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SECURITY ASSESSMENT REPORT

ASSESSMENT SUBJECT: SafeNote.apk

Ho Chi Minh City, 2023

CMC TELECOM

Version	1.0
Target	SafeNote.apk
Date	06/04/2023
Document Type	Report
Prepared By	Tran Truong Giang

MỤC LỤC

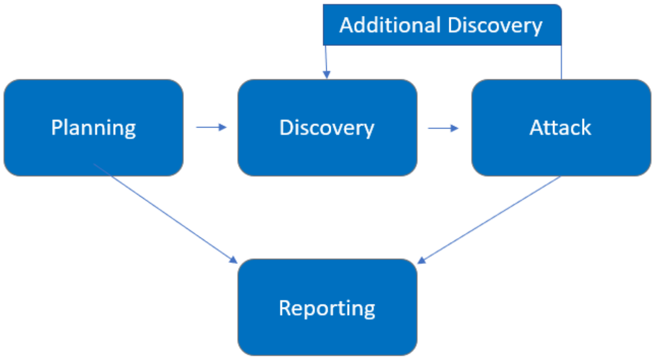
I. Overview

1. Synopsis

From March 07, 2023 – March 10, 2023 CMCCS and REDACTED had collaborated to conduct the penetration test for the app SafeNote.apk. All tests follow the OWASP standards.

The assessment procedure includes:

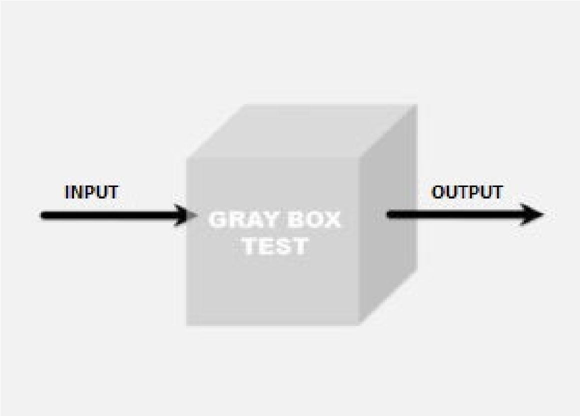
- Planning: Identify the subject and scope for assessment
- Discovery: Test, Scan, Search and Identify intel relevant to the test subject including Versions, Vulnerabilities, Weakness, Sensitive data, etc
- Attack: CMC Personnel will perform attacks and exploits on discovered vulnerabilities.
- Reporting: Document the vulnerabilities along with the method of exploit recognised on the test subject, and recommendation for remedy.



2. Method of implementation

Gray Box Pen-testing: In this method, the internal structure of the application is known partially (usually internal account or test account)

With Grey Box Pentesting, CMC will be provided with an internal account along with necessary information of the system to conduct the test.



3. Classification of Vulnerabilities

CLASSIFICATION OF VULNERABILITY		
Level	**CVSS V3 Scoring**	**Description**
Critical	9 – 10	Vulnerabilities that allow hackers to attack from the outside in with the highest privilege, exposing sensitive or full data, impacting severely the information integrity (data is modified or completely erased) as well as its availability (all services are shut down)
High	7 – 8,9	Vulnerabilities allowing attackers to impact the system within a certain scope such as taking over user authority to access a device without authentication, exposing large amount of data (but have low level of sensitivity), data is subjected to modification and its integrity is affected, leading to the system being stalled of interrupted. However, the impact is not too severe to the reputation of the organisation and only affects a group of users
Medium	4 – 6,9	Vulnerabilities at this level is usually used as a predecessor for future attacks and exploits to potentially affect the system at a higher level. These types of vulnerabilities can cause nuisance for users but usually do not affect the availability of the service directly

Low	0,1 – 3,9	Vulnerabilities that leak data at a low level where said data are not valuable for exploits and does not affect the integrity of the information as well as the activities of the system. The fix is often feasible and easy with little to no cost. Organisations' reputation is not affected

4. Scope of Work

Method of Implementation	Test Object
Black Box Pen-testing	App SafeNote.apk

5. Summary of Testing Process

After discussing with REDACTED on ensuring the continual availability of the app SafeNote.apk. CMC proposed conducting the penetration test from 27/03/2023 – 08/04/2023. The detail of work is as follow:

STT	Contents of work performed		Condition
1	Collection Of Information	Determine the types of data connections that the app uses 3G, WiFi connection, NFC connection, Bluetooth.	PASS
		The permissions that the app requires when installing.	PASS
		Collect information about unfamiliar domains or IP connections in the application.	PASS
		Collect information about the SDK if built into the app.	PASS
2	Static Analysis	Evaluate the authentication mechanism.	FAIL
		Check the anti-root, anti-vm, cert-pinning mechanisms (if any) of the application.	PASS
		Check the app's permission configurations.	PASS
		Check the configuration in the Manifest (Activity Hijacking) file.	PASS
		Check session management mechanisms and insecure cookie storage.	PASS
		Check for sensitive information in logs, code, in directories or in sqlite.	FAIL
		Check information about libraries, dependencies, and open source from 3rd	PASS

		parties.	
		Data transport cascade assessment.	PASS
		Evaluate the possibility of decompiling source code and tampering with applications.	FAIL
3	Dynamic Analysis	Evaluate Web App issues related to the application: XSS, Command Injection, CRSF, SQL Injection, Cookies …	PASS
		Evaluation of the application’s encryption machanisms.	FAIL
		Analyze files created during application installation.	PASS
		Memory analysis.	PASS
		Evaluation of authentication mechanisms.	FAIL
		Evaluating the authorization mechanism.	PASS
		Evaluation of session management mechanisms.	PASS
		Data transfer layer assessment.	PASS
		Evaluate server-side attacks from the application.	PASS

II. Details of Implementation

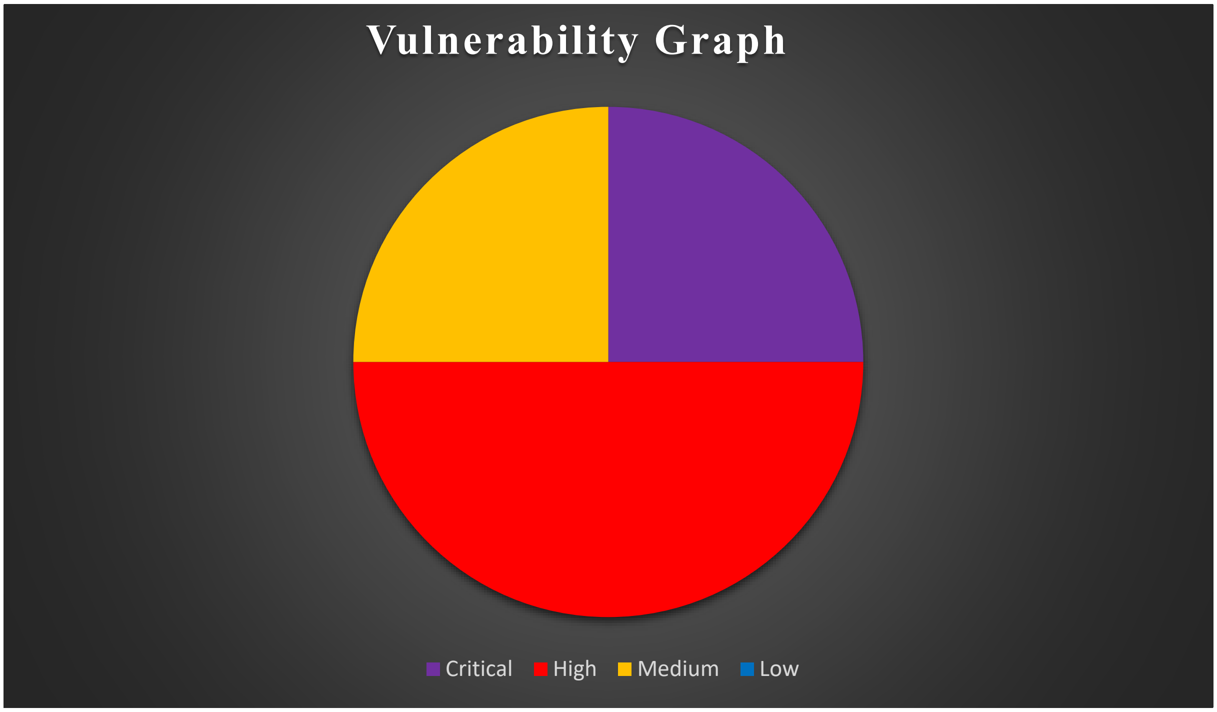
1. Application Information

Platform	Android
Package Name	com.els.safenote
Version	Android 11
Min SDK	16
Target SDK	24
MD5	3ea6097be40583e9f11a940afbe02fcc
SHA1	950c546d2555f36579d0731d519735bc10fe220c
SHA256	a1728c0740bb6e0d3fe8241c6418201a9e9927a90c9245de6bc73ac75a3a6fcd

2. Summarized findings and Vulnerability Graph

Classification	Quantity
Target	SafeNote.apk
Total vulnerabilities found	04

CRITICAL/ HIGH / MEDIUM / LOW	01	02	01	00



3. Vulnerability List

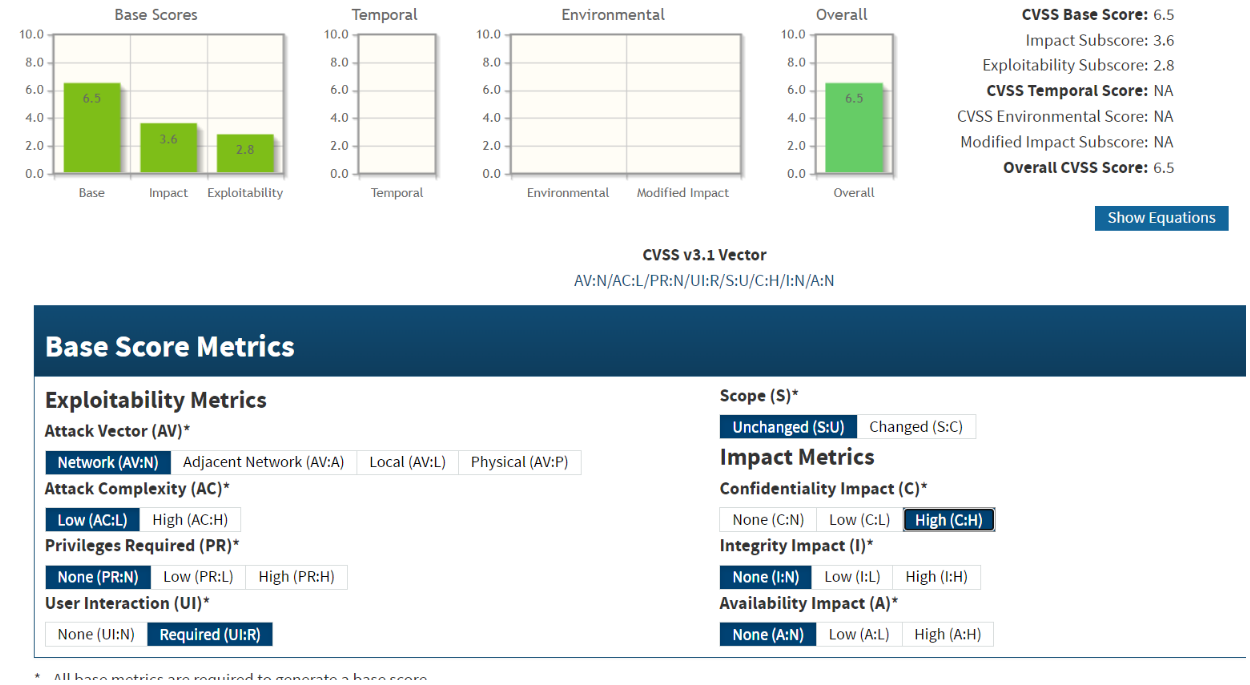
No	VULNERABILITY LIST	STATUS
1	**Application Backup Enabled**	**MEDIUM**
2	**Weak Cryptography**	**HIGH**
3	**Debug Mode Enabled**	**CRITICAL**
4	**Insecure Storage in Shared Preferences**	**HIGH**

4. Vulnerability details

4.1 Application Backup Enabled

The following summaries the vulnerability's severity ratings.

Possibility	HIGH	Technical Impact	MEDIUM	Business Impact	MEDIUM



CVSS Base Score: 6.5
Impact Subscore: 3.6
Exploitability Subscore: 2.8
CVSS Temporal Score: NA
CVSS Environmental Score: NA
Modified Impact Subscore: NA
Overall CVSS Score: 6.5

CVSS v3.1 Vector
AV:N/AC:L/PR:N/UI:R/S:U/C:H/I:N/A:N

Base Score Metrics

Exploitability Metrics

Attack Vector (AV)*
[✓ Network (AV:N)] Adjacent Network (AV:A) Local (AV:L) Physical (AV:P)

Attack Complexity (AC)*
[✓ Low (AC:L)] High (AC:H)

Privileges Required (PR)*
[✓ None (PR:N)] Low (PR:L) High (PR:H)

User Interaction (UI)*
None (UI:N) [✓ Required (UI:R)]

Scope (S)*
[✓ Unchanged (S:U)] Changed (S:C)

Impact Metrics

Confidentiality Impact (C)*
None (C:N) Low (C:L) [✓ High (C:H)]

Integrity Impact (I)*
[✓ None (I:N)] Low (I:L) High (I:H)

Availability Impact (A)*
[✓ None (A:N)] Low (A:L) High (A:H)

* All base metrics are required to generate a base score

Description:

This is a feature that is used to enable a backup storage device such as an external hard drive or an online cloud storage account. When enabled, a copy of the data stored on the primary storage device is backed up to the secondary device on a regular basis. This provides an extra layer of protection if the primary storage device fails or is damaged.

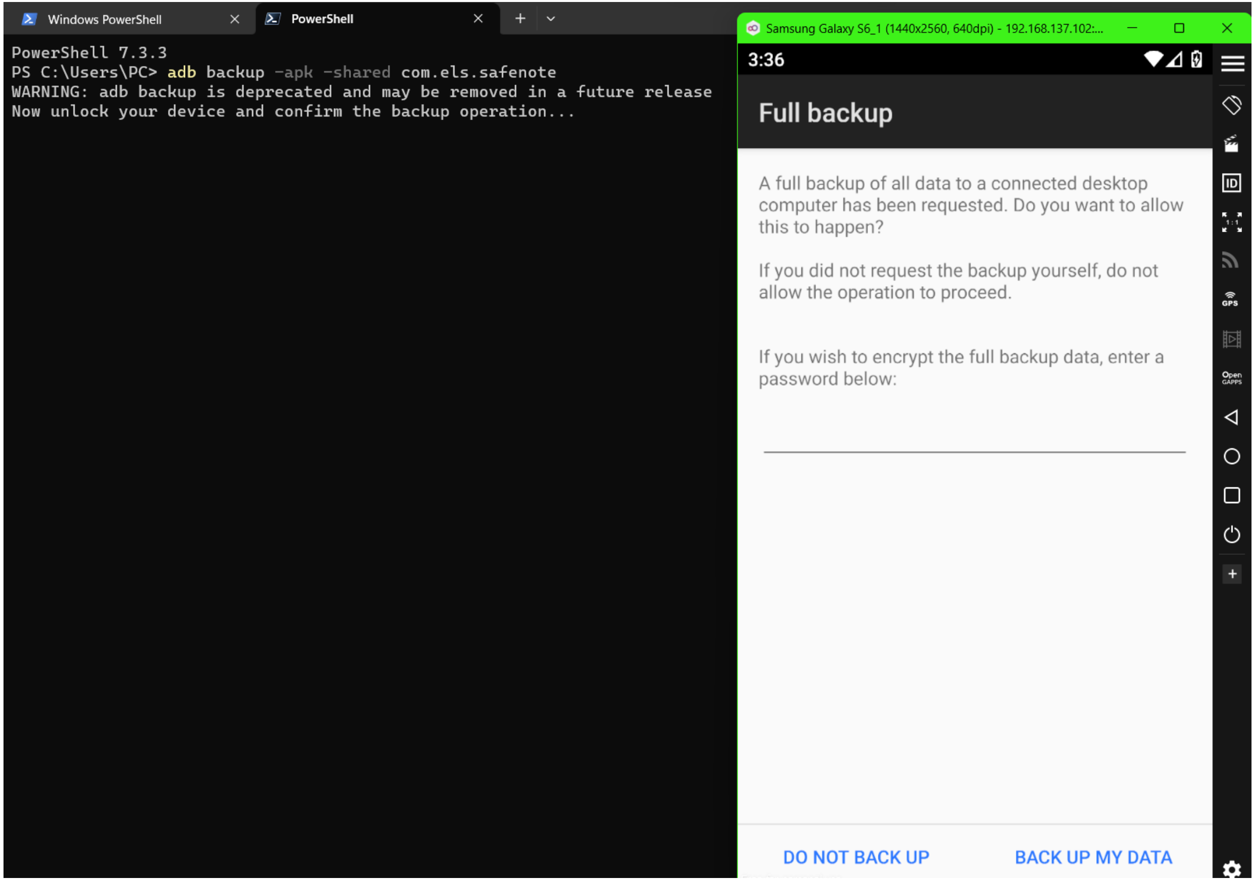
In this case, the application did not control which kind of data will be backed up. Therefore, the attacker can backup the data the get the sensitive information.

Proof of Concept:

Use jadx to reverse the apk file. In AndroidManifest.xml, we can see that this application allow backup feature

```
android:allowBackup="true"
```

Use adb backup com.els.safenote to create a backup file. In the device, it will ask for permission to backup, choose backup my data, we will get the file named backup.ab



Windows PowerShell
PowerShell
Samsung Galaxy S6_1 (1440x2560, 640dpi) - 192.168.137.102:...
3:36

```
PowerShell 7.3.3
PS C:\Users\PC> adb backup -apk -shared com.els.safenote
WARNING: adb backup is deprecated and may be removed in a future release
Now unlock your device and confirm the backup operation...
```

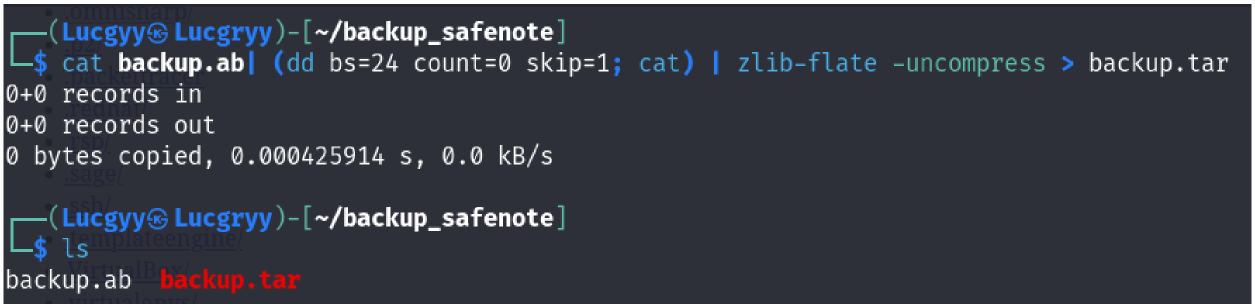
Full backup

A full backup of all data to a connected desktop computer has been requested. Do you want to allow this to happen?

If you did not request the backup yourself, do not allow the operation to proceed.

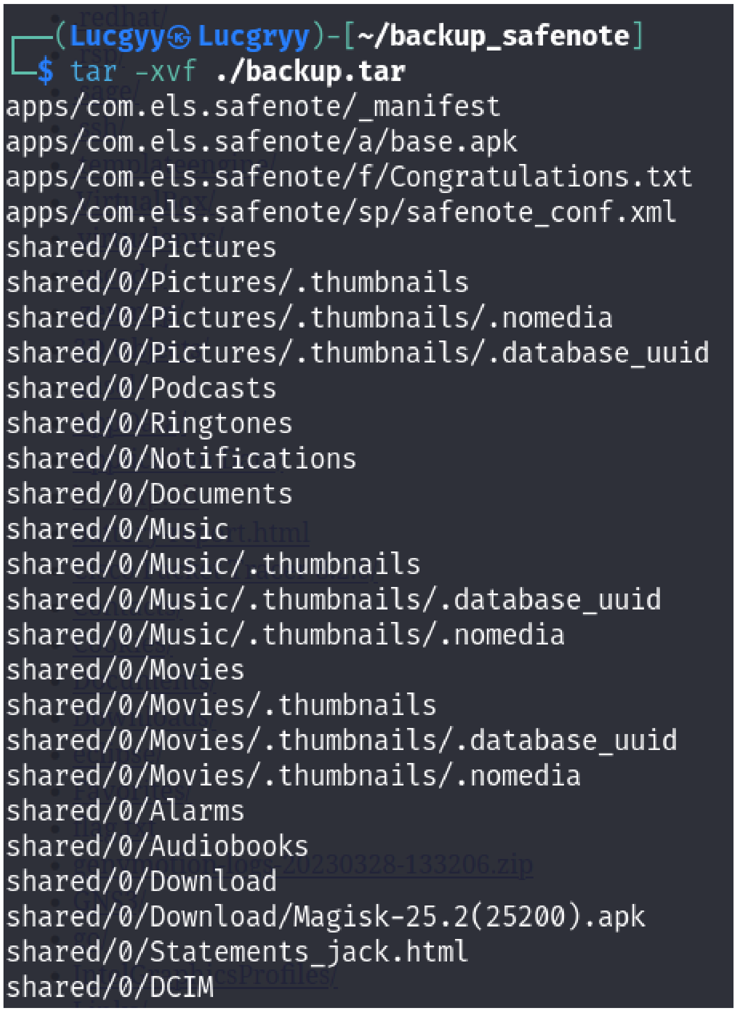
If you wish to encrypt the full backup data, enter a password below:

Convert the backup.ab into backup.tar like below



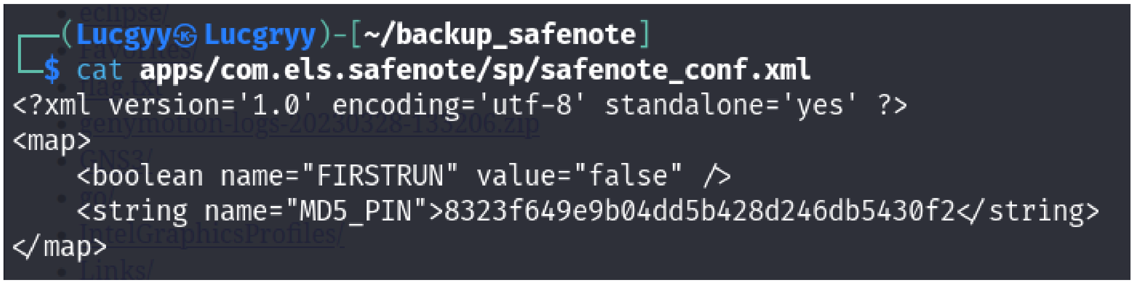
```
┌──(Lucgyy㉿Lucgryy)-[~/backup_safenote]
└─$ cat backup.ab| (dd bs=24 count=0 skip=1; cat) | zlib-flate -uncompress > backup.tar
0+0 records in
0+0 records out
0 bytes copied, 0.000425914 s, 0.0 kB/s

┌──(Lucgyy㉿Lucgryy)-[~/backup_safenote]
└─$ ls
backup.ab  backup.tar
```

Extract that .tar file



```
┌──(Lucgyy㉿Lucgryy)-[~/backup_safenote]
└─$ tar -xvf ./backup.tar
apps/com.els.safenote/_manifest
apps/com.els.safenote/a/base.apk
apps/com.els.safenote/f/Congratulations.txt
apps/com.els.safenote/sp/safenote_conf.xml
shared/0/Pictures
shared/0/Pictures/.thumbnails
shared/0/Pictures/.thumbnails/.nomedia
shared/0/Pictures/.thumbnails/.database_uuid
shared/0/Podcasts
shared/0/Ringtones
shared/0/Notifications
shared/0/Documents
shared/0/Music
shared/0/Music/.thumbnails
shared/0/Music/.thumbnails/.database_uuid
shared/0/Music/.thumbnails/.nomedia
shared/0/Movies
shared/0/Movies/.thumbnails
shared/0/Movies/.thumbnails/.database_uuid
shared/0/Movies/.thumbnails/.nomedia
shared/0/Alarms
shared/0/Audiobooks
shared/0/Download
shared/0/Download/Magisk-25.2(25200).apk
shared/0/Statements_jack.html
shared/0/DCIM
```

We can read the content of the Shared Preferences



```
┌──(Lucgyy㉿Lucgryy)-[~/backup_safenote]
└─$ cat apps/com.els.safenote/sp/safenote_conf.xml
<?xml version='1.0' encoding='utf-8' standalone='yes' ?>
<map>
    <boolean name="FIRSTRUN" value="false" />
    <string name="MD5_PIN">8323f649e9b04dd5b428d246db5430f2</string>
</map>
```

Exploitation Tool:

adb, Genymotion, jadx, Test Manual

Recommendation:

Set up the back up rule to control which kind of information in backed up. More detail here: [Back up user data with Auto Backup | Android Developers]

If the application do not allow backup, set the allowBackup to false in AndroidManifest.xml

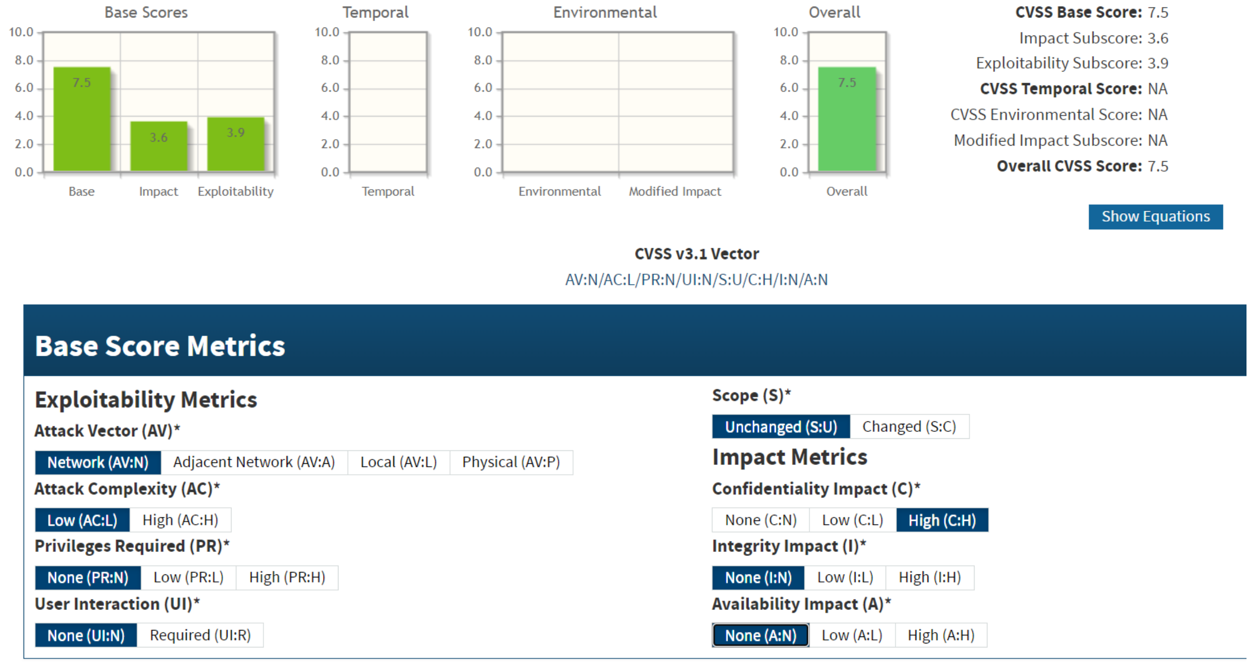
References:

[Back up user data with Auto Backup | Android Developers]

4.2 Weak Cryptography

The following summaries the vulnerability's severity ratings.

Possibility	**HIGH**	**Technical Impact**	**HIGH**	**Business Impact**	**HIGH**



CVSS Base Score: 7.5
Impact Subscore: 3.6
Exploitability Subscore: 3.9
CVSS Temporal Score: NA
CVSS Environmental Score: NA
Modified Impact Subscore: NA
Overall CVSS Score: 7.5

CVSS v3.1 Vector
AV:N/AC:L/PR:N/UI:N/S:U/C:H/I:N/A:N

Base Score Metrics

Exploitability Metrics

Attack Vector (AV)*
● Network (AV:N) ○ Adjacent Network (AV:A) ○ Local (AV:L) ○ Physical (AV:P)

Attack Complexity (AC)*
● Low (AC:L) ○ High (AC:H)

Privileges Required (PR)*
● None (PR:N) ○ Low (PR:L) ○ High (PR:H)

User Interaction (UI)*
● None (UI:N) ○ Required (UI:R)

Scope (S)*
● Unchanged (S:U) ○ Changed (S:C)

Impact Metrics

Confidentiality Impact (C)*
○ None (C:N) ○ Low (C:L) ● High (C:H)

Integrity Impact (I)*
● None (I:N) ○ Low (I:L) ○ High (I:H)

Availability Impact (A)*
● None (A:N) ○ Low (A:L) ○ High (A:H)

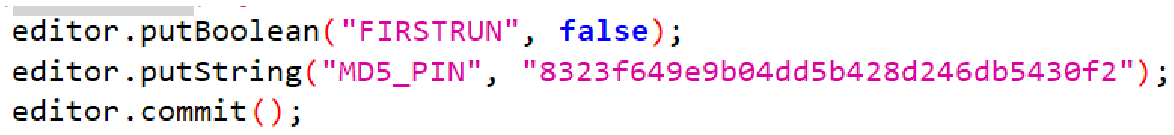
Description:

This is the vulnerable that cryptographic algorithm that is easily broken or cracked by a motivated attacker. It is considered to be vulnerable because it lacks the necessary strength or complexity to withstand a determined attack. Weak algorithms can be used to encrypt data or authenticate access, but they are easily broken by attackers due to their lack of robustness.

In this case, the programmer used MD5 algorithm, a very popular algorithm with poor security. Moreover, the programmer use hard-coded MD5 hash value for cryptographic purpose

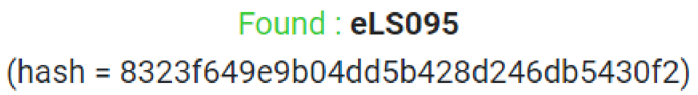
Proof of Concept:

Using jadx to reversing the apk file. In the class named Login , we can see the variable MD5_PIN in Shared Preferences: " 8323f649e9b04dd5b428d246db5430f2"



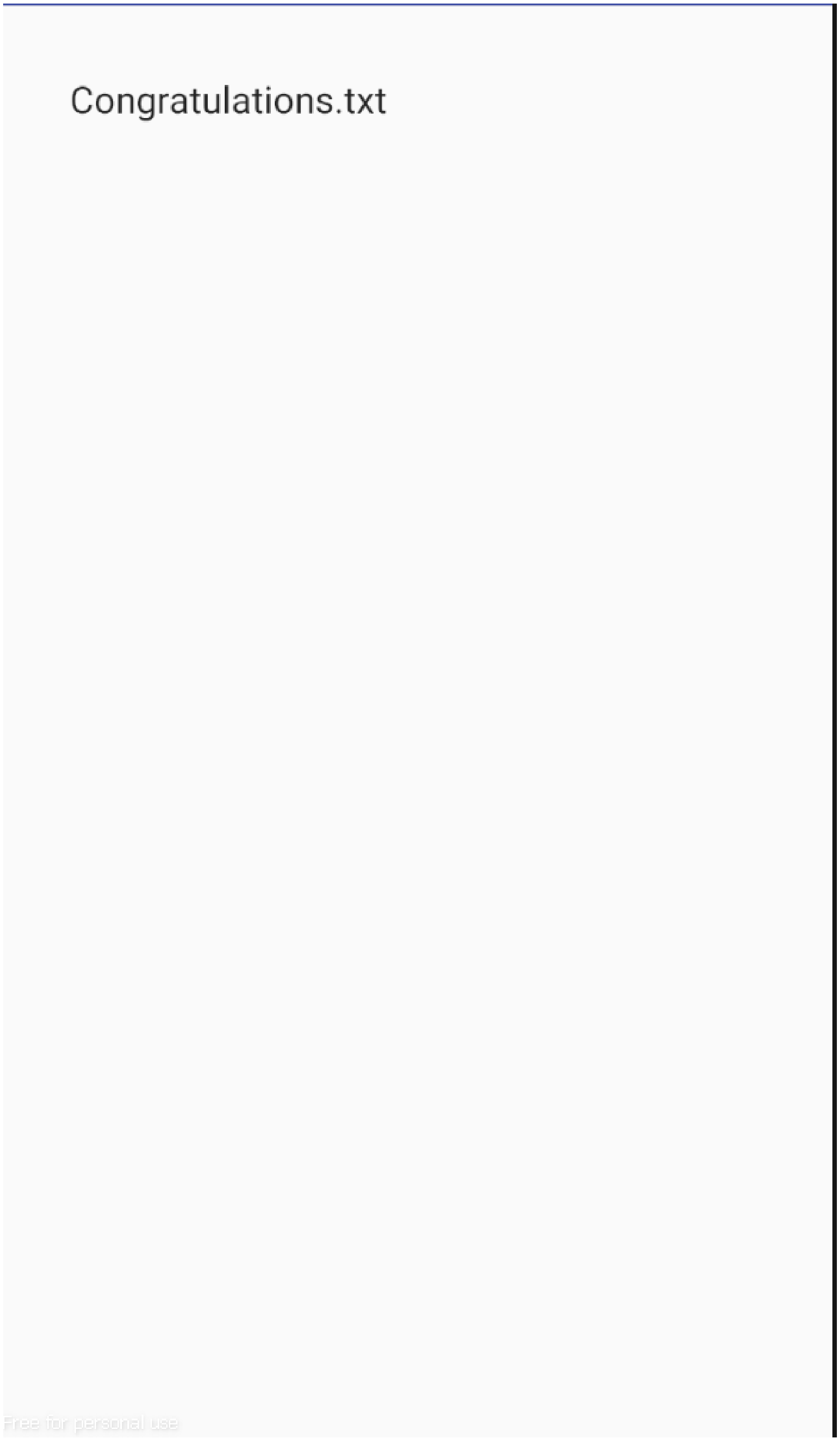
```
editor.putBoolean("FIRSTRUN", false);
editor.putString("MD5_PIN", "8323f649e9b04dd5b428d246db5430f2");
editor.commit();
```

Using website [MD5 Online | Free MD5 Decryption, MD5 Hash Decoder]() to crack the MD5 hash, we get: eLS095



Found : **eLS095**
(hash = 8323f649e9b04dd5b428d246db5430f2)

Enter that PIN code, we login successfully



Congratulations.txt

Exploitation Tool:

Genymotion, jadx, Test Manual

Recommendation:

Use android Keystore system to store key securely

Get the key:

```
KeyGenerator keyGenerator;
SecretKey secretKey;
try {
    keyGenerator = KeyGenerator.getInstance("AES");
    keyGenerator.init(256);
    secretKey = keyGenerator.generateKey();
 } catch (Exception e) {
    e.printStackTrace();
 }
```

Initialize the IV:

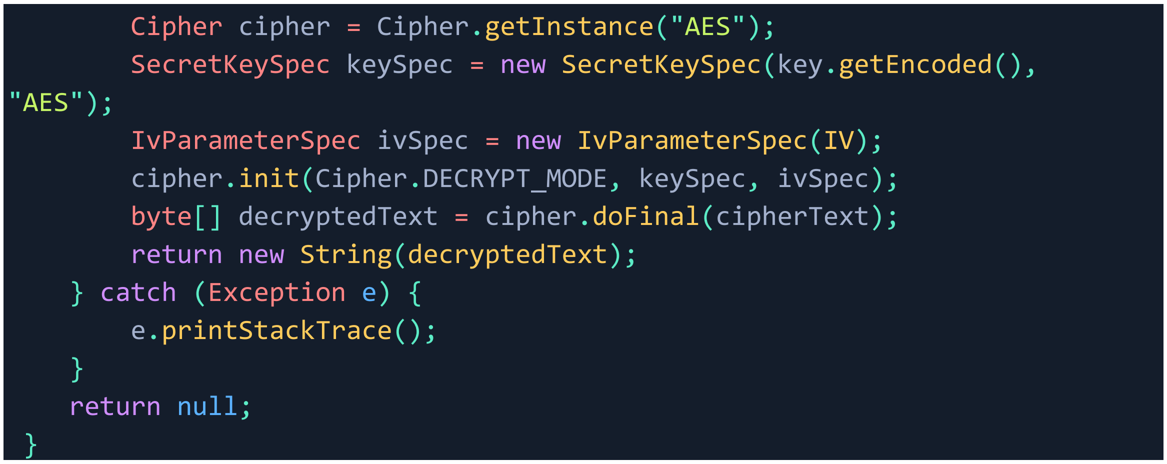
```
byte[] IV = new byte[16];
SecureRandom random;
random = new SecureRandom();
random.nextBytes(IV);
```

Encryption:

```
public static byte[] encrypt(byte[] plaintext, SecretKey key, byte[] IV)
throws Exception {
    Cipher cipher = Cipher.getInstance("AES");
    SecretKeySpec keySpec = new SecretKeySpec(key.getEncoded(), "AES");
    IvParameterSpec ivSpec = new IvParameterSpec(IV);
    cipher.init(Cipher.ENCRYPT_MODE, keySpec, ivSpec);
    byte[] cipherText = cipher.doFinal(plaintext);
    return cipherText;
 }
```

Decryption:

```
public static String decrypt(byte[] cipherText, SecretKey key, byte[] IV)
{
    try {
```



```
        Cipher cipher = Cipher.getInstance("AES");
        SecretKeySpec keySpec = new SecretKeySpec(key.getEncoded(),
"AES");
        IvParameterSpec ivSpec = new IvParameterSpec(IV);
        cipher.init(Cipher.DECRYPT_MODE, keySpec, ivSpec);
        byte[] decryptedText = cipher.doFinal(cipherText);
        return new String(decryptedText);
    } catch (Exception e) {
        e.printStackTrace();
    }
    return null;
 }
```

- Use SHA256 hashing algorithm instead of MD5

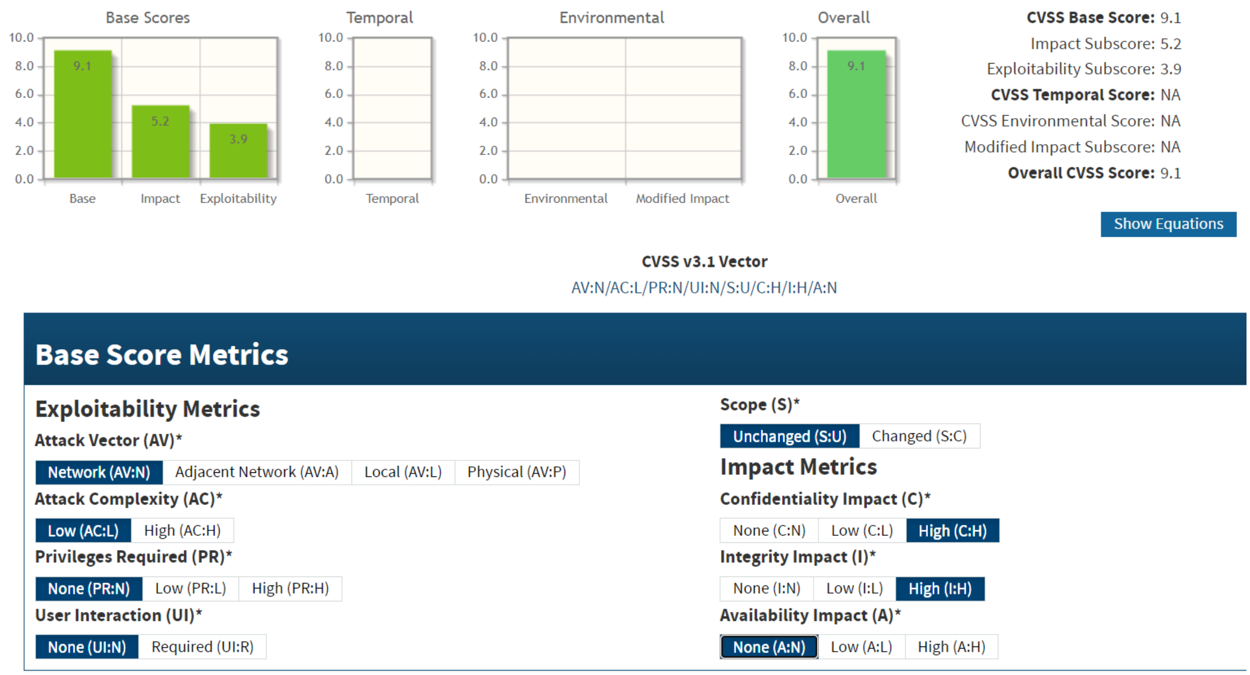
References:

AES 256 Encryption and Decryption in Android with Example (amarinfotech.com)
Android Keystore system | Android Developers

4.3 Debug Mode Enabled

The following summarises the vulnerability's severity ratings.

Possibility	**HIGH**	**Technical Impact**	**CRITICAL**	**Business Impact**	**HIGH**



CVSS Base Score: 9.1
Impact Subscore: 5.2
Exploitability Subscore: 3.9
CVSS Temporal Score: NA
CVSS Environmental Score: NA
Modified Impact Subscore: NA
Overall CVSS Score: 9.1

CVSS v3.1 Vector
AV:N/AC:L/PR:N/UI:N/S:U/C:H/I:H/A:N

Base Score Metrics

Exploitability Metrics

Attack Vector (AV)*
[✓ Network (AV:N)] Adjacent Network (AV:A) Local (AV:L) Physical (AV:P)

Attack Complexity (AC)*
[✓ Low (AC:L)] High (AC:H)

Privileges Required (PR)*
[✓ None (PR:N)] Low (PR:L) High (PR:H)

User Interaction (UI)*
[✓ None (UI:N)] Required (UI:R)

Scope (S)*
[✓ Unchanged (S:U)] Changed (S:C)

Impact Metrics

Confidentiality Impact (C)*
None (C:N) Low (C:L) [✓ High (C:H)]

Integrity Impact (I)*
None (I:N) Low (I:L) [✓ High (I:H)]

Availability Impact (A)*
[✓ None (A:N)] Low (A:L) High (A:H)

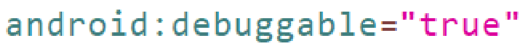
Description:

This is a security vulnerability that allows a user to access the application's debug mode and bypass certain security checks. This can be exploited to gain access to sensitive data, modify application configurations, or execute malicious code

In this case, the developer forget to disable the debugging feature

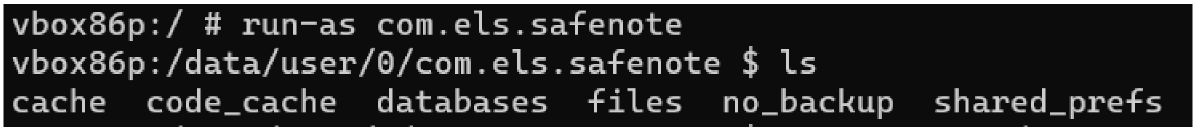
Proof of Concept:

Use jadx to reverse the apk file. In AndroidManifest.xml, we can see that this application enabled debugging

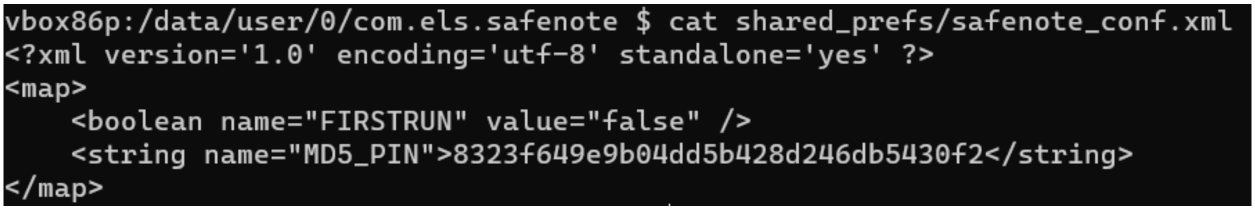


```
android:debuggable="true"
```

With that feature, the attacker can access the application's data as non-rooted user for example sqlite, shared preferences,...



```
vbox86p:/ # run-as com.els.safenote
vbox86p:/data/user/0/com.els.safenote $ ls
cache   code_cache   databases   files   no_backup   shared_prefs
```



```
vbox86p:/data/user/0/com.els.safenote $ cat shared_prefs/safenote_conf.xml
<?xml version='1.0' encoding='utf-8' standalone='yes' ?>
<map>
    <boolean name="FIRSTRUN" value="false" />
    <string name="MD5_PIN">8323f649e9b04dd5b428d246db5430f2</string>
</map>
```

Exploitation Tool:

adb, Genymotion, jadx, Test Manual

Recommendation:

In AndroidManifest.xml, set the ‘debuggable’ attribute to ‘false’

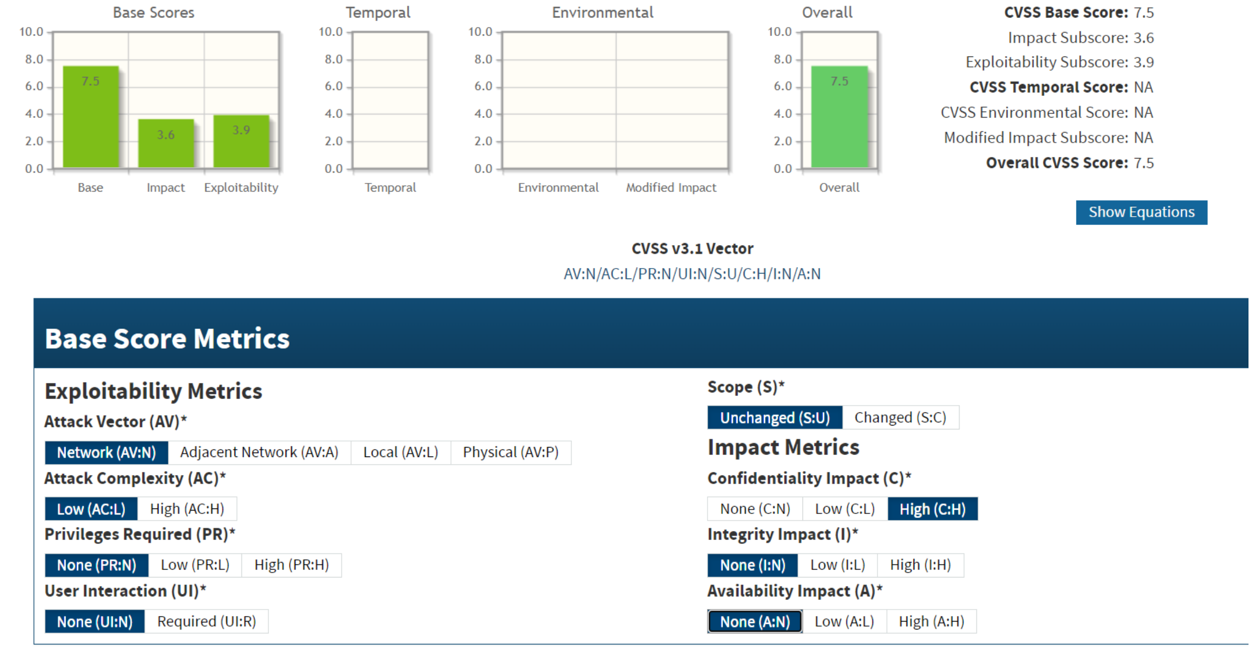
***References**:*

[Exploiting debuggable android applications | Infosec Resources (infosecinstitute.com)]

4.4 Insecure Storage in Shared Preferences

The following summaries the vulnerability’s severity ratings.

Possibility	**HIGH**	**Technical Impact**	**MEDIUM**	**Business Impact**	**MEDIUM**



CVSS Base Score: 7.5
Impact Subscore: 3.6
Exploitability Subscore: 3.9
CVSS Temporal Score: NA
CVSS Environmental Score: NA
Modified Impact Subscore: NA
Overall CVSS Score: 7.5

CVSS v3.1 Vector
AV:N/AC:L/PR:N/UI:N/S:U/C:H/I:N/A:N

Base Score Metrics

Exploitability Metrics

Attack Vector (AV)*
[✓ Network (AV:N)] Adjacent Network (AV:A) Local (AV:L) Physical (AV:P)

Attack Complexity (AC)*
[✓ Low (AC:L)] High (AC:H)

Privileges Required (PR)*
[✓ None (PR:N)] Low (PR:L) High (PR:H)

User Interaction (UI)*
[✓ None (UI:N)] Required (UI:R)

Scope (S)*
[✓ Unchanged (S:U)] Changed (S:C)

Impact Metrics

Confidentiality Impact (C)*
None (C:N) Low (C:L) [✓ High (C:H)]

Integrity Impact (I)*
[✓ None (I:N)] Low (I:L) High (I:H)

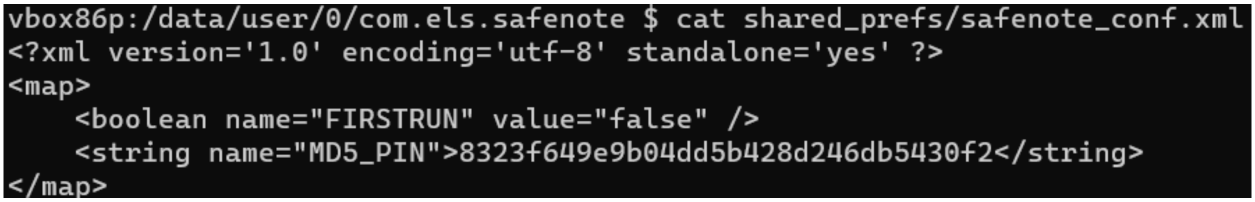
Availability Impact (A)*
[✓ None (A:N)] Low (A:L) High (A:H)

Description:

This application use Shared Preferences to stored the MD5 value of the pin code which can get access to the 'Safe Note' service. This is dangerous because the attacker can easily get access to the Shared Preferences.

Proof of Concept:

The Shared preferences is stored in /data/data/com.els.safenote/shared_prefs



```
vbox86p:/data/user/0/com.els.safenote $ cat shared_prefs/safenote_conf.xml
<?xml version='1.0' encoding='utf-8' standalone='yes' ?>
<map>
    <boolean name="FIRSTRUN" value="false" />
    <string name="MD5_PIN">8323f649e9b04dd5b428d246db5430f2</string>
</map>
```

Exploitation Tool:

adb, Genymotion, jadx, Test Manual

Recommendation:

Do not stored sensitive data in Shared Preferences.

***References**:*

[Data Storage on Android - OWASP MASTG (gitbook.io)]