# Another one for the collection - Mespinoza (Pysa) Ransomware

dissectingmalwa.re/another-one-for-the-collection-mespinoza-pysa-ransomware.html

Sat 14 December 2019 in Ransomware

Back in October of 2019 the Mespinoza Ransomware family first surfaced via Malspam. On the 14th of December it returned with a new extension .pysa so let's see if any changes have been made.

Fun Fact: The Extension "pysa" is probably derived from the Zanzibari Coin with the same name. Apparently it's quite popular with collectors. But enough of the pocket change, so let me put my two cents in on this sample :D

***A general disclaimer as always: downloading and running the samples linked below will lead to the encryption of your personal data, so be f$cking careful. Also check with your local laws as owning malware binaries/ sources might be illegal depending on where you live.***

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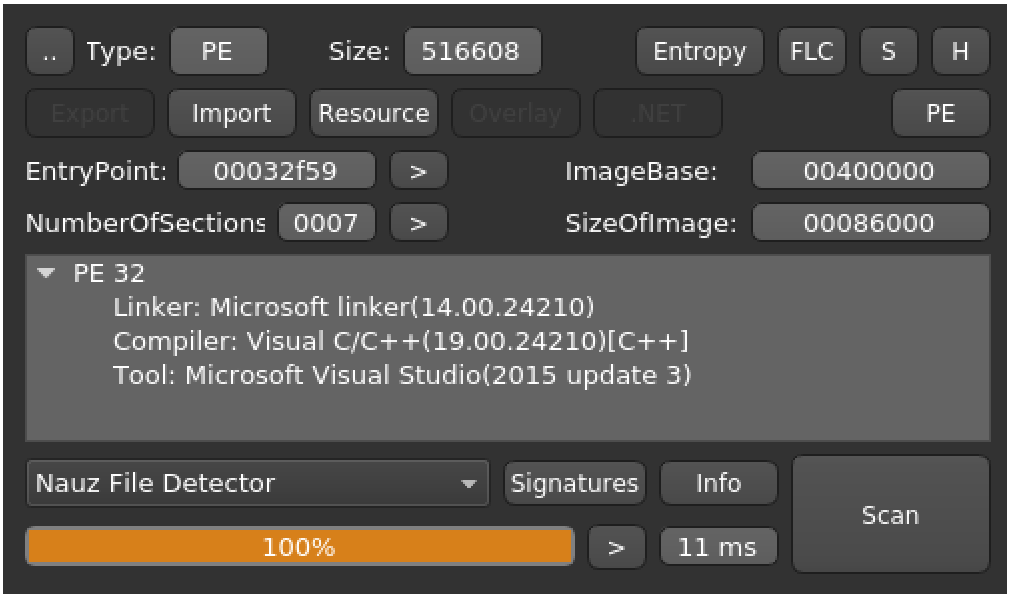
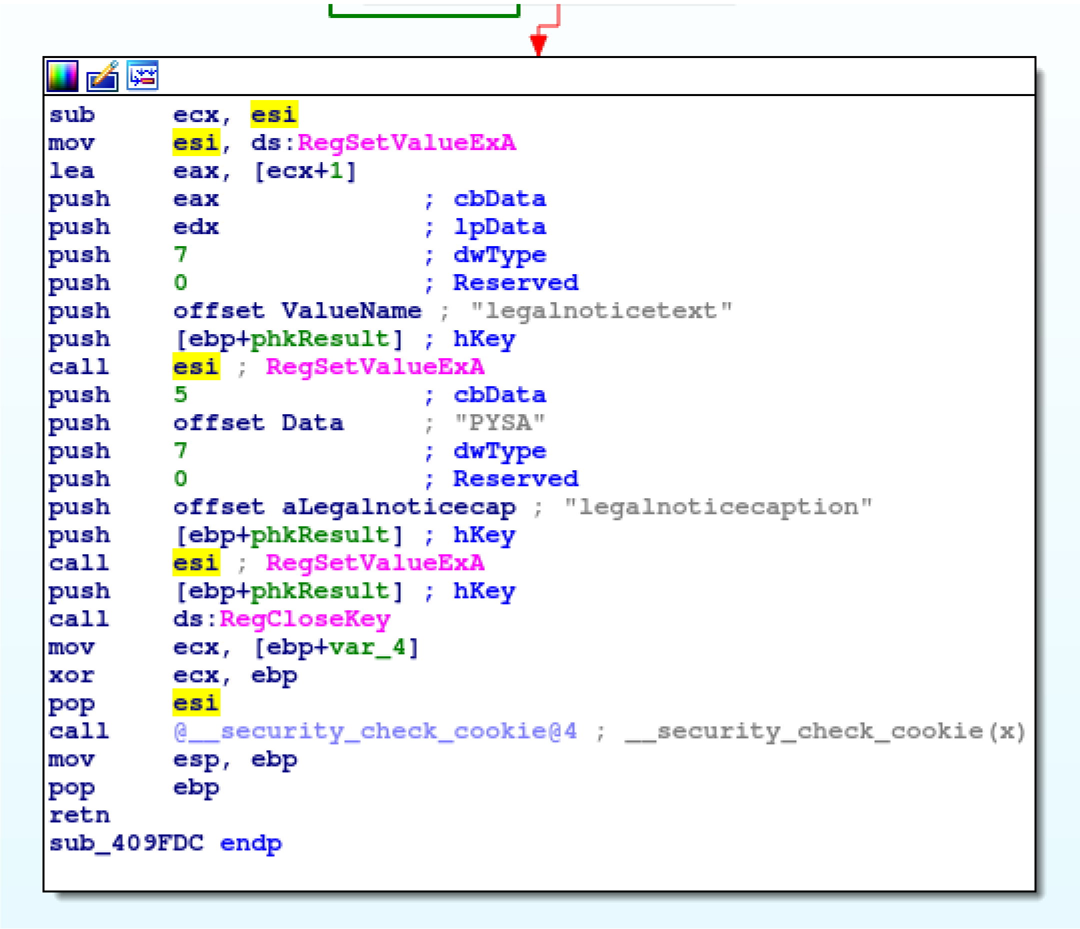
Mespinoza (.pysa) @ AnyRun | VirusTotal | HybridAnalysis --> `sha256 a18c85399cd1ec3f1ec85cd66ff2e97a0dcf7ccb17ecf697a5376da8eda4d327`

As always: Running Detect it easy on the executable:



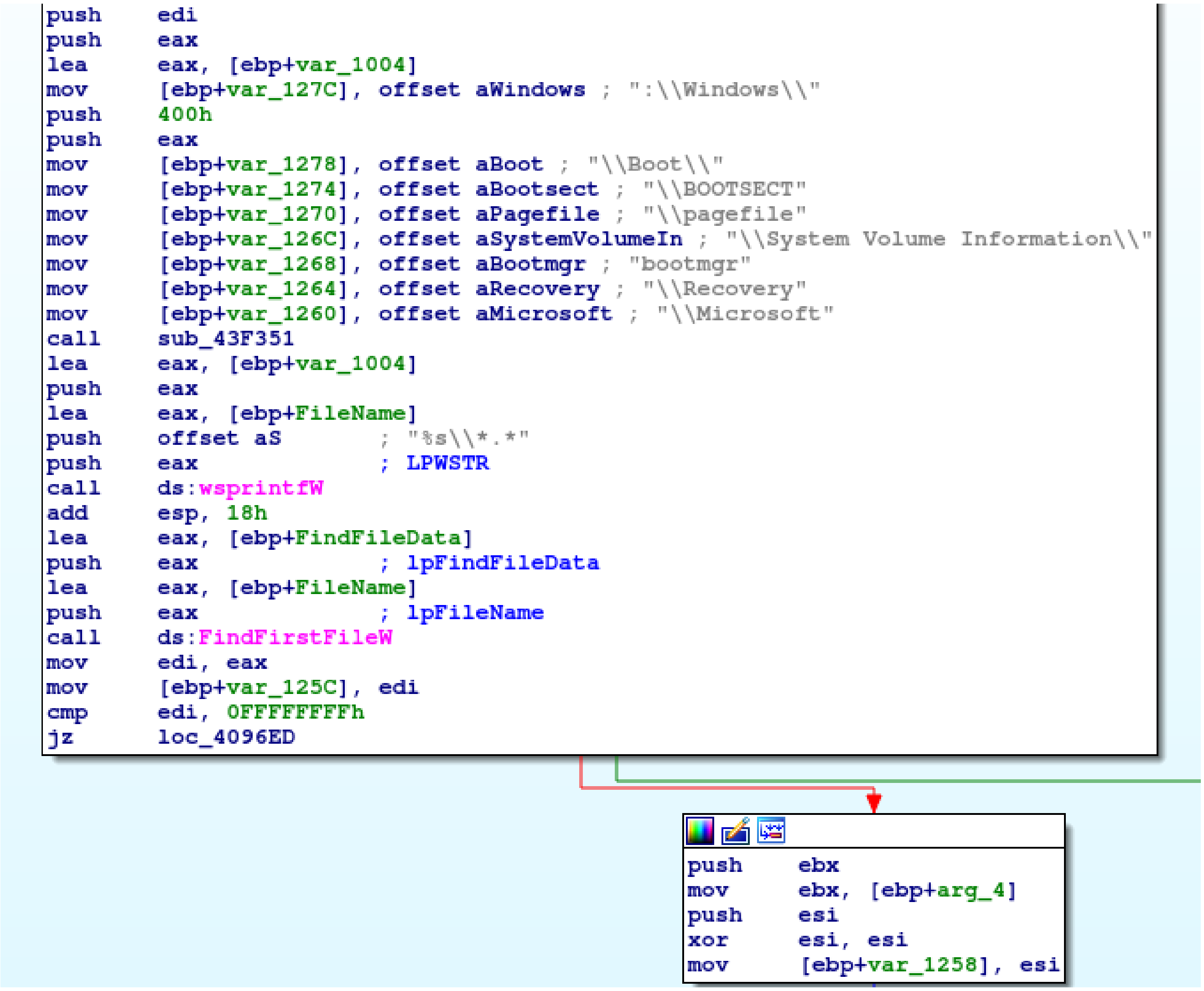
```
Type: PE    Size: 516608
EntryPoint: 00032f59          ImageBase: 00400000
NumberOfSections 0007         SizeOfImage: 00086000
PE 32
    Linker: Microsoft linker(14.00.24210)
    Compiler: Visual C/C++(19.00.24210)[C++]
    Tool: Microsoft Visual Studio(2015 update 3)
Nauz File Detector
100%    11 ms
```

One of the first things it will do is modify the `SOFTWARE\Microsoft\Windows\CurrentVersion\Policies\System` Registry Key to set the following values. Unfortunately I couldn't confirm this action in a sandbox with RegShot yet.



```
sub     ecx, esi
mov     esi, ds:RegSetValueExA
lea     eax, [ecx+1]
push    eax                 ; cbData
push    edx                 ; lpData
push    7                   ; dwType
push    0                   ; Reserved
push    offset ValueName ; "legalnoticetext"
push    [ebp+phkResult] ; hKey
call    esi ; RegSetValueExA
push    5                   ; cbData
push    offset Data         ; "PYSA"
push    7                   ; dwType
push    0                   ; Reserved
push    offset aLegalnoticecap ; "legalnoticecaption"
push    [ebp+phkResult] ; hKey
call    esi ; RegSetValueExA
push    [ebp+phkResult] ; hKey
call    ds:RegCloseKey
mov     ecx, [ebp+var_4]
xor     ecx, ebp
pop     esi
call    @__security_check_cookie@4 ; __security_check_cookie(x)
mov     esp, ebp
pop     ebp
retn
sub_409FDC endp
```

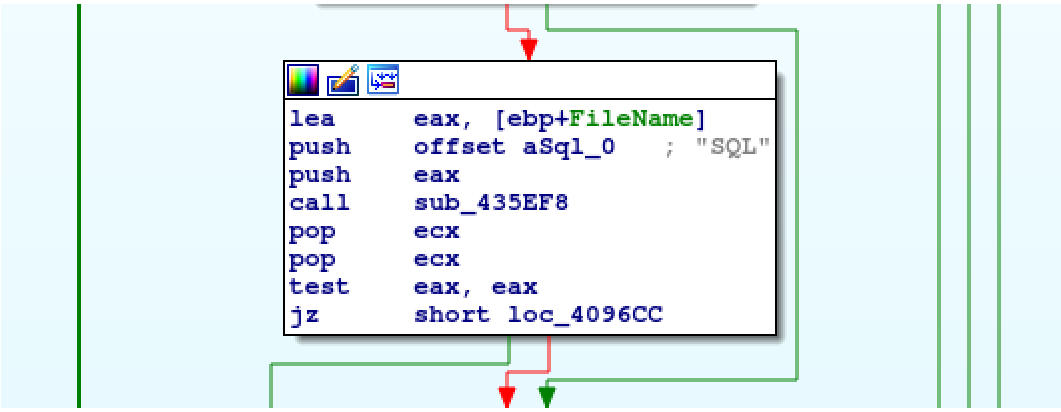
To retain basic functions of the Operating System Mespinoza will spare certain directories related directly to Windows and critical files.



```
push    edi
push    eax
lea     eax, [ebp+var_1004]
mov     [ebp+var_127C], offset aWindows ; ":\\Windows\\"
push    400h
push    eax
mov     [ebp+var_1278], offset aBoot ; "\\Boot\\"
mov     [ebp+var_1274], offset aBootsect ; "\\BOOTSECT"
mov     [ebp+var_1270], offset aPagefile ; "\\pagefile"
mov     [ebp+var_126C], offset aSystemVolumeIn ; "\\System Volume Information\\"
mov     [ebp+var_1268], offset aBootmgr ; "bootmgr"
mov     [ebp+var_1264], offset aRecovery ; "\\Recovery"
mov     [ebp+var_1260], offset aMicrosoft ; "\\Microsoft"
call    sub_43F351
lea     eax, [ebp+var_1004]
push    eax
lea     eax, [ebp+FileName]
push    offset aS          ; "%s\\*.*"
push    eax                ; LPWSTR
call    ds:wsprintfW
add     esp, 18h
lea     eax, [ebp+FindFileData]
push    eax                ; lpFindFileData
lea     eax, [ebp+FileName]
push    eax                ; lpFileName
call    ds:FindFirstFileW
mov     edi, eax
mov     [ebp+var_125C], edi
cmp     edi, 0FFFFFFFFh
jz      loc_4096ED
```

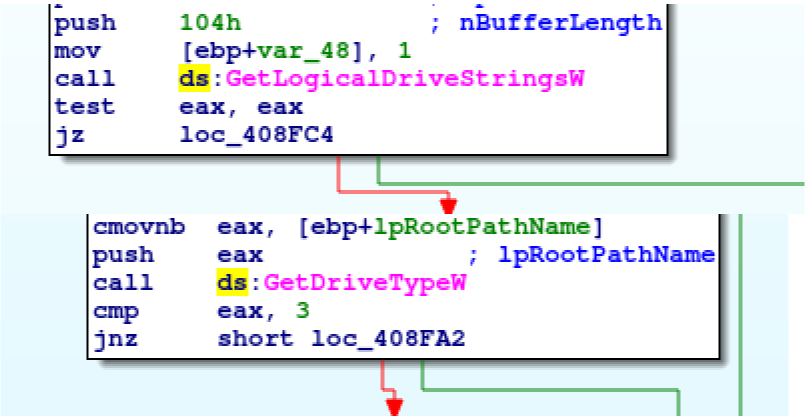
```
push    ebx
mov     ebx, [ebp+arg_4]
push    esi
xor     esi, esi
mov     [ebp+var_1258], esi
```

It will also specifically look for SQL related processes. I will have to confirm this with a debugger, but most of the time database processes are killed by Ransomware to disrupt the service and make the files available for encryption.



```
lea     eax, [ebp+FileName]
push    offset aSql_0    ; "SQL"
push    eax
call    sub_435EF8
pop     ecx
pop     ecx
test    eax, eax
jz      short loc_4096CC
```

Of course Mespinoza won't stop with the system drive so it will check for connected removable media or shared network drives. *GetDriveTypeW* will tell it which type of media the selected device belongs to.



```
push    104h            ; nBufferLength
mov     [ebp+var_48], 1
call    ds:GetLogicalDriveStringsW
test    eax, eax
jz      loc_408FC4
```

```
cmovnb  eax, [ebp+lpRootPathName]
push    eax             ; lpRootPathName
call    ds:GetDriveTypeW
cmp     eax, 3
jnz     short loc_408FA2
```

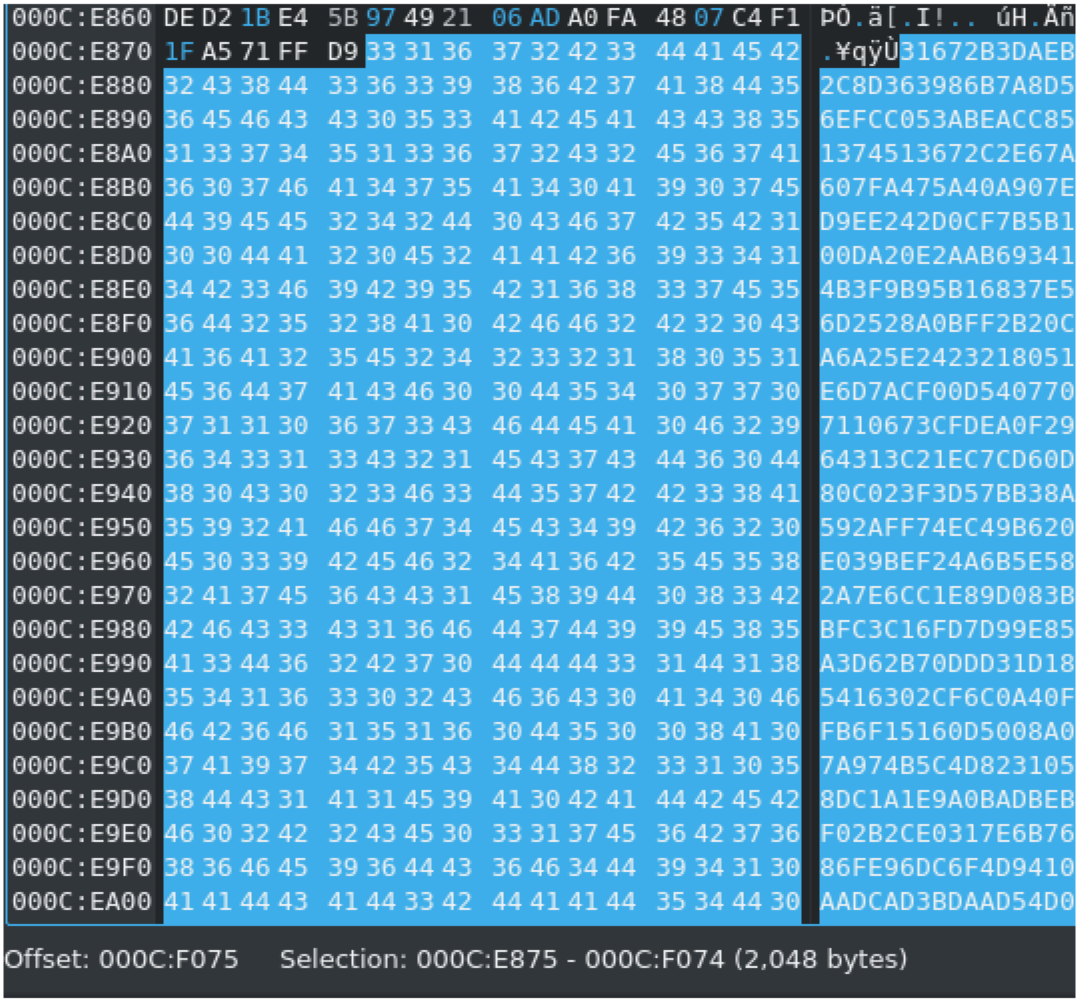
Up until now I have not seen a ransomware sample running *verclsid.exe*, so let's investigate: *{0B2C9183-C9FA-4C53-AE21-C900B0C39965}* corresponds to C:\Windows\system32\SearchFolder.dll and *{0C733A8A-2A1C-11CE-ADE5-00AA0044773D}* matches the CLSID of IDBProperties which is part of the Microsoft SQL Server.

```
C:\Windows\system32\verclsid.exe" /S /C {0B2C9183-C9FA-4C53-AE21-C900B0C39965} /I
{0C733A8A-2A1C-11CE-ADE5-00AA0044773D} /X 0x401
```

After looking at a string dump I found this hex string which is probably the key blob. I'll try to verify this with x32dbg later.

```
30820220300D06092A864886F70D01010105000382020D00308202080282020100 9CC3A0141B5488CD31B7
```

Turns out that the encrypted key is appended to the end of each file affected by the ransomware (which is a common tactic for some strains).



```
000C:E860 DE D2 1B E4  5B 97 49 21  06 AD A0 FA  48 07 C4 F1  ÞÒ.ä[.I!.. úH.Äñ
000C:E870 1F A5 71 FF  D9 33 31 36  37 32 42 33  44 41 45 42  .¥qÿÙ31672B3DAEB
000C:E880 32 43 38 44  33 36 33 39  38 36 42 37  41 38 44 35  2C8D363986B7A8D5
000C:E890 36 45 46 43  43 30 35 33  41 42 45 41  43 43 38 35  6EFCC053ABEACC85
000C:E8A0 31 33 37 34  35 31 33 36  37 32 43 32  45 36 37 41  1374513672C2E67A
000C:E8B0 36 30 37 46  41 34 37 35  41 34 30 41  39 30 37 45  607FA475A40A907E
000C:E8C0 44 39 45 45  32 34 32 44  30 43 46 37  42 35 42 31  D9EE242D0CF7B5B1
000C:E8D0 30 30 44 41  32 30 45 32  41 41 42 36  39 33 34 31  00DA20E2AAB69341
000C:E8E0 34 42 33 46  39 42 39 35  42 31 36 38  33 37 45 35  4B3F9B95B16837E5
000C:E8F0 36 44 32 35  32 38 41 30  42 46 46 32  42 32 30 43  6D2528A0BFF2B20C
000C:E900 41 36 41 32  35 45 32 34  32 33 32 31  38 30 35 31  A6A25E2423218051
000C:E910 45 36 44 37  41 43 46 30  30 44 35 34  30 37 37 30  E6D7ACF00D540770
000C:E920 37 31 31 30  36 37 33 43  46 44 45 41  30 46 32 39  7110673CFDEA0F29
000C:E930 36 34 33 31  33 43 32 31  45 43 37 43  44 36 30 44  64313C21EC7CD60D
000C:E940 38 30 43 30  32 33 46 33  44 35 37 42  42 33 38 41  80C023F3D57BB38A
000C:E950 35 39 32 41  46 46 37 34  45 43 34 39  42 36 32 30  592AFF74EC49B620
000C:E960 45 30 33 39  42 45 46 32  34 41 36 42  35 45 35 38  E039BEF24A6B5E58
000C:E970 32 41 37 45  36 43 43 31  45 38 39 44  30 38 33 42  2A7E6CC1E89D083B
000C:E980 42 46 43 33  43 31 36 46  44 37 44 39  39 45 38 35  BFC3C16FD7D99E85
000C:E990 41 33 44 36  32 42 37 30  44 44 44 33  31 44 31 38  A3D62B70DDD31D18
000C:E9A0 35 34 31 36  33 30 32 43  46 36 43 30  41 34 30 46  5416302CF6C0A40F
000C:E9B0 46 42 36 46  31 35 31 36  30 44 35 30  30 38 41 30  FB6F15160D5008A0
000C:E9C0 37 41 39 37  34 42 35 43  34 44 38 32  33 31 30 35  7A974B5C4D823105
000C:E9D0 38 44 43 31  41 31 45 39  41 30 42 41  44 42 45 42  8DC1A1E9A0BADBEB
000C:E9E0 46 30 32 42  32 43 45 30  33 31 37 45  36 42 37 36  F02B2CE0317E6B76
000C:E9F0 38 36 46 45  39 36 44 43  36 46 34 44  39 34 31 30  86FE96DC6F4D9410
000C:EA00 41 41 44 43  41 44 33 42  44 41 41 44  35 34 44 30  AADCAD3BDAAD54D0
```

Offset: 000C:F075    Selection: 000C:E875 - 000C:F074 (2,048 bytes)

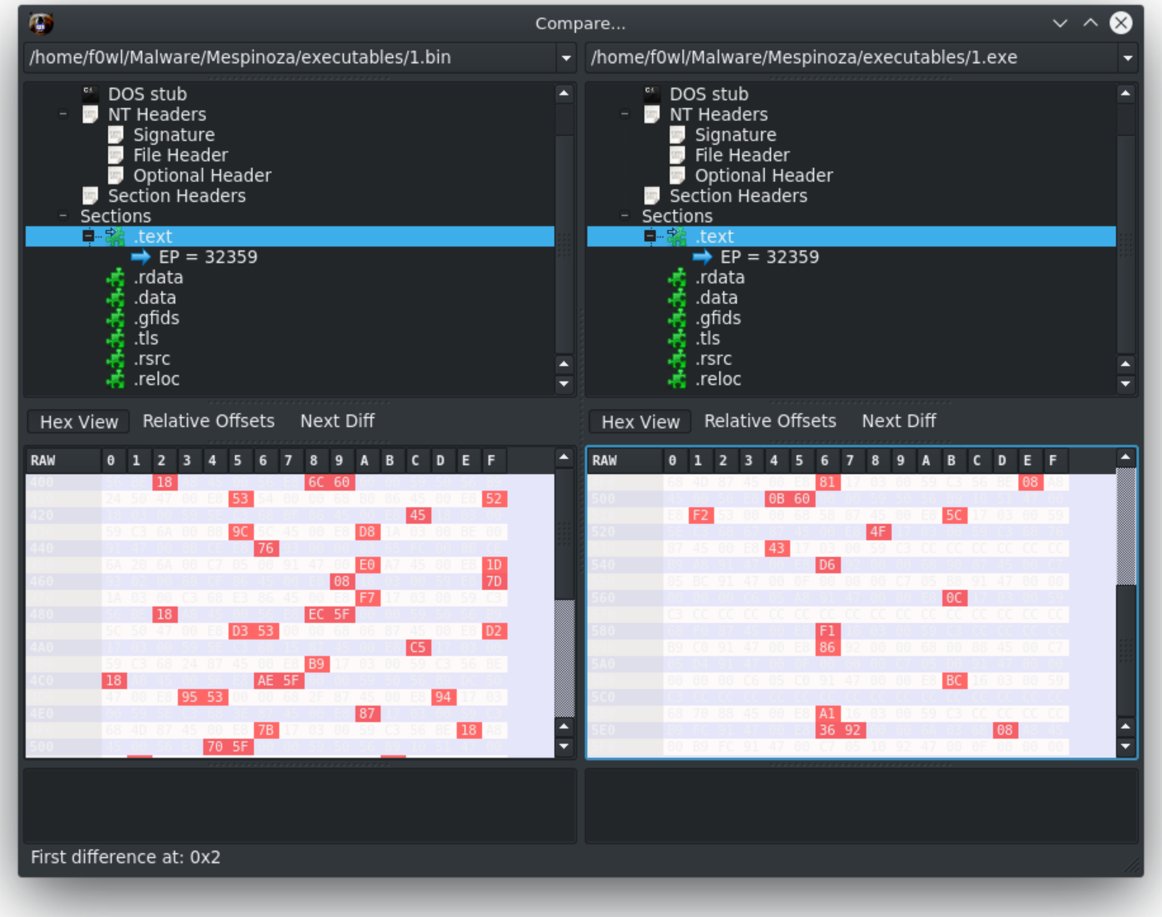
As this article is work in progress I will update it as soon as I can. As I did not see the Malware deleting the Volume Shadow Copies until now, so one option for possible victims would be to run Photorec or Recuva to check for recoverable files.

## Update 22.01.2020:

There's a new version of the Mespinoza / .pysa Variant compiled on the 18th of Jańuary:

Mespinoza (.pysa) @ AnyRun --> `` `sha256 e9662b468135f758a9487a1be50159ef57f3050b753de2915763b4ed78839ead ``

In the screenshot below you can see a comparison of the old sample (1.exe) and the new one (1.bin). Exept for a few minor changes the two samples are mostly identical:



```
/home/f0wl/Malware/Mespinoza/executables/1.bin
  DOS stub
  NT Headers
    Signature
    File Header
    Optional Header
  Section Headers
Sections
  .text
    EP = 32359
  .rdata
  .data
  .gfids
  .tls
  .rsrc
  .reloc
```

```
/home/f0wl/Malware/Mespinoza/executables/1.exe
  DOS stub
  NT Headers
    Signature
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  Section Headers
Sections
  .text
    EP = 32359
  .rdata
  .data
  .gfids
  .tls
  .rsrc
  .reloc
```

First difference at: 0x2

The public Key used by the criminals is still the same (converted from hex to raw, key blob located in the binary):

```
MIICIDANBgkqhkiG9w0BAQEFAAOCAg0AMIICCAKCAgEA6dYN+TogNihncAJNXRhtUeyj7EQ/BIGbupIM
q5PRI3a1+HqMXEk5vdb3NhzFBUoVhY/jTEE71flTwHM73q9PrgovaYSl8HeXZaU+HkqjF7Ofu4Qf+SDk
oPxcubX4cFYV1r97z9vcFgFehzk+9CofEnHWEo2N656QGRXeO0PaJX/riiL672KHzMDNKzfZQnmpMHL+
KzeyJaaPVVz7V9qCCkjT+IT26xtG2jY5tggepfLQfB6ExxaoJ1j0GapQMIZ3k6F1AtBmfcNvyu3cW29a
bIOCsu1QRzfq6iSau2xx0ZaRz0l3vgU79PCLtsGw7BNPtKZdDL9dA879aKWlDBIizc3lg4IpHxdf5MOT
mpQR0kst3kyOieNlIjEAyewyRQ788o3qs8k9SS+89CD916AMEVqRcQH8ugBv5ocs0xAf+2bHe13ogIRc
iTz9ALTvtMSqhNptEBP/z+lIhuMTs2MrJRTaQLpVHUIlqAcQuLm8AHIYdGmBXEvUqPjRIo+L9Jb+P1XU
cXYHvOZUBV0VFSOoyQeqiBeaYS+PhCV6TmTRHsH/8XkPt/eGXm3Dk4feYNaZ5a9uQKYc9Akt6G0N+P8T
7zobyAWfQNqGFJhklh6JEAJw58XCJNdmETT68kfwtQ+XFB4caUHessaJ369lprAj4TjDUFfYkkm74ntG
4nVtL+sCARE===
```

The Ransomnote contents stayed the same, exept for the contact email addresses. Here are the contents of Readme.README:

```
Hi Company,

Every byte on any types of your devices was encrypted.
Don't try to use backups because it were encrypted too.

To get all your data back contact us:
raingemaximo@protonmail.com
gareth.mckie3l@protonmail.com
--------------

FAQ:

1.
   Q: How can I make sure you don't fooling me?
   A: You can send us 2 files(max 2mb).

2.
   Q: What to do to get all data back?
   A: Don't restart the computer, don't move files and write us.

3.
   Q: What to tell my boss?
   A: Protect Your System Amigo.
```

## MITRE ATT&CK

*T1215* --> Kernel Modules and Extensions --> Persistence

*T1045* --> Software Packing --> Defense Evasion

*T1012* --> Query Registry --> Discovery

*T1114* --> Email Collection --> Collection

## *IOCs*

### Mespinoza (pysa)

```
1.exe --> SHA256: a18c85399cd1ec3f1ec85cd66ff2e97a0dcf7ccb17ecf697a5376da8eda4d327
          SSDEEP: 12288:aVchT6oi+OeO+OeNhBBhhBBpiOTn5CjGGc4dXOsOjKf:aVc1Jiin5yGpMIj

File size: 504.50 KB
```

### Associated Files

```
Readme.README
%temp%\update.bat
```

### E-Mail Addresses

```
aireyeric@protonmail[.]com
ellershaw.kiley@protonmail[.]com

Used in previous campaigns:

mespinoza980@protonmail[.]com
alanson_street8@protonmail[.]com
lambchristoffer@protonmail[.]com
```

## Ransomnote

```
Hi Company,

Every byte on any types of your devices was encrypted.
Don't try to use backups because it were encrypted too.

To get all your data back contact us:
aireyeric@protonmail.com
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--------------

FAQ:

1.
   Q: How can I make sure you don't fooling me?
   A: You can send us 2 files(max 2mb).

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   Q: What to tell my boss?
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```