



# Fing Developer's Guide

Development Toolkit Documentation

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# 1. Introduction

Device recognition technology is at the core of Fing App - the network scanning and troubleshooting tool downloaded over 35 million times and scanning millions of networks around the world every day. Fing's Device Recognition technology identifies billions of connected devices quickly and accurately and provides valuable insights about networks and connected devices. Development teams can save substantial time and resources by implementing Fing technology in applications for the connected world.

Fing's Development Toolkit consists of a Software Development Kit (SDK) for mobile apps and embedded devices that allow developers access to Fing's proprietary machine learning expertise and unrivaled device identification. The SDK analyses a device's Wi-Fi network and emits details about the connected devices and Fing's cloud service identifies specific device properties including make, model, category, operating system and version. Access a snapshot of currently connected and previously connected devices for a given network.

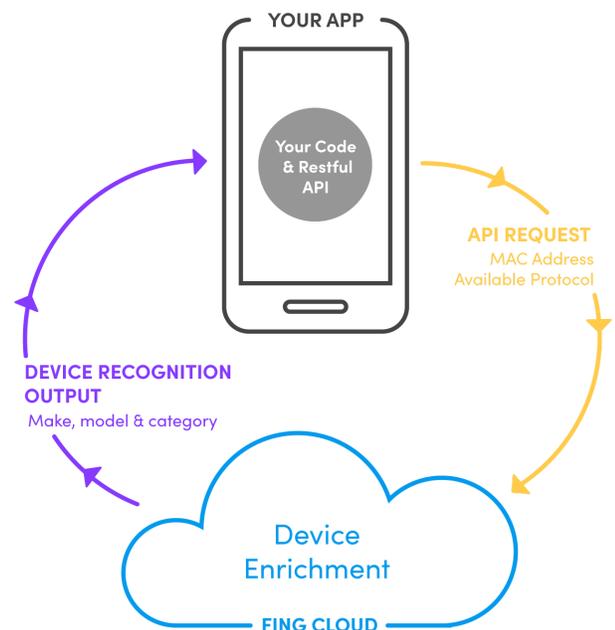
## The key benefits for developers are:

- Improve existing user experience which relies on poorly implemented Device Identification, often developed internally.
- Accelerate time to market of products, apps and services that rely on accurate real-time connected device identification.
- Easily integrate non-invasive and light touch network discovery and device recognition capabilities without the need to create low-level networking technology and fingerprinting.

## How it Works

Fing's proprietary technology leverages an ever-expanding crowdsourced knowledge to understand discovery protocols including Bonjour (Multicast-DNS) queries, UPnP queries, SNMP requests, DHCP monitoring and NetBIOS queries.

Fing's Device Recognition technology analyses and provides the best match data for each device. Fing's catalogue currently has more than one hundred types of device ranging from tablets to surveillance cameras. Device types are grouped into eight categories - mobile, entertainment, home & office, network, server, home automation, surveillance, engineering. In addition Fing provides, in JSON text



format, the full set of network details and analysis for each network protocol the devices comply with.

## 2. Integrate Fing Development Toolkit into your native app

Using Fing’s developer tools is simple and straightforward on iOS and Android. Create an app, access your unique Fing License Key and simply add the relevant frameworks for Fing integration. You can then initialize Fing and start a network scan.

### Integration with an iOS app

Fing SDK is available as an Objective-C Framework library, suitable to be used with the standard development tools (Xcode) and to be published on the official Apple Store. As a framework, it may also be used by applications written in Swift language. It is compatible with Apple iOS 9.x and beyond.

Fing SDK requires the following items to be added in **“Linked Frameworks and Libraries”** in your Xcode project.

<a href="#">libresolv.9.tdb</a>	<a href="#">Foundation.framework</a>
<a href="#">libsqlite3.tdb</a>	<a href="#">CFNetwork.framework</a>
<a href="#">SystemConfiguration.framework</a>	<a href="#">CoreTelephony.framework</a>
<a href="#">Security.framework</a>	

The FingKit framework itself shall be added as **“Embedded Binaries”** as well; Xcode automatically includes the framework in the final package. To import and use the functionalities of the FingKit modules, you shall simply import the module main header.

```
#import <FingKit/FingKit.h>
```

Functionalities are accessed via the main singleton class [FingScanner](#).

### Integration within an Android app

The SDK is available as an AAR (Android Archive) library, suitable to be used with the standard development tools (Android Studio) and to be published on the official Play Store. As a framework, it may also be used by applications written in Kotlin language. It is

compatible with Android 4.4 and above. The following dependencies should be added in your Gradle-based or Maven-based project.

Group	Name	Version
com.android.support	appcompat-v7	27.1.1
com.google.android.gms	play-services-analytics	16.0.5
com.google.protobuf	protobuf-java	2.6.1
org.snmp4j	snmp4j	2.5.0

The archive [fing-kit.aar](#) should be placed locally in a folder placed at the same level of the Android app source code, (e.g. if your source code is in `<root/app/src>`, place the library in `<root/app/libs>`) and it will be added as transitive compilation item in your build system.

Android Studio automatically includes the framework in the final package. Below is an excerpt of a Gradle build module that includes the library in the build system.

#### Android (Gradle)

```
allprojects {
    repositories {
        jcenter()
        flatDir {
            dirs 'libs'
        }
        google()
    }
}

dependencies {
    compile(name:'fing-kit', ext:'aar') {
        transitive=true
    }

    implementation 'com.android.support:appcompat-v7:27.1.1'
    implementation 'com.google.android.gms:play-services-analytics:16.0.5'
    implementation 'com.google.protobuf:protobuf-java:2.6.1'
    implementation 'org.snmp4j:snmp4j:2.5.0'
}
```

The functionalities are accessed via the main singleton class [FingScanner](#).

## 3. API Specification

### Asynchronous design

Fing SDK operates asynchronously, to ensure your App is never blocked during each operation. A callback block is used to deliver the result of an operation, or the error object in case the operation could not be completed. All callback methods are invoked in the main thread on iOS and Android.

#### iOS (Objective-C)

```
typedef void (^FingResultCallback)
(NSString *_Nullable result, NSError *_Nullable error);
```

#### Android (Java)

```
public interface FingResultCallback {
    void handle(String result, Exception error);
}
```

Parameter	iOS/Android Type	Description
<b>Result</b>	<code>NSString *</code> / <code>String</code>	The result coming from Fing. It may be nil/null if there is no result or if an error occurred. The result is usually in JSON format, but in general it depends on the type of operation
<b>Error</b>	<code>NSError *</code> / <code>Exception</code>	An error descriptor, in case the operation may not be completed.

If successful, the completion callback result string contains a JSON-formatted result and a nil/null error.

The execution of the scanning request must be initiated from main thread in foreground execution on both platforms; executing the activity from a scheduled background task on Android or in the background mode on iOS may lead to inconsistent states and errors.

### Error Handling

On Android, errors are represented as Exception objects passed as parameters. On iOS, the completion callback may return one of the following error codes in the `NSError` object if the attempt to validate the key failed.

Error Code	Description
<b>-100</b>	The provided key is not valid
<b>-101</b>	The service replied, but could not validate the key

-102	The operation timed out
-300	Scan operation failed

## License Key validation

To enable the functionalities delivered by the Fing SDK, you must first obtain a License Key from [sales@fing.com](mailto:sales@fing.com) and validate it. The validation requires access to the internet, and it shall be executed at every application session in order to activate the features; a missing or failed validation disables the features of the Fing SDK.

### iOS (Objective-C)

```
-(void) validateLicenseKey:(NSString *) key
    withToken:(NSString *) token
    completion:(nullable FingResultCallback) completion;
```

### Android (Java)

```
public void validateLicenseKey(String key,
    String token,
    FingResultCallback completion);
```

The method accepts the following list of parameters:

Parameter	iOS/Android Type	Description
<b>Key</b>	<code>NSString *</code> / <code>String</code> <i>(Required)</i>	The unique license key that enable the usage of Fing API. The key is used to identify the owner, assess the services that are enabled for a given license and to ensure the usage of the functionalities within the agreed terms.
<b>Token</b>	<code>NSString *</code> / <code>String</code> <i>(Optional, max 512 characters)</i>	A token generated by your App or by your backend services, that will be sent back to your remote services through a webhook. The purpose of the optional token is to allow you to recognise, if needed, the activation of a session using your license key.
<b>Completion</b>	<code>FingResultCallback</code> <i>(Optional)</i>	A callback block that is invoked when the validation terminates.

If successful, the callback contains a JSON-formatted result as described in the following table, and a `nil/null` error.

Key	Value	Example
<code>kitLicenseId</code>	Your license key	Will be the same value passed as parameter

<b>kitCustomerId</b>	Your unique customer identifier, assigned on sign up. Usually, it's your company or App name	ACME
<b>expiryDate</b>	The time at which the provided key expires and a new key or new validation shall be performed	2016/11/23 02:00:07
<b>state</b>	The state of the license. It may be one of: Ok Suspended Revoked	Ok
<b>grantDiscovery</b>	A Boolean value indicating if the network discovery feature is granted by your license	true
<b>grantEnrichment</b>	A Boolean value indicating if a Fing Service enrichment is enabled. Enrichment provides additional results on top the local scan, such as device type recognition.	true
<b>grantAccount</b>	<i>Deprecated feature.</i> A Boolean value indicating if the ability to attach the App to an account is granted by your license.	true
<b>usageToken</b>	A token assigned to the running device for the present month	ABC123
<b>usageCounted</b>	A Boolean value indicating if this validation was the first validation of the licensing period	true

If the validation could not be performed or fails, a description of the error is reported in the [NSError](#) object.

An example of the JSON result is reported below.

#### iOS and Android (JSON)

```
{
  "kitLicenseId": "ABC123",
  "kitCustomerId": "ACME",
  "expiryDate": "2016/12/30 00:00:00",
  "state": "Ok",
  "grantDiscovery": "true",
  "grantEnrichment": "true",
  "grantAccount": "false",
  "usageToken": "ABC123",
  "usageCounted": "false"
}
```

A failure to validate the key is reported via an [NSError](#). Every error in the validation process disables all functionalities.

## Network Info

Fing allows to conveniently retrieve network details from the Wi-Fi the device is connected to. The network details may be retrieved through the following method:

iOS (Objective-C)

```
-(void) networkInfo:(nullable FingResultCallback) completion;
```

Android (Java)

```
public void networkInfo(FingResultCallback completion);
```

If successful, the callback contains a JSON-formatted result as described in the following table, and a `nil/null` error.

Key	Value	Example
<b>address</b>	The base IP address of the network	192.168.0.0
<b>netmask</b>	The netmask expressed as CIDR notation. It represents the number of bits that make up the subnet part, and consequently the remaining bits identify the host part	24
<b>bssid</b>	The BSSID, that is the MAC Address of the Access Point the device is connected to at the moment	AA:BB:CC:00:01:02
<b>ssid</b>	The name of the network, as assigned by the network administrator	My Network
<b>gatewayAddress</b>	The IP Address of the network gateway, if available	192.168.0.1
<b>dnsAddress</b>	The IP Address of the network DNS, if available	192.168.0.1
<b>hasConnectivity</b>	<i>Discriminates if the current connection with the server has network connectivity</i>	true

## Network Scan

This functionality is accessed via a single method that performs the scan and enrichment of data, if enabled. The scan is integrated with the Fing Device Recognition Service, based on the features and services enabled on your API key.

iOS (Objective-C)

```
-(void) networkScan:(nullable FingScanOptions *) options
    completion:(nullable FingResultCallback) completion;
-(void) networkScanStop;
```

## Android (Java)

```
public void networkScan(FingScanOptions options,
                       FingResultCallback completion);
public void networkScanStop();
```

Scan progress is delivered asynchronously to a completion handler, so that hosting Apps can be informed and display the progress of the execution.

The method “scan” accepts the following list of parameters:

Parameter	iOS/Android Type	Description
<b>options</b>	<a href="#">FingScanOptions</a> * <i>(Optional)</i>	The set of options to tune the network scan procedure.  See Scan Options for details
<b>completion</b>	<a href="#">FingResultCallback</a> <i>(Optional)</i>	A callback block that is invoked when the validation terminates. The validation may check both locally and remotely the given key, and report the result or an empty result with an error.  See section 4 for details.

## Stopping a Scan

The scan can be stopped at any time using the corresponding method `networkScanStop`; if the scan was not running at that time, nothing is performed. After the stop operation is requested, all pending updates and the enrichment update will be delivered to scan completion handler.

## Scan Options

You may enable and tune the scan process through a set of Options. The following scan options may be specified through the appropriate [FingScanOptions](#) object:

Option	iOS/Android Type	Description
<code>reverseDnsEnabled</code>	Bool/boolean	Enables Reverse DNS
<code>upnpEnabled</code>	Bool/boolean	Enables UPnP scan
<code>bonjourEnabled</code>	Bool/boolean	Enables Bonjour scan
<code>netbiosEnabled</code>	Bool/boolean	Enables NetBIOS scan
<code>snmpEnabled</code>	Bool/boolean	Enables SNMP scan

<code>maxNetworkSize</code>	<code>NSInteger / integer</code>	Imposes a maximum network size
<code>resultLevelScanInProgress</code>	<code>FingScanResultLevel</code>	<p>The level of results that shall be returned while the scan is in progress.</p> <p>One of <code>FingScanResultNone</code>, <code>FingScanResultSummary</code>, <code>FingScanResultFull</code>.</p> <p>The default value is <code>FingScanResultNone</code>.</p>
<code>resultLevelScanCompleted</code>	<code>FingScanResultLevel</code>	<p>The level of results that shall be returned when the scan is complete.</p> <p>The default value is <code>FingScanResultSummary</code>.</p>
<code>resultLevelScanEnriched</code>	<code>FingScanResultLevel</code>	<p>The level of results that shall be returned when the scan is enriched.</p> <p>The default value is <code>FingScanResultFull</code></p>
<code>outputFormat</code>	<code>NSString * / String</code>	<p>The output format, expressed as MIME type.</p> <p>Currently only “application/json” is supported.</p>

Please note that scan options are supported only on iOS at the moment.

## 4. Data structure of a Fing scan

Regardless of the platform being used, the Fing returns the same set of results in the requested format. At the moment, JSON format is supported, which allow an easy integration with any kind of hosting app or process. Since iOS 11, MAC addresses may not be retrieved for the local device and the scanned device, and are therefore not reported in the JSON result.

### Summary dataset of the network

For the current network, Fing will provide a JSON data structure describing the network details and analysed properties. This is the set of details returned at Summary level.

Key	Value	Example
<b>nodes_count</b>	The amount of nodes found in the network	12
<b>nodes_up_count</b>	The amount of nodes found online in the network. The state of network devices is preserved locally by the system and merged with the latest scan	10
<b>nodes_down_count</b>	The amount of nodes found offline in the network. The state of network devices is preserved locally by the system and merged with the latest scan	2
<b>last_scan_timestamp</b>	The time of the last scan	2016/11/23 02:00:07
<b>network_short_address</b>	The network address, in CIDR format	192.168.0.1/24
<b>progress</b>	The progress of the scan, in percentage from 0 to 100	80
<b>enriched</b>	A boolean flag discriminating if this scan has been enriched by Fing Device Recognition service	true
<b>completed</b>	A boolean flag discriminating if this scan completes the scan progress. Depending on the license and enrichment, the last scan report may come from as as the last operation of the scan or as the last operation after the scan has completed	false

## Extended dataset of the network

This is the set of details returned at Full level, in addition to all the details provided at Summary level. This structure is contained in the “**network**” JSON key.

Key	Value	Example
<b>last_change_timestamp</b>	The time of the last change	2016/11/23 02:00:07
<b>gateway_ip_address</b>	The IP address of the gateway	192.168.0.1
<b>gateway_mac_address</b>	The MAC address of the gateway	AB:00:DD:FF:01:CC
<b>address</b>	The network address	192.16.0.0
<b>address_type</b>	IPv4 or IPv6	IPv4
<b>dns_address</b>	The IP address of the DNS	192.168.0.1

<b>mask_prefix_length</b>	The netmask length applied by the scan engine, in bits	24
<b>original_prefix_length</b>	The netmask length as defined in the network, in bits	22
<b>name</b>	The network name from the Wi-Fi SSID, if any	My Network
<b>bssid_list</b>	A list of the access points BSSID	["AB:00:DD:FF:01:CC", "AB:00:DD:FF:01:CD"]
<b>time_zone</b>	The time zone of the scanning device	Europe/London

## Service Provider dataset

If internet connection is available, the scan reports also additional details on the ISP connection and location. Some of these details may not be available, depending on the user's connection.

Key	Value	Example
<b>address</b>	The public IP address	44.211.2.94
<b>host_name</b>	The public host name	host.viacom.com
<b>country_code</b>	The 2-letters country code	UK
<b>country_code_3</b>	The 3-letters country code	ITA
<b>country_name</b>	The name of the country	United States
<b>country_region_code</b>	The region code	LAZ
<b>country_region</b>	The region name	Tuscany
<b>country_city</b>	The city name	Washington
<b>country_postal_code</b>	The latitude of the ISP point in decimal degrees	W10 5BN
<b>latitude</b>	The longitude of the ISP point in decimal degrees	20.23123
<b>longitude</b>	The time zone of the scanning device	-82.22938
<b>isp_name</b>	The name of the Internet Service Provider	AT&T
<b>organization</b>	The name of the organization providing Internet Access	Your Local Building
<b>net_speed</b>	The nominal network speed	40 Mbs

## Network node base dataset

For each identified device, Fing will provide a data structure describing the network details and analyzed properties.

Key	Value	Example
<b>best_name</b>	The best name of the device, evaluated from the names returned from the various protocols it replies to	"HP 2832", "Marco's iPhone"
<b>best_type</b>	A single type identifying its major role. It's intended to be as brandless as possible	"Laptop", "Mobile", "Photo Camera".
<b>best_category</b>	A single major category the device falls in	"Entertainment" for a TV, "Personal" for a laptop, "IT" for a server
<b>best_make</b>	The name of the makers/vendor of the device. It may overlap with the manufacturer, but it may be also different in case the network interface (ETH, WIFI) is different.	"Apple", "Belkin" (but not "Foxconn")
<b>best_model</b>	The human-readable name of the model	"iPhone 5S", "P9"
<b>best_os</b>	The name of the Operating system, when applicable	"iOS 9.3.2", "Android 5.0.1", "Windows 7".
<b>mac_address</b>	The MAC Address of the device that is currently using to connect to the network	"06:5c:89:c9:e7:d1"
<b>vendor</b>	The name of the company that is officially manufacturing the network interface (ETH or WIFI). Names are reviewed and optimized to be consistent	"Samsung", "Apple", "Lenovo" for major brands, but also "Foxconn" for manufacturers that registered their components directly
<b>ip_addresses</b>	The list of IP address assigned to the device in the current network. It may be multiple if the element is a network bridge or if it's temporarily being assigned multiple addresses	"172.28.0.14"
<b>host_name</b>	The DNS name of the device	"mydevice.thissite.com"
<b>state</b>	Discriminates if the device is connected to the network or not. Can be "UP" or "DOWN"	"UP"

<b>first_seen_timestamp</b>	The timestamp the device was first discovered in this network	“2016-04-28 11:34:45”
<b>last_change_timestamp</b>	The timestamp the device changed the state (UP/DOWN)	“2016-04-28 11:34:45”

## Network node extended dataset for NetBIOS

In addition to general-purpose properties, Fing exports for NetBIOS the following JSON structure, contained in the “[netbios](#)” JSON key.

Property	Description	Example
<b>name</b>	The NetBIOS name is used to uniquely identify the NetBIOS services listening on the first IP address that is bound to an adapter. The NetBIOS name is also known as a NetBIOS computer name.	“MACBOOKPRO”
<b>domain</b>	A type of Fully-qualified Domain Name.	“mypc.locallan”
<b>user</b>	An optional user name. Due to security concerns, this is rarely available in the standard implementation	“MARCO”

## Network node extended dataset for Bonjour

In addition to general-purpose properties, Fing exports for Bonjour the following JSON structure, contained in the “[bonjour](#)” JSON key.

Property	Description	Example
<b>name</b>	The Bonjour name the device publishes	“My Macbook”
<b>model</b>	The Bonjour model the device publishes	“SCD8291221”, “Apple TV4,5”
<b>os</b>	The Bonjour Operating System name the device publishes	“Linux 12.4”
<b>service_list</b>	A list of Bonjour services published by the device	“_afpovertcp._tcp.local.” “_smb._tcp.local.”

## Network node extended dataset for UPnP

In addition to general-purpose properties, Fing exports for UPnP the following JSON structure, contained in the “[upnp](#)” JSON key.

Property	Description	Example
<b>name</b>	The UPnP name the device publishes	“My Macbook”
<b>make</b>	The UPnP Make name the device publishes	“Samsung”
<b>model</b>	The UPnP Model the device publishes	“SCD8291221”
<b>type_list</b>	A list of UPnP device types published by the device	“urn:Belkin:device:controllee:1”
<b>service_list</b>	A list of UPnP services published by the device	“urn:Belkin:service:manufacture:1” “urn:Belkin:service:smartsetup:1”

## Network node extended dataset for SNMP

In addition to general-purpose properties, Fing exports for SNMP the following JSON structure, contained in the “[snmp](#)” JSON key.

Property	Description	Example
<b>name</b>	The SNMP name the device publishes	“HP”
<b>description</b>	The SNMP description of the device	“Cisco IOS Software, C3750 Software (C3750-IPSERVICESK9-M), Version 12.2(46)SE”
<b>location</b>	The SNMP location of device	“North Corridor”
<b>contact</b>	The SNMP contact point	“admin@cisco.com”
<b>sysoid</b>	The unique identifier of the device type	“1.3.6.1.4.1.9.1.516”

## Network node extended dataset for DHCP

In addition to general-purpose properties, Fing exports for DHCP the following JSON structure, contained in the “[dhcp](#)” JSON key.

Property	Description	Example
<b>name</b>	The DHCP name the device publishes	“My Macbook”

vendor	TThe DHCP vendor	“Samsung”
--------	------------------	-----------

## The type of devices that Fing recognises

For each device, Fing will analyse all the details and provide the best match among its supported types and categories. The list is reviewed and grows constantly as our machine learning evolves.

Group	Description
<b>Mobile</b>	Generic, Mobile, Tablet, MP3 Player, eBook Reader, Smart Watch, Wearable, Car
<b>Audio &amp; Video</b>	Media Player, Television, Game Console, Streaming Dongle, Speaker/Amp, AV Receiver, Cable Box, Disc Player, Satellite, Audio Player, Remote Control, Radio, Photo Camera, Photo Display, Mic, Projector
<b>Home &amp; Office</b>	Computer, Laptop, Desktop, Printer, Fax, IP Phone, Scanner, Point of Sale, Clock, Barcode Scanner
<b>Home Automation</b>	IP Camera, Smart Device, Smart Plug, Light, Voice Control, Thermostat, Power System, Solar Panel, Smart Meter, HVAC, Smart Appliance, Smart Washer, Smart Fridge, Smart Cleaner, Sleep Tech, Garage Door, Sprinkler, Electric, Doorbell, Smart Lock, Touch Panel, Controller, Scale, Toy, Robot, Weather Station, Health Monitor, Baby Monitor, Pet Monitor, Alarm, Motion Detector, Smoke Detector, Water Sensor, Sensor, Fingbox, Domotz Box
<b>Network</b>	Router, Wi-Fi, Wi-Fi Extender, NAS, Modem, Switch, Gateway, Firewall, VPN, PoE Switch, USB, Small Cell, Cloud, UPS, Network Appliance
<b>Server</b>	Virtual Machine, Server, Terminal, Mail Server, File Server, Proxy Server, Web Server, Domain Server, Communication, Database
<b>Engineering</b>	Raspberry, Arduino, Processing, Circuit Board, RFID Tag

## 5. Integrate Fing using Apache Cordova

Fing’s Development Toolkit may also be used through systems that rely on cross-platform mobile development toolkit based on Apache Cordova, such as Ionic 1 and 2, PhoneGap and similar. All such platforms rely on Javascript development and specific plugins that extend the core functionality to interact with additional frameworks.

In order for the plugin to work correctly, you shall use the default tools (npm) to install the system, the plugin and the dependencies mentioned in this document. A typical workflow includes the following steps:

- Install the basic system

- ◆ npm install
- ◆ bower install
- Install iOS or Android platforms
  - ◆ ionic platform add ios
  - ◆ ionic platform add android
- Install the plugin
  - ◆ ionic plugin add ./fingkit
- if not already present, manually add Fingkit.framework in the embedded binaries of your Xcode project
- Build for the target platforms
  - ◆ ionic build ios
  - ◆ ionic build android

In order for the plugin to work correctly, you shall use the default tools (npm) to install the system, the plugin and the dependencies mentioned in this document. A typical workflow includes the following steps:

```
lipo -remove i386 FingKit.framework/FingKit -output  
FingKit.framework/FingKit  
  
lipo -remove x86_64 FingKit.framework/FingKit -output  
FingKit.framework/FingKit
```