Wireless Module Expert

UC15

Embedded Linux USB Driver User Guide

UMTS/HSPA Module Series

Rev. UC15_Embedded_Linux_USB_Driver_User_Guide_V1.0

` Date: 2013-12-09

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About the Document

History

Revision	Date	Author	Description
1.0	2013-12-09	Clare CHEN	Initial

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1 Introduction

This document mainly introduces how to generate the USB driver for the module in embedded Linux OS, and how to use the module after the USB driver has been installed successfully.

2 Product Overview

UC15 has the ability to conduct the wireless communication. Therefore, applications such as voice call, short message and network can be run well in the embedded Linux system.

In order to use the physical USB interface of the module, you must generate the USB driver for the module first. This module is a composite USB device and it includes five function interfaces and these five interfaces have different functionalities. The details are shown as below:

Table 1: Interface Description

DM Interface	Diagnose port
Reserved Interface	Reserved
AT Interface	For AT commands
Modem Interface	For PPP connections and AT commands
NDIS Interface	Network driver interface

NOTE

The NDIS interface is unavailable temporarily.

3 System Setup

Linux OS includes a generic USB to serial driver for GSM/WCDMA modem. You can make the module available in the embedded Linux OS by adding some kernel configuration items and information (VID/PID) in Linux kernel.

The first part of this chapter describes the structure of Linux USB driver and the rest explains how to build the USB driver for the module.

3.1. Linux USB Driver Structure

USB is a kind of hierarchical bus structure. The data transmission between USB devices and host is achieved by USB controller. The following picture illustrates the architecture of USB driver. Linux USB host driver includes three parts: USB host controller driver, USB core and USB device drivers.

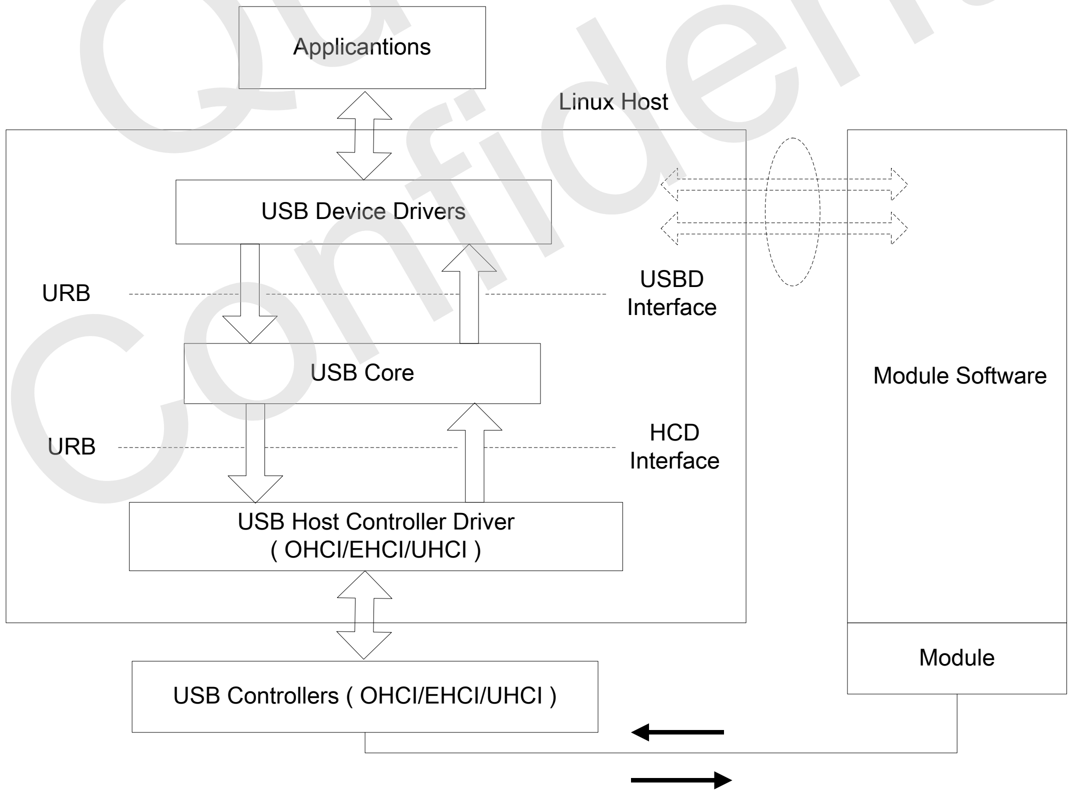


Figure 1: USB Driver Structure

The USB host controller driver, the bottom of the hierarchical structure, is a software module which interacts directly with hardware.

USB core, the core of the whole USB host driver, is responsible for the management of USB bus, USB bus devices, and USB bus bandwidth. It provides the interfaces for USB device driver, through which the applications can access the USB system files.

USB device drivers interact with the applications, and mainly provide the interfaces for accessing the specific USB devices.

3.2. Create the Driver

During the development based on embedded Linux OS, you must retrieve the Linux kernel source code files and install an appropriate cross compiler first, then modify the kernel configuration and corresponding source code files. Compile the kernel to generate image file, and burn the file into the target machine (The OS of the target machine is Android 4.0.3, and the corresponding Linux kernel version is 3.0.8).The detailed steps are shown as below.

3.2.1. Install Cross Compiler

Cross-compilation is an important technology for embedded development. Its feature is that the source code files are not compiled in native machine but the other one. In general we call the native machine as target machine and the other one as host machine.

The reason for adopting cross-compilation is that most embedded target system cannot provide enough resources to compile source code files, so we have to realize that in a high-performance host machine in which we will create an environment of cross-compilation for the target machine.

In general, the vendor of the embedded machine would provide the cross compiler and the install method about it. Here, we use the cross compiler "arm-linux-gcc-4.5.1" as an example. First install it and add the compiler’s path in the system environment variables, and re-logout the system, then you can use the cross compiler to compile the source code files.

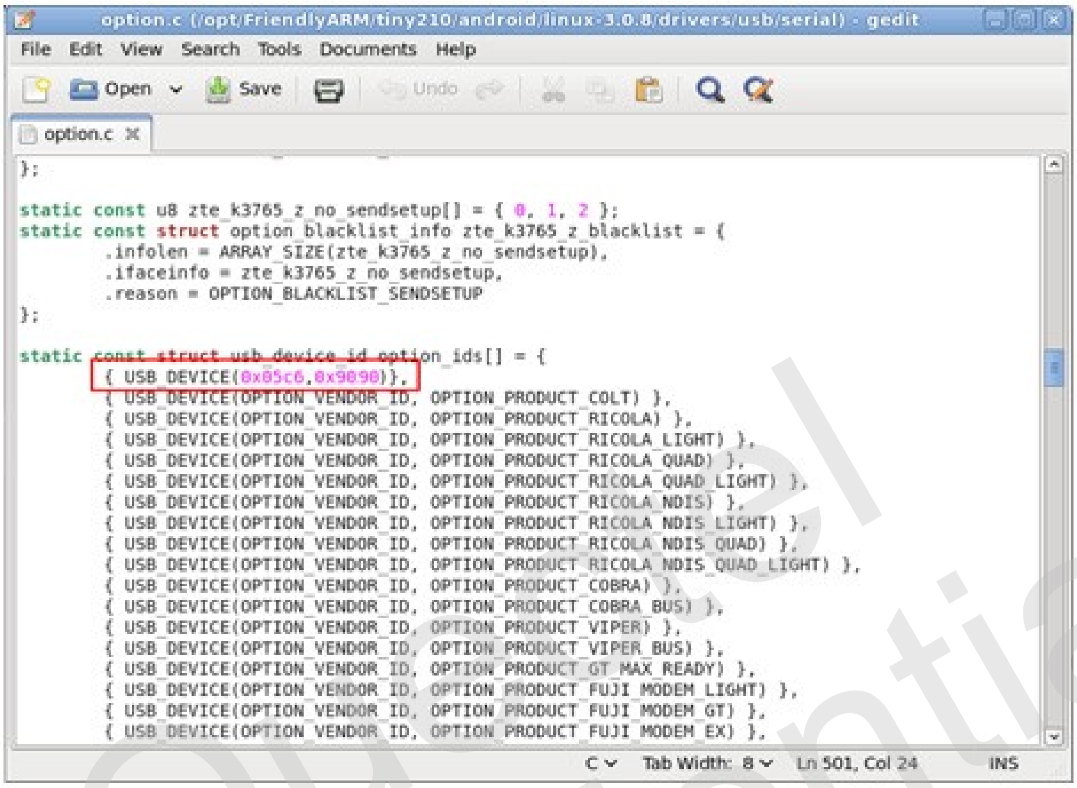
3.2.2. Modify the Source Code File of Linux Kernel

Modify the source code file "option.c" in Linux kernel by adding VID and PID of the module, so that the OS can recognize it.

The UC15’s VID and PID are shown as follows:

- VID–0x05c6
- PID–0x9090

Open the file "option.c" in the path of "/drivers/usb/serial" and find the structure array of "static structusb_device_idoption_ids[]". Insert "{USB_DEVICE(0x05c6,0x9090)}," to the array, then save and close it. The content of the file "option.c" is shown as below:


option.c (/opt/FriendlyARM/tiny210/android/linux-3.0.8/drivers/usb/serial) - gedit
File Edit View Search Tools Documents Help
Open
Save
Undo
option.c
C
Tab Width: 8
Ln 501, Col 24
INS

```
};

static const u8 zte_k3765_z_no_sendsetup[] = { 0, 1, 2 };
static const struct option_blacklist_info zte_k3765_z_blacklist = {
        .infolen = ARRAY_SIZE(zte_k3765_z_no_sendsetup),
        .ifaceinfo = zte_k3765_z_no_sendsetup,
        .reason = OPTION_BLACKLIST_SENDSETUP
};

static const struct usb_device_id option_ids[] = {
        { USB_DEVICE(0x05c6,0x9090)},
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_COLT) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_RICOLA) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_RICOLA_LIGHT) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_RICOLA_QUAD) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_RICOLA_QUAD_LIGHT) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_RICOLA_NDIS) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_RICOLA_NDIS_LIGHT) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_RICOLA_NDIS_QUAD) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_RICOLA_NDIS_QUAD_LIGHT) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_COBRA) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_COBRA_BUS) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_VIPER) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_VIPER_BUS) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_GT_MAX_READY) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_FUJI_MODEM_LIGHT) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_FUJI_MODEM_GT) },
        { USB_DEVICE(OPTION_VENDOR_ID, OPTION_PRODUCT_FUJI_MODEM_EX) },
```

Figure 2: The Content of the File "option.c"

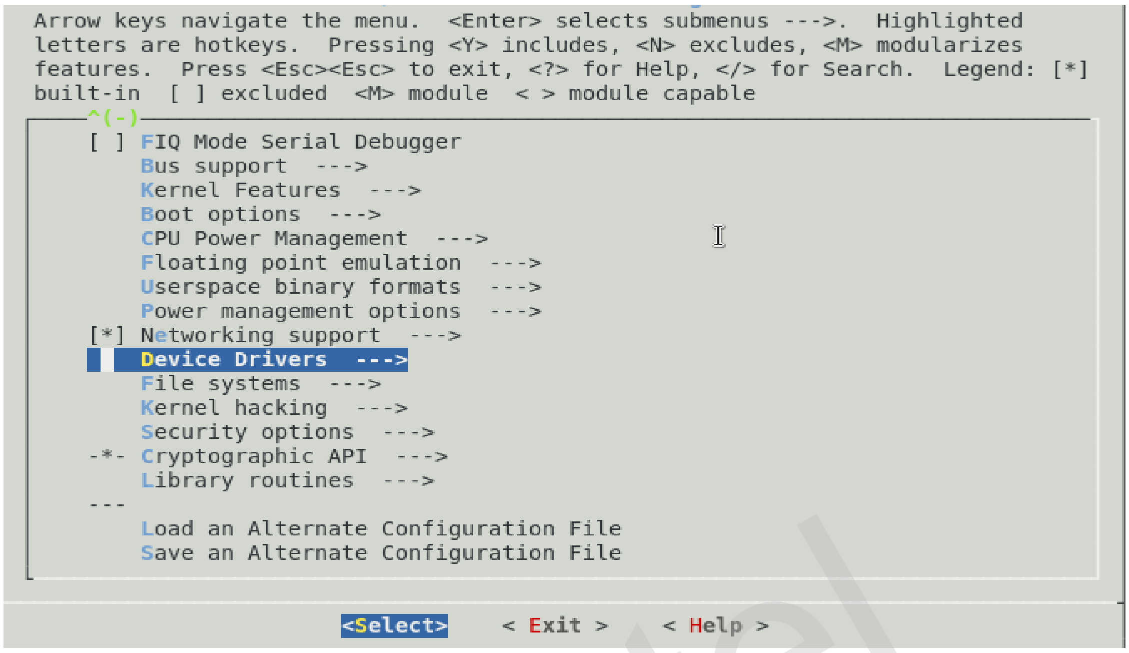
3.2.3. Modify Kernel Configuration

Select the configuration items of USB to serial driver of the Linux kernel, so that the OS can support the module.

Retrieve the appropriate kernel source code version for your embedded system. Unpack it to your host machine and put it in its root directory type:

```
#make menuconfig
```

Configure the kernel compiling items in the pop-up window. And browse through the menus "**Device Driver**" → "**USB Support**" → "**USB Serial Converter support**" and choose "**USB Generic Serial Driver**" and "**USB driver for GSM and CDMA modems**" as build-in , the illustration is shown as below:

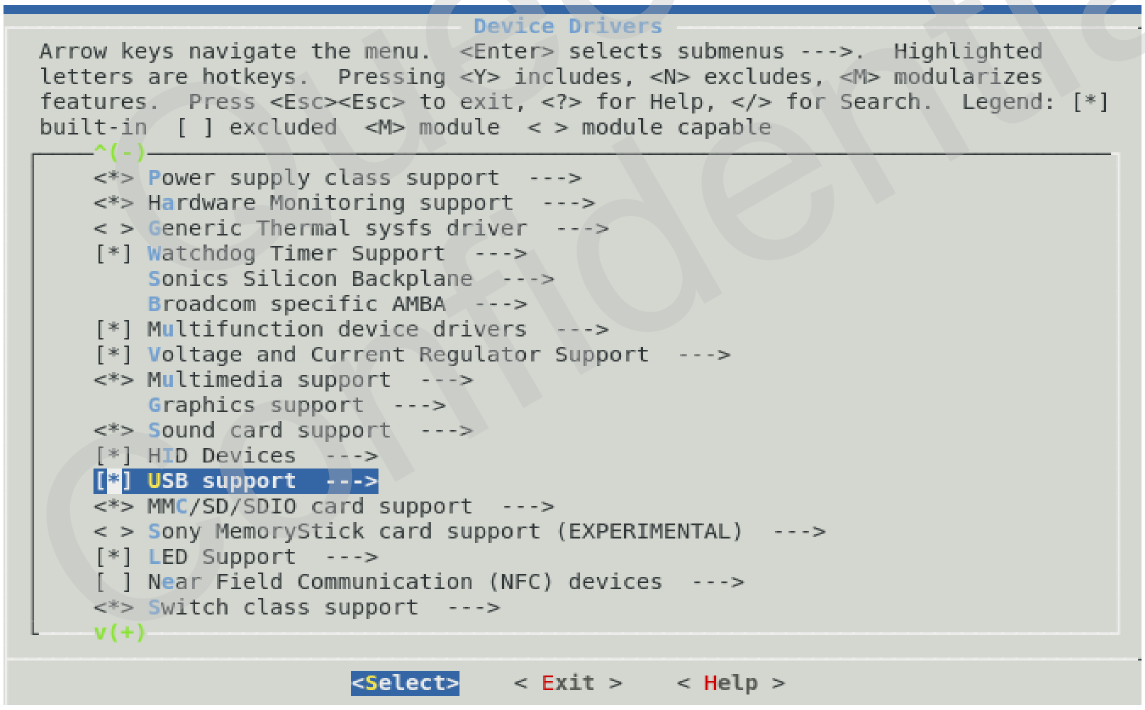


```
 Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted
 letters are hotkeys.  Pressing <Y> includes, <N> excludes, <M> modularizes
 features.  Press <Esc><Esc> to exit, <?> for Help, </> for Search.  Legend: [*]
 built-in  [ ] excluded  <M> module  < > module capable

     [ ] FIQ Mode Serial Debugger
         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
         Save an Alternate Configuration File

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

Figure 3: Select Device Drivers

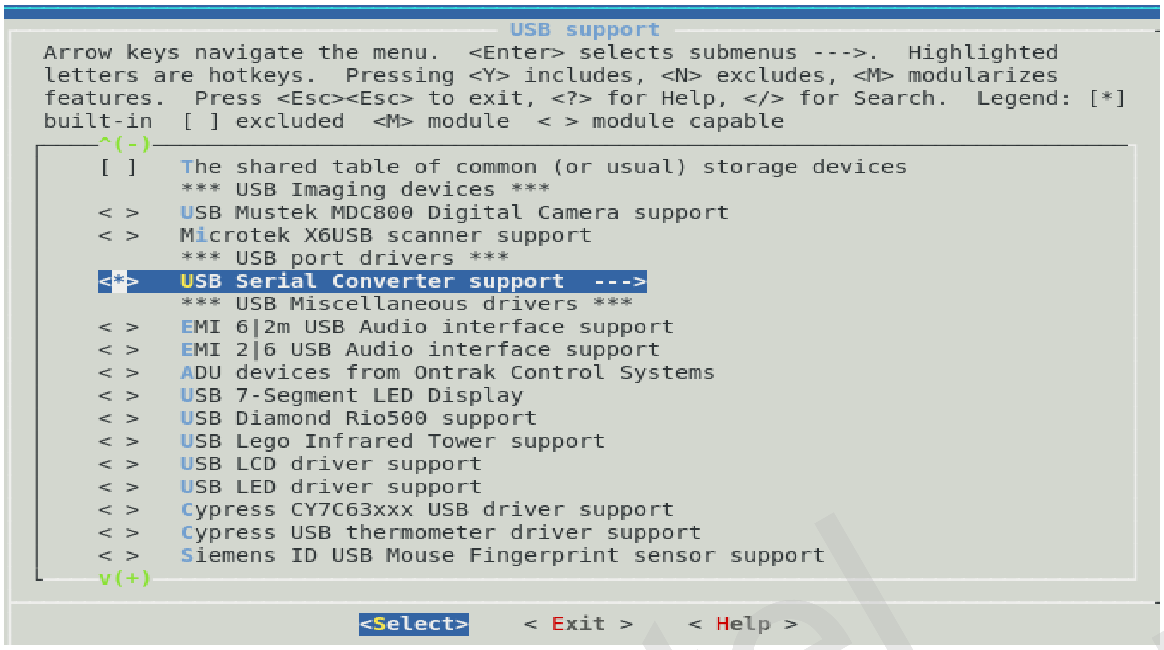


```
                         Device Drivers
 Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted
 letters are hotkeys.  Pressing <Y> includes, <N> excludes, <M> modularizes
 features.  Press <Esc><Esc> to exit, <?> for Help, </> for Search.  Legend: [*]
 built-in  [ ] excluded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

     <*> Power supply class support  --->
     <*> Hardware Monitoring support  --->
     < > Generic Thermal sysfs driver  --->
     [*] Watchdog Timer Support  --->
         Sonics Silicon Backplane  --->
         Broadcom specific AMBA  --->
     [*] Multifunction device drivers  --->
     [*] Voltage and Current Regulator Support  --->
     <*> Multimedia support  --->
         Graphics support  --->
     <*> Sound card support  --->
     [*] HID Devices  --->
     [*] USB support  --->
     <*> MMC/SD/SDIO card support  --->
     < > Sony MemoryStick card support (EXPERIMENTAL)  --->
     [*] LED Support  --->
     [ ] Near Field Communication (NFC) devices  --->
     <*> Switch class support  --->

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

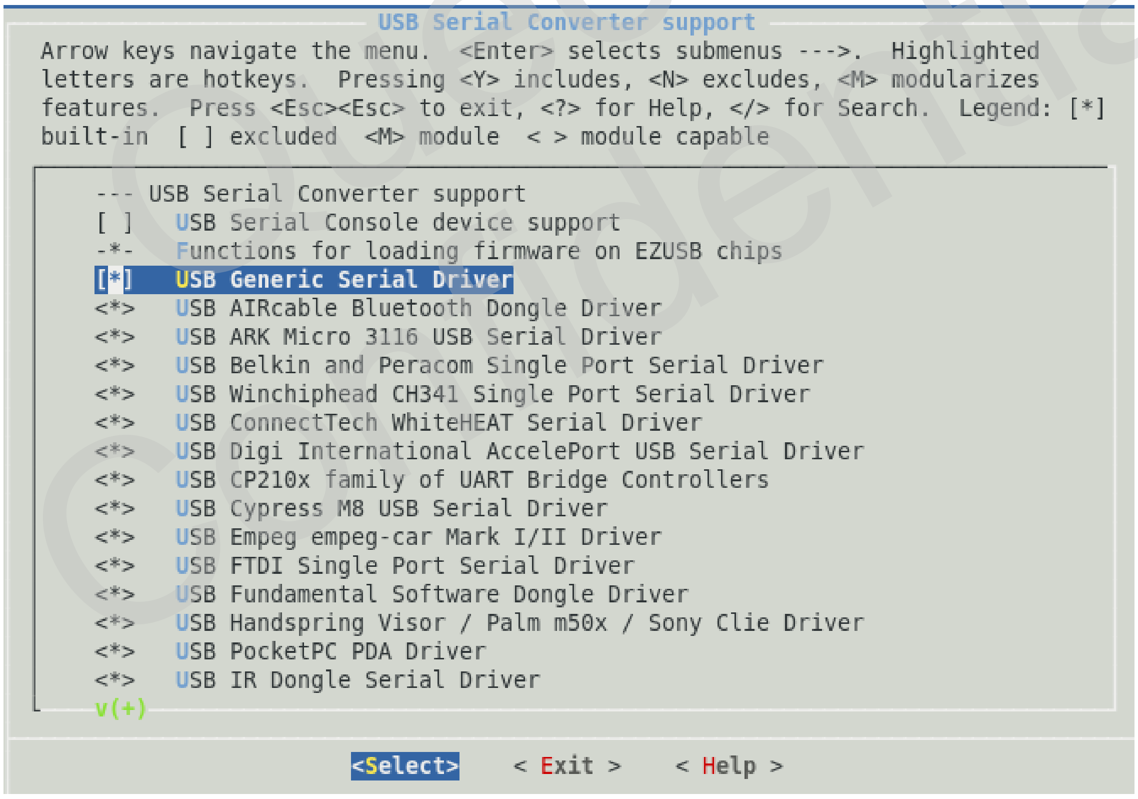
Figure 4: Select USB Support



```
                         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
     ^(-)
     [ ]    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 LED driver support
     < >    Cypress CY7C63xxx USB driver support
     < >    Cypress USB thermometer driver support
     < >    Siemens ID USB Mouse Fingerprint sensor support
     v(+)

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

Figure 5: Select USB Serial Converter Support

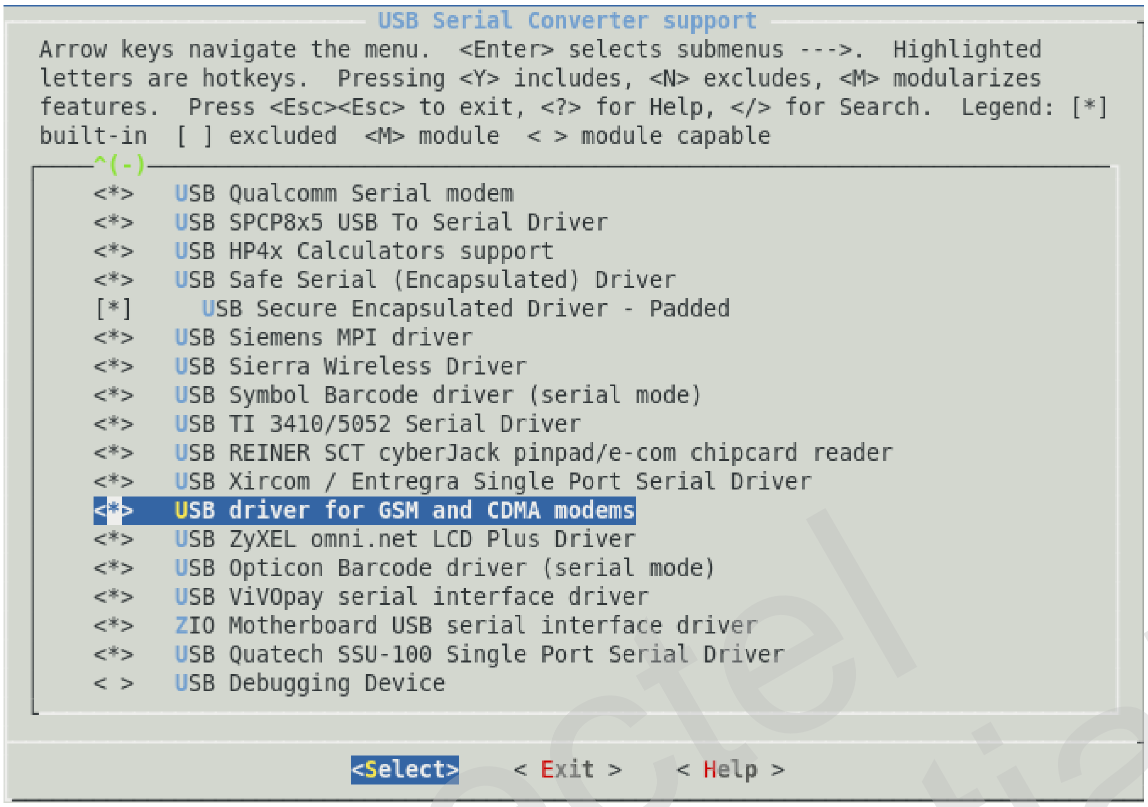


```
                   USB Serial Converter support
 Arrow keys navigate the menu.  <Enter> selects submenus --->.  Highlighted
 letters are hotkeys.  Pressing <Y> includes, <N> excludes, <M> modularizes
 features.  Press <Esc><Esc> to exit, <?> for Help, </> for Search.  Legend: [*]
 built-in  [ ] excluded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

     --- USB Serial Converter support
     [ ]   USB Serial Console device support
     -*-   Functions for loading firmware on EZUSB chips
     [*]   USB Generic Serial Driver
     <*>   USB AIRcable Bluetooth Dongle Driver
     <*>   USB ARK Micro 3116 USB Serial Driver
     <*>   USB Belkin and Peracom Single Port Serial Driver
     <*>   USB Winchiphead CH341 Single Port Serial Driver
     <*>   USB ConnectTech WhiteHEAT Serial Driver
     <*>   USB Digi International AccelePort USB Serial Driver
     <*>   USB CP210x family of UART Bridge Controllers
     <*>   USB Cypress M8 USB Serial Driver
     <*>   USB Empeg empeg-car Mark I/II Driver
     <*>   USB FTDI Single Port Serial Driver
     <*>   USB Fundamental Software Dongle Driver
     <*>   USB Handspring Visor / Palm m50x / Sony Clie Driver
     <*>   USB PocketPC PDA Driver
     <*>   USB IR Dongle Serial Driver
     v(+)

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

Figure 6: Select USB Generic Serial Driver



```
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 Qualcomm Serial modem
        <*>   USB SPCP8x5 USB To Serial Driver
        <*>   USB HP4x Calculators support
        <*>   USB Safe Serial (Encapsulated) Driver
        [*]     USB Secure Encapsulated Driver - Padded
        <*>   USB Siemens MPI driver
        <*>   USB Sierra Wireless Driver
        <*>   USB Symbol Barcode driver (serial mode)
        <*>   USB TI 3410/5052 Serial Driver
        <*>   USB REINER SCT cyberJack pinpad/e-com chipcard reader
        <*>   USB Xircom / Entregra Single Port Serial Driver
        <*>   USB driver for GSM and CDMA modems
        <*>   USB ZyXEL omni.net LCD Plus Driver
        <*>   USB Opticon Barcode driver (serial mode)
        <*>   USB ViVOpay serial interface driver
        <*>   ZIO Motherboard USB serial interface driver
        <*>   USB Quatech SSU-100 Single Port Serial Driver
        < >   USB Debugging Device

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

Figure 7: Select USB Drivers for GSM and CDMA Modems

Make sure the mandatory items have been selected, then save and exit.

3.2.4. Compile the Kernel

The last step of building the driver is using the cross compiler to compile the kernel. Before inputting the command below, you should locate the kernel's root directory and type first.

```
#make
```

After compiling the kernel successfully, the "zImage" file will be created in the path "$(kernel_src)/arch/arm/boot/", then you can burn it into the target machine and connect the module to the machine.

3.3. Load the Driver

When the module is connected with the Linux kernel system mentioned above, the system will recognize the module and read its device descriptor, then create five interface devices automatically, listed as below. After that, you can use these five interface devices.

- /dev/ttyUSB0
- /dev/ttyUSB1
- /dev/ttyUSB2
- /dev/ttyUSB3
- /dev/ttyUSB4

You can check the result in the terminal by the inputting following command:

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

If the five device node files are listed, it is certain that the module has been recognized by Linux/Android OS. And the corresponding relations between the interfaces and the devices are shown as below:

Table 2: Relationship between Interfaces and Devices

Index	Interface Name	Device Name
0	DM interface	/dev/ttyUSB0
1	Reserved interface	/dev/ttyUSB1
2	AT interface	/dev/ttyUSB2
3	Modem interface	/dev/ttyUSB3
4	NDIS interface	/dev/ttyUSB4

4 Instructions for Use

After the USB driver of the module has been loaded successfully, you can use the module.

It is suggested to dispose the voice call and SMS service on AT interface and dispose the Data service on modem interface.

4.1. Modify the Rights of the Devices' Port

Before using the module, make sure that the two ports can be read, written and executed.

For example, type the commands below in the terminal to modify the rights:

```
chomd 777 /dev/ttyUSB2
chomd 777 /dev/ttyUSB3
```

4.2. Test AT Commands on the Devices' Port

You can use serial debugging tools to send AT commands, to check whether the module can work.

When you configure the serial debugging tools, the serial port must be "**/dev/ttyUSB2**" or "**/dev/ttyUSB3**" and the sending data may be as follows:

Sending data: **AT\r\n**
Received data: **OK**

If the received data is "**OK** ", it indicates that the module is available.

4.3. Create a PPP Connection

In general, you should create a PPP connection before using the data service of the module. The command of creating a PPP connection in terminal is shown as below:

```
# pppd call Module-UC15
```

The parameter "Module-UC15" is a script file of PPP dial. In general, the PPP dial script files include three files: "Module-UC15", "Chat-Module-UC15-connect" and "Chat-Module-UC15-disconnect".

The content of the file "Module-UC15" is shown as below:

```
#/etc/ppp/peers/Module-UC15
# Usage: root>pppd call Module-UC15
# Keep pppd attached to the terminal
# Comment this to get daemon mode pppd
nodetach
# For sanity, keep a lock on the serial line
lock
# Serial Device to which the HSPDA phone is connected
/dev/ttyUSB3
# Serial port line speed
115200
user<insert here the correct username for authentication>
password <insert here the correct password for authentication>
# No hardware flow control
nocrtscts
# Ask the peer for up to 2 DNS server addresses
usepeerdns
# The phone is not required to authenticate
noauth
# pppd must not propose any IP address to the peer
noipdefault
# No ppp compression
novj
novjccomp
noccp
# If you want to use the HSDPA link as your gateway
defaultroute
ipcp-accept-local
ipcp-accept-remote
# The chat script (be sure to edit that file, too!)
connect 'chat -s -v -f /etc/ppp/peers/Chat-Module-UC15-connect'
# The close script (be sure to edit that file, too!)
disconnect 'chat -s -v -f /etc/ppp/peers/Chat-Module-UC15-disconnect'
```

The content of the file “Chat-Module-UC15-connect” is shown as below:

```
ABORT 'NO CARRIER'
ABORT 'ERROR'
ABORT 'NO DIALTONE'
ABORT 'BUSY'
ABORT 'NO ANSWER'
'' AT
'' ATE0
# Dial the number
OK ATD*99#
CONNECT ''
```

The content of the file "Chat-Module-UC15-disconnect" is shown as below:

```
ABORT   OK
ABORT   BUSY
ABORT   DELAYED
ABORT   "NO ANSWER"
ABORT   "NO CARRIER"
ABORT   "NO DIALTONE"
ABORT   VOICE
ABORT   ERROR
ABORT   RINGING
TIMEOUT   12
""   \K
""   +++ATH
SAY "\nGoodbay\n"
```

After creating PPP connection successfully, you can browse internet with the default browser of Android OS.

5 Appendix A Reference

Table 3: Terms and Abbreviations

Abbreviation	Description
OS	Operating System
PID	Product ID
VID	Vendor ID