DIFO 2017 - Lab 1 Report

Group number: Group 14

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Exercise 1 - Hashing

Objective: Our objective for this exercise was to find the hash values of all four files and to verify the hash values match from a text file that contains all the hash values of the four files.

Tools: md5deep64.exe version 4.4, sha256deep64.exe version 4.4 and whirlpooldeep64.exe version 4.4.

- **What files (and/or folders) did you hash?**

'hello', 'hello (2)', 'hello (3)' and 'hello (4)' files were all hashed using md5deep64.exe, sha256deep64.exe and whirlpooldeep64.exe.

The commands used were:

i) This is using md5deep64:

> C:\...path...\md5deep64.exe hello
da5c61e1edc0f18337e46418e48c1290 " hello"

> C:\...path...\md5deep64.exe "hello (2)"
cdc47d670159eef60916ca03a9d4a007 "hello (2)"

> C:\...path...\md5deep64.exe "hello (3)"
cdc47d670159eef60916ca03a9d4a007 "hello (3)"

> C:\...path...\md5deep64.exe "hello (4)"
da5c61e1edc0f18337e46418e48c1290 " hello"

ii) This is using sha256deep64:

> C:\...path...\sha256deep64.exe hello
fad878bd261840a4ea4a8277c546d4f46e79bbeb60b059cee41f8b50e28d0e88 C:\...path...\hello

> C:\...path...\sha256deep64.exe "hello (2)"
1316543942a8c6cd754855500cd37068edbbd8b31c4979d2825a4e799fed6102 "C:\...path...\hello (2)"

> C:\...path...\sha256deep64.exe "hello (3)"
60d13913155644883f130b85eb24d778314014c9479aedb5f6323bf38ad3a451 "C:\...path...\hello (3)"

> C:\...path...\sha256deep64.exe "hello (4)"
1c4ff4e490b15b2b214f26c5654decccbcbea9eb900f88649dc7b1e42341be56 "C:\...path...\hello (4)"

iii) This is using whirlpooldeep64:

> C:\...path...\whirlpooldeep64.exe "C:\...path...\hello"
1f4388f4a81a6cfacde955cf5fd84c4e76f12876db3356e2a84efda91f8c44407b3626b770d9752f9b0aa05927e
7fb7c66e07ea96ea47ece2ca78a40cedb9d7e

> C:\...path...\whirlpooldeep64.exe "C:\...path...\hello (2)"
aae0a840704962b3026cf5b2058aa1a3d7752e6d562e0a843ce0abf7107666fb475ac45df08587c468f7754847
f2be4cebd1172dedfebfaa6527c8da2b1bc364

> C:\...path…\whirlpooldeep64.exe "C:\...path…\hello (3)"

959593fe62721c9d058831eaa742f103d1b853b43a81a94dd30cc89a6dafb6926b64bdd7b0ef16a4c566601f8
1af95988fb952720482562a6269728ef5f5d5fb

> C:\...path…\whirlpooldeep64.exe "C:\...path…\hello (4)"
4324731f2340b0d5ce741f566abd7ebf8a1c18a15e4835bd8c25bdc974ec275a6e088982422456060bf145d70
13cd0aa8ac1b62ee3f8149bfd6490e6a5a95efa

- **Which algorithms did you choose?**

  Initially, we only used md5 algorithm and we noticed using md5, the 'hello' with 'hello (4) files would have the same hash values where 'hello (2)' with 'hello (3)' files would also have the same hash values. Because of this finding, we decided to use sha256 and whirlpool algorithms to ensure and confirm if these files truly would have the same hash values. While using sha256 and whirlpool algorithms, we discovered the hash values were not the same for all four files.

  The algorithms chosen for hashing 'hello', 'hello (2)', 'hello (3)' and 'hello (4)' were sha256, whirlpool and md5. The reason algorithm sha256 and whirlpool generated different hash values were: sha256 digested input message length up to 2^{64} bits in length and whirlpool digested input message length up to 2^{256} which resulted into different hash values for all four files. Whirlpool generated 512 bits length and sha256 generated 256 bits length.

- **Suppose you would need to calculate the hash sums of several files and folders, how could you do that using the tools and resources provided? Provide a description and exact commands.**

  According to the http://md5deep.sourceforge.net/[1], '-r' flag could be used to hash all files within a folder recursively. This '–r' option didn't hash the folder but only the files inside a folder.

  Command used:
  > C:\..input path…\whirlpooldeep64.exe -t -r C:\..input folder path > output_whirlpool.txt

  Results from Output_test.txt:
  1f4388f4a81a6cfacde955cf5fd84c4e76f12876db3356e2a84efda91f8c44407b3626b770d9752f9b0aa0592
  7e7fb7c66e07ea96ea47ece2ca78a40cedb9d7e 2017:09:14:12:27:34
  C:\Users\cs2lab\Desktop\Shared_Folder\DiFo2017\Lab1\Exercise1_Hashing\test\hello

  959593fe62721c9d058831eaa742f103d1b853b43a81a94dd30cc89a6dafb6926b64bdd7b0ef16a4c56660
  1f81af95988fb952720482562a6269728ef5f5d5fb 2017:09:14:12:27:34
  C:\Users\cs2lab\Desktop\Shared_Folder\DiFo2017\Lab1\Exercise1_Hashing\test\hello (3)

  aae0a840704962b3026cf5b2058aa1a3d7752e6d562e0a843ce0abf7107666fb475ac45df08587c468f7754
  847f2be4cebd1172dedfebfaa6527c8da2b1bc364 2017:09:14:12:27:34
  C:\Users\cs2lab\Desktop\Shared_Folder\DiFo2017\Lab1\Exercise1_Hashing\test\hello (2)

  4324731f2340b0d5ce741f566abd7ebf8a1c18a15e4835bd8c25bdc974ec275a6e088982422456060bf145
  d7013cd0aa8ac1b62ee3f8149bfd6490e6a5a95efa 2017:09:14:12:27:34
  C:\Users\cs2lab\Desktop\Shared_Folder\DiFo2017\Lab1\Exercise1_Hashing\test\hello (4)

  > C:\..input path… \md5deep64.exe -t –r C:\..input folder path > output_md5.txt

  Results from Output_test.txt:
  da5c61e1edc0f18337e46418e48c1290 2017:09:14:12:27:34
  C:\Users\cs2lab\Desktop\Shared_Folder\DiFo2017\Lab1\Exercise1_Hashing\test\hello

[1] the http://md5deep.sourceforge.net/

cdc47d670159eef60916ca03a9d4a007 2017:09:14:12:27:34
C:\Users\cs2lab\Desktop\Shared_Folder\DiFo2017\Lab1\Exercise1_Hashing\test\hello (2)

cdc47d670159eef60916ca03a9d4a007 2017:09:14:12:27:34
C:\Users\cs2lab\Desktop\Shared_Folder\DiFo2017\Lab1\Exercise1_Hashing\test\hello (3)

da5c61e1edc0f18337e46418e48c1290 2017:09:14:12:27:34
C:\Users\cs2lab\Desktop\Shared_Folder\DiFo2017\Lab1\Exercise1_Hashing\test\hello (4)

> C:\..input path… \shar256deep64.exe –r C:\..input folder path > output_md5.txt

Results from Output_test.txt:
fad878bd261840a4ea4a8277c546d4f46e79bbeb60b059cee41f8b50e28d0e88
C:\Users\cs2lab\Desktop\Shared_Folder\DiFo2017\Lab1\Exercise1_Hashing\test\hello

1316543942a8c6cd754855500cd37068edbbd8b31c4979d2825a4e799fed6102
C:\Users\cs2lab\Desktop\Shared_Folder\DiFo2017\Lab1\Exercise1_Hashing\test\hello (2)

60d13913155644883f130b85eb24d778314014c9479aedb5f6323bf38ad3a451
C:\Users\cs2lab\Desktop\Shared_Folder\DiFo2017\Lab1\Exercise1_Hashing\test\hello (3)

1c4ff4e490b15b2b214f26c5654decccbcbea9eb900f88649dc7b1e42341be56
C:\Users\cs2lab\Desktop\Shared_Folder\DiFo2017\Lab1\Exercise1_Hashing\test\hello (4)

- **Come up with an efficient way to match hash sums – so that you can automatically identify files that might (or might not be) of interest. Describe how you did this and which exact programs you used, and reflect upon why this might be useful for a forensic examiner in their work life.**

The *findstr* command could be used to match and verify hash values of a file but this method was not as efficient as using the *md5deep64.exe, sha256deep64.exe* and *whirlpooldeep64.exe* with the '-m' option directly. We also used '-r' to recursively hash all files in a folder. The reason was *findstr* was not a tool to generate hash values. It would only to search string values and compared the string to a file that contained the particular searched string. With *md5deep64.exe, sha256deep64.exe* and *whirlpooldeep64.exe,* they would generate hash values and would match the hash values of the files to the file that would contain the hash values to be verified.

Example commands used were:

> C:\..input path…\md5deep64.exe -rm C:\..input folder path…
> C:\..input path…\sha256deep64.exe -rm C:\..input folder path…
> C:\..input path…\whirlpooldeep64.exe -rm C:\..input folder path…

The test files we used were in our test folder such as:
install61.iso (214428 KB), test1.txt (1KB), test2.txt(1KB), md5_hash.txt(1KB), fciv.exe(83KB) and Suspicious_File (1274KB).
These files were located in the *C:\..input path…*.

There were other options that could be used for more efficient matching of hash values, they were:

'-i|I' by specifying the threshold of the file sizes
'-jnn' by generating hash values in multithread method instead sequentially
'-o' by specifying what file type to hash

When using '-i' option, it would be more efficient if all files were a particular size that was less than specified threshold value. This would only generate the hash values for only those files under the threshold.
With using '-jnn', this would allow for a large file or many sets of files to be hashed and would generate hash values in a multithread method. It is more efficient because it would create one producer thread to scan the file system and one hashing thread per CPU core[2] of the machine performance.

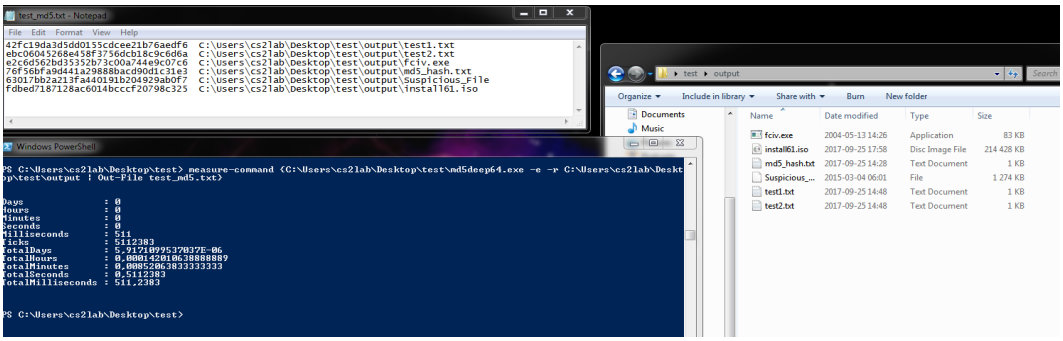
[2] www.md5deep.sourceforge.net/md5deep.html

By using '-o', one could specify what file type to hash instead of generating hash values for all files.

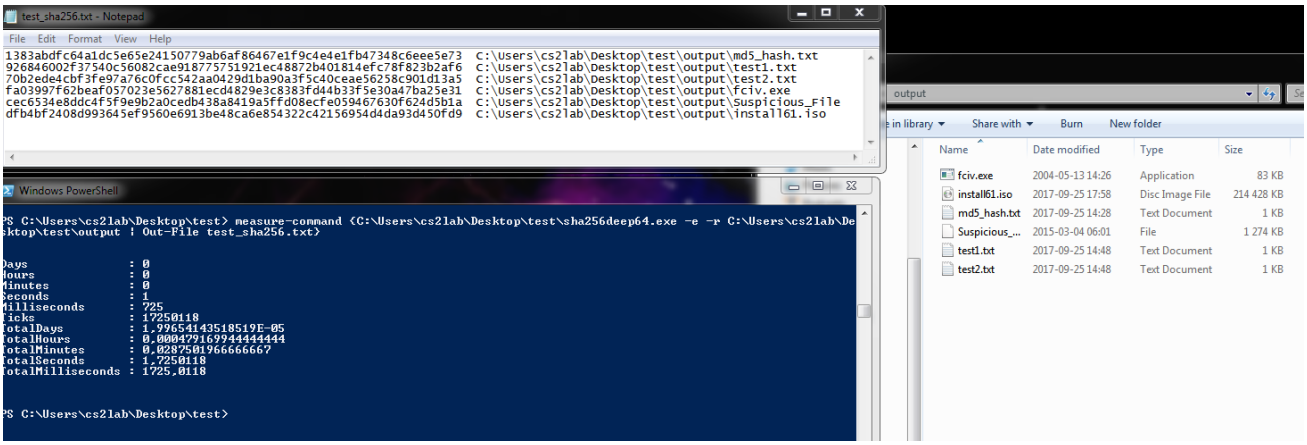
- **Which hashing algorithms did you use? How long did each algorithm take to run?**
  We used md5 and sha256 algorithms to hash our test files. The test files used for this timing algorithms test were install61.iso (214428 KB), test1.txt (1KB), test2.txt(1KB), md5_hash.txt(1KB), fciv.exe(83KB) and Suspicious_File (1274KB).

  With md5 algorithm, it took 511milliseconds where sha256 algorithm took 1725milliseconds.

  Example commands used were:
  > measure-command {C:\..input path...\md5deep64.exe -r C:\..input folder path...\ | Out-File test_md5.txt}



> measure-command {C:\..input path...\sha256deep64.exe -r C:\..input folder path...\ | Out-File test_sha256.txt}



Exercise 2 - File Headers

Objective: Acquire data by acquisition to ensure the integrity of evidence was read-only prior to analyzing the data.

Chain-of-custody: generated hash values for all evidence acquired.

Tools used: We used these tools: TrID version 1.80, AccessData FTK Imager version 3.4.2.6, HexEdit version 4.0 and Exiftool version 10.6.1.0 to identify the filer header and footer information. All twelve files' header hexadecimal values were identified by using the Gary Kessler File Signature Table[3].

With File: 01

Result for file 01: We were able to identify this file to be a JPEG file because the file header hexadecimal values (FF D8 FF E0 00 10 4A 46 49 46 00) matched to the Gary Kessler File Signature table. But with TrID, it provided matching based on percentage of accuracy. There were four matching found for file '01' using TrID. 38.1 % and 28.6% of JPG file type matching but there were also 23.8% and 9.5% matching to MP3 file type. See table below.

Tools	File type	Header	Footer/trailer
FTK imager	JFIF - JPEG	FF D8 FF E0 00 10 4A 46 49 46 00	FF D9
HexEdit	JFIF - JPEG	FF D8 FF E0 00 10 4A 46 49 46 00	FF D9
TrID	38.1% matching JPG 28.6% matching JPG 23.8% matching MP3 9.5% matching MP3	N/A	N/A
Exiftool	JPEG	N/A	N/A

FTK Imager with mode set to hex-viewer automatic, a picture of WWII airplanes could be seen. To confirm that this file was a jpeg file, we renamed the 01 file to *'01.jpg'* and was able to open it, see figure 1.

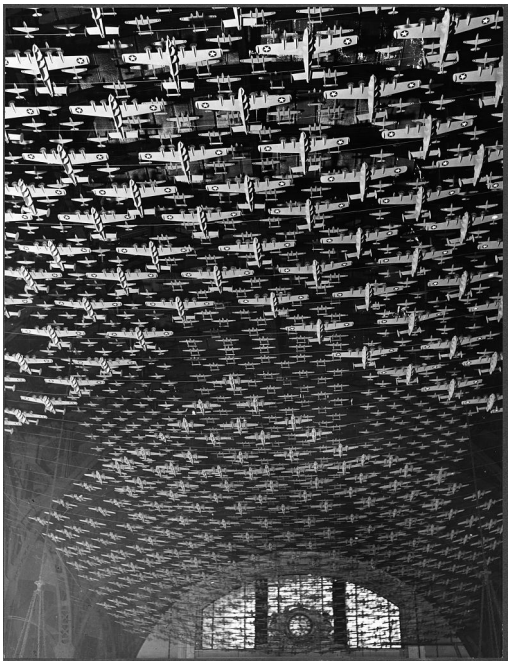


Figure-1: WWII airplanes.

With File: 02

Result for file 02: We were able to identify this file to be a GIF file, see table below. With FTK Imager: when

[3] http://www.garykessler.net/library/file_sigs.html

mode was set to hex-view automatic, ‘02’ file was shown as GIF file type with a picture of Bipolar Direct-Current. See table below:

Tools	File type	Header	Footer/trailer
FTK Imager	GIF87ag	47 49 46 38 37 61 67 01	00 3B (.;)
HexEdit	GIF87ag	47 49 46 38 37 61 67 01	00 3B (.;)
TrID:	60% matching GIF, 30% matching GIF	N/A	N/A
ExifTool	GIF	N/A	N/A

Also to confirm, we renamed the ’02’ file to ’02.gif’and it opened up to:

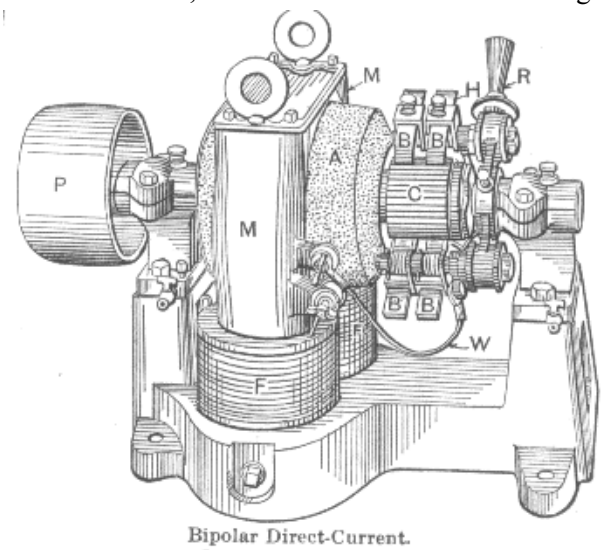


Figure-2: 02.gif

With File: 03

Result for file 03: We were able to identify this file to be an internet shortcut because according to Gary Kessler File Signature Table, there was no file type matching the file header hexadecimal information that we had retrieved from FTK Imager and HexEdit. But according to TrID, it found matching to URL for 91.7% and 8.3 for INI file type. See table below.

Tools	File type	header	Footer/trailer
FTK Imager Note: mode automatic displays as: [InternetShortcut] URL=http://www.dc3.mil/challenge/ Modified=70C990463628CB0139	[InternetShortcut]	5B 49 6E 74 65 72 6E 65-74 53 68 6F72 74 63 75 74 5D	No footer
HexEdit [InternetShortcut] URL=http://www.dc3.mil/challenge/ Modified=70C990463628CB0139	[InternetShortcut]	5B 49 6E 74 65 72 6E 65-74 53 68 6F72 74 63 75 74 5D	No footer
TrID:	91.7% matching URL; 8.3% matching INI	Windows URL shortcut INI Generic Configuration	N/A
ExifTool	Unknown file type err	N/A	N/A

Note: [InternetShortcut] URL=http://www.dc3.mil/challenge/..Modified=70C990463628VB0139File04

With File: 04

Result for file 04: We were able to identify this file to be a PK Zip file. With FTK Imager mode set to hex-viewer automatic, it revealed as PK file type from the file header. See table below.

Tools	File type	header	Footer/trailer
FTK Imager	PK	50 4B 03 04	50 4B
HexEdit	PK	50 4B 03 04	50 4B

			00 00 00 = …
TrID:	100% matching ZIP	ZIP compressed archive	N/A
Exiftool	ZIP	N/A	N/A

Also, to confirm we renamed '04' file to '04.zip' and opened the zip package. We discovered the 04.zip file contained *exif.exe, ReadMe.txt and exif.chm*. We speculated the user who used this exif.exe application wanted to obtain metadata[4] information from a still camera image. The metadata information might contain camera and picture setting including GPS information.

With File: 05

Result for file 05: We were able to identify this file to be an XPI. Any file with this file type was an add-on for any browser. To confirm this, we renamed the 05 file to '05.zip' and extracted the zip which it contained several files and folders. See table below.

Tools	File type	header	Footer/trailer
FTK Imager	PK	50 4B 03 04	00 00 00 = …
HexEdit	PK	50 4B 03 04	00 00 00 = …
TrID:	66.6% = XPI, 33% = ZIP, 0.1% = CEL	Mozilla Firefox Browser extension ZIP compression archive Autodesk FLIC Image File extension	N/A
Exiftool	ZIP	N/A	N/A

From this file '*install.rdf*', it explained that this package was an extension for Mozillla Firefox and the name was "Exif Viewer", see figure-3 below:

```
<?xml version="1.0"?>
<RDF:RDF xmlns:em="http://www.mozilla.org/2004/em-rdf#"
         xmlns:NC="http://home.netscape.com/NC-rdf#"
         xmlns:RDF="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
  <RDF:Description RDF:about="urn:mozilla:install-manifest"
                   em:id="exif_viewer@mozilla.doslash.org"
                   em:name="Exif Viewer"
                   em:version="1.55"
                   em:description="Extracts and displays the Exif (Exchangeable Image
File), IPTC-NAA/IIM (International Press Telecommunications Council / Newspaper
Association of America / Information Interchange Model), and IPTC Core (Adobe XMP,
Extensible Metadata Platform) metadata, as stored by digital still cameras, in both
local and remote JPEG images."
                   em:creator="Alan Raskin, araskin@allstream.net"
                              em:homepageURL="http://araskin.webs.com/exif/
exif.html">
    <em:targetApplication RDF:resource="rdf:#$p+bJJ3"/>
    <em:targetApplication RDF:resource="rdf:#$u+bJJ3"/>
  </RDF:Description>
  <RDF:Description RDF:about="rdf:#$u+bJJ3"
                   em:id="{3550f703-e582-4d05-9a08-453d09bdfdc6}"
                   em:minVersion="1.5"
                   em:maxVersion="3.0.*" /><!-- Thunderbird (should be 2.0.0.*) -->
  <RDF:Description RDF:about="rdf:#$p+bJJ3"
                   em:id="{ec8030f7-c20a-464f-9b0e-13a3a9e97384}"
                   em:minVersion="1.5"
                   em:maxVersion="3.6.*" /><!-- Firefox (was 3.5.*) -->
</RDF:RDF>
```

Figure-3: "install.rdf" content.

We speculated the user who used this exif.exe application wanted to obtain metadata information from a still camera image. The metadata information might contain camera and picture setting including GPS information.

With File: 06

Result for file 06: We were able to identify this file to be a DMG file for the Mac. See table below:

Tools	File type	header	Footer/trailer
FTK Imager	DMG	At top get this:78 01 63 60 found this at : 3C 3F 78 6D 6C 20 76 65 72 73 69 6F 6E 3D 22 31 2E 30 22 3F 3E *Gary Kessler Signature File Table:* -78 01 73 0D 62 62 60 is DMG;	No footer

4 http://araskin.webs.com/exif/exif.html

		-3C 3F 78 6D 6C 20 76 65 72 73 69 6F 6E 3D 22 31 2E 30 22 3F 3E is XML	
HexEdit	DMG	Got:78 01 63 60 *Gary Kessler Signature File Table:* 3C 3F 78 01 73 0D 62 62 60	No footer
TrID: Marco Pontello marcopon@gmail.com	50% DMG 50% XMI	Disk Image (Macintosh) compressed XML XMill is an efficient XML data compressor	N/A
Exiftool	Unknown file type	N/A	N/A

Tracing through HexEdit on row e92f0 (see figure-4 below), we found xml information pertaining to the Apple 'XML property list' which was explained from this link *http://newosxbook.com/DMG.html*. To confirm, we renamed the 06 file to '06.dmg' and opened it from a Macintosh. This dmg package contained '*Hex Fiend.app'* (see figure-5 below).

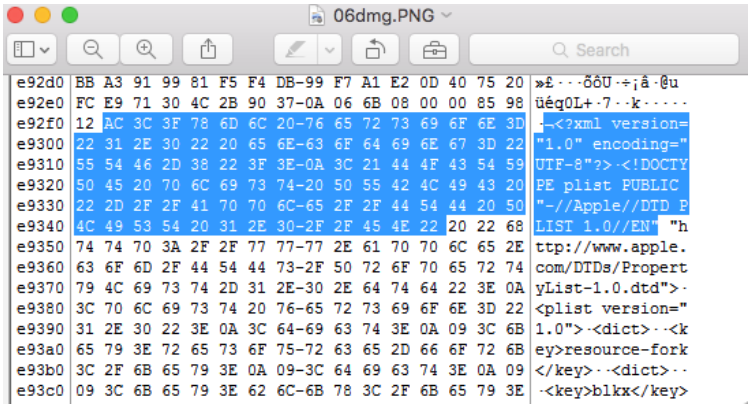


Figure 4: *06.dmg*

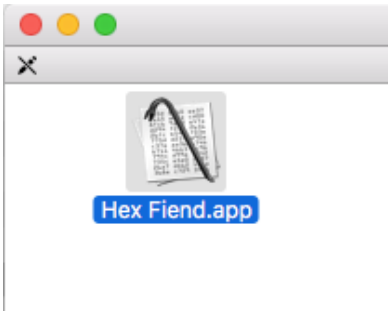


Figure-5: *06.dmg content*

This Hex Fiend.app was a hex editor application for a Macintosh.

With File: 07

Result for 07 file: we were able to identify this file to be a RPM file that was a Red Hat Linux Package Manager file. See table below:

Tools	File type	header	Footer/trailer
FTK Imager	HTTP	68 74 74 70	No footer
HexEdit	HTTP	68 74 74 70	No footer
TrID:	100% RPM Package generic	RedHat Package Manager file since seeing several files nested inside from reading the hex	N/A
Exiftool	Unknown file type	N/A	N/A

To confirm this 07 file, we opened *'07'* file on Kali and confirmed it was RPM file. This file package

contained directories of \etc, \usr and \var, (see figure-6 below), where each of these folders contained further nested directories for Apache server files.

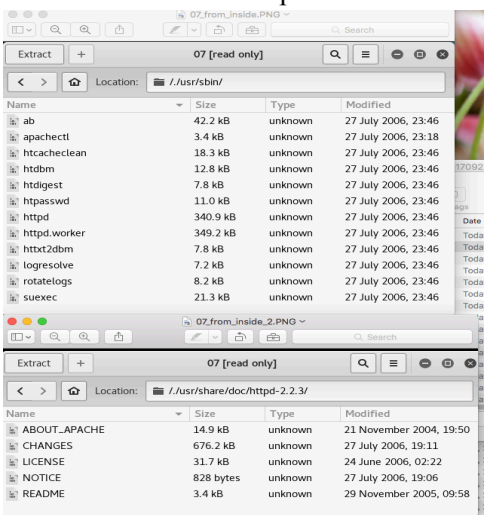


Figure-6: *07.rpm content*

With File: 08

Result for 08 file: we were able to identify this file to be a CHM file from Microsoft Compiled HTML. See table below:

Tools	File type	header	Footer/trailer
FTK Imager	ITSF	49 54 53 46 *Gary Kessler Signature File Table:* Microsoft Compiled HTML Help File	No footer
HexEdit	ITSF	49 54 53 46 *Gary Kessler Signature File Table:* Microsoft Compiled HTML Help File	No footer
TrID: Davide "Airex" Airaghi airex"AT"Tiscali"DOT".it	100% CHM file	Microsoft Compiled HTML Help File	No footer
Exiftool Language code: English (U.S.)	CHM	N/A	N/A

To confirm, we downloaded CHM viewer and able to see that *'08'* file was a chm file for Nvidia Control Panel informaton.

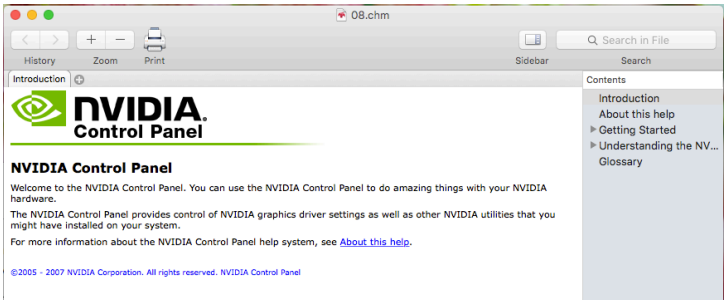


Figure-7: *08.chm content*

With File: 09

Result for 09 file: we were able to identify this file to be a MIDI file from FTK Imager, HexEdit and TrID. To confirm, we renamed 09 file to *'09.mid'* and able to play the music. It was a MIDI sound file.

Tools	File type	header	Footer/trailer
FTK Imager	MThd MIDI	4D 54 68 64 *Gary Kessler Signature File Table:* Musical Instrument Digital Interface (MIDI) sound file	No footer

HexEdit	MThd MIDI	49 54 53 46 *Gary Kessler Signature File Table:* Musical Instrument Digital Interface (MIDI) sound file	No footer
TrID:	100% MIDI	MIDI Music URL: www.midi.org	No footer
exiftool	Unknown file type	N/A	N/A

With File: 10

Result for 10 file: we were able to identify this file to be a ReadMe file from FTK Imager and HexEdit. From Gary Kessler Signature File Table, there was no file type for a file extension as *'.txt'*. With FTK Imager mode set to hex-view automatic, we were able to see a README file of Microsoft File Checksum Integrity Verifier V2.05. See table below:

	File type	header	Footer/trailer
FTK Imager	A readme file from Microsoft File Checksum Integrity	4D 69 63 72 6F 73 6F 66 Microsoft (R) File Checksum Integrity Verifier V2.05 README file *Gary Kessler Signature File Table:* Microsoft type of file when have these 4D 69 63 72 as the 4 bytes	No footer
HexEdit	A readme file from Microsoft File Checksum Integrity	4D 69 63 72 6F 73 6F 66 Microsoft (R) File Checksum Integrity Verifier V2.05 README file *Gary Kessler Signature File Table:* Microsoft type of file when have these 4D 69 63 72 as the 4 bytes	No footer
TrID:	0.0% matched	N/A	N/A
exiftool	Unknown file type	N/A	N/A

To confirm, we renamed 10 file to '10.txt' and opened it. It was a ReadMe file for File Checksum Integrity Verifier. But we tried to rename the 10 file to *'10.doc'* or *'10.docx'* and we were not able to open the file.

With File: 11

Result for 11 file: we were able to identify this file to be a Microsoft Word doc file from TrID and Exiftool. With FTK Imager mode set to hex-viewer to text, we were able to see the information about '*Robocopy is a 32 bit command-line tool'* information. Also when we renamed the 11 file to *'11.doc'* and it opened up as a windows word doc. It was a user manual of Robocopy.exe (Robust File Copy Utility version XP010). See table below:

Tools	File type	header	Footer/trailer
FTK Imager	OLE	D0 CF 11 E0 A1 B1 1A E1 *Gary Kessler Signature File Table:* An Object Linking and Embedding (OLE) format known as Compound Binary File format by Microsoft used by Microsoft Office	No footer
HexEdit	OLE	D0 CF 11 E0 A1 B1 1A E1 *Gary Kessler Signature File Table:* An Object Linking and Embedding (OLE) format known as Compound Binary File format by Microsoft used by Microsoft Office	No footer
TrID:	36% DOC 33.7 % XLS 21.3% DOC 9%	Microsoft Word Doc Microsoft Excel sheet Microsoft Word doc (old ver) Generic OLE2/Multistream Compound File	No footer
Exiftool	DOC	N/A	N/A

With File: 12

Result for 12 file: we were able to identify this file to be a Bit Torrent file from TrID and Exiftool. See table below:

Tools	*File type*	*header*	*Footer/trailer*
FTK Imager	N/A	64 38 3A 61 6E 6E 6F 75 Gary Kessler has no info with this header decimal value	N/A
HexEdit	N/A	64 38 3A 61 6E 6E 6F 75 Gary Kessler has no info with this header decimal value	N/A
TrID:	57.7% TORRENT 42.3% TORRENT	Bit Torrent Link (Trackerless) Bit Torrent Link	N/A
ExifTool	Torrent	Note: file extension: torrent	N/A

From FTK Imager and HexEdit, we found these info:

d8:announce39:http://torrent.ubuntu.com:6969/announce13:announce-listll39:http://torrent.ubuntu.com:6969/announceel44:http://ipv6.torrent.ubuntu.com:6969/announceee7:comment29:Ubuntu CD releases.ubuntu.com13:creation datei1256817676e4:infod6:lengthi724353024e4:name29:ubuntu-9.10-desktop-amd64.iso12:piece lengthi524288e6:pieces27640:l

Ubunte CD release from 2009 name29:ubuntu-9.10-desktop-amd64.iso

Exercise 3 – Anti Forensics

Objective: Acquire data by acquisition to ensure the integrity of evidence was read-only prior to analyzing the data.

Evidences: To acquire the c.mp3 and Suspicious_File evidence files by using file carving technique to investigate what these two files really were.

Chain-of-custody: generated hash values for all evidence acquired from tools.

Tools used: EnCase version 8.04, AccessData FTK Imager version 3.4.2.6, GpgEX part of Gpgwinversion 3.0.0, Elcomsoft Forensic Disk Decryptor version 1.12.324.3299, HexEdit version 4.0, Scalpel, Foremost, TrID version 1.80, Exiftool version 10.6.1.0, Malwaretracker.com and Virustotal.com.

Note: EnCase, Scalpel and Foremost automatically performed the file carving on these two evidence files.

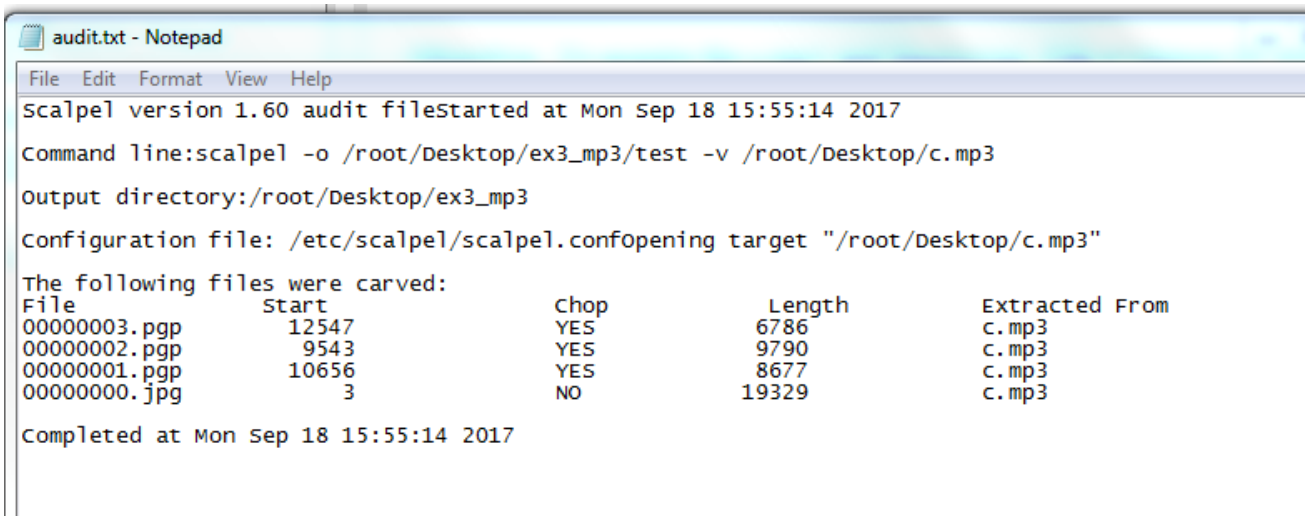
I) Acquisition: c.pm3

How did you proceed your examination and analysis of the files? Describe methodology and your results

From Kali(linux), commands used for c.mp3 file

- scalpel –o /root/Desktop/ex3_mp3/test –v /root/Desktop/c.mp3

Resulted with extraction of c.mp3 file into one JPG file and three of PGP files. See appendix 1(c.mp3).


audit.txt - Notepad

File Edit Format View Help

```
Scalpel version 1.60 audit fileStarted at Mon Sep 18 15:55:14 2017

Command line:scalpel -o /root/Desktop/ex3_mp3/test -v /root/Desktop/c.mp3

Output directory:/root/Desktop/ex3_mp3

Configuration file: /etc/scalpel/scalpel.confOpening target "/root/Desktop/c.mp3"

The following files were carved:
File              Start              Chop          Length          Extracted From
00000003.pgp        12547            YES           6786            c.mp3
00000002.pgp         9543            YES           9790            c.mp3
00000001.pgp        10656            YES           8677            c.mp3
00000000.jpg            3            NO           19329            c.mp3

Completed at Mon Sep 18 15:55:14 2017
```

Figure-8: Summary Scalpel report on c.mp3 file.

- The 00000000.jpg file was a picture of Keira Knightley. See figure-9 below.

- Figure-9: Result of 00000000.jpg file.

- With three PGP files, we were not able to decrypt using this GpgEX tool.
- PGP files were not able to decrypt because GpgEX tool required a key to decrypt a pgp file.

- Foremost tool used on Kali and command used was:

  - Foremost -o /root/Desktop/ex3_mp3/test –i /root/Desktop/c.mp3

  Extraction result was only one file. It was a 00000000.jpg file. Opening this extracted 0000000.jpg file revealed it was the same picture as from scalpel extracted 0000000.jpg file.

Analysis:

1) From Windows: we used HexEdit and TrID to analyze further this c.mp3. It appeared to be that the c.mp3 file header has been modified with '49 44 33' to hide the real file type which was JFIF. But according to TrID, it reported 100% matching to mp3 file.

Tools	*File type*	*header*	*Footer/trailer*
HexEdit	JFIF	49 44 33 FF D8 FF E0 00 10 4A 46 49 46 49 46 00 '4A 46 49 46' = JFIF Gary: FF D8 FF E0 xx xx 4A 46 ÿØÿà..JF 49 46 00 IF. JFIF, JPE, JPEG, JPG JPEG/JFIF graphics file	FF D9
FTK Imager	No data found	N/A	N/A
ExifTool	File Format Error	N/A	N/A
TrID:	100% matching MP3	Note: not a real mp3 file 49 44 33 : only read the 3 bytes from header info and assume it is mp3	N/A

Malwaretracker.com/doc.php was used to analyze further of c.mp3 file:

Md5: 670a8c0db494ced4882e44b27dbd6af2
Sha1: c5e6e5e1715e90879829264c88ad83160bbe358c
Sha256:
Content/type: audio ID3 type verion 2.255.216
Analysis time: 5.2s
Result: clean

Virustotal.com was used to analyze further of c.mp3 file:

Md5: 670a8c0db494ced4882e44b27dbd6af2
Sha1: c5e6e5e1715e90879829264c88ad83160bbe358c
FileType: MP3
ID3Size 0
MIMETYPE audio/mpeg
Warning: invalid ID3 header

Summary of c.mp3 file:

Could you identify the files? If so, what type of files were they? Could you find anything peculiar about the files?

It appeared to be an image JPEG file but not a mp3 file. Based on the Virustotal.com warning message, the invalid ID3 header confirmed with HexEdit that the first 3 bytes of header information were modified to be a mp3 file in order to hide the real purpose of this JPEG file. Also, the extension was modified to *'.mp3'* instead of *'.jpg'*.

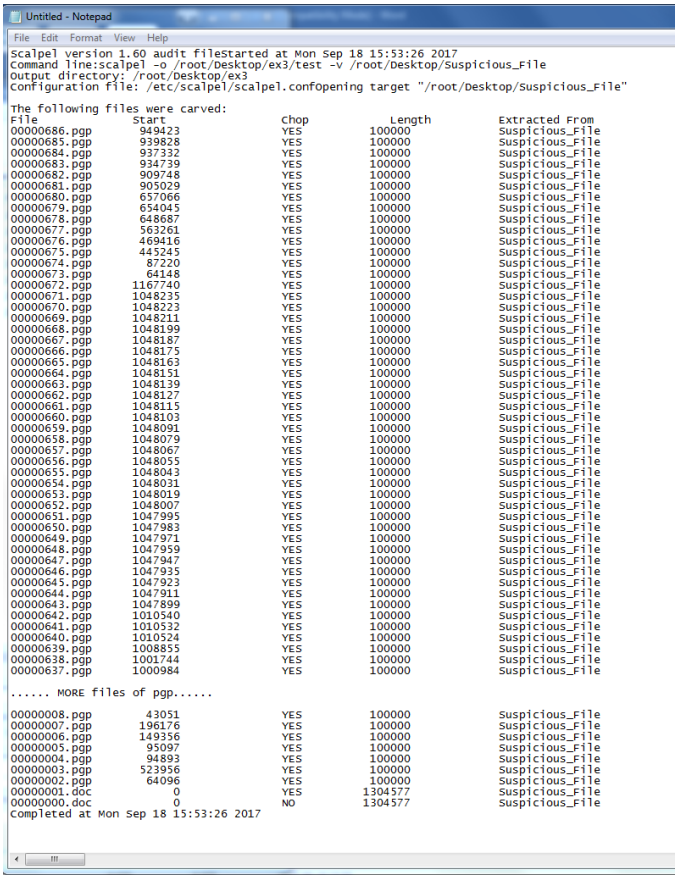
II) <u>Acquisition:</u> Suspicious_File

How did you proceed your examination and analysis of the files? Describe methodology and your results.

1) Scalpel from Kali(linux) commands was used for <u>Suspicious_File</u> file:

- scalpel –o /root/Desktop/ex3_mp3/test –v /root/Desktop/ Suspicious_File

Resulted with extraction of Suspicious_File file into 687 files where two files (00000000.doc and 00000001.doc) were doc files and the rest were PGP files. See appendix 2 (Suspicious_File).



Untitled - Notepad

File Edit Format View Help

```
Scalpel version 1.60 audit fileStarted at Mon Sep 18 15:53:26 2017
Command line:scalpel -o /root/Desktop/ex3/test -v /root/Desktop/Suspicious_File
Output directory: /root/Desktop/ex3
Configuration file: /etc/scalpel/scalpel.confopening target "/root/Desktop/Suspicious_File"

The following files were carved:
File              Start           Chop          Length          Extracted From
00000686.pgp       949423          YES          100000          Suspicious_File
00000685.pgp       939828          YES          100000          Suspicious_File
00000684.pgp       937332          YES          100000          Suspicious_File
00000683.pgp       934739          YES          100000          Suspicious_File
00000682.pgp       909748          YES          100000          Suspicious_File
00000681.pgp       905029          YES          100000          Suspicious_File
00000680.pgp       657066          YES          100000          Suspicious_File
00000679.pgp       654045          YES          100000          Suspicious_File
00000678.pgp       648687          YES          100000          Suspicious_File
00000677.pgp       563261          YES          100000          Suspicious_File
00000676.pgp       469416          YES          100000          Suspicious_File
00000675.pgp       445245          YES          100000          Suspicious_File
00000674.pgp        87220          YES          100000          Suspicious_File
00000673.pgp        64148          YES          100000          Suspicious_File
00000672.pgp      1167740          YES          100000          Suspicious_File
00000671.pgp      1048235          YES          100000          Suspicious_File
00000670.pgp      1048223          YES          100000          Suspicious_File
00000669.pgp      1048211          YES          100000          Suspicious_File
00000668.pgp      1048199          YES          100000          Suspicious_File
00000667.pgp      1048187          YES          100000          Suspicious_File
00000666.pgp      1048175          YES          100000          Suspicious_File
00000665.pgp      1048163          YES          100000          Suspicious_File
00000664.pgp      1048151          YES          100000          Suspicious_File
00000663.pgp      1048139          YES          100000          Suspicious_File
00000662.pgp      1048127          YES          100000          Suspicious_File
00000661.pgp      1048115          YES          100000          Suspicious_File
00000660.pgp      1048103          YES          100000          Suspicious_File
00000659.pgp      1048091          YES          100000          Suspicious_File
00000658.pgp      1048079          YES          100000          Suspicious_File
00000657.pgp      1048067          YES          100000          Suspicious_File
00000656.pgp      1048055          YES          100000          Suspicious_File
00000655.pgp      1048043          YES          100000          Suspicious_File
00000654.pgp      1048031          YES          100000          Suspicious_File
00000653.pgp      1048019          YES          100000          Suspicious_File
00000652.pgp      1048007          YES          100000          Suspicious_File
00000651.pgp      1047995          YES          100000          Suspicious_File
00000650.pgp      1047983          YES          100000          Suspicious_File
00000649.pgp      1047971          YES          100000          Suspicious_File
00000648.pgp      1047959          YES          100000          Suspicious_File
00000647.pgp      1047947          YES          100000          Suspicious_File
00000646.pgp      1047935          YES          100000          Suspicious_File
00000645.pgp      1047923          YES          100000          Suspicious_File
00000644.pgp      1047911          YES          100000          Suspicious_File
00000643.pgp      1047899          YES          100000          Suspicious_File
00000642.pgp      1010540          YES          100000          Suspicious_File
00000641.pgp      1010532          YES          100000          Suspicious_File
00000640.pgp      1010524          YES          100000          Suspicious_File
00000639.pgp      1008855          YES          100000          Suspicious_File
00000638.pgp      1001744          YES          100000          Suspicious_File
00000637.pgp      1000984          YES          100000          Suspicious_File

...... MORE files of pgp......

00000008.pgp        43051          YES          100000          Suspicious_File
00000007.pgp       196176          YES          100000          Suspicious_File
00000006.pgp       149356          YES          100000          Suspicious_File
00000005.pgp        95097          YES          100000          Suspicious_File
00000004.pgp        94893          YES          100000          Suspicious_File
00000003.pgp       523956          YES          100000          Suspicious_File
00000002.pgp        64096          YES          100000          Suspicious_File
00000001.doc            0          YES         1304577          Suspicious_File
00000000.doc            0          NO          1304577          Suspicious_File
Completed at Mon Sep 18 15:53:26 2017
```

Figure-10: Scalpel results.

- With PGP files, we downloaded Elcomsoft Forensic Disk Decryptor to try to decrypt PGP files. But this tool also asked for the keys to these PGP files in order to decrypt them. We could not process further.

- Foremost tool on Kali:

> foremost –i /root/Desktop/ex3/Suspicious_file –o /root/Desktop/test

  - Foremost extracted into one OLE file (00000000.ole).

- EnCase on Windows 7:

  Using EnCase, we were able to file carve Suspicious_File and discovered there were two files wrapped inside the Suspicious_File. These two files were ‘Details’ and ‘File_0’. See figure-11 below:

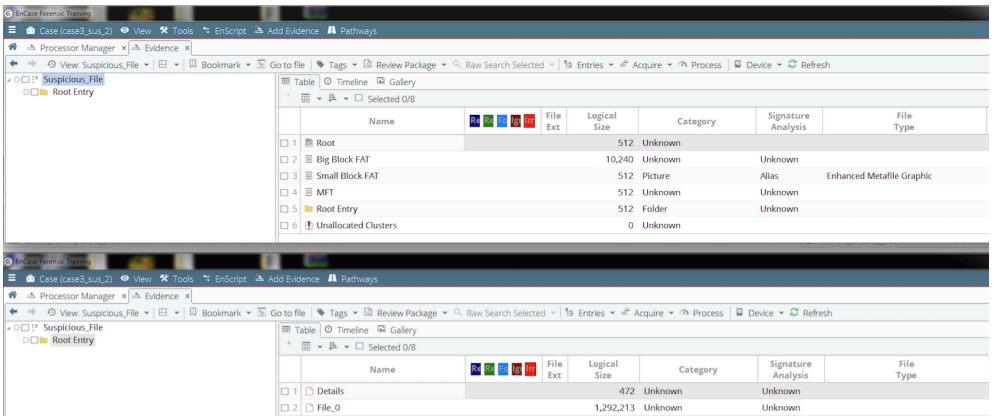


Figure-11: EnCase result.

Analysis: Suspicious_File

Tools	*File type*	*header*	*Footer/trailer*
FTK	OLECF	D0 CF 11 E0 A1 B1 1A E1 *Gary Kessler Signature File Table:* According to Gary Kessler, it was an OLECF file.	N/A
HexEdit	OLECF	D0 CF 11 E0 A1 B1 1A E1 *Gary Kessler Signature File Table:* According to Gary Kessler, it was an OLECF file.	N/A
TrID:	100% OLE2	Generic OLE2 Multistream Compound File	N/A
Exiftool	N/A	N/A	N/A

Malwaretracker.com/doc.php site redirected us to this Cryptam.com for analysis of Suspicious_File, see figure-12 below:

Sample Details

original filename: **Suspicious_File**

size: **1304576 bytes**
submitted: **2014-01-27 07:39:41**
md5: **63017bb2a213fa440191b204929ab0f7**
sha1: **f454953c6ae4496b21d2e4c1006842aff60b90eb**
sha256: **cec6534e8ddc4f5f9e9b2a0cedb438a8419a5ffd08ecfe059467630f624d5b1a**
ssdeep: **24576:ATgRvu+fNB53r3j1HXQ+5ql8ie+i0QMv4RhDHd91S1etww4qEyY9c4jC1CV+E4cY:ATgRvu+fNB53r3j1HA+5ql8iePd91YeX**
content/type: **Composite Document File V2 Document, No summary info**
analysis time: **53.57 s**
result: **malware [150]**
embedded executable: **found**

signature hits:

```
2638: string.This program cannot be run in DOS mode
1244080: string.LoadLibraryA
1243996: string.GetModuleHandleA
1244048: string.GetCommandLineA
1246706: string.GetSystemMetrics
1243770: string.GetProcAddress
1243712: string.EnterCriticalSection
1243400: string.CloseHandle
1244398: string.CreateFileA
1247318: string.RegOpenKeyExA
1081060: string.user32.dll
1163676: string.KERNEL32
1161103: string.ExitProcess
1246846: string.GetMessageA
1246552: string.CreateWindowExA
dropped.file exe 91babceabb2263975b0c4309e82ca977 / 1302016 bytes / @ 2560
```

Figure-12: Malwaretracker results.

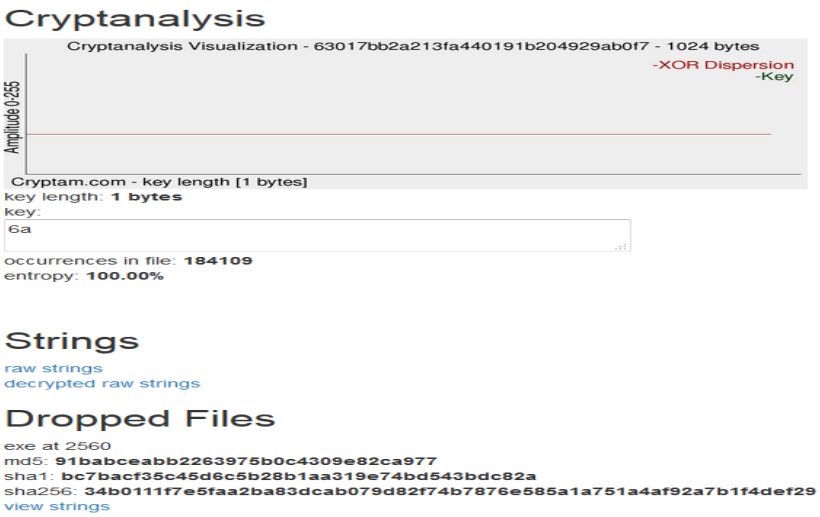


Figure-13: Key generated from Cryptam.com to decrypt the hex.

According to Malwaretracker.com analysis of the Suspicious_File, it had identified 150 malwares, see figure-12. It also had identified some strings that looked like function calls from a program and identified a *'dropped.file exe'* program. We also noticed this *'dropped.file exe'* had it's own hash value from Malwaretracker. While analyzing the output from Cryptanalysis section (see figure-13), a key value was found '6a'. We speculated that this key value was used to decrypt the raw string data presented by Malwaretracker of *'dropped.file exe'.* When accessing this link 'decrypted raw strings' option, we noticed these peculiarities:

- It revealed that there were several files with the word 'copyright' such as:
  - *Copyright (C) 1998, Thomas G. Lane*
  - *deflate 1.1.3 Copyright 1995-1998 Jean-loup Gailly*
  - *inflate 1.1.3 Copyright 1995-1998 Mark Adler*
  - *Copyright (c) 1992-2001 by P.J. Plauger, licensed by Dinkumware, Ltd. ALL RIGHTS RESERVED.*
  - *Copyright 2003 - 2004 PopCap Games, Inc.*

- Additionally, we found these URL of:
  - *http://www.popcap.com/win32updatecheck2.php?prod=*
  - *http://www.popcap.com/register.php?theGame=*
  - *http://www.microsoft.com/directx*
  - *http://www.popcap.com/beta_validate.php?prod=*
  - *http://store.gamehouse.com/buyzuma.jsp?AID=%AFFIL%&D=%DAYS%&M=%MINUTES%*

- And these information:
  - *OriginalFilename*
  - *Zuma.exe*
  - *ProductName*
  - *Zuma Deluxe*
  - *ProductVersion*
  - *1.0.0.1*
  - *SpecialBuild*
  - *Presented by GameHouse*

- We also discovered there were random information such as:
  - *TimeZoneName=Arab Standard Time*
  - *Names of months but May, June and July months were missing*
  - *Names of days*
  - *Instructions*

- *names of players and characters*
- *names of sounds files*
- *names of image files and many more…..*

Virustotal.com:

According to Virustotal.com, we were able to obtain similar information as EnCase because both tools identified two files, Details and File_0, see figure-14 below.

Virustotal.com identified the information and listed on the *Detection* info tab:

Generic OLE2 Multistream Compound File

Detection: CAT-QuickHeal: OLE.Win32.Agent.EB

NANO-Antivirus: Virus.Win32.Gen.ccmw

From *Details* tab:

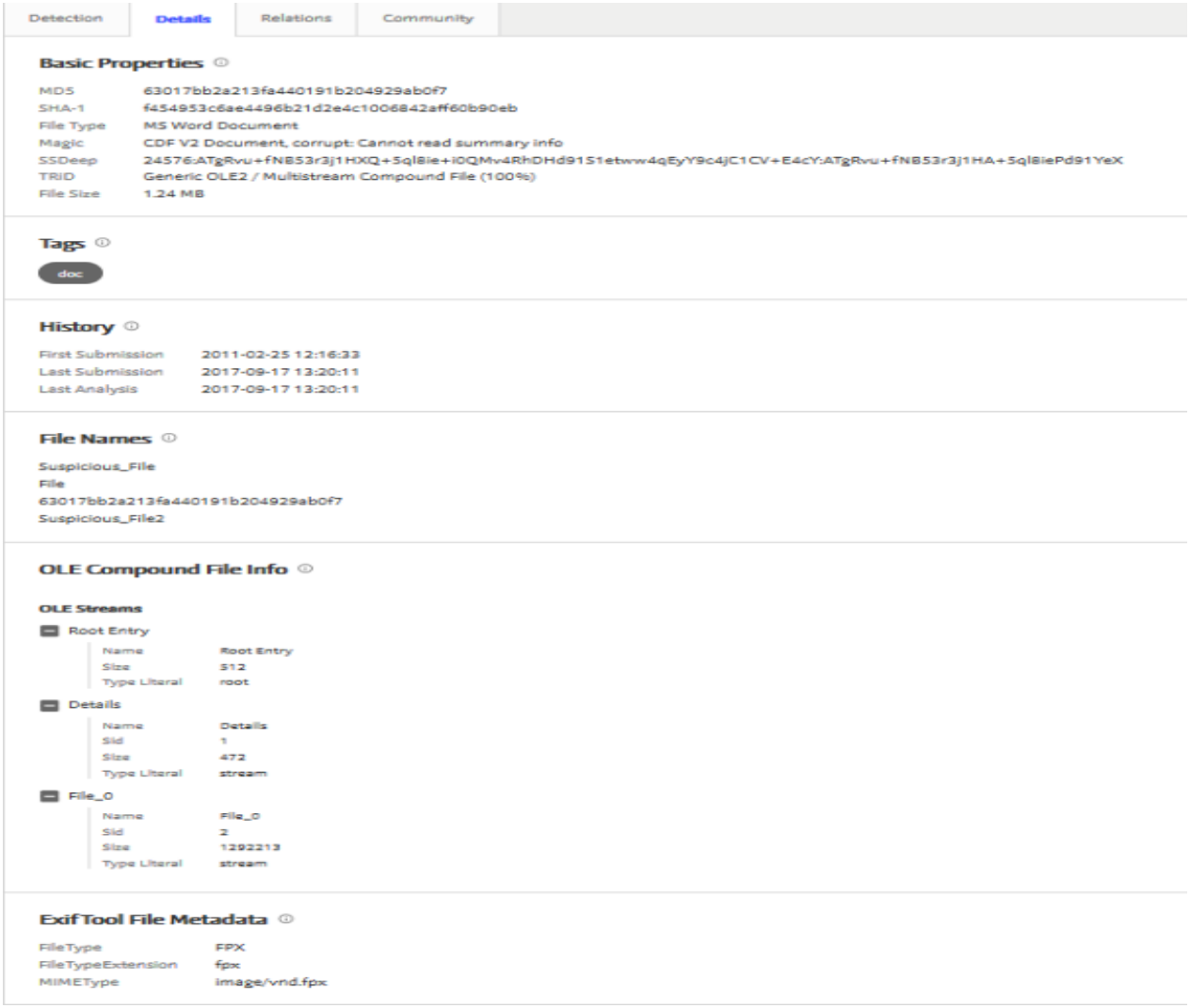


Figure-14: Virustotal.com results

We speculated what VirusTotal had detected two types of viruses, they were: *'OLE.Win32.Agent.EB'* and *'Virus.Win32.Gen.ccmw'* . Additionally, it had identified two files that were similarly named as EnCase results and they were *'Details'* and *'File_0'*, see figure-14.

Summary of Suspicious_File:

Could you identify the files? If so, what type of files were they? Could you find anything peculiar about

the files?

We were not really able to identify Suspicious_File because it appeared to contain multiple files that were wrapped into one large file. We were able to carve the files by using Scalpel, Foremost and EnCase. Only Scalpel tool was able to carve out 687 files (see appendix-2) where Foremost carved only one file out and EnCase carved two files out. Also we speculated that there could be two viruses stored in the Suspicious_File based on the findings from Virustotal.com and Malwaretracker.com. See Analysis section above regarding the peculiarities found.

Exercise 4 - Acquisition

See *DIFO2017_Lab1_Report_Group14_Ex4.pdf* for answer to Exercise 4.

Exercise 5 - Cracking

Objective: To crack the protected and or encrypted files by using brute force technique.

Evidences: Unnamed 1.xls, casssh.pdf, Untitles.docx, hr.gpg.tar and wallet.dat

Chain-of-custody: Used md5 and sha256 algorithm to hash the evidence files.

Tools used: Hashcat version 3.6.0, AccessData PRTK version 8.1.0 build 946 and sha256deep64.exe version 4.4.

Acquisition: The steps to acquire the evidence files used were:

a) Md5deep64.exe and sha256deep64.exe used to generate md5 and sha256 hash values:

Name	MD5	SHA256
casssh.pdf	f77f0c2ea19035ace1d47b266245984d	a5ba8562717a9c128bdb87d3b0b327cea7bb24f33fd599d5de8fc6d41c174d02
ht.zip.tar.gpg	159ef8f471caef32db49dc9b331e10a5	2fe1cd6a80f6609efbc4fc142ce552ef46155f0fe1b0b765f0b12ea7fd5d8f8b
untitled.docx	3a9b988f1496b2598cf08023603bcf3c	c28739a4507ca3f39ac0cf1a06de6f58d410b3a1fb8724268264d1cbe67e8112
wallet1.dat	fbf3b26fcf8e9fe4ec2e70175255e36c	6c073f77c40ca84a1ada73452633b58359d055e37ae75dcec0f663538db859a5
Untitled 1.ods	0a4532f87c41c31f1b716cd21ea8fa51	126b46eb0c3891f86f38af95b810ed083f242e5aaaa5bbd84caf9f1ee28af6a3

b) To ensure that we didn't alter these five evidence files, we used the copied of the evidence files to crack the passwords on these files.

1) Casssh.pdf: We used dictionary brute force attack with this evidence file using 'Access Data Password Recovery Toolkit (PRTK)' tool.

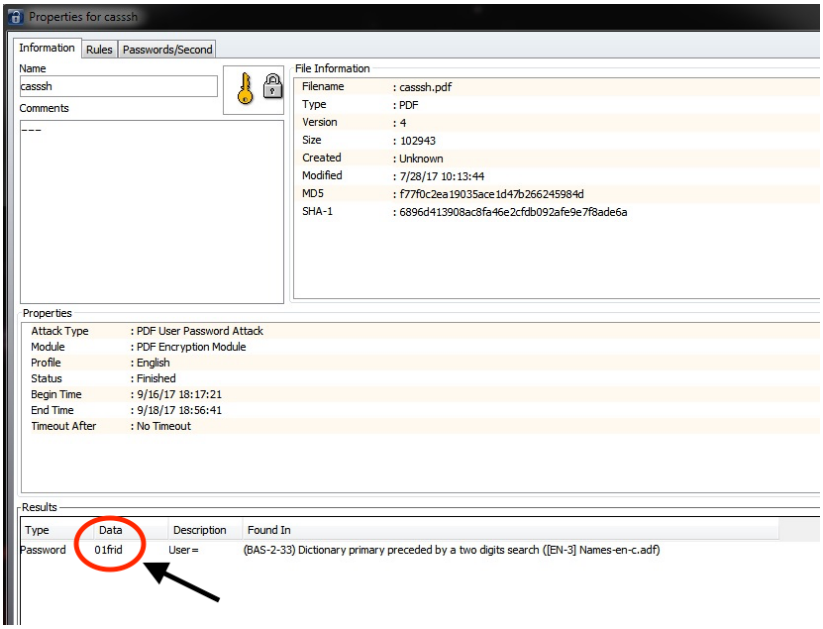


Figure-15: Password for pdf file

It tooks about 8 hours to crack this casssh.pdf and two days to verify the password. The password was '01frid' for this *'casssh.pdf'* file. By using this password, we were able to open the *'casssh.pdf'* file and the result was:

Figure-16: Result of casssh.pdf.

2) ht.zip.tar.gpg: We started the password cracking process on 2017-09-18 14:38:10 using 'Access Data Password Recovery Toolkit (PRTK)' and

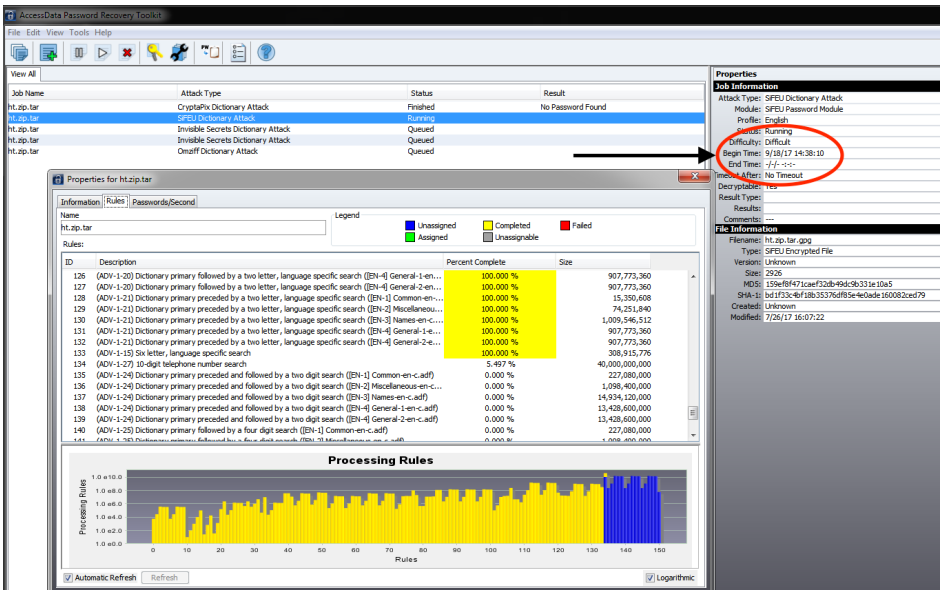


Figure-17: Result of "***ht.zip.tar.gpg***"

we were not able to complete this file due to taking too long to crack. The reasons were: it had multiple Attack type rule policies that were needed to be processed to crack the password on this file, see figure-17 above.

We could crack with one of the Attack Type rule policy and the result was 'no password found' (see figure 18 below) and other Attack type rule policies continued to process, which it had taken more than two weeks.

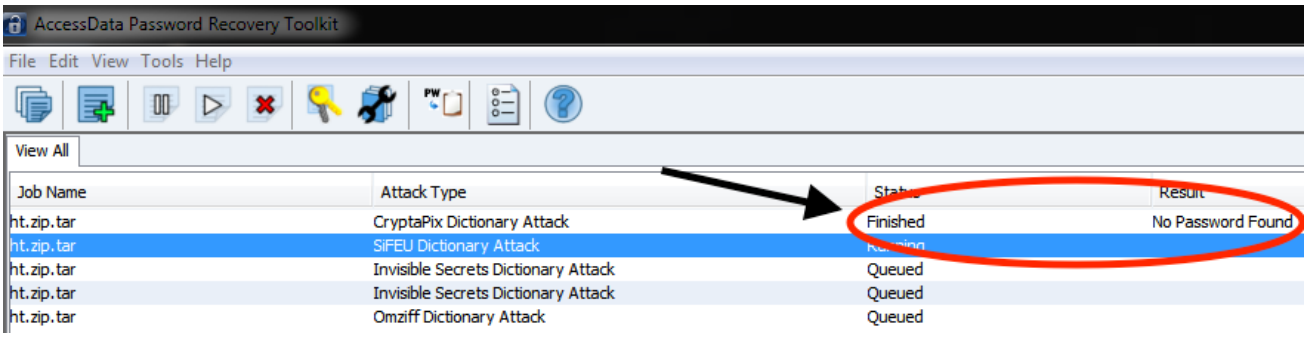


Figure-18: Finished with one file rule policy

3) Untitled 1.ods, untitled.docx:
We used 'Access Data Password Recovery Toolkit (PRTK)' to crack *'Untitled 1.ods'* and *'untitled.docx'* files. These files also have been running more than two weeks similar to file '*ht.zip.tar.gpg'* procedure above and still it has been continuing to process. We were not able to complete these files for password cracking due to limited time resource.

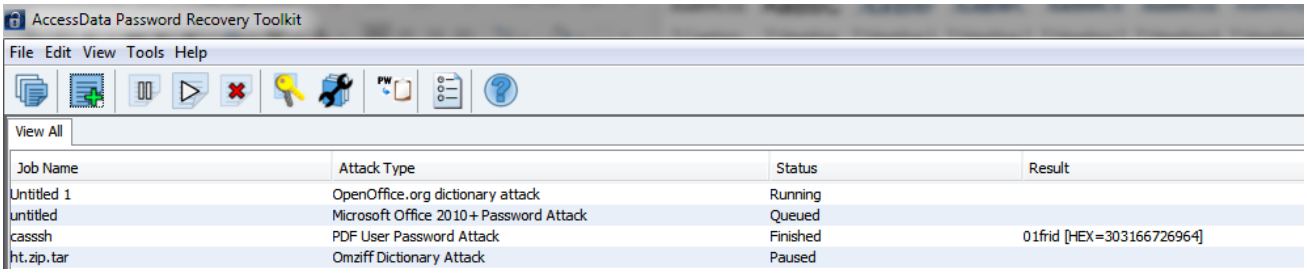


Figure 19: Result of ***Untitled 1.ods, untitled.docx:***

4) wallet1.dat: We used 'Access Data Password Recovery Toolkit (PRTK)' to crack *'wallet1.dat'* and an error message had occurred. The error was "Unable to identify file type for decryption", see figure-20.

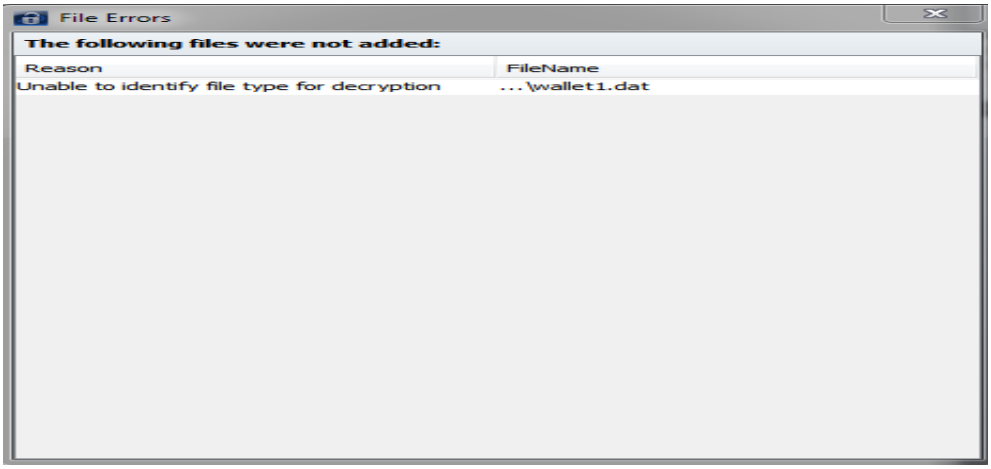


Figure 20: Result of ***wallet1.dat***

5) We used PWD2 (10.11.200.152) machine as well to crack this file *'casssh.pdf'* by using Hashcat tool. Command used were:

>C:\Users\group 14\Desktop\hashcat-3.6.0>hashcat64 -m 10500 -a 3 "C:\Users\group 14\Desktop\Exercise5_Cracking\casssh_hash"

Casssh.pdf file was the only file we were able to crask successfully using hashcat. It took about one hour to crack this file. The password we cracked was '01frid' same as using PRTK application on a Windows machine.

Also, we tried to crack other evidence files such as '*ht.zip.tar.gpg'* using Hashcat on the PWD2 server and it took too long because we were limited with time resource on this server. The other evidence files were not executed by using Hashcat.

Exercise 6 - Steganography

Objective: To find any hidden data from the two evidence (*c1l.png* and *c2l.png*) files given.

Evidences: *c1l.png* and *c2l.png*

Chain-of-custody: generated hash values using md5deep64.exe.

Tools used: Exiftool version 10.6.1.0, md5deep64 version 4.4, TweakPNG version 1.4.6, Rizzy.py and Stepic-0.3.

Identify the two files, what they do depict?
From visual inspection, these two files (*c1l.png and c2l.png*) depicted CS2 in large black block letters and with smaller blue text of Cyber Systems Security Laboratory on the right side of CS2. See figure 21.

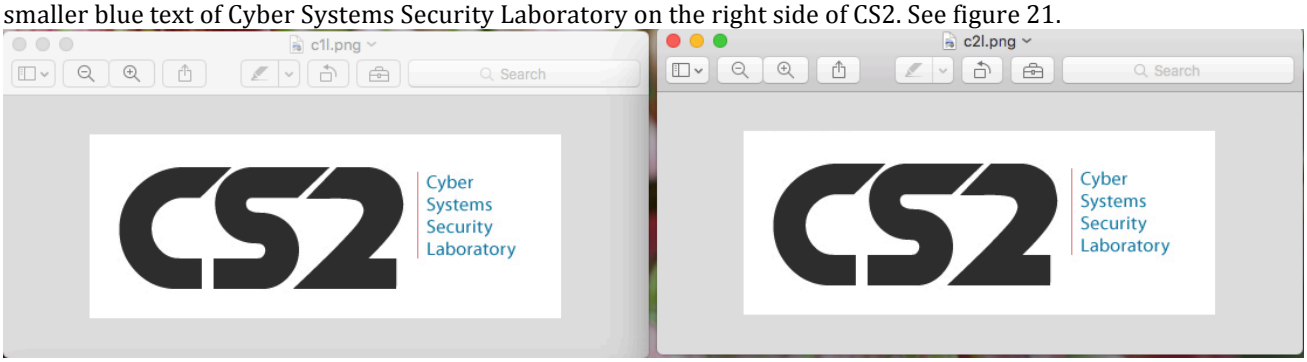


Figure 21: Visual inspection of evidence files.

From the visual inspection, there seen to be no differences between these two files so far.

What are their hash sums?

The hash algorithm used was md5 on both *c1l.png* and *c2l.png* files.
- *c1l.png* hash value: 601450fd443v42f4ece0e3f001ed73b3
- *c2l.png* hash value: b914cc2043a6d5b31ff4bb6f5f1291fc

After we generated the hash values for these two files, we realized there could be differences between these two files since the hash values provided by md5deep64.exe were different.

What are their META data?
Using Exiftool, it identified these two files as unique files because we noticed that *c2l.png* didn't have information of *Significant Bits, Pixels Per Unit X, Pixels Per Unit Y, and Pixel Units* such as the *c1l.png* file had. See figure 22.

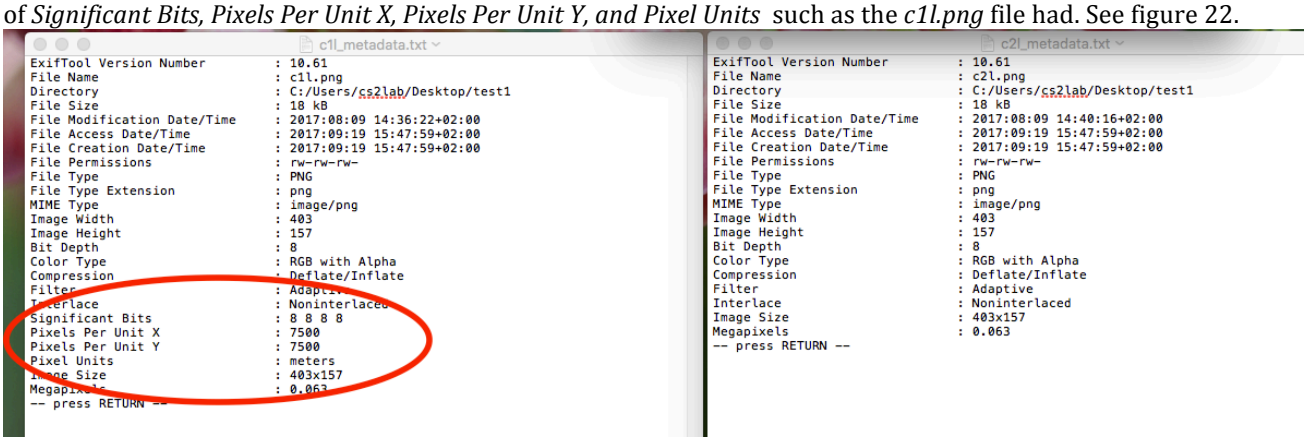


Figure 22: Metadata information of evidence files.

Which tool/tools did you use to find out if there was any message in the image(s)?

Tools used were: TweakPNG, Exiftool, md5deep64.exe, rizzy.py and stepic.py.

With TweakPNG.exe, it provided the critical chunks information of the evidence files such as IHDR, sBIT, pHYs, IDAT and IEND, See figure-23 which led us to believe that there could be hidden message in one of the evidence file.

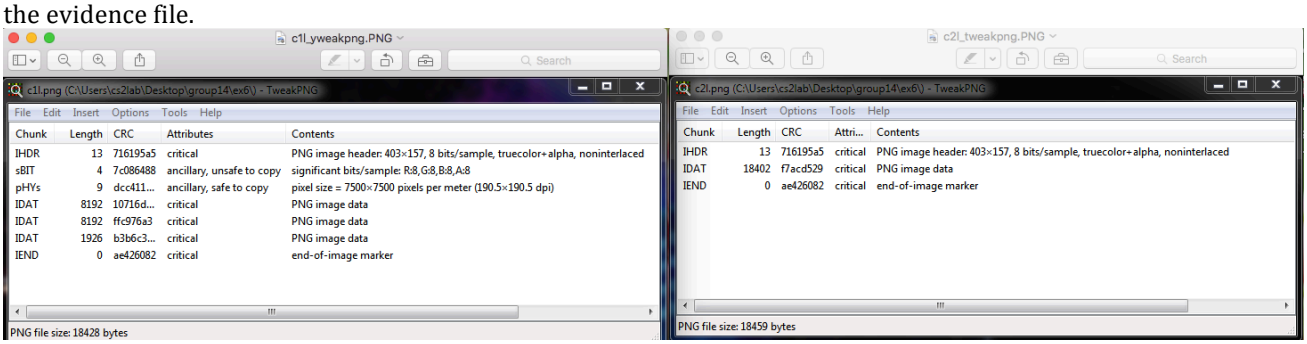


Figure 23: Critical chunks information of evidence files.

When using the Rizzy.py and stepic.py tools, both tools revealed a hidden message from *c2l.png* file which was *'http://xdsa5xcrrrxxxolc.onion/'*. See figure 24:

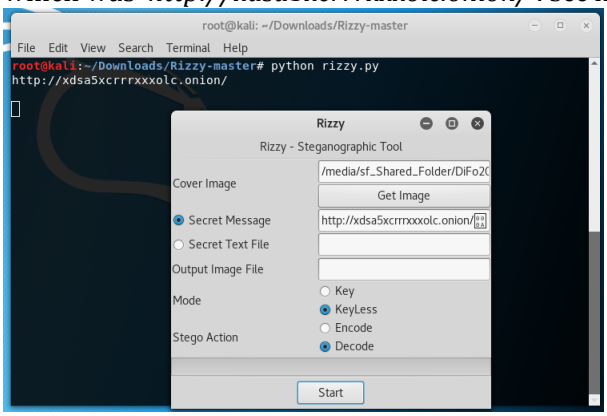


Figure-24: Rizzy.py found hidden message from *c2lp.png*.

Additionally, both rizzy.py and stepic.py tools found this *'invalid UTF-8 string passed'* from *c1l.png.* See figure -25:

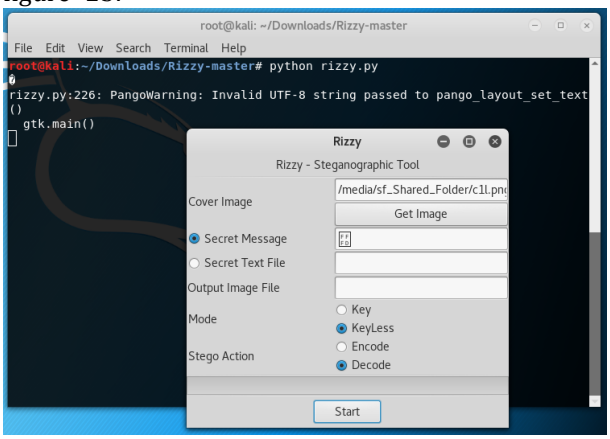


Figure-25: Rizzy.py found invalid UTF-8 message from *c1lp.png*.

Analysis:

How was the message hidden in the image?

We speculated that the hidden message was hidden inside the IDAT chunk in the *c2l.png* file. The reason how we derided to this conclusion was that we used rizzy.py to encrypt the hidden message of *'http://xdsa5xcrrrxxxolc.onion/'* from *c2l.png* to *c1l.png*. The test output file *c1l_encoded.png* also had the same critical chunks information like *c2l.png*. See figure-26 and compare to Figure-23.

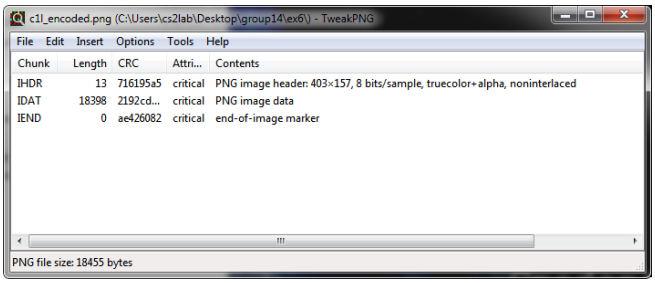


Figure 26: Critical chunks information of *c1l_encoded.png.*

One could see that both *c2l.png* and *c1l_encoded.png* files had the same critical chunks information, see Table-1 below. This confirmed our theory that *c2l.png* had been altered to contain a hidden message and that *c1l.png* was the source for *c2l.png* file. Due to this confirmation test, it allowed us to be able to perform a comparison test.

Table-1: PNG critical chunks information

Critical Chunks	c1l.png	c2l.png	c1l_encoded.png (a test file)
IHDR	Yes	No	No
IDAT	Found 3 chunks	Only 1 IDAT found	Only 1 IDAT
sBit	Yes	No	No
pHYs	Yes	No	No
IEND	Yes	Yes	Yes
Hidden message	Invalid of UTF-8 string	http://xdsa5xcrrrxxxolc.onion/	http://xdsa5xcrrrxxxolc.onion/

By looking at these critical chunks information, it led us to experiment with another png file (*jaguar.png*) that we downloaded from the Internet. We wanted to confirm what a regular png file would have for the critical chunks information so that we could confidently conclude if the *c1l.png* file was an original file and it hadn't been altered in anyway.

By using the *jaguar.png*, we discovered that it did contain the same critical chunks information like *c1l.png* file except that the *jaguar.png* had more IDAT chunks. The extra IDAT chunks might ment that the *jaguar.png* contained more image data than *c1l.png* file. When we encoded the same hidden message from *c2l.png* into *jaguar.png* file, it also revealed that the critical chunks information were same as *c2l.png* file, see Table-2 below.

Table-2: PNG critical chunk information

Critical Chunks	c1l.png	c2l.png	c1l_encoded.png (a test file)	jaguar.png	jaguar_encoded.png (a test file)
IHDR	Yes	No	No	Yes	No
IDAT	Found 3 chunks	Only 1 IDAT found	Only 1 IDAT	38 IDAT found	9 IDAT found
sBit	Yes	No	No	Yes	No
pHYs	Yes	No	No	Yes	No
IEND	Yes	Yes	Yes	Yes	No
Hidden message	Invalid of UTF-8 string	http://xdsa5xcrrrxxxolc.onion/	http://xdsa5xcrrrxxxolc.onion/	Invalid of UTF-8 string	http://xdsa5xcrrrxxxolc.onion/

Could you have found the message in any other way?

Maybe HexExit tool can be used as an alternative tool to find the hidden message in c2l.png file.

Appendix 1: c.mp3

```
root@kali:~/Desktop/test# scalpel -o /root/Desktop/test/output_mp3/ -v /root/Desktop/test/c.mp3
Scalpel version 1.60
Written by Golden G. Richard III, based on Foremost 0.69.
Output directory: "/root/Desktop/test/output_mp3"
Configuration file: "/etc/scalpel/scalpel.conf"
Coverage maps directory: "/root/Desktop/test/output_mp3"

Opening target "/root/Desktop/test/c.mp3"

Total file size is 19332 bytes
Image file pass 1/2.
Read 19332 bytes from image file.
/root/Desktop/test/c.mp3: 100.0% |**********************|   18.9 KB    00:00 ETAA jpg header was found at : 3
Memory reallocation performed, total header storage = 101
A jpg footer was found at : 19330
Memory reallocation performed, total footer storage = 101
A pgp header was found at : 10656
Memory reallocation performed, total header storage = 101
A pgp header was found at : 9543
Memory reallocation performed, total header storage = 101
A pgp header was found at : 12547
Allocating work queues...
Work queues allocation complete. Building carve lists...
Carve lists built.  Workload:
art with header "\x4a\x47\x04\x0e" and footer "\xcf\xc7\xcb" --> 0 files
art with header "\x4a\x47\x03\x0e" and footer "\xd0\xcb\x00\x00" --> 0 files
gif with header "\x47\x49\x46\x38\x37\x61" and footer "\x00\x3b" --> 0 files
gif with header "\x47\x49\x46\x38\x39\x61" and footer "\x00\x3b" --> 0 files
jpg with header "\xff\xd8\xff\xe0\x00\x10" and footer "\xff\xd9" --> 1 files
png with header "\x50\x4e\x47\x3f" and footer "\xff\xfc\xfd\xfe" --> 0 files
bmp with header "\x42\x4d\x3f\x3f\x00\x00\x00" and footer "" --> 0 files
tif with header "\x49\x49\x2a\x00" and footer "" --> 0 files
tif with header "\x4d\x4d\x00\x2a" and footer "" --> 0 files
avi with header "\x52\x49\x46\x46\x3f\x3f\x3f\x3f\x41\x56\x49" and footer "" --> 0 files
mov with header "\x3f\x3f\x3f\x3f\x6d\x6f\x6f\x76" and footer "" --> 0 files
mov with header "\x3f\x3f\x3f\x3f\x6d\x64\x61\x74" and footer "" --> 0 files
mov with header "\x3f\x3f\x3f\x3f\x77\x69\x64\x65\x76" and footer "" --> 0 files
mov with header "\x3f\x3f\x3f\x3f\x73\x6b\x69\x70" and footer "" --> 0 files
mov with header "\x3f\x3f\x3f\x3f\x66\x72\x65\x65" and footer "" --> 0 files
mov with header "\x3f\x3f\x3f\x3f\x69\x64\x73\x63" and footer "" --> 0 files
mov with header "\x3f\x3f\x3f\x3f\x70\x63\x6b\x67" and footer "" --> 0 files
mpg with header "\x00\x00\x01\xba" and footer "\x00\x00\x01\xb9" --> 0 files
mpg with header "\x00\x00\x01\xb3" and footer "\x00\x00\x01\xb7" --> 0 files
fws with header "\x46\x57\x53" and footer "" --> 0 files
doc with header "\xd0\xcf\x11\xe0\xa1\xb1\x1a\xe1\x00\x00" and footer
"\xd0\xcf\x11\xe0\xa1\xb1\x1a\xe1\x00\x00" --> 0 files
doc with header "\xd0\xcf\x11\xe0\xa1\xb1" and footer "" --> 0 files
pst with header "\x21\x42\x4e\xa5\x6f\xb5\xa6" and footer "" --> 0 files
dbx with header "\xcf\xad\x12\xfe\xc5\xfd\x74\x6f" and footer "" --> 0 files
idx with header "\x4a\x4d\x46\x39" and footer "" --> 0 files
```

mbx with header "\x4a\x4d\x46\x36" and footer "" --> 0 files
wpc with header "\x3f\x57\x50\x43" and footer "" --> 0 files
htm with header "\x3c\x68\x74\x6d\x6c" and footer "\x3c\x2f\x68\x74\x6d\x6c\x3e" --> 0 files
pdf with header "\x25\x50\x44\x46" and footer "\x25\x45\x4f\x46\x0d" --> 0 files
pdf with header "\x25\x50\x44\x46" and footer "\x25\x45\x4f\x46\x0a" --> 0 files
mail with header "\x41\x4f\x4c\x56\x4d" and footer "" --> 0 files
pgd with header "\x50\x47\x50\x64\x4d\x41\x49\x4e\x60\x01" and footer "" --> 0 files
pgp with header "\x99\x00" and footer "" --> 1 files
pgp with header "\x95\x01" and footer "" --> 0 files
pgp with header "\x95\x00" and footer "" --> 2 files
pgp with header "\xa6\x00" and footer "" --> 0 files
txt with header "\x2d\x2d\x2d\x2d\x2d\x42\x45\x47\x49\x4e\x20\x50\x47\x50" and footer "" --> 0 files
rpm with header "\xed\xab" and footer "" --> 0 files
wav with header "\x52\x49\x46\x46\x3f\x3f\x3f\x3f\x57\x41\x56\x45" and footer "" --> 0 files
ra with header "\x2e\x72\x61\xfd" and footer "" --> 0 files
ra with header "\x2e\x52\x4d\x46" and footer "" --> 0 files
dat with header "\x72\x65\x67\x66" and footer "" --> 0 files
dat with header "\x43\x52\x45\x47" and footer "" --> 0 files
zip with header "\x50\x4b\x03\x04" and footer "\x3c\xac" --> 0 files
java with header "\xca\xfe\xba\xbe" and footer "" --> 0 files
max with header "\x56\x69\x47\x46\x6b\x1a\x00\x00\x00\x00" and footer "\x00\x00\x05\x80\x00\x00" --> 0 files
pins with header "\x50\x49\x4e\x53\x20\x34\x2e\x32\x30\x0d" and footer "" --> 0 files
Carving files from image.
Image file pass 2/2.
/root/Desktop/test/c.mp3: 100.0% |**********************| 18.9 KB 00:00 ETAOPENING /root/Desktop/test/output_mp3/pgp-34-0/00000003.pgp
CLOSING /root/Desktop/test/output_mp3/pgp-34-0/00000003.pgp
OPENING /root/Desktop/test/output_mp3/pgp-34-0/00000002.pgp
CLOSING /root/Desktop/test/output_mp3/pgp-34-0/00000002.pgp
OPENING /root/Desktop/test/output_mp3/pgp-32-0/00000001.pgp
CLOSING /root/Desktop/test/output_mp3/pgp-32-0/00000001.pgp
OPENING /root/Desktop/test/output_mp3/jpg-4-0/00000000.jpg
CLOSING /root/Desktop/test/output_mp3/jpg-4-0/00000000.jpg
Processing of image file complete. Cleaning up...
Done.
Scalpel is done, files carved = 4, elapsed = 0 seconds.

Appendix 2: Suspicious_File

1) edit the scalpel.conf file to so that would allow scalpel carve any file type.

```
root@kali:~# vi /etc/scalpel/scalpel.conf
root@kali:~# scalpel -o /root/Desktop/test -v /root/Desktop/test/Suspicious_File
Scalpel version 1.60
Written by Golden G. Richard III, based on Foremost 0.69.
Output directory: "/root/Desktop/test"
Configuration file: "/etc/scalpel/scalpel.conf"
Coverage maps directory: "/root/Desktop/test"
```

2) root@kali:~# scalpel -o /root/Desktop/test/output/ -v /root/Desktop/test/Suspicious_File

```
Scalpel version 1.60
Written by Golden G. Richard III, based on Foremost 0.69.
Output directory: "/root/Desktop/test/output"
Configuration file: "/etc/scalpel/scalpel.conf"
Coverage maps directory: "/root/Desktop/test/output"

Opening target "/root/Desktop/test/Suspicious_File"

Total file size is 1304576 bytes
Image file pass 1/2.
Read 1304576 bytes from image file.
/root/Desktop/test/Suspicious_File: 100.0% |**********|   1.2 MB   00:00 ETAA doc header was found at : 0
Memory reallocation performed, total header storage = 101
A doc footer was found at : 0
Memory reallocation performed, total footer storage = 101
A doc header was found at : 0
Memory reallocation performed, total header storage = 101
A pgp header was found at : 64096
Memory reallocation performed, total header storage = 101
A pgp header was found at : 523956
A pgp header was found at : 94893
Memory reallocation performed, total header storage = 101
A pgp header was found at : 95097
A pgp header was found at : 149356
A pgp header was found at : 196176
A pgp header was found at : 262143
A pgp header was found at : 856818
A pgp header was found at : 982885
A pgp header was found at : 1108369
A pgp header was found at : 1204055
A pgp header was found at : 1217347
A pgp header was found at : 1223699
A pgp header was found at : 1237111
A pgp header was found at : 1277062
A pgp header was found at : 18771
Memory reallocation performed, total header storage = 101

A pgp header was found at : 1048235
A pgp header was found at : 1167740
A pgp header was found at : 64148

Memory reallocation performed, total header storage = 101
A pgp header was found at : 87220
A pgp header was found at : 445245
A pgp header was found at : 469416
A pgp header was found at : 563261
```

A pgp header was found at : 648687
A pgp header was found at : 654045
A pgp header was found at : 657066
A pgp header was found at : 905029
A pgp header was found at : 909748
A pgp header was found at : 934739
A pgp header was found at : 937332
A pgp header was found at : 939828
A pgp header was found at : 949423
Allocating work queues...
Work queues allocation complete. Building carve lists...
Carve lists built. Workload:
art with header "\x4a\x47\x04\x0e" and footer "\xcf\xc7\xcb" --> 0 files
art with header "\x4a\x47\x03\x0e" and footer "\xd0\xcb\x00\x00" --> 0 files
gif with header "\x47\x49\x46\x38\x37\x61" and footer "\x00\x3b" --> 0 files
gif with header "\x47\x49\x46\x38\x39\x61" and footer "\x00\x3b" --> 0 files
jpg with header "\xff\xd8\xff\xe0\x00\x10" and footer "\xff\xd9" --> 0 files
png with header "\x50\x4e\x47\x3f" and footer "\xff\xfc\xfd\xfe" --> 0 files
bmp with header "\x42\x4d\x3f\x3f\x00\x00\x00" and footer "" --> 0 files
tif with header "\x49\x49\x2a\x00" and footer "" --> 0 files
tif with header "\x4d\x4d\x00\x2a" and footer "" --> 0 files

.....(NOTE: we removed pgp files due to redundency).....

doc with header "\xd0\xcf\x11\xe0\xa1\xb1\x1a\xe1\x00\x00"
and footer "\xd0\xcf\x11\xe0\xa1\xb1\x1a\xe1\x00\x00" --> 1 files
doc with header "\xd0\xcf\x11\xe0\xa1\xb1" and footer "" --> 1 files
pst with header "\x21\x42\x4e\xa5\x6f\xb5\xa6" and footer "" --> 0 files
dbx with header "\xcf\xad\x12\xfe\xc5\xfd\x74\x6f" and footer "" --> 0 files
idx with header "\x4a\x4d\x46\x39" and footer "" --> 0 files
mbx with header "\x4a\x4d\x46\x36" and footer "" --> 0 files
wpc with header "\x3f\x57\x50\x43" and footer "" --> 0 files
htm with header "\x3c\x68\x74\x6d\x6c" and footer "\x3c\x2f\x68\x74\x6d\x6c\x3e" --> 0 files
pdf with header "\x25\x50\x44\x46" and footer "\x25\x45\x4f\x46\x0d" --> 0 files
pdf with header "\x25\x50\x44\x46" and footer "\x25\x45\x4f\x46\x0a" --> 0 files
mail with header "\x41\x4f\x4c\x56\x4d" and footer "" --> 0 files
pgd with header "\x50\x47\x50\x64\x4d\x41\x49\x4e\x60\x01" and footer "" --> 0 files
pgp with header "\x99\x00" and footer "" --> 2 files
pgp with header "\x95\x01" and footer "" --> 13 files
pgp with header "\x95\x00" and footer "" --> 656 files
pgp with header "\xa6\x00" and footer "" --> 14 files
txt with header "\x2d\x2d\x2d\x2d\x2d\x42\x45\x47\x49\x4e\x20\x50\x47\x50" and footer "" --> 0 files
rpm with header "\xed\xab" and footer "" --> 0 files
wav with header "\x52\x49\x46\x46\x3f\x3f\x3f\x3f\x57\x41\x56\x45" and footer "" --> 0 files
ra with header "\x2e\x72\x61\xfd" and footer "" --> 0 files
ra with header "\x2e\x52\x4d\x46" and footer "" --> 0 files
dat with header "\x72\x65\x67\x66" and footer "" --> 0 files
dat with header "\x43\x52\x45\x47" and footer "" --> 0 files
zip with header "\x50\x4b\x03\x04" and footer "\x3c\xac" --> 0 files
java with header "\xca\xfe\xba\xbe" and footer "" --> 0 files
max with header "\x56\x69\x47\x46\x6b\x1a\x00\x00\x00\x00" and footer "\x00\x00\x05\x80\x00\x00" --> 0 files
pins with header "\x50\x49\x4e\x53\x20\x34\x2e\x32\x30\x0d" and footer "" --> 0 files
Carving files from image.
Image file pass 2/2.
/root/Desktop/test/Suspicious_File: 100.0% |**********|
 1.2 MB 00:00 ETAOPENING /root/Desktop/test/output/pgp-35-0/00000686.pgp
CLOSING /root/Desktop/test/output/pgp-35-0/00000686.pgp

OPENING /root/Desktop/test/output/pgp-35-0/00000685.pgp
CLOSING /root/Desktop/test/output/pgp-35-0/00000685.pgp
OPENING /root/Desktop/test/output/pgp-35-0/00000684.pgp
CLOSING /root/Desktop/test/output/pgp-35-0/00000684.pgp

.....(nOTE: we removed pgp files due to redundency).....

OPENING /root/Desktop/test/output/pgp-33-0/00000010.pgp
CLOSING /root/Desktop/test/output/pgp-33-0/00000010.pgp
OPENING /root/Desktop/test/output/pgp-33-0/00000009.pgp
CLOSING /root/Desktop/test/output/pgp-33-0/00000009.pgp
OPENING /root/Desktop/test/output/pgp-33-0/00000008.pgp
CLOSING /root/Desktop/test/output/pgp-33-0/00000008.pgp
OPENING /root/Desktop/test/output/pgp-33-0/00000007.pgp
CLOSING /root/Desktop/test/output/pgp-33-0/00000007.pgp
OPENING /root/Desktop/test/output/pgp-33-0/00000006.pgp
CLOSING /root/Desktop/test/output/pgp-33-0/00000006.pgp
OPENING /root/Desktop/test/output/pgp-33-0/00000005.pgp
CLOSING /root/Desktop/test/output/pgp-33-0/00000005.pgp
OPENING /root/Desktop/test/output/pgp-33-0/00000004.pgp
CLOSING /root/Desktop/test/output/pgp-33-0/00000004.pgp
OPENING /root/Desktop/test/output/pgp-32-0/00000003.pgp
CLOSING /root/Desktop/test/output/pgp-32-0/00000003.pgp
OPENING /root/Desktop/test/output/pgp-32-0/00000002.pgp
CLOSING /root/Desktop/test/output/pgp-32-0/00000002.pgp
OPENING /root/Desktop/test/output/doc-21-0/00000001.doc
CLOSING /root/Desktop/test/output/doc-21-0/00000001.doc
OPENING /root/Desktop/test/output/doc-20-0/00000000.doc
CLOSING /root/Desktop/test/output/doc-20-0/00000000.doc
Processing of image file complete. Cleaning up...
Done.
Scalpel is done, files carved = 687, elapsed = 1 seconds.

References

1) http://md5deep.sourceforge.net/

2) www.md5deep.sourceforge.net/md5deep.html

3) http://www.garykessler.net/library/file_sigs.html

4) http://araskin.webs.com/exif/exif.html