# Android Oreo

**Overview for Sitara and Jacinto Devices**

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**TEXAS INSTRUMENTS**

# Overview

# What is new in Oreo?

- First public version to include Android for Automotive:
  - Introduction of Vehicle HAL
  - Boot performance improvement
  - Introduction of Google Automotive Services

- Major architecture change with introduction to Treble:
  - Modular design for easier, faster, and less costly for OEM to update devices
  - Emphasis and alignment with Long-Term Stable (LTS) Kernel model with 6-year support.
  - Minimum 4.4 LTS for new devices.
  - Introduction of VTS (Vendor Test Suite):
    - Compliance test suite for SoC and OEMs for Android system qualification
    - In addition to CTS (Compatibility Test Suite) compliance for OS and frameworks.
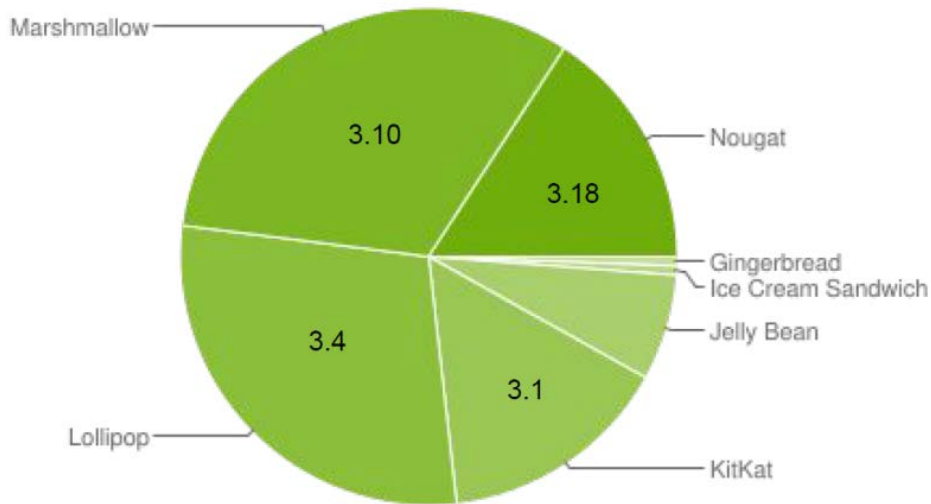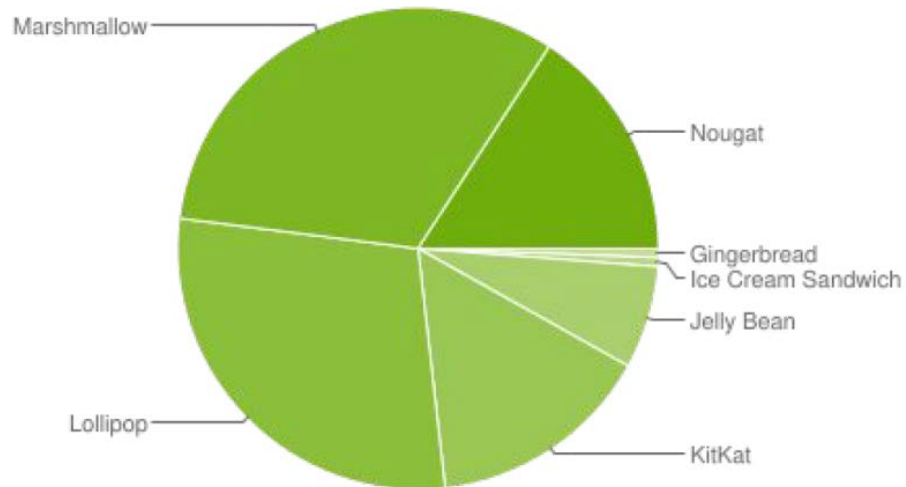
# Project Treble

# What is Project Treble?

Problem: Android fragmentation and adoptability problem

Kernel

Userspace

# What is Project Treble?

Solution: Modular design to reduce Android fragmentation

- Faster kernel adoption

- Better kernel security

- Easier device upgrades and longer product cycle

- Better software quality and testability

| | | | | |
|---|---|---|---|---|
| Reduce fragmentation | Google | | | |
| Bring new devices to market faster | Google | SoC | ODM | OEM |
| Easier device upgrades | Google | | | OEM |
| Quality | Google | SoC | ODM | OEM |
| Testability | Google | SoC | ODM | OEM |
| Extensibility, customizability | | SoC | ODM | OEM |
| Close AOSP ↔ Turn-key feature gap | Google | SoC | | |

# Linaro support for Google-Android Project Treble

## Project Goals

- Extending internally to all supported TI Sitara and Jacinto devices (AM572x is the chosen 32b ARM platform for this effort)

- Make migrations to latest LTS kernel and Android Pastry easier and faster

- Provide test coverage for Linux upstream, Android-common and improve test validation for key ARM platforms

- Extend Project Treble features

### eLTS

- Testing of Linux repositories maintained by GKH to extend maintenance cycle from 2 to 6 years

### Android Common

- Google owned and maintained LTS kernel. Qualified by Linaro. Reduces time to market for Android LTS.
- Android-Common is tested by Google/Linaro on QEMU, HiKey and x86.. Google/Linaro support issue triaging.
- Linaro/SoC Vendor triages the issues that are seen on the other reference platforms
- Platforms supported by Linaro: TI X15, hikey, ARM Juno, Dragonboard 410c, x86

### Treble Reference Implementation

- New features for Treble developed under this project.
- Currently, two features that are in work: OPTEE and Gatekeeper HAL, AVB (Android Verified Boot) 2.0.
- TI X15 supported platform for this activity

### LKFT and LLCT

- Test improvement for GKH branches plus the Android_common and platform variants for that
- Upstream Android feature set to mainline Linux
- https://lkft.linaro.org/

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- **Bootloader**
  - **Device tree overlays:**
    - Recommendation to use DT, DTO with separation of base board definition for minimum boot in DT and everything else in overlay.
    - Bootloader must patch the main DT blob with the overlay before passing the combined device tree to the kernel.
    - Vendor board-specific nodes must be added to kernel device tree as overlays.
  - **Verified boot:** Recommendation to do integrity check with AVB2.0 for all Android partitions.

- **Kernel**
  - Must be up-to-date with android-common containing LTS and security patch updates.
  - **Modularization**: Recommendation to use drivers as loadable external modules from read-only vendor partition.
  - **Early Mount**: Must enable first stage mount to make sure init can load SELinux policy fragments that are spread across system and vendor partitions
  - **Interface Requirements**: sysfs, dev, procs https://source.android.com/devices/architecture/kernel/reqs-interfaces
  - **Kernel Hardening** features help mitigate kernel vulnerabilities and find bugs in kernel drivers (Hardened Usercopy, PAN Emulation, KASLR)

- **Android**
  - The goal is to replace the framework without having to rebuild HALs
  - Must HIDL-ize TI Multimedia, Graphics and Display HAL
  - Move SoC vendor-specific configuration, firmware, drivers, and libraries to read-only vendor partition
  - Enable Full_product_treble for supported TI devices.

- **Testability**
  - **Vendor Test Suite (VTS):**
    - Provides extensive new functionality for Android testing and promotes a test-driven development process
    - Mandatory compliance test for all SoC vendors
  - **Tests**
    - VTS-Kernel (Including LTP, Kselftest, Common-kernel) ~900 tests
    - VTS-HIDL/HAL ( ~2400 tests); Testing Each API in each HAL

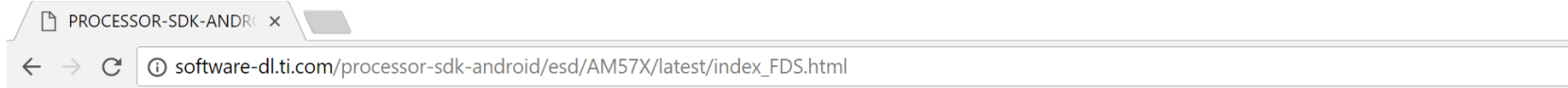# Catalog Processor SDK Android

# Catalog Processor SDK Android (PANDSDK)

- Android SDK releases supporting AM57x family of devices
- Catalog releases began in 2Q17 based on Android Marshmallow* and current release is on Android Oreo.
- Release notes and other documentation available on ti.com:
  http://downloads.ti.com/processor-sdk-android/esd/docs/latest/android/Overview.html
- Quarterly release cadence
- Catalog PANDSDK releases:

| Android Version | Release link | Linux Kernel | U-boot | Release Date |
|---|---|---|---|---|
| Marshmallow* | Proc SDK v4.0 (6AM.1.3) | 4.4.67 | 2016.05 | 2Q17 |
| Marshmallow* | Proc SDK v4.1 (6AM.1.3) | 4.4.88 | 2016.05 | 3Q17 |
| Oreo | Proc SDK v4.2 (6AO.1.0) | 4.4.91 | 2016.05 | 4Q17 |
| Oreo | Proc SDK v4.3 (6AO.1.1) | 4.4.117 | 2016.05 | 1Q18 |

*Considered development releases and should not be used in production. Production projects should target Oreo releases.

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# Catalog PANDSDK: ti.com release page



PROCESSOR-SDK-ANDROID ×

software-dl.ti.com/processor-sdk-android/esd/AM57X/latest/index_FDS.html

## PROCESSOR-SDK-ANDROID-AM57X Product downloads

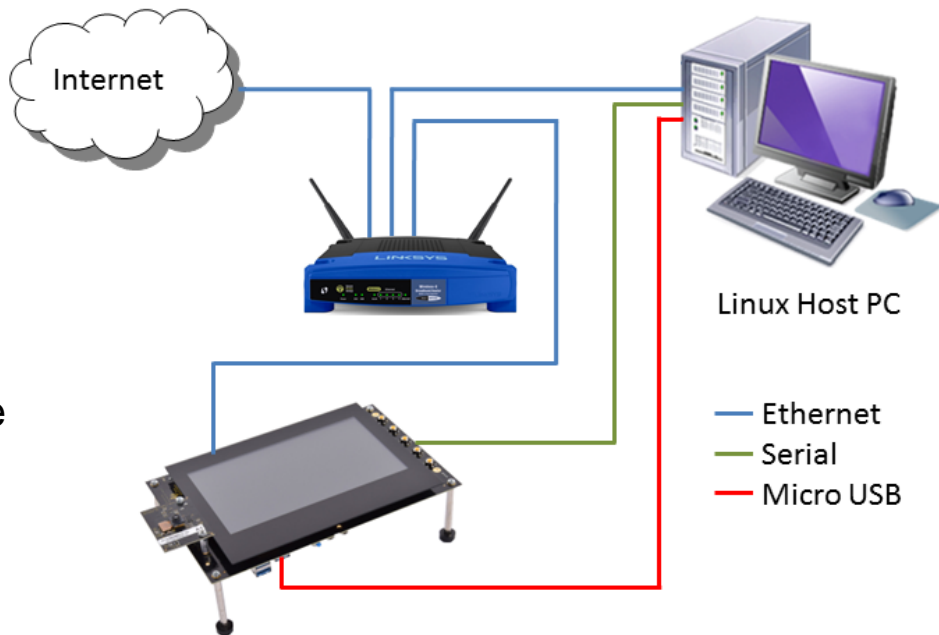| Title | Description | Size |
|---|---|---|
| AM57xx Android SDK Essentials | | |
| ti-processor-sdk-android-am57xx-evm-04.03.00.05-Linux-x86-Install.bin | AM57xx EVM Android SDK (64-bit Binary) | 1662056K |
| AM57xx Android SDK Optional Addons | | |
| Download Pinmuxtool | AM57xx Pin Mux Configuration Utility | |
| AM57xx Android SDK SD Card Creation | | |
| Android SD Card Creation Guide | Instructions for creating an SD Card with Android | |
| AM57xx Android SDK Documentation | | |
| Processor SDK Android Release Notes | Link to Release Notes for Processor SDK Android | |
| AM572x EVM Quick Start Guide | Quick Start Guide that was included in the EVM kit | |
| AM571x IDK Quick Start Guide | Quick Start Guide that was included in the EVM kit | |
| Processor SDK Android Getting Started Guide | Getting Started Guide | |
| Processor SDK Android Developer Guide | Link to the online Software Developers Guide which has the latest content | |

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# Catalog PANDSDK release components

- **android-devkit** has the cross-compile toolchain and libraries

- **bin** contains helper scripts/utilities for flashing and connecting to the EVM

- **board-support:**
  - **aosp** contains a snapshot manifest file and the 'repo' tool used to download the Android sources
  - **linux** is a git repository containing Linux kernel sources
  - **prebuilt-images** contains out-of-box experience images
  - **u-boot** is a git repository containing the U-boot sources

- **docs** includes licenses and manifest files

- **Makefile** provides build targets for many of the SDK components from the top-level of the SDK

- **setup.sh** is the script used to flash the EVM with prebuilt-images

```
├── android-devkit
│   └── arm-linux-androideabi-4.9.x
├── bin
│   ├── aapt
│   ├── adb
│   ├── create-sdcard.sh
│   ├── extract-rootfs.sh
│   ├── fastboot
│   ├── fastboot.sh
│   ├── lib
│   ├── lib64
│   ├── make_ext4fs
│   ├── mkbootimg
│   ├── setup-minicom.sh
│   ├── setup-uboot-env.sh
│   └── simg2img
├── board-support
│   ├── aosp-6AO.1.1
│   ├── linux-4.4.117+gitAUTOINC+eb496200ef-geb496200ef
│   ├── prebuilt-images
│   └── u-boot-2016.05+gitAUTOINC+5ddd5a8a25-g5ddd5a8a25
├── docs
│   ├── aosp-6AO.1.1_manifest.xml
│   ├── licenses
│   ├── NOTICE.html
│   ├── Processor-SDK_Android_AM57X_Manifest.doc
│   ├── Processor-SDK_Android_AM57X_Manifest.html
│   ├── software_manifest.htm
│   └── software_manifest.txt
├── filesystem
├── Makefile
├── processor-sdk-android-gsg-04.03.00.05.pdf
├── Rules.make
└── setup.sh
```

# Catalog PANDSDK: Getting started

- Step 1: Configure a Linux host machine

- Step 2: Install Processor SDK Android

- Step 3: Create an SD Card containing the U-boot bootloader

- Step 4: Set up your development environment (example shown to the right)

- Step 5: Run the setup.sh script to flash the pre-built bootloader, Linux kernel, and Android filesystem to your EVM.

- Step 6: Remove the SD card and reboot

Full instructions available here:
http://software-dl.ti.com/processor-sdk-android/esd/docs/latest/android/Overview.html#processor-sdk-android-getting-started-guide

Internet

Linux Host PC

— Ethernet
— Serial
— Micro USB

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# Catalog PANDSDK development

- Step 1: Install pre-requisite packages on your host machine.

- Step 2: Use the 'repo sync' command to pull the Android file system sources to your development machine (~70GB).
NOTE: The Linux kernel and U-boot source is provided in the SDK

```
cd ~/ti-processor-sdk-android-am57xx-evm-04.00.00.xx/board-support/aosp-6AM.1.3/
./repo sync
```

- Step 3: Export environment variables

```
cd ~/ti-processor-sdk-android-am57xx-evm-04.00.00.xx/
make u-boot
```

- Step 4: Use the PANDSDK top-level Makefile to build U-boot, the Linux kernel and the device tree binaries.

```
cd ~/ti-processor-sdk-android-am57xx-evm-04.00.00.xx/
make linux
make linux-dtbs
```

- Step 5: Navigate to the Android sources pulled in Step 2 and export the Linux kernel directory location.

- Step 6: Gather the newly built images and flash them to the EVM using a provided script.

```
cd ~/ti-processor-sdk-android-am57xx-evm-04.00.00.xx/board-support/aosp-.../
export KERNELDIR=~/ti-processor-sdk-android-am57xx-evm-04.00.00.xx/board-support/linux-.../
. build/envsetup.sh
lunch full_am57xevm-userdebug
make -j8 clean
make -j8
```

Full instructions available here:
http://software-dl.ti.com/processor-sdk-android/esd/docs/latest/android/Overview.html#processor-sdk-android-building-the-sdk

# Catalog PANDSDK: Boards supported

AM572x General Purpose EVM
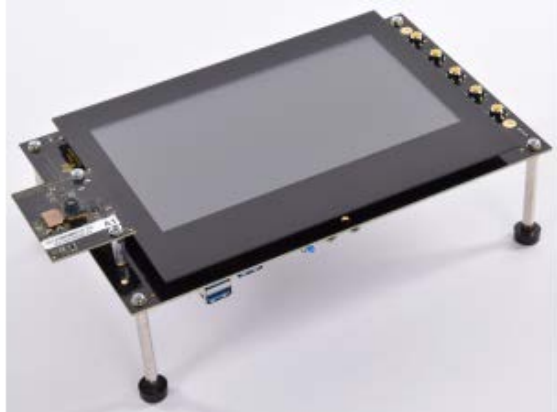


- AM571x Industrial Development Kit + LCD:
  Used to evaluate single-core A15 performance
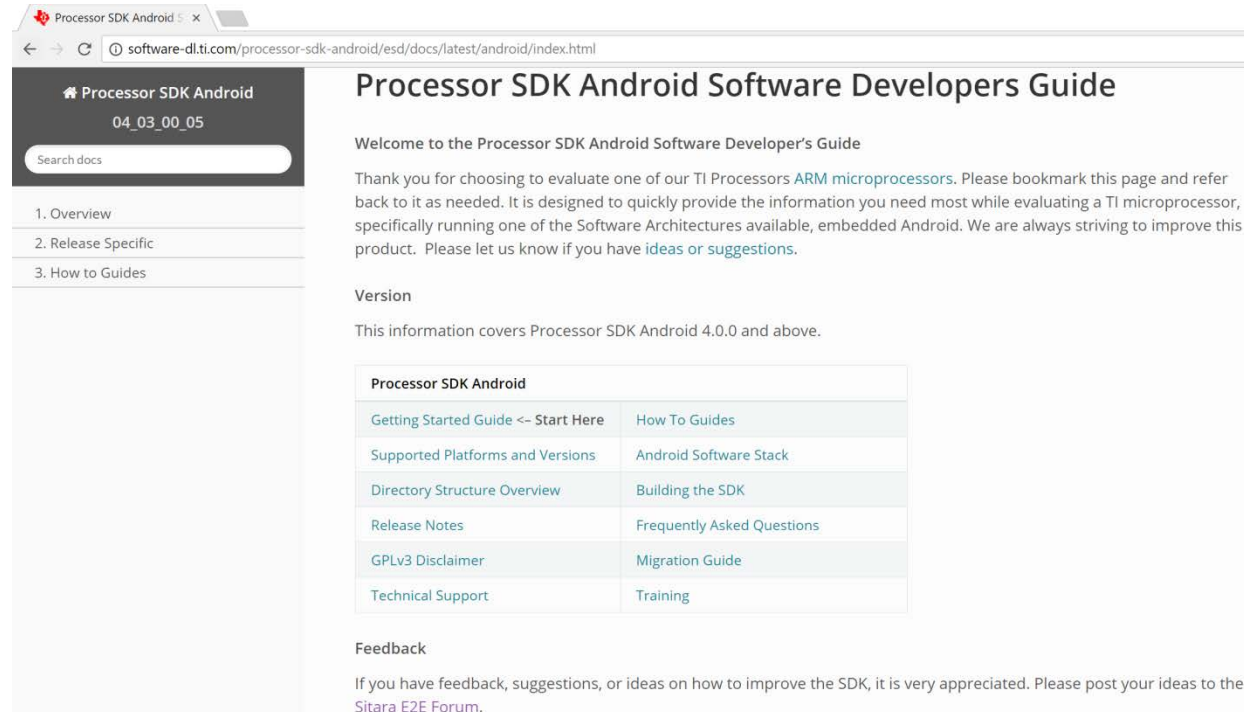  (AM570x)

- AM572x Industrial Development Kit + LCD



More info:

http://software-dl.ti.com/processor-sdk-android/esd/docs/04_03_00_05/android/Release_Specific.html#supported-platforms-and-versions

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# Catalog PANDSDK support resources

- Software Developer's Guide landing page:
  http://software-dl.ti.com/processor-sdk-android/esd/docs/latest/android/Overview.html



- Sitara E2E Forums: http://e2e.ti.com/support/arm/sitara_arm/f/791