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RK3399Pro_NPU_上电及启动介绍

RK3399Pro_NPU_Power_Up_and_Boot_Introduction

（技术部，第二系统产品部）

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V1.10	周为新 Zhou Weixin	2019.06.10	添加休眠死机相关 log Added related log for crash in sleep	
V1.20	周为新 Zhou Weixin	2019.08.14	添加 npu pcie 通信版本说明 Added NPU pcie communication version description	
V1.21	周为新 Zhou Weixin	2019.09.23	8.1 版本 usb idProduct 变更说明 Updated usb idProduct description for 8.1 version	
V1.22	周为新 Zhou Weixin	2019.10.09	9.0 版本 usb idProduct 变更说明 添加 usb 版本 adb 连接 npu 说明 Updated usb idProduct description for 9.0 version and added the description of usb version adb connection with NPU	

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目 录 Contents

前 言 PREFACE.....2
1 硬件框架 HARDWARE FRAMEWORK.....3
2 功能流程说明 FUNCTION PROCESS INTRODUCTION.....3
2.1 NPU_UPGRADE 自启动服务，包含 NPU 的上电及升级 NPU_UPGRADE AUTO-START SERVICE, INCLUDING POWER UP AND UPGRADE OF NPU.....3
2.2 NPU_UPGRADE 上电部分 NPU_POWERCTRL NPU_UPGRADE POWER-UP PART NPU_POWERCTRL.....3
2.3 NPU_UPGRADE 升级部分 UPGRADE_TOOL NPU_UPGRADE UPGRADING PART UPGRADE_TOOL.....4
2.4 NPU 启动正常标志 FLAG OF NPU NORMAL START.....4
2.5 自动休眠 AUTO SLEEP.....4
2.6 ADB 访问 NPU（目前只支持 NPU 使用 USB3.0 通信的版本） ADB ACCESS TO NPU (CURRENTLY ONLY SUPPORT THE VERSION OF NPU USING USB3.0 COMMUNICATION).....5
3 NPU 启动失败分析 NPU BOOT FAILURE ANALYSIS.....6
3.1 确认 NPU 是否正常进入烧写模式 CHECK WHETHER NPU ENTERS THE FLASHING MODE NORMALLY OR NOT.....6
3.2 休眠死机 CRASH IN SLEEP.....7
3.3 DDR 初始化失败 DDR INITIALIZATION FAILURE.....8
3.4 相关 DEBUG 命令 RELATED DEBUG COMMANDS.....9
3.5 软件配置确认 CONFIRM SOFTWARE CONFIGURATION.....9
4 NPU 启动正常，但是 DEMO 运行异常 NPU STARTS NORMALLY, BUT DEMO DOESN'T WORK 10
4.1 SSD/POSE APP DEMO 启动黑屏 SSD/POSE APP DEMO START WITH BLACK SCREEN.....10

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前 言 Preface

概述 Overview

本文档主要介绍 Rockchip RK3399Pro npu 上电及升级控制介绍，及相关 debug 方法。

This document mainly introduces Rockchip RK3399Pro NPU power up, upgrade control, and relative debugging methods.

产品版本 Product version

芯片名称 Chipset name	内核版本 kernel version
RK3399Pro	Linux4.4

读者对象 Object

本文档（本指南）主要适用于以下工程师：

This document (guide) is mainly suitable for the following engineers:

技术支持工程师

Field application engineers

软件开发工程师

Software development engineers

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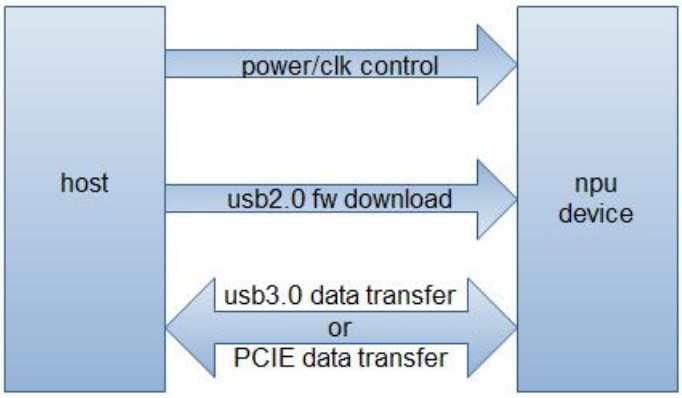
1 硬件框架 Hardware framework



RK3399Pro 系统端(android/linux os)为 host，NPU 端(linux os)为 device，host 控制 NPU 的上电及固件升级，通过 usb2.0 升级固件(升级到 DDR，所以每次开机都要重新升级)，通过 usb3.0/PCIE 传输模型数据。

RK3399Pro system (android / linux os) serves as host and NPU side (linux os) as device. The host controls the power-up and firmware upgrade of NPU, upgrading the firmware through USB2.0 (upgrade to DDR, so it requires to upgrade once boot up), and transferring the model data through USB3.0 / PCIE.

2 功能流程说明 Function process introduction

2.1 npu_upgrade 自启动服务，包含 npu 的上电及升级 npu_upgrade auto-start service, including power up and upgrade of NPU

```
rk3399pro:/ # cat vendor/etc/init/npu_upgrade.rc
service npu_upgrade vendor/bin/npu_upgrade MiniLoaderAll.bin uboot.img trust.img boot.img
    class core
    oneshot
seclabel u:r:npu_upgrade:s0
```

2.2 npu_upgrade 上电部分 npu_powerctrl Npu_upgrade power-up part npu_powerctrl

```
rk3399pro:/ #cat vendor/bin/npu_upgrade
/vendor/bin/npu_powerctrl -i
/vendor/bin/npu_powerctrl -o
```

这部分控制 npu 上电，如果上电正常，usb 会枚举到 180a 设备，npu 进入烧写模式

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This part controls the power up of NPU. If it is normal, the USB will enumerate 180a device and NPU will enter into the flashing mode.

[4.437235] usb 3-1: New USB device found, idVendor=2207, idProduct=180a

rk3399pro:/ # npu_powerctrl

Usage:npu_powerctrl [-s] [-r] [-o] [-i] [-d]

-s npu enter sleep

-r wakup npu

-o power up or reset npu

-i gpio init

-d power down

2.3 npu_upgrade 升级部分 upgrade_tool Npu_upgrade upgrading part upgrade_tool

指定固件路径： DIR="/vendor/etc/npu_fw"

Specify the firmware path: DIR="/vendor/etc/npu_fw"

指定升级工具路径：UPGRADE_TOOL=/vendor/bin/upgrade_tool

Specify the upgrade tool path: UPGRADE_TOOL=/vendor/bin/upgrade_tool

烧写 log: data/npu.log

Download log: data/npu.log

正常烧写完后 NPU 自动启动

NPU automatically starts after flashing normally.

注意：npu fw 没有提供源码，只有提供固件

Note: The source code of npu fw is not available and only firmware is provided.

2.4 NPU 启动正常标志 Flag of NPU normal start

usb3.0:

[14.265132] usb 4-1: New USB device found, idVendor=2207, idProduct=1808

or

[14.246378] usb 4-1: New USB device found, idVendor=2207, idProduct=0019

PCIE:

[14.024987] usb 1-1: New USB device found, idVendor=2207, idProduct=1005

2.5 自动休眠 Auto sleep

默认配置 NPU 空闲 15s 自动休眠

The NPU will automatically sleep while it is idle for 15s by default.

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rk3399pro:/ # getprop |grep npu.in

[npu.inactivity.sleep.secs]: [15]

关闭自动休眠:

Turn off auto sleep:

"setprop npu.inactivity.sleep.secs 0"

查看设备状态及手动唤醒：

Check the device status and manually wake up NPU:

rk3399pro:/ # lsusb //休眠后无法查看到 NPU 设备 unable to see NPU device after sleep

rk3399pro:/ # npu_powerctrl -r //手动唤醒 NPU Manually wake up NPU

rk3399pro:/ # lsusb

Bus 004 Device 003: ID 2207:1808

or

Bus 004 Device 003: ID 2207:0019

以下是休眠状态 log:

The following is the sleep log:

[PowerManager] key value is PowerKey, screen off

[PowerManager] screenOff

[PowerManager] open BACKLIGHT_BRIGHTNESS fail

[30.550996] PM: suspend entry 1970-01-01 00:00:30.547250431 UTC

[30.551027] PM: Syncing filesystems ... done.

[30.551152] Freezing user space processes ... (elapsed 0.001 seconds) done.

[30.552327] Freezing remaining freezable tasks ... (elapsed 0.001 seconds) done.

[30.553414] Suspending console(s) (use no_console_suspend to debug)

2.6 adb 访问 NPU（目前只支持 NPU 使用 usb3.0 通信的版本）Adb access to NPU (currently only support the version of NPU using usb3.0 communication)

rk3399pro:/ # adb_arm devices

List of devices attached

75ccfac14ef7e76c device

rk3399pro:/ # adb_arm shell

/ #

/ # exit

rk3399pro:/ #

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3 NPU 启动失败分析 NPU boot failure analysis

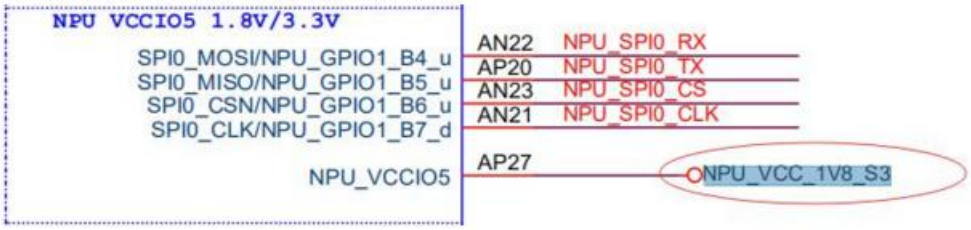
3.1 确认 NPU 是否正常进入烧写模式 Check whether NPU enters the flashing mode normally or not

rk3399pro:/ # dmesg |grep 180a

[4.437235] usb 3-1: New USB device found, idVendor=2207, idProduct=180a

a. 以下电源没有供会导致无法识别 180a

a. If the following powers are not turned on, 180a will not be recognized.



b.logcat -s NPU_POWER 确认上电控制是否正常，比如相关的 gpio 是否有 request 错误的，状态是否正常。

b. logcat -s NPU_POWER to check whether the power-up control is normal or not, for example, whether the related gpio has request error or not, whether the status is normal or not.

cat /d/gpio 查看相关的电源 gpio 是否正确，是否有被复用的

cat /d/gpio to check whether the related power gpio is correct or not, whether it is reused or not.

```
#define NPU_VDD_0V8_GPIO          "4"    //GPIO0_PA4
#define NPU_VDD_LOG_GPIO          "10" //GPIO0_PB2
#define NPU_VCC_1V8_GPIO          "11" //GPIO0_PB3
#define NPU_VDD_CPU_GPIO          "54" //GPIO1_PC6
#define NPU_VCCIO_3V3_GPIO        "55" //GPIO1_PC7
#define NPU_VDD_GPIO              "56" //GPIO1_PD0
#define CPU_RESET_NPU_GPIO        "32" //GPIO1_PA0
#define NPU_PMU_SLEEP_GPIO        "35" //GPIO1_A3
#define CPU_INT_NPU_GPIO          "36" //GPIO1_A4
```

c. 以下是正常 maskrom 状态 io

c. The following shows the status io of normal maskrom.

```
rk3399pro:/ # cat d/gpio |grep sysfs
 gpio-4   (                    |sysfs               ) out hi
 gpio-10  (                    |sysfs               ) out hi
 gpio-11  (                    |sysfs               ) out hi
 gpio-32  (                    |sysfs               ) out hi
 gpio-35  (                    |sysfs               ) in  hi
```

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```
 gpio-36   (                    |sysfs               ) out lo
 gpio-54   (                    |sysfs               ) out hi
 gpio-55   (                    |sysfs               ) out hi
 gpio-56   (                    |sysfs               ) out hi
rk3399pro:/ # cat /sys/kernel/debug/clk/clk_wifi_pmu/clk_rate
24000000
rk3399pro:/ # cat /sys/kernel/debug/clk/clk_wifi_pmu/clk_enable_count
1
```

3.2 休眠死机 Crash in sleep

休眠错误 log: 没有正常唤醒导致上层无法访问 USB 设备节点

Sleep error log: the upper layer cannot access the USB device node due to abnormal wakeup.

Logcat |grep NPU

E NPU_POWER: npu resume timeout in one second

D NPU_POWER: resume -1

E NPUTransfer: usb read failed: ret = -4: LIBUSB_ERROR_NO_DEVICE

E NPU_POWER: It is sleeping state, nothing to do!

手动休眠唤醒：

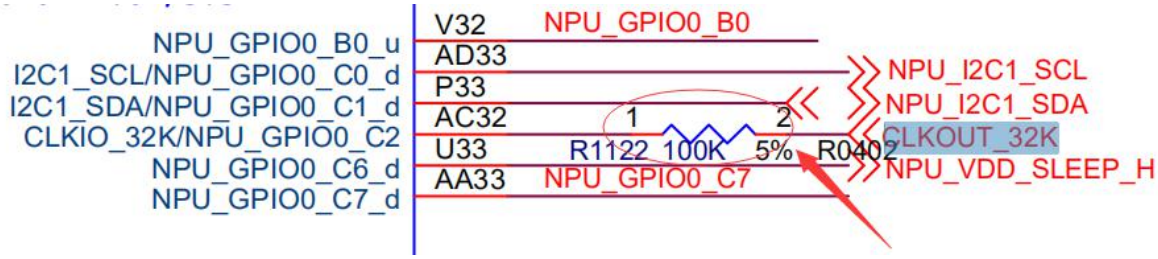
Manual sleep and wakeup:

休眠(sleep)： rk3399pro:/ # npu_powerctrl -s

唤醒(wakeup)： rk3399pro:/ # npu_powerctrl -r

a. 休眠需要外部的 32k 时钟，确认电阻有贴，确认 clk 有打开

a. Sleep requires an external 32k clock. Make sure the resistor is pasted, and the clk is enabled.



cat d/clk/rk808-clkout2/clk_enable_count

echo r 0xf2 > sys/rk8xx/rk8xx_dbg bit8 enable:1

最新版本是不需要连接 32k 的

The latest version does not require clkout-32k

hardware/rockchip/upgrade_tool$

commit 14b5d7e4e5b81ae31266cdf47866b195301a7976

Author: Weixin Zhou <zwx@rock-chips.com>

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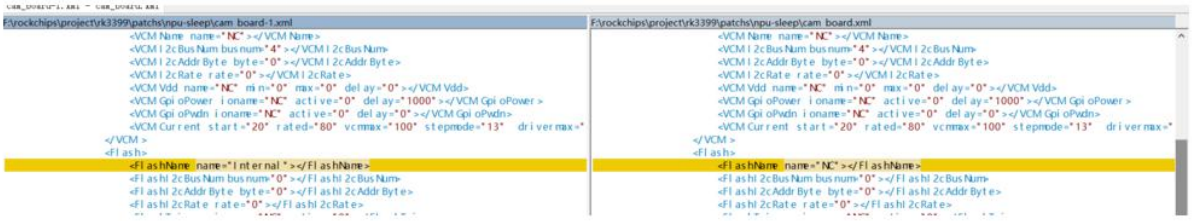
Date: Fri Jan 10 17:45:55 2020 +0800

npu_fw/npu_pcie_fw: npu sleep with pvtm 32k in stead of external 32k

b. 是否使用了 cif camera, isp0_flash 与 cpu_int_npu 复用，会导致 io 异常无法唤醒。

b. Whether cif camera is used or not. isp0_flash is reused with cpu_int_npu, which will cause io exception and fail to wake up.



c. vdd_npu 电源控制是连接到 NPU 端控制的，默认使用的是 tcs452x，不支持修改，该电源初始化错误会导致休眠死机。

c. The vdd_npu power is connected to NPU and controlled by NPU using tcs452x by default and cannot be modified. This power initialization error will cause crash in sleep.

3.3 DDR 初始化失败 DDR initialization failure

DDR Version V1.02 20190404_no_atag_soc_info_dbg
col error
Returning to boot ROM...

Modification: R3104 should be NC

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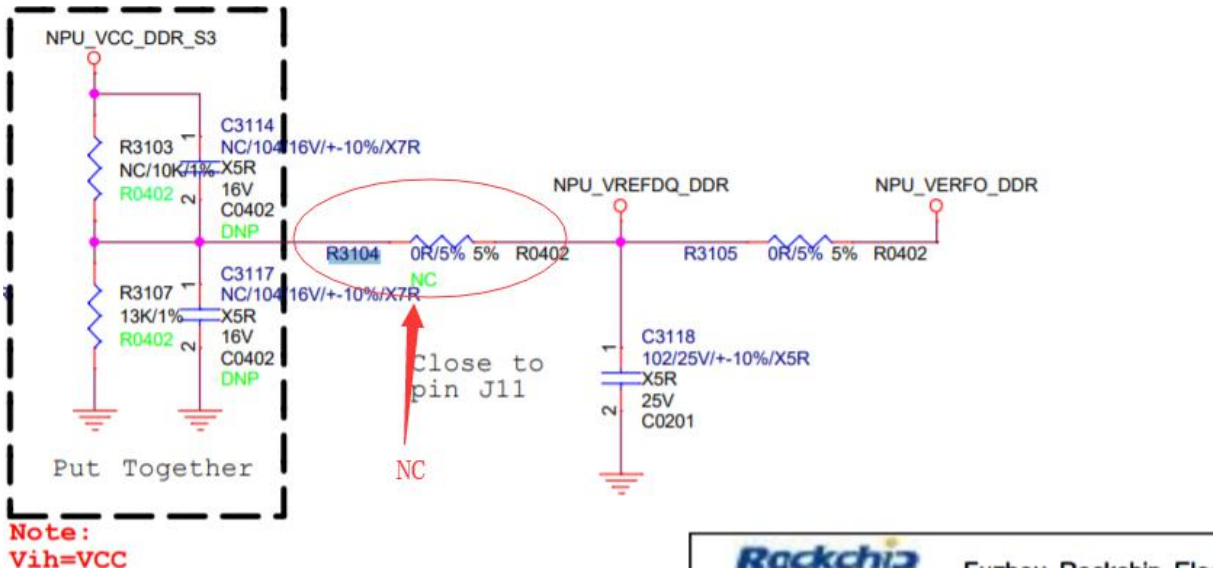

3.4 相关 debug 命令 Related debug commands

a. 手动上电烧写 Manually power-up to flash

start npu_upgrade

或者 or

vendor/bin/npu_upgrade MiniLoaderAll.bin uboot.img trust.img boot.img

b. 上电进入烧录模式 Power up and enter the flashing mode

rk3399pro:/ # npu_powerctrl -o

rk3399pro:/ # [9419.717848] usb 1-1: new high-speed USB device number 64 using xhci-hcd

[9419.839635] usb 1-1: New USB device found, idVendor=2207, idProduct=180a

[9419.839720] usb 1-1: New USB device strings: Mfr=0, Product=0, SerialNumber=0

[9419.848262] rk-hdmi-dp-sound hdmi-dp-sound: ASoC: CPU DAI (null) not registered

3.5 软件配置确认 Confirm software configuration

RK official development board	Dts android8.1 adnroid9.0	Lunch
RK_EVB_RK3399PRO_XXX_V10	rk3399pro-evb-v10dts rk3399pro-evb-v10-avb.dts	lunch rk3399pro-userdebug
RK_EVB_RK3399PRO_XXX_V11\V12	rk3399pro-evb-v11.dts rk3399pro-evb-v11-avb.dts	lunch rk3399pro-userdebug
RK_EVB_RK3399PRO_XXX_V13	rk3399pro-evb-v13-multi-cam.dts rk3399pro-evb-v13-multi-cam-avb.dts	lunch rk3399pro_pcie-userdebug

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RK_EVB_RK3399PRO_XXX_V14	Pcie： rk3399pro-evb-v13-multi-cam.dts rk3399pro-evb-v14-multi-cam-avb.dts Usb3： rk3399pro-evb-v11.dts rk3399pro-evb-v11-avb.dts	Pcie： Lunch rk3399pro_pcie_v14-userdebug Usb3： Lunch rk3399pro_usb3_v14-userdebug

Note:

V14 evb support npu transfer by usb2+pcie or usb2+usb3 which is switch by hardware.

4 NPU 启动正常，但是 demo 运行异常 NPU starts normally, but demo doesn't work

4.1 SSD/pose app demo 启动黑屏 SSD/pose app demo start with black screen

1. 在设置选项赋予 demo camera 的访问权限
   The App need give the permission of access to camera in settings
2. 通信异常如 pcie，dma chn 如果为 busy 是 pcie 通信异常
   Communication abnormalities such as pcie, dma chn, if it is busy, the pcie communication is abnormal.
   console:/ # cat d/pcie/pcie_trx
   irq_num = 0, loop_count = 0,loop_threshold = 0,lwa = ff, rwa = ff, lra = 0,list : (empty), dma chn : (free)
3. Logcat 看到以下 1)log，请使用 2)patch，(android 9.0)
   Show the log like 1) in logcat, apply the following patch to fix, (android 9.0)

1) 07:06:18.436 416 952 E Camera2-Parameters: generated preview size list is empty!!
2) RKDocs/release_patches/rk3399pro$ obtain patch. (frameworks/av$ git apply support_low_frame.patch)

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