Enabling CDC-ETHER Connection for Skywire® CAT1

NimbeLink Corp
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1. Introduction

1.1 Orderable Part Numbers

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Description</th>
<th>Carrier</th>
<th>Network Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>NL-SW-LTE-GELS3</td>
<td>Skywire CAT1 LTE Firmware 4.3.1.0</td>
<td>Verizon</td>
<td>LTE</td>
</tr>
<tr>
<td>NL-SW-LTE-GELS3-B</td>
<td>Skywire CAT1 LTE Firmware 4.3.2.0</td>
<td>Verizon</td>
<td>LTE</td>
</tr>
<tr>
<td>NL-SW-LTE-GELS3-C</td>
<td>Skywire CAT1 LTE Firmware 4.3.3.0-29979</td>
<td>Verizon</td>
<td>LTE</td>
</tr>
<tr>
<td>NL-SW-LTE-GELS3-D</td>
<td>Skywire CAT1 LTE Firmware 4.3.3.0-36343</td>
<td>Verizon</td>
<td>LTE</td>
</tr>
<tr>
<td>NL-AB-BBBC</td>
<td>Skywire BeagleBone Black Cape</td>
<td>Any</td>
<td>Any</td>
</tr>
</tbody>
</table>

1.2 Overview
The Skywire® CAT1 LTE modem supports CDC_ETHER, an Ethernet over USB protocol that allows for an easy data connection. This application note provides a working example of setting up the CDC_ETHER connection on a BeagleBone Black.

1.3 A Note on CDC_ETHER
For CDC_ETHER to work, the Linux kernel needs to have support for the CDC_ETHER USB device class built in. If it does, then when the modem is connected via USB, an ethernet device will simply appear (usually as “usb0”, “usb1”, etc.). If it does not appear, then chances are the Linux kernel version you have does not support CDC_ETHER.

1.4 Testing
This procedure was tested on the following OSs and hardware:

**Hardware**
BeagleBone Black Rev. 3

**Operating Systems Supported**
Debian 8.3 (Kernel 4.1.15-ti-rt-r43)

**Operating Systems found as NOT Supported by default**
Debian 7.x (Kernel 3.8.x)
2. BeagleBone Black Setup

2.1 Overview
Setting up the CDC_ETHER connection on the BeagleBone Black allows for automatic setup and connection, providing an easy way to get an internet data connection to your BeagleBone Black.

2.2 BeagleBone Black Setup
Start your BeagleBone Black and log in as root.
Edit the following file with your favorite text editor. This example uses nano:

```
# nano /etc/network/interfaces
```

There will be setup for having the USB port share internet with your workstation, and unless it has been edited, will read as follows:

```
# Ethernet/RNDIS gadget (g Ether)
# Used by: /opt/scripts/boot/autoconfigure_usb0.sh
iface usb0 inet static
    address 192.168.7.2
    netmask 255.255.255.252
    network 192.168.7.0
    gateway 192.168.7.1
```

By default, this enables sharing internet access over the USB port from a PC. Comment out the lines that set up this connection to prevent conflict with the CDC_ETHER connection:

```
# Ethernet/RNDIS gadget (g Ether)
# Used by: /opt/scripts/boot/autoconfigure_usb0.sh
# iface usb0 inet static
#    address 192.168.7.2
#    netmask 255.255.255.252
#    network 192.168.7.0
#    gateway 192.168.7.1
```

Save and close the file, and reboot the BeagleBone Black:

```
# reboot
```
2.2 Modem Setup

You will need to set your APN in the modem. To do this, connect to the modem using a terminal program such as screen, minicom, or picocom. This example uses picocom, and the modem will show up as /dev/ttyACM0:

```
# picocom -b 115200 /dev/ttyACM0
```

Once connected, issue the following command:

```
AT+CGDCONT=3,"IPV4V6","[your apn]"
```

Replacing `[your apn]` with the APN of your SIM. For instance, if you setup your modem with a Public Static IP address, you would enter:

```
AT+CGDCONT=3,"IPV4V6","mw01.vzwinternet"
```

Depending on the firmware of the modem you are using, you may need to issue an AT command to enable CDC_ETHER functionality.

To check the firmware of your modem, connect to it using a terminal program such as screen, minicom, or picocom. This example uses picocom, and the modem will show up as /dev/ttyACM0:

```
# picocom -b 115200 /dev/ttyACM0
```

Once connected, issue the following command to check the firmware version:

```
ATI
```

If you have version 4.3.1.0c, exit your terminal program, shutdown the Beaglebone Black, and power cycle the modem and Beaglebone Black, making sure to remove both USB and DC power. Reboot, and then continue to step 2.3. If you have version 4.3.2.0, issue the command:

```
ATI1
```

If your version listed on the line `A-REVISION` is `4.3.2.0-22272`, exit your terminal program, shutdown the Beaglebone Black, and power cycle the modem and Beaglebone Black, making sure to remove both USB and DC power. Reboot, and then continue to step 2.3.

If your version listed on the line `A-REVISION` is `4.3.2.0-25132` or greater, or `4.3.3.0-29632` or greater, the CDC_ETHER connection does not start on power up. In order for it to start by default, issue the following command:

```
AT+SQNAUTOINTERNET=1
```

Exit your terminal program, shutdown the Beaglebone Black, and power cycle the modem and Beaglebone Black, making sure to remove both USB and DC power. Reboot, and then continue to step 2.3.
2.3 Verify and Test The Connection

Once the BeagleBone Black has rebooted, log in. The CDC_ETHER connection will automatically come up as usb1:

```
# ifconfig
eth0      Link encap:Ethernet  HWaddr 68:9e:19:8f:eb:0d
          UP BROADCAST MULTICAST DYNAMIC  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)
          Interrupt:177

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:180 errors:0 dropped:0 overruns:0 frame:0
          TX packets:180 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:14888 (14.5 KiB)  TX bytes:14888 (14.5 KiB)

usb1      Link encap:Ethernet  HWaddr 02:10:81:64:82:60
          inet addr:192.168.15.144  Bcast:192.168.15.255  Mask:255.255.255.0
          inet6 addr: fe80::10:81ff:fe64:8260/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST DYNAMIC  MTU:1500  Metric:1
          RX packets:145 errors:0 dropped:0 overruns:0 frame:0
          TX packets:204 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:15402 (15.0 KiB)  TX bytes:26119 (25.5 KiB)
```

You can now test the connection:

```
# ping google.com
PING google.com (63.84.3.23) 56(84) bytes of data.
64 bytes from 63.84.3.23: icmp_seq=1 ttl=52 time=45.0 ms
64 bytes from 63.84.3.23: icmp_seq=2 ttl=52 time=51.0 ms
64 bytes from 63.84.3.23: icmp_seq=3 ttl=52 time=62.3 ms
64 bytes from 63.84.3.23: icmp_seq=4 ttl=52 time=54.9 ms
64 bytes from 63.84.3.23: icmp_seq=5 ttl=52 time=307 ms
64 bytes from 63.84.3.23: icmp_seq=6 ttl=52 time=55.3 ms
64 bytes from 63.84.3.23: icmp_seq=7 ttl=52 time=59.8 ms
^C
--- google.com ping statistics ---
7 packets transmitted, 7 received, 0% packet loss, time 20066ms
rtt min/avg/max/mdev = 45.068/90.920/307.869/88.724 ms
```
Your CDC_ETHER connection is now setup.
3. Troubleshooting

3.1 No connection in Section 2.3

Firmware version: 25132 and newer

If you do not get an internet connection with your testing in Section 2.3, use your terminal program to connect to the Skywire and issue the following command:

AT^SICA?

If the response looks similar to below:

^SICA: 1,1
^SICA: 2,0
^SICA: 3,1
^SICA: 4,0
^SICA: 8,0

Specifically, if the third line read:

^SICA: 3,0

Then the modem was not able to connect to the network correctly. The most common reason for this is the APN is not correct. Verify that your APN is correct and re-enter it. If you signed up for service at go.nimbelink.com, the default APN is:

NIMBLINK.GW12.VZWENTP

If you specifically requested a Public Dynamic IP address, the default APN is:

VZWINTERNET

If you specifically requested a Public Static IP address, the default APN is:

MW01.VZWSSTATIC

However, this APN differs by region.

If the above options do not work and you signed up for service through NimbeLink, please contact us at:

product.support@nimbelink.com

to get your APN information. Please include your SIM ID and IMEI of your Skywire.

If you signed up for service directly through Verizon or through another partner, please contact Verizon or that partner to get your APN information.
3.2 Connection Stops After a Short Time
If your connection is failing consistently after a few minutes after starting, check if you
have ModemManager installed on your system. If you do, there is a bug in
ModemManager that closes the connection. Disabling or removing ModemManager
fixes the issue.

To disable ModemManager, issue:

```
# killall -STOP ModemManager
```

Note: This will need to be issued each time you reboot your system.

To uninstall ModemManager, use your distribution's package manager. For example, on
Debian and Ubuntu, issue:

```
# apt-get remove ModemManager
```

This bug has been identified on Ubuntu 16.04 and its derivatives, and the steps outlined
in this section have verified fixing the issue.