华为WCDMA/CDMA模块设备在 Android系统的内核驱动集成指导文档

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2011-2-9	V1.0			初稿	方晓志 00110321
2011-5-3	V1.0.1			基于系统自带驱动进行修改，使能电源管理。	刘其峰 KF39449
2011-8-25	V1.2.1			加入MC509在Android下升级失败的解决方案	刘其峰 KF39449
2011-11-10	V1.2.3			根据USB协议规范，加入零包机制。针对usb1.1协议不添加零包，针对usb2.0协议及以上添加零包。以解决模块升级遇到零包法处理问题。增加部分为4.1.1小节的第5部分内容。	刘其峰 KF39449

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1　目的

本文档主要是针对华为模块设备基于Android系统的内核驱动集成开发活动进行相关的指导说明。主要面向基于Android系统的产品开发商的驱动开发人员。

2　范围

本文档适用于：

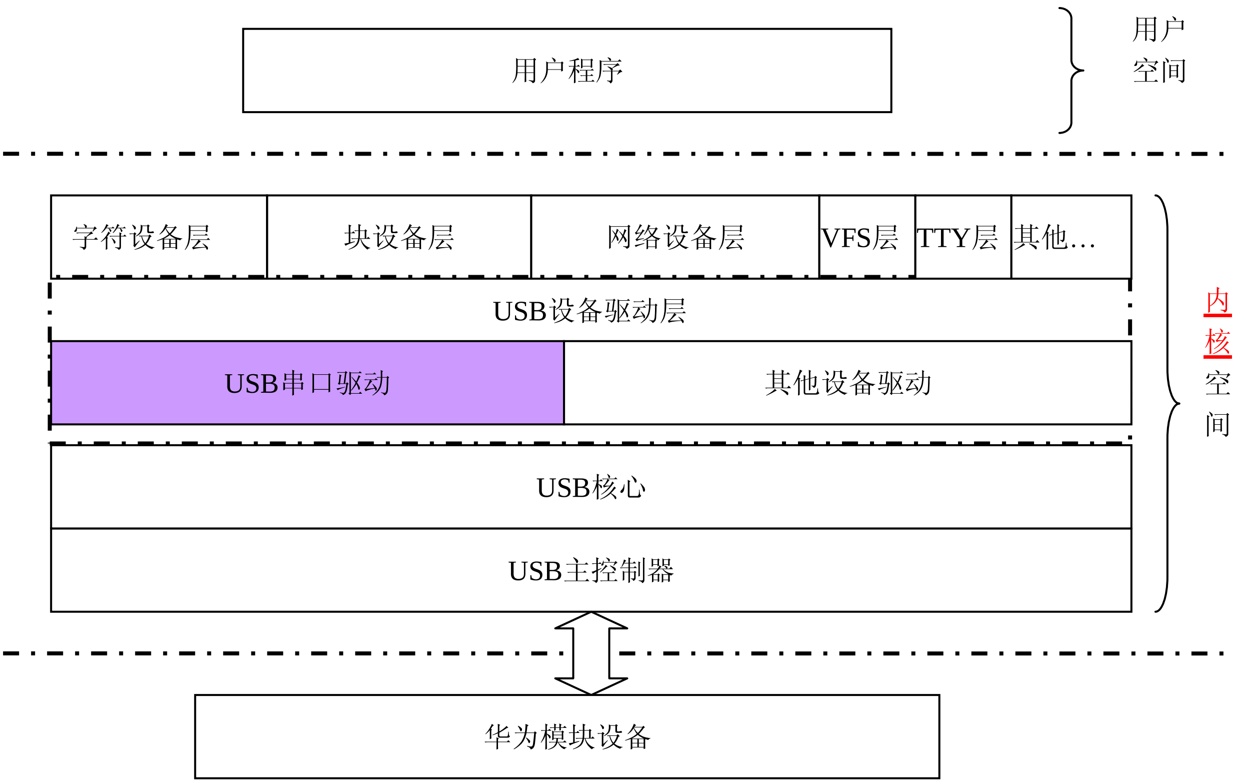
1) 华为WCDMA/CDMA制式的模块设备。
2) Android 2.3(linux-2.6.35内核)及以上版本的Android系统。

3　总体概述

3.1　Android 系统的 Linux 内核支持华为模块设备的驱动架构

华为模块设备和Android系统主要通过USB接口进行数据通信。Android系统上的Linux内核需要根据华为模块设备上报的USB设备接口加载USB驱动，USB驱动正确加载后，华为模块才能正常工作。

Android系统中和支持华为模块设备相关的Linxu内核驱动架构，如下图所示：



如上图所示，在Linux系统中的USB驱动架构中，跟华为模块设备相关的驱动模块是USB串口驱动模块。其中，

- **USB串口驱动：**USB的串口驱动，支持如modem端口，AT端口等；该驱动模块的代码(option.c)已经内置在Linux内核的源码中。

4 Android 系统的 Linux 内核驱动集成方案

4.1 Android 内核的 USB 串口驱动集成步骤

本集成方案涉及到的Linux内核源码文件是：

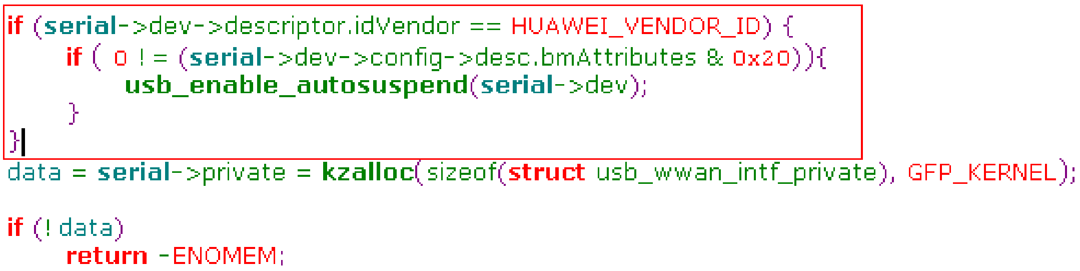
drivers/usb/serial/option.c

drivers/usb/serial/usb_wwan.c

4.1.1 USB 串口驱动集成的修改内容

1. 因linux-2.6.35以上的内核已经自带有 selective suspend 电源管理特性，所以我们只需将电源管理的开关打开，USB串口驱动就将支持 selective suspend 电源管理。
2. 只需在/drivers/usb/serial/option.c 中的option_probe（）函数内加入红框部分语句如

下所示：



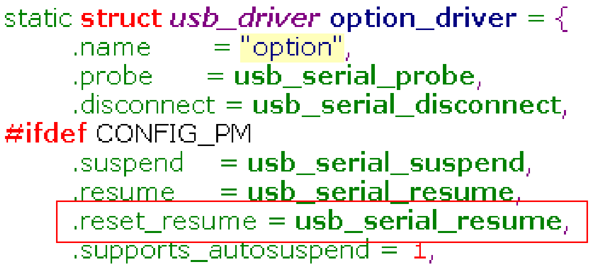
```
if (serial->dev->descriptor.idVendor == HUAWEI_VENDOR_ID) {
     if ( 0 ! = (serial->dev->config->desc.bmAttributes & 0x20)){
          usb_enable_autosuspend(serial->dev);
     }
}
data = serial->private = kzalloc(sizeof(struct usb_wwan_intf_private), GFP_KERNEL);

if (! data)
     return -ENOMEM;
```

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);

     }

}
```

即可支持selective suspend 特性。

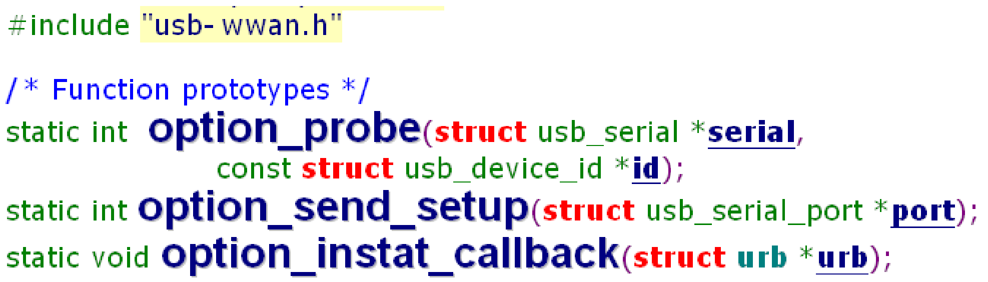
3. 增加对reset_resume函数的调用，加入红框部分语句如下所示：



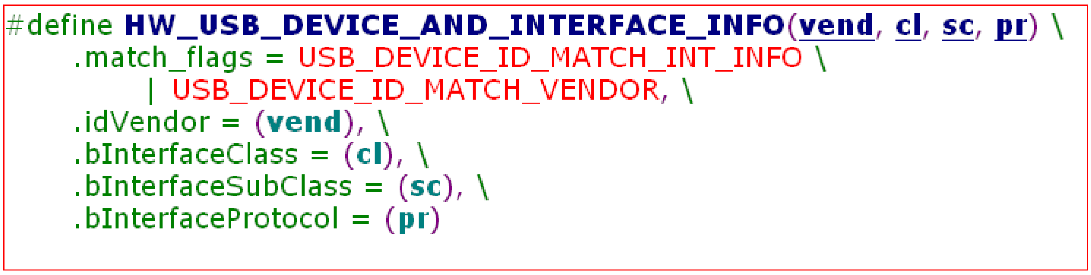
```
static struct usb_driver option_driver = {
	.name       = "option",
	.probe      = usb_serial_probe,
	.disconnect = usb_serial_disconnect,
#ifdef CONFIG_PM
	.suspend    = usb_serial_suspend,
	.resume     = usb_serial_resume,
	.reset_resume = usb_serial_resume,
	.supports_autosuspend = 1,
```

4. 增加了对新PID的支持，修改部分如下：

a) 增加图示红框部分宏定义



```
#include "usb-wwan.h"

/* Function prototypes */
static int  option_probe(struct usb_serial *serial,
                const struct usb_device_id *id);
static int option_send_setup(struct usb_serial_port *port);
static void option_instat_callback(struct urb *urb);
```



```
#define HW_USB_DEVICE_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)
```

b) 在 static const struct usb_device_id option_ids[ ] id列表中增加如下语句:

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0xff, 0xff) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x01) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x02) },

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

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

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

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x06) },

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

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

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x0C) },

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

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

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

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

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

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

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

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

```
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x16) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x31) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x32) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x33) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x34) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x35) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x36) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x3A) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x3B) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x3C) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x3D) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x3E) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x3F) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x46) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x01) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x02) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x03) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x04) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x05) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x06) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x0A) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x0B) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x0C) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x0D) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x0E) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x0F) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x10) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x12) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x13) },
```

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x14) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x15) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x16) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x31) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x32) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x33) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x34) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x35) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x36) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x3A) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x3B) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x3C) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x3D) },

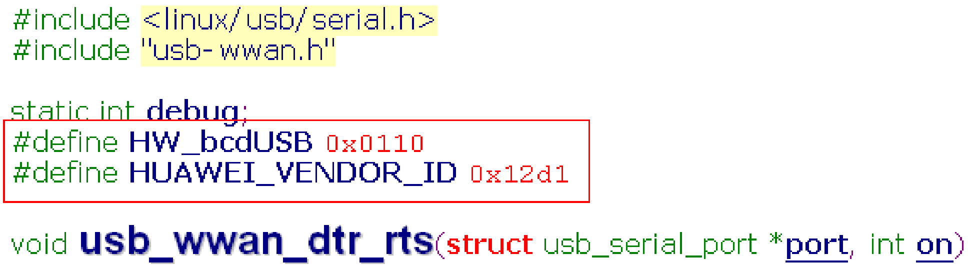
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x3E) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x3F) },

{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x02, 0x46) },

5. 添加零包机制，以解决模块升级问题,修改文件为 drivers/usb/serial/usb_wwan.c

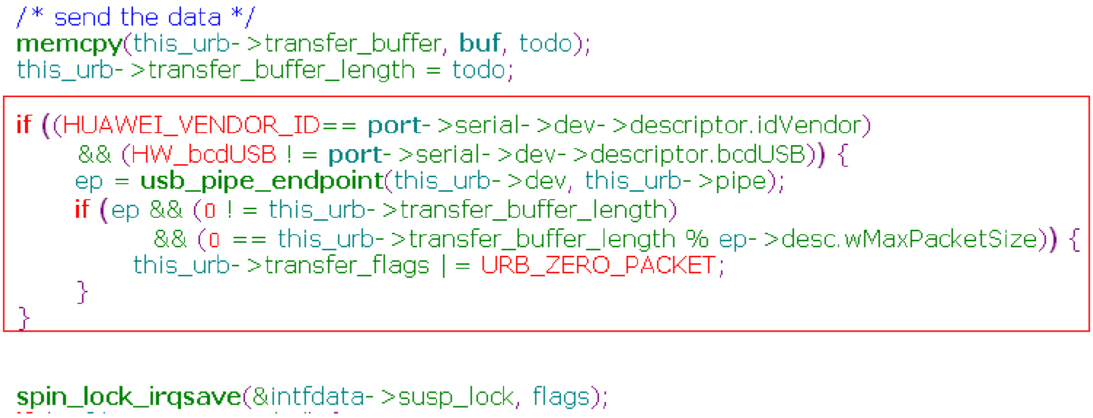
5.1. 增加对bcdUSB值的定义： #define HW_bcdUSB 0x0110，增加对华为vid值的定义： #define HUAWEI_VENDOR_ID 0x12d1，如红框位置所示：



```
#include <linux/usb/serial.h>
#include "usb-wwan.h"

static int debug;
#define HW_bcdUSB 0x0110
#define HUAWEI_VENDOR_ID 0x12d1

void usb_wwan_dtr_rts(struct usb_serial_port *port, int on)
```

5.2. 先在usb_wwan_write函数内增加定义：struct usb_host_endpoint *ep;

然后在usb_wwan_write函数增加对零包的判断，增加部分如红框所示：



```
/* send the data */
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);
```

6. 修改Android内核的编译配置(在kernel根目录下的.config文件中),确保下面的的配置项已经被选定。具体的配置操作请参考4.1.2节。

   i. USB电源管理特性的相关配置项:

   CONFIG_USB_SUSPEND=y

   ii. 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

   iii. PPP拨号的相关配置项:

   CONFIG_PPP=y

   CONFIG_PPP_MULTILINK=y

   CONFIG_PPP_FILTER=y

   CONFIG_PPP_ASYNC=y

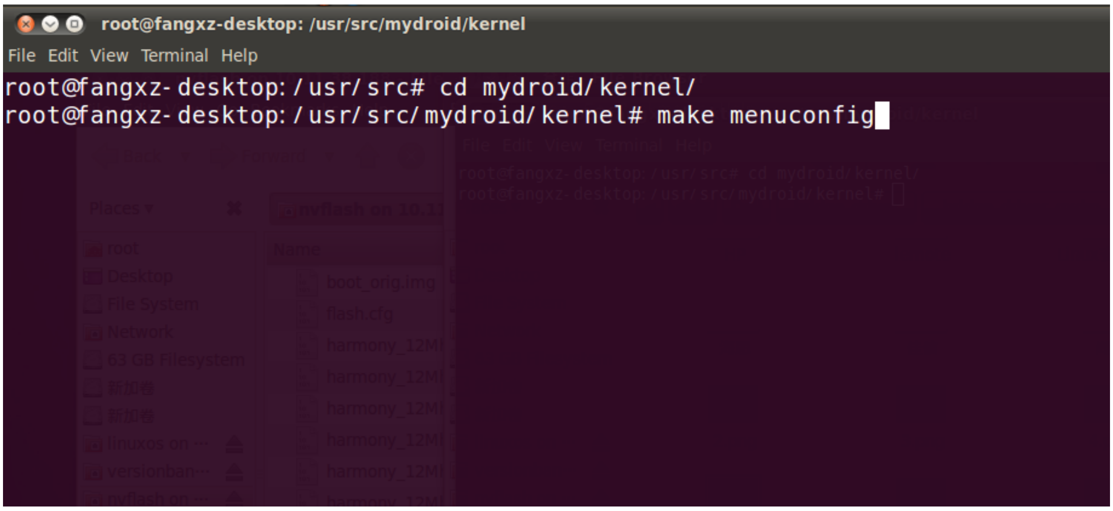
   CONFIG_PPP_SYNC_TTY=y

   CONFIG_PPP_DEFLATE=y

   CONFIG_PPP_BSDCOMP=y

4.1.2 USB 串口驱动集成配置的操作步骤

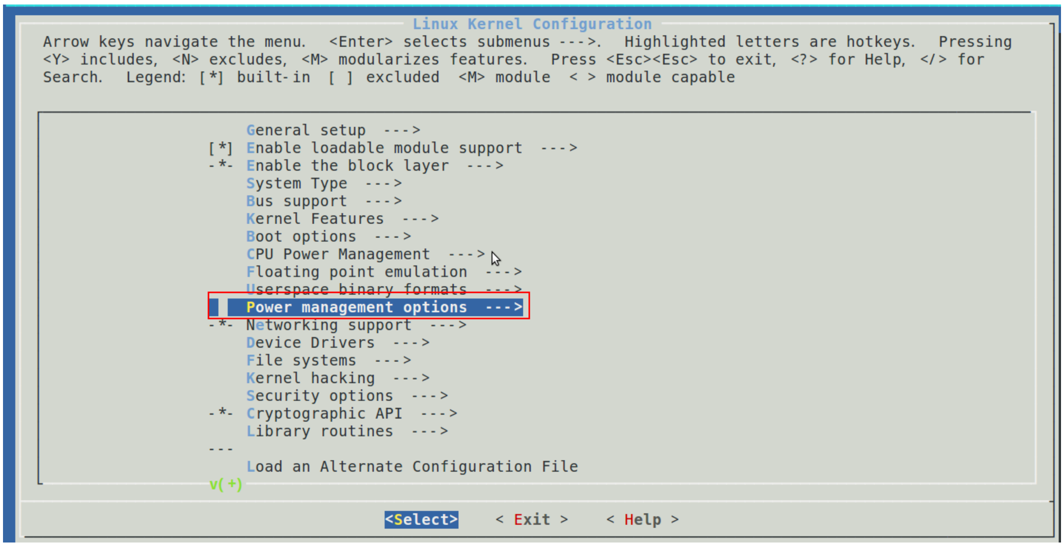
1. 打开Terminal工具，进入kernel目录（假定kernel在/usr/src/mydroid/目录下，即cd /usr/src/mydroid/kernel），然后执行make <configuration>命令（在本文中，假定使用标准的make menuconfig）。


root@fangxz-desktop: /usr/src/mydroid/kernel
File Edit View Terminal Help

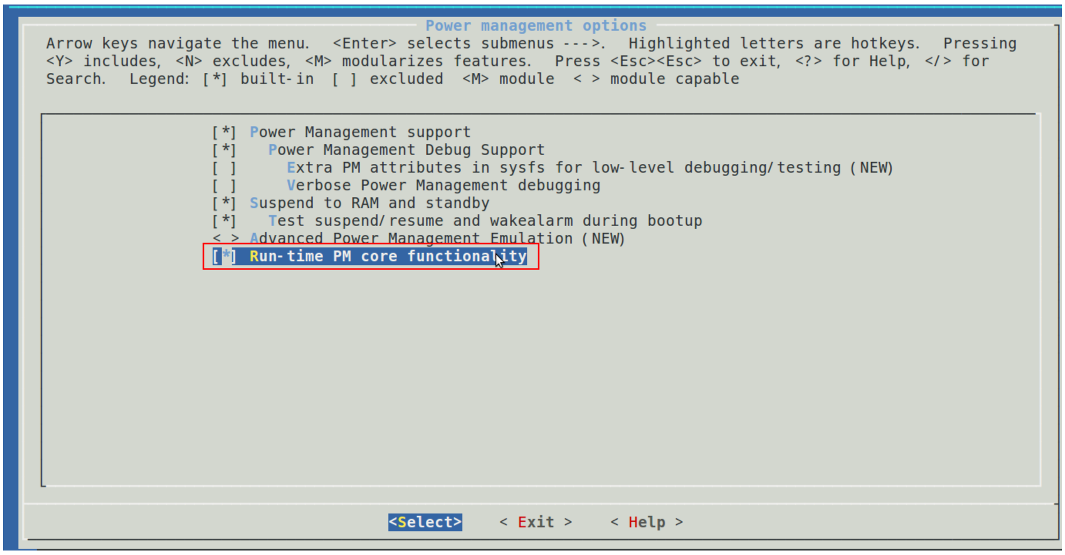
```
root@fangxz-desktop:/usr/src# cd mydroid/kernel/
root@fangxz-desktop:/usr/src/mydroid/kernel# make menuconfig
```

2. 选择相关的配置项

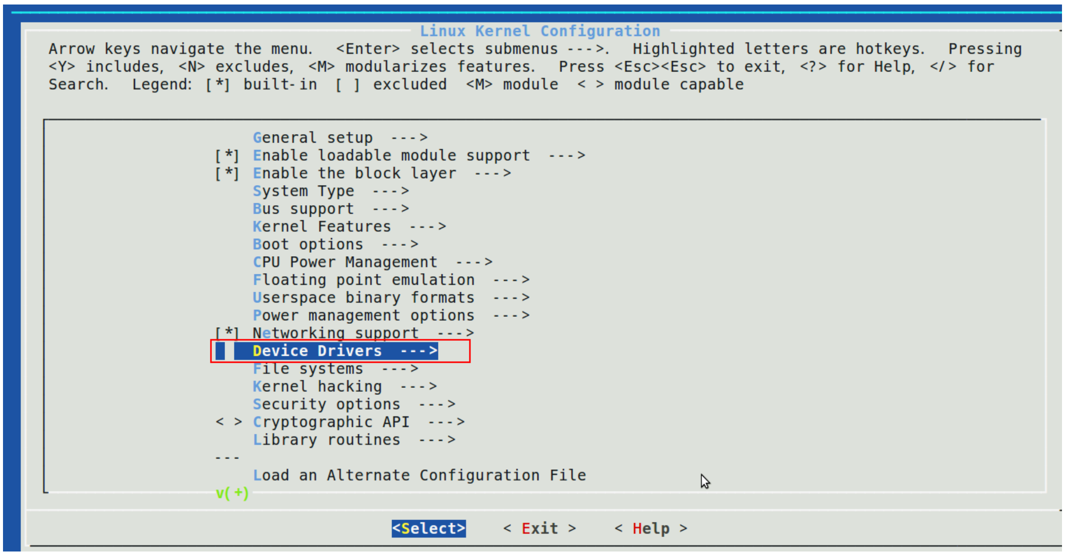
   1. USB电源管理特性的相关配置项：



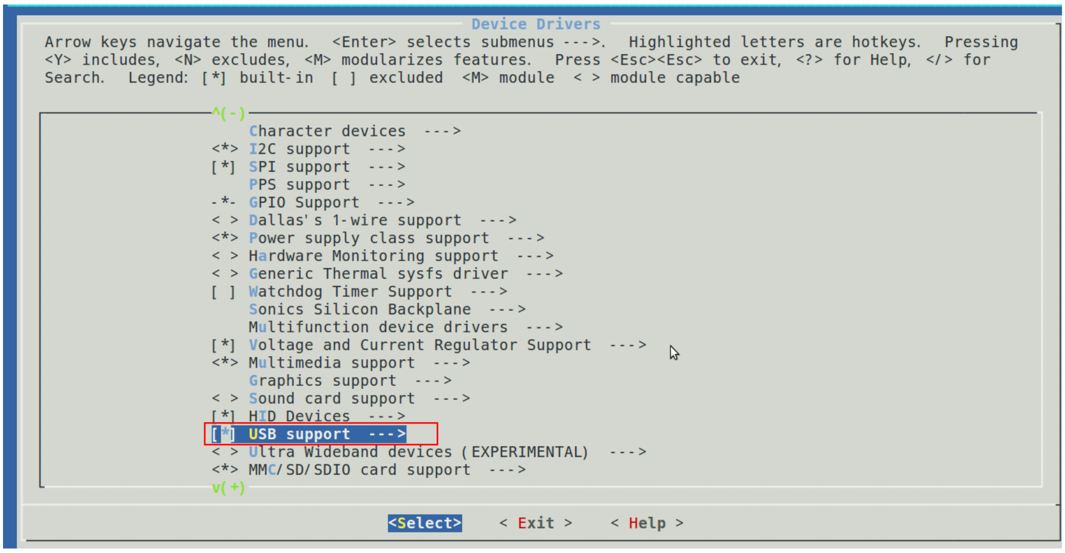
```
                           Linux Kernel Configuration
 Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted letters are hotkeys.  Pressing
 <Y> includes, <N> excludes, <M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </> for
 Search.  Legend: [*] built-in  [ ] excluded  <M> module  < > module capable

                        General setup  --->
                    [*] Enable loadable module support  --->
                    -*- Enable the block layer  --->
                        System Type  --->
                        Bus support  --->
                        Kernel Features  --->
                        Boot options  --->
                        CPU Power Management  --->
                        Floating point emulation  --->
                        Userspace binary formats  --->
                        Power management options  --->
                    -*- Networking support  --->
                        Device Drivers  --->
                        File systems  --->
                        Kernel hacking  --->
                        Security options  --->
                    -*- Cryptographic API  --->
                        Library routines  --->
                    ---
                        Load an Alternate Configuration File
                    v(+)

                         <Select>    < Exit >    < Help >
```



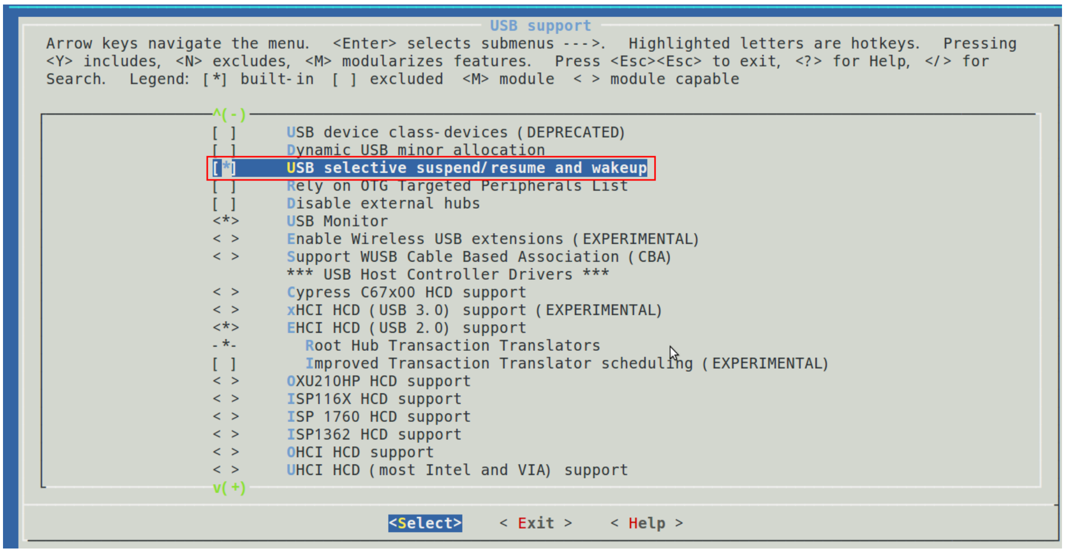
```
                           Power management options
 Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted letters are hotkeys.  Pressing
 <Y> includes, <N> excludes, <M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </> for
 Search.  Legend: [*] built-in  [ ] excluded  <M> module  < > module capable

                    [*] Power Management support
                    [*]   Power Management Debug Support
                    [ ]     Extra PM attributes in sysfs for low-level debugging/testing (NEW)
                    [ ]     Verbose Power Management debugging
                    [*] Suspend to RAM and standby
                    [*]   Test suspend/resume and wakealarm during bootup
                    < > Advanced Power Management Emulation (NEW)
                    [*] Run-time PM core functionality

                         <Select>    < Exit >    < Help >
```



```
                        Linux Kernel Configuration
 Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted letters are hotkeys.  Pressing
 <Y> includes, <N> excludes, <M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </> for
 Search.  Legend: [*] built-in  [ ] excluded  <M> module  < > module capable

                      General setup  --->
                  [*] Enable loadable module support  --->
                  [*] Enable the block layer  --->
                      System Type  --->
                      Bus support  --->
                      Kernel Features  --->
                      Boot options  --->
                      CPU Power Management  --->
                      Floating point emulation  --->
                      Userspace binary formats  --->
                      Power management options  --->
                  [*] Networking support  --->
                      Device Drivers  --->
                      File systems  --->
                      Kernel hacking  --->
                      Security options  --->
                  < > Cryptographic API  --->
                      Library routines  --->
                  ---
                      Load an Alternate Configuration File
                  v(+)

                    <Select>    < Exit >    < Help >
```

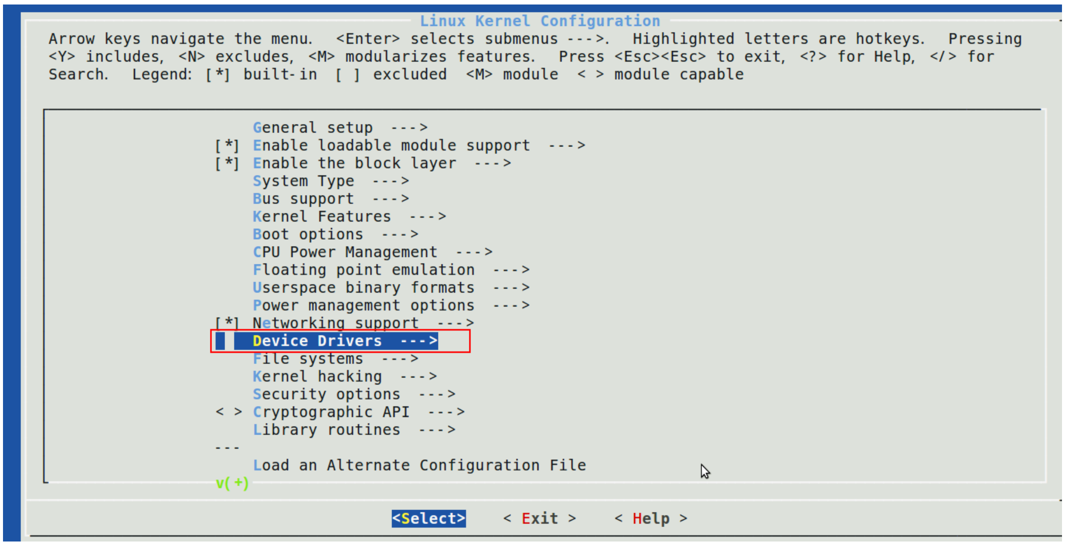


```
                          Device Drivers
 Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted letters are hotkeys.  Pressing
 <Y> includes, <N> excludes, <M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </> for
 Search.  Legend: [*] built-in  [ ] excluded  <M> module  < > module capable

                  ^(-)
                      Character devices  --->
                  <*> I2C support  --->
                  [*] SPI support  --->
                      PPS support  --->
                  -*- GPIO Support  --->
                  < > Dallas's 1-wire support  --->
                  <*> Power supply class support  --->
                  < > Hardware Monitoring support  --->
                  < > Generic Thermal sysfs driver  --->
                  [ ] Watchdog Timer Support  --->
                      Sonics Silicon Backplane  --->
                      Multifunction device drivers  --->
                  [*] Voltage and Current Regulator Support  --->
                  <*> Multimedia support  --->
                      Graphics support  --->
                  < > Sound card support  --->
                  [*] HID Devices  --->
                  [*] USB support  --->
                  < > Ultra Wideband devices (EXPERIMENTAL)  --->
                  <*> MMC/SD/SDIO card support  --->
                  v(+)

                    <Select>    < Exit >    < Help >
```

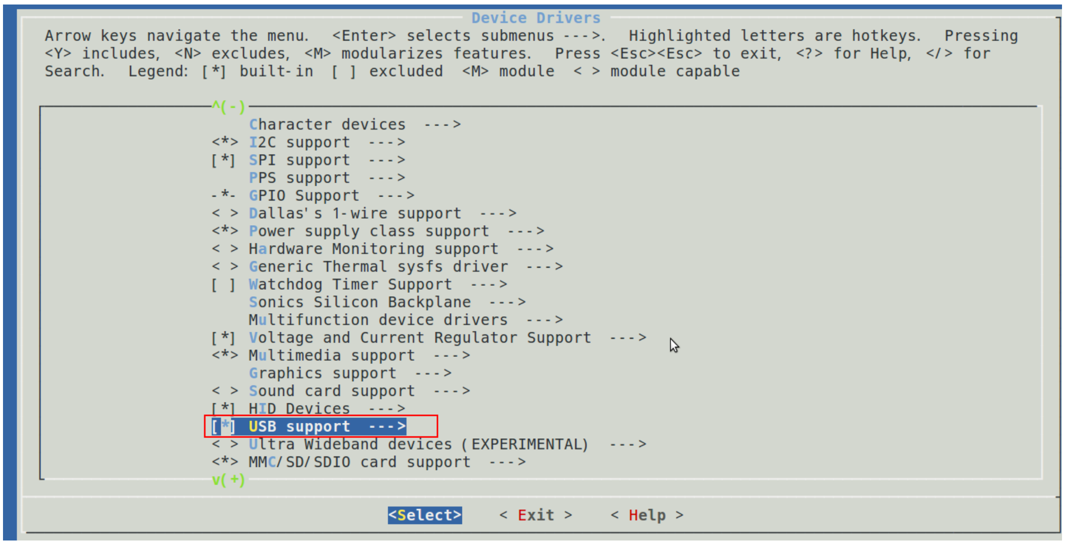


```
                           USB support
 Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted letters are hotkeys.  Pressing
 <Y> includes, <N> excludes, <M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </> for
 Search.  Legend: [*] built-in  [ ] excluded  <M> module  < > module capable

                  ^(-)
                  [ ]     USB device class-devices (DEPRECATED)
                  [ ]     Dynamic USB minor allocation
                  [*]     USB selective suspend/resume and wakeup
                  [ ]     Rely on OTG Targeted Peripherals List
                  [ ]     Disable external hubs
                  <*>     USB Monitor
                  < >     Enable Wireless USB extensions (EXPERIMENTAL)
                  < >     Support WUSB Cable Based Association (CBA)
                          *** USB Host Controller Drivers ***
                  < >     Cypress C67x00 HCD support
                  < >     xHCI HCD (USB 3.0) support (EXPERIMENTAL)
                  <*>     EHCI HCD (USB 2.0) support
                  -*-       Root Hub Transaction Translators
                  [ ]       Improved Transaction Translator scheduling (EXPERIMENTAL)
                  < >     OXU210HP HCD support
                  < >     ISP116X HCD support
                  < >     ISP 1760 HCD support
                  < >     ISP1362 HCD support
                  < >     OHCI HCD support
                  < >     UHCI HCD (most Intel and VIA) support
                  v(+)

                    <Select>    < Exit >    < Help >
```

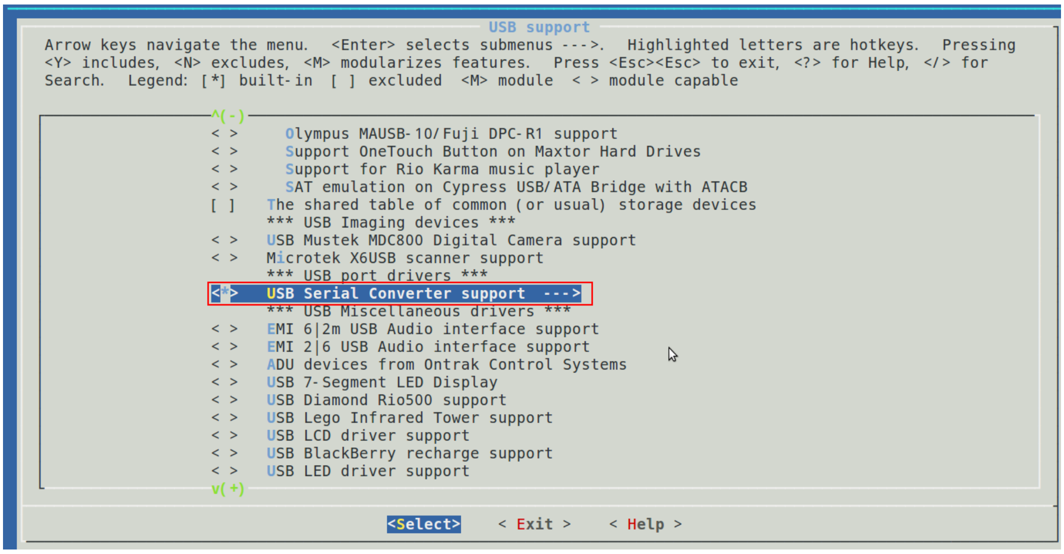
2. USB串口驱动相关的配置项



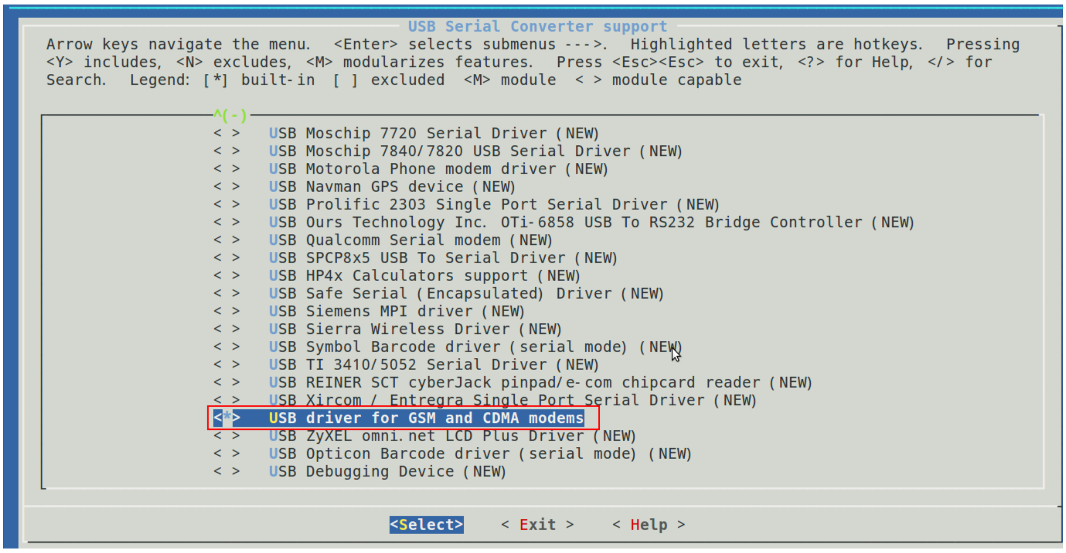
```
                          Linux Kernel Configuration
 Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted letters are hotkeys.  Pressing
 <Y> includes, <N> excludes, <M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </> for
 Search.  Legend: [*] built-in  [ ] excluded  <M> module  < > module capable

                        General setup  --->
                    [*] Enable loadable module support  --->
                    [*] Enable the block layer  --->
                        System Type  --->
                        Bus support  --->
                        Kernel Features  --->
                        Boot options  --->
                        CPU Power Management  --->
                        Floating point emulation  --->
                        Userspace binary formats  --->
                        Power management options  --->
                    [*] Networking support  --->
                        Device Drivers  --->
                        File systems  --->
                        Kernel hacking  --->
                        Security options  --->
                    < > Cryptographic API  --->
                        Library routines  --->
                    ---
                        Load an Alternate Configuration File
                    v(+)

                       <Select>    < Exit >    < Help >
```



```
                               Device Drivers
 Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted letters are hotkeys.  Pressing
 <Y> includes, <N> excludes, <M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </> for
 Search.  Legend: [*] built-in  [ ] excluded  <M> module  < > module capable

                    ^(-)
                        Character devices  --->
                    <*> I2C support  --->
                    [*] SPI support  --->
                        PPS support  --->
                    -*- GPIO Support  --->
                    < > Dallas's 1-wire support  --->
                    <*> Power supply class support  --->
                    < > Hardware Monitoring support  --->
                    < > Generic Thermal sysfs driver  --->
                    [ ] Watchdog Timer Support  --->
                        Sonics Silicon Backplane  --->
                        Multifunction device drivers  --->
                    [*] Voltage and Current Regulator Support  --->
                    <*> Multimedia support  --->
                        Graphics support  --->
                    < > Sound card support  --->
                    [*] HID Devices  --->
                    [*] USB support  --->
                    < > Ultra Wideband devices (EXPERIMENTAL)  --->
                    <*> MMC/SD/SDIO card support  --->
                    v(+)

                       <Select>    < Exit >    < Help >
```

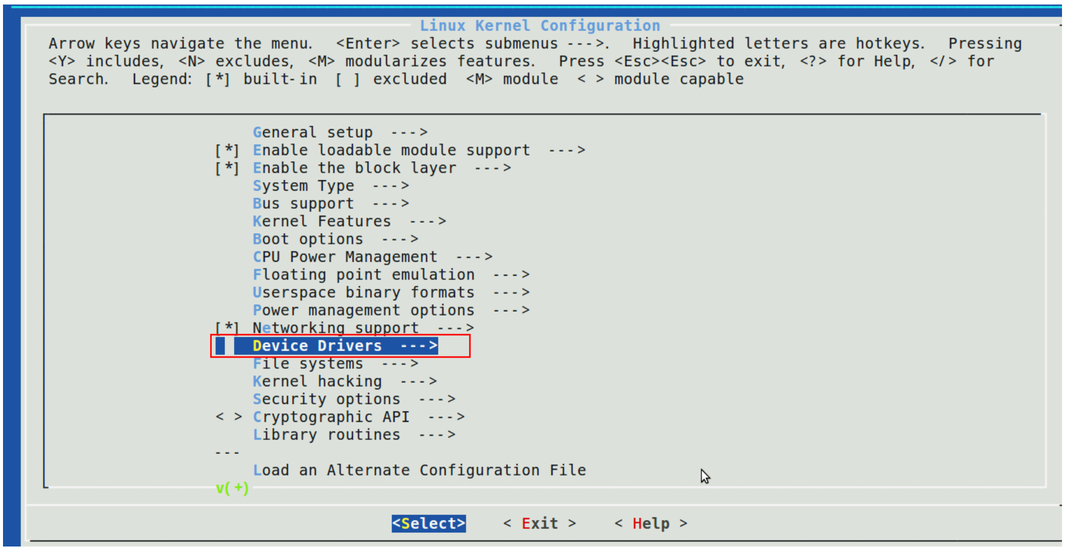


```
                                USB support
 Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted letters are hotkeys.  Pressing
 <Y> includes, <N> excludes, <M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </> for
 Search.  Legend: [*] built-in  [ ] excluded  <M> module  < > module capable

                    ^(-)
                    < >      Olympus MAUSB-10/Fuji DPC-R1 support
                    < >      Support OneTouch Button on Maxtor Hard Drives
                    < >      Support for Rio Karma music player
                    < >      SAT emulation on Cypress USB/ATA Bridge with ATACB
                    [ ]    The shared table of common (or usual) storage devices
                           *** USB Imaging devices ***
                    < >    USB Mustek MDC800 Digital Camera support
                    < >    Microtek X6USB scanner support
                           *** USB port drivers ***
                    <*>    USB Serial Converter support  --->
                           *** USB Miscellaneous drivers ***
                    < >    EMI 6|2m USB Audio interface support
                    < >    EMI 2|6 USB Audio interface support
                    < >    ADU devices from Ontrak Control Systems
                    < >    USB 7-Segment LED Display
                    < >    USB Diamond Rio500 support
                    < >    USB Lego Infrared Tower support
                    < >    USB LCD driver support
                    < >    USB BlackBerry recharge support
                    < >    USB LED driver support
                    v(+)

                       <Select>    < Exit >    < Help >
```

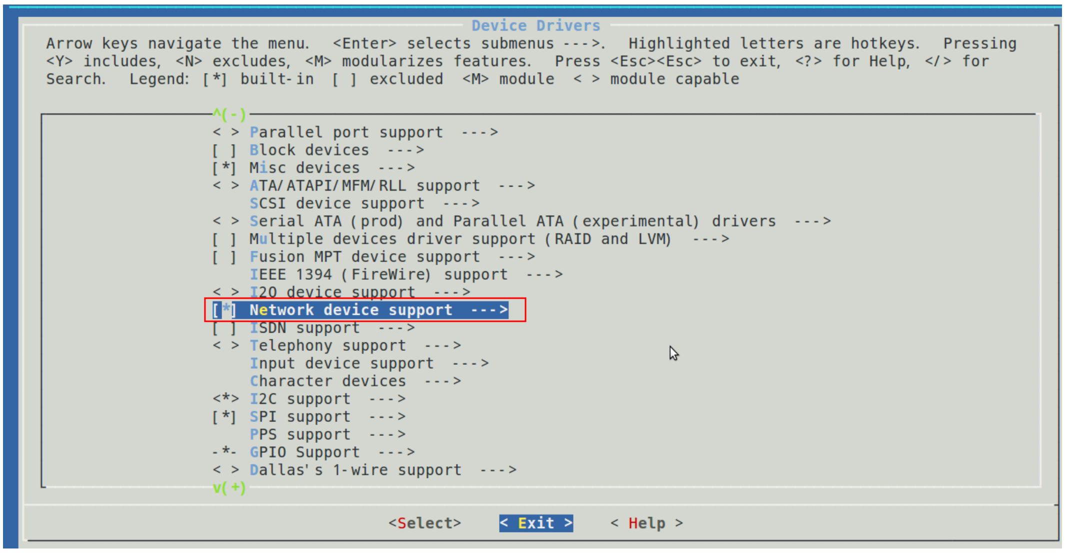


```
                         USB Serial Converter support
  Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted letters are hotkeys.  Pressing
  <Y> includes, <N> excludes, <M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </> for
  Search.  Legend: [*] built-in  [ ] excluded  <M> module  < > module capable

                       ^(-)
                       < >   USB Moschip 7720 Serial Driver (NEW)
                       < >   USB Moschip 7840/7820 USB Serial Driver (NEW)
                       < >   USB Motorola Phone modem driver (NEW)
                       < >   USB Navman GPS device (NEW)
                       < >   USB Prolific 2303 Single Port Serial Driver (NEW)
                       < >   USB Ours Technology Inc. OTi-6858 USB To RS232 Bridge Controller (NEW)
                       < >   USB Qualcomm Serial modem (NEW)
                       < >   USB SPCP8x5 USB To Serial Driver (NEW)
                       < >   USB HP4x Calculators support (NEW)
                       < >   USB Safe Serial (Encapsulated) Driver (NEW)
                       < >   USB Siemens MPI driver (NEW)
                       < >   USB Sierra Wireless Driver (NEW)
                       < >   USB Symbol Barcode driver (serial mode) (NEW)
                       < >   USB TI 3410/5052 Serial Driver (NEW)
                       < >   USB REINER SCT cyberJack pinpad/e-com chipcard reader (NEW)
                       < >   USB Xircom / Entregra Single Port Serial Driver (NEW)
                       <*>   USB driver for GSM and CDMA modems
                       < >   USB ZyXEL omni.net LCD Plus Driver (NEW)
                       < >   USB Opticon Barcode driver (serial mode) (NEW)
                       < >   USB Debugging Device (NEW)

                          <Select>    < Exit >    < Help >
```

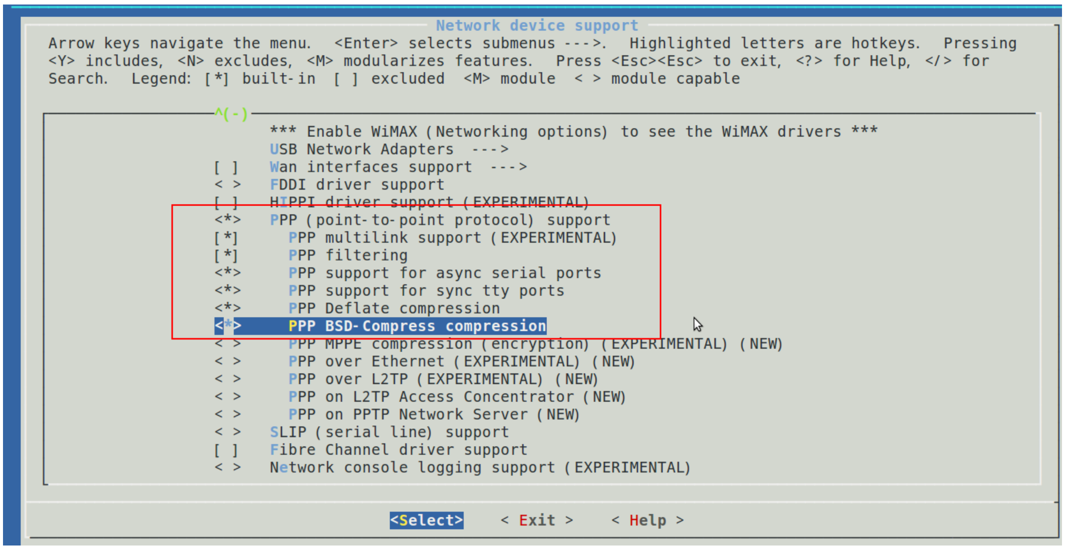
3.　PPP拨号的相关配置项



```
                         Linux Kernel Configuration
  Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted letters are hotkeys.  Pressing
  <Y> includes, <N> excludes, <M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </> for
  Search.  Legend: [*] built-in  [ ] excluded  <M> module  < > module capable

                           General setup  --->
                       [*] Enable loadable module support  --->
                       [*] Enable the block layer  --->
                           System Type  --->
                           Bus support  --->
                           Kernel Features  --->
                           Boot options  --->
                           CPU Power Management  --->
                           Floating point emulation  --->
                           Userspace binary formats  --->
                           Power management options  --->
                       [*] Networking support  --->
                           Device Drivers  --->
                           File systems  --->
                           Kernel hacking  --->
                           Security options  --->
                       < > Cryptographic API  --->
                           Library routines  --->
                       ---
                           Load an Alternate Configuration File
                       v(+)

                          <Select>    < Exit >    < Help >
```

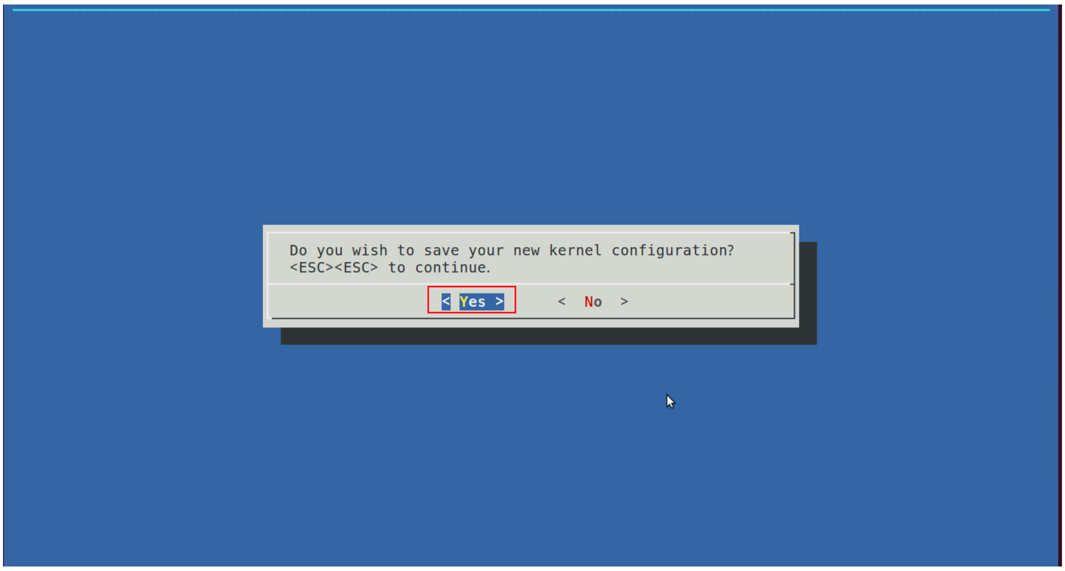


```
                         Device Drivers
  Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted letters are hotkeys.  Pressing
  <Y> includes, <N> excludes, <M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </> for
  Search.  Legend: [*] built-in  [ ] excluded  <M> module  < > module capable

                       ^(-)
                       < > Parallel port support  --->
                       [ ] Block devices  --->
                       [*] Misc devices  --->
                       < > ATA/ATAPI/MFM/RLL support  --->
                           SCSI device support  --->
                       < > Serial ATA (prod) and Parallel ATA (experimental) drivers  --->
                       [ ] Multiple devices driver support (RAID and LVM)  --->
                       [ ] Fusion MPT device support  --->
                           IEEE 1394 (FireWire) support  --->
                       < > I2O device support  --->
                       [*] Network device support  --->
                       [ ] ISDN support  --->
                       < > Telephony support  --->
                           Input device support  --->
                           Character devices  --->
                       <*> I2C support  --->
                       [*] SPI support  --->
                           PPS support  --->
                       -*- GPIO Support  --->
                       < > Dallas's 1-wire support  --->
                       v(+)

                          <Select>    < Exit >    < Help >
```



```
                           Network device support
  Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted letters are hotkeys.  Pressing
  <Y> includes, <N> excludes, <M> modularizes features.  Press <Esc><Esc> to exit, <?> for Help, </> for
  Search.  Legend: [*] built-in  [ ] excluded  <M> module  < > module capable

                       ^(-)
                             *** Enable WiMAX (Networking options) to see the WiMAX drivers ***
                             USB Network Adapters  --->
                       [ ]   Wan interfaces support  --->
                       < >   FDDI driver support
                       [ ]   HIPPI driver support (EXPERIMENTAL)
                       <*>   PPP (point-to-point protocol) support
                       [*]     PPP multilink support (EXPERIMENTAL)
                       [*]     PPP filtering
                       <*>     PPP support for async serial ports
                       <*>     PPP support for sync tty ports
                       <*>     PPP Deflate compression
                       <*>     PPP BSD-Compress compression
                       < >     PPP MPPE compression (encryption) (EXPERIMENTAL) (NEW)
                       < >     PPP over Ethernet (EXPERIMENTAL) (NEW)
                       < >     PPP over L2TP (EXPERIMENTAL) (NEW)
                       < >     PPP on L2TP Access Concentrator (NEW)
                       < >     PPP on PPTP Network Server (NEW)
                       < >   SLIP (serial line) support
                       [ ]   Fibre Channel driver support
                       < >   Network console logging support (EXPERIMENTAL)

                           <Select>    < Exit >    < Help >
```

7. 如上操作选完所须选项后，通过选择<Exit>按钮，逐层退出各个配置界面。最后在保存配置界面中，选择”Yes”选项并退出。



```
  Do you wish to save your new kernel configuration?
  <ESC><ESC> to continue.

                < Yes >      <  No  >
```

8. 完成配置后，即可运行 make 命令，开始编译修改后的内核。

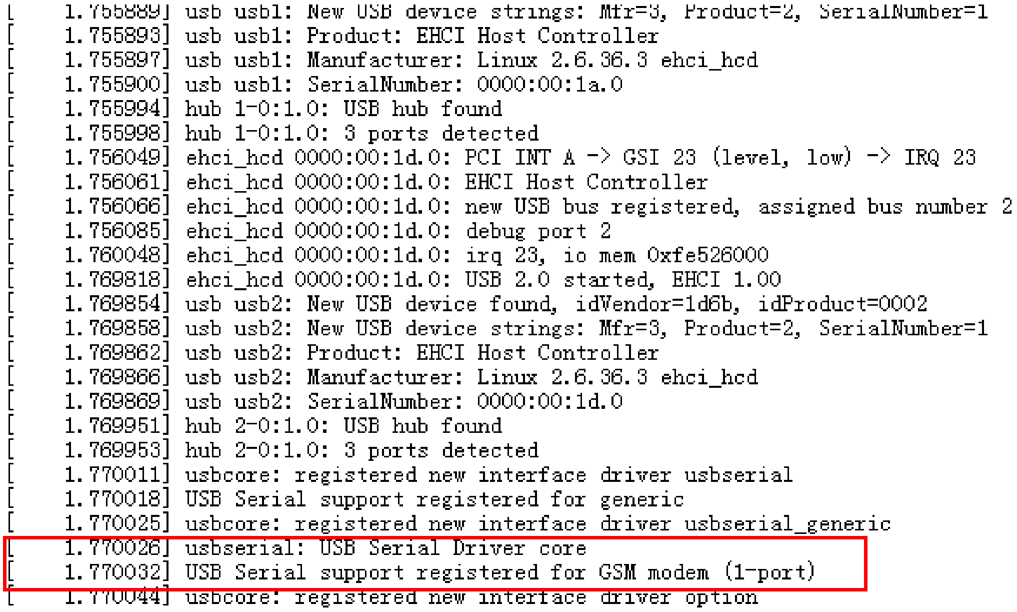
5 附录

5.1 确认系统中是否已经存在正确的 USB 串口驱动

执行如下命令查看内核的log信息：

```
dmesg
```

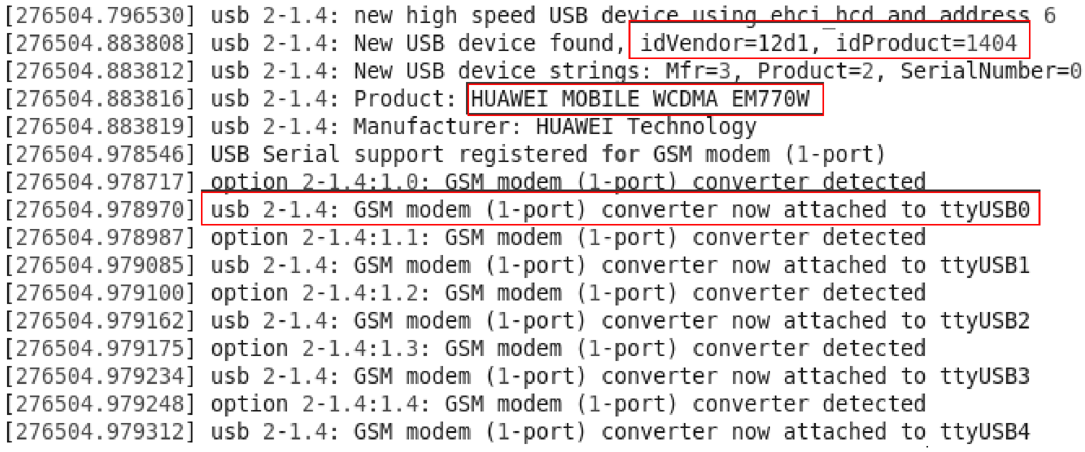
假如内核的log信息中存在如下(或相似)的信息，则说明系统已经存在正确的USB串口驱动了：



```
[    1.755889] usb usb1: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[    1.755893] usb usb1: Product: EHCI Host Controller
[    1.755897] usb usb1: Manufacturer: Linux 2.6.36.3 ehci_hcd
[    1.755900] usb usb1: SerialNumber: 0000:00:1a.0
[    1.755994] hub 1-0:1.0: USB hub found
[    1.755998] hub 1-0:1.0: 3 ports detected
[    1.756049] ehci_hcd 0000:00:1d.0: PCI INT A -> GSI 23 (level, low) -> IRQ 23
[    1.756061] ehci_hcd 0000:00:1d.0: EHCI Host Controller
[    1.756066] ehci_hcd 0000:00:1d.0: new USB bus registered, assigned bus number 2
[    1.756085] ehci_hcd 0000:00:1d.0: debug port 2
[    1.760048] ehci_hcd 0000:00:1d.0: irq 23, io mem 0xfe526000
[    1.769818] ehci_hcd 0000:00:1d.0: USB 2.0 started, EHCI 1.00
[    1.769854] usb usb2: New USB device found, idVendor=1d6b, idProduct=0002
[    1.769858] usb usb2: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[    1.769862] usb usb2: Product: EHCI Host Controller
[    1.769866] usb usb2: Manufacturer: Linux 2.6.36.3 ehci_hcd
[    1.769869] usb usb2: SerialNumber: 0000:00:1d.0
[    1.769951] hub 2-0:1.0: USB hub found
[    1.769953] hub 2-0:1.0: 3 ports detected
[    1.770011] usbcore: registered new interface driver usbserial
[    1.770018] USB Serial support registered for generic
[    1.770025] usbcore: registered new interface driver usbserial_generic
[    1.770026] usbserial: USB Serial Driver core
[    1.770032] USB Serial support registered for GSM modem (1-port)
[    1.770044] usbcore: registered new interface driver option
```

5.2 获取单板当前的端口映射情况信息

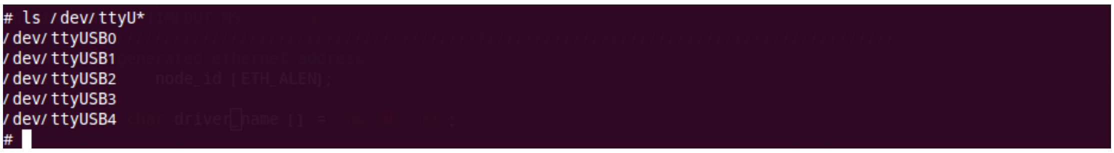
- 查看驱动是否加载成功，同样执行 dmesg 命令，假如log信息中存在如下(或相似)的信息，则说明驱动已经被成功加载，(idProduct因产品的不同而不同)。



```
[276504.796530] usb 2-1.4: new high speed USB device using ehci_hcd and address 6
[276504.883808] usb 2-1.4: New USB device found, idVendor=12d1, idProduct=1404
[276504.883812] usb 2-1.4: New USB device strings: Mfr=3, Product=2, SerialNumber=0
[276504.883816] usb 2-1.4: Product: HUAWEI MOBILE WCDMA EM770W
[276504.883819] usb 2-1.4: Manufacturer: HUAWEI Technology
[276504.978546] USB Serial support registered for GSM modem (1-port)
[276504.978717] option 2-1.4:1.0: GSM modem (1-port) converter detected
[276504.978970] usb 2-1.4: GSM modem (1-port) converter now attached to ttyUSB0
[276504.978987] option 2-1.4:1.1: GSM modem (1-port) converter detected
[276504.979085] usb 2-1.4: GSM modem (1-port) converter now attached to ttyUSB1
[276504.979100] option 2-1.4:1.2: GSM modem (1-port) converter detected
[276504.979162] usb 2-1.4: GSM modem (1-port) converter now attached to ttyUSB2
[276504.979175] option 2-1.4:1.3: GSM modem (1-port) converter detected
[276504.979234] usb 2-1.4: GSM modem (1-port) converter now attached to ttyUSB3
[276504.979248] option 2-1.4:1.4: GSM modem (1-port) converter detected
[276504.979312] usb 2-1.4: GSM modem (1-port) converter now attached to ttyUSB4
```

- 当前模块设备的modem、pcui等端口的设备文件名称 查询命令：

ls   /dev/ttyUSB*



```
# ls /dev/ttyU*
/dev/ttyUSB0
/dev/ttyUSB1
/dev/ttyUSB2
/dev/ttyUSB3
/dev/ttyUSB4
# 
```