ethical.blue Magazine

Metadata

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- Program Debug Information
- File Artifacts and Anomalies
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0xde54

Index

23:59:59.9999999 UTC, December 31, 9999

Metadata is information about data. It has a wide definition. For example, a book in a library typically has metadata, including the author, title, and publication year.

It is similar to a file on a computer. Any file has attributes like file type, size, and timestamps. This information is related to a file system and can be obtained in various ways. For example, one can use the `Get-Item` command-let in PowerShell (Scriptum 1).

```
Get-Item "C:\de54\anomaly.exe" |
   Select-Object Name, CreationTime,
   LastWriteTime, LastAccessTime
   | Format-List
```

Scriptum 1. Get file creation, modification, and last access times (PowerShell)

Example file attributes can be as presented below (Scriptum 2).

```
Name:           anomaly.exe
CreationTime:   15.10.2012 02:00:00
LastWriteTime:  15.10.2012 02:00:00
LastAccessTime: 17.03.2026 17:55:21
```

Scriptum 2. Example timestamps from Get-Item in PowerShell

Easy ways for timestamp manipulation can lead to anomalous values. Example from Scriptum 3 contains PowerShell code that sets the file creation time to a future value.

```
Add-Type -AssemblyName System.IO;
   [System.IO.File]::SetCreationTime
   ("C:\\de54\\anomaly.exe",
   [DateTime]::new(3050, 10, 15,
    3, 3, 0));
```

Scriptum 3. Set file creation time in PowerShell using .NET methods

Now, file creation time can be read using PowerShell and .NET methods as in Scriptum 4.

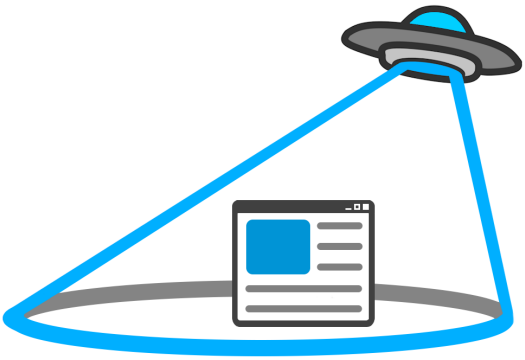
```
(Get-Item "C:\de54\anomaly.exe").
   CreationTime.ToString(
   "yyyy-MM-dd HH:mm:ss");
```

Scriptum 4. Read file creation time in PowerShell using .NET methods

The timestamp value will be printed to the console. See below.

```
3050-10-15 03:03:00
```

The limit is `DateTime.MaxValue`. That is 23:59:59.9999999 UTC, December 31, 9999.



```
LastAccessTime : 31.12.9999 23:59:59

PS C:\>
```

```
.blue

ype -AssemblyName System.IO; [System.IO.File]::SetLastAccessTime(
omaly.exe", [DateTime]::MaxValue);
tem "C:\de54\anomaly.exe" | Select-Object Name, CreationTime,
, LastAccessTime | Format-List

   : anomaly.exe
   : 31.12.9999 23:59:59
   : 31.12.9999 23:59:59
e : 31.12.9999 23:59:59
```

```
зона://ethical.blue

PS C:\> Add-Type -AssemblyName
"C:\\de54\\anomaly.exe", [DateT
PS C:\> Get-Item "C:\de54\anoma
LastWriteTime, LastAccessTime |

Name           : anomaly.exe
CreationTime   : 31.12.9999 23:
LastWriteTime  : 31.12.9999 23:
LastAccessTime : 31.12.9999 23:

PS C:\>
```

```
зона://ethical.blue

PS C:\> Add-Type -AssemblyName System.IO; [System.IO.File]::SetLastAccessTime(
"C:\\de54\\anomaly.exe", [DateTime]::MaxValue);
PS C:\> Get-Item "C:\de54\anomaly.exe" | Select-Object Name, CreationTime,
LastWriteTime, LastAccessTime | Format-List

Name           : anomaly.exe
CreationTime   : 31.12.9999 23:59:59
LastWriteTime  : 31.12.9999 23:59:59
LastAccessTime : 31.12.9999 23:59:59

PS C:\>
```

```
она://ethical.blue

C:\> Add-Type -AssemblyName System.IO; [System.IO.File]::SetLastAccessTime(
\\de54\\anomaly.exe", [DateTime]::MaxValue);
C:\> Get-Item "C:\de54\anomaly.exe" | Select-Object Name, CreationTime,
tWriteTime, LastAccessTime | Format-List

e           : anomaly.exe
ationTime   : 31.12.9999 23:59:59
tWriteTime  : 31.12.9999 23:59:59
tAccessTime : 31.12.9999 23:59:59

C:\>
```

```
зона://ethical.blue

PS C:\> Add-Type -AssemblyName System.IO; [S
"C:\\de54\\anomaly.exe", [DateTime]::MaxValu
PS C:\> Get-Item "C:\de54\anomaly.exe" | Sel
LastWriteTime, LastAccessTime | Format-List

Name           : anomaly.exe
CreationTime   : 31.12.9999 23:59:59
LastWriteTime  : 31.12.9999 23:59:59
LastAccessTime : 31.12.9999 23:59:59

PS C:\>
```

```
Name System.IO; [System.IO.File]::SetLastAccessTime(
DateTime]::MaxValue);
anomaly.exe" | Select-Object Name, CreationTime,
ime | Format-List

xe
9 23:59:59
9 23:59:59
9 23:59:59
```

```
зона://ethical.blue

PS C:\> Add-Type -AssemblyName System.IO; [System.
"C:\\de54\\anomaly.exe", [DateTime]::MaxValue);
PS C:\> Get-Item "C:\de54\anomaly.exe" | Select-Ob
LastWriteTime, LastAccessTime | Format-List

Name           : anomaly.exe
CreationTime   : 31.12.9999 23:59:59
LastWriteTime  : 31.12.9999 23:59:59
LastAccessTime : 31.12.9999 23:59:59
```

Disable Geotags in Photos on Android

EXIF (Exchangeable Image File Format) is a metadata standard [1] supported by almost all digital camera manufacturers. If a digital camera has a built-in GPS module and the feature is enabled, photos can be geotagged.

Simply put, the EXIF metadata may contain GPS coordinates of the location where the photo was taken.

Geotags can be disabled by denying the Camera app access to the device's location, as shown in Figure 1.

EXIF metadata can be viewed in various ways. However, uploading a picture to a webpage may sometimes strip the metadata.

Detailed information on EXIF metadata can be obtained using ExifTool created by Phil Harvey, available at exiftool.org.

ExifTool.exe is a console program. An example command that clears EXIF metadata can be:

```
exiftool.exe -all="" "C:\img\*.jpg"
```

Note that *.jpg is a wildcard expression that matches all files with the .jpg extension in the provided folder.

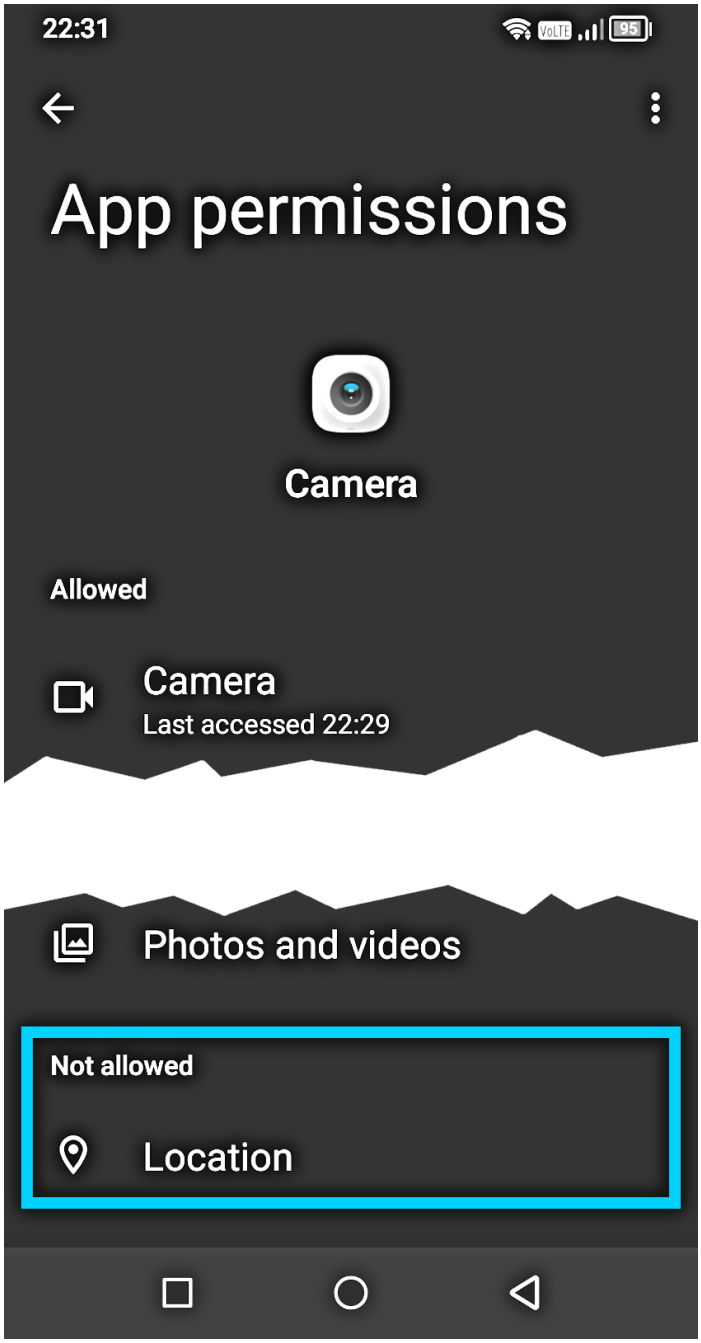


Figure 1. Disable adding geotags in photos on an Android device

Redirect Unwelcome Visitors to Null

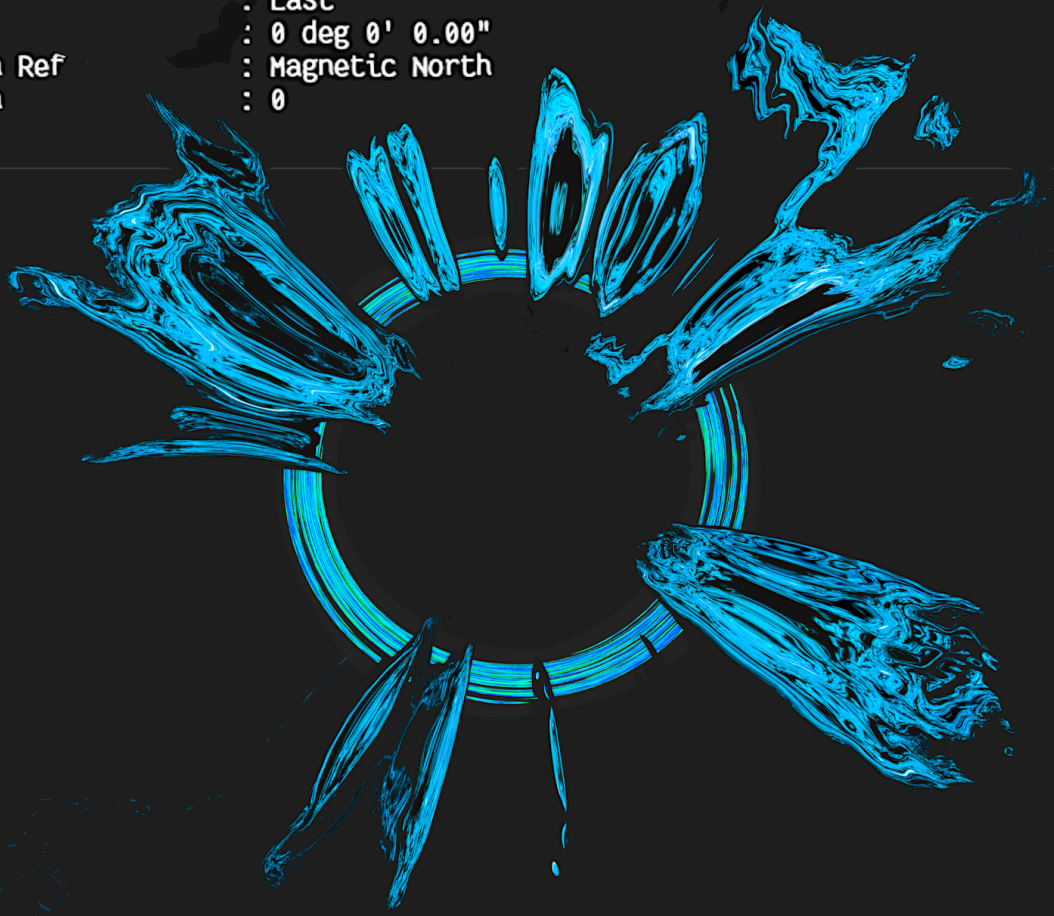
GPS Coordinates: 0° 0' 0" N, 0° 0' 0" E


exiftool_files


exiftool.exe

de54.jpg

```
зона://ethical.blue
PS C:\de54> exiftool.exe -a -gps:all de54.jpg
GPS Latitude Ref                : North
GPS Latitude                    : 40 deg 42' 46.08"
GPS Longitude Ref               : West
GPS Longitude                   : 74 deg 0' 21.60"
GPS Img Direction Ref           : Magnetic North
GPS Img Direction               : 0
PS C:\de54> exiftool -gpsposition="0.0000, 0.0000" de54.jpg
    1 image files updated
PS C:\de54> exiftool.exe -a -gps:all de54.jpg
GPS Latitude Ref                : North
GPS Latitude                    : 0 deg 0' 0.00"
GPS Longitude Ref               : East
GPS Longitude                   : 0 deg 0' 0.00"
GPS Img Direction Ref           : Magnetic North
GPS Img Direction               : 0
PS C:\de54>
```



Document Metadata

Embedded objects in complex formats may still contain metadata even after the main file cleanup (Figure 2).

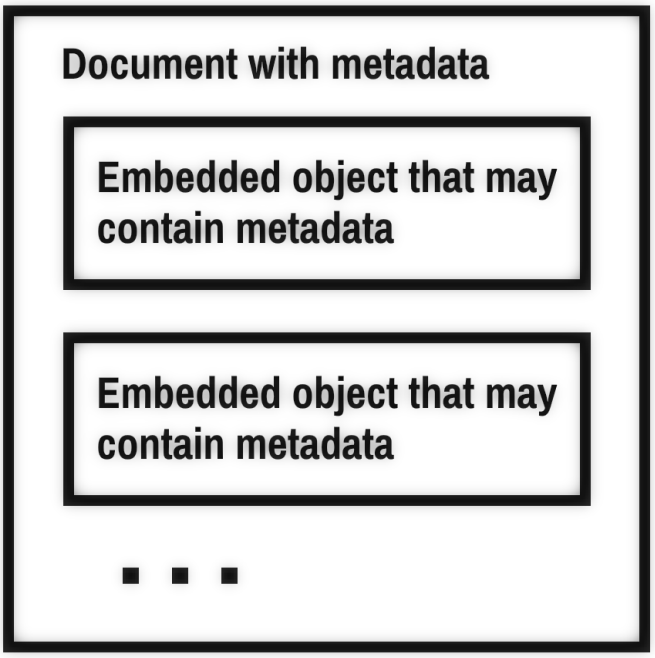


Figure 2. Embedded objects with metadata

Extracting metadata from .docx files is quite simple. See Figure 3. Embedded metadata may need detailed analysis to extract, but it is still possible.

Verify documents and embedded objects before publication. Check document details, remove unnecessary metadata, and export to PDF if possible.

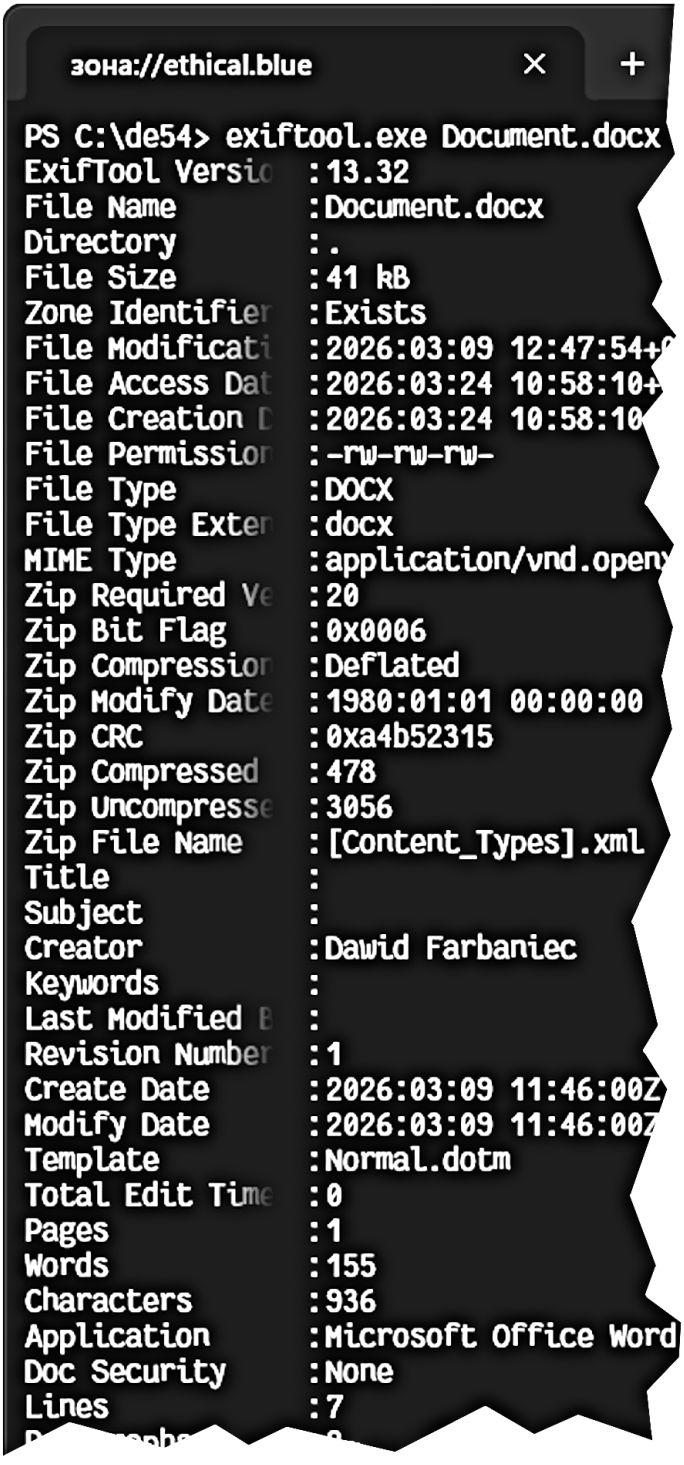


Figure 3. Document.docx file metadata

Program Database Path Embedded in Microsoft Visual C++ Executable

App.exe

```
зона://ethical.blue
PS C:\de54> Format-Hex App.exe -Offset 0x9734 -Count 0x2A

   Label: C:\de54\App.exe

          Offset Bytes                                           Ascii
                 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
          ------ ----------------------------------------------- -----
0000000000009734 43 3A 5C 64 65 35 34 5C 65 74 68 69 63 61 6C 2E C:\de54\ethical.
0000000000009744 62 6C 75 65 5C 41 70 70 5C 78 36 34 5C 44 65 62 blue\App\x64\Deb
0000000000009754 75 67 5C 41 70 70 2E 70 64 62                   ug\App.pdb

PS C:\de54>
```

C:\de54\ethical.blue\App\x64\Debug\App.pdb

Extract Embedded Text Strings

Executable files may contain plaintext strings as well as obfuscated ones.

Let's create a simple ELF file on Kali Linux.

The first command creates a C++ source file main.cpp with example code.

```
echo -e "#include <iostream> \n int
    main() { std::cout << \"ethical.
   blue\"; return 0; }" > main.cpp
```

The second command builds main.cpp to an executable named ethical.elf.

```
g++ -o ./ethical.elf ./main.cpp
```

The created file can be executed by typing file name ./ethical.elf and will print:

```
ethical.blue
```

The `strings` command looks for printable strings in a file (Figure 4).

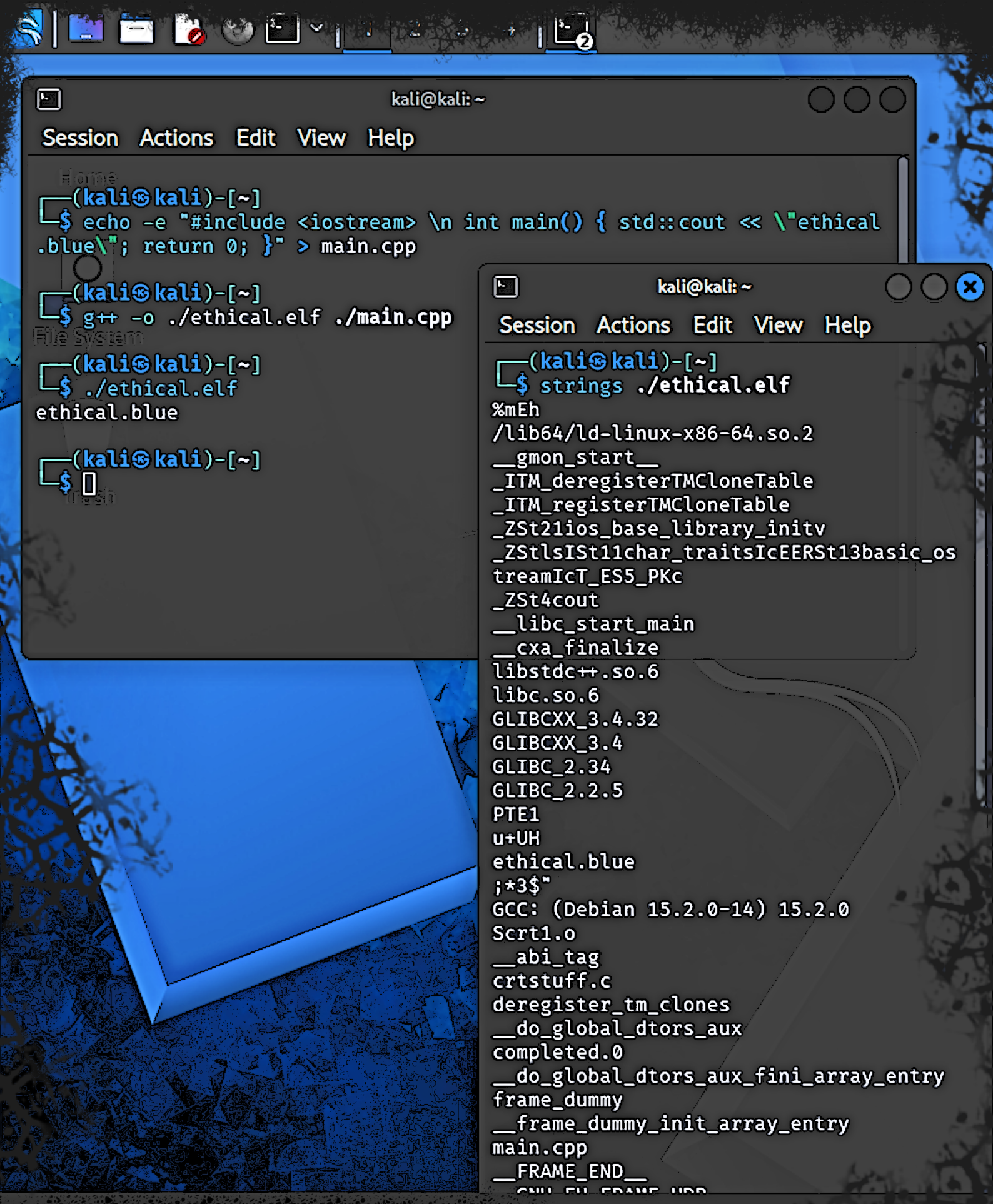
Here, in 3OHA laboratory, we use the `strings` command in the reconnaissance phase. It should be understood that the anomaly contains the specified string and nothing more.

Deeper analysis is needed to verify that embedded strings are not intended to mislead.

```
┌──(kali㉿kali)-[~]
└─$ strings ./ethical.elf
%mEh
/lib64/ld-linux-x86-64.so.2
__gmon_start__
_ITM_deregisterTMCloneTable
_ITM_registerTMCloneTable
_ZSt21ios_base_library_initv
_ZStlsISt11char_traitsIcEERS
_ZSt4cout
__libc_start_main
__cxa_finalize
libstdc++.so.6
libc.so.6
GLIBCXX_3.4.32
GLIBCXX_3.4
GLIBC_2.34
GLIBC_2.2.5
PTE1
u+UH
ethical.blue
;*3$"
GCC: (Debian 15.2.0-14) 15.2
Scrt1.o
__abi_tag
crtstuff.c
deregister_tm_clones
__do_global_dtors_aux
completed.0
__do_global_dtors_aux_fini_a
```

Figure 4. Look for printable strings in a file

Extract Embedded Text Strings



Obfuscated String Solver

Anomalies found in 3OHA may contain obfuscated strings. Embedded text strings that are not plaintext may not catch the eye during quick reconnaissance.

FLARE Obfuscated String Solver [2] is a tool that can extract:

- static ASCII and UTF-16LE strings,
- strings constructed on the stack at program run-time,
- a special form of stack strings, decoded on the stack (tight strings),
- strings decoded in a function.

This solution can automate manual reverse engineering of the string decryption routine found in the anomaly.

The FLOSS tool can be used just like strings.exe to enhance basic static analysis.

For example:

```
.\floss.exe Anomaly.de54.Win64.exe
```

Use .\floss.exe -h to display help on available program parameters.

Obfuscated String Solver

```
зона://ethical.blue
PS C:\de54> .\floss.exe Sample.MSVC++.Win64.A.exe
```

```
зона://ethical.blue
zh-chs
zh-cht
zh-cn
zh-hk
zh-mo
zh-sg
zh-tw
zu-za
CONOUT$
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Sample.MSVC++.Win64.A (Microsoft Visual C++)
```

floss.exe

Sample.MSVC++.
Win64.A.exe

Embedded Firmware Artifacts

Firmware is a binary blob embedded in the device hardware. It can be stored in flash memory or other types of storage and often contains machine code and data that are crucial for the device to operate.

In many embedded systems, the firmware is packed, encrypted, and obfuscated. It may contain bootloaders, operating systems, and other components merged into a unified binary image. Acquiring firmware for analysis can be as straightforward as downloading a binary image from the manufacturer's website or as challenging as performing invasive hardware extraction.

The most common methods are:

- Download a firmware image from the manufacturer's website.
- Intercept network traffic during a device firmware update.
- Extract the firmware through exposed hardware debug interfaces.
- Identify the chip, desolder it, place it in a compatible reader, and dump the contents.

Now, let's skip to the moment when the firmware has already been dumped into a file.

Dumped firmware is typically a continuous byte blob. Merged components can be identified using binwalk, a firmware analysis tool. See Figure 5.

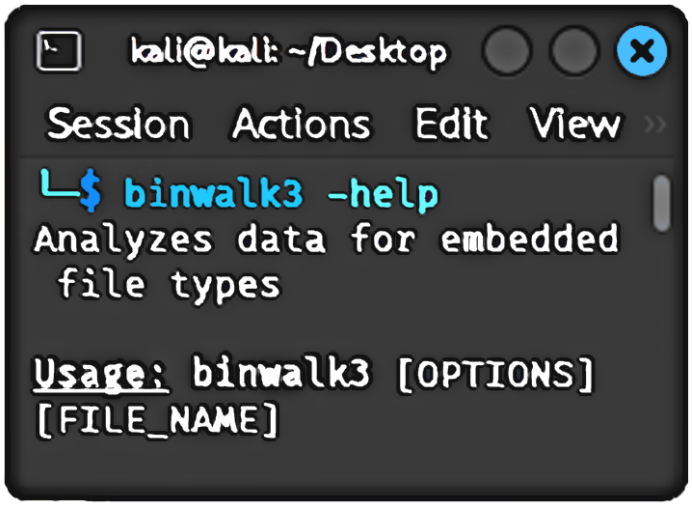


Figure 5. binwalk (Firmware Analysis Tool)

Use `binwalk3 -eM cctv-firmware` to automatically extract known file types and recursively scan extracted files (Figure 6).

Figure 6. Extract files with binwalk

Dissected elements are located in the `extractions` folder and its subfolders. To navigate to a specific folder, use the `cd` command. For example:

```
cd ./cctv-firmware.extracted
```

The `ls` command is used to list all files and directories in the current working directory or a specified path. The folder names correspond to hexadecimal offsets.

```
400     30400    C00900   C2DB94
C45118 C5C7D4   C74508   C8BEE4
CA3588 ...
```

Use `binwalk --disasm` option to identify the CPU architecture of a file using the capstone disassembler. For example:

```
binwalk --disasm ./dump.bin
```

The result contains offset and description:

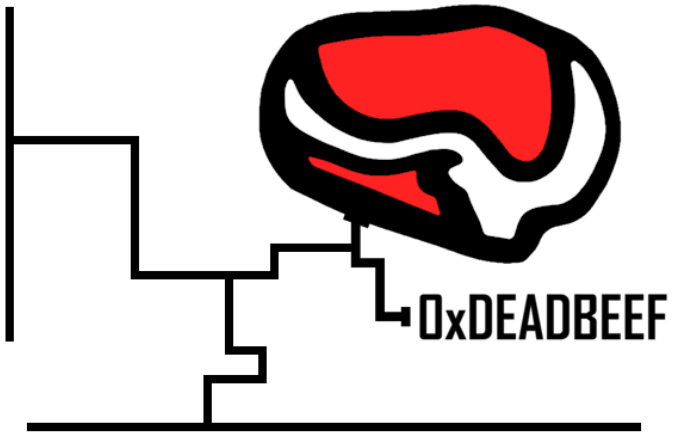
```
0xA48 ARM executable code, 32-bit,
little endian, at least 1250
valid instructions
```

Another option is `binwalk --signature`. It scans the target file(s) for common file signatures. For example:

```
binwalk --signature ./dump.bin
```

The result contains offset and description:

```
0x0 Linux kernel ARM boot
executable zImage (little-endian)
```



When working with firmware, it is often necessary to extract a specific fragment from a binary file. This can be achieved using the `dd` command in a terminal. For example:

```
dd if=decompressed.bin of=dump.bin
   bs=1 skip=4718712 count=14038
```

The command above extracts 14,038 bytes starting at offset 4,718,712 from decompressed.bin and writes them to dump.bin.

Once the binary fragments are extracted, the `strings` and `grep` commands can be used to search for specific text patterns. The command below uses the `-i` flag to search for the string "arm" in dump.bin, ignoring case.

```
strings dump.bin | grep -i "arm"
```

After the reconnaissance phase, the dissected firmware components are ready for further analysis in reverse engineering tools, such as debuggers, disassemblers, and fuzzers.

Firmware Extraction


```
kali@kali: ~/Desktop/extractions/cctv-firmware.extracted/30400
Session  Actions  Edit  View  Help

┌──(kali㉿kali)-[~/Desktop/extractions/cctv-firmware.extracted/30400]
└─$ binwalk --disasm dump.bin

DECIMAL       HEXADECIMAL     DESCRIPTION
--------------------------------------------------------------------------------
2632          0xA48           ARM executable code, 32-bit, little endian,
 at least 1250 valid instructions
```

```
kali@kali: ~/Desktop/extractions/cctv-firmware.extracted/30400/Linux-4.19.91.bin.extracted/60AE
Session  Actions  Edit  View  Help

┌──(kali㉿kali)-[~/…/cctv-firmware.extracted/30400/Linux-4.19.91.bin.extracted/60AE]
└─$ dd if=decompressed.bin of=dump.bin bs=1 skip=4718712 count=14038
14038+0 records in
14038+0 records out
14038 bytes (14 kB, 14 KiB) copied, 0.0327094 s, 429 kB/s

┌──(kali㉿kali)-[~/…/cctv-firmware.extracted/30400/Linux-4.19.91.bin.extracted/60AE]
└─$ binwalk --signature dump.bin

DECIMAL       HEXADECIMAL     DESCRIPTION
--------------------------------------------------------------------------------
0             0x0             YAFFS filesystem root entry, little endian, type file,
```

```
kali@kali: ~/Desktop/extractions/cctv-firmware.extracted/400/uimage_data.bin.extracted/0
Session  Actions  Edit  View  Help

┌──(kali㉿kali)-[~/…/cctv-firmware.extracted/400/uimage_data.bin.extracted/0]
└─$ strings decompressed.bin | grep -i "arm"
arch=arm
cpu=armv7
arm-linux-gcc.br_real (Buildroot 2020.02.9-10-g744f210) 8.4.0
arm-trusted-firmware
ARM Trusted Firmware
arm64
ARM CA9 global timer init successfully
ARM CA9 global timer had already been initiated
```

Windows Shortcut File (*.LNK)

A Microsoft Windows shortcut file has a .LNK extension, which is hidden by default. The .LNK file contains metadata that can be extracted.

When a shortcut file is opened by a program, two different things can happen. The application can resolve the .LNK file and open the target, or it may not resolve it and simply open the shortcut.

Unintended shortcut resolution can be avoided by changing the .LNK file extension. For example, with a simple PowerShell command:

```
Rename-Item -Path C:\m.LNK -NewName C:\m.LNK.anomaly
```

The Shell Link (.LNK) binary file format in pseudo-C syntax can be:

```
struct WindowsShortcut {
  struct ShellLinkHeader sHeader;
  struct LinkTargetIDList sTarget;
  struct LinkInfo sInfo;
  struct StringData sStringData;
  struct ExtraData sExtraData;
};
```

A detailed description of .LNK files can be found in the document [MS-SHLLINK] Shell Link (.LNK) Binary File Format.

The dotLNK tool, including C# source code, can be downloaded from:

//ethical.blue/n/dotLNK.zip

It is a simple console program that takes only one parameter — the .LNK file path.

See Figure 7.

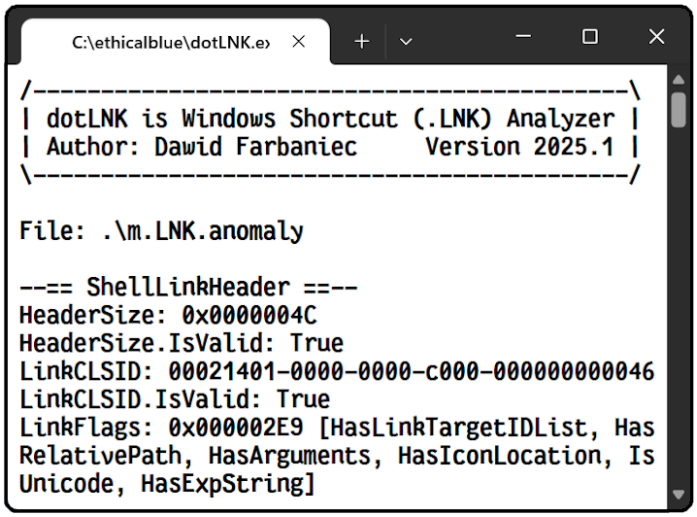
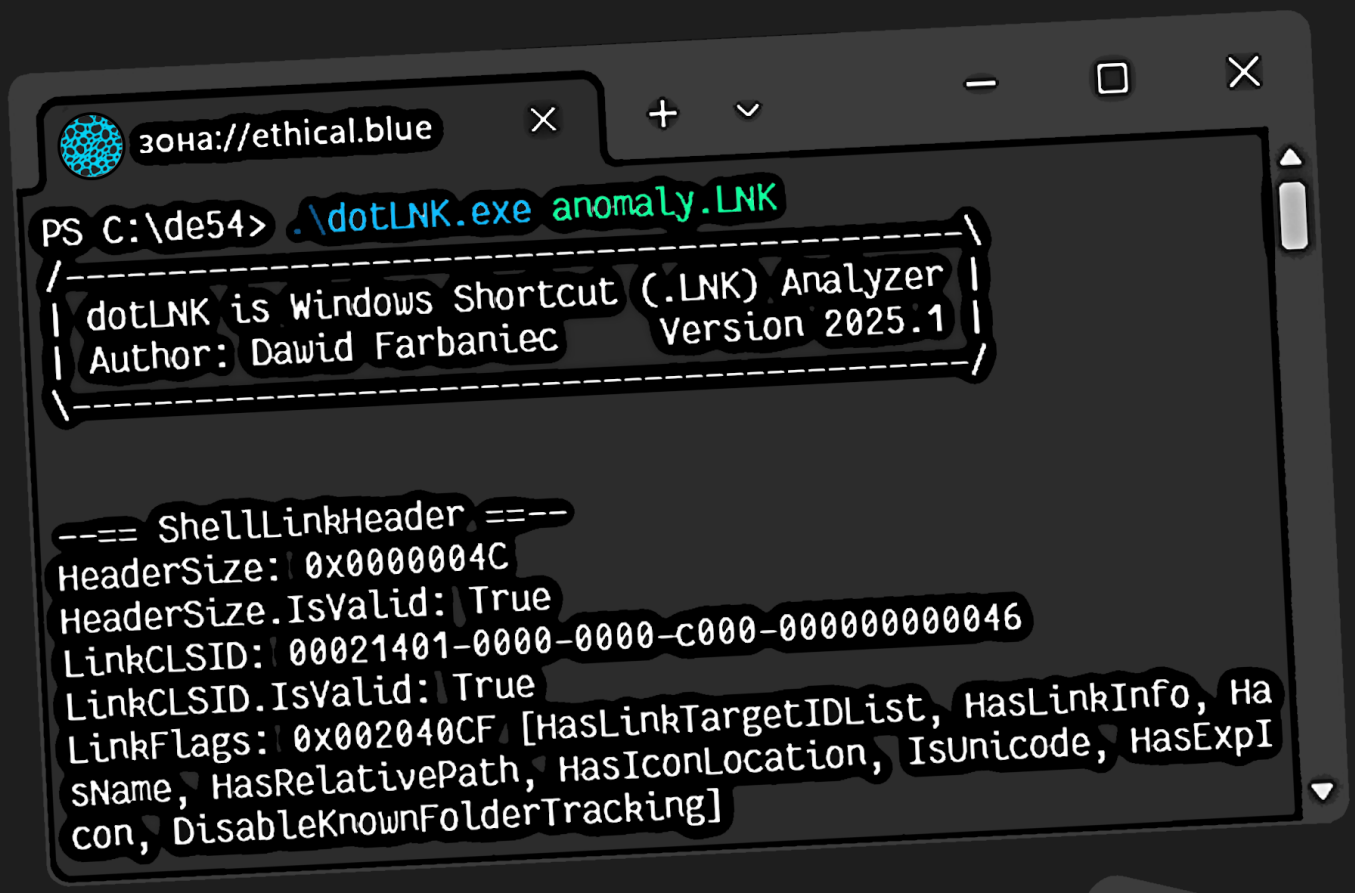
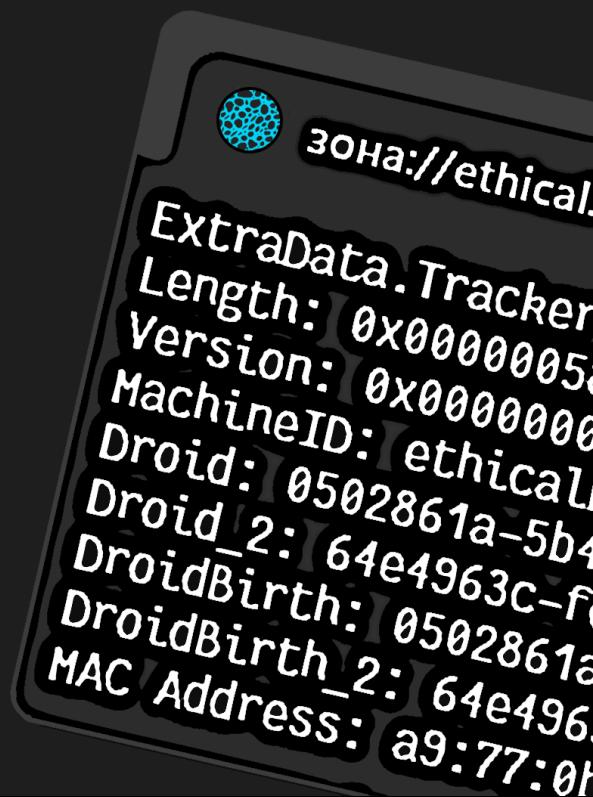


Figure 7. dotLNK (.LNK Analysis Tool)

Analyze a Windows Shortcut (.LNK)

ANOMALY





with a dotLNK Console App


Dawid Farbaniec
0xae58
blue Magazine
x86-64 (x64) Assembly Lang
Мова Асемблера (Мова
x86-64 (x64) Assemblerspr
Lingua Assemblatoria
podstawy PowerShell
ystemach Microsoft Windows
Asembler x64/arm64)
e w językach C#/IL
ucha bloków

Bibliography

[1] Japan Electronics and Information Technology Industries Association (JEITA), *Exchangeable Image File Format for Digital Still Cameras: EXIF Version 3.0*, 2024.

[2] Mandiant, Inc., *FLARE Obfuscated String Solver Documentation*, 2026.

[3] Microsoft Corporation, *[MS-SHLLINK]: Shell Link (.LNK) Binary File Format*, 2025.

[4] Microsoft Corporation, *Windows PowerShell Language Specification Version 3.0*, 2012.

[5] OffSec Services Limited, *https://www.kali.org/tools/binwalk/*, 2026.

[6] OffSec Services Limited, *https://www.kali.org/tools/binwalk3/*, 2026.

[7] Phil Harvey, *https://exiftool.org/*, 2026.