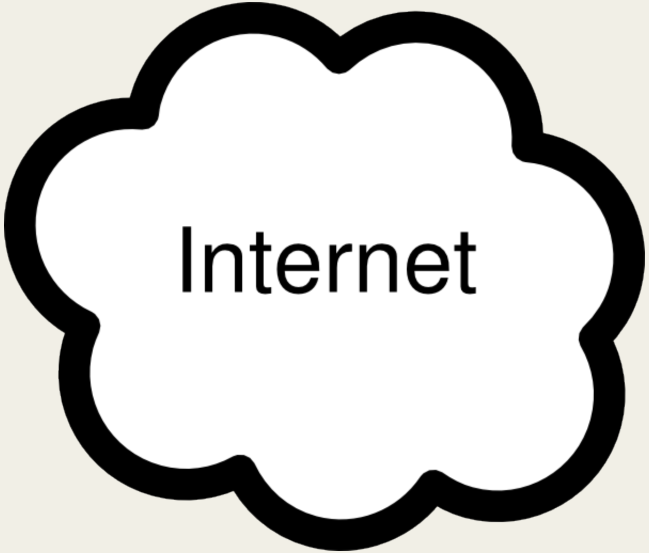
Motivation

- Examine malicious IP ranges in certain ASNs from a new perspective
- Look beyond the simple counting of number of bad domains, bad IPs hosted on prefixes of an ASN

How ?

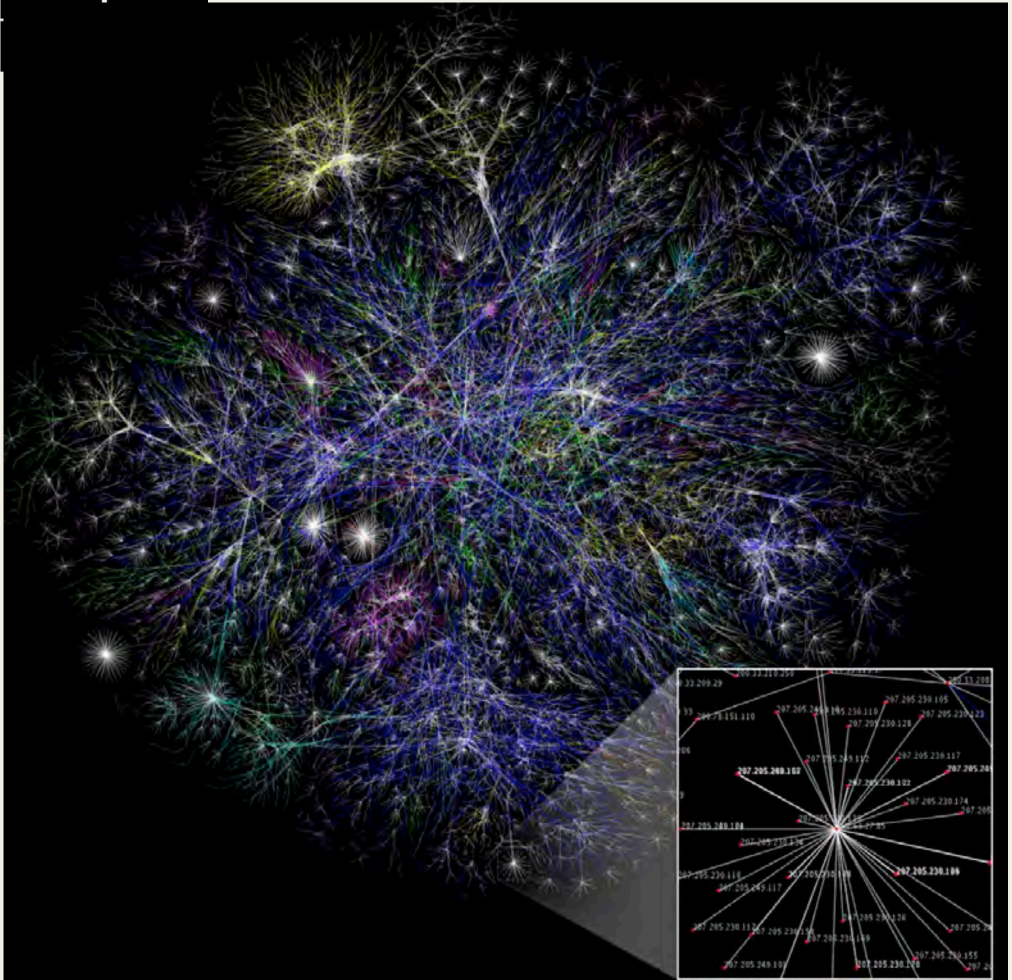
- Look at topology of AS graph
- Look at finer granularity than BGP prefix: sub-allocated ranges within BGP prefixes

Internet 101 & BGP



Internet 101 & BGP

Meet the Internet



Network of Networks, it’s a Graph!

Each organizations on the Internet is called an Autonomous system.

Each dot represents an Autonomous system (AS).

AS is identified by a number. OpenDNS is 36692, Google is 15169.

Each AS has one or more Prefixes. 36692 has 56 (ipv4 and IPv6) network prefixes.

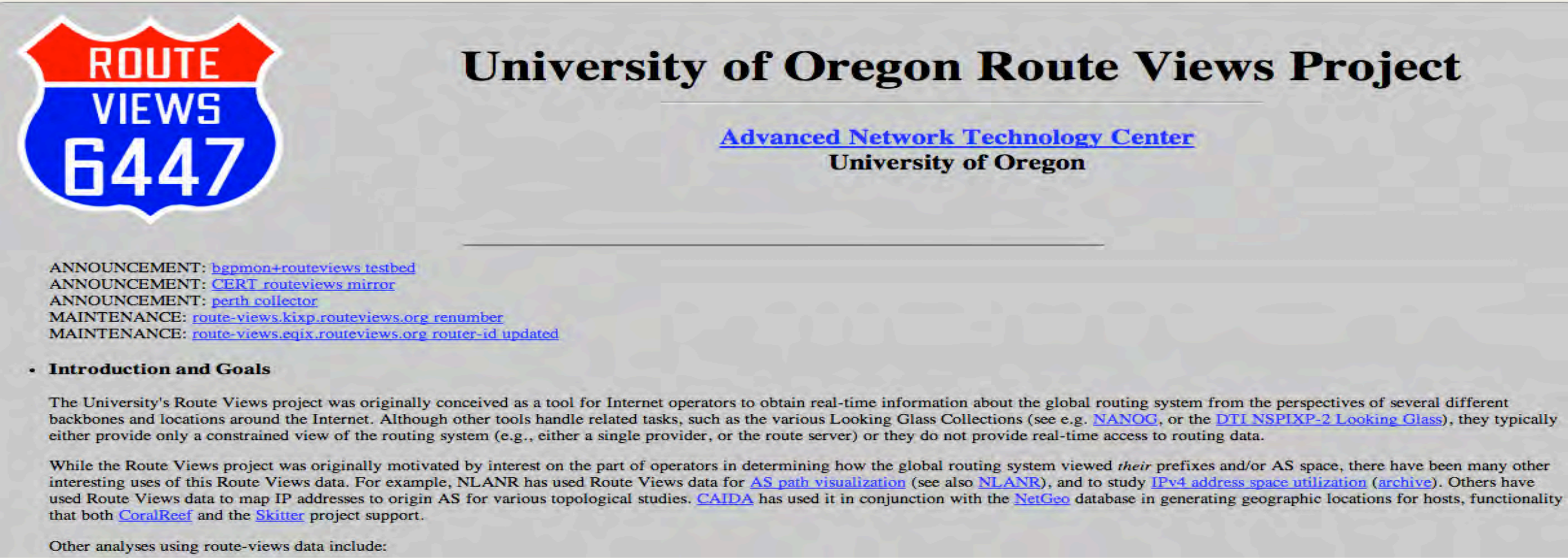
BGP is the glue that makes this work!

AS graph

- BGP routing tables
- Valuable data sources
- Routeviews
- Cidr-report
- Hurricane Electric database http://bgp.he.net/
- **500,000+ BGP prefixes**
- **46,000+ ASNs**

AS graph

- Route Views http://archive.routeviews.org/bgpdata



University of Oregon Route Views Project

Advanced Network Technology Center
University of Oregon

ANNOUNCEMENT: bgpmon+routeviews testbed
ANNOUNCEMENT: CERT routeviews mirror
ANNOUNCEMENT: perth collector
MAINTENANCE: route-views.kixp.routeviews.org renumber
MAINTENANCE: route-views.eqix.routeviews.org router-id updated

- **Introduction and Goals**

The University's Route Views project was originally conceived as a tool for Internet operators to obtain real-time information about the global routing system from the perspectives of several different backbones and locations around the Internet. Although other tools handle related tasks, such as the various Looking Glass Collections (see e.g. NANOG, or the DTI NSPIXP-2 Looking Glass), they typically either provide only a constrained view of the routing system (e.g., either a single provider, or the route server) or they do not provide real-time access to routing data.

While the Route Views project was originally motivated by interest on the part of operators in determining how the global routing system viewed *their* prefixes and/or AS space, there have been many other interesting uses of this Route Views data. For example, NLANR has used Route Views data for AS path visualization (see also NLANR), and to study IPv4 address space utilization (archive). Others have used Route Views data to map IP addresses to origin AS for various topological studies. CAIDA has used it in conjunction with the NetGeo database in generating geographic locations for hosts, functionality that both CoralReef and the Skitter project support.

Other analyses using route-views data include:

AS graph

- Cidr Report http://www.cidr-report.org/as2.0/

Original Concept: Tony Bates, Revised by: Philip Smith, Further Revised: Geoff Huston

IPv6 CIDR Report: www.cidr-report/v6

CIDR REPORT for 23 Feb 14

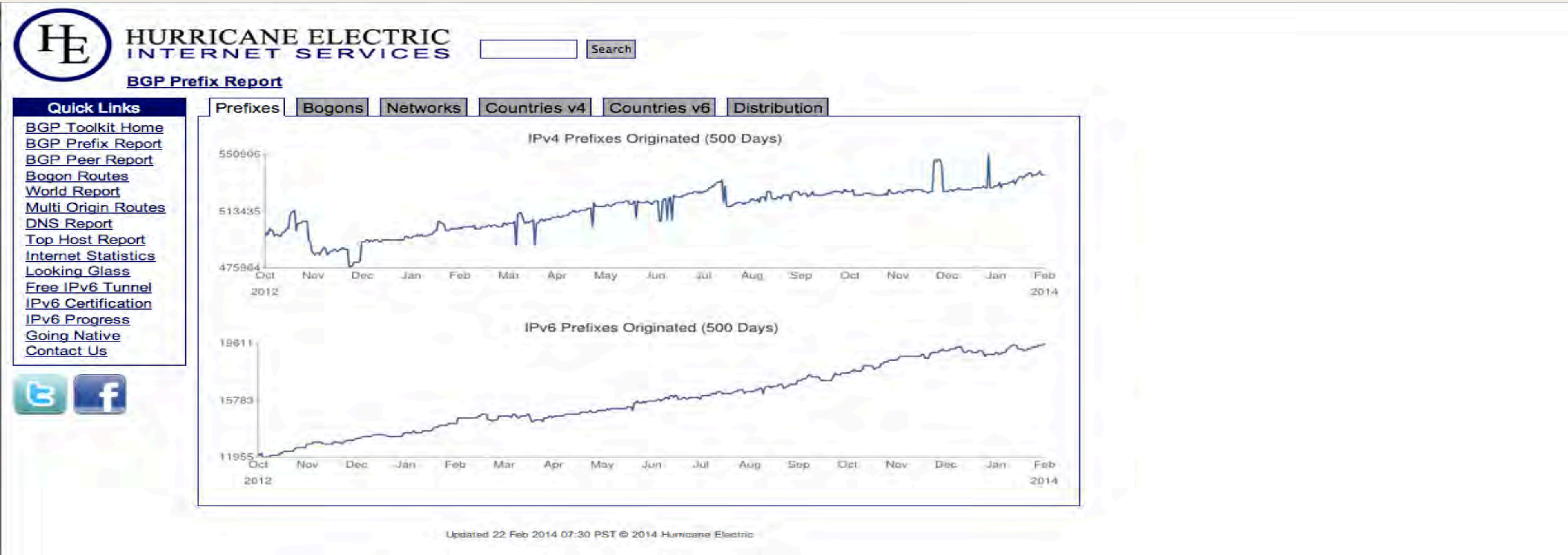
This report was generated at Sun Feb 23 06:14:14 2014 AEST.

Report Sections:

Status Summary

AS graph

- Hurricane Electric database http://bgp.he.net/



HURRICANE ELECTRIC
INTERNET SERVICES

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BGP Prefix Report

Quick Links

- BGP Toolkit Home
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- Looking Glass
- Free IPv6 Tunnel
- IPv6 Certification
- IPv6 Progress
- Going Native
- Contact Us

Prefixes | Bogons | Networks | Countries v4 | Countries v6 | Distribution

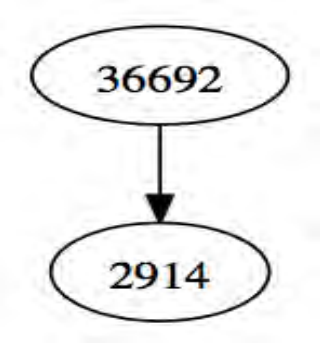
IPv4 Prefixes Originated (500 Days)

IPv6 Prefixes Originated (500 Days)

Updated 22 Feb 2014 07:30 PST © 2014 Hurricane Electric

AS graph

- Build AS graph
- Directed graph: node=ASN, a directed edge from an ASN to an upstream ASN
- TABLE_DUMP2|1392422403|B|96.4.0.55|11686|67.215.94.0/24|11686 4436 2914 36692|IGP|96.4.0.55|0|0||NAG||



AS graph

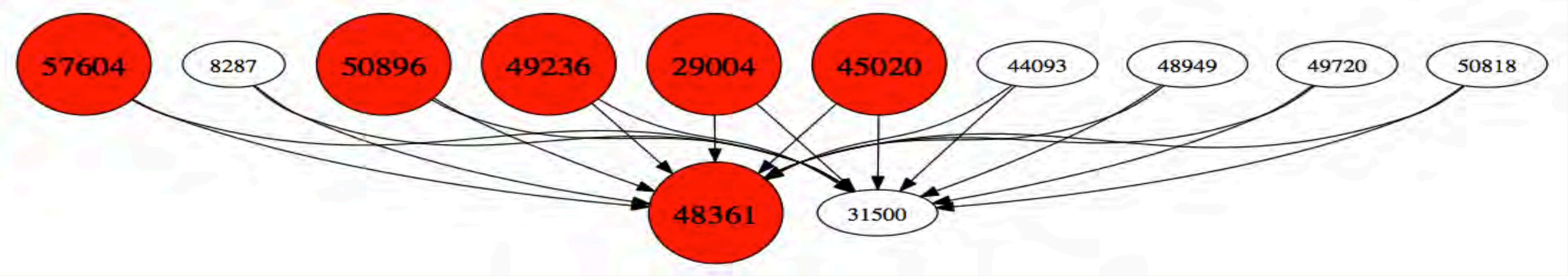
Focus of this study:

- Peripheral ASNs that are siblings, i.e. they have common parents in the AS graph (share same upstream AS)
- Cluster peripheral ASNs by country
- Find interesting patterns: certain siblings in certain countries are delivering similar suspicious campaigns

Use Case 1:
Suspicious Sibling Peripheral ASNs

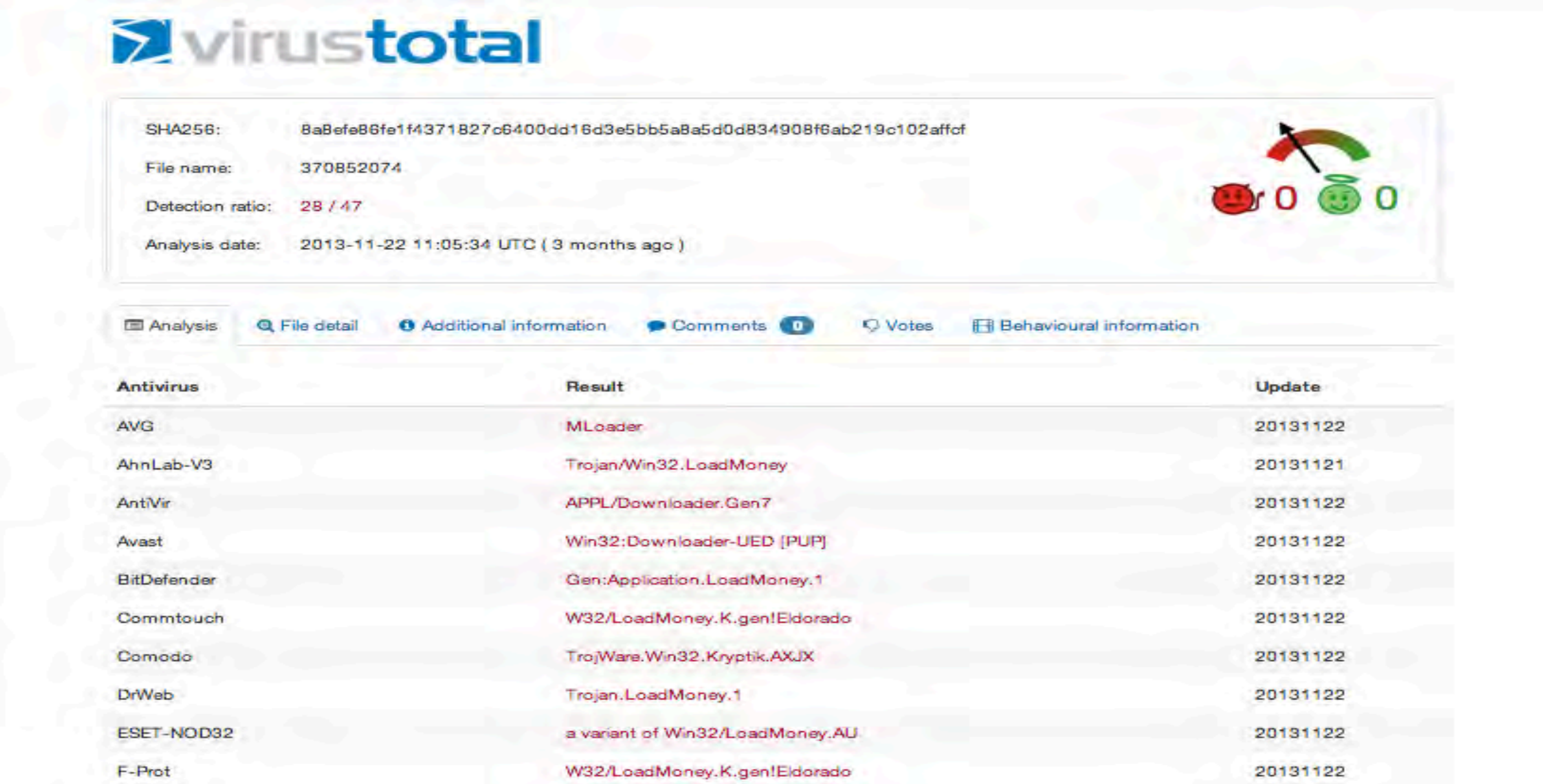
Peripheral ASNs and their upstreams

- January 8th topology snapshot, Ukraine, Russia



- 10 sibling peripheral ASNs with 2 upstream ASNs
- /23 or /24 serving TrojWare.Win32.Kryptik.AXJX
- Trojan-Downloader.Win32.Ldmon.A-08

Peripheral ASNs and their upstreams



SHA256: 8a8efe86fe1f4371827c6400dd16d3e5bb5a8a5d0d834908f6ab219c102affcf

File name: 370852074

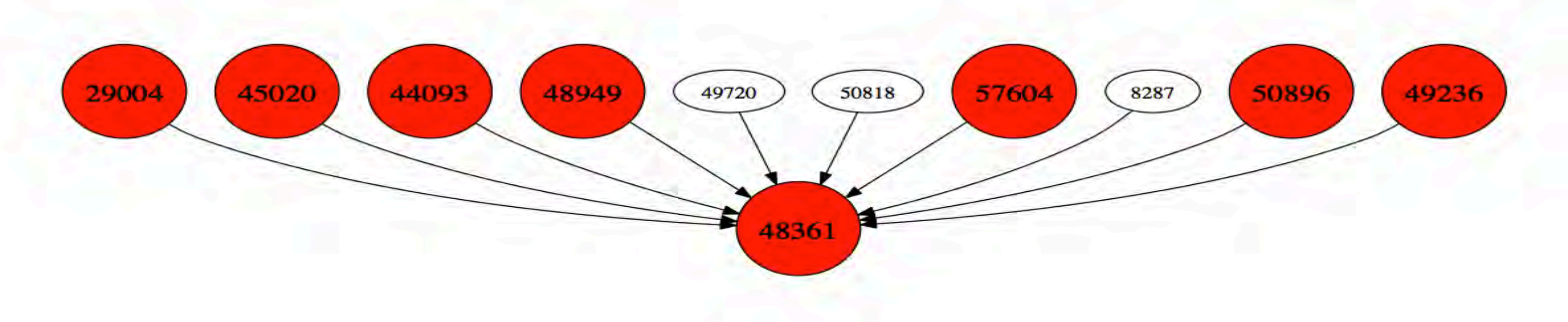
Detection ratio: 28 / 47

Analysis date: 2013-11-22 11:05:34 UTC (3 months ago)

Antivirus	Result	Update
AVG	MLoader	20131122
AhnLab-V3	Trojan/Win32.LoadMoney	20131121
AntiVir	APPL/Downloader.Gen7	20131122
Avast	Win32:Downloader-UED [PUP]	20131122
BitDefender	Gen:Application.LoadMoney.1	20131122
Commtouch	W32/LoadMoney.K.gen!Eldorado	20131122
Comodo	TrojWare.Win32.Kryptik.AXJX	20131122
DrWeb	Trojan.LoadMoney.1	20131122
ESET-NOD32	a variant of Win32/LoadMoney.AU	20131122
F-Prot	W32/LoadMoney.K.gen!Eldorado	20131122

Peripheral ASNs and their upstreams

- February 21st topology snapshot, Ukraine, Russia



- AS31500 detached itself from the peripheral ASNs (stopped announcing their prefixes)
- More peripherals started hosting suspicious payload domains
- 3100+ malware domains on 1020+ IPs hosting malware

Peripheral ASNs and their upstreams

- Taking a sample of 160 live IPs
- Server setup is similar:

50 IPs with:

```
22/tcp   open  ssh        OpenSSH 6.2_hpn13v11 (FreeBSD 20130515; protocol 2.0)
8080/tcp open  http-proxy 3Proxy http proxy
Service Info: OS: FreeBSD
```

108 IPs with:

```
22/tcp open  ssh     OpenSSH 5.3 (protocol 1.99)
80/tcp open  http?
```

Peripheral ASNs and their upstreams

- The payload url were live on the entire range of IPs before any domains were hosted on them
- Seems the IP infrastructure is set up in bulk and in advance
- http://pastebin.com/X83gkPY4

Use Case 2:
Detecting Sibling ASNs through BGP outages

BGP messages

Two important BGP message types:

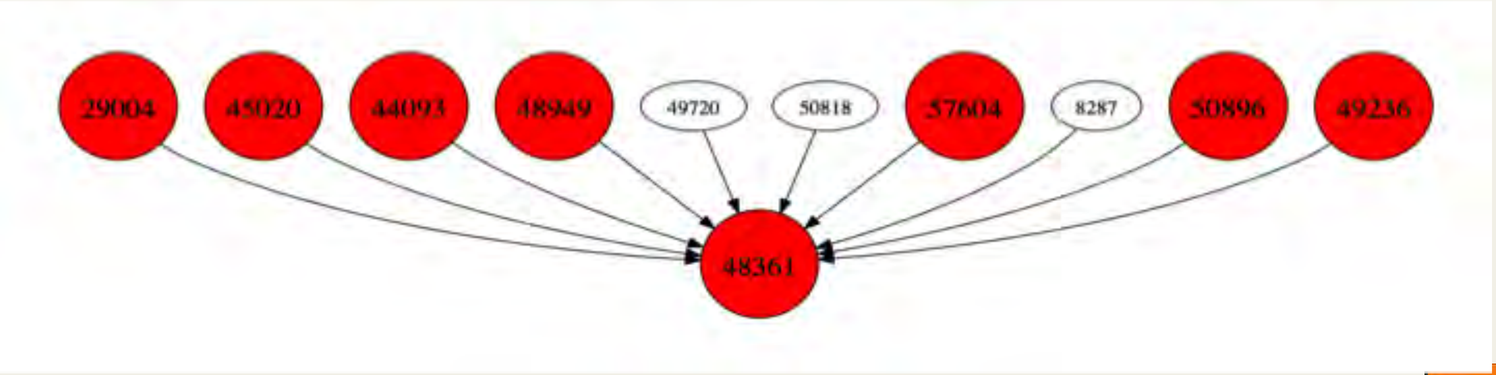
1. Update messages to announce a new path for a one or more prefixes

2. Withdrawal messages to inform BGP speakers that a certain prefix can no longer be reached.

By correlating these messages we can detect outages globally and in real time

Sibling ASNs

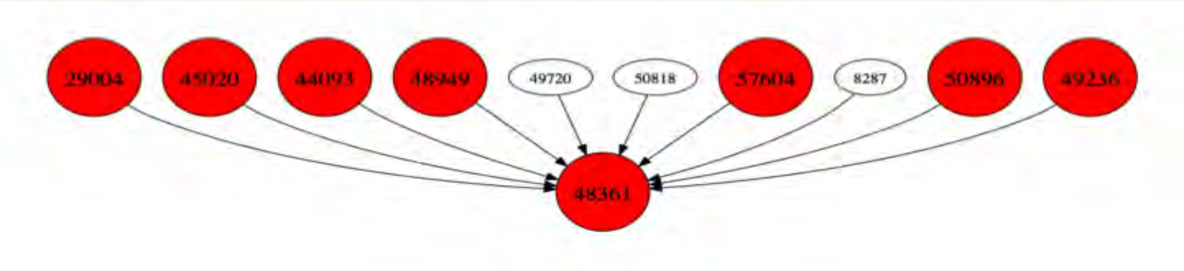
All hosting same malware



Overlapping BGP outages

	57604	8287	50896	49236	29004	45020	44093	48949	49720	50818	48361
57604x		20	17	12	22	16	11	24	20	13	5
8287	20x		41	15	17	17	15	18	18	15	5
50896	17	41x		17	16	17	18	19	16	18	7
49236	12	15	17x		8	15	13	8	12	17	3
29004	22	17	16	8x		12	22	28	18	9	6
45020	16	17	17	15	12x		12	12	12	15	4
44093	11	15	18	13	22	12x		16	10	13	6
48949	24	18	19	8	28	12	16x		20	9	8
49720	20	18	16	12	18	12	10	20x		10	4
50818	13	15	18	17	9	15	13	9	10x		4
48361	5	5	7	3	6	4	6	8	4	4x	

Overlapping BGP outages



	57604	**29004**	48361
57604		**22**	5
29004	**22**		6
48361	5	6	

Overlapping outages

ISP 48361	AS57604 91.233.89.0/24	AS29004 195.39.252.0/23
no outage	down for 35 minutes 2013-07-12 18:53 - 2013-07-12 19:28	down for 36 minutes 2013-07-12 18:53 - 2013-07-12 19:29
no outage	down for 497 minutes 2013-07-12 21:33 - 2013-07-13 05:50	down for 497 minutes 2013-07-12 21:33 - 2013-07-13 05:50
no outage	down for 479 minutes 2013-07-22 21:57 - 2013-07-23 05:56	down for 479 minutes 2013-07-22 21:57 - 2013-07-23 05:56
no outage	down for 33 minutes 2013-07-23 18:51 - 2013-07-23 19:24	down for 33 minutes 2013-07-23 18:51 - 2013-07-23 19:24
no outage	down for 63 minutes 2013-07-29 04:54 - 2013-07-29 05:57	down for 63 minutes 2013-07-29 04:54 - 2013-07-29 05:57

- Unique approach for finding related ASNs

- Overlapping outages could mean
  - Most likely relying on same infrastructure
  - Same Data center
  - Same Routing / Switching infrastructure
  - Same organization hiding behind different ASns

Use case 3:
Malicious sub-allocated ranges

Malicious sub-allocated ranges

- Case of OVH

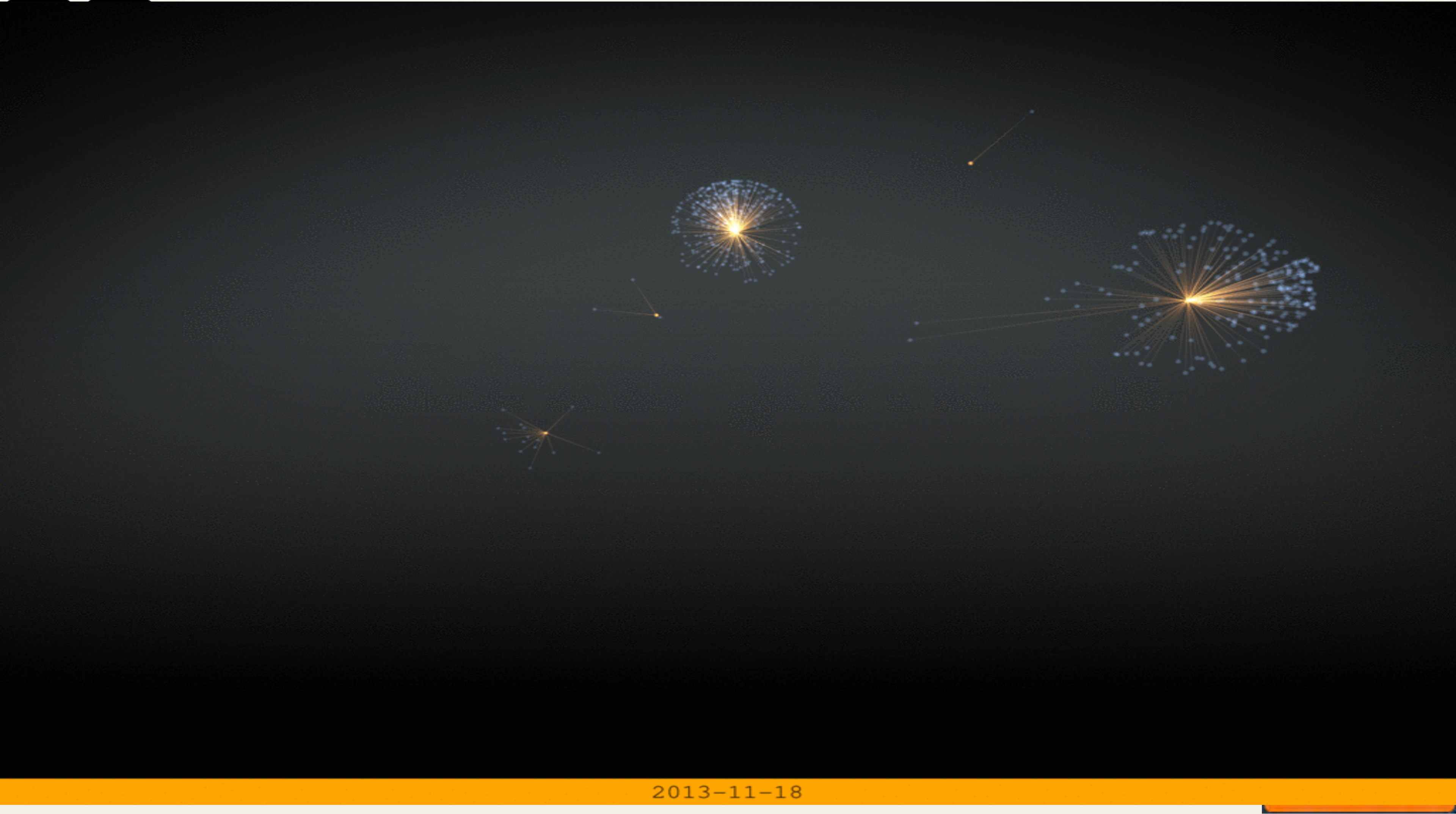
OVH.COM

- Sub-allocated ranges reserved by same suspicious customers, serving Nuclear Exploit kit domains
- Users are lead to the Exploit landing sites through malvertising campaigns, then malware is dropped on victims’ machines (e.g. zbot)
- Monitoring patterns for 5 months (Oct 2013-Feb 2014)

Nuclear Pack v2.0

Malicious sub-allocated ranges

- For several months, OVH ranges have been abused
- Notable fact: IPs were exclusively used for hosting Nuclear Exploit subdomains, no other sites hosted



2013-11-18

Malicious sub-allocated ranges

- Some OVH sub-allocated ranges used in Jan-Feb 2014 (now re-assigned)

192.95.50.208 - 192.95.50.215

198.50.183.68 - 198.50.183.71

192.95.42.112 - 192.95.42.127

192.95.6.112 - 192.95.6.127

192.95.10.208 - 192.95.10.223

192.95.7.224 - 192.95.7.239

192.95.43.160 - 192.95.43.175

192.95.43.176 - 192.95.43.191

198.50.131.0 - 198.50.131.15

Malicious sub-allocated ranges

- Feb 7th, bad actors moved to a Ukrainian hosting provider http://www.besthosting.ua/
- 31.41.221.143 2014-02-14 2014-02-14 0
- 31.41.221.142 2014-02-12 2014-02-14 2
- 31.41.221.130 2014-02-12 2014-02-14 2
- 31.41.221.140 2014-02-12 2014-02-12 0
- 31.41.221.139 2014-02-12 2014-02-12 0
- 31.41.221.138 2014-02-11 2014-02-12 1
- 31.41.221.137 2014-02-10 2014-02-11 1
- 31.41.221.136 2014-02-10 2014-02-11 1
- 31.41.221.135 2014-02-10 2014-02-10 0
- 31.41.221.134 2014-02-09 2014-02-19 10
- 31.41.221.132 2014-02-08 2014-02-09 1
- 31.41.221.131 2014-02-07 2014-02-08 1

Malicious sub-allocated ranges

- Feb 14th, bad actors moved to a Russian hosting provider http://pinspb.ru/
- 5.101.173.10 2014-02-21 2014-02-22 1
- 5.101.173.9 2014-02-19 2014-02-21 2
- 5.101.173.8 2014-02-19 2014-02-19 0
- 5.101.173.7 2014-02-18 2014-02-19 1
- 5.101.173.6 2014-02-18 2014-02-18 0
- 5.101.173.5 2014-02-17 2014-02-18 1
- 5.101.173.4 2014-02-17 2014-02-17 0
- 5.101.173.3 2014-02-16 2014-02-17 1
- 5.101.173.2 2014-02-15 2014-02-16 1
- 5.101.173.1 2014-02-14 2014-02-15 1

Malicious sub-allocated ranges

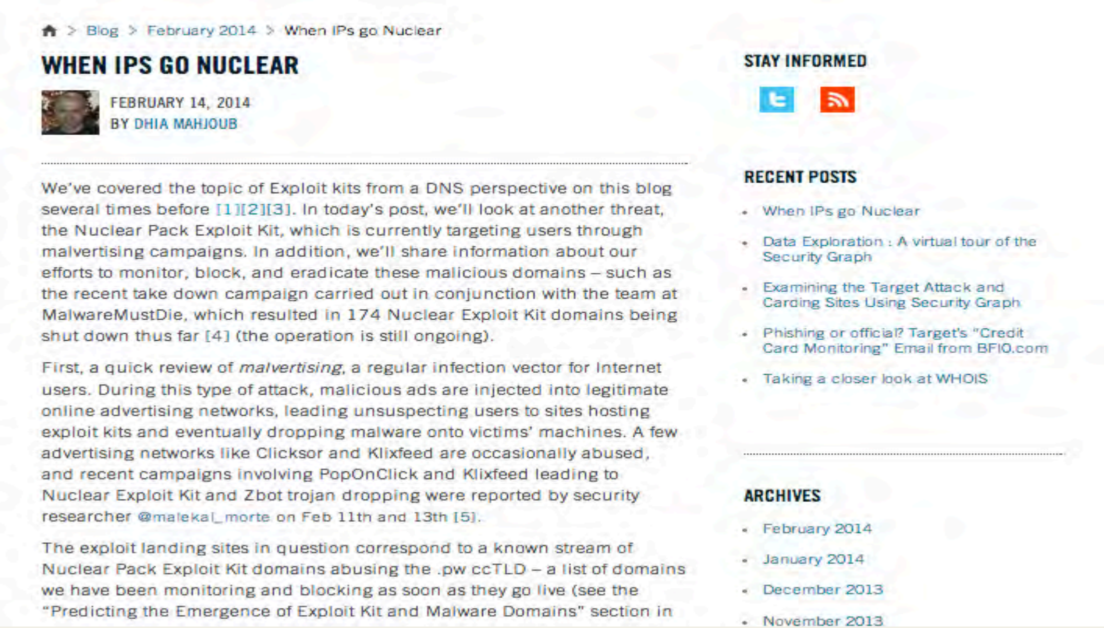
- Feb 22nd, bad actors moved back to OVH
- Notable fact: They change MO, IPs have been allocated and used in the past for other content -> evasion technique or resource recycling
- But during all this time, bad actors still kept the name server infrastructure on OVH on ranges reserved by same customers

Malicious sub-allocated ranges

- **198.50.143.73 2013-11-25 2014-02-24 91**
- **198.50.143.69 2013-11-25 2014-02-24 91**
- **198.50.143.68 2013-11-25 2014-02-24 91**
- **198.50.143.67 2013-11-26 2014-02-24 90**
- **198.50.143.65 2013-11-24 2014-02-23 91**
- **198.50.143.66 2013-11-25 2014-02-23 90**
- 198.50.143.64 2013-11-24 2014-01-25 62
- 198.50.143.75 2013-12-03 2013-12-10 7
- 198.50.143.79 2013-11-25 2013-12-10 15
- 198.50.143.78 2013-11-25 2013-12-10 15
- 198.50.143.74 2013-11-25 2013-12-10 15
- 198.50.143.72 2013-11-25 2013-12-10 15
- 198.50.143.71 2013-11-25 2013-12-10 15
- 198.50.143.76 2013-11-25 2013-12-09 14
- 198.50.143.70 2013-11-26 2013-12-09 13
- 198.50.143.77 2013-11-26 2013-12-05 9

Malicious sub-allocated ranges

- http://labs.umbrella.com/2014/02/14/when-ips-go-nuclear/
- Take down operations of domains



> Blog > February 2014 > When IPs go Nuclear

WHEN IPS GO NUCLEAR

FEBRUARY 14, 2014
BY DHIA MAHJOUB

We've covered the topic of Exploit kits from a DNS perspective on this blog several times before [1][2][3]. In today's post, we'll look at another threat, the Nuclear Pack Exploit Kit, which is currently targeting users through malvertising campaigns. In addition, we'll share information about our efforts to monitor, block, and eradicate these malicious domains – such as the recent take down campaign carried out in conjunction with the team at MalwareMustDie, which resulted in 174 Nuclear Exploit Kit domains being shut down thus far [4] (the operation is still ongoing).

First, a quick review of *malvertising*, a regular infection vector for Internet users. During this type of attack, malicious ads are injected into legitimate online advertising networks, leading unsuspecting users to sites hosting exploit kits and eventually dropping malware onto victims' machines. A few advertising networks like Clicksor and Klixfeed are occasionally abused, and recent campaigns involving PopOnClick and Klixfeed leading to Nuclear Exploit Kit and Zbot trojan dropping were reported by security researcher @malekal_morte on Feb 11th and 13th [5].

The exploit landing sites in question correspond to a known stream of Nuclear Pack Exploit Kit domains abusing the .pw ccTLD – a list of domains we have been monitoring and blocking as soon as they go live (see the "Predicting the Emergence of Exploit Kit and Malware Domains" section in

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- Taking a closer look at WHOIS

ARCHIVES

- February 2014
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Predicting malicious domains IP infrastructure

Tracking reserved ranges

- Reserved ranges on OVH by same malicious customer
- Dec 1st to 31st 2013: **28 ranges, 136 IPs, 86 used**
- Jan 1st to 31st 2014: **11 ranges, 80 IPs, 33 used**
- Feb 1st to 28th 2014: **4 ranges, 28 IPs, 26 used**
- Mar 1st to 20th 2014: **43 ranges,**
  - **40 ranges** on Mar 7th , **352 IPs, 208 used**
  - **3 ranges** on Mar 10th , **12 IPs, 7 used**
- Used for Nuclear EK domains, Nuclear domains’ name servers, and browlock

Tracking reserved ranges

- 86 ranges are all in these prefixes

388	198.50.128.0/17
128	192.95.0.0/18
80	198.27.64.0/18
12	142.4.192.0/19

Malicious sub-allocated ranges

- For Nuclear, In addition to sub-allocated ranges reserved by same actors (for OVH case)
- The live IPs all have same server setup (fingerprint):
- 31.41.221.131 to 31.41.221.143

```
22/tcp  open  ssh     OpenSSH 5.5p1 Debian 6+squeeze4 (protocol 2.0)
80/tcp  open  http    nginx web server 0.7.67
111/tcp open  rpcbind
```

- 5.101.173.1 to 5.101.173.10

```
22/tcp  open  ssh     OpenSSH 6.0p1 Debian 4 (protocol 2.0)
80/tcp  open  http    nginx web server 1.2.1
111/tcp open  rpcbind
```

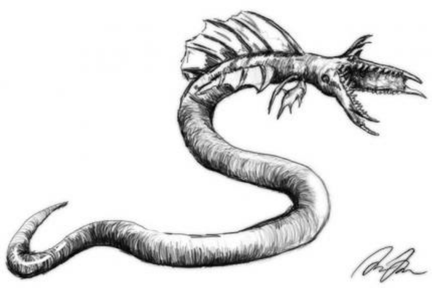
Malicious sub-allocated ranges

- 198.50.143.64 to 198.50.143.79

```
22/tcp  open     ssh        OpenSSH 5.5p1 Debian 6+squeeze4 (protocol 2.0)
80/tcp  open     http        nginx web server 0.7.67
445/tcp filtered microsoft-ds
```

- In some cases, IPs are brought online in small chunks
- The name server IPs also have the same fingerprint
- The combination of these different indicators has made predictions practically always accurate for several months, until bad actors change to a different MO
- Method still efficient when applied to other threats
- -> One can **block/monitor** IPs **before they** even **start hosting** domains

Detecting Malicious Subdomains under Compromised domains



Malicious subdomains under compromised domains

- Detecting malicious subdomains injected under compromised domains, most notably GoDaddy domains
- Subdomains serving Exploit kits (e.g. Nuclear, Angler, FlashPack), browlock, malvertising
- Various payloads dropped (e.g. zbot variants, kuluoz)
- Monitoring patterns for 5+ months (Feb 2014-present)

Malicious subdomains under compromised domains

- Sample of several hundred IPs hosting malicious subdomains
- Top 5 abused ASNs
  - 16276 OVH SAS
  - 24961 myLoc managed IT AG
  - 15003 Nobis Technology Group, LLC
  - 41853 LLC NTCOM
  - 20473 Choopa, LLC

Malicious subdomains under compromised domains

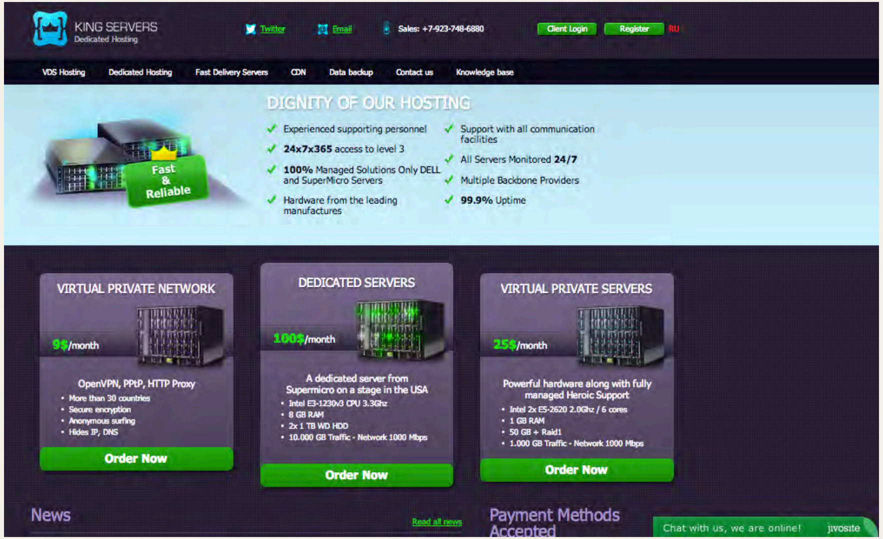
- OVH most abused with 18% of total collected malicious IPs
- Bad actors shifted MO since Use Case 3 study

Malicious subdomains under compromised domains

Before	Now
Abuse ccTLDs (e.g. .pw, .in.net, .ru, etc) using rogue/victim resellers/registrars	Supplement with abusing compromised domains
Use reserved IPs exclusively for Exploit kit, browlock attacks	Supplement with using recycled IPs that hosted legit content in the past
Bring attack IPs online in contiguous chunks	Supplement with bringing IPs up in randomized sets or one at a time
Abuse OVH Canada: possible to predictively correlate rogue customers with attack IPs through ARIN rwhois	Abuse OVH Europe spanning numerous countries' IP pools (e.g. France, Belgium, Italy, UK, Ireland, Spain, Portugal, Germany, Netherlands, Finland, Czech, Russia)

Small abused or rogue hosting providers

- http://king-servers.com/en/ hosted Angler, Styx, porn, pharma
- Described on WOT “offers bulletproof hosting for Russian-Ukrainian criminals”



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- Hides IP, DNS

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- Intel E3-1230v3 CPU 3.3Ghz
- 8 GB RAM
- 2x 1 TB WD HDD
- 10.000 GB Traffic - Network 1000 Mbps

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- 1 GB RAM
- 50 GB + Raid1
- 1.000 GB Traffic - Network 1000 Mbps

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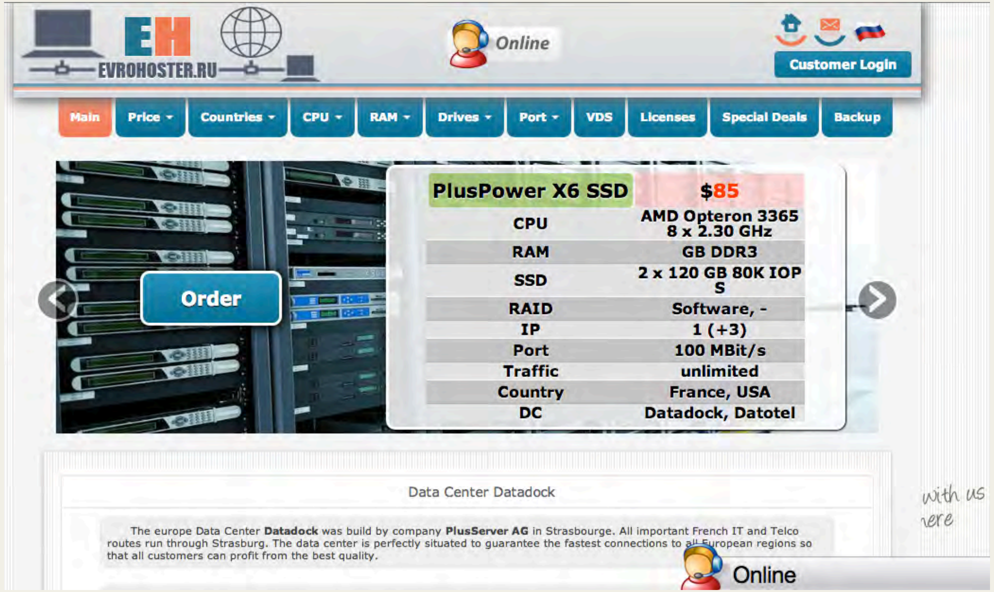
Small abused or rogue hosting providers

- http://evrohoster.ru/en/ hosted browlock through redirections from porn sites



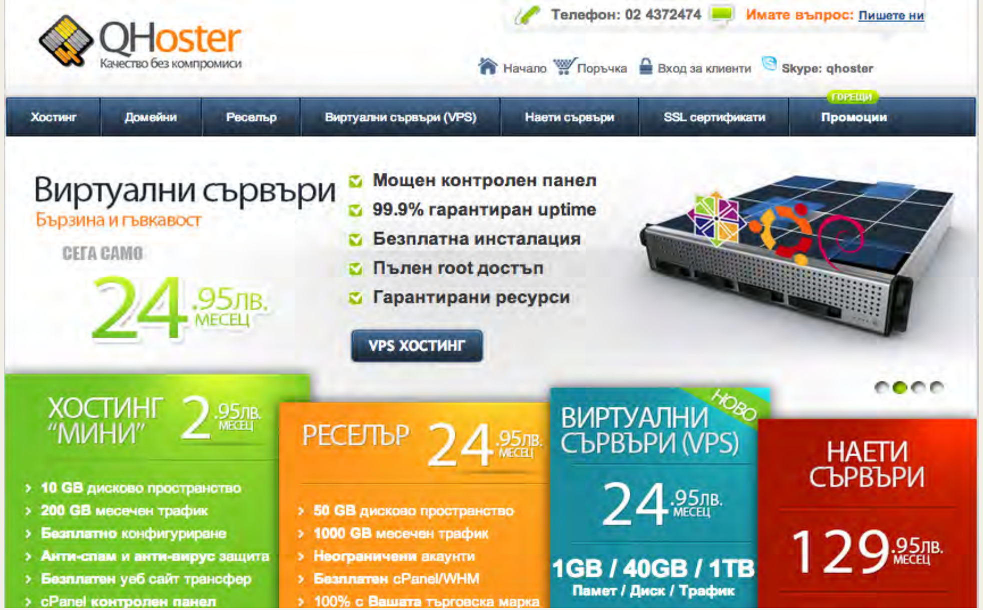
PlusPower X6 SSD	$85
CPU	AMD Opteron 3365 8 x 2.30 GHz
RAM	GB DDR3
SSD	2 x 120 GB 80K IOP S
RAID	Software, -
IP	1 (+3)
Port	100 MBit/s
Traffic	unlimited
Country	France, USA
DC	Datadock, Datotel

Data Center Datadock

The europe Data Center **Datadock** was build by company **PlusServer AG** in Strasbourge. All important French IT and Telco routes run through Strasburg. The data center is perfectly situated to guarantee the fastest connections to all European regions so that all customers can profit from the best quality.

Small abused or rogue hosting providers

- http://www.qhoster.bg/ hosted Nuclear



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- Гарантирани ресурси

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- Анти-спам и анти-вирус защита
- Безплатен уеб сайт трансфер
- cPanel контролен панел

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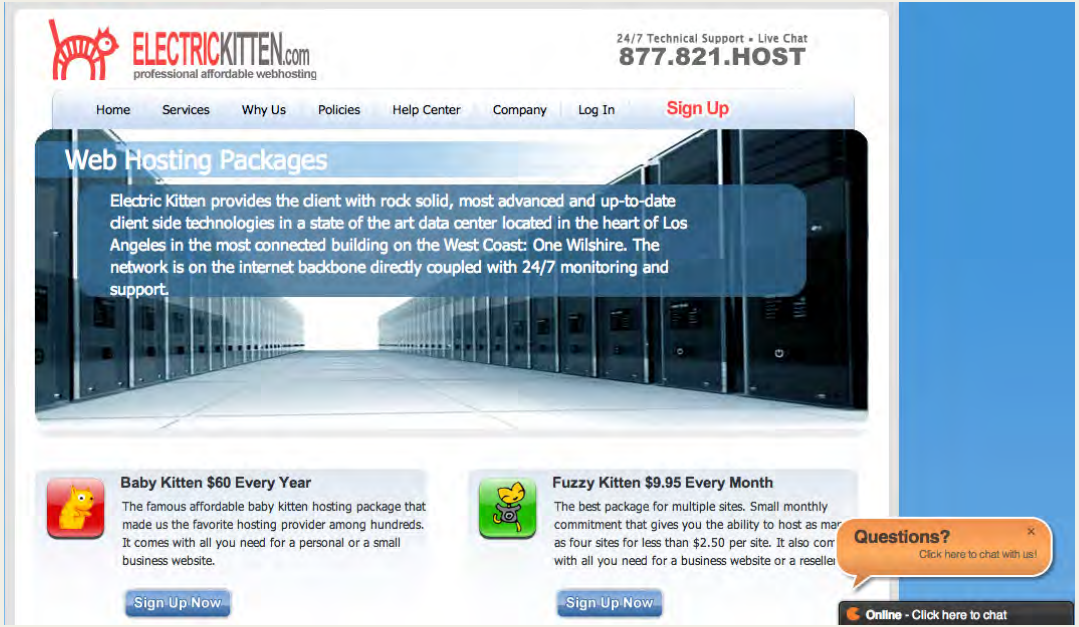
НАЕТИ СЪРВЪРИ 129.95лв. МЕСЕЦ

Small abused or rogue hosting providers

- http://www.electrickitten.com/web-hosting/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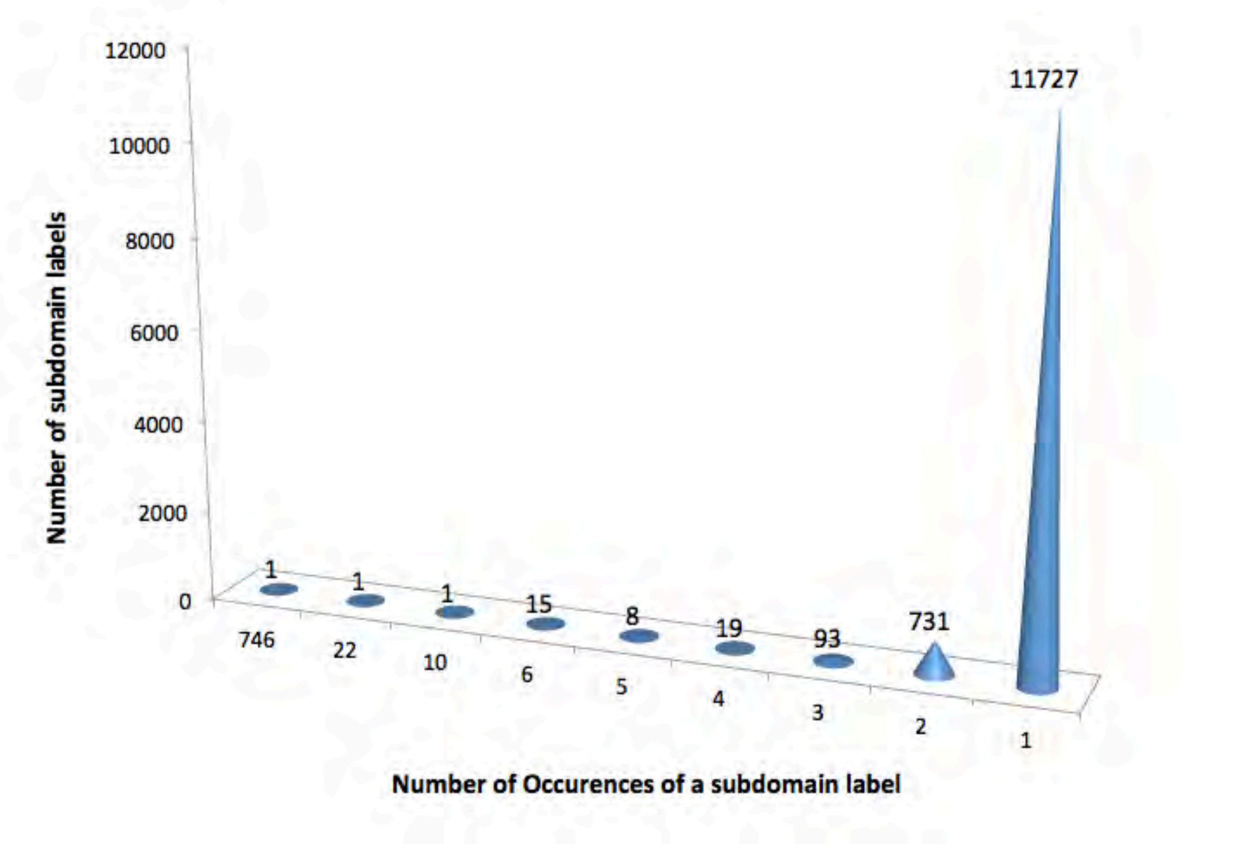
Small abused or rogue hosting providers

- http://www.xlhost.com/ hosted Angler EK domains
- https://www.ubiquityhosting.com/ hosted browlock.
- http://www.codero.com/
- http://hostink.ru/

String Analysis of injected subdomains

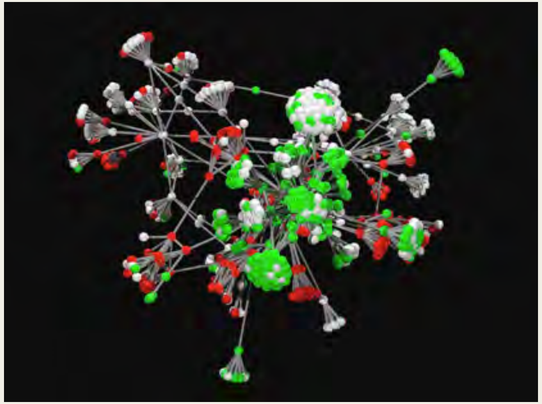
- Sample of 19,000+ malicious subdomains injected under 4,200+ compromised GoDaddy domains
- 12,000+ different labels
- Top 5 used labels:
  - police
  - alertpolice
  - css
  - windowsmoviemaker
  - solidfileslzsr

String Analysis of injected subdomains

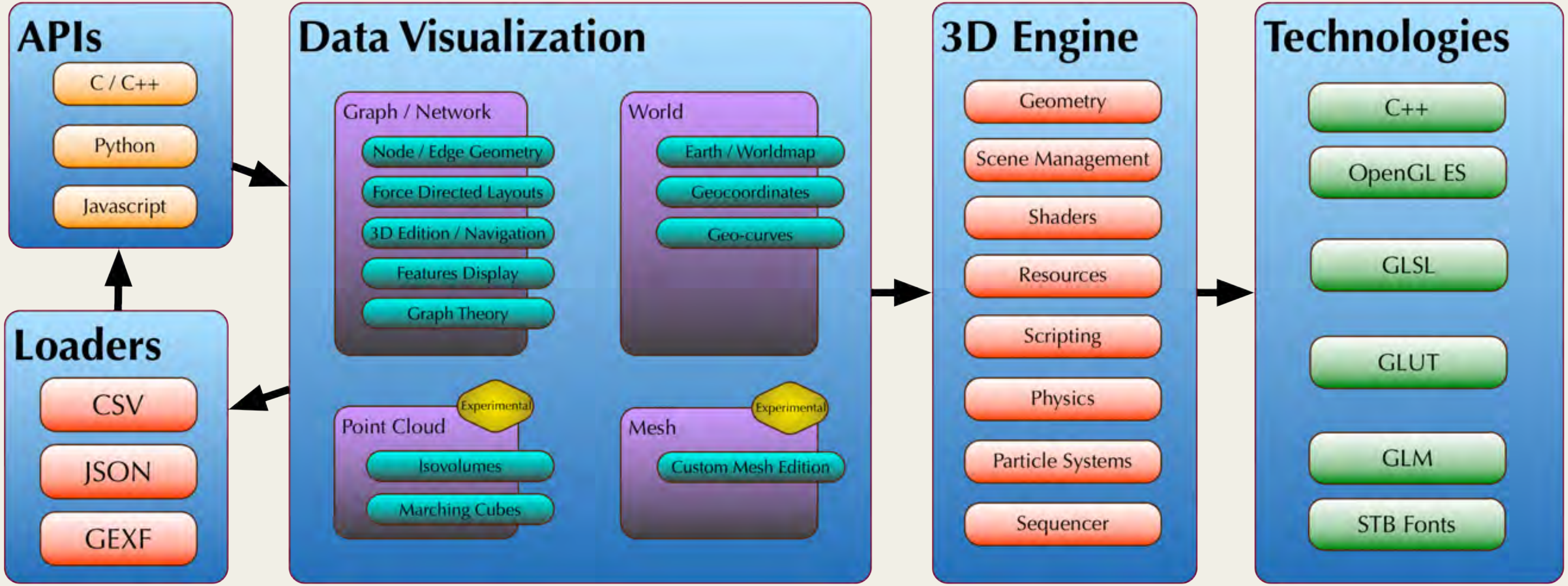


Part 3:

Visualizing Knowledge with our 3D engine

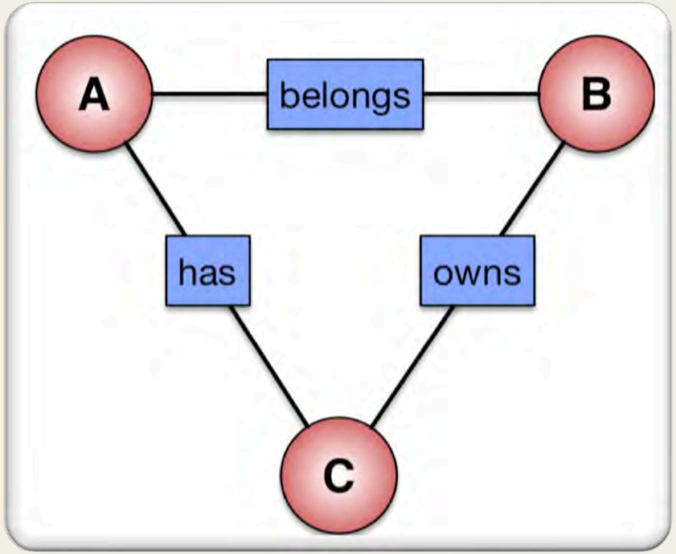


OpenGraphiti

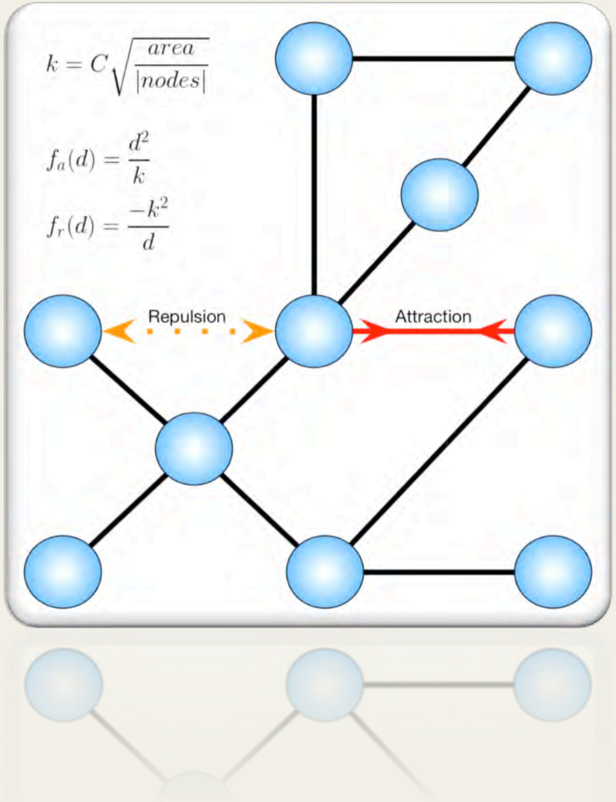


SemanticNet Python Library

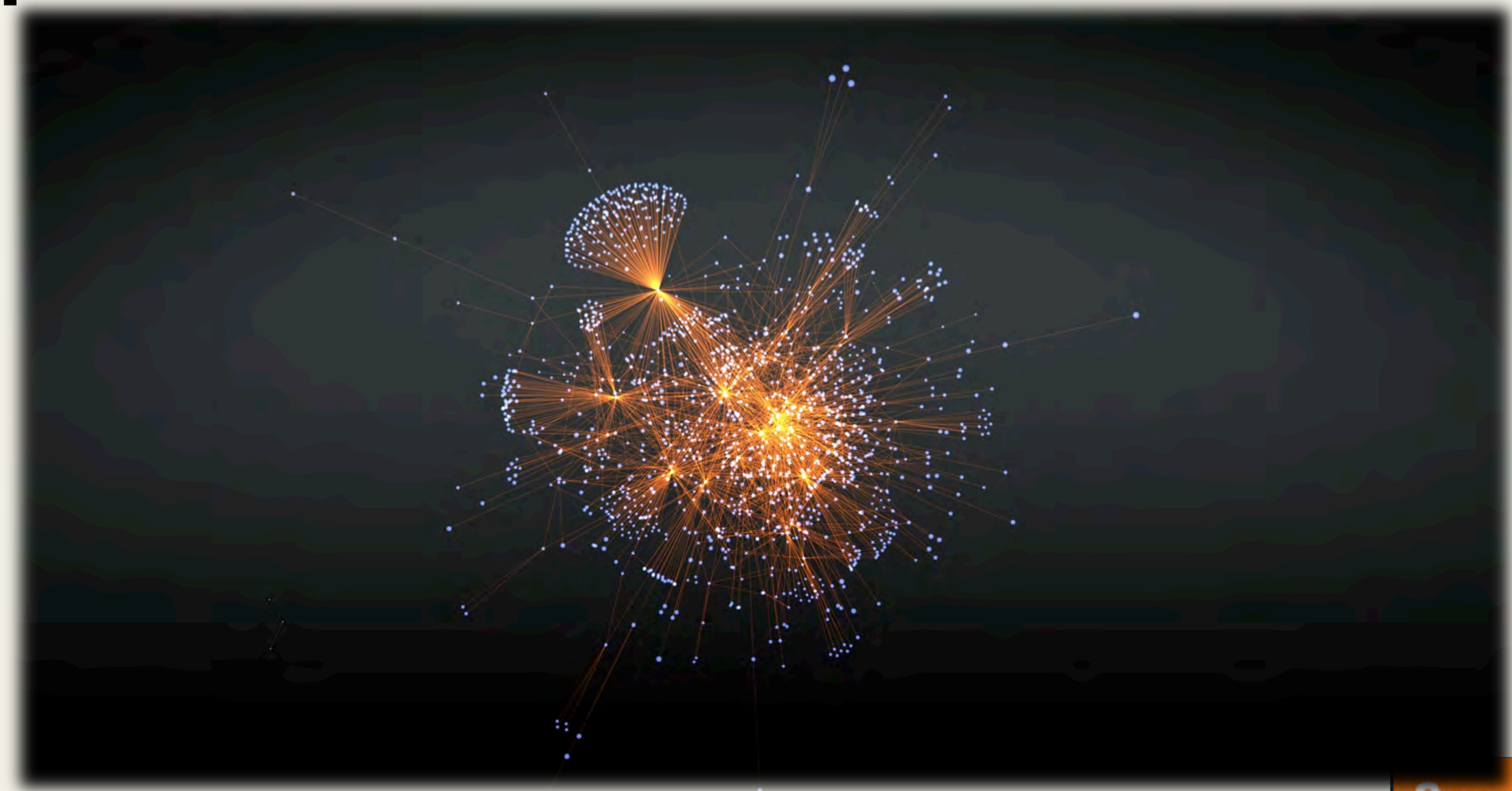
```python
#!/usr/bin/env python

import sys
import semanticnet as sn

graph = sn.Graph()

a = graph.add_node({"label" : "A"})
b = graph.add_node({"label" : "B"})
c = graph.add_node({"label" : "C"})

graph.add_edge(a, b, {"type" : "belongs"})
graph.add_edge(b, c, {"type" : "owns"})
graph.add_edge(c, a, {"type" : "has"})

graph.save_json("output.json")
```



Particle Physics

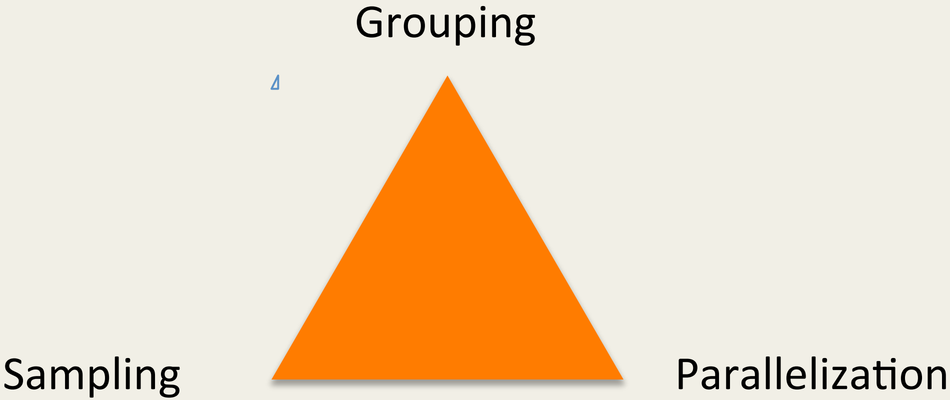


Canadian AS Network



Data goes Supernova

3 Generic Approaches

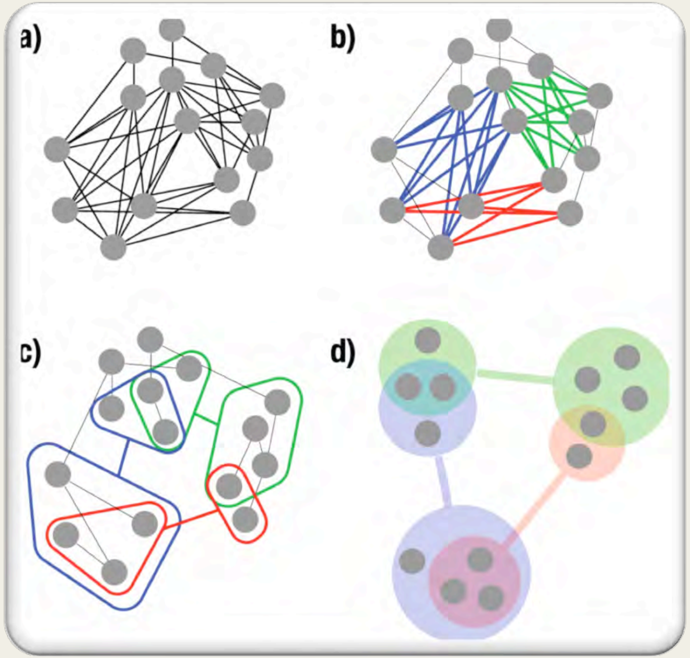


Grouping

Sampling

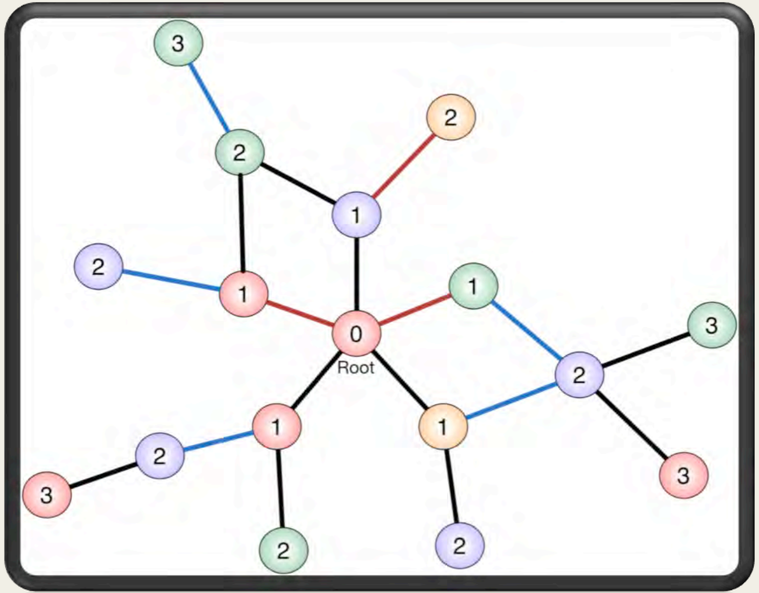
Parallelization

Entity Grouping

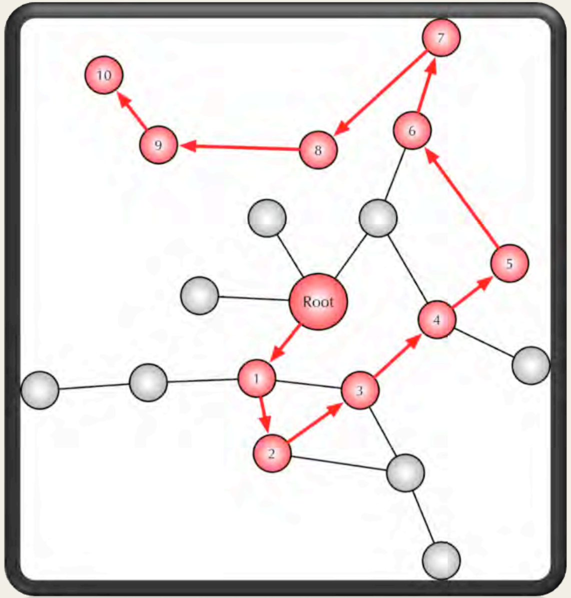


Sampling

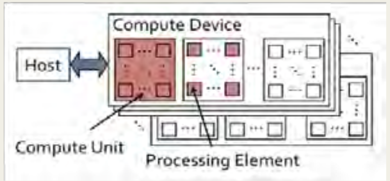
Breadth First Search

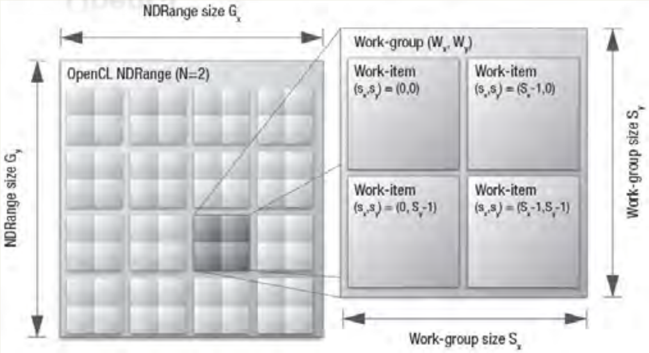


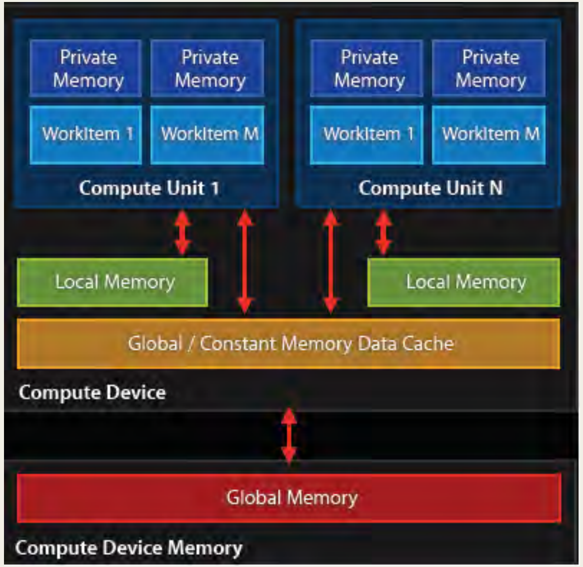
Random Walk



Parallelization




NDRange size G_x
OpenCL NDRange (N=2)
NDRange size G_y
Work-group (W_x, W_y)
Work-item $(s_x,s_y) = (0,0)$
Work-item $(s_x,s_y) = (S_x-1,0)$
Work-item $(s_x,s_y) = (0, S_y-1)$
Work-item $(s_x,s_y) = (S_x-1,S_y-1)$
Work-group size S_y
Work-group size S_x



Why ?

- Actors populate the knowledge graph
- Creation is understood, output is complex
- Layout closer to the *“natural shape”* of data structure
- Take advantage of the GPU to untangle information
- Humans are good at processing shapes and colors

Full AS Network

Future Work

Oculus

LEAP
MOTION
LEAP
The remarkably accurate, incredibly natural way to interact with your computer.

3D VISION 2
WIRELESS GLASSES KIT

Conclusion

- Efficient methods to catch malware DNS and IP style
- Fast flux botnets used as proxy networks
- Investigate IP space from novel perspectives: AS graph topology, granularity finer than BGP prefix
- Detect suspicious sibling peripheral ASNs
- Detect sibling ASNs using BGP outages monitoring
- Predict malicious IP ranges
- Detect malicious subdomains under compromised domains
- Novel 3D visualization engine used as graph navigation and investigation tool

  Supports state of the art 3D technologies (Force directed, OpenCL, GLSL Shaders, etc.)

References

- Distributed Malware Proxy Networks, B. Porter, N. Summerlin, BotConf 2013
- http://labs.opendns.com/2013/12/18/operation-kelihos-presented-botconf-2013/
- http://blog.malwaremustdie.org/2013/12/short-talk-in-botconf-2013-kelihos.html
- https://zeustracker.abuse.ch/
- http://www.malware-traffic-analysis.net/
- http://techhelplist.com/index.php/tech-tutorials/41-misc/465-asprox-botnet-advertising-fraud-general-overview-1
- VirusTotal

Thank you

(Q & A)