



🕒 2016年8月26日-27日

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# World Of Tech 2016

## 移动互联网技术峰会

THE BEST MOBILE TECH IN HERE

**主办: 51CTO**



# APK 瘦身的实践与演进

张志博 2016.08.27

# About Shanbay

- 全面、有效提升英语能力的移动互联网学习平台
- 拥有包括扇贝单词、扇贝听力、扇贝口语、扇贝新闻、扇贝读书、扇贝炼句在内的六大学习应用
- 目前唯一能让用户在移动端完成英语听说读写和词汇训练的学习系统
- 截止2016年8月，用户已突破3200万
- 广泛的优质合作

**OXFORD**  
UNIVERSITY PRESS

**Collins**

亚马逊  
**amazon.cn**

**lonely planet**

 **译林出版社**  
YILIN PRESS

...

# Big Elephant in the Room

移动网络 23.49%\* (2G, 4.09%)

+

多数第三方应用市场不是 system app

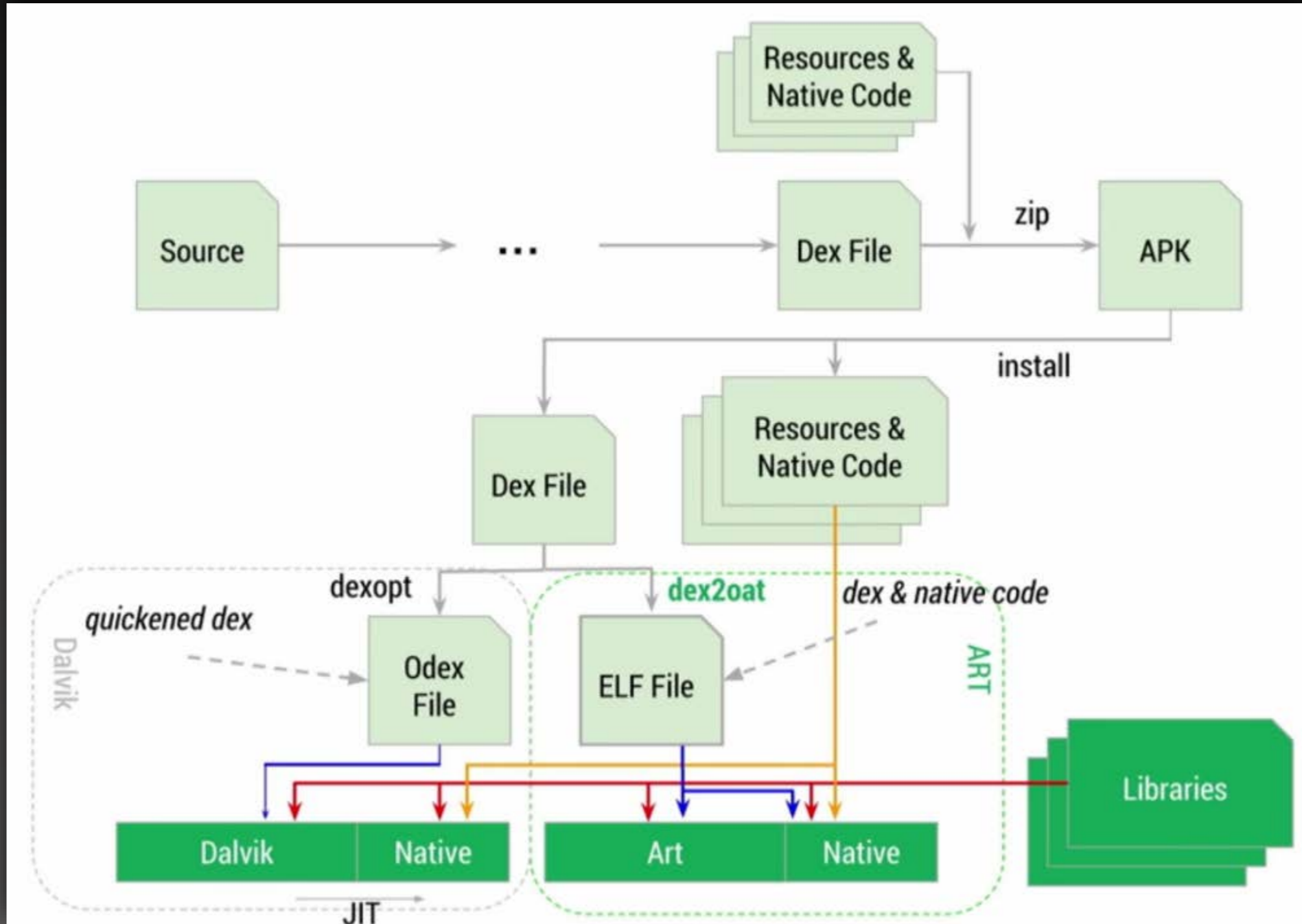
||

用户对APK大小敏感

附带影响： 1. 安装时间      2. 安装成功率



# The life of an APK



# APK的构成

Name	Modified On	Size	Compressed
AndroidManifest.xml	June 6, 2016 at 2:56 PM	48.1 KB	7.3 KB
assets		2.5 MB	1.4 MB
classes.dex	June 6, 2016 at 2:53 PM	7.8 MB	3.2 MB
com		3.6 KB	2.5 KB
lib		555.4 KB	244.8 KB
manifest	June 6, 2016 at 2:56 PM	89 B	73 B
org		907 B	519 B
res		6.9 MB	6.1 MB
resources.arsc	June 6, 2016 at 2:56 PM	805.6 KB	805.6 KB

1 of 9 selected, 18.6 MB uncompressed

STORE, NOT DEFLATE

# APK的构成

## App code

Bytecode  
classes.dex

Native code  
libs/<arch>/\*.so

## Resources

res/

resources.arsc

## Misc

assets/

META-INF/

AndroidManifest.xml



# APK的构成

## Top200 Apps\*

	.dex	.so	/res	.arsc	/asset
解压前 (MiB)	3.5220	4.4762	4.6461	0.8069	5.5955
解压后 (MiB)	8.6136	8.9623	5.6321	0.9923	8.0238

平均APK大小: 20.1227MiB

# 01 App Code | .dex

- Proguard
- redex

# 01 App Code | .so

ABI	Supported Instruction Set(s)	Notes
<a href="#">armeabi</a>	<ul style="list-style-type: none"><li>• ARMV5TE and later</li><li>• Thumb-1</li></ul>	No hard float.
<a href="#">armeabi-v7a</a>	<ul style="list-style-type: none"><li>• armeabi</li><li>• Thumb-2</li><li>• VFPv3-D16</li><li>• Other, optional</li></ul>	Incompatible with ARMv5, v6 devices.
<a href="#">arm64-v8a</a>	<ul style="list-style-type: none"><li>• AArch-64</li></ul>	
<a href="#">x86</a>	<ul style="list-style-type: none"><li>• x86 (IA-32)</li><li>• MMX</li><li>• SSE/2/3</li><li>• SSSE3</li></ul>	No support for MOVBE or SSE4.
<a href="#">x86_64</a>	<ul style="list-style-type: none"><li>• x86-64</li><li>• MMX</li><li>• SSE/2/3</li><li>• SSSE3</li><li>• SSE4.1, 4.2</li><li>• POPCNT</li></ul>	
<a href="#">mips</a>	<ul style="list-style-type: none"><li>• MIPS32r1 and later</li></ul>	Uses hard-float, and assumes a CPU:FPU clock ratio of 2:1 for maximum compatibility. Provides neither micromips nor MIPS16.
<a href="#">mips64</a>	<ul style="list-style-type: none"><li>• MIPS64r6</li></ul>	

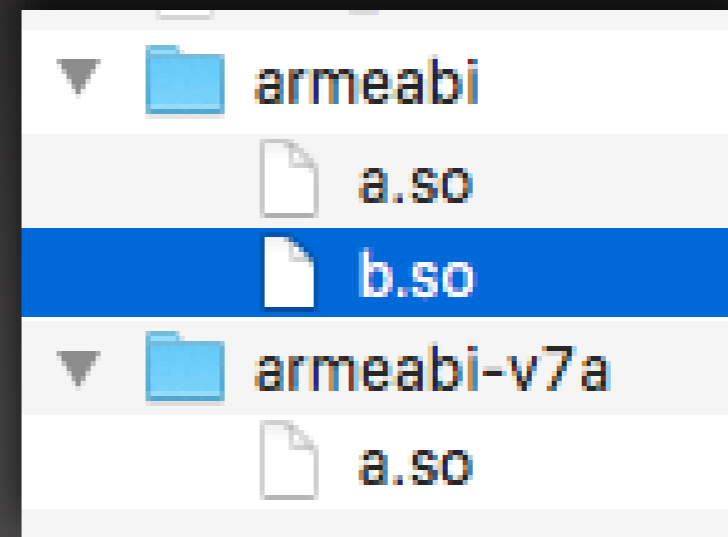
# 01

App Code | .so

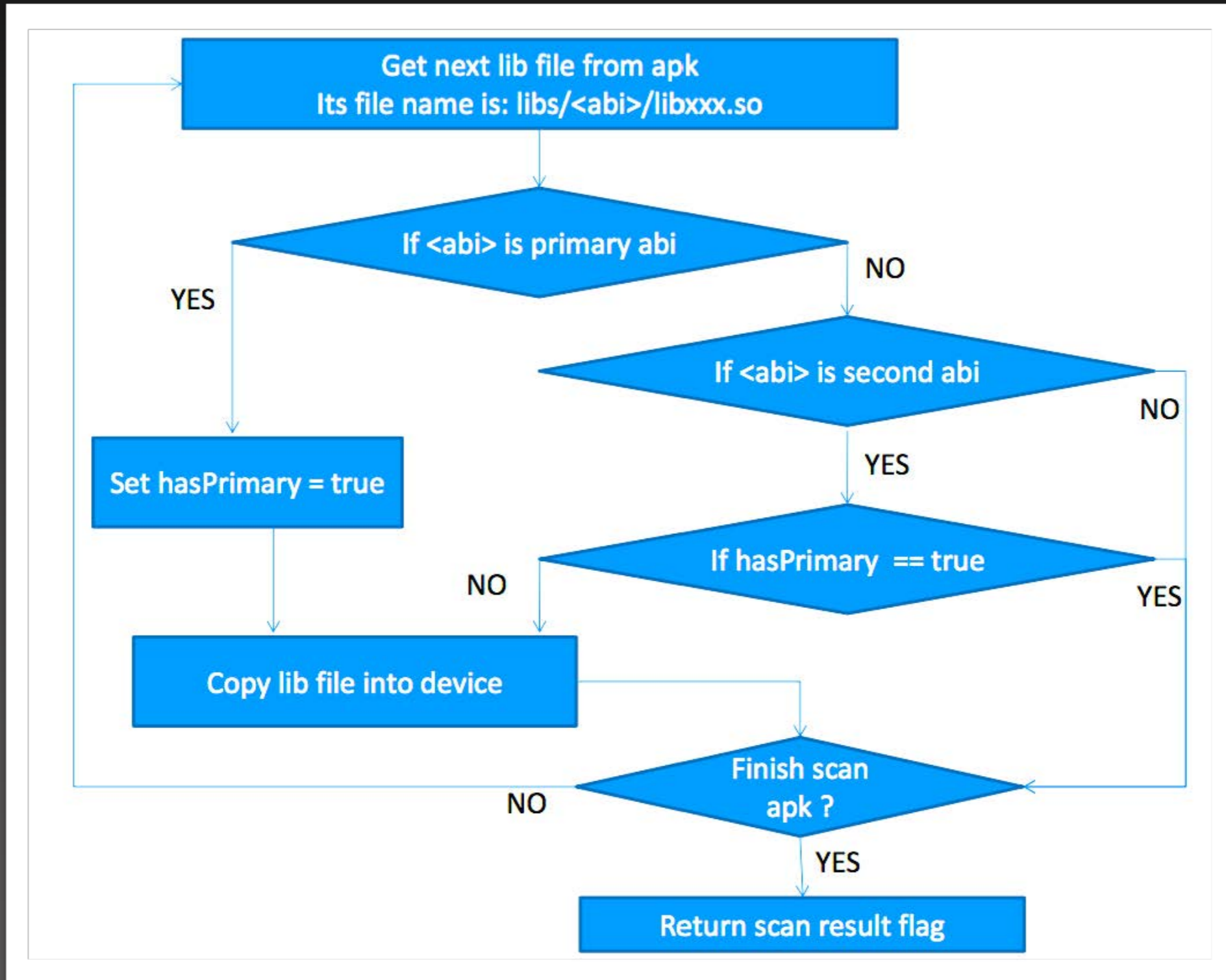
- armeabi
- armeabi-v7a
- arm64-v8a
- x86
- x86\_64
- mips
- mips64

Houdini

# 01 App Code | .so



# 01 App Code | .so



# 01 App Code | .so

```
static install_status_t
iterateOverNativeFiles(JNIEnv *env, jstring javaFilePath, jstring javaCpuAbi, jstring javaCpuAbi2,
    iterFunc callFunc, void* callArg) {
    ScopedUtfChars filePath(env, javaFilePath);
    ScopedUtfChars cpuAbi(env, javaCpuAbi);
    ScopedUtfChars cpuAbi2(env, javaCpuAbi2);

    ZipFileRO zipFile;

    if (zipFile.open(filePath.c_str()) != NO_ERROR) {
        ALOGI("Couldn't open APK %s\n", filePath.c_str());
        return INSTALL_FAILED_INVALID_APK;
    }

    const int N = zipFile.getNumEntries();

    char fileName[PATH_MAX];
    bool hasPrimaryAbi = false;

    for (int i = 0; i < N; i++) {
        const ZipEntryRO entry = zipFile.findEntryByIndex(i);
        if (entry == NULL) {
```

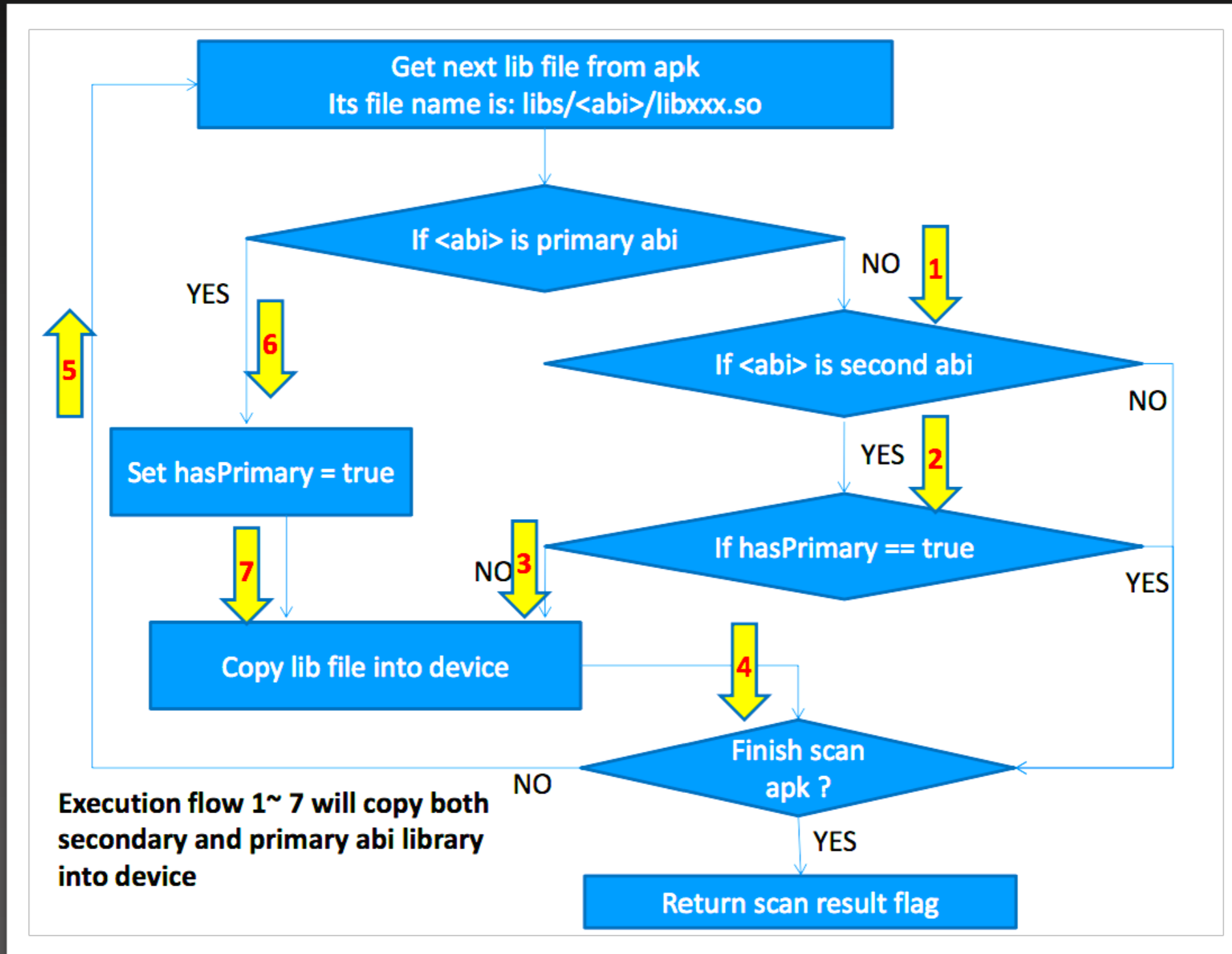
```
/*
 * Simple string hash function for non-null-terminated strings.
 */
/*static*/ unsigned int ZipFileRO::computeHash(const char* str, int len)
{
    unsigned int hash = 0;

    while (len--)
        hash = hash * 31 + *str++;

    return hash;
}
```

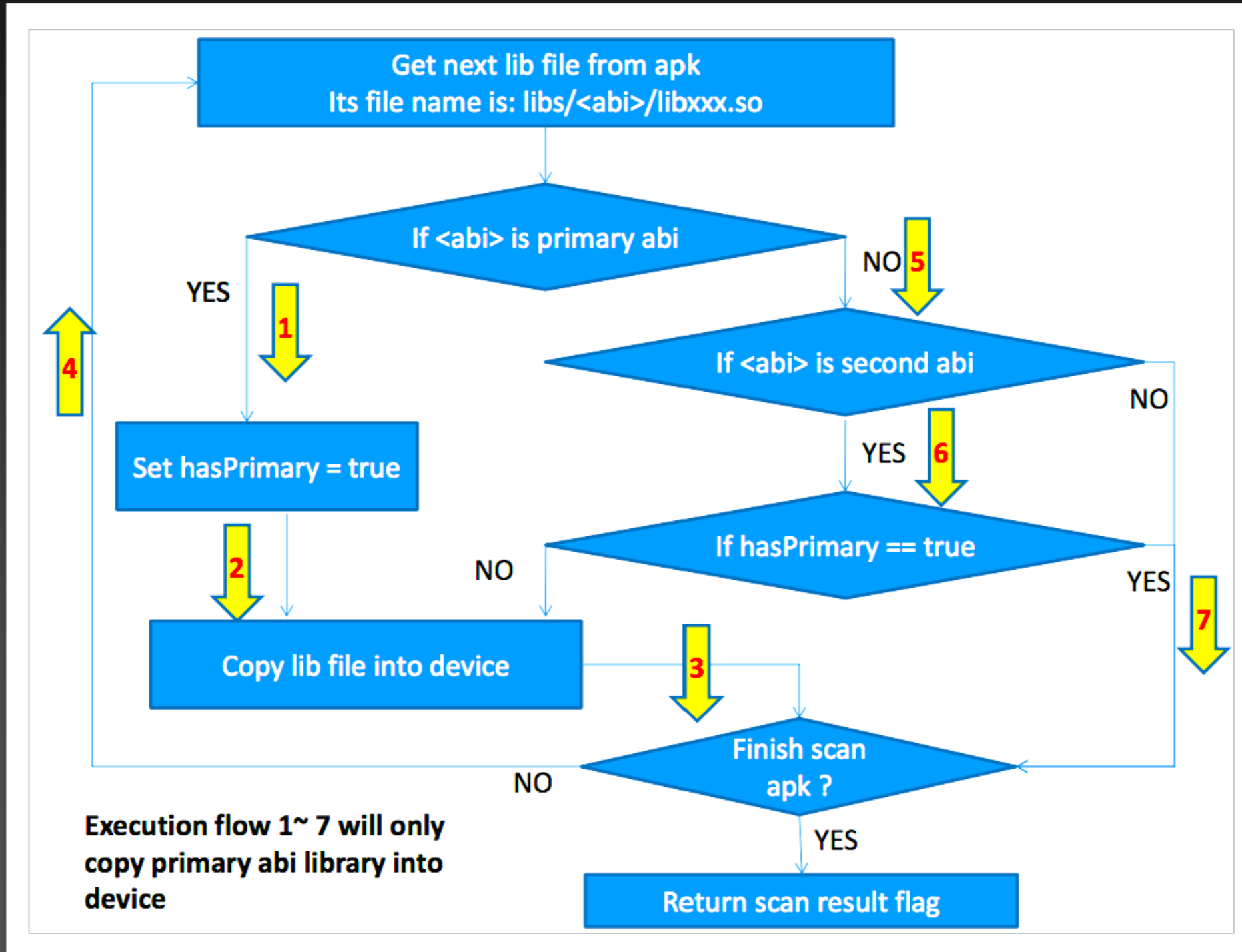
# 01

App Code | .so





# 01 App Code | .so



# 01

## App Code | .so

History		Expand All
zhenghua wang	Uploaded patch set 1.	Feb 2, 2014
zhenghua wang	Patch Set 2: Commit message was updated	Feb 2, 2014
zhenghua wang	Patch Set 3: Commit message was updated	Feb 2, 2014
zhenghua wang	Patch Set 4: Commit message was updated	Feb 2, 2014
Jeff Brown	Patch Set 4: Code-Review+1 (1 comment)	Feb 8, 2014
zhenghua wang	Uploaded patch set 5.	Feb 9, 2014
Deckard Autoverifier	Patch Set 5: Verified-1 This is an automated message from the Deckard Autoverifier. Patchset merges and builds in AOSP. Patchset merges but does n..	Feb 26, 2014
Narayan Kamath	Patch Set 5: I discovered this problem when working on related 64 bit changes. I'm going to fix this change up and accept it, since I need it there.	Apr 7, 2014
Narayan Kamath	Patch Set 5: Code-Review-1 Ok, it turns out that most of this will be completely rewritten (in a slightly different way) for the 64 bit work. (I'll make sure y...	Apr 8, 2014
Deckard Autoverifier	Patch Set 5: -Verified	Apr 9, 2014
Narayan Kamath	Abandoned this is fixed in lollipop (and the code is in AOSP). thanks for the excellent summary and investigation	Nov 28, 2014

# 01 App Code | .so

1. pre Android 5.0: 可能会从不同 abi 目录复制 .so
2. Android 5.0+: 只从单个 abi 目录复制 .so

# 01 App Code | .so

Pre-launch report [publish to start testing](#)

Supported devices

Pre-launch report [publish to start testing](#)

Supported devices

Pre-launch report [publish to start testing](#)

Supported devices

Pre-launch report	<a href="#">publish to start testing</a>
Supported Android devices	<b>12432 devices</b> (479 removed)
API levels	9+
Screen layouts	4 screen layouts ▼
Localizations	default + 78 languages ▼
Features	1 feature ▼
Required permissions	1 permission ▼
OpenGL ES versions	1.0+
OpenGL textures	all textures
Native platforms	<b>arm64-v8a, armeabi, armeabi-v7a, mips, mips64, x86, x86_64</b>

\* [http://storage.googleapis.com/play\\_public/supported\\_devices.csv](http://storage.googleapis.com/play_public/supported_devices.csv)

# 01 App Code | .so

	API 9	API 14	
arm	12903	11659	-1244
armv7	12432	11612	-820
	-471	-47	

# 01

App Code | .so

1. 只保留 armeabi , armeabi-v7a
2. 对只有 armeabi 版本的第三方 .so, 复制到 armeabi-v7a/

```
$ readelf -A a.so
Attribute Section: aeabi
File Attributes
Tag_CPU_name: "5TE"
Tag_CPU_arch: v5TE
```

\* ndk/toolchains/arm-linux-androideabi-<version>/prebuilt/<platform>/bin/arm-linux-androideabi-readelf

# Native libs open from APK

Since Android 6.0+

```
<application android:extractNativeLibs="false">
```

- \*.so files are not copied out from APK.
- `System.loadLibrary(...)` just works.

# 02 Resources

- `resources.arsc`
- `images`
- `audios`



# 02 Resources | resources.arsc

Name	Value	Start	Size
▶ struct arsc_string_offset_utf8 string_offsets[42]	res/color/selector_bg_start_btn.xml	D0h	4h
▶ struct arsc_string_offset_utf8 string_offsets[43]	res/color/selecotr_test_setting_text_color.xml	D4h	4h
▶ struct arsc_string_offset_utf8 string_offsets[44]	res/color/selecotr_test_setting_no_test_color.xml	D8h	4h
▶ struct arsc_string_offset_utf8 string_offsets[45]	res/color/selecotr_test_description_color.xml	DCh	4h
▶ struct arsc_string_offset_utf8 string_offsets[46]	res/color/group_tab_text.xml	E0h	4h
▶ struct arsc_string_offset_utf8 string_offsets[47]	res/drawable/biz_selector_icon_day.xml	E4h	4h
▶ struct arsc_string_offset_utf8 string_offsets[48]	res/color/common_selector_text_with_border.xml	E8h	4h
▶ struct arsc_string_offset_utf8 string_offsets[49]	res/drawable/abc_cab_background_internal_bg.xml	ECh	4h
▶ struct arsc_string_offset_utf8 string_offsets[50]	res/drawable/abc_cab_background_top_material.xml	F0h	4h
▶ struct arsc_string_offset_utf8 string_offsets[51]	res/color/common_selector_btn_text.xml	F4h	4h
▶ struct arsc_string_offset_utf8 string_offsets[52]	res/color/abc_secondary_text_material_light.xml	F8h	4h
▶ struct arsc_string_offset_utf8 string_offsets[53]	res/color/abc_secondary_text_material_dark.xml	FCh	4h

4bytes \* 3500nullEntries \* 50 languages = 700k

## 02 Resources | resources.arsc

- [github.com/google/android-arscblamer](https://github.com/google/android-arscblamer)

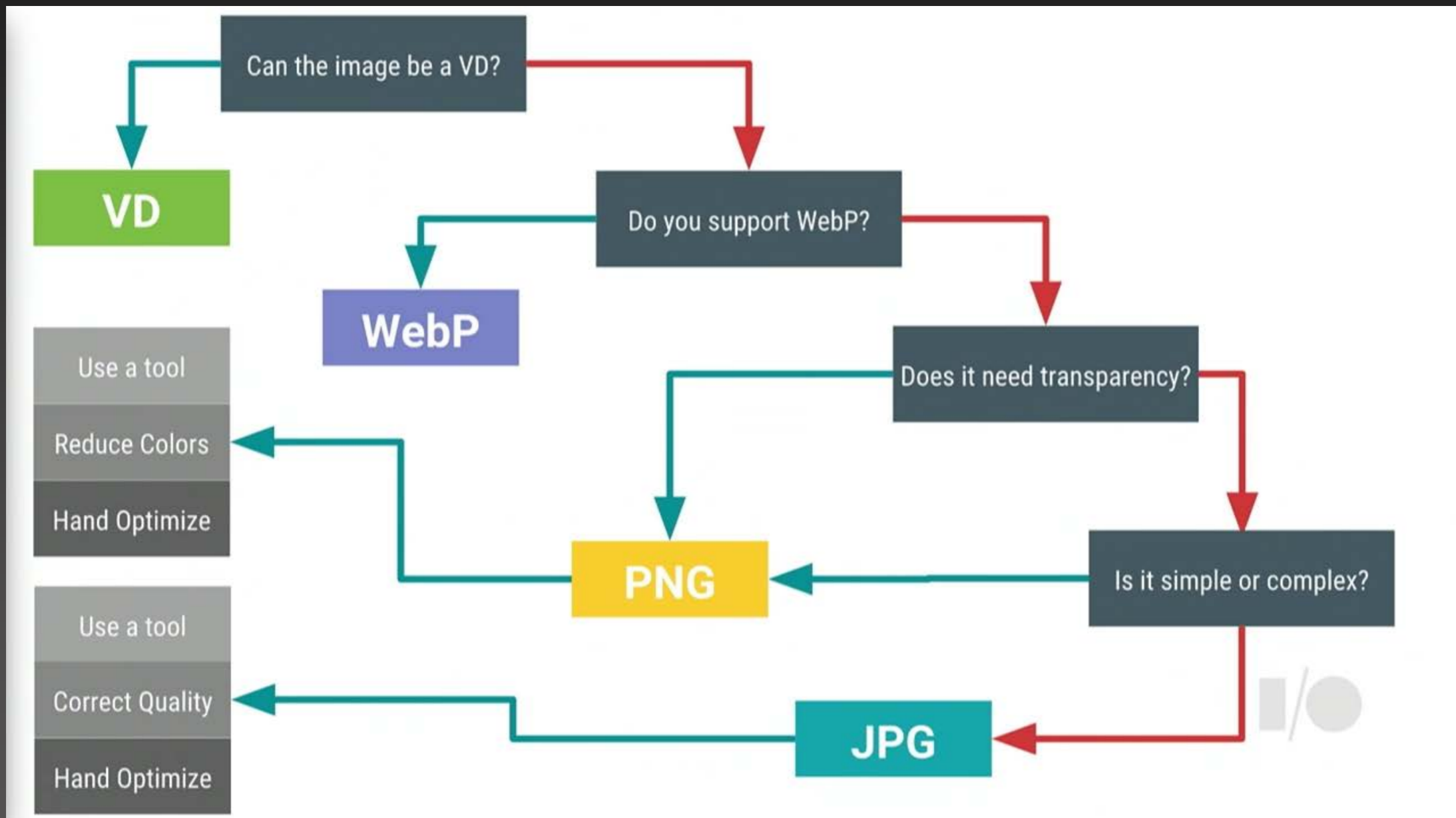
```
android {  
    defaultConfig {  
        resConfigs "en", "zh"  
    }  
}
```

gradle:2.1.4

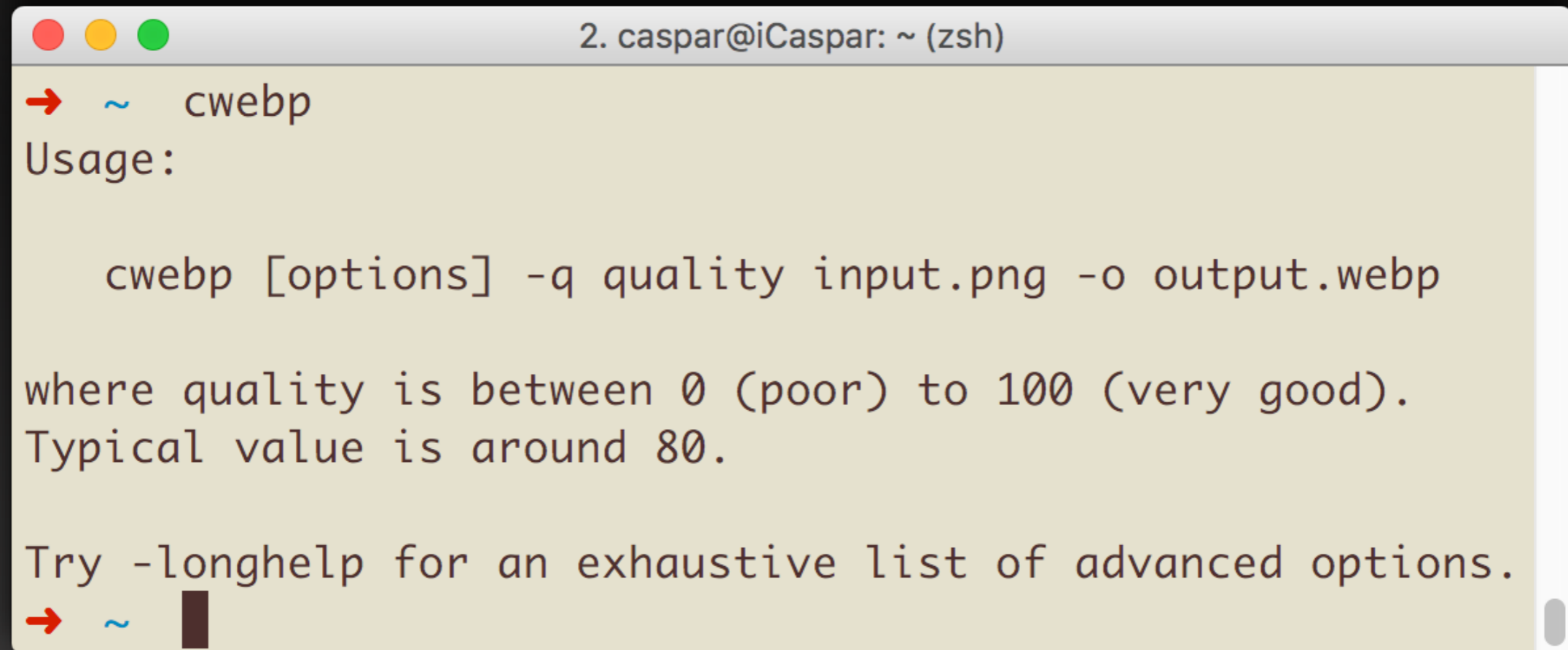
```
android {  
    defaultConfig.with {  
        resourceConfigurations << "zh"  
    }  
}
```

gradle-experimental:0.7.3

# 02 Resources | images



## 02 Resources | images



```
2. caspar@iCaspar: ~ (zsh)
→ ~ cwebp
Usage:

    cwebp [options] -q quality input.png -o output.webp

where quality is between 0 (poor) to 100 (very good).
Typical value is around 80.

Try -longhelp for an exhaustive list of advanced options.
→ ~ █
```

- API 14+, alpha support API 17+

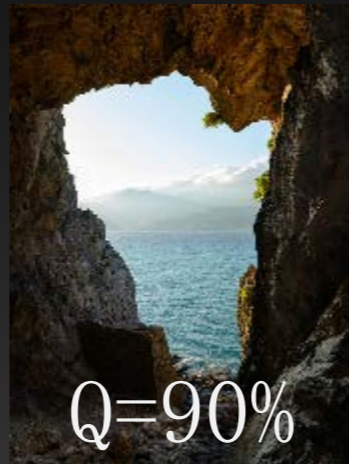
# 02 Resources | images

- 删除 meta data
- 无损 ( Zopfli )
- 有损 ( 如何量化损失? SSIM or butteraugli\*\*)

\* <https://github.com/google/zopfli>

\*\* <https://github.com/google/butteraugli>

# 02 Resources | images



$B_g = 0.8$



$B_g = 1.07$

$B_g < 1.1$



$B_g = 1.27$

...

## 02 Resources | images

- 脚本化
- 格式选定（是否需要超过256色，是否需要alpha通道）
- 删除 meta data，无损压缩
- 有损压缩试错

ImageOptim-CLI  
(OptiPNG, PNGCrush, Zopfli, JPEGoptim ...)

## 02 Resources | images

```
aaptOptions {  
    cruncherEnabled = false  
}
```



## 02 Resources | images

- mp3 to aac

# 02 Resources

- **AndResGuard:** AndResGuard is a tool to proguard resource.

## MANIFEST.MF

```
Name: res/layout/biz_fragment_faq.xml ↵  
SHA1-Digest: y10Ug4R8sK5jk50CodZST4n0GdQ=  
Name: r/z/er.xml ↵  
SHA1-Digest: y10Ug4R8sK5jk50CodZST4n0GdQ=
```

- DO NOT deflate resources.arsc
- DO NOT use 7zip

# 03 Ref

- 《与 `.so` 有关的一个长年大坑》
- 《APK 瘦身的正确姿势》

THE END