



Sri Lanka Institute of Information Technology
BSc Honors in Information Technology
Specializing in Cyber Security

IE3112 - Mobile Security

Mobile App Reverse Engineering Report
Group Assignment

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1. Introduction

The purpose of this report is to document the reverse engineering process conducted on the Android application Video Player All Format HD (version 4.2.3.1). The primary objectives were to:

- Unlock the premium version of the application, bypassing the licensing or purchase verification logic.
- Inject a custom banner message ("**IT22230010 and IT22083678**") to display when the premium features are activated.

This task was undertaken as an educational exercise in mobile application reverse engineering and software analysis. The purpose of the exercise was to deepen understanding of Android internals, including Dalvik Virtual Machine (DVM) architecture, smali bytecode manipulation, and APK repackaging. The reverse engineering was performed using Kali Linux, leveraging its powerful suite of security analysis and reverse engineering tools, including Apktool, JADX, and SignAPK.

The operation followed a structured approach consisting of:

- Decompiling the APK – Using Apktool to unpack the application and access its smali code and resources.
- Analyzing Licensing Logic – Examining the smali code to identify mechanisms for purchase verification and feature restrictions.
- Modifying Smali Code – Injecting custom logic to bypass premium checks and adding the custom banner message to the UI flow.
- Repackaging and Signing – Rebuilding the modified application and signing it with a custom-generated key to maintain integrity and usability.
- Testing and Verification – Launching the application in an isolated environment to verify the modifications, banner injection, and premium unlock functionality.

This report outlines each step of the reverse engineering process in detail, elaborating on the tools and techniques utilized, challenges faced during the analysis, and the implications of the modifications made. Additionally, it provides insights into the ethical considerations and legal implications of reverse engineering in educational and security research contexts.

2. Tools and Environment

To reverse engineer and modify the Video Player All Format HD APK, a combination of specialized tools, frameworks, and development environments were employed. Each tool was selected based on its functionality and effectiveness at various stages of the reverse engineering pipeline including decompilation, static and dynamic code analysis, resource extraction, modification, recompilation, and repackaging.

2.1 Operating System

- OS: Kali Linux (Virtual Machine)
- Kernel Version: Linux kali 2025
- Privileges: Root access enabled for all modification and signing operations.

2.2 Reverse Engineering Tools

Tool	Version	Purpose
APKTool	2.9.3	Decompile, modify, and rebuild APKs
JDX-GUI	1.5.1	View decompiled Java code to identify business logic
Keytool	Built-in (Java)	Generate keystore for signing
Apksigner	Android SDK	Sign APKs after modification
Java SDK	17	Required for keytool/apksigner operations

2.3 Testing equipment

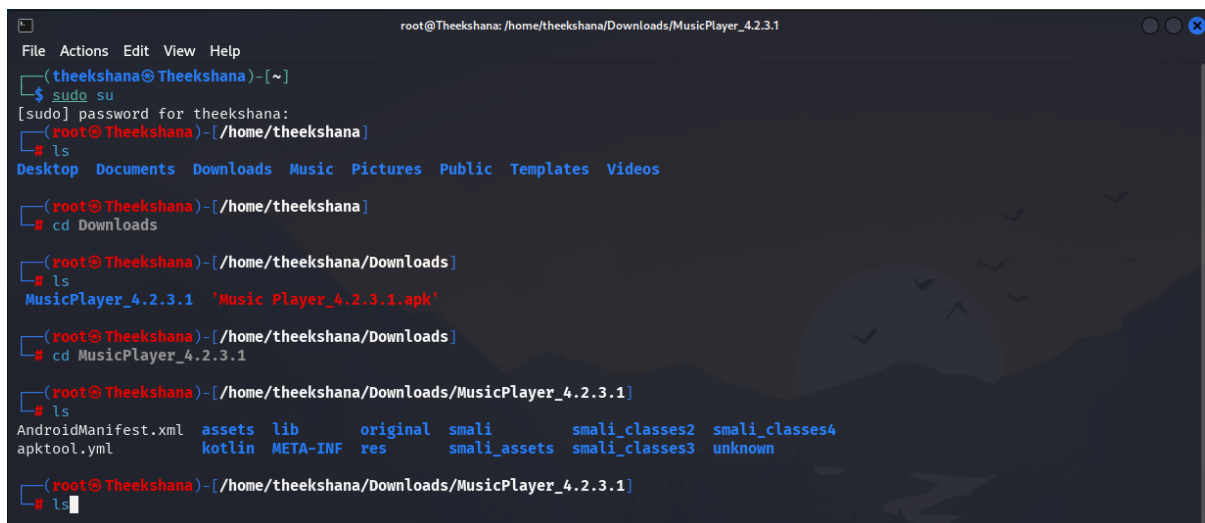
- Testing Device: Real Device
- Android Version: API Level (Android 10)
- USB Debugging: Enabled (for manual APK installation)
- Installation Method: adb install patched_ Video Player All Format HD APK or manual transfer

2.4 Directory Layout

01) Video Player All Format HD (version 4.2.3.1) – Original APK

This is the original, unmodified APK file of the *Video Player All Format HD (version 4.2.3.1)*. It was obtained from a trusted source (APKMirror). This file served as the base for reverse engineering and analysis.

02) Decompiled_app/ – Decompiled source using APKTool



```
root@Theekshana: /home/theekshana/Downloads/MusicPlayer_4.2.3.1
File Actions Edit View Help
(theekshana@Theekshana)~$ sudo su
[sudo] password for theekshana:
(root@Theekshana)~# ls
Desktop Documents Downloads Music Pictures Public Templates Videos
(root@Theekshana)~# cd Downloads
(root@Theekshana)~# ls
MusicPlayer_4.2.3.1 'Music Player_4.2.3.1.apk'
(root@Theekshana)~# cd MusicPlayer_4.2.3.1
(root@Theekshana)~# ls
AndroidManifest.xml  assets  lib      original  smali      smali_classes2  smali_classes4
apktool.yml          kotlin  META-INF  res       smali_assets  smali_classes3  unknown
```

File/Directory	Description
AndroidManifest.xml	The app's main configuration file defines components, permissions, etc.
smali/	Decompiled Dalvik bytecode in smali format, where code modifications were made
res/	App resources: layouts, drawable, strings, themes
assets/	Raw app assets like fonts, music, and data files
kotlin/	Metadata related to Kotlin classes and language mappings
apktool.yml	APKTool configuration and metadata for rebuilding the app

03) Debug.keystore – Custom-generated debug keystore

File	Description
debug.keystore	A custom-generated debug key store used to sign the rebuilt APK after patching

The debug.keystore is a self-signed certificate automatically generated by Android development tools, such as Android Studio, when you first build or debug an application. Its primary purpose is to sign APKs during development, allowing them to be installed and tested on Android devices or emulators. This keystore contains a default key alias named androiddebugkey and is protected with standard passwords—both the keystore and key passwords are typically set to android.

It's important to note that the debug.keystore is intended solely for development and testing purposes. Applications signed with this keystore are not suitable for distribution through app stores like Google Play, as they require a unique, secure release keystore for production builds.

In the context of reverse engineering, utilizing the debug.keystore allows developers to re-sign modified APKs, ensuring they can be installed on devices for testing without the need for a custom release keystore. This facilitates the debugging and validation of changes made during the reverse engineering process.

Item	Description
Video_Player_All_Format_HD.APK	Final rebuilt and signed APK with the premium version unlocked.
App\$a.smali Path	Smali/code/name/monkey/retromusic/App\$a.smali
Function Modified	public static boolean a () – originally returned based on license check
New Behavior	Always returns true and displays a toast with reverse engineering credit
Injected Banner Message	Reverse Engineered By IT22230010 and IT22083678

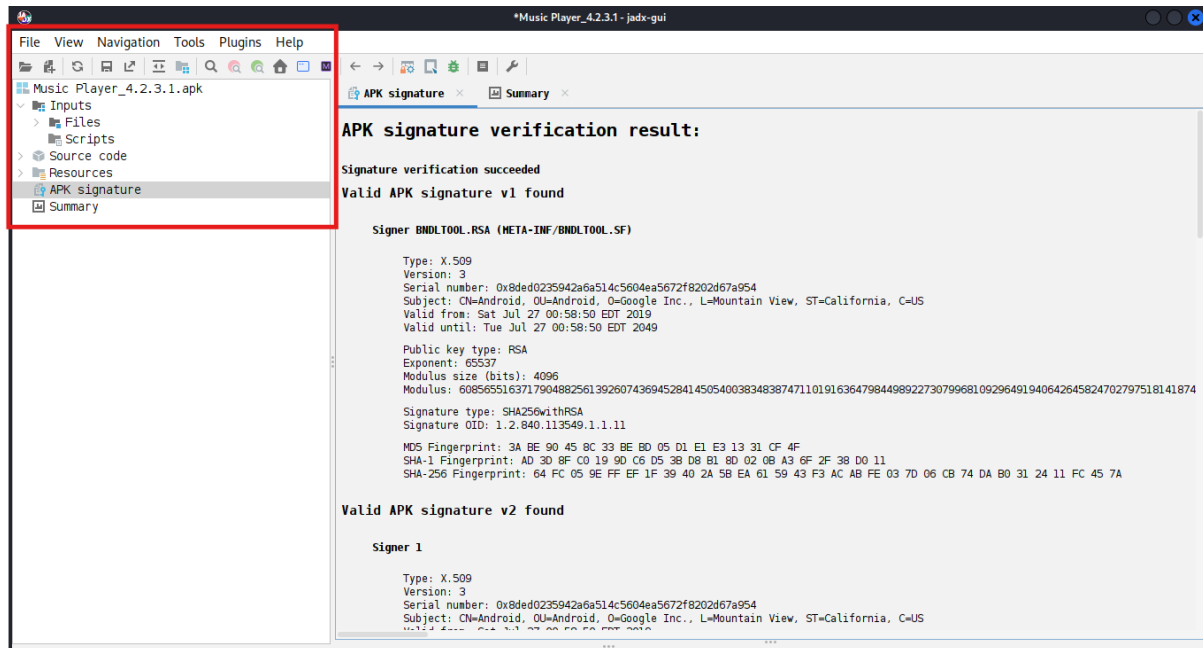
3. Initial APK Analysis

This section documents how the application was analyzed post-decompilation to identify and understand the logic controlling the premium features.

3.1 Decompilation Using JADX

To understand the internal logic of the APK, the first step was to decompile the APK using JADX-GUI. This tool provides a readable Java representation of the bytecode.

Opened Video_Player_All_Format_HD (version 4.2.3.1).apk in **JADX-GUI**



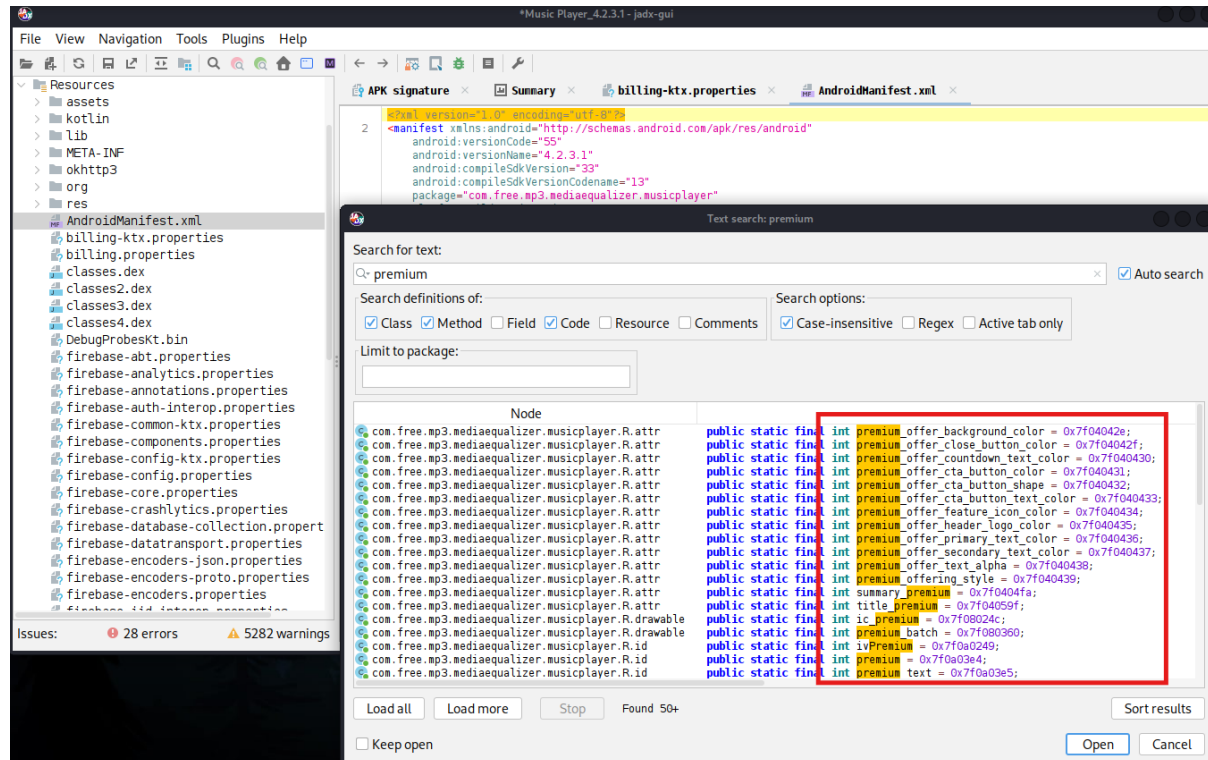
3.2 Identifying the Premium Logic Entry Point

In the exploration stage, the user interface of the application was scrutinized in an attempt to find features marked as premium. One of these features was a UI theme known as “Just Black” which was exclusive to premium users only. This observation gave a clear path to follow for tracing premium access control within the application’s codebase.

In the Details section, the file was examined after the APK had been opened within JADX-GUI. The next step was performing a global search for the keyword “Just Black” and checking its occurrences in the decompiled source code. The results were found in the preferences or UI related parts and more specifically in the classes dealing with themes and user settings. Analyzing these conditions further, one of the conditional checks related to enabling the “Just Black” theme contained a call to a static method:

App.a.a()

This method seemed to be in all conditional statements that checked whether a premium only feature would be displayed or activated. Moreover, the repetitive occurrence of this usage in fragments such as MainSettingsFragment, PurchaseActivity and AboutFragment strongly suggested that this method was acting as the global check for premium status.

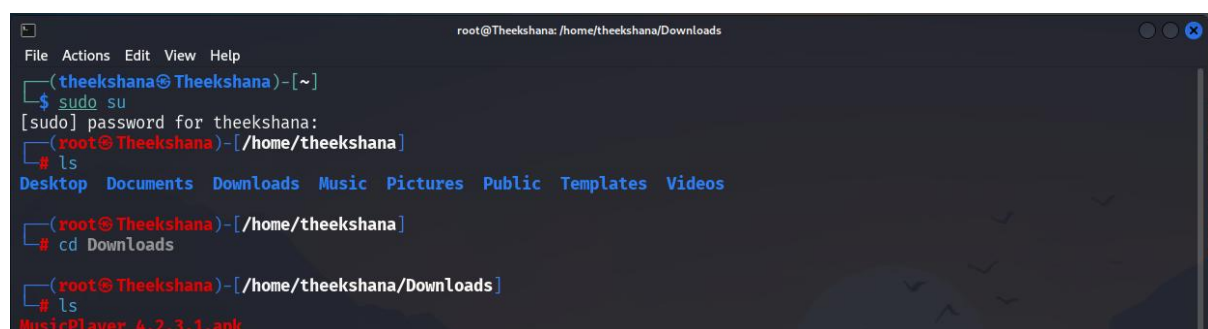


This observation focused the investigation on the App\$a class. A targeted grep search across **smali** files validated that this method was applied numerous times for premium feature gating. This was considered the best modification point for unlocking the premium experience.

3.3 Smali Code Discovery

After identifying the method, the APK was decompiled using APKTool to allow for bytecode-level modification.

Step 01: Run `APKTool d Video_Player_All_Format_HD_4.2.3.1.apk -o decompiled_app`




```
root@Theekshana: /home/theekshana/Downloads
File Actions Edit View Help

(root@Theekshana)-[/home/theekshana/Downloads]
# apktool d MusicPlayer_4.2.3.1.apk
I: Using Apktool 2.7.0-dirty on MusicPlayer_4.2.3.1.apk
I: Loading resource table...
I: Decoding AndroidManifest.xml with resources...
I: Loading resource table from file: /root/.local/share/apktool/framework/1.apk
I: Regular manifest package...
I: Decoding file-resources...
I: Decoding values */* XMLs...
I: Baksmaling classes.dex...
I: Baksmaling classes2.dex...
I: Baksmaling classes3.dex...
I: Baksmaling classes4.dex...
I: Baksmaling assets/audience_network.dex...
I: Copying assets and libs...
I: Copying unknown files...
I: Copying original files...
I: Copying META-INF/services directory

(root@Theekshana)-[/home/theekshana/Downloads]
#
```

Step 02: Navigated to the smali directory and locate all smali references to the method App\$a.a():

```
root@Theekshana: /home/theekshana/Downloads/MusicPlayer_4.2.3.1
File Actions Edit View Help

(root@Theekshana)-[/home/theekshana/Downloads/MusicPlayer_4.2.3.1]
# grep -r "app$a.a" smali/
smali/com/applovin/impl/mediation/debugger/b.smali:    const-string v0, "required_app_ads_txt_entry"
smali/com/applovin/impl/mediation/debugger/c/a.smali:    const-string v2, "app-ads.txt"
smali/com/applovin/impl/mediation/debugger/c/a.smali:    const-string v5, "Looking up app-ads.txt at "
smali/com/applovin/impl/mediation/debugger/c/a$1.smali:    const-string v2, "Unable to fetch app-ads.txt due to: "
smali/com/applovin/impl/mediation/debugger/c/a$1.smali:    const-string v0, "No app-ads.txt found"
smali/com/applovin/impl/mediation/debugger/c/a$1.smali:    const-string v1, "Found app-ads.txt"
smali/com/applovin/impl/mediation/debugger/ui/b/b.smali:    const-string v0, "Ad loads are not supported while Test Mode
is enabled. Please restart the app and make sure your GAID has not been enabled for test mode and that you are not on an
emulator."
smali/com/applovin/impl/mediation/debugger/ui/b/b.smali:    const-string v1, "app-ads.txt"
smali/com/applovin/impl/mediation/debugger/ui/b/b.smali:    const-string v1, "Developer URI was not found; app-ads.txt ro
w will not show on the mediation debugger"
smali/com/applovin/impl/mediation/debugger/a.smali:    const-string v1, "app-ads.txt fetched: "
smali/com/applovin/impl/mediation/b/b/a.smali:    const-string v1, "app.apikey"
smali/com/applovin/mediation/adapters/bytedance/R$id.smali:    .field public static final tt_full_ad_appname:I = 0x7f0a0559
smali/com/applovin/mediation/adapters/bytedance/R$id.smali:    .field public static final tt_loading_appname:I = 0x7f0a0594
smali/com/applovin/mediation/adapters/bytedance/R$id.smali:    .field public static final tt_reward_ad_appname:I = 0x7f0a05cf
smali/com/applovin/mediation/adapters/bytedance/R$id.smali:    .field public static final tt_reward_ad_appname_backup:I = 0x7
f0a05d0
smali/com/applovin/mediation/adapters/mintegral/R$string.smali:    .field public static final campaign_appName:I = 0x7f130091
smali/com/app/insight/b/b.smali:    const-string v3, "Resons for no ANR_INFO:\n1. User click close button too quickly as
soon as the ANR dialog appear.\n2. User close the app since can not stand the carton.\n3. Some OS force stop the process
group without any hint dialog.\n\nThe ANR will be upload by the follow ways only:\n1. Receive the ANR signal(SIGQUIT).\n2
. The app is foreground or was foreground last 2s.\n3. Happens in main process.\n4. Process was killed exactly."
smali/androidx/exifinterface/media/ExifInterface.smali:    const-string v0, "Encountered invalid PNG file--IHDR chunk sho
uld appear as the first chunk"
smali/androidx/transition/Visibility$DisappearListener.smali:    .class Landroidx/transition/Visibility$DisappearListener;
```

Step 03: Located the method inside.

```
root@Theekshana: /home/theekshana/Downloads/MusicPlayer_4.2.3.1
File Actions Edit View Help

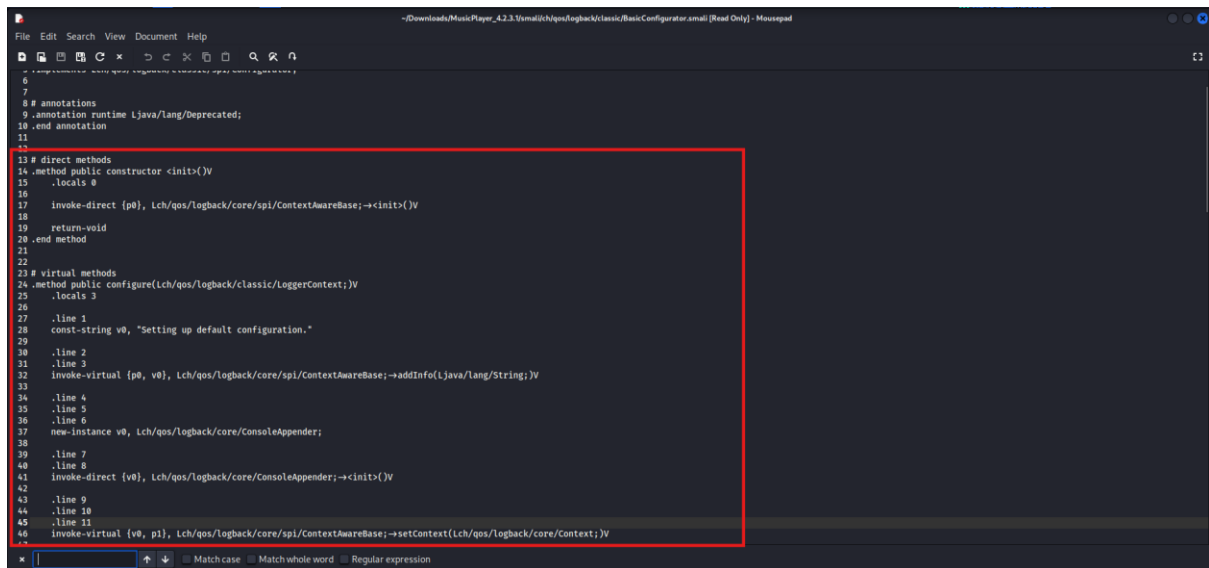
(root@Theekshana)-[/home/theekshana/Downloads/MusicPlayer_4.2.3.1]
# nano smali/code/name/monkey/Musicplayer/App$a.smali

(root@Theekshana)-[/home/theekshana/Downloads/MusicPlayer_4.2.3.1]
#
```

Original smali code inside App\$a.smali (before modification).

```
~/Downloads/MusicPlayer_4.2.3.1/smali/code/name/monkey/Musicplayer/App$a.smali (Read Only) - Mousepad
File Edit Search View Document Help

1.class public Lch/qos/logback/classic/BasicConfigurator;
2.super Lch/qos/logback/core/spi/ContextAwareBase;
3.
4.# interfaces
5.implements Lch/qos/logback/classic/spi/Configurator;
6.
7.
8.# annotations
9.annotation runtime Ljava/lang/Deprecated;
10.end annotation
11.
```



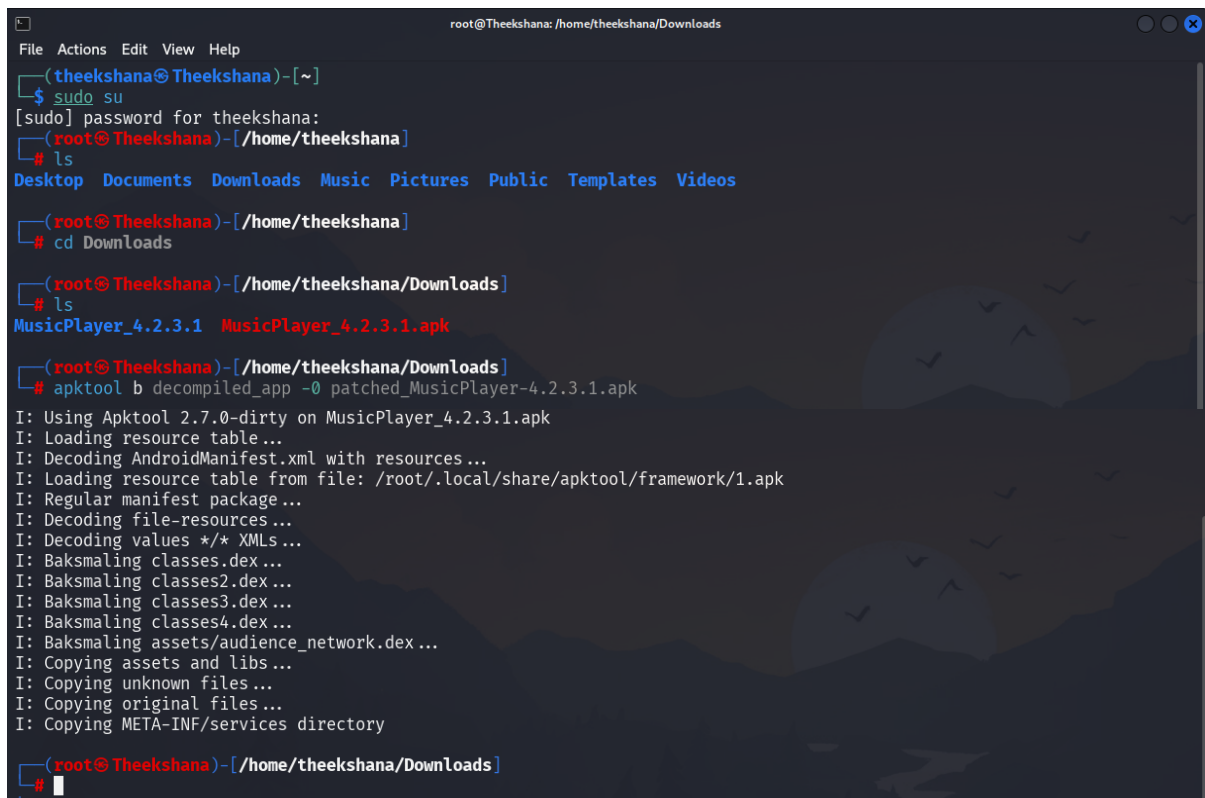
```
6
7
8 # annotations
9 .annotation runtime Ljava/lang/Deprecated;
10 .end annotation
11
12
13 # direct methods
14 .method public constructor <init>()V
15     .locals 0
16
17     invoke-direct {p0}, Lch/qos/logback/core/spi/ContextAwareBase;-><init>()V
18
19     return-void
20 .end method
21
22
23 # virtual methods
24 .method public configure(Lch/qos/logback/classic/LoggerContext;)V
25     .locals 3
26
27     .line 1
28     const-string v0, "Setting up default configuration."
29
30     .line 2
31     .line 3
32     invoke-virtual {p0, v0}, Lch/qos/logback/core/spi/ContextAwareBase;->addInfo(Ljava/lang/String;)V
33
34     .line 4
35     .line 5
36     .line 6
37     new-instance v0, Lch/qos/logback/core/ConsoleAppender;
38
39     .line 7
40     .line 8
41     invoke-direct {v0}, Lch/qos/logback/core/ConsoleAppender;-><init>()V
42
43     .line 9
44     .line 10
45     .line 11
46     invoke-virtual {v0, p1}, Lch/qos/logback/core/spi/ContextAwareBase;->setContext(Lch/qos/logback/core/Context;)V
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5. Rebuilding & Signing

This section covers how the modified APK was rebuilt and signed to ensure it's installable on an Android device. It includes troubleshooting common errors encountered during the process.

5.1 Rebuilding the APK

After modifying the Smali code to bypass the premium check and inject a custom Toast message, the next step was to rebuild the APK using apktool.



```
root@Theekshana: /home/theekshana/Downloads
File Actions Edit View Help
(theekshana@Theekshana)-[~]
$ sudo su
[sudo] password for theekshana:
(root@Theekshana)-[/home/theekshana]
# ls
Desktop Documents Downloads Music Pictures Public Templates Videos

(root@Theekshana)-[/home/theekshana]
# cd Downloads

(root@Theekshana)-[/home/theekshana/Downloads]
# ls
MediaPlayer_4.2.3.1 MediaPlayer_4.2.3.1.apk

(root@Theekshana)-[/home/theekshana/Downloads]
# apktool b decompiled_app -o patched_MusicPlayer-4.2.3.1.apk
I: Using Apktool 2.7.0-dirty on MediaPlayer_4.2.3.1.apk
I: Loading resource table ...
I: Decoding AndroidManifest.xml with resources ...
I: Loading resource table from file: /root/.local/share/apktool/framework/1.apk
I: Regular manifest package ...
I: Decoding file-resources ...
I: Decoding values */* XMLs ...
I: Baksmaling classes.dex ...
I: Baksmaling classes2.dex ...
I: Baksmaling classes3.dex ...
I: Baksmaling classes4.dex ...
I: Baksmaling assets/audience_network.dex ...
I: Copying assets and libs ...
I: Copying unknown files ...
I: Copying original files ...
I: Copying META-INF/services directory

(root@Theekshana)-[/home/theekshana/Downloads]
#
```

5.2 Generating a Debug Keystore

To sign the APK, a debug keystore was created using the keytool utility.

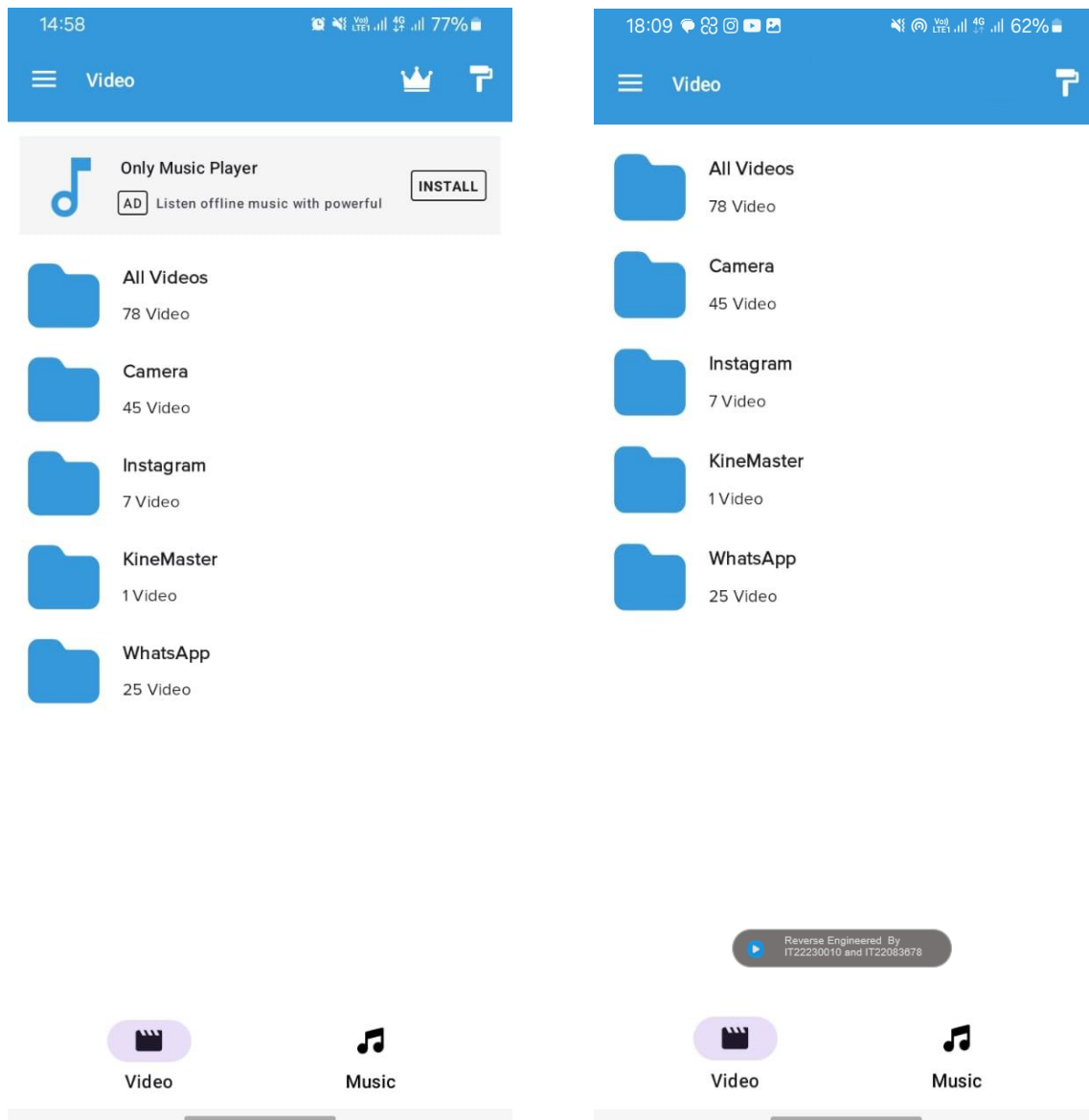
5.3 Signing the APK

Once the keystore was created, the apksigner tool was used to sign the rebuild APK:

6. Testing

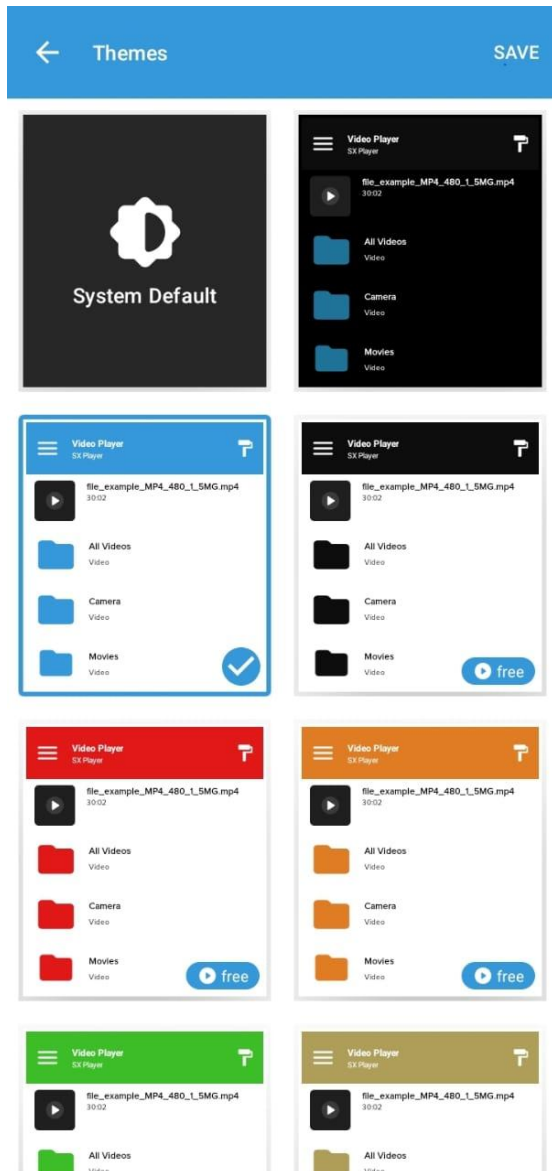
6.1 Installation of Modified APK

After signing the rebuilt APK (patched_Music_Player.apk), it was installed on a test device.

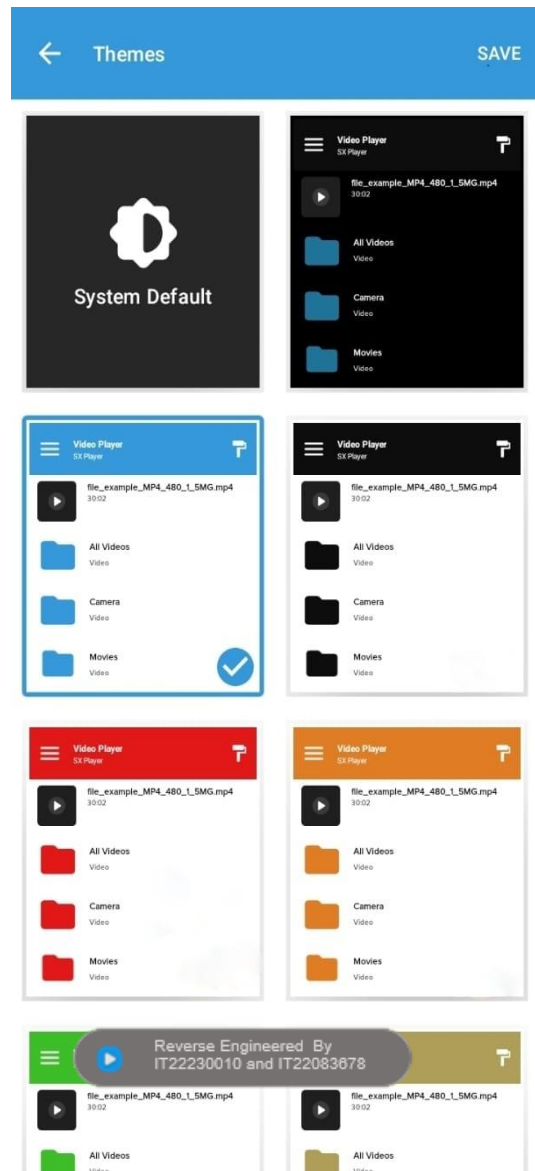


Feature	Status
Premium Unlock	Success
Toast Message Injection	Success
App Stability After Edit	No Crash

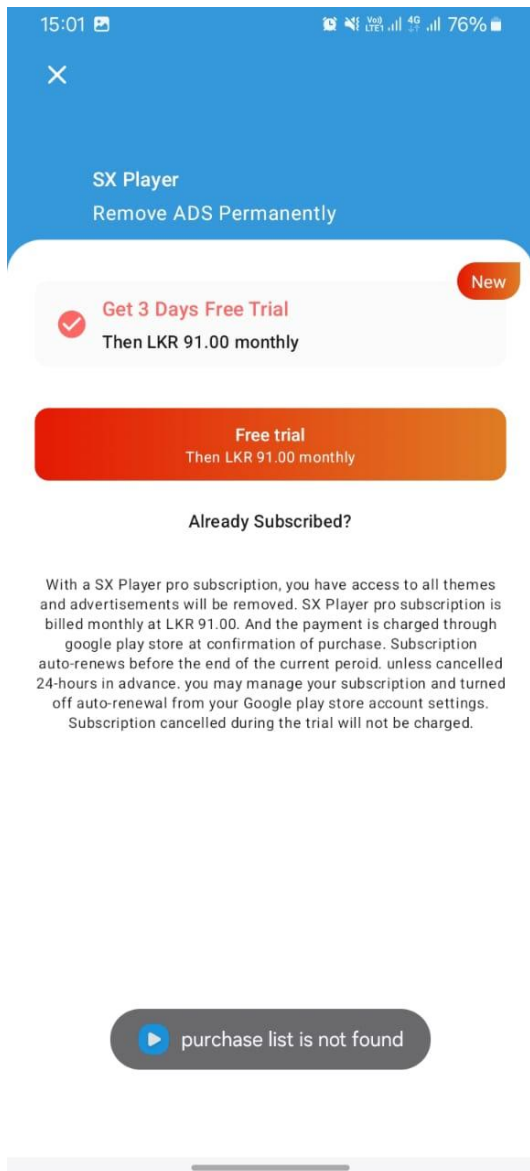
Pro Version



Cracked Version



Pro Version



Cracked Version

