Rockchip

USB Initialization Log Analysis

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前言

概述

本文档主要提供Rockchip SDK平台Kernel 3.10和Kernel 4.4 USB子系统初始化时相关的日志分析。

读者对象

本文档（本指南）主要适用于以下工程师：

技术支持工程师 软件工程师 硬件工程师

修订记录

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1 Linux USB子系统简介

在Linux系统中，提供了主机侧和设备侧视角的USB驱动框架及通用驱动程序。

- 主机侧分为USB Core、HOST控制器驱动，HUB驱动和各设备类驱动。
- 设备侧分为Gadget框架、Devices控制器驱动和各设备类Function驱动。

2 Rockchip SoC USB控制器列表

芯片\控制器	EHCI&OHCI	DWC2	DWC3
RV1108	Y	Y	N
RK312X	Y	Y	N
RK3288	Y	Y	N
RK322X	Y	Y	N
RK322XH	Y	Y	Y
RK3328	Y	Y	Y
RK3366	Y	Y	Y
RK3368	Y	Y	N
RK3399	Y	N	Y

3 Kernel 3.10

3.1 适用芯片

本章节介绍Linux Kernel 3.10初始化日志，主要适用于RV1108、RK312X、RK3288、RK322X、RK322XH、RK3328、RK3368等有运行Kernel 3.10 SDK的平台。

3.2 主机侧日志

3.2.1 USB CORE

```
01 [    0.959817]  usbcore: registered new interface driver usbfs
02 [    0.959890]  usbcore: registered new interface driver hub
03 [    0.960070]  usbcore: registered new device driver usb
...
```

以上是Linux Kernel 3.10启动阶段USB模块最早输出的3句log。01行表示注册USB文件系统，系统正常启动后，对应生成/sys/bus/usb/目录；02行表示成功注册USB HUB驱动；03行表明注册USB通用设备驱动，即usb_generic_driver。通常USB设备都是以设备的身份先与usb_generic_driver匹配，成功之后，会分裂出接口，当对接口调用device_add()后，会引起接口和接口驱动的匹配。

3.2.2 设备类驱动

```
01 [    1.234947]  usbcore: registered new interface driver catc
02 [    1.235015]  usbcore: registered new interface driver kaweth
03 [    1.235109]  usbcore: registered new interface driver pegasus
04 [    1.235180]  usbcore: registered new interface driver rtl8150
05 [    1.235246]  usbcore: registered new interface driver r8152
06 [    1.235379]  usbcore: registered new interface driver hso
07 [    1.235451]  usbcore: registered new interface driver asix
08 [    1.235515]  usbcore: registered new interface driver ax88179_178a
09 [    1.235586]  usbcore: registered new interface driver cdc_ether
10 [    1.235656]  usbcore: registered new interface driver cdc_eem
11 [    1.235727]  usbcore: registered new interface driver dm9601
12 [    1.235793]  usbcore: registered new interface driver dm9620
13 [    1.235867]  usbcore: registered new interface driver smsc75xx
14 [    1.235996]  usbcore: registered new interface driver smsc95xx
15 [    1.236065]  usbcore: registered new interface driver gl620a
16 [    1.236132]  usbcore: registered new interface driver net1080
17 [    1.236197]  usbcore: registered new interface driver plusb
18 [    1.236266]  usbcore: registered new interface driver rndis_host
19 ...
```

上面为主机侧设备类驱动，即各个USB设备HOST端的驱动程序，可通过menuconfig进行配置。

```
Location:
  |     -> Device Drivers
  |        -> USB support
  |        *** USB Device Class drivers ***
  |        < > xxx
  |        < > xxx
```

3.2.3 Host控制器驱动

3.2.3.1 EHCI

```
01 [    1.243691]  ehci_hcd: USB 2.0 'Enhanced' Host Controller (EHCI) Driver
02 [    1.243722]  ehci-platform: EHCI generic platform driver
03 [    1.244307]  ehci-platform ff5c0000.usb: EHCI Host Controller
04 [    1.244358]  ehci-platform ff5c0000.usb: new USB bus registered, assigned bus number 3
05 [    1.244875]  ehci-platform ff5c0000.usb: irq 48, io mem 0xff5c0000
06 [    1.252401]  ehci-platform ff5c0000.usb: USB 2.0 started, EHCI 1.00
07 [    1.252526]  usb usb3: New USB device found, idVendor=1d6b, idProduct=0002
08 [    1.252561]  usb usb3: New USB device strings: Mfr=3, Product=2, SerialNumber=1
09 [    1.252593]  usb usb3: Product: EHCI Host Controller
10 [    1.252623]  usb usb3: Manufacturer: Linux 3.10.104 ehci_hcd
11 [    1.252654]  usb usb3: SerialNumber: ff5c0000.usb
12 [    1.253238]  hub 3-0:1.0: USB hub found
13 [    1.253284]  hub 3-0:1.0: 1 port detected
14 ...
```

上述为EHCI控制器初始化完整打印，从log可以获取到如下信息：

- 控制器基本信息，包括中断号、设备虚拟地址、控制器版本等信息。
- EHCI控制器被枚举为一个USB2.0 Root HUB (hub 3-0:1.0)，同时也可以看出该HUB被分配的BUS Number (3)。

3.2.3.2 OHCI

```
01 [    1.253939]  ohci_hcd: USB 1.1 'Open' Host Controller (OHCI) Driver
02 [    1.253970]  ohci-platform: OHCI generic platform driver
03 [    1.254316]  ohci-platform ff5d0000.usb: Generic Platform OHCI controller
04 [    1.254366]  ohci-platform ff5d0000.usb: new USB bus registered, assigned bus number 4
05 [    1.254456]  ohci-platform ff5d0000.usb: irq 49, io mem 0xff5d0000
06 [    1.308870]  usb usb4: New USB device found, idVendor=1d6b, idProduct=0001
07 [    1.308909]  usb usb4: New USB device strings: Mfr=3, Product=2, SerialNumber=1
08 [    1.308942]  usb usb4: Product: Generic Platform OHCI controller
09 [    1.308973]  usb usb4: Manufacturer: Linux 3.10.104 ohci_hcd
10 [    1.309004]  usb usb4: SerialNumber: ff5d0000.usb
11 [    1.309601]  hub 4-0:1.0: USB hub found
12 [    1.309648]  hub 4-0:1.0: 1 port detected
13 ...
```

上述为OHCI控制器初始化完整打印，同EHCI，从log也可以获取到如下信息：

- 控制器基本信息，包括中断号、设备虚拟地址、控制器版本等信息。

- OHCI控制器被枚举为一个USB1.1 Root HUB (hub 4-0:1.0)，同时也可以看出该HUB被分配的BUS Number (4)。

3.2.3.3 DWC2 Host

```
01 [    1.313609]  usb20_otg ff580000.usb: DWC OTG Controller
02 [    1.313660]  usb20_otg ff580000.usb: new USB bus registered, assigned bus number 5
03 [    1.313719]  usb20_otg ff580000.usb: irq 55, io mem 0x00000000
04 [    1.313833]  usb usb5: New USB device found, idVendor=1d6b, idProduct=0002
05 [    1.313868]  usb usb5: New USB device strings: Mfr=3, Product=2, SerialNumber=1
06 [    1.313900]  usb usb5: Product: DWC OTG Controller
07 [    1.313931]  usb usb5: Manufacturer: Linux 3.10.104 dwc_otg_hcd
08 [    1.313962]  usb usb5: SerialNumber: ff580000.usb
09 [    1.314523]  hub 5-0:1.0: USB hub found
10 [    1.314568]  hub 5-0:1.0: 1 port detected
11 [    1.315013]  usb20_host: version 3.10a 21-DEC-2012
12 ...
```

上述为DWC2 HOST控制器初始化完整打印，同其它Host控制器，从log也可以获取到如下信息：

- 控制器基本信息，包括中断号、设备虚拟地址、控制器版本（version 3.10a 21-DEC-2012）等信息。
- DWC2 HOST控制器被枚举为一个USB2.0 Root HUB (hub 5-0:1.0)，同时也可以看出该HUB被分配的BUS Number (5)。

3.2.3.4 DWC3 Host

```
01 [    1.240046]  xhci-hcd xhci-hcd.0.auto: xHCI Host Controller
02 [    1.240104]  xhci-hcd xhci-hcd.0.auto: new USB bus registered, assigned bus number 1
03 [    1.241268]  xhci-hcd xhci-hcd.0.auto: irq 99, io mem 0xff600000
04 [    1.241409]  usb usb1: New USB device found, idVendor=1d6b, idProduct=0002
05 [    1.241443]  usb usb1: New USB device strings: Mfr=3, Product=2, SerialNumber=1
06 [    1.241477]  usb usb1: Product: xHCI Host Controller
07 [    1.241508]  usb usb1: Manufacturer: Linux 3.10.104 xhci-hcd
08 [    1.241539]  usb usb1: SerialNumber: xhci-hcd.0.auto
09 [    1.242232]  hub 1-0:1.0: USB hub found
10 [    1.242282]  hub 1-0:1.0: 1 port detected
11 [    1.242570]  xhci-hcd xhci-hcd.0.auto: xHCI Host Controller
12 [    1.242617]  xhci-hcd xhci-hcd.0.auto: new USB bus registered, assigned bus number 2
13 [    1.242734]  usb usb2: New USB device found, idVendor=1d6b, idProduct=0003
14 [    1.242771]  usb usb2: New USB device strings: Mfr=3, Product=2, SerialNumber=1
15 [    1.242803]  usb usb2: Product: xHCI Host Controller
16 [    1.242834]  usb usb2: Manufacturer: Linux 3.10.104 xhci-hcd
17 [    1.242865]  usb usb2: SerialNumber: xhci-hcd.0.auto
18 [    1.243408]  hub 2-0:1.0: USB hub found
19 [    1.243451]  hub 2-0:1.0: 1 port detected
20 ...
```

DWC3 Host集成XHCI控制器，上述为XHCI控制器初始化完整打印，从log可以获取到如下信息：

- 控制器基本信息，包括中断号、控制器物理地址等信息。
- XHCI控制器分别被枚举为一个USB3.0 Root HUB (hub 1-0:1.0)和一个USB2.0 Root HUB (hub 2-0:1.0)，同时也可以看出两个HUB分别被分配到的BUS Number。

3.3 设备侧日志

目前，运行Kernel 3.10 SDK的Rockchip芯片上仅集成DWC2 IP，所以Devices控制器仅DWC2一个，内核使用dwc_otg_310驱动，位于drivers/usb/dwc_otg_310目录。

3.3.1 DWC2 Peripheral

```
01 [    1.312160]  usb20_otg: version 3.10a 21-DEC-2012
02 [    1.312963]  Core Release: 3.10a
03 [    1.312992]  Setting default values for core params
04 [    1.313179]  Using Buffer DMA mode
05 [    1.313207]  Periodic Transfer Interrupt Enhancement - disabled
06 [    1.313233]  Multiprocessor Interrupt Enhancement - disabled
07 [    1.313262]  OTG VER PARAM: 0, OTG VER FLAG: 0
08 [    1.313288]  ^^^^^^^^^^^^^^^^^Device Mode
...
```

上面为Devcies控制器初始化log，从log也可以得到一些控制器信息。

- 01-02行：控制器软件版本（ version 3.10a 21-DEC-2012 ），IP版本：3.10a
- 控制器当前的工作模式和部分参数的配置。

3.3.2 DWC2 Peripheral枚举日志

```
01 [    9.208851]  [otg id chg] last id -1 current id 64
02 [    9.208971]  rk_battery_charger_detect_cb , battery_charger_detect 6
03 [    9.308586]  Using Buffer DMA mode
04 [    9.308692]  Periodic Transfer Interrupt Enhancement - disabled
05 [    9.308710]  Multiprocessor Interrupt Enhancement - disabled
06 [    9.308729]  OTG VER PARAM: 0, OTG VER FLAG: 0
07 [    9.308745]  ^^^^^^^^^^^^^^^^^Device Mode
08 [    9.308774]  dwc_otg_hcd_resume, usb device mode
09 [    9.409073]  wc_otg_hcd_suspend, usb device mode
10 [    9.799241]  ***************vbus detect*****************
11 [    9.801964]  rk_battery_charger_detect_cb , battery_charger_detect 1
12 [    9.924721]  Using Buffer DMA mode
13 [    9.924755]  Periodic Transfer Interrupt Enhancement - disabled
14 [    9.924772]  Multiprocessor Interrupt Enhancement - disabled
15 [    9.924790]  OTG VER PARAM: 0, OTG VER FLAG: 0
16 [    9.924807]  ^^^^^^^^^^^^^^^^^Device Mode
17 [    9.924873]  ******************soft connect!!!******************
18 [   10.038883]  USB RESET
19 [   10.129663]  ndroid_work: sent uevent USB_STATE=CONNECTED
20 [   10.133049]  USB RESET
21 [   10.256977]  android_usb gadget: high-speed config #1: android
22 [   10.257999]  android_work: sent uevent USB_STATE=CONFIGURED
23 [   10.297006]  mtp_open
24 ...
```

上面log为DWC2 peripheral枚举的完整日志。

- 01行表示检测到USB ID变化，有USB线接入；
- 03-07为控制器重新初始化log；
- 10行表示检测到VBUS；
- 18 - 22行为USB枚举成功，并通过UEVENT事件通知Android层Gadget连接成功。

---

4 Kernel 4.4

4.1 适用芯片

本章节介绍Linux Kernel 4.4初始化日志，主要适用于RK312X、RK3288、RK322X、RK322XH、RK3328、RK3366、RK3368，RK3399等有运行Kernel 4.4 SDK的平台。

4.2 主机侧日志

4.2.1 USB CORE及设备类驱动

跟Linux Kernel 3.10相同，usbcore注册USB文件系统、注册USB HUB驱动，以及注册USB通用设备驱动，log同Linux Kernel 3.10 。

设备类驱动亦同Kernel 3.10，log和配置方式也相同。

4.2.2 Host控制器驱动

4.2.3.1 EHCI

```
01 [    0.869076] ehci_hcd: USB 2.0 'Enhanced' Host Controller (EHCI) Driver
02 [    0.869099] ehci-pci: EHCI PCI platform driver
03 [    0.869191] ehci-platform: EHCI generic platform driver
04 [    0.873032] ehci-platform ff5c0000.usb: EHCI Host Controller
05 [    0.873078] ehci-platform ff5c0000.usb: new USB bus registered, assigned bus number 2
06 [    0.873322] ehci-platform ff5c0000.usb: irq 44, io mem 0xff5c0000
07 [    0.883191] ehci-platform ff5c0000.usb: USB 2.0 started, EHCI 1.00
08 [    0.883418] usb usb2: New USB device found, idVendor=1d6b, idProduct=0002
09 [    0.883438] usb usb2: New USB device strings: Mfr=3, Product=2, SerialNumber=1
10 [    0.883454] usb usb2: Product: EHCI Host Controller
11 [    0.883469] usb usb2: Manufacturer: Linux 4.4.103 ehci_hcd
12 [    0.883484] usb usb2: SerialNumber: ff5c0000.usb
13 [    0.884226] hub 2-0:1.0: USB hub found
14 [    0.884291] hub 2-0:1.0: 1 port detected
15 ...
```

上述为EHCI控制器初始化完整打印，从log也可以获取到如下信息：

- 控制器基本信息，包括中断号、设备虚拟地址、控制器驱动版本等信息。
- EHCI控制器被枚举为一个USB2.0 Root HUB (hub 2-0:1.0)，同时也可以看出该HUB被分配的BUS Number (2)。

4.2.3.2 OHCI

```
01 [    0.884853] ohci_hcd: USB 1.1 'Open' Host Controller (OHCI) Driver
02 [    0.884897] ohci-platform: OHCI generic platform driver
03 [    0.885315] ohci-platform ff5d0000.usb: Generic Platform OHCI controller
04 [    0.885352] ohci-platform ff5d0000.usb: new USB bus registered, assigned bus number 3
05 [    0.885551] ohci-platform ff5d0000.usb: irq 45, io mem 0xff5d0000
06 [    0.940734] usb usb3: New USB device found, idVendor=1d6b, idProduct=0001
07 [    0.940763] usb usb3: New USB device strings: Mfr=3, Product=2, SerialNumber=1
08 [    0.940783] usb usb3: Product: Generic Platform OHCI controller
09 [    0.940800] usb usb3: Manufacturer: Linux 4.4.103 ohci_hcd
10 [    0.940815] usb usb3: SerialNumber: ff5d0000.usb
11 [    0.941546] hub 3-0:1.0: USB hub found
12 [    0.941597] hub 3-0:1.0: 1 port detected
13 ...
```

上述为OHCI控制器初始化完整打印，同EHCI，从log也可以获取到如下信息：

- 控制器基本信息，包括中断号、设备虚拟地址、控制器驱动版本等信息。
- OHCI控制器被枚举为一个USB1.1 Root HUB (hub 3-0:1.0)，同时也可以看出该HUB被分配的BUS Number (3)。

4.2.3.3 DWC2 Host

```
01 [    0.579425] ff580000.usb supply vusb_d not found, using dummy regulator
02 [    0.579500] ff580000.usb supply vusb_a not found, using dummy regulator
03 [    0.866540] dwc2 ff580000.usb: EPs: 10, dedicated fifos, 972 entries in SPRAM
04 [    0.867120] dwc2 ff580000.usb: DWC OTG Controller
05 [    0.867163] dwc2 ff580000.usb: new USB bus registered, assigned bus number 1
06 [    0.867211] dwc2 ff580000.usb: irq 43, io mem 0x00000000
07 [    0.867428] usb usb1: New USB device found, idVendor=1d6b, idProduct=0002
08 [    0.867449] usb usb1: New USB device strings: Mfr=3, Product=2, SerialNumber=1
09 [    0.867466] usb usb1: Product: DWC OTG Controller
10 [    0.867480] usb usb1: Manufacturer: Linux 4.4.103 dwc2_hsotg
11 [    0.867495] usb usb1: SerialNumber: ff580000.usb
12 [    0.868254] hub 1-0:1.0: USB hub found
13 [    0.868303] hub 1-0:1.0: 1 port detected
14 ...
```

上述为DWC2 HOST控制器初始化完整打印，同其它Host控制器，从log也可以获取到如下信息：

- 控制器基本信息，包括中断号、设备虚拟地址、控制器部分配置信息。
- DWC2 HOST控制器被枚举为一个USB2.0 Root HUB (hub 1-0:1.0)，同时也可以看出该HUB被分配的BUS Number (1)。

4.2.3.4 DWC3 Host

```
01 [    0.942624] xhci-hcd xhci-hcd.7.auto: xHCI Host Controller
02 [    0.942662] xhci-hcd xhci-hcd.7.auto: new USB bus registered, assigned bus number 4
03 [    0.943032] xhci-hcd xhci-hcd.7.auto: hcc params 0x0220fe64 hci version 0x110 quirks
   0x00210010
04 [    0.943107] xhci-hcd xhci-hcd.7.auto: irq 185, io mem 0xff600000
05 [    0.943357] usb usb4: New USB device found, idVendor=1d6b, idProduct=0002
06 [    0.943378] usb usb4: New USB device strings: Mfr=3, Product=2, SerialNumber=1
```

```
07 [    0.943395] usb usb4: Product: xHCI Host Controller
08 [    0.943410] usb usb4: Manufacturer: Linux 4.4.103 xhci-hcd
09 [    0.943425] usb usb4: SerialNumber: xhci-hcd.7.auto
10 [    0.944176] hub 4-0:1.0: USB hub found
11 [    0.944226] hub 4-0:1.0: 1 port detected
12 [    0.944647] xhci-hcd xhci-hcd.7.auto: xHCI Host Controller
13 [    0.944676] xhci-hcd xhci-hcd.7.auto: new USB bus registered, assigned bus number 5
14 [    0.944779] usb usb5: We don't know the algorithms for LPM for this host, disabling
LPM.
15 [    0.944943] usb usb5: New USB device found, idVendor=1d6b, idProduct=0003
16 [    0.944963] usb usb5: New USB device strings: Mfr=3, Product=2, SerialNumber=1
17 [    0.944979] usb usb5: Product: xHCI Host Controller
18 [    0.944994] usb usb5: Manufacturer: Linux 4.4.103 xhci-hcd
19 [    0.945009] usb usb5: SerialNumber: xhci-hcd.7.auto
20 [    0.945718] hub 5-0:1.0: USB hub found
21 [    0.945766] hub 5-0:1.0: 1 port detected
22 ...
```

DWC3 Host集成XHCI控制器，上述为XHCI控制器初始化完整打印，从log可以获取到如下信息：

- 控制器基本信息，包括中断号、设备虚拟地址、控制器版本等信息。
- XHCI控制器分别被枚举为一个USB3.0 Root HUB (hub 4-0:1.0)和一个USB2.0 Root HUB (hub 5-0:1.0)，同时也可以看出两个HUB被分配到的BUS Number。

4.3 设备侧日志

目前，Rockchip SoC除RK3399 芯片外，其它芯片都是集成DWC2 OTG IP，RK3399集成DWC3 OTG IP，支持USB3.0，所以设备侧log分dwc2和dwc3阐述。

Kernel 4.4，DWC2使用drivers/usb/dwc2目录驱动；DWC3使用drivers/usb/dwc3目录驱动。

4.3.1 DWC2/DWC3 Peripheral

Kernel 4.4，开机在没有连接USB线的情况下，对于DWC2，如果控制器为OTG模式，日志同DWC2 Host；如果为Peripheral模式，则没有特别log输出；DWC3跟DWC2类似。

4.3.2 DWC2 Peripheral枚举日志

```
01 [   18.566773] read descriptors
02 [   18.566811] read descriptors
03 [   18.566820] read strings
04 [   18.631141] dwc2 ff580000.usb: bound driver configfs-gadget
05 [   18.767106] dwc2 ff580000.usb: new device is high-speed
06 [   18.796143] android_work: sent uevent USB_STATE=CONNECTED
07 [   18.807125] dwc2 ff580000.usb: new device is high-speed
08 [   18.835990] dwc2 ff580000.usb: new address 1
09 [   18.871528] configfs-gadget gadget: high-speed config #1: b
10 [   18.871732] android_work: sent uevent USB_STATE=CONFIGURED
11 ...
```

上面Log为DWC2 Peripheral枚举的完整日志。

- 01-03行Android层开始配置Gadget；
- 04-05为控制器枚举信息；
- 06行表示枚举成功，Gadget通过Uevent向Android发送Connected消息；
- 10行Gadget通过Uevent向Android发送Configured消息；表示Gadget配置成功。

4.3.3 DWC3 Peripheral枚举日志

```
01 [   13.924130] fusb302 4-0022: CC connected in 1 as UFP
02 [   14.061902] phy phy-ff770000.syscon:usb2-phy@e450.5: charger = USB_SDP_CHARGER
03 [   15.633013] fusb302 4-0022: PD disabled
04 [   15.635514] cdn-dp-fb fec00000.dp-fb: lanes count does not change: 0
05 [   15.651643] rockchip-dwc3 usb@fe800000: USB peripheral connected
06 [   19.811878] read descriptors
07 [   19.811923] read strings
08 [   19.938589] android_work: sent uevent USB_STATE=CONNECTED
09 [   19.973662] configfs-gadget gadget: super-speed config #1: b
10 [   19.974071] android_work: sent uevent USB_STATE=CONFIGURED
11 ...
```

上面log为DWC3 Peripheral枚举的完整日志。

- 01行FUSB302检测到USB线有接入；
- 02行充电检测启动，因为接着PC，所以为标准充电器；
- 06-07行Android层开始配置Gadget；
- 08行表示枚举成功，Gadget通过Uevent向Android发送Connected消息；
- 09-10行，USB Config配置成功，Gadget通过Uevent向Android发送Configured配置成功消息。