# Guide to Kernel Driver Integration in Android for Huawei WCDMA & CDMA & LTE Modules

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# About This Document

## Revision History

| Document Version | Date | Chapter | Change Description |
|---|---|---|---|
| V1.0 | 2010-11-29 | | Completed the draft |
| V1.0.1 | 2011-05-03 | | Add the method of modifying the kernel files to support new PIDs and to enable the autosuspend feature |
| V1.2.1 | 2011-08-25 | | Add the method to solve upgrade problem in android system used by MC509 |
| V1.2.3 | 2011-11-10 | | Enable zero Packet feature. |
| V1.2.4 | 2013-01-31 | | Update the comment scope |
| V1.2.6 | 2013-09-06 | 2 | Updated Table 2-1 Linux kernel driver architecture supporting Huawei modules in Android |
| | | All | Added the description related to the CDC ECM Driver |
| | | All | Added the product scope of LTE |
| | | 5 | Added chapter Appendix |

# Contents

# 1 Purpose

This guide instructs the kernel driver integration development for Huawei modules based on Android operating system (OS). It is intended for the driver developers of the products based on Android OS.

# 2 Scope

This guide applies to:

- Embedded Linux with kernel version 2.6.35 or later[1]
- Android 2.3 (Linux kernel 2.6.35) or later
- Huawei LTE, WCDMA and CDMA Modules

**NOTE**

[1]: If the host does not care power consumption of Huawei modules, the Linux can be integrated with kernel version 2.6.18 or later.

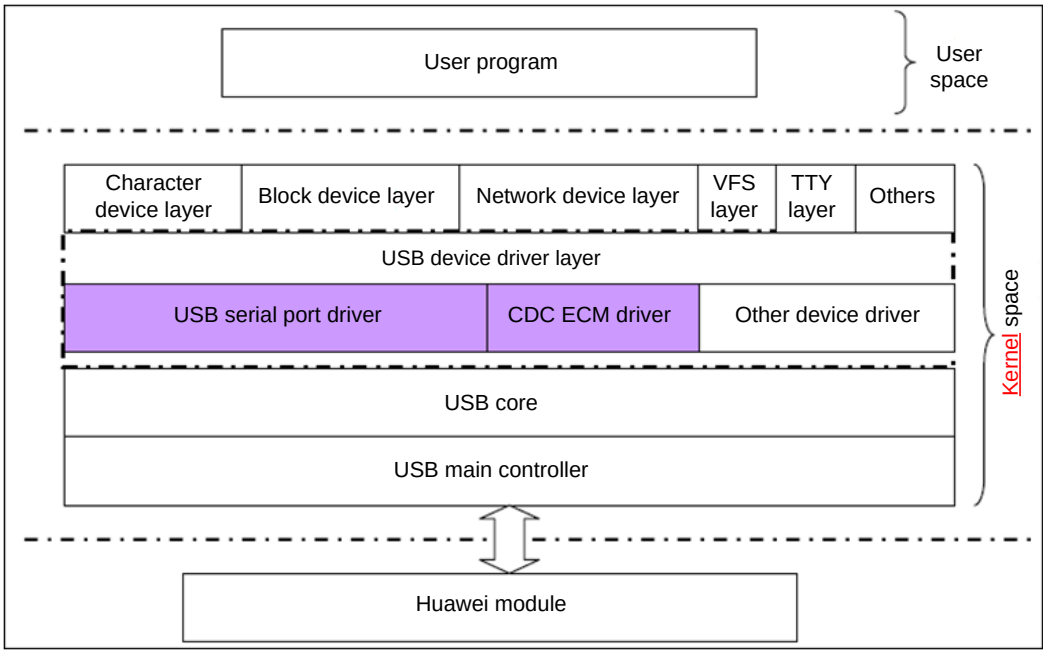
# 3 Overview

## 3.1 Linux Kernel Driver Architecture Supporting Huawei Modules in Android

Huawei modules communicate with Android mainly over Universal Serial Bus (USB) ports. Linux kernel of Android needs to load USB drivers according to the information about the USB device ports reported by Huawei modules. Huawei modules can work normally only after the correct USB drivers are loaded.

Figure 3-1 shows the Linux kernel driver architecture supporting Huawei modules in Android.

**Figure 3-1** Linux kernel driver architecture supporting Huawei modules in Android



As shown in Figure 3-1 , in the USB driver architecture of Linux, the drivers related to Huawei modules are the USB serial port driver and CDC ECM driver.

- USB serial port driver: supports the ports such as the modem port and the AT command port. The code file (**option.c**) of this driver has been added into the source code of Linux kernel.
- CDC ECM driver: works as a standard ECM network port driver for USB and is used to transport network data.

# 4 Android's Linux Kernel Driver Integration Scheme

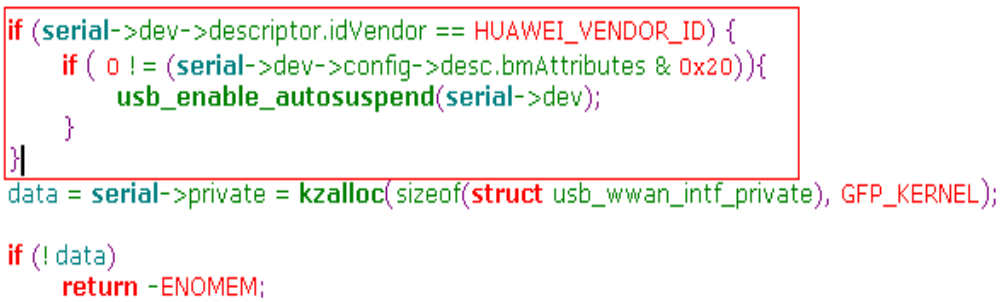
## 4.1 USB Serial Port Driver of Android Kernel

This integration scheme involves the following Linux kernel source code files:

- drivers/usb/serial/option.c
- drivers/usb/serial/usb_wwan.c

### 4.1.1 Revision on USB Serial Port Driver Integration

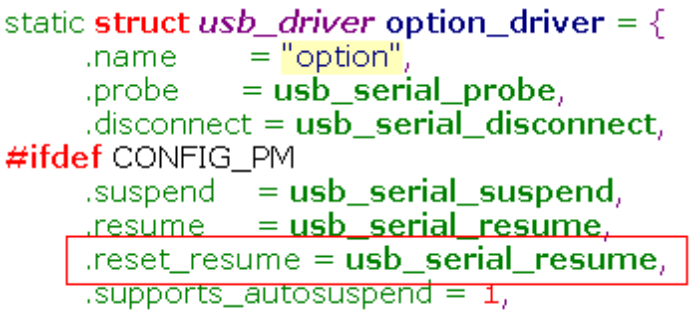
1. Linux kernels in version 2.6.35 or later versions have the selective suspend feature for USB serial port drivers. Therefore, enable this feature and the USB serial port drivers will support the selective suspend feature for power management.
2. To enable this feature, add the contents enclosed in the red rectangle in the following figure into the **option_attach ()** function in the **option.c** file in **/drivers/usb/serial/**. As the following figure illustrates, first add the macro of #define HUAWEI_VENDOR_ID 0x12d1.




Copy and paste the following contents:

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

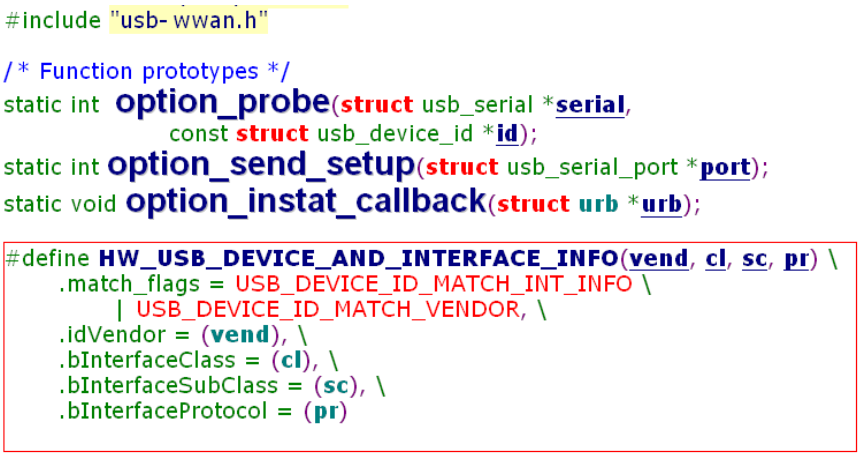
3. To invoke the **reset_resume** function, add the sentence enclosed in the red rectangle in the following figure. (If this operation is cancelled in some versions, the sentence enclosed in the red rectangle does not need to be added.)




Copy and paste the following contents:

```
.reset_resume = usb_serial_resume,
```

4. Add new supporting declarations for Huawei modules. Modifications are as follows:
   - Add the macro definition enclosed in the red rectangle in the following figure.




Copy and paste the following contents:

```
#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)
```

   - Add the following sentences to the **static const struct usb_device_id option_ids[ ] id** list:

```
{ 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, 0x31) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x32) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x0D) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x0E) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x3B) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x3D) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x1B) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x1C) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x01, 0x1D) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03, 0x14) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03, 0x17) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03, 0x18) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03, 0x1B) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03, 0x1C) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03, 0x48) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03, 0x49) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03, 0x4B) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03, 0x4C) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03, 0x4D) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03, 0x78) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x03, 0x7B) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04, 0x0D) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04, 0x4D) },
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```

```
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04, 0x7A) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x04, 0x7C) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05, 0x0F) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05, 0x3B) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05, 0x3D) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05, 0x3E) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05, 0x1B) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05, 0x1C) },
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```

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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05, 0x78) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x05, 0x7C) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06, 0x63) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06, 0x4B) },
```

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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06, 0x4C) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06, 0x4D) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06, 0x78) },
{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06, 0x79) },
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{ HW_USB_DEVICE_AND_INTERFACE_INFO(HUAWEI_VENDOR_ID, 0xff, 0x06, 0x7D) },
```

5. Enable the zero packet feature to solve problems caused by module upgrades. The file to be modified is in the **drivers/usb/serial/usb_wwan.c** directory.
   - Add the definition of the bcdUSB value (#define HW_bcdUSB 0x0110) and the definition of the Huawei vid value (#define HUAWEI_VENDOR_ID 0x12d1), as shown in the red rectangle in the following figure.

```
#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)
```

Copy and paste the following contents:

```
#define HW_bcdUSB 0x0110
#define HUAWEI_VENDOR_ID 0x12d1
```

   - Add the definition of "struct usb_host_endpoint *ep" in the **usb_wwan_write** function. Then add the judgment of ZERO_PACKET in the **usb_wwan_write** function, as shown in the red rectangle in the following figure.

```
/* 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);
```

Copy and paste the following contents:

```
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;
    }
}
```

6. Modify the compilation configuration of Android kernel (in the **.config** file in the kernel root directory), and ensure that the following configuration options are enabled. For detailed configuration operations, see section 4.1.2 "Configuration Procedures for USB Serial Port Driver Integration."
   - Configuration options related to USB power management:

     ```
     CONFIG_USB_SUSPEND=y
     ```
   - Configuration options related to the USB serial port driver:

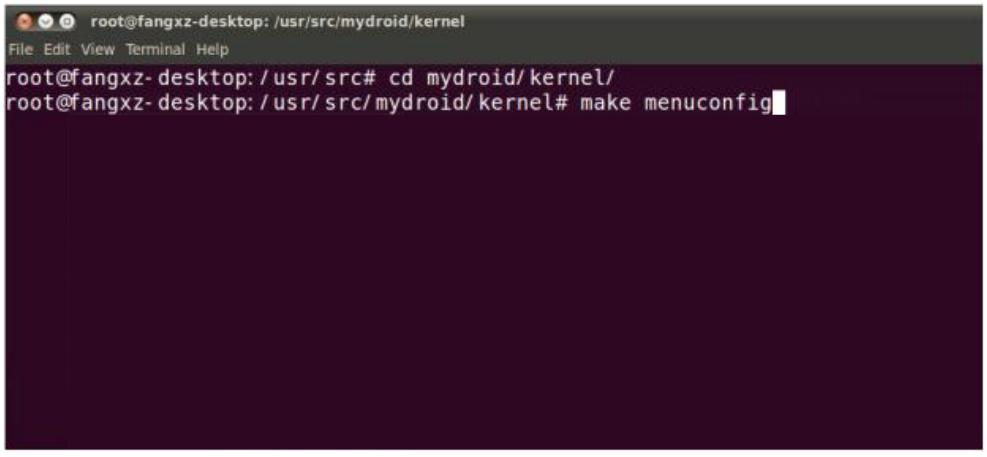
     ```
     CONFIG_USB_SERIAL=y
     CONFIG_USB_SERIAL_OPTION=y
     CONFIG_USB_SERIAL_WWAN=y
     ```
   - Configuration options related to PPP dial-up connections:

     ```
     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 Configuration Procedures for USB Serial Port Driver Integration

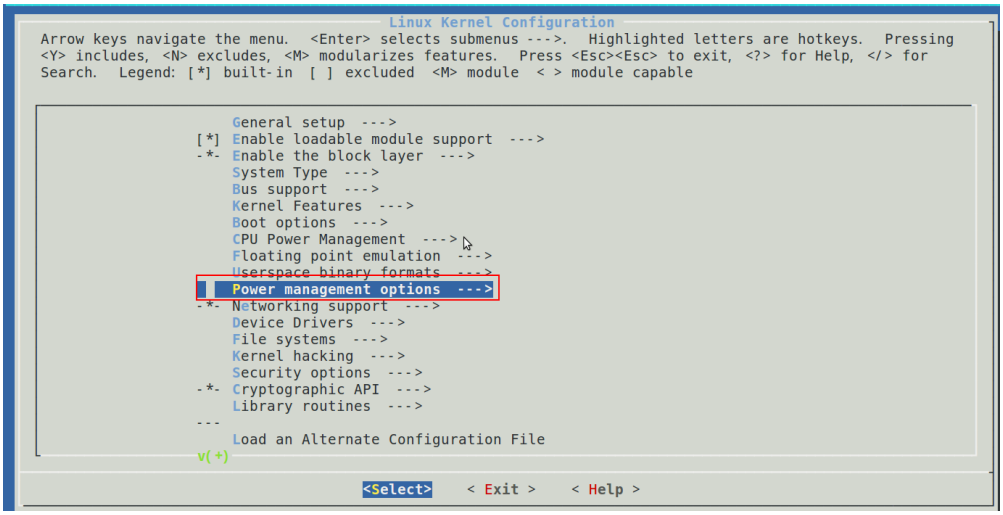
To configure USB serial port driver integration, perform the following steps:

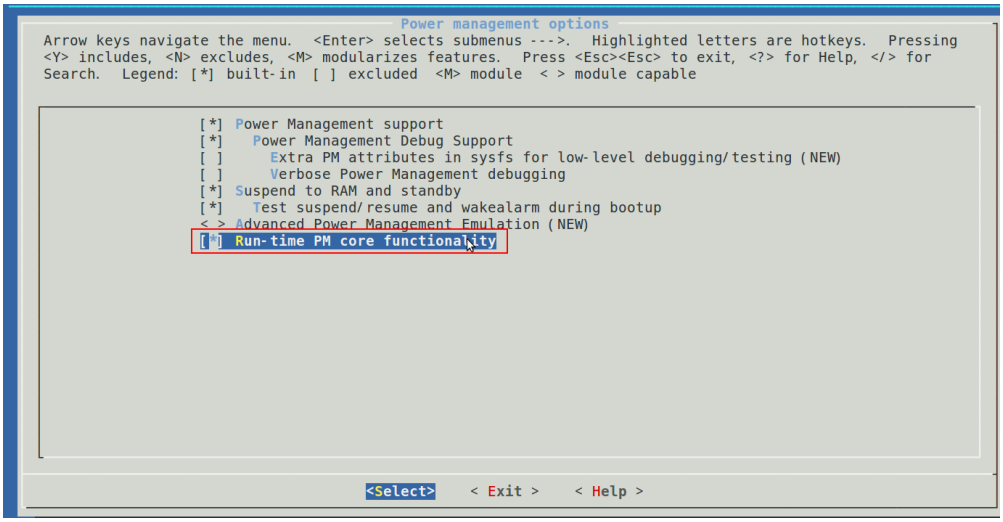
Step 1 Run the **Terminal** tool, enter the **kernel** directory (assume that the kernel is in the **/usr/src/myandroid/** directory, that is, **cd /usr/src/myandroid/kernel**), and then run the **make <configuration>** command (in this guide, assume that the standard **make menuconfig** command is used).

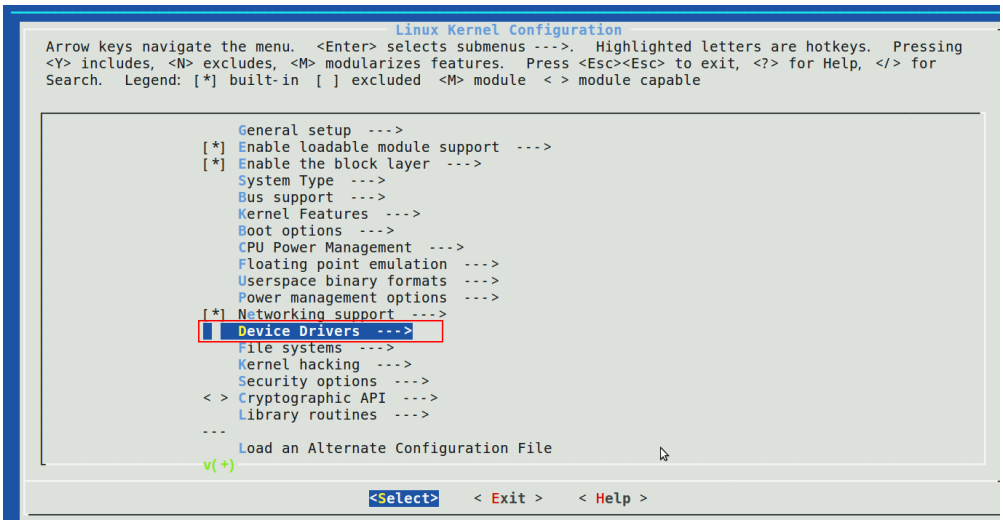


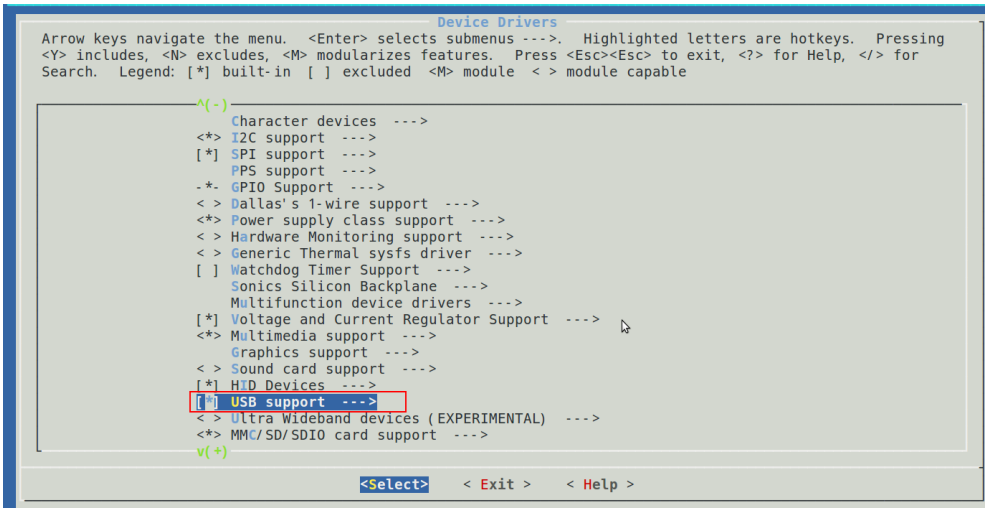

Step 2 Select related configuration options.

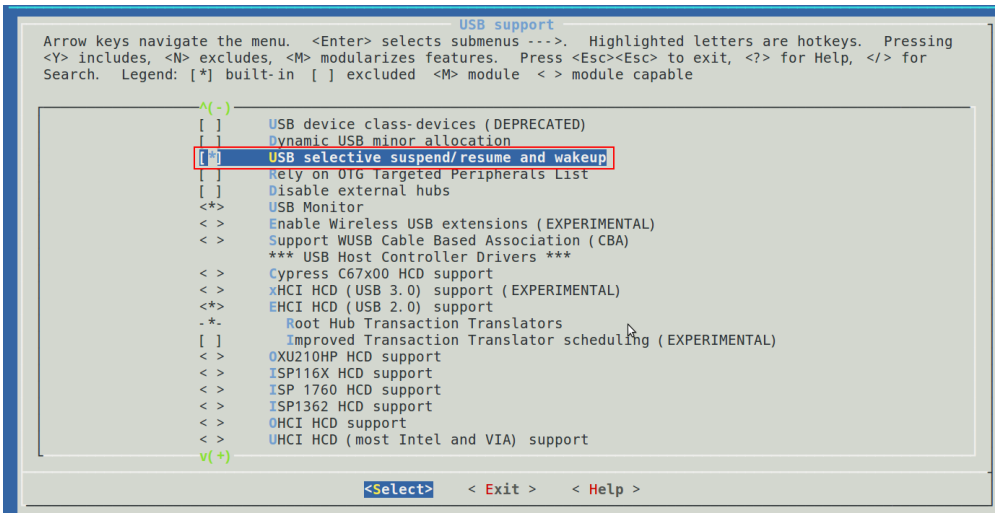
1. Configuration options related to USB power management:



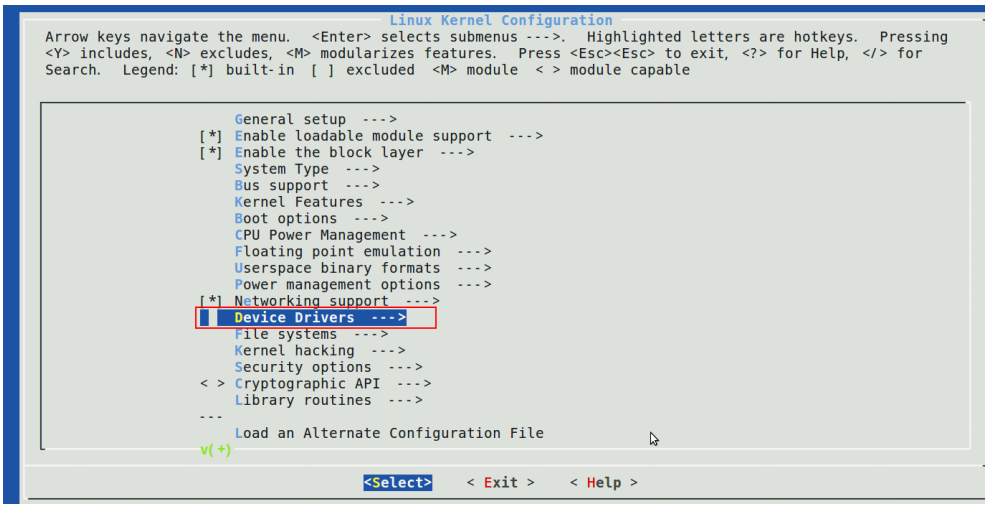



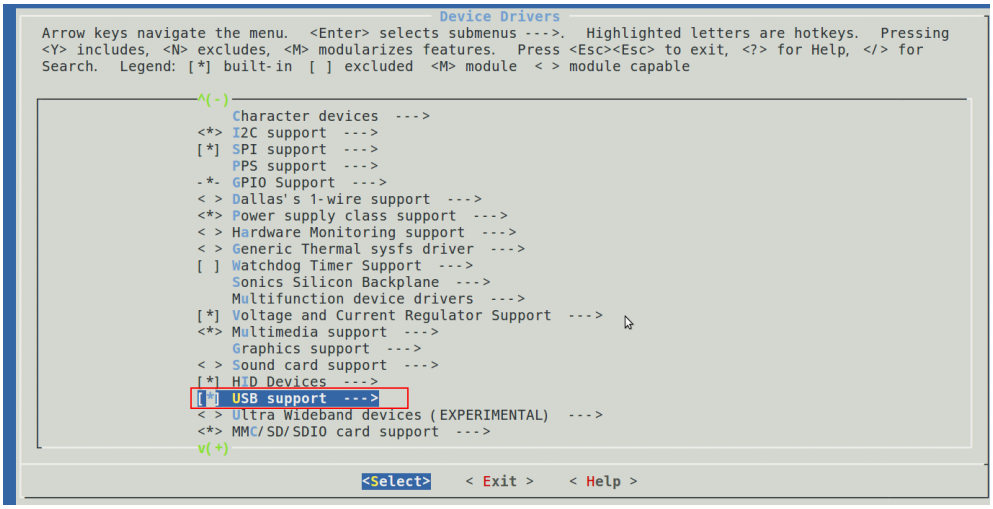



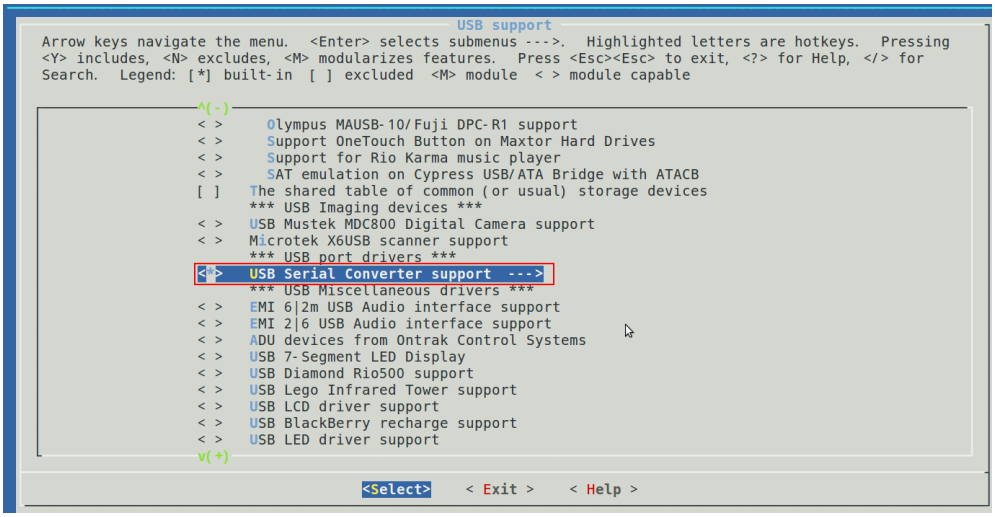


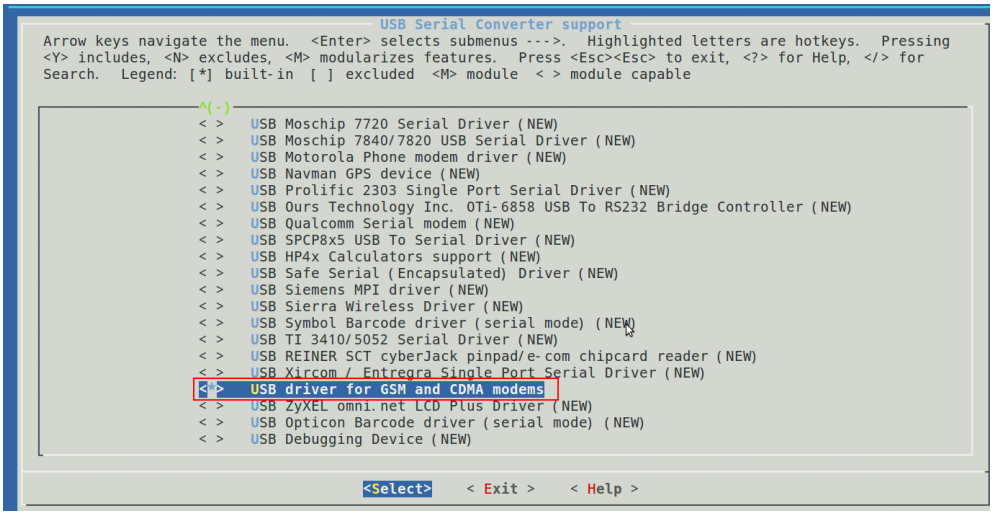




2. Configuration options related to the USB serial port driver:

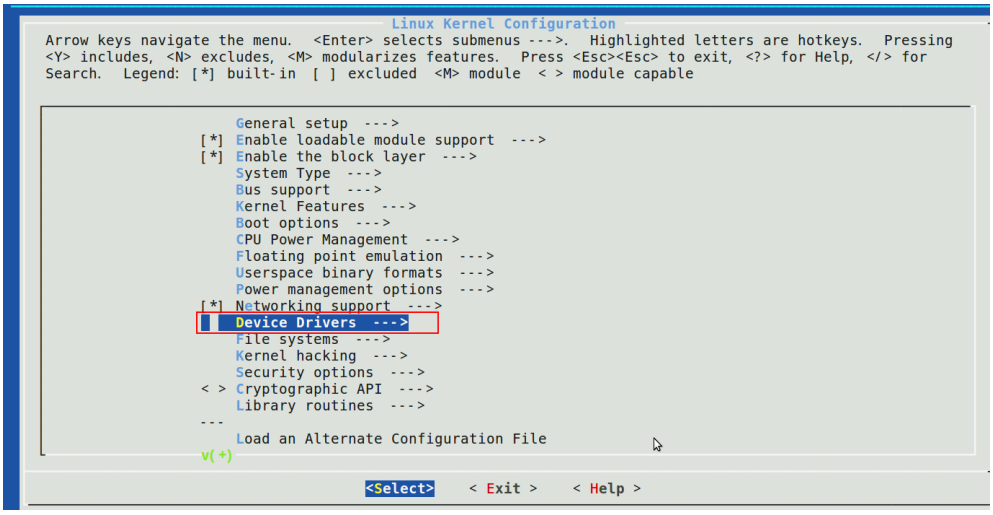


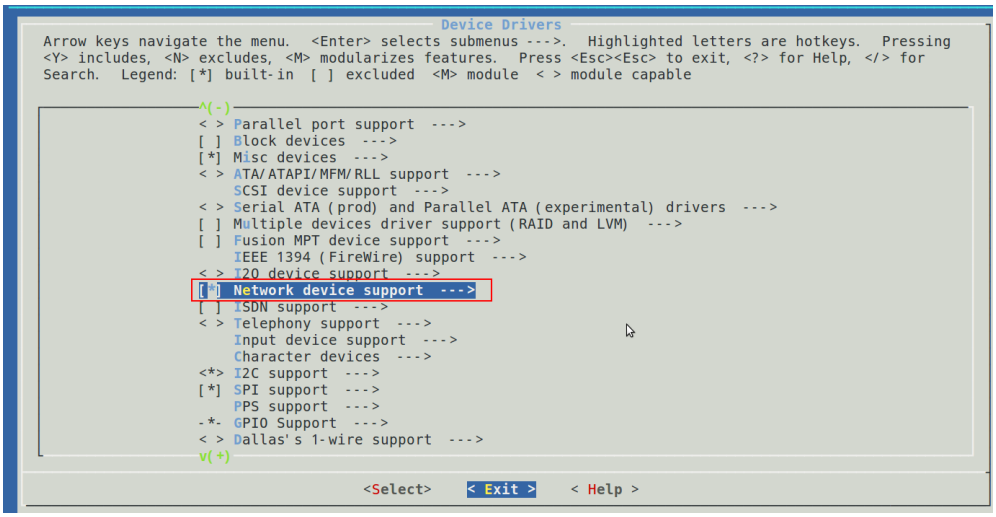


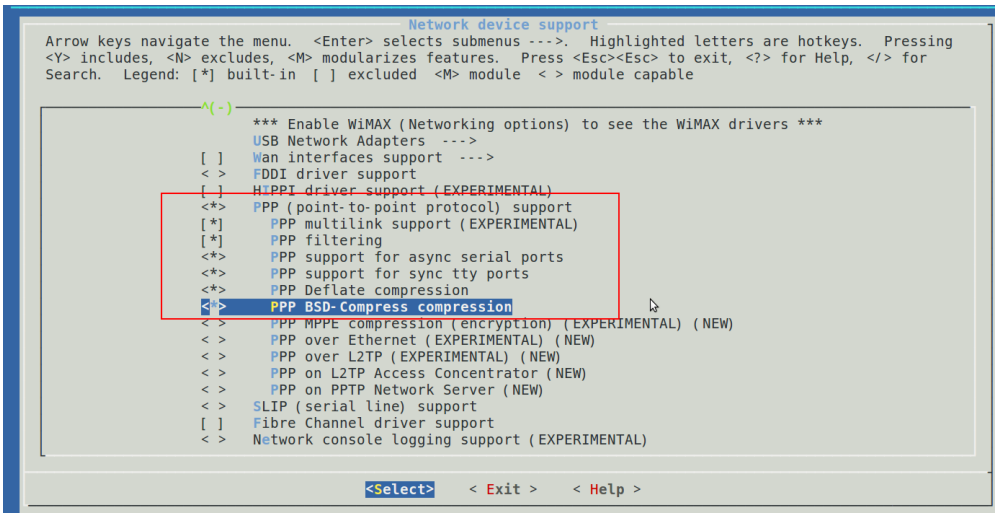



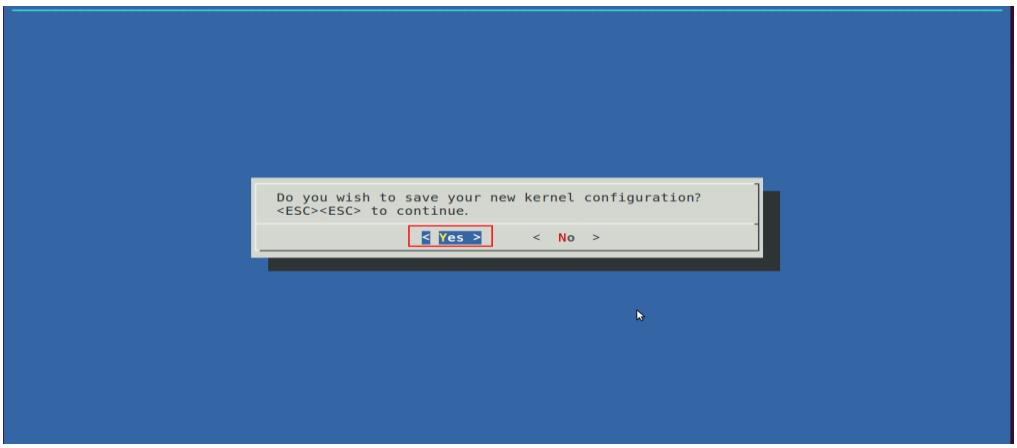

3. Configuration options related to PPP dial-up connections:



Step 3 Select **Exit** to exit all configuration screens. Then, in the window for saving the configuration, select **<Yes>** to exit and save the configuration.




Step 4 After the configuration is completed, run the **make** command to compile the revised kernel version.

**----End**

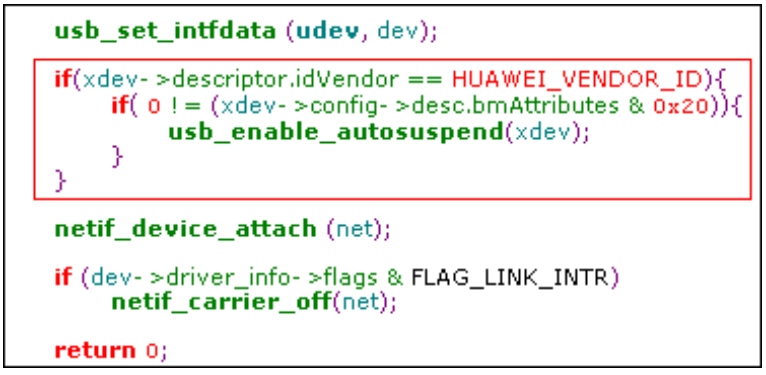
# 4.2 Android's Linux Kernel CDC ECM Driver Integration

This integration scheme involves the following Linux kernel source code file:

`drivers/net/usb/usbnet.c.`

## 4.2.1 Revision on CDC ECM Driver Integration

To enable this feature, add the contents enclosed in the red rectangle in the following figure into the **usbnet_probe ()** function in the **usbnet.c** file in **drivers/net/usb/**. As shown in the following figure, first add the macro of #define HUAWEI_VENDOR_ID 0x12d1.




Copy and paste the following contents:

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

```
        usb_enable_autosuspend(xdev);
         }
}
```

## 4.2.2 Configuration Procedures for CDC ECM Driver Integration

To configure CDC ECM driver integration, perform the following steps:

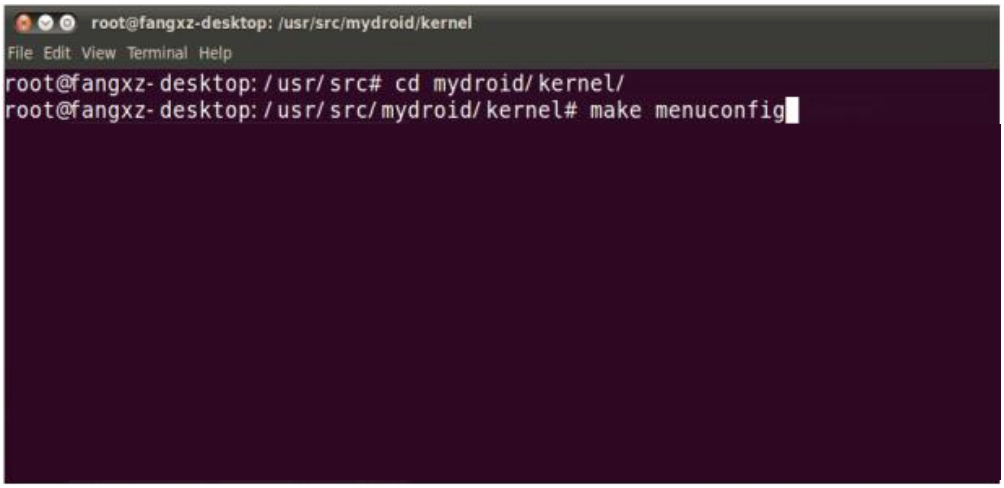
Step 1 Modify the compilation configuration of Android kernel (in the **.config** file in the kernel root directory), and ensure that the following configuration options are enabled.

Relevant configuration options related to CND ECM driver integration:

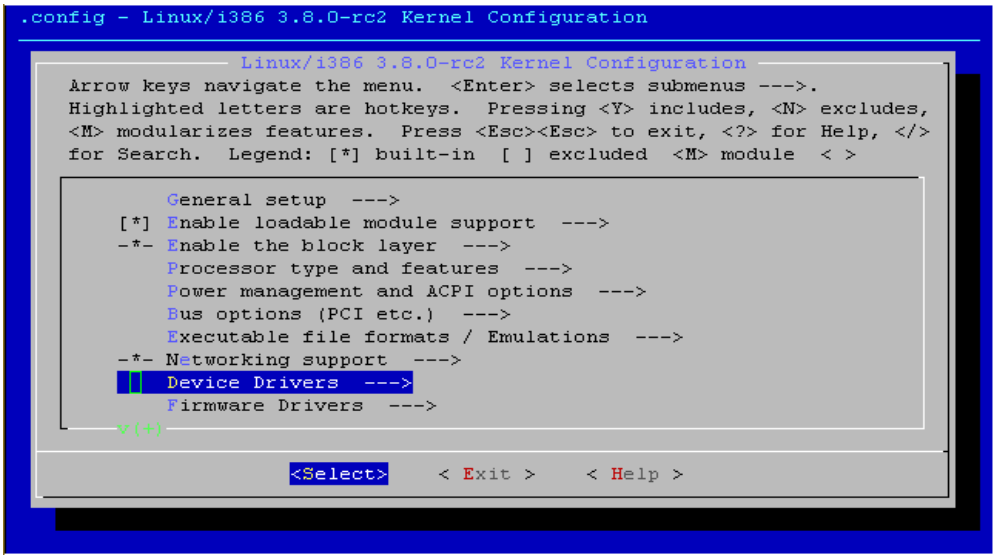
```
CONFIG_USB_USBNET=y
CONFIG_NETDEVICES=y
CONFIG_USB_NET_CDCETHER=y
```

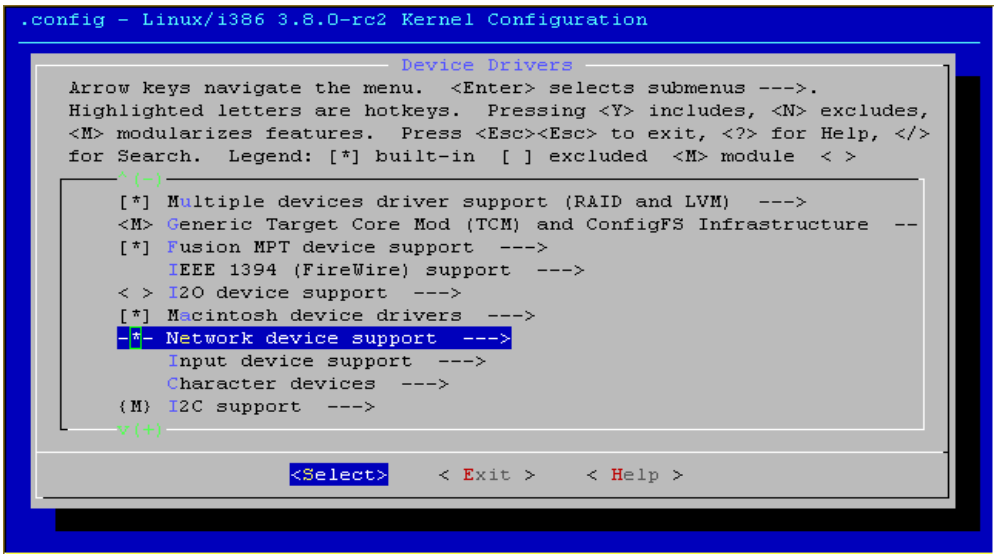
Step 2 Specific operations are as follows:

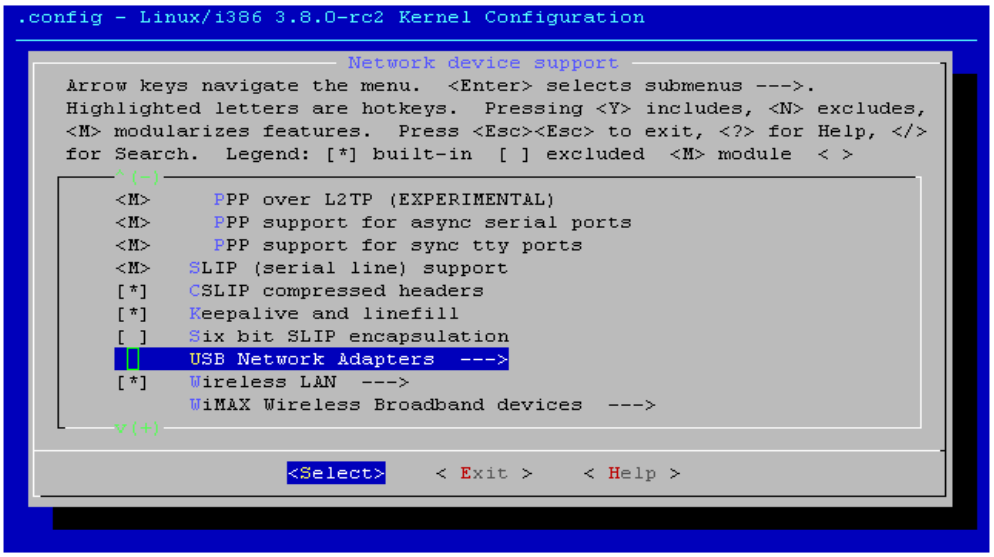
1. Run the **Terminal** tool, enter the **kernel** directory (assume that the kernel is in the **/usr/src/myandroid/** directory, that is, **cd /usr/src/myandroid/kernel**), and then run the **make <configuration>** command (in this guide, assume that the standard **make menuconfig** command is used).

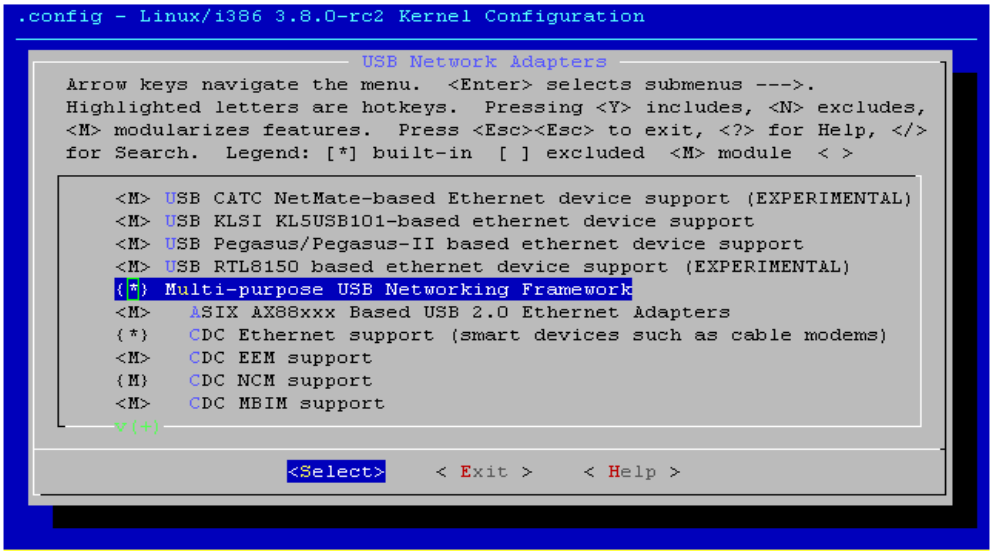


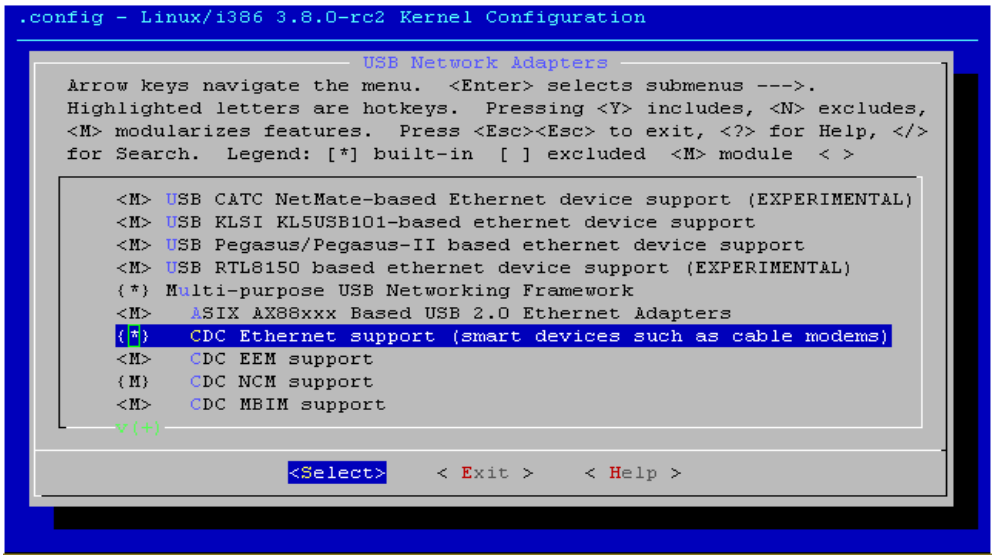

2. Configure the CDC ECM driver configuration options, as shown in the following figures.



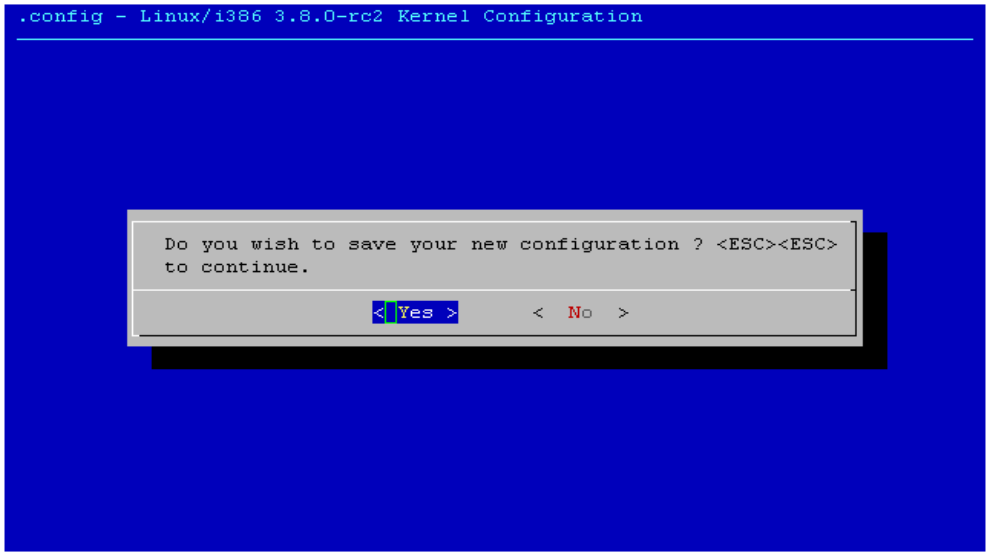








Step 3 Select **Exit** to exit all configuration screens. Then, in the window for saving the configuration, select **<Yes>** to exit and save the configuration.




Step 4 After the configuration is completed, run the **make** command to compile the revised kernel version.

**----End**

# 5 Appendix

## 5.1 Checking Whether the Correct USB Serial Port Driver Exists in the Kernel

Run the following command to check the kernel log information:

```
dmesg
```

If the following information (or similar information) exists in the kernel log, the correct USB serial port driver has been integrated into the kernel.

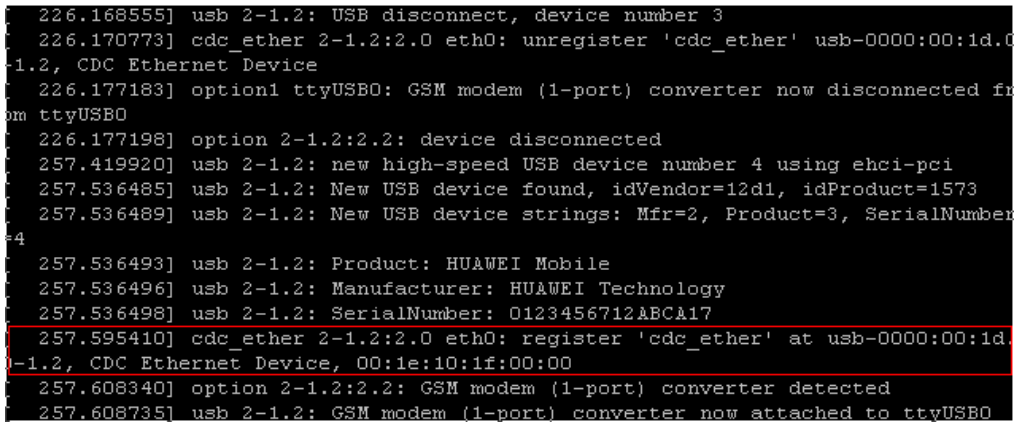
```
[    1.755889] usb usb1: New USB device strings: Mfr=3, Product=2, SerialNumber=1
[    1.755893] usb usb1: Product: EHCI Host Controller
[    1.755897] usb usb1: Manufacturer: Linux 2.6.36.3 ehci_hcd
[    1.755900] usb usb1: SerialNumber: 0000:00:1a.0
[    1.755994] hub 1-0:1.0: USB hub found
[    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 Checking Whether the Correct CDC ECM Driver Exists in the Kernel

Run the following command to check the kernel log information:

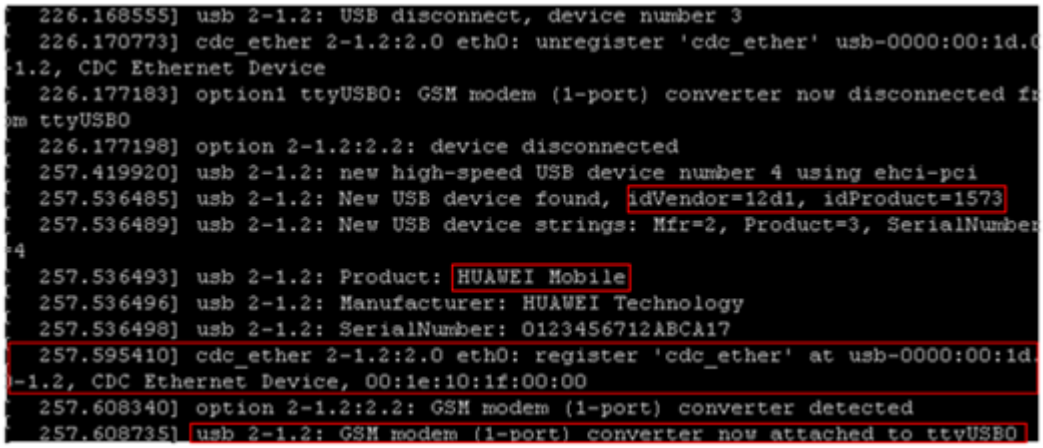
```
dmesg
```

If the information in the red rectangle in the following figure exists in the kernel log, the correct CDC ECM driver has been integrated into the kernel.




# 5.3 Obtaining the Port Mapping Information of the Board

Run the **dmesg** command to check whether the driver for Huawei modules has been loaded successfully. If the information in the red rectangle in the following figure exists in the kernel log, the correct driver has been loaded successfully. (The value of **idProduct** varies with the actual product.)




To query the device file names of Huawei modules' ports (such as the modem and pcui ports), run the following command:

```
ls /dev/ttyUSB*
```