Compiling Features for Malicious Software

Muhammad Najmi bin Ahmad Zabidi

SIGINT
Hack In The Box 2011
Kuala Lumpur

12th Oct 2011

Malware in short

- is a software
- maliciousness is defined on the risks exposed to the user
- sometimes, when in vague, the term “Potentially Unwanted Program/Application” (PUP/PUA) being used

Methods of detections

- Static analysis
- Dynamic analysis

This talk is more *static analysis*

Analysis of strings

- Important, although *not foolproof*
- Find *interesting calls* first
- Considered *static analysis*, since no executing of the binary

Methods to find interesting strings

- Use strings command (on *NIX systems)
- Editors
- Checking with Import Address Table (IAT)

Python

- a scripting language
- a robust, powerful programming language

My Python scripts

- Based from several existing Python scripts - malware analyzer, zerowine sandboxes,PE scanner
- I merged them and modified some parts so that it will be able to produce single page of report
- This tool is needed for my research work(bigger objective)
- Analysis of the binary while it is still packed

Stuffs to look at

- “Interesting” Application Programming Interface-API calls
- Virtual Machine(VM) detector
- Outbound connect, especiall Internet Relay Chat-IRC commands. Possibbly a member of botnets

python-pefile module

- Written by Ero Carrera
- python-pe provides quite a number of functions
- Everything can be dumped by print pe.dump_info()

Regular Expression search using re

import re provides regexp capability to find strings in the binary This array of calls INTERESTING_CALLS = ["CreateMutex"...], provides ranges of calls to be fetched The following fetched the represented strings

```
for calls in INTERESTING_CALLS:
                        if re.search(calls, line):
                                if not calls in performed:
                                        print "[+] Found an Interesting call to: ",calls
                                        performed.append(calls)
```

Looking at Dynamic Link Library -DLL

Some DLLs are interesting to look at, they contain functions that me be used for malicious activities. For e.g: Kernel32.dll, provides *“low-level operating system functions for memory management and resource handling"*

Contents of kernel32.dll

```
1. CopyFileA
2. CopyFileExA
3. CopyFileExW
4. CopyFileW
5. CreateFileA
6. CreateFileW
7. DeleteFileA
8. DeleteFileW
9. MoveFileA
10. MoveFileExA
11. MoveFileExW
12. MoveFileW
13. MoveFileWithProgressA
14. MoveFileWithProgressW
15. OpenFile
16. ReadFile
17. ReadFileEx
18. ReadFileScatter
19. ReplaceFile
20. ReplaceFileA
21. ReplaceFileW
22. WriteFile
23. WriteFileEx
24. WriteFileGather
```

Source: [Marhusin et al., 2008]

Using Python PE

```
import hashlib
import time
import binascii
import string
import os, sys
import commands
import pefile
import peutils
import string

pe = pefile.PE(sys.argv[1])
print "DLL \t\t API NAME"
for imp in pe.DIRECTORY_ENTRY_IMPORT:
        print imp.dll
for api in imp.imports:
        print "\t\t%s" %api.name
```

```
najmi@vostro:~/rogue-av$ avgscan BestAntivirus2011.exe
AVG command line Anti-Virus scanner
Copyright (c) 2010 AVG Technologies CZ

Virus database version: 271.1.1/3943
Virus database release date: Fri, 07 Oct 2011 14:34:00 +08:00

BestAntivirus2011.exe  Trojan horse FakeAlert.ACN

Files scanned      :  1(1)
Infections found   :  1(1)
PUPs found         :  0
Files healed       :  0
Warnings reported  :  0
Errors reported    :  0
najmi@vostro:~/rogue-av$ md5sum BestAntivirus2011.exe
7f0ba3e7f57327563f0ceacbd08f8385  BestAntivirus2011
```

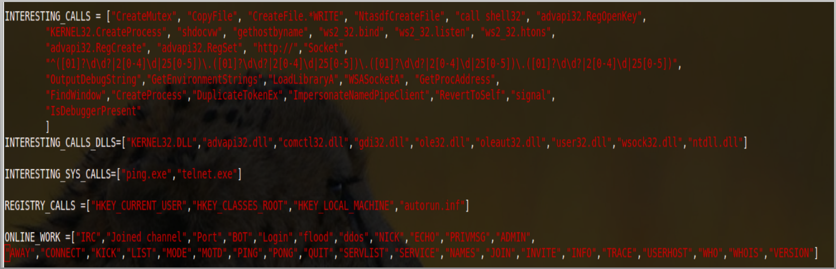
```
$ python ../dll-scan.py BestAntivirus2011.exe
DLL                             API NAME
ADVAPI32.dll
USER32.dll
KERNEL32.dll
ole32.dll
OLEAUT32.dll
GDI32.dll
COMCTL32.dll
SHELL32.dll
WININET.dll
WSOCK32.dll
                                 None
                                 None
                                 None
                                 None
                                 None
                                 None
                                 None
                                 None
```

Anti Virtual Machine Malware

```
"Red Pill":"\x0f\x01\x0d\x00\x00\x00\x00\xc3",
"VirtualPc trick":"\x0f\x3f\x07\x0b",
"VMware trick":"VMXh",
"VMCheck.dll":"\x45\xC7\x00\x01",
"VMCheck.dll for VirtualPC":"\x0f\x3f\x07\x0b\xc7\x45\xfc\xff\xff\xff\xff",
"Xen":"XenVMM", # Or XenVMMXenVMM
"Bochs & QEmu CPUID Trick":"\x44\x4d\x41\x63",
"Torpig VMM Trick": "\xE8\xED\xFF\xFF\xFF\x25\x00\x00\x00\xFF
              \x33\xC9\x3D\x00\x00\x00\x80\x0F\x95\xC1\x8B\xC1\xC3",
"Torpig (UPX) VMM Trick": "\x51\x51\x0F\x01\x27\x00\xC1\xFB\xB5\xD5\x35
                              \x02\xE2\xC3\xD1\x66\x25\x32
                    \xBD\x83\x7F\xB7\x4E\x3D\x06\x80\x0F\x95\xC1\x8B\xC1\xC3"
```

Source: ZeroWine source code

Strings detector



```
INTERESTING_CALLS = ["CreateMutex", "CopyFile", "CreateFile.*WRITE", "NtasdfCreateFile", "call shell32", "advapi32.RegOpenKey",
        "KERNEL32.CreateProcess", "shdocvw", "gethostbyname", "ws2_32.bind", "ws2_32.listen", "ws2_32.htons",
        "advapi32.RegCreate", "advapi32.RegSet", "http://","Socket",
        "^([01]?\d\d?|2[0-4]\d|25[0-5])\.([01]?\d\d?|2[0-4]\d|25[0-5])\.([01]?\d\d?|2[0-4]\d|25[0-5])\.([01]?\d\d?|2[0-4]\d|25[0-5])",
        "OutputDebugString","GetEnvironmentStrings","LoadLibraryA","WSASocketA", "GetProcAddress",
        "FindWindow","CreateProcess","DuplicateTokenEx","ImpersonateNamedPipeClient","RevertToSelf","signal",
        "IsDebuggerPresent"
        ]
INTERESTING_CALLS_DLLS=["KERNEL32.DLL","advapi32.dll","comctl32.dll","gdi32.dll","ole32.dll","oleaut32.dll","user32.dll","wsock32.dll","ntdll.dll"]

INTERESTING_SYS_CALLS=["ping.exe","telnet.exe"]

REGISTRY_CALLS =["HKEY_CURRENT_USER","HKEY_CLASSES_ROOT","HKEY_LOCAL_MACHINE","autorun.inf"]

ONLINE_WORK =["IRC","Joined channel","Port","BOT","Login","flood","ddos","NICK","ECHO","PRIVMSG","ADMIN",
"AWAY","CONNECT","KICK","LIST","MODE","MOTD","PING","PONG","QUIT","SERVLIST","SERVICE","NAMES","JOIN","INVITE","INFO","TRACE","USERHOST","WHO","WHOIS","VERSION"]
```

Detect Anti VMs

```
$python comp-detect.py vm-detect-malware/bfe00ca2aa27501cb4fd00655435555d
DLL                    API NAME
WS2_32.dll
KERNEL32.dll
USER32.dll
GDI32.dll
ole32.dll
                    CoCreateInstance

[+]Detecting Anti Debugger Tricks...
***Detected trick TWX (TRW detection)
***Detected trick isDebuggerPresent (Generic debugger detection)
***Detected trick TRW (TRW detection)

[+]Detecting VM tricks..
***Detected trick VirtualPc trick
***Detected trick VMCheck.dll for VirtualPC

Analyzing registry...
Check whether this binary is a bot...
Analyzing interesting calls..
[+] Found an Interesting call to:  CreateMutex
[+] Found an Interesting call to:  GetEnvironmentStrings
[+] Found an Interesting call to:  LoadLibraryA
[+] Found an Interesting call to:  GetProcAddress
[+] Found an Interesting call to:  IsDebuggerPresent
```

Detect Bots, Detect Debugger Detector

```
Analyzing  013a6dd86261acc7f9907740375ad9da
DLL                API NAME
KERNEL32.dll
USER32.dll
ADVAPI32.dll
MSVCRT.dll
GDI32.dll
ole32.dll
SHELL32.dll
                DuplicateIcon
Detecting VM existence...

No trick detected.
Analyzing registry...
Check whether this binary is a bot...
[+] Malware Seems to be IRC BOT: Verified By String : Port
[+] Malware Seems to be IRC BOT: Verified By String : SERVICE
[+] Malware Seems to be IRC BOT: Verified By String : Login
Analyzing interesting calls..
[+] Found an Interesting call to:  LoadLibraryA
[+] Found an Interesting call to:  GetProcAddress
[+] Found an Interesting call to:  IsDebuggerPresent
[+] Found an Interesting call to:  http://
```

With registry addition

```
Analyzing  e665297bf9dbb2b2790e4d898d70c9e9

Analyzing registry...
[+] Malware is Adding a Key at Hive:  HKEY_LOCAL_MACHINE
^G^@Label11^@^A^AÃł^Nreg add "HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows NT\CurrentVersion
 File Execution Options\Rx.exe" /v debugger /t REG_SZ /d %systemrot%\repair\1sass.exe /f^M

....

[+] Malware Seems to be IRC BOT: Verified By String : ADMIN
[+] Malware Seems to be IRC BOT: Verified By String : LIST
[+] Malware Seems to be IRC BOT: Verified By String : QUIT
[+] Malware Seems to be IRC BOT: Verified By String : VERSION
Analyzing interesting calls..
[+] Found an Interesting call to:  FindWindow
[+] Found an Interesting call to:  LoadLibraryA
[+] Found an Interesting call to:  CreateProcess
[+] Found an Interesting call to:  GetProcAddress
[+] Found an Interesting call to:  CopyFile
[+] Found an Interesting call to:  shdocvw
```

Checking entropy

- Looking at randomness in the binary
- Entropy - referring to Shannon's entropy[Lyda and Hamrock, 2007]
- If the score is X>0 and X<1 or X>7, it is being denoted as *suspicious*
- python-pefile modules provides get_entropy() function for this

PE sections to look for

```
TEXT
DATA
.idata
.rdata
.reloc
.rsrc
.tls
```

Binary file structure

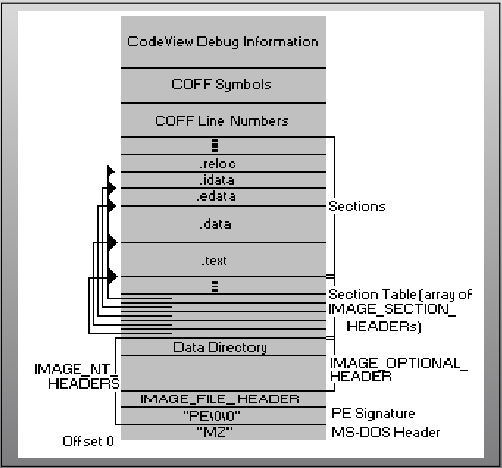


Figure: Structure of a file[Pietrek, 1994]

Python as a tool

Entropy analysis

```
 print "\n[+]Now check for binary entropy.."
        for sec in pe.sections:
                #s = "%-10s %-12s %-12s %-12s %-12f" % (
                s = "%-10s %-12s" %(
                ''.join([c for c in sec.Name if c in string.printable]),
                        sec.get_entropy())
                if sec.SizeOfRawData == 0 or (sec.get_entropy() > 0
and sec.get_entropy() < 1) or sec.get_entropy() > 7:
                                 s += "[SUSPICIOUS]"
                print "",s
```

Checking entropy...

```
[+]Now check for binary entropy..
%s .text       6.84045277182
%s rdata       0.0          [SUSPICIOUS]
%s .data       7.99566735324[SUSPICIOUS]
%s .ice        6.26849761461
```

END

najmi.zabidi@gmail.com

Special thanks

Thanks to Joxean, Beenu Arora

Bibliography

Lyda, R. and Hamrock, J. (2007).
Using entropy analysis to find encrypted and packed malware.
Security & Privacy, IEEE, 5(2):40–45.

Marhusin, M. F., Larkin, H., Lokan, C., and Cornforth, D. (2008).
An evaluation of api calls hooking performance.
In *Proc. Int. Conf. Computational Intelligence and Security CIS '08*, volume 1, pages 315–319.

Pietrek, M. (1994).
Peering inside the pe: A tour of the win32 portable executable file format.
http://msdn.microsoft.com/en-us/library/ms809762.aspx.