华为模块

Linux 内核驱动集成指导

文档版本　2.0

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关于本文档

修订记录

文档版本	日期	章节	说明
V1.2.9	2013-12-30		第一次发布
V2.0	2014-11-17	All	更新支持的内核系统和内核版本
		All	更新 USB 和 CDC ECM 驱动集成说明
		All	增加 CDC MBIM 和电源驱动集成说明
		8	增加 make menuconfig 配置
		9	增加 FAQ
		10	增加缩略语

目录

1 目的

本文档主要针对华为模块设备基于 Linux 内核系统（如 Android、Ubuntu 和 Chrome OS 等）驱动集成开发活动进行相关的指导说明，主要面向基于 Linux 内核产品开发商的驱动开发人员。

2 范围

功能	描述	
支持的系统	Linux、Android 和 Chrome OS	
支持的模块制式	WCDMA/CDMA/LTE	
支持的内核版本	2.6.12 以前的版本	本文档不支持
	2.6.12～2.6.21	支持 USB 串口驱动集成（章节 4 ）
	2.6.22～2.6.31	• 支持 USB 串口驱动集成（章节 4 ） • 支持 CDC ECM 驱动集成（章节 5 ）
	2.6.32～3.8	• 支持 USB 串口驱动集成（章节 4 ） • 支持 CDC ECM 驱动集成（章节 5 ） • 支持电源管理集成（章节 7 ）
	3.9 及以后的版本	• 支持 USB 串口驱动集成（章节 4 ） • 支持 CDC ECM 驱动集成（章节 5 ） • 支持 CDC MBIM 集成（章节 6 ） • 支持电源管理集成（章节 7 ）

3 概要

本文档主要介绍如何修改 Linux 内核代码，使客户系统（如 Android 等）能够正常加载模块。因本文档支持的系统都是基于 Linux 内核的系统，下文统一称 Linux 侧。

华为模块在 Linux 侧使用的驱动分为两部分。

- **自研接口**：对应使用的内核驱动名称为 option，这部分接口需要将华为模块的驱动适配数据添加到驱动中才能正常使用。
- **通用接口**：如 ECM、MBIM。对于这部分接口，华为模块直接适配通用驱动，无需修改代码。

两部分驱动都需要进行内核编译配置项设置，确保驱动编译进内核。

4 USB 串口驱动集成

USB 串口驱动集成可满足模块最基本功能的使用。

4.1 简要说明

该部分为华为自研接口，包括：Modem、PCUI、Diag、GPS 和 GPS Control 等。其中，

- Modem 端口用于 Linux 侧和华为模块进行 PPP-Modem 拨号命令及数据业务的交互。
- PCUI 端口用于 Linux 侧与华为模块进行普通 AT 命令的交互。
- Diag 端口用于抓取华为模块侧 log 信息。
- GPS 和 GPS Control 端口用于下发 GPS 相关命令和获取 GPS NMEA 信息。

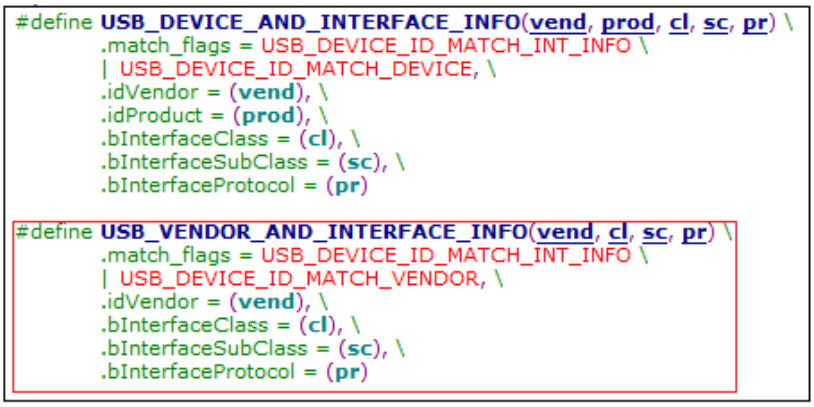
这部分集成涉及修改的 Linux 内核源码文件为：

```
linux_src/drivers/usb/serial/option.c
linux_src/drivers/usb/serial/usb_wwan.c
linux_src/include/linux/usb.h
```

4.2 代码修改

4.2.1 增加宏定义

步骤 1　在 **linux_src/include/linux/usb.h** 中添加如下宏：



若部分内核已经添加，则无需添加此部分。详文如下：

```
#define USB_VENDOR_AND_INTERFACE_INFO(vend, cl, sc, pr) \
    .match_flags = USB_DEVICE_ID_MATCH_INT_INFO \
        | USB_DEVICE_ID_MATCH_VENDOR, \
    .idVendor = (vend), \
    .bInterfaceClass = (cl), \
    .bInterfaceSubClass = (sc), \
    .bInterfaceProtocol = (pr)
```

步骤 2 在 **linux_src/drivers/usb/serial/option.c** 文件中的 **static const struct usb_device_id option_ids[]**的 id 列表中增加如下语句, 用于匹配设备数据。

说明
必须确保内核代码中已包含如下列表中所有语句，否则，可能导致模块 USB 端口映射不正常。

以下括号内对应内容为**{VID,InterfaceClass, InterfaceSubClass, InterfaceProtocol}**。

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0xff,
0xff) },
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x01) },
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x02) },
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x03) },
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x04) },
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x05) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x06) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x31) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x32) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x33) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x34) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x35) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x36) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x61) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x62) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x63) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x64) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x65) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x66) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x0A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x0B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x0D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x0E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x0F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x3A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x3B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x3D) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x3E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x3F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x6A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x6B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x6D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x6E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x6F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x10) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x12) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x13) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x14) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x15) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x17) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x18) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x19) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x1A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x1B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x1C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x1D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x48) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x49) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x4A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x4B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x4C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x4D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x72) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x73) },

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0x74) },

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0x75) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x78) },

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0x79) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x7A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x7B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x7C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01,
0x7D) },

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0x03) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
0x04) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
0x05) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
0x06) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
0x31) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
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0x35) },

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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
0x3E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
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```

```
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
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```

```
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
0x7B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
0x7C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02,
0x7D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x01) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x02) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x03) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x05) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x06) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x31) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x32) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x33) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x34) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x35) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x36) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x61) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x62) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x63) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x64) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x65) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x66) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x0A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x0B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x0D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x0E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x0F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x3A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x3B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x3D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x3E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x3F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x6A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x6B) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x6D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x6E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x6F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x10) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x12) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x13) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x14) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x15) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x17) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x18) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x19) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x1A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x1B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x1C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x1D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x48) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x49) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x4A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x4B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x4C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x4D) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x72) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x73) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x74) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x75) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x78) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x79) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x7A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x7B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x7C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03,
0x7D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x01) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x02) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x03) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x04) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x05) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x06) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x31) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x32) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x33) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x34) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x35) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x36) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x61) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x62) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x63) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x64) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x65) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x66) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x0A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x0B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x0D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x0E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x0F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x3A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x3B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x3D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x3E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x3F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x6A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x6B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x6D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x6E) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x6F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x10) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x12) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x13) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x14) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x15) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x17) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x18) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x19) },

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0x1A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x1B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x1C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x1D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x48) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x49) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x4A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x4B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x4C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x4D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x72) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x73) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x74) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x75) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x78) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x79) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x7A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x7B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x7C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04,
0x7D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x01) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x02) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x03) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x04) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x05) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x06) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x31) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x32) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x33) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x34) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x35) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x36) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x61) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x62) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x63) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x64) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x65) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x66) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x0A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x0B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x0D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x0E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x0F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x3A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x3B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x3D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x3E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x3F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x6A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x6B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x6D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x6E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x6F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x10) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x12) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x14) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x15) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x17) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x18) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x1A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x1B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x1C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x4A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x4C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x4D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x72) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x73) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x74) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x75) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x78) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x79) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x7A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x7B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x7C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05,
0x7D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
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0x31) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x32) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x33) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x34) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x35) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x36) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x61) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x62) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x63) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
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{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x65) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x66) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x0A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x0B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x0D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x0E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x0F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x3A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x3B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x3D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x3E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x3F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x6A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x6B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x6D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x6E) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x6F) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x10) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x12) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x13) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x14) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x15) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x17) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x18) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x19) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x1A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x1B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x1C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x1D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x48) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x49) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x4A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x4B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x4C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x4D) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x72) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x73) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x74) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x75) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x78) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x79) },
```

```
{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x7A) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x7B) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x7C) },

{ USB_VENDOR_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06,
0x7D) },
```

4.2.2 添加 USB 零包机制

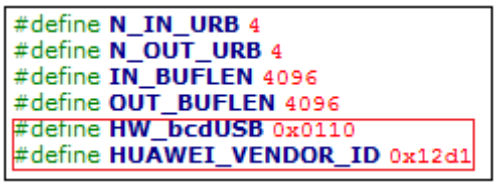
根据 USB 协议，添加关于传输中对于零包的处理。

修改文件为 **linux_src/drivers/usb/serial/usb_wwan.c**。

步骤 1 增加对 bcdUSB 值的定义：**#define HW_bcdUSB 0x0110**；

增加对华为 vid 值的定义：**#define HUAWEI_VENDOR_ID 0x12d1**。

如图所示：

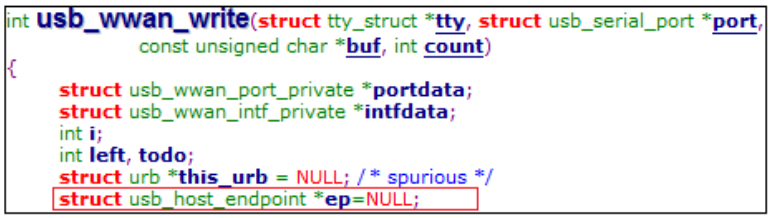


详文如下：

```
#define HW_bcdUSB 0x0110

#define HUAWEI_VENDOR_ID 0x12d1
```

步骤 2 在 **linux_src/drivers/usb/serial/usb_wwan.c 文件中的 usb_wwan_write** 函数内增加定义：**struct usb_host_endpoint *ep=NULL;**，增加位置如下图红框所示：



详文如下：

```
struct usb_host_endpoint *ep=NULL;
```

步骤 3 在 **usb_wwan_write** 函数增加对零包的判断，增加位置如红框所示：

```
memcpy(this_urb->transfer_buffer, buf, todo);
this_urb->transfer_buffer_length = todo;

if((HUAWEI_VENDOR_ID == port->serial->dev->descriptor.idVendor)
  && (HW_bcdUSB != port->serial->dev->descriptor.bcdUSB)){
  ep = usb_pipe_endpoint(this_urb->dev, this_urb->pipe);
  if(ep && (0 != this_urb->transfer_buffer_length)
    && (0 == this_urb->transfer_buffer_length % ep->desc.wMaxPacketSize)){
    this_urb->transfer_flags |= URB_ZERO_PACKET;
  }
}

spin_lock_irqsave(&intfdata->susp_lock, flags);
if (intfdata->suspended) {
   usb_anchor_urb(this_urb, &portdata->delayed);
   spin_unlock_irqrestore(&intfdata->susp_lock, flags);
}
```

详文如下：

```
if((HUAWEI_VENDOR_ID == port->serial->dev->descriptor.idVendor)
    && (HW_bcdUSB != port->serial->dev->descriptor.bcdUSB)){
    ep = usb_pipe_endpoint(this_urb->dev, this_urb->pipe);
    if(ep && (0 != this_urb->transfer_buffer_length)
        && (0 == this_urb->transfer_buffer_length %
ep->desc.wMaxPacketSize)){
        this_urb->transfer_flags |= URB_ZERO_PACKET;
    }
}
```

4.3 内核的编译配置

文本配置方式，修改 linux_src/目录下的.config 文件。

- USB 串口驱动相关的配置项：

  ```
  CONFIG_USB_SERIAL=y
  CONFIG_USB_SERIAL_OPTION=y
  CONFIG_USB_SERIAL_WWAN=y
  ```

  说明

  USB 串口驱动相关配置项在 make menuconfig 的图像界面配置方法，请参考 8.1 。

- PPP 拨号的相关配置项：

  ```
  CONFIG_PPP=y
  CONFIG_PPP_MULTILINK=y
  CONFIG_PPP_FILTER=y
  CONFIG_PPP_ASYNC=y
  ```

```
CONFIG_PPP_SYNC_TTY=y
CONFIG_PPP_DEFLATE=y
CONFIG_PPP_BSDCOMP=y
```

说明

PPP 拨号相关配置项在 make menuconfig 的图像界面配置方法，请参考 8.2 。

5 CDC ECM 驱动集成

5.1 简要说明

CDC ECM 驱动是华为模块适配标准的 ECM 通用驱动，无需额外的代码修改，直接配置编译项即可。该功能支持内核 2.6.22 及以后的版本。对于内核为 2.6.22 之前的版本，Linux 侧若需要使用数据业务，则需要集成 PPP 相关配置项（参考章节 4.3 中关于 PPP 配置项的说明），使用 PPP-Modem 拨号的方式进行数据业务。

5.2 内核编译配置

文本配置方式，修改 Android 内核的编译配置（在 **linux_src/**目录下的**.config** 文件中）。

CDC ECM 驱动的相关配置项：

```
CONFIG_USB_USBNET=y
CONFIG_NETDEVICES=y
CONFIG_USB_NET_CDCETHER=y
```

说明

make menuconfig 的图像界面配置，请参考 8.3 。

6 CDC MBIM 驱动集成

6.1 简要说明

CDC MBIM 驱动是华为模块适配标准的通用驱动，无需额外的代码修改，直接配置编译项即可。该功能支持内核 3.9 及以后的版本。

6.2 内核的编译配置

文本配置方式，修改 Android 内核的编译配置（在 **linux_src/**目录下的**.config** 文件中）。

CDC MBIM 驱动的相关配置项：

```
CONFIG_USB_USBNET=y
CONFIG_NETDEVICES=y
CONFIG_USB_NET_CDC_MBIM=y
```

说明

make menuconfig 的图像界面配置，参考 8.4 。

7 电源管理集成

该功能集成支持内核 2.6.32 及以后的版本。对内核 2.6.32 之前的版本，休眠唤醒功能则不支持。

7.1 USB 串口驱动电源管理集成

因 Linux-2.6.32 以上的内核已自带 selective suspend 电源管理特性，所以只需将电源管理的开关打开，USB 串口驱动即支持 selective suspend 电源管理。

7.1.1 代码修改

步骤 1 首先，确定修改的位置，不同版本可能修改的函数不同。在 **linux_src/drivers/usb/serial/option.c** 文件中，找到结构体中 **option_1port_device** 和 attach 指向的函数。内核 2.6.35 此处指向的是 **usb_wwan_startup()**函数，如下图。

```
static struct usb_serial_driver option_1port_device = {
    .driver = {
    .owner =    THIS_MODULE,
    .name =     "option1",
    },
    .description       = "GSM modem (1-port)",
    .usb_driver        = &option_driver,
    .id_table          = option_ids,
    .num_ports         = 1,
    .probe             = option_probe,
    .open              = usb_wwan_open,
    .close             = usb_wwan_close,
    .dtr_rts   = usb_wwan_dtr_rts,
    .write             = usb_wwan_write,
    .write_room        = usb_wwan_write_room,
    .chars_in_buffer   = usb_wwan_chars_in_buffer,
    .set_termios       = usb_wwan_set_termios,
    .tiocmget          = usb_wwan_tiocmget,
    .tiocmset          = usb_wwan_tiocmset,
    .attach            = usb_wwan_startup,
    .disconnect        = usb_wwan_disconnect,
    .release           = usb_wwan_release,
    .read_int_callback = option_instat_callback,
#ifdef CONFIG_PM
    .suspend           = usb_wwan_suspend,
    .resume            = usb_wwan_resume,
#endif
};
```

步骤 2 定义 **linux_src/drivers/usb/serial/usb_wwan.c** 中的 **usb_wwan_startup()**函数变量后，加入红框部分语句，即可支持 selective suspend 特性。（先增加宏 **#define HUAWEI_VENDOR_ID 0x12d1**）

```
int usb_wwan_startup(struct usb_serial *serial)
{
    int i, j, err;
    struct usb_serial_port *port;
    struct usb_wwan_port_private *portdata;
    u8 *buffer;

    dbg("%s", __func__);

    if (serial->dev->descriptor.idVendor == HUAWEI_VENDOR_ID) {
        if ( 0 != (serial->dev->config->desc.bmAttributes & 0x20)){
            usb_enable_autosuspend(serial->dev);
        }
    }
```

详文如下：

```
if (serial->dev->descriptor.idVendor == HUAWEI_VENDOR_ID) {
if ( 0 != (serial->dev->config->desc.bmAttributes & 0x20)){
usb_enable_autosuspend(serial->dev);
}
}
```

步骤 3 在 **linux_src/drivers/usb/serial/option.c** 文件的 **option_driver** 的结构体中，增加对 **reset_resume** 函数的调用（复位一个已被挂起的 USB 设备时调用此函数），加入红框部分语句。如图所示：（部分版本已取消，若没有则不需添加）

```
static struct usb_driver option_driver = {
      .name       = "option",
      .probe      = usb_serial_probe,
      .disconnect = usb_serial_disconnect,
#ifdef CONFIG_PM
      .suspend    = usb_serial_suspend,
      .resume     = usb_serial_resume,
      .reset_resume = usb_serial_resume,
      .supports_autosuspend = 1,
#endif
      .id_table   = option_ids,
      .no_dynamic_id = 1,
};
```

详文如下：

```
.reset_resume = usb_serial_resume,
```

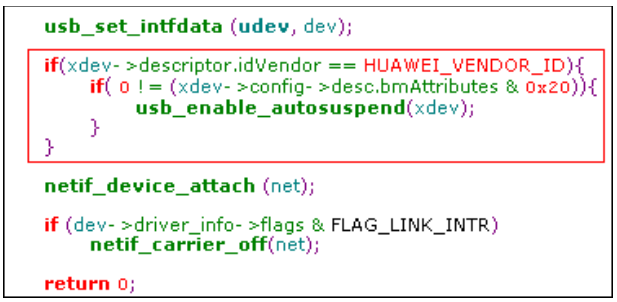
7.1.2 内核的编译配置

文本配置方式：修改 Android 内核的编译配置（在 **linux_src/**目录下的**.config** 文件中）。

```
CONFIG_USB_SUPPORT=y
CONFIG_USB =y
CONFIG_PM_RUNTIME=y
CONFIG_USB_SUSPEND=y
```

7.2 CDC ECM 电源管理集成

CDC ECM 驱动修改部分：在 **linux_src/drivers/net/usb/usbnet.c** 中的 **usbnet_probe()**函数内加入红色框部分语句，即可支持 selective suspend 特性。如图所示（先增加宏**#define HUAWEI_VENDOR_ID 0x12d1**）：

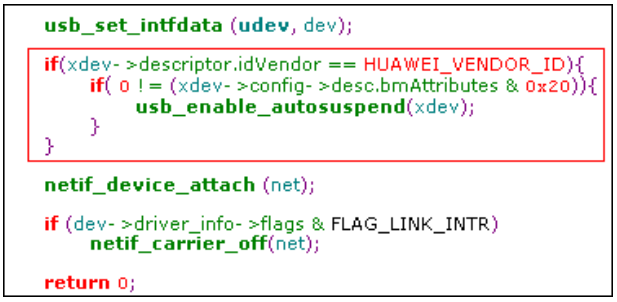


详文如下：

```
if(xdev->descriptor.idVendor == HUAWEI_VENDOR_ID){
        if( 0 != (xdev->config->desc.bmAttributes & 0x20)){
            usb_enable_autosuspend(xdev);
        }
    }
```

7.3 CDC MBIM 电源管理集成

CDC MBIM 驱动修改部分：在 **linux_src/drivers/net/usb/usbnet.c** 中的 **usbnet_probe(……)**函数内加入红色框部分语句，即可支持 selective suspend 特性。如图所示（先增加宏**#define HUAWEI_VENDOR_ID 0x12d1**）：



详文如下：

```
if(xdev->descriptor.idVendor == HUAWEI_VENDOR_ID){
        if( 0 != (xdev->config->desc.bmAttributes & 0x20)){
            usb_enable_autosuspend(xdev);
```

```
        }
    }
```

7.4 自动休眠延迟时间修改设置

电源管理开启时，系统默认的自动休眠延迟时间是 2 秒，即主机和模块之间的 USB 通信。如果出现空闲时间超过该时间值，则主机会自动使 USB 模块进入休眠状态。客户可以在下表的基础上，根据自己的需要修改该延迟时间。

产品型号	自动休眠的最小延迟时间	原因
MU736	5s	GPS 定位首次数据上报可能概率性较长，5s 能保证首次 GPS 数据上报

在 **linux_src/drivers/usb/core/usb.c** 中，修改如下：

```
static int nousb;/* Disable USB when built into kernel image */

#ifdef CONFIG_USB_SUSPEND
static int usb_autosuspend_delay = 2;/* Default delay value,* in seconds */

module_param_named(autosuspend, usb_autosuspend_delay, int, 0644);
MODULE_PARM_DESC(autosuspend, "default autosuspend delay");
```

详文如下

```
static int usb_autosuspend_delay = 2;/* Default delay value,* in
seconds */
```

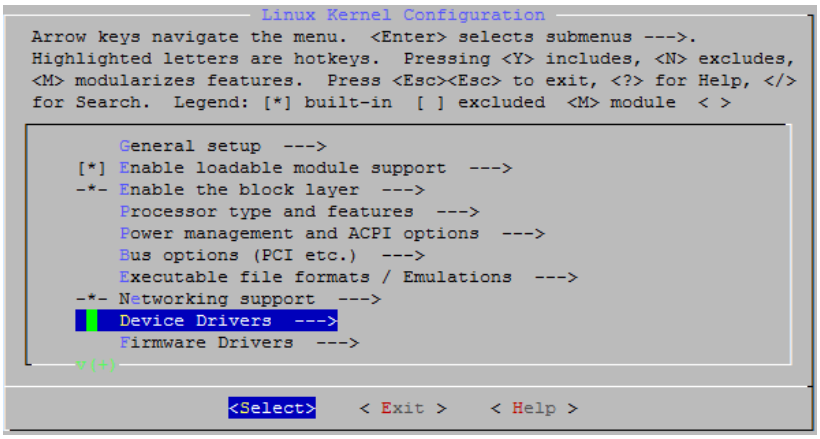
可通过修改 **usb_autosuspend_delay** 的值修改延迟时间。

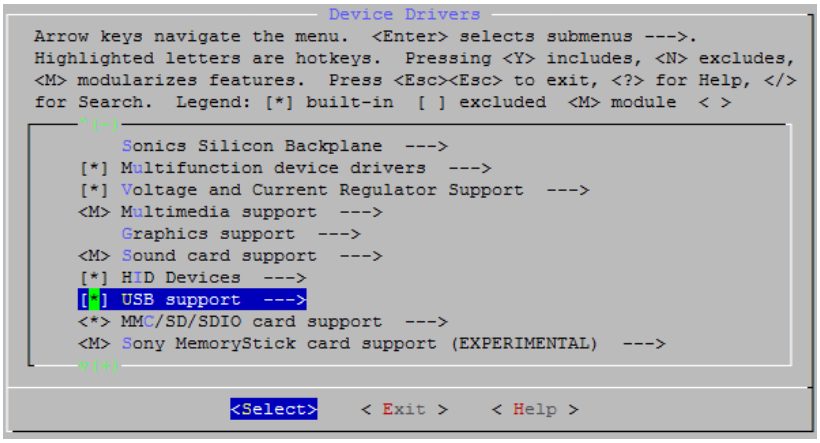
说明

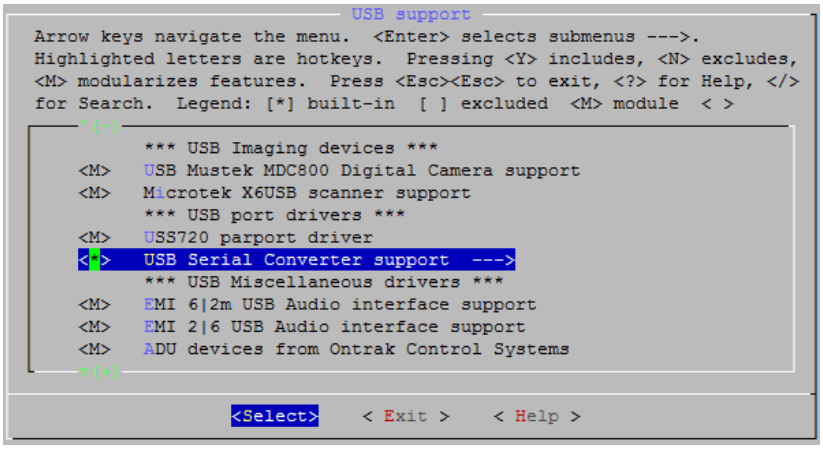
- 需确保该休眠延迟时间大于模块的 GPS 数据上报周期的时间（确保 GPS 数据上报过程中，系统不会自动使模块进入休眠，避免 GPS 数据传输中断）。
- 模块的 GPS 数据上报周期的时间设置，请参考产品 AT 命令手册的 **AT^WPDFR**。默认情况下，GPS 数据上报周期为 1s，自动休眠的最小延迟时间为 2s。

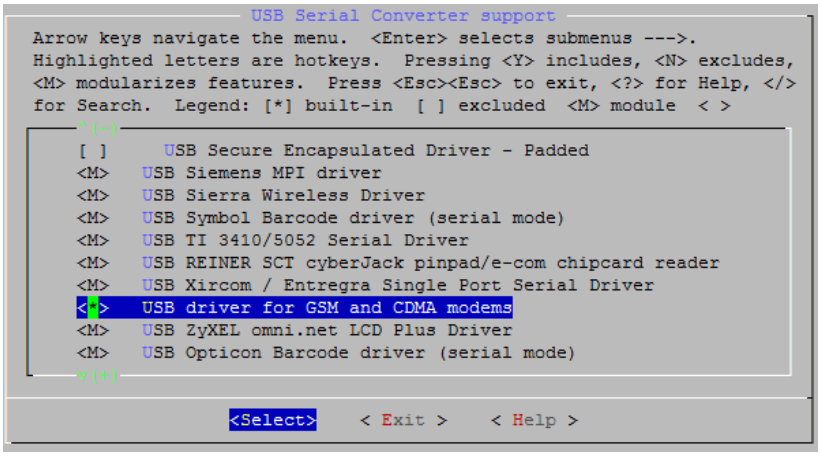
8 make menuconfig 配置

8.1 USB 串口驱动编译配置项

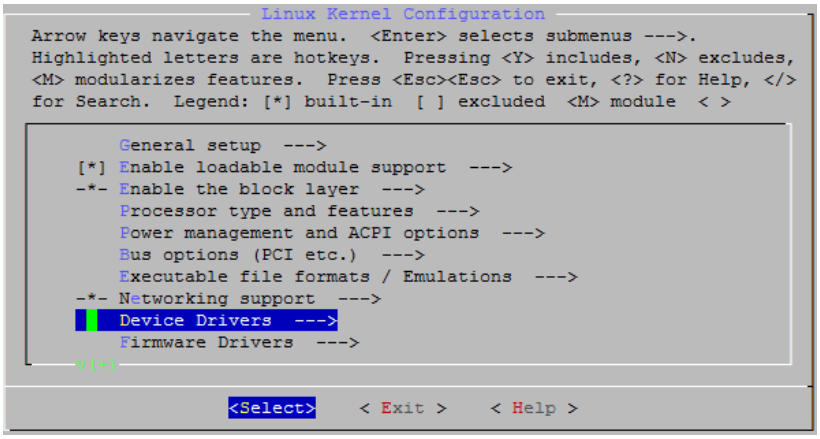


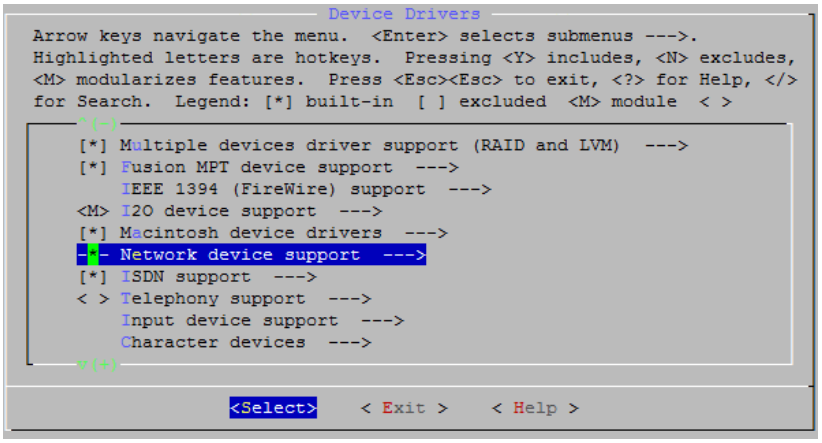


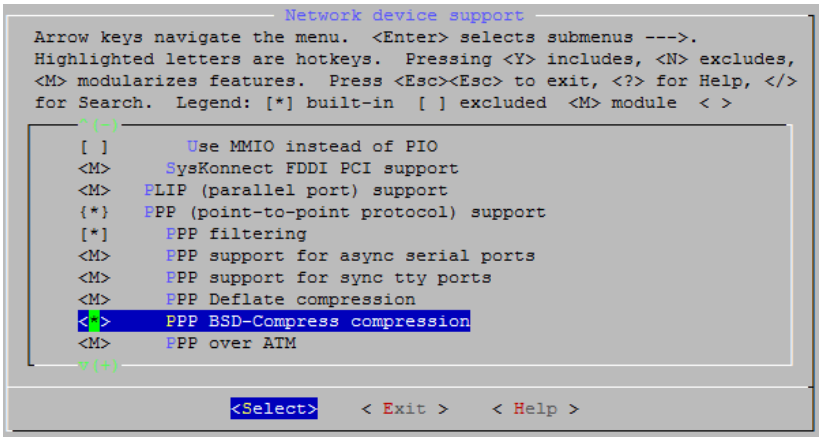




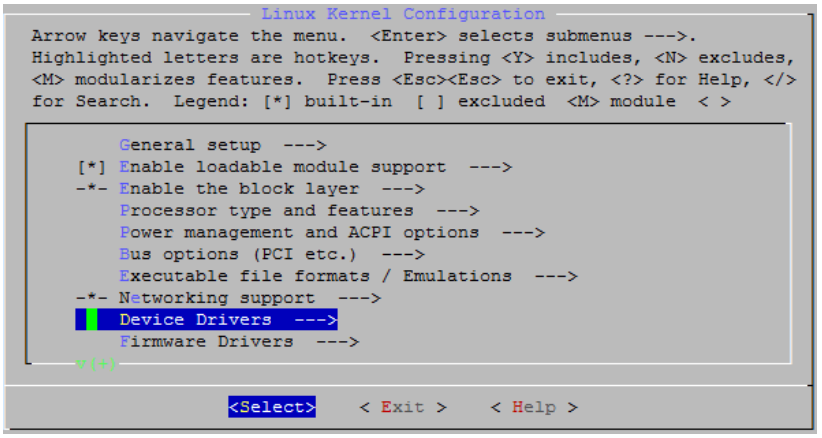
8.2 PPP 拨号的相关配置项

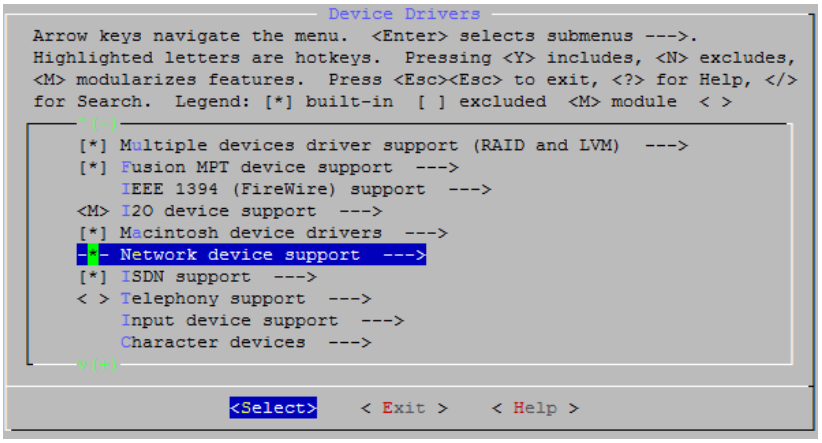


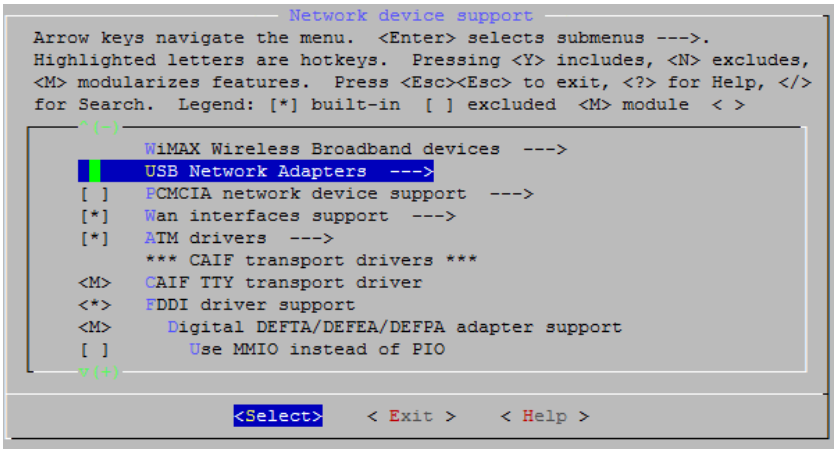


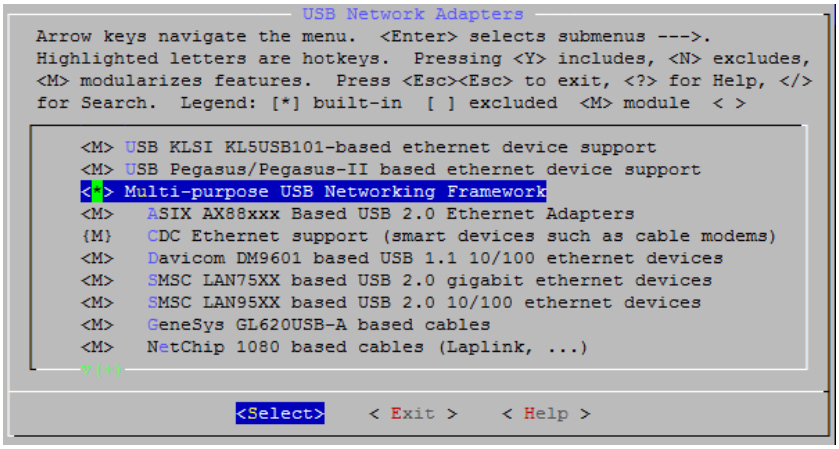


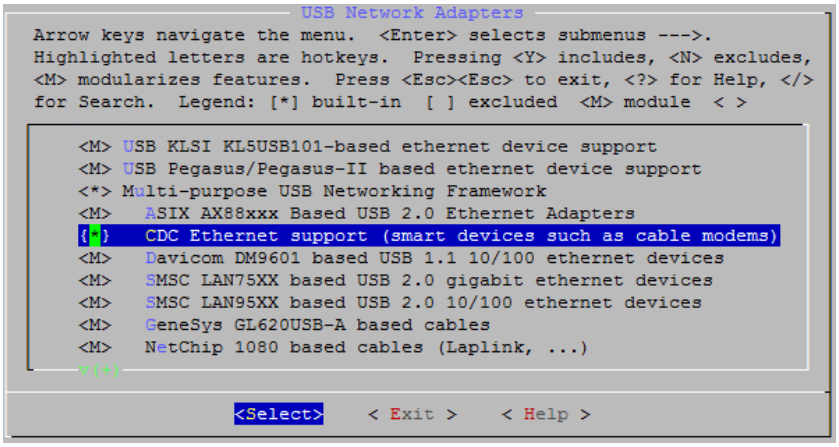
8.3 CDC ECM 驱动编译配置项



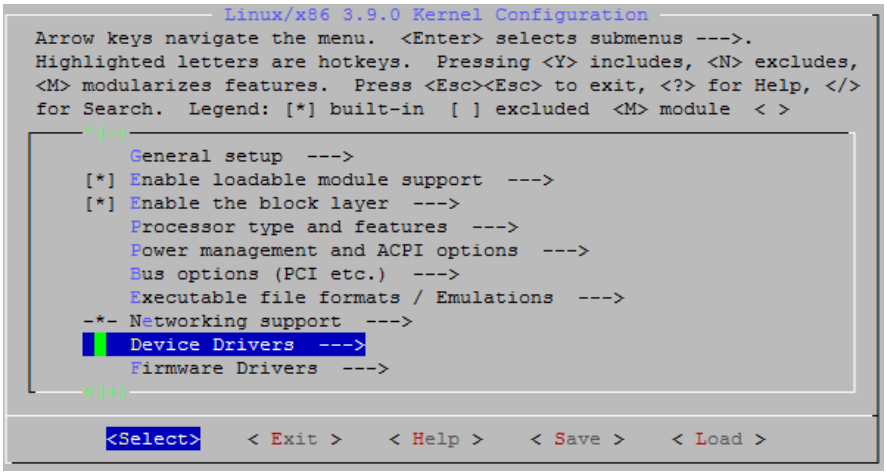


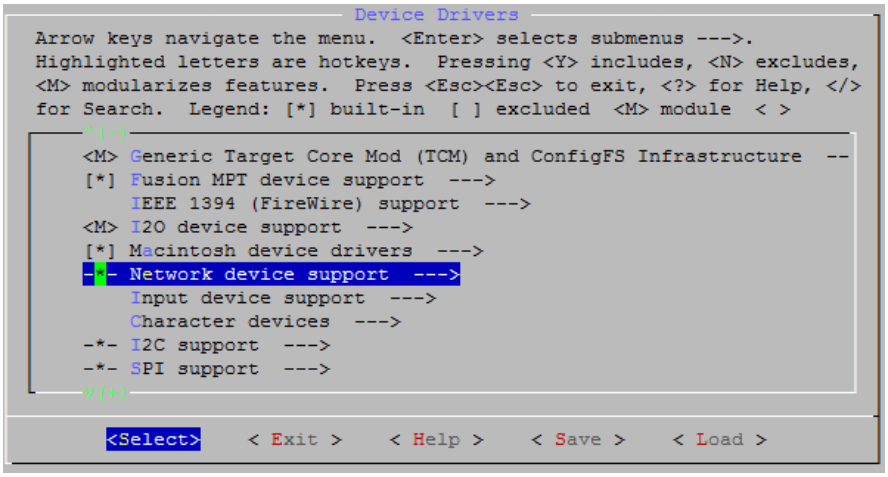


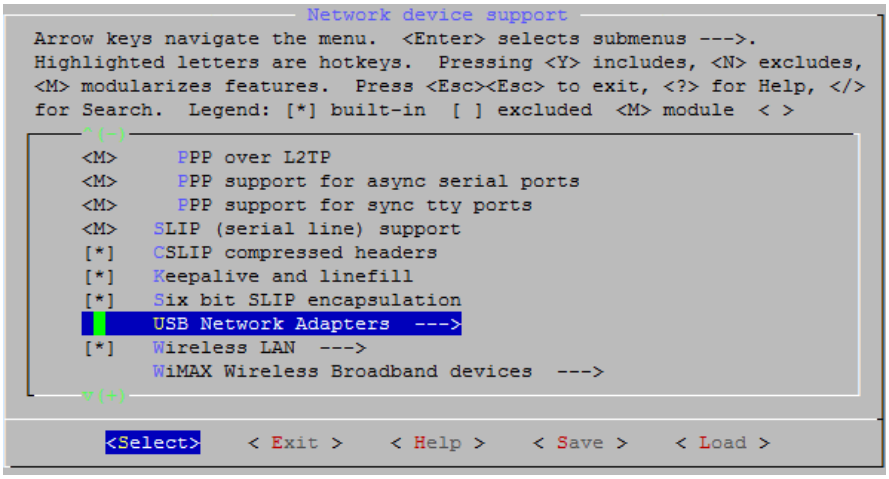


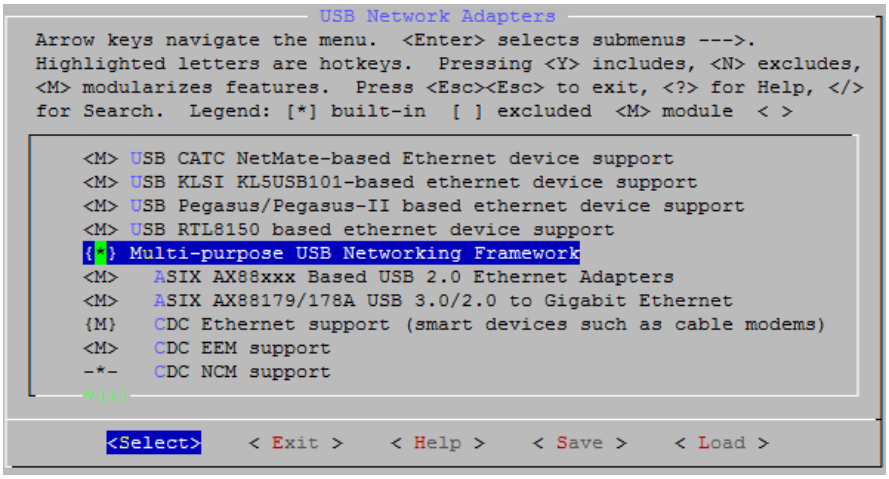


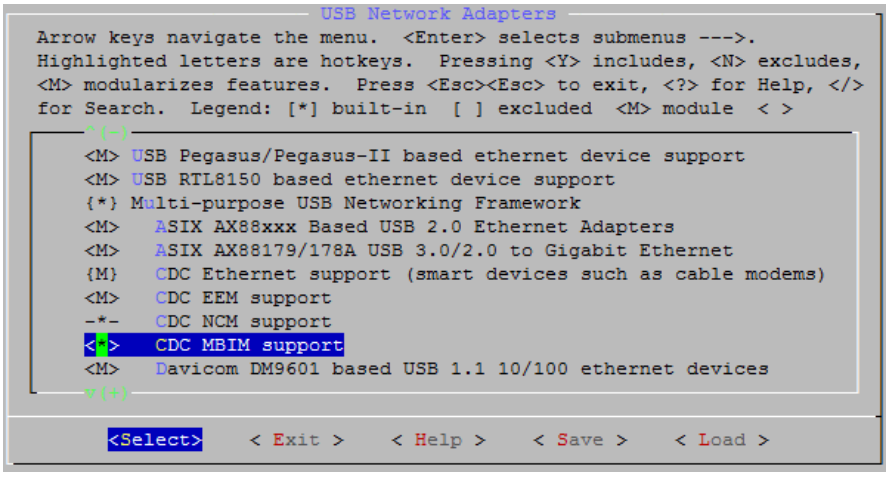
8.4 CDC MBIM 驱动编译配置项



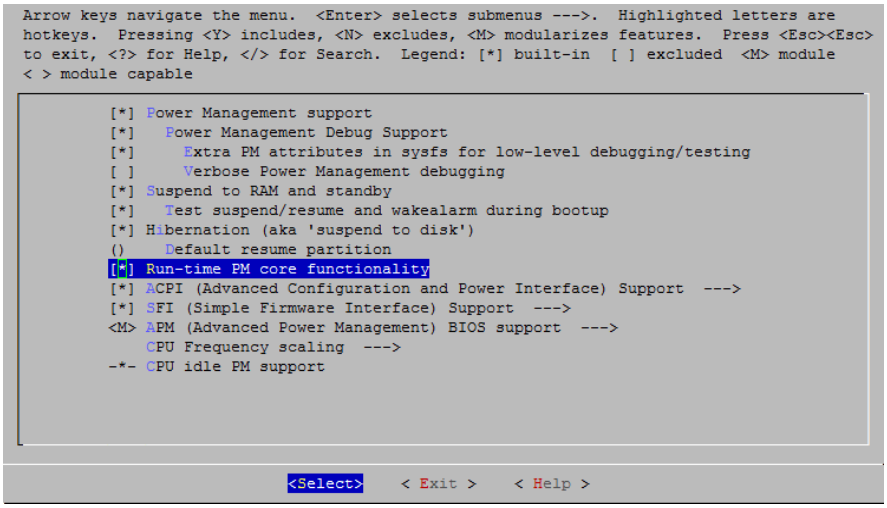


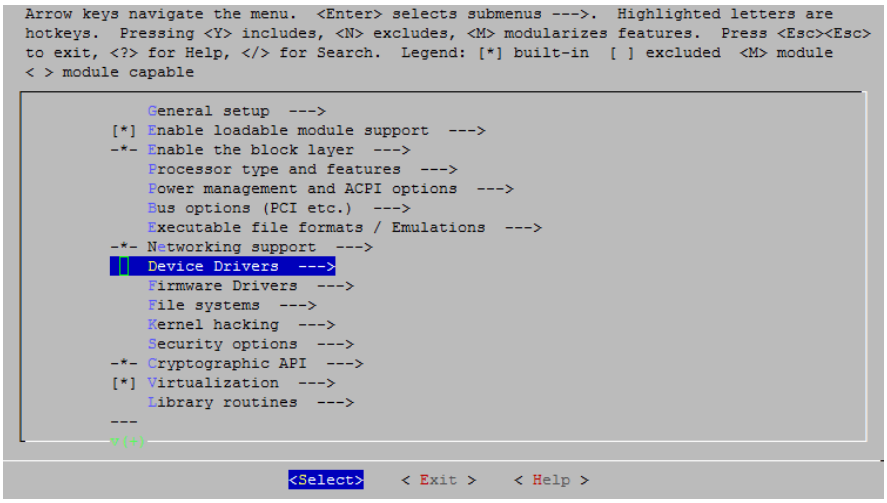


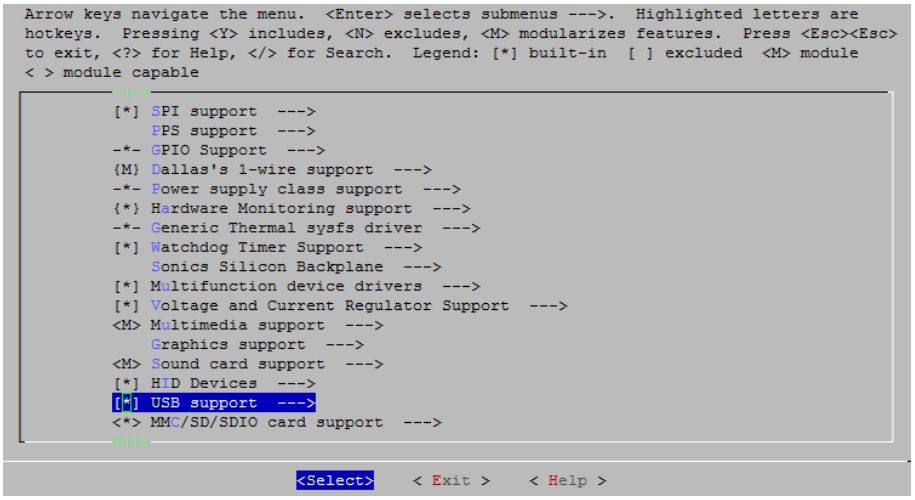


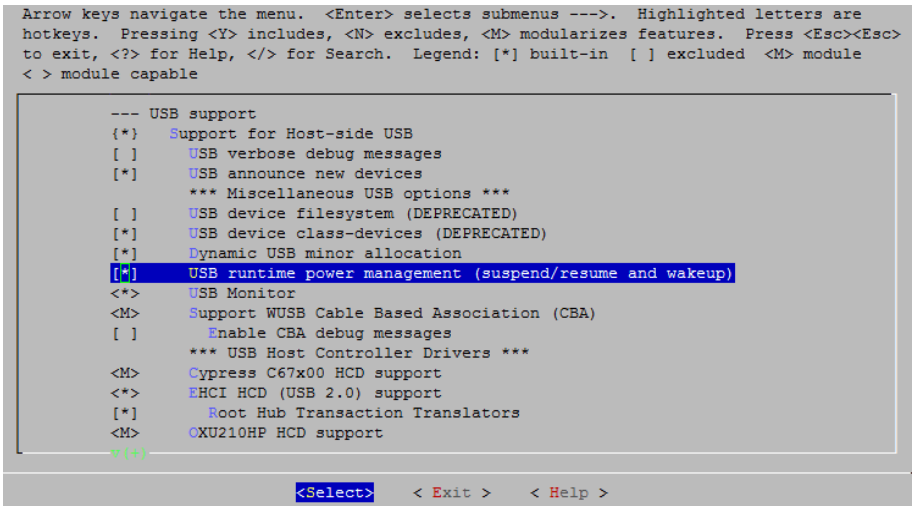


8.5 电源管理配置项









9 FAQ

9.1 如何确认系统中是否已经存在正确的 USB 串口驱动

打开 **Terminal**，执行命令 **dmesg**，查看内核的 log 信息。如查看到类似如下图内容，即说明设备正常加载。

```
[1558586.308060] usb 1-1.2: new high-speed USB device number 7 using ehci-pci
[1558586.402563] usb 1-1.2: New USB device found, idVendor=12d1, idProduct=1404
[1558586.402568] usb 1-1.2: New USB device strings: Mfr=3, Product=2, SerialNumber=0
[1558586.402571] usb 1-1.2: Product: HUAWEI MOBILE WCDMA EM770W
[1558586.402574] usb 1-1.2: Manufacturer: HUAWEI Technology
[1558586.404738] option 1-1.2:1.0: GSM modem (1-port) converter detected
[1558586.404916] usb 1-1.2: GSM modem (1-port) converter now attached to ttyUSB0
[1558586.405016] option 1-1.2:1.1: GSM modem (1-port) converter detected
[1558586.405168] usb 1-1.2: GSM modem (1-port) converter now attached to ttyUSB1
[1558586.405260] option 1-1.2:1.2: GSM modem (1-port) converter detected
[1558586.405389] usb 1-1.2: GSM modem (1-port) converter now attached to ttyUSB2
[1558586.405459] option 1-1.2:1.3: GSM modem (1-port) converter detected
```

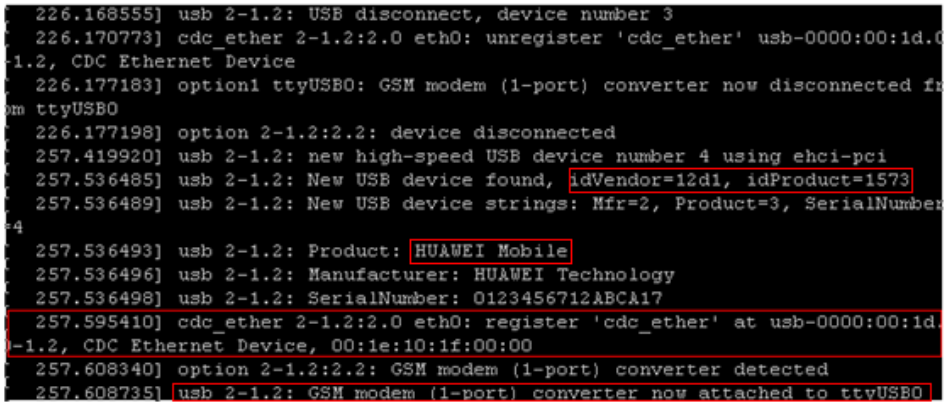
9.2 如何确认系统中是否已经存在正确的 CDC ECM 驱动

打开 **Terminal**，执行命令 **dmesg**。如出现下图红框部分信息，则说明存在正确的 CDC ECM 驱动。

```
[  226.168555] usb 2-1.2: USB disconnect, device number 3
[  226.170773] cdc_ether 2-1.2:2.0 eth0: unregister 'cdc_ether' usb-0000:00:1d.0
-1.2, CDC Ethernet Device
[  226.177183] option1 ttyUSB0: GSM modem (1-port) converter now disconnected fr
om ttyUSB0
[  226.177198] option 2-1.2:2.2: device disconnected
[  257.419920] usb 2-1.2: new high-speed USB device number 4 using ehci-pci
[  257.536485] usb 2-1.2: New USB device found, idVendor=12d1, idProduct=1573
[  257.536489] usb 2-1.2: New USB device strings: Mfr=2, Product=3, SerialNumber
=4
[  257.536493] usb 2-1.2: Product: HUAWEI Mobile
[  257.536496] usb 2-1.2: Manufacturer: HUAWEI Technology
[  257.536498] usb 2-1.2: SerialNumber: 0123456712ABCA17
[  257.595410] cdc_ether 2-1.2:2.0 eth0: register 'cdc_ether' at usb-0000:00:1d.
0-1.2, CDC Ethernet Device, 00:1e:10:1f:00:00
[  257.608340] option 2-1.2:2.2: GSM modem (1-port) converter detected
[  257.608735] usb 2-1.2: GSM modem (1-port) converter now attached to ttyUSB0
```

9.3 如何获取单板当前的端口映射情况信息

步骤 1 执行命令 **dmesg**，查看驱动是否加载成功。假如 log 信息中存在下图中红框部分信息，则说明驱动已经被成功加载（idProduct 因产品的不同而不同）。



步骤 2 当前模块设备的 Modem 和 PCUI 等端口的设备文件名称查询命令：`ls /dev/ttyUSB*`

```
root@localhost:~/linux-3.9# ls /dev/ttyUSB*
/dev/ttyUSB0  /dev/ttyUSB1  /dev/ttyUSB2  /dev/ttyUSB3  /dev/ttyUSB4  /dev/ttyUSB5
```

对多数华为模块，Modem 端口对应**/dev/ttyUSB0**；Diag 端口对应**/dev/ttyUSB1**；PCUI 端口对应**/dev/ttyUSB2**。

9.4 出现端口类似不是从 ttyUSB0 开始的情况如何处理

需确定 ttyUSB 口的使用情况。在断开模块时，确认系统是否已释放 ttyUSB0 端口资源。

9.5 如何手动加载串口驱动

确认已配置添加编译驱动 option 进入内核（参考章节 4 ）。

步骤 1 查询模块的 VID 和 PID（Linux 系统上可通过输入 **lsusb** 获取，如果不支持该命令，可以通过 windows 或相关产品文档获得）。若得到模块的 VID=12D1，PID=1573，则说明华为模块 USB 串口驱动加载成功。

步骤 2 打开 Terminal，输入 **echo "12d1 1573" >/sys/bus/usb-serial/drivers/option1/new_id**。

步骤 3 输入 **dmesg** 或者 **ls /dev/ttyUSB***，查看加载是否成功。

9.6 若无法映射端口或无法查找对应端口形态需要提供哪些 log

步骤 1 打开 **Terminal**，执行命令 **dmesg** 并保存输出结果于 **dmesg.txt** 文档。

步骤 2 执行命令 **ls –l /sys/bus/usb/drivers/**，保存输出结果于 **logcat.txt** 文档，确保此目录下有 option 选项。

步骤 3 执行命令 **ls –l /sys/bus/usb/drivers/option/***/**，保存输出结果于 **logcat.txt** 文档。

步骤 4 执行命令 **cat /sys/bus/usb/drivers/option/***/bInterface***，保存输出结果于 **logcat.txt** 文档。

步骤 5 如果能执行命令 **cat /proc/bus/usb/devices**，将输出结果保存于 **logcat.txt** 文档（如果不能请忽略此命令）。

10 缩略语

缩略语	英文全名	中文解释
CDC	Communications Device Class	连接设备配置
CDMA	Code Division Multiple Access	码分多址接入
ECM	Ethernet Networking Control Model	以太网控制模型
GPS	Global Positioning System	全球定位系统
LTE	Long Term Evolution	长期演进
MBIM	Mobile Broadband Interface Model	移动宽带接口模型
OS	Operating system	操作系统
PPP	Point-to-Point Protocol	点对点协议吗
USB	Universal Serial Bus	通用串行总线
WCDMA	Wideband Code Division Multiple Access	宽带码分多址