Project Treble: a lifelong technical debt

Introduction

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Background

- We were helping SoC and device manufacturers to make their devices run Android for some time now…




- This guy felt different

…because of Treble.

Agenda

- What is Treble?
- Why did Google need it?
- What are the Treble components?
- Are there any problems with Treble?
- What Android 9 shows us about Treble?

Quotes from Google

- *“Project Treble is probably the **biggest** re-architecture of Android since it started.“*

  Dave Burke, Android's VP of engineering.

- *"I don't think there's ever been something remotely even close to the **complexity** of Treble in terms of infrastructure change to the platform."*

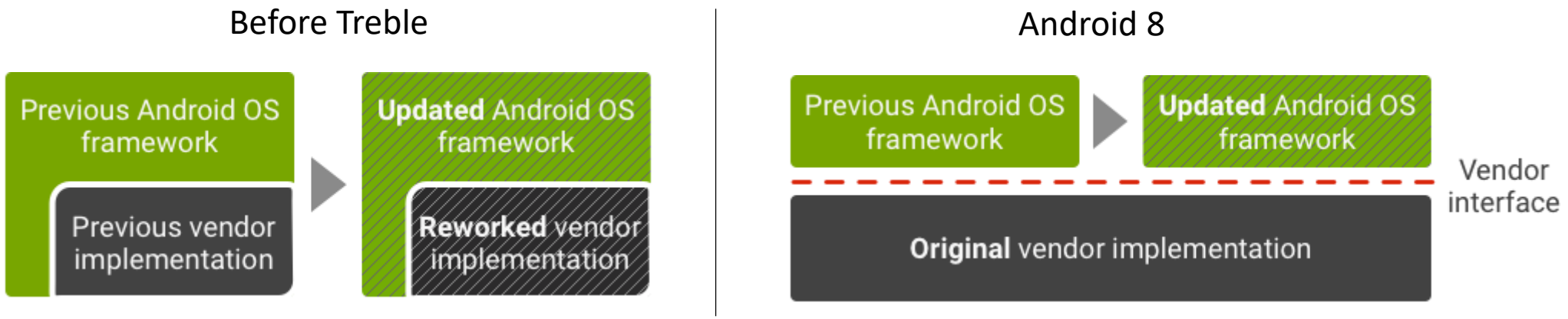
  Romain Guy, Android's Graphics lead engineer

- *“Treble involved upwards of **300 developers** within Android engineering itself contributing to this, across 30 teams.“*

  Iliyan Malchev, the head of Project Treble

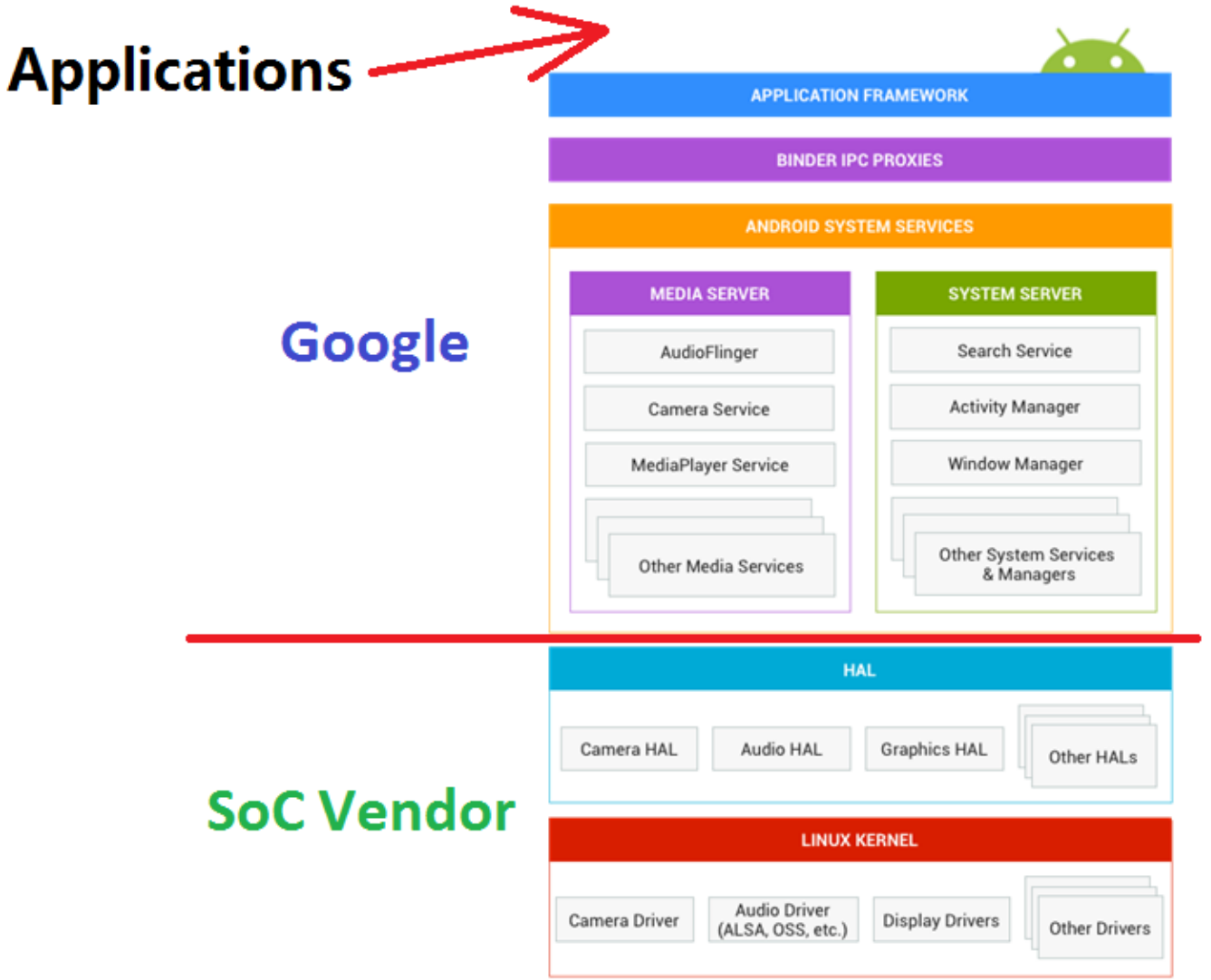
Project Treble

- *Android 8.0* ***re-architected*** *the Android OS framework (in a project known as Treble) to make it easier, faster, and less costly for manufacturers* ***to update devices*** *to a new version of Android. © Google*



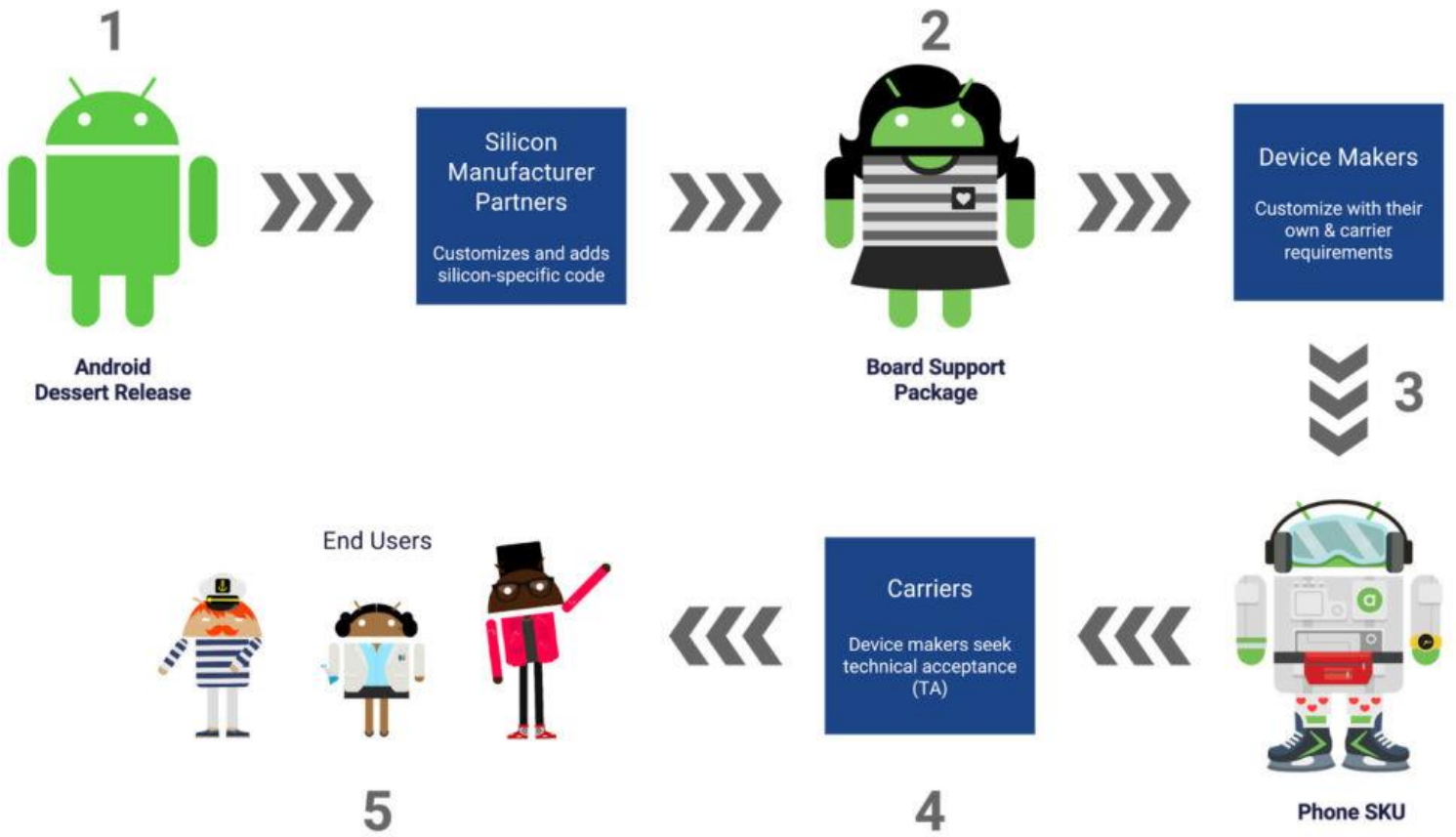
AOSP Architecture

- Android System Services and everything above is “Android Framework”. It’s basically provided by Google.
- HALs and Kernel are provided by SoC and Hardware vendors.



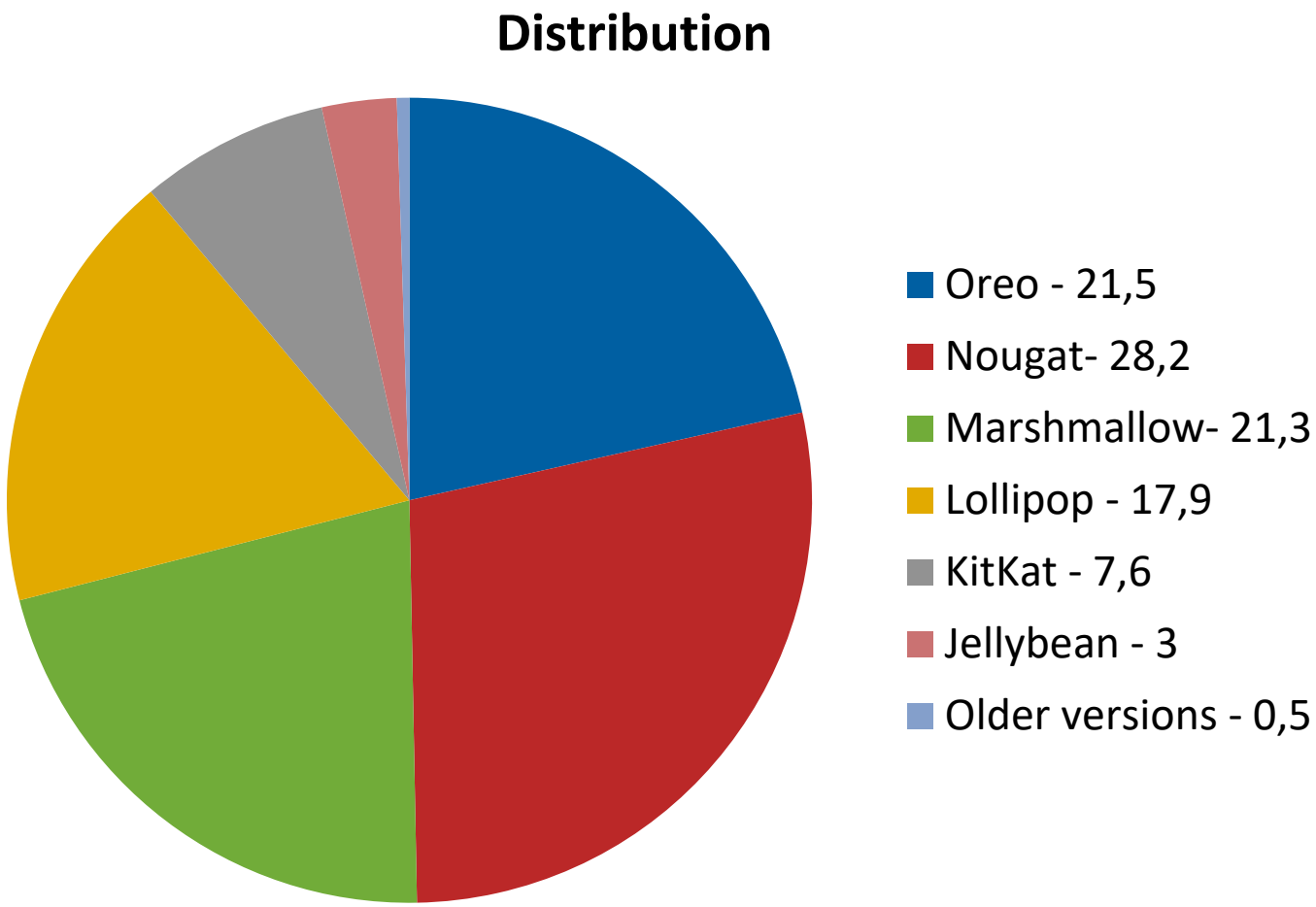
Why Google needed Treble?

- Step 1 to Step 5 used to take 6-12 months *(That if device manufacturers bothered with updates at all)*



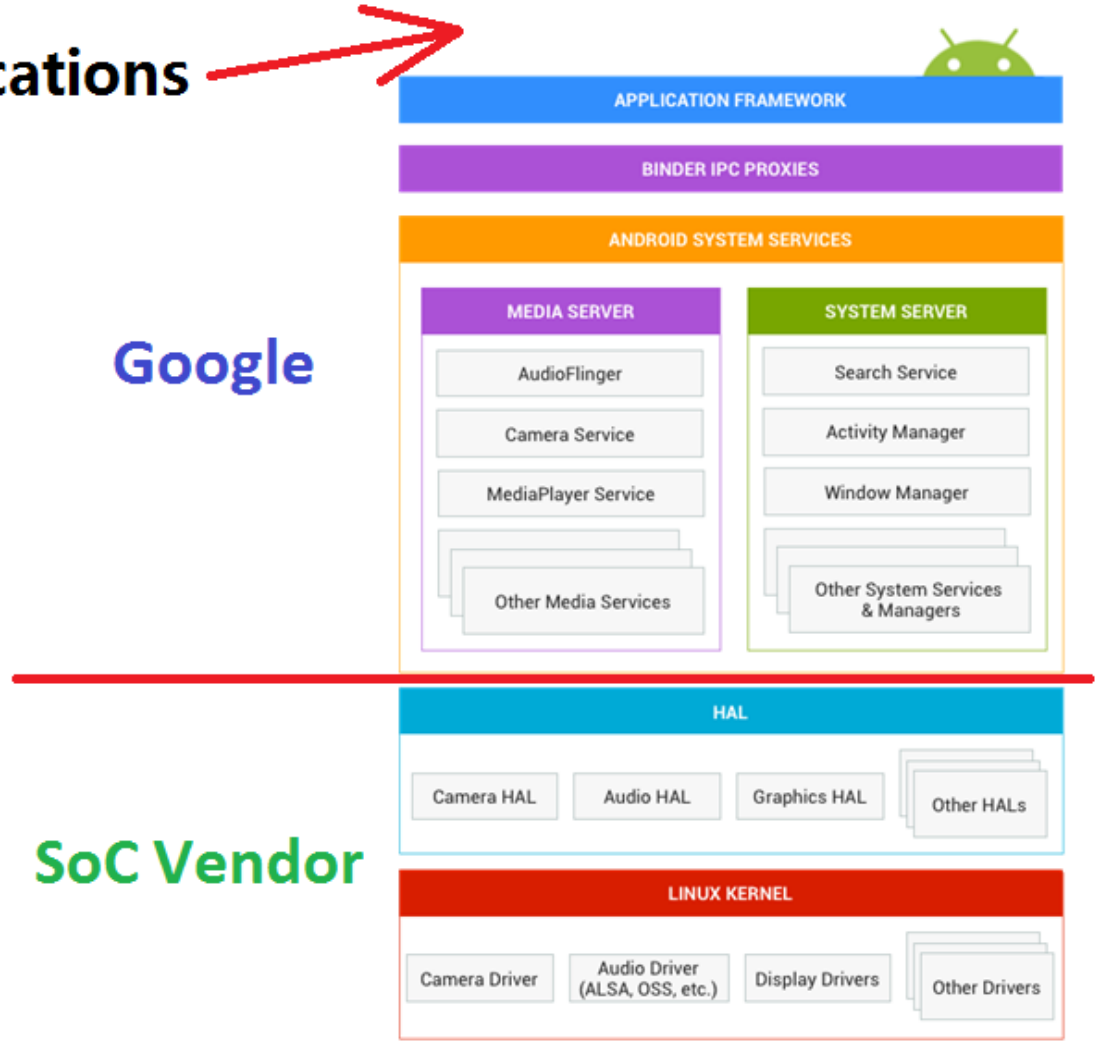
Pie chart without Pie

- As of October 26, 2018 only 21,5% of Android devices were running Oreo
- As of October 11, iOS 12 is running on 53% active devices
- Less than 0.1% of active devices run Android Pie



Why upgrade took so much time?

- Google realized that application developers will need fixed APIs



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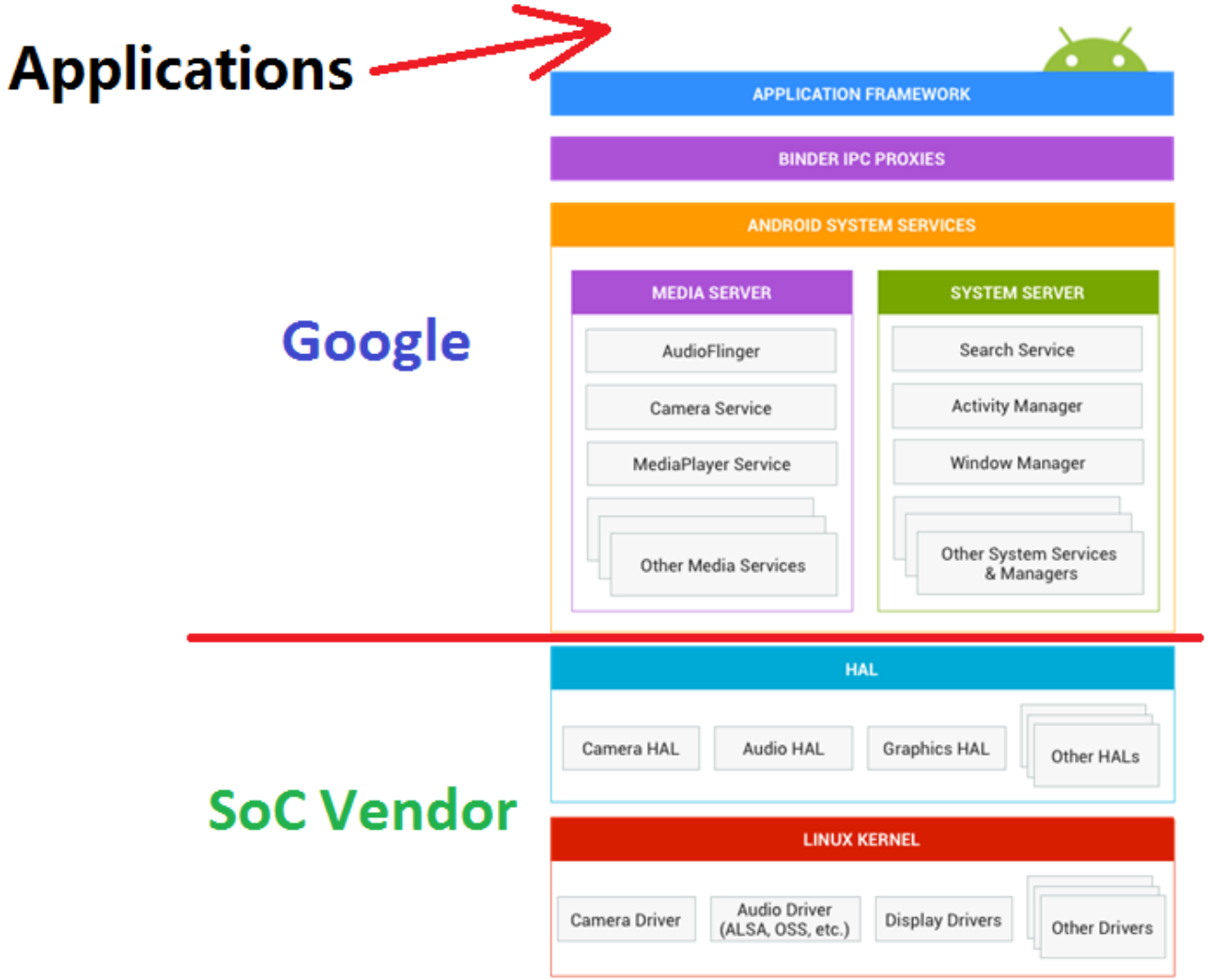

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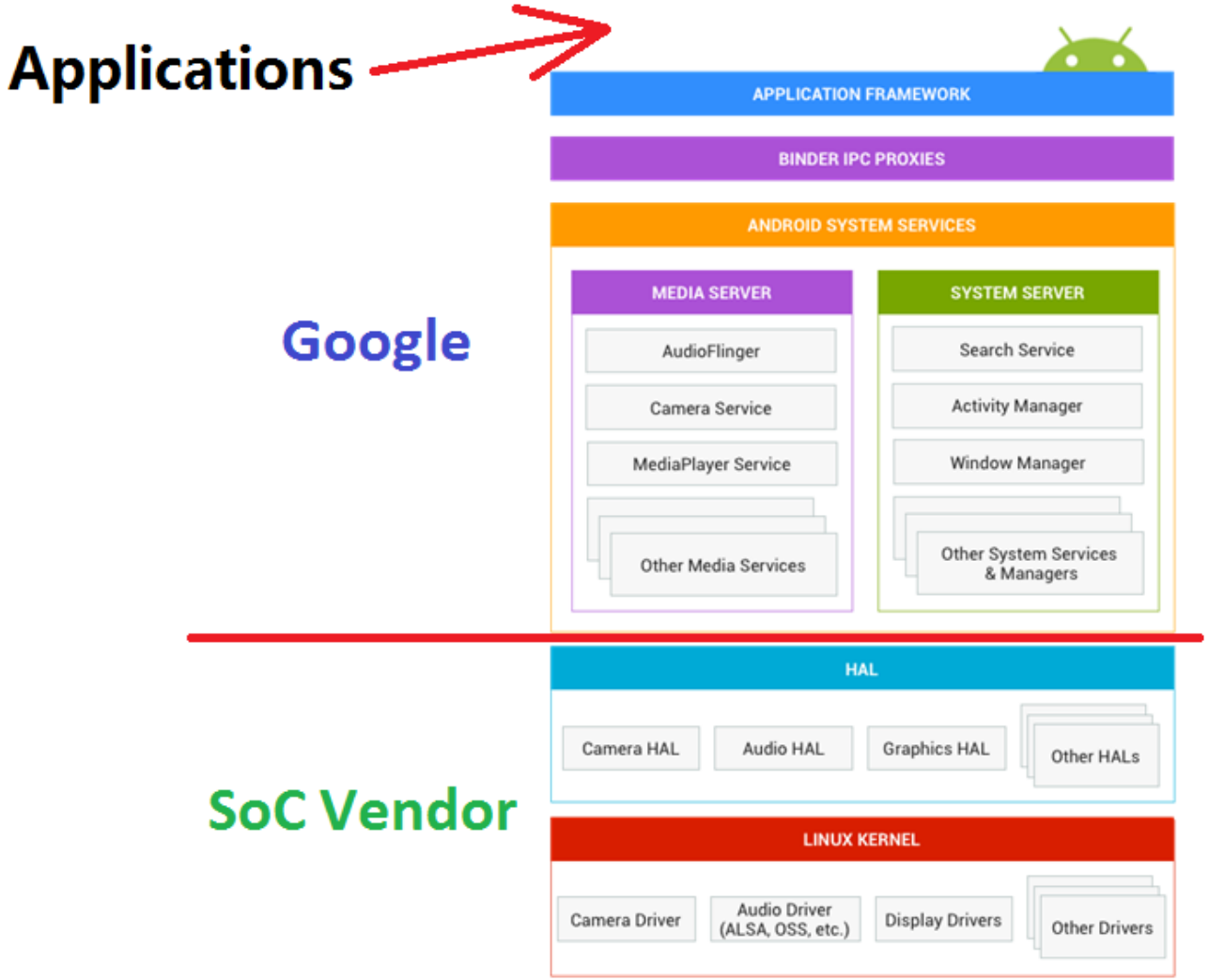
- This red line on the right didn't actually exist before Treble



Treble components

- New HAL types
- Hardware Interface Definition Language (HIDL)
- New Partitions
- ConfigStore HAL
- Device Tree Overlays
- Vendor NDK
- Vendor Interface Object
- Vendor Test Suite (VTS)

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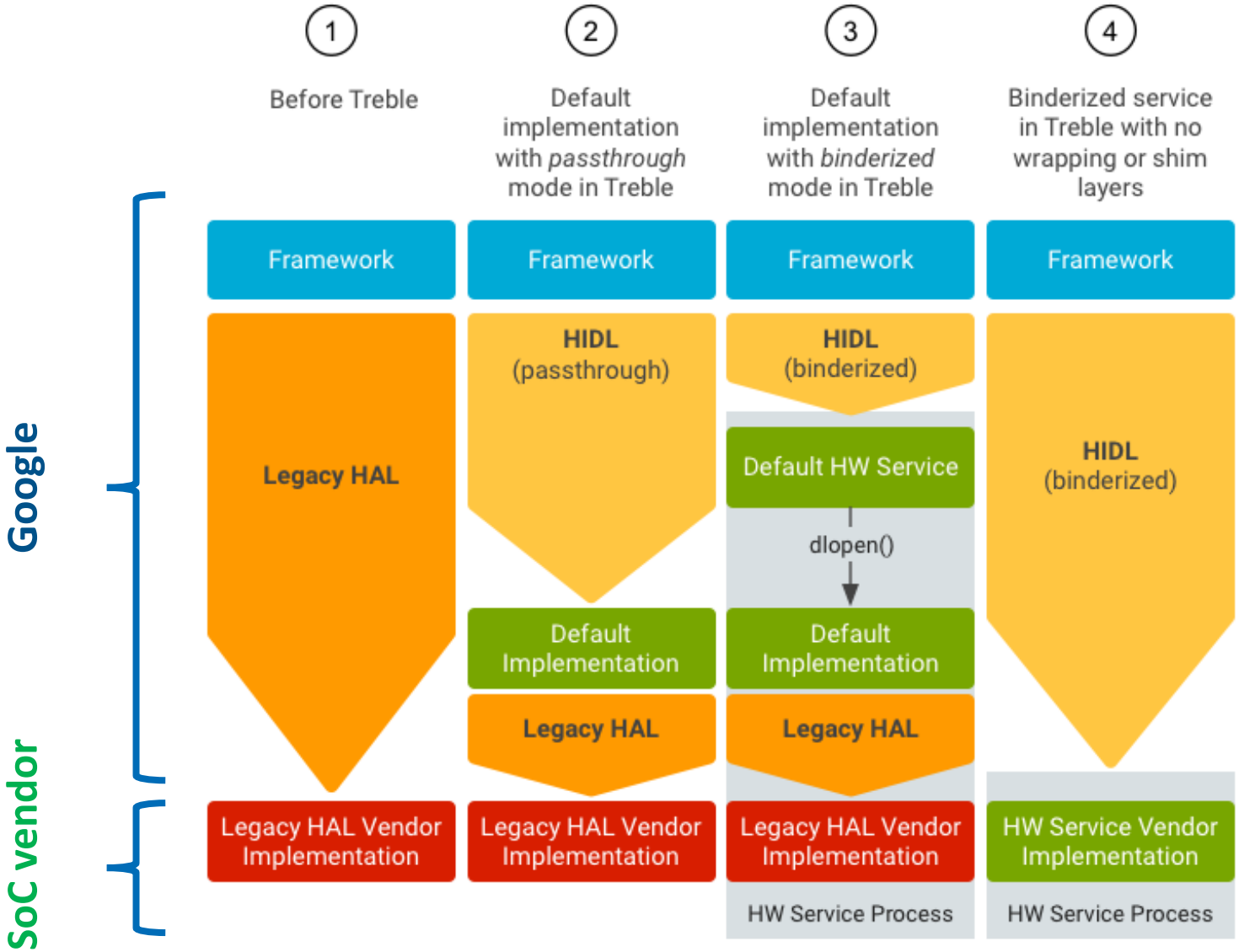
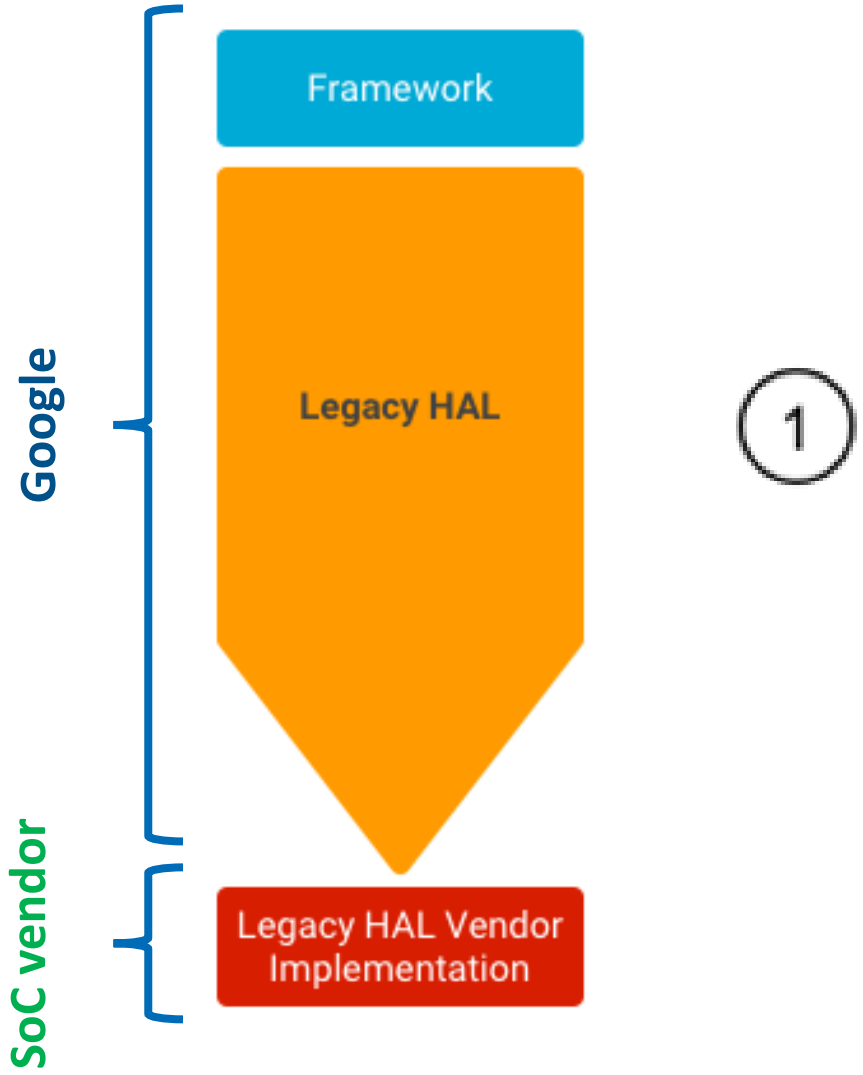
Four steps of HALs



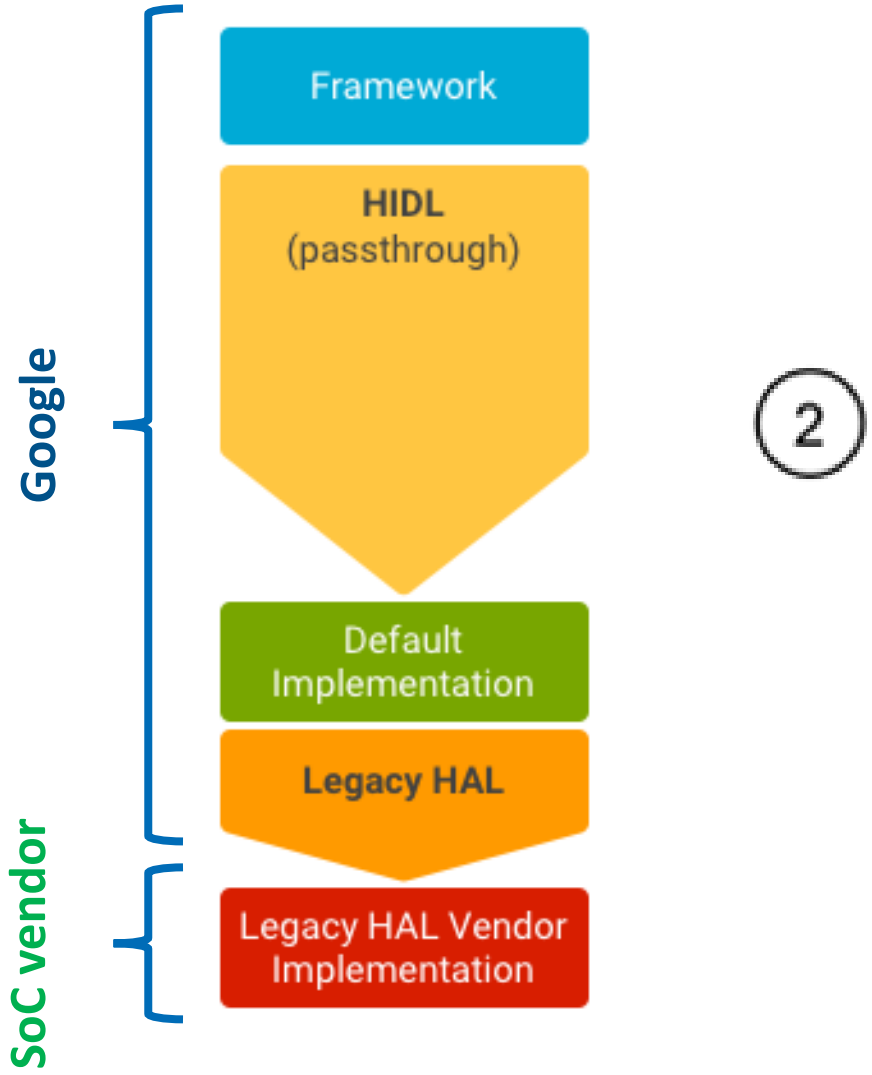
HALs before Treble

- Before Treble HAL interfaces were defined as a bunch of C header files in *hardware/libhardware* folder. Each new version of Android meant new interface that HAL needed to support.



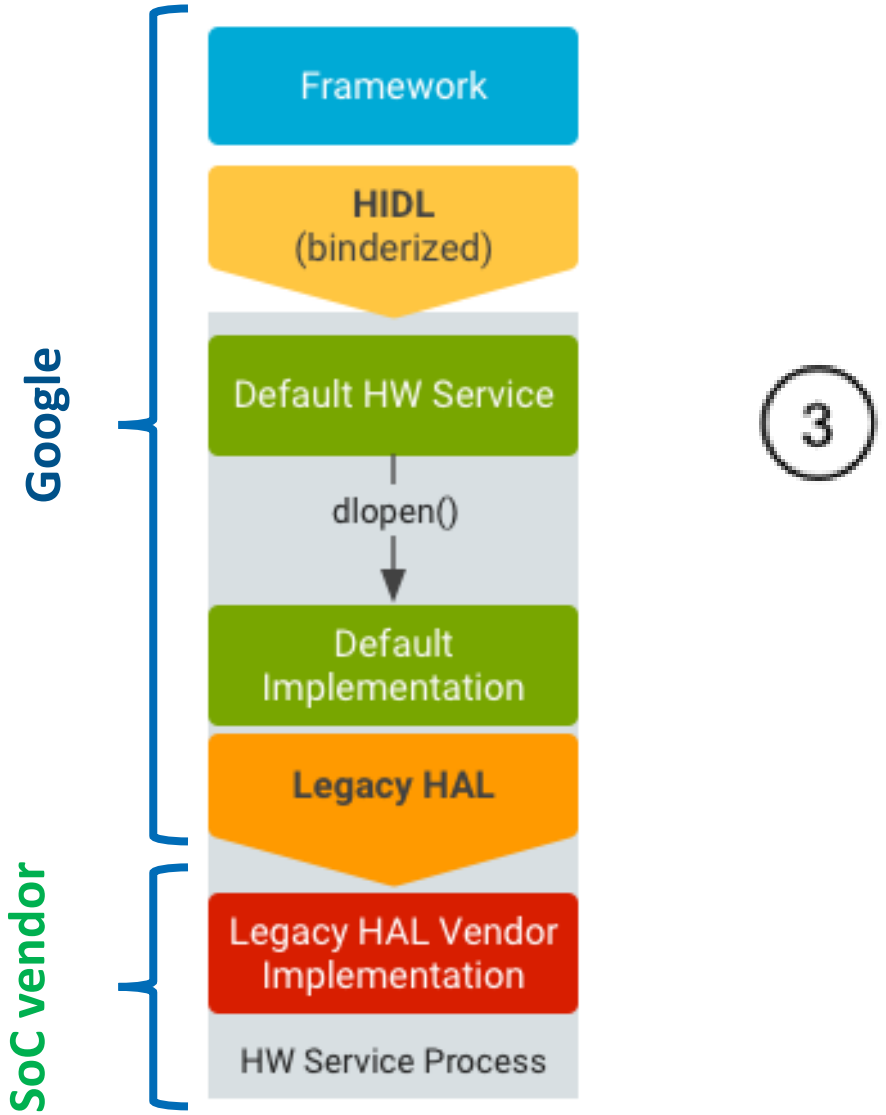
Pass-through HALs

- Pass-through HALs have HIDL interface, but you call them directly from your process, not through Binder



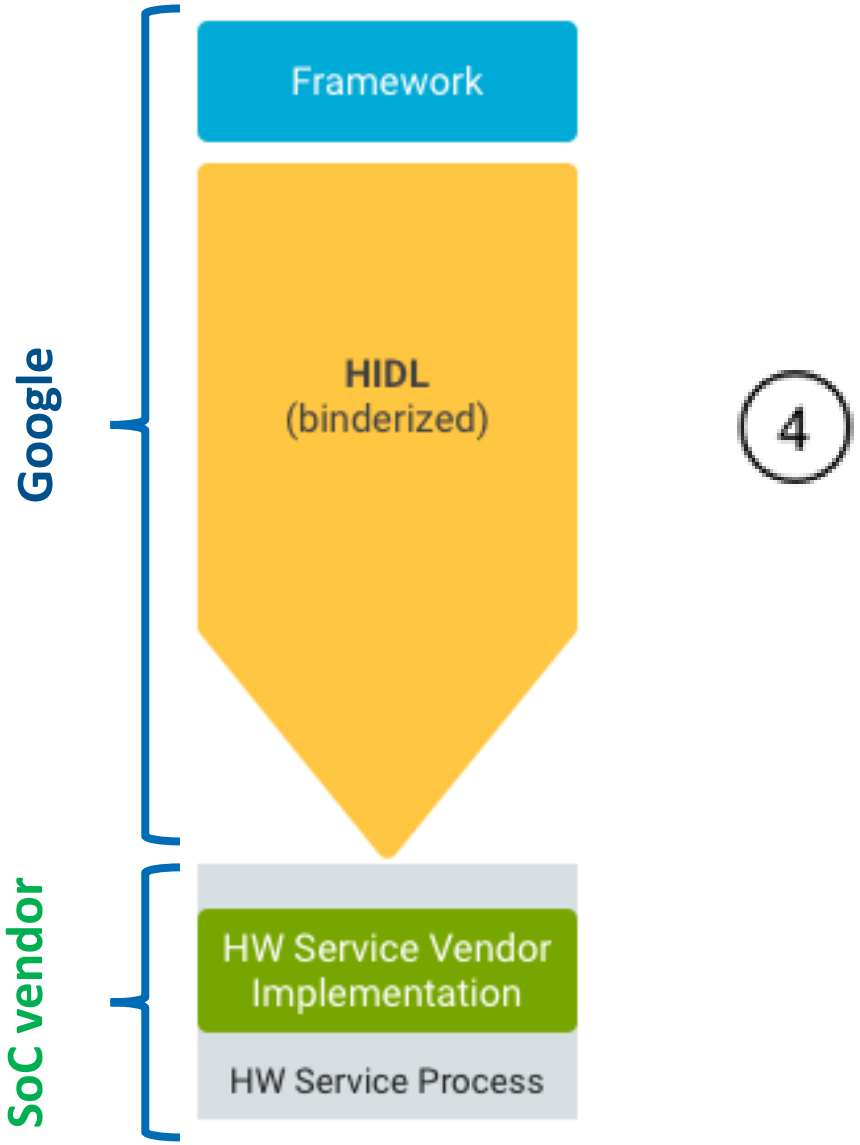
Binderized HALs

- Binderized HALs run in their own process and accessible only thru Binder IPC calls
- Google already created a wrapper for Legacy HALs



Your own HALs

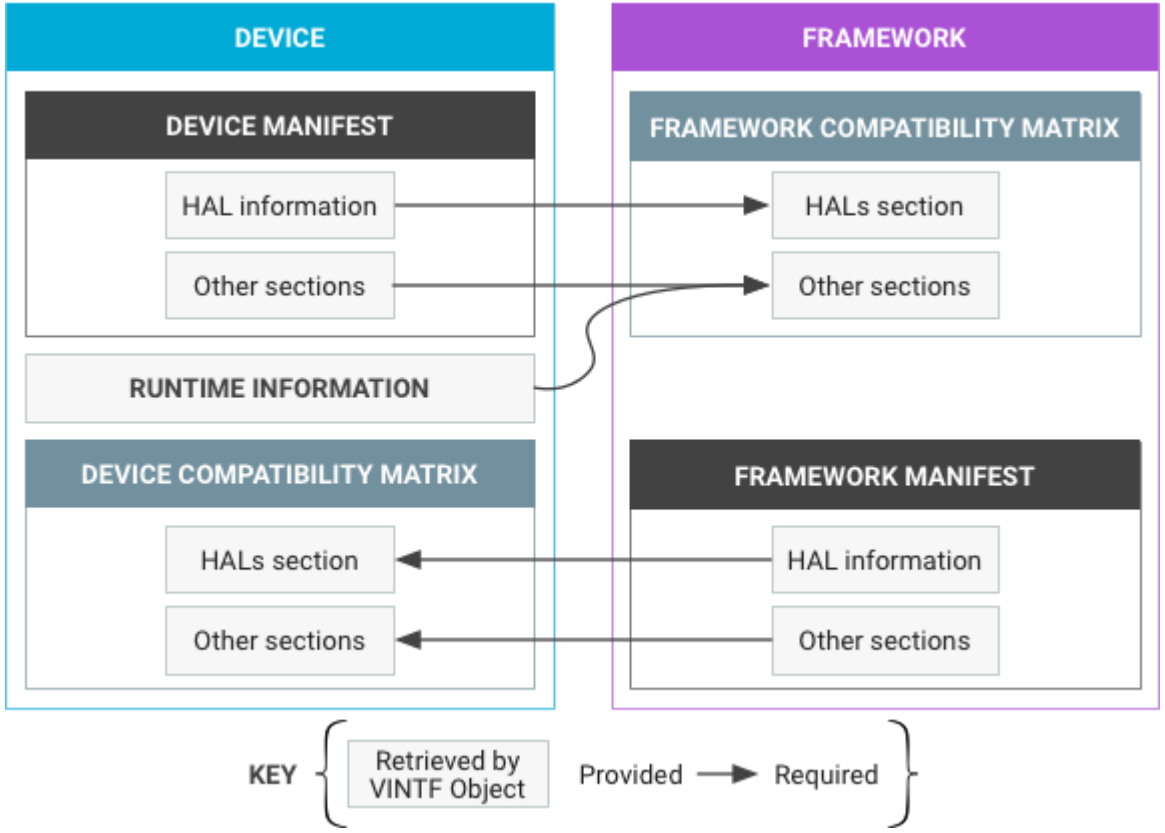
- Binderized HALs as they are meant to be…
- You are free to use either C++ or Java
- We didn't bother with them though…



Vendor Interface Object

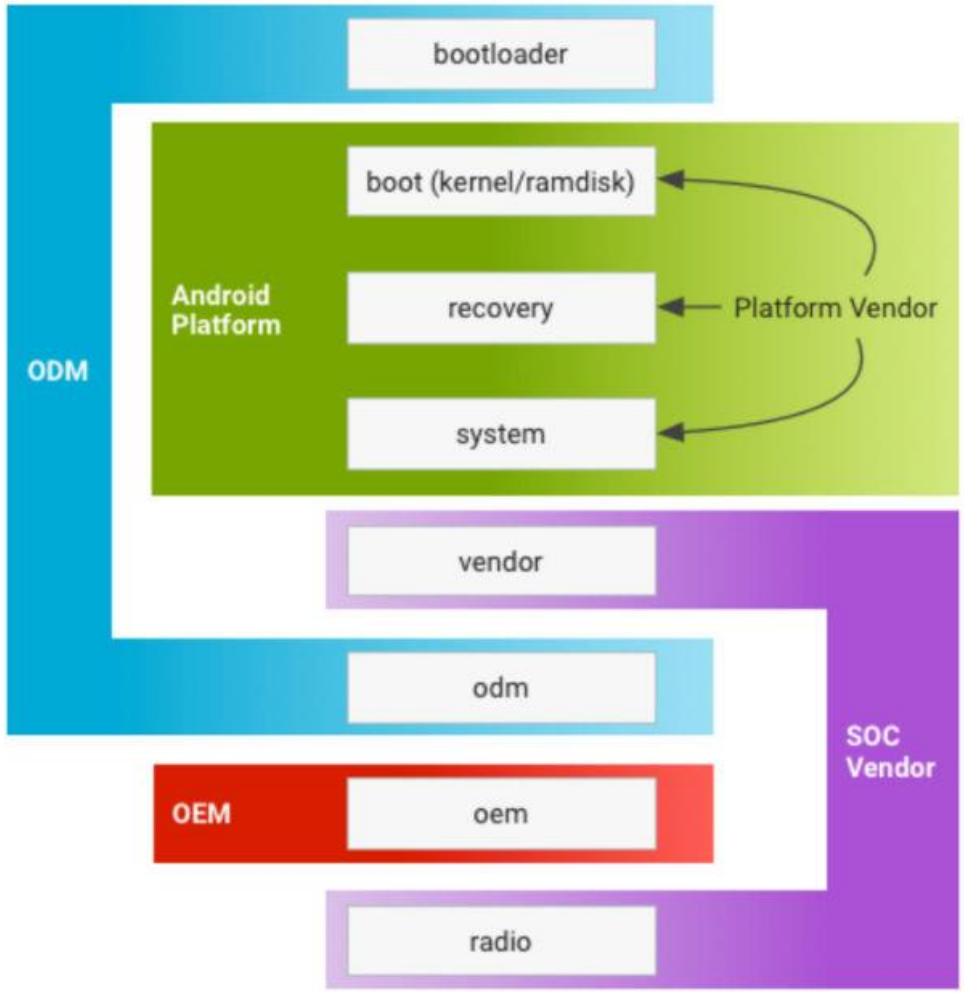
- 4 things need to match for upgrade to be successful:
  - HALs (versions and interfaces)
  - Kernel (version and configs)
  - SE Policy (Security Policy versions)
  - AVB (Android Verified Boot)

    library version



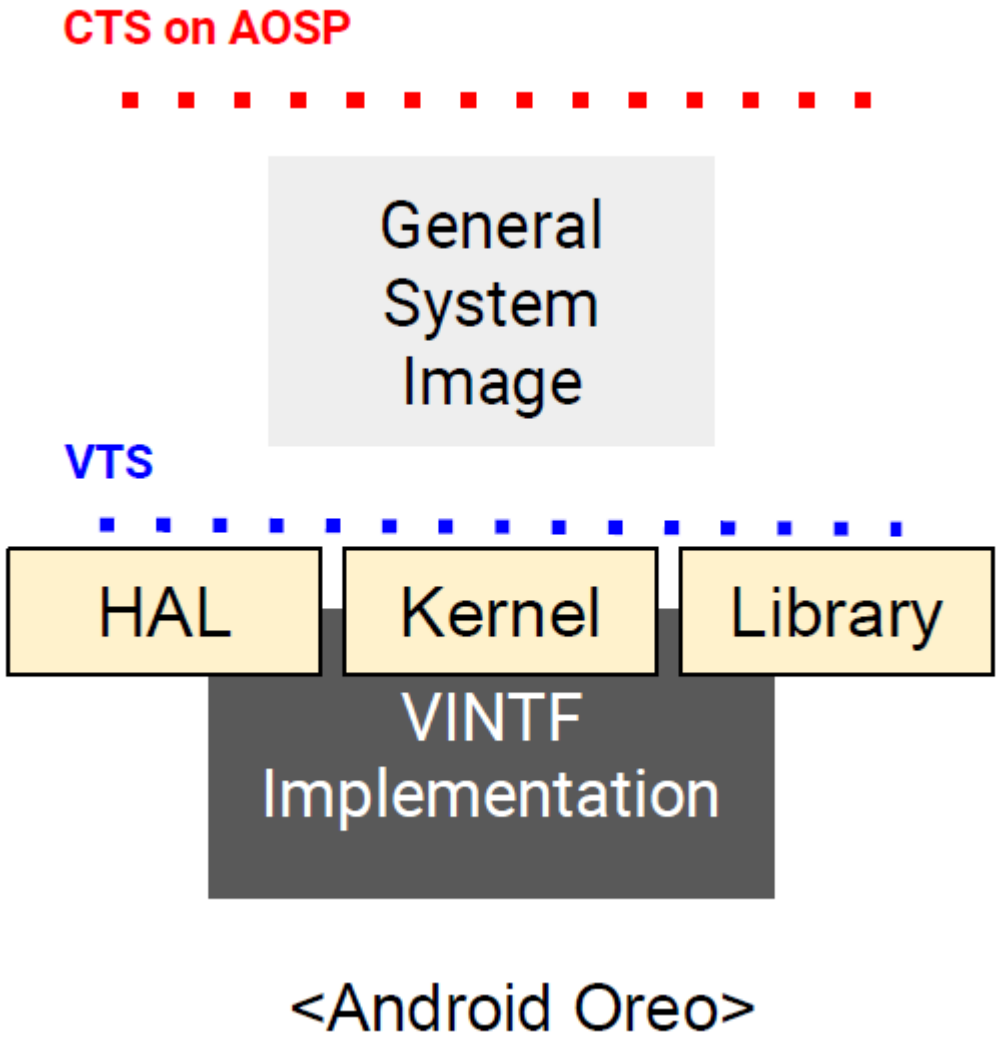
New partitions

- Now everybody needs to support the “Golden Image”. This is a reference */system* image that you can put on your device and it **must** run.



Vendor Test Suite

- VTS is essentially the same thing as CTS, but few layers deeper into the system



Before and After

Before Treble:

- HALs were libraries with C-header API
- HALs were included in OTA package
- HALs were mixed with System Services in */system*
- Only application API is tested on certification

After Treble:

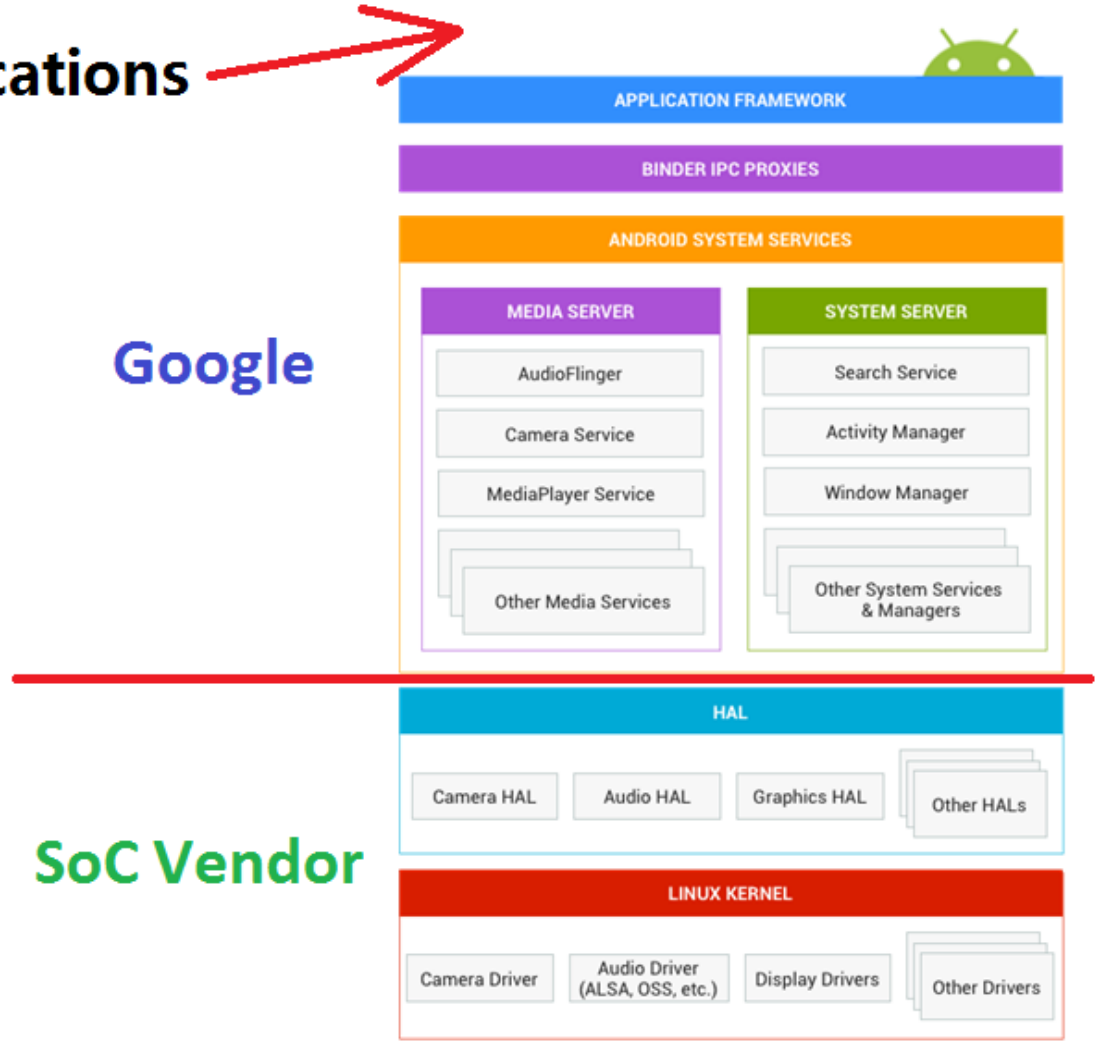
- HALs are services with HIDL API
- HAL versions are checked in OTA
- HALs have their own */vendor* partition
- Vendor interface is also tested on certification

Problems with Treble?

- Updating BSP to support Treble is a huge effort for SoC vendor
- You'll always need pass-through HALs
- Big change means many bugs
- Uniformity could bring sameness

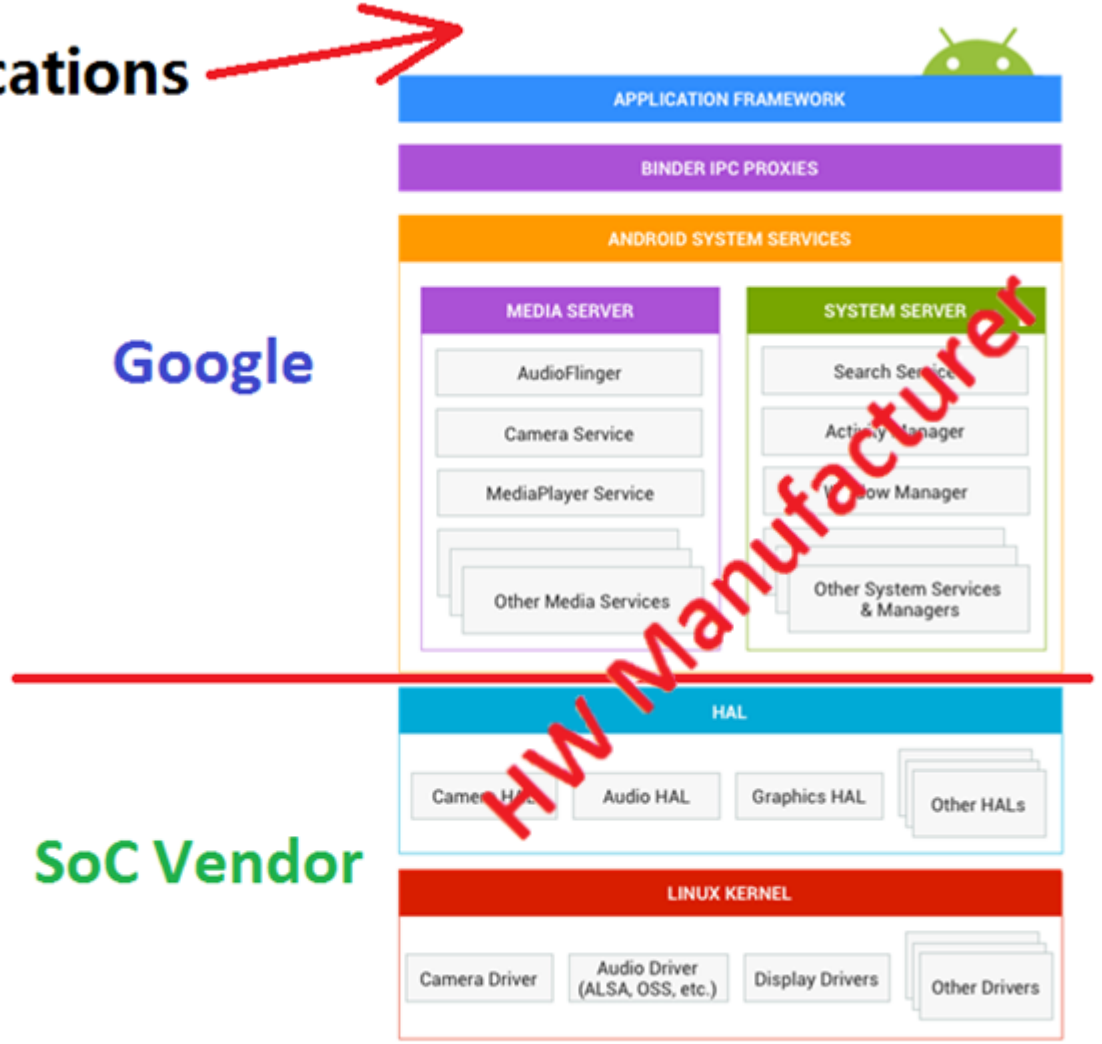
Why upgrade is still difficult?

- SoC vendors does not have to do much for upgrade now…



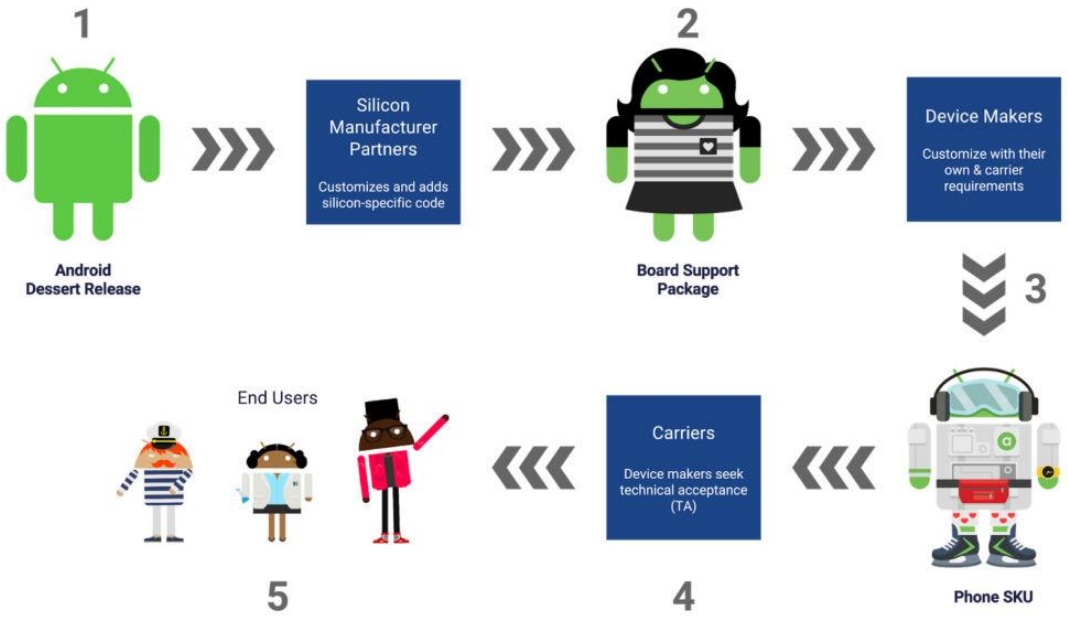
Why upgrade is still difficult?

- SoC vendors does not have to do much for upgrade now…
- But device manufacturer still has a lot to do for upgrade

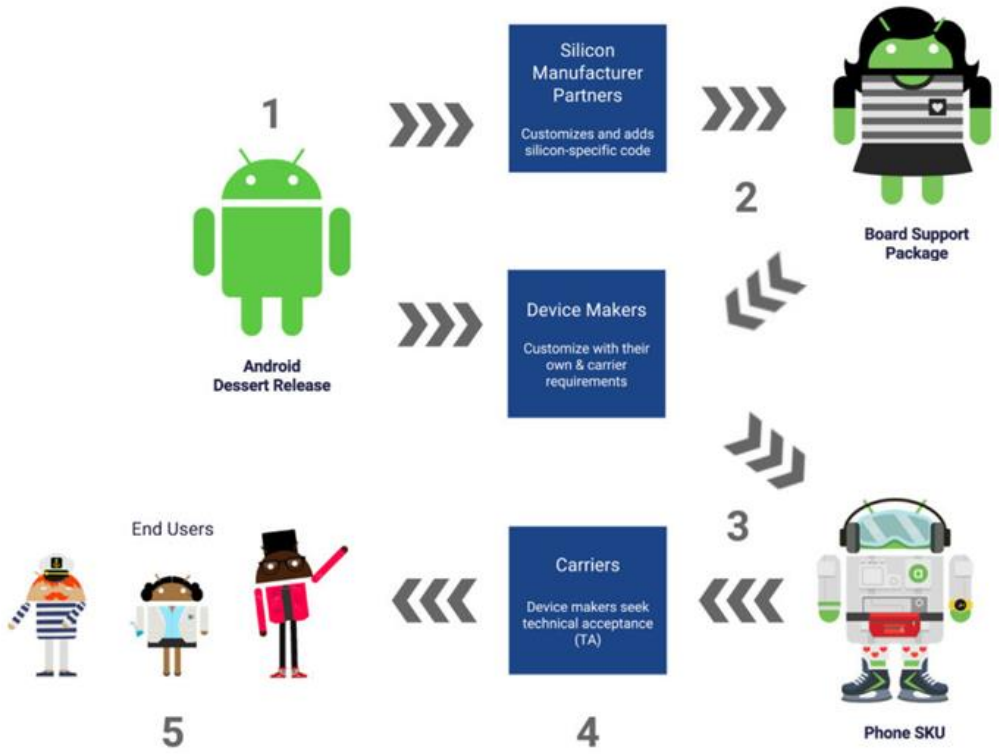


Result

Before Treble



After Treble



What's new in Android P for Treble?

- Most of the Treble was done in Oreo. Android 9 has only a few final touches to add.

- Today there are 18 devices supporting Android P:
  - ✓ 3 Pixels
  - ✓ 4 Android One devices
  - ✓ 11 phones from 5 vendors

- Mandatory target API level for app developers. API level 26 (Android 8.0) is mandatory for all new apps now.

Summary

- Project Treble is a fix for an old architectural mistake in Android
- Google has to pay for this mistake
- We also paid for this mistake…
- Despite all Project Treble was successful, probably…

Q&A

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