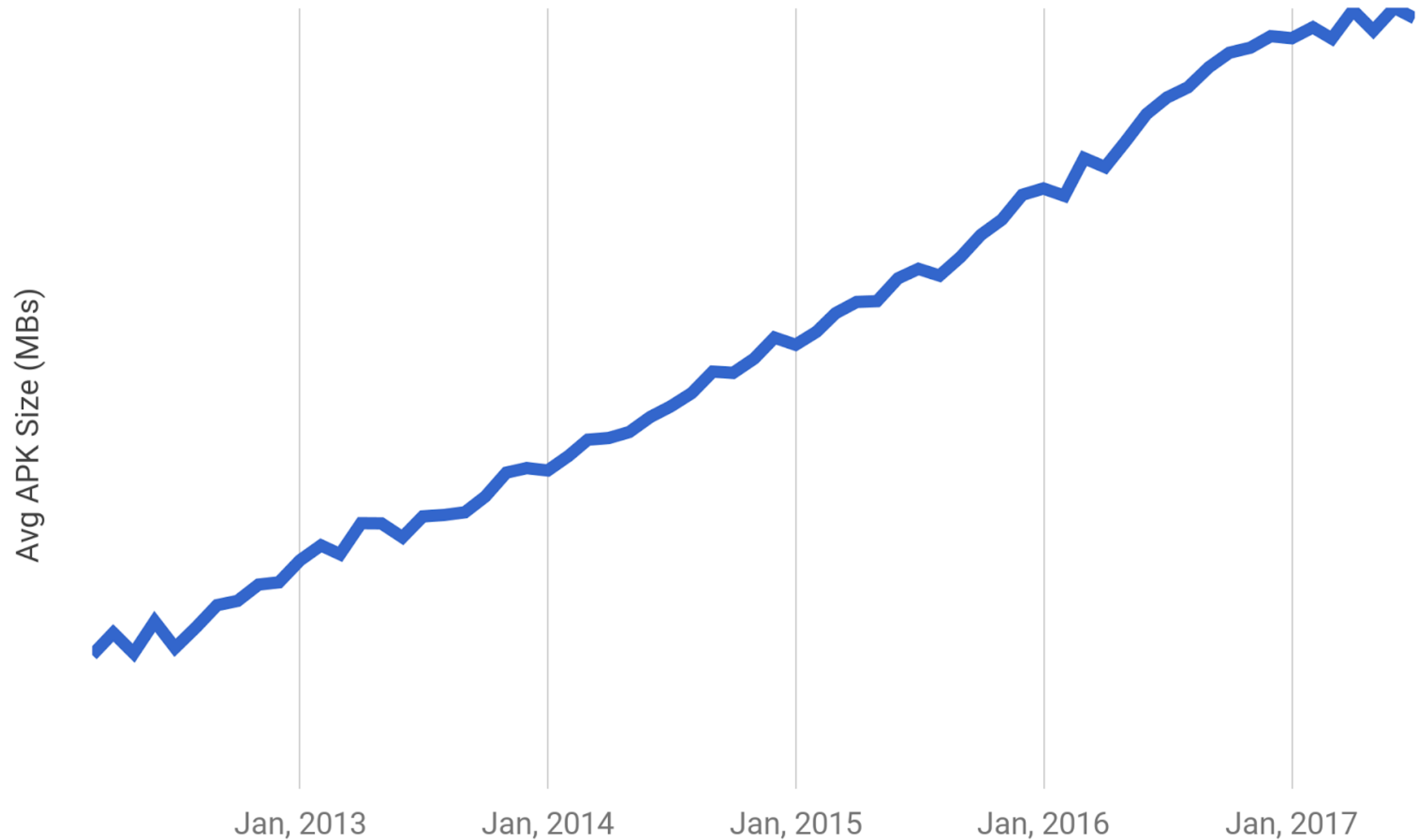


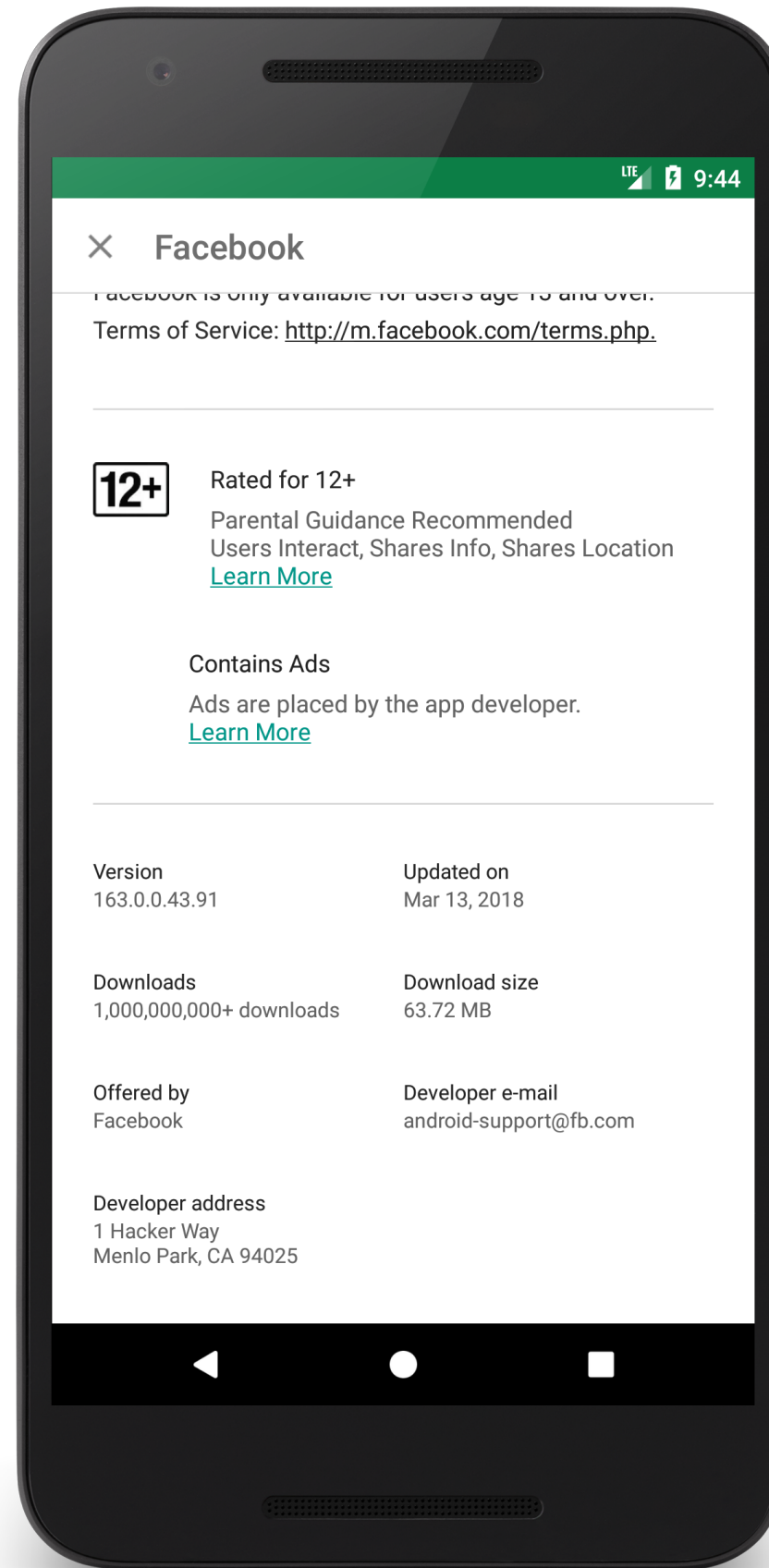
Optimize APK size



Kirill Rozov
Lead Android Developer

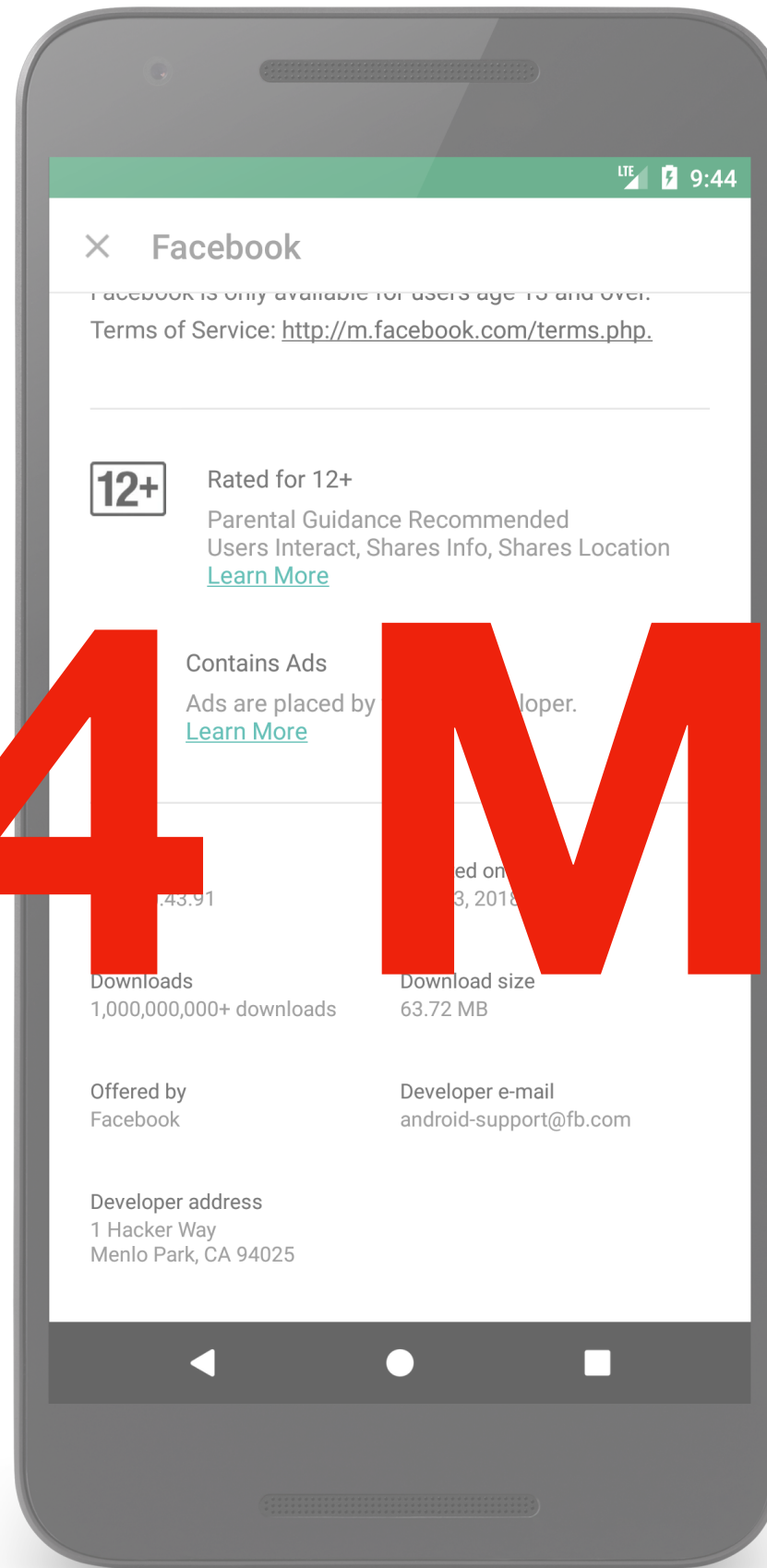
Average downloaded APK size



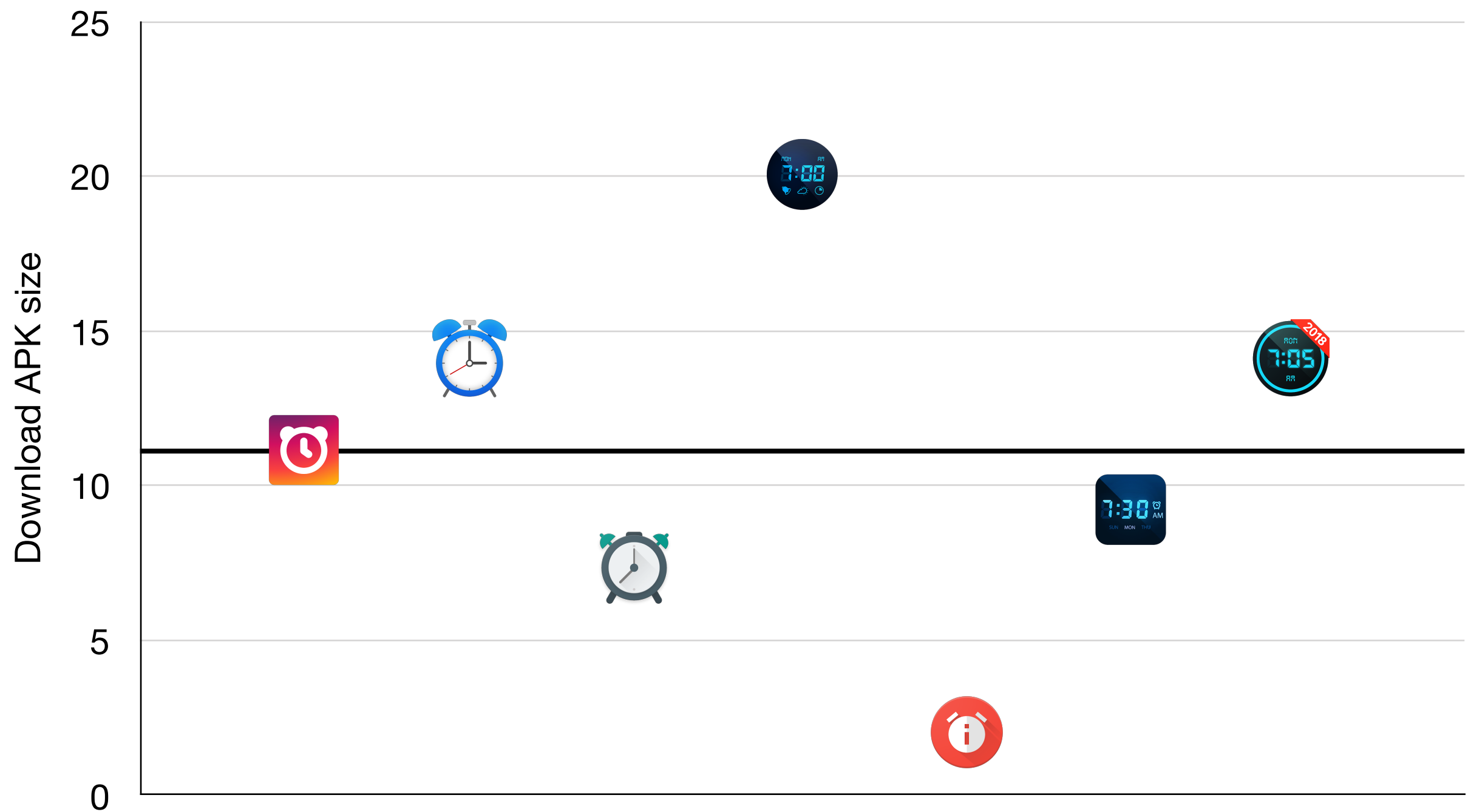




64 MB



What for?



Size from Google Play for Xiaomi Mi A1 Android 8.0

Why it's problem?

Why it's problem?

- Support low-end devices

Why it's problem?

- Support low-end devices
- Low space on device memory

Why it's problem?

- Support low-end devices
- Low space on device memory
- How long time it will take to download app

I need it right now!!!

Why it's problem?

- Support low-end devices
- Low space on device memory
- How long time it will take to download app
I need it right now!!!
- No Wi-Fi

Why it's problem?

- Support low-end devices
- Low space on device memory
- How long time it will take to download app
I need it right now!!!
- No Wi-Fi
- Cellular data costs

Negatives Effects

Negatives Effects

- Lower install conversion rate

Negatives Effects

- Lower install conversion rate
- Google Play Featuring problems

Negatives Effects

- Lower install conversion rate
- Google Play Featuring problems
- Google Play Security Checks problems

Negatives Effects

- Lower install conversion rate
- Google Play Featuring problems
- Google Play Security Checks problems
- Problems with Instant App (4Mb limits)





APK Structure

APK Structure

File	Raw File Size	Download Size	% of Total Download size	
▶ res	77.7 KB	71.7 KB	93.8%	
▶ META-INF	2.3 KB	2.2 KB	2.9%	
01 classes.dex	1.2 KB	1.2 KB	1.6%	
resources.arsc	3.8 KB	833 B	1.1%	
<> AndroidManifest.xml	495 B	495 B	0.6%	

APK Structure

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▶ jsr305_annotations	104 B	104 B	0%		
▶ error_prone	98 B	98 B	0%		

Size related to app

Size related to app

- APK size

Size related to app

- APK size
- Initial download size

Size related to app

- APK size
- Initial download size
- On-device install size

Size related to app

- APK size
- Initial download size
- On-device install size
- Update download size

Size related to app

- APK size
- Initial download size
- On-device install size
- Update download size

Graphic Optimizations

Image Optimizers

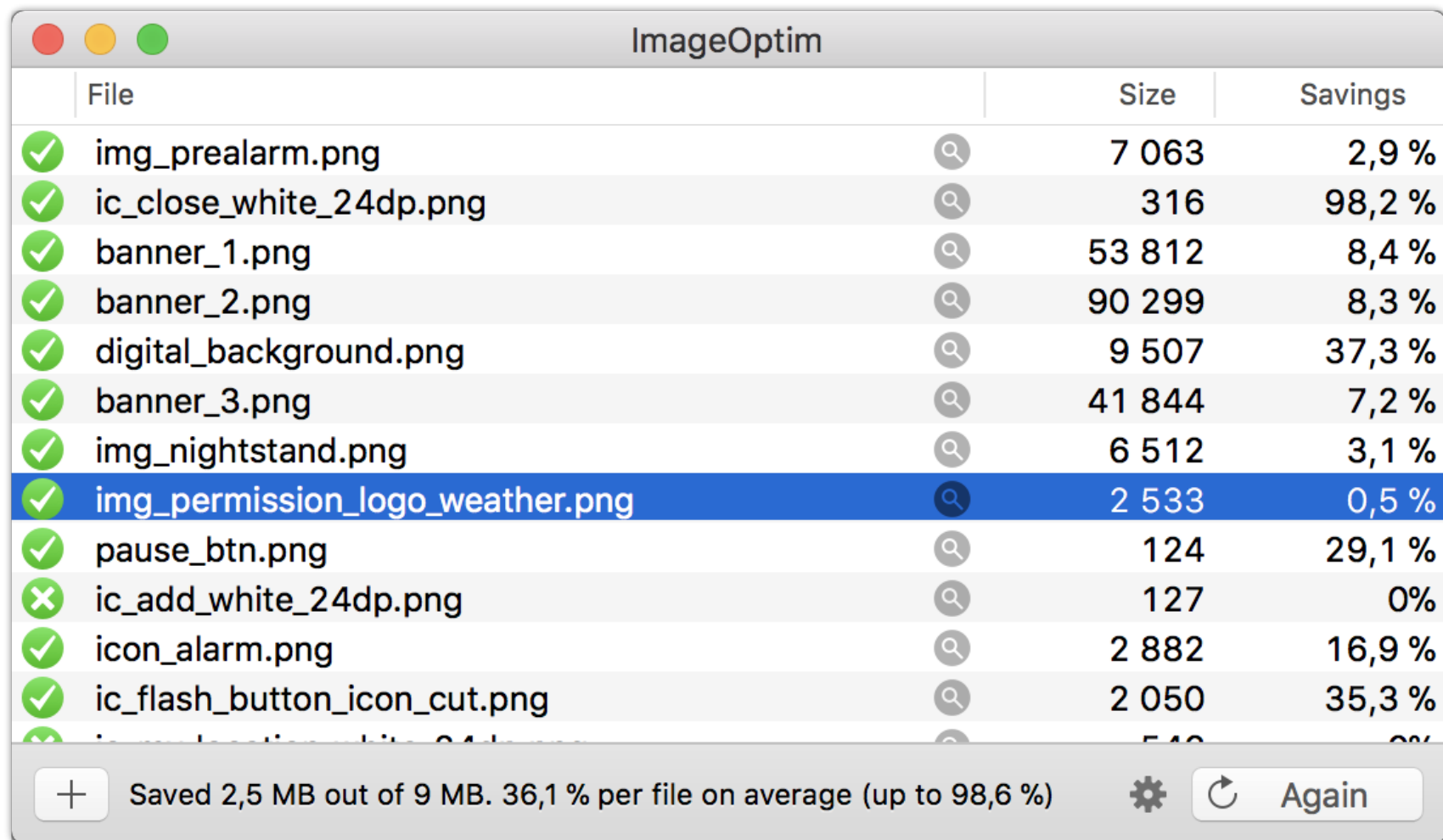


PNG optimizer



PNGQuant	ImageMagick	PNGGauntlet	PNGOut
PNGCrush	OptiPNG	CryoPNG	PNG Compressor
Yahoo Smush.it	PNGOptimizer	PunyPNG	TinyPNG
PNGWolf	Advpng	DeflOpt	Defluff
Huffmix	TruePNG	PNGng-s9	zopfliPNG

ImageOptim



The image shows a screenshot of the ImageOptim application window. The window has a title bar with three colored buttons (red, yellow, green) and the text 'ImageOptim'. Below the title bar is a table with three columns: 'File', 'Size', and 'Savings'. The table lists 14 files, each with a green checkmark icon to its left and a magnifying glass icon to its right. The file 'img_permission_logo_weather.png' is highlighted with a blue background. At the bottom of the window, there is a status bar with a plus icon, a text summary, a gear icon, a refresh icon, and the word 'Again'.

File	Size	Savings
✓ img_prealarm.png	7 063	2,9 %
✓ ic_close_white_24dp.png	316	98,2 %
✓ banner_1.png	53 812	8,4 %
✓ banner_2.png	90 299	8,3 %
✓ digital_background.png	9 507	37,3 %
✓ banner_3.png	41 844	7,2 %
✓ img_nightstand.png	6 512	3,1 %
✓ img_permission_logo_weather.png	2 533	0,5 %
✓ pause_btn.png	124	29,1 %
✗ ic_add_white_24dp.png	127	0%
✓ icon_alarm.png	2 882	16,9 %
✓ ic_flash_button_icon_cut.png	2 050	35,3 %
✗ ic_flash_button_icon_cut.png	5 410	0%

+ Saved 2,5 MB out of 9 MB. 36,1 % per file on average (up to 98,6 %) ⚙️ ↻ Again

Optimization results

9.0 MB

Optimization results



6.5 MB

Optimization results

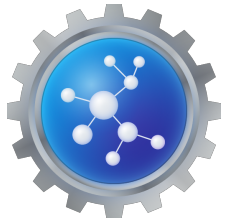


6.5 MB

228 Images
Save: **28%**
Average: **36%**
Max saving: **98.6%**

Android PNG Cruncher

```
android {  
    buildTypes {  
        release {  
            // Disable PNG optimisation  
            crunchPngs false  
        }  
    }  
}
```



SVGO

SVGO npm package 1.0.5 dependencies out-of-date build passing coverage 75%

SVG Optimizer is a Nodejs-based tool for optimizing SVG vector graphics files.

Why?

SVG files, especially those exported from various editors, usually contain a lot of redundant and useless information. This can include editor metadata, comments, hidden elements, default or non-optimal values and other stuff that can be safely removed or converted without affecting the SVG rendering result.

What it can do

SVGO has a plugin-based architecture, so almost every optimization is a separate plugin.

Use WebP

PNG vs WebP



PNG, 958 KB

-70%

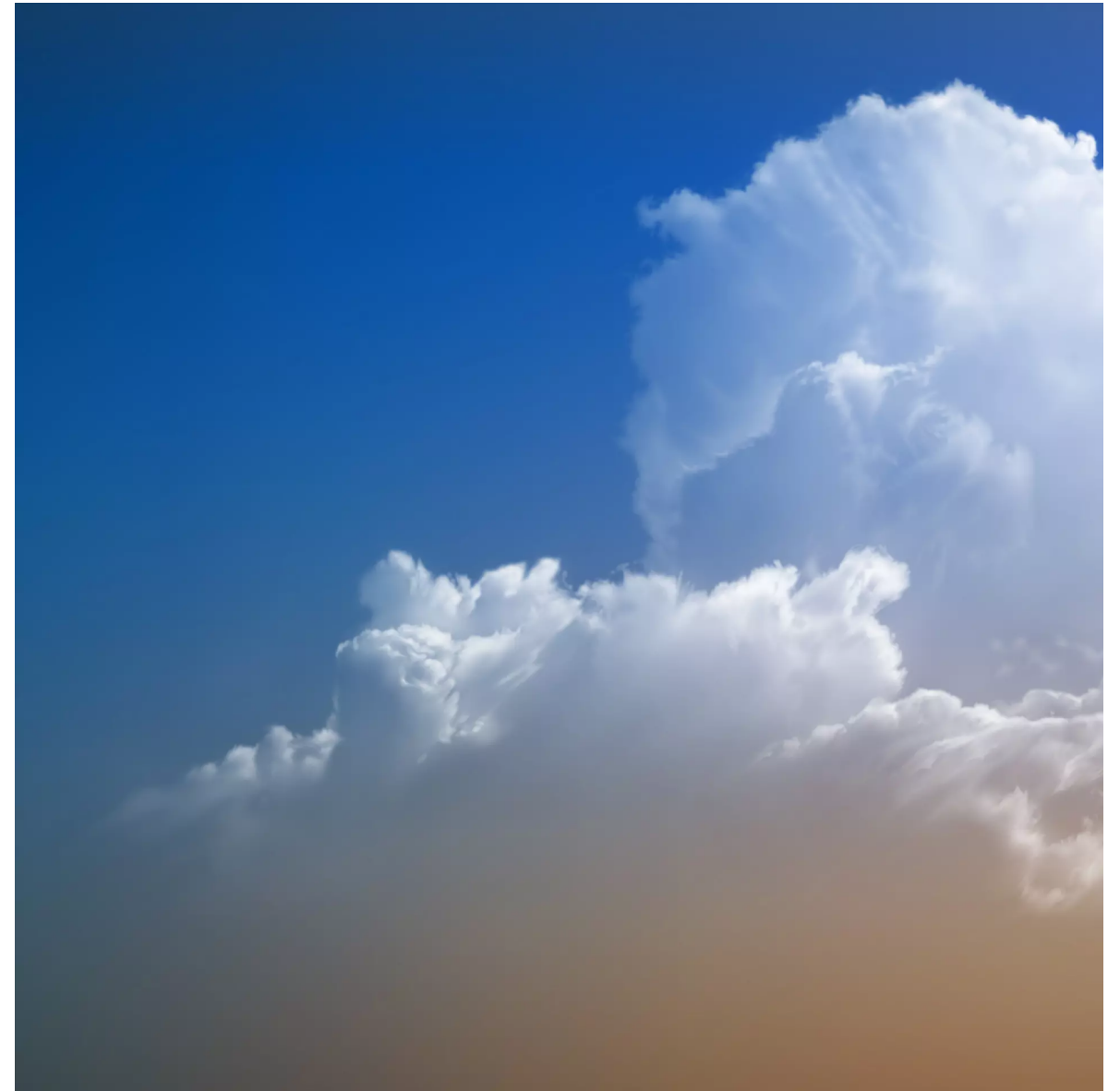


WebP 100%, 286 KB

PNG vs WebP



PNG, 958 KB



WebP 75%, 29 KB

-97%

 Android

▼

▼

 app

▶ manifests

▶ java

▼

 res

▼

 drawable

ic_background.jpg

ic_launcher_background.xml

ic_launcher_foreground.xml (v24)

▶

 mipmap

▶

 values

▶

 Gradle Scripts

Search Everywhere [Double](#) 

Go to File [⌘N](#)

Recent Files [⌘E](#)

Navigation Bar [⌘↵](#)

Drop files here to open

 Android

▼

▼

 app

▶ manifests

▶ java

▼

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▶

 Gradle Scripts

Search Everywhere Double ⤴

Go to File ⤴⌘N

Recent Files ⌘E

Navigation Bar ⌘↵

Drop files here to open

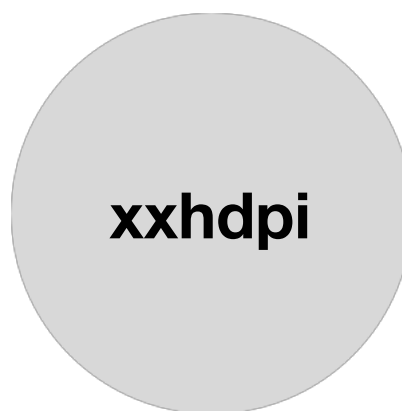
Vector graphics

Vector graphics

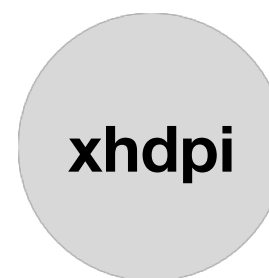
PNG, 100x100dp, 8 bit



3.6 KB



2.5 KB



1.6 KB



1.1 KB



0.7 KB

Vector graphics

Size, bytes	Optimized PNG, 5 files	SVG	VectorDrawable	Android Shape
RAW	10,023	359	416	232
In APK	10,023	-	371	241

Glide + SVG

build **passing** Download **1.0.0** Android Arsenal **SvgGlidePlugin** License **Apache 2.0**

SvgImageLoaderPlugins

Plugin for load SVG in Glide 4. Based on [AndroidSVG](#) library.

Grab the latest via Gradle:

```
repository {  
    jcenter()  
}  
  
implementation 'com.kirich1409.svgplugin:glide4:1.0.0'
```

Library requires Android SDK 15+

For library work don't forget create AppGlideModule like described [here](#).



POTrace



PNG



SVG

Reuse graphics





Image tint

```
<ImageView  
    android:src="@drawable/ic_favorite_black_48dp"  
    android:tint="@color/blue"  
/>
```

```
Drawable.setTint(int)  
Drawable.setTint(ColorStateList)
```

Optimize images

- Use image optimizer
- Use WebP
- Use vector graphics
- Reuse similar images

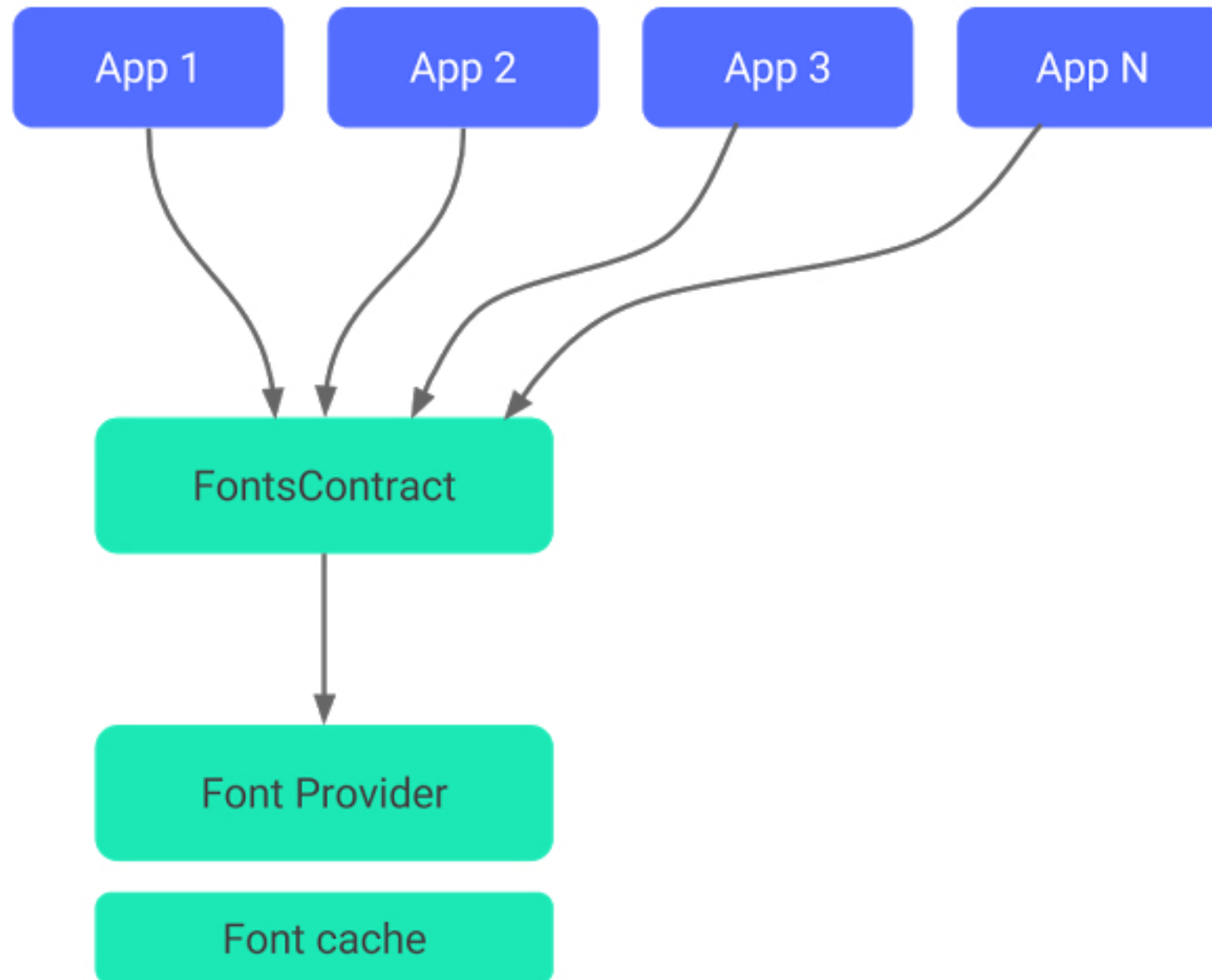
Resources Optimizations

Fonts

File	Raw File Size	Download Size	% of Total Download size
01 classes3.dex	1.6 MB	1.5 MB	5.9% 
▼ assets	630.9 KB	592.1 KB	2.3% 
▼ fonts	400.3 KB	377.8 KB	1.5% 
T Roboto-Medium.ttf	91.4 KB	84.8 KB	0.3%
T Roboto-Bold.ttf	62.3 KB	58.9 KB	0.2%
T Roboto-Light.ttf	61.1 KB	57.9 KB	0.2%
T Roboto-Regular.ttf	61 KB	57.8 KB	0.2%
T Roboto-Thin.ttf	60.6 KB	57.3 KB	0.2%
T digital_clock_ko.ttf	3 KB	2.9 KB	0%
T digital_clock_pt.ttf	2.9 KB	2.8 KB	0%
T digital_clock_nb.ttf	2.9 KB	2.7 KB	0%
T digital_clock_es.ttf	2.8 KB	2.7 KB	0%
T digital_clock_da.ttf	2.8 KB	2.7 KB	0%
T digital_clock_it.ttf	2.8 KB	2.7 KB	0%
T digital_clock_zh_tw.ttf	2.8 KB	2.7 KB	0%
T digital_clock_zh_hk.ttf	2.8 KB	2.7 KB	0%
T digital_clock_zh_cn.ttf	2.8 KB	2.7 KB	0%
T digital_clock_tr.ttf	2.8 KB	2.7 KB	0%
T digital_clock_th.ttf	2.7 KB	2.6 KB	0%
T digital_clock_ja.ttf	2.7 KB	2.6 KB	0%
T digital_clock_fr.ttf	2.8 KB	2.6 KB	0%
T digital_clock.ttf	2.8 KB	2.6 KB	0%
T digital_clock_in.ttf	2.7 KB	2.6 KB	0%
T digital_clock_nl.ttf	2.5 KB	2.4 KB	0%
T digital_clock_ru.ttf	2.5 KB	2.4 KB	0%
T digital_clock_pl.ttf	2.5 KB	2.4 KB	0%
T digital_clock_fi.ttf	2.5 KB	2.4 KB	0%
T digital_clock_sv.ttf	2.5 KB	2.4 KB	0%
T digital_clock_de.ttf	2.5 KB	2.4 KB	0%
T digital_clock_cs.ttf	2.4 KB	2.3 KB	0%
T digital_clock_vi.ttf	2.2 KB	2.1 KB	0%
T digital_clock_ar.ttf	2.1 KB	2 KB	0%

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digital_clock_ko.ttf	3 KB	2.9 KB	0%
digital_clock_pt.ttf	2.9 KB	2.8 KB	0%
digital_clock_nb.ttf	2.9 KB	2.7 KB	0%
digital_clock_es.ttf	2.8 KB	2.7 KB	0%
digital_clock_da.ttf	2.8 KB	2.7 KB	0%
digital_clock_it.ttf	2.8 KB	2.7 KB	0%
digital_clock_zh_tw.ttf	2.8 KB	2.7 KB	0%
digital_clock_zh_hk.ttf	2.8 KB	2.7 KB	0%
digital_clock_zh_cn.ttf	2.8 KB	2.7 KB	0%
digital_clock_tr.ttf	2.8 KB	2.7 KB	0%
digital_clock_th.ttf	2.7 KB	2.6 KB	0%
digital_clock_ja.ttf	2.7 KB	2.6 KB	0%
digital_clock_fr.ttf	2.8 KB	2.6 KB	0%
digital_clock.ttf	2.8 KB	2.6 KB	0%
digital_clock_in.ttf	2.7 KB	2.6 KB	0%
digital_clock_nl.ttf	2.5 KB	2.4 KB	0%
digital_clock_ru.ttf	2.5 KB	2.4 KB	0%
digital_clock_pl.ttf	2.5 KB	2.4 KB	0%
digital_clock_fi.ttf	2.5 KB	2.4 KB	0%
digital_clock_sv.ttf	2.5 KB	2.4 KB	0%
digital_clock_de.ttf	2.5 KB	2.4 KB	0%
digital_clock_cs.ttf	2.4 KB	2.3 KB	0%
digital_clock_vi.ttf	2.2 KB	2.1 KB	0%
digital_clock_ar.ttf	2.1 KB	2 KB	0%

Downloadable fonts



**Unnecessary
resources**

Resource shrinker

```
android {  
    buildTypes {  
        release {  
            minifyEnabled true  
            shrinkResources true  
        }  
    }  
}
```

Resource configurations

```
android {  
    defaultConfig {  
        resConfigs 'ru', 'en', 'es', 'fr', 'ge'  
    }  
}
```

Resource configurations

```
android {  
    defaultConfig {  
        resConfigs 'ru', 'en', 'es', 'fr', 'ge'  
        resConfigs 'mdpi', 'hdpi', 'xhdpi', 'xxhdpi'  
        resConfigs 'normal', 'large', 'xlarge'  
    }  
}
```

Resource Optimizations

- Downloadable fonts
- Remove unused resources
- Reuse resources

Resource Optimizations

- Downloadable fonts
- Remove unused resources
- Reuse resources
- Use recommended media formats
AAC for audio, H264 AVC for Video and etc.

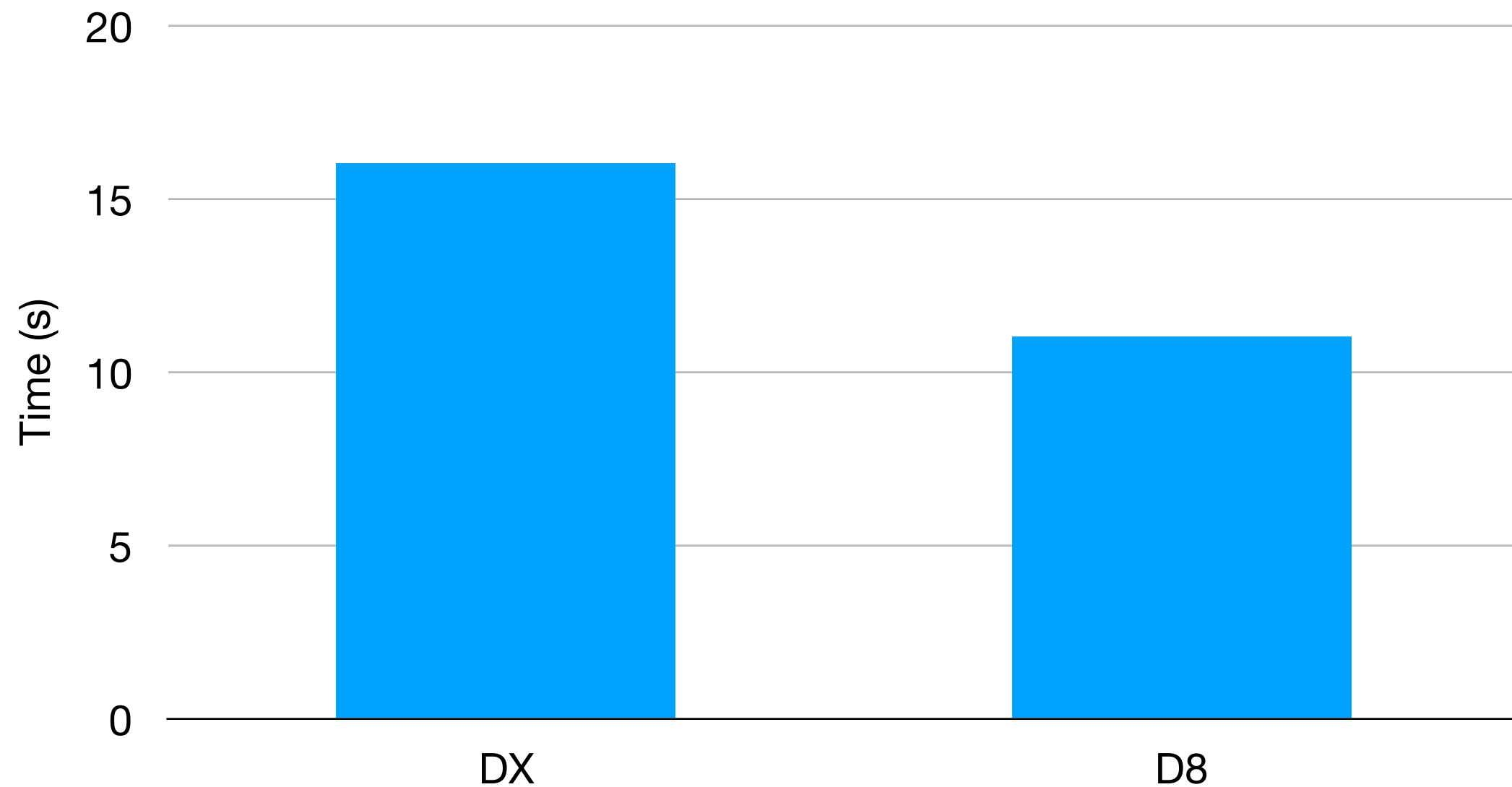
Resource Optimizations

- Downloadable fonts
- Remove unused resources
- Reuse resources
- Use recommended media formats
AAC for audio, H264 AVC for Video and etc.
- Update strings over-the-air

Code Optimizations

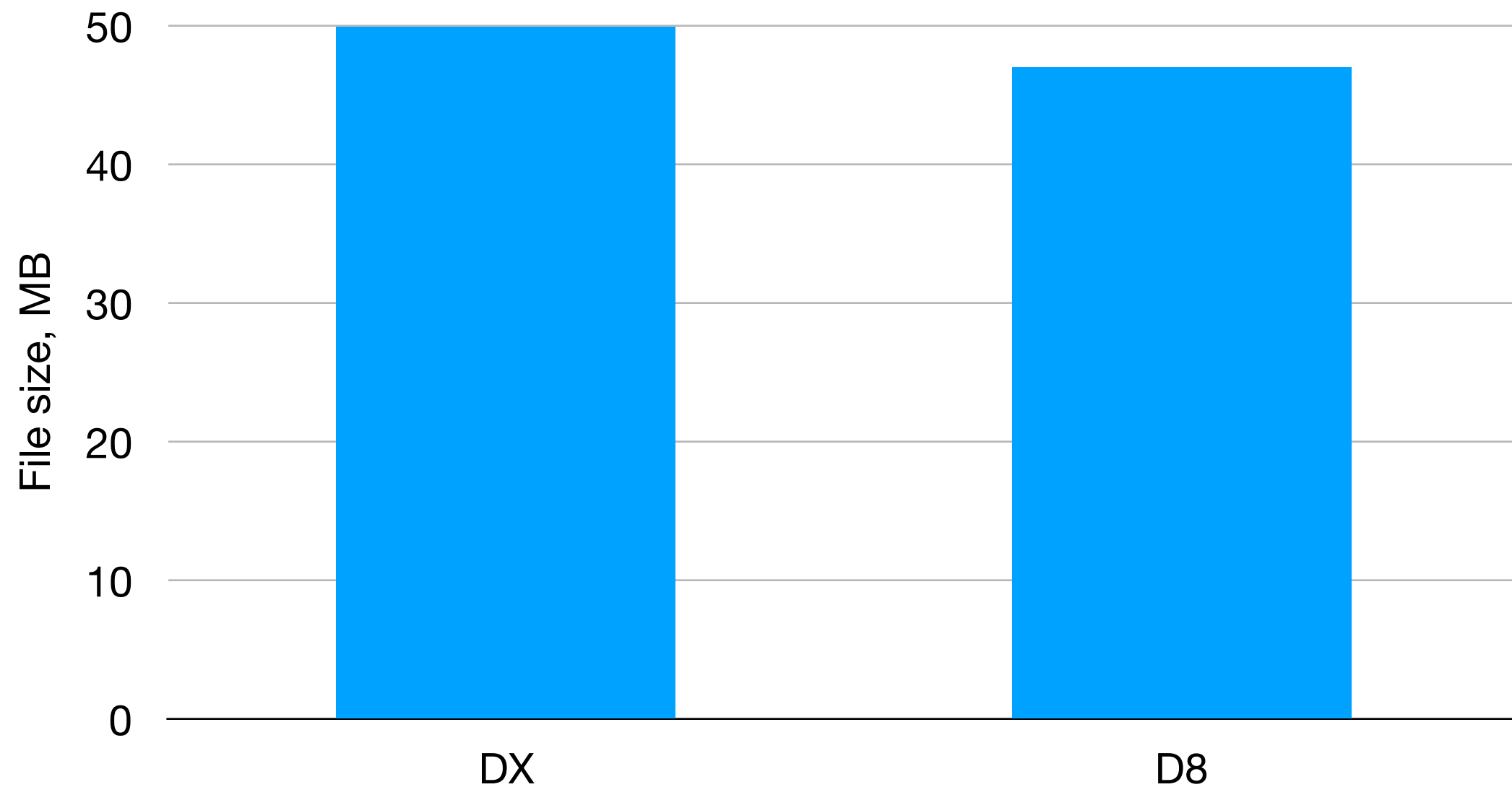
D8 dex compiler

DX compilation time



* Tested with benchmark project [here](#)

.dex file size

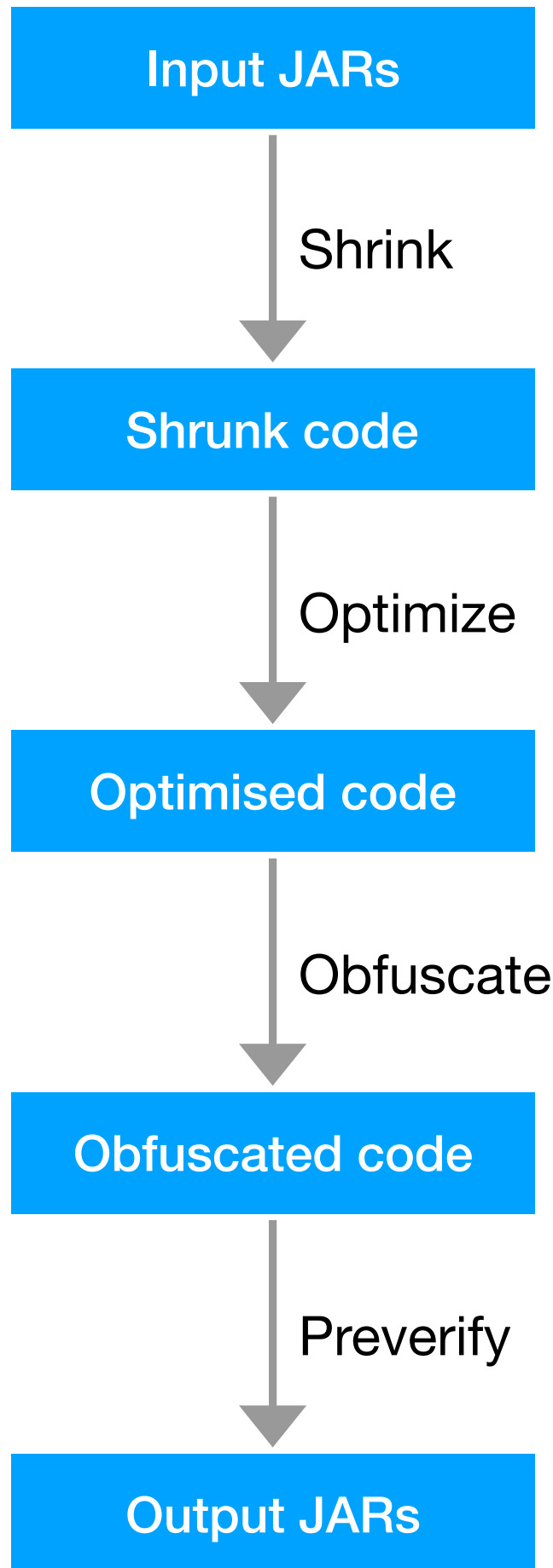


* Tested with benchmark project [here](#)

Code optimizations tools

Code optimizations tools

- Java bytecode
 - ProGuard
 - DexGuard
 - R8
- dex
 - Facebook ReDex



ProGuard Result

	No optimization	Optimization	Optimization + obfuscation
.dex size	2.6 Mb	1.2 Mb	0.9 Mb
Classes number	4827	2747	2715
Method references	42664	22319	18922

External libraries usage

External libraries usage

External libraries usage

- Remove unused Android Support Library parts

External libraries usage

- Remove unused Android Support Library parts
- Try to don't add libraries for 1 class/method usage

External libraries usage

- Remove unused Android Support Library parts
- Try to don't add libraries for 1 class/method usage
- Reflection based libraries can't be properly optimised and shrinked

External libraries usage

- Remove unused Android Support Library parts
- Try to don't add libraries for 1 class/method usage
- Reflection based libraries can't be properly optimised and shrinked
- Don't add debug libraries to a release builds
 - Facebook Stetho
 - LeakCanary
 - etc.

Native libraries

Remove unused ABIs

```
android {  
    defaultConfig {  
        ndk {  
            abiFilters 'armeabi-v7a', 'arm64-v8a', 'x86'  
        }  
    }  
}
```

Code Optimisations

- Use D8 compiler instead of DX
- Code optimizations & shrinker tools
- Be careful about using external libraries
- Remove support of unused ABIs

Other Optimizations

APK Structure

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▶ jsr305_annotations	104 B	104 B	0%		
▶ error_prone	98 B	98 B	0%		

Packaging options

```
android {  
    packagingOptions {  
        exclude "/okhttp3/**"  
        exclude "/com/google/api/**"  
        exclude "/kotlin/**"  
        exclude "/com/applovin/**.java"  
        exclude "/META-INF/*.version"  
        exclude "/META-INF/**.pro"  
        exclude "/META-INF/services/**"  
        exclude "**/*.kotlin_module"  
        exclude "**/*.properties"  
        exclude "**/*.xml"  
    }  
}
```



Google Play

Features

Features

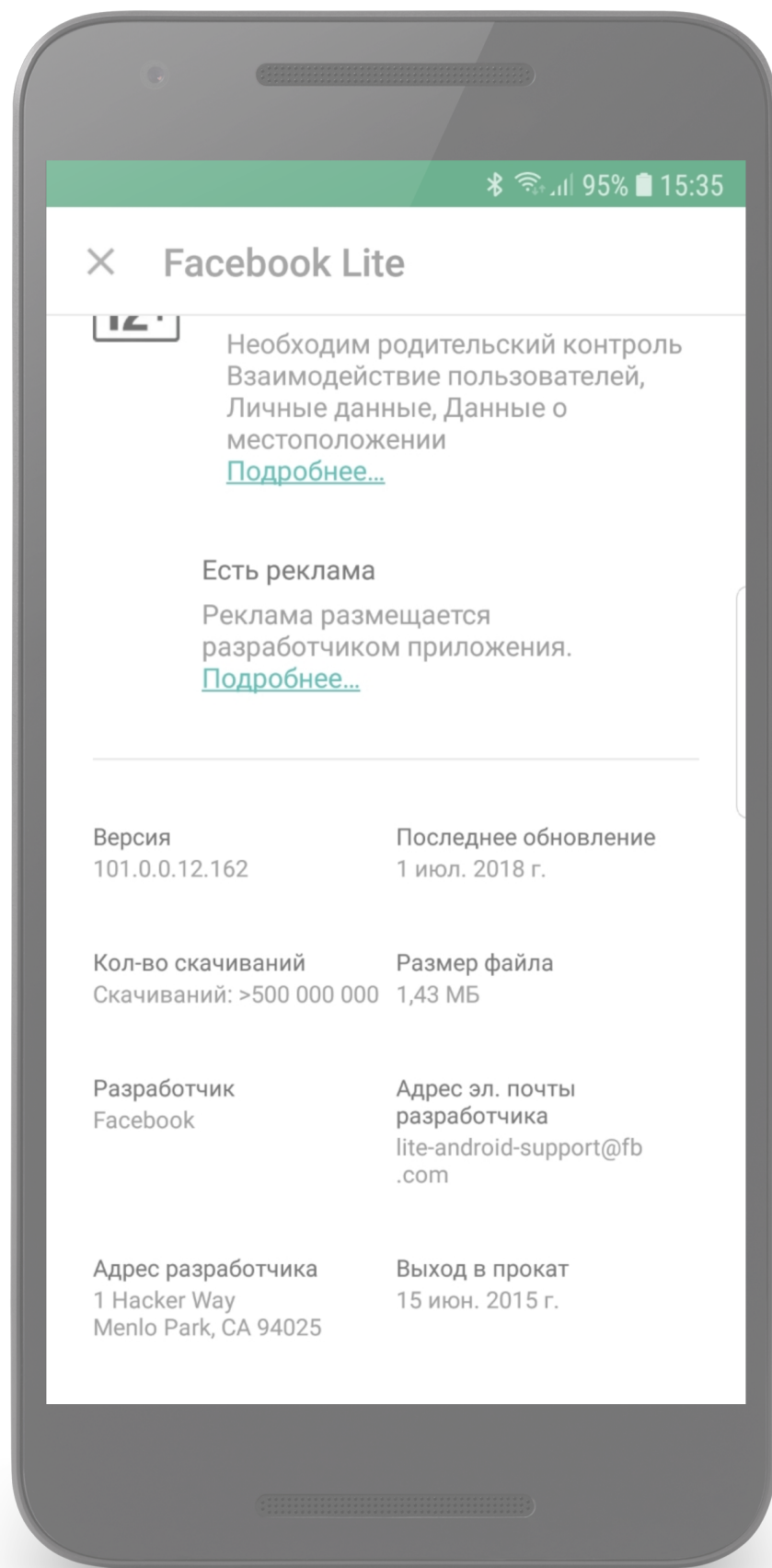
- Special compression format

Features

- Special compression format
- File-by-File updates

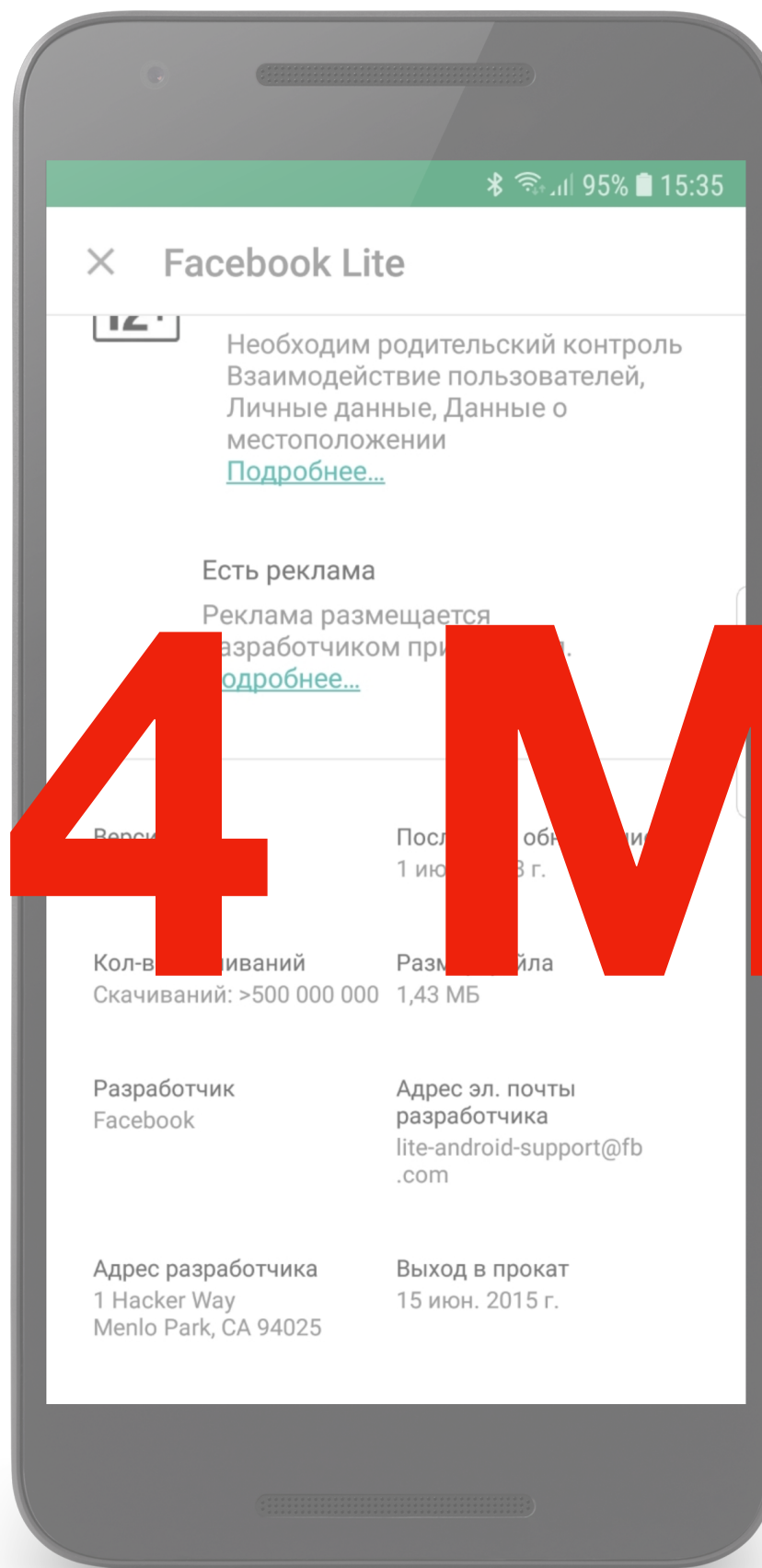
Features

- Special compression format
- File-by-File updates
- Lite Version





1.4 МВ



Features

- Special compression format
- File-by-File updates
- Lite Version

Features

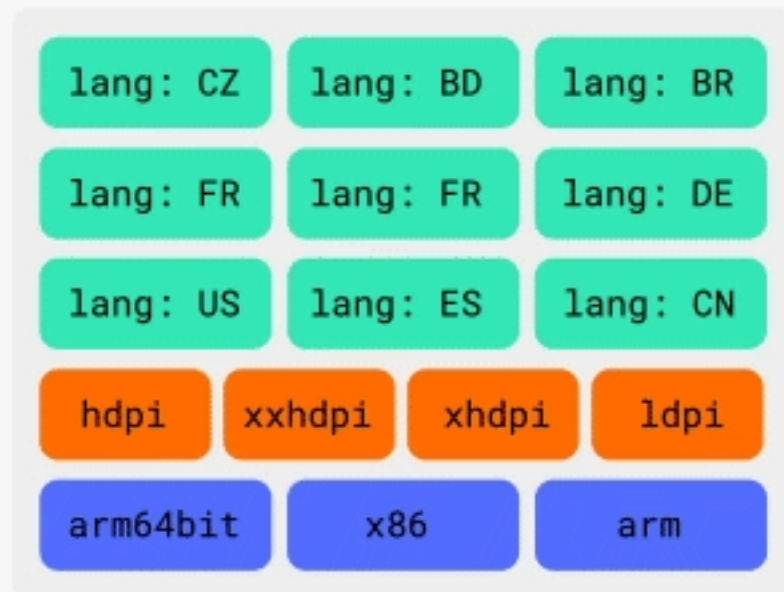
- Special compression format
- File-by-File updates
- Lite Version
- Multiple APKs

Google Play Multiple APKs

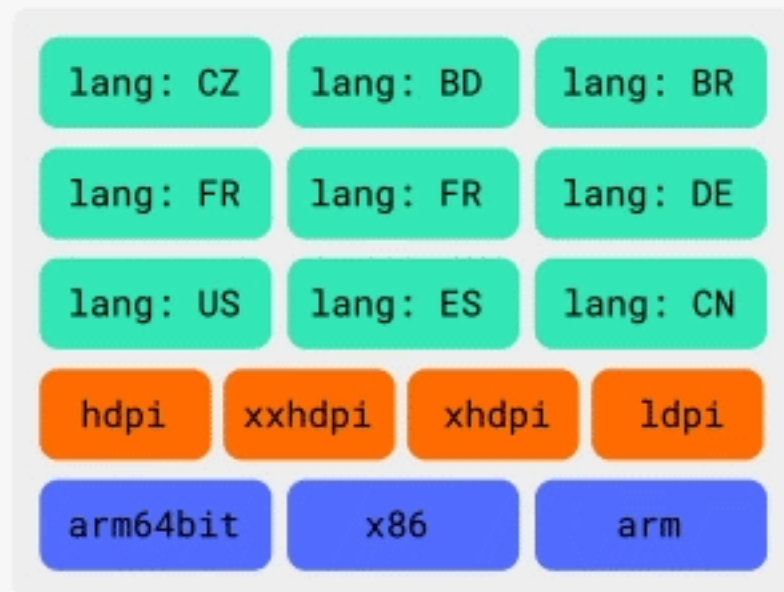
- OpenGL texture compression formats
- Screen sizes and densities
- Device feature sets
- Platform versions
- CPU architectures
- Special APK for Android Go Edition

Google Play Dynamic Delivery

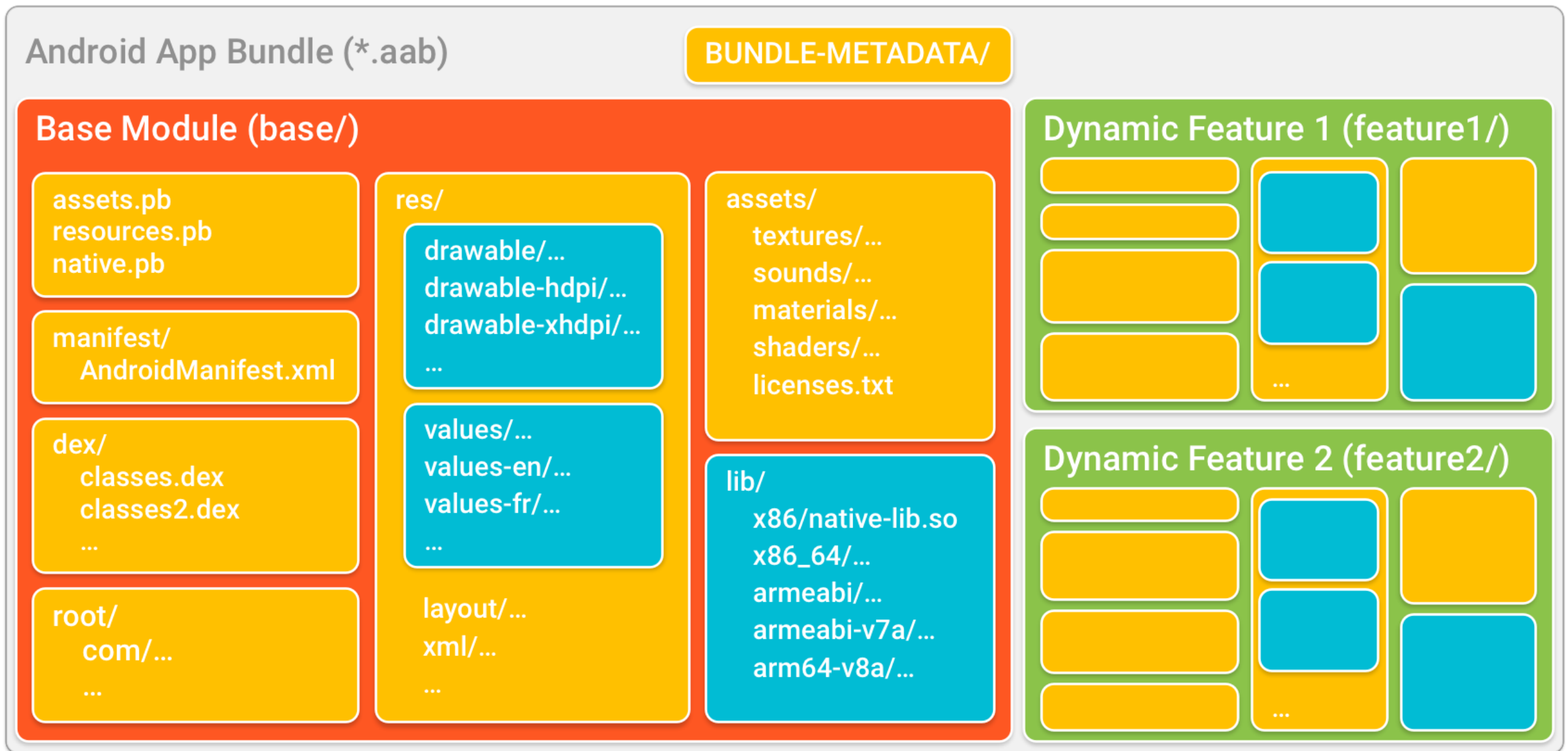
Google Play Dynamic Delivery



Google Play Dynamic Delivery



Android App Bundle



Notes about App Bundle

- App Bundle has limitations for now
- Required Android Studio 3.2
- Need to apply Google Play App Signing
- Google Play internal test track for test App Bundle in few minutes
- bundletool for build an APK from App Bundle





Q&A



Kirill Rozov
Lead Android Developer