Malware analysis “sample2.exe”

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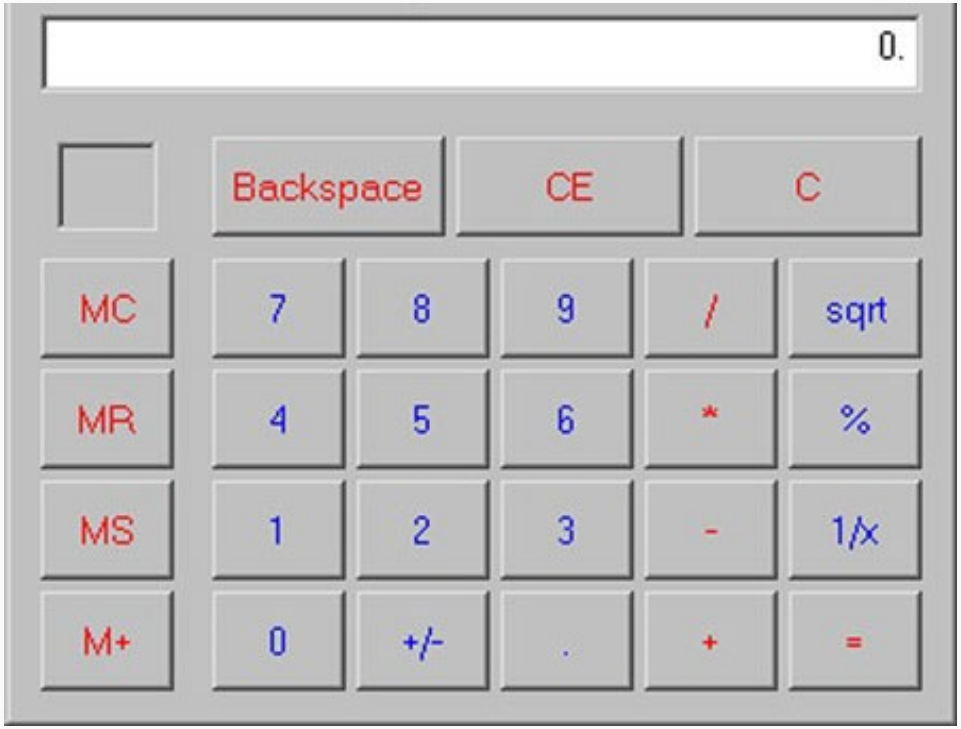
9 Gennaio 2020

Summary

Simple calculator app



But under the hood...

Summary

- Post requests
- Security center deactivation
- Infection

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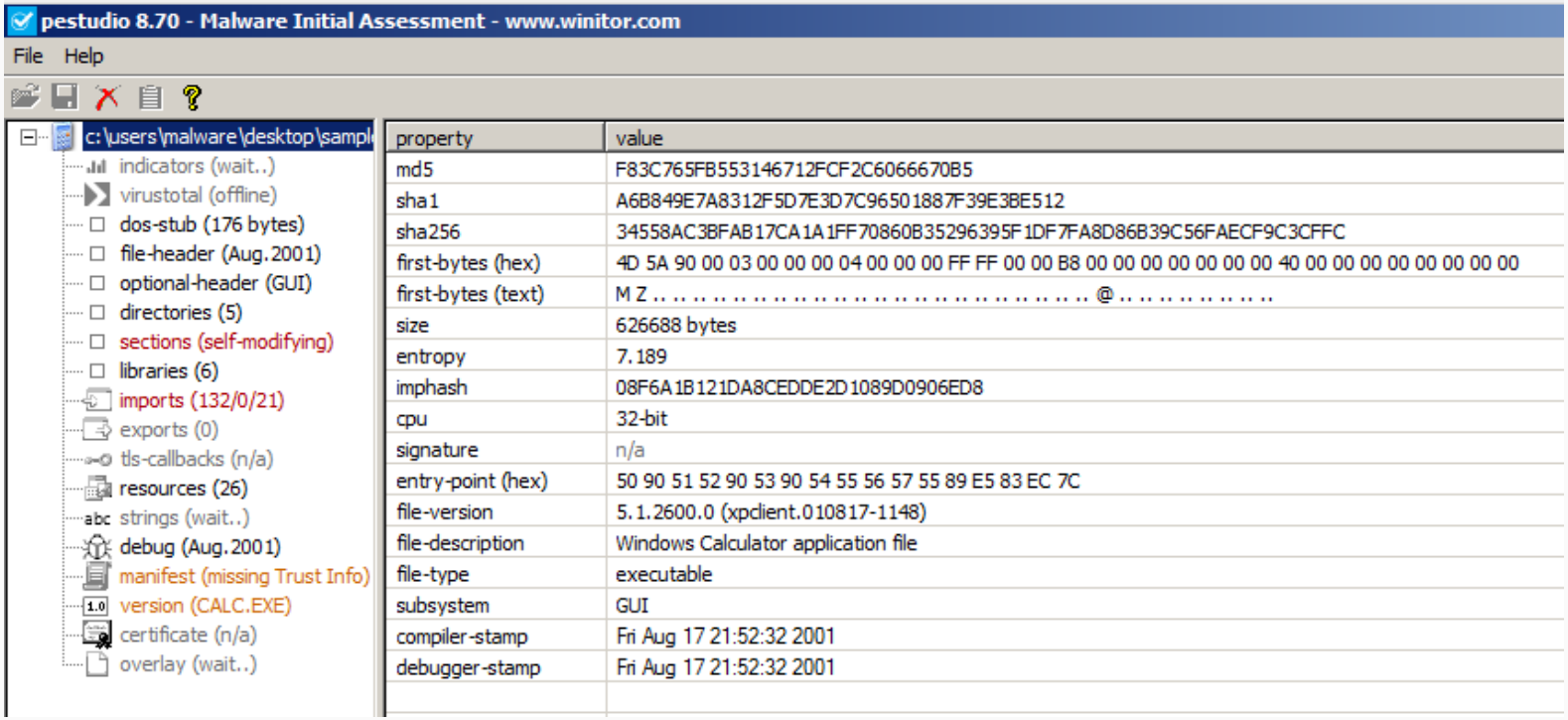
- Post requests
- Security center deactivation
- Infection $\longrightarrow$ Polymorphic malware

Static analysis

Static analysis

First look



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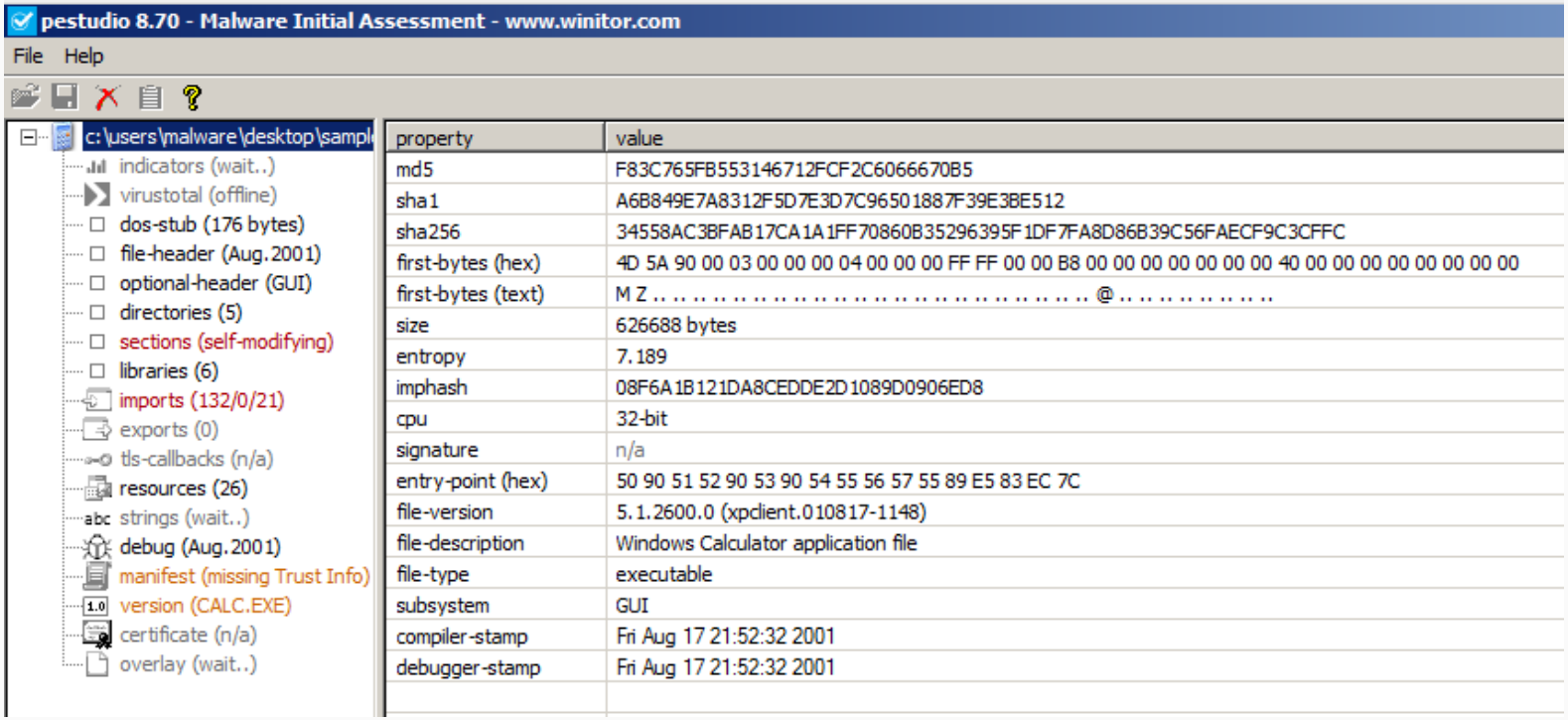

High entropy

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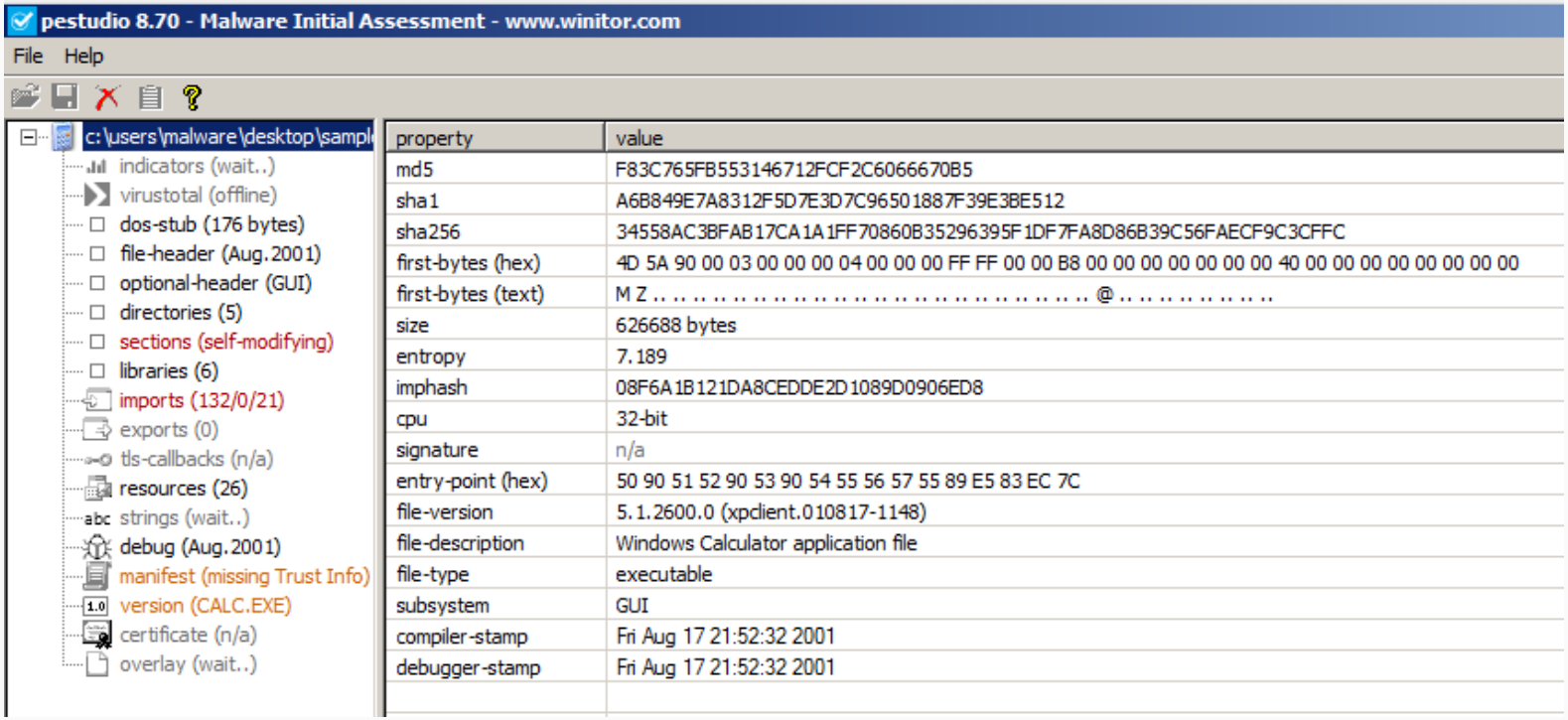

High entropy $\longrightarrow$ Obfuscation or Packing?

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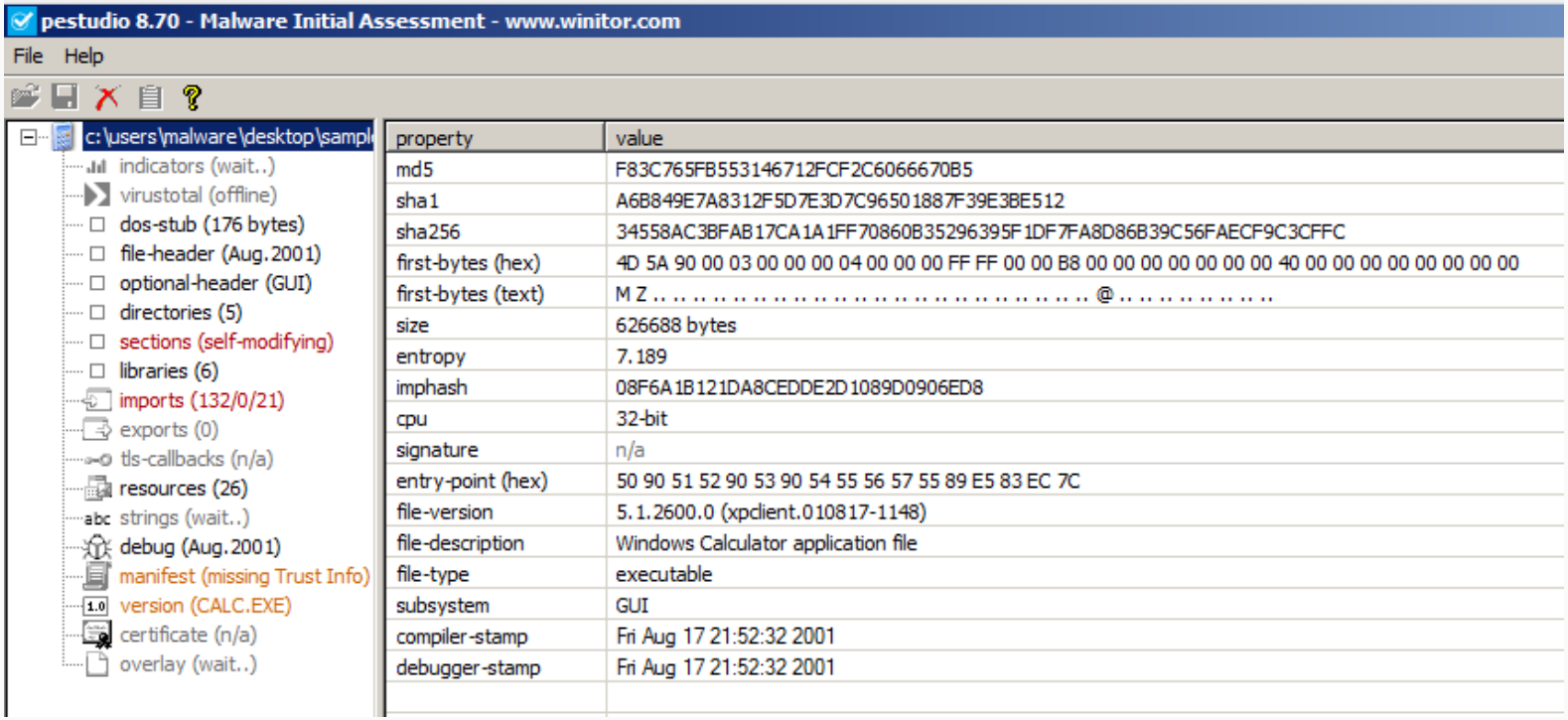
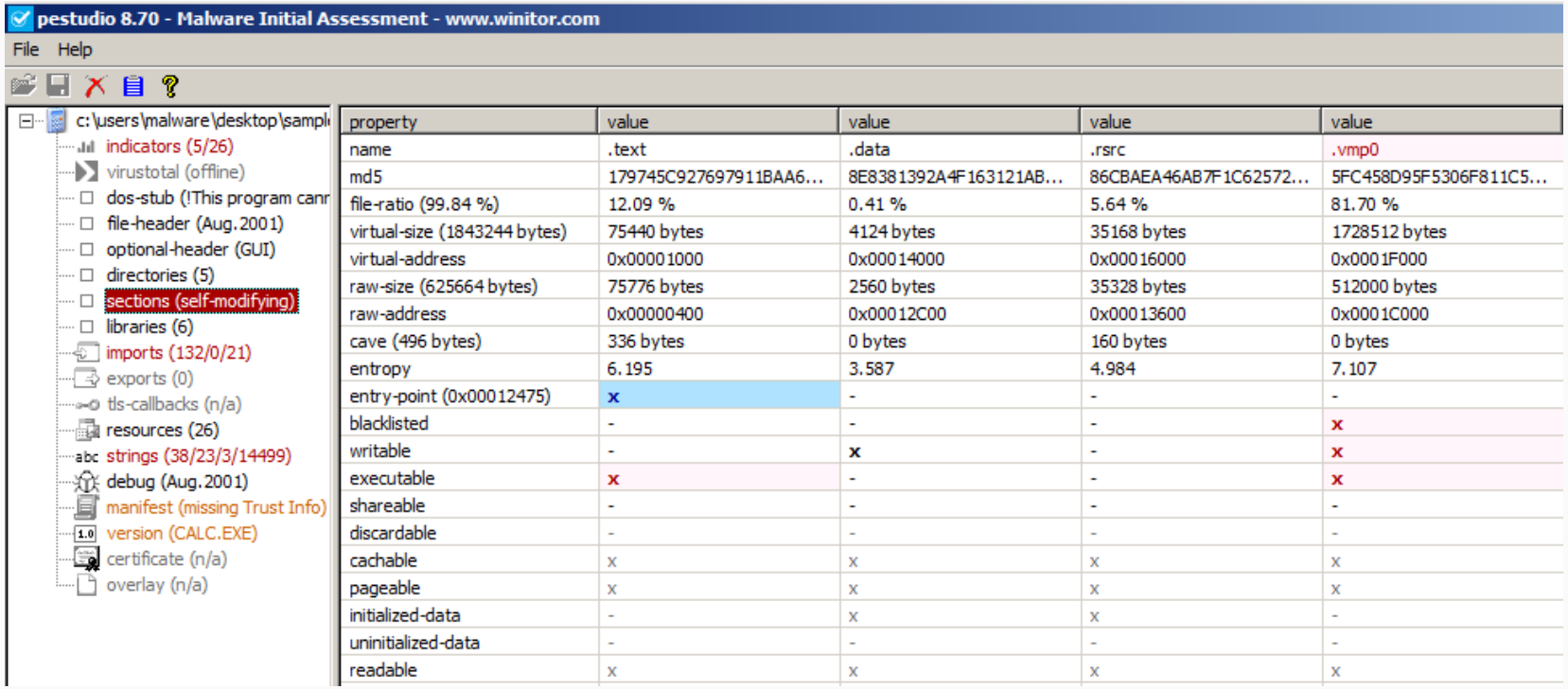


High entropy $\longrightarrow$ Obfuscation or Packing?

Let's look at the sections

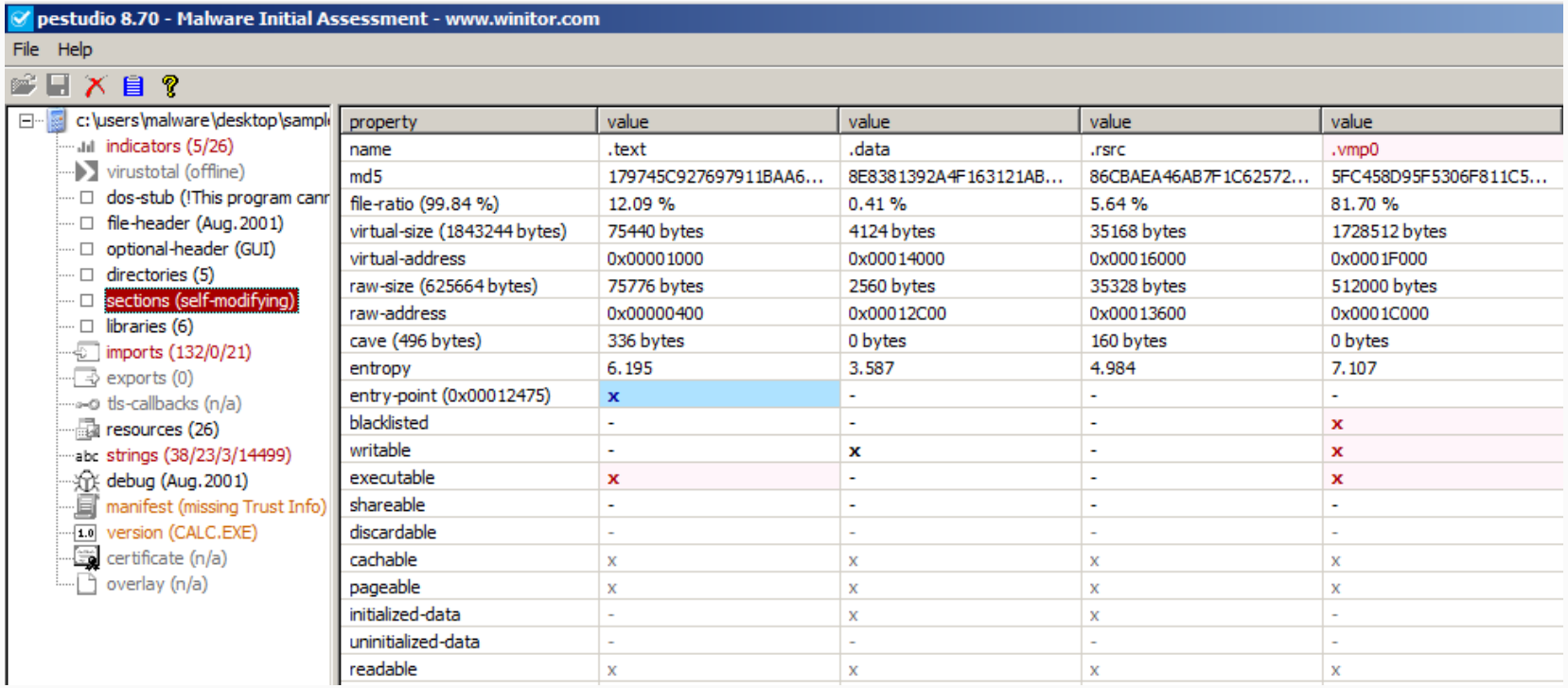
Sections



property	value	value	value	value
name	.text	.data	.rsrc	.vmp0
md5	179745C927697911BAA6...	8E8381392A4F163121AB...	86CBAEA46AB7F1C62572...	5FC458D95F5306F811C5...
file-ratio (99.84 %)	12.09 %	0.41 %	5.64 %	81.70 %
virtual-size (1843244 bytes)	75440 bytes	4124 bytes	35168 bytes	1728512 bytes
virtual-address	0x00001000	0x00014000	0x00016000	0x0001F000
raw-size (625664 bytes)	75776 bytes	2560 bytes	35328 bytes	512000 bytes
raw-address	0x00000400	0x00012C00	0x00013600	0x0001C000
cave (496 bytes)	336 bytes	0 bytes	160 bytes	0 bytes
entropy	6.195	3.587	4.984	7.107
entry-point (0x00012475)	x	-	-	-
blacklisted	-	-	-	x
writable	-	x	-	x
executable	x	-	-	x
shareable	-	-	-	-
discardable	-	-	-	-
cachable	x	x	x	x
pageable	x	x	x	x
initialized-data	-	x	x	-
uninitialized-data	-	-	-	-
readable	x	x	x	x

The first three sections are OK! But **.vmp0** NO!

Sections



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- Both writable and executable

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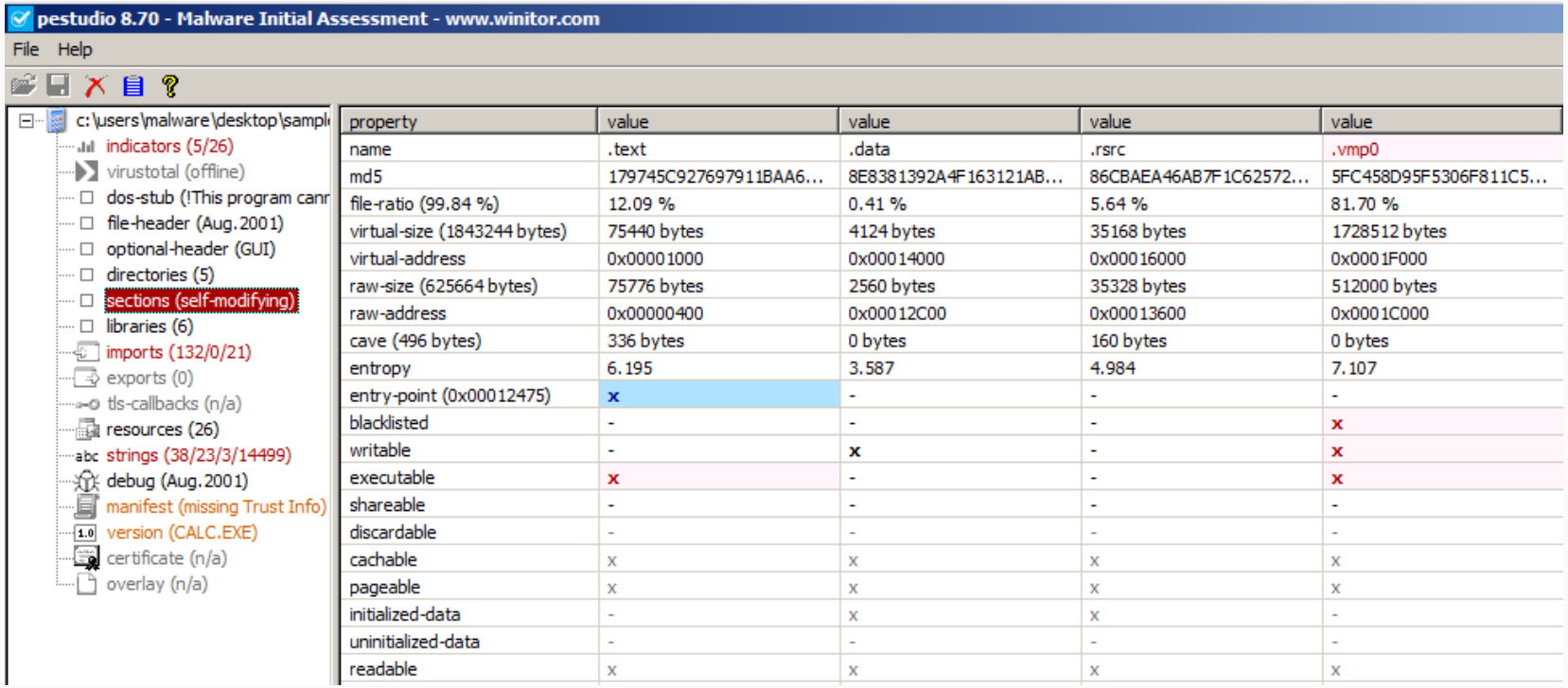

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- High entropy
- Big portion of code (87%)
- Both writable and executable $\longrightarrow$ Very suspicious

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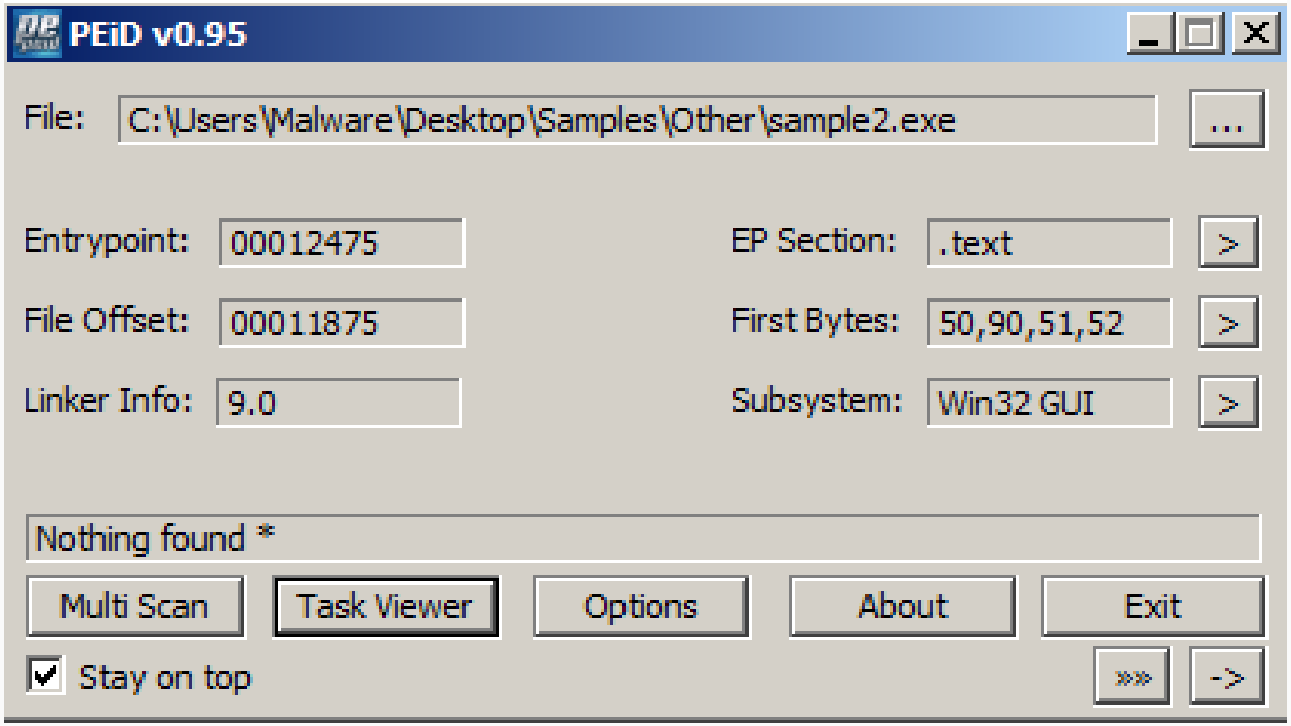

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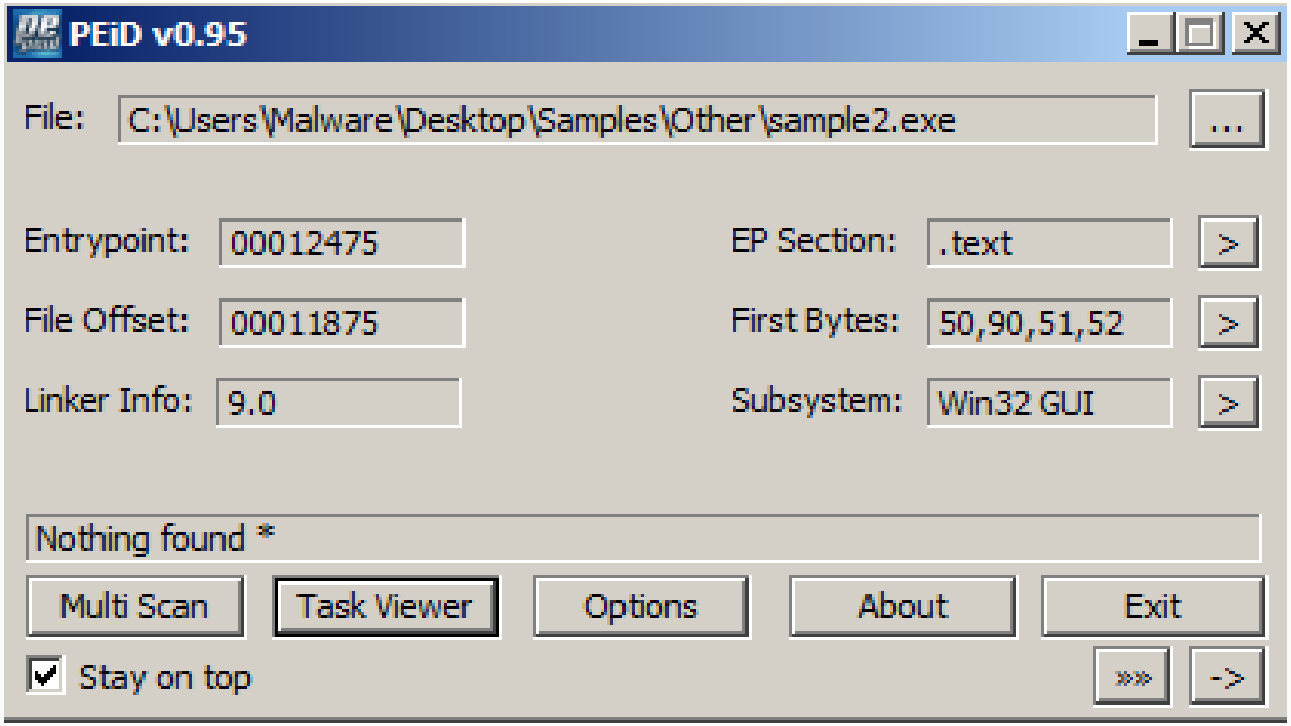
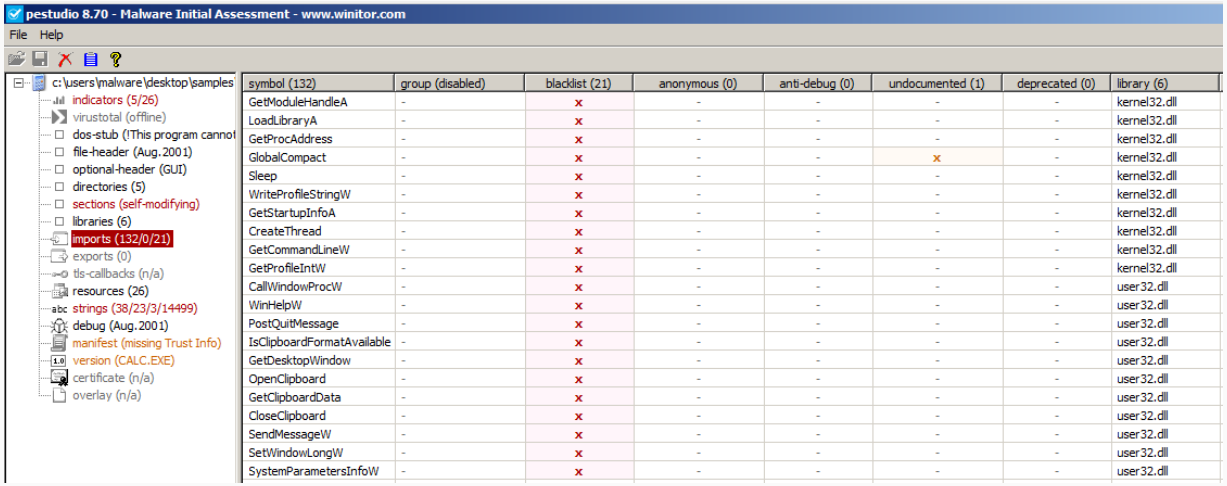


PeID confirms our supposition.

The name **vmp0** is given by **VMProtect**.

Imports



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- loadLibraryA
- getProcAddressA
- getStartupInfoA
- getCommandLineW

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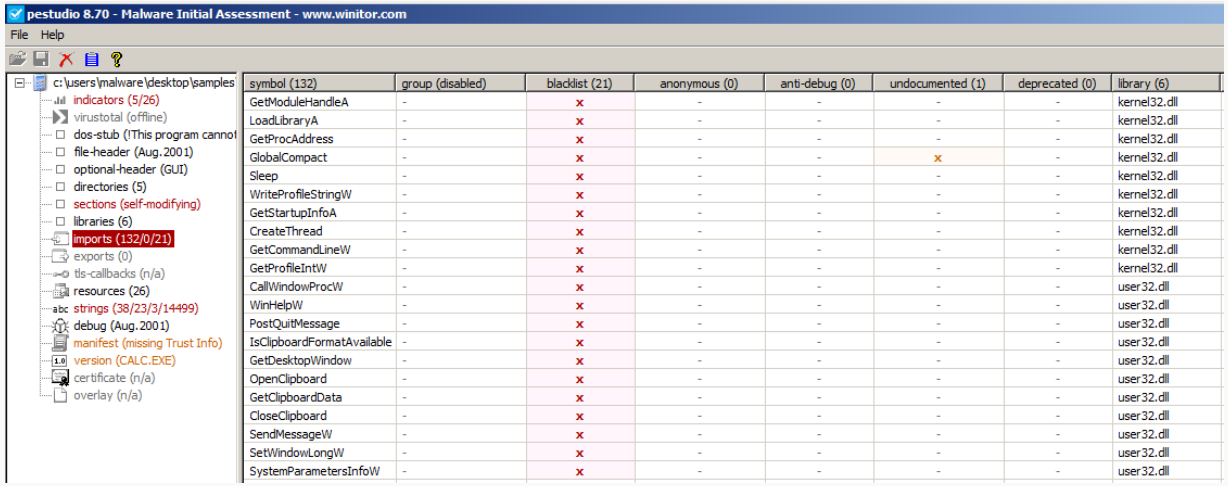

symbol (132)	group (disabled)	blacklist (21)	anonymous (0)	anti-debug (0)	undocumented (1)	deprecated (0)	library (6)
GetModuleHandleA	-	x	-	-	-	-	kernel32.dll
LoadLibraryA	-	x	-	-	-	-	kernel32.dll
GetProcAddress	-	x	-	-	-	-	kernel32.dll
GlobalCompact	-	x	-	-	x	-	kernel32.dll
Sleep	-	x	-	-	-	-	kernel32.dll
WriteProfileStringW	-	x	-	-	-	-	kernel32.dll
GetStartupInfoA	-	x	-	-	-	-	kernel32.dll
CreateThread	-	x	-	-	-	-	kernel32.dll
GetCommandLineW	-	x	-	-	-	-	kernel32.dll
GetProfileIntW	-	x	-	-	-	-	kernel32.dll
CallWindowProcW	-	x	-	-	-	-	user32.dll
WinHelpW	-	x	-	-	-	-	user32.dll
PostQuitMessage	-	x	-	-	-	-	user32.dll
IsClipboardFormatAvailable	-	x	-	-	-	-	user32.dll
GetDesktopWindow	-	x	-	-	-	-	user32.dll
OpenClipboard	-	x	-	-	-	-	user32.dll
GetClipboardData	-	x	-	-	-	-	user32.dll
CloseClipboard	-	x	-	-	-	-	user32.dll
SendMessageW	-	x	-	-	-	-	user32.dll
SetWindowLongW	-	x	-	-	-	-	user32.dll
SystemParametersInfoW	-	x	-	-	-	-	user32.dll

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Other dealing with **Threads**, **Clipboard**, **System**

Other

- **Version**: Legit information, but no date
- **Strings**: Thousands of crypted strings
- **Certificate**: it is missing

Dynamic analysis

Dynamic analysis

We used 3 tools:

- **regshot**, to detect files and registers alterations between a time lapse;
- **procmon**, to log system functions called by the malware;
- **fakenet**, to track internet traffic in a simulated network.

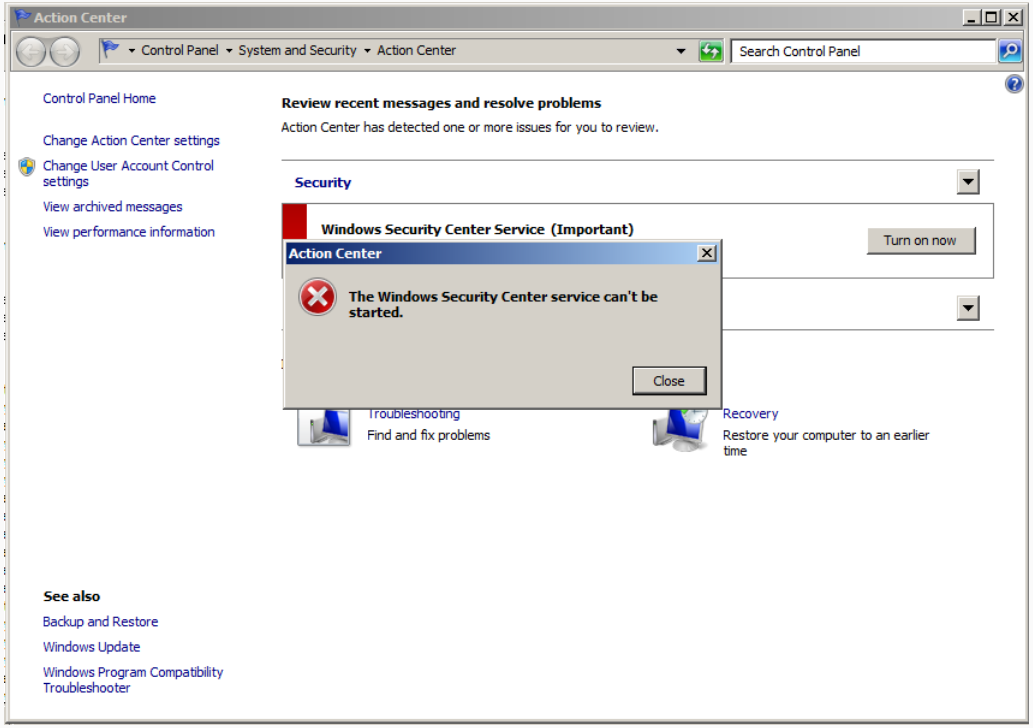
Dynamic analysis

In order to get consistent results we followed this schedule:

1. launch Fakenet;
2. launch and setup Procmon;
3. launch Regshot, setup path and run of its first shot;
4. start Procmon analysis and launch of the malware;
5. interaction with calculator by the GUI;
6. stop Procmon tracking
7. second Regshot shot;
8. stop Fakenet;

First run

We ran the malware without any tools.



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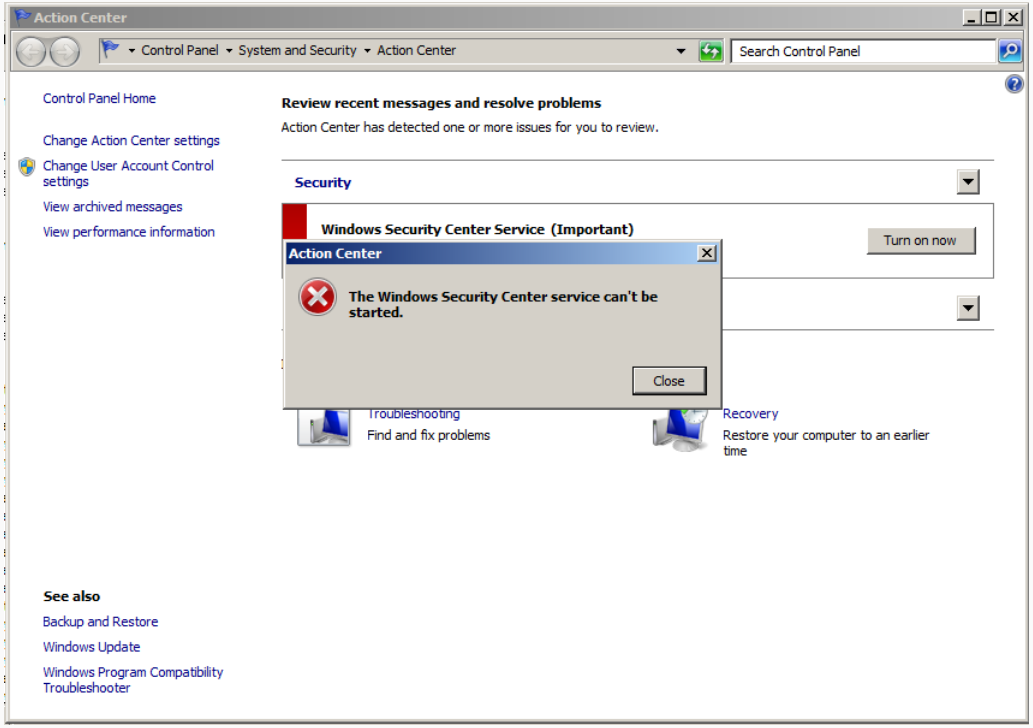

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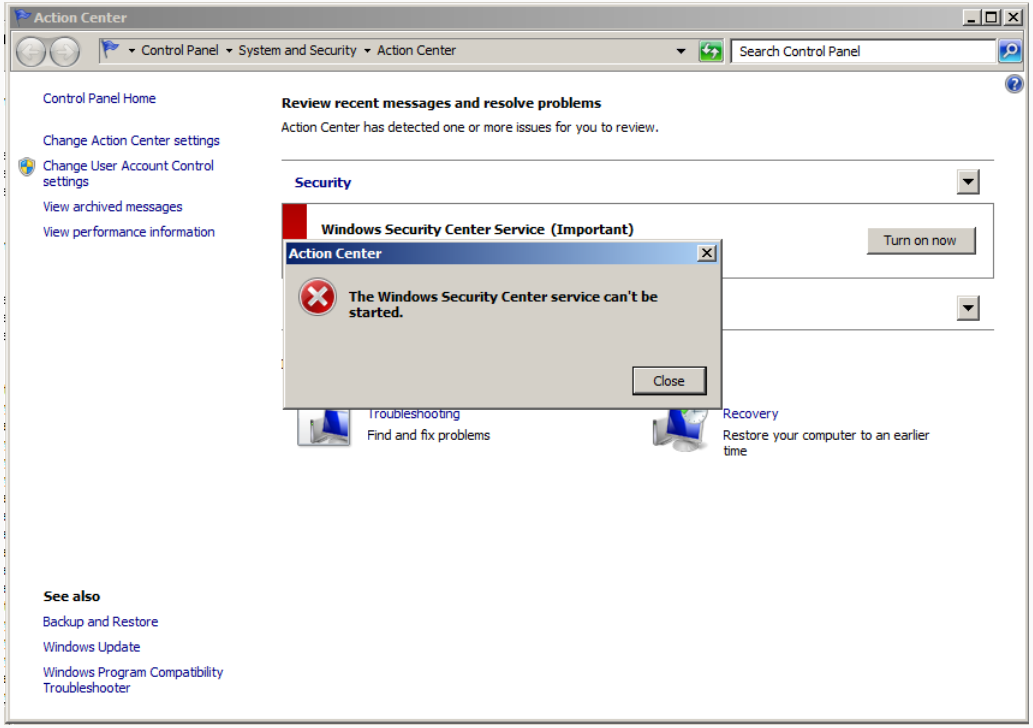

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The malware needs time to perform those actions.

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There are not imported libraries to send HTTP requests
$\longrightarrow$ *dynamically imported*

Procmon

We used procmon to keep track of every action made by the malware
Dividing them in 3 categories:

- DLL
- Registry
- Files

DLL

We measured 46 different dll files loaded with the *LoadImage* primitive.

Among them the most interesting are:

- **cryptbase - crypt32**: to handle cryptography
- **ws2_32**: to manage web socket

Registry

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The only keys modified were:

- Language list, which has no interesting effects
- Windows internet zones set to 0 which means *Allow anything* for each network type

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We obtained the sequence of actions that the malware implement to infect other files

- Read the *.exe* victim file.
- Write of the content plus the infected part in a *.vir* file with the same name.
- Copy of the content of the *.vir* file to the *.exe* one changing the EOF location.
- Set of fake information on the executable such as creation and last access time.
- Delete the *.vir* file.

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The infected files were many, and in different location.

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The main ones were:

- Windows Media Player
- Internet Explorer
- Windows Defender
- Windows Mail
- Windows Photo Viewer
- and more...

We inspect the infected files with pestudio and we found a new section called **.vmp0**

Regshot

With regshot we had a confirmation of all the actions tracked with procmon.

The fact that caught our attention was the registry change related to the Windows Security Center.

$$\texttt{HKLM}\backslash\texttt{System}\backslash\texttt{CurrentControlSet}\backslash\texttt{services}\backslash\texttt{wscsvc}\backslash\texttt{Start} = 4$$

The value 4 means disabled.

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`HKLM\System\CurrentControlSet\services\wscsvc\Start` = 4

The value 4 means disabled.

The weird thing is that this value change has not been made by the malware.

We discovered that the value was changed by **services.exe**

Reverse engineering

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The reverse engineering was divided in 2 phases:

- Code rebuilding
- Debugging

Code rebuilding

We explored the cfg of the start funcion created by IDA, and we built a pseudo code for the first part, which deals with the decryption of the obfuscated zone.

```
1  //Constant pointer to the code: 0x101E00B
2  char *code_start = 0x183A+0x1FB4+0x101BADF-0x12C2;
3  unsigned int i, j;
4  for (int i=0; i<7; i++){
5    for (int j=0x33cc1; j>0x12c5; j--){
6      code_start[j] ^= (char)(i / 6) + 0x58U;
7    }
8  }
9  for (int i=0; i<0x24880; i++)
10   DAT_0109c000[i] = DAT_0101f6cd[i];
11 for (int i=0; i<0xa1c8; i++)
12   DAT_011b9000[i] = DAT_010440cd[i];
13
```

Code rebuilding

The *.vmp0* section is decrypted through a cycle that perform an arithmetic xor of the code with a certain key.

The cycle is repetead 7 times, but during the last one the key is incremented by one.

The key is $0x58$.

Debugging

To debug the code we used Ollydbg alongside procmon, executing instructions one by one, stepping over the function calls and keeping track of the actions performed.

We had 2 main target:

- Detect the infection function
- Detect the deactivation of the security center

Debugging

Eventually we achieved a procedure to debug the infection function:

1. breakpoint in 0101273*A*; then after the *RET* the malware enters the obfuscated section.
2. breakpoint in 010*AAB*30; then there is the creation of the second thread which is the analyzed one.
3. breakpoint in 010*BD*0*A*9 which is the begin of the target function

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In particular we discovered that the thread calls FUN_010ACABF,

which then calls FUN_0109F059,

which then calls iteratively FUN_010B0CAD;

this last one contains FUN_010BD0A9 which is the target function that performs the malicious actions.

Infection

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This procedure is huge, with too much code to reverse; it even contains a recursive call inside.

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$\longrightarrow$ *probable priviledge escalation*

Conclusions

Static Analysis		
Category	Select	Score
Packed	Packed	2
Strings	Suspicious Strings	3
Imports	Suspicious	2
Sections	Abnormal Sections	1
Main Icon	Legitimate Icon	0
Additional Icons	Legitimate	0
Dialogs	Legitimate	0
Version Information	Present	0
Digital Signature	Not Present	2
	Total Score	10
	Verdict	Potentially Suspicious

Dynamic Analysis		
Category	Select	Score
Persistence	Multiple Entries	2
File Manipulation	Affects other files	2
Process Manipulation	Affects other processes	2
Registry Manipulation	Registry manipulation	1
Additional Processes	Doesn't start other processes	0
Removal Resistance	No removal prevention	0
Analysis Resistance	No analysis prevention	0
Interface/Visibile Activity	GUI/Interface	0
Network Activity	Network Activity	1
Rootkit Behaviour	Rootkit Behaviour	2
System Calls	Suspicious system calls	1
Behaviour	Expected behaviour	0
	Total Score	11
	Verdict	Suspicious

Summing up the result of our analysis we can describe the malware as a polymorphic one, which performs variuos malicious actions such as internet connections, replications on other system programs and deactivates the security center. It disguise itself as a calculator, fooling the average user.