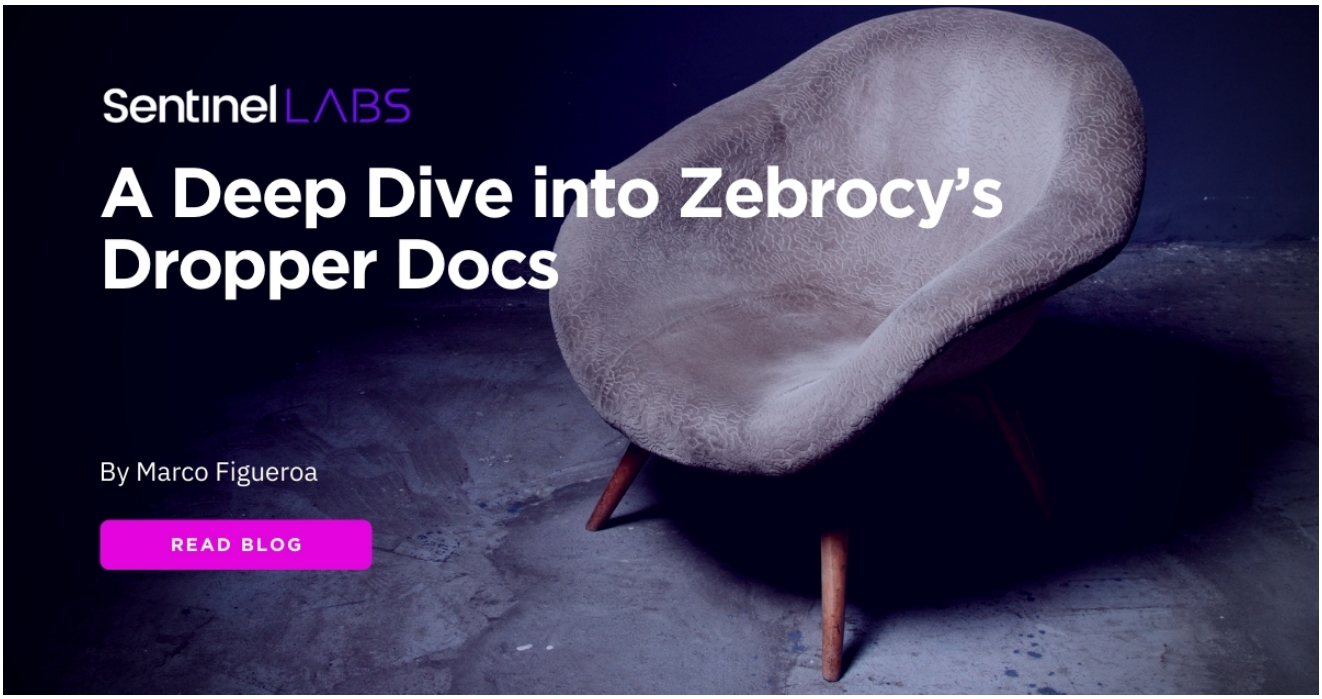
A Deep Dive into Zebrocy's Dropper Docs

labs.sentinelone.com/a-deep-dive-into-zebrocys-dropper-docs/

Marco Figueroa



Contributor: Amitai Ben Shushan Ehrlich

Sofacy is an APT threat actor that's been around since 2008 and rose to prominence with the election hacks of 2016. Better known as FancyBear or APT28, this threat actor targets governments, military, and private organizations and has been known to engage in hack-and-leak operations. In the past couple of years, Sofacy has drastically retooled and largely evaded analysts. One of the more consistent subgroups is known as Zebrocy. Their targeting appears primarily focused on former Soviet Republics and, more recently, Asia.

In March 2021, we observed a cluster of activities targeting Kazakhstan with Delphocy – malware written in Delphi and previously associated with Zebrocy. The Word documents that were observed purport to be from a Kazakhy company named Kazchrome, a mining and metal company and one of the world's largest producers of chrome ore and ferroalloys.

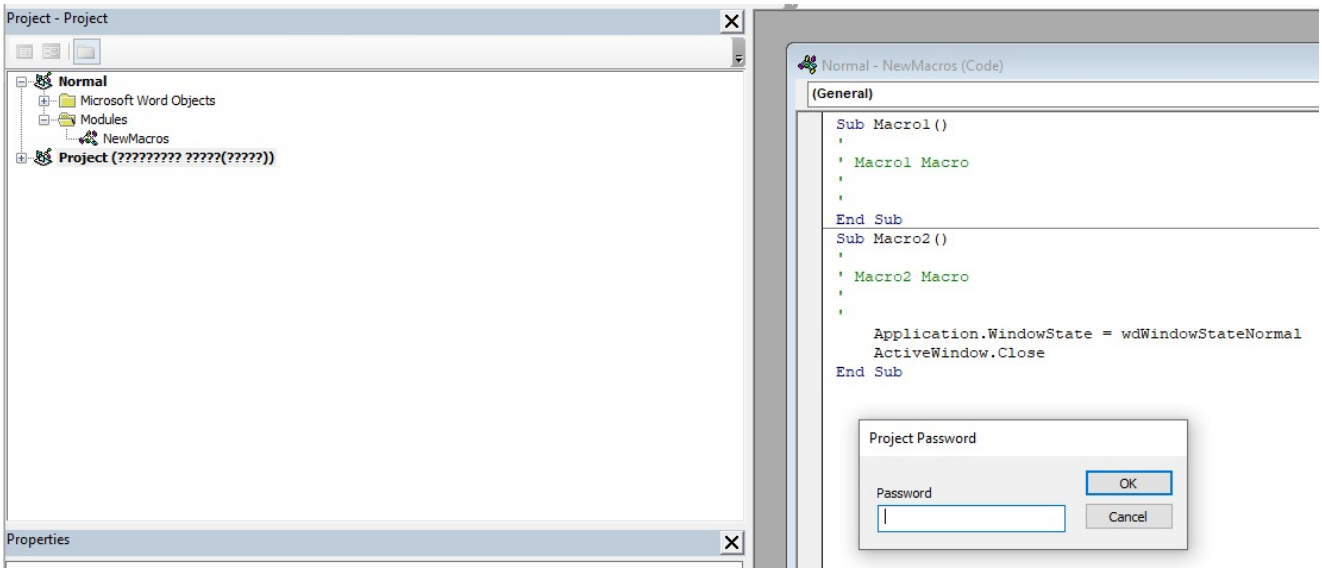
In total, we found six Delphocy Word documents that appear to be related to this cluster, all of which contain the same VBA script that drops a PE. Out of the six Word documents, two appear to be authentic uploads to VirusTotal by victims originating from Kazakhstan. The uploaded files contain what appeared to be the original filenames Авансовый отчет(новый).doc and Форма докладной (служебной) записки.doc.

In this post, we take a deep dive into these samples and share some techniques other analysts can employ to reverse engineer Delphocy dropper docs. We show how researchers can bypass password-protected macros and describe both how to decompile Delphi using IDR (Interactive Delphi Reconstructor) and how to import the saved IDC file into Ghidra using dhrake's plugin.

The results of our analysis led us to discover further Zebrocy clusters; a list of IOCs and YARA detection rules are provided to enable threat hunters to search for these and related artifacts in their environments.

Bypassing VBA Macro Password Protection

When analyzing Office documents with VBA macros, threat hunters have many different tools and techniques that do the job, but I've built a habit that I still use when I first started reversing malware to bypass password-protected macros manually.



1. Open up your favorite hex editor. I use HxD.
2. Load the Word Document.
3. Search for the following text:
    1. `CMG=`
    2. `GC=`
    3. `DPB=`
4. Add an `x` to each of them:
    1. `CMGx=`
    2. `GCx=`
    3. `DPBx=`
5. Save the file with the changes.

HxD - [C:\Users\Marco\Desktop\Авансовый отчет(новый).doc]

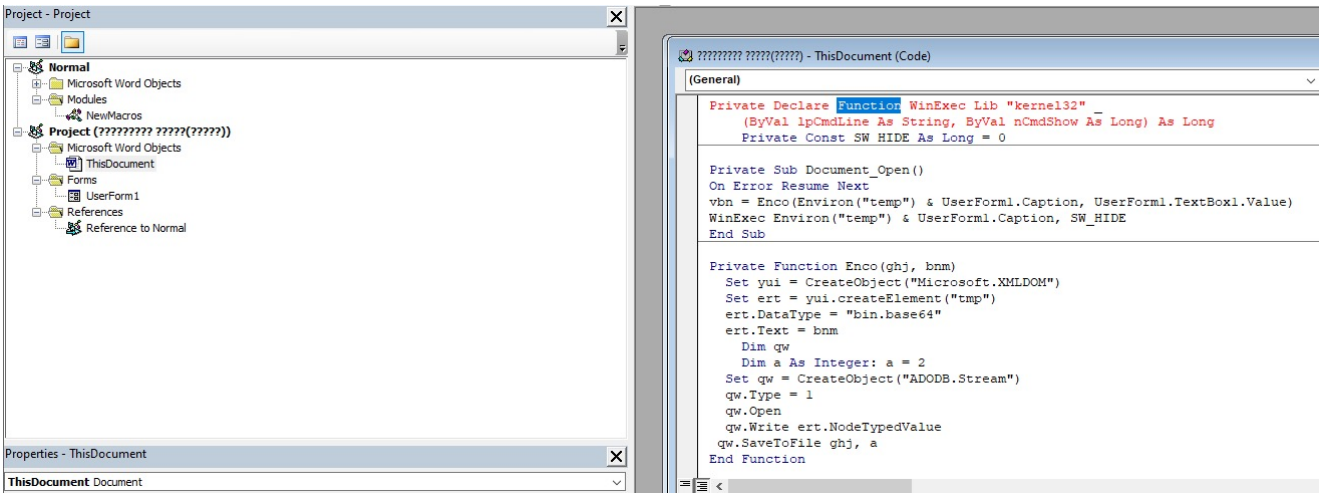
File Edit Search View Analysis Tools Window Help

16 | Windows (ANSI) | hex

Авансовый отчет(новый).doc

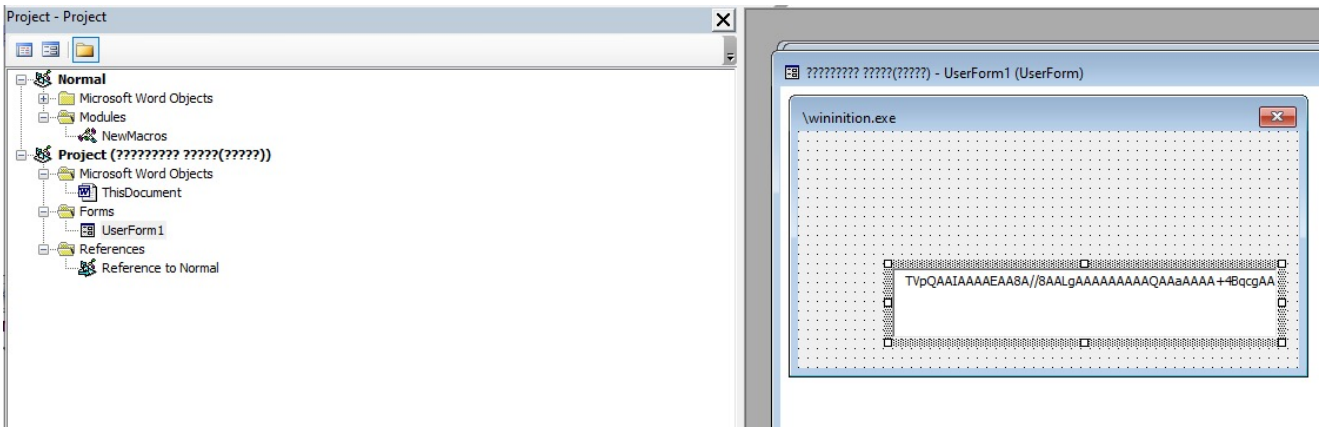
```
Offset(h)  00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F  Decoded text
004B8110   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
004B8120   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
004B8130   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
004B8140   49 44 3D 22 7B 30 30 30 30 30 30 30 30 2D 30 30  ID="{00000000-00
004B8150   30 30 2D 30 30 30 30 2D 30 30 30 30 2D 30 30 30  00-0000-0000-000
004B8160   30 30 30 30 30 30 30 30 30 7D 22 0D 0A 44 6F 63  000000000}"..Doc
004B8170   75 6D 65 6E 74 3D 54 68 69 73 44 6F 63 75 6D 65  ument=ThisDocume
004B8180   6E 74 2F 26 48 30 30 30 30 30 30 30 30 0D 0A 42  nt/&H00000000..B
004B8190   61 73 65 43 6C 61 73 73 3D 55 73 65 72 46 6F 72  aseClass=UserFor
004B81A0   6D 31 0D 0A 48 65 6C 70 46 69 6C 65 3D 22 22 0D  m1..HelpFile="".
004B81B0   0A 4E 61 6D 65 3D 22 50 72 6F 6A 65 63 74 22 0D  .Name="Project".
004B81C0   0A 48 65 6C 70 43 6F 6E 74 65 78 74 49 44 3D 22  .HelpContextID="
004B81D0   30 22 0D 0A 56 65 72 73 69 6F 6E 43 6F 6D 70 61  0"..VersionCompa
004B81E0   74 69 62 6C 65 33 32 3D 22 33 39 33 32 32 32 30  tible32="3932220
004B81F0   30 30 22 0D 43 4D 47 78 3D 22 31 35 31 37 42 39  00".CMGx="1517B9
004B8200   35 42 43 39 46 37 43 44 46 37 43 44 46 33 44 31  5BC9F7CDF7CDF3D1
004B8210   46 33 44 31 22 0D 0A 44 50 42 3D 22 41 44 41 46  F3D1"..DPB="ADAF
004B8220   30 31 43 33 30 31 34 36 31 45 34 36 31 45 42 39  01C301461E461EB9
004B8230   45 32 34 37 31 45 36 31 36 46 30 31 44 30 36 30  E2471E616F01D060
004B8240   39 33 43 35 39 41 37 43 34 44 33 30 46 36 34 41  93C59A7C4D30F64A
004B8250   35 31 42 44 45 44 44 41 39 38 45 43 31 35 39 30  51BDEDDA98EC1590
004B8260   43 39 42 31 39 31 46 46 22 0D 47 43 78 3D 22 34  C9B191FF".GCx="4
004B8270   35 34 37 45 39 36 42 31 39 30 32 31 41 30 32 31  547E96B19021A021
004B8280   41 30 32 22 0D 0A 0D 0A 5B 48 6F 73 74 20 45 78  A02"....[Host Ex
```

When opening the Word document and viewing the macro this time, you can see the script as well as the Forms. When analyzing the function, what immediately sticks out is the `ert.DataType = “bin.base64”`, showing that the UserForm1 is encoded with base64.

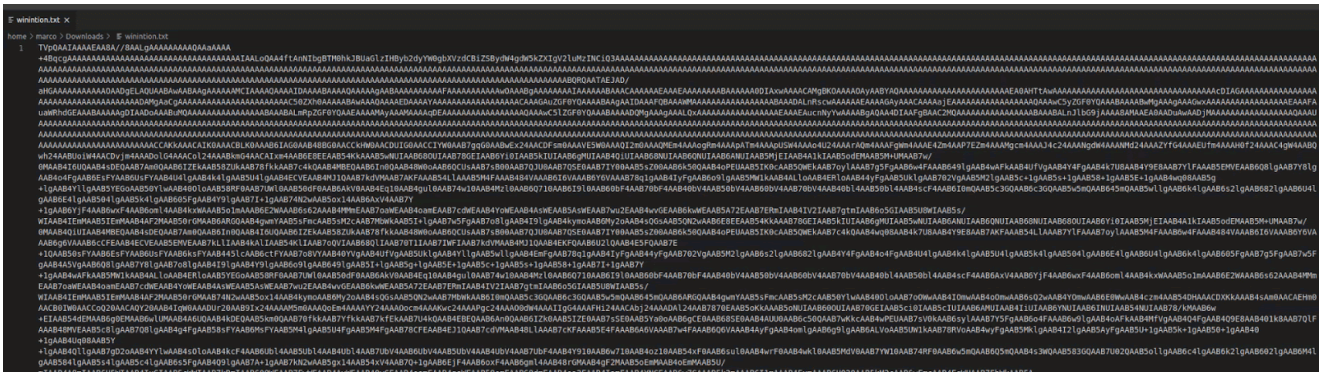


Wininition UserForm

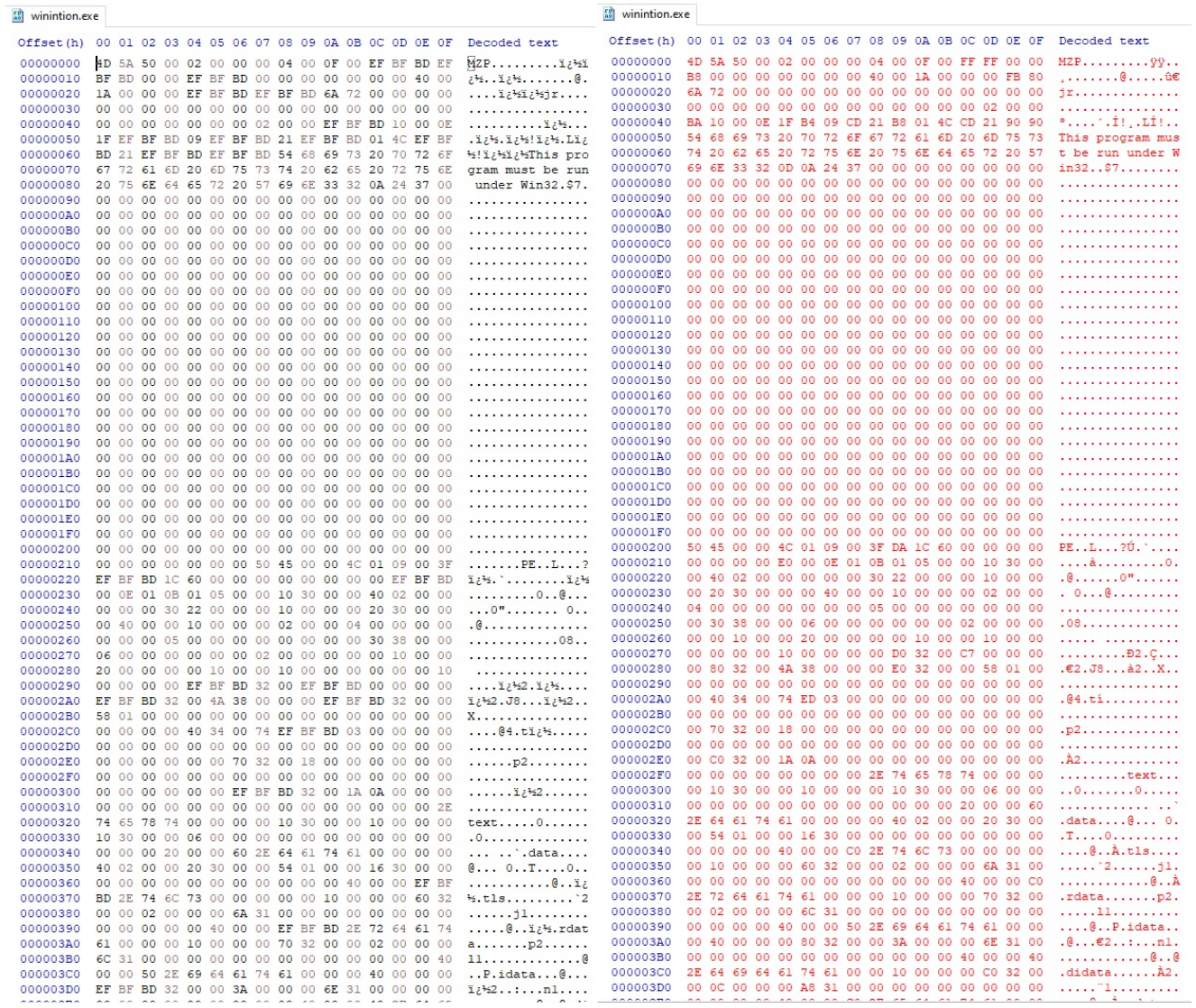
When selecting on UserForm1, the textbox reveals a `base64` encoded string; we know this because of the function we discussed above. The next step is to copy the entire string into a file so it can be decoded.



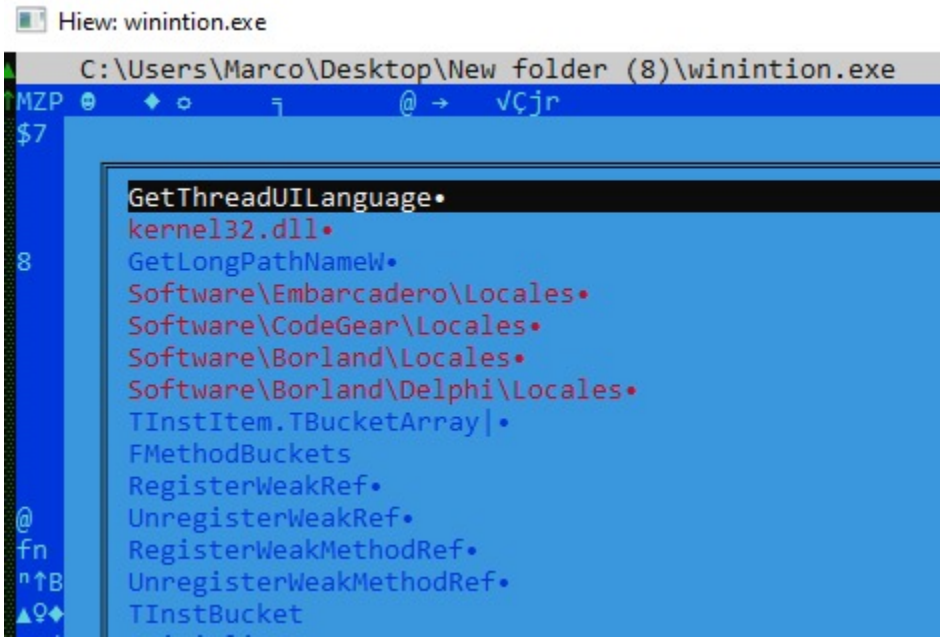
Now we decode the binary from `base64` and save it to disk as `wininition.exe`.



Following that, clean the headers using HxD, and then use PE-Bear to fix the sections headers to move to the next phase of the analysis.



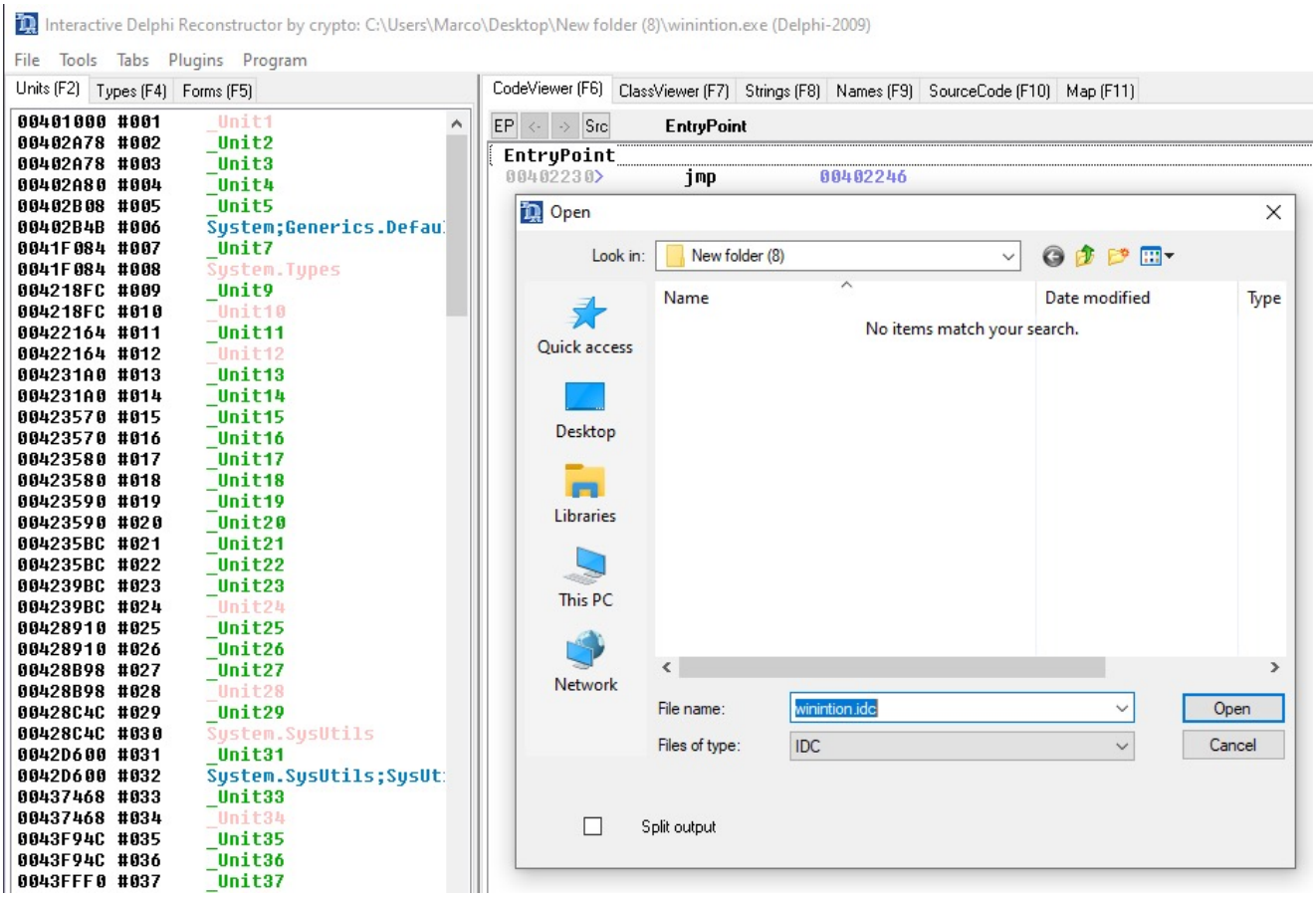
When triaging a binary, the go-to tool is Hiew to investigate and look for clues for a deeper understanding. With `wininition`, I notice the Embarcadero string, which means that this binary was written in Delphi. When reversing Delphi binaries I've always used IDR (Interactive Delphi Reconstructor). IDR is a decompiler of executable files and dynamic libraries (DLL) written in Delphi.

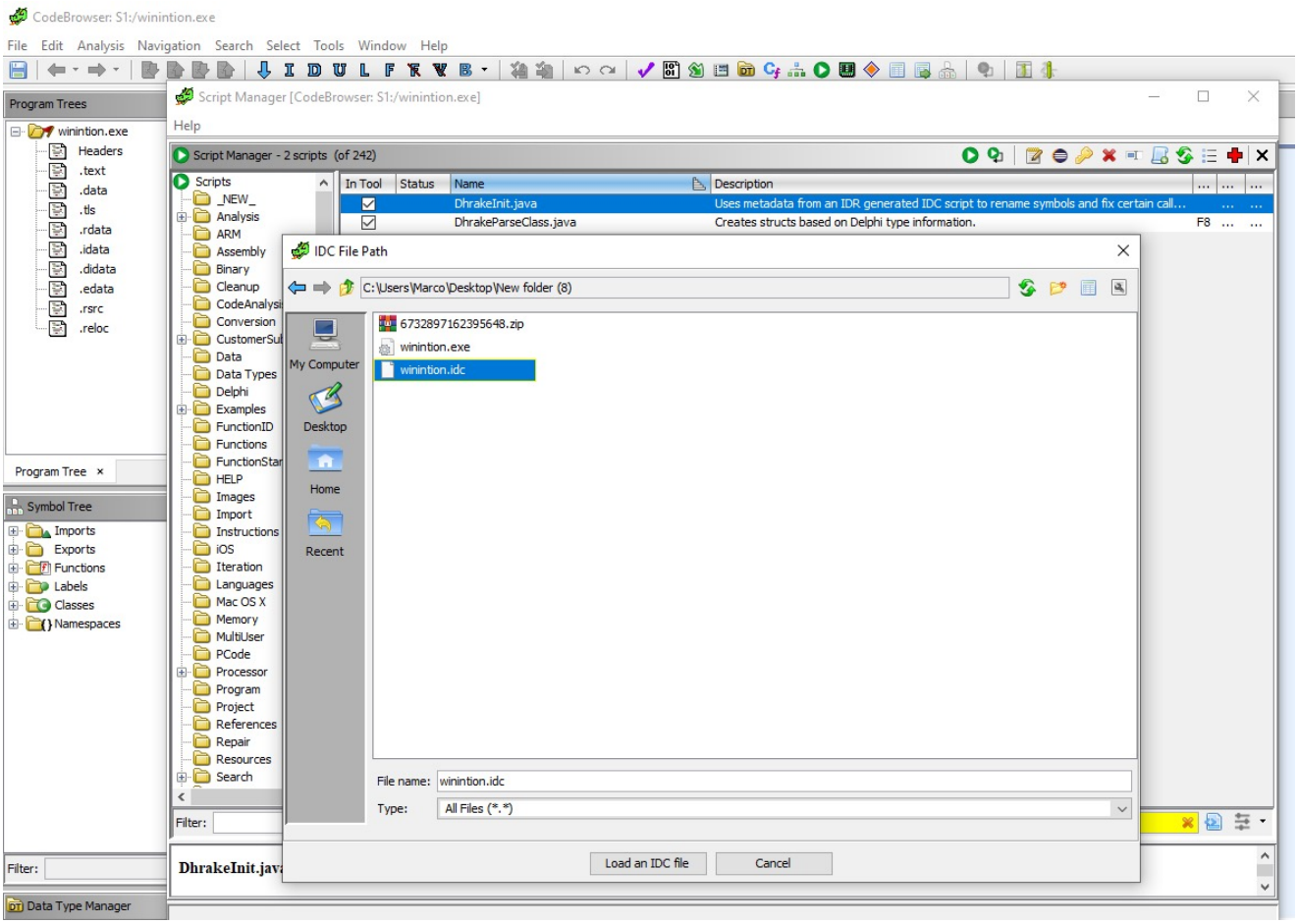


Reversing Delphi Binaries with Ghidra and dhrake

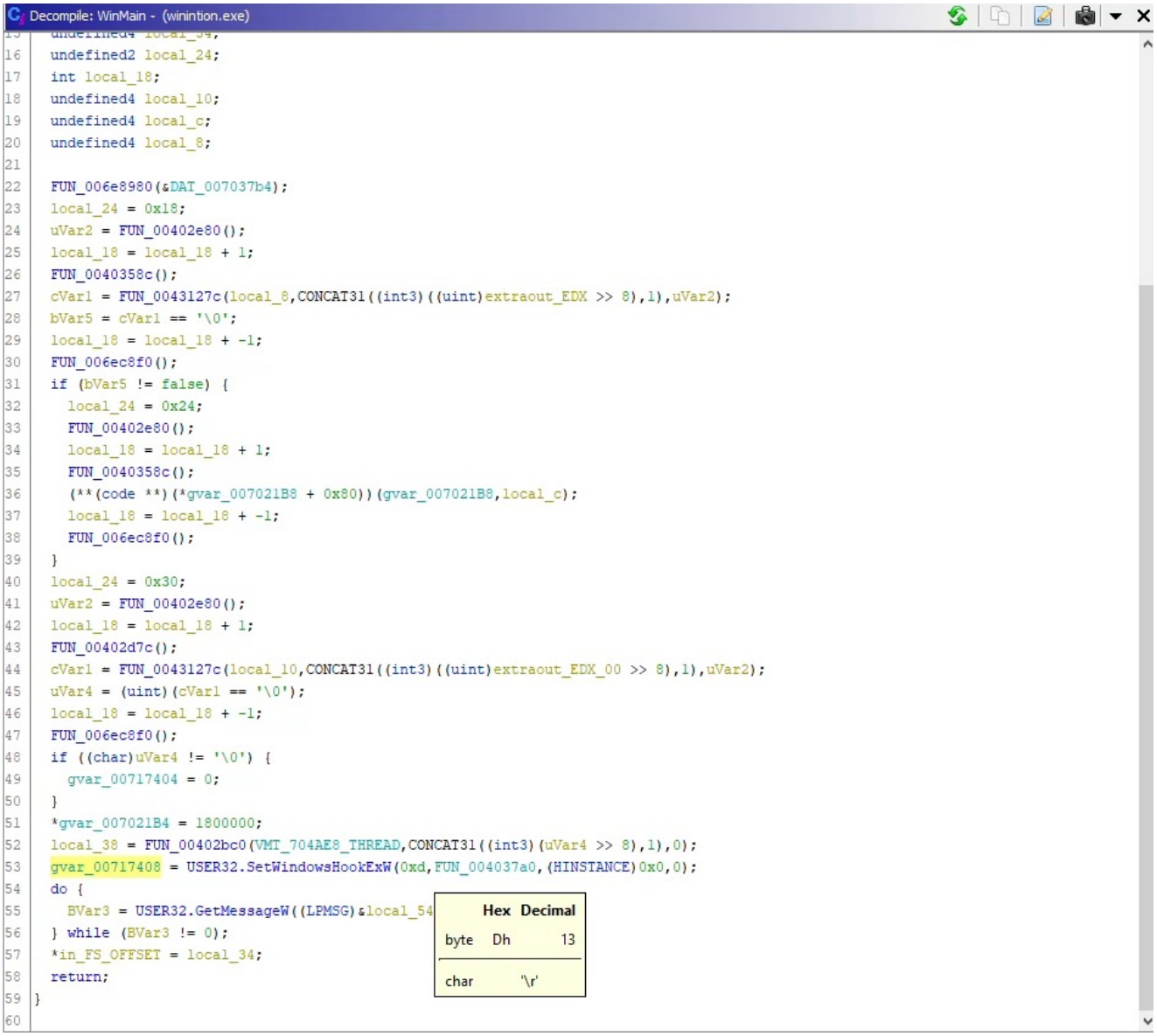
When searching for the latest developments with IDR, I came across a fantastic plugin for Ghidra, a collection of scripts for reverse engineering Delphi binaires in Ghidra using IDR's output to IDC. It was published over a year ago, but it is a gem if threat hunters are using Ghidra.

dhrake allows you to import the IDC file from IDR into Ghidra. This will import the Symbol names, function signatures and create structs for Delphi classes. This plugin extracts and applies the Delphi symbols from the IDC file, which is generated by IDR, and attempts to find cases where Ghidra has incorrectly determined the entry point of a function. If you've never imported a plugin to Ghidra please read this post. I've saved the IDC to a selected folder. I then install the plugin in Ghidra and run the script it prompts for the IDC file and then load it!


Interactive Delphi Reconstructor by crypto: C:\Users\Marco\Desktop\New folder (8)\winintion.exe (Delphi-2009)
File Tools Tabs Plugins Program
Units (F2) Types (F4) Forms (F5)
00401000 #001 _Unit1
00402A78 #002 _Unit2
00402A78 #003 _Unit3
00402A80 #004 _Unit4
00402B08 #005 _Unit5
00402B4B #006 System;Generics.Defau
0041F084 #007 _Unit7
0041F084 #008 System.Types
004218FC #009 _Unit9
004218FC #010 _Unit10
00422164 #011 _Unit11
00422164 #012 _Unit12
004231A0 #013 _Unit13
004231A0 #014 _Unit14
00423570 #015 _Unit15
00423570 #016 _Unit16
00423580 #017 _Unit17
00423580 #018 _Unit18
00423590 #019 _Unit19
00423590 #020 _Unit20
004235BC #021 _Unit21
004235BC #022 _Unit22
004239BC #023 _Unit23
004239BC #024 _Unit24
00428910 #025 _Unit25
00428910 #026 _Unit26
00428B98 #027 _Unit27
00428B98 #028 _Unit28
00428C4C #029 _Unit29
00428C4C #030 System.SysUtils
0042D600 #031 _Unit31
0042D600 #032 System.SysUtils;SysUt
00437468 #033 _Unit33
00437468 #034 _Unit34
0043F94C #035 _Unit35
0043F94C #036 _Unit36
0043FFF0 #037 _Unit37
CodeViewer (F6) ClassViewer (F7) Strings (F8) Names (F9) SourceCode (F10) Map (F11)
EP Src EntryPoint
EntryPoint
00402230> jmp 00402246
Open
Look in: New folder (8)
Quick access
Desktop
Libraries
This PC
Network
Name
Date modified
Type
No items match your search.
File name: winintion.idc
Files of type: IDC
Open
Cancel
Split output



In the `winiinition` binary, the first function WinMain has `SetWindowsHookExW` function, which is a hook procedure to monitor a system for certain types of events. The hook procedures low-level keyboard input events is `WH_KEYBOARD_LL`, which is the number 13 in the parameter. This hook is a mechanism that intercepts keystroke events. All the events are then saved to a log file to be sent to a C2.



The C2 is obfuscated using hex that can be converted to ascii:

```
68747470733A2F2F7777772E786268702E636F6D2F646F6D696E617267726561746173696E6F64797373
```

```
hxxps://www.xbhp[.]com/dominargreatasianodyssey/wp-content/plugins/akismet/style.php
```

```
68747470733A2F2F7777772E63346373612E6F72672F696E636C756465732F736F75726365732F66656C69
```

```
hxxps://www.c4csa[.]org/includes/sources/felims.php
```

Note: These appear to be compromised domains.

Conclusion

Analysis of these documents led us to find other Zebrocy clusters. As Zebrocy continues to evolve its scope, organizations must have the proper visibilities and detection capabilities to find this threat actor. We hope the techniques discussed in this post will be useful to other

researchers in analyzing Delphocy dropper docs in particular, and documents with password-protected macros in general.

Indicators of Compromise

Word Documents

SHA256

3b548a851fb889d3cc84243eb8ce9cbf8a857c7d725a24408934c0d8342d5811
1dd03c4ea4d630a59f73e053d705185e27e2e2545dd9caedb26a824ac5d11466
1e8261104cbe4e09c19af7910f83e9545fd435483f24f60ec70c3186b98603cc
c213b60a63da80f960e7a7344f478eb1b72cee89fd0145361a088478c51b2c0e
2bf088955007b4f47fe9187affe65fffea234ff16596313a74958a7c85129172
d9e7325f266eda94bfa8b8938de7b7957734041a055b49b94af0627bd119c51c

SHA1

fc0b7ad2ae9347d6d2ababe2947ffb9f7cc73030
71b4b9f105de94090fc36d9226faaa1db6d9f3d1
6a8f63c4491adcf2cf7f76cd1481c5647615a6c9
a3ecf1fdc1206e9d3061530fa91775cf3d97f788
ae01ca2cf0dc07abb3a7bef9930e38c9212975d5
66b39f4fd1dd51c2f548330e5818f732dad0aa28

VBA

SHA256

a442135c04dd2c9cbf26b2a85264d31a5ac4ec5d2069a7b63bc14b64a6dd82b7

SHA1

6ec4eb883752b70db134ac0f4e0d5b4a77196184

Wininition

SHA256

ee7cfc55a49b2e9825a393a94b0baad18ef5bfced67531382e572ef8a9ecda4b

SHA1

afbdb13d8f620d0a5599cbc7a7d9ce8001ee32f1

URLs

hxxps://www.xbhp[.]com/dominargreatasianodyssey/wp-content/plugins/akismet/style.php
hxxps://www.c4csa[.]org/includes/sources/felims.php

Yara Rules

```
rule apt_RU_delphocy_encStrings {
  meta:
    desc = "Hex strings in Delphocy drops"
    author = "JAG-S @ SentinelLabs"
    version = "1.0"
    TLP = "White"
    last_modified = "04.09.2021"
    hash0 = "ee7cfc55a49b2e9825a393a94b0baad18ef5bfced67531382e572ef8a9ecda4b"
    hash1 = "07b2d21f4ef077ccf16935e44864b96fa039f2e88c73b518930b6048f6baad74"

  strings:
    $enc_keylogger2 = "5B4241434B53504143455D" ascii wide
    $enc_keylogger3 = "5B5441425D" ascii wide
    $enc_keylogger4 = "5B53484946545D" ascii wide
    $enc_keylogger5 = "5B434F4E54524F4C5D" ascii wide
    $enc_keylogger6 = "5B4553434150455D" ascii wide
    $enc_keylogger7 = "5B454E445D" ascii wide
    $enc_keylogger8 = "5B484F4D455D" ascii wide
    $enc_keylogger9 = "5B4C4546545D" ascii wide
    $enc_keylogger10 = "5B55505D" ascii wide
    $enc_keylogger11 = "5B52494748545D" ascii wide
    $enc_keylogger12 = "5B444F574E5D" ascii wide
    $enc_keylogger13 = "5B434150534C4F434B5D" ascii wide
    $cnc1 =
"68747470733A2F2F7777772E786268702E636F6D2F646F6D696E617267726561746173696616E6F6479737
 ascii wide
    $cnc2 =
"68747470733A2F2F7777772E63346373612E6F72672F696E636C756465732F736F75726365732F66656C6
 ascii wide

  condition:
    uint16(0) == 0x5a4d and (any of ($cnc*) or all of ($enc_keylogger*))
}
```

```
rule apt_RU_Delphocy_Maldocs {
  meta:
    desc = "Delphocy dropper docs"
    author = "JAG-S @ SentinelLabs"
    version = "1.0"
    TLP = "White"
    last_modified = "04.09.2021"
    hash1 = "3b548a851fb889d3cc84243eb8ce9cbf8a857c7d725a24408934c0d8342d5811"
    hash2 = "c213b60a63da80f960e7a7344f478eb1b72cee89fd0145361a088478c51b2c0e"
    hash3 = "d9e7325f266eda94bfa8b8938de7b7957734041a055b49b94af0627bd119c51c"
    hash4 = "1e8261104cbe4e09c19af7910f83e9545fd435483f24f60ec70c3186b98603cc"

  strings:
    $required1 = "_VBA_PROJECT" ascii wide
    $required2 = "Normal.dotm" ascii wide
    $required3 = "bin.base64" ascii wide
    $required4 = "ADODB.Stream$" ascii wide
    $author1 = "Dinara Tanmurzina" ascii wide
    $author2 = "Hewlett-Packard Company" ascii wide
    $specific = "Caption         =   "wininition.exe"" ascii wide
    $builder1 = "Begin {C62A69F0-16DC-11CE-9E98-00AA00574A4F} UserForm1" ascii wide
    $builder2 = "{02330CFE-305D-431C-93AC-29735EB37575}{33D6B9D9-9757-485A-89F4-
4F27E5959B10}" ascii wide
    $builder3 = "VersionCompatible32="393222000"" ascii wide
    $builder4 = "CMG="1517B95BC9F7CDF7CDF3D1F3D1"" ascii wide
    $builder5 =
"DPB="ADAF01C301461E461EB9E2471E616F01D06093C59A7C4D30F64A51BDEDDA98EC1590C9B191FF""
ascii wide
    $builder6 = "GC="4547E96B19021A021A02"" ascii wide

  condition:
    uint32(0) == 0xE011CFD0 and all of ($required*) and (all of ($author*) or
$specific or 5 of ($builder*))
}
```