Prepare

1. Prepare a usb-serial cable, a 5V/3A adaptor type-c power supply. The serial cable is used for console debug and type-c cable is used for android image download and ADB debug.
2. Prepare a SDcard at least 8GB for linux development, android only support emmc boot.
3. The SOC rom first boot media is emmc, so board can't bootup from SDcard if the emmc is bootable with any image flashed, more info please refer to board boot sequence.
4. Only A311D variant board have camera, mipi panel and npu support.

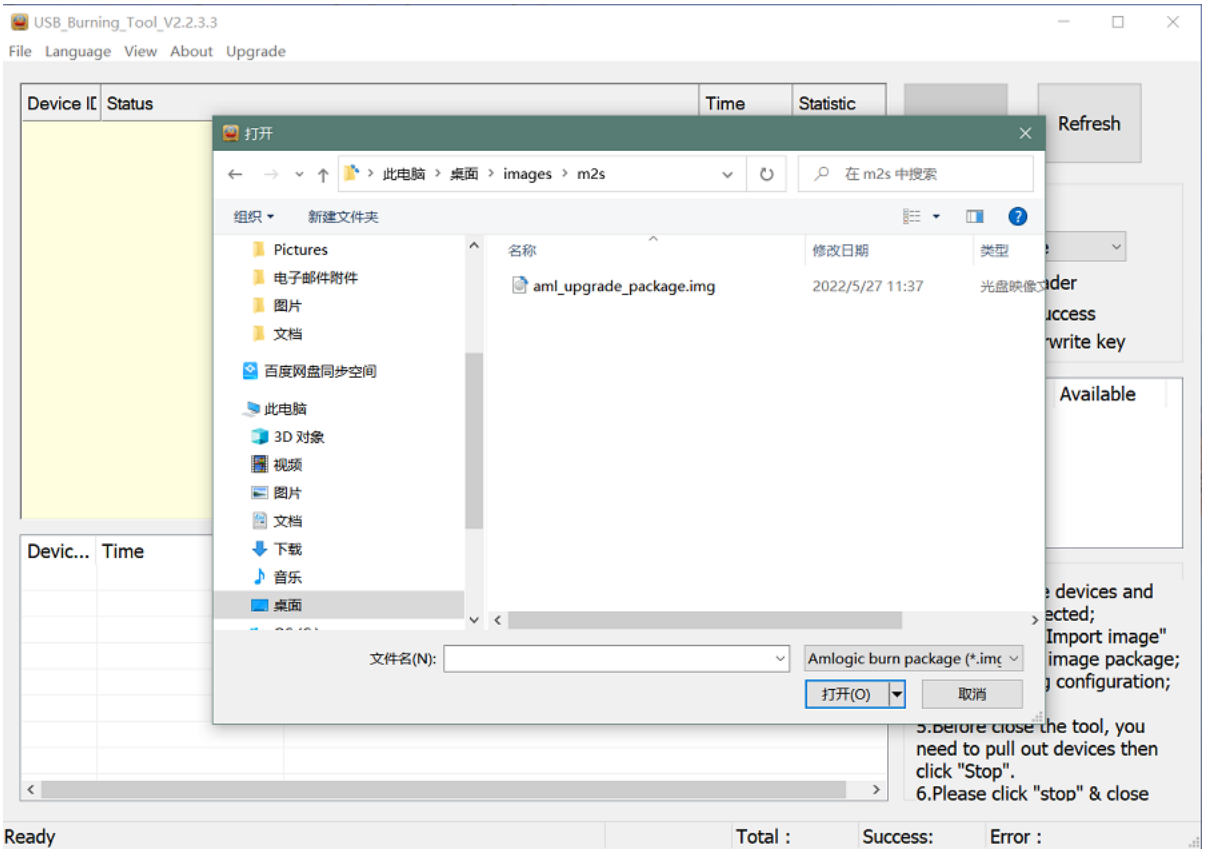
Android

Prepare

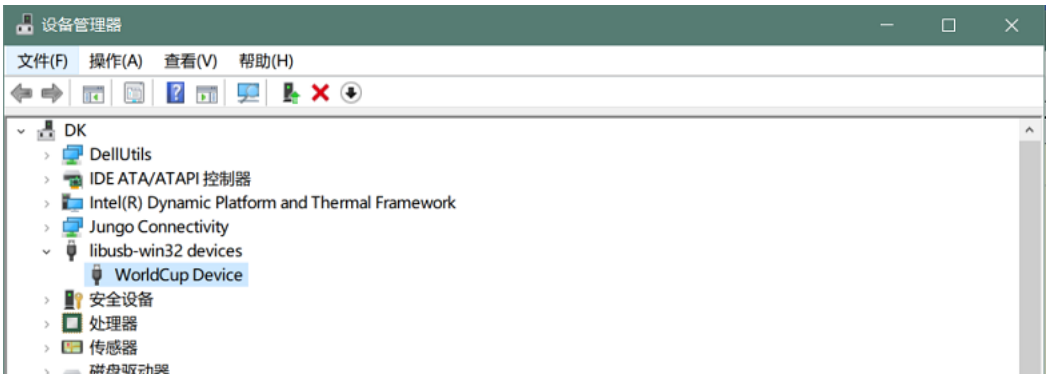
1. Download and install the AML Usb Burning Tool for android image download via type-c, only support windows.
2. Download the latest android image, and confirm that the md5 checksum is correct.

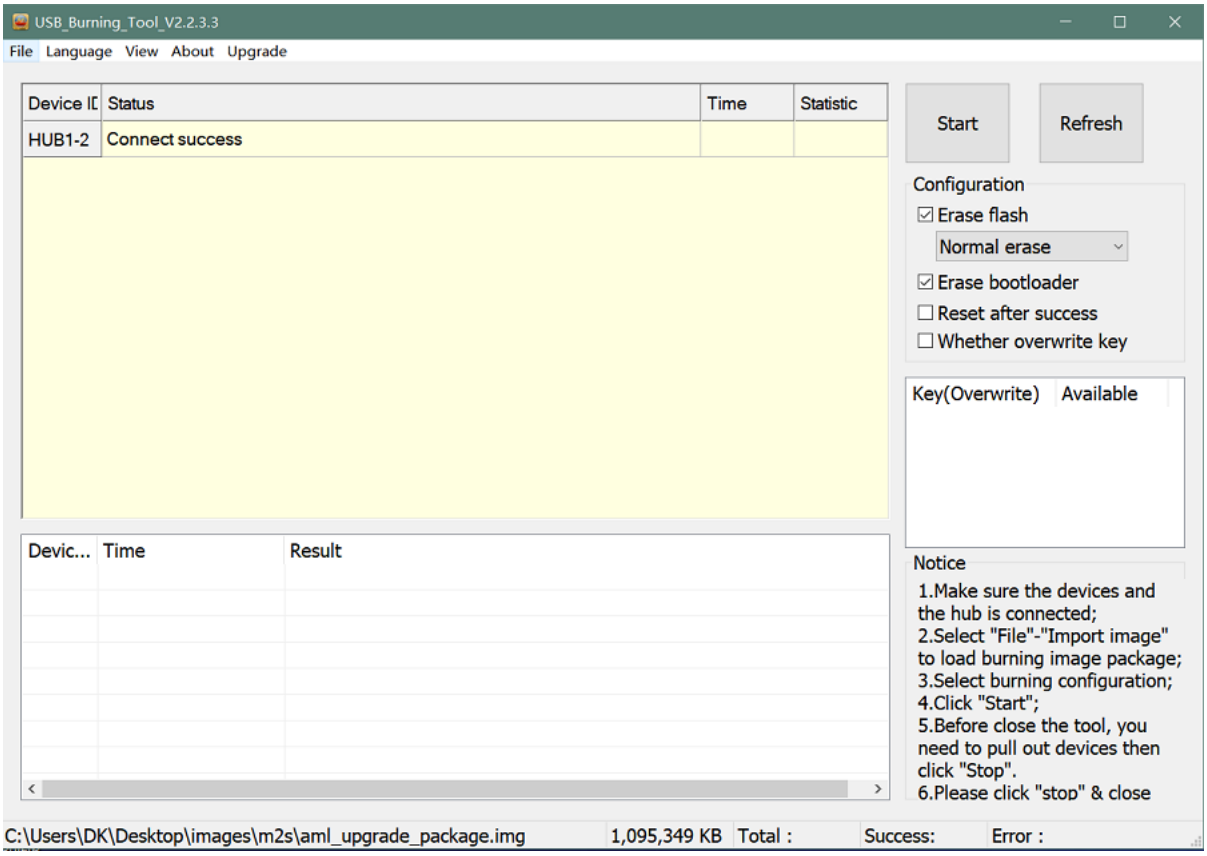
Install Image with Usb Burning Tool

1. Open USB_Burning_Tool.exe, select menu File->Import image, choose the android image file aml_upgrade_package.img.

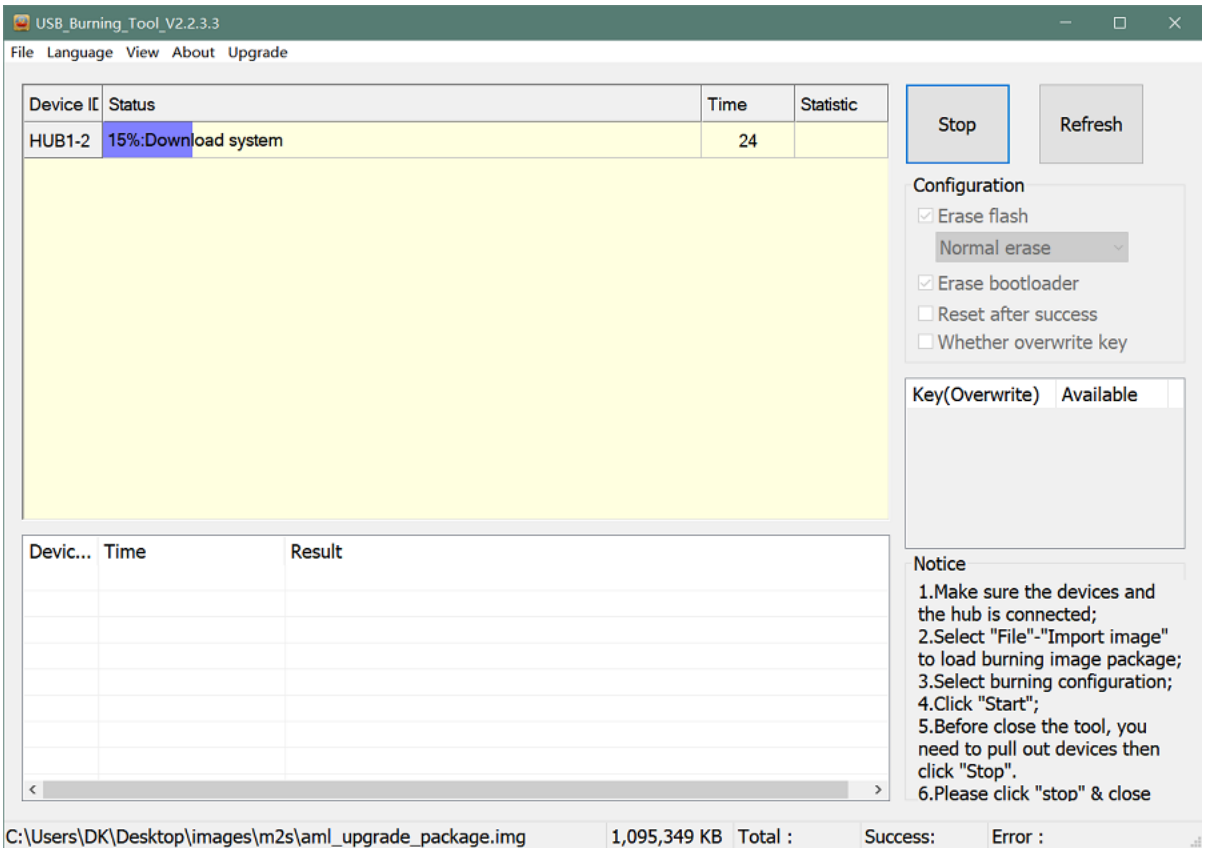


2. Press and hold USB button on the board, plugin type-c usb cable to PC or press the RST button if power adapter already connected, about two seconds later, release the button, the board will be identified correctly.

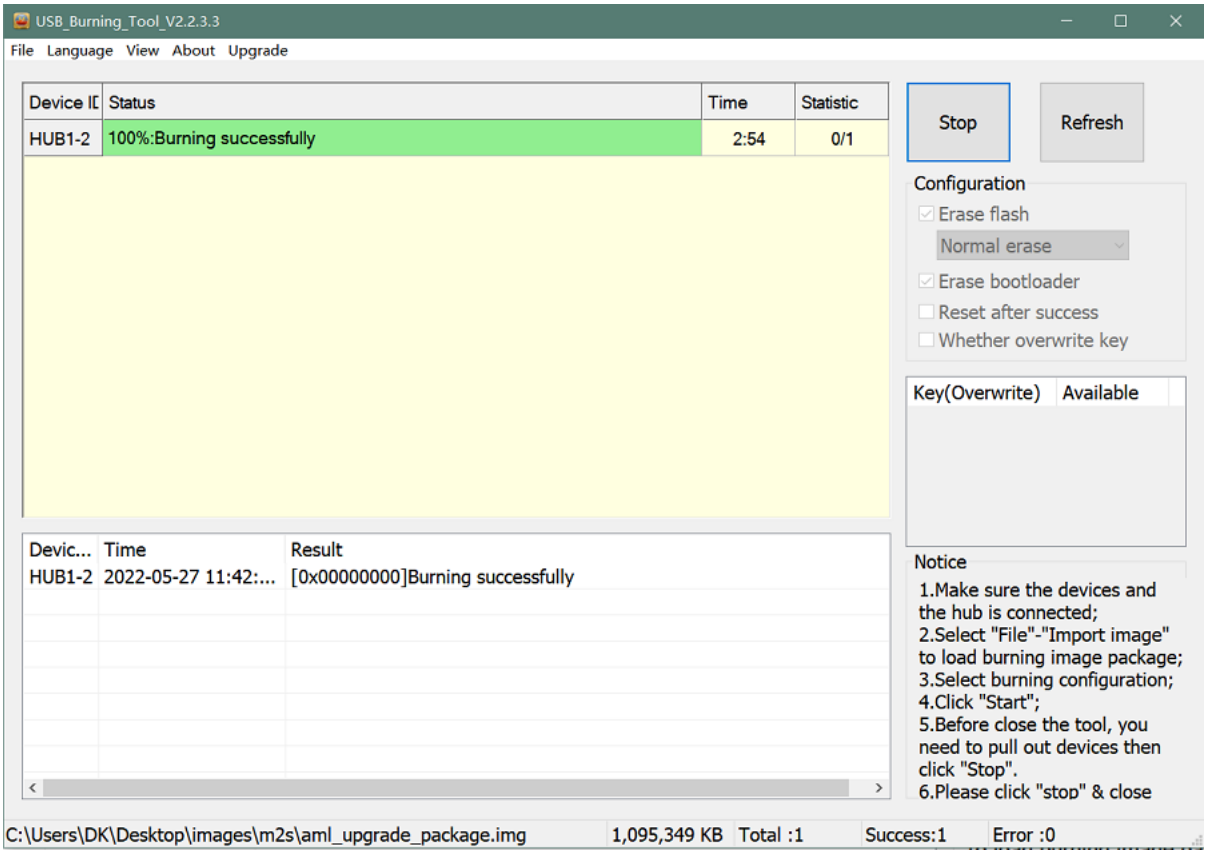




3. Click the Start button of the download tool and wait for upgrade complete.



4. After Burning successfull, Unplug the type-c usb and connect to power supply adaptor to startup.

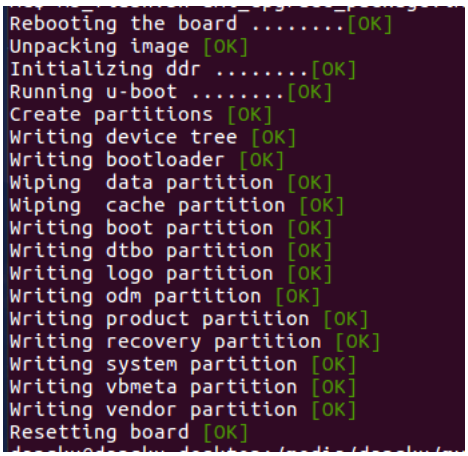


5. Click the Stop button to cancel the upgrade process and close the USB Buring Tool.

Install Image with Aml Flash Tool

aml-flash-tool is a linux platform opensource image flash util for Amlogic android.

```
$ ./flash-tool.sh --img=/path/to/aml_upgrade_package.img --parts=all --wipe --soc=g12a --reset=y
```



Build Android Source Code

1. Get Android 9.0 source code

```
$ https://github.com/BPI-SINOVOIP/BPI-A311D-Android9
```

or you can get the source code tar archive from BaiduPan(pincode: 8888) or GoogleDrive

2. Build the Android 9.0 Source code

Please read the source code README.md

Android DTB overlay

Bananapi M2S DTBO idx value table, default idx value is 0 in release image.

Bananapi M2S DTBO idx value table		
idx value	device tree overlay	description
0	android_p_overlay	default dtbo, no use
1	wifi_bt_rtl8822cs	enable bpi rtl8822cs wifi/bt module
2	i2c1	enable i2c 1
3	i2c2	enable i2c 2
4	sdio	enable sdio
5	uart1	enable 2 pins uart 1
6	uart1_cts_rts	enable 4 pins uart 1
7	uart2	enable 2 pins uart 2
8	hifi_pcm5122	enable i2s pcm5122 HiFi DAC

How to apply a new dtbo

1. ADB command via sysfs

```
root@dangku-desktop:/tmp# adb root
restarting adbd as root
root@dangku-desktop:/tmp# adb remount
remount succeeded
root@dangku-desktop:/tmp# adb shell
bananapi_m2s:/ # echo dtbo > /sys/class/unifykeys/name
bananapi_m2s:/ # echo "1" > /sys/class/unifykeys/write
bananapi_m2s:/ # reboot
```

2. Uart console command via sysfs

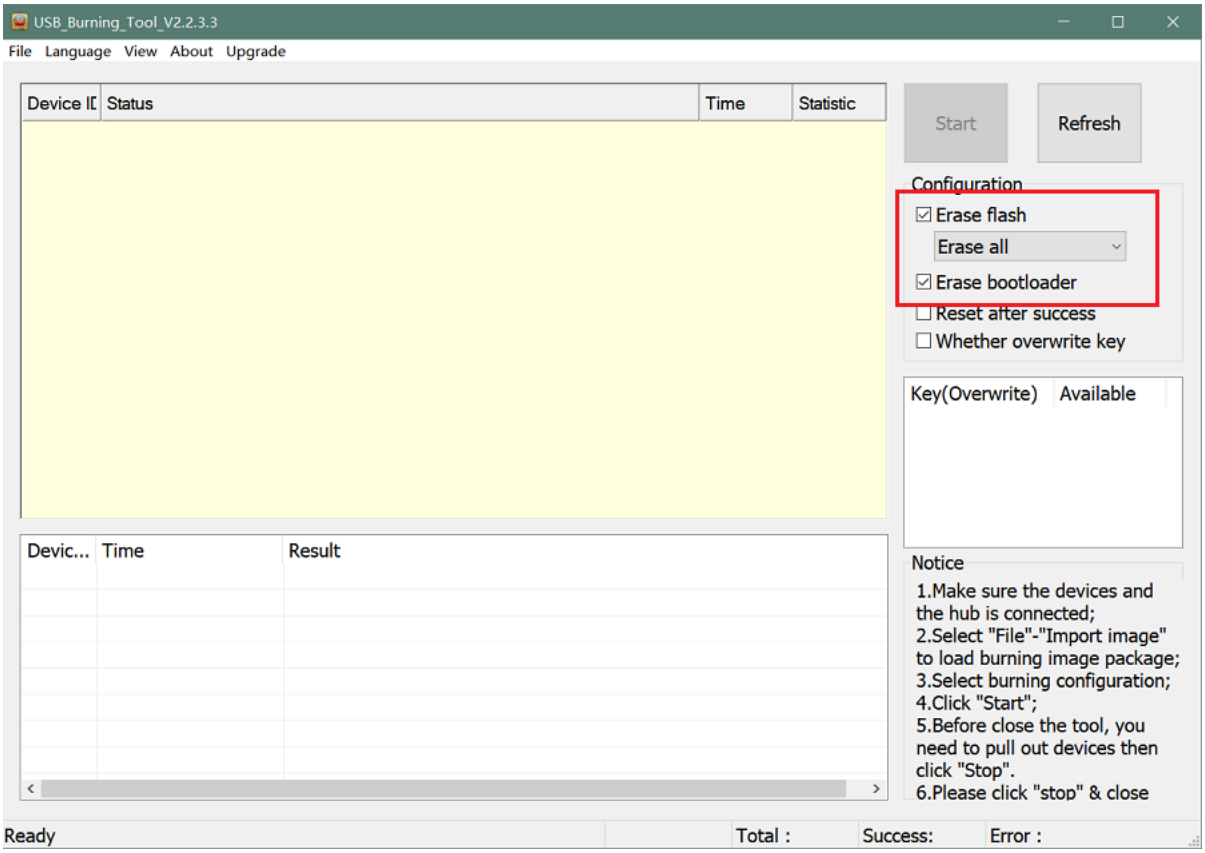
```
console:/ $
console:/ $ su
console:/ # echo dtbo > /sys/class/unifykeys/name
[  115.702781@0] unifykey: name_store() 1302, name dtbo, 4
[  115.702856@0] unifykey: name_store() 1311
console:/ #
console:/ # echo "1" > /sys/class/unifykeys/write
[  129.262659@0] unifykey: write_store()  is a string
[  129.262733@0] unifykey: dtbo, 1, 1
[  129.265312@0] unifykey: amlkey_write 393
[  129.292347@1] emmc_key_write:149, write ok
console:/ #
console:/ # reboot
```

3. Settings App(To-Do)

Check the bootup uart debug message and confirm which dtbo is loaded actually, here "1" means set idx=1 to apply wifi_bt_rtl8822cs dtbo.

```
load dtb from 0x1000000 ......
      Amlogic multi-dtb tool
      Single dtb detected
find 2 dtbos
dtbos to be applied: 1
Apply dtbo 1
```

Unifykeys is stored in a specific emmc part, "Normal erase" selected in USB_Burning_Tool will not erase this data for next update, you must select "Erase all" if you want the default dtbo idx to be applied after image download.



Build Android image with a specific DTBO default.

1. Default build-in overlays are defined in device/bananapi/bananapi_m2s/Kernel.mk, you can add a new overlay dtbo here.

```
DTBO_DEVICETREE := android_p_overlay wifi_bt_rtl8822cs i2c1 i2c2 sdio uart1 uart1_cts_rts uart2 hifi_pcm5122
```

2. Default apply DTBO idx is defined in device/bananapi/bananapi_m2s/BoardConfig.mk, you can change the idx value to set which overlay dtbo will be applied default.

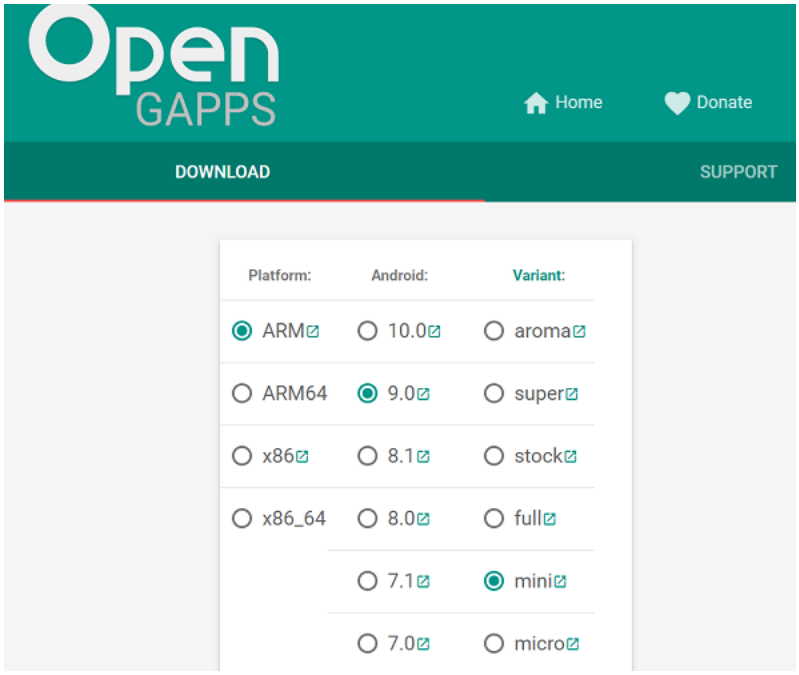
```
BOARD_KERNEL_CMDLINE += androidboot.dtbo_idx=0
```

3. DTS files are in common/arch/arm64/boot/dts/amlogic/overlay/bananapi_m2s/

More info about android device tree overlays, please refer to google android offical site

Install OpenGapps

1. Download install package from OpenGapps, Android release image is arm/android 9.0 variant.



2. Download device_id.apk.
3. Copy the OpenGapp package to a udisk or sdcard root directory.
4. Create a txt file named **factory_update_param.aml** in udisk or sdcard root directory with the following android recovery parameter content, and replace the file name with the actual downloaded package.

udisk:

```
--wipe_cache
--update_package=/udisk/open_gapps-arm-9.0-pico-20210327.zip
```

sdcard:

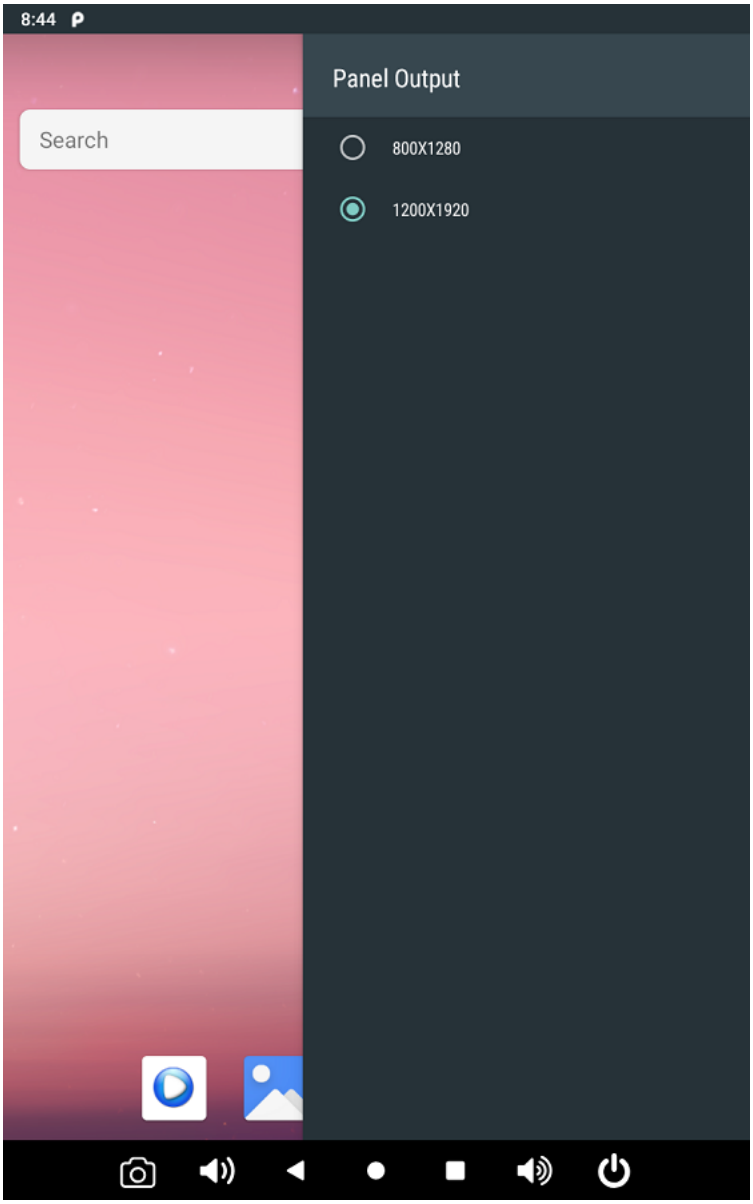
```
--wipe_cache
--update_package=/sdcard/open_gapps-arm-9.0-pico-20210327.zip
```

5. Plugin the udisk or sdcard to the board and poweron.

6.OpenGapps install and certify.
watch this video on bilibili

Switch Mipi Panel

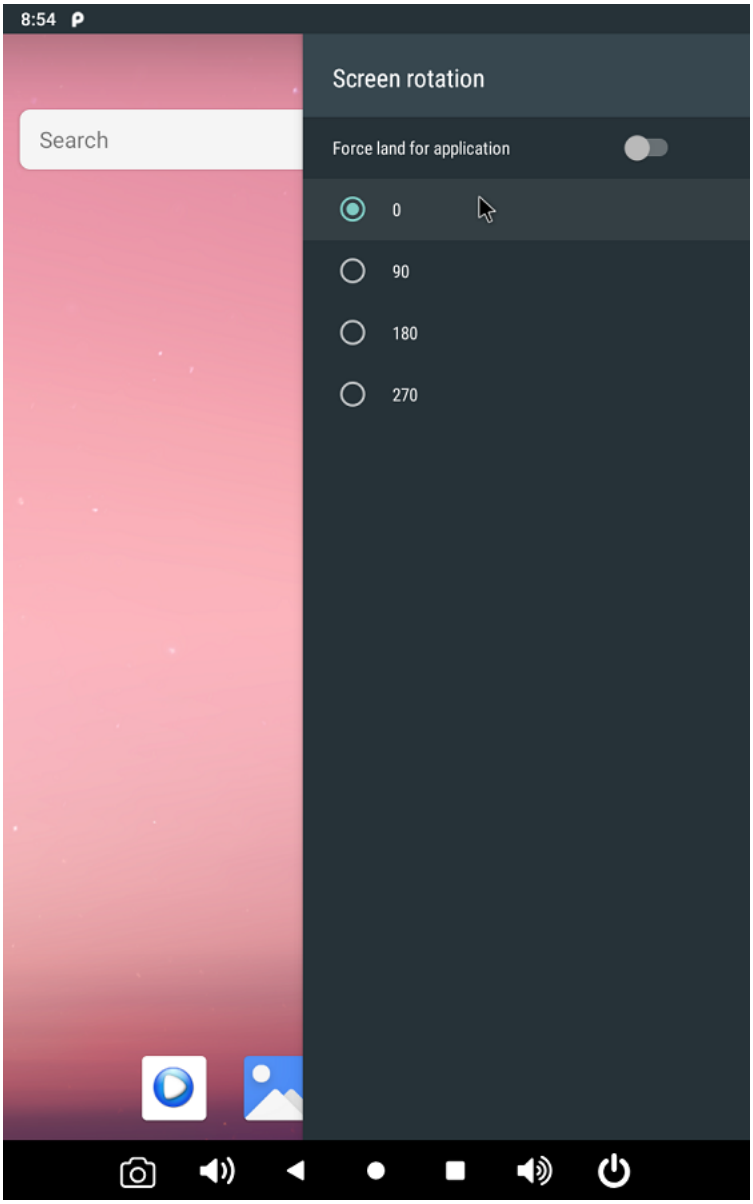
The default android release image only support one mipi panel because hw has no detect logic for different panel at boot, so [800x1280 bpi panel] enabled as default, but you can change to [1200x1920 bpi panel] as defualt in Settings->Panel Output



Panel Rotation

The two 10" mipi panels are all portrait hw display, so the default android release image is portrait mode, but you can rotate it to 90/180/270 in two ways.

1. UI Rotation in Settings->Display->Screen rotation



2. SurfaceFlinger rotation, need modify android source code and build
Change the default sf rotation property

```
diff --git a/device/bananapi/bananapi_m2s/bananapi_m2s.mk b/device/bananapi/bananapi_m2s/bananapi_m2s.mk
index 1f51703..d592a44 100644
--- a/device/bananapi/bananapi_m2s/bananapi_m2s.mk
+++ b/device/bananapi/bananapi_m2s/bananapi_m2s.mk
@@ -579,6 +579,6 @@ PRODUCT_PROPERTY_OVERRIDES += \
 else
 PRODUCT_PROPERTY_OVERRIDES += \
     ro.sf.lcd_density=213 \
-    ro.sf.primary_display_orientation=0
+    ro.sf.primary_display_orientation=90
 endif
```

Change the touch panel rotation in dts

```
diff --git a/common/arch/arm64/boot/dts/amlogic/bananapi_m2s.dts b/common/arch/arm64/boot/dts/amlogic/bananapi_m2s.dts
index 4a698b0..3d41b63 100755
--- a/common/arch/arm64/boot/dts/amlogic/bananapi_m2s.dts
+++ b/common/arch/arm64/boot/dts/amlogic/bananapi_m2s.dts
@@ -876,8 +876,8 @@
                reg = <0x5d>;
                reset-gpio = <&gpio GPIOA_6 GPIO_ACTIVE_HIGH>;
                irq-gpio = <&gpio GPIOA_5 GPIO_ACTIVE_HIGH>;
-               rotation = <4>; /* sf_rotation 0 */
-               //rotation = <0>; /* sf_rotation 90*/
+              //rotation = <4>; /* sf_rotation 0 */
+              rotation = <0>; /* sf_rotation 90*/
```

```
                //rotation = <5>; /* sf_rotation 180 */
                //rotation = <3>; /* sf_rotation 270 */
```

Custom Android Boot Logo

Android bootloader limit boot logo fb display size is 1080p60hz/1920x1080 default, and android kernel dtb partition table limit boot logo partition size to 16MB default .

1. Prepare a 16bit bmp file and named boot-logo.bmp

2. Compress the bmp file to boot-logo.bmp.gz

```
$ gzip boot-logo.bmp
```

3. Download m2s_android_bootlogo_tool.zip

4. Extract this tool

```
$ unzip m2s_android_bootlogo_tool.zip
$ cd m2s_android_bootlogo_tool/
$ ls -l logo/
-rwxr--r-- 1 dangku dangku 525054 Sep 25 16:54 bootup.bmp
-rwxr--r-- 1 dangku dangku 525054 Sep 25 16:54 bootup_secondary.bmp
-rwxr--r-- 1 dangku dangku    184 May 19  2020 upgrade_bar.bmp
-rwxr--r-- 1 dangku dangku 180072 May 19  2020 upgrade_error.bmp
-rwxr--r-- 1 dangku dangku 180072 May 19  2020 upgrade_fail.bmp
-rwxr--r-- 1 dangku dangku 180072 May 19  2020 upgrade_logo.bmp
-rwxr--r-- 1 dangku dangku 180072 May 19  2020 upgrade_success.bmp
-rwxr--r-- 1 dangku dangku    184 May 19  2020 upgrade_unfocus.bmp
-rwxr--r-- 1 dangku dangku 180072 May 19  2020 upgrade_upgrading.bmp
```

5. Copy the boot-logo.bmp.gz

```
$ cp boot-logo.bmp.gz logo/bootup.bmp
$ cp boot-logo.bmp.gz logo/bootup_secondary.bmp
```

6. Create target logo.img with img pack tool, the binary and related libs of m2s_android_bootlogo_tool are copy from <android-source-dir>/out/host/linux-x86

```
$ ./logo_img_packer -r logo logo.img
```

7. Flash boot logo with fastboot

```
$ adb root
$ adb remount
$ adb reboot fastboot
```

Wait few seconds and check whether fastboot connected

```
$ fastboot device
1234567890      fastboot
$ fastboot flashing unlock_critical
$ fastboot flashing unlock
$ fastboot flash logo logo.img
$ fastboot reboot
```

Linux

Prepare

1. Linux image support SDcard or EMMC bootup, but you should read the boot sequence at first.

2. It’s recommended to use A1 rated cards, 8GB at least.

3. Make sure bootable EMMC is formatted if you want bootup from SDcard, more info refer to Erase EMMC for SDcard Bootup

4. Make sure SDcard is formatted without Linux image flashed if you want bootup from EMMC and use Sdcard as storage.

5. Install bpi-tools on your Linux PC(if flash image with other tools, ignore this step). If you can't access this URL or any other install problem, please go to bpi-tools source repo, download and install this tools manually.

```
$ apt-get install pv
$ curl -sL https://github.com/BPI-SINOVOIP/bpi-tools/raw/master/bpi-tools | sudo -E bash
```

6. Download Linux latest Linux Image, and confirm that the md5 checksum is correct.

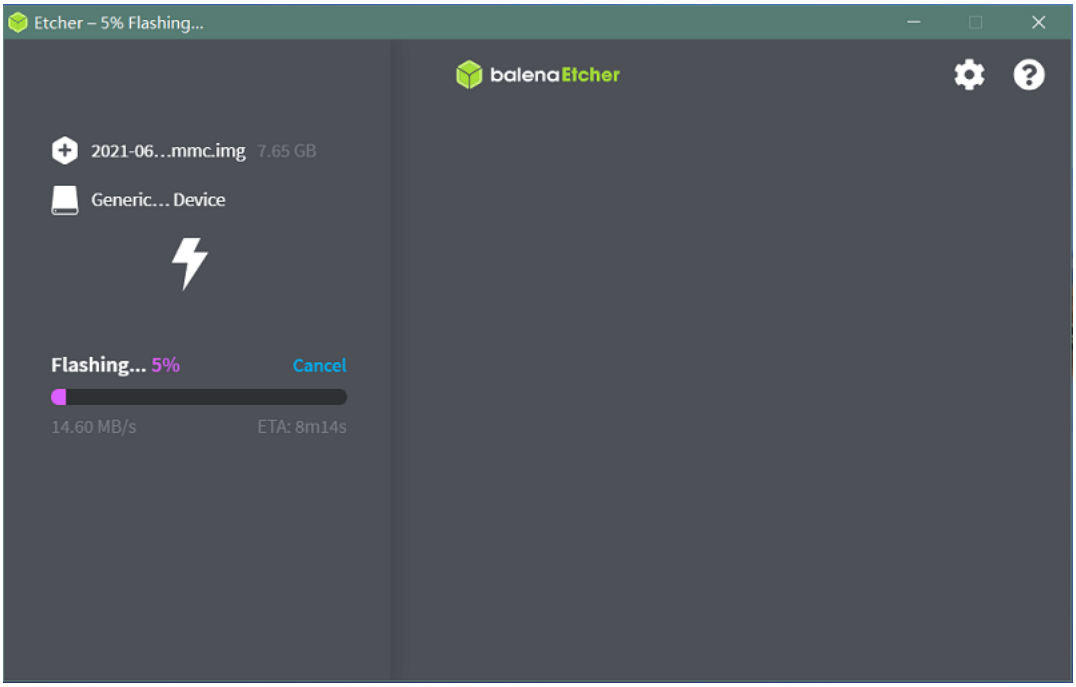
7. Default login: pi/bananapi or root/bananapi

8. The wiki guide is only for bananapi 4.9 bsp ubuntu/debian images.

Install Image to SDcard

1. Install Image with Balena Etcher on Windows, Linux and MacOS.

   Balena Etcher is an opensource GUI flash tool by Balena, Flash OS images to SDcard or USB drive



2. Install Image with Balena Cli on Windows, Linux and MacOS.
Balena CLI is a Command Line Interface for balenaCloud or openBalena. It can be used to flash linux image. Download the installer or standalone package from balena-io and install it correctly to your PC, then you can use the "local flash" command option of balena to flash a linux image to sdcard or usb drive.

```
$ sudo balena local flash path/to/xxx-bpi-m2s-xxx.img.zip
$ sudo balena local flash path/to/xxx-bpi-m2s-xxx.img.zip --drive /dev/disk2
$ sudo balena local flash path/to/xxx-bpi-m2s-xxx.img.zip --drive /dev/disk2 --yes
```

3. Install Image with dd command on Linux, umount SDcard device /dev/sdX partition if mounted automatically. Actually bpi-copy is the same as this dd command.

```
$ sudo apt-get install pv unzip
$ sudo unzip -p xxx-bpi-m2s-xxx.img.zip | pv | dd of=/dev/sdX bs=10M status=noxfer
```

4. Install the linux image in udisk with bpi-tools on Linux, plug SDcard to Linux PC and run

```
$ sudo apt-get install pv unzip
$ sudo bpi-copy xxx-bpi-m2s-xxx.img.zip /dev/sdX
```

Install Image to EMMC

1. Prepare a SDcard with Linux image flashed and bootup board with this SDcard.

2. Copy Linux image to udisk, plug the udisk to board and mount it.

3. Install with dd command, umount mmcblk0p1 and mmcblk0p2 partition if mounted automatically. Actually bpi-copy is the same as this dd command.

```
$ sudo apt-get install pv unzip
$ sudo unzip -p xxx-bpi-m2s-xxx.img.zip | pv | dd of=/dev/mmcblk0 bs=10M status=noxfer
```

4. Install with bpi-tools command

```
$ sudo apt-get install pv unzip
$ sudo bpi-copy xxx-bpi-m2s-xxx.img.zip /dev/mmcblk0
```

5. After download complete, power off safely and eject the SDcard.

Build Linux Source Code

1. Get the Linux bsp source code

```
$  git clone https://github.com/BPI-SINOVOIP/BPI-M2S-bsp
```

2. Build the bsp source code

Please read the source code README.md

3. If you want build uboot and kernel separately, please download the u-boot the kernel only, get the toolchains, boot script and other configuration files from BPI-M2S-bsp

DTB overlay

1. DTB overlay is used for 40pin gpios multi-function configuration and install in vfat boot partition, you can check the mount point with mount command.

```
root@bananapi:~# ls /boot/overlays/
custom_ir.dtbo      pwm_b-backlight.dtbo  spi0.dtbo
ds3231.dtbo         pwm_c-beeper.dtbo     uart1_cts_rts.dtbo
hifi_pcm5102a.dtbo  pwm_cd-c.dtbo         uart1.dtbo
hifi_pcm5122.dtbo   pwm_cd.dtbo           uart2.dtbo
i2c1.dtbo           pwm_ef.dtbo           waveshare_tft24_lcd.dtbo
i2c2.dtbo           pwm_ef-f.dtbo         waveshare_tft35c_lcd.dtbo
pwm_ab.dtbo         sdio.dtbo             waveshare_tft35c_rtp.dtbo
```

2. Update the overlays env in vfat /boot/env.txt to enable what you want.

```
# Device Tree Overlays
#   uart1           -- Enable UART1 (uart_A, GPIO Header PIN8 & PIN10)
#   pwm_c           -- Enable PWM_C (GPIO Header PIN7)
#   i2c2            -- Enable i2c2 (GPIO Header PIN3 & PIN5)
#   spi0            -- Enable SPI0 (GPIO Header PIN19 & PIN21 & PIN23 & PIN24)
overlays="i2c2 spi0 uart1"
```

3. Must be restart the board for overlay dtb loaded.

Enable Camera

The linux release image is camera disabled default, according to the following configuration, it can be enabled by yourself.

1. Update the dtb overlays env in /boot/env.txt to enable camera dtbo.

```
overlays="os08a10"
```

2. Add camera modules to /etc/modules

```
iv009_isp_iq
iv009_isp_lens
iv009_isp_sensor
iv009_isp
```

3. Create and add camera modules options to /etc/modprobe.d/os08a10.conf

```
#choose camera calibration parameters
options iv009_isp_iq cali_name=0
#choose isp register sequence
options iv009_isp_sensor isp_seq_num=0
```

4. Enable camera isp systemd service

```
$ sudo systemctl enable camera_isp_3a_server.service
```

Camera device is /dev/video0 after reboot.

Switch Mipi Panel

The default linux release image only support one mipi panel because hw has no detect logic for different panel at boot, so 800x1280 bpi panel enabled as default, but you can change to [1200x1920 bpi panel] as defualt in /boot/lcd_env.txt

```
# Mipi panel type
#    Symbol    | Resolution
# ---------------------+-------------
#    "lcd_0"   | 10" 800x1280 panel
#    "lcd_1"   | 10" 1200x1920 panel
panel_type=lcd_0
```

Note: Dual display is not work on linux, so disconnect hdmi cable when mipi used.

Panel Rotation

The two 10" mipi panels are all portrait hw display, so the default release image is portrait mode, but you can rotate it to 90/180/270.

For Desktop image, create a xorg configuration file /usr/share/X11/xorg.conf.d/10-fbdev-rotate.conf with contents:

```
Section "Device"
    Identifier "Configured Video Device"
    # Rotate off
#   Option "Rotate" "off"
    # Rotate Right / clockwise, 90 degrees
    Option "Rotate" "CW"
    # Rotate upside down, 180 degrees
#   Option "Rotate" "UD"
    # Rotate counter clockwise, 270 degrees
#   Option "Rotate" "CCW"

EndSection

Section "InputClass"
    Identifier "Coordinate Transformation Matrix"
    MatchIsTouchscreen "on"
    MatchProduct "goodix-ts"
    MatchDevicePath "/dev/input/event0"
    MatchDriver "libinput"
    # Rotate Right / clockwise, 90 degrees
    Option "CalibrationMatrix" "0 1 0 -1 0 1 0 0 1"
    # Rotate upside down, 180 degrees
#   Option "CalibrationMatrix" "-1 0 1 0 -1 1 0 0 1"
    # otate counter clockwise, 270 degrees
#   Option "CalibrationMatrix" "0 -1 1 1 0 0 0 0 1"

EndSection
```

For Server image, you can change the framebuffer rotation in two ways:

1. Sysfs dynamically change.

```
echo 0 > /sys/class/graphics/fbcon/rotate    //origin 0 degree
echo 1 > /sys/class/graphics/fbcon/rotate    //90 degree
echo 2 > /sys/class/graphics/fbcon/rotate    //180 degree
echo 3 > /sys/class/graphics/fbcon/rotate    //270 degree
```

2. Boot Configuration change.
change the fb_rotate env in /boot/env.txt

```
# Framebuffer Rotate
# 0 - origin 0 degree
# 1 - 90 degree
# 2 - 180 degree
# 3 - 270 degree
fb_rotate=0
```

WiringPi

Note: This WiringPi only support set 40pin gpio to output, input, pwm or software pwm, for io functions as i2c, spi, ..., you must enable dtb overlay in boot.ini

1. Build and install wiringPi, for debian, you must install sudo before build

```
$ sudo apt-get update
$ sudo apt-get install build-essential git
$ git clone https://github.com/Dangku/amlogic-wiringPi
$ cd amlogic-wiringPi
$ chmod a+x build
$ sudo ./build
```

2. Run **gpio readall** to show all 40pins status.

```
root@bananapi:~# gpio readall
 +-----+-----+---------+------+---+--- M2S ---+---+------+---------+-----+-----+
 | I/O | wPi |   Name  | Mode | V | Physical | V | Mode |   Name  | wPi | I/O |
 +-----+-----+---------+------+---+----++----+---+------+---------+-----+-----+
 |     |     |    3.3V |      |   |  1 || 2  |   |      | 5V      |     |     |
 | 493 |   8 |   SDA.2 | ALT1 | 1 |  3 || 4  |   |      | 5V      |     |     |
 | 494 |   9 |   SCL.2 | ALT1 | 1 |  5 || 6  |   |      | 0V      |     |     |
 | 481 |   7 |  IO.481 |   IN | 1 |  7 || 8  | 1 | ALT1 | TxD1    | 15  | 488 |
 |     |     |      0V |      |   |  9 || 10 | 1 | ALT1 | RxD1    | 16  | 489 |
 | 479 |   0 |  IO.479 |   IN | 1 | 11 || 12 | 0 | IN   | IO.461  | 1   | 461 |
 | 480 |   2 |  IO.480 |   IN | 1 | 13 || 14 |   |      | 0V      |     |     |
 | 483 |   3 |  IO.483 |   IN | 1 | 15 || 16 | 1 | IN   | IO.476  | 4   | 476 |
 |     |     |    3.3V |      |   | 17 || 18 | 1 | IN   | IO.477  | 5   | 477 |
 | 484 |  12 |    MOSI | ALT4 | 1 | 19 || 20 |   |      | 0V      |     |     |
 | 485 |  13 |    MISO | ALT4 | 1 | 21 || 22 | 1 | IN   | IO.478  | 6   | 478 |
 | 487 |  14 |    SLCK | ALT4 | 1 | 23 || 24 | 1 | OUT  | SS      | 10  | 486 |
 |     |     |      0V |      |   | 25 || 26 | 1 | IN   | IO.492  | 11  | 492 |
 | 432 |  30 |  IO.432 |   IN | 0 | 27 || 28 | 0 | IN   | IO.431  | 31  | 431 |
 | 490 |  21 |  IO.490 |   IN | 1 | 29 || 30 |   |      | 0V      |     |     |
 | 491 |  22 |  IO.491 |   IN | 1 | 31 || 32 | 0 | IN   | IO.495  | 26  | 495 |
 | 482 |  23 |  IO.482 |   IN | 0 | 33 || 34 |   |      | 0V      |     |     |
 | 462 |  24 |  IO.462 |   IN | 0 | 35 || 36 | 1 | IN   | IO.501  | 27  | 501 |
 | 460 |  25 |  IO.460 |   IN | 0 | 37 || 38 | 0 | IN   | IO.464  | 28  | 464 |
 |     |     |      0V |      |   | 39 || 40 | 0 | IN   | IO.463  | 29  | 463 |
 +-----+-----+---------+------+---+----++----+---+------+---------+-----+-----+
 | I/O | wPi |   Name  | Mode | V | Physical | V | Mode |   Name  | wPi | I/O |
 +-----+-----+---------+------+---+--- M2S ---+---+------+---------+-----+-----+
```

3. BPI GPIO Extend board and examples in amlogic-wiringPi/examples

blinkall, blink all pin header gpios, no extend board.
lcd-bpi, BPI LCD 1602 display module example.
52pi-bpi, BPI OLED Display Module example.
matrixled-bpi, BPI RGB LED Matrix Expansion Module example.
berryclip-bpi, BPI BerryClip Module

RPi.GPIO

Build and install, for debian, you must install sudo before build

```
$ sudo apt-get update
$ sudo apt-get install build-essential python python-dev python-setuptools git
$ git clone https://github.com/Dangku/RPi.GPIO-Amlogic.git
$ cd RPi.GPIO-Amlogic
$ sudo python setup.py clean --all
$ sudo python setup.py build install
```

WiringPi2-Python

Build and install, for debian, you must install sudo before build

```
$ sudo apt-get update
$ sudo apt-get install build-essential python python-dev python-setuptools swig git
$ git clone --recursive  https://github.com/Dangku/WiringPi2-Python-Amlogic.git
$ cd WiringPi2-Python-Amlogic
$ sudo python setup.py install
```

Luma.Examples

luma.examples use GPIO.BCM gpio mode default, so you should map 40pin header pins to bcm gpio number and connect the hardware correctly.

1. build and install RPi.GPIO
build bananapi m2s RPi.GPIO with python3 instead of python because luma uses python3.

```
$ sudo apt-get update
$ sudo apt-get install build-essential python3 python3-dev python3-setuptools git
$ git clone https://github.com/Dangku/RPi.GPIO-Amlogic.git
$ cd RPi.GPIO-Amlogic
$ sudo python3 setup.py clean --all
$ sudo python3 setup.py build install
```

you can change the bcmledpin variable in test/led.py to your hardware backlight gpio and run it to check RPi.GPIO works well.

```
$ sudo python3 test/led.py
```

hardware backlight will repeat on and off

2. luma.examples libs install

```
$ sudo usermod -a -G i2c,spi,gpio pi
```

if group does not exist, the following command will create it:

```
$ sudo groupadd --system xxx
```

```
$ sudo apt-get install python3-dev python3-pip libfreetype6-dev libjpeg-dev build-essential
$ sudo apt-get install libsdl-dev libportmidi-dev libsdl-ttf2.0-dev libsdl-mixer1.2-dev libsdl-image1.2-dev
$ git clone https://github.com/rm-hull/luma.examples.git
$ cd luma.examples
```

install luma.core, luma.emulator, luma.lcd, luma.le-matrix, luma.oled pip libs, make sure this step without error or downloading interrupted, try again if get errors

```
$ sudo -H pip install -e .
```

or

```
$ sudo -H pip3 install -e .
```

for debian buster(python 3.7) which does not include /usr/bin/pip in package python3-pip, and will get the following errors when install luma packages with pip3

```
...
WARNING, No "Setup" File Exists, Running "buildconfig/config.py"
Using UNIX configuration...

/bin/sh: 1: sdl2-config: not found
/bin/sh: 1: sdl2-config: not found
```

```
/bin/sh: 1: sdl2-config: not found
...
```

install sdl2 related packages to fix this issue, then install luma libs again with pip3

```
$ sudo apt-get install libsdl2-dev libsdl2-ttf-dev libsdl2-mixer-dev libsdl2-image-dev
$ sudo -H pip3 install -e .
```

check installed luma pip libs

```
$ pip3 list | grep luma

  luma.core          2.4.0
  luma.emulator      1.4.0
  luma.lcd           2.10.0
  luma.led-matrix    1.7.0
  luma.oled          3.11.0
```

3. examples test
Enable i2c or spi overlays before running test examples

```
$ cd examples
$ sudo python3 bounce.py --config ../conf/ili9341.conf
```

HDMI LCD

Bananapi M2S Tested HDMI LCD	
panel	/boot/env.txt
Waveshare 3.5inch 480x320	hdmi_autodetect=no hdmi=480x320p60hz
Waveshare 3.5inch 640x480	
Waveshare 5inch 800x480	
Waveshare 7inch 1024x600	
Waveshare 7.9inch 400x1280	
Waveshare 9inch 2560x1600	hdmi_autodetect=no hdmi=2560x1600p60hz
Waveshare 10.1inch 1024x600	
Waveshare 10.1inch 1280x800	
Waveshare 13.3inch 1920x1080	
Waveshare 15.6inch 1920x1080	

backlight control

```
https://github.com/Dangku/Waveshare-USB-Brightness
```

Custom Linux Boot Logo

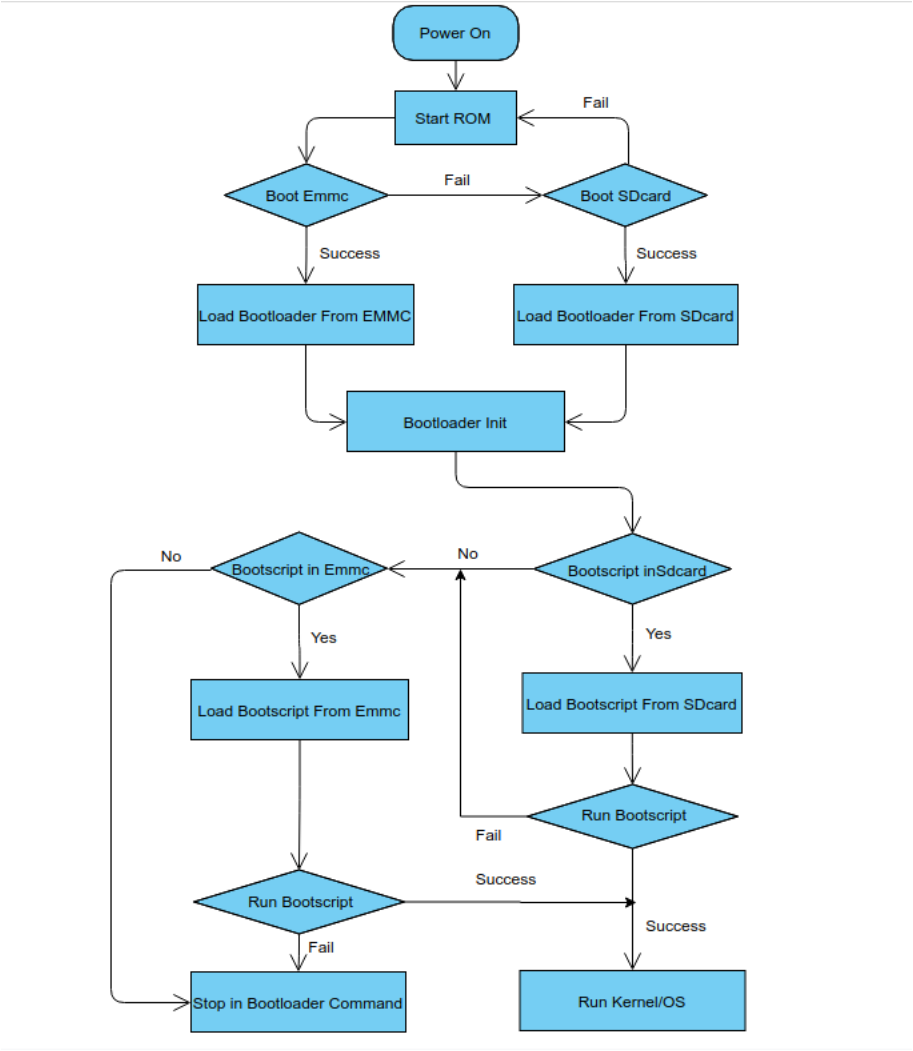
Linux uboot limit boot logo fb size to 1080p60hz/1920x1080 default, so oversize resolution will not be supported by default image, but you can modify uboot source code to support it.

1. Prepare a 24bit bmp file and named boot-logo.bmp

2. copy the target file to /boot/firmware/ or /boot/ directory.

Other Development

Boot Sequence



Check bootloader loaded from SDcard or EMMC at the beginning of the console debug messages

1. Rom load bootloader from SDcard (Linux log example)

```
...

BL2 Built : 15:21:42, Mar 26 2020. g12a g486bc38 - gongwei.chen@droid11-sz

Board ID = 1
Set cpu clk to 24M
Set clk81 to 24M
Use GP1_pll as DSU clk.
DSU clk: 1200 Mhz
CPU clk: 1200 MHz
Set clk81 to 166.6M
board id: 1
Load FIP HDR DDR from SD, src: 0x00010200, des: 0xfffd0000, size: 0x00004000, part: 0
fw parse done
PIEI prepare done
fastboot data verify
result: 255
Cfg max: 12, cur: 1. Board id: 255. Force loop cfg
DDR4 probe

...
```

2. Rom load bootloader from EMMC(Android Log example)

```
...

Board ID = 1
Set cpu clk to 24M
Set clk81 to 24M
Use GP1_pll as DSU clk.
DSU clk: 1200 Mhz
CPU clk: 1200 MHz
```

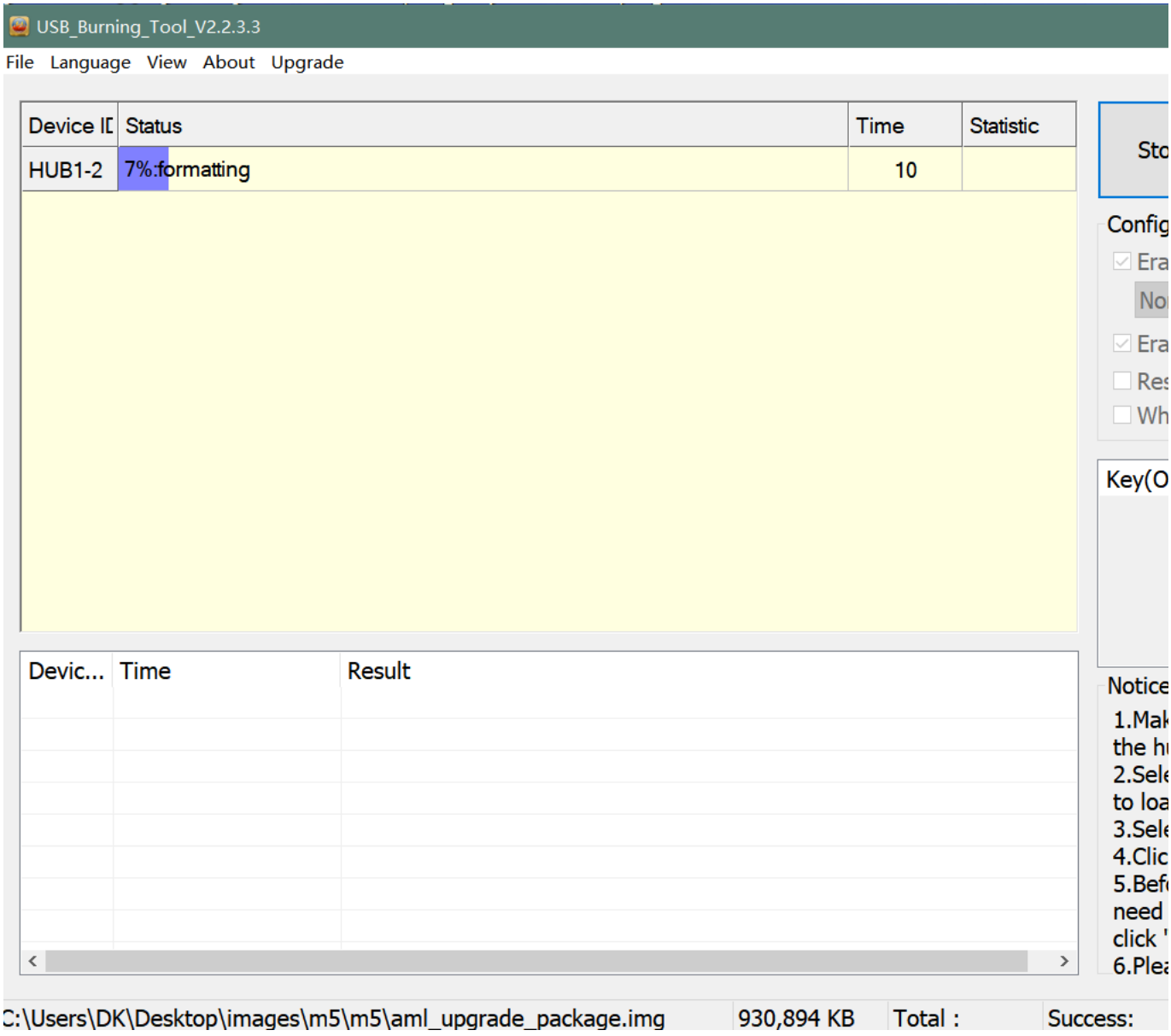
```
Set clk81 to 166.6M
eMMC boot @ 0
sw8 s
board id: 1
Load FIP HDR DDR from eMMC, src: 0x00010200, des: 0xfffd0000, size: 0x00004000, part: 0
fw parse done
PIEI prepare done
00000000
emmc switch 1 ok
ddr saved addr:00016000
Load ddr parameter from eMMC, src: 0x02c00000, des: 0xfffd0000, size: 0x00001000, part: 0
00000000

...
```

Erase EMMC for SDcard Bootup

There are four possible scenarios should be pay attention to, EMMC already flashed Android image, EMMC already flashed Linux image, boot process hangup in BL2 and EMMC empty.

1. Bootable EMMC with Android image flashed

a). Using usb burning tool, unplug the type-c usb cable while the download process at **7% formatting**



b). Using Android Fastboot tool, make sure the adb/fastboot tools is work on your PC before doing this.

```
root@dangku-desktop:/tmp# adb root
adbd is already running as root
root@dangku-desktop:/tmp# adb remount
remount succeeded
root@dangku-desktop:/tmp# adb shell
bananapi_m2s:/ # reboot fastboot
```

Wait a few seconds for board reboot to fastboot mode

```
root@dangku-desktop:/tmp# fastboot devices
1234567890   fastboot
root@dangku-desktop:/tmp# fastboot flashing unlock_critical
...
OKAY [  0.044s]
finished. total time: 0.044s
root@dangku-desktop:/tmp# fastboot flashing unlock
...
OKAY [  0.047s]
finished. total time: 0.047s
root@dangku-desktop:/tmp# fastboot erase bootloader
erasing 'bootloader'...
OKAY [  0.059s]
finished. total time: 0.059s
root@dangku-desktop:/tmp# fastboot erase bootloader-boot0
erasing 'bootloader-boot0'...
OKAY [  0.036s]
finished. total time: 0.036s
root@dangku-desktop:/tmp# fastboot erase bootloader-boot1
erasing 'bootloader-boot1'...
OKAY [  0.035s]
finished. total time: 0.035s
```

c). Using uboot command, connect a debug console cable and press ESC while power on to enter uboot command line

```
bananapi_m2s_v1#amlmmc erase 1
emmckey_is_protected(): protect
start = 0,end = 57343
start = 221184,end = 30535679
Erasing blocks 0 to 8192 @ boot0
start = 0,end = 8191
Erasing blocks 0 to 8192 @ boot1
start = 0,end = 8191
bananapi_m2s_v1#reset
resetting ...
SM1:BL:511f6b:81ca2f;FEAT:A0F83180:20282000;POC:F;RCY:0;EMMC:0;READ:0;CHK:1F;READ:0;CHK:1F;READ:0;CHK;
```

These two ways actually erase the bootloader part of EMMC android, After bootup from SDcard Linux, You'd better format the whole EMMC by dd command.

d). The simplest way is insert the SDcard with Linux image flashed before power on, the Android bootloader will check boot.ini file whether exist in SDcard vfat partition, so that the SDcard Linux will bootup. After bootup, you can format the whole EMMC by dd command and then flash the Linux image to EMMC.

```
...
BPI: try boot from sdcard
reading boot.ini
2453 bytes read in 3 ms (797.9 KiB/s)
## Executing script at 03080000
Starting boot.ini...
reading env.txt
3483 bytes read in 7 ms (485.4 KiB/s)
HDMI: Autodetect: 1080p60hz
reading Image.gz
10924573 bytes read in 611 ms (17.1 MiB/s)
reading bananapi_m2s.dtb
88054 bytes read in 12 ms (7 MiB/s)
reading uInitrd
11704481 bytes read in 655 ms (17 MiB/s)
reading overlays/wifi_bt_rtl8822cs.dtbo
729 bytes read in 6 ms (118.2 KiB/s)
```

2. Bootable EMMC with Linux image flashed

a). Using uboot command, connect a debug console cable and press ESC while power on to enter uboot command line

```
bananapi_m2s# mmc erase 0 1000
```

b). Linux u-boot also check boot.ini file whether exist in SDcard vfat partition so that the SDcard Linux will bootup. After bootup, you can format the whole EMMC by dd command or flash the Linux image directly to EMMC.

3. A **extreme situation** is bootloader or uboot corrupted, Rom load it from EMMC but hangup in u-boot or BL2, for example the boot process will hangup in BL2 of EMMC if dram init failed, The only way is format the EMMC with usb burning tool, or download the Android image completely and then try other ways to erase EMMC or flash Linux image to EMMC.

4. Rom will try to load bootloader from SDcard directly if EMMC is empty.

Erase Emmc Android by dd command

If the board is flashed android before, the whole emmc must be erased by these commands if you want bootup it with SDcard Linux image.

```
$ sudo dd if=/dev/zero of=/dev/mmcblk0boot0 bs=1M status=noxfer
$ sudo dd if=/dev/zero of=/dev/mmcblk0boot1 bs=1M status=noxfer
$ sudo dd if=/dev/zero of=/dev/mmcblk0 bs=1M status=noxfer
$ sync
```

Wifi/BT support

1. Android test and support.

```
rtl8723bu wifi/bt(usb)
rtl8188eu wifi(usb)
rtl8821cu wifi/bt(usb)
rtl8822cs wifi/bt(sdio/uart)
rtl8814au wifi(usb), please get the aircrack-ng driver and install.
```

How to enable Android Wifi/BT

USB type: Plug-in the usb dongle to usb host port and reboot the system, After bootup, you can enable or disable wifi and bluetooth in Settings app.
SDIO/UART type: Connect the hardware module to 40pin header correctly and configure the Android DTB overlay to enable it.

Note: Android is not support that ethernet and wifi are both connected at the same time, Ethernet have a higher prioprity than wifi, it means wifi can't connect network if ethernet already connected, and wifi will drop connection if ethernet cable plugin.

2. Linux test and support.

```
rtl8188eu wifi(usb)
rtl8192eu wifi(usb)
rtl8723bu wifi/bt(usb)
rtl8811au wifi(usb)
rtl8812au wifi(usb)
rtl8812bu wifi(usb)
rtl8821cu wifi/bt(usb)
rtl8822cs wifi/bt(sdio/uart)
```

How to enable Linux Wifi

Wifi module drivers are already prebuild in the release images.

USB type: Plug-in the usb dongle to usb host port and driver will be loaded automatically.
SDIO/UART type:

1). Connect the hardware module to 40pin header correctly.
2). Configure the dtb overlay

```
  overlays="wifi_bt_rtl8822cs"
```

3). Add the wifi module name to /etc/modules for loaded automatically next boot.

```
# This file contains the names of kernel modules that should be loaded
# at boot time, one per line. Lines beginning with "#" are ignored.
88x2cs
```

How to enable Linux Bluetooth

1). Please download rtk-linux-bt-driver source code, build and install usb or uart rtk linux bluetooth drivers/firmwares to your image.
2). For USB type, plug-in the usb dongle to usb host port and driver will be loaded automatically.
3). For UART type, Configure the dtb overlay as the same as wifi before install the bluetooth drivers/firmwares. hci_uart driver will be loaded when rtk-hciuart.service start.

Cloud-init&Snap

Cloud-init and Snap service are enabled default, you can disable or remove them.

1. disable or remove cloud-init

```
$ sudo touch /etc/cloud/cloud-init.disabled
```

or

```
$ sudo apt purge cloud-init
```

2. disable or remove snap

```
$ sudo apt purge snapd
```

Enable rc-local

The systemd service rc-local.service already exists in release image, but there is no [Install] part in the unit file. As a result, Systemd is unable to enable it. First, we must update the file.

```
$ sudo nano /lib/systemd/system/rc-local.service
```

```
[Unit]
Description=/etc/rc.local Compatibility
Documentation=man:systemd-rc-local-generator(8)
ConditionFileIsExecutable=/etc/rc.local
After=network.target

[Service]
```

```
Type=forking
ExecStart=/etc/rc.local start
TimeoutSec=0
RemainAfterExit=yes
GuessMainPID=no

[Install]
WantedBy=multi-user.target
Alias=rc-local.service
```

Create /etc/rc.local file.

```
sudo nano /etc/rc.local
```

```
#!/bin/sh
#
# rc.local
#
# This script is executed at the end of each multiuser runlevel.
# Make sure that the script will "exit 0" on success or any other
# value on error.
#
# In order to enable or disable this script just change the execution
# bits.
#
# By default this script does nothing.

exit 0
```

Add executable permission to /etc/rc.local

```
$ sudo chmod +x /etc/rc.local
```

Enable rc-local.service and reboot

```
$ sudo systemctl enable rc-local.service
$ sudo reboot
```

Enable sudo for Debian

The release Debian image do not install sudo default, with "su -" command, user can change to root. If you like sudo, you can install it.

```
$ su root
Password:(enter bananapi)

# apt-get update
# apt-get install sudo
# adduser pi sudo
```

Then please do logout and login again

Install Docker Engine

Install Docker Engine on Ubuntu 20.04 Server

1. Set up the repository

Update the apt package index and install packages to allow apt to use a repository over HTTPS:

```
$ sudo apt-get update
$ sudo apt-get install apt-transport-https ca-certificates curl gnupg lsb-release
```

Add Docker’s official GPG key:

```
$ curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo gpg --dearmor -o /usr/share/keyrings/docker-archive-keyring.gpg
```

Set up the stable repository

```
$  echo \
   "deb [arch=arm64 signed-by=/usr/share/keyrings/docker-archive-keyring.gpg] https://download.docker.com/linux/ubuntu \
   $(lsb_release -cs) stable" | sudo tee /etc/apt/sources.list.d/docker.list > /dev/null
```

2. Install Docker Engine

```
$ sudo apt-get update
$ sudo apt-get install docker-ce docker-ce-cli containerd.io
```

3. Verify the Docker Engine is installed correctly by running the hello-world image.

```
$ sudo docker run hello-world
```

```
root@ubuntu:~# docker run hello-world
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
109db8fad215: Pull complete
Digest: sha256:df5f5184104426b65967e016ff2ac0bfcd44ad7899ca3bbcf8e44e4461491a9e
Status: Downloaded newer image for hello-world:latest

Hello from Docker!
This message shows that your installation appears to be working correctly.

To generate this message, Docker took the following steps:
 1. The Docker client contacted the Docker daemon.
 2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
    (arm64v8)
 3. The Docker daemon created a new container from that image which runs the
    executable that produces the output you are currently reading.
 4. The Docker daemon streamed that output to the Docker client, which sent it
    to your terminal.

To try something more ambitious, you can run an Ubuntu container with:
 $ docker run -it ubuntu bash

Share images, automate workflows, and more with a free Docker ID:
 https://hub.docker.com/

For more examples and ideas, visit:
 https://docs.docker.com/get-started/
```

Install docker with a simple command

```
$ curl -sSL get.docker.com | sudo sh
```

Install Docker Engine on other Linux distributions